National Directorate of Water
Mozambique

Environmental and Social Impact Assessment (ESIA) for Completion of the Corumana Dam

Volume 3: Environmental Management Plan

Draft
April 2011
National Directorate of Water
Mozambique

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<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>ARA-Sul</td>
<td>Southern Regional Water Authority/Administração Regional de Águas do Sul</td>
</tr>
<tr>
<td>DNA</td>
<td>National Directorate of Water /Direcção Nacional de Águas</td>
</tr>
<tr>
<td>CEMP</td>
<td>Construction Environmental Management Plan</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>EMP</td>
<td>Environmental Management Plan</td>
</tr>
<tr>
<td>EPDA</td>
<td>Environmental Pre-feasibility Study and Scoping Definition /Estudo de Pré-viabilidade Ambiental de Definição de Âmbito</td>
</tr>
<tr>
<td>EWR</td>
<td>Environmental Water Requirements</td>
</tr>
<tr>
<td>ESIA</td>
<td>Environmental and Social Impact Assessment</td>
</tr>
<tr>
<td>DEAT</td>
<td>Department of Environmental Affairs and Tourism, South Africa</td>
</tr>
<tr>
<td>FAII</td>
<td>Fish Assemblage Integrity Index</td>
</tr>
<tr>
<td>FSL</td>
<td>Full Supply Level</td>
</tr>
<tr>
<td>GoM</td>
<td>Government of the Republic of Mozambique</td>
</tr>
<tr>
<td>IIMA</td>
<td>Tripartite Interim Agreement for Co-operation on the Protection and Sustainable Utilization of the Incomati and Maputo Watercourses</td>
</tr>
<tr>
<td>I&amp;AP</td>
<td>Interested and Affected Parties</td>
</tr>
<tr>
<td>KNP</td>
<td>Kruger National Park</td>
</tr>
<tr>
<td>MICOA</td>
<td>Ministry for Coordination of Environmental Affairs /Ministério para a Coordenação da Acção Ambiental</td>
</tr>
<tr>
<td>Mm³</td>
<td>Million cubic meters</td>
</tr>
<tr>
<td>SASS5</td>
<td>South African Scoring System</td>
</tr>
<tr>
<td>SGB</td>
<td>Sabie Game Park</td>
</tr>
<tr>
<td>SIA</td>
<td>Socio-economic Impact Assessment</td>
</tr>
<tr>
<td>SMEC</td>
<td>Snowey Mountain Environmental Consultants</td>
</tr>
<tr>
<td>TDS</td>
<td>Total Dissolved Solids</td>
</tr>
<tr>
<td>ToR</td>
<td>Terms of Reference</td>
</tr>
<tr>
<td>VEGRAI</td>
<td>Vegetation Response Assessment Index</td>
</tr>
</tbody>
</table>
Executive Summary

The Government of the Republic of Mozambique has initiated a National Water Resources Development Program to strengthen the role of the water resources sector in sustaining economic growth and reducing poverty. The National Water Policy (Política de Águas), the National Water Resources Management Strategy (Estratégia Nacional de Gestão de Recursos Hídricos - ENGRH) and the Regulations for Licenses and Concessions (Regulamento de Licença e Concessões de Água - RLCA) informs the Program’s planned investments to address persistent impacts associated with high hydroclimatic variability and recurrent floods and droughts.

As part of the Program, the Government of the Republic of Mozambique is planning for and undertaking a series of large infrastructures improvements to substantially improve both quality and quantity of water supply to its greater capital area of Maputo. Under the auspices of the Tri-Partite Technical Committee of the Interim IncoMaputo Agreement and with several years of feasibility analysis, the rehabilitation and completion of Corumana Dam, located in Maputo Province’s Moamba District in southern Mozambique, has been identified as the next priority investment for the source of bulk water supply for the Greater Maputo Metropolitan Area.

In realizing the potential of the infrastructure of the Corumana Dam, the Government is being supported by the World Bank. As part of preparation of the project to undertake rehabilitation and completion of the dam, the Government has carried out an Environmental and Social Impact Assessment in line with national legislation, the World Bank safeguard policies and the World Bank Group Environmental, Health and Safety Guidelines of 2007.

This is the third of four volumes prepared as part of the Environmental and Social Impact Assessment (ESIA) for the completion of the Corumana Dam. Volume 1 includes the Environmental Impact Assessment (EIA), developed to address the impacts on the biophysical environment from the planned completion of the Corumana Dam. Volume 2 presents the findings from the Social Impact Assessment (SIA) with an overview of the socioeconomic, cultural and health related context of the project affected communities and the area they live in. This, Volume 3, outlines the Environmental Management Plan (EMP) detailing the mitigation measures necessary to reduce any negative impact on the biophysical and human environment resulting from the completion of the Corumana Dam and a series of longer term monitoring measures to assist with operations and capacity building. The final section of the ESIA, Volume 4, provides the detailed Resettlement Action Plan (RAP) for the households and assets located with the buffer zone boundary of the maximum flood level of the reservoir.
The Project

The Corumana Dam is an existing embankment dam that was constructed during 1983 to 1989 (inclined core rock fill dam with a 45 m height and 3,050 m crest length). The dam is located on the Sabíe River, immediately downstream of the border with the Republic of South Africa approximately 90 km north-west of Mozambique’s capital Maputo in the Moamba District (25°13'10.10"S; 32° 8'2.31"E). The dam was not completed in 1989 due to lack of funding and the civil war. The Project involves completing the dam and increasing the full supply level (FSL) from the current 111 masl to 117 masl, with a flood surcharge water level of approximately 120 masl. Increasing the FSL of the reservoir’s originally intended capacity will increase the dam’s current storage from 720 Mm$^3$ at present to an estimated 1,240 Mm$^3$.

The proposed completion of the Corumana Dam includes civil and hydro-mechanical works, consulting services for design and supervision and technical assistance. These activities will be completed by DNA who owns the dam through the Government Ministry of Public Works and Housing, and the Administração Regional de Águas do Sul, ARA-Sul (Southern Regional Water Authority) who administrates and operates the dam. The specific infrastructure improvements involve the addition of the following elements:

- Six crest radial spillway gates and ancillary hydromechanical equipment;
- Repair works of concrete pillars/abutments;
- Strengthening works on the existing dam; and
- Construction of saddle dam with fuse plug emergency spillway;

The dam was originally constructed for improving flood control, regulation for downstream irrigation abstractions and hydropower production. Completion of the Corumana Dam has been identified as the next priority investment for bulk water supply to the Greater Maputo Metropolitan Area (GMMA).

With existing sources of supply fully committed and the yield from the existing Corumana Dam insufficient to meet increasing demands, the no project option would result in predicted shortages in water supply to the Greater Maputo Metropolitan Area by 2015. This would have significant implications for economic growth and development, reduce the quality of service, and increase the cost to the most vulnerable sections of society without access to piped water supplies and the incidence of waterborne disease.

The EIA also assessed the implications of an operational alternative FSL of 115 masl against the design 117 masl. The associated impacts identified in the EIA are considered to be adequately addressed through the set of proposed mitigation measures outlined in the following chapters.
Environmental Management Plan

Purpose and Objectives
The purpose of the EMP is to ensure that (i) any negative environmental and social impacts as a result of the completion of the Corumana Dam are avoided or mitigated to an acceptable degree and (ii) any positive environmental impacts are enhanced where feasible. The EMP is intended to ensure that all aspects of the Corumana Dam components of the project comply with relevant Mozambican legislation, World Bank Operational Policies (safeguard policies), and generally accepted international standards of good practice. The EMP also seeks to ensure that the measures identified in the EIA for mitigating adverse environmental impacts will be properly implemented.

The Contractor(s) will be required, as will be stated in the bidding documents and as part of their contract, to prepare their own Construction Environmental Management Plan (CEMP). For specific environmental management actions the contractor prepares a Method Statement, which needs to be approved by the Supervising Engineer and the Client. The Supervising Engineer will be required by contractual obligation to monitor the adequate implementation of the CEMP and the Method Statements.

The EMP further outlines a number of activities to be supported during project implementation that are directed toward enhancing the long term environmental sustainability of dam operations. This includes technical and financial support under the project for series of operational measures that compliment the environmental management of construction activities and the specific provisions to be addressed by the Contractors.

These are outlined in detail in the following sections of the EMP and will be reviewed and revised, as needed, during the detailed design, tendering, construction and operational phases of the project to ensure that they are integrated with the schedule of works for the dam.

Impacts to be Mitigated
The ESIA identified and assessed a total of 21 potential impacts associated with completion of the Corumana Dam. These impacts were assessed with respect to probability, severity, duration and magnitude of impact. The classification methodology was applied in accordance with international standards as reflected in the EIA regulation guidelines developed by the Department of Environment and Tourism in South Africa (DEAT, 1998).

Of the identified impacts, seven are classified as Medium Impact, 11 as Low Impact, one as Very Low Impact, one as No Impact with the final potential impact identified as part of the community consultations in preparation of the SIA being a risk to physical cultural heritage. A detailed overview of these impacts, the level of associated risk and the proposed mitigation measures is provided in Table 3-1.
The Environmental Management Plan outlines the suitable mitigation measures necessary to manage and mitigate the risks of these impacts. Further, the required institutional responsibility, timing and funding for carrying out the mitigation measures are elaborated in subsequent chapters. Successful management of the risks of several of the identified impacts will necessitate a degree of cooperation and collaboration with upstream stakeholders given the Corumana reservoir’s geographic location on the border with the Republic of South Africa and with the Kruger National Park directly upstream.

The Project has a designated component for managing impacts and developing opportunities of the social and environmental dimensions of the Project-affected area. This component is fully funded and will be implemented by DNA and ARA-Sul with the support of an Environmental and Social Management Team financed through the Project’s Technical Assistance.

EMP Activities

The Environmental Management Plan outlines a series of activities that are to be implemented during the project to address the potential environmental issues identified as part of the assessment and enhance the long term sustainable operation of the dam. This includes a series of measures to be adhered to during the detailed design, tendering, construction phases of the project, along with longer term measures that should be integrated into the operations of the dam.

