

1.0 OVERVIEW

Water Quality Management Plan (WQMP) provides a comprehensive overview of the overall water quality management system of Baleh HEP Project. This is to ensure that all water quality issues at the implementation stage until the operational stage are addressed and mitigated in compliance with relevant state and federal environmental requirements.

2.0 SCOPE

WQMP is a plan formulated to determine the state of water quality, address contributing sources and significant impact as well as identification of mitigation measures during implementation and operational stages of Baleh HEP

3.0 OBJECTIVES

The objectives of WQMP are:

- To assess the quality of water in tandem to Class IIB of the National Water Quality Standards for Malaysia (NWQSM) or its existing baseline condition (pre-construction period) for Baleh HEP and its components;
- To formulate and implement effective measures to minimize the pollution of waterways from the project establishment; and
- To maintain the quality of water at an appropriate level that is suitable for riverine fisheries, unaffected by the project construction and maintained at acceptable quality for domestic use by the communities downstream of the project.

3.0 ENVIRONMENTAL IMPACTS AND MITIGATION

Table 1 shows the developed mitigation measures based on Baleh SEIA Report, as well as appropriate timing of executing mitigation measures and reporting requirement, which are examined against the different stages of Baleh HEP Project development

Project Activities	Environmental Aspects/ Potential Impacts	Mitigation Measures ¹	Timing	Reporting Requirements
CONSTRUCTION STAGE				
<ul style="list-style-type: none"> Major construction works Earthworks (cutting and filling) 	Soil <ul style="list-style-type: none"> Soil erosion and sedimentation Decreased slope stability and increased risk of slope failure 	<ul style="list-style-type: none"> Erosion and Sedimentation Plan (ESCP) shall be prepared for the major construction areas of the Baleh HEP Project ESCP shall be prepared prior to the commencement of works and shall be included in the site-specific plans prepared for each major construction sites Proper muck disposal sites have been identified to avoid muck going into the river Maintain a natural green belt around the reservoir periphery is recommended Slopes on both banks above the maximum flood level shall be maintained with the existing vegetation for the creation of a green belt around the reservoir rim Soil erosion control measures will include bio-engineering measures, vegetative measures, reduction in use of fuel wood and management measures Mixed plantation of coniferous and broadleaf trees, in combination with bushes and grasses, suited to the characteristics of a particular site shall be planted 	<p>Upon commencement of site construction works (Periodically)</p> <p><i>ESCP needs to be prepared prior to commencement of ground works, and revise where required</i></p>	<ul style="list-style-type: none"> Erosion and Sediment Control Plan (ESCP) Biomass Removal Plan (BRP) Periodical internal ESC report (contractual requirement) Periodical internal/ external ECA report Quarterly EMR report
<ul style="list-style-type: none"> Quarry establishment 		<ul style="list-style-type: none"> An Explosive Storage Magazine Plan shall be developed to ensure proper handling and storage of magazine by the quarry operator Restrict clearing of quarry site shall to necessary area of rock extraction Sedimentation ponds are recommended for the retention of eroded particles from the quarry. Establishment of proper drainage to channel the runoff to the sedimentation ponds before final discharge into the waterway, i.e. Putai river and tributary of Baleh river Regular desilting of the sedimentation ponds Utilise an environmentally friendly blast initiation system in blasting operation The quarry sites shall be rehabilitated and replanted with species indigenous to the area 	<p>Upon commencement of construction works (Periodically)</p>	
<ul style="list-style-type: none"> Major construction works Earthworks Presence of workers on-site 	Surface Water Quality <ul style="list-style-type: none"> Deterioration of surface water quality Waste <ul style="list-style-type: none"> Generation of biomass waste Generation of earth waste Generation of municipal waste Generation of sewage and domestic wastewater 	<ul style="list-style-type: none"> No waste of any kind should be disposed of directly into any of the rivers Base camp, workers' quarters and site offices shall be provided with individual septic tanks capable of treating the sewage to Standard B under the Second Schedule of the Environmental Quality (Sewage) Regulations 2009 Construction wastes and earth stockpiles shall be located away from waterways Scheduled wastes shall be properly stored and contained 	<p>Upon commencement of site construction works (Periodically)</p>	<ul style="list-style-type: none"> Quarterly EMR report Periodical internal ESC report (contractual requirement) Periodical internal/ external ECA report

