WATER RESOURCES COMMISSION

SPILLAGE AND DEWATERING GUIDELINES

September 2018

Table of Contents

1.0 Introduction

The Water Resources Commission (WRC), in 2001 developed the Water Use Regulations LI 1692, which outlined the procedure for acquiring water rights for various categories of water uses. In 2012, the WRC reviewed Schedule B of the Regulations to include other categories of water use. These were construction, damming, dewatering, diversion, dredging and spillage (controlled).

Dewatering and spillage may be necessitated by several reasons including heavy downpour, high groundwater levels, site maintenance, among others. Dewatering and spillage are essential activities that need to be well planned and properly implemented to prevent or reduce their negative effects on water bodies and catchments.

Dewatering and spillage involve all manner of raw water released into the environment. The WRC defines dewatering as an intentional lowering of water level e.g., groundwater level. Spillage (controlled) is also defined as the controlled release of freshwater into the environment e.g., fresh water spillage from a dam into a river. Spillage may adversely affect aquatic ecosystems as well as endanger the lives of the inhabitants of surrounding communities.

1.1 Scenarios for Dewatering/Spillage

- **Dewatering Scenarios**
  - Removal of water from mine pits caused by water intrusion due to puncturing an aquifer during mining operations.
  - Removal of water from a mine pit as a result of runoff after a heavy downpour.
- **Discharge Scenarios**
  - Discharge of treated water from tailings dams or mine pits that contain sulphide ores.
  - Discharge of water from dewatering activities into receiving water bodies.

- **Spillage Scenarios**

  - ***Controlled Spillage of Water***: Spilling water from dams/reservoirs and weirs to maintain the mechanical integrity/properties of the structure to avoid failure. The spilling is usually done through the spillway or weir in a controlled manner.

  - ***Uncontrolled/Accidental Spillage of Water:*** This is when the water storage facility suddenly breaks to release all the water it has stored. In this case, the volume of water spilled, frequency of spill and flow rate of spilled water are not controlled. This scenario can occur when there is heavy rain and flooding beyond spillway capacity or when tailings dams collapse due to negligent operation.

1.2 Objective of Guidelines

This document provides the requisite information as a guide for dewatering and spilling of raw water. The objective of this guideline is to provide technical and practical steps for both regulators and proponents to facilitate the issuance of permits (case specific), whilst protecting the environment and individuals.

The guidelines provide information on:

- Regulatory institution
- Communication
- Relevant institutions/stakeholders
- Factors to consider
- Aquatic ecosystem protection
- Monitoring
- Emergency response plan
- Raw water guidelines

Information is based on environmentally friendly methods and best practices for the aquatic environment, and the inhabitants within the catchment, and water use criteria for domestic supply and protection of aquatic ecosystems.

2.0 Regulatory Institution

The mandatory regulatory institution which issues permits for spillage and dewatering is the Water Resources Commission. The requisite permit must be obtained before any spillage and dewatering can be undertaken.

3.0 Communicating the Spill/Dewatering Process to Relevant Institutions

Before the spill, all interested parties must be duly informed. This includes communities downstream, agencies involved, and all interest groups. These institutions and stakeholders must be given at least five (5) days prior notice before spilling is done. The five (5) days prior notice is ample time for effective awareness creation on the spilling operation to be done.

4.0 Relevant Institutions and Stakeholders

Other relevant institutions and stakeholders, apart from the WRC, which must be informed before spilling and/or dewatering is carried out include:

- The District Assemblies within which the receiving water body flows
- Traditional Authorities / leadership within the communities likely to be affected
- Communities which will be affected
- Water Users downstream whose operations are likely to be affected
- National Disaster Management Organisation
- Environmental Protection Agency
- Stakeholders should be prioritized for effective communication, depending on the prevailing circumstances, whiles the other stakeholders can be notified.
- Media/press (media houses)
- Other relevant institutions

5.0 Factors to Consider Before Spillage/ Dewatering

Certain parameters will influence the swiftness of flow of water, quantity of sediments that will be carried along, chemicals from the environment that will dissolve in the water and the general effect of the spill. It is necessary therefore to consider the following factors before any spillage / dewatering is carried out:

5.1 Geomorphology

Dewatering and spillage from hydro dams, quarry, mineral mining sites, and construction sites among others affects the geology and other geomorphological features within the affected area. Dewatering and spillage can have adverse effect on the hydrology of the area, land elevation, soil and its geological formation as well as influence erosion, weathering, flooding, subsidence, mass wasting, mudflows and landslides.