Given these longer term objectives, the EMP recommends a number of plans that need to be developed and implemented during the project. These should be done with the support of an independent, professional environmental and social management consulting firm to support ARA-Sul and assist ARA-Sul staff through on-the-job and formal training in enhancing the internal capacity for environmental and social management so that longer term environmental and social management issues can be handled by ARA-Sul environmental and management staff. Specific measures include the following:

i. Construction and Workers Camp Management Plan to minimize the potential negative impacts of construction activities and outline the Contractors responsibilities in relation to environmental management, along with Environmental Supervision by the Supervising Engineer, as part of their contract. The EMP is to be included in the tender documentation to ensure that all Contractors and sub-contractors comply with the requirements of the EMP. Based on the EMP, the Contractor(s) will prepare and implement as part of their contractual arrangement their own EMP, called Construction EMP (CEMP). More complex environmental management issues will be handled through the preparation and implementation of Method Statements, which will need to be approved by the Supervising Engineer and the Client’s Environmental and Social Management Team;
ii. **An Inundation Preparation Plan** prepared during the first year of project implementation and implemented prior to impoundment. This would include the following:

a. Identification and removal of potential sources of water contamination, such as garbage dumps and latrines in order to protect water quality;

b. Limited biomass clearing within carefully selected portions of the area to be inundated to facilitate fishing and navigation on portions of the reservoir. The areas which would be cleared will be discussed with key stakeholders.

c. Survey and transplant of threatened plant species if found within the area to be inundated;

d. Survey and salvage of physical cultural resources, including potential archaeological sites and fossils;

e. Baseline survey on water-borne diseases in the wider project area with a focus on intestinal and urinary bilharzias and malaria; and

f. Preparation of an Emergency Preparedness Plan (EPP) in order to warn the population around the reservoir and downstream of the dam in case of severe flooding around the reservoir and downstream of the dam, large operational flood releases and emergency situations. A draft EPP has been prepared under a separate contract during preparation. The final EPP will be approved 12 months before reservoir inundation.

iii. **A Reservoir Management Program** that would be prepared during the first two years of implementation and include the following:

a. **Environmental Zoning** of the reservoir (e.g. for fishing and controlled hunting) and the area around the reservoir through a consultative process with all major stakeholders in order to protect wildlife resources, biodiversity, and water quality;

b. **Patrolling** designated sections of the Corumana Reservoir to reduce wildlife poaching risks, in collaboration with the conservation area managers and local fishing communities;

c. **Management of the catchment area** around the reservoir in Mozambique in order to protect the reservoir from excessive sedimentation, eutrophication in order to protect water quality, particularly since the Corumana reservoir is a drinking water reservoir;
d. **Reservoir fisheries development and management** for the development and management of the reservoir fisheries, based on sustainable harvests of native fish species; and

e. **Invasive Aquatic Plant Management** to monitor the spread of non-native aquatic plant species (such as water hyacinth, salvinia and azolla) and outline control options in the event that infestation becomes problematic.

iv. **An Environmental Water Releases Program** that would take into account considerations such as (i) limiting backwater flooding within the Kruger National Park; (ii) ensuring an adequate area of floodplain grasslands along the reservoir shoreline, to provide grazing for wildlife and livestock; (iii) reducing impacts to downstream channel morphology, including river bank erosion; and (iv) enhancing downstream water quality, along with the conditions for fish and other aquatic life. This program will recommend technical criteria and decision-making procedures for environmental water releases; these recommendations will serve as a key input to the revised Operating Rules for the Corumana Dam. The new Operating Rules will be approved by ARA-Sul prior to any raising of the reservoir’s full supply level above the current 111 meters asl. This program will include long-term monitoring of water quality, fish species, macroinvertebrates, and other environmental quality parameters, to provide a feedback mechanism for future adjustments to environmental water releases from the Corumana Dam; and

v. **An Environmental Monitoring Plan** for the monitoring of primarily water quality in the reservoir and downstream of the dam, sedimentation deposition upstream of the dam, downstream river morphology and impacts on wildlife, effectiveness of the control of poaching, etc.

3 **Institutional Responsibilities**

The Environmental Management Plan outlines the institutional roles and responsibilities in relation to each of the activities and mitigation measures proposed under the EMP. This includes those during implementation and for the long term operation phase. These are summarised as follows:

- The National Directorate of Water (DNA), as the dam owner and executing entity for the IDA financed project, has overall responsibility during implementation for ensuring compliance with the provisions of the EMP;

- The Regional Water Authority – Southern Region (ARA-Sul), as the Dam Operator, has responsibility for implementing the activities required under the EMP and shall be responsible for inclusion of these in the long term operation phase;
• The Environmental and Social Management Team, headed by staff from ARA-Sul and supported by technical assistance under the project through an independent consulting firm, will implement the activities under the EMP during project implementation and support capacity enhancement within ARA-Sul to support integration of long term activities into the operation of the dam;

• The Supervising Engineer will include one or more qualified environmental specialists with responsibility for monitoring and auditing the Contractors compliance with the Construction and Workers Camp Management Plan, which will form part of the implementation specifications and contractual arrangements of the Contractors;

• The Contractor, who will appoint an Environmental Manager, will be responsible for the daily, on-site implementation and management of the provisions required under the Construction and Workers Camp Management Plan; and

• The Ministry for Coordination of Environmental Affairs (MICOA), who is responsible for ensuring compliance with national environmental legislation, including audit and inspection functions of those activities that are likely to cause negative environmental impacts.
### Table 1-1 Summary of Scheduling, Responsibilities, and Budget for the EMP Activities

<table>
<thead>
<tr>
<th>EMP Mitigation / Enhancement Measures</th>
<th>Frequency/Schedule</th>
<th>Responsibility</th>
<th>Budget Estimate (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction and Workers Camp Management Plan</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plan included in bid documents for main civil works</td>
<td>Prior to launch of bids</td>
<td>Supervising Engineer</td>
<td>Engineering Contract</td>
</tr>
<tr>
<td>Implementation of the Plan</td>
<td>Continuous</td>
<td>Contractor</td>
<td>Bid Lump Sum</td>
</tr>
<tr>
<td>Monitoring compliance with the Plan</td>
<td>Monthly</td>
<td>Supervising Engineer</td>
<td>Eng Contract</td>
</tr>
<tr>
<td>Environmental awareness training</td>
<td>Prior to site access</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td><strong>Inundation Preparation Plan</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plan finalised</td>
<td>Project year 1</td>
<td>ESM Team</td>
<td>TA Contract</td>
</tr>
<tr>
<td>Identification of potential sources of water contamination (i.e. garbage dumps and latrines)</td>
<td>Completed 12months prior to impoundment</td>
<td>ESM Team / ARA-Sul</td>
<td>TA Contract</td>
</tr>
<tr>
<td>Removal of potential sources of water contamination (i.e. garbage dumps and latrines)</td>
<td>Completed 6 months prior to impoundment</td>
<td>Sub-contractor</td>
<td>50,000</td>
</tr>
<tr>
<td>Survey for threatened plant species within the reservoir inundation area</td>
<td>Undertaken at least 24 months prior to completion; Completed 18 months prior to impoundment</td>
<td>ESM Team</td>
<td>TA Contract</td>
</tr>
<tr>
<td>Transplant any identified threatened plant species as required</td>
<td>Completed 6 months prior to impoundment</td>
<td>ESM Team</td>
<td>50,000</td>
</tr>
<tr>
<td>Survey of physical cultural resources within the reservoir inundation area</td>
<td>Completed 6 months prior to impoundment</td>
<td>ESM Team</td>
<td>TA Contract</td>
</tr>
<tr>
<td>Salvage of any identified physical cultural resources as required</td>
<td>Completed 6 months prior to impoundment</td>
<td>ESM Team</td>
<td>50,000</td>
</tr>
<tr>
<td><strong>Reservoir Management Plan</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMP Mitigation / Enhancement Measures</td>
<td>Frequency/Schedule</td>
<td>Responsibility</td>
<td>Budget Estimate (US$)</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------</td>
<td>--------------------------------------------------</td>
<td>-------------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Plan finalised</td>
<td>By end of Project Year 2</td>
<td>ESM Team</td>
<td>TA Contract</td>
</tr>
<tr>
<td>Environmental zoning consultative process</td>
<td>Project Years 1-2</td>
<td>EMS Team</td>
<td>25,000</td>
</tr>
<tr>
<td>Consultative reservoir management forum established and meeting</td>
<td>Quarterly, beginning Project Year 2</td>
<td>ARA-Sul</td>
<td>20,000</td>
</tr>
<tr>
<td>Reservoir patrols to reduce poaching</td>
<td>Recurrent, beginning Project Year 2</td>
<td>ARA-Sul / Conservation entity</td>
<td>15,000</td>
</tr>
<tr>
<td>Reservoir fisheries management plan (equipment, workshops etc.)</td>
<td>First two years of project</td>
<td>ARA-Sul / ESM Team</td>
<td>60,000</td>
</tr>
<tr>
<td>Reservoir fisheries surveys</td>
<td>Annually</td>
<td>EMS Team</td>
<td>140,000</td>
</tr>
<tr>
<td>Invasive Aquatic Plant Survey</td>
<td>Once per year</td>
<td>EMS Team</td>
<td>15,000</td>
</tr>
<tr>
<td>Invasive Aquatic Plant Control measures</td>
<td>As needed</td>
<td>ARA-Sul</td>
<td>Subject to survey</td>
</tr>
<tr>
<td>Monitoring causes of waterborne disease and remedial actions</td>
<td>Baseline study in Project Year 1; recurrent monitoring thereafter, with remedial actions as needed</td>
<td>ARA-Sul/EMS Team</td>
<td>50,000</td>
</tr>
<tr>
<td>Boat and associated operating costs</td>
<td>Start of project</td>
<td>DNA / ARA-Sul</td>
<td>30,000</td>
</tr>
</tbody>
</table>

