FINTROL® POND, LAKE AND RESERVOIR USE MONOGRAPH FOR COMPLETE REMOVAL OF FISH

USE IN PONDS, LAKES, AND RESERVOIRS

These use instructions may be more, but not less, restrictive than use instructions on the product label. Use directions in this monograph provide guidance on conducting Fintrol® (antimycin A) treatments to ponds, lakes, and reservoirs for complete removal of fish. The term "antimycin" is reserved for the concentration (normally in µg/L or ppb) of active ingredient. The term "Fintrol®" is reserved for commercial product (volume normally in ml) that is composed of concentrate and diluent. An amount (ml) of Fintrol® is added to water to obtain the desired concentration (µg/L or ppb) of active ingredient antimycin. Fintrol® contains 11% (w/w) antimycin. The unique nature of each application site often requires minor adjustments to method and recommended rate of application within label limits. Should individual pond, lake, or reservoir conditions require major deviation from use directions, a Special Local Need 24(c) registration should be obtained from the appropriate state agency.

Under specified environmental conditions (particularly water temperatures between 40 and 80°F and pH values <8.5) antimycin is extremely toxic to fish. Environmental variables related to adequate distribution of Fintrol® in ponds, lakes, and reservoirs guide the process in determining the decision to use Fintrol® and what method(s) of application are employed. High pH waters (>8.5), greater lake depths (> 30 ft), presence of a thermocline, high (> 80 ºF) and low (< 40 ºF) water temperatures, excessive sunlight and agitation, and dense aquatic vegetation are factors that limit the effectiveness of Fintrol® in complete removal of fish from ponds, lakes, and reservoirs (see Section I).

This monograph contains instructions for application and neutralization of Fintrol® for complete removal of fish, identification of environmental variables affecting antimycin effectiveness, determination of effective treatment levels, and determination of stream discharge for treating inlets and neutralizing outlets, required safety and technical training, and determination of project effectiveness. Application of Fintrol® to a pond, lake, or reservoir should not occur until an applicator's license or permit is obtained from the appropriate state agency. Because local environmental conditions vary, consult with the state fish and wildlife agency to ensure the method and rate of application are appropriate for selected site. The monograph is arranged in the following sections:

I. Considerations and Restrictions

The use of Fintrol® for complete removal of fish should be carefully evaluated prior to implementation of an application. The effectiveness of a Fintrol® application to a standing body of water can be negatively affected by a variety of chemical and physical factors not generally present in streams or rivers. High water pH values (>8.5), low (< 40 ºF) and high (> 80 ºF) water temperatures, direct sunlight, abundant organic material and aquatic plants, and depths that promote thermocline development all serve to increase likelihood that antimycin will be rendered ineffective at killing the target species. Fish communities common in ponds, lakes and reservoirs often include species more tolerant of antimycin (e.g., ictalurids) that may require higher concentrations of antimycin than are allowed on the label. Thus, Fintrol® normally is not used for removal of ictalurids, as these fishes are quite tolerant of antimycin. The selection of Fintrol® as the appropriate piscicide for complete removal of fish from a pond, lake, or reservoir should generally be limited to conditions that include relatively shallow depths, low to moderate pH levels, sensitive target species, and minimal aquatic plant growth. Employ techniques that ensure complete mixing throughout the water column while minimizing agitation of bottom substrates containing high organic content. Pre-application surveys should be conducted to determine the appropriate time of year to avoid undesirable conditions described above. It is advisable to treat all inlets during the standing water treatment to ensure complete removal of the target species (see Stream and River Use Monograph). Prior to implementation of a full-scale treatment, bioassays should be conducted to determine proper antimycin concentration during treatment to ensure complete removal of fish (see Sections III and IV).

