

## 9.1

*INTRODUCTION*

During the construction and operation phases, different activities have the potential to generate wastewater, accidental spills, sedimentation, and increased water consumption, which could lead to impacts on the hydrology and quality of surrounding freshwater bodies. In the Project Study Area, the Ayeyarwady River is identified as the most prominent potential receiving body. Therefore, it is important to understand the interaction between impacts generated from construction and operation activities of the Project and the subsequent effects on surface water quality and hydrology. This Chapter presents an evaluation of the potential impacts on surface water associated with the construction and operation of the proposed Project based on the impacts identified during Scoping (outlined in **Chapter 5**). Mitigation measures have also been provided where necessary to be implemented alongside in-place controls to reduce the potential residual impacts to acceptable levels.

## 9.2

*ASSUMPTIONS AND LIMITATIONS*

The assessment of potential impacts related to surface water in this section is based on the environmental baseline data (presented within **Chapter 5**), socio-economic baseline data (presented within **Chapter 6**) and the information available from the Sponsor at the time of writing. Judgements and assessments have been made based on professional knowledge and previous experience of ERM. It is noted that no quantitative modelling has been undertaken with regards to any elements of the surface water impact assessment. Should there be significant changes in factors such as assumed input data, engineering design of wastewater management and treatment components of the Project, or agreed assessment criteria, then elements of this impact assessment and associated management, mitigation and monitoring measures may be needed to reflect these changes.

The environmental parameters sampled in the baseline survey (refer to **Chapter 5**) are based upon commonly found contaminants.

This chapter focuses purely on water bodies as the receptor. It is recognised that any changes to surface water may potentially impact sensitive receptors that utilise these surface water resources. It is recognised that there is considerable cross over between assessment of impacts to surface water, and assessment of impacts to fish stock, mangrove ecosystems and any surface water users. In this regard, this chapter assesses impacts and develops management, mitigation and monitoring measures in relation to reducing impacts to surface water only. Assessing impacts to receptors from identified changes to water quality or hydrology (identified as a result of this **Chapter**) has been undertaken within the scope of **Chapter 13**, **Chapter 14** and **Chapter 17**, and taken into account the various management, mitigation and monitoring measures developed within this chapter.

Based on the IFC Scoping Study and the Project Description in **Chapter 2**, the key potential impacts on surface water identified arise from the following activities.

#### Construction Phase

- Power Plant
  - Pre-commissioning & Testing
  - Wastewater Discharges and Run-off
  - Waste Storage & Disposal
  - Accidental Events (spills/uncontrolled releases)
- Water Supply Pipeline and Water Discharge Pipeline
  - New Pumping Station or retrofit (Sedimentation/Siltation)
- Gas Supply Pipeline
  - Accidental Events (spills, uncontrolled releases)

#### Operation Phase

- Power Plant
  - Waste Storage & Disposal
  - Accidental events (spills/uncontrolled releases)
- Water Supply Pipeline and Water Discharge Pipeline
  - Cooling Water Withdrawal
- Gas Supply Pipeline
  - Accidental Events (leaks, uncontrolled releases)

The surface water impact assessment is based on international guidelines. The requirements of these international guidelines have been reviewed and discussed in detail in **Chapter 3**.

There are no permanent surface water features present at the Project Site. The Ayeyarwady River is approximately 10 km northwest from the Project Site. An irrigation canal runs from the pumping station at the Ayeyarwady River to the north of the Project Site, being 0.5 km from the boundary at the closest point. The Ayeyarwady River is about 2,170 km long and has a total drainage of about 411,000 km<sup>2</sup> <sup>(1)</sup>. The catchment above Sangaing (downstream of Mandalay) has a total drainage of 117,900 km<sup>2</sup> and supplies a mean annual discharge of 8,024 m<sup>3</sup>/s <sup>(2)</sup>. During the low water season (December through May), riverine morphology alternates between single and multiple channel reaches, the latter created by sand island deposits that emerge near the mouths of convergent tributaries and above

<sup>(1)</sup> Vorosmarty C. J., Fekete & B. A. Tucker, (1998) River Discharge Database, Version 1.1.1. (RivDis,V1 supplement).

<sup>(2)</sup> Vorosmarty C. J., Fekete & B. A. Tucker, (1998) *Op cite*

and below channel constrictions. Extensive floodplains border the waterways in many places <sup>(1)</sup>.

According to local fishermen interviewed at the initial site visit during preparation of the IFC Scoping Report, the river floods significantly in the wet season. The last significant flood to affect the area was recorded in 2013, affecting mainly the villages along the banks of the Ayeyarwady River <sup>(2)</sup>. No further details are available on this flood event at this stage.

Flow measurement results from the Ayeyarwady River, near the withdrawal location for the Project, have been estimated to be in the range of 64 m<sup>3</sup>/s (measured on March 28, 2015) to 660 m<sup>3</sup>/s (measured on August 8, 2014).

### 9.5.2 *Water Use*

In the Mandalay region, populations may have access to water supply through a network of piped water system and private wells and moat water <sup>(3)</sup>. The source of the piped water supply is from ground water, mainly from tube wells pumping along the banks of the Ayeyarwady River. Until 2006, only 60% of the city area was covered by piped water supply. While those residing in the cities, not covered by the piped water supply had to rely on water from tube wells dug by WSD/MCDC and international donor projects, those residing outside the urban areas have to rely on sources such as open dug wells, springs, rivers and ponds. In Myingyan, the source of irrigation is a piped water supply from canals and streams.

Fishing is not a popular activity in the Project area villages, with the exception of Tha Pyay Thar, as it is the village located closest to the Ayeyarwady River, and Gyoke Pin. Further details on fisheries in the Project area are provided in **Chapter 6**.

### 9.5.3 *Water Quality*

Based on the baseline monitoring results for surface water quality in the Ayeyarwady River from July 2014 to July 2015, with the exception of TSS and total coliform bacteria, all other monitored parameters were found to be below the WBG/IFC guideline values.

## 9.6 *ASSESSMENT METHODOLOGY*

Potential impacts on water quality and hydrology associated with the construction and operation of the Project have been reviewed in the scoping. Based on this review, potential sources of surface water impact that may arise during the construction and operation phases of the Project have been identified and are presented in the following sections. All the identified sources of potential impacts are then evaluated and their impact significance is determined considering the factors of the nature and magnitude of impacts and sensitivity of the surface water bodies.

- <sup>(1)</sup> Smith B. D., Hobbs L., (2002), Status of Irrawaddy dolphins *Orcaella Brevirostris* in the upper reaches of the Ayeyarwady River, Myanmar, The Raffles Bulletin of Zoology, Supplement No. 10
- <sup>(2)</sup> <http://c4i.me/site/2013/09/18/flash-flood-asia-myanmar-burma-3/>, C4I For Humanity, accessed 20-06-2014
- <sup>(3)</sup> In the old capital of Burmese King, there is a palace surrounded by moat and water from moat was used for water supply in the past as a main source of water (drinking and domestic use).

### 9.6.1 *Impact Identification*

There are a number of intrusive activities that occur throughout the lifecycle of the Project which, if not managed effectively, may cause impacts to the surface water in the vicinity of the Project Area. The temporal and spatial spread of activities will mean that actual impacts will be dependent on the specific activities. Accordingly, to enable clearer identification of impacts and development of management and mitigation measures specific to each activity, the potential surface water impacts are described on an activity basis.

Note that any impacts to surface water quality have the potential to cause secondary impacts to aquatic ecology and local fisheries. However, these impacts are assessed in separate sections, namely **Chapter 14** (Biodiversity), and **Chapter 15** (Social Impact Assessment), respectively.

## 9.7 **ASSESSMENT OF IMPACTS**

### 9.7.1 *Construction Phase*

Construction of the power plant will be carried out by the construction contractor appointed by the Sponsor. The construction phase for the Project will comprise of primarily two distinct phases: (a) civil construction work that would require a minimum of one year for completion; and (b) mechanical and electrical work for Plant commissioning. The entire construction phase is expected to continue for approximately 22.5 months. The approximate number of workers for both civil and mechanical works is expected to be around 600 - 900. During the construction phase, potential water quality impacts may arise from domestic wastewater discharge, inappropriate waste storage and disposal, contaminated surface water runoff, and sedimentation.