**Environmental Water Releases Program**

<table>
<thead>
<tr>
<th>Establish proposed regime for Environmental Water Releases, including decision-making criteria and procedures, and environmental quality targets</th>
<th>Prior to launching bids for main civil works</th>
<th>EMS Team</th>
<th>TA Contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bio-monitoring surveys of EWR sites</td>
<td>Semi-annually</td>
<td>ARA-Sul / EMS Team</td>
<td>650,000</td>
</tr>
<tr>
<td>Integrate EWR estimates in design works for the dam</td>
<td>Prior to launching bids for main civil works</td>
<td>Design Engineer</td>
<td>TA / Engineering</td>
</tr>
<tr>
<td>Provide feedback mechanisms for the operating rules</td>
<td>Prior to completion</td>
<td>ARA-Sul</td>
<td>TA / Engineering</td>
</tr>
</tbody>
</table>

**Environmental Monitoring Plan**

<p>| River topography profiling &amp; sediment monitoring                               | Annually                                    | ARA-Sul / EMS Team                  | TA Contract           |</p>
<table>
<thead>
<tr>
<th>EMP Mitigation / Enhancement Measures</th>
<th>Frequency/Schedule</th>
<th>Responsibility</th>
<th>Budget Estimate (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reservoir water quality, including thermal stratification</td>
<td>Quarterly</td>
<td>ARA-Sul / EMS Team</td>
<td>TA Contract</td>
</tr>
<tr>
<td>Water quality monitoring upstream and downstream</td>
<td>Semi-annually</td>
<td>ARA-Sul / ESM Team</td>
<td>TA Contract</td>
</tr>
<tr>
<td>River discharge monitoring</td>
<td>At least monthly</td>
<td>ARA-Sul</td>
<td>TA Contract</td>
</tr>
<tr>
<td>Flora and fauna monitoring</td>
<td>Semi-annually</td>
<td>ARA-Sul / ESM Team</td>
<td>TA Contract</td>
</tr>
<tr>
<td>Water quality monitoring equipment</td>
<td>Acquire in Project Year 1</td>
<td>DNA / ARA-Sul</td>
<td>80,000</td>
</tr>
<tr>
<td>Consultation, Participation and Management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training, capacity building, study tours and workshops</td>
<td>As needed</td>
<td>DNA</td>
<td>120,000</td>
</tr>
<tr>
<td>Technical Assistance</td>
<td>6mths of effectivenees</td>
<td>DNA</td>
<td>1,500,000</td>
</tr>
<tr>
<td>Vehicles</td>
<td>Year 1</td>
<td></td>
<td>90,000</td>
</tr>
<tr>
<td><strong>Total Cost Estimate</strong></td>
<td></td>
<td></td>
<td><strong>2,945,000</strong></td>
</tr>
</tbody>
</table>
Description of the Project

- **The existing Corumana Dam**

  The Corumana Dam is an existing, inclined core rock fill embankment dam that was established during the period 1983 to 1989. The dam is situated in the Moamba district on the Sabié River at the border to the Republic of South Africa, approximately 90 km north-west of Maputo.

**Ownership**

The Government of the Republic of Mozambique owns the dam through the Direcção Nacional de Águas, DNA (the National Directorate for Water) of the Ministry of Public Works and Housing. Operation, management and maintenance of the dam are the responsibility of the Administração Regional de Águas do Sul, ARA-Sul (Southern Regional Water Authority).

**Purpose of the Dam**

The original purposes of the dam were the regulation of flow in the Sabié River for improved flood control, the provision of irrigation water along the Sabié and Incomati rivers downstream thereof and generation of hydroelectric energy.

**Previous resettlement**

The construction of the Corumana Dam between 1983 and 1989 led to the relocation of the communities of the locality of Matunganhane situated along the Sabié River upstream the dam around the reservoir. Local displacement also occurred as a result of the civil war in the 1980s. More recent resettlement has also taken place in 2002 when the Sabie Game Park (SGP) was established on the northern shore of the reservoir where the community of Magonela was relocated and a new community, Ndindiza, was created.

**Characteristics of the existing dam**

The existing dam has a height of 45 m and the inclined core rock fill embankment has a crest length of 3,050 m. The dam has a spillway with six ungated openings, a concrete chute and a stilling basin at the right abutment. Two concrete ducts for water releases are located under the dam with a control tower at the inlets for operation of trash screens and emergency gates. The dam is operated at 111 masl, the elevation of the spillway sill with a reservoir capacity of approximately 720 Mm$^3$. The originally intended height (with spillway gates) is 117 masl with an estimated reservoir capacity of 1,240 Mm$^3$.

**Location of the dam**

25°13'10.10"S : 32° 8'2.31"E
Southern Mozambique, Maputo Province, Moamba District
Sabié River, major tributary of the Incomati River

- **Completion of Corumana Dam (the Project)**

  The Corumana Dam is an existing 45 m high embankment dam that was constructed during 1983 to 1989. The dam is situated on the Sabié River,
immediately downstream of the border with the Republic of South Africa approximately 90 km north-west of Mozambique’s capital Maputo in the Moamba District.

A tripartite study by Mozambique, South Africa and Swaziland under the auspices of the Tripartite Interim Agreement for Co-operation on the Protection and Sustainable Utilization of the Incomati and Maputo Watercourses (IIMA) on the Augmentation of Water Supply to the City of Maputo and its Metropolitan Area (October 2009) identified completion of the Corumana Dam as one of the next priority interventions. The Master Plan for the Greater Maputo Water Supply System (February 2011) has also confirmed that completion of the Corumana Dam must be regarded as the first choice for the next step in water resources development given the lower risk in time and cost and the more immediate possibility of implementation.

The Environmental Impact Assessment and a Technical Services and Dam Safety assignment undertaken during preparation have both performed hydrological analyses to determine the potential impacts of the increased reservoir and the extent of possible back-flooding. Alternative operating levels for the reservoir were also assessed.

The dam was intentionally constructed for improving flood control, regulation for downstream irrigation abstractions and providing hydropower production. Since 1989, it has been in operation but resources were insufficient to install the six spillway gates and complete the hydro-mechanical works. As a result, it is being operated at the level of 111 masl, corresponding to the elevation of the spillway sill, seven meters below the designed full supply level of 117 masl. Mean inflow is approximately 17.6 m$^3$/s of which 9.5 m$^3$/s can be released as firm water yield. Increasing the water level from 111 masl to its originally intended level of 117 masl could increase the reservoir capacity from 720 Mm$^3$ to 1,240 Mm$^3$, thereby increasing the incremental safe yield to provide bulk source for water supply for the Greater Maputo Metropolitan Area (GMMA).

The proposed completion of the Corumana Dam includes civil and hydro-mechanical works, consulting services for design and supervision and technical assistance. These activities will be completed by Direcção Nacional de Águas, DNA (the National Directorate for Water) who owns the dam through the Government Ministry of Public Works and Housing, and the Administração Regional de Águas do Sul, ARA-Sul (Southern Regional Water Authority) who administrates and operates the dam. The specific infrastructure improvements involve the addition of the following elements:
- Six crest radial spillway gates and ancillary hydro-mechanical equipment;
- Repair works of concrete pillars/abutments;
- Strengthening works on the existing dam; and
- Construction of saddle dam with fuse plug emergency spillway.

Figure 0-1  Corumana Dam site (Source: Google earth)
Figure 0-2  Corumana Dam seen from downstream embankment (Source: Google earth)
Radial gates

Increasing the FSL of the dam will be achieved by installing six radial gates on the spillway crest. Each gate will span an opening of approximately 18 m between 4.5 m wide concrete piers. Each of the gates will be driven by two hydraulic hoists. Stoplogs, travelling hoist and necessary electrical equipment will be installed as well.

The concrete piers were constructed between 1983 and 1989. These piers have blockouts in the reinforced concrete for the following items which will have to be installed prior to the instalment of the radial gates:

- Radial gate trunnion support beams;
- Upper hydraulic servomotor supports;
- Foundations for the stoplog hoist superstructure foundation;
Guide plates and seal plates for the stoplogs; and

Seal plates for the radial gates.

The existing structures have been subject to weathering for some twenty years. In order to ensure that the existing concrete is capable of supporting the addition of the gates the concrete will be tested and any needed repairs will be carried out. Any rusted components will also be replaced.

Strengthening works on the dam
Seepage from the dam has been observed. Geotechnical investigations will be carried out to assess the extent of remedial works needed to strengthen the dam and prevent seepage.

Saddle dam with fuse plug emergency spillway
As a mitigating measure against flooding, a saddle dam with fuse plug emergency spillway will be constructed some three kilometres south of the Corumana Dam. At this site there is a natural saddle formation with a topographical elevation of 118.3 masl at its lowest point. With the existing dam crest at 122.5 masl, during very high flooding water would be spilled out of the reservoir in this area, as the fuse plug emergency spillway would be activated and water be directed to a discharge channel towards the Massecate tributary of the Sabie River. Final designs of the saddle dam with fuse plug emergency spillway will be developed during early project implementation.

Ancillary facilities
Temporary working and construction camps and storage facilities will have to be established. These facilities will operate the approximately 24 months expected duration of construction work. In addition, access roads for the transport of material and machinery may have to be constructed or improved. The locations and layouts of all these facilities will be selected and planned by the Civil Works Contractor, in accordance with the requirements of the Construction and Workers’ Camp Management Plan (see below in Section 3.2) and subject to the approval of the Environmental and Social Management Team and DNA.

Environmental Management Plan

Introduction
This Environmental Management Plan (EMP) for the completion of the Corumana Dam addresses how to manage the project’s impacts on the biophysical environment. To address specific socioeconomic impacts, Volume 4 provides a detailed Resettlement Action Plan (RAP) which incorporates income restoration strategies and a Community Livelihood Plan.
The EMP outlines provisions for environmental management of construction activities and details specific provisions to be addressed by the Contractors. These will be revised during Year 1 of project implementation, in parallel with the Final Design of the Corumana Dam civil works and included as part of the bidding documentation.

The EMP also includes several specific plans that will be further specified and then carried out during project implementation. Except for the Inundation Preparation Plan, these other plans are directed toward longer term support during the operation phase of the reservoir. The project includes financial provisions for an independent consulting firm to be retained by DNA to assist ARA-Sul in implementation of these activities, which will be used to enhance the on-site capacity and the sustainability of environmental operational measures.

