Arc Lake Restoration Project: Environmental Assessment

Alaska Department of Fish and Game

Division of Sport Fish

43961 K-Beach Road, Suite B

Soldotna, AK 99669

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LETTER TO THE U.S. FISH AND WILDLIFE SERVICE

Date: 7/11/2008

TO: United State Fish and Wildlife Service (USFWS)

The Alaska Department of Fish and Game has developed an Environmental Assessment (EA) that proposes eradicating illegally introduced northern pike population in Arc Lake using the piscicide rotenone. The northern pike population has decimated the stocked coho salmon fishery in Arc Lake. In addition, the proximity of these pike to critical wild salmon and trout fisheries exposes these fisheries to an increased risk from further illegal northern pike introductions. The objectives of this treatment are to completely remove the northern pike population and restock Arc Lake with coho salmon or rainbow trout. This will restore a quality angling opportunity for the public while helping to protect critical wild fisheries. Arc Lake is a 16 surface-acre natural pothole lake. It is located approximately two miles south of Soldotna near the Soldotna landfill. The EA is available for viewing online at: http://www.sf.adfg.state.ak.us/region2/pike/

Please contact Rob Massengill at (907) 262-9368 if you would like a copy or have questions. Please submit any comments related to this project to the address or email below by August 25 2008.

Arc Lake Restoration Project: Environmental Assessment
Alaska Department of Fish and Game
43961 K-Beach Road, Suite B
Soldotna, AK 99669
or email at: robert.massengill@alaska.gov

Sincerely,
Rob Massengill - Fisheries Biologist

ALASKA DEPARTMENT OF FISH AND GAME

DIVISION OF SPORT FISH

Environmental Assessment of the proposed rotenone treatment of Arc Lake for the purpose of invasive northern pike eradication and the restoration of the coho salmon or rainbow trout fishery

PART I: PROPOSED ACTION DESCRIPTION

A. Type of Proposed Action: Remove the northern pike population that has decimated the stocked coho salmon fishery in Arc Lake, so that this fishery can be restored. Eradicating the northern pike population will also reduce the threat that they could be introduced into nearby wild salmon and trout habitats.

B. Agency Authority for the Proposed Action: By consent of the Alaska Board of Fisheries, the Alaska Department of Fish and Game is authorized to perform such acts per Alaska Statue (AS 16.35.200).

C. Estimated Commencement Date: October 2008

D. Name and Location of the Project: Arc Lake Restoration Project - removal of an invasive northern pike population through the application of rotenone, a naturally occurring botanical piscicide. Arc Lake is located in T04N R11W Sec. 12 near the Soldotna landfill, approximately two miles south of Soldotna and is a natural lake (Figure 1 and Figure 2). The land surrounding Arc Lake is publicly owned (City of Soldotna, Kenai Peninsula Borough and State of Alaska (DOT)).

E. Project Size (acres affected)

1. Developed/residential - 0 acres
2. Industrial - 0 acres
3. Open space/Woodlands/Recreation - 0 acres
4. Wetlands/Riparian - Arc Lake is 18 acres in size, has a maximum depth of 15 feet, and a volume of 144 acre-feet. There is no surface outlet from this lake (Figure 3).
5. Floodplain - 0 acres
6. Irrigated Cropland - 0 acres
7. Dry Cropland - 0 acres
8. Forestry- 0 acres
9. Rangeland - 0 acres

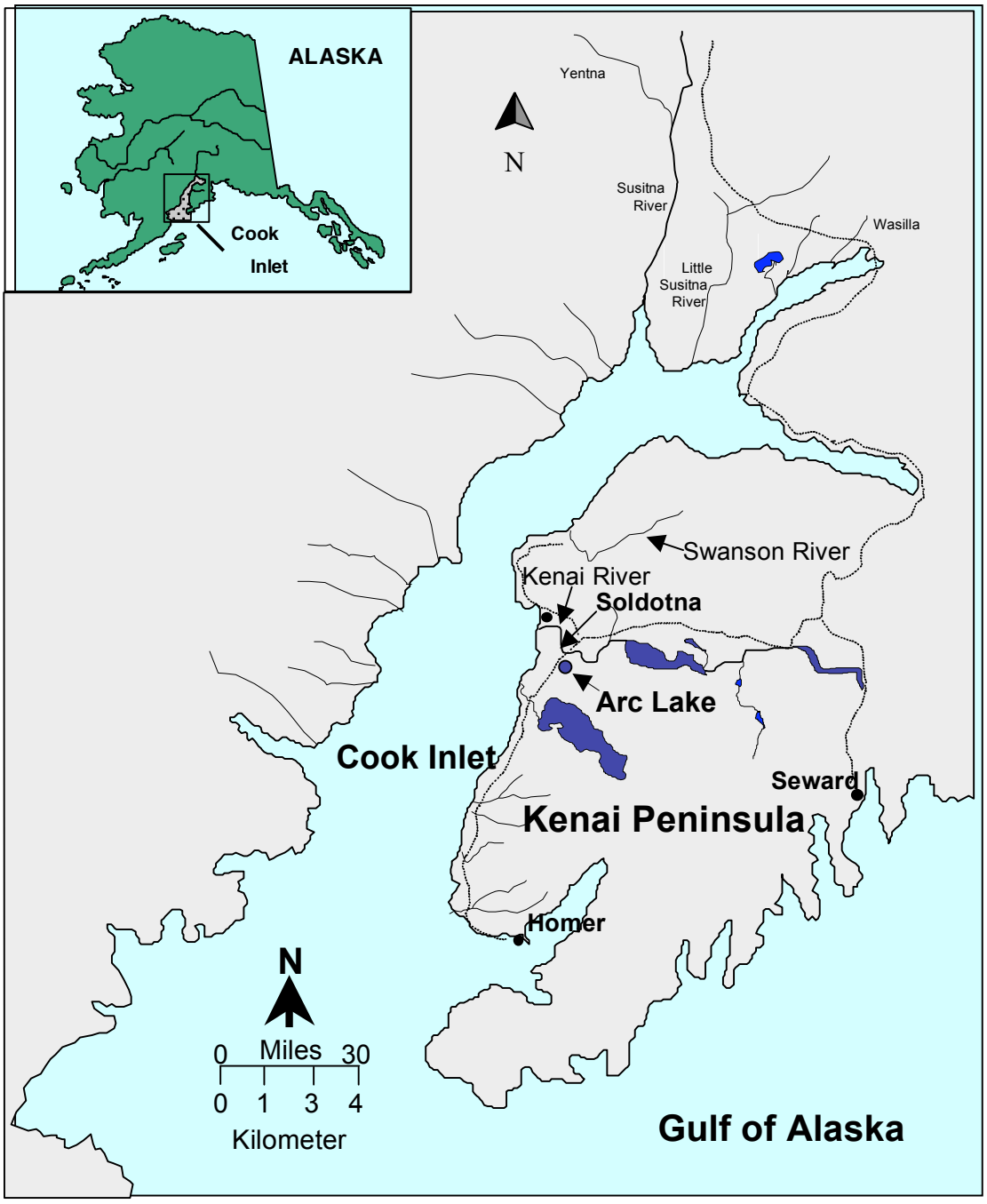

Figure 1. The Kenai Peninsula, Alaska.

Figure 2. Aerial image of Arc Lake and City of Soldonta.

Figure 3. Bathymetric map of Arc Lake.

Elevation: 150'
Shoreline Length: 0.8 mi
Volume: 144 Acre-feet.
Mean Depth: 8.6'
Surface Acres: 18 Acres
Maximum Depth: 15'
ADF&G Management Area: Northern Kenai Peninsula

F. Summary and Purpose of the Proposed Action

Background

In 1965, the Alaska Department of Fish and Game (ADF&G) treated Arc Lake with rotenone to remove a native stickleback population before stocking the lake with rainbow trout in 1966. Since stocking began, Arc Lake has provided a quality recreational angling opportunity for rainbow trout (*Oncorhynchus mykiss*), coho salmon (*Oncorhynchus kisutch*) and Chinook salmon (*Oncorhynchus tshawytscha*). By 1987, ADF&G stocked Arc Lake exclusively with coho salmon annually until northern pike (*Esox lucius*) were discovered in the fall of 2000. Although Arc Lake has no surface outlets, it is located less than two miles from the Kenai River which contains world-class wild salmon and trout fisheries. The invasive northern pike population in Arc Lake could serve as a source of fish to be illegally transported into the Kenai watershed where their impacts to native salmon and trout populations could be devastating.

Purpose

The proposed action is to remove all fish in Arc Lake using the piscicide CFT Legumine™ (5% liquid rotenone). Upon project completion, the lake will be restocked with hatchery produced rainbow trout or coho salmon.