#### **Wastewater Discharges and Runoff**

Wastewater discharge and runoff during the construction phase may lead to contamination of freshwater sources if not managed appropriately. During the construction phase, there are a number of anticipated wastewater sources.

Workers will be accommodated in a worker's camp adjacent to the site, and sanitary wastewater streams from the workers could potentially impact surface water. Sanitary facilities, including toilets and septic tanks, will be provided for the use of the construction workforce both on-site and at the workers' accommodation. If not adequately designed and positioned to reflect the local hydrological and hydrogeological patterns, untreated sanitary wastewater due to leakages or overflows could have the potential to enter surface water. Periods of high rainfall could lead to overflow, or rapid through-flow, of the effluent to surface water prior to its full digestion in the septic tanks. Raw sewage can impact surface water quality by promoting the growth of algae and delivering pathogens that may be harmful to human and ecological receptors. Sanitary wastewater is generally characterized as having a high concentration of solids (suspended and dissolved), biochemical oxygen demand (BOD) and chemical oxygen demand (COD), nutrients (nitrogen, ammonia) and faecal coliform counts. The organic substances (e.g. hydrocarbon, protein) are decomposed in water, and the decomposition of organic matter will reduce the oxygen content dissolved in water. Quantities of sanitary wastewater discharge for

the Project are not yet known, but estimates can be made based on the number of workers. The approximate number of people onsite during the construction phase is expected to be an average of 600 people per day. Conservatively assuming 100 L/person/day of water consumption, and considering sanitary wastewater production to be 80% of water consumption per person (for non-continuous use), this equates to the production of 48,000 liters of sanitary wastewater daily. In addition, construction activities such as site clearance, earthworks, disposal of back fill materials, installation of hard standing areas, etc., could cause runoff of unconsolidated sediments during rainfall. The generation of sediment laden run off could be transferred to the nearby freshwater bodies, which could increase total suspended solids and turbidity in receiving waters. Construction or retrofit of the pumping station at the Ayeyarwady River may cause impacts on surface water quality if piling or dredging activities are required. This could result in localised impacts such as runoff and erosion of exposed bare soil, slopes and earth, and release of cement materials into surface water bodies with stormwater runoff. Baseline surveys for the Ayeyarwady River found that there were already elevated levels of TSS.

Wastewater may also be generated from washing of equipment and machinery on site, as well as from the concrete batching plant. This wastewater may contain suspended solids and traces of hydrocarbons. The discharge of wastewater produced during concreting can also lead to changes in the pH of the receiving water body, if not first treated.

The type of treatment system to be used will be an aerobic type of septic tank, which is a common method of sanitary wastewater treatment used during construction of various industrial facilities. Solids are retained in the septic tank, and the clear (treated) water will be discharged to the site drainage. The capacity of the system is based on the number of workers and will be equivalent to 48 (simultaneous) persons. Additional septic tanks will be provided, if necessary, depending upon the location and number of workers as per the site condition.

The contractor will be responsible for ensuring that any wastewater discharged meets the applicable World Bank/ IFC General EHS Guidelines prior to discharge of such wastewater. Stormwater runoff will be drained to a common settlement tank to remove solids, before being discharged to a common drain.

Potential impacts to surface water quality are expected to be short-term and localised in nature, and can be controlled if wastewater treatment systems are adequately designed.

The significance of potential impacts to surface water due to wastewater discharges and runoff during the construction phase are assessed in the following table, and mitigation measures are presented.

<b>Impact</b>	Potential for impacts to surface water due to wastewater discharges and sediment-laden runoff.			
<b>Nature</b>	<b>Negative</b>	Positive	Neutral	
	Potential impacts to surface water would be considered to be adverse (negative).			
<b>Type</b>	<b>Direct</b>	Indirect	Induced	Cumulative
	Impacts to surface water would be direct impacts from Project activities.			
<b>Duration</b>	Temporary	Short-term	<b>Long-term</b>	Permanent
	The construction phase will last approximately 22.5 months. The duration of potential impacts is therefore long-term.			

<b>Extent</b>	<b>Local</b>	Regional	International		
	Potential impacts would be limited to the Project site footprint, as well as areas downstream of the Project site, and hence would be considered to be local.				
<b>Scale</b>	Based on experience with similar projects, the total approximate quantities of wastewater that could be a potential source of impact during this stage (assuming an average of 600 workers per day) include: <ul style="list-style-type: none"> <li>48,000 L/day of sanitary wastewater</li> </ul>				
<b>Frequency</b>	Impacts to surface water from wastewater discharges could occur intermittently but repeatedly throughout the day for the duration of the construction phase (12-16 months).				
<b>Magnitude</b>	Positive	Negligible	Small	<b>Medium</b>	Large
	Potential impacts to surface water quality in the Project area from wastewater discharges and runoff are expected to be of Medium magnitude.				
<b>Receptor/ Resource Sensitivity</b>	Low	<b>Medium</b>		High	
	Surface water quality analysis from the baseline surveys indicated that the surface water near the Project site had elevated levels of total coliform and total suspended solids. The Project is near some sensitive receptors with regards to surface water quality, such as agricultural lands, which rely on surface water for irrigation. Overall sensitivity is rated as Medium.				
<b>Significance</b>	Negligible	Minor	<b>Moderate</b>		Major
	The combination of a Medium Resource Sensitivity and Medium Impact Magnitude will result in an overall Moderate Impact.				

### Mitigation and Management Measures

The following measures will be put in place for the Project during construction phase:

- Install silt trap to treat surface run-off from bunded areas prior to discharge to the stormwater system;
- Implement adequate sanitary facilities, (one toilet for every 25 workers up to the first 100, and one for every 50 thereafter) will be provided for the construction workforce;
- Liquid effluents arising from construction activities will be treated to the applicable IFC guideline prior to discharge;
- Septic tanks will be provided to treat sanitary discharge;
- Exposed soil surfaces should be protected by paving or fill material as soon as possible to reduce the potential of soil erosion and subsequent sedimentation;
- Open stockpiles of construction materials or construction wastes on-site should be covered with tarpaulin or similar fabric during rainstorms;
- Use methods for minimising sediment runoff, as appropriate to the conditions on-site, including wheel cleaning facilities;
- Provision of channels, earth bunds or sand bag barriers on site to direct stormwater to silt removal facilities;
- Design drainage pipes and culverts for the controlled release of storm flows;
- Protect temporary trafficked areas on-site with coarse stone ballast or equivalent;
- Regularly, and particularly following rainstorms, inspect and maintain drainage systems and erosion control and silt removal facilities to ensure proper and efficient operation at all times;
- Provide measures to reduce the ingress of site drainage into excavations. If trenches have to be excavated during the wet season, excavate and backfill them in short sections wherever practicable. Discharge any water pumped out from trenches or foundation excavations into storm drains via silt removal facilities;
- Mulch to stabilise exposed areas, where practicable and appropriate;

- Re-vegetate areas promptly, where practicable and appropriate;
- Provide measures to prevent the washing away of construction materials, soil, silt or debris into any drainage system of open stockpiles of construction materials;
- Install onsite wastewater treatment facilities or processes such as filtration, flocculation or biochemical treatment before discharge to river;
- Surface run-off from bunded areas should pass through oil/water separators prior to discharge to the stormwater system;
- Wastewater collected from canteen kitchens, including that from basins, sinks and floor drains, should be discharged into sanitary sewers via grease traps. The sanitary sewer should then be treated prior to discharge or reuse as greywater; and
- Oil-contaminated water, if any, will be collected and handled by local licensed wastewater sub-contractors (if available, to be determined at a later stage).

### **Residual Impacts**

If the recommended mitigation measures are implemented, residual impact significance would be **minor**.

### **Waste Storage and Disposal**

During the construction phase, waste materials, if not stored and disposed of appropriately, have the potential to cause surface water contamination through direct release or from contaminated stormwater runoff.