### Purpose and Objectives

The purpose of the EMP is to ensure that (i) any negative environmental and social impacts as a result of the completion of the Corumana Dam are avoided or mitigated to an acceptable degree and (ii) any positive environmental impacts are enhanced where feasible. The EMP is intended to ensure that all aspects associated with completion of the Corumana Dam comply with relevant Mozambican legislation, World Bank safeguard Policies, and generally accepted international standards of good practice, such as the World Group Environmental, Health and Safety Guidelines of April 2007, which can be found on [www.worldbank.org](http://www.worldbank.org) or [www.ifc.org](http://www.ifc.org). The EMP also seeks to ensure that the measures identified in the EIA for mitigating adverse environmental impacts will be properly implemented.

The EMP further outlines a number of activities to be supported during project implementation that are directed toward enhancing the longer term environmental sustainability of dam operations. This includes technical and financial support under the project for series of operational measures that compliment the environmental management of construction activities and the specific provisions to be addressed by the Contractors. These are outlined in detail in the following sections of the EMP and will be reviewed and revised, as needed, during the detailed design, tendering, construction and operational phases of the project to ensure that they are integrated with the schedule of works for the dam.

### Updates to the EMP

The EMP is a dynamic document, which may be subject to change or modification as a result of project development or changes on the site. The EMP is subject to review, revision and updating to reflect the requirements at the design, tendering, construction, and operational phase of the project. Any substantive changes to the EMP during project implementation shall be to be presented by DNA to the World Bank’s for its No-Objection, as well as to MICOA when legally required.
Impacts to be Mitigated

The EIA has identified the potential impacts and their significance that are outlined in the overview table provided below.
Inundation and loss of terrestrial habitats.

- **Risk:** Backwater effect in Sabie River (i.e., upstream inundation in a flood event) within the Republic of South Africa as a result of raising the FSL.
- **Impact:** Medium
- **Details:** At a FSL of 117 masl the backwater effect is estimated to be 730 m into South Africa. The affected stretch would be 450 m for the alternative FSL of 115 masl. In a -1-in-200 year return period flood at FSL 117 masl, the backwater effect could reach approximately 1,195 m into South Africa and be confined to the river channel. In the same 1-in-200 year return period flood at FSL of 115 masl, the backwater effect could reach 1,050 m into South Africa and be confined to the river channel.

**Mitigation:** Operating Rules of the dam allow for draw down of the reservoir, particularly during flood conditions, to diminish upstream inundation.

**Table 3-1 Overview table of impact classification and details**

<table>
<thead>
<tr>
<th>No</th>
<th>Risk</th>
<th>Impact</th>
<th>Details</th>
<th>Mitigation</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Backwater effect in Sabie River (i.e., upstream inundation in a flood event) within the Republic of South Africa as a result of raising the FSL.</td>
<td>Medium</td>
<td>At a FSL of 117 masl the backwater effect is estimated to be 730 m into South Africa. The affected stretch would be 450 m for the alternative FSL of 115 masl. In a -1-in-200 year return period flood at FSL 117 masl, the backwater effect could reach approximately 1,195 m into South Africa and be confined to the river channel. In the same 1-in-200 year return period flood at FSL of 115 masl, the backwater effect could reach 1,050 m into South Africa and be confined to the river channel.</td>
<td>Operating Rules of the dam allow for draw down of the reservoir, particularly during flood conditions, to diminish upstream inundation.</td>
</tr>
<tr>
<td>2</td>
<td>Induced sedimentation as a result of raised FSL to 115 or 117 masl.</td>
<td>Medium</td>
<td>In a 1 in 200 year return period flood, the zone of induced sedimentation caused by a FSL of 117 masl could extend 1,080 m into South Africa. In the same 1 in 200 year return period flood at FSL of 115 masl, the zone of induced sedimentation could reach 935 m into South Africa.</td>
<td>Operating rules of the dam allow for draw down of the reservoir, particularly during flood conditions, to diminish upstream inundation.</td>
</tr>
<tr>
<td>3</td>
<td>Inundation and loss of terrestrial habitats.</td>
<td>Medium</td>
<td>Increasing the FSL of the reservoir will inundate terrestrial habitats thus leading to a loss surrounding the present reservoir. The following areas of natural habitat around the Corumana reservoir will be affected by inundation after raising the FSL to 117 masl: i) 888 ha of Sclerocarya birrea – Acacia nigrescens Savanna; ii) 445 ha of Lebombo South Landscape; and iii) 274 ha Floodplain Grassland. Raising the FSL to 115 masl would affect a total terrestrial area that is 40% smaller. The following areas of natural habitat around the Corumana reservoir would be affected by inundation after raising the FSL to 115 masl: i) 469 ha of Sclerocarya birrea – Acacia nigrescens Savanna; ii) 214 ha of Lebombo South Landscape; and iii) 242 ha Floodplain Grassland. The hydrological modelling has showed that FSL 115 masl or 117 masl will rarely be obtained (i.e. in only about 10% of the time), so some of the affected area will only be affected part of the time. Riparian vegetation along a narrow stretch of the river channel extending some 730 m into South Africa (where Kruger National Park lies) will be inundated at a FSL of 117 masl. The affected stretch would be 450 m for a FSL of 115 masl.</td>
<td>Floodplain Grassland is expected to re-establish on higher ground along the new reservoir shoreline. The two main terrestrial natural habitat types that would be lost through reservoir inundation (Sclerocarya birrea – Acacia nigrescens Savanna and Lebombo South Landscape) occur extensively in the Kruger National Park, the existing Sabie Game Park, and in the area of the proposed Ingwe Game Park, such that measures to ensure further protection of these habitat types outside the reservoir inundation zone are not considered necessary.</td>
</tr>
<tr>
<td>4</td>
<td>Narrowing of the downstream river channel and increase in riverine vegetation as a result of raising the FLS to 115 or 117 masl.</td>
<td>Medium</td>
<td>Increased storage capacity following completion could mean smaller floods (i.e., 1 in 10 year return period flood) would be absorbed. A reduction in sedimentation carrying floods could lead to increased erosion immediately downstream of the dam wall. An area that is particularly vulnerable to erosion is around the road bridge approximately 2 km downstream of the dam.</td>
<td>Environmental water release requirements incorporated into the dam’s operating rules. Implementation of environmental flow program and monitoring plan.</td>
</tr>
<tr>
<td>5</td>
<td>Loss of some individuals of 3 threatened plant species as a</td>
<td>Medium</td>
<td>Three threatened plant species potentially occur in the area to be inundated: Adenium swazicum (Endangered), Ipomoea venosa (Vulnerable) and Turbina longiflora</td>
<td>Intensive survey to locate any invididuals of these threatened plant species within the future inundations zone, followed by relocating</td>
</tr>
</tbody>
</table>
Impact on grazing potential in Sabie Game Park due to inundation of Floodplain Grassland.
Medium
Floodplain Grassland likely plays an important role in the grazing dynamics of herbivores, particularly as grazing potential decreases in the dry season. While re-establishment of grassland is expected to be quite fast there will be a temporary loss in winter grazing until it re-establishes under new operating conditions.
Ensuring adequate Floodplain Grassland along the reservoir shoreline for wildlife and livestock will be among the key technical criteria used in the environmental flow requirements to inform development of the new Operating Rules for the dam.

Increase in prevalence rates of waterborne diseases.
Medium
African reservoirs are known for causing significant increases in intestinal and/or urinary bilharzia (aka schistosomiasis) and malaria.
A baseline of these waterborne diseases will be established before the complete inundation of the reservoir; monitoring of these waterborne diseases will be carried out in the years following complete inundation. If required, both types of bilharzia can be easily treated with the drug Praziquantel, while malaria can be effectively controlled through the distribution and use of impregnated mosquito nets.

Reduction in annual downstream flow as a result of increased FSL.
Low
Increases in the historical firm yield, reduced spillage and higher evaporation losses (yield and spillage) are estimated to decrease downstream flows by approximately 5.1%.
Environmental water release requirements incorporated into Operating Rules. Implementation of environmental water releases and monitoring programs.

Invasion of non-native species on bare soil and in dam reservoir.
Low
A number of potential invasive species are present in the vicinity of the reservoir, including *Parthenium hysterophorus* as an alien herb and seed bank. Increased reservoir area might possibly result in increased infestation of aquatic plants currently present (Water Lettuce *Pistia stratiotes*; Water Hyacinth *Eichhornia crassipes*; Red Water Fern *Azolla filiculoides*; and Kariba Weed *Salvinia molesta*), particularly if eutrophic conditions develop.
Monitoring measures to be implemented will be specified in the Reservoir Management Plan, including a longer-term contingency plan to be developed with ARA-Sul. Basin wide collaboration through TPTC and upstream with the SANParks biocontrol program, to be put in place. Currently, the South African National Parks Board (SANParks) is controlling alien plants in the river systems of Kruger National Park.

Threat to aquatic and riparian biota and habitats as a result of increased FSL.
Low
No habitats or species of conservation importance or concern were collected or identified (IUCN Red List). Since Corumana Dam has been in place and the reservoir has been in operation since 1989, there is no new threat to migrating fish species.
Environmental Monitoring Plan provides for regular biological monitoring in the reservoir and downstream of the Corumana Dam.

Negative environmental footprint from construction of the saddle dam with fuse plug emergency spillway.
Low
The saddle dam will cover an area of approximately 0.1km² (10 ha) of Floodplain Grassland.
Relatively small area of habitat loss with no specific mitigation measures. Habitat is well represented in the project area.

Temporary loss of habitat in footprint of emergency spillway and temporary impacts of erosion.
Low
Excavation for the emergency spillway will temporarily remove approximately 0.4 km² (40 ha) of Floodplain Grassland. During and immediately after, the area is vulnerable to erosion which may lead to increased suspended solids in runoff. In the long term, however, surrounding grass species are likely to re-establish themselves in the exposed area.
Construction and Workers Camp Management Plan requires contractors to plan all excavations, topsoil and subsoil storage so as to minimize runoff and erosion. Managed re-vegetation—using native plant species—by the Contractor of this area will assist natural restoration.

