



Appendix 13-A SunWater Environmental Management Standards



Fish Management

Standard No: EM 18
Revision No: 1
Authorised by: M, BI (O&M)
Approved by: GM, O&M

PURPOSE:

The purpose of this policy is to minimise the impact of operation and maintenance activities on fish.

SCOPE:

This policy applies to all employees or contractors who undertake planning, construction, operation and/or maintenance activities that may harm fish in channels or streams, particularly through dewatering activities and acrolein applications.

DIRECTIVE:

SunWater shall conduct operations and activities in a manner, which considers and minimises the impact to fish and other aquatic life in channels or streams

DEFINITIONS:

Electrofishing: Passing an electric current through water to either coerce fish movement or stun fish for removal to another habitat.

Fish Exclusion Device: Devices installed at pump off-takes to prevent transfer of fish from river systems into delivery channels – refer to WSS Guideline ‘Fish Exclusion from Channels’.

PROCEDURE:

Channel Systems

1. O&M staff undertaking maintenance activities in channels will take all reasonable and practicable efforts to prevent fish deaths. As a minimum, the following actions will be considered as means of preventing fish deaths prior to conducting any maintenance activity that poses a threat to fish (e.g. dewatering, acrolein treatments, etc):
 - a. Coercing fish to leave the channel through means such as mild electro-fishing, progressively draining the channel, or pre-dosing channels with extremely low doses of acrolein;
 - b. Electro-fishing or netting the channel system to remove fish to a safe habitat under the supervision/advice of a suitably experienced person/organisation (e.g. Sunfish, DPI Fisheries, fish stocking groups, etc.);
 - c. Installation of fish exclusion devices at pump off-takes.

All of these options will be considered in consultation with the WSS Technical Services Engineer. Implementation of any of the above options will be at the Technical Services Engineer’s discretion.

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2. Prior to conducting any channel maintenance activity that poses a risk of killing fish, the Service Delivery Co-ordinator/Supervisor will notify WSS. Where possible this notification should be provided at least two weeks in advance of the maintenance event to allow WSS to prepare communication to interested parties such as the EPA or fish interest groups.

Watercourses (including dams and weirs)

1. Before conducting any work within a watercourse staff will assess the potential for fish deaths to arise as a result of the planned work (e.g. Complete the WMS for dewatering on the intranet)
2. Where work is assessed as having the potential to cause fish deaths, staff will take all reasonable and practicable measures to either:
 - a. Remove fish from the work area to a safe habitat under the supervision/advice of a suitably experienced person/organisation (e.g. Sunfish, DPI Fisheries, fish stocking groups, etc.); or
 - b. Modify the work activity so that fish deaths are avoided.
3. The WSS Technical Services Engineer will be consulted prior to conducting the work in relation to:
 - The perceived likelihood of fish deaths occurring as a result of the planned work; and
 - Intended fish removal processes / work modifications to avoid fish deaths. Approval will be required from Technical Services Engineer before any removal processes are employed.
4. Fabridam operation can result in fish stranding due to the sudden reduction of flows downstream during inflation and upstream during deflation. Fabridams shall be operated in a manner, which minimises the risk of fish stranding and/or fish deaths.

Fish Deaths

1. If fish deaths occur despite all reasonable and practicable efforts to prevent them, they will be managed in accordance with the Fish Kills Emergency Response Procedure available on the SunWater Intranet (ERP 1 Fish Deaths).
2. Where fish deaths occur unrelated to any particular activity, they may be investigated using the guidelines outlined in Standard EM 18.2 Investigating Fish Death Events

REVISION HISTORY

Date	Revision	Approved By	Description of Change/Reason for Release
Nov 2002	0	GM(O&M)	Previously issued under O&M EMS, change to number
Oct 2004	1	GM(O&M)	Format change for SunWater EMS

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Investigating Fish Deaths

Standard No: EM 18.1

Revision: 0

Authorised: MSM

Approved: COO

Purpose: To outline the process for investigating fish death events.

Scope: This standard is to be used by regional environmental staff responsible for the investigating of and reporting on fish death events. It applies to all situations where dead fish are discovered in or near SunWater storages (including channels and drains).