The majority of the generated wastes from the Project during the construction phase will be non-hazardous. General construction waste will comprise of surplus or off-specification materials such as concrete, steel cuttings/filings, wooden planks, packaging paper or plastic, wood, plastic pipes, metals, etc. Domestic wastes consisting of food waste, plastic, glass, aluminium cans and waste packages will also be generated by the construction workforce. A small proportion of the waste generated during construction will be hazardous, including used paint, engine oils, hydraulic fluids and waste fuel, spent solvents from equipment cleaning activities, and spent batteries or spent acid/alkali from the maintenance of machinery on site.

Based on experience with similar projects, the total approximate quantities of non-hazardous and hazardous waste that could be a potential source of impact during this stage (assuming an average of 600 workers per day) include:

- 600 kg/day of solid (non-hazardous) waste; and
- 135 kg/month hazardous waste.

Infill will be used for backfilling, while steel waste will be sold as scrap. Wooden crates will be disposed by authorized 3<sup>rd</sup> party disposal contractors. Hazardous wastes will be disposed of by authorized 3<sup>rd</sup> party disposal contractors. The construction contractor will handle, store and dispose of all waste in accordance with applicable guidelines. Concrete waste of inert nature will be stored in a laydown area near the concrete batching plant and will be reused where possible. Any bitumen waste will be stored separately in a lined area to be disposed of by licensed contractors.

The significance of potential impacts to surface water due to contamination from inappropriate waste storage and disposal during the construction phase are assessed in the following table, and mitigation measures are presented.

<b>Impact</b>	Potential for surface water contamination from inappropriate waste management.			
<b>Nature</b>	<b>Negative</b>	Positive	Neutral	
	Potential impacts to surface water would be considered to be adverse (negative).			
<b>Type</b>	<b>Direct</b>	Indirect	Induced	Cumulative
	Impacts to surface water would be direct impacts from Project activities.			
<b>Duration</b>	Temporary	Short-term	<b>Long-term</b>	Permanent
	The construction phase will last approximately 22.5 months. The duration of impacts is therefore long-term.			
<b>Extent</b>	<b>Local</b>	Regional	International	
	Potential impacts would be limited to the Project area and downstream of the Ayeyarwady River, and hence would be considered to be local.			
<b>Scale</b>	<p>Construction activities will take place within the Project area. Based on experience with similar projects, the total approximate quantities of waste that could be a potential source of impact during this stage (assuming an average of 600 workers per day) include:</p> <ul style="list-style-type: none"> <li>• 600 kg/day of solid waste</li> <li>• 135 kg/month hazardous waste</li> </ul> <p>The scale of potential impacts due to release of waste is potentially large due to the quantities present during this stage, but appropriate waste management practices will mitigate the impacts.</p>			
<b>Frequency</b>	Impacts to surface water due to inappropriate waste storage and disposal could occur intermittently but repeatedly throughout the day for the duration of the construction phase.			
<b>Magnitude</b>	Positive	Negligible	<b>Small</b>	Medium Large
	Potential impacts to surface water quality in Project area due to inappropriate waste disposal are expected to be of Small magnitude.			
<b>Receptor/ Resource Sensitivity</b>	Low	<b>Medium</b>	High	
	Surface water quality analysis from the baseline surveys indicated that the surface water near the Project site had elevated levels of total coliform and total suspended solids. The Project is near sensitive resources with regards to surface water quality, such as agricultural lands, which rely on surface water for irrigation. Overall sensitivity is rated as Medium.			
<b>Significance</b>	Negligible	<b>Minor</b>	Moderate	Major
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.			

## Mitigation and Management Measures

The following measures will be put in place for the Project during construction phase:

- Implement the same mitigation measures to minimize impacts to Waste Management (**Chapter 13**);
- Provide training to labourers for waste disposal in designated areas and use of sanitation facilities;
- Implement proper storage of the construction materials and wastes to minimise the potential damage or contamination of the materials;
- Implement construction materials inventory management system to minimise over-supply of the construction materials, which may lead to disposal of the surplus materials at the end of the construction period;
- Segregate hazardous and non-hazardous waste and provide appropriate containers for the type of waste type (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimise odour nuisance);
- Store wastes in closed containers away from direct sunlight, wind and rain;
- Store waste systematically to allow inspection between containers to monitor leaks or spills;
- Ensure that storage areas have impermeable floors and containment, of capacity to accommodate 110% of the volume of the largest waste container; and
- Dispose of waste by licensed contractors.

## Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.

## Accidental Spills and Leaks

Surface water contamination may occur during the construction phase due to accidental leaks or spills of chemicals or hazardous materials such as oils, lubricants or fuel from heavy equipment, and improper chemical/fuel storage. Additionally, HRSG chemical cleaning during the pre-commissioning activities may impact surrounding surface water quality, should leakages of HRSG cleaning chemicals occur. Such spills can impact surface water quality either due to direct discharge or indirect discharge due to stormwater runoff. In addition, discharges of oily bilge or ballast water from barges could impact surface water quality during construction.

Based on experience with similar projects, the total approximate quantities of hazardous materials that could be a potential source of impact during this stage include:

- 30,000 L/month diesel fuel;
- Small, infrequent quantities of lubricants, oil; and
- HRSG cleaning chemicals.

Spill control measures such as storage and handling of chemicals and fuels on impervious areas (such as concrete surfaces) will be implemented to minimize impacts in case of spills. Heavy equipment will be checked for lubricant leaks, and

workers will be trained not to dispose of waste improperly in the area. Liquid effluents arising from construction activities will be treated to the applicable World Bank/IFC guidelines prior to discharge.

The significance of potential impacts to surface water due to contamination from accidental spills and leaks during the construction phase are assessed in the following table, and mitigation measures are presented.

<b>Impact</b>	Potential for impacts to surface water due to contamination from accidental releases of hazardous substances such as fuels, oils or lubricants, as well as improper chemical/fuel storage.			
<b>Nature</b>	<b>Negative</b>	Positive	Neutral	
	Potential impacts to surface water would be considered to be adverse (negative).			
<b>Type</b>	<b>Direct</b>	Indirect	Induced	Cumulative
	Impacts to surface water would be direct impacts from Project activities.			
<b>Duration</b>	Temporary	Short-term	<b>Long-term</b>	Permanent
	The construction phase will last approximately 22.5 months. The duration of potential impacts is therefore long-term.			
<b>Extent</b>	<b>Local</b>	Regional	International	
	Potential impacts would be limited to the Project site footprint and gas pipeline and transmission line corridors, and hence would be considered to be local.			
<b>Scale</b>	Based on experience with similar projects, the total approximate quantities of hazardous materials that could be a potential source of impact during this stage include: <ul style="list-style-type: none"> <li>• 30,000 L/month diesel fuel</li> <li>• Small, infrequent quantities of lubricants, oil</li> <li>• Hydrostatic testing chemicals</li> </ul> The scale of potential impacts due to release of hazardous materials is potentially large due to the quantities present during this stage, but accidental release is an unlikely, unplanned occurrence.			
<b>Frequency</b>	Potential impacts would be expected to be infrequent, only taking place during rainfall, after loss of containment or accidental spills.			
<b>Magnitude</b>	Positive	Negligible	<b>Small</b>	Medium
	Potential impacts to surface water quality in the Project area due to accidental releases is expected to be of Small magnitude.			
<b>Receptor/ Resource Sensitivity</b>	Low	<b>Medium</b>	High	
	Surface water quality analysis from the baseline surveys indicated that the surface water near the Project site had elevated levels of total coliform and total suspended solids. The Project is near sensitive resources with regards to surface water quality, such as agricultural lands, which rely on surface water for irrigation. Overall sensitivity is rated as Medium.			
<b>Significance</b>	Negligible	<b>Minor</b>	Moderate	Major
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.			