Inundation of habitats following 1 in 1,000 year return period flood would activate the fuse plug and channel water through a re-vegetated arch. The floodplain grassland will be impacted. A channel will be constructed as part of the project to discharge water from the reservoir.
<table>
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<tr>
<th>No</th>
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<th>Impact</th>
<th>Details</th>
<th>Mitigation</th>
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<tbody>
<tr>
<td>14</td>
<td>Backwater effect on riparian vegetation as a result of increased FSL.</td>
<td>Low</td>
<td>Backwater effects and induced sedimentation due to increasing the FSL of the dam will affect riparian vegetation upstream the reservoir during flood events. This area was severely affected as a result of the 1 in 100 year flood in 2000. Impact on the non-marginal zone not considered significant given that all plants collected were classified as Least Concern. No plants of high conservation value were observed at the assessed area.</td>
<td>Environmental Monitoring Plan provides for continued monitoring to allow for long term assessment. The new Operating Rules for the Corumana Dam are expected to minimize the frequency and duration of any backwater flooding within the Kruger National Park.</td>
</tr>
<tr>
<td>15</td>
<td>Negative impact on upstream macroinvertebrate fauna as a result of increasing the FSL.</td>
<td>Low</td>
<td>An increased FSL to 115 or 117 masl may induce sedimentation and inundation upstream. However, impact is considered to be low as extent of sedimentation and inundation is expected to be over a small area confined within the existing channel.</td>
<td>Environmental Monitoring Plan includes assessment of macroinvertebrates and how they respond to any long-term negative impacts</td>
</tr>
<tr>
<td>16</td>
<td>Negative impact on upstream fish populations due to induced sedimentation at higher FSL</td>
<td>Low</td>
<td>An increased FSL to 115 or 117 masl may induce sedimentation and inundation upstream. However, impact is considered to be low as extent of sedimentation and inundation is expected to be over a small area confined within the existing channel.</td>
<td>Environmental Monitoring Plan includes fish monitoring to assess and respond to any long term negative impacts</td>
</tr>
<tr>
<td>17</td>
<td>Negative impact of reduced downstream flows on aquatic and riparian environments and increased erosion as a result of increasing the FSL.</td>
<td>Low</td>
<td>The aquatic and riparian environments downstream the dam have been shown to be impacted significantly by anthropogenic activities. Riparian vegetation described as Largely Modified, macroinvertebrate fauna Seriously Modified and fish fauna as Moderately Modified. The estimated 5.1% reduction in downstream flows at FSL 117 masl is not expected to have a significant negative impact. The impacts on aquatic flora and fauna downstream as a result of increased erosion of the river channel immediately downstream of the dam wall is considered a Low Impact.</td>
<td>Environmental Monitoring Plan provides for downstream assessment of any longer-term changes in aquatic and riparian ecosystems.</td>
</tr>
<tr>
<td>18</td>
<td>Construction impacts</td>
<td>Low</td>
<td>The application of improper construction methodologies and outdated machinery as well as improper handling, storage, use and disposal of construction materials and wastes during construction could result in the pollution of soil, groundwater and air.</td>
<td>Construction and Workers Camp Management Plan, along with the Construction EMP (CEMP) to be prepared and implemented by the Contractor, outlines necessary measures to manage and mitigate negative construction impacts.</td>
</tr>
<tr>
<td>19</td>
<td>Negative impact on ability of fish populations to adjust as a result of increasing FSL.</td>
<td>Very Low</td>
<td>Increasing the FSL of the reservoir will most likely enlarge the existing fishery in the reservoir (estimated net increase of total size of fishery is expected to increase by 2%). The common artisanal species present in the reservoir are environmental generalists (Sharptooth Catfish Clarias garteipus; Common Carp Cyprinus carpio; and Mozambique Tilapia Oreochromis mossambicus). Although the reservoir will expand in area, it is unlikely to undergo changes that would significantly harm existing fish populations, including of the species with more specialized ecological requirements.</td>
<td>Implementation of the Fisheries Program as part of the Reservoir Management Plan includes includes regular monitoring, improved zoning to protect fish breeding habitats, and improved management.</td>
</tr>
<tr>
<td>20</td>
<td>Increased seepage from the dam embankment.</td>
<td>No</td>
<td>Seepage from the dam has been observed on the downstream side of the embankment. Increasing the FSL to 117 masl could increase the pressure on the geotechnical investigations carried out as part of Dam Safety Audit during project preparation.</td>
<td>Geotechnical investigations carried out as part of Dam Safety Audit during project preparation.</td>
</tr>
<tr>
<td>No</td>
<td>Risk</td>
<td>Impact</td>
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|    |                                         |        | seeage area and increase flow. However, the project will reduce this impact to none through the dam safety assessment and design contract for the dam works to be financed by the project.                                      | Remedial measures to be financed under project implementation  
Dam safety Panel of Experts appointed to advise on safety aspects                                                                                                                                                                                      |
| 21 | Loss of physical cultural heritage      | -      | The only sites with cultural and historical value around the Corumana Dam are the Mahungo and Malengane mounts where massacres occurred during the war of 1976-1992. Family graves are considered sacred places. | Additional survey and salvage of archeological items and fossils as part of the Inundation Preparation Plan  
Construction and Workers Camp Management Plan includes chance finds procedures for archaeological relics, fossils, or other physical cultural resources that might be uncovered during construction.  
Resettlement Action Plan provides for addressing family graves                                                                                                                     |
EMP Activities

The Environmental Management Plan outlines a series of activities that are to be implemented during the project to address the potential environmental issues identified as part of the assessment and enhance the long term sustainable operation of the dam. This includes a series of measures to be adhered to during the detailed design, tendering, construction phases of the project, along with longer term measures that should be integrated into the operations of the dam.

Given these longer term objectives, the EMP recommends a number of plans that need to be developed and implemented during the project. These will be done with the support of an independent, professional environmental and social management consulting firm to support ARA-Sul and assist ARA-Sul staff through on-the-job and formal training in enhancing the internal capacity for environmental and social management so that longer term environmental and social management issues can be handled by ARA-Sul environmental and management staff. Specific measures include the following:

i. **Construction and Workers Camp Management Plan** to minimize the potential negative impacts of construction activities and outline the Contractors responsibilities in relation to environmental management, along with Environmental Supervision by the Supervising Engineer, as part of their contract. The EMP is to be included in the tender documentation to ensure that all Contractors and sub-contractors comply with the requirements of the EMP. Based on the EMP, the Contractor(s) will prepare and implement as part of their contractual arrangement their own EMP, called Construction EMP (CEMP). More complex environmental management issues will be handled through the preparation and implementation of Method Statements, which will need to be approved by the Supervising Engineer and the Client’s Environmental and Social Management Team;

ii. **An Inundation Preparation Plan** prepared during the first year of project implementation and implemented prior to impoundment. This would include the following:

   a. Identification and removal of potential sources of water contamination, such as garbage dumps and latrines in order to protect water quality;

   b. Limited biomass clearing within carefully selected portions of the area to be inundated to facilitate fishing and navigation on portions of the reservoir. The areas which would be cleared will be discussed with key stakeholders;

   c. Survey and transplant of threatened plant species if found within the area to be inundated;
d. Survey and salvage of physical cultural resources, including potential archaeological sites and fossils;

e. Baseline survey on water-borne diseases in the wider project area with a focus on intestinal and urinary bilharzias and malaria; and

f. Preparation of an Emergency Preparedness Plan (EPP) in order to warn the population around the reservoir and downstream of the dam in case of severe flooding around the reservoir and downstream of the dam, large operational flood releases and emergency situations. A draft EPP has been prepared under a separate contract during preparation. The final EPP will be approved 12 months before reservoir inundation.

iii. A Reservoir Management Program that would be prepared during the first two years of implementation and include the following:

a. Environmental Zoning of the reservoir (e.g. for fishing and controlled hunting) and the area around the reservoir through a consultative process with all major stakeholders in order to protect wildlife resources, biodiversity, and water quality;

b. Patrolling designated sections of the Corumana Reservoir to reduce wildlife poaching risks, in collaboration with the conservation area managers and local fishing communities;

c. Management of the catchment area around the reservoir in Mozambique in order to protect the reservoir from excessive sedimentation, eutrophication in order to protect water quality, particularly since the Corumana reservoir is a drinking water reservoir;

d. Reservoir fisheries development and management for the development and management of the reservoir fisheries, based on sustainable harvests of native fish species; and

e. Invasive Aquatic Plant Management to monitor the spread of non-native aquatic plant species (such as water hyacinth, salvinia and azolla) and outline control options in the event that infestation becomes problematic

iv. An Environmental Water Releases Program that would take into account considerations such as (i) limiting backwater flooding within the Kruger National Park; (ii) ensuring an adequate area of floodplain grasslands along the reservoir shoreline, to provide grazing for wildlife and livestock; (iii) reducing impacts to downstream channel morphology, including river bank erosion; and (iv) enhancing downstream water quality, along with the conditions for fish and other aquatic life. This program will recommend technical criteria and decision-making procedures for environmental water releases; these recommendations will
serve as a key input to the revised Operating Rules for the Corumana Dam. The new Operating Rules will be approved by ARA-Sul prior to any raising of the reservoir’s full supply level above the current 111 meters asl. This program will include long-term monitoring of water quality, fish species, macroinvertebrates, and other environmental quality parameters, to provide a feedback mechanism for future adjustments to environmental water releases from the Corumana Dam; and

v. **An Environmental Monitoring Plan** for the monitoring of primarily water quality in the reservoir and downstream of the dam, sedimentation deposition upstream of the dam, downstream river morphology and impacts on wildlife, effectiveness of the control of poaching etc.

Each of these activities and tasks are described further below.

