Stormy Lake Restoration Project: Environmental Assessment

Alaska Department of Fish and Game

Division of Sport Fish

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1.0 INTRODUCTION

The northern pike *Esox lucius* is an invasive species in Southcentral Alaska and has been implicated in the decline of native fisheries throughout the region. Currently, there is an established northern pike population in Stormy Lake on the northwestern Kenai Peninsula. Stormy Lake is a 403 surface-acre natural lake that connects via a ¾ mile outlet stream to the Swanson River. It is located 8.5 miles northeast of Nikiski and is surrounded by lands managed by the Alaska Department of Natural Resources (DNR) and the Kenai National Wildlife Refuge (KNWR). The invasive northern pike population has caused the near complete loss of native wild rainbow trout Oncorhynchus mykiss and Arctic char *Salvelinus alpinus* fisheries in the lake. In addition, the connection of Stormy Lake to the Swanson River threatens the drainage's productive native wild trout and salmon fisheries should Stormy Lake's northern pike population disperse.

The Alaska Department of Fish and Game (ADF&G) developed this Environmental Assessment (EA) to address eradicating the illegally introduced northern pike population in Stormy Lake. The objective is to completely remove the invasive northern pike population and restock Stormy Lake with its native fish assemblage using representative fish collected from the lake and temporarily held off site during the eradication effort. In addition, Arctic char broodstock would be collected from the lake and reared in a hatchery for reintroduction after the northern pike are removed. These efforts would restore popular angling opportunities for the public and help protect valuable native wild fisheries throughout the Swanson River drainage. Three alternatives for accomplishing this are discussed in this EA. The first, the no action alternative, would not achieve the objective as the northern pike population would remain in the lake. The second alternative would involve draining all of the water from Stormy Lake to eradicate the northern pike, and the third alternative would involve using a piscicide called "rotenone" to remove them.

1.1 Purpose and Need for Action

The purposes of this EA are to: (1) present and evaluate alternative approaches for invasive northern pike eradication in Stormy Lake; (2) propose selection of the alternative that best meets the needs of the Alaska Department of Fish and Game invasive northern pike eradication objectives while minimizing potential environmental impacts; (3) provide an opportunity for public input on eradication options; and (4) determine whether the scope and magnitude of impacts expected from implementation of the preferred alternative warrant preparation of an environmental impact statement (EIS). If significant impacts are expected, an EIS would be prepared. If not, the ADF&G would select the preferred alternative. In either case, U.S. Fish and Wildlife Service (USFWS; the agency tasked with granting Federal authority for the preferred alternative) will disclose its final decision and supporting rationale in a separate decision document.

1.2 Background

The northern pike is native to Alaska north and west of the Alaska Range and near Yakutat in the southeast. Northern pike do not naturally occur in Southcentral Alaska (Figure 1) and first arrived there from an illegal introduction into Bulchitna Lake in the Yentna River drainage in the 1950's (ADF&G 2007). Kenai Peninsula northern pike are believed to have originated from an illegal introduction to the Soldotna Creek drainage (a Kenai River Tributary) during the 1970s

and quickly spread from the initial introduction site on their own and through additional introductions (McKinley In prep.; anonymous report[1]). Kenai Peninsula water bodies where northern pike exist, once existed, are rumored to exist, or which are believed highly vulnerable to infestation are shown in Figure 2.

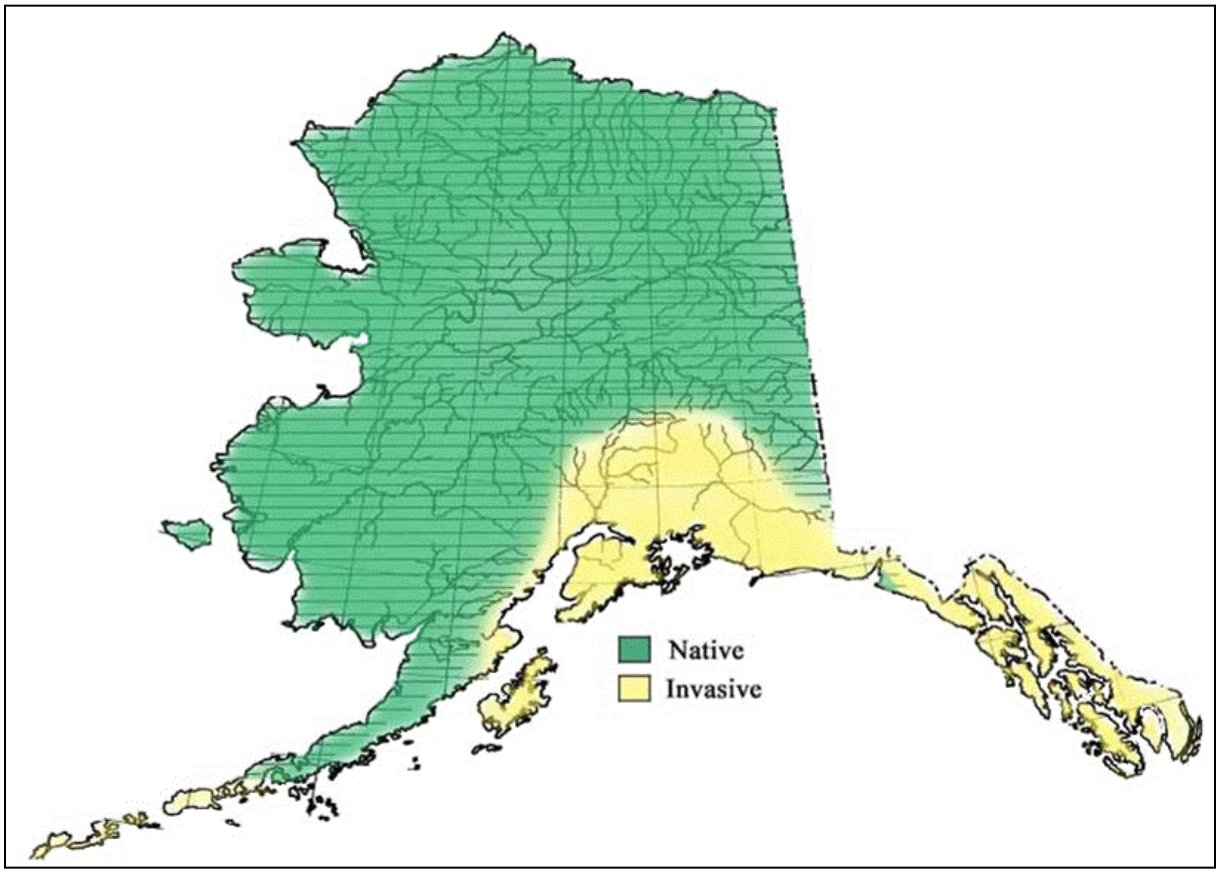

Figure 1. Map of Alaska showing native and invasive range of northern pike.

[1] Report titled *Northern Pike (Esox Lucius) in the Soldotna Creek System*, author is anonymous, available at the Soldotna ADF&G Office.

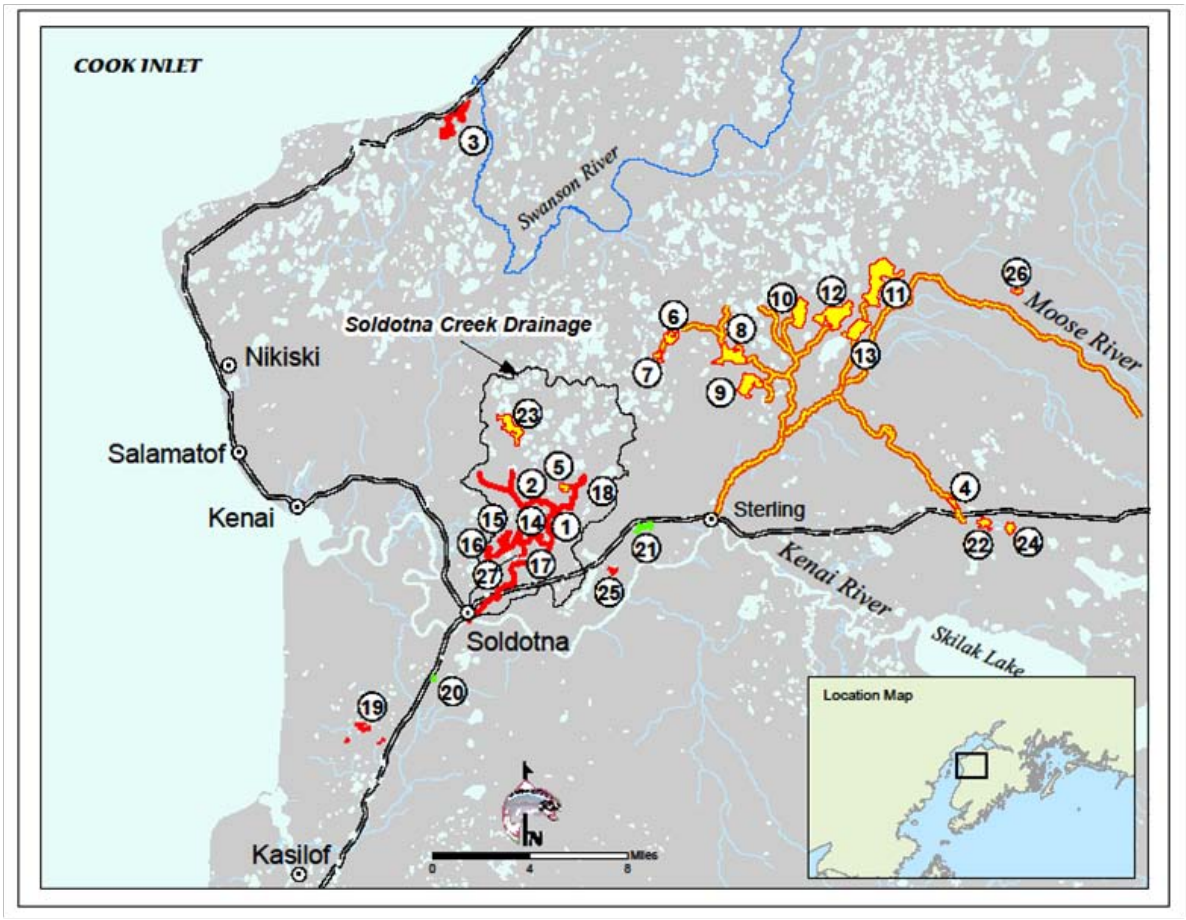

Figure 2. Kenai Peninsula waters with confirmed northern pike populations (red), waters with unconfirmed reports of northern pike or waters believed highly vulnerable to infestation (yellow) and waters where northern pike have been eradicated (green).

***Location codes**:* (1) Derks Lake, (2) Sevena Lake, (3) Stormy Lake, (4) Watson Lake (5) Cisca Lake, (6) Silver Lake, (7) Mosquito Lake, (8) Camp Island Lake, (9) Grebe Lake, (10) Rock Lake, (11) Swan Lake, (12) Loon Lake, (13) Moosehorn Lake, (14) East Mackey Lake, (15) West Mackey Lake, (16) Union Lake, (17) Stormy Lake, (18) Tree Lake, (19) Tote Road Area lakes [6], (20) Arc Lake, (21) Scout Lake, (22) Egumen Lake, (23) Spirit Lake, Peterson Lake (24), Hall Lake(25) and Bear Lake (26).

Northern pike are considered an invasive species in Southcentral Alaska because they are not native to the region and their introduction has the ability to cause economic and/or environmental harm (ADF&G 2002). Northern pike have been implicated in the decline of localized salmonid abundance in Southcentral Alaska (Rutz 1999, McKinley In prep.) and may prefer soft-finned juvenile salmonids over other available prey species (Rutz, 1996 and 1999). Consumption of native juvenile salmonids by introduced northern pike has also been observed elsewhere in the northwestern United States (Rich 1992, McMahon and Bennett 1996, Schmetterling 2001, Muhlfeld et al. 2008). In Southcentral Alaska, northern pike prey may be particularly vulnerable to predation because they evolved in the absence of these predators whereas in interior Alaska, northern pike share an evolutionary history with their prey which evolved adaptations for predator-avoidance (Oswood et al. 2000).

Invasive northern pike on the Kenai Peninsula have already reduced or eliminated native wild fish populations from some Kenai Peninsula lakes (McKinley In. prep.) and caused the

cessation of ADF&G fish stocking in three other lakes. Northern pike were confirmed in Stormy Lake by ADF&G in 2001 (Begich and McKinley 2005). Stormy Lake drains into the Swanson River via a ¾ mile outlet steam (Figure 3). A net barrier at the outlet of Stormy Lake has been maintained by ADF&G since 2001 to reduce the chance that northern pike can leave the lake and enter the Swanson River.

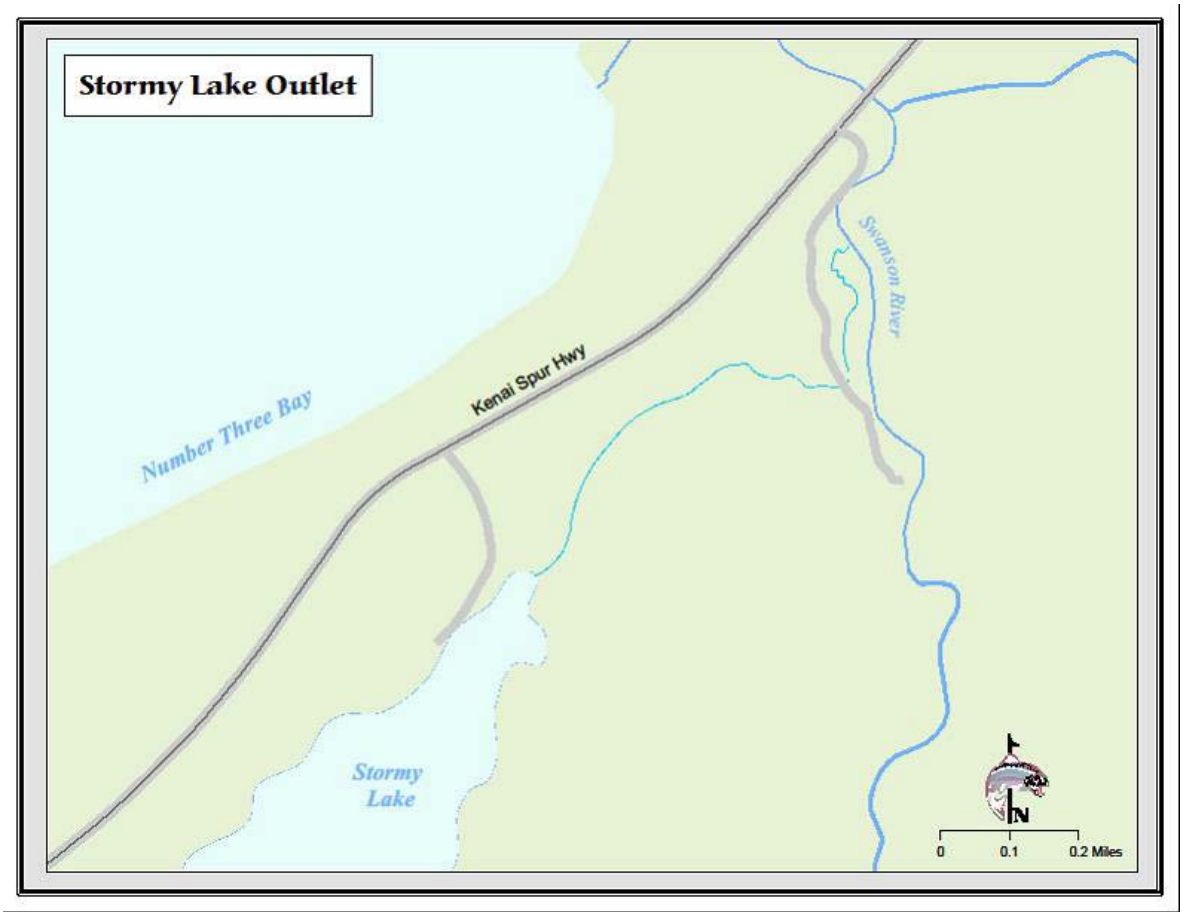

Figure 3. Map of the Stormy Lake outlet creek.

The Swanson River drainage is considered highly vulnerable to northern pike infestation because of the prevalent habitat and prey resources suitable for northern pike. The Swanson River drains a large portion of the Kenai National Wildlife Refuge and is well known for its popular native wild coho salmon *Oncorhynchus kisutch* and rainbow trout fisheries. Annual coho salmon escapement to the Swanson River can exceed 20,000 fish (Jones et al. 1993). The ADF&G Statewide Harvest Survey (SWHS) estimated that 4,621 angler days were expended in the Swanson River drainage in 2009 resulting in a catch of 6,577 rainbow trout and 3,367 coho salmon (Jennings et al. 2011). Both species rear in shallow, slow-moving waters which are ideal habitat for northern pike (Mecklenburg 2002) and are characteristic throughout the Swanson River drainage. Both coho salmon and rainbow trout fisheries have severely declined in similar habitats heavily impacted by northern pike such as Alexander Creek in the Matanuska-Susitna Valley (Ivey and Oslund 2011).

Invasive northern pike appear to have severely reduced the populations of native fish populations inhabiting Stormy Lake including rainbow trout, Arctic char and coho salmon.

Anecdotal angler reports describe Stormy Lake as a well known producer of large rainbow trout and Arctic char prior to the northern pike introduction. Recent ADF&G gillnetting efforts in 2009 and 2010 captured relatively few native fish species in Stormy Lake. During approximately 2,000 hours of netting during this period, ADF&G only caught 150 longnose suckers *Catostomus catostomus*, 3 rainbow trout, and 2 Arctic char. The ADF&G Statewide Harvest Survey estimated only 31 rainbow trout and no Arctic char were caught by sport anglers in 2008 (Jennings et al. 2010). In comparison, the 1994 estimated native fish catch from Stormy Lake was 567 rainbow trout and 835 Arctic char (Howe et al. 1995).

Since 2008 the ADF&G has maintained signage at public access points along the Swanson River drainage. The signage requests anglers to retain and report any northern pike captured. To date, no northern pike have been reported through this effort although some anglers have mistakenly reported sticklebacks believing them to be juvenile northern pike. Only once (2008) has the SWHS estimated a catch of northern pike from the Swanson River (Jennings et al. 2010), and the estimate was based on a report of a single northern pike caught by an angler who did not respond to a special request to provide additional catch details (Gretchen Jennings, ADF&G, Division of Sport Fish, personnel communication). In 2007, the Department conducted some fish survey work in the Crane Lake and Gruska Lake drainages (Swanson River tributaries with habitat believed highly vulnerable to northern pike infestation), and no northern pike were detected (Figure 4). Because a self-sustaining northern pike population is not known to exist in the Swanson River drainage outside of Stormy Lake, the Department may have an opportunity to remove them before they become established elsewhere in the drainage and cause irrevocable damage to valuable native fishes and the fisheries that are dependent upon them.

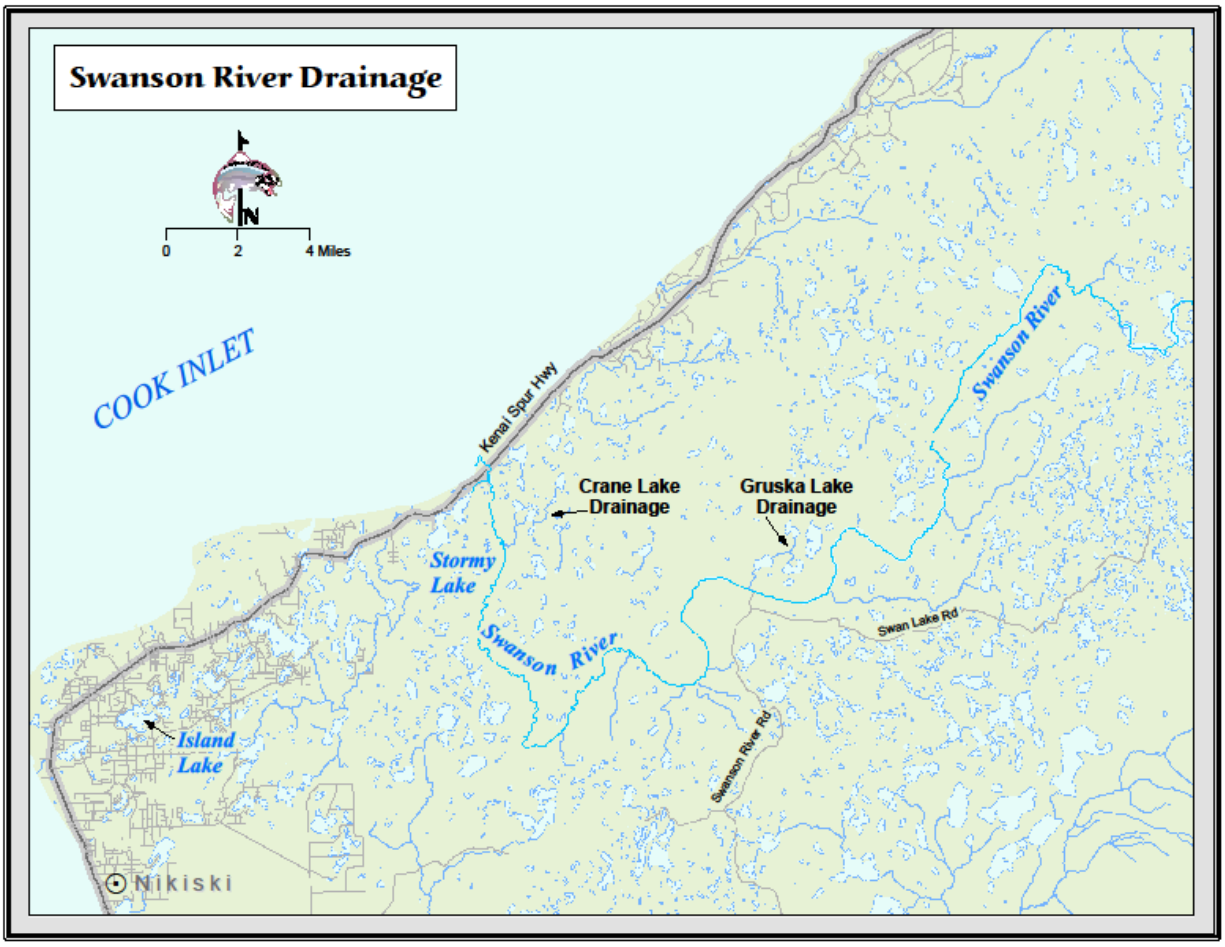

Figure 4. Map of the Swanson River drainage

1.3 Legal Authorities

By consent of the Alaska Board of Fisheries, the ADF&G is authorized to perform acts leading to the eradication of fish populations per Alaska Statute (AS 16.35.200). Further, ADF&G is mandated by law to "Manage, protect, maintain, improve, and extend the fish, game and aquatic plant resources of the state…" (Alaska Fish and Game Laws and Regulations, Section 16.05.020). Removing invasive northern pike from Stormy Lake would serve to restore native wild salmonid fisheries and aquatic habitat, reduce the likelihood of northern pike expanding elsewhere in the Swanson River drainage, and support ADF&G's long-term goal of eradicating invasive northern pike from the entire Kenai Peninsula. It is the ADF&G's legal responsibility to remove the threat imposed by invasive northern pike to protect the fisheries in the Swanson River drainage and improve the recreational fishing quality of Stormy Lake.

Additionally, the ADF&G Division of Sport Fish has developed planning documents to guide the Department's actions regarding invasive northern pike. These documents include the Management Plan for Invasive Northern Pike located online at: http://www.adfg.alaska.gov/static/species/nonnative/invasive/pike/pdfs/invasive_pike_management_plan.pdf and the Alaska Aquatic Nuisance Species Management Plan located online at: http://www.adfg.alaska.gov/static/species/nonnative/invasive/pdfs/ak_ansmp.pdf .