Prior to Fintrol® application to a pond, lake, or reservoir, determine if any rare and/or protected species occur in project area. If such species are present, authorization from appropriate state and federal agencies for Fintrol,® use is necessary. Contact the appropriate state or local water department to determine if water withdrawal, for domestic, municipal, or agricultural purposes occurs within ½-mile of the treated water

body, especially from areas downstream of the treated water body. The application of Fintrol® should be coordinated with appropriate agency to ensure no water is withdrawn downstream during Fintrol® application and for the period required for all treated water to neutralize (typically up to 14 days). There should be no contact by members of public with treated water and no treated water should be used for agricultural or domestic purposes until 48 hours after bioassay results indicate that antimycin has neutralized. Do not directly treat domestic water supplies.

Because of limited effectiveness, avoid treating with Fintrol® when water pH values are > 8.5 or temperatures <40 ºF or > 80 ºF. Reconsider treating with Fintrol® when standing water conditions prevent adequate mixing, such as dense aquatic vegetation, depths >30 ft, or presence of strong thermoclines. On bright sunny days and/or at high elevations, consider treating surface waters of a lake during the early morning or late afternoon periods to minimize neutralization. Avoid treating during times of the year when conditions are not conducive to complete mixing of Fintrol® in the water body (periods of strong thermoclines or ice cover).

II. Determination of Water Volume

The water volume of the pond, lake, or reservoir must be determined in order to calculate the amount of Fintrol® needed. If a stream discharges into the water body, measurement of stream discharge also is necessary for proper application of Fintrol® to all waters associated with the treatment area. To determine stream discharge, check methods described in Section VI, and utilize the Fintrol® Stream and River Use Monograph for treating inlets. Use Fintrol® dispensing stations upstream of standing water body as appropriate to prevent escapement of target fish species.

Water volume in a pond, lake, or reservoir is determined by the use of bathymetric maps, surface area determination by GPS (global positioning system) receivers or using topographical maps and associated depth profiles, or known water body volumes from controlling agencies. Volume is normally calculated in units of acre-ft:

$$\textbf{(1)} \qquad V = A \cdot D \qquad \textbf{where}$$

V = standing water volume (acre-ft)
A = surface area (acres)
D = mean depth (ft).

To determine mean depth, make a series of transects across the lake measuring depth with a weighed line or a depth finder. Add the soundings and divide by the number of soundings to get mean depth.

If volume is being calculated from a bathymetric map, use the area circumscribed by successively deeper depth intervals to calculate the volume of water in a series of

truncated cones. Total volume of lake is calculated by summing the volumes for individual stratums:

$$\textbf{(2)} \qquad V = \sum [(H/3) \cdot (A_1 + A_2 + \sqrt{A_1 A_2})] \quad \textbf{where}$$

V = total standing water volume of the lake (acre-ft)
H = vertical depth of the stratum (ft)
A_1 = area of the upper surface (acre) stratum
A_2 = area of the lower surface (acre) stratum.

Surface area can be measured most easily using a handheld GPS receiver with a tracking mode that allows for area calculation based on multiple measurements taken around the perimeter of the waterbody. Surface area can also be measured accurately with conventional survey equipment (level and rod), where the level is positioned at a control point and multiple measurements of distance and angle are taken around the perimeter of the lake. The measurements are then plotted on graph paper allowing area within the perimeter to be calculated.

When Fintrol® is applied to a pond, lake, or reservoir, antimycin does not neutralize as rapidly as in a stream or river. Multiple applications generally are not necessary if an adequate concentration and duration are attained. Neutralization of antimycin is accelerated in standing water body conditions that include higher pH values (>8.5), elevated temperature (>80º F), direct sunlight, and presence of dense aquatic vegetation. In addition, adequate mixing of Fintrol® throughout the standing water body is inhibited by depths >30 ft, aquatic vegetation, and presence of a thermocline (see Section I).