### Institutional Responsibilities

The Environmental Management Plan outlines the institutional roles and responsibilities in relation to each of the activities and mitigation measures proposed under the EMP during construction and operation. This includes those during implementation and for the long term operation phase. These are summarised as follows:

- The National Directorate of Water (DNA), as the dam owner and executing entity for the IDA financed project, has overall responsibility during implementation for ensuring compliance with the provisions of the EMP. The DNA will report at a minimum every three months to the GoM and Lenders;

- The Regional Water Authority – Southern Region (ARA-Sul), as the Dam Operator, has responsibility for implementing the activities required under the EMP and shall be responsible for inclusion of these in the long term operation phase. ARA-Sul will report at a minimum every three months to DNA;

- The Environmental and Social Management Team (ESMT), headed by staff from ARA-Sul and supported by technical assistance under the project through an independent consulting firm, will develop and implement the activities under the EMP during project implementation and support capacity enhancement within ARA-Sul to support integration of long-term activities into the operation of the dam. This team will also need to approve the Construction EMP (CEMP) and Method Statements. The ESMT will report at a minimum every month to ARA-Sul;

- The Supervising Engineer will include one or more qualified environmental specialists with responsibility for monitoring and auditing the Contractors compliance with the Construction and Workers Camp Management Plan and the Contractors EMP, which will form
part of the implementation specifications and contractual arrangements of the Contractors. The Supervising Engineer will report monthly to the ESMT;

- The Contractor, who will appoint an Environmental Manager, will be responsible for the daily, on-site implementation and management of the provisions required under the Construction and Workers Camp Management Plan. The contractor will prepare and implement as part of their contract, a Construction EMP (CEMP) which will be implemented by the Contractor’s Environmental Management Unit headed by an Environmental Manager. For more complex environmental management issues the Contractor prepares Method Statements, which will need to be approved by the Supervising Engineer and the ESMT. The Environmental Manager reports weekly to the Supervising Engineer; and

- The Ministry for Coordination of Environmental Affairs (MICOA) is by law responsible for ensuring compliance with national environmental legislation, including audit and site inspection functions during construction and operation and of those activities that are likely to cause negative environmental impacts, to verify that the approved EMP and its approval conditions are being implemented as stipulated in the Environmental License.

**Responsibilities of DNA**

The National Directorate of Water (DNA), as the owner of the dam on behalf of the GoM and executing entity for the IDA financed project, has responsibility for the following:

- Ensure compliance with provisions of the EMP, national legislation, policies and plans in relation to the environment and water resources management measures as well as with World Bank Operational Policies;

- Provide technical support to ARA-Sul in implementation of activities under the EMP; and

- Provide regular progress reports during implementation to ARA-Sul, DNA, MICOA, and the World Bank on compliance with the EMP.

**Responsibilities of ARA-Sul**

The Regional Water Authority – Southern Region (ARA-Sul), as the Dam Operator, has responsibility for the following:

- Oversee implementation of all activities required under the EMP;
• Nominate a member of ARA-Sul staff to coordinate implementation of the EMP as head of the project’s Environmental and Social Management Team;

• Make ARA-Sul staff available for environmental training, including working collaboratively with the Technical Assistance provided under the project to implement particular environmental management measures;

• Provide qualified staff to carry out recurrent tasks included under the EMP, such as biomonitoring, reservoir patrols and water quality monitoring, or ensure that such activities are carried out through operating agreements or contracts with other entities;

• Oversee the work of the Supervising Engineer and the Civil Works Contractor and associated subcontractors;

• Oversee that the Supervising Engineer will employ one or more qualified environmental specialists who will be responsible for the monitoring of the adequate implementation of the CEMP and Methods Statements as part of their contract;

• Facilitate adaptive responses to any unforeseen environmental and social problems that arise during project construction; and

• Apply all appropriate financial penalties in case of non-performance or serious non-compliance with the EMP, CEMP prepared and implemented by the contractor(s), or other environmental legal requirements.

Responsibilities of the Environmental and Social Management Team

The Environmental and Social Management Team (ESMT) will be headed by a suitably qualified staff member from ARA-Sul and supported by Technical Assistance financed under the project. This Technical Assistance will be provided through an independent consulting firm retained through a competitive selection process.

The ESMT will be responsible for the following:

• Implement activities under the EMP for the duration of the project;

• Revise and update the EMP as required to reflect the requirements at the design, tendering, construction, and operational phase of the project. Any substantive changes to the EMP will be subject to the review and No-Objection of MICOA and the World Bank;

• Support capacity enhancement within ARA-Sul for integration of long-term activities within the operation of the dam;
• Assist in development and implementation of activities envisaged under the EMP during Year 1 of project implementation, before bidding begins on the civil works for Corumana Dam completion;

• Liaise with and take into due consideration stakeholder comments received on the EMP, implementation of the activities contained herein, or any related documentation associated with the works at the Corumana Dam;

• Ensure the development and the timely implementation of all plans and tasks, except for those tasks specifically assigned to other entities such as the Civil Works Contractor or Supervising Engineer;

• Approve the Construction EMP (CEMP) and Method Statements.

• Train and otherwise build capacity within ARA-Sul (formal and on-the-job training) to carry out those EMP activities that are recurrent or longer term in nature, extending beyond the time horizon of the project;

• Liaise with ARA-Sul as the dam operator, and the design engineer, to ensure that environmental flows recommendations are adequately reflected in the Operating Rules for the Corumana Dam and that long term systems and capacity is in place for environmental monitoring; and

• Provide monthly progress reports during implementation to ARA-Sul, DNA, MICOA, and the World Bank.

**Responsibilities of the Supervising Engineer**

The Supervising Engineer will be a firm contracted by DNA or ARA-Sul to supervise closely the daily work carried out by the Civil Works Contractor and relevant sub-contractors, including the environmental, social, health, and safety aspects.

The staff with environmental responsibilities for the Supervising Engineer will include (at a minimum) an Environmental Supervisor, who will lead the supervision of the environmental, social, health and safety aspects of Corumana Dam civil works, in accordance with the Construction and Workers Camp Management Plan and the Construction EMP (CEMP) that comprises part of the EMP.

The responsibilities of the Supervising Engineer include the following:

• Carry out regular environmental, social, health and safety site surveillance to investigate the Contractors’ site practice, equipment, work methodologies, and implementation of Method Statements with respect to pollution control and adequacy of environmental mitigation implemented, health and safety practices, and to ensure that the Construction and Workers Camp Management Plan and CEMP are complied with;
- Monitor regularly the implementation of environmental mitigation measures and the Contractor’s compliance with environmental protection, pollution prevention and control measures, health and safety at the construction site and off the construction site (e.g. speed limits), and contractual requirements;

- Advise the Contractor and associated sub-contractors on environmental improvement, awareness, and proactive pollution prevention measures;

- Specify remedial mitigation measures that the Contractor must carry out, in the case of non-compliance with any part of the EMP, CEMP or other environmental legal requirements. Oversee the implementation of remedial measures to reduce environmental damage and improve health and safety practices of the Contractor;

- Calculate the financial penalties that the Contractor will suffer for particular types and length of environmental, social, health and safety non-compliance. These penalties need to be part of the Contractor’s contract; and

- Ensure that environmental, social, health, and safety issues are prominently mentioned in the Supervising Engineer’s periodic progress reports to ARA-Sul.

**Responsibilities of the Civil Works Contractor**

The Contractor for the works associated with completion of the Corumana Dam shall be responsible for full compliance with the letter and spirit of all environmental mitigation, as well as social, health and safety measures specified in the Construction and Workers’ Camp Management Plan and the Construction EMP. The Contractor will prepare and implements as part of their contract a Construction EMP (CEMP) which will be implemented by the Contractor’s Environmental Management Unit headed by a workplace Environmental Manager (EM). For more complex environmental management issues, the Contractor will prepare Method Statements that will need to be approved by the Supervising Engineer and the ESMT. The Environmental Manager reports weekly to the Supervising Engineer.

All Contractors and associated sub-contractors shall also ensure compliance with all Mozambican environmental laws and regulations, applicable World Bank Operational Policies (safeguard policies) and World Bank Group Environmental, Health and Safety Guidelines of April 2007, as well as international conventions. The Contractor shall appoint the workplace Environmental Manager and additional environmental specialists and staff as needed.
The EM is expected to have at least five years relevant working experience regarding environmental and social management of infrastructure construction projects, and should be familiar with Mozambique’s environmental legal requirements.

The Contractor will be responsible for ensuring that all sub-contractors and workers are adequately informed and trained to comply fully with the letter and spirit of all environmental requirements specified in the EMP, the CEMP, the Environmental License(s) granted by MICOA, and other Mozambican and international legal requirements.

Responsibilities of Ministry for Coordination of Environmental Affairs (MICOA)

The Ministry for Coordination of Environmental Affairs (MICOA) is responsible for project classification, review of the environmental impact assessment process, issuing of environmental licenses, and compliance monitoring.

According to the national Environment Act (Law No. 20/97 of October 1) all public and private activities with the potential of negative environmental impact, must be preceded by an Environmental Impact Assessment (EIA) with a view to obtaining an Environmental License (EL). The EL precedes any other legal license required. The Process of Environmental Impact Assessment is regulated by Decree No. 45/2004 of September 29, which recently has been updated in some of its provisions through the Decree No. 42/2008 of November 4.

MICOA is primarily responsible for:

- Classifying projects in line with the Regulation of the Process of Environmental Impact Assessment (Decree No. 45/2004 of September 29);

- Reviewing and approving the Pre-Feasibility Study and Scoping Definition (EPDA) report and terms of reference (EPDA/ToR) through its National Directorate for Environmental Impact Assessment (DNAIA) in line with the General Directive for Environmental Impact Studies (Ministerial Diploma 129/2006 of July 19) for Category A projects;

- Issuing the Environmental License through DNAIA pending approved EIA and EMP reports;

- Undertaking public environmental audits as regulated by the Environmental Audit Process (Decree No. 32/2003 of August 20) which also regulates any privately executed environmental audit; and

- Any environmental inspection as regulated by Environmental Inspection Process (Decree No. 11/2006 of July 15) which grants full access to sites and required information, and governs other legal mechanisms for inspection, supervision, control and surveillance of compliance with environmental protection.
Construction and Workers Camp Management Plan or Construction EMP

Introduction
The Construction and Workers Camp Management Plan contains specifications for technical and management procedures and practices for mitigating environmental, social, health and safety impacts from construction and workers camps, i.e. construction sites, workshops, temporary stockpile sites, fuel installations, other storage and work areas and workers’ accommodations. The enforced wearing of the appropriate Personal Protection Equipment (PPE) will be an essential tool to reduce safety and health risks.