These plans aid in identifying specific threats from invasive northern pike, lists the statues and regulations pertinent to invasive species, and outlines the processes to follow when planning projects to evaluate, prevent, control, and/ or eradicate invasive northern pike. The Division's strategic plan also lists "minimizing impacts of invasive species on fish stocks, recreational fisheries, and fish habitat" as one of its objectives: (http://www.adfg.alaska.gov/static/fishing/PDFs/sport/StrategicPlan2010Final.pdf). Finally, the Division's invasive northern pike planning team has identified northern pike eradication from Stormy Lake as one of its top priorities.

1.4 Issues

1.4.1 Issues Selected for Detailed Analysis

In May of 2011, the ADF&G conducted a public scoping process to solicit public comment on a course of action regarding invasive northern pike removal in Stormy Lake (Appendix 1). Among the participants, opinions varied greatly, but key concerns centered on maintaining a quality family-friendly fishing and recreation site in the lake and minimizing ecological and anthropomorphic impacts from pike eradication methods. Concerns expressed during public scoping were considered in ADF&G's analysis of the alternative actions, and a detailed report of the public scoping comments and concerns can be found in Appendix 1. Specific to rotenone, however, the primary concerns received in the scoping comments are summarized below.

1.4.2 Comments on Ecological Effects

During public scoping, concern was expressed about the potential of rotenone to:

- Affect non-target organisms in Stormy Lake such as frogs, insects, and plankton
- Affect wildlife around Stormy lake such as moose and waterfowl
- Bioaccumulate in fish
- Penetrate into ground water

1.4.3 Comments on Human Health

During public scoping, concern was expressed about perceptions that rotenone could:

- Cause diseases in humans such as Parkinson's Disease
- Have negative human health consequences that research hasn't yet identified

2.0 ALTERNATIVES

In this section, a range of alternatives are described for management of invasive northern pike from Stormy Lake. A "no action" alternative and two eradication alternatives are presented. Alternatives that were considered during public scoping but rejected prior to developing this environmental assessment are described at the end of this section.

2.1 Alternative 1: No Northern Pike Eradication (no action alternative)

Alternative 1 would discontinue management of invasive northern pike in Stormy Lake. ADF&G would not make any attempt to remove northern pike from the lake, restore its native fish populations, or improve recreational angling opportunities in the lake.

2.2 Alternative 2: Lake Draining

In 2009, ADF&G contracted HDR Alaska Inc. to investigate options for northern pike containment and/ or removal from Stormy Lake to prevent their dispersal to the Swanson River system (ADF&G 2009). ADF&G was interested in exploring non-chemical options in this analysis. During their investigation, HDR was primarily looking to design barriers to the lake outlet to prevent pike spread (see Section 2.4). However, one of the concepts HDR developed involved completely draining Stormy Lake to remove northern pike entirely, and, hence, eliminate the chance that they would spread from the lake. Besides chemical renovation, draining all of the water from a water body is the only other proven method for eradicating entire populations of fish. HDR designed two options to drain Stormy Lake. Both options capitalize off the proximity of Stormy Lake to Cook Inlet. They would both require routing a drainage structure under the Kenai Spur Highway (Figure 4) and piping water directly from Stormy Lake to Cook Inlet. The two techniques considered are described below:

2.2.1 Lake Tap

Utilizing existing horizontal oil-drilling technology, Stormy Lake could be "tapped" in the deepest part of the lake (~50 ft), and the lake water could be routed underground to Cook Inlet. The exact diameter of the pipe used to drain the lake would be contingent on a geotechnical evaluation and draining schedule relative to cost. It is estimated that a 14-inch diameter pipe draining by gravity would take approximately 22 months to empty the lake whereas increasing the pipe diameter to 18 inches would drain the lake in half that time.

Generally, a lake tap includes an inline control gate below ground with a tunnel to access the controls. Drill rods are set and removed prior to accessing the deepest region of the lake. Piercing through the deepest area is accomplished with an explosive charge once the drill rods have been removed and the original hole has been filled in. This requires a subsurface debris containment structure to collect the blasted material to keep it from clogging the drain pipe. A smaller drain pipe (i.e. less than 14 inches) might be able to tap into the lake bottom directly and control the drainage flow with a gate valve at the outlet. This would eliminate the aforementioned infrastructure, but it would greatly increase the drainage duration which is undesirable.

For the lake tap, horizontal wells would need to be constructed. These are drilled using the same rotary drilling techniques used to drill vertical wells, essentially with a drill string being rotated by a surface rig. This system would be made up of joints of steel alloy drill pipe, drill collars, and the drill bit which would be controlled by surface computers. The lake tap drain pipe would start at the Cook Inlet Bluff and end at the deepest part of the lake in the narrow section

closest to the Kenai Spur Highway. The drain pipe would be entirely below ground. A 2,500 foot temporary access road would need to be built from the Kenai Spur Highway to Cook Inlet to access the drill rig and spill way construction at the bluff. However, if constructed during the winter, this could be accomplished by building an ice road.

This alternative is expensive and would cost a minimum of approximately $700K. Once drained completely, it is estimated that it would take about five years for the lake to refill. Because of this duration, ADF&G would not be able to hold over or rear native fish in captivity or in another lake for reintroduction to Stormy Lake. Instead, fish from the Swanson River drainage would have to recolonize Stormy Lake as it refills.

2.2.2 Pumping

Draining Stormy Lake with pumps would be much faster than the lake tap, but this would depend on the number of pumps used. For example, a series of eight pumps with four, 24-inch drain pipes operating at 74,000 gallons/minute could completely drain the lake in approximately one month.

Pumping the lake water to Cook Inlet would require a series of generators on shore, multiple high-capacity pumps on a floating platform in the lake, and several drain pipes running approximately 3,000 feet to Cook Inlet. The number of each of these components needed would depend on the desired schedule for draining the lake and project cost. The more generators, pumps, and pipes, the quicker the draining could be accomplished, but the more expensive the project would be.

The infrastructure needed to pump water from the lake would include a permanent work pad and fuel spill containment system for the generators and the temporary floating platform for the pumps in the lake. In addition, the drain pipes would need to be routed underground beneath the Kenai Spur Highway using either existing culverts where possible and/ or constructing new ones. Drain pipes would need to withstand pumping pressures and be made of welded steel.

The lake drain would begin in the deepest part of the lake located in the narrow section closest to the Kenai Spur Highway. Once under the highway, the drainage route would continue approximately 2,500 feet to reach the bluff at Cook Inlet. This section of drain pipes would likely run above ground. A 2,500 foot temporary access road from the highway to Cook Inlet would be necessary for the drain pipe assembly and spill way construction, but as with the lake tap, an ice road could be built if constructed during the winter.

Though far more efficient than the lake tap in terms of time, pumping Stormy Lake would be significantly more expensive. To drain Stormy Lake in one month, HDR estimated it would cost just under four million dollars. As with the lake tap, it would take an estimated five years for the lake to refill, and fish recolonization to the lake would have to occur naturally over time from Swanson River stocks.

2.3 Alternative 3: Rotenone Treatment (Preferred Alternative)

ADF&G's preferred alternative involves removing invasive northern pike from Stormy Lake using rotenone: CFT Legumine™ and Prentox® Prenfish™ Fish Toxicant Powder. Following treatment and natural detoxification, the lake would be restocked with its native fish assemblage using individuals collected and temporarily relocated to net pens in another lake or used for broodstock for future restocking.

This alternative offers the highest probability of achieving the goals of improving the recreational fishery in Stormy Lake and reducing the threat of invasive northern pike dispersing to other areas.

2.3.1 Description of Rotenone

Rotenone is a naturally occurring substance derived from the roots of tropical plants in the bean and pea family including jewel vine (*Derris* spp.) and lacepod (*Lonchocarpus* spp.*)* that are found in Australia, Oceania, southern Asia, and South America (Ling 2003). People have used rotenone for centuries to capture fish for food in areas where these plants are naturally found (Quigley 1956, Bearez 1998, Robertson and Smith-Vaniz 2008), and it has been used in fisheries management in North America since the 1930s (Finlayson et al. 2000).

Rotenone acts by inhibiting oxygen transfer needed for cellular respiration. The biochemical process affected by rotenone takes place within the cell mitochondria and involves blocking electron transport by inhibiting NADH-ubiquinone reductase, resulting in the uncoupling of the metabolic pathway oxidative phosphorylation (Singer and Ramsay 1994, USEPA 2007). Fish die from tissue anoxia due to cardiac and neurological failure (Ling 2003). It is effective at low concentrations with fish because it is readily absorbed into the bloodstream through the thin cell layer of the gills. Mammals and other non-gill breathing animals do not have this rapid absorption route into the bloodstream and can tolerate exposure to concentrations much higher than those used to kill fish. Non-target organisms that do not have this rapid absorption route are not negatively affected at these concentrations (Finlayson 2000, Ling 2003, NPS 2006, USEPA 2007, MFW&P 2008).

2.3.2 Description of the Proposed Rotenone Treatment

The boundary for this treatment would be Stormy Lake, its outlet creek, and 12.5 acres of wetlands adjacent to Stormy Lake (should it have surface waters present that could allow fish to survive). All waters would be treated with Prentox® Prenfish™ Fish Toxicant Powder (EPA reg# 655-691) or CFT Legumine™ (EPA reg# 75338-2). Prentox® Prenfish™ Fish Toxicant Powder is pure ground plant material typically containing 7.4% rotenone (Appendices 2 and 3). CFT Legumine™ (Appendices 4 and 5) is a liquid rotenone formulation containing 5% rotenone with additives (described in detail in section 4.3.3) that increase dispersion and emulsification in water. About two-thirds of the lake would be treated with powdered product and about one-third would be treated with liquid formulation. Using a combination of the two products makes the overall project more cost effective than using liquid rotenone, alone. The powder rotenone product (Prentox®) would be used in shallower areas of the lake whereas the liquid product (CFT Legumine™) would be used to treat the deepest sections and areas most protected from wave action (weedy bays, etc.). The target concentration for the treatment would be within the product label guidelines for both liquid and powder rotenone and is anticipated to be about 1 parts per million (ppm) of rotenone product (.05 ppm active ingredient/rotenone).

An entire lake treatment is anticipated to take two to four days to complete. Treating the outflow creek separately would require at least one additional day. Stormy Lake would be treated in August or early September of 2012. This timing is preferred because: 1) the relatively warm water available that time of year would promote faster natural deactivation of rotenone, 2) rotenone is more effective at warm temperatures, 3) upcoming fall turnover of the lake would help disperse the rotenone to deep areas, 4) all northern pike eggs would have hatched (eggs are resistant to rotenone), and 5) it would reduce or eliminate the need for potassium permanganate ($KMNO_4$) to deactivate the rotenone in the outlet stream as stream discharges are expected to be relatively low. A warm water treatment would also shorten the duration that

rotenone remains toxic and shorten the period relocated native fish from Stormy Lake would be held in net pens at another lake. There is a possibility that piscivorous waterfowl present on Stormy Lake would be temporarily displaced because of the removal of their prey base. However, there are many nearby lakes for these animals to relocate to, and the quicker detoxification timing allowed for by the proposed treatment schedule would give ADF&G the opportunity to restock Stormy Lake with native fish prior to ice up to begin the restoration of the lake's fish community.

Prior to the treatment, signage would be placed at all access locations to Stormy Lake in compliance with all applicable legal requirements related to pesticide applications. Materials and equipment required to complete the rotenone application would be transported to Stormy Lake by truck. Secure onsite storage of all rotenone products would be accomplished by either containing them inside enclosed cargo containers or within a temporarily erected fence enclosure. An impermeable ground liner bermed around its perimeter would be in place to contain any spill at the storage site. Onsite storage could last for about one week.

The rotenone would be primarily dispersed in the lake by applicators using outboard-powered motorboats. Boats would be equipped with gas-powered pumping systems that would premix lake water with the rotenone products (liquid or powdered product) and then discharge the premixture to the surface waters and propeller wash of the boat. Applicators would use both backpack sprayers and a craft capable of traveling over dense emergent aquatic vegetation (airboat, mud buddy and/or ATV) to apply rotenone to heavily vegetated nearshore areas and adjacent inundated wetlands of the lake. Drip stations would dispense rotenone into the outlet creek for eight hours which should be enough time to ensure that fish residing in the outlet or that may escape the lake's net barrier during treatment are affected. If necessary, the outlet stream could be treated a second time.

Flowing waters can require multiple treatments to remove target species because dilution reduces the amount of time rotenone remains active. The need for this would be tested during treatment by observing the effects of the rotenone on caged sentinel fish in the outlet stream. Caged sentinel fish would also be placed below the confluence of the outlet stream and the Swanson River. If these fish exhibit stress or die, the rotenone in the outflow creek would be deactivated with $KMNO_4$ although this likely would not be needed as dilution with the Swanson River should render the rotenone concentration far below the 2.0 ppb threshold requiring deactivation. In the unlikely event that rotenone does enter the Swanson River at a dangerous concentration for fish, by avoiding the immediate area fish in the area should be able to escape rotenone's effects. Fish are capable of detecting rotenone and are expected to avoid it when in open waters where they are not confined, unlike fish in a closed lake where they cannot escape rotenone exposure (Finlayson 2000). Within Stormy Lake, caged sentinel fish would be used to evaluate the treatment effectiveness in real-time, and periodic water samples would be collected post-treatment and analyzed for rotenone content by a laboratory with extensive experience in testing rotenone concentrations (i.e. Washington State Chemical and Hops Lab).

After the rotenone completely deactivates in Stormy Lake, an evaluation of the treatment's success using gillnets would help assess if the lake is free of northern pike. To ensure compliance with the Migratory Bird Treaty Act, gillnets would be monitored daily during daylight hours and owl decoys would be positioned near the gillnets to discourage waterfowl from using the area. Net monitoring has been successful in increasing bycatch survival during previous gillnetting efforts because entangled animals can be quickly released.

Water quality and macroinvertebrates would be sampled before and after the treatment to document biological recovery and maintenance of water quality. If the Stormy Lake treatment successfully eradicates the northern pike population (as determined by post-treatment gillnet evaluations) and when water quality and macroinvertebrate populations resemble those observed pre-treatment, the lake would be restocked with native fish species collected earlier from Stormy Lake. Efforts would be made prior to the rotenone treatment to collect and hold over representatives of all fish species found in the lake. Natural recolonization of Stormy Lake would also occur from fish in the Swanson River system if the net barrier at the outlet of Stormy Lake is removed following the eradication of northern pike.

2.4 Alternatives Considered but Eliminated from Analysis Netting and Barriers

2.4.1 Mechanical Removal/Netting

This alternative would involve using gill nets and/or trap nets to remove northern pike. Under specific conditions, gillnets have been successfully used to remove unwanted fish from lakes. Bighorn Lake, a 5.2-acre lake located in Banff National Park in Alberta, Canada, was gillnetted from 1997 to 2000 to remove an invasive population of brook trout (Parker et al. 2001). Over 10,000 net nights (1 net night = 1 net set overnight for at least 12 hours) were conducted over a four-year period to remove the population that totaled 261 fish. The researchers concluded that the removal of nonnative trout using gillnets was impractical for larger lakes (> 5 acres). In clear lakes, fish have the ability to acclimate to the presence of gillnets and avoid them. These researchers reported observing brook trout avoiding gillnets within two hours of being set.

Knapp and Matthews (1998) reported that Maul Lake, a 3.9-acre lake in the Inyo National Forest in California, was gillnetted from 1992 to 1994 to remove a brook trout population. The population consisted of 97 fish that were removed after 108 net days of effort. Following the removal of brook trout Maul Lake was mistakenly restocked with rainbow trout. Efforts to remove them using gillnets were implemented immediately. From 1994 through 1997, 4,562 net days were required to remove 477 rainbow trout from the lake. Knapp and Matthews (1998) reported that gillnets could be used as an alternative to chemical treatment, but they acknowledged that the small size and shallow depth of Maul Lake leant itself to a successful fish eradication using gillnets. Their criteria for successful fish removal using gillnets included lakes less than 3.9 surface acres, were less than 19 feet deep, and had little or no inflow or outflow to perpetuate reinvasion, and no natural reproduction of the fish population.

Several years of intensive seasonal gillnetting efforts failed to completely remove northern pike from Derks Lake or Sevena Lake on the Kenai Peninsula (Begich and McKinley, 2005, Massengill 2010, Massengill 2011). The implementation of this alternative would not eliminate the possibility that northern pike migrate out of Stormy Lake and into the Swanson River. To be effective, the netting effort would need to continue indefinitely taxing Department resources. Mechanical removal is not deemed a preferred alternative to restore the lake. Bycatch of desirable native species would be expected to further diminish the depressed populations of rainbow trout and Arctic char. Additionally, it is plausible that unintentional take of migratory birds and other aquatic animals could also occur during an extensive and long-term gillnetting operation in Stormy Lake. Ultimately, however, because mechanical removal of northern pike is unlikely to remove them entirely, this alternative was eliminated from analysis because the ultimate goal is now eradication. Without eradicating northern pike from the lake, the risk will remain that this invasive species could spread to the Swanson River.

2.4.2 Fish Passage Barrier

Along with the lake draining options discussed in section 2.2, HDR Alaska Inc. designed several fish passage barrier options for ADF&G (ADF&G 2009). These ranged from a simple trap improving upon the existing fyke net at the Stormy Lake outlet to a complex facility designed to collect and sort fish. Fish passage barrier(s) capable of containing northern pike in Stormy Lake would be problematic because it would be very costly to install and maintain a permanent barrier year round, especially with a lack of electricity. A barrier would need to allow passage of native fish while prohibiting movement of all life stages/sizes of northern pike. It is unclear how effective any structure would be at preventing larval pike movement. Icing and debris loading would require expensive and time-consuming maintenance that would be incurred annually. The estimated construction costs for such a barrier for the outlet of Stormy Lake ranged from $390K to $610K not including annual maintenance costs, but even then may not be capable of incorporating design features needed to exclude all life history stages of invasive northern pike (ADF&G 2009). A barrier would also require permanent landscape impacts that include a 500 foot access road and construction of a substantial barrier structure. Ultimately, however, the barrier options were eliminated from analysis because they would allow the northern pike population in Stormy Lake to remain and the depressed populations of native fish to continue to decline or disappear. Again, as long as invasive pike are present in the lake, there is a high likelihood that they will eventually escape the lake, and the barrier options would not allow ADF&G to meet its current goal of eradicating this population of northern pike.

3.0 AFFECTED ENVIRONMENT

3.1 Land Status

The Stormy Lake Restoration Project is located in T08N, R10W, within Sections 15,20,21,36 and 37 (Seward Meridian, Kenai Peninsula). Stormy Lake is in the lower Swanson River drainage and is located about one third mile east of Cook Inlet and about 8.5 miles northeast of Nikiski and just east of the Kenai Spur Highway. The land surrounding Stormy Lake is publicly owned (Alaska Department of Natural Resources (ADNR) and Kenai National Wildlife Refuge (KNWR)) (Figure 5).

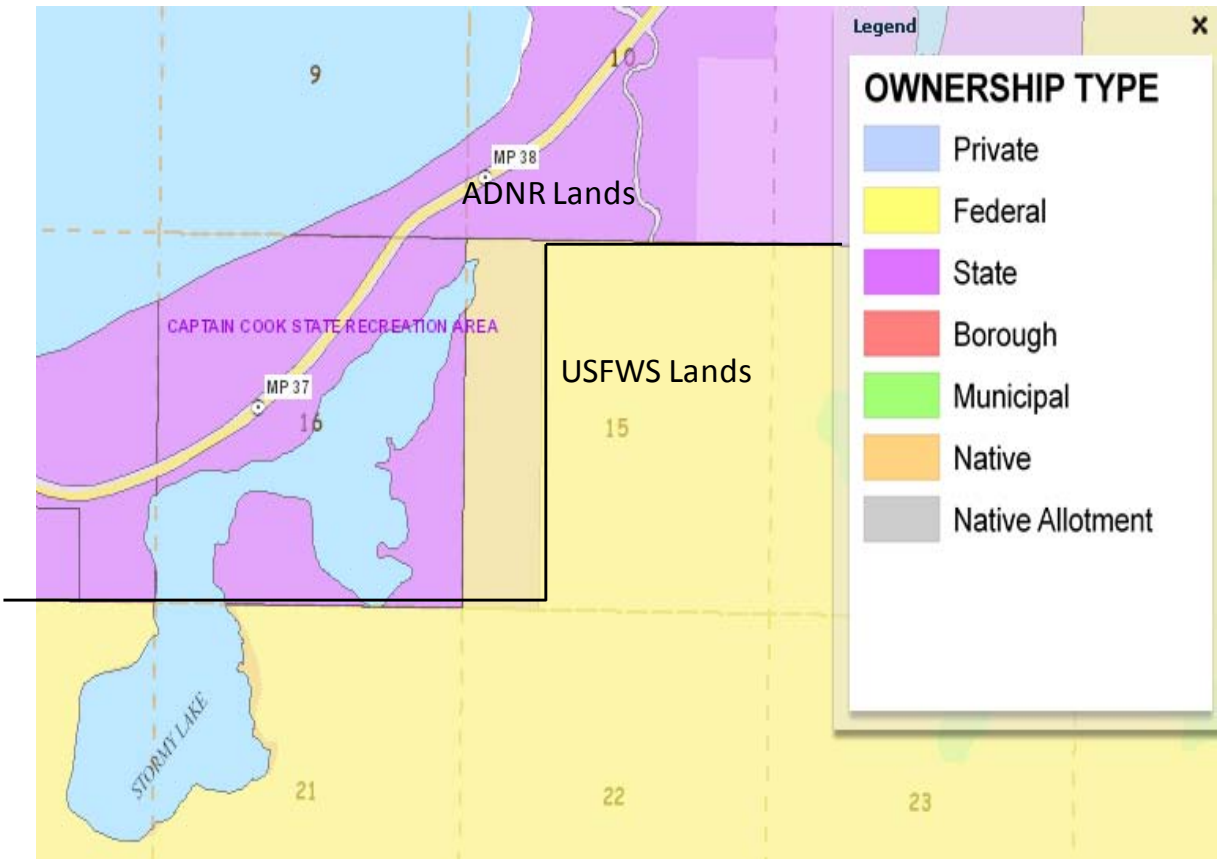

Figure 5. Kenai Peninsula Borough land ownership map of the Stormy Lake area.