Directive:

1. All fish death events occurring in SunWater storages or distribution systems, numbering over 50 (or less if suspicious circumstances), shall be investigated;
2. Information shall be collected so as to assist in determining the possible cause(s) of the event, and specifically whether the deaths occurred due to activities undertaken by Sunwater;
3. Where the likely cause of death is obvious (eg. Acrolein related, draining of channels, storage overtopping, major inflows, lake overturn) detailed investigation may not be required. The Environmental Services Manager will provide advice, however if unsure, follow the Emergency Response Plan – Major Fish Deaths.

Procedure:

1. Prepare Fish Death Kits in preparation (now, prior to fish deaths occurring).

Fish Death Kits should be maintained at all major storages or depots where practical.

The contents of a Fish Death Kit are listed on the next page, which may be printed out and stored with the Fish Death Kit.

2. Follow Emergency Response Plan – Major Fish Deaths.

The Emergency Response Plan – Major Fish Deaths forms part of the Incident Management System and guides you through what to do during a fish death, and allows for you to log events.

If you are approached by members of the public, a government officer or other third party whilst in the field, restrict comments to readily observable and indisputable facts. If required, advise them to contact the Regional Manager, Manager, Public Affairs (3120 0043), or Chief Operating Officer (3120 0058).

3. Determine possible causes of the fish death event, using information collected above and cross-referencing against that provided in Table 1 (pages 2 -4). It should be noted that you are not obliged to make a determination of the cause of the fish deaths – remember to report facts only – and if you are unsure or you feel further information is required, simply note this in the incident report.

4. Report findings to the Environmental Services Manager via QM2 F1 Fish Death Incident Report, Photographs, Water Quality results etc.

References:

- Emergency Response Plan – Major Fish Deaths (Incident Management System);
- Management of Injured or Dead Wildlife in SunWater Controlled Areas (Standard EM26)
- SunWater Alert Fax (QM2 F2)
- QM2 F1 Fish Death Incident Report



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Fish Death Kit Contents

Print and Fix this to the top of your Kit and keep contents maintained

Put all kit items in an Esky, which can be used in the event of a fish death, and replaced after the event.

Additional items not in Kit:

- Camera
- Ice
- Water Quality Sampling Equipment (SDL)

Forms/ Documents

- Emergency Response Plan – Major Fish Deaths (from Incident Management System)
- QM2 F1 Fish Death Incident Report Forms (including spares)
- EM18.1 Investigating Fish Deaths standard (plus spares)
- EM18.1 F1 Laboratory Analysis Form (available on the Intranet, or from the Environmental Services team) – this form includes the address to send the samples to.
- Pens, to complete forms & write notes, during investigation

PPE & C

- PVC gloves
- Face mask
- Waterproof bandaids / bandages (to cover cuts before touching dead fish)

Sample Containers

- 4 x 1 L plastic sample bottles (order from Environmental Services group or local Laboratory or Chemist)
- 4 x 1 L glass sample bottles (order as above)
- Roll of Alfoil (for separating glass bottle from plastic lid for suspected chemical contamination samples)
- Bucket with rope attached
- Tape, to tape up esky with samples
- recommended* - 6 pack sized esky for smaller samples



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Table 1 – Information on Different Causes of Fish Deaths

Fish deaths can occur due to one or more natural causes, human causes or sometimes an interaction of both. A summary of some different causes of fish deaths is as follows:

Cause	Signs	Contributing Factors	Other Information
Acrolein Treatment	Dead fish in channels after treatment with acrolein	<ul style="list-style-type: none"> ✓ Recent application of Acrolein in channel system or balancing storage. ✓ Recommended withholding period not observed ✓ Treated water not contained within distribution system 	
Lack of dissolved oxygen	Gasping at the surface	<ul style="list-style-type: none"> ✓ Draining of channels ✓ Input of large amounts of plant matter into waterways (eg: following significant rains after periods of drought) ✓ Input of nutrients resulting in algal blooms or growth of aquatic plants (most critical at night or in overcast weather) ✓ Interference in the natural flow of a waterway resulting in stagnant conditions ✓ Inputs of dissolved metals (eg: Fe) from acid sulphate drainage which flocculate in water (a process which uses up oxygen) 	Death by suffocation Critical minimum DO concentration varies between species
Water temperature changes	-	<ul style="list-style-type: none"> ✓ Overturning (stratification) – indicated by temperature profile of water column uniform from surface to bottom and dissolved oxygen levels low and uniform throughout water column ✓ Extreme weather events ✓ Inputs of low (eg: bottom off-takes in storages) or high temperature water into waterway 	Particularly apparent in small water bodies
Salinity changes	-	<ul style="list-style-type: none"> ✓ Rapid drop in salinity levels following a major storm event (more evident in estuarine environments) ✓ Rapid increase in salinity due to breach of sand barriers at river 	-