III. Conducting Bioassays

A bioassay using caged sentinel fish is the simplest way to evaluate the site-specific performance of antimycin for choosing a Fintrol® application rate. To conduct a bioassay, place 3 to 5 fish (target or closely related species) into each of five buckets that have been filled with treatment site water. Water in the first bucket has antimycin at the highest anticipated Fintrol®application rate. The second, third and fourth buckets have consecutive 50% serial dilutions of the first bucket (e.g., 10, 5, 2.5 and 1.25 ppb antimycin). The last bucket contains no antimycin and serves as the control. Buckets are placed in the lake or nearby stream to maintain water temperature. It may be necessary to provide air to the fish for the duration of the bioassay. Determine survival in the buckets after a 24-h period. The antimycin concentration that results in all fish stressed within 6 hours and dead within 24 hours is the minimum effective dose. The treatment rate (normally 1.5 to 2 times the minimum effective does) should take into account factors that affect the performance of antimycin (see Section I).

Bioassays are also used to determine the efficacy of the treatment by placing caged fish (target species or a close relative) throughout the water body at various depths. Check

the survival of the fish 24 hours after complete mixing of the Fintrol® in the water body. Bioassays are also used to determine when the water body has neutralized prior to restocking with fish.

Bioassays are also used to determine the efficacy of potassium permanganate ($KMnO_4$) neutralization of an outlet stream (see Section VI). Place caged fish (the target species or a close relative) in stream 30 minutes travel time downstream of the neutralization $KMnO_4$ drip. If all fish survive for 48 hours, then the $KMnO_4$ neutralization was complete.

IV. Fintrol® Application Rate

The concentration of antimycin needed to eliminate all fish depends upon target species and environmental conditions associated with the pond, lake, or reservoir. For sensitive species, such as salmonids and centrarchids, antimycin concentrations of 5 ppb may be adequate in waters above temperatures of 60 °F or 10 ppb in waters below temperatures of 60 °F (see Table 1, Fintrol® Use Directions Leaflet). Cyprinids may require antimycin concentrations up to 25 ppb in waters below temperatures of 60 °F. Antimycin normally is not used for removal of ictalurids, as these fishes are quite tolerant of antimycin. Bioassays using site water should be used to determine the effective concentration for target species in the particular water body within the limits of the label (see Section III).. To maximize success of treatment in complete removal of fish, water volume in the treatment area should be reduced and inflowing water source(s) should be temporarily halted, if possible, or treated with Fintrol® for period no less than the duration of the lake application. The amount of Fintrol® applied to a standing body of water is determined by:

$$\textbf{(3)} \qquad A = V \cdot X \cdot 12.3 \qquad \textbf{where}$$

A = amount of Fintrol® (ml)
V = volume of water (acre-ft)
X = desired concentration of antimycin (ppb).

The amount of Fintrol® (ml) needed (from equation 3) to achieve 1, 5, 10 and 25 ppb antimycin concentrations at various water volumes is provided by:

Water Volume (acre-ft)	1 ppb	5 ppb	10 ppb	25 ppb
0.1	1	6	12	31
0.2	2	12	25	62
0.3	4	18	37	92
0.4	5	25	49	123
0.5	6	31	62	154
1.0	12	62	123	308
2.0	25	123	246	615

3.0	37	185	369	923
4.0	49	246	492	1,230
5.0	62	305	615	1,538
10.0	123	615	1,230	3,075

V. Application of Fintrol® to Pond, Lake, or Reservoir

Because antimycin neutralizes rapidly once applied to water, multiple concurrent applications (e.g., boats) may be necessary to ensure that Fintrol® application is completed and antimycin is thoroughly mixed throughout the water column within 8 hours. The half-life of antimycin varies inversely with temperature and pH of water. The water body should be divided up into manageable quadrants that can be treated individually within 8 hours. Dispense an appropriate amount of Fintrol® into each quadrant. Inflowing water should be treated with Fintrol® (see Fintrol® Stream and River Use Monograph), beginning with the treatment of the water body and continuing for the duration of the treatment. A second treatment of the inflowing water the day after treatment may be desired to ensure that no target species have taken refuge.