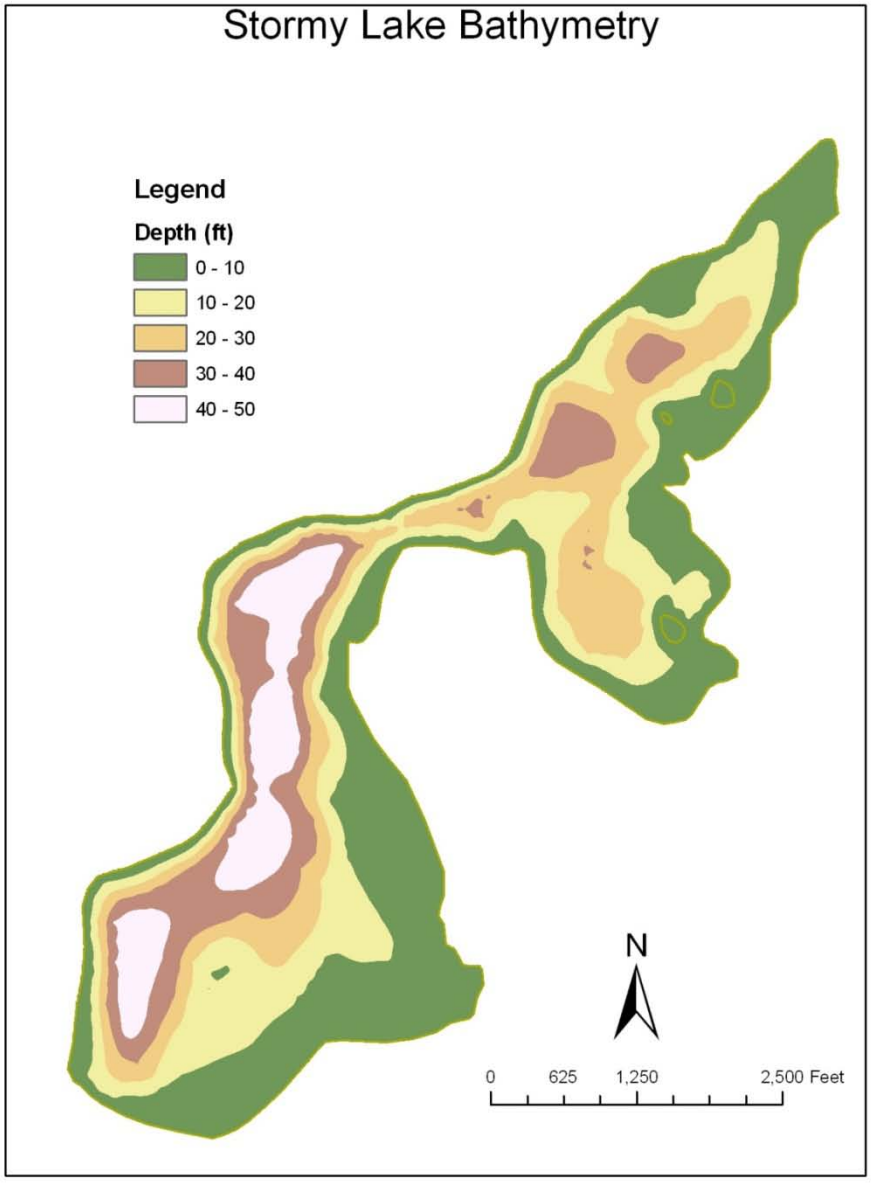

Figure 6. Stormy Lake bathymetric map.

3.2 Physical Environment

Stormy Lake is a natural lake. It covers 403 surface acres, has a maximum depth of ~50 feet, and a volume of ~7,000 acre-feet (Figure 6). Stormy Lake has a ¾ mile long outlet stream that connects to the Swanson River near river mile one (Figure 3). There are approximately 12.5 acres of surrounding wetlands seasonally connected to the lake that provide potential juvenile northern pike rearing habitat if the area is inundated with water.

3.3 Biological Environment

3.3.1 Vegetation

The watershed encompassing Stormy Lake is approximately 2.5 square miles (1,640 acres) of lowland boreal forest and wetlands. The lake itself contains several areas of dense aquatic vegetation, especially on the north end near the outlet stream and in the southeast section of the lake where there is an extensive area of emergent bulrushes.

3.3.2 Fish

The native fish assemblage of Stormy Lake and its outlet creek includes threespine stickleback *Gasterousteus aculeatus*, lamprey *Lampetra* spp., sculpin *Cottus* spp., rainbow trout, Arctic char, longnose sucker and coho salmon. Additional native fish species found elsewhere in the Swanson River drainage include: sockeye salmon *Oncorhyncus nerka*, chinook salmon *Oncorhyncus tshawytscha*, pink salmon *Oncorhyncus gorbuscha*, eulachon *Thaleichthys pacificus* and Dolly Varden *Salvelinus malma* (Jones et al. 1993).

3.3.3 Wildlife

Mammals common to the area surrounding Stormy Lake include brown and black bears, moose, wolves, coyotes, snowshoe hare, lynx, muskrats, beaver, mink, river otter, weasel, red squirrels, porcupine, flying squirrels, shrews, voles and domesticated dogs and cats. Piscivorous birds common to the area include bald eagles, herring gull, Bonaparte's gull, parasitic jaeger, common loon, horned grebe, red-necked grebe, crow, raven, magpie, stellar jay, gray jay and osprey. Additionally, several non-piscivorous species of birds including various passerines, woodpeckers, geese, ducks, plovers, owls, etc. are present in the area. The wood frog is the only amphibian in Stormy Lake. There are also robust populations of numerous aquatic invertebrate species in the lake.

3.3.4 Threatened and Endangered Species

There are no threatened or endangered species or species of concern in Stormy Lake or its outflow creek. However, the Cook Inlet Beluga whale is endangered and is found in nearby Cook Inlet.

3.4 Human Environment

3.4.1 Economy

The coastal waters off Nikiski, where Stormy Lake is located, are a productive area for oil and gas development, but Stormy Lake, itself, contributes to the local economy by providing a popular recreational site for fishing, boating, and wildlife viewing. As part of the Captain Cook State Recreation Site, Stormy Lake has a day use area and public boat launch with a $5 per day parking fee.

3.4.2 Recreational Use

Public access to Stormy Lake is on land owned by the Alaska Department of Natural Resources Division of Parks and Recreation and the Kenai National Wildlife Refuge. As mentioned, Stormy Lake has a public boat launch and is a popular location for recreational boaters, sport anglers, and wildlife watchers/ photographers.

4.0 ENVIRONMENTAL CONSEQUENCES

The purpose of this section is to identify and describe the ecological and human health impacts of the alternatives. Potential impacts are discussed within three broad subject areas: physical environment, biological environment, and human environment. The discussion, especially pertaining to the preferred alternative, focuses largely on issues that were identified during public scoping or that ADF&G recognizes as potential concerns likely to arise during future public comment periods for this project.

4.1 Physical Environment

4.1.1 Impacts from Alternative 1 to Soils

The soils underlying Stormy Lake would not be affected if the northern pike population remained in the lake.

4.1.2 Impacts from Alternative 2 to Soils

Impacts from draining Stormy Lake to the underlying soils would depend on the draining option selected. In either case, a geotechnical evaluation, wetlands delineation, and hydrogeology assessment would need to be conducted. For the lake tap method, the substrate between Stormy Lake and Cook Inlet would be directly affected by the drilling activities. This substrate is made up of unconsolidated glacial deposits, and it is possible that drilling could be interrupted by the presence of glacial erratic (boulders). This could be determined and planned for during the geotechnical evaluation. With the pumping option, soils and substrate would be less affected by direct drilling activities. In that case, the primary impacts would be from construction of culverts below the Kenai Spur Highway if existing culverts could not be used. The pumping option, however, would require more infrastructure building which would impact underlying soils. For both the lake tap and the pumping options, a temporary road would need to be built, and the construction of this would alter the underlying substrate in the area of the road.

4.1.3 Impacts from Alternative 3 to Soils

No rotenone contamination of soils and/ or groundwater is anticipated to result from this project. Rotenone binds readily to sediments and is ultimately broken down in soil and water (Skaar 2001; Engstrom-Heg 1971, 1976; Ware 2002). Rotenone penetrates approximately one inch in most soil types; the only exception is sandy soil where movement is about three inches (Hisata 2002). The primary soil types in the Stormy Lake area consists of decaying organics (0-4 inches from the surface) overlaying a silt and loam mixture (2-16 inches from the surface) and gravelly loamy sand/sandy loam (8-60 inches from the surface) with most soils classified as moderately to highly permeable (Van Patten 2005). Therefore, it is expected that, at the very maximum, rotenone would only penetrate soil about three inches in the Stormy Lake area, and any rotenone that is bound in the soils underlying the lake would naturally break down. Rotenone degradation rates in soil are dependent on soil temperature, soil physicochemical properties and sunlight exposure. Rotenone embedded on soil surfaces but exposed to sunlight has been shown to degrade 50% after five to seven hours (Cavoski et. al. 2007). Rotenone embedded in soil without sunlight exposure was shown to degrade 50% in 8 days at 20C° and 25 days at 10C° (Cavoski et. al. 2008).

4.1.4 Impacts from Alternative 1 to Water Quality

Allowing northern pike to remain in Stormy Lake would not negatively affect the lake's water quality.

4.1.5 Impacts from Alternative 2 to Water Quality

This alternative would purposefully drain all of the water out of Stormy Lake into Cook Inlet. As such, the lake's water quality would be somewhat moot.

It is likely that the drainage of ~ 7,000 acre-feet of fresh water into Cook Inlet could temporarily decrease the salinity of Cook Inlet waters near the discharge pipes, although the degree of this would be influenced by the drainage duration and Cook Inlet currents. Alterations to Cook Inlet salinity would likely be minor, but nevertheless, could occur. The discharge also has the potential to increase turbidity and stir up sediments where it enters Cook Inlet.

The lengthy time period required for the lake to refill (~5 years) could temporarily influence water quality in the lake as it recharges. For example, pockets of stagnant, standing water that refill earliest in the deepest sections of the lake could be subject to more algae blooms than would occur when the lake water is interconnected. Also, run-off recharging the lake may have a larger nutrient load which could, again, result in temporary algae blooms in the lake during periods of low volume. The benefit, however, would be that robust phytoplankton populations would stimulate zooplankton production and facilitate the reestablishment of invertebrate populations in the lake.

4.1.6 Impacts from Alternative 3 to Water Quality

This project would intentionally introduce rotenone, a natural botanical piscicide, to surface waters to kill invasive fish, but the anticipated impacts would be short-term. CFT Legumine™ (5% rotenone) and Prentox® Prenfish™ Fish Toxicant powder (~7.4% rotenone) are registered by both the Environmental Protection Agency (EPA) and the Alaska Department of Environmental Conservation and are deemed safe to use to eradicate invasive fish when applied according to label instructions. The proposed treatment using a combination of the two products would result in a peak rotenone concentration of ~1.0 ppm (or .05 ppm active ingredient (rotenone)). According to the EPA's re-registration of rotenone, there are no adverse environmental or human health effects from rotenone when is used at these concentrations (USEPA 2007).

There are three ways in which rotenone can be detoxified once applied. The first detoxification method involves dilution by other water sources. This may be accomplished by groundwater or surface water mixing with treated water and diluting the rotenone below 2.0 parts per billion (ppb) which is the threshold that requires deactivation (Finalyson et al. 2010). It is estimated that rotenone entering the Swanson River from the Stormy Lake outflow creek, based on flow rates measured in late summer, would quickly dilute well below the 2.0 ppb threshold (additional details on this are discussed in section 4.3.6). However, dilution would be expected to be a minor contributing factor to the overall detoxification of rotenone in Stormy Lake, itself. The second method of detoxification involves the application of an oxidizing agent such as potassium permanganate. This dry crystalline substance is mixed with water to detoxify the rotenone. Detoxification is typically accomplished after about 15-30 minutes of mixing between the two compounds at a 1:1 ratio. Detoxification by this method would be used in the unlikely event that rotenone enters the Swanson River from the Stormy Lake outlet stream at concentrations lethal to fish as detected in real-time by the condition of caged sentinel fish in that location. The third and most common method of rotenone detoxification is to allow the rotenone to naturally breakdown. Rotenone is susceptible to natural detoxification through a variety of mechanisms, but warm water temperatures and exposure to sunlight are the two factors with the greatest influence on degradation rate (Ware 2002; ODFW 2008; Loeb and

Engstrom-Heg 1970; Engstrom-Heg 1972; Gilderhus et a1. 1986). Rotenone released into relatively warm water (~15°C) is expected to fully detoxify within 2 to 4 weeks (Dawson et al. 1991; Brian Finlayson retired California DFG pesticide specialist, personal communication). Available Stormy Lake water temperature data indicates temperature in August and September is expected to be near 15° C (Appendix 6). This was also the case back in 2000 when ADF&G treated a small unnamed lake near Nikiski with rotenone during late September to eradicate illegally introduced yellow perch *Perca flavescens*. Immediately following the treatment the rotenone concentration was 0.15 ppm, after one week rotenone concentrations dropped to 0.05 ppm, and after two weeks rotenone was not detectable (less than 0.01 ppm). Further, no rotenone was detected from any sediment samples including those taken immediately after treatment (ADF&G Unpublished).

The degradation of rotenone can result in at least 20 different products of which only one is toxic (rotenolone) (Cheng et al. 1972). Rotenolone is approximately one order of magnitude less toxic than rotenone (Finlayson 2000). The ultimate breakdown products of rotenone are carbon dioxide and water (more information is available online at:
http://www.dfw.state.or.us/fish/local_fisheries/diamond_lake/FAQs.asp).

There are several formulations of rotenone available as a piscicide, including liquid and powder products. Prentox® Prenfish™ Fish Toxicant Powder is pure ground root product and contains no additives. CFT Legumine™ is a liquid rotenone mixture, and its other ingredients facilitate the emulsification and dispersion of rotenone in water. The CFT Legumine™ formulation was analyzed for the California Fish and Game Department in 2007 (Fisher 2007). This analysis showed that the primary ingredients (carrier compounds) are soluble organic compounds (SOCs) such as diethylene glycol ethyl ether (DGEE) (61.1%), Fennedefo 99™ (17.1%), N-methyl pyrrolidone (9.8%), rotenone (5.12%) and rotenolone (0.72%). These compounds in the formulation would naturally biodegrade in Stormy Lake and are expected to reach undetectable levels within a week to several weeks. However, N-methyl pyrrolidone and DGEE would be expected to dissipate more slowly because they are water soluble and would not readily dissipate through volatilization. For more information visit:
http://www.cdph.ca.gov/HealthInfo/environhealth/water/Pages/LakeDavis.aspx.
Also, a thorough description of the toxicity or these compounds can be found in section 4.3.3.

Studies indicate that the other compounds in liquid rotenone formulations have not been detected at harmful levels in groundwater associated with rotenone application (Finlayson et al. 2000; Ridley et al. 2006; Fisher 2007). Case studies in Montana have concluded that rotenone movement through groundwater does not occur (MFWP 2008). Three subsurface water rights are found in the immediate area of Stormy Lake all belonging to ADNR (Appendix 7). No private wells are known to exist in the immediate area of Stormy Lake although two public use hand-pump wells are located about 200 feet from the lake. One is near the swimming beach parking lot by the southern lake basin and another is near the middle of the lake at a picnic/day use area. Neither well is operational as both are missing the pump handle. Because Stormy Lake water must travel through lake sediments, soil, and gravel to reach ground aquifers, and rotenone is known to bind readily with these materials, no contamination of ground water is anticipated. Available well logs and USGS information for the Nikiski/Stormy Lake area were evaluated by an Alaska Department of Natural Resources hydrologist for potential groundwater concerns related to treating Stormy Lake with rotenone (Appendix 8) In summary, the hydrologist had no concerns for rotenone contaminating potable groundwater supplies because of the inability of rotenone to travel more than a few inches through soil, few users down gradient, low quality aquifers near the surface and no bedrock in the area.

As previously mentioned, potassium permanganate ($KMNO_4$) (Appendix 9) is a strong oxidizer that can be used to deactivate rotenone (USEPA 2007, Finlayson et al. 2010). The only potential use of $KMNO_4$ for this project would be to deactivate the rotenone in the Stormy Lake outflow creek. Pre-treatment discharge measurements of the creek and the Swanson River would help assess if dilution alone would accomplish the rotenone deactivation or whether the treatment would benefit from being delayed until more favorable discharges are present. In addition, during and after a rotenone application the responses of sentinel fish held within the mixing zone of the Swanson River and outlet creek would provide a secondary method to assess whether $KMNO_4$ treatment is warranted.

Regardless, a deactivation station would be set up before the rotenone treatment begins in the lower section of the outlet creek in case deactivation is warranted at any time. If used, $KMNO_4$ would be released into the creek with a mechanical dispenser. Deactivation of the stream discharge with $KMNO_4$ would be continued until sentinel fish just upstream of the $KMNO_4$ dispenser no longer demonstrated rotenone-related stress symptoms for four consecutive hours as suggested by Finlayson et al. (2010).

$KMN0_4$ is toxic to fish at relatively low concentrations and is more toxic in alkaline waters than soft water (Markings and Bills 1975). Acute toxicity exposure time (LC50 value) to rainbow trout at 12°C, pH of 7.5 when exposed to 5 mg/L it is about 11 hours (Markings and Bills 1975). If $KMNO_4$ concentrations are in balance with rotenone concentrations, then toxic levels of $KMNO_4$ are reduced through the oxidation of organic components and rotenone (Finlayson et al. 2010). $KMNO_4$ deactivates rotenone in distilled water at approximately a 1:1 ratio after 60 minutes of contact time (Finalyson et al. 2010). During deactivation, adjustments to $KMNO_4$ concentrations must be made to account for varying water temperature, exposure time and background oxygen demand as explained in Finlayson et al. (2010). $KMNO_4$ degradation products are considered less toxic than the product itself (Appendix 9). Finalyson et al. (2010) explain that $KMNO_4$ be measured periodically during the deactivation process so the correct ratio of rotenone: $KMNO_4$ can be maintained. The anticipated $KMNO_4$ residual left in the Stormy Lake outlet stream after interacting with rotenone and other organics in the stream is 1mg/L.

Following a rotenone treatment, there may be a substantial number of fish carcasses present. Bradbury (1986) reported that approximately 70% of rotenone-killed fish in Washington lakes immediately sink. Parker (1970) reported that at water temperatures of 5° C and cooler, dead fish required 20-41 days to surface. The most important factors inhibiting fish from surfacing are cooler water (<10° C) and deep water (> 15 feet). Stormy Lake has a maximum depth of 50 feet, and the desired treatment period (late-August/early September) would likely result in water that is ~15° C (ADF&G, unpublished data) so some dead fish would likely be exposed.

Bradbury (1986) reported that 9 of 11 water bodies in Washington treated with rotenone experienced an algae bloom shortly after treatment. This occurred from the input of phosphorus to the water as fish decayed. Bradbury further noted that approximately 70% of the phosphorus content in the dead fish would be released into the lake through bacterial decay. This stimulates phytoplankton production which in turn increases zooplankton production, providing prey for macroinvertebrates and fish. This change in water chemistry is viewed as a benefit to stimulate plankton growth (UDWR 2007). Any changes or impacts to water quality resulting from decaying fish would be short-term and minor. Nonetheless, ADF&G personnel would recover and dispose of all exposed dead fish, at least once every several days until carcass scarcity no longer justifies the effort, and monitor water quality for one year post-treatment. Fish in the Swanson River would not be expected to be affected by this treatment, only in the treatment area (lake and outflow creek). A net trap would be placed in the outlet creek to prevent dead

fish from floating to the Swanson River. Regardless, ADF&G would monitor caged sentinel fish in the Swanson River as well as look for dead fish in Swanson River downstream of the outlet creek confluence on a daily basis until sentinel fish in the outlet creek indicate the rotenone has fully degraded.

In summary, a rotenone treatment would be confined to Stormy Lake, its outflow creek and adjacent wetlands with standing surface water suitable for fish survival. Any waters discharging from the outlet creek and mixing with the Swanson River should result in a rotenone concentration below the 2.0 ppb threshold that requires deactivation or else it would be deactivated with $KMNO_4$. As required by state regulation, ADF&G would submit a pesticide permit application to the Alaska Department of Environmental Conservation (ADEC) which must be approved prior to treating Stormy Lake with rotenone and would fully comply with any/all permit conditions. Additionally, in compliance with the USFWS Integrated Pest Management Policy (http://www.fws.gov/policy/569fwl.html), a Pesticide Use Proposal (PUP) would be prepared and submitted to the USFWS for review and approval. This project would also be conducted in compliance with the federal Clean Water Act, including any National Pollution Discharge Elimination System (NPDES) permitting requirements.

4.2 Biological Environment

4.2.1 Impacts from Alternative 1 to Vegetation

Aquatic macrophyte populations in Stormy Lake would not be directly affected by northern pike if they remain in the lake.

4.2.2 Impacts from Alternative 2 to Vegetation

On lands surrounding Stormy Lake, impacts to vegetation from the lake draining options would be attributed mainly to heavy equipment used during the infrastructure construction. However, this could partially be mitigated by constructing ice roads during the winter.

Within Stormy Lake, itself, draining all the water would eventually kill all submerged and emergent aquatic macrophytes in the lake. The long-term ecological impacts from this would likely be minor as the seed bank in the substrate underlying the lake should allow the plant communities to reestablish after the lake recharges.

4.2.3 Impacts from Alternative 3 to Vegetation

Stormy Lake has a concrete ramp boat launch with an adjacent gravel parking lot that would serve as the project storage and operating base for the proposed rotenone treatment. Basing operations from the boat launch area should greatly reduce trampling of vegetation around the lake caused by the rotenone application and associated application equipment. However, the installation and operation of drip stations and rotenone deactivation station along the Stormy Lake outlet creek may require pruning brush in a five foot circumference at each station (4-8 stations could be installed).

In the southern basin of Stormy Lake there is a wetland adjacent to the lake that can become inundated with surface water during very wet periods. If high water conditions existed at the time of treatment, it would be prudent to treat all exposed surface waters in that wetland as northern pike could potentially access those waters from Stormy Lake. The only practical way to apply rotenone to this area would be with a team of backpack sprayers or by an applicator operating an ATV equipped with a pumping/spraying apparatus. The total amount of wetland acreage that would be potentially sprayed using either method is estimated at 12.5 acres

(Figure 7) Vegetation could be trampled in this wetland from foot traffic or ATV operation, but particularly so with ATV use. To minimize trampling if an ATV is used, the ATV would be equipped with a high pressure pumping system that could spray the pesticide premixture up to 75 feet either direction reducing the area that would need to be driven to apply the pesticide. Any vegetation trampling effects would be expected to be minimal and short-term in duration and would occur at a time of year when many grasses have completed their seasonal growth.

Finally, there is a bed of emergent aquatic vegetation (bulrushes) in the south basin of Stormy Lake that would likely require the use of an airboat or mud-buddy (specialized outboard) to apply the rotenone because the vegetation is too dense for a typical outboard boat to operate in. It is anticipated that the bulrushes would sustain some damage near the waterline which may result in visible boat swaths through the vegetation. No direct, immediate, or long-term impacts to vegetation are anticipated from the rotenone itself because rotenone does not negatively affect plants at concentrations necessary to kill fish.

Figure 7. Approximate wetland area (bordered with red highlighting) adjacent to Stormy Lake that may be treated with rotenone if high water conditions are present at time of treatment.

4.2.4 Impacts from Alternative 1 to Wildlife

Northern pike are top predators in aquatic environments, and they are very opportunistic in their diet. Besides fish, northern pike will prey on invertebrates, frogs, mice, muskrats, ducklings and other small waterfowl. Northern pike are non-native predators in Stormy Lake, so if their population remains, predation on native animals will continue. It is plausible that the Stormy Lake native rainbow trout and Arctic char populations will be lost entirely if the northern pike population remains.

4.2.5 Impacts from Alternative 2 to Wildlife

Wildlife species characteristic to the area are described in 4.2.6. Draining the lake would eventually displace wildlife such as waterfowl from the lake because there would not be abundant or available prey. During the draining, however, fish-eating wildlife would likely be temporarily attracted to the lake basin to forage on trapped and desiccating aquatic organisms. Once this prey is depleted, it would likely take several years before the lake provides functional habitat for waterfowl and other wildlife because of the slow recharge duration expected.

4.2.6 Impacts from Alternative 3 to Wildlife

Large Mammals: Grizzly bears, black bears, and wolves are found in the Stormy Lake area but are not dependent on the lake or fish from the lake for food although some salmon predation by bears likely occurs in the outlet creek. The removal of exposed dead fish resulting from this project would reduce the potential for these species to consume rotenone-killed fish in great quantity. Even if rotenone-killed fish were consumed by mammals, there would be no adverse effects because the rotenone at low dosages is expected to be degraded by enzymes in the animals' digestive tracts (Finlayson et al. 2000; USEPA 2007). The LC50 to female rats from oral ingestion is 320 mg/Kg (Lowe 2006). No evidence of carcinogenicity has been documented in mice/rat studies (National Toxicology Program 1986). Following rotenone treatment, frequent monitoring of the lake to collect dead fish should limit fish carcasses from becoming an attractant to bears.