It is intended that this plan will form part of the implementation specifications and contractual arrangements of the Contractor. The Environment and Social Management Team will review and revise the specifications outlined in the Construction and Workers Camp Management Plan, as well as the Construction EMP (CEMP) and Method Statements which will be prepared and implemented by the Contractor(s), in consultation with the detailed design and tender documentation preparation, as needed. Any revisions will be submitted to DNA for review and approval, as well as to MICOA and the World Bank when required.

Objective
The objective of the Construction and Workers Camp Management Plan or the Construction EMP is to minimize the potential negative impacts of construction activities, including workers’ camps and construction traffic, on host communities, wildlife and the environment, on the local population and to minimize health and safety risks. The Contractor prepares and implements their own CEMP, which includes the management and mitigation of construction and work camp related activities on host communities, wildlife and the environment. These impacts should include HIV/AIDS awareness and prevention activities, noise/dust management and management of construction related traffic.

Table 0-2. Overview of construction-related impacts to be mitigated through the Construction and Workers Camp Management Plan or Construction EMP (CEMP) and Method Statements prepared and implemented by the Contractor

<table>
<thead>
<tr>
<th>Environmental, Social and Health and Safety Impacts</th>
<th>Source</th>
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| **Soil and groundwater pollution** | - Spillages of fuel, lubrication oils and hydraulic fluids from construction vehicles and machinery and spills from storage areas  
- Improper methodology for mixing of cement and concrete  
- Disposal of construction wastes |
| **Surface water pollution** | - Inundation of pit latrines, rubbish dumps etc  
- Erosion from work sites, including the excavation for emergency spillway  
- Spillages of fuel, lubrication oils, hydraulic fluids or other hazardous substances from construction vehicles and machinery or spillages from storage areas  
- Stormwater run-off  
- Discharge of wastewater from construction sites or workers camp  
- Washing of vehicles or equipment |
| **Air Pollution** | - Dust emission (from road use and transportation of materials; exposed soil in working areas and during reservoir clearance; material stockpiles, quarry operations, aggregate crushing, blasting at the quarry and work sites, and cement manufacturing.  
- Particulate and gas emissions from construction machinery and vehicles |
| **Noise and vibration** | - Heavy vehicles and construction machinery, blasting |
| **Traffic related and construction accidents** | Construction activities and construction related traffic could lead, if not well managed, to an increase in construction related accidents. The CEMP needs to contain detailed specification how to minimize construction related accidents through the preparation and implementation of a Contractor Health and Safety and Traffic Management Plan. |
| **Waste** | - Inert construction waste  
- Household waste  
- Hazardous construction waste |
| **Increase in HIV/AIDS infections** | Construction workers sexual activities could increase HIV/AIDS infections. An awareness creation program for workers and surrounding communities will be needed and workers should have access to sufficient free condoms. |
| **Disturbance to flora and fauna** | - Construction worker and contractor activities that could harm animal and plant life in the project area, such as hunting, wildlife capture, burning of vegetation |
Specifications

Requirements for workers and construction camps and sites

Construction camps includes all construction sites, workshops, temporary stockpile sites, fuel installations, other storage and work areas, required by the Contractor, subcontractors and suppliers.

The camps shall be constructed and operated so that nuisances of operations and pollution of air, soil, groundwater and surface waters are avoided or minimised. In addition the health and safety of workers and the local population shall be taken into consideration. Specific requirements for the construction and operation of the sites to fulfill this are outlined in the following.

Locality and site plan

The Contractor shall submit a locality and site plan of all construction camps and any new or improved access roads. This site plan will indicate the location of fuel supplies, stockpile sites, offices, and the construction area for approval by DNA prior to establishing any camps or access roads. Site offices and storages and workshops shall be located more than 200 m from existing residential settlements and not close to water bodies. The Contractor must make every feasible effort to choose the location of construction camps, access roads, and other ancillary facilities so as to avoid or minimize the clearing of natural vegetation.

Fencing of the sites

The “sites” here refers to all areas required for construction purposes, including quarries and staff/employee living quarters. The boundaries of the site shall be demarcated prior to any work commencing on the site. It is the responsibility of the Contractor to decide on an appropriate system of protective fencing for the site. The site boundary demarcation fence shall be removed when the site is decommissioned and fully or almost fully restored to its original state.

The Contractor shall ensure that all their plants, labour and materials remain within the boundaries of the site and he shall ensure that materials used for construction on the site do not blow on or move outside the site.

Materials Handling and Storage

In order to mitigate pollution of soil, groundwater and surface water the procedures for handling and storage of materials outlined below shall be complied with.

The Contractor shall ensure that he is familiar with the requirements for the safe storage, handling and disposal of petroleum, chemical, harmful and hazardous materials.

The Contractor shall ensure that information on all hydrocarbons, petroleum, chemical, harmful and hazardous substances are available to all personnel on
site. The Contractor shall furthermore be responsible for the training and education of all personnel on site who will be handling the material about its proper use, handling and disposal.

**Fuel Storage.** Fuels required for use during construction shall be stored in an enclosed central depot at the construction camp at distances of at least 50 m from any water course, water body or well.

Fuel tanks shall be placed on a concrete, or similar impermeable, base surrounded by a brick bund without drainage points or other breaches. The bund shall have a volume of at least 110% of the maximum capacity of the tank. If more than one tank is stored within the bund, the system must be capable of storing 110% of the capacity of the largest tank or 25% of the capacity of all tanks.

Accumulated rainwater in bunds shall be pumped out of the bund to either drains or the ground if uncontaminated. In case of fuel spillage the spilled fuel should be recollected and contaminated bund treated by the absorbents: sawdust, sand or straw. All fuel/hydrocarbon dispensing nozzles are to be of a drip control design and securely locked when not in use.

Tanks containing fuels shall have lids and shall remain firmly shut. Only empty and externally clean tanks may be stored on the bare ground. All empty but externally dirty tanks shall be stored on an area where the ground is protected (e.g. concrete slab, covered store house, etc.).

Gas and liquid fuel shall not be stored in the same storage area.

The Contractor shall take all the necessary precautions to prevent fires or spills at the fuel stores. No smoking shall be allowed inside the stores and within 3 m of a bund.

The Contractor shall ensure that there is adequate fire-fighting equipment at the fuel stores and at the construction sites. At the construction sites no smoking will be allowed. Designated smoking areas will need to be indicated.

**Lubricant Storage.** Lubricants shall be stored in drums or tins that are either sealed or have tightly fitting caps. All containers must be closed unless in use. Decanting of lubricants must be carried out in a specific area that has been previously identified and suitably protected.

The floor of any storage of decanting area shall be impervious (such as concrete) to lubricants and kept clean at all times. The floor shall slope towards a central sump, all liquids collected in the sump shall be disposed of as hazardous waste.

Lubricants shall be stored under cover in a no smoking area.

All lubricant impregnated cotton waste and rags shall be promptly disposed of and handled as hazardous waste.
Explosives and Blasting. Explosive materials storage must be away from residential areas, administrative areas or other public areas, the location of the storage must be accepted and approved by relevant authority and comply with existing Mozambican regulations and international standards. Also the transport of explosives needs to comply with Mozambican and international standards. As part of the Construction EMP (CEMP) the Contractor prepares and implements an approved Blasting Plan. Local communities need to be made aware of the contents of this Blasting Plan. It is recommended that the Contractor makes a photographic inventory in a circle of 500 to 800 meter from the blasting site of property that could be damaged in order to avoid illegal claims after blasting. The Blazing Plan needs to be approved by the Supervising Engineer and the ESMT. Explosives must be securely guarded, with precise record-keeping of inventory. Unauthorized use of explosives (such as for fishing) must be strictly prohibited and enforced.

Servicing and Refuelling of Construction Equipment

The Contractor shall ensure that all servicing and/or refueling of vehicles and equipment takes place within the construction camp at a designated area situated more than 50 m from any watercourse, water body or well. Vehicles must not be left without supervision during refuelling.

The ground under the servicing and refueling areas shall be protected against pollution caused by spills and/or tank overfills. The method of protecting the ground shall be identified by the Contractor and agreed in writing with the Principal Agent prior to being installed. All waste shall be collected and separated according to type of waste, contained on site and stored in water-tight containers prior to disposal off-site as hazardous waste at a site approved by MICOA. All equipment that leaks shall be repaired immediately or removed from the site.

The Contractor shall only change oil or lubricants at agreed and designated locations, except if there is a breakdown or an emergency repair. In such instances, the Contractor, shall ensure that he has Drizit pads or similar, and/or drip trays available to collect any oil or fluid. The only permitted method of refueling and refilling lubricants is by means of a pump.

Accidental Spills

The Contractor shall take all reasonable precautions to prevent the pollution of the ground and/or water resources on and adjacent to the site as a result of their activities.

Such pollution could result from the release, accidental or otherwise, of chemicals, oils, fuels, sewage and waste products and so forth

The Contractor shall be responsible for establishing an emergency procedure for dealing with spills or release of petroleum, chemical, harmful and hazardous materials. He shall also ensure that the relevant construction personnel are familiar with these emergency procedures.
All spills or accidents involving such materials are to be recorded. The clean up of spills and any damage caused by the spill shall be for the Contractor’s account.

The Contractor shall obtain Drizit pads and booms, or similar designed products or materials to soak up oil, petrol and diesel. These materials shall be readily available for use wherever construction equipment is working, fuel and lubricants is being offloaded and stored and equipment is filled and serviced. The Contractor shall ensure that he is familiar with the correct use and disposal of any materials designed to soak up petroleum products.

The Contractor shall ensure that no oil, petrol, diesel, and the likes are discharged onto the ground or in watercourses.

Pumps and other machinery requiring oil, diesel, and similar products that are to remain in one position for longer than two days shall be placed on drip trays. The drip trays shall be watertight and shall be emptied regularly and the contaminated water disposed off-site at a facility capable of handling such waste liquid. Drip trays shall be cleaned before any possible rain events that may result in the drip trays overflowing, and before long week ends and holidays.

The Contractor shall remove all oil, petrol, diesel-soaked soil immediately and shall dispose of it as hazardous waste.

**Cement and Concrete Operations**

Cement and concrete shall be regarded as materials that are potentially damaging to the natural environment on account of the very high pH of the material, and the chemicals contained therein. The Contractor shall ensure that all operations that involve the use of cement and concrete are carefully controlled.