Proposed Activities

Rotenone is a naturally occurring substance derived from the roots of tropical plants in the bean family including jewel vine (*Derris* spp.) and lacepod (*Lonchocarpus* spp.) that are found in Australia, Oceania, southern Asia, and South America (Ling 2003) (Appendix 1). Native people have utilized 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). It has been used in fisheries management in North America since the 1930s (Finlayson et al. 2000).

Rotenone acts by inhibiting oxygen transfer at the cellular level. 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. Therefore, non-target organisms that do not have gills are not negatively affected at the concentrations necessary to kill fish (Finlayson 2000, Ling 2003, NPS 2006, USEPA 2007, MFW&P 2008).

The boundary for this treatment is Arc Lake itself. The waters would be treated with CFT Legumine™ (5-7.5% liquid rotenone), which would be contained within the lake boundaries. The label recommendations for concentrations for "normal pond use" would be followed when treating the lake. On-site assays using caged northern pike will be used to determine the appropriate concentrations needed within product label guidelines, which is estimated to be about1.0 ppm of CFT Legumine™ formulation (0.05 ppm of active rotenone) or about 1.0 mg of CFT Legumine™ per liter of water.

The preferred timing of the treatment would be late fall 2008, just prior to freeze-up. This typically occurs in mid-October. Rotenone naturally degrades with light and temperature (USEPA 2007). Therefore, coldwater application of rotenone would enhance the active life of the chemical and ensure a longer exposure just prior to when dissolved oxygen levels naturally drop and when lake turnover is expected to help distribute the rotenone. The persistence of rotenone in the lake will likely last from several weeks to several months depending on water temperatures, sunlight intensity, alkalinity and organic load. Although there is no

domestic use of water from Arc Lake, signs would be posted to warn people not to drink or to swim until the rotenone naturally degrades and sentinel fish survive, likely by spring 2009.

Materials and equipment required to complete the project would be transported to the site by truck. The rotenone would be dispersed in the lake with a small motorboat equipped with a venturi pumping system that would mix lake water with the rotenone formulation and then discharge the mixture to the surface waters into the propeller wash behind the boat. Caged sentinel rainbow trout or coho salmon would be used to measure the toxicity of the water in the lake. After the treatment, caged fish will be used to evaluate when the waters have naturally detoxified. The rotenone label specifies that once caged fish survive 24 hours in treated water, it is considered detoxified and is safe for restocking.

All dead fish that surface will be collected by ADF&G staff and disposed of at the Soldotna landfill. The Washington Department of Fish and Wildlife has examined various studies that documented the percentage of dead fish that float to the water surface after rotenone treatment. They estimated that approximately 70% of rotenone-killed fish sink to the bottom in water varying in temperature from 44° to 81° F and that most carcasses that surface will do so within 24 hours after treatment (Bradbury 1986). Dead fish stimulate plankton growth and aid in the recovery of zooplankton and aquatic insect populations (UDWR 2007).

Gillnet sampling would commence within several days of the treatment to determine the effectiveness of the rotenone treatment, and if no pike are found, the lake would be sampled again with gillnets in spring 2009 to confirm eradication. The gillnetting effort planned to detect pike survival in Arc Lake after treatment would include 12 gill nets, each 120 ft long, 6 ft deep, with 6 panels of mesh (one each of 1/2 in, 5/8 in, ¾ in, 1 in, 11/2 in, and 2 in). Gillnetting would occur for three days and occur only during daylight hours. To ensure compliance with the Migratory Bird Treaty Act, gillnets will be monitored frequently (several times a day) to minimize the potential for the unauthorized "take" of loons and other birds that might become entangled in the gillnets. Owl decoys will be positioned near the set gillnets to discourage other birds, particularly waterfowl.

If live northern pike are detected after the treatment, a second treatment would be planned for that winter (2008-2009) and applied as an under-ice treatment. Under ice treatment is accomplished by drilling multiple holes in the lake ice and pumping in the piscicide directly into the lake. In the unlikely event that live northern pike are detected after a second treatment, a third treatment similar to the fall 2008 treatment would be conducted in fall 2009.

Monitoring is a major component of this type of management activity. Pre-treatment baseline data collection will include water quality (i.e., temperature, dissolved oxygen, pH, specific conductance and alkalinity), water and sediment chemical sampling (to determine if any background rotenone-based compounds or volatile organic compounds are present), and sampling for predominant macroinvertebrate taxa. Water quality and macroinvertebrates will be monitored for at least 2 years after treatment (2009 and 2010) to document biological recovery and maintenance of water quality. Chemical analysis of water and sediment samples will be conducted by a laboratory immediately before and periodically after treatment until background levels are realized.

The environmental fate of rotenone in an under-ice environment in Alaska is undocumented; therefore, the time sufficient to monitor the complete degradation of rotenone is unknown. Interestingly, a small unnamed Kenai Peninsula lake was treated with rotenone by ADF&G during late September 2000 to eradicate illegally introduced yellow perch (*Perca flavescens*). Immediately following the treatment, water samples were tested indicating the rotenone concentration had attained 0.15 ppm, after 1 week rotenone concentrations dropped to 0.05 ppm, and after 2 weeks rotenone was not detectable. No rotenone was detected from any sediment samples including those taken immediately after treatment (ADF&G Unpublished).

Arc Lake will likely be stocked with fish in summer 2010. Approximately 3,200 coho salmon fingerlings were

stocked annually before the discovery of pike, and a similar stocking level is anticipated after northern pike are eradicated.

Funding

The proposed action would be primarily federally funded through allocations to ADF&G from the U.S. Fish and Wildlife Service, Aquatic Nuisance Species Program. ADF&G Region II personnel will provide all manpower required to complete the project.

PART II. ENVIRONMENTAL REVIEW AND COMMENTS

A. NATURAL ENVIRONMENT

1. Land Resources Will the proposed action result in:	Impact Unknown	None	Minor	Potentially significant	Can impact be mitigated
a. Soil instability or changes in geologic substructure?		X			
b. Disruption, displacement, erosion, compaction, moisture loss, or over-covering of soil which would reduce productivity or fertility?		X			
c. Destruction, covering or modification of any and unique geologic or physical features?		X			
d Changes in siltation, deposition or erosion patterns that my modify the channel of a river or stream or the bed or shore of a lake?		X			
e. Exposure of people of property to earthquakes, landslides, ground failure, or other natural hazard?		X			

2. Water Will the proposed action result in:	Impact Unknown	None	Minor	Potentially significant	Can impact be mitigated
a. Discharge into surface water or any alteration of surface water quality including but not limited to temperature, dissolved oxygen or turbidity?			**X**	**YES**	**2a**
b. Changes in drainage patterns or rate and amount of surface runoff?		**X**			
c. Alteration of the course or magnitude of flood water or other flows?		**X**			
d. Changes in the amount of surface water in any water body or creation of a new water body?		**X**			
e. Exposure of people or property to water related hazards such as flooding?		**X**			
f. Changes in the quality of groundwater?		**X**			**2f**
g. Changes in the quantity of groundwater?		**X**			
h. Increase in risk of contamination of surface or groundwater?			**X**	**YES**	**see 2a,f**
i. Effects on any existing water right or reservation?		**X**			
j. Effects on other water users as a result of any alteration in surface or groundwater quality?		**X**			**2j**
k. Effects on other users as a result of any alteration in surface or groundwater quality?			**X**		
1. Will the project affect a designated floodplain?		**X**			
m. Will the project result in any discharge that will affect federal or state water quality regulations? (Also see 2a)			**X**	**YES**	**2m**

Comment 2a. This project would intentionally introduce a pisicide to surface water to kill invasive fish. It is anticipated the impacts would be short-term. CFT Legumine™ (5% liquid) is an EPA registered piscicide and is safe to use to eradicate invasive fish when applied according to label instructions. The proposed concentration of CFT Legumine™ is 1 ppm, but this may be adjusted within the label's allowed limits based upon the results of on-site assays.

There are three ways in which rotenone can be detoxified once applied. The first detoxification method involves basic dilution by fresh water. This may be accomplished by fresh groundwater or surface water flowing into the lake. The second method of detoxification involves the application of an oxidizing agent such as potassium permanganate. This dry crystalline substance is mixed with lake water to produce a concentration of liquid sufficient to detoxify the concentration of rotenone applied. Detoxification is typically accomplished after about 15-30 minutes of mixing between the two compounds (CWE Properties Ltd, 2004).

The third and most common method is to allow the rotenone to naturally breakdown. Rotenone is a compound that is susceptible to natural detoxification through a variety of mechanisms such as water chemistry, water temperature, organic load, and exposure to oxygen and sunlight (Ware 2002; ODFW 2008; Loeb and Engstrom-Heg 1971; Engstrom-Heg 1972; Gilderhus et a1. 1986). Rotenone persistence studies have found that in cold water (32°- 46° F), the half-life of rotenone ranges from 3.5 to 20 days (Gilderhus et al. 1986; Dawson et al. 1991, USEPA 2007).