There is a year-round presence of moose at Stormy Lake. It is possible that any of these species may ingest water from the lake during the treatment period or that moose feed on aquatic vegetation in the lake. EPA-approved bioassays indicate that, at the proposed concentrations, rotenone would have no effect on mammals that drink the treated water (Schnick 1974a, 1974b; Herr et al. 1967). Ingestion of treated waters by any terrestrial wildlife would have no adverse effects because of the low rotenone concentration found in the lake water and the enzymatic action in the animals' digestive tracts. Particularly, the gastrointestinal absorption of rotenone is inefficient (Finlayson et al. 2000).

Finally, rotenone has a low acute toxicity via the dermal route of exposure and receives a toxicity category IV rating; in rabbits, the LD50 is >5000mg/kg (USEPA 2007). Risk of inhalation exposure to rotenone from the liquid CFT Legumine™ to wildlife is nonexistent because the vapors rapidly dissipate, and the application method for powdered rotenone which involves using a semi-closed system pumping apparatus prevents exposure hazard to wildlife. In conclusion, this project would have no significant impact on game mammals.

Other mammals: Coyote, lynx, muskrat, beaver, mink, otter, weasel, snowhsoe hare, red squirrel, porcupine, flying squirrel, shrew, vole and domesticated dogs and cats are present in the area. Some of these mammals could scavenge on rotenone killed fish or drink treated lake water. The effects of rotenone on non-target organisms have been studied extensively. Again mammals, in general, are not affected by rotenone in fisheries treatment concentrations because they neutralize rotenone by enzymatic action in their stomach and intestines (Finlayson 2000: AFS 2002; USEPA 2007). Laboratory tests have been conducted in which rats and dogs have been fed forms of rotenone as part of their diet for periods of six months to two years (Marking 1988). Observed effects included diarrhea, decreased food consumption, and weight loss. Researchers reported that despite the unusually high treatment concentrations of rotenone fed to rats and dogs, the chemical did not cause tumors or reproductive problems in these mammals.

CDFG (1994) studies of potential risks to terrestrial animals found that a 22-pound dog would have to drink thousands of gallons of lake water or eat thousands of pounds of rotenone killed fish in 24 hours to receive a lethal dose. The State of Washington reported that a half-pound mammal (red squirrel size) would need to consume 12.5 mg of pure rotenone to receive a lethal dose (Bradbury 1986). It is important to note that nearly all of the aforementioned examples were based upon subjecting laboratory specimens to unusually high concentrations of rotenone that are far above concentrations used in fisheries management uses. For this project, ADF&G would use rotenone products containing 5% to 7.4% rotenone. Assuming the primary way an

animal may consume the compound under field conditions is by drinking lake water, a half-pound animal would need to drink 66 gallons of Stormy Lake water treated at 0.05 ppm rotenone to receive a lethal dose. Based on this information, we expect the impacts to non-target organisms to range from non-existent to short-term.

Migratory waterfowl/ Birds: Birds common to the area that could potentially consume dead fish following treatment include bald eagles, herring gull, Bonaparte's gull, parasitic jaeger, common loon, horned grebe, red-necked grebe, crow, raven, magpie, stellar jay, gray jay and osprey. Additionally, non-piscivorous birds such as passerines, woodpeckers, geese, ducks, plovers, owls, etc. are present in the area. During the proposed treatment period, most piscivorous waterfowl would not have migrated from Stormy Lake and may be temporarily displaced, but the availability of other waters in close proximity to the project area should minimize any impacts. Following the treatment, it is likely that some birds would remain and forage on rotenone-killed fish, however research has indicated it is not physiologically possible for birds to consume sufficient quantities of rotenone-killed fish to result in a lethal dose (Finlayson 2000: USEPA 2007).

Rotenone residues in dead fish are generally very low (<0.1 ppm), unstable, and not readily absorbed through the gut of the animal eating the fish (Finlayson et al. 2000). A bird weighing ¼ pound would have to consume 100 quarts of treated water or more than 40 pounds of fish and invertebrates within 24 hours to receive a lethal dose. This same size bird would normally consume 0.2 ounces of water and 0.32 ounces of food daily, thus a safety factor of 1,000 to 10,000 fold exists under normal conditions for birds and mammals. The LD50 values for mallard ducks and ring-necked pheasants were 2200 mg/kg and1680 mg/kg, respectively, as found online at: http://pmep.cce.cornell.edu/profiles/extoxnet/pyrethrins-ziram/rotenone-ext.html. Regardless, ADF&G efforts to remove rotenone-killed fish that surface following treatment would minimize risks to these birds; thus, impacts should be negligible.

Human activity associated with the application of rotenone in Stormy Lake and the subsequent treatment success evaluation using gillnets could temporarily disrupt bird use of the area. Specifically, during the gillnet evaluation, some birds could be lost to net entanglement. To mitigate this, owl decoys would be placed near gillnets to discourage bird use near nets, and gillnets would be tended regularly so entangled birds can be released. In general, however, because northern pike are known to opportunistically prey on birds (Solomon 1945, Brown 2005) activities that result in the eradication of these fish from the lake would actually benefit avian populations in the area in the long-term.

Threatened or Endangered Species: The Cook Inlet beluga whale is the only endangered species found in the area of Cook Inlet. No direct impacts to beluga whales are expected because Stormy Lake and its outlet creek are not utilized by beluga whales. Any rotenone that may enter Cook Inlet via discharge from the Swanson River drainage would be well below detectable limits and would pose no threat to fish, birds or mammals. Rotenone, at fish management concentrations, poses no known threat to wild mammals.

A possible indirect benefit to beluga whale from this proposed piscicide application is the restoration of coho salmon habitat (Stormy Lake) which may experience an increase in coho salmon production because juvenile coho salmon rearing in the lake would no longer be preyed upon by northern pike. Adult coho salmon are a forage species for Cook Inlet beluga whales during summer and fall when salmon migrate through Cook Inlet to natal spawning destinations.

4.2.7 Impacts from Alternative 1 to Aquatic Resources

Though northern pike are opportunistic feeders, their preference is for fish. They have already decimated the rainbow trout and Arctic char fisheries in Stormy Lake and reduced populations of other native fishes such as longnose suckers, sticklebacks, sculpins, and lampreys. As long as northern pike remain in Stormy Lake, native fish populations will continue to decrease, and restoration of their populations will remain improbable.

4.2.8 Impacts from Alternative 2 to Aquatic Resources

Draining Stormy Lake would eventually result in the mortalities of most aquatic organisms in the lake. However, wood frogs and aquatic invertebrates would naturally recolonize the lake once it sufficiently recharges. Fish species would have to recolonize from the Swanson River because the recharge duration (~five years) is too long to efficiently hold over native fish from the lake in captivity or in net pens in another lake. Because of this, ADF&G would not be able to preserve the genetic integrity of Stormy Lake's fish stocks. The largest impact from this would be to the lake's Arctic char population. Arctic char do not occur in the Swanson River, so the population in Stormy Lake would likely be permanently lost. It is a unique population on the Kenai Peninsula in that these fish can attain weights of eight pounds which is considerably larger than in other Kenai lakes. Loss of the Arctic char population in Stormy Lake would be an unfortunate consequence of the lake draining option.

4.2.9 Impacts from Alternative 3 to Aquatic Resources

Fish: This project is designed to eradicate invasive northern pike using rotenone. It is anticipated that all fish remaining in the lake and outlet stream during a treatment would be lost. Again, native fish species that inhabit the lake and outlet stream include threespine stickleback, longnose sucker, rainbow trout, coho salmon, Arctic char, sculpin (spp.) and lamprey (spp). An intensive effort would be made to collect representatives of all salmonids, sticklebacks and longnose sucker populations so those populations can be restored. These fish would be relocated temporarily to another area lake and held in floating net pens. Fish held in net pens would be provided supplemental feed throughout their retention which could be up to two months. These fish would be released back into Stormy Lake once the northern pike population is deemed eradicated and the lake fully detoxified. In addition to the native fish rescue/reintroduction, the Stormy Lake outflow creek could serve as a pathway for natural recolonization of native fish including sculpin, lamprey, coho salmon and rainbow trout that disperse from the Swanson River. Stormy Lake Arctic char are believed to be in low abundance and Arctic char do not inhabit the Swanson River mainstem. An effort would be made to collect Stormy Lake Arctic char for both broodstock and for temporarily relocating adults in net pens until they can be reintroduced back to Stormy Lake. Stormy Lake Arctic char eggs and milt collections would be coordinated by ADF&G hatchery staff during September through October of 2011. Eggs would be fertilized and incubated at William Jack Hernandez Sport Fish Hatchery under isolated quarantine measures, and returned to Stormy Lake for release after the lake detoxifies from the treatment. If adult Arctic char collection and/or egg incubation attempts fail, it may be necessary to transplant wild Arctic char collected from another lake in the drainage to Stormy Lake pending ADF&G fish transport permit approval.

The existing sport fishery in Stormy Lake is now primarily for northern pike, and to a much lesser degree for rainbow trout and Arctic char. Anecdotal angler reports describe Stormy Lake as a well known producer of large rainbow trout and Arctic char prior to the proliferation of northern pike. Sport fishing would be temporarily impacted by this project. After native fish are

reintroduced to the lake post-treatment and have had time to fully recolonize, the native fisheries should provide an increase in sport fishing opportunities over what currently exists.

Invertebrates: Generally, zooplankton species are more vulnerable to rotenone than fish or macro invertebrates (Bradbury 1986, Melaas et al. 2001, Vinson et al. 2010). However, many zooplankton species have life stages (eggs, resting stages) that are very rotenone resistant so complete eradication is unlikely (Kiser et al. 1963, Melass et al. 2001). Zooplankton populations have been observed to fully recover to pre-treatment levels within one to three years of a rotenone treatment in Southcentral Alaska with no observed loss of species (Chlupach 1977). Recent rotenone treatments at Arc Lake and Scout Lake on the Kenai Peninsula indicate invertebrate diversity remained comparable to pretreatment levels less than one year post treatment, but zooplankton abundance was temporarily reduced (Massengill In prep a,b). Chandler and Marking (1982) found that clams and snails were between 50 and 150 times more tolerant than fish to rotenone. Because of their short life cycles (Anderson and Wallace 1984), good dispersal ability (Pennack 1989) and generally high reproductive potential (Anderson and Wallace 1984), aquatic invertebrates are capable of rapid recovery from disturbance (Jacobi and Deegan 1977; Boulton et al. 1992; Matthaei et al. 1996). Recolonization would include aerial dispersal of adult invertebrates from adjacent areas of the project area (e.g., mayflies and caddis flies).

Amphibians: Wood frogs are the only amphibians on the Kenai Peninsula and presumed to be common to the Stormy Lake area. Wood frogs mate in the spring, and their offspring quickly develop from egg to tadpole to frog. This northern adaptation helps ensure complete metamorphosis before fall freeze-up (ADF&G Wildlife Notebook Series: Frogs and Toads http://www.adfg.alaska.gov/static/education/wns/frogs_and_toads.pdf). Adult frogs are generally more resistant to the effects of rotenone than fish. Grisak et al. (2007) conducted laboratory studies on long-toed salamanders, Rocky Mountain tailed frogs, and Columbia spotted frogs and concluded that the adult life stages of these species would not suffer an acute response to rotenone, but larval and tadpole stages could be affected by rotenone at fish killing concentrations. These authors recommended rotenone treatments at times when the larva were not present, such as in the early spring or later in the fall. It is anticipated that surrounding ponds and wetlands that are not treated would help restore any potential depletion of wood frog populations at Stormy Lake. Healthy wood frog tadpoles were observed in Scout Lake (Sterling, Alaska) the spring following a fall rotenone treatment (Massengill In prep. b)

4.3 Human Environment

4.3.1 Impacts from Alternative 1 to Public Safety and Health

Leaving the invasive northern pike population in Stormy Lake would not result in any human health or safety impacts.

4.3.2 Impacts from Alternative 2 to Public Safety and Health

Draining Stormy Lake would not result in significant public safety and health impacts, although the empty lake basin could present a potential falling or entrapment hazard. It is likely that there would be offensive odors from dead and decaying organisms in the lake such as fish, aquatic vegetation and algae.

4.3.3 Impacts from Alternative 3 to Public Safety and Health

Although pesticides are widely used to control unwanted species, legitimate public concerns have been raised regarding health and human safety. As with any pesticide, direct exposure or consumption of piscicides can potentially have harmful or sometimes fatal effects on humans. Rotenone is an EPA-registered pesticide under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (USEPA 2007). Rotenone is also registered for use in Alaska by the Alaska Department of Environmental Conservation. Although Alaska does not have established water quality criteria for rotenone, the EPA's recent re-registration eligibility decision for rotenone (USEPA 2007) provides human health risk conclusions.

An EPA assessment of acute dietary risk was based on the maximum solubility of rotenone in water (200 ppb). Any additional rotenone in water would not further increase the concentration available for exposure. The EPA concluded that acute dietary exposure estimates for drinking water and eating fish from rotenone treated waters was below the Agency's level of concern. The EPAs chronic dietary exposure assessment of rotenone was performed for only drinking water because rotenone degrades rapidly and has a low propensity to bioaccumulate in fish (providing potential exposure to human consumers of the fish). The EPA estimated the drinking water level of concern (DWLOC) to be 40 ppb (rotenone) for the most sensitive subgroup (infants and children). Therefore, at the anticipated rotenone concentration planned for Stormy Lake and its outlet creek (~50 ppb), the DWLOC would be exceeded by 20% for a relatively short time (i.e. several days) until the rotenone degraded naturally below the DWLOC level. However, the DWLOC (40 ppb) is for chronic long-term dietary exposure and is a scenario not likely to occur at Stormy Lake because there are no public or private surface water intakes on the lake. Signage would be posted to warn the public not to drink Stormy Lake water, eat fish from the lake or have contact with the water until monitoring ensures the rotenone has completely degraded. However, as an example of rotenone toxicity relative to levels of concern, a 160-pound adult would have to drink thousands of gallons of treated lake water at one sitting to receive a lethal dose (Gleason et al. 1969).

Studies have indicated that rotenone is a strong mitochondrial inhibitor and, under some conditions, produces features of Parkinson's disease (Betarbet et al. 2000). A review of published data since the initial study by Betarbet et al (2000) suggests that the rotenone-treated rat models used in the Betarbet study are based on atypical parkinsonism rather than idiopathic Parkinson's disease, and that such studies are not applicable to piscicidal uses of rotenone (Höglinger et al. 2006). Hollingworth (2001) in his chapter on inhibitors of oxidative phosphorylation (including rotenone) does not consider rotenone a cause of Parkinson's disease. A recent study by Montojo et al. (2010) suggests that mice exposed to rotenone mixed with chloroform injected through a feeding tube developed Parkinson-like symptoms, however

dosages were administered for three months at dosages far exceeding those used in fishery applications. ADF&G is not aware of any study claiming that rotenone causes Parkinson's disease or any other human health concern when used in fishery management concentrations.

As discussed in section 4.1.6, CFT Legumine™, the liquid rotenone mixture that would be used in Stormy Lake, contains additives to facilitate its emulsification and dispersion in water. The other rotenone product, Prentox® Prenfish™ Fish Toxicant Powder, does not contain additives. CFT Legumine™ was analyzed for the California Fish and Game Department in 2007 (Fisher 2007), and the toxicities of the individual ingredients identified during that analysis are described below:

Diethylene glycol ethyl ether (DGEE) is the primary ingredient of CFT Legumine™. With respect to the environmental fate of this compound, volatilization, photolysis, and hydrolysis are all processes that are not expected to occur to a significant degree in surface waters (SPECTRUM, Chemical Fact Sheet, 2008). Rather, biodegradation is the most likely removal mechanism for the compound and 48-87% degradation would be expected in 20 days; DGEE was observed to degrade greater than 90% after 28 days (information found online at: http://toxnet.nlm.nih.gov/). Because DGEE is water soluble, it will not bind to sediments and it has a low ability to bioconcentrate in aquatic organisms (http://toxnet.nlm.nih.gov/). When tested on rats, the oral LD50 (oral dose that kills 50% of test animals) was 5.54 g/kg (Bingham et al. 2001). In a lake treated with 1 mg/L of CFT Legumine™, it would be expected that the concentration of DGEE would be at a concentration of 0.61 mg/L or 0.00061 ml/L. The estimated lethal dose (LD) of the chemical to humans is ~1 ml/kg of body weight or about 70 ml (or 70 g) for a 70-kg person. A 70-kg person drinking two liters of water from the lake (normal daily water intake) would only consume 0.00122 ml/L of the compound, which is 1/57,000th of a fatal dose. The oral LD50 for dogs is around 3.0 g/kg, while for rats and mice the LD50 is 5.5-8.7 g/kg. A 10-kg (22 lb) dog drinking one liter of treated lake water would only ingest 1/49,000th of the LD50.

Fennedefo 99™ is primarily a fatty acid ester mixture that contains polyethylene glycol (PEGs) and alcohol and is used with rotenone as an emulsifying agent. The fatty acid ester mixture is likely derived from "tall oil". Tall oil fatty acids are a byproduct of wood pulp. For more information on tall oil visit: http://www.harting.cl/talloil.html. PEGs are common ingredients in a variety of consumer products, including soft-drink syrups (as an antioxidant), lotions and antifreeze (Fisher 2007). PEGs are highly soluble, have low volatility and rapidly degrade within days. The fatty acids in the fatty acid ester mixture do not exhibit volatility, are virtually insoluble, and are readily biodegraded, although over a slightly longer period of time than the PEGs (Fisher 2007).

N-Methyl pyrrolidone is increasing in use as a solvent because of its low toxicity. It is used as a solvent for pharmaceuticals for oral ingestion (Ott 2008). This compound is expected to behave similarly to DGEE in an aquatic environment. Biodegradation is the pathway most likely to affect its removal from the environment, rather than volatilization, hydrolysis or photolysis (for more information visit http://toxnet.nlm.nih.gov/). The persistence of this compound in water has not been reported, but it has been found to have a half-life of 4.0, 8.7 and 11.5 days in clay, loam or sand, respectively. N-methyl pyrrolidone has been classified as readily biodegradable under aerobic conditions (Concise International Chemical Assessment document available at: http://www.inchem.org/. When rats and mice were tested, the oral LD50 reported values ranged from 3.9-7.7 g/kg. The LD50 of methyl pyrrolidone is similar to DGEE, but its concentration following lake treatment is expected to be only 1/6th that of DGEE, and acute toxic conditions should not arise for mammals drinking the water following treatment.

Other trace compounds in the formulation include an array of volatile organic compounds (VOCs), but all at very low concentrations. All compounds, with the exception of polyethylene glycols (PEG), would be below the reporting limits of California. At the diluted treatment concentration expected in Stormy Lake, PEG levels would be far below the California reporting limits.

Regarding exposure to trace constituents in liquid rotenone including CFT Legumine™, trichloroethylene and naphthalene are known carcinogens. Both have been detected in CFT Legumine™, but trichloroethylene was absent from most product lots recently analyzed (Fisher 2007) and the estimated concentration of trichloroethylene and naphthalene at treatment concentration is ~0.0000073 mg/L and 0.000255 mg/L respectively which is far below the Human Based Screening Level (HBSL) for exposure to surface waters for a child (CDFG 2007).

A study of airborne drift associated with two rotenone products (a liquid and a powdered formulation) was conducted in California (CARB, 1997), and results showed that the rotenone levels adjacent to a treatment area immediately following a treatment, were, at the highest, 1,000 fold lower than the estimated no observed effect level (NOEL) of 0.43 mg. of rotenone per cubic meter collected over a 24-hour period.

Mild odors from the rotenone products may be present following the Stormy Lake treatment. The odor from the solvents in liquid rotenone products could last from several hours to several days, depending on air conditions. However, the product manufacturer advertises that the newest CFT Legumine™ formulation is virtually odor free because it contains fewer solvents than other liquid rotenone formulations. Nonetheless, relatively "heavy" organic solvent compounds tend to sink or remain close to the ground and move downwind. The California Department of Pesticide Regulation (CDPR 1998, cited in Finlayson et al. 2000) found no health effects from odors from rotenone formulations that consisted of greater solvent concentrations than those found in current supplies of CFT Legumine™. Prentox® Prenfish™ Fish Toxicant Powder is pure ground root product and contains no additives although the product label states it has an odor similar to wet chalk or dirt. The northern pike carcasses resulting from this project may cause objectionable odors. Collecting and removing visible carcasses coupled with the likelihood many would sink (Bradbury 1986) should help mitigate odor concerns. Finally, because outboard motors would be used with the boat applications, there would be emissions from two and four-stroke outboard motors, but these would dissipate rapidly. Any impacts caused by objectionable odors from the rotenone, fish carcasses, or outboard emissions are expected to be short-term and minor.

Recreational contact (swimming, wading, etc.) or drinking of treated lake water would be discouraged with signage and issuance of a news release that would remain in effect until the rotenone fully deactivated which is expected to take 2-6 weeks. The product labeling states that recreational contact with treated water (<90 ppb rotenone) is allowed after the rotenone is applied, however, the Department would prefer that all such contact be avoided until the rotenone is no longer present based on lab results of water samples and the twenty-four hour survival of caged sentinel fish held in the lake. As mentioned, exposed dead fish would be collected and removed when practical from the treatment site, particularly where humans may encounter them (swimming beach, boat launch area). The lake closure and clean-up efforts would eliminate any reasonable route for rotenone exposure and subsequent human health concerns.

To address concern of rotenone traveling outside the treatment area, an estimate for the maximum rotenone content occurring in the Swanson River after mixing with the rotenone

treated waters (1.0ppm) of the Stormy Lake outflow creek is found in Appendix 10. This estimate is likely inflated because the calculation applied the lowest discharge measured in the lower Swanson River during August and September coupled with double the highest discharge measured in the outlet creek (measured at the upper end of the creek). Doubling the discharge near the creeks origin was done to account for likely gain from groundwater throughout its length. This resulting estimate (1.43ppb) is well below the 2.0 ppb threshold (Finlayson et al. 2010) requiring chemical deactivation and nowhere near the EPA's Drinking Water Level of Concern of 40 ppb.

Signage posted outside of the treatment area at access points along the lower Swanson River would inform anglers or other users of any nearby treatment-related activities that could be occurring. Impacts to the sport fishery in the lower Swanson River should be very limited but could involve the temporary discoloration (purple staining) of the outlet creek, and to a lesser degree, the lower Swanson River if rotenone deactivation using $KMNO_4$ is warranted in the outlet creek.

4.3.4 Impacts from Alternative 1 to Worker Safety and Health

There would not be any project activities with the "no action" alternative, so there would not be any impacts to worker safety and health.

4.3.5 Impacts from Alternative 2 to Worker Safety and Health

Impacts to worker safety would be similar to those experienced with oil drilling and construction activities. Contractors hired by ADF&G to build the infrastructure to drain the lake would be required to follow best management practices for their work.

4.3.6 Impacts from Alternative 3 to Worker Safety and Health

Any potential threats to worker safety and health (i.e. the rotenone applicators) would be greatly reduced with proper use of safety equipment including personal protective equipment (PPE). PPE that would be worn at all times by applicators and others working in direct contact with the rotenone products. The PPE includes Tyvek suits or raingear tops and bottoms (waders could substitute for bottoms), full face air-purifying respirators or half-mask respirators with safety goggles, and rubber or nitrile gloves.

Dry powdered rotenone products pose the greatest airborne risk, mostly to the applicators, because they are in direct contact with undiluted product and product particulates can become airborne. To reduce exposure risk, the product would be applied via a semi-closed pumping system that premixes the powder with lake water to form a slurry just prior to discharge from the boat, and applicators would adhere to the safety protocol indicated by Finlayson et al. (2010) and/or any product label requirements. One safety measure involves the use a foam gasket to seal out rotenone dust that otherwise might escape from the rotenone container opening where a vacuum line draws the rotenone powder into the pumping/mixing apparatus. Prentox® Prenfish™ Fish Toxicant Powder containers would only be opened in the boat and away from individuals not wearing PPE.