Project Activities	Environmental Aspects/ Potential Impacts	Mitigation Measures ¹	Timing	Reporting Requirements
	<ul style="list-style-type: none"> Generation of scheduled waste Generation of construction waste 			
<ul style="list-style-type: none"> Decommissioning of site installations 	Waste <ul style="list-style-type: none"> Generation of construction waste 	<ul style="list-style-type: none"> Decommissioned parts shall be placed at designated temporary sites The area of decommissioned installations shall be cleaned Where possible sell, recycle and reuse the waste materials Landfill(s) shall be closed as per the closure plan approved by the Natural Resources and Environment Board A Decommissioning and Rehabilitation Plan is recommended to be prepared and submitted to NREB in advance for approval and full pull-out of contractor. (This applies in the event of any decommissioning of the dam and its ancillary facilities) 	During decommissioning stage (Periodically)	<ul style="list-style-type: none"> Rehabilitation and Abandonment Plan (RAP)
RESERVOIR IMPOUNDMENT STAGE				
<ul style="list-style-type: none"> Water release from reservoir 	Hydrology <ul style="list-style-type: none"> Impact to environmental flow Impact to the downstream users and the river ecosystem health Low dissolved oxygen levels are expected at the downstream discharge, during impoundment, due to the use of a low-level outlet intake for inflow 	<ul style="list-style-type: none"> During the impoundment period, a controlled discharge equivalent to environmental flow is recommended to be released from the reservoir. The recommended environmental flow is within the 90th percentile flow (or 10% natural low flow), which is equivalent to about 250 m³/s Maintenance of constant minimum residual flow (downstream) Preserve existing key features of the river's natural hydrograph Minimum clearance for access roads, jungle trails and for other construction purposes outside the reservoir Carry out re-vegetation and landscaping of the slopes in pace with the progress of the project Clearing of vegetation during dry season in the impoundment site. For areas within the 50 m from the riverbanks, clearing activity shall be done right before the dam is impounded To study and assess the impact of Baleh HEP impoundment and operation on dissolved oxygen levels and provide recommendations and mitigating measures to improve dissolved oxygen levels. 	During water release (Periodically)	<ul style="list-style-type: none"> Hydrometrics Monitoring Report (for downstream flow. Eg: minimum 250 m³/s) Downstream Flow Monitoring Plan Discharge Dissolved Oxygen Modelling Quarterly EMR report Periodical internal ESC report (contractual requirement) Periodical internal/ external ECA report
<ul style="list-style-type: none"> Biomass removal 	Soil Soil erosion and sedimentation of the reservoir Surface Water Quality <ul style="list-style-type: none"> Deterioration of surface water quality due to: <ul style="list-style-type: none"> consumption of dissolved oxygen production and emission of noxious gases and chemicals Enriched water quality which may lead to production of invasive aquatic plants 	<ul style="list-style-type: none"> Limit area of biomass removal Biomass removal at shoreline strip to be done just before inundation, i.e. start clearing from lower elevation then to higher elevation Maximize harvest and utilization of commercial forest biomass Limit non-commercial forest biomass removal to a relatively narrow, strip of shallow, periodically inundated shoreline, where, if biomass is left to decompose Removal of non-commercial forest biomass from the reservoir shoreline 	Upon biomass removal (Periodically)	<ul style="list-style-type: none"> Quarterly EMR report Periodical internal ESC report (contractual requirement) Periodical internal/ external ECA report Quarterly EMR report Periodical internal ESC report (contractual requirement) Periodical internal/ external ECA report
DAM OPERATION STAGE				
<ul style="list-style-type: none"> Dam and reservoir operation 	Hydrology	<ul style="list-style-type: none"> For water levels greater than MOL: Normal operations, with discharges always greater than the environmental flow 	Upon operation (Periodically)	<ul style="list-style-type: none"> Hydrology Monitoring Plan

Project Activities	Environmental Aspects/ Potential Impacts	Mitigation Measures ¹	Timing	Reporting Requirements
	<ul style="list-style-type: none"> Reduction in flood flows and flood levels to the downstream areas Higher low flows during the dry seasons Reduction in the fluctuations of downstream river discharge and water levels Loss of connectivity between the main channel and important floodplains, wetlands and lakes. 	<ul style="list-style-type: none"> For water levels below MOL: Observation of an environmental flow release structure to maintain a discharge at least 250 m³/s downstream 		
	<p>Downstream Water quality</p> <ul style="list-style-type: none"> Erosion and sedimentation along river channels downstream of the dam 	<ul style="list-style-type: none"> A Detailed Sediment Transport Modeling is recommended for the Baleh River downstream of the proposed dam so that locations that are subjected to erosion, transport or deposition can be identified, and appropriate mitigation measures can be formulated for better environmental management 	Upon operation (Periodically)	<ul style="list-style-type: none"> Water Quality Continuous Monitoring System (CMS) Water Quality Monitoring Program Detailed Sediment Transport Modeling (Sediment Control Plan)
	<p>Reservoir Water Quality</p> <p>Degradation of reservoir water quality due to pollution sources from within the Baleh dam catchment entering the reservoir</p>	<ul style="list-style-type: none"> The dam operator should consider draw offs from the top 10m in order to ensure that the DO level in the discharge is suitable To ensure the DO level in the draw off water is suitable, the dam operator should consider a draw off, ideally at 5m interval from FSL up to just the hypolimnion, or anoxic zone in order to allow flexibility in draw off depths, depending on the actual temperature and DO profile in the reservoir as the levels rise fluctuates 	Upon operation (Periodically)	<ul style="list-style-type: none"> Water Quality Continuous Monitoring System (CMS)
	Erosion and sedimentation in the dam reservoir	<ul style="list-style-type: none"> A 100m buffer zone around the reservoir boundary to minimize sediment run-off to the reservoir 		

Table 1: Potential Impacts and Mitigation Measures

4.0 WATER QUALITY MONITORING AND REPORTING

Table 2 below presents the water quality related initiatives developed for Baleh HEP for the implementation and operation stages to ensure the commitments to water quality issues are put into action

Relevant Water Quality Initiatives	Implementation	Operation
<i>By SEB</i>		
A. Water Quality Re-baselining	√	
B. Water Quality Performance Analysis	√	√
C. Turbidity and Total Suspended Solids Monitoring	√	
D. EMR Submission Review, Reply and Record	√	
E. Discharge Dissolved Oxygen Modelling	√	√
F. Water Quality Continuous Monitoring System		√
<i>By relevant Contractors/ Operators</i>		
A. Erosion And Sediment Control Plan	√	
B. Waste Management Plan	√	
C. Turbidity and Total Suspended Solids Monitoring	√	√

Table 2: Water Quality Monitoring and Reporting