It has been demonstrated that in 46° F water decreases in mortality rate corresponded with degrading concentrations of rotenone such that rotenone concentrations are no longer lethal to test fish with 18 days of treatment (Gilderhus et al. 1986). However, an under-ice application of rotenone conducted in Minnesota showed that target levels of rotenone were sustained over a month until substantial snowmelt occurred that allowed sunlight to penetrate which resulted in a rapid breakdown of rotenone (Bandow 1989). It is conceivable under optimal conditions (low light, low temperature and low organic load) that rotenone could persist for months under the ice at concentrations lethal to fish, which would increase the likelihood that all northern pike in Arc Lake would be killed during this treatment.

Because Arc Lake has no obvious surface water inlet to detoxify the lake water and groundwater recharge rates are unknown, the preferred detoxification method would be to allow the rotenone to degrade naturally over time. Even if the rotenone persists during winter beneath the ice, as the Minnesota treatment suggests it could, we anticipate that all rotenone in Arc Lake would detoxify by the time the lake ice melts in spring 2009.

The degradation of rotenone results in at least 20 different degradation 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 (for more information visit http://www.prentiss.com/Products/fishman.htm).

There are several formulations of rotenone available as a piscicide, including liquid and powder formulations. CFT Legumine™ is a liquid mixture of rotenone and other organic compounds that facilitate the emulsification and dispersion of rotenone in water. CFT Legumine™ was analyzed by an independent contractor for the California Fish and Game Department in 2007 (Fisher 2007). This analysis showed that the primary ingredients 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%).

Fennedefo 99™ is primarily a fatty acid ester mixture and polyethylene glycol (PEGs) 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 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).

Other compounds in Fennedefo 99™ include an array of volatile organic compounds (VOCs), but all in very low concentrations. All compounds, with the exception of polyethylene glycols (PEG), would be below the reporting limits of California. At the diluted concentration levels expected in Arc Lake, PEG levels would be

far below the California reporting limits.

Regarding exposure to trace constituents in liquid rotenone including CFT Legumine™, trichloroethylene (TCE) is a known carcinogen. It is present in CFT Legumine™, but the concentration of this substance in water immediately following treatment (~0.0000073 mg/L) is far below the level permissible in drinking water (Fisher 2007).

Diethylene glycol ethyl ether (DGEE) is the majority ingredient of CFT Legumine™. With respect to the environmental fate of this compound, volatilization, photolysis, and hydrolyses are all processes that will not be expected to occur to a significant degree in surface waters (SPECTRUM, Chemical Fact Sheet, 2006). Biodegradation is the most likely removal mechanism for the compound and 48-87% degradation would be expected in 20 days (for more information visit http://toxnet.nlm.nih.gov/). DGEE in water was observed to degrade greater than 90% after 28 days. Because DGEE is water soluble, it will not bind to sediments or bioconcentrate in fish. When tested on rats, the oral LD50 (oral dose that kills 50% of test animals) was 5.54g/kg (Bingham et al. 2001).

In a lake treated with 1mg/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 ~1mL/kg of body weight or about 70ml (or 70g) for a 70kg person. A 70 kg person drinking two liters of water from the lake (normal daily water intake) would only consume 0.00122mL/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. To put this simply, unless humans or other mammals (represented here by dogs, rats and mice) drink about 195 gallons of treated water for every pound of their body weight, they will not be at risk.

N-Methyl pyrrolidone. 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 effect 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. 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.

In summary, CFT Legumine™ contains a mixture of rotenone, VOCs and SOCs and more water soluble chemicals, methyl pyrrolidone and DEGEE. The VOCs and SOCs in the formulation are expected to reach undetectable levels within a week to several weeks. However, N-methyl pyrrolidone and DEGEE would be expected to dissipate more slowly because they are water soluble and will not readily dissipate through volatilization, but both chemicals are biodegradable (for more information visit http://www.cdph.ca.gov/HealthInfo/environhealth/water/Pages/LakeDavis.aspx).

Following rotenone treatment, there may be a substantial quantity of dead pike carcasses. Bradbury (1986) reported that approximately 70% of rotenone-killed fish in Washington lakes immediately sink. Parker (1970) reported that at water temperatures of 40° F and cooler, dead fish required 20-41 days to surface. The most important factors inhibiting fish from surfacing are cooler water (<50 °F) and deep water (> 15 feet). Arc Lake has a maximum depth of 15 feet and the desired treatment period (Oct-April) would likely result in water that is 32-45 °F (Massengill *In prep*.) and would potentially result in few recoverable fish. Bradbury (1986) also 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. Arc Lake is already exposed to abnormal concentrations of bird waste because gulls feeding at the nearby landfill often utilize the lake to rest and stage. High levels of preexisting fecal coli-form bacteria may be present and will be tested for before treating Arc Lake with a piscicide. Nonetheless, ADF&G personnel will recover and dispose of all surfacing dead fish at regular intervals until ice-up, an then again after ice-out until no dead fish are observed.

Comment 2f: No contamination of groundwater is anticipated to result from this rotenone treatment. Because Arc Lake has no surface flow outlet, water must leach out of the lake through its bed or via evaporation. Rotenone binds readily to sediments and is broken down in soil and water (Skaar 2001; Engstrom-Heg 1971, 1976; Ware 2002). Rotenone penetrates approximately 1 inch in most soil types; the only exception is sandy soil where movement is about 3 inches (Hisata 2002). The primary soil type in the Arc Lake area consists of silty loam which is a clay and sand mixture (Van Patten 2005). Other 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) and case studies in Montana have concluded that rotenone movement through groundwater does not occur (MFWP 2008). Regardless, there are no known groundwater wells in close proximity to Arc Lake. The nearest groundwater well to the project site is located approximately 100 yards to the north (Alaska Department of Transportation maintenance station). Because water leaving Arc Lake must travel through lake sediments, soil, and gravel, and rotenone is known to bind readily with these substances, no contamination of ground water is anticipated.

Comment 2j: The existing sport fishery in Arc Lake is for northern pike. Anecdotal evidence suggest fishing effort for northern pike is light, yet there may be sport fishers who prefer northern pike that will experience lost opportunity. The loss of northern pike fishing opportunity would be minimal because there are six lakes within 3 miles of Arc Lake that provide northern pike fishing, some of which provide a high quality fishing experience in terms of fishing success.

Comment 2m: The treatment will be confined to Arc Lake and no discharge is expected to occur outside of the lake. As required by state regulation, ADF&G will submit a pesticide permit application to the Alaska Department of Environmental Conservation (ADEC) which must be approved prior to treating Arc Lake with rotenone.

3. Air Will the proposed action result in:	Impact Unknown	None	Minor	Potentially significant	Can impact be mitigated
a. Emission of air pollutants or deterioration of ambient air quality? (Also see 13 c)			**X**		**3a**
b. Creation of objectionable odors?			**X**		**3b**
c. Alteration of air movement, moisture, or temperature patterns or any change in climate, either locally or regionally?		**X**			
d. Adverse effects on vegetation, including crops, due to increase emissions of pollutants?		**X**			
e. Will the project result in any discharge which will conflict with federal or state air quality regs.		**X**			

Comment 3a: Emissions from four-stroke outboard motors would be produced,but are expected to dissipate rapidly.

Comment 3b: CFT Legumine™ contains some solvents that make it soluble in water. The odor from these solvents can last from several hours to several days, depending on air conditions. The product manufacturer now advertises that the new CFT Legumine™ formulation is virtually odor free since reducing or eliminating a number of solvents. 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 that found in CFT Legumine™. Applicators will have the greatest potential contact with odors. However, as the product label recommends, they will wear respirators for protection. Any impacts caused by objectionable odors would be short-term and minor.

The northern pike carcasses from this project may cause objectionable odors. Collecting and/or sinking dead fish in the lake will help mitigate this, making the effects from these odors short-term and minor.

4. Vegetation Will the proposed action result in:	Impact Unknown	None	Minor	Potentially significant	Can impact be mitigated
a. Changes in the diversity, productivity or abundance of plant species (including trees, shrubs, grass, crops and aquatic plants)?			**X**		**4a**
b. Alteration of a plant community?		**X**			
c. Adverse effects on any unique, rare, threatened, or endangered species?		**X**			
d. Reduction in acreage or productivity of any agricultural land?		**X**			
e. Establishment of spread of noxious weeds?		**X**			
f. Will the project affect wetlands, or prime and unique farmland?		**X**			

Comment 4a: Arc Lake is located south of Soldotna and there is one unimproved boat launch/access that can be used for this project. There is also a small dirt parking area near the lake that will be used. Thus, there should be little trampling of vegetation around the lake. No direct, immediate, or long-term impacts to vegetation are anticipated from the treatment itself because rotenone does not negatively affect plants at concentrations necessary to kill fish.