CFT Legumine™ is a liquid, and the product Material Safety Data Sheet (MSDS) states "do not breathe spray mist" and identifies appropriate respirators for use by the product handlers/applicators. Only individuals working with the concentrated product could be at risk, and they would be protected with the appropriate protective respirators. Although volatile and semi-volatile organic compounds and ethylene glycol-based compounds have been identified in the CFT Legumine™ formulation, when compared to Health Based Screening Levels (HBSL)

values, no compound in CFT Legumine™ exceeded the HBSLs. This indicates there are no significant inhalation risks from the vapors of this product (CDFG, 2007).

In general, the greatest human health risks associated with a rotenone treatment are associated with the applicators because they work directly with the undiluted, concentrated rotenone products. However, as stated, as long as safety protocols are adhered to, and proper PPE is utilized, exposure risks to applicators are minimal.

4.4 Conclusion

Although no decision has been reached, factors that led to the identification of a preferred alternative are discussed in this section.

The no action alternative would essentially allow the status quo to continue which would maintain or reduce current low levels of angling opportunity. As long as invasive northern pike remain in Stormy Lake, ADF&G would not have the ability to restore the fisheries there, and angling opportunities for the local public would continue to be limited. There would also be continued risk that northern pike could disperse from Stormy Lake to the Swanson River and endanger its native wild salmonid fisheries. Finally, ADF&G has a legal responsibility to protect, maintain, and improve fishery resources, and choosing to leave invasive northern pike in Stormy Lake, where they could eventually spread into the pristine Swanson River system, is contradictory to this responsibility. The no action alternative was not identified as a preferred alternative.

Draining Stormy Lake would not be a practical alternative because of its sheer size, complexity, and associated wetlands. Dewatering is a method that can result in eradication of unwanted fish. However, it is a much more feasible option for small impoundments or lakes with existing water control structures or for very small water bodies that can be pumped dry. Given the size and complexity of Stormy Lake, the estimated cost for dewatering the lake was estimated to range from $660K to $3,900K and would require 2,500 feet of temporary road construction within the Captain Cook State Recreation Area (ADF&G 2009). Further, draining the lake would leave pockets of water in the deepest areas of the lake bed that would likely still require chemical treatment to ensure northern pike did not survive there. It is estimated that the lake could take up to five years to refill to capacity prolonging the impact of the restoration effort on the community and delaying its benefits to the ecology of the region.

ADF&G's goal is to eradicate the northern pike population from Stormy Lake. This would allow the Department to restore native fish populations to the lake as well as the sport fisheries that depend on them. Most importantly, eradication would prevent this invasive species from spreading further into a susceptible system where eradication would no longer be possible. If northern pike successfully establish in the Swanson River system, there will be substantial and irreversible impacts to anadromous fishes and other wildlife. ADF&G has a window of opportunity to prevent this from happening, and based on the mission of the agency, it has a legal responsibility to do so. Though lake draining could accomplish this goal, the long duration of that alternative, the infrastructure that would need to be built, and the overall cost were the primary factors resulting in it not being identified as a preferred alternative.

In contrast to the lake draining alternatives, a rotenone treatment in Stormy Lake would take only a few months to complete from the application itself to the native fish restoration. No permanent infrastructure would be required, and the project would be the most cost-effective, costing less than $300K.

ADF&G evaluated the human health and ecological effects associated with the use of rotenone in this document. It is concluded that, in piscicidal concentrations and in accordance with label requirements and FIFRA, rotenone would not pose any unreasonable adverse ecological or human health risks. To further minimize risk, ADF&G would, in cooperation with Alaska State Parks and the Kenai National Wildlife Refuge, close the treatment area to the public during the pesticide application so that there would be no exposure risk during that period. After the treatment, signage would advise people not to contact or drink the lake water until the rotenone is fully deactivated. Though this is not legally necessary, ADF&G would prefer to take this conservative approach to ensure the highest level of public safety possible. This, of course, would temporarily affect recreation on the lake, but certainly for a much shorter duration than would be experienced if one of the lake draining alternatives was selected.

If the lake is temporarily closed to the public for the rotenone treatment and signage prevents people from contacting or drinking the water post-treatment, the only tangible human health risks associated with the rotenone treatment would be to the applicators because they would be working with the pure, undiluted rotenone products. However, those risks would be minimized by proper use of personal protective equipment and by following best management practices. Rotenone applicators would all be fit tested for respirators and trained in pesticide applications. Several ADF&G pike biologists have been formally trained in the use of rotenone through the National Conservation Training Center. In addition, several ADF&G biologists are also State of Alaska certified pesticide applicators. If a rotenone application occurs, all assisting personal would either be individually certified or supervised by a certified pesticide applicator. Emergency protocols would be established prior to the treatment activities in the event of an accident. Those protocols would be described in a detailed "treatment plan" that would be reviewed by all assisting project personal before the project begins.

The ecological impacts from a rotenone treatment in Stormy Lake would be far shorter in duration than the lake drainage alternatives. As described in detail in this document, rotenone ultimately breaks down into carbon dioxide and water and does not impact most organisms without gills when used in fisheries management concentrations. Rotenone has been used on five other occasions for northern pike eradication in Southcentral Alaska. In these other treatments, rotenone was applied late in the fall just prior to ice-up so as not to interrupt open water recreation for the public. This timing also maximized the duration that rotenone would remain toxic to fish. In these cases, rotenone was detectable in the water bodies up to nine months (mainly while the lakes were frozen). If rotenone is applied to Stormy Lake, the treatment would occur earlier (late summer) to ensure it degrades faster so that native fish restoration can occur within the same season. Even with the longer project durations experienced during ADF&G's previous rotenone projects, invertebrate populations were found to quickly rebound, and other species such as wood frogs and waterfowl also returned immediately after ice out. Based on the vast literature available on rotenone projects and the Department's previous experience with the piscicide, ADF&G would expect no unreasonable long-term negative ecological impacts from treating Stormy Lake with rotenone. Therefore, the rotenone treatment alternative was identified by ADF&G as the preferred alternative to accomplish the goal of eradicating northern pike from Stormy Lake and protecting the pristine Swanson River system from this invasive predator.

5.0 CONSULTATION AND COORDINATION

As mentioned in section 1.4, ADF&G conducted a public scoping process to solicit input on the alternatives, including the barrier options described in 2.4.2. The public scoping process is described in detail in Appendix 1. Through this EA and a public comment period for the Department of Environmental Conservation (ADEC) Pesticide Use Permit, the public will again have an opportunity to comment on this proposed action. To commence with the proposed action, this National Environmental Policy Act (NEPA) process will have to conclude with a Finding of No Significant Impact (FONSI), the ADEC will have to issue a Pesticide Use Permit, the State would need to be in compliance with National Pollutant Discharge Elimination System (NPDES) permitting requirements, a USFWS Pesticide Use Proposal will need to be prepared and approved, and the Alaska Board of Fisheries and ADF&G Division of Sport Fish director will have to grant approval.

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Appendix 1. Summary report of public scoping and comments received during the Stormy Lake Restoration public scoping period.

Stormy Lake Scoping Summary Report

To: Rob Massengill, ADF&G

Date: July 7, 2011

From: Sara Wilson Doyle, USKH, Planner/Public Involvement

Subject: Stormy Lake Invasive Northern Pike Public Scoping Process Input Summary

Scoping Process

In April 2011, the Alaska Department of Fish and Game (ADF&G) contracted USKH, a multi-discipline design firm, to facilitate a public scoping process to gather input in order to guide the Department's response to the Stormy Lake invasive northern pike issue. This memo presents a summary of public input gathered in May and early June 2011, using the following outreach and scoping process:

Stakeholder interviews: ADF&G provided USKH with a contact list of organizations and individuals identified as having a specific interest or likely concerns around potential actions to control or remove northern pike from Stormy Lake. Phone conversations were held with eighteen stakeholders to both inform them about the scoping process, and to gather input on northern pike's presence and potential measures to remove them from Stormy Lake.

Public meetings: Four public scoping meetings were held in May 2011 on the Kenai Peninsula, in locations accessible to lake users, nearby residents, and interested citizens:

May 13 - 6:30 pm to 8:00 pm (slide show at 6:45 pm) Nikiski Community Recreation Center

May 14 - 10:00 am to Noon (slide show at 10:15 am) Nikiski Community Recreation Center

May 25 - 12:00 pm to 1:30 pm (slide show at 12:15 pm) Challenger Learning Center of Alaska

May 25 - 6:30 pm to 8:00 pm (slide show at 6:45 pm) Challenger Learning Center of Alaska

Outreach prior to the meeting included phone contact and/or email to more than one hundred organizations and individuals, a press release and newspaper meeting announcements, and the posting of fliers in key locations, including at Stormy Lake. Twenty-five individuals attended the series of meetings, and turnout was likely influenced by of a number of factors (timing, weather, the lack of private land adjacent to Stormy Lake, and multiple opportunities for providing input by phone). The meetings included an informative PowerPoint presentation by ADF&G staff, followed by a question and answer session with ADF&G staff knowledgeable about invasive pike issues. Following this, facilitated input was then sought from residents regarding potential actions to control or remove northern pike from Stormy Lake, both in a facilitated discussion and

using input forms to solicit written comments. Kenai Peninsula media (radio and print) attended one meeting, providing radio and newspaper coverage around the scoping effort.

Input forms/written comments: Seven individuals submitted written input concerning northern pike's presence and potential measures to remove northern pike from Stormy Lake. Two individuals provided in-depth written comments, including information and data they had gathered relevant to the issue.

Public Input Summary

During the scoping process several major categories of input and public opinion emerged. Following is an aggregated summary, specific to broader categories, covering the issues and public opinions shared by members of the public, interested organizations, and community leaders. The statements that follow are directly based from public comments and opinions provided over the course of the scoping process.

Stormy Lake

Public input helped ADF&G gain a better understanding of use patterns associated with Stormy Lake, and its importance to nearby residents in Nikiski and visitors from the Kenai Peninsula and beyond. Key themes related to Stormy Lake and its recreational use and community importance include:

Community Context: Stormy Lake is a large (400+ acre) lake within the Captain Cook State Recreation Area, 25 miles north of Kenai on the North Kenai Road within the community of Nikiski. The lake offers a peaceful, natural recreational setting which is road accessible, with infrastructure including a day use area, toilets, water, picnic shelter, swimming beach, and a boat launch. Beyond these facilities, there are no residential or other developments proximate to Stormy Lake. This lake is very important to some community residents as a hometown fishing hole and valued recreational resource.

Recreational Uses: Although there are many lakes on the northern Kenai Peninsula, and many fishing opportunities in the region, Stormy Lake offers a unique recreational opportunity for a number of reasons:

Size/Accessibility: Stormy Lake is larger, more accessible, and more open when compared with most of the lakes available for public use on the northern Kenai Peninsula. This allows the use of larger lake boats, and a relatively accessible, safe, and recreational experience which attracts families, Nikiski residents, and some tourists.

Year Round Opportunities: Stormy Lake supports fishing year round, including easily accessible boat-based angling in the summer, and winter ice fishing. The lake also provides local residents with swimming opportunities, and supports picnics and other day uses. Additionally, hunters and trappers use the area, and some recreational diving and mining activities are present.

Fishing Past and Present: Historically, Stormy Lake has provided a sport catch of rainbow and Arctic char. Some residents of Nikiski have fished Stormy Lake for decades and very much enjoyed the quality of fishing prior to the illegal introduction of northern pike, first documented in 2001. More recently, no char and few rainbows have been caught in Stormy, which has caused a number of anglers to choose to fish elsewhere. Other anglers, including local residents and

some tourists, now consider Stormy Lake and its current pike fishing as a favored fishing destination for several reasons:

Accessibility – Stormy Lake is road accessible, and its facilities and size make it easy to use compared with other public use lakes and streams.

Kid Friendly – Many Kenai Peninsula angling opportunities involve carrying gear, and worries about bears, fast running water, and crowds of anglers engaged in "combat fishing." During the scoping process several parents and grandparents described that, in their view, Stormy is an important attraction for Kenai Peninsula residents who want to introduce children to fishing in a safe and easy environment. They feel that pike bite more consistently and the "play" is dynamic, which combined with the easy accessibility and great natural setting make it the ideal recreational and angling environment for children.

Pike's Eating Qualities – A number of Alaskans living on the Kenai Peninsula grew up in locations, such as Wisconsin and Minnesota, where pike was a valued food source with a cultural tradition of use. Select individuals from this heritage expressed their opinion during scoping that some pike should be maintained on the Kenai Peninsula expressly for eating purposes. In their opinion, many of the Kenai Peninsula's stocked, landlocked lakes with trout and salmon "offer poor eating compared with northern pike, which is a very tender and edible fish." One individual asked if ADF&G could explore options for maintaining some pike for eating on the Kenai Peninsula, while reducing their risk to other fisheries (e.g., have a dedicated pike fishery in a landlocked lake, or remove pike and add sterilized musky to Stormy Lake).

Desired Future Fishing Opportunities: Anglers are divided in terms of what they would like to see happen at Stormy Lake, representing two different courses of action for ADF&G in terms of Stormy Lake's future fishing opportunities.

Restore the Native Fishery: Many residents and stakeholders who have fished Stormy Lake in the past, prior to pike introduction, would like the pike removed and the native fish stocks restored. Some Nikiski residents who used to fish Stormy Lake now travel to fish for char and rainbow trout and would love to be able to fish the way they used to at Stormy, prior to pike. Other fishermen who initially appreciated the pike after they were introduced into Stormy Lake, now see a decline in their size since the pike have eaten out most of the other species, and recognize that pike removal and restoration would improve fishing and make them interested in fishing at Stormy Lake again.

Retain and Enhance Pike Fishing: Other anglers are passionate about leaving the pike in Stormy Lake because they want the opportunity they now enjoy to continue for them and their children and grandchildren into the future. Some have even proposed promoting pike as an enhanced fishing opportunity, with ADF&G providing food (from the Trail Lakes Hatchery) to help pike grow larger, and developing tourism that enhances lake fishing on the Peninsula as a year round alternative to river fishing.

Regional Pike Infestation Concerns

Because of the regional implications associated with pike infestations, public input also focused on concerns around the threat of pike spreading from Stormy Lake to other Kenai Peninsula fisheries. Key concerns include:

Threats to the Swanson River Drainage, Kenai National Wildlife Refuge, and beyond: A number of stakeholders expressed concerns that Stormy Lake's northern pike could naturally disperse throughout what is now a relatively pristine drainage system and into the Kenai National Wildlife Refuge. The Swanson River Drainage is a significant attraction for anglers seeking rainbow trout, salmon, and Arctic char in a more remote wilderness setting, often on extended canoe trips. The Swanson River Drainage's natural characteristics, as a relatively shallow, slow moving, and vegetated drainage system make it attractive pike habitat. Stormy Lake connects to the Swanson River Drainage via a small ¾-mile creek which provides a corridor for fish movement. Because Stormy Lake provides a potential source for pike dispersal into this large, pristine waterway system in the refuge, a number of participants believe that pike should have been eradicated "yesterday." Stormy Lake is viewed as a "disaster waiting to happen" following the example of the pike infestations on the Soldotna Creek drainage and the Susitna drainage. Additionally, there is a lot of habitat suitable for pike in the Moose River drainage, and potentially pike could spread to this and a number of other river systems on the Kenai Peninsula. Finally, in addition to natural dispersal, Stormy Lake's pike present a possible source for the intentional or unintentional spreading of northern pike on the Kenai through catch and release into other waterways.

Threats to genetically important native fish stock: The Kenai Peninsula is home to native fish species, which are recognized by many stakeholders as having a genetic heritage that is important to preserve into the future. A concern raised during the scoping process is that the char fishery has been severely impacted by northern pike, and could be lost. Other fisheries in the Swanson River drainage are also at risk should northern pike become established elsewhere in the drainage. One participant requested that, because of these risks, ADF&G should take measures to preserve representative populations of native stock, such as Stormy Lake's Arctic char, before they disappear. Perhaps land locked lakes on the refuge could host these native population representative stocks with ADF&G support.

Economic threats: Angling is a significant economic engine on the Kenai Peninsula. The region is branded as one of the world's few premier fishing destinations for salmon and rainbow trout. During this scoping process several organizations representing anglers and tourism expressed strong concerns about the potential of invasive species to impact these opportunities. As one participant expressed "anyone can fish pike in the lower 48, but they won't come to Alaska if that is all we have to offer." During the scoping process, a number of participants sharing this concern expressed a strong desire for ADF&G to act quickly to eliminate pike from all locations on the Kenai Peninsula before they spread any further through the region. Their view is that if pike populations get out of control, it may not be possible to retain the world class angling that is vital to the Kenai Peninsula's economy.

Alternatives to Address Pike in Stormy Lake

The public scoping process focused to a large extent on ADF&G sharing potential alternatives for addressing the pike issue in Stormy Lake and asking for public comments. Eradication and other measures to eliminate pike risks are being considered by ADF&G based on the departments' mandate to:

Protect Alaska's fisheries within Alaska Fish and Game Laws and Regulations (Section 16.05.020);

Control invasive species in its 2010-2014 Sport Fish Division Strategic Plan; and

Provide sustained yield fisheries within the State of Alaska Constitution.

Following is a summary of input around the three main alternatives presented by ADF&G as being reasonably effective for eliminating pike and/or limiting pike's escape into the Swanson River drainage: 1) Chemical treatment; 2) Dewatering; and 3) Physical barriers. Additionally, input is summarized for a "do nothing" option which was advocated by a few participants:

Chemical Treatment: ADF&G presented a broad array of data on Rotenone, a chemical derived from the root of a bean family plant, as a means for eradicating northern pike in Stormy Lake. Input reflected a split of opinions, generally along two themes:

Rotenone is a proven, generally safe, and affordable alternative – A number of scoping process participants were knowledgeable about other lakes in the lower 48, or on the Kenai Peninsula where Rotenone had been effectively used, and had played a positive role in restoring a fishery with no apparent adverse impacts. These participants all supported the use of Rotenone, and many strongly advocated for ADF&G to move forward with this approach. Moreover, some participants believe that because chemical treatment is the most affordable and quickest method for pike removal in Stormy Lake, rotenone should be the preferred approach since time delays associated with seeking funding or implementing other options could mean that ADF&G misses its current window of opportunity for stopping the spread of pike in the region.

NO Rotenone should be used in Stormy (or any other lake) – A number of participants do not want any chemical treatment methods used because of strong concerns over potential impacts to humans and other life forms in the lake's vicinity. Although research was presented describing Rotenone's limited toxicity to mammals, birds, and plants, along with the precautions ADF&G would use to help minimize these risks during application, a number of participants still do not want ADF&G to use any chemicals such as Rotenone in Stormy Lake. These participants expressed a general mistrust of chemicals when it comes to human and animal health, and some participants do not believe that the research tells the whole story or can account for more subtle or potential long term impacts. Some participants cited medical studies, or provided anecdotal stories about wildlife impacts as a basis for their concerns. Also, while some participants were concerned about the use of Rotenone in Stormy Lake, others attended scoping meetings even though they do not live near Nikiski, because in principle they believe that no Rotenone should be used in any lakes on the Kenai Peninsula.

Dewatering - ADF&G presented the option of draining Stormy Lake to eliminate pike. This mechanical approach primarily involves drilling under North Kenai Road and creating an underground outlet to drain Stormy Lake into the Cook Inlet. Public opinions and reactions to this alternative tended to focus on a few of this alternatives obvious downsides:

Overall cost and timeline: This option has a significantly higher cost than the other pike elimination alternatives presented by ADF&G. The need to secure funds, and the time requirements to complete additional engineering and develop the necessary infrastructure would potentially add a year or years to the timetable for eliminating pike from Stormy Lake. Some participants who believe that the spread of pike is an urgent threat see this option as having too many hurdles and delays.

Site impacts: Nikiski residents and visitors to Stormy Lake enjoy the natural environment and small development footprint at that recreation site. The dewatering option would require a construction pad and access road to be developed, along with other site disturbances. Some residents expressed a concern over these modifications and impacts, and requested that ADF&G select an alternative that limits the development footprint to the greatest extent possible.

Loss of recreation opportunities during the lake refill process: After dewatering is complete, refilling the lake will take an estimated five years to complete. For several Nikiski residents this longer timeframe is undesirable given their regular use of Stormy Lake as one of the few local, public access areas.

Concern over effectiveness: Pike are extremely hardy and, if dumped into Cook Inlet, some individuals believe that the pike could very well survive salt water and penetrate into the Swanson River drainage or other river system, which could make the pike infestation worse on the Kenai Peninsula.

Barriers – ADF&G is currently using temporary net barrier system to try to stop the passage of pike into the Swanson River Drainage. During the public scoping process ADF&G presented an option of leaving pike in Stormy Lake, but building a sturdier, more permanent barrier designed to withstand flood events and wildlife intrusions, which currently limit the effectiveness of the temporary barrier and create regular maintenance issues for ADF&G. Input around this alternative focused on several issues, and was preferred by pike fishing advocates:

Retain pike and reduce risks: Several scoping participants support this alternative because it maintains pike fishing in Stormy Lake, which they value, and helps address ADF&G's concerns over the threat of pike entering the Swanson River Drainage and the Refuge.

Eliminate pike habitat near the barrier and outflow: One fisherman who wants to see pike retained at Stormy advocated dredging at the lake outflow to a depth of 20 to 30 feet for a distance of around 120 feet to eliminate the pike friendly habitat at the outflow. In his opinion, eliminating pike breeding habitat at the outflow, in combination with barrier systems to restrict the movement of pike, could reduce the risks of pike migration into the Swanson River Drainage and allow ADF&G to maintain opportunities for pike fishing into the future in Stormy Lake.

Unacceptable risk: A number of participants expressed concern that as long as pike are in Stormy Lake, illegal and unintentional introductions of pike into other water bodies still present an unacceptable risk. Additionally, small eggs and fry may be able to penetrate the barrier and enter the Swanson River Drainage.

"Do Nothing Approach" – A couple of participants in the scoping process expressed strong opinions that ADF&G should leave Stormy Lake alone and "let nature take its course." These views follow two lines of reasoning:

Let nature run its course: Pike are native to much of Alaska and eventually will spread. Instead of fighting pike with taxpayers' time and money, or using interventions like chemicals, just let nature do what it is going to do.

Stormy's outflow is not pike friendly: One individual stated their belief that the iron concentration in Stormy Lake's outflow creek is high and prevents northern pike from utilizing the creek and entering the Swanson River. He believes that this is why no pike have been found in the Swanson River drainage after ten years. As a resident of Nikiski, regular user of Stormy Lake, and passionate pike fisherman, he strenuously objected to ADF&G taking any measure to eliminate pike, seeing it as a waste of time and money and a big threat to local residents' and tourist's enjoyment of the lake.

Ongoing Public Outreach

A final category of public comments raised during the scoping process relates to public outreach to stop people from illegally and unintentionally spreading pike, and public dialogue around the future of Stormy Lake. Major themes raised include:

People are the problem – Some residents were aware when the illegal introduction of pike occurred in Stormy Lake, and are worried that even if ADF&G eradicates pike, that it only takes "one stupid person" to undo the effort. In their opinion, it is important for ADF&G to work with anglers to understand why they like pike, and to help provide reasonable alternatives (fun, delicious, kid friendly species). Additionally, increasing fines, and ongoing education are very important to help deter this very real threat.

Work with the local community – The Nikiski Community Council President who attended one meeting expressed a desire to have the informative ADF&G scoping meeting PowerPoint brought back to his community in the fall or winter when residents tend to be more available to participate in public meetings. He reflected that for years it has been a community goal to further enhance Stormy Lake as the "crown jewel" of the community and the Captain Cook State Recreation Area, however, this has not happened because of a lack of funding and institutional support. ADF&G and the Captain Cook State Recreation Area need to work with the community of Nikiski more closely to enhance Stormy Lake and address common concerns and issues, including, but not limited to northern pike.