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Cause	Signs	Contributing Factors	Other Information
		<ul style="list-style-type: none"> mouths and sudden incursion of saline water ✓ Rapid increase in salinity due to evaporation of water in confined water bodies 	
pH stress	Gill and skin damage Body lesions associated with "red spot disease"	<ul style="list-style-type: none"> ✓ Chemical spills or other contaminated runoff ✓ Industrial effluents ✓ Acid sulphate drainage 	Fish have a limited tolerance to abnormal pH concentrations
Toxic algae	-	<ul style="list-style-type: none"> ✓ Presence of toxin producing BGA and dinoflagellate's 	-
Excessive plant growth	Refer lack of dissolved oxygen	<ul style="list-style-type: none"> ✓ Through the processes of photosynthesis and respiration, there can be a supersaturation of dissolved oxygen levels in water during the day (excess oxygen is toxic to fish) or oxygen depletion at night. ✓ Reduced DO levels due to decomposition of large amounts of plant matter 	Excessive plant growth is often a result of excessive nutrient concentrations in waterways and is more likely to occur in warmer weather.
Sediment disturbance / excessive turbidity / "brown blood disease" – nitrogen blood poisoning	Gasping at the surface (suffocation from clogging of gills) Gills appear to be clogged with, or oozing "brown blood"	<ul style="list-style-type: none"> ✓ Disturbance (eg: due to increased flows, direct disturbance, etc) of nutrient rich organic matter present in bottom sediments, and subsequent issues associated with decomposition of this matter in the water column. ✓ Gills clogged with particulate matter or injured by abrasive particles. 	-
Contamination by Chemicals	Refer pH stress, Acid Sulphate Drainage	<ul style="list-style-type: none"> ✓ Inputs of pesticides, herbicides, heavy metals, etc 	Adjacent landuse is important if contamination, chemical or otherwise, is considered a possible cause
Ammonia	-	<ul style="list-style-type: none"> ✓ Fertilisers ✓ Organic pollution ✓ Collapsing algal blooms 	NH ₃ is potentially toxic to fish and its proportion relative to NH ₄ ⁺ increases with pH.



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Cause	Signs	Contributing Factors	Other Information
		<ul style="list-style-type: none"> ✓ Overcrowding of fish ✓ Industrial effluents 	
Sunburn	White lesions on top of head, accompanied by cloudless weather and very clear water	<ul style="list-style-type: none"> ✓ High temperatures ✓ Limited shade / protection 	-
Parasites and disease	Sometimes lesions or haemorrhages but these may not always be present	<ul style="list-style-type: none"> ✓ Fish are subject to a variety of bacterial and viral infections and parasitic infestations. These are often a secondary cause of fish kills in fish already stressed by other factors 	-
Acid sulphate drainage	Gill and skin damage Body lesions associated with "red spot disease" Suffocation (gasping at the surface)	<ul style="list-style-type: none"> ✓ Acidic runoff / drainage from disturbed acid sulphate soils ✓ Inputs of dissolved metals from acid sulphate drainage resulting in fish deaths from metal toxicity, or flocculated (precipitated) metal causing low DO levels and clogging of gills 	Acid sulphate soils occur in estuarine and coastal areas only, typically where surface elevation is <5m
Gas bubble disease (bubbles of gas in the blood vessels)	Bubbles visible in the fins and on the head, also present in the gills and behind the eyes	<ul style="list-style-type: none"> ✓ Supersaturation of dissolved gases in the water, usually as a result of high energy inputs (eg: flow over a spillway, heated water discharges from power station operations) 	Death by blockage of blood supply to vital organs
Hydrogen sulfide (H ₂ S)	Smell (rotten eggs) Larger fish affected first Dark brown gill filaments	<ul style="list-style-type: none"> ✓ Release of H₂S is usually the result of collapsing algal blooms, or disturbance of anoxic sediments or thermal stratification (eg: due to releases from dams or changing weather conditions). 	-
Lifecycle related	-	<ul style="list-style-type: none"> ✓ Some fish make seasonal migrations for breeding and sometimes die after spawning or their journeys can expose them to stressful environmental conditions. 	Fish kills confined to single species only