5. Fish and Wildlife Will the proposed action result in:	Impact Unknown	None	Minor	Potentially significant	Can impact be mitigated
a. Deterioration of critical fish or wildlife habitat?		**X**			
b. Changes in the diversity or abundance of game animals or bird species?			**X**	**yes**	**5b**
c. Changes in diversity or abundance of nongame species?			**X**	**yes**	**5c**
d. Introduction of new species into an area?		**X**			
e. Creation of a barrier to the migration or movement of animals?		**X**			
f. Adverse effects on any unique, rare, threatened, or endangered species?		**X**			
g. Increase in conditions that stress wildlife populations or limit abundance (including harassment, legal or illegal harvest or other human activity)?			**X**		**See 5b,c**
h. Will the project be performed in any area in which T & E species are present, and will the project affect any T & E species on their habitat? (Also 5f)		**X**			
i. Will the project introduce or export any species not presently or historically occurring in the receiving location? (Also see 5d)		**X**			

Comment 5b: Fish: This project is designed to kill non-indigenous invasive fish. It is not believed any fish species other than northern pike inhabit the lake based on ADF&G test netting results during the summer of 2007. Sticklebacks were native to Arc Lake prior to a rotenone application designed to remove them in the 1960's. Minnow traps will be set in the summer of 2008 to determine if the stickleback population has survived although none have been observed by ADF&G staff that has recently worked at Arc Lake. All stocked coho salmon appear to have been eliminated by northern pike or naturally expired since stocking was discontinued.

Game Mammals: Grizzly bears, black bears and wolves are found in the area but are not dependent on the lake or fish from the lake for food. The infrequent occurrence of bears in this area, human activity related to the project implementation, and the removal of dead fish resulting from this project would reduce the potential for these species to consume rotenone-killed fish. Even if rotenone-killed fish were consumed by bears, there would be no adverse effects because the rotenone would be degraded by enzymes in the animals' digestive tracts (Finlayson et al. 2000, USEPA 2007). Because this project is planned for autumn, freeze-up conditions

would further limit bear scavenging behavior at the lake. Following rotenone treatment, daily monitoring of the lake to collect dead fish should limit fish carcasses from becoming an attractant to bears. The project itself would have no impact on bears.

Ingestion of treated waters by terrestrial wildlife should also have no adverse effects because of the low rotenone concentrations and enzymatic action in the animal's digestive tracts. Also, the gastrointestinal absorption of rotenone is inefficient (Finlayson et al. 2000).

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 almost nonexistent. Only individuals working with the concentrated product could be at risk and they would be protected with appropriate protective respirators suggested by the product manufacturer.

There is a year-round distribution of moose and seasonal (spring-fall) presence of caribou in the area. It is possible these species may ingest water from the lake during the treatment period. 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).

Migratory waterfowl: During the proposed treatment period, most waterfowl will have already migrated from the area. The remaining waterfowl that could be present during the proposed treatment may be temporarily displaced from the Arc Lake area, but the availability of other waters in close proximity to the project area should minimize any impacts. It is possible that these birds may feed on rotenone-killed fish carcasses shortly after treatment. However, research has indicated it is not physiologically possible for birds to consume sufficient quantity of rotenone-killed fish to result in a lethal dose (Finlayson 2000 and 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 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 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. No latent or continuing toxicity is expected because under normal conditions rotenone will not persist for more than a few weeks (CDFG 1994). The LD50 values for mallard ducks and ring-necked pheasants, based on formulated product (34.5% a.i. rotenone), were 2200 mg/kg and1680 mg/kg, respectively (Turner et al. 2007).

A late fall application of rotenone at Arc Lake may limit the availability of treated fish and water to migratory waterfowl if ice forms shortly after treatment. Human activity associated with the application of rotenone in Arc Lake and subsequent monitoring and fish carcass collection should further temporarily reduce utilization of Arc Lake by waterfowl.

Other Birds: Dead fish will result from this project. Birds common to the area that could potentially consume dead fish 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. It is possible that some of these birds will be present and consume rotenone-killed fish. There are high concentrations of bald eagles and gulls that feed at the Soldotna landfill immediately south of Arc Lake. There are also high numbers of these birds to the north along the Kenai River feeding on salmon during the summer and fall. Efforts to remove rotenone-killed fish that surface following treatment would minimize risks to these birds; thus, impacts would be negligible. Long-term impacts from removing Arc Lake's northern pike population would not have significant impact on birds. In addition, because northern pike are known to opportunistically prey on waterbirds, the eradication of these fish from the lake may actually benefit avian populations in the area.

Comment 5c: Non-game species that might be present during this project include zooplankton, aquatic insects, wood frogs, some birds, and some small mammals.

Invertebrates: In general, most studies report that aquatic invertebrates, except zooplankton, are much less sensitive to rotenone treatment than fish (Schnick 1974b). Anderson (1970) reported that comparisons between samples of zooplankton taken before and after a rotenone treatment did not change substantially. Houf and Campbell (1977) reported that no long-term significant reduction in aquatic invertebrates was observed due to the effects of rotenone, which was applied at concentrations twice as high as those proposed for the Arc lake project. In most cases, the reduction of aquatic invertebrates was temporary, and most treatments used a higher concentration of rotenone than proposed here (Schnick 1974b). In a study on the relative tolerance of different types of aquatic invertebrates to rotenone, Engstrom-Heg et al. (1978) reported that the long-term impacts of rotenone are mitigated because those insects that were most sensitive to rotenone also tended to have the highest rate of re-colonization. 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 will include aerial dispersal of adult invertebrates from adjacent areas of the project area (e.g., mayflies and caddisflies).

Amphibians: Wood frogs are the only amphibians on the Kenai Peninsula. Attempts to capture wood frogs at Arc Lake were unsuccessful, although they are believed common to the area and probably inhabit the wetlands surrounding the lake. 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). 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, which aligns well with the timing of the proposed fall Arc Lake treatment.

Nongame mammals: Various mammals from coyotes to shrews in size could be present and scavenge on rotenone killed fish or drink treated lake water. The effects of rotenone on non-target organisms have been studied extensively. Mammals, in general, are not affected because they neutralize rotenone by enzymatic action in their stomach and intestines (Finlayson 2000, AFS 2002, and 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 on potential risks to terrestrial animals found that a 22-pound dog would have to drink 7,915 gallons of lake water within 24 hours or eat 660,000 pounds of rotenone-killed fish to receive a lethal dose. The State of Washington reported that a half-pound mammal would need to consume 12.5 mg of pure rotenone to receive a lethal dose (Bradbury 1986). In this project we are using a 5% rotenone solution. 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 an unlikely 66 gallons of Arc Lake water treated at the planned 1 ppm concentration..

It is important to note that nearly all of these examples involved subjecting laboratory specimens to unusually high concentrations of rotenone or conducting tests on animals that would not be exposed to rotenone during normal use in fisheries management. Based on this information we expect the impacts to non-target organisms

to range from non-existent to short-term.

B. HUMAN ENVIRONMENT

6. Noise/Electrical Effects Will the proposed action result in:	Impact Unknown	None	Minor	Potentially significant	Can impact be mitigated
a. Increase in existing noise levels?			**X**		**6a**
b. Exposure of people to severe or nuisance noise levels?		**X**			
c. Creation of electrostatic or electromagnetic effects that could be detrimental to human health or property		**X**			
d. Interference with radio or television reception and operation?		**X**			

Comment 6a: The only noise generated from this project would result from the use of an outboard motor during application of the rotenone and collection of dead fish afterwards. The noise generated from these activities would be short-term and minor.

7. Land Use Will the proposed action result in:	Impact Unknown	None	Minor	Potentially significant	Can impact be mitigated
a. Alteration or interference with the productivity or profitability of the existing land use area?		**X**			
b. Conflicted with a designated natural area or area of unusual scientific or educational importance?		**X**			
c. Conflict with any existing land use whose presence would constrain or potentially prohibit the proposed action?		**X**			
d. Adverse effects on the relocation of residences?		**X**			

8. Risk/Health Hazards Will the proposed action result in:	Impact Unknown	None	Minor	Potentially significant	Can impact be mitigated
a. Risk of an explosion or release of hazardous substances (including, but not limited to oil, pesticides, chemicals, or radiation) in the event of an accident or other forms of disruption?			**X**		**8a**
b. Affect an existing emergency response or emergency evacuation plan or create a need for a new plan?		**X**			**8b**
c. Creation of any human health hazard or potential hazard?		**X**			**see 8a,c**
d. Will any chemical toxicants be used?		**X**			**see 8a**

Comment 8a: The principal risk of human exposure to hazardous materials from this project would be limited to the rotenone applicators. All applicators would wear all necessary safety equipment such as a fitted respirator, goggles, rubber boots, Tyvek overalls, and nitrile gloves. All applicators have been trained on the safe handling and application of the piscicide at a formal course taught at the U.S. Fish and Wildlife Service Natural Conservation Training Center in Shepherdstown, West Virginia. At least one and most likely several Alaska Department of Environmental Conservation certified pesticide applicators would supervise and administer the project. Rotenone would be transported, handled, applied and stored according to the label specifications to reduce the probability of human exposure or spill. Accidental spillage is a concern and appropriate spill response plans will be developed for the Arc Lake restoration plan prior to treatment.