ADF&G's consideration of input – During the scoping process a number of participants expressed appreciation that ADF&G was asking for input and pro-actively raising this issue for public discussion. Additionally, some participants expressed a desire for additional public input opportunities as they move forward.

Summary

Input gathered during the public scoping process represents a spectrum of public views and concerns, with no clear consensus around one course of action. In summary, northern pike in Stormy Lake, and the species' potential to spread to other Kenai Peninsula water bodies and drainages, presents a complex resource management issue. ADF&G future action or inaction, no matter the course, will be of concern to at least some segment of the population based on the input received during the scoping process. As ADF&G considers options, members of the public largely expressed a common interest in a course of action that if possible, achieves the following outcomes:

Maintains fishing opportunities in Stormy Lake with species that people enjoy eating, and are fun to fish, particularly for local residents, tourists, beginning anglers and children who cannot participate in the busy, riverine fishing on the Kenai Peninsula.

Action is timed and completed in a manner that minimizes impacts to all forms of recreation that occur near and surrounding Stormy Lake including fishing, swimming, boating, hunting, etc.

Preserves the Kenai Peninsula's world class fisheries, including the Kenai National Wildlife Refuge and Swanson River drainage's rich and genetically important populations of rainbow trout, salmon, Arctic char, and other species.

Minimizes health risks to humans and other species, while considering issues related to both direct exposure and long term potential effects.

Limits environmental and site impacts to both Stormy Lake and the Captain Cook ***State*** Recreation Area, popular recreational areas which are valued for their scenic and natural qualities.

Presents a reasonable cost with a reasonable likelihood of effectiveness.

Appendix 2. Prentox Rotenone Fish Toxicant Powder product label.

RESTRICTED USE PESTICIDE
DUE TO AQUATIC, ACUTE ORAL AND INHALATION TOXICITY
For retail sale to, and use by, Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's certification.

ROTENONE FISH TOXICANT POWDER

ACTIVE INGREDIENTS:	
Rotenone- Minimum Guaranteed	7.4% w/w
Other Associated Resins	11.1%
OTHER INGREDIENTS:	81.5%
TOTAL:	100.0% w/w

ROTENONE ASSAY _____ % ROTENONE

PRENTOX® - Registered Trademark of Prentiss Incorporated

KEEP OUT OF REACH OF CHILDREN

DANGER
POISON

FIRST AID
Have the product container or label with you when calling a poison control center or physician, or going for treatment.

If swallowed	• Call a Poison Control Center, physician, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by the Poison Control Center or physician. • Do not give anything by mouth to an unconscious or convulsing person.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a Poison Control Center, physician, or the National Pesticide Information Center at 1-800-858-7378 for treatment advice.
If in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a Poison Control Center, physician, or the National Pesticide Information Center at 1-800-858-7378 for treatment advice.
If inhaled	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. • Call a Poison Control Center, physician, or the National Pesticide Information Center at 1-800-858-7378 for treatment advice.

For information on this pesticide product (including health concerns, medical emergencies, or pesticide incidents), call the National Pesticide Information Center at 1-800-858-7378.

SEE INSIDE LEAFLET FOR ADDITIONAL PRECAUTIONARY STATEMENTS AND DIRECTIONS FOR USE

Manufactured by: 5/02 **E.P.A. REG. NO. 655-691**
E.P.A. EST. NO. 655-GA-1

PRENTISS INCORPORATED
Plant: Kaolin Road, Sandersville, GA 31082
Office: C.B. 2000, Floral Park, NY 11002-2000

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
DANGER

Fatal if inhaled or swallowed. Harmful if absorbed through the skin. Causes moderate eye irritation. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals. Do not breathe dust. Use a dust/mist filtering respirator (MSHA/NIOSH approval number prefix TC-21C), or a NIOSH approved respirator with any N, R, P or HE filter. Avoid contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling and before eating, drinking or using tobacco. Remove contaminated clothing and wash clothing before reuse.

ENVIRONMENTAL HAZARDS

This pesticide is extremely toxic to fish. Fish kills are expected at recommended rates. Consult your State Fish and Game Agency before applying this product to public waters to determine if a permit is needed for such an application. Do not contaminate untreated water when disposing of equipment washwaters.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.
STORAGE: Store only in original container, in a dry place inaccessible to children and pets. If spilled, sweep up and dispose of as below.
PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.
CONTAINER DISPOSAL: Completely empty bag into application equipment. Then dispose of bag in a sanitary landfill or by incineration, or if allowed by State and local authorities by burning. If burned, stay out of smoke.

DIRECTIONS FOR USE
It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

USE RESTRICTIONS:
Use against fish in lakes, ponds, and streams (immediately above lakes and ponds).

Since such factors as pH, temperature, depth, and turbidity will change effectiveness, use this product only at locations, rates, and times authorized and approved by appropriate state and Federal fish and wildlife agencies. Rates must be within the range specified in the labeling.

Properly dispose of dead fish and unused product. Do not use dead fish as food or feed.

Do not use water treated with rotenone to irrigate crops or release within ½mile upstream of a potable water or irrigation water intake in a standing body of water such as a lake, pond or reservoir.

Note to User: Adjust pounds of Rotenone according to the actual Rotenone Assay as noted under the Ingredient Statement on this label. For example, if the required amount of 5% rotenone is 21 pounds, and the Rotenone Assay is 7%, use 5/7 of 21 pounds or 15 pounds of this product to yield the proper amount of active rotenone.

APPLICATION DIRECTIONS:

Treatment of Lakes and Ponds

1. **Application Rates and Concentrations of Rotenone**

The actual application rates and concentrations of rotenone needed to control fish will vary widely, depending on the type of use (e.g. selective treatment, normal pond treatment, etc.) and the factors listed above. The table below is a general guide for the proper rates and concentrations.

2. **Total Amount of Product Needed for Treatment**

To determine the total number of pounds needed for treatment, divide the number of acre-feet covered by one pound for a specific type of use (e.g., selective treatment, etc.), as indicated in the table below, into the number of acre-feet in the body of water.

General Guide to the Application Rates and Concentrations of Rotenone Needed to Control Fish in Lakes and Ponds[1]

Type of Use	No. of Acre-Feet Covered by One Pound	Parts Per Million	
		Active Rotenone	5% Product
Selective Treatment	3.7 to 2.8	0.005 - 0.007	0.10 - 1.3
Normal Pond Use	0.74 to 0.37	0.025 - 0.050	0.5 - 1.0
Remove Bullheads or Carp	0.37 to 0.185	0.050 - 0.100	1.02 - 2.0
Remove Bullheads or Carp in Rich Organic Ponds	0.185 to 0.093	0.100 - 0.200	2.0 - 4.0
Pre-impoundment Treatment above Dam	0.123 to 0.074	0.150 - 0.250	3.0 - 5.0

5. **Restocking**

Waters treated with this product detoxify within 2 to 4 weeks after treatment, depending on pH, temperature, water hardness, and depth. To determine if detoxification has occurred, place live boxes containing samples of fish to be stocked in treated waters. More rapid detoxification can be accomplished by adding Potassium Permanganate or chlorine at a 1:1 ratio with the concentration of rotenone applied, plus sufficient additional compound to satisfy the chemical oxidation demand caused by organic matter that may be present in the treated water.

Treatment of Streams Immediately Above Lakes and Ponds

The purpose of treating streams immediately above lakes and ponds is to improve the effectiveness of lake and pond treatments and not to control fish in streams per se. The term "immediately" means the first available site above the lake or pond where treatment is practical.

In order to treat a stream immediately above a lake or pond, you must select a concentration of active rotenone, compute the flow rate of a stream, calculate the application rate, select an exposure time, estimate the amount of product needed, and follow the method of application.

1. **Concentration of Active Rotenone**

Select the "Concentration of Active Rotenone" based on the type of use from those on the table. For example, if you select "Normal Pond Use" you could select a concentration of "0.025 Parts per Million".

2. **Computation of Flow Rate for Stream**

Select a cross section of the stream where the banks and bottom are relatively smooth and free of obstacles. Divide the surface width into 3 equal sections and determine the water depth and surface velocity at the center of each section. In slowly moving streams, determine the velocity by dropping a float attached to 5 feet of loose, monofilament fishing line. Measure the time required for the float to move 5 feet. For fast-moving streams, use a longer distance. Take at least three readings at each point. To calculate the flow rate from the information obtained above, use the following formula:

$$F = \frac{Ws \times D \times L \times C}{T}$$

where F = flow rate (cu. ft./sec.), Ws = surface width (ft.), D = mean depth (ft.), L = mean distance traveled by float (ft.), C = constant (0.8 for rough bottoms and 0.9 for smooth bottoms), and T = mean time for float (sec.).

For example, after using the above formula, you might have computed the stream's flow rate to be "10 cu. ft. per sec."

3. **Calculation of Application Rate**

In order to calculate the application rate (expressed as "pound per sec"), you convert the rate in the table (expressed as "pound per acre-feet"), to "pound per cu. feet" and multiply by the flow rate (expressed as "cu. ft. per sec."). Depending on the size of the stream and the type of equipment, the rate could be expressed in other units, such as "ounces per hr."

The application rate for the stream above is calculated as follows:

$$R_s = R_p \times C \times F$$

where R_s = Application Rate for Stream (lb/sec), R_p = Application Rate for Pond (lb/acre feet), C = 1 acre foot/43560 cu. ft., and F = Flow Rate (cu. ft/sec).

In the example, the Application Rate for Stream would be:
R_s = 1 lb/0.74 acre-foot x 1 acre-foot/43560 cu. ft. x 10 cu. ft./sec.
R_s = .00031 lb/sec or 17.9 oz./hr.

4. **Exposure Time**

The "Exposure Time" would be the period of time (expressed in hours or seconds) during which target fish should **not** enter the lake or pond under treatment. In the example, this period of time could be 4 hours.

5. **Amount of Product**

Calculate the "Amount of Product" for a stream by multiplying the "Application Rate for Stream" by the "Exposure Time". In the example, the "Amount of Product" would be 71.6 oz. (17.9 oz./hr. x 4 hr.) or 4.5 lb.

RE-ENTRY STATEMENT

Do not allow swimming in rotenone-treated water until the application has been completed and all pesticide has been thoroughly mixed into the water according to labeling instructions.

[1]Adapted from Kinney, Edward, 1965 Rotenone in Fish Pond Management. USDI Washington, D.C. Leaflet FL-576.

Computation of acre-feet for lake or pond: An acre-foot is a unit of water volume having a surface area of one acre and a depth of one foot. Make a series of transects across the surface, taking depths with a measured pole or weighted line. Add the measurements and divide by the number made to determine the average depth. To compute **total acre-feet**, multiply this average depth by the number of surface acres, which can be determined from an aerial photograph or plat drawn to scale.

3. **Pre-Mixing Method of Application**

Pre-mix one pound of Rotenone with 3 to 10 gallons of water. Uniformly apply over water surface or bubble through underwater lines.

Alternately place undiluted powder in burlap sack and trail behind boat. When treating deep water (20 to 25 feet) weight bag and tow at desired depth.

4. **Removal of Taste and Odor**

Rotenone treated waters do not retain a detectable taste or odor for more than a few days to a maximum of one month. Taste and odor can be removed immediately by treatment with activated charcoal at a rate of 30 ppm. for each 1 ppm. Rotenone remaining (Note: As Rotenone detoxifies, less charcoal is required).

Appendix 3. Rotenone Fish Toxicant Powder Material Safety Data Sheet.

Material Safety Data Sheet
U.S. Department of Labor (OSHA 29 CFR 1910.1200)

Section 1: Product and Company Identification

Product: **655-691** **Prentox® Prenfish™ Fish Toxicant Powder**

Manufacturer's Name: **Prentiss Incorporated**
C. B. 2000
Floral Park, NY 11001

Telephone Number: **(516) 326-1919**

Section II: Composition/Information on Ingredients

Ingredient Name:	OSHA PEL	ACGIH TLV	%
Rotenone (CAS # 83-79-4)	(TWA) 5 mg/M³	(TWA) 5 mg/M³	7.4
Other Cube Resins	None	None	11.1
Other Ingredients	None	None	81.5

Section 3: Hazards Identification:

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Emergency Overview:

A tan powder with a wet chalk or dirt-like odor.

- Fatal if inhaled or swallowed
- Harmful if absorbed through skin
- Causes moderate eye irritation
- May cause allergic skin reactions in some individuals
- This pesticide is extremely toxic to fish

Potential Health Effects:

Primary Route(s) of Entry:
Ingestion, inhalation, and skin contact

Eyes:
Causes moderate eye irritation

Skin:
Harmful if absorbed through the skin. Prolonged or frequently repeated skin contact may cause allergic skin reactions in some individuals.

Ingestion:
Fatal if swallowed

Inhalation:
Fatal if inhaled

Signs and symptoms of acute overexposure:
May cause irritation of the eyes, nose and throat in addition to temporary numbness. Prolonged or repeated exposure can cause nausea, vomiting, abdominal cramps, muscle tremors, poor muscle coordination, seizures, shallow breathing, skin rashes and eye, nose and mouth lesions.

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Section 4: First Aid Measures:

Eyes:
Flush eyes with plenty of water for 15 minutes. Get medical attention if irritation persists

Skin:
Wash with plenty of soap and water. Get medical attention if irritation persists

Ingestion:
Call a physician or Poison Control Center. Drink 1 or 2 glasses of water and induce vomiting by touching back of throat with finger. Do not induce vomiting or give anything by mouth to an unconscious person.

Inhalation:
Remove person to fresh air. If not breathing, give artificial respiration, preferably mouth to mouth. Get medical attention

Note to Physician:
If a small amount is ingested (or if treatment is delayed), oral administration of large amounts of activated charcoal and a cathartic is probably sufficient therapy.
Do not administer milk, cream or other substances containing vegetable or animal fats, which enhance the absorption of lipophilic substances.

Section 5: Fire Fighting Measures:

Extinguishing Media:
Carbon dioxide, dry chemical, foam or water

Fire Fighting Instructions:
As in any fire, wear self-contained breathing apparatus, pressure demand, MSHA/NIOSH approved (or equivalent), and full protective gear. Keep upwind. Isolate hazard area. Avoid inhalation of smoke and fumes. Use water or foam to reduce fumes. Do not touch spilled material. If possible, move containers from area. Extinguish only if flow can be stopped. Use flooding amounts of water as a fog. Cool containers with flooding amounts of water from as far a distance as possible. Avoid breathing vapors.

Flammability Classification/Rating:
NFPA/OSHA Class: IIIB
NFPA Rating (Fire): 1

Section 6: Accidental Release Measures:

General and Disposal: Use proper protective equipment to minimize personal exposure (see Section 8). Take all necessary action to prevent and to remedy the adverse effect of the spill. Ensure that the disposal is in compliance with all Federal, State/Provincial, and local regulations (see Section 13 for applicable RCRA number). Refer to Section 15 for applicable Reportable Quantity (RQ) and other regulatory requirements.

Land Spill: Sweep or shovel spilled material into a tightly sealed container. Dispose of with chemical waste.

Section 7: Handling and Storage:

Handling Precautions:
Do not breathe dust. Avoid contact with eyes, skin or clothing.

Storage Precautions:
Do not contaminate water, food or feed by storage. Store in a dry place, away from excessive temperature extremes.

Work/Hygienic Practices:
Wash thoroughly with soap and water after handling and before eating, drinking or using tobacco. Remove contaminated clothing and wash before reuse.

Section 8: Exposure Controls/Personal Protection:

Manufacturing, formulation and other Non-Agricultural uses.

Engineering controls:
Control airborne concentrations below the appropriate exposure guideline (see Section 2 for applicable OSHA/ACGIH Exposure Limits). Local exhaust ventilation may be necessary.

Eye/Face Protection:
Wear safety glasses, splash goggles or face shield.

Skin Protection:
Wear chemical resistant gloves (Neoprene, Nitrile rubber or PVC) and other protective clothing to avoid skin contact.

Respiratory Protection:
Ensure good ventilation. If not adequate, use a chemical cartridge type respirator approved by the National Institute of Occupational Health and Safety.

General Protection:
Eye wash facility and safety shower should be available. Wear a protective apron, long sleeves and pants to prevent skin contact.

Section 9: Physical and Chemical Properties:

Appearance:
Tan powder

Odor:
Wet chalk or dirt-like odor.

Basic Physical Properties:

Physical State: Solid

Solubility (H_2O): Insoluble

Bulk Density: Fluffed – 0.24 gm/cm^3 (14.7 lb./cu. Ft.). Packed – 0.45 gm/cm^3 (28.1 lb./cu. Ft.)

Section 10: Stability and Reactivity:

Stability: Stable.

Conditions to Avoid (Stability): High temperatures and constant exposure to sunlight

Incompatible Materials: Avoid strong oxidizers and reducing agents

Hazardous Polymerization: Will not occur

Section 11: Toxicological Information:

The following data were developed with rotenone dust containing 5% rotenone.

Eye Effects:

Irritation (Rabbit): Slightly irritating.

Skin Effects:

Irritation (Rabbit): Non-irritating.

Absorption (Rabbit): LD_{50} > 2,020 mg/kg (Slightly Toxic).

Sensitization (Guinea Pig): Sensitizing

Acute Oral Effects:

LD_{50} (Rat, male): 874 mg/kg (Slightly Toxic).

(Rat, female): 99.2 mg/kg (Moderately Toxic).

Acute Inhalation Effects:

4 hour LC_{50} (Rat, Male): 0.087 mg/L (Moderately Toxic).

4 hour LC_{50} (Rat, Female): 0.045 mg/L (Highly Toxic).

4 hour LC_{50} (Rat): 0.056 mg/L (Moderately Toxic).

Note: the severity classifications listed above are those of Prentiss Incorporated, and, particularly for eye irritation, may not always coincide with EPA-mandated Precautionary Statements.

The following data were developed with rotenone, the active ingredient in this product.

Chronic (Cancer) Information:

Rotenone was not carcinogenic when tested in rats and mice.

Carcinogenicity: **NTP:** No **IARC:** No **OSHA:** No

Teratogenicity (Birth Defects):

Rotenone was not teratogenic or fetotoxic when tested in rats and mice.

Reproductive Effects:

Rotenone had no adverse effects on reproduction when tested over two successive generations in rats.

Mutagenicity (Genetic Effects):

Rotenone was not mutagenic nor clastogenic when tested in the Ames test, Yeast test, Mouse Lymphoma test, Mouse Micronucleus test, Chromosome Aberration test and the Mitotic Recombination test in Yeast.

Section 12: Ecological Information:

Other Environmental Information:

This pesticide is extremely toxic to fish. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans or other waters, unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance, contact your State Water Board or Regional Office of the EPA

Section 13: Disposal Considerations:

Do not contaminate water, food or feed by disposal.

Pesticide Disposal:

Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency or the Hazardous Waste Representative at the nearest EPA Regional Office for guidance.

Container Disposal:

Completely empty liner by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of liner in a sanitary landfill or by incineration if allowed by State and local authorities. If drum is contaminated and cannot be reused, dispose of in the same manner.

RCRA Information:

RCRA Hazardous Waste Ingredients: None.

Section 14: Transport Information:

Proper Shipping Name: Pesticide, Solid, Toxic, n.o.s. (Rotenone)
Hazard Class: 6.1, PG I
DOT Identification Number: UN2588
DOT Shipping Label: POISON

Additional Shipping Paper Description: Marine Pollutant

Note: For transport purposes (49 CFR Part 173.132), the calculated 1 hour LC_{50} (Rat) is: 0.224 mg/L (dust)

Section 15: Regulatory Information:

U.S. Federal Regulatory Information:

EPA Reg. No.: 655-691
TSCA Inventory: Registered pesticide, exempt from TSCA.
SARA Title III Notification and Information:

Section 302 (EHS) ingredients: None.
Section 304 (CERCLA & EHS) ingredients (RQ): None.
Section 313 ingredients: None.

SARA Title III Notifications and Information:

SARA Title III Hazard Classes:

Acute Health Hazard: Yes
Chronic Health Hazard: No
Fire Hazard: No
Sudden Release of Pressure Hazard: No
Reactivity Hazard: No

Regulated Ingredients:

Ingredient: Rotenone

CAS Number: 83-79-4

Percent by Weight: 7.4

Regulations:

Illinois Toxic Substance
Massachusetts Hazardous Substance
New Jersey Special Health Hazardous Substance
New Jersey Workplace Hazardous Substance
Pennsylvania Workplace Hazardous Substance

U.S. State Regulatory Information:

California (Proposition 65): This product does not contain any chemical which is known to the State of California to cause cancer or birth defects, or other reproductive harm.

Canadian Regulatory Information:

CPC Number: None
WHMIS Classification for Control Product Regulations (CPR): Registered pesticide under US FIFRA regulations; exempt from CPR classification.
The MSDS contains all CPR required hazard-related information.
WHMIS Hazard Rating: See HMIS rating (Section 16).

Section 16: Other Information:

NFPA Hazard Rating:

Health: 2 – Moderate
Fire: 1 – Slight
Reactivity: 0 – Negligible
Special:

HMIS Hazard Rating:

Health: 2 – Moderate
Fire: 1 – Slight
Reactivity: 0 – Negligible
Protection: J

Date Prepared: August 14, 2000
Supersedes: November 3, 1997
Reason: Revision of sections 3, 5, 6, 7, 8, 9, 11, 13, 14, 15

The information and recommendations contained herein are based upon data believed to be correct. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein.

Appendix 4. CFT Legumine™ product label.

RESTRICTED USE PESTICIDE
Due to aquatic toxicity
For retail sale to, and use only by, Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's certification.

CFT Legumine™

Fish Toxicant

For Control of Fish in Lakes, Ponds, Reservoirs, and Streams

ACTIVE INGREDIENTS:

Rotenone	5.0%	w/w
Other Associated Resins	5.0%	
OTHER INGREDIENTS[1]	90.0%	
Total	100.0%	

[1] Contains Petroleum Distillates

CFT Legumine is a trademark of CWE Properties Ltd., LLC

KEEP OUT OF REACH OF CHILDREN

WARNING

FIRST AID Have product container or label with you when obtaining treatment advice.	
If swallowed	• Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice. • Do not give any liquid to the person. · Do not anything to an unconscious person • Do not induce vomiting unless told to do so by the poison control center or doctor.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice.
If inhaled	• Move person to fresh air. • If person is not breathing, call an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. • Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice.
If in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice.
Note to Physician: Contains Petroleum Distillates. Vomiting may cause aspiration pneumonia. For information on this pesticide product (including health concerns, medical emergencies, or pesticide incidents), call the National Pesticide Information Center at 1-800-858-7378.	

EPA Reg. No. 655-899

Manufactured for CWE Properties Ltd., LLC, P.O. Box 336277, Greeley CO 80633

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
WARNING

May be fatal if inhaled or swallowed. Causes moderate eye irritation. Harmful if absorbed through skin. Do not breathe spray mist. Do not get in eyes, on skin, or on clothing. Wear goggles or safety glasses.

When handling undiluted product, wear either a respirator with an organic-vapor-removing cartridge with a prefilter approved for pesticides (MSHA/NIOSH approval number prefix TC-23C), or a canister approved for pesticides (MSHA/NIOSH approval number prefix 14G), or a NIOSH approved respirator with an organic vapor (OV) cartridge or canister with any R, P, or HE prefilter.

Wash thoroughly with soap and water after handling and before eating, drinking, or using tobacco. Remove contaminated clothing and wash before reuse. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.

ENVIRONMENTAL HAZARDS

This pesticide is extremely toxic to fish. Fish kills are expected at recommended rates. Consult your State Fish and Game Agency before applying this product to public waters to determine if a permit is needed for such an application. Do not contaminate untreated water when disposing of equipment washwaters.

CHEMICAL AND PHYSICAL HAZARDS

FLAMMABLE: KEEP AWAY FROM HEAT AND OPEN FLAME. FLASH POINT MINIMUM 45°F (7°C).