## Mitigation and Management Measures

The following measures will be put in place for the Project during construction phase:

- Disposal sites to be designed for hazardous and non-hazardous waste, including sludge disposal;
- Hazardous waste storage areas will comply with best practice/ international standards;
- Mitigation measures/ monitoring programme with regard to accidental events/ spills shall be communicated to the EPC Contractor at the early stages of the Project implementation;
- Carry out land contamination assessments and identification of legacy contaminated land sites;

- Contractor will prepare unloading and loading protocols and train staff to prevent spills and leaks;
- Contractor will prepare guidelines and procedures for immediate clean-up actions following any spillages of oils, fuels or chemicals;
- A site specific Emergency Response Plan will be prepared by the Contractor for soil clean-up and decontamination;
- Fuel tanks and chemical storage areas will be sited on sealed areas and provided with locks to prevent unauthorized entry;
- Use of spill or drip trays to contain spills and leaks;
- Use of spill control kits to contain and clean small spills and leaks;
- The storage areas for oil, fuel and chemicals will be surrounded by bunds or other containment devices to prevent spilled oil, fuel and chemicals from percolating into the ground or reaching the receiving waters;
- Contractor will implement a training program to familiarise staff with emergency procedures and practices related to contamination events;
- Implement a construction materials inventory management system to minimise over-supply of the construction materials, which may lead to disposal of the surplus materials at the end of the construction period;
- Provide dedicated storage areas for construction materials to minimise the potential for damage or contamination of the materials;
- Segregate hazardous and non-hazardous waste and provide appropriate containers for the waste types generated (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimise odour nuisance);
- Store wastes in closed containers away from direct sunlight, wind and rain.
- Provide enough space to allow for inspection between waste containers so as to identify any leaks or spills;
- Ensure storage areas have impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest storage container;
- Storage of inert concrete waste in a laydown area near the concrete batching plant and reuse of these wastes under floors or roads;
- Dispose of hazardous waste including bitumen by licensed contractors;
- Oil-contaminated water will be collected and handled by local licensed wastewater sub-contractors (if available, to be determined at a later stage); and
- Vehicle servicing areas, vehicle wash bays and lubrication bays will, as far as practical, be located within roofed and cemented areas. The drainage in these covered areas will be connected to sewers via an oil/water interceptor.
- Only barge operators that comply with the relevant local and international standards and are permitted to operate barges for transportation purposes will be engaged.
- Barges used for Project material transport will be independently inspected and audited by the Project EHS Management Team. Each barge will be inspected at least once every 6 months and records maintained. If any continued non-compliance is observed over two (2) audit inspections, the Project will terminate the services of the barge transporter.

### **Residual Impacts**

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.

The operation phase is expected to continue for approximately 25 years. The average number of permanent workers present during operation is expected to be approximately 80. The assessment of operational phase impacts includes those arising both from routine operations and maintenance of the power plant. During the operation phase, potential surface water impacts may arise from domestic wastewater discharge, inappropriate waste storage and disposal, contaminated surface water runoff, cooling water withdrawal, erosion, and sedimentation.

#### *Wastewater Discharges and Runoff*

Sources and estimated quantities of wastewater generation from the Plant during the operation and maintenance phase are as follows:

- Sludge from river water pre-treatment : 1 m<sup>3</sup>/hr
- DM plant neutralized water : 5 m<sup>3</sup>/hr
- Cooling tower blowdown : 70.5 m<sup>3</sup>/hr
- Stormwater: intermittent
- Washing water from Main Block : intermittent
- Sanitary wastewater (sewage): ~ 4 m<sup>3</sup>/hr

Stormwater, industrial wastewater and sewage water will be collected and treated in the power plant prior to discharge. Wastewater conditions will comply with the international standards, as described in **Chapter 3**. All treated wastewater will be collected, monitored and discharged into the irrigation canal.

As wastewater will be discharged to the irrigation canal, there may be potential impacts to downstream users of the irrigation canal due to altered water quality. In particular, some water quality-related problems in irrigated agriculture include high salinity, which can reduce water availability to crops, and excess ions (such as sodium, chloride or boron) which can accumulate in sensitive crops to cause crop damage and reduce yields. Excessive nutrients may also reduce crop yield or quality. There also exists some evidence that irrigation water temperature can affect crop quality, because colder water holds more dissolved oxygen, and colder water usually contains less dissolved salt.

There are very few international standards relating specifically to water quality for irrigation purposes. However, the Food and Agriculture Organization (FAO) does have Guidelines for Interpretations of Water Quality for Irrigation, which are presented in **Table 9.1**. The Project will, as much as possible, control the effluent discharged to the irrigation canal to be below the “Severe” restriction on use according to the indicative guidelines. In addition, the temperature of the effluent discharged will not exceed 40°C in winter and 45°C in summer. Sembcorp is also currently in discussions with MEPE and the Water Resource Utilization Department (WRUD) to agree on appropriate quality of water discharge into the irrigation canal.

**Table 9.1** *FAO Guidelines for Interpretations of Water Quality for Irrigation*<sup>1</sup>

Potential Irrigation Problem				Units	Degree of Restriction on Use		
					None	Slight to Moderate	Severe
<b>Salinity</b> (affects crop water availability) <sup>2</sup>							
	<b>EC<sub>w</sub></b>			dS/m	< 0.7	0.7 – 3.0	> 3.0
	(or)						
	<b>TDS</b>			mg/l	< 450	450 – 2000	> 2000
<b>Infiltration</b> (affects infiltration rate of water into the soil. Evaluate using EC <sub>w</sub> and sodium adsorption ratio (SAR) together) <sup>3</sup>							
	<b>SAR</b>	= 0 – 3	<b>and EC<sub>w</sub></b>	=	> 0.7	0.7 – 0.2	< 0.2
		= 3 – 6		=	> 1.2	1.2 – 0.3	< 0.3
		= 6 – 12		=	> 1.9	1.9 – 0.5	< 0.5
		= 12 – 20		=	> 2.9	2.9 – 1.3	< 1.3
		= 20 – 40		=	> 5.0	5.0 – 2.9	< 2.9
<b>Specific Ion Toxicity</b> (affects sensitive crops)							
	<b>Sodium (Na)</b> <sup>4</sup>						
	surface irrigation			SAR	< 3	3 – 9	> 9
	sprinkler irrigation			me/l	< 3	> 3	
	<b>Chloride (Cl)</b> <sup>4</sup>						
	surface irrigation			me/l	< 4	4 – 10	> 10
	sprinkler irrigation			me/l	< 3	> 3	
	<b>Boron (B)</b> <sup>5</sup>			mg/l	< 0.7	0.7 – 3.0	> 3.0
	<b>Trace Elements</b> (see Table 21)						
<b>Miscellaneous Effects</b> (affects susceptible crops)							
	<b>Nitrogen (NO<sub>3</sub> - N)</b> <sup>6</sup>			mg/l	< 5	5 – 30	> 30
	<b>Bicarbonate (HCO<sub>3</sub>)</b>						
	(overhead sprinkling only)			me/l	< 1.5	1.5 – 8.5	> 8.5
	pH				<b>Normal Range 6.5 – 8.4</b>		

An overview of management of wastewater and treatment from the Plant is as follows:

**Wastewater Treatment System**

The wastewater system will collect and neutralize chemical wastes from the water treatment plant (regeneration waste) and the drainage from chemical containment areas.

Drains from all equipment containment drainage, spills, floor wash downs and fire protection discharges will be led to oil-water separator. One oil/water separator will be designed for outdoor, underground in RCC construction.

The precise effluent characteristics of the wastewater from the Plant are not yet known. However, it will only consist of the chemical wastewater from regeneration wastes and the cooling tower blow down. Other industrial wastewater that is typical of a coal fired plant – like coal storage yard wash water, air preheater wash water etc, are not present for this facility. All effluents will be treated to comply with

<sup>1</sup> Adapted from University of California Committee of Consultants 1974.

discharge limit criteria according to international standards, as described in **Chapter 3**.

Note that Myingyan municipality will be engaged for appropriate disposal of the dried sludge from process wastewater, and will be by a licensed waste contractor.

#### **Plant Wastewater Monitoring System**

The Central Monitoring Basin will collect all the neutralized wastes, separated water from oil-water separator, and cooling tower blow down water for monitoring to ensure compliance to wastewater effluent quality before discharge. The wastewater will be discharged to the irrigation canal outside of the Power Plant.