To minimize the possible negative effects of dewatering and spillage on the natural and artificial geomorphological features within the spillage and dewatering zones, the following should be considered / should be provided:

- The intended spillage or dewatering period.
- Flow rate and frequency.
- Preparation of a dewatering and/or spillage plan (i.e. a map indicating drainage path).
- Identification of possible hydrogeological and hydrological effects during and after the planned activity and ways to minimize or prevent these negative effects.
- Detailed identification of downstream tributaries that are likely to be affected, including the following:
    - seasonal standing groundwater levels
    - soil types and their hydrogeology
    - comprehensive groundwater quality indicators
    - the water quality at risk near the dewatering or spillage site
    - the water quality/quantity at any planned water release point
- Preparation of a strategy for monitoring and managing any impacts of the dewatering or spillage activity during and after the planned project duration.

The Commission highly advices against dewatering or spillage activities that:

- Deviate from the defined dewatering or spillage plan that might lead to local flooding.

- Lead to profound erosion or any land or structural failure within the dewatering or spillage zone.

- Leach significant quantities of contaminants, (metals listed in the Annex A), which may be harmful to the quality of surface or groundwater resources along the zone of the planned activity.

Dewatering options to minimize environmental harm:

- Recharge of local groundwater, provided the quality of the extracted water meets the relevant criteria set by regulatory agencies. The recharge activity should be carried out without any significant risk to native vegetation, wetlands, and other ecosystem structures or services where applicable;

- Recycling, provided the water quality is suitable for its intended use. Recycling options include dust control, process circuit water, cooling water systems or wash-down water. The reuse activity must also be acceptable to other relevant government authorities;

- Irrigation of vegetated land provided the water quality meets the required water quality standards for irrigation.

5.2 Rate of Release

Flow rates of receiving waterbodies should be determined in order not to disturb the river flow. The release of water should not be turbulent, but a gradual process that would not cause flooding and excessive disturbance to aquatic life, and other stakeholders downstream. This process tends to preserve the river morphology and environment.

5.3 Water Quality

This refers to the chemical, physical, biological, and aesthetic properties of water. Water quality determines the fitness of water for an intended use. In this case the water quality of both the incoming spill and the receiving water body must be known. Raw water quality levels should be within WRC's recommended Water Quality Guidelines in the Appendix. As a rule, the quality of the water to be spilled and/or dewatered should not be in excess in any one parameter.

5.4 Season At Time of Spillage

Ghana has two definite seasons, the wet and dry seasons. The season should be considered before spilling and dewatering to avoid flooding and other negative effects.

5.5 Volume of Water

The volume of water to be spilled at a particular time should not cause flooding. Therefore, knowledge of the carrying capacity of the receiving water body is vital, hence, gauges should be installed to monitor the water level and flow. If flooding would occur or flooding is anticipated based on the volume, then sections 3.0 and 4.0 of this document should apply.

6.0 Aquatic Ecosystem Protection

The release of raw water into water bodies can cause numerous habitat impacts resulting from the changes in water quality. The impacts may include the loss of downstream habitats as the salinities of estuarine areas decrease from the inflow of large quantities of freshwater.

If sediment characteristics are changed drastically at the location of spilling or dewatering, the benthic community composition may be altered permanently. This can lead to reductions in the biological productivity of the habitat at the spill or dewatering site for some aquatic resources as their prey species and important habitat types, such as aquatic vegetation, are no longer present. Raw water releases at high velocities may scour sediments near the outlet and within the water body. This can lead to a change in the community composition because many benthic organisms are sensitive to grain size.