Application to the standing water body is accomplished by a variety of methods. Most often, Fintrol® is diluted in water (maximum 10% v/v) and dispensed into the prop wash from a tank held in a motor-driven boat . Do not dilute Fintrol® until immediately before application. Standing bodies of water should be mapped in grids and Fintrol® applied to each grid in a systematic manner, covering the body of water from one end to the other, to ensure complete coverage. Deeper water bodies may require the use of a pump mechanism to ensure adequate mixing throughout the water column. Caged fish using the target species (or a close relative) should be placed at surface, mid-depth and bottom locations to verify that toxic levels of antimycin were present throughout the entire water body. Shoreline areas should have dilute Fintrol® (maximum10% v/v) applied by use of a spraying apparatus (either boat-mounted or backpack).

VI. Neutralization

In standing water bodies that do not have outflows, neutralization with potassium permanganate ($KMnO_4$) is generally not necessary. Antimycin gradually neutralizes over time and, depending upon water body conditions, usually degrades within 14 days.

In the case of water discharging from the treatment area, such as below the dam of a treated reservoir, application of potassium permanganate at the origin of discharge should be accomplished. Although antimycin typically neutralizes naturally within about 900 to 1,500 feet (30 to 45 minutes travel time) of the stream length, neutralization stations should be used to ensure that antimycin does not persist beyond the treatment reach. Potassium permanganate can be dispensed into the middle of the stream with same type

apparatus used to dispense Fintrol® to flowing water bodies (see Fintrol® Stream and River Use Monograph). Potassium permanganate will neutralize (oxidize) antimycin within 30 minutes travel time within the neutralization zone (approximately 1,200 feet).

A concentration of 1 mg/L $KMnO_4$, above the background permanganate demand of the stream water (generally around 1 mg/L $KMnO_4$) generally is sufficient to neutralize antimycin. It is desirable to maintain 1 mg/L $KMnO_4$ residual at the end of the neutralization zone. Thus, a neutralization rate of approximately 3 mg/L $KMnO_4$ is typically used, depending on the background permanganate demand of the water (1 mg/L $KMnO_4$ to neutralize antimycin + 1 mg/L $KMnO_4$ background demand + 1 mg/L $KMnO_4$ residual at end of zone). *In-situ* fish bioassays should be conducted to verify background potassium permanganate demand and levels necessary to neutralize antimycin (see Section III). Fish residing in the neutralization zone may be killed as antimycin is oxidized and potassium permanganate is reduced.

Estimate the background permanganate demand of the streambed in the neutralization zone prior to Fintrol® application. Prior to application, test the neutralization operation by applying $KMnO_4$ to achieve an instream concentration of 2 mg/L for 1 to 2 hours (or longer if necessary) and measuring $KMnO_4$ residual at the end of the neutralization zone (30 minutes downstream). Residual $KMnO_4$ may be measured by using a variety of analytical methods (e.g., DPD Colorimetric Method or Spectophotometric Standard Method). $KMnO_4$ residual over time will stabilize as the background permanganate in the streambed is used up. If the $KMnO_4$ concentration at the end of the neutralization zone is not 1 mg/L then, proportionately increase or decrease the rate of $KMnO_4$ drip. Wait an hour and take another measurement; repeat the procedure as necessary to assure 1 mg/L residual level of $KMnO_4$ at the end of the neutralization zone. This ensures that antimycin does not persist beyond the neutralization zone.

Determine stream discharge (from Equations 6 or 7 below). Dispense $KMnO_4$ from container at constant rate that will provide desired stream concentration. A 2.5% w/v (10 pounds $KMnO_4$ crystals in 50 gallons of water) potassium permanganate solution is dispensed at a constant concentration using equation:

$$\textbf{(4)} \qquad \mathbf{LF = Y \cdot 70 \cdot Q} \qquad \textbf{where}$$

LF = flow of liquid 2.5% $KMnO_4$ solution (ml/min)
Y = desired $KMnO_4$ concentration in stream (mg/L)
Q = stream discharge (ft^3/s).

Alternatively, $KMnO_4$ crystals can be added directly to the stream using a mechanical auger or other device using equation:

(5) $SF = Y \cdot 1.7 \cdot Q$ where

SF = flow of solid $KMnO_4$ crystals (g/min)
Y = desired $KMnO_4$ concentration in stream (mg/L)
Q = stream discharge (ft^3/s).