#### **Sanitary Wastewater (Sewage) Treatment System**

Sanitary wastewater will be treated by a package sewage treatment facility. The capacity of the plant will be sufficient for simultaneous use by 25 equivalent (simultaneous) persons, and the volumetric capacity will be designed to ensure it can accommodate the above mentioned quantities. The sewage water system will consist of underground pipelines with catch basins. The sewage water will be collected by sewage water pipe and gravity flow, which will convey the sanitary wastewater to the sewage water treatment device. One set of septic tanks will be installed underground to treat the sanitary wastewater. Treated wastewater will be combined with the plant wastewater before discharge.

The actual final design specification for the treatment system will be provided during the engineering stage of the Project. However, Indicative Values of the Treated Sanitary Sewage Discharges (per WB/IFC guidelines) are as follows:

- pH – 6 to 9
- BOD – 30 mg/l
- COD – 125 mg/l
- Total Nitrogen – 10 mg/l
- Total Phosphorus – 2 mg/l
- Oil & Grease – 10 mg/l
- TSS – 50 mg/l

#### **Stormwater Drainage System**

The stormwater drainage system will consist of a series of underground conduits and drainage outflows. The drainage system will be designed to be able to accommodate a worst-case storm event based on local meteorological conditions. Additional details on the potential volumes of stormwater runoff that may occur during operations are presented in *Section 9.7.2.5*.

#### **Oily Water Treatment System**

Oily wastewater treatment is designed to treat the oily water from the main power block. Oily wastes are treated by an oil water separator and the treated water will drain to the irrigation canal near the Plant.

Instrumentation will be used to monitor the Plant's compliance with discharge limitations. In the event that the effluent discharge is detected above the effluent discharge limit criteria, isolation valves will be automatically closed to prevent accidental discharge of untreated effluent.

The significance of potential impacts to surface water due to wastewater discharges and runoff during the operation phase are assessed in the following table, and mitigation measures are presented.

<b>Impact</b>	Potential for impacts to surface water due to wastewater discharges during plant operation. Potential secondary impacts to downstream users of irrigation canal.			
<b>Nature</b>	<b>Negative</b>	Positive	Neutral	
	Potential impacts to surface water would be considered to be adverse (negative).			
<b>Type</b>	<b>Direct</b>	Indirect	Induced	Cumulative
	Impacts to surface water would be direct impacts from Project activities.			
<b>Duration</b>	Temporary	Short-term	<b>Long-term</b>	Permanent
	The operation phase will last approximately 22 years. The duration of potential impacts is therefore long-term.			
<b>Extent</b>	<b>Local</b>	Regional	International	
	Potential impacts would be limited to the Project site footprint, as well as areas downstream of the Project site, and hence would be considered to be local.			
<b>Scale</b>	<p>Sources and estimated quantities of wastewater generation from the Plant during the operation and maintenance phase are as follows:</p> <ul style="list-style-type: none"> <li>• Sludge from river water pre-treatment : 1 m<sup>3</sup>/hr</li> <li>• DM plant neutralized water : 5 m<sup>3</sup>/hr</li> <li>• Cooling tower blowdown : 70.5 m<sup>3</sup>/hr</li> <li>• Stormwater: intermittent</li> <li>• Washing water from Main Block : intermittent</li> <li>• Sanitary wastewater (sewage): ~ 4 m<sup>3</sup>/hr</li> </ul> <p>The scale of potential impacts due to release of wastewater is potentially large due to the quantities present during this stage, but in-place treatment and management systems will reduce effluent levels to within IFC standards.</p> <p>Discharged water will be treated to meet applicable IFC EHS Guidelines, as well as FAO Guidelines as applicable for irrigation water.</p>			
<b>Frequency</b>	Impacts to surface water from wastewater discharges could occur intermittently but repeatedly throughout the day for the duration of the operation phase (25 years).			
<b>Magnitude</b>	Positive	Negligible	<b>Small</b>	Medium
	Potential impacts to surface water quality in the Project area from wastewater discharges and runoff are expected to be of Small magnitude.			
<b>Receptor/ Resource Sensitivity</b>	Low	<b>Medium</b>	High	
	Surface water quality analysis from the baseline surveys indicated that the surface water near the Project site had elevated levels of total coliform and total suspended solids. The Project is near some sensitive receptors with regards to surface water quality, such as agricultural lands, which rely on surface water for irrigation. Overall sensitivity is rated as Medium.			
<b>Significance</b>	Negligible	<b>Minor</b>	Moderate	Major
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.			

### Mitigation and Management Measures

The following measures will be put in place for the Project during operation phase:

- Install oil/water separators to treat surface run-off prior to discharge to the stormwater system;
- Implement adequate sanitary facilities for onsite personnel;

- Liquid effluents arising from operations will be treated to the applicable IFC guideline prior to discharge;
- Design drainage pipes and culverts for the controlled release of storm flows.
- Install onsite wastewater treatment facilities or processes such as filtration, flocculation or biochemical treatment before discharge;
- Wastewater collected from canteen kitchens, including that from basins, sinks and floor drains, should be discharged into sanitary sewers via grease traps. The sanitary sewer should then be treated prior to discharge or reuse as greywater;
- Conduct monitoring of temperature at the cooling water discharge point at a frequency of once every 15 days;
- Implement discharge system shutdown in event that discharge temperature of effluent exceeds standard;
- Efforts to be made to increase the cycle of concentration to reduce the volume of blow down and consequently the volume of make-up water required by the cooling tower;
- Stormwater drainage and wastewater will be treated in accordance to the applicable WB/IFC EHS Guidelines for Thermal Power Plant (2008);
- Separated oil will be disposed of as part of oily wastes and handled as a hazardous waste stream. The treated de-oiled water will be discharged with the plant wastewater. The Project will study the possibility to transfer to cooling water basin and used as part of cooling water stream during detailed engineering;
- The sewage from the entire plant area will be collected and treated in a sewage treatment plant (STP). No untreated sewage will be directly discharged into the Ayeyarwady River or the irrigation canal near the site, or disposed of on land, for the duration of the project life cycle;
- The treated effluent will comply with WB/IFC EHS Guidelines for Thermal Power Plant (2008) before discharge outside the plant premises.
- In order to monitor STP performance, continuous evaluation and monitoring of discharge parameters will be undertaken at the outlet point of STP.
- The stormwater drainage system will be periodically inspected for blockages and cleaned at least once before the monsoon season each year; and
- Operating personnel will be trained to visually inspect discharged water quality for oil and grease traces (that will be visible on the surface) periodically and take appropriate corrective actions.

### **Residual Impacts**

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.

### *Waste Storage and Disposal*

During the operation and maintenance phase, waste materials, if not stored and disposed of appropriately, have the potential to cause impacts to surface water quality.

The majority of the generated wastes from the Project during the operation phase will be non-hazardous. A small proportion of the waste generated during construction will be hazardous, including used paint, engine oils, hydraulic fluids and

waste fuel, spent solvents from equipment cleaning activities, and spent batteries or spent acid/alkali from the maintenance of machinery on site.

Based on experience with similar projects, the total approximate quantities of non-hazardous and hazardous waste that could be a potential source of impact during this stage (assuming an average of 80 workers per day) include:

- 80 kg/day of solid (non-hazardous) waste; and
- 18 kg/month hazardous waste.

Hazardous wastes will be disposed of by authorized 3<sup>rd</sup> party disposal contractors. The Sponsor will handle, store and dispose of all waste in accordance with applicable guidelines.

The significance of potential impacts to surface water due to contamination from waste storage and disposal during the operation phase are assessed in the following table, and mitigation measures are presented.