For information on this pesticide product (including health concerns, medical emergencies, or pesticide incidents), call the National Pesticide Information Center at 1-800-858-7378.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

STORAGE: Store only in original containers, in a dry place inaccessible to children and pets. This product will not solidify nor show any separation at temperatures down to 40°F and is stable for a minimum of one year when stored in sealed drums at 70°F.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, contact your state pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Triple rinse or equivalent. Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

CFT Legumine is registered for use by or under permit from, and after consultation with State and Federal Fish and Wildlife Agencies.

GENERAL INFORMATION

This product is a specially formulated product containing rotenone to be used in fisheries management for the eradication of fish from lakes, ponds, reservoirs and streams.

Since such factors as pH, temperature, depth and turbidity will change effectiveness, use this product only at locations, rates, and times authorized and approved by appropriate State and Federal Fish and Wildlife Agencies. Rates must be within the range specified on the label.
Properly dispose of unused product. Do not use dead fish for food or feed.
Do not use water treated with rotenone to irrigate crops or release within ½ mile upstream of a potable water or irrigation water intake in a standing body of water such as a lake, pond or reservoir.

Re-entry Statement: Do not allow swimming in rotenone-treated water until the application has been completed and all pesticide has been thoroughly mixed into the water according to labeling instructions.

FOR USE IN PONDS, LAKES, AND RESERVOIRS

The actual application rates and concentrations of rotenone needed to control fish will vary widely, depending on the type of use (e.g., selective treatment, normal pond use, etc.) and the factors listed above. The table below is a general guide for the proper rates and concentrations.
This product disperses readily in water both laterally and vertically, and will penetrate below the thermocline in thermally stratified bodies of water.

Computation of Acre-Feet: An acre-foot is a unit of volume of a body of water having the area of one acre and the depth of one foot. To determine acre-feet in a given body of water, make a series of transects across the body of water taking depths with a measured pole or weighted line. Add the soundings and divide by the number made to determine the average depth. Multiply this average depth by the total surface area in order to determine the acre-feet to be treated. If number of surface acres is unknown, contact your local Soil Conservation Service, which can determine this from aerial photographs.

Amount of CFT Legumine Needed for Specific Uses: To determine the approximate number of gallons needed, find your "Type of Use" in the first column of the table below and then divide the corresponding numbers in the fourth column, "Number of Acre-Feet Covered by One Gallon" into the number of acre-feet in your body of water.

Type of Use	Parts per Million		Number of Acre-Feet Covered by One Gallon
	CFT Legumine	Active Rotenone	
Selective Treatment	0.10 to 0.13	0.005 to 0.007	30 to 24
Normal Pond Use	0.5 to 1.0	0.025 to 0.050	6.0 to 3.0
Remove Bullheads or Carp	1.0 to 2.0	0.050 to 0.100	3.0 to 1.5
Remove Bullheads or Carp in Rich Organic Ponds	2.0 to 4.0	0.100	1.5 to 0.75
Preimpoundment Treatment Above Dam	3.0 to 5.0	0.150 to 0.250	1.0 to 0.60

*Adapted from Kinney, Edward. 1965. Rotenone in Fish Pond Management. USDI Washington, DC Leaflet FL-576

Pre-Mixing and Method of Application: Pre-mix with water at a rate of one gallon of CFT Legumine to 10 gallons of water. Uniformly apply over water surface or bubble through underwater lines.

Detoxification: Water treated with this product will detoxify under natural conditions within one week to one month depending upon temperatures, alkalinity, etc. Rapid detoxification can be accomplished by adding chlorine or potassium permanganate to the water at the same rate as CFT Legumine in parts per million, plus enough additional to meet the chlorine demand of the untreated water.

Removal of Taste and Odor: Waters treated with this product do not retain a detectable taste or odor for more than a few days to a maximum of one month. Taste and odor can be removed immediately by treatment with activated charcoal at a rate of 30 ppm for each 1 ppm of CFT Legumine remaining. (Note: As this product detoxifies, less charcoal is required.)

Restocking After Treatment: Wait 2 to 4 weeks after treatment. Place a sample of fish to be stocked in wire cages in the coolest part of the treated waters. If the fish are not killed within 24 hours, the water may be restocked.

USE IN STREAMS IMMEDIATELY ABOVE LAKES, PONDS, AND RESERVOIRS

The purpose of treating streams immediately above lakes, ponds and reservoirs is to improve the effectiveness of lake, pond and reservoir treatments by preventing target fish from moving into the stream corridors, and not to control fish in streams per se. The term "immediately" means the first available site above the lake, pond or reservoir where treatment is practical, while still creating a sufficient barrier to prevent migration of target fish into the stream corridor.

In order to completely clear a fresh water aquatic habitat of target fish, the entire system above or between fish barriers must be treated. See the use directions for streams and rivers on this label for proper application instructions.

In order to treat a stream immediately above a lake, pond or reservoir you must: (a) Select the concentration of active rotenone, (b) Compute the flow rate of the stream, (c) Calculate the application rate, (d) Select an exposure time, (e) Estimate the amount of product needed, (f) Follow the method of application.

To prevent movement of fish from the pond, lake, or reservoir, the stream treatment should begin before and continue throughout treatment of the pond, lake or reservoir until mixing has occurred.

1. Concentration of Active Rotenone

Select the concentration of active rotenone based on the type of use from those listed on the table. Example: If you select "normal pond use" you could select a concentration of 0.025 parts per million.

2. Computation of Flow Rate for Stream

Select a cross section of the stream where the banks and bottom are relatively smooth and free of obstacles. Divide the surface width into 3 equal sections and determine the water depth and surface velocity at the center of each section. In slowly moving streams, determine the velocity by dropping a float attached to 5 feet of loose monofilament fishing line. Measure the time required for the float to move 5 feet. For fast-moving streams, use a longer distance. Take at least three readings at each point. To calculate the flow rate from the information obtained above, use the following formula:

$$F = \frac{Ws \times D \times L \times C}{T}$$

Where F = flow rate (cubic feet/second), Ws = surface width (feet), D = mean depth (feet), L = mean distance traveled by float (feet), C = constant (0.8 for rough bottoms and 0.9 for smooth bottoms), T = mean time for float (sec.).

3. Calculation of Application Rate

In order to calculate the application rate (expressed as gallons/second), convert the rate in the table (expressed as gallons/acre-feet) to gallons per cubic feet and multiply by the flow rate (expressed as cubic feet/second). Depending on the size of the stream and the type of equipment, the rate could be expressed in other units, such as ounces/hour, or cc/minute.

The application rate for the stream is calculated as follows:

$$R_s = R_p \times C \times F$$

Where R_s = application rate for stream (gallons/second), R_p = application rate for pond (gallons/acre-feet), C = 1 acre-foot/43560 cubic feet and F = flow rate of the stream (cubic feet/second).

4. Exposure Time

The exposure time would be the period of time (expressed in hours or minutes) during which CFT Legumine is applied to the stream in order to prevent target fish from escaping from the pond into the stream corridor.

5. Amount of Product

Calculate the amount of product for a stream by multiplying the application rate for streams by the exposure time.

$$A = R_s \times H$$

Where A = the amount of product for the stream application, R_s = application rate for stream (gallons/second) and H = the exposure time expressed in seconds.

FOR USE IN STREAMS AND RIVERS

Only state or Federal Fish and Wildlife personnel or professional fisheries biologists under the authorization of state or Federal Fish and Wildlife agencies are permitted to make applications of CFT Legumine for control of fish in streams and rivers. Informal consultation with Fish and Wildlife personnel regarding the potential occurrence of endangered species in areas to be treated should take place. Applicators must reference the Stream and River use Monograph before making any application to streams or rivers.

CFT LEGUMINE STREAM AND RIVER USE MONOGRAPH

USE IN STREAMS AND RIVERS

The following use directions are to provide guidance on how to make applications of CFT Legumine to streams and rivers. The unique nature of every application site could require minor adjustments to the method and rate of application. Should these unique conditions require major deviation from the use directions, a Special Local Need 24(c) registration should be obtained from the state.

Before applications of CFT Legumine can be made to streams and rivers, authorization must be obtained from state or federal Fish and Wildlife agencies. Since local environmental conditions will vary, consult with the state Fish and Wildlife agency to ensure the method and rate of application are appropriate for that site.

Contact the local water department to determine if any water intakes are within one mile downstream of the section of stream, river, or canal to be treated. If so, coordinate the application with the water department to make sure the intakes are closed during treatment and detoxification.

Application Rates and Concentration of Rotenone

Slow Moving Rivers: In slow moving rivers and streams with little or no water exchange, use instructions for ponds, lakes and reservoirs.

Flowing Streams and Rivers: Apply rotenone as a drip for 4 to 8 hours to the flowing portion of the stream. Multiple application sites are used along the length of the treated stream, spaced

approximately ½ to 2 miles apart depending on the water flow travel time between sites. Multiple sites are used because rotenone is diluted and detoxified with distance. Application sites are spaced at no more than 2 hours or at no less than 1-hour travel time intervals. This assures that the treated stream remains lethal to fish for a minimum of 2 hours. A non-toxic dye such as Rhodamine-WTR or fluorescein can be used to determine travel times. Cages containing live fish placed immediately upstream of the downstream application sites can be used as sentinels to assure that lethal conditions exist between sites.

Apply rotenone at each application site at a concentration of 0.25 to 1.0 part per million of CFT Legumine. The amount of CFT Legumine needed at each site is dependent on stream flow (see Computation of Flow Rate for Stream).

Application of Undiluted Material

CFT Legumine can drain directly into the center of the stream at a rate 0.85 to 3.4 cc per minute for each cubic foot per second of stream flow. Flow of undiluted CFT Legumine into the stream should be checked at least hourly. This is equivalent to from 0.5 to 2.0 ppm of this product, or from 0.025 to 0.100 ppm rotenone. Backwater, stagnant, and spring areas of streams should be sprayed by hand with a 10% v/v solution of CFT Legumine in water to assure a complete coverage.

Calculation of Application Rate:

$$X = F (1.699 B)$$

X = cc per minute of CFT Legumine applied to the stream, F = the flow rate (cu.ft/sec.) see Computation of Flow Rate for Stream section of the label, B = parts per million desired concentration of CFT Legumine

Total Amount of Product Needed for Treatment: Streams should be treated for 4 to 8 hours in order to clear the treated section of stream of fish. To determine the total amount of CFT Legumine required, use the following equation:

$$Y = X (0.0158 C)$$

Y = gallons of CFT Legumine required for the stream treatment, X = cc per minute of CFT Legumine applied to the stream, C = time in hours of the stream treatment.

Application of Diluted Material

Alternatively, for stream flows up to 25 cubic feet per second, continuous drip of diluted CFT Legumine at 80 cc per minute can be used. Flow of diluted CFT Legumine into the stream should be checked at least hourly. Use a 5 gallon reservoir over a 4 hour period, a 7.5 gallon reservoir over a 6 hour period, or a 10 gallon reservoir over an 8 hour period. The volume of the reservoir can be determined from the equation:

$$R = H \times 1.25$$

Where R = the volume of the reservoir in gallons, H = the duration of the application in hours.

The volume of CFT Legumine diluted with water in the reservoir is determined from the equation:

$$X = Y(102\ F)H$$

Where X = the cc of CFT Legumine diluted in the reservoir, Y = parts per million desired concentration of CFT Legumine, F = the flow rate (cubic feet/second), H = the duration of the application (hours).

For flows over 25 cubic feet per second, additional reservoirs can be used concurrently. Back-water, stagnant and spring areas of streams should be sprayed by hand with a 10% v/v solution of CFT Legumine in water to assure a complete coverage.

Detoxification

To limit effects downstream, detoxification with potassium permanganate can be used at the downstream limit of the tre ated area. Within ½ to 2 miles of the furthest downstream CFT Legumine application site, the rotenone can be detoxified with a potassium permanganate solution at a resultant stream concentration of 2 to 4 parts per million, depending on rotenone concentration and permanganate demand of the water. A 2.5% (10 pounds potassium permanganate to 50 gallons of water) permanganate solution is dripped in at a continuous rate using the equation:

$$X = Y(70\ F)$$

Where X = cc of 2.5% permanganate solution per minute, Y = ppm of desired permanganate concentration, F = cubic feet per second of stream flow.

Flow of permanganate should be checked at least hourly. Live fish in cages placed immediately above the permanganate application site will show signs of stress signaling the need for beginning detoxification. Detoxification can be terminated when replenished fish survive and show no signs of stress for at least four hours.

Detoxification of rotenone by permanganate requires between 15 to 30 minutes contact time (travel time). Cages containing live fish can be placed at these downstream intervals to judge the effectiveness of detoxification. At water temperatures less than 50°F detoxification may be retarded, requiring a longer contact time.

WARRANTY STATEMENT

Our recommendations for the use of this product are based upon tests believed to be reliable. The use of this product being beyond the control of the manufacturer, no guarantee, expressed or implied, is made as to the effects of such or the results to be obtained if not used in accordance with directions or established safe practice. To the extent consistent with applicable law, the buyer must assume all responsibility, including injury or damage, resulting from its misuse as such, or in combination with other materials.

Appendix 5. CFT Legumine™ Material Safety Data Sheet

CWE Properties Ltd., LLC – P.O. Box 336277 – Greeley, CO 80633

CFT Legumine™ EPA Reg. No. 75338-2

Material Safety Data Sheet

SECTION 1: CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT/CHEMICAL NAME: CFT Legumine™

Emergency Contact: 1-800-858-7378 (National Pesticide Information Center)

Transportation Emergency Contact: 1-800-858-7378 (National Pesticide Information Center

Manufactured for: CWE Properties Ltd., LLC
P.O. Box 336277
Greeley, CO 80633

SECTION 2: HAZARDS IDENTIFICATION SUMMARY

KEEP OUT OF REACH OF CHILDREN –WARNING – May be fatal if inhaled. May be fatal if swallowed. Causes substantial, but temporary, eye injury. Causes skin irritation. Do not breathe spray mist. Do not get in eyes, on skin, or on clothing. Wear goggles or safety glasses. This product is an orange, viscous liquid with slight petroleum odor.

SECTION 3: COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Ingredients:	Percentage By Weight	CAS No.	TLV (Units)
Rotenone	5.00	83-79-4	5 mg/m3
Other Associated Resins	5.00		
Inert Ingredients, Including N-Methylpyrrolidone	90.00	872-50-4	not listed

SECTION 4: FIRST AID MEASURES

IF SWALLOWED: Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-900-858-7378 immediately for treatment advice. Do not induce vomiting unless told to do so by the Poison Control Center or physician. Do not give any liquid to the person. Do not give anything by mouth to an unconscious or convulsing person.

IF INHALED: Remove victim to fresh air. If not breathing, give artificial respiration, preferably by mouth-to-mouth. Call a physician, Poison Control Center, or the National Pesticide Information

Emergency Telephone Number: 1-800-858-7378

Revision Date: July 12, 2007

Center at 1-800-858-7378 immediately for treatment advice.

IF IN EYES: Hold eyelids open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice.

IF ON SKIN OR CLOTHING: Take off contaminated clothing. Rinse skin with plenty of water for 15-20 minutes. Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice.

Note: Have the product container or label with you when obtaining treatment advice.

SECTION 5: FIRE FIGHTING MEASURES

Flash Point (Method Used): 192°F (89°C) (Closed Cup)

Flammable Limits: LFL: Not established
UFL: Not established

Extinguishing Media: CO_2, foam, dry chemical water spray.

Special Fire Fighting Procedures: Use self-contained breathing apparatus and full protective equipment. Fight fire from upwind from a safe distance and keep non-essential personnel out of area.

SECTION 6: ACCIDENTAL RELEASE MEASURES

SPILL/LEAK PROCEDURES: Wear protective clothing as described in Section 8 (Exposure Controls / Personal Protection) of this MSDS. Absorb liquid with material such as clay, sand, sawdust, or dirt. Sweep up and place in a suitable container for disposal and label the contents. Area can be washed down with a suitable solution of bleach or soda ash and an appropriate alcohol (methanol, ethanol, or isopropanol). Follow this by washing with a strong soap and water solution. Absorb any excess liquid as indicated above, and add to the disposal container. This product is extremely toxic to fish. Fish kills are expected at recommended use rates. Keep spills and cleaning runoff out of municipal sewers and open bodies of water.

SECTION 7: HANDLING AND STORAGE

HANDLING: Avoid inhalation of vapors. Harmful if swallowed, inhaled or absorbed through skin. Avoid contact with skin. Wear clean protective clothing. Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet. Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing. Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

STORAGE: Store in original containers only. Store in a dry place away from children and domestic animals. Do not store at temperatures below 40 F/4.4^{O}C. This product is stable for a minimum of 1 year when stored in sealed drums at 70^{O}F/21.1 $_{o}$C. Do not contaminate water, food or feed by storage or disposal.

SECTION 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS: Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHS PELs (see section 3).
RESPIRATORY PROTECTION: When working with an undiluted product in a confined space, use a non-powered air purifying respirator equipped with an N–, R-, or P-series filter. For emergency or non-routine operations (cleaning reactor vessels or storage tanks), wear an SCBA"

Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres. If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **PROTECTIVE CLOTHING/EQUIPMENT:** Wear chemical-resistant gloves, boots, and aprons to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Viscous liquid
Appearance and Odor: Orange liquid with slight solvent odor.
Specific Gravity: 1.019 g/ml
Bulk Density: 8.506 lbs./gal.

Emergency Telephone Number: 1-800-858-7378

Revision Date: July 12, 2007

SECTION 10: STABILITY AND REACTIVITY

Stability: Stable at room temperature in closed containers under normal storage and handling conditions.
Conditions to Avoid: None known.
Incompatibility: Strong acids and strong oxidizers,
Hazardous Decomposition Products: Oxides of carbon.
Hazardous Polymerization: Will not occur.

SECTION 11: TOXICOLOGICAL INFORMATION

Acute Oral LD_{50} (rat): 55.3 – 264 mg/kg
Acute Dermal LD_{50} (rabbit): >2020 mg/kg
Inhalation LC_{50} (rat): 0.048 mg/L (4 HR)
Eye Irritation (rabbit): Moderately irritating
Skin Irritation (rabbit): Moderately irritating
Skin Sensitization (guinea pig): Not a sensitizer
Carcinogenic Potential: Not listed by IARC, NTP, or OSHA. ACGIH lists Rotenone as TLV A4: Not classifiable as to human carcinogenicity.

SECTION 12: ECOLOGICAL INFORMATION

This product is extremely toxic to fish. Fish kills are expected at recommended usage rates. Consult local Fish and Game agencies before applying this product to public waters to determine if a permit is needed for such an application.

SECTION 13: DISPOSAL CONSIDERATIONS

Do not reuse empty containers. **Plastic:** Triple rinse (or equivalent), then offer for recycling, or puncture and dispose of in a sanitary landfill, or incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke. **Metal:** Triple rinse (or equivalent), then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill or by other procedures approved by state and local authorities. Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture or rinsate is a violation of Federal law and may contaminate groundwater. Do not contaminate water, food or feed by storage or disposal.

SECTION 14: TRANSPORT INFORMATION

U.S DOT Shipping Description: Pesticide, Liquid, Toxic, N.O.S. (Rotenone), 6.1, UN2902, III, Marine Pollutant, ERG Guide 151Emergency Telephone Number: 1-800-858-7378

SECTION 15: REGULATORY INFORMATION

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) HAZARD RATINGS:

Category	Rating
Health	4
Flammability	2
Instability	0

0: Least
1: Slight
2: Moderate
3: High
4: Severe

SARA Hazard Notification/Reporting:
SARA Title III Hazard Category:
Immediate: Yes – Fire: No – Delayed: No – Reactive: No
Reportable Quantity (RQ) U.S. CERCLA: Not listed
SARA Title III, Section 313: N-methylpyrrolidone (CAS: 872-50-4) 10.0%
RCRA Waste Code: Not listed
California Proposition 65: WARNING: This product contains chemicals known to the State of California to cause cancer or birth defects or other reproductive harm.

SECTION 16: OTHER INFORMATION

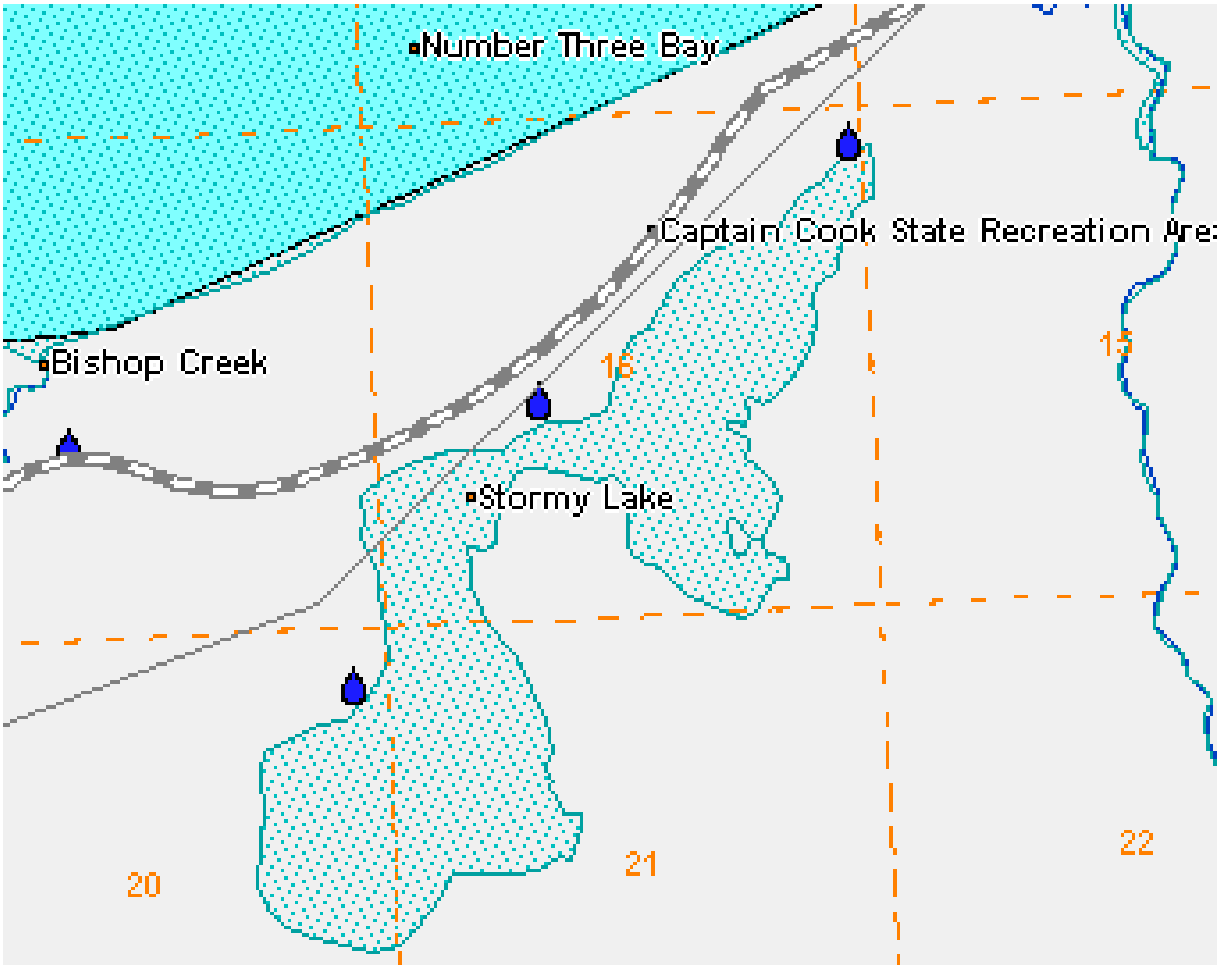
Prepared by: ERR
Issue Date: July 12, 2007
Revision Notes: July 12, 2007
NOTE: *CFT Legumine is a Restricted Use Pesticide due to Aquatic Toxicity*

NOTICE: The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warranty, expressed or implied, is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state, and local laws and regulations.