A cage with live fish should be placed at the end of the neutralization zone (approximately 1,200 feet and 30 minutes travel time downstream of neutralization station) to ensure that stream water is neutralized. Dispensing potassium permanganate should begin about 1 hour before Fintrol® is expected to arrive at the neutralization site and continue, at a minimum, for 1 hour following passage of all treated water from upstream sections, normally determined by travel time from the furthest Fintrol® upstream application site. This procedure will result in the neutralization of the vast majority of antimycin applied during the treatment. However, extremely low levels of antimycin may kill fish over a prolonged period of time, and the only way to confirm that a toxic level of antimycin is no longer present in the stream is to perform live fish bioassays. Fish should survive in the treated waters in the absence of potassium permanganate for 48 hours before the antimycin is deemed completely neutralized. Backup neutralization applicators should be available at the neutralization site

Determine stream discharge with flow meter or by float method. Discharge determinations should be made where the channel is straight, flow is laminar, depth and streambed materials are uniform and objects do not block or disrupt flow.

Use a flow meter to estimate water velocity at 10 or more points along a transect oriented perpendicular to streamflow. Depth can be measured with topset rod on which flow meter is mounted. The mean velocity should be determined at each point and is accomplished by taking the measurement at 0.6 of water column depth if depth is less than 3 feet and at 0.2 and 0.8 of water column depth if depth is greater than 3 feet. Each measurement point represents the center of a cell, the width of which is half the distance between adjacent measurements. Stream discharge (Q) is calculated by summing the discharge calculations for individual cells. To minimize error, discharge from any individual cell should not exceed 10% of total discharge. Stream discharge is calculated by equation:

(6) $Q = \sum (V \cdot D \cdot W)$ where

Q = stream discharge (ft^3/s)
V = mean velocity of cell (ft/s)
D = depth of cell (ft)
W = width of cell (ft).

Alternatively and less accurately, discharge can be estimated by recording time required for a semi-buoyant object, such as an orange, to float a given distance. Float time for the object should be determined for a minimum of 5 feet in slow-velocity streams and 10 to 20 feet in moderate to rapid velocity streams. Divide the surface width into three equal sections (this may not be feasible for streams narrower than 10 feet). Water depth should be measured in the center of each section at a minimum of 3 points, and averaged. Time required for float to move specified distance should be measured at least 3 times for each section, and averaged for discharge calculation. Stream discharge is calculated by equation:

$$\textbf{(7)} \qquad Q = (W \cdot D \cdot L \cdot C) \div T \qquad \textbf{where}$$

Q = stream discharge (ft^3/s)
W = mean surface width for all stream sections (ft)
D= mean depth for all three sections (ft)
L= mean distance traveled by float for all three sections (ft)
C = constant (0.8 for rough and 0.9 for smooth bottoms)
T = mean time for float to travel mean distance L for all three sections (s).

VII. Collection of Dead Fish

To eliminate the opportunity for human exposure by consuming antimycin-contaminated fish, recoverable dead fish should be collected and disposed of consistent with the requirements of the local land use or fish and wildlife agency.

VIII. Public Notification

To ensure public safety and limit liability, signs should be posted in the treatment area warning against contact with treated water and consumption of dead fish during Fintrol® treatment and for a 48-hour period of time after treated waters are neutralized. Signs should be posted at normal entrance routes (trails and roads) to the treatment area. Signs should clearly display dates of treatment, when consumptive water-use is safe, and agency to contact for additional information. High public-use areas may be closed to the public until the antimycin in the water has been neutralized for 48 hours.

In areas where livestock or pets may be exposed to the Fintrol® and potassium permanganate, owners should be notified so they can prevent access to treated water by their animals during the treatment.