<b>Impact</b>	Potential for surface water contamination from inappropriate waste management.			
<b>Nature</b>	<b>Negative</b>	Positive	Neutral	
	Potential impacts to surface water would be considered to be adverse (negative).			
<b>Type</b>	<b>Direct</b>	Indirect	Induced	Cumulative
	Impacts to surface water would be direct impacts from Project activities.			
<b>Duration</b>	Temporary	Short-term	<b>Long-term</b>	Permanent
	The operation phase will last approximately 22 years. The duration of potential impacts is therefore long-term.			
<b>Extent</b>	<b>Local</b>	Regional	International	
	Potential impacts would be limited to the Project site footprint, as well as areas downstream of the Project site, and hence would be considered to be local.			
<b>Scale</b>	Based on experience with similar projects, the total approximate quantities of non-hazardous and hazardous waste that could be a potential source of impact during this stage (assuming an average of 80 workers per day) include: <ul style="list-style-type: none"> <li>• 80 kg/day of solid (non-hazardous) waste</li> <li>• 18 kg/month hazardous waste</li> </ul>			
<b>Frequency</b>	Impacts to surface water due to inappropriate waste storage and disposal could occur intermittently but repeatedly throughout the day for the duration of the operation phase.			
<b>Magnitude</b>	Positive	Negligible	<b>Small</b>	Medium Large
	Potential impacts to surface water quality in Project area due to inappropriate waste disposal are expected to be of Small magnitude.			
<b>Receptor/ Resource Sensitivity</b>	Low	<b>Medium</b>	High	
	Surface water quality analysis from the baseline surveys indicated that the surface water near the Project site had elevated levels of total coliform and total suspended solids. The Project is near some sensitive receptors with regards to surface water quality, such as agricultural lands, which rely on surface water for irrigation. Overall sensitivity is rated as Medium.			
<b>Significance</b>	Negligible	<b>Minor</b>	Moderate	Major
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.			

### Mitigation and Management Measures

The following measures will be put in place for the Project during operation phase:

- Implement the same mitigation measures to minimize impacts to Waste Management (**Chapter 13**);

- Provide training to all staff for waste disposal in designated areas and use of sanitation facilities;
- Segregate hazardous and non-hazardous waste and provide appropriate containers for the type of waste type (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimise odour nuisance);
- Store wastes in closed containers away from direct sunlight, wind and rain;
- Store waste systematically to allow inspection between containers to monitor leaks or spills;
- Ensure that storage areas have impermeable floors and containment, of capacity to accommodate 110% of the volume of the largest waste container and
- Dispose of waste by licensed contractors.

## Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.

### *Water Intake*

As discussed in **Chapter 2**, the Project will require raw water intake from the Ayeyarwady River for several processes during the operational phase, make up water for cooling towers, demineralized water system, service water system, potable water system, etc. Small quantities may also be required during the construction phase. This water withdrawal from the Ayeyarwady River may have potential impacts related to existing water uses, as follows:

- Impact on downstream agricultural water users; and
- Impact on downstream fishing activity having negative impact on fisherman's livelihood

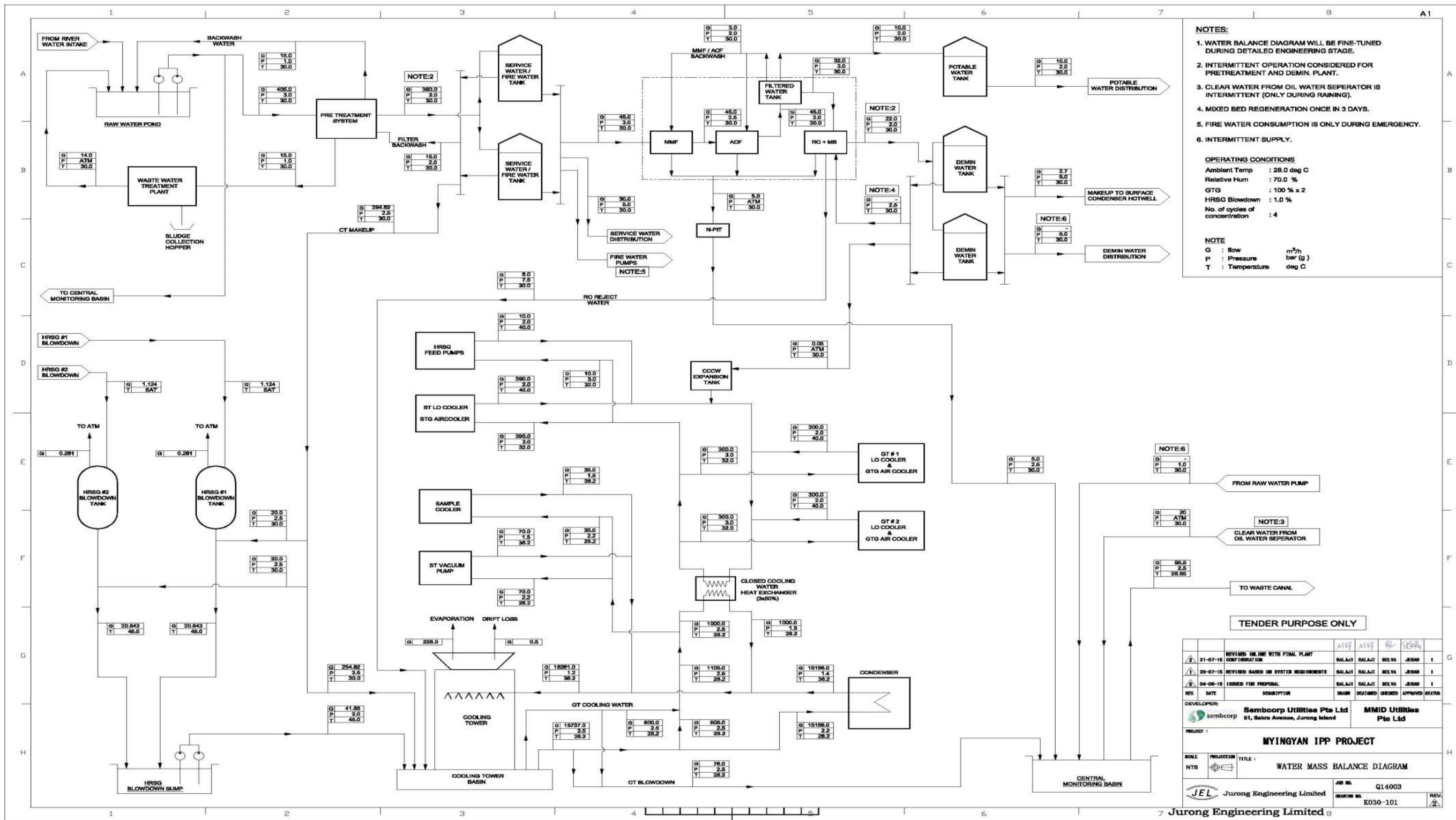
According to the Sponsor, an average of approximately 0.12 m<sup>3</sup>/s (405 m<sup>3</sup>/hr) water will be required from the river intake to supply Project operations. The maximum water requirements from the Ayeyarwady River are expected to be 0.13 m<sup>3</sup>/s, and the minimum water requirements are expected to be 0.028 m<sup>3</sup>/s. The Project's Water Balance Diagram is shown in **Figure 9.1**.

The lowest flow rate estimated from flow velocity measurements in the dry season in the southern channel of the Ayeyarwady River, where the Project will withdraw from, is 64 m<sup>3</sup>/s, which would be equivalent to 5,529,600 m<sup>3</sup>/day. The maximum intake requirement for the Project is expected to be 0.13 m<sup>3</sup>/s, which would be equivalent to 11,232 m<sup>3</sup>/day assuming the maximum intake was required over a 24 hour period. This is equivalent to approximately 0.20% of the lowest dry season flow in the southern channel of the river. This is based on a worst case scenario, comparing the Project's maximum expected water withdrawal requirements, with a constant withdrawal over a 24-hour period, during the lowest measured flow rate in the dry season.

Based on the above comparison of the Project's water intake requirements with the estimated flow rates of the river from July 2014 to July 2015, it is expected that there will be adequate flow to support the Project's water withdrawal, and the Project is

not expected to have any significant impacts on current water users for the southern channel of the Ayeyarwady River.

Figure 9.1 Water Balance Diagram



The significance of potential impacts to surface water due to the Project's water intake during the operation phase is assessed in the following table, and mitigation measures are presented.