Comment 8b: ADF&G is preparing a rotenone treatment plan that addresses all aspects of safety for personnel on the application team. Elements of the plan include establishing a clear chain of command, training, delegation and assignment of responsibility, clear lines of communication between members, spill contingency, first aid, emergency responder information, personal protective equipment, monitoring and quality control, and other details. Implementing this project should have no impact on existing emergency plans. Because of ADF&G's implementation plan, the risk of emergency response would be minimal and any affects to potential emergency responders would be short-term and minor.

Comment 8c: 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 at full strength can 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).

Although Alaska does not have established water quality criteria for rotenone, the EPAs recent reregistration 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 of 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 and eating and fish from rotenone treated waters was below the Agency's level of concern.

The EPAs chronic dietary exposure assessment of rotenone was performed for drinking water only because rotenone degrades rapidly and has a low propensity to bioaccumulate in 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 Arc Lake (~50 ppb), the DWLOC would be exceeded by 20% for a relatively short time (probably several days to several weeks) until the rotenone degraded naturally below the DWLOC level. However, the DWLOC (40ppb) is for chronic long-term dietary exposure and is a scenario not likely to occur with the Arc Lake project because there are no public or private water intakes, the application would be late fall just prior to freeze-up conditions and signs and public notices would be posted to warn the public not to drink the water after treatment until monitoring ensures the rotenone has completely degraded.

As an example of rotenone toxicity, a 160 pound adult would have to drink 23,000 gallons and a 22 pound child would need to drink over 1400 gallons of rotenone-treated water at one sitting to receive a lethal dose at pisicidal concentrations (Gleason et al 1969).

There have been previous concerns that rotenone exposure could be linked to Parkinson's disease, but this linkage has since been refuted. In a study in which rats were injected with rotenone for several weeks, researchers reported finding lesions characteristic of Parkinson's disease (Betarbet et al. 2000). However, these results have been challenged on the basis of methodology: (1) that the continuous intravenous injection method used leads to "continuously high levels of the compound in the blood," and (2), that dimethyl sulfoxide (DMSO) was used to enhance tissue penetration whereas normal routes of exposure actually slow introduction of chemicals into the bloodstream. Finally, injecting rotenone into the body is not a normal way of assimilating the compound. Marking (1988) found no Parkinson-like results a similar study. Extensive research has demonstrated that rotenone does not cause birth defects (HRI 1982), gene mutations (Van Geothem et al. 1981; BRL 1982) or cancer (Marking 1988). Spencer and Sing (1982) reported that rats fed diets laced with 10 to 1,000 ppm rotenone over a 10-day period did not suffer any reproductive dysfunction. Rotenone was found to have no direct role in fetal development of rats that were fed exceedingly high concentrations of rotenone. Typical concentrations of actual rotenone used in fishery management range from 0.025 to 0.50 ppm and are far below those administered during most toxicology studies.

Public health issues surrounding the use of rotenone have been studied extensively (USEPA 2007). In general, the EPA through the FIFRA certification process has concluded that use of rotenone for fish control does not present unreasonable risks. Finlayson et al. (2000) reported that the EPA "has concluded that the use of rotenone for fish control does not present a risk of unreasonable adverse effects to humans and the environment." In relation to air quality, they further note that "No public health effects from rotenone use as a piscicide have been reported." No waiting period is specified for swimming in rotenone-treated water. Aside from the rotenone itself, liquid formulations also consist of petroleum emulsifiers. Finlayson (2000) wrote regarding the health risks of these constituent elements:

"...the EPA has concluded that the use of rotenone for fish control does not present a risk of unreasonable adverse effects to humans and the environment. The California Environmental Protection Agency found that adverse impacts from properly conducted, legal uses of liquid rotenone formulations in prescribed fish management projects were nonexistent or within acceptable levels (memorandum from J. Wells, California Department of Pesticide Regulation, to Finlayson, 3 August 1993). CFT Legumine™ does contain trace amounts of various benzenes that are expected to degrade rapidly through photolytic and biological degradation mechanisms. Other substances found in low concentrations in CFT Legumine™ include the solvent hexanol, polyethylene glycols (PEGs) and fatty acids, all of which are readily biodegradable. None of these constituents identified in the liquid rotenone formulation appear to be at concentrations that suggest human health risks through water, or ingestion exposure scenarios and no relevant regulatory criteria are exceeded in estimated exposure concentrations (Fisher 2007)."

The product labels states:

"…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. . . . 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 the labeling instructions. This product is flammable and should be kept away from heat and open flame ..."

The major risks to human health from rotenone come from accidental exposure during application. This is the only time when humans are exposed to concentrations that are greater than those needed to eradicate fish and when inhalation or dermal exposure risk is greatest. To prevent accidental exposure to liquid rotenone the Alaska Department of Environmental Conservation requires applicators to be:

- Working under the direct supervision of a trained and certified pesticide applicator
- Equipped with the proper safety gear, which, in this case, includes fitted respirator, eye protection, rubberized gloves, and a hazardous material suit
- In possession of product labels during use
- Storing materials only in approved containers that are properly labeled
- Adhering to the product label requirements for storage, handling, and application"

Any threats to human health during application will be greatly reduced with proper use of safety equipment. People recreating in the area would likely not be exposed to the treatments because a temporary lake access closure would preclude them from being in the area. Public notification through news releases, signs, and ADF&G personnel in the project area should be adequate to keep unintended recreationists from being exposed to any treated waters. Dead fish that surface in the lake would be collected and removed from the site on a daily basis until dead fish are no longer present.

9. Community Impact Will the proposed action result in:	Impact Unknown	None	Minor	Potentially significant	Can impact be mitigated
a. Alteration of the location, distribution, density, or growth rate of the human population of the area?		**X**			
b. Alteration of the social structure of a community?		**X**			
c. Alteration of the level of distribution of employment or community or personal income?		**X**			
d. Changes in the industrial or commercial activity?		**X**			
e. Increased traffic hazards or effects on existing transportation facilities or patterns of movement of people and goods?		**X**			

10. Public Services/Taxes/Utilities	Impact Unknown	None	Minor	Potentially significant	Can impact be mitigated
a. Will the proposed action have an effect upon or result in the need for new or altered governmental services in any of the following areas: fire or police protection, schools, parks/recreational facilities, roads or other public maintenance, water supply, sewer or septic systems, solid water disposal, health, or other governmental services? If any, specify:			**X**		**10a**
b. Will the proposed action have an effect upon the local or state tax base and revenues?		**X**			
c. Will the proposed action result in need for new facilities or substantial alterations of any of the following utilities: electric power, natural gas, other fuel supply or distribution systems, or communications?		**X**			
d. Will the proposed action result in increase use of any energy source?		**X**			
e. Define projected revenue sources		**X**			
f. Define projected maintenance costs		**X**			

Comment 10a: The City of Soldotna Parks and Recreation Department administers the land containing the public access to Arc Lake. The Soldotna Parks and Recreation Department was asked to collaborate with ADF&G to temporarily close the Arc Lake access area to public use during the time surrounding the treatment application through the use of appropriate signs and public announcements.

11. Aesthetics/Recreation	Impact Unknown	None	Minor	Potentially significant	Can impact be mitigated
a. Alteration of any scenic vista or creation of an aesthetically offensive site or effect that is open to public view?			**X**		**11a**
Alteration of the aesthetic character of a community or neighborhood?		**X**			
c. Alteration of the quality or quantity of recreational/tourism opportunities and settings?			**X**		**11 a,c**
d. Will any designated or proposed wild and scenic rivers, trails or wilderness areas be impacted? (Also see 11a, 11c)		**X**			

Comment 11a: Public access to Arc Lake is on land owned by the City of Soldotna and administered by the Soldotna Parks and Recreation Department. Public access will be discouraged at Arc Lake immediately before, during, and immediately after treatment, using appropriate signage and public notices. It is also possible that offending odors could arise from decomposing fish shortly after treatment or from the CFT Legumine™ formulation. The odors from CFT Legumine™ would be expected to dissipate within a few days after treatment. Also, planned routine removal of fish carcasses post-treatment would be expected to minimize offensive odors.