IX. Safety and Technical Training

Among field personnel involved in a pond or lake application, at least the project leader must be a state-certified pesticide applicator. On larger projects, state certified applicators for each application and neutralization crew is desirable. Depending upon

project, it may be prudent to advise area medical facilities of activities. Prior to treatment, the project leader should provide a safety briefing to all personnel. At a minimum, the training should ensure that all personnel understand Fintrol® label instructions, the Fintrol® Pond, Lake and Reservoir Use Monograph, Material Safety Data Sheets (MSDSs) for compounds used in the treatment, symptoms of antimycin A poisoning, emergency care, personal protective equipment (PPE), general pesticide safety, chain of command, location of first aid stations, and communication network. People wearing contact lenses should not be in direct contact with Fintrol®. Each participant should be provided with appropriate PPE to ensure safe and successful application. It is strongly recommended that at least the project leader have successfully taken a training course on piscicide use (e.g., U.S. Fish and Wildlife Service National Conservation Training Center FIS2132 or equivalent) within 5 years of the application. This will ensure that the project has the latest information on application methods and safety precautions.

X. Personal Protective Equipment (PPE)

Each piscicide applicator must wear at a minimum goggles and pesticide resistant gloves (i.e., nitrile) as PPE when applying Fintrol® to a stream. To further minimize possible applicator exposure, it is recommended that each applicator also wear protective outer clothing such as Tyvek® disposable coveralls. Long-sleeve shirts and felt-sole boots are also recommended. Each applicator should have a personal eye sprayer and sufficient fresh water for a day. At a minimum, each crew (e.g. application, neutralization, fish collection) has a radio that enables communication among crews.

XI. Project Evaluation and Subsequent Treatment(s)

One treatment is usually sufficient for complete removal of fish from a pond, lake or reservoir. Check cages no sooner than 24 hours after complete mixing of Fintrol® in the water body for survival of caged fish. Nets, traps and electrofishing gear may be instrumental in determining the efficacy of the treatment. Accurate recording of data is essential for planning any necessary subsequent treatments. If the treatment was not successful in the complete removal of all fish, determine what factors may have influenced the outcome (see Section I). After determining reason(s) for the project failure, make corrections and retreat the water body as soon as possible. Unlike stream treatments there is little benefit in separating treatments by a season or year.

Unintended fish kills outside of the original treatment area should be reported to the appropriate agency and a report of adverse effects should be filed with the U. S. Environmental Protection Agency under Section 6(a)2 of the Federal Insecticide, Fungicide and Rodenticide Act. This report should contain a thorough description of the extent of nontarget mortality (species and number affected) and the conditions under which the incident occurred.

XII. Transportation, Decontamination and Spill Containment

No special arrangement is needed for transporting Fintrol® but ensure that adequate padding is in the Fintrol® Fish Toxicant Kit to protect against breakage of the Fintrol® diluent and Fintrol® concentrate glass bottles. All Fintrol® is transported in labeled service containers. Potassium permanganate should be transported in separate service containers. All personnel involved in the application are required to be conversant with antimycin toxicity, the product MSDS, the spill contingency plan, and have proper protective clothing and eyewear protection.

All mixing and loading operations are conducted within a bermed area lined with plastic that has the capacity to contain all of the volume of the material at the site, or within the treatment site. A certified aquatic pest control applicator must be present during mixing, loading, and application operations. The person in charge of the treatment, the certified applicator, should conduct a reconnaissance of the treatment area. When handling the concentrated material, protective goggles and chemically resistant gloves must be worn, and protective clothing (e.g., Tyvek® coveralls) is recommended. Personnel should wash thoroughly with soap and water after handling material.

Should the material spill onto the ground, immediately contain the spill to prevent contamination of adjacent areas. Shovels and other hand tools are used for immediate containment and channelization of the spilled material into a containment area. The following actions must be taken as necessary to contain a spill on the ground: (1) Stop the spillage at its source; (2) Dike-in pools, as appropriate; (3) Materials such as clay, soils, or straw are used to absorb standing material; and (4) Spill site is neutralized with potassium permanganate, as necessary. Major spills are reported to the supervisor of the treatment and he/she will inform cooperating agencies, as required. Disposal of contaminated material is done in accordance with state law.