Turbidity plumes of suspended particulates caused by the scouring of the substrate can reduce light penetration and lower the rate of photosynthesis and the primary productivity of an aquatic area while elevated turbidity persists. Fish and invertebrates in the immediate area may suffer a wide range of adverse effects, including avoidance and abandonment of the area, reduced feeding ability and growth, impaired respiration, a

reduction in egg hatching success, and resistance to disease if elevated levels of suspended particulates persist.

To retain the natural ecology of the receiving water body, avoid siting spillage and dewatering pipeline outlets within water bodies. Additional guidance as to measures to be put in place at the discharge outlet to ensure landscape integrity and that of the quality of the receiving medium is required, probably discharges into raised bunds until water quality meets regulatory criteria.

7.0 Monitoring

The company should develop and maintain a programme that monitors, records and reports on the effects of dewatering. The programme should include the following:

- Quantities of raw water released;
- Visual inspections of the spillage / dewatering system to confirm its integrity
- Impacts at the point of release with suitable monitoring facilities, e.g. bores to record the effects of pumping on the water table;
- Relevant water quality analysis of the water released and the receiving water body;
- Specific changes in elevation of the receiving water body over time; and
- Periodic investigations of the impacts on vegetation and water resources. Photographic records of vegetation and other sensitive parameters should be included, as appropriate.

8.0 Emergency Response Plan

As part of a company's safety and health programme, there is the need to have an Emergency Response Plan. Well-prepared companies must keep a plan of action and the appropriate clean up materials on hand in case of an emergency. A simplified emergency action plan for spilling and dewatering may include the following steps:

8.1 List of Contacts

A company's emergency response plan should include a list of contacts of people, experts and agencies that can be contacted for services and assistance in cases of emergency during spilling or dewatering. The list may include operators, spill response team, government agencies, media representatives, traditional heads, security services and community members who can be contacted in such cases and inform all others that are likely to be affected by the incident. All relevant stakeholders must be informed within one (1) hour of the incident. It is important that the list of contacts is updated as and when necessary.

8.2 Notification of Response Team

The response team should be contacted and informed about the incident in order for them to take the required steps towards containing the incident at hand.

8.3 Communication (and emergency assembling point)

Accurate, concise and timely information to the communities through public address systems, the press via radio and TV are very important in a situation of emergency. A considerable press attention must be expected and a strategy for handling information should therefore be part of the emergency response plan. During abnormal circumstances, the emergency staff should be relieved by a public relations manager.

8.4 Evacuation

After information concerning the emergency spillage or dewatering has been circulated, evacuate all persons within the area affected to save lives, animals and properties. If necessary, an arrangement for compensation should be made for the affected persons.

8.5 Personal Protective Equipment

All apparatus and protective equipment should be made available to the personnel tasked with controlling the incidence. All conditions necessary for achieving a casualty-free operation should be complied with.

8.6 Simulation Exercises

Simulation exercises and training sessions based on the Emergency Response Plan are necessary to identify if the plan works in practice. There should be an annual desktop simulation and once in every three years, an actual simulation and drill should be carried out based on the previous recorded emergency flow rates.

The operations manager should evaluate what exercises are required based on changes in the Emergency Response Plan, previous exercises and experience from accidents within the spilling and dewatering areas.

8.7 Evaluation

Evaluation of exercises is important, and sufficient time should be allocated to the evaluation. All the participants of the exercise should be given the opportunity to comment on positive and negative experiences from the exercise. A summary report from the exercise should be prepared, and where possible reviews of the Emergency Response Plan are to be included.