Comment 11c: The primary objectives of this project are to: (1) reduce the threat of northern pike being illegally introduced into critical fishery habitat including the nearby Kenai River and, (2) improve angling quality at Arc Lake which would result in increased use by recreationists. The benefits of eradicating this invasive pike population would outweigh any short-term social impacts associated with the actual rotenone treatment. Any aesthetic impacts would be short-term and minor and would be directly associated with the actual rotenone treatment and immediate aftermath, including dead fish in the project area.

The existing sport fishery in Arc Lake is for northern pike. Anecdotal evidence suggests fishing effort for northern pike is light, yet there may be sport fishers who prefer northern pike that will experience lost opportunity. To help mitigate the loss of northern pike fishing opportunity there are six lakes within 3 miles of Arc Lake that provide northern pike fishing, some of which provide a high quality fishing experience.

12. Cultural/Historical Resources	Impact Unknown	None	Minor	Potentially significant	Can impact be mitigated
a. Destruction or alteration of any site, structure or object of prehistoric, or paleontological importance?		**X**			
b. Physical change that would affect unique cultural views?		**X**			
c. Effects on existing religious or sacred uses of a site or area?		**X**			
d. Will the project affect historic or cultural resources?		**X**			

13. Summary Evaluation of Significance Will the proposed action, considered as a whole:	Impact Unknown	None	Minor	Potentially significant	Can impact be mitigated
a. Have impacts that are individually limited, but cumulatively considerable? (A project or program may result in impacts on two or more separate resources which creates a significant effect when considered together or in total).		**X**			
b. Involve potential risks or adverse effects which are uncertain but extremely hazardous if they were to occur?		**X**			
c. Potentially conflict with the substantive requirements of any local, state, or federal law, regulation, standard or formal plan?		**X**			
d. Establish a precedent or likelihood that future actions with significant environmental impacts will be proposed?		**X**			
e. Generate substantial debate or controversy about the nature of the impacts that would be created?	**X**			**yes**	**13e**
f. Is the project expected to have organized opposition or generate substantial public controversy?	**X**			yes	**13f**
g. List any federal or state permits required.					**13g**

Comment 13e and 13f: In general**,** the use of pesticides can generate controversy. Outreach efforts by the Department would help to educate the public on the safe and effective use of rotenone. It is not known if this project would have organized opposition. One reason that ADF&G is considering this course of action is that invasive northern pike have already affected fisheries in the Soldotna Creek drainage and have resulted in lost fishing opportunity in three lakes that were previously stocked with rainbow trout or salmon.

In part, this project was initiated over concerns for diversity in the area's fisheries. Arc Lake is easily accessible and provided a quality stocked salmon fishery before northern pike were illegally introduced.

Comment 13g: The following permits and approvals were obtained:

ADEC (Alaska Department of Environmental Conservation): Pesticide Use Permit (Appendix 2).

Alaska Board of Fisheries: Written consent of approval to use rotenone was requested of and granted by the Alaska Board of Fisheries (Appendix 3).

ADNR (Alaska Department of Natural Resources): submission of an ADNR Coastal Project Questionnaire and Certification Statement resulting in a collaborative determination by ADEC that an Alaska Coastal Management Program (ACMP) Consistency Review was not required (Appendix 4).

PART III. ALTERNATIVES

Alternative 1. No Action

The no action alternative would allow the status quo to continue which would maintain or reduce angling opportunity. As long as invasive northern pike remain in Arc 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. Further, there would be continued risk that northern pike could be transported from Arc Lake to nearby wild fisheries.

Alternative 2 - Rotenone treatment and rainbow trout or salmon stocking (Proposed Action)

The Proposed Action involves removing the aforementioned species from Arc Lake using CFT Legumine™. Following treatment and natural detoxification, the lake would be restocked with rainbow trout or salmon.

This alternative offers the highest probability of achieving the goals of improving the recreational fishery in Arc Lake for public use and reducing the threat of invasive northern pike in Arc Lake being transported illegally to other areas.

Alternative 3 - Mechanical Removal

This alternative would involve using gill nets and/or trap nets to selectively remove northern pike. Once all northern pike were removed, Arc Lake would be restocked with rainbow trout or salmon.

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 2 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 successfully 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 a viable 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.

Information could not be obtained about the probability of success in using gillnets or trap nets to completely remove northern pike from Arc Lake. In any event, Arc Lake exceeds surface area criteria described by other researchers.

Deploying gillnets and traps would require frequent on-site inspections to check and reset nets. This method of fish removal at Arc Lake would require an unreasonable commitment of time and manpower. Gillnetting, the more efficient of the two mechanical methods listed, could expose birds and aquatic mammals to the risk of net entanglement in water. Although attempts can be made to visually discourage birds from approaching

gillnets by using owl decoys or similar, prolonged and unattended gillnetting would likely result in significant bird bycatch because of the proximity of Arc Lake to the Soldotna landfill which attracts large numbers of eagles and gulls to the area. Therefore, gillnets would not be deployed to selectively remove northern pike for this project.

PART IV. ENVIRONMENTAL ASSESSMENT CONCLUSION SECTION

A) Is an EIS required?

Section 102(2)(C) of NEPA establishes the threshold "trigger" that starts the NEPA process. Since this project is being funded in part with federal dollars, the Federal decision-maker has to answer this key question – Might this proposed action be "a major Federal action significantly affecting the quality of the human environment"? If the Federal agency does not find significance, e.g. the alternatives analyzed in the EA would not significantly affect the environment, a Finding of No Significant Impact (FONSI) can be prepared.

After reviewing the information provided by the applicant, the assessment of environmental impact contained in Part II of this document, and the responses to the public comments that were received, the U.S. Fish and Wildlife Service has accepted the EA and has prepared and signed a FONSI for the project as described above.

B) Public Involvement (revised on 9/8/2008).

This EA was posted on the ADF&G internet site found at: http://www.sf.adfg.state.ak.us/statewide/invasivespecies/index.cfm/FA/rotenone.projects or was mailed directly to persons who requested it. Any interested citizens were encouraged to contact the preparer of this EA to discuss the proposal.

Public scoping/notifications:

1) The local ADF&G advisory committees (Kenai/Soldotna, Cooper Landing, and Central Peninsula) and other identified stakeholders were notified and given a project synopsis of the Arc Lake restoration proposal on 4/25/2008 and again called or emailed with an update on the project status during the period of late July through early August, 2008 (Appendix 5).

2) A public meeting to discuss invasive northern pike issues on the Kenai Peninsula, including the Arc Lake restoration proposal, was held on 5/1/2008 at the Kenai River Center in Soldotna Alaska.

3) A presentation was given to the Soldotna City Council on the Arc Lake restoration proposal on 7/23/2008 at the Soldotna City Hall.

4) ADF&G news release issued on 7/30/2008 announcing that the Arc Lake and Cheney Lake public commenting periods were open for the pesticide use applications and environmental assessments (Appendix 6).

5) A presentation was given to the Kenai Peninsula Borough Assembly on the Arc Lake restoration proposal on 8/5/2008 at the Kenai Borough Assembly Meeting.

6) Public notices for the Arc Lake restoration pesticide use permit application were printed in the Peninsula Clarion on 7/23/08 and 7/24/08 as required by ADEC for the pesticide use permitting process.

7) A synopsis describing the project was distributed to residents residing within ¼ mile of Arc Lake during early August of 2008. These flyers also listed project contact information.

C) Duration of the comment period

The comment period was 30 days. Public comments were accepted from July 23 through August 23, 2008.

D. Summary of public comments received and Department responses.

Public comments and the Department responses are found in Appendix 7. A letter from the Kenai Peninsula Borough Land Management Division to ADEC supporting the use of rotenone to treat Arc Lake is found in Appendix 8.