Appendix 6. Stormy Lake water quality data collected in 2006 and 2007.

	2007				2008								
Measured parameters	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Site 1 (middle of northern lake basin)													
Temperature (Celcius)	15.5	5.8	2.5	2.0	2.8	2.8	2.9	3.4	7.9	12.9	14.0	14.5	13.2
Specific Conductivity (S/cm)	0.06	0.05	0.05	0.06	0.03	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06
Disolved Oxygen (mg/L)	6.9	10.8	15.2	11.3	9.7	6.6	9.4	8.3	10.2	8.7	7.4	6.7	8.5
ph	6.9	6.5	8.4	7.5	7.2	7.3	7.3	7.6	7.5	7.4	7.5	7.6	7.8
Visibility (m)	5.5	3.5	3.5	4.5	N/A	3.5	5.7	1.5	3.0	3.4	3.2	3.4	3.0
Ice thickness (in)				13	20	25	24	25					
Site 2 (middle of lake near deepest area)													
Temperature (Celcius)	N/A	6.4	2.8	2.3	2.7	3.0	3.1	3.3	7.5	11.6	13.5	13.9	12.7
Specific Conductivity (S/cm)	N/A	0.05	0.05	0.06	0.07	0.08	0.06	0.07	0.06	0.06	0.06	0.06	0.06
Disolved Oxygen (mg/L)	N/A	10.9	14.8	11.7	10.1	6.4	8.0	7.8	10.0	9.3	9.4	6.4	6.8
ph	N/A	7.2	6.7	7.5	7.1	7.2	7.4	7.6	7.4	7.5	7.5	7.5	7.6
Visibility (m)	N/A	4.0	3.5	3.8	N/A	4.2	5.7	1.8	2.2	3.6	3.5	3.1	2.6
Ice thickness (in)				14	N/A	22	24	25					
Site 3 (middle southern lake basin)													
Temperature (Celcius)	15.9	6.2	2.8	1.9	2.5	2.6	2.7	3.1	7.8	12.1	13.7	14.2	13.3
Specific Conductivity (S/cm)	0.05	0.05	0.05	0.06	0.11	0.06	0.06	0.07	0.34	0.06	0.06	0.06	0.06
Disolved Oxygen (mg/L)	7.7	10.8	14.7	12.8	11.4	8.1	10.6	10.0	10.1	9.9	8.2	6.5	8.8
ph	6.9	6.8	6.6	7.6	7.2	7.3	7.3	7.8	7.5	7.5	7.5	7.5	7.9
Visibility (m)	5.5	3.5	3.5	4.5	N/A	4.0	5.7	1.8	2.5	3.6	4.1	3.1	2.7
Ice thickness (in)				14	N/A	22	24	25					
a Mean values obtained by average of reading throughout water column taken at one meter intervals.													

Appendix 7. Map of subsurface water rights in the Stormy Lake area.



Note: Tear drop symbols identify subsurface water rights held by the Alaska Department of Natural Resources. Map provided online at:
http://dnr.alaska.gov/mlw/mapguide/wr_intro.htm

Appendix 8. Memo on groundwater risk for the Stormy Lake area.

MEMORANDUM State of Alaska

Department of Natural Resources Main Telephone: (907) 269-8600

Division of Mining and Water Management Hydrology Fax: (907) 269-8947

Alaska Hydrologic Survey Personal Telephone: (907) 269-8639

E-mail: roy.ireland@alaska.gov

July 12, 2011

To: Rob Massengill

Alaska Dept. of Fish and Game

Fisheries Biologist

Sport Fish Div.

From: Roy Ireland

AK DNR, DMLW, Alaska Hydrologic Survey

Hydrologist

Subject: Stormy Lake

Pulled several well logs from the general area of the lake (key numbers: 2074, 17165, 17168, 17169 and 34047). These well logs show no consistency in aquifer formation and are spread over a relatively large area. There is no mention of bedrock.

As you are aware, there are relatively few wells in the area to start with, and there are no drillers within the Kenai in compliance with state statutes to submit water well logs. Accordingly, data is sparse.

I performed a search on related information and came across a pdf file of a document produced by the USGS. I was able to extract some of the information and have presented it below. Unfortunately, it was an image created from an older document and I had to do character recognition, so there may be typographic errors.

An extract from:

HYDROLOGY AND THE EFFECTS OF INDUSTRIAL PUMP1 ME

IN THE NIKISKI AREA, ALASKA

By Gordon I. Nelson

U.S. Geological Survey

Water-Resources Investigations 81-685

GEOLOGIC SETTING

Bedrock

Bedrock consists of moderately indurated sandstone, siltstone, claystone, and coal. No wells penetrate bedrock within the study area, and it is presumed to be deeper than 500 ft below land surface, oil and gas wells near the eastern edge of the study area have penetrated bedrock at a depth of approximately 590 ft.

The potential for producing ground water from bedrock is much less than from the overlying unconsolidated materials. Although the bedrock provides up to 50 gpm to wells in parts of the Kenai Peninsula, it is not a significant aquifer in the Nikiski area.

Unconsolidated Sediments

The unconsolidated sediments overlying bedrock consist of mixed deposits of glacial, fluvial, lacustrine and estuarine origin. The distribution of surficial materials within the study area has been mapped by Anderson and Jones (1972) and is shown in figure 4. The till is poorly sorted and yields little water to wells. However, thin beds and stringers of fluvial sand and gravel within the till provide water to some wells. Undifferentiated drift is composed of mixed till, outwash deposits, and lacustrine sediments. Deposits of coarse sand and gravel within this unit provide more than 1,000 gal/min to some wells in the area. Outwash-plain deposits are materials that were deposited in front of ancient glaciers. They are composed of well sorted sand and gravel and have good permeability and porosity. Coastal-plain deposits occur in areas of low relief , They are composed primarily of sand and grade to stratified clay, silt, and fine sand at depth, The water table in areas of coastal plain deposits is generally within a few feet of land surface. Abandoned-channel deposits are composed of fluvial sand and gravel entrenched in older sedimentary deposits. The generally high porosity and permeability of abandoned-channel deposits give them a high potential for producing water to wells.

At a depth of about 100 ft below land surface, there is an extensive layer of clay and silt that may have been deposited in a proglacial lake (Karlstrom, 1964) or in Cook Inlet. This clay layer is underlain by a complex and poorly defined unit of mixed glacial, fluvial, and lacustrine sediments. Much of this unit is composed of fine sand that yields little water to wells.

However, it also contains significant deposits of well-sorted sand and gravel that constitute the major confined aquifers of the Nikiski area. Some wells completed in these aquifers yield more than 1,000 gal/min of water.

HYDROLOGIC SYSTEM

Hydrologic Setting

(Omitted)…Of the water that infiltrates, some returns to the atmosphere by evaporation and transpiration, and some percolates down to the water table where it recharges the unconfined aquifer. Ground water in the unconfined aquifer flows toward streams and toward springs and the coastal bluffs where it discharges. Ground water in the unconfined aquifer also leaks downward through the clay units to recharge the deeper confined aquifers. Ground water in the confined aquifers flows toward the coast and discharges under Cook Inlet. Lakes in the Nikiski area are recharged by precipitation and by ground-water inflow. Lakes lose water to evaporation, to ground-water outflow, and to outlet streams.

Stream flow (Omitted)…

Aquifers

There are three major aquifers in the Nikiski area. The uppermost aquifer is unconfined; the lower two are confined.

The unconfined aquifer is the aquifer in which most domestic wells are completed. It is hydraulically connected to Beaver and Bishop Creeks and to many of the lakes in the area. The unconfined aquifer is recharged by precipitation, and it discharges water naturally to Cook Inlet, to creeks, and to underlying aquifers. Many springs occur along the Cook Inlet bluffs where the unconfined aquifer crops out above high tide level.

The base of the unconfined aquifer is an extensive layer of silt and clay that is termed the upper confining layer, Undulations in the upper confining layer generally conform to topography, No lakes are known to breach the upper confining layer. Locally, the low-permeability silt and clay grade laterally into fine sand having greater permeability.

The upper confined aquifer underlies the upper confining layer and is the aquifer in which most commercial and industrial wells are completed; it receives recharge from the

overlying aquifer by leakage through the confining layer. It discharges water to Cook Inlet, to lower aquifers, and, in the vicinity of Bishop and Beaver Creeks, upward into the unconfined aquifer and then into the creeks. The aquifer probably crops out a short distance offshore in Cook Inlet. Rates of recharge to the upper confined aquifer may not be uniform over the entire area; recharge may be concentrated where the confining layer is most permeable.

Although the upper confined aquifer yields large quantities of water to wells west of Cabin Lake, it is not a productive aquifer throughout the Nikiski area* A 351-ft well drilled 1,000 ft northwest of Cabin Lake penetrated materials that were predominantly of low permeability in

the depth-equivalent Interval of the upper confined aquifer. Only a 2-ft thick unit immediately below the confining layer yielded water to the well, Similarly, the well at the southeast end of section B-B' in figure 7 penetrated predominantly fine-grained materials in the interval that is the depth equivalent of the upper confined aquifer, The upper confined aquifer is poorly defined away from the industrial area.

The lower confined aquifer is separated from the upper confined aquifer by a silt and clay unit that is generally more than 100 ft thick. The lower confined aquifer is poorly defined throughout the study area. It may actually consist of many interconnected lenses and layers of sand and gravel at depths greater than 303 ft below land surface. The aquifer is probably recharged by slow leakage from the overlying aquifer. Natural flow is toward Cook Inlet. The top of the aquifer is about 200 ft below sea level, well below the floor of Cook Inlet within about 6 mi of Nikiski. The discharge area may therefore be many miles offshore.

Lakes

The dominant control of the level of open lakes (i.e. lakes that have an outlet to a stream), is the altitude of the outlet. Changes in annual recharge or in pumping near such lakes cause the lake discharge to vary, but the lake level changes little. Daniel's Lake (fig. 8) is an open lake. Bernice Lake (fig. 8) is open when the water level is above the altitude of the outlet, 77.2 ft above sea level. However, it was a closed lake from the time the U.S. Geological Survey began to monitor lake levels in 1970 until the outlet began flowing again in 1980.

The levels of closed lakes, those without an outlet stream, fluctuate several feet from year to year. Fluctuations are caused by changes in annual recharge and by ground-water pumping. The magnitude of the fluctuations is also related to lake size, distance from the lake to a hydrologic boundary (such as a creek, a groundwater divide, or a center of pumping, and properties of the aquifer that surrounds and underlies the lake.

As you see, there is no known occurrence of bedrock (or any associated fractures) that could have facilitated migration of lake water into the confined aquifers. Flow is generally from the sediments to the water body where it is lost again to surficial outflow, evapotranspiration and possibly some reentry into the unconfined aquifer. Any migration would be filtered by the sandy, and often silty, bottoms of the lakes and streams.

As you indicate, the chemical is rapidly removed from any water moving through silty sands and gravels; accordingly, there should be minimal possibility of the chemical migrating towards any current source of potable water.

Some years back, I was made aware of a series of earthquake fractures that allowed water to migrate from one aquifer to another. I am not sure of the location, but it should not be of concern in this instance because of the sediment filtering that will occur.

Appendix 9. Potassium permanganate material data safety sheet

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MATERIAL SAFETY DATA SHEET

Potassium Permanganate

Section 01 - Chemical And Product And Company Information

Product Identifier ..... Potassium Permanganate, all grades

Product Use ..... Oxidizing & bleaching, disinifectant, deodorizer, remove iron & manganese from water, tanning, algicide, dye ingredient.

Supplier Name..... ClearTech Industries Inc.
2302 Hanselman Avenue
Saskatoon, SK. Canada
S7L 5Z3

Prepared By..... ClearTech Industries Inc. Technical Department
Phone: (306)664-2522

Preparation Date..... April 1, 2010

24-Hour Emergency Phone..... 306-664-2522

Section 02 - Composition / Information on Ingredients

Hazardous Ingredients.....	Potassium permanganate	97-100%
CAS Number.....	Potassium permanganate	7722-64-7

Synonym (s)..... Permanganic acid, potassium permanganate free flow NSF, potassium permanganate BP crystals NSF, potassium permanganate BP crystals, potassium permanganate free flow, Condy's crystals, permanganate of potash.

Section 03 - Hazard Identification

Inhalation..... Excessive inhalation is irritating to the nose, throat, and upper espiratory tract. It may cause central nervous system depression, spasm, inflammation and edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms of over-exposure include burning, coughing, laryngitis, shortness of breathe, headache, nausea, and vomiting.

Skin Contact / Absorption..... Severe irritation or burns.

Eye Contact..... Severe irritation or burns. Usually where the chemical touches the eye a hardened, ulcer-like dark-brown injury develops. Swelling of the eyelid and conjunctiva as well as bleeding can occur. Permanent eye eye damage is possible.

Ingestion..... Ingestion causes burns to the mouth and throat and severe gastro-intestinal distress. Symptoms include nausea, vomiting, abdominal pain, a slowing of the pulse, and shock with a fall in blood pressure. Generally ingestion of concentrations up to 1% cause burning of the throat, nausea, vomiting, and abdominal pain. Ingestion of concentrations from 1% to 3% cause anemia and swelling of the throat with possible suffocation. Ingestion of concentration from 3% to 5% may cause kidney damage.

Exposure Limits..... OSHA/PEL= 5mg/m^3

Section 04 - First Aid Measures

Inhalation..... Remove victim to fresh air. Give artificial respiration only if breathing has stopped. If breathing is difficult, give oxygen. Seek immediate medical attention.

Skin Contact / Absorption..... Remove contaminated clothing. Wash affected area with soap and water. Seek medical attention if irritation occurs or persists.

Eye Contact..... Flush immediately with water for at least 20 minutes. Forcibly hold eyelids apart to ensure complete irrigation of eye tissue. Seek immediate medical attention

Ingestion..... Call physician. If swallowed do not induce vomiting. If conscious give large amounts of water. Follow with diluted vinegar, fruit juice or whites of eggs beaten with water.

Additional Information..... Not available

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Section 05 - Fire Fighting

Conditions of Flammability..... Non-flammable. However, the product is a strong oxidizer and will give off oxygen when heated.

Means of Extinction..... Use water spray to blanket fire, cool fire exposed containers, and to flush nonignited spills or vapors away from fire. Suffocating type extinguishers are not as effective as water. Do not allow water runoff to enter sewers or waterways.

Flash Point..... Not applicable

Auto-ignition Temperature..... Not applicable

Upper Flammable Limit ..... Not applicable

Lower Flammable Limit..... Not applicable

Hazardous Combustible Products... Thermal decomposition yields oxygen and toxic fumes of manganese oxides.

Special Fire Fighting Procedures..... Wear NIOSH-approved self-contained breathing apparatus and protective clothing. Potassium permanganate is a NFPA Class 2 Oxidizer, it will increase the burning rate or cause spontaneous ignition of combustible material with which in comes into contact.

Explosion Hazards..... Strong oxidants may explode when shocked, or if exposed to heat, flame, or friction. Also may act as initiation source for dust or vapor explosions. Contact with oxidizable substances may cause extremely violent combustion. Sealed containers may rupture when heated. Sensitive to mechanical impact.

Section 06 - Accidental Release Measures

Leak / Spill..... Wear appropriate personal protective equipment. Ventilate area. Stop or reduce leak if safe to do so. Prevent material from entering sewers. Soak up spill with absorbent material which does not react with spilled chemical. Put material in suitable, covered, labelled containers. Flush area with water. Shovel spilled solid into clean, dry, labelled containers and cover. Flush area with water.

Deactivating Materials..... Neutralize with dilute solutions of sodium sulphite, sodium metabisulphite, sodium bisulphite, or sodium thiosulphate.

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Section 07 - Handling and Storage

Handling Procedures..... Use proper equipment for lifting and transporting all containers. Use sensible industrial hygiene and housekeeping practices. Wash thoroughly after handling. Avoid all situations that could lead to harmful exposure.

Storage Requirements..... Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage and moisture. Isolate from any source of heat or ignition. Avoid storage on wood floors. Separate from incompatibles, combustibles, organic or other readily oxidizable materials. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

Section 08 - Personal Protection and Exposure Controls

Protective Equipment

Eyes..... Chemical goggles, full-face shield, or a full-face respirator is to be worn at all times when product is handled. Contact lenses should not be worn; they may contribute to severe eye injury.

Respiratory..... None required where adequate ventilation exists. If airborne concentration exceeds the TLV by up to 10 times a half face particulate respirator is required. For airborne concentrations up to 50 times the TLV, a full face NIOSH approved dust/mist respirator is required. For higher levels or where the concentration is unknown a self contained breathing apparatus is recommended.

Gloves..... Impervious gloves of chemically resistant material (rubber or PVC) should be worn at all times. Wash contaminated clothing and dry thoroughly before reuse.

Clothing..... Body suits, aprons, and/or coveralls of chemical resistant material should be worn at all times. Wash contaminated clothing and dry thoroughly before reuse.

Footwear..... Impervious boots of chemically resistant material should be worn.

Engineering Controls

Ventilation Requirements..... Mechanical ventilation (dilution or local exhaust), process or personnel enclosure and control of process conditions should be provided. Supply sufficient replacement air to make up for air removed by exhaust systems.

Other..... Emergency shower and eyewash should be in close proximity.

Section 09 - Physical and Chemical Properties

Physical State	Solid
Odor and Appearance	Odourless dark purple to bronze crystals
Odor Threshold	Not applicable
Specific Gravity (Water=1)	2.70
Vapor Pressure (mm Hg, 20C)	Not available
Vapor Density (Air=1)	Not available
Evaporation Rate	Not available
Boiling Point	Not available
Freeze/Melting Point	Decomposes at approximately 240°C
pH	Not available
Water/Oil Distribution Coefficient	Not available
Bulk Density	166.8 lb/ft^3
% Volatiles by Volume	0% at 21°C
Solubility in Water	65g/L @ 20°C
Molecular Formula	$KMnO_4$
Molecular Weight	158.04

Section 10 - Stability and Reactivity

Stability	Stable under ordinary conditions of use and storage.
Incompatibility	Organic materials, combustible materials, reducing agents, strong acids, peroxides, alcohols, ammonium nitrate, ammonium perchlorate, dichloromethylsilane, antimony, arsenic, phosphorous, sulphur, titanium, carbon, iron salts, mercury salts, hypophosphites, hyposulphites, sulphites, oxalates, halides, hydrides, arsenites, and heat.

Hazardous Products of Decomposition.. Contact with hydrochloric acid liberates chlorine. Explodes when in contact with sulphuric acid, peroxides, nitric acid, alcohols, arsenic, phosphorous, sulphur, titanium, and anhydrides. Contact with other incompatibles results in ignition and rapid burning.

Polymerization..... Will not occur.

Section 11 - Toxicological Information

Irritancy..... Strong irritant or corrosive

Sensitization..... Repeated contact may cause sensitization in some individuals.

Chronic/Acute Effects..... Repeated intake of manganese compounds by ingestion & inhalation can result in chronic manganese poisoning characterized by impairment of the central nervous system. Early symptoms include sluggishness, sleepiness, and weakness of the legs. Advances cases show uncontrollable laughter, spastic gait, emotional disturbances, fixed facial expressions, and falling down while walking. A higher incidence of pneumonia has been found in workers exposed to some airborne managanese compounds. Men exposed to manganese dusts showed a decrease in fertility. Target organs: respiratory system, central nervous system, blood, and kidneys.

Synergistic Materials..... Not available

Animal Toxicity Data..... LD_{50}(oral,rat): 1090mg/kg

Carcinogenicity..... Not considered to be carcinogenic by IARC or ACGIH

Reproductive Toxicity..... May have adverse reproductive effects.

Teratogenicity..... Not considered a teratogen in "Dangerous Properties of Industrial Materials" 7th edition.

Mutagenicity..... Potassium permanganate caused mutations in several short-term tests involving bacteria and mouse cells.

Section 12 - Ecological Information

Fish Toxicity..... Not available

Biodegradability..... Not available

Environmental Effects..... Not available

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Section 13 - Disposal Consideration

Waste Disposal.....Dispose in accordance with all federal, provincial, and/or local regulations including the Canadian Environmental Protection Act.

Section 14 - Transportation Information

TDG Classification

Class..... 5.1

Group..... II

PIN Number..... UN 1490

Other..... Secure containers (full and/or empty) with suitable hold down devises during shipment.

Section 15 - Regulatory Information

WHMIS Classification.....C, E

NOTE: THE PRODUCT LISTED ON THIS MSDS HAS BEEN CLASSIFIED IN ACCORDANCE WITH THE HAZARD CRITERIA OF THE CANADIAN CONTROLLED PRODUCTS REGULATIONS. THIS MSDS CONTAINS ALL INFORMATION REQUIRED BY THOSE REGULATIONS.

NSF Certification.....Product is certified under NSF/ANSI Standard 60 for disinfection and oxidation at a maximum dosage of 50mg/L (note: only free flow and BP crystals that are labeled as NSF are certified).

Section 16 - Other Information

Note: The responsibility to provide a safe workplace remains with the user. The user should consider the health hazards and safety information contained herein as a guide and should take those precautions required in an individual operation to instruct employees and develop work practice procedures for a safe work environment. The information contained herein is, to the best of our knowledge and belief, accurate. However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by the use of this material. It is the responsibility of the user to comply with all applicable laws and regulations.

Attention: Receiver of the chemical goods / MSDS coordinator

As part of our commitment to the Canadian Association of Chemical Distributors (CACD) Responsible Distribution® initiative, ClearTech Industries Inc. and its associated companies require, as a condition of sale, that you forward the attached Material Safety Data Sheet(s) to all affected employees, customers, and end-users. ClearTech will send any available supplementary handling, health, and safety information to you at your request.

If you have any questions or concerns please call our customer service or technical service department.

ClearTech Industries Inc. - Locations

Corporate Head Office: 2302 Hanselman Avenue, Saskatoon, SK, S7L 5Z3
Phone: 306-664-2522
Fax: 306-665-6216

www.ClearTech.ca

Location	Address	Postal Code	Phone Number	Fax Number
Richmond, B.C.	12431 Horseshoe Way	V7A 4X6	604-272-4000	604-272-4596
Calgary, AB.	5516E - 40th St. S.E.	T2C 2A1	403-279-1096	403-236-0989
Edmonton, AB.	11750 - 180th Street	T5S 1N7	780-452-6000	780-452-4600
Saskatoon, SK.	2302 Hanselman Avenue	S7L 5Z3	306-933-0177	306-933-3282
Regina, SK.	555 Henderson Drive	S42 5X2	306-721-7737	306-721-8611
Winnipeg, MB.	340 Saulteaux Crescent	R3J 3T2	204-987-9777	204-987-9770
Mississauga, ON.	7480 Bath Road	L4T 1L2	905-612-0566	905-612-0575

24 Hour Emergency Number - All Locations - 306-664-2522

Appendix 10. Estimated rotenone concentration after the treated Stormy Lake outlfow creek mixes with the Swanson River.

Minimum Swanson River discharge observed in August or September [a]	Estimated Stormy Lake outlet creek discharge during August or September[b,c]	Estimated rotenone concentration in the Swanson River after mixing with rotenone treated creek discharge
46 cfs [c]	1.32 cfs	1.43 ppb [d]

a Data source: Inghram, M., and R. Ireland. 1990. Kenai Peninsula Streamflow Data, 1989. Alaska Department of Natural Resources, Division of Geological and Geophysical Surveyes. Public-Data File 90-3.

b Source: Massengill, R. Unpublished stream flow data collected in 2007 through 2009. Alaska Department of Fish and Game Sport Fish Division, Soldotna Office.

c Estimate is double that measured at the upper end of the outlet creek to help compensate for any groundwater gain that occurs farther downstream

d cfs= cubic feet per second

e ppb = parts per billion