<b>Impact</b>	Project water withdrawal from the Ayeyarwady River may have potential impacts related to existing water uses, as follows: <ul style="list-style-type: none"> <li>Impact on downstream agricultural water users.</li> <li>Impact on downstream fishing activity having negative impact on fisherman's livelihood.</li> </ul>			
<b>Nature</b>	<b>Negative</b>	Positive	Neutral	
	Potential impacts to hydrology and water use would be considered to be adverse (negative).			
<b>Type</b>	<b>Direct</b>	Indirect	Induced	Cumulative
	Impacts to surface water would be direct impacts from Project activities.			
<b>Duration</b>	Temporary	Short-term	<b>Long-term</b>	Permanent
	The operation phase will last approximately 22 years. The duration of potential impacts is therefore long-term.			
<b>Extent</b>	<b>Local</b>	Regional	International	
	Water use impacts from the Project would be local to the project footprint and vicinity of water withdrawal at the Ayeyarwady River.			
<b>Scale</b>	The maximum intake requirement for the Project is expected to be 0.13 m <sup>3</sup> /s. This is equivalent to approximately 0.20% of the lowest dry season flow in the southern channel of the river.			
<b>Frequency</b>	Water intake for the Project would be near-continuous for the Project's duration.			
<b>Magnitude</b>	Positive	Negligible	<b>Small</b>	Medium Large
	Potential impacts to surface water quality in Project area due to inappropriate waste disposal are expected to be of Small magnitude.			
<b>Receptor/ Resource Sensitivity</b>	Low	<b>Medium</b>	High	
	There are a number of current water uses in the Project area, and the Ayeyarwady River is considered an important water resource. The resource/receptor sensitivity is considered Medium.			
<b>Significance</b>	Negligible	<b>Minor</b>	Moderate	Major
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.			

### Mitigation and Management Measures

The following measures will be put in place for the Project during operation phase:

- The Project commits to comply with following WB/IFC EHS Guideline measures or equivalent of them that are pertinent to river water intake systems:
  - Reduction of intake flow to such a level that there is sufficient flow in the river to maintain resource use (i.e., irrigation) as well as biodiversity during annual mean low flow conditions.

### Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.

#### *Cooling Water Discharge*

The Project's cooling water discharge may cause impacts from release of water with significantly higher temperature than the ambient temperature in the surrounding surface water. The cooling water blowdown will be collected in a monitoring

chamber (to ensure compliance with effluent discharge limits) before discharge into the existing irrigation canal.

The Sponsor estimates that cooling water blowdown will consist of approximately 70.5 m<sup>3</sup>/hr on a continuous basis.

The cooling water and all other effluents will be disposed to the irrigation canal after being treated according to the applicable WB/IFC EHS Guidelines for Thermal Power Plants (2008).

As the cooling water will be discharged to the irrigation canal, there may be potential impacts to downstream users of the irrigation canal due to altered water quality, as described in “Wastewater Discharges and Runoff” above.

The significance of potential impacts to surface water due to cooling water discharge during the operation phase are assessed in the following table, and mitigation measures are presented.

<b>Impact</b>	Potential for surface water impacts from discharge of cooling water. Potential secondary impacts to downstream users of irrigation canal.			
<b>Nature</b>	<b>Negative</b>	Positive	Neutral	
	Potential impacts to surface water would be considered to be adverse (negative).			
<b>Type</b>	<b>Direct</b>	Indirect	Induced	Cumulative
	Impacts to surface water would be direct impacts from Project activities.			
<b>Duration</b>	Temporary	Short-term	<b>Long-term</b>	Permanent
	The operation phase will last approximately 22 years. The duration of potential impacts is therefore long-term.			
<b>Extent</b>	<b>Local</b>	Regional	International	
	Potential impacts would be limited to the Project site footprint, as well as areas downstream of the Project site, and hence would be considered to be local.			
<b>Scale</b>	Cooling water blowdown will consist of approximately 70.5 m <sup>3</sup> /hr. The water is discharged into the irrigation canal near the Plant, which is over 10 km from the Ayeyarwady River. Discharged water will be treated to meet applicable IFC EHS Guidelines, as well as FAO Guidelines as applicable for irrigation water.			
<b>Frequency</b>	Impacts to surface water due to cooling water discharge could occur intermittently but repeatedly throughout the day for the duration of the operation phase.			
<b>Magnitude</b>	Positive	Negligible	<b>Small</b>	Medium Large
	Potential impacts to surface water in the Project area due to cooling water discharge is expected to be of Small magnitude.			
<b>Receptor/ Resource Sensitivity</b>	Low	<b>Medium</b>	High	
	Surface water quality analysis from the baseline surveys indicated that the surface water near the Project site had elevated levels of total coliform and total suspended solids. The temperature of the Ayeyarwady River was found to range from 22.4 to 29.36 degrees Celcius. Overall sensitivity is rated as Medium.			
<b>Significance</b>	Negligible	<b>Minor</b>	Moderate	Major
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.			

## Mitigation and Management Measures

The following measures will be put in place for the Project during operation phase:

- Comply with WB/IFC EHS Guidelines for Thermal Power Plant (2008) regarding the cooling water discharge standards;
- Cooling water discharge will be regularly monitored for temperature at the outfall point; and
- Monitor surface water quality at the wastewater discharge point as per the Environment Monitoring Program formulated for the Project.

## Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.

### *Impacts to Surface Water Hydrology from Increased Impervious Surfaces*

During the operation phase, the physical footprint of the power plant and gas supply pipeline will increase the impermeable area of the Project site, resulting in changed hydrological characteristics, such as reduced water infiltration to the soil, which could create additional surface run-off (and increase the flow velocity of this run-off), as well as reducing infiltration into subsurface aquifers. Surface water bodies may have the potential to be affected by changes to their flow rates and discharge volumes due to variation in the drainage patterns in their basin. In addition, the increased stormwater runoff from the Project's impermeable surfaces will have to be accommodated by the drainage channel of the Project site, as well as the irrigation canal (which is the eventual point of discharge).

To provide an estimate of stormwater volume that will need to be accommodated by the drainage channel/irrigation canal, peak runoff discharges around the Project site have been estimated using an analytical calculation which takes into account catchment area, rainfall intensity and runoff coefficient (also called the "Rational Method"). The peak runoff discharge from the impermeable surfaces of the Project site is estimated as follows:

$$Q = 0.278 \times 10^{-6} CIA \quad \text{Eq. 1}$$

where

$Q$  = estimated runoff flow rate ( $m^3/s$ )

$C$  = runoff coefficient

$I$  = rainfall intensity ( $mm/hour$ )

$A$  = catchment area ( $m^2$ )

For rainfall intensity, a return period of 25 to 100 years is commonly used in sizing detention ponds or drainage ditches (Osman Akan, 1993<sup>(1)</sup>). During their study of the Letpadaung Copper Mine in Salingyi<sup>(2)</sup>, Knight Piésold found that, for a 1-in-100 year storm of 15-minute duration, the rainfall intensity in the region was 221 mm/h. Salingyi is 65 km north of Myingyan, and the rainfall data is therefore expected to be very similar.

As a worst case scenario, taking the catchment area to be equivalent to a concrete surface (C = 0.90), and the area of the Project footprint (including pipelines) to be 10.55 ha (10,550 m<sup>2</sup>), the estimated runoff for a worst case 15-minute duration storm with a return period of 100 years, would be approximately 0.000162 m<sup>3</sup>/s, or 0.58 m<sup>3</sup>/hr. Therefore, the drainage channel should be designed to allow for the maximum runoff rate as indicated above.

The significance of potential impacts to surface water due to increased runoff from impervious surfaces during the operation phase are assessed in the following table, and mitigation measures are presented.