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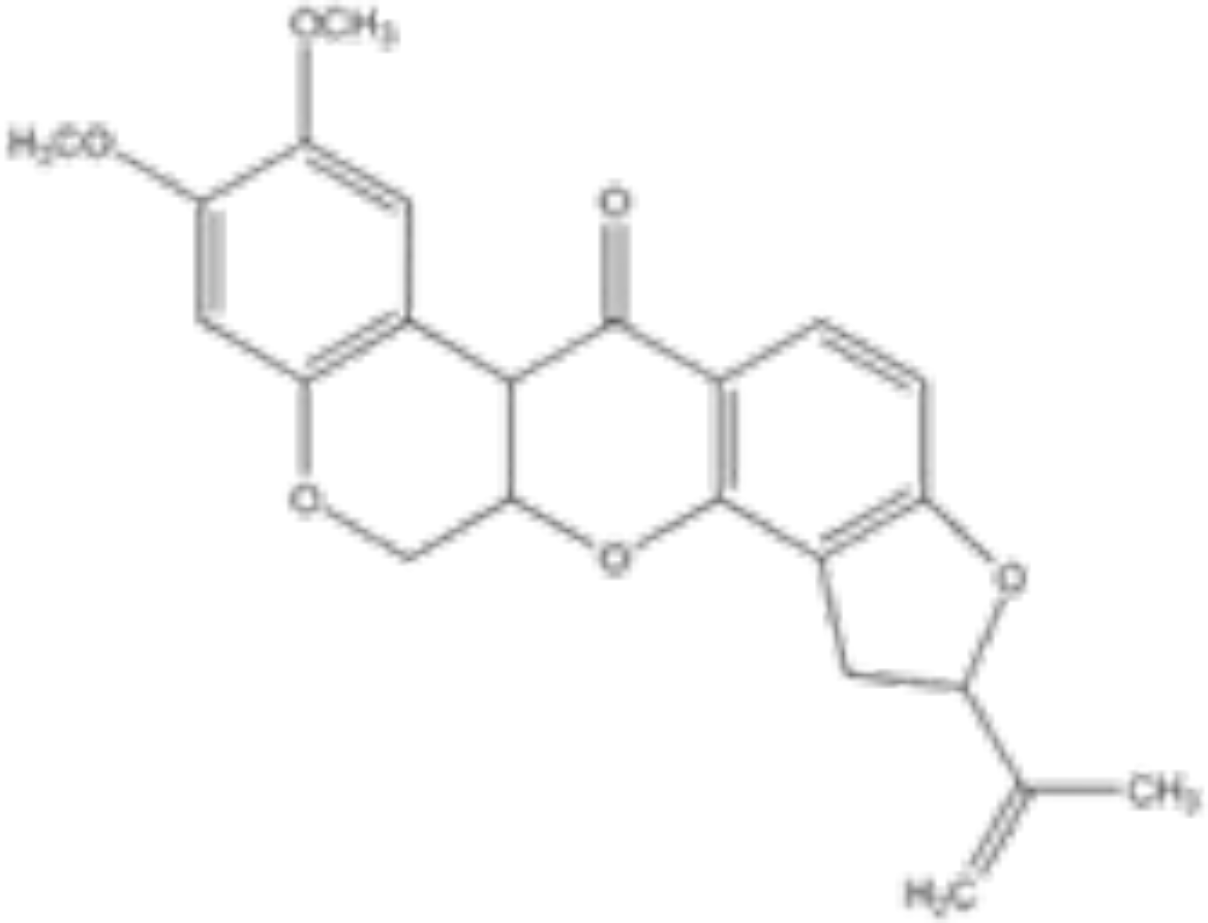
APPENDIX

Appendix 1. Molecular structure of rotenone.



Appendix 2. Copy of the ADEC Pesticide Use Permit for the Arc Lake Restoration Project.

STATE OF ALASKA
DEPARTMENT OF ENVIRONMENTAL CONSERVATION 555
CORDOVA STREET
ANCHORAGE, ALASKA 99501

PERMIT TO APPLY PESTICIDES

Permit No.: 08-0828-09-AQU-02
Date Issued: August 28, 2008
Date Effective: October 7, 2008 Date
Expires: December 31, 2009

The Alaska Department of Environmental Conservation (ADEC) , under authority of Alaska Statute 46.03.330 and Title 18, Chapter 90.525 of the Alaska Administrative Code (18 AAC 90.525), hereby grants a Permit to Apply Pesticides to:

Robert Massengill
Alaska Department ofFish and Game 43961
Kalifornsky Beach Road, Suite B Soldotna,
Alaska 99669

For the purpose of applying the pesticide **CFT Legumine Fish Toxicant,** EP A Registration Number **75338-2** to waters of the state to eradicate invasive Northern Pike in Arc Lake, near Soldotna, Alaska.

The permit holder shall manage and apply the pesticide in accordance with 18 AAC 90 and the permit application materials submitted July 16, 2008. In addition, the following permit conditions and stipulations are required:

1. Use pesticides only in the manner specified by the label instructions. Adhere to all the requirements specified by the pesticide product label.

2. Ensure that pesticides are applied only by a person properly certified by DEC to apply such pesticides, or a person under the direct supervision of a person so certified.

3. Apply pesticides using properly calibrated equipment, and in strict compliance with safety precautions.

4. Public notification signs must be posted prior to pesticide application at each point of access to the lake, as specified in 18 AAC 90.630(a). Signs shall remain posted at the treatment site until application is complete.

5. Maintain the following records for each pesticide used. Records must be available to DEC upon request:
    - Product name
    - EP A registration number
    - Target pest
    - Date and time of application
    - Method of application
    - Weather conditions during application

- Amount of pesticide used
- Location and size of treatment area
- Names of applicators
- Purchase, storage, and disposal information

6. Dispose of empty pesticide containers in accordance with label directions and 18 AAC 90.615(a). Any burning of pesticide containers must be done in compliance with 18 AAC 50.

7. Immediately report any spill or accident, alleged accident, or complaint to the DEC Pesticide Program at 1-800-478-2577.

8. Ensure that decontamination, safety, and spill clean up supplies are available at the treatment site at all times during application.

9. Store all pesticide containers securely, as required by 18 AAC 90.615(d). Post a warning notice on the outside of each storage area in compliance with 18 AAC 90.615(e)-(h).

10. No later than **March 31, 2010,** submit a written Summary of Treatment Results in accordance with 18 AAC 90.535. This summary must include the following information for **each** pesticide used:
    - Product name
    - EP A registration number
    - Target pest
    - Dates and times of application
    - Method of application
    - Weather conditions during applications
    - Total amount of pesticide used
    - Location and size of treatment area
    - Names of applicators
    - Purchase, storage, and disposal information
    - Assessment of success or failure of the treatments
    - Any observed effect on human health, safety or welfare, animals, or the environment

In addition to the above stipulations, the ADEC Pesticide Program may monitor treatments to ensure compliance with 18 AAC 90 and the Permit Conditions and Stipulations.

This permit expires on **December 31, 2009,** or upon completion of the above described project, whichever comes first, and may be revoked in accordance with 18 AAC 90.540.

Kristin J. Ryan
Environmental Health Director

Appendix 3. Copy of the letter of consent by the ADF&G Board of Fisheries for treating Arc Lake and Cheney Lake with rotenone.

STATE OF ALASKA

DEPARTMENT OF FISH AND GAME
BOARD OF FISHERIES

SARAH PALIN, GOVERNOR

ADF&G
P.O. BOX 115526
JUNEAU, AK 99811-5526
PHONE: (907) 465-4110
FAX: (907) 465-6094

Charles Swanton
Director, Sport Fish Division
Alaska Department of Fish and Game
P.O. Box 115526
Juneau, AK 99811

August 20, 2008

Dear Mr. Swanton,

The Board of Fisheries received your August 12, 2008 letter asking for Board consent for the use rotenone to eradicate a non-indigenous Northern Pike populations from Cheney Lake in Anchorage and Arc Lake near Soldotna. The Board supports its use in this project. Board members were polled and there was no opposition.

Please contact Executive Director Jim Marcotté (465-6095) if you have any questions.

Regards,

Mel Morris
Chairman, Alaska Board of Fisheries

cc: Board of Fisheries members
Rob Bentz, ADF&G
Jim Hasbrouck, ADF&G
Robert Massengill, ADF&G

Appendix 4. Copy of the ADEC determination that a Project Coastal Management Program Review is not required for the Arc lake Restoration Project.

STATE OF ALASKA
DEPT. OF ENVIRONMENTAL CONSERVATION
DIVISION OF ENVIRONMENTAL HEALTH
PESTICIDES PROGRAM

SARAH PALIN, GOVERNOR

1700 E. Bogard Rd. Bldg B. Ste 103
Wasilla, Alaska 99654
PHONE: (907) 376-1856
FAX: (907) 376-2382
http://www.dec.state.ak.us/

July 23, 2008

Mr. Robert Massengill
Alaska Department of Fish and Game
43961 Kalifomsky Beach Road, Suite B
Soldotna, AK 99669

Dear Mr. Massengill

Subject: ARC LAKE PESTICIDE PERMIT

The Department of Environmental Conservation (DEC) has determined that an Alaska Coastal Management Program (ACMP) consistency review of your project is not required. This determination is based on the coastal district's response that this project does not include activities that are subject to a district enforceable policy.

The department will continue with review of your application for authorization under DEC authorities that are excluded from ACMP consistency review and determination.

If you have any questions about this review, please contact me at 907-376-1856 or e-mail Karin.Hendrickson @alaska.gov.

Sincerely,
Karin Hendrickson
Environmental Specialist

cc: Randy Bates, DNR, DC OM
Mr. Gary Williams, Kenai Peninsula Borough Coastal District Coordinator
Dan Easton, DEC, Deputy Commissioner

Appendix 5. Synopsis of Arc lake project proposal.