9.0 Glossary

Accidental spillage	The unforeseen release of raw water, which escapes into the surrounding environment including water bodies.
Dewatering	The planned removal of unwanted raw water, which may be released into the environment / water body directly. It may be the removal of ground water, process water, water entrained or carried along by oil or gas, or water used to transport solids
Discharge	The volume rate of water flow, including any suspended solids (e.g., sediments), dissolved chemicals or biologic material which is transported through a given cross-sectional area, or may be the movement of water out of an area of saturated soil/rock or the volume of water moving down a stream or river per unit of time.
Geomorphology	The physical features of the surface of the earth and their relation to its geological structures. The science of landforms with an emphasis on their origin, evolution form and distribution across the physical landscape.
Geology	Related to solid earth, the rocks of which it is composed and the process by which they change over time.
Groundwater	The water found underground in the cracks and spaces in soil, sand and rock. It is stored in and moves slowly through geologic formations of soil, sand and rocks called aquifers which may be abstracted and accessed by digging, mechanized or manual drilling, or by any other method
Raw water	The natural water found in the environment, such as rainwater, ground water, and water from bodies like lakes and rivers.
Spillage	This refers to the deliberate action of allowing raw water to flow through a channel that carries the water over or around a dam.
Catchment areas	An area where all runoff is being conveyed.

10.0 Raw Water Guidelines Table

The Table below indicates the water quality criteria for domestic use and aquatic ecosystem.

Water Quality Guidelines for Spillage

CONSTITUENT/PARAMETER	DOMESTIC WATER USE	AQUATIC ECOSYSTEMS
Algae (µg/l chlorophyll-a)	0-1	-
Algae (cells/ml)	0-50	
Aluminium (mg/l)	0.0.15	-
Ammonia (mg/N)	0-1.0	7
Arsenic (µg/l)	0-10	0.5mg/l (total Arsenic)-
Soluble Arsenic		0.1mg/l
Asbestos Fibre Count (Fibres/l)	$0\text{-}1\times10^{6}$	-
Atrazine (µg/l)	0-2	-
Cadmium (µg/l)	0-5	ˣ<0.1
Calcium (mg/l as Ca)	0-32	0-100
Chloride (mg/l)	0-100	-
Chromium (mg/l)	0-0.05	0.1 (chromium +6)
Copper (mg/l)	0-0.1	2.5
Cynanide (µg/l)	-	0-1.0 (for total Cyanide)
Cyanide (dissociated as weak acid)		0.6
Free cyanide		0.2
Dissolved Oxygen	-	80%- 120%
Dissolved Organic Carbon (mg C/L)	0-5	-
Escherichia coli (counts/100ml)	0	-
Faecal Coliform (counts/100ml)	0	-
Fluoride (mg/l)	0-1.0	-
Iron (mg/l)	0-0.1	Not more than 10%
Lead (mg/l)	0-10	
Magnesium (mg/l as Mg)	0-30	0-100
Manganese (mg/l)	0-0.05	-
Mercury (mg/l)	0-1	0.04
Nitrate / Nitrite (mg/l as N)	0-6	-0.01 for nitrite
Nickel (µg/l)	-	0-0.1
Nitrogen (mg/l)	-	Not more than 15%
Odour (TON)	1	-
Pesticides	-	Aldin – 0.01 DDT – 0.0015 Dieldrin – 0.005 Dursban – 0.001 Endosulfan – 0.003 Endrin – 0.002 Heptachlor – 0.005 Lindane – 0.015 2,4-dichlorophenol – 4.0
pH (Aesthetics & Human Health)	6.0-9.0	-
pH (Aquatic Ecosystem)	-	> 0.5 > 5%
Potassium (mg/l)	0-50	
Temperature	-	->2° C or > 10% (<3° above ambient)
Total Dissolved Salts/Solids	-	> 15%
Selenium (mg/l)	0-20	-
Sodium (mg/l)	0-100	-
Sulphate (mg/l)	0-200	-
Total Coliforms (counts/100ml)	0-5	-
Total Dissolved Solids (mg/l)	0-450	
Electrical Conductivity (mS/m)	0-70	-

Total Hardness (mg CaCo3/l)	0-50	0-50
Total Suspended Solids	-	< 100mg/l
Turbidity (NTU)	0-1	-
Zinc (mg/l)	0-3	2.0

*Note: Water to be spilled should conform to the domestic water use criteria if the receiving water body is used for domestic activities by surrounding communities and by water treatment facilities for the eventual distribution of potable water. Otherwise they must fall within the criteria for the protection of aquatic ecosystems.