<b>Impact</b>	Potential for surface water impacts from altered hydrology due to an increase in impervious surfaces in the Project area.			
<b>Nature</b>	<b>Negative</b>	Positive	Neutral	
	Potential impacts to surface water would be considered to be adverse (negative).			
<b>Type</b>	<b>Direct</b>	Indirect	Induced	Cumulative
	Impacts to surface water would be direct impacts from Project activities.			
<b>Duration</b>	Temporary	Short-term	<b>Long-term</b>	Permanent
	The operation phase will last approximately 22 years. The duration of potential impacts is therefore long-term.			
<b>Extent</b>	<b>Local</b>	Regional	International	
	Potential impacts would be limited to the Project site footprint, as well as areas downstream of the Project site, and hence would be considered to be local.			
<b>Scale</b>	The estimated runoff from Project surfaces for a worst case 15-minute duration storm with a return period of 100 years, would be approximately 0.000162 m <sup>3</sup> /s, or 0.58 m <sup>3</sup> /hr.			
<b>Frequency</b>	Impacts to surface water due to increased rainwater runoff would occur during rainfall events, and will be more frequent during the rainy season.			
<b>Magnitude</b>	Positive	Negligible	<b>Small</b>	Medium Large
	Potential impacts to surface water in the Project area due to increased rainfall runoff from impervious surfaces are expected to be of Small magnitude.			
<b>Receptor/ Resource Sensitivity</b>	Low	<b>Medium</b>		High
	There are a number of current water uses in the Project area, and the Ayeyarwady River is considered an important water resource. The resource/receptor sensitivity is considered Medium.			
<b>Significance</b>	Negligible	<b>Minor</b>	Moderate	Major
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.			

(1) Osman Akan, A. 1993. Urban Stormwater Hydrology.  
[http://books.google.co.th/books?id=ZyJtRojkDg0C&pg=PA6&lpg=PA6&dq=design+ponds+return+period+duration+rainfall&source=web&ots=U4jCFGjeK&sig=dLhEjM42jFuFital3VXcTUSRtl&hl=en&sa=X&oi=book\\_result&resnum=5&ct=result](http://books.google.co.th/books?id=ZyJtRojkDg0C&pg=PA6&lpg=PA6&dq=design+ponds+return+period+duration+rainfall&source=web&ots=U4jCFGjeK&sig=dLhEjM42jFuFital3VXcTUSRtl&hl=en&sa=X&oi=book_result&resnum=5&ct=result)

(2) Knight Piésold. 2013. Myanmar Wanbao Mining Copper Ltd Letpadaung Copper Project, Environmental and Social Impact Assessment

## Mitigation and Management Measures

The following measures will be put in place for the Project during operation phase:

- Ensure that drainage channel and irrigation canal has enough capacity to accommodate the increased rainfall runoff from the Project's impervious surface.

## Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.

### *Accidental Spills and Leaks*

Accidental releases from operational activities, including the gas supply pipeline, and PCB and SF6 insulant chemicals from operation of the transmission line, have the potential to impact surrounding surface water and groundwater. Leakage from chemical storage facilities may result in surface & groundwater contamination. Uncontrolled releases from operational activities of the water supply and discharge pipelines may also cause release of contents causing sedimentation and/or siltation of river. A further risk to water resources during the operational phase is from a potential spill in back up fuel (should this be used to provide a back up fuel supply during breaks in the gas supply). These discharges may have a direct impact on the water quality which in turn would have ecological implications.

Based on experience with similar projects, the total approximate quantities of hazardous materials that could be a potential source of impact during this stage include:

- 4,000 L/month diesel fuel; and
- Small, infrequent quantities of lubricants, oil.

Spill control measures such as storage and handling of chemicals and fuels on impervious areas (such as concrete surfaces) will be implemented to minimize impacts in case of spills. Heavy equipment will be checked for lubricant leaks, and workers will be trained on the proper handling and management of waste. Liquid effluents arising from construction activities will be treated to the applicable World Bank/IFC guidelines prior to discharge. All hazardous materials will be segregated and stored according to their MSDS, and will be disposed of appropriately.

The significance of potential impacts to surface water due to contamination from accidental spills and leaks during the operation and maintenance phase are assessed in the following table, and mitigation measures are presented.

<b>Impact</b>	Potential for impacts to surface water due to contamination from accidental releases of hazardous substances such as fuels, oils or lubricants, as well as improper chemical/fuel storage.				
<b>Nature</b>	<b>Negative</b>	Positive	Neutral		
	Potential impacts to surface water would be considered to be adverse (negative).				
<b>Type</b>	<b>Direct</b>	Indirect	Induced	Cumulative	
	Impacts to surface water would be direct impacts from Project activities.				
<b>Duration</b>	Temporary	Short-term	<b>Long-term</b>	Permanent	
	The operation phase will last approximately 22 years. The duration of potential impacts is therefore long-term.				
<b>Extent</b>	<b>Local</b>	Regional	International		
	Potential impacts would be limited to the Project site footprint and gas pipeline and transmission line corridors, and hence would be considered to be local.				
<b>Scale</b>	<p>Based on experience with similar projects, the total approximate quantities of hazardous materials that could be a potential source of impact during this stage include:</p> <ul style="list-style-type: none"> <li>• 4,000 L/month diesel fuel</li> <li>• Small, infrequent quantities of lubricants, oil</li> </ul> <p>The scale of potential impacts due to release of hazardous materials is potentially large due to the quantities present during this stage, but accidental release is an unlikely, unplanned occurrence.</p>				
<b>Frequency</b>	Potential impacts would be expected to be infrequent, only taking place during rainfall, after loss of containment or accidental spills.				
<b>Magnitude</b>	Positive	Negligible	<b>Small</b>	Medium	Large
	Potential impacts to surface water quality in the Project area due to accidental releases is expected to be of Small magnitude.				
<b>Receptor/ Resource Sensitivity</b>	Low	<b>Medium</b>	High		
	Surface water quality analysis from the baseline surveys indicated that the surface water near the Project site had elevated levels of total coliform and total suspended solids. The Project is near sensitive resources with regards to surface water quality, such as agricultural lands, which rely on surface water for irrigation. Overall sensitivity is rated as Medium.				
<b>Significance</b>	Negligible	<b>Minor</b>	Moderate	Major	
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.				

## Mitigation and Management Measures

The following measures will be put in place for the Project during operation phase:

- To optimize use of antifouling and corrosion inhibiting chemicals, appropriate depth of water intake will be maintained, and use of screens will be ensured;
- Minimum required quantities of chlorinated biocides or alternatively intermittent shot dosing of chlorine will be practised rather than continuous low level feed;
- Waste storage areas will be equipped with secondary containment and spill control measures (similar to the hazardous material storage areas) to limit impact to ground;
- Liquid wastes such as waste oil, etc. will be collected and stored for recycling in cemented areas;
- All drainage/tanks, etc. will be positioned on concrete hard standing to prevent any seepage into ground;
- Disposal sites to be designed for hazardous and non-hazardous waste, including sludge disposal;
- Hazardous waste storage areas will comply with best practice/ international standards;
- Store and handle all hazardous substances in accordance with their MSDS.

- Keep a register for all hazardous substances on site and relevant Material Safety Data Sheets (MSDSs) readily accessible for reference.
- Fuel tanks and chemical storage areas will be sited on sealed areas and provided with locks to prevent unauthorized entry;
- Use of spill or drip trays to contain spills and leaks;
- Use of spill control kits to contain and clean small spills and leaks;
- The storage areas for oil, fuel and chemicals will be surrounded by bunds or other containment devices to prevent spilled oil, fuel and chemicals from percolating into the ground or reaching the receiving waters;
- Provide enough space to allow for inspection between waste containers so as to identify any leaks or spills;
- Ensure storage areas have impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest waste container;
- Oil-contaminated water will be collected and handled by local licensed wastewater sub-contractors (if available, to be determined at a later stage);
- Guidelines and procedures should be established for immediate clean up actions following any spillages of oil, fuel or chemicals;
- As part of the facility-wide HSEMS, SOPs will be prepared to manage any oil spills, leaks and/or seepages. SOPs will cover transport, handling, storage, use and disposal of oil/ oil wastes/ empty drums etc. Operating personnel will be trained on the SOPs and monitored in their use on a daily basis;
- Acids and other hazardous materials will be stored in a dedicated room as per their MSDS specifications with adequate ventilation;
- The spill prevention and response guidance presented in Sections 1.5 and 3.7 respectively of the WB/IFC General IFC EHS Guidelines (2007) will be followed and implemented.

### **Residual Impacts**

If the recommended mitigation measures are implemented, residual impact significance would be **negligible**.