Arc Lake Restoration Project Synopsis

Alaska Department of Fish and Game

Sport Fish Division

Soldotna, Alaska

Contact: Robert Begich– Area Management Biologist (Sport Fish)

Ph (907) 262-9368

Northern pike *Esox lucius* do not naturally occur in Southcentral Alaska. Populations of invasive northern pike on the Kenai Peninsula resulted from illegal introductions in the Soldotna Creek drainage during the 1970's, and they have since spread to other Kenai Peninsula waters. Although native to much of Alaska, northern pike can severely alter aquatic ecosystems and fish assemblages that evolved in their absence. Currently, sixteen Kenai Peninsula lakes have been confirmed with northern pike and three of those lakes were formerly stocked by the Alaska Department of Fish and Game (ADF&G).

Typically, invasive northern pike in Southcentral Alaska dominate the fish community within a lake and reduce or eliminate the native fish species, particularly in shallow lakes where prey have difficulty avoiding predation. Of particular local concern are the vulnerable salmon and trout-rich Kenai and Swanson River drainages. Northern pike could establish reproducing populations in key fish rearing areas and impact these fisheries beyond the damage that has already occurred in the Soldotna Creek drainage. Expansion of invasive northern pike into new areas of the Kenai and Swanson River drainages, or other waters, would negatively impact valuable fisheries.

Netting and control barriers have been used by ADF&G to reduce pike populations on some Kenai Peninsula waters but these methods will not eliminate them. ADF&G is proposing to restore some lakes by eradicating northern pike. The preferred strategy is to treat the lake with a pisicide (rotenone), a naturally occurring plant derivative of the bean family that prevents a fish from using oxygen absorbed in the blood. Rotenone naturally degrades with light and temperature and does not enter the groundwater. No public health effects from rotenone uses as a piscicide have been reported.

Arc Lake is located two miles south of the Soldotna Bridge along the Sterling Highway. Northern pike were discovered there in 2000 by ADF&G stocked lakes personnel and stocking was discontinued. Because Arc Lake is relatively small in size (sixteen surface acres) and the surrounding lands are public (City of Soldotna, Kenai Peninsula Borough, State of Alaska), it lends itself as a strong candidate for an initial restoration effort. A successful restoration effort at Arc Lake will serve as a positive transition to the long-term goal of eradicating northern pike and

restoring other Kenai Peninsula waters. Removing invasive pike from Arc Lake will restore a stocked lake fishing opportunity. Even more important, the removal of this species will lessen the possibility that the population expands through illegal introduction into nearby critically important systems like the Kenai River.

ADF&G is currently preparing an Environmental Assessment and initiating the local public participation process for this project. The rotenone treatment is being planned for fall 2008. If treated, Arc Lake will be monitored throughout winter and spring to assure that pike eradication was successful. If all pike are removed, Arc Lake could be re-stocked with salmon or rainbow trout during 2009.

Appendix 6. Copy of the ADF&G news release announcing the public commenting periods for the Arc Lake and Cheney Lake environmental assessments and pesticide use permits were open.

NEWS RELEASE

ALASKA DEPARTMENT OF FISH AND GAME
Denby S. Lloyd, Commissioner

DIVISION OF SPORT FISH
Charles O. Swanton, Director

Contact: Kristine Dunker, Fisheries Biologist
Anchorage (907) 267-2809
Robert Begich, Fisheries Biologist
Soldotna (907) 262-9368

July 30, 2008

RESTORATION OF TWO ANCHORAGE AND KENAI AREA LAKES

ADF&G Plans to Eradicate Invasive Northern Pike Populations

ADF&G is planning to use a naturally occurring pesticide to eradicate northern pike in two landlocked lakes and is seeking public comment. ADF&G has prepared environmental assessment documents and applied for pesticide application permits through the Alaska Department of Environmental Conservation for both lakes. The public participation processes for these projects are now beginning. The environmental assessments can be viewed online at:
http://www.sf.adfg.state.ak.us/statewide/ap/ap/planning/PDFs/CheneyLake(2).pdf
http://www.sf.adfg.state.ak.us/statewide/ap/ap/planning/PDFs/ArcLake(2).pdf
Written public comments on these projects will be accepted through August 21, 2008.

Northern pike are native to most of Alaska, but were illegally stocked in Southcentral. Where northern pike are native, they are a valuable sport and subsistence fish. Outside of their native range, northern pike can cause tremendous ecological and economic damage. Pike deplete populations of salmon and trout in shallow, vegetated water bodies, and have severely affected local fisheries.

Cheney Lake in Anchorage and Arc Lake south of Soldotna are both small lakes that were once popular, accessible recreational fisheries. Northern pike introduced into these lakes have destroyed these popular fisheries. Currently, ADF&G cannot justify stocking these lakes with trout or salmon because the pike eat nearly all of them. More importantly, as long as numerous northern pike are in these lakes, there is increased potential for them to be introduced to nearby waters. Cheney Lake is located close to Chester Creek which supports wild salmon runs, resident trout, and Dolly Varden. Arc Lake is about two miles from the Kenai River which supports world renown salmon and trout fisheries.

During the last five years, ADF&G has addressed the pike issue by liberalizing bag limits for pike and setting gill nets to reduce pike populations in several Southcentral lakes. These efforts have not removed a significant number of pike. ADF&G is currently proposing to re-establish the fisheries in Cheney and Arc Lakes by eradicating all of the pike in these lakes. The most practical method to accomplish this involves using an organic chemical called rotenone. Rotenone is a naturally occurring substance derived from the roots of tropical plants. Historically, it has been used by indigenous peoples in the tropics to catch fish for food and by fish managers in the U.S. to conserve native trout fish. Rotenone is also a common ingredient in agricultural and garden insecticides. Rotenone interrupts a biochemical process that allows

fish to use oxygen in their blood, resulting in fish mortality. In the concentrations necessary to kill fish, rotenone is not dangerous for birds or mammals. No public health effects from the use of rotenone in fish management have been reported, although consuming fish following treatment is not recommended.

Cheney and Arc Lakes, because of their small size, lost recreational opportunities, and because of their close proximity to wild salmon and trout systems are strong candidates for initial lake restoration efforts. Successful restoration of these lakes will serve as a step toward restoring other Southcentral lakes where invasive northern pike threaten wild fish stocks or have damaged existing fisheries. The rotenone treatments are being planned for the fall of 2008. If the lakes are treated according to these plans, the lakes will be monitored throughout winter and spring to assure that pike have been eradicated. If all pike have been successfully removed, rainbow trout or land-locked coho salmon can be re-stocked in these lakes during the spring of 2009.

For more information on these projects, please contact ADF&G biologists Kristine Dunker (Anchorage) at 267-2889 or Robert Begich (Soldotna) at 262-9368 or see http://www.sf.adfg.state.ak.us/statewide/invasivespecies/index.cfm/FA/rotenone.home.

Appendix 7. Comments received during the public commenting periods for the Arc Lake Restoration Project Environmental Assessment and ADEC Pesticide Use Application public and ADF&G responses.

1) **Comment**: Letter from the Kenai Peninsula Borough Land Management Division to the Alaska Department of Environmental Conservation in support of the project and pesticide use permitting (Appendix 8): **ADF&G response**: None

2) **Comment:** Fecal coliform bacteria has been rumored to be an issue for Arc Lake, therefore, would restocking trout or salmon after treatment be advisable? **ADF&G response:** Fecal coliform bacteria is present to some degree in nearly all waterbodies. The Department will coordinate testing for fecal coliform bacteria levels in Arc Lake prior to restocking the lake with trout or salmon. However, high levels of these indicator bacteria have little or no influence on the quality of fish for human consumption. While alive, the fish is protected from waterborne contaminants by the mucus, scales and skin covering its body. Proper fish cleaning, rinsing, refrigeration and cooking should always be used. This will eliminate the pathogenic bacteria from the food according to United States Geological Survey information found online at: (http://water.usgs.gov/wrri/05grants/progress.completion_reports/VI/2005VI51B.pdf).

3) **Comment:** Plans to eradicate northern pike from Arc Lake is an over reaction to the problem because the lake is landlocked and poses little risk to other fisheries. **ADF&G response:** The Department believes treating Arc Lake to eradicate invasive northern pike will eliminate an easy source for northern pike to be collected for illegal introductions elsewhere. In addition, technical treatment skills obtained by treating a small lake such as Arc Lake will be invaluable for planning future treatments for larger more complex waterbodies.

4) **Comment:** Because northern pike can self-sustain in area lakes without the need for restocking, the Department should not eradicate them as they provide a self-sustaining sport fishery. **ADF&G response**: The Department believes the economic and ecological damage to wild and stocked Kenai Peninsula fisheries caused by invasive northern pike far exceeds the benefit that sport fishing for northern pike provides. There will continue to be other local lakes that will provide opportunity to fish for northern pike.

Appendix 8. Letter from the Kenai Peninsula Borough Land Management Division sent to ADEC commenting on the ADF&G pesticide use application to treat Arc Lake with a piscicide.