Concrete mixing shall only take place in the construction camp or in agreed specific areas on site.

Concrete must not be mixed directly on the ground.

Water and slurry from concrete mixing operations shall be contained to prevent pollution of the ground surrounding the mixing points. Old cement bags shall be placed in wind and spill proof containers as soon as they are empty. The Contractor shall not allow closed, open or empty bags to lie around the site.

Where exposed aggregate finishes are specified the Contractor shall collect all cementladen water and store it in conservancy tanks for disposal off site at an approved disposal site.

All visible remains of excess concrete shall be physically removed immediately and disposed of as waste. Washing the visible signs into the ground is not acceptable. All excess aggregate shall also be removed.

**Solid Waste Management**
The Contractor shall institute a waste control and removal system for the site.

All waste shall be disposed of off site at an approved landfill site. Burning of waste on any construction site is forbidden.

The Contractor shall supply waste bins/skips for waste separation (e.g., paper carton, glass, plastic bottles, wood etc.) throughout the site at locations where construction personnel are working. The bins shall be provided with lids and an external closing mechanism to prevent their contents blowing out and shall be scavenger-proof to keep out baboons and other animals that may be attracted to the waste. The Contractor shall ensure that all personnel immediately deposit all waste in the waste bins for removal by the Contractor. Bins shall be emptied on a daily basis and the waste removed to a temporary storage sitewhere it shall be properly contained in water and windproof containers until disposed of. The bins shall not be used for any purposes other than waste collection.

It shall be forbidden to mix non-hazardous waste with hazardous waste. Hydrocarbons, petroleum, chemical, harmful and hazardous waste throughout the site shall be stored in enclosed areas. The enclosed areas shall be clearly marked. Such waste shall be disposed of off site at a MICOA approved hazardous waste disposal site.

The personnel involved in the handling of hazardous and non-hazardous waste shall undergo specific training in:

- Waste handling;
- Waste treatment; and
- Waste storage and waste separation.

**Waste Water Management**

**Discharge of Construction Water.** The Contractor shall construct and operate the necessary collection and wastewater treatment facilities for wastewater to prevent pollution. In case where water is mixed with oil, oil/water separators shall be installed. The oil should be stored in drums as hazardous waste and disposed off in approved manner. The Contractor shall dispose of collected waste water in a manner agreed with the ESMT and MICOA.

The Contractor may discharge “clean” silt laden water overland, preferably grass land at the construction site and allow this water to filter into the ground. However, he shall ensure that he does not cause erosion as a result of any overland discharge.

All washing of plant/equipment/concreting equipment and the likes shall take place within the construction camp. Water from washing operations shall be collected in a conservancy tank removed them the site and disposed of in the
agreed manner. The Contractor is encouraged to recycle dirty wash water to
minimise the amount required to be removed off-site.

Trucks delivering concrete shall not wash the trucks or the chutes on the site or
in any environmentally sensitive areas. All washing operations shall take place
off-site at a location where waste water can be disposed of in an acceptable
manner.

Kitchen wastes shall be disposed into soak pits. Wastewater from campsites will
be discharged and disposed in a kitchen sump located at least 15 meters from any
body of water. Sump capacity should be at least 1.3 times the maximum volume
of wastewater discharged. The bottom of the pit should be filled with coarse
gravel and the sides shored up with board, and so forth to prevent erosion and
collapse of the pit.

Sanitary wastes shall be disposed into septic tanks or treated in small compact
wastewater treatment plant(s) and disposed of in an environmentally sound
manner.

**Run-off from Construction Camp.** Natural run-off shall be diverted away from
any camp. Storm water drainage systems to discharge all surface run off from the
camp site to a silt retention pond which shall be sized to provide a minimum of
15 minutes retention for storm water flow from the whole site that will be
generated by a 20 year return period rainfall having duration of at least 15

minutes. The run-off coefficient to be used in the calculation of the silt pond

volume shall be 0.9. Silt ponds shall be maintained in an efficient condition for
use throughout the construction period with trapped silt and soil particles being
regularly removed and transported and placed in waste material disposal All
discharges from the silt retention pond shall be channelled to natural water via a
grassed swale at least 20 meters in length with suitable longitudinal gradient.

All run-offs from working areas, which contains sediment, should be collected in

settling ponds before being discharged from the premises. Water from washing,
screening, or dust reduction plants should be treated in a like manner. Accepted

methods for removal of sediment from run-off include settling ponds, hay bale

filters, aggregate filters, wetlands (shallow ponds planted with suitable swamp
plants). For borrow pits in vegetated areas, runoff should be directed through
vegetation prior to reaching any watercourse to enable further filtering of
sediment.

Erosion Control

Erosion control measures, e.g. geomembranes, hay barriers etc., shall be applied
during construction activities to prevent increased runoff into the watercourses.
Special attention shall be given to erosion control of the excavation of the
emergency spillway at the planned saddle dam south of the reservoir.

Contractor will plan all excavations, separate topsoil from subsoil and store it
separately in such a way as to reduce to a minimum any runoff. Contractors will
be required to organize and cover material storage areas and to isolate wash
down areas from watercourses by selecting areas that are not free draining into
any watercourse. Top soil should be reinstated after construction is finished.

Where any area of the spread is at risk from silt pollution washing off into a
watercourse of water body, effective measures will be put in place to ensure that
such pollution does not occur. Such measures may include:

• Use of silt fences or geomembranes
• Use of straw bales to deflect and filter water
• Use of a system of bunds and grips to prevent water from entering
  watercourses and so forth

Stockpiles, Borrow Pits and Quarries

Borrow pits and quarries shall be prohibited where they might interfere with the
natural or designed drainage patterns. Riverbed locations shall be prohibited if
they might undermine or damage the river banks, or require works in the wetted
area, which carry too much fine material downstream.

Ideally the borrow pits should be located within the future inundation zone of the
raised reservoir. If this is not possible the following measures must be taken. The
Contractor shall ensure that all borrow pits and quarries are rehabilitated to its
original or near original state after construction finishes. This means the
rehabilitated quarries should be in a tidy condition with stable side slopes, and
are drained ensuring that no stagnant water bodies are created which could breed
mosquitoes, and other sources for waterborne diseases.

In any borrow pit and disposal site, the Contractor shall:
• Identify and demarcate locations for stockpiles (separate areas for top soil and sub-surface soil) and borrow pits, ensuring that they are at least 15 meters away from critical areas such as steep slopes, erosion-prone soils, and areas that drain directly into sensitive water bodies (except the sites designed with rock wall to cover the surroundings).

• Limit extraction of material to approved and demarcated borrow pits.

• Stockpile topsoil when first opening the borrow pit. After all usable borrow has been removed, the previously stockpiled topsoil should be spread back over the borrow area and graded to a smooth, uniform surface, sloped to drain. On steep slopes, benches or terraces may have to be specified to help control erosion.

• Excess overburden should be stabilized and re-vegetated. Where appropriate, organic debris and overburden should be spread over the disturbed site to promote re-vegetation. Natural re-vegetation is preferred to the extent practicable. If natural regeneration is not adequate for the site, then managed re-vegetation will need to be carried out, taking care to avoid the use of any non-native, potentially invasive species.

• Once the job is completed, all construction-generated debris should be removed from the site.

Alternatively the borrow pit could be rehabilitated into shallow wetlands that are attractive to birds, fish, amphibians, reptiles and other fauna. Such rehabilitation should include:

• Re-shaping of the pits so that they have gentle slopes in order to facilitate animals to drink and that they have a relatively natural shape.

• Introduction of native fish species to facilitate development of a wetland ecosystem and control mosquito numbers.
For this activity, the contractor shall provide a specific Method Statement subject to approval by DNA, the Supervising Engineer and the Environmental and Social Management Team.

Minimization of the total disturbed area is the best method of reducing erosion caused by storm water run-off and weed invasion. Boundary markers, such as stakes and flagging tape, shall be used to indicate to machinery operators the extent of areas to be cleared.

All run-offs from working areas, which contains sediment, should be collected in settling ponds before being discharged from the premises. Water from washing, screening, or dust reduction plants should be treated in a like manner. Accepted methods for removal of sediment from run-off include settling ponds, geomembranes, hay bale filters, aggregate filters, wetlands (shallow ponds planted with suitable swamp plants). For borrow pits in vegetated areas, run-off should be directed through vegetation prior to reaching any watercourse to enable further filtering of sediment.

Control of Noise and Air Pollution

Construction machinery and vehicles generate noise and air pollution in the form of exhaust gasses. Dust from transported and stockpiled material also contributes to air pollution.

Noise and Exhaust Gases. The Contractor shall employ Best Practicable Means to control all noise generating activities. The Contractor shall identify all noisy activities together with appropriate control mechanisms. The noise levels as specified in the World Bank Goup General Environmental, Health and Safety Guidelines of April 2007, need to be complied with.

Mitigation of impacts of noise and exhaust gasses can be achieved through the following measures:

- Confining operations to reasonable operating hours. This is the simplest means of avoiding unreasonable noise impacts. Another effective means is
to provide appropriate separation distance to enable the noise to decay to acceptable levels;

- Establishing enclosures around stationary noisy activities. Solid barriers, such as bund walls and topographical features, provide the most effective 'in line' reduction of sound levels;

- Avoid using any vehicles, either on or off road with grossly excessive, exhaust or noise emissions; and

- Regular maintenance of engines to ensure that emissions are minimised, for example by cleaning fuel injectors. Routine maintenance will be to a high standard to ensure that vehicles are safe and that emissions and noise are minimised.

**Dust**

The following measures should be applied to minimize dust nuisances:

- The speed of vehicles is an important factor in the generation of dust.

The speed of all construction-related traffic should be at or below 15 km/h on streets within 200 m of the site; In addition, where transport routes are along unsealed roads, it may be advisable to slow down in the vicinity of residents along these routes. Install speed barriers and enforce speed limits of 40 km/h for this purpose.

- The nature of the material being transported and its potential to emit dust should be considered in the loading of trucks. Generally, the highest point of the load should not exceed the height of the tray walls, unless the load is covered.

- Spray water at the site, and on dirt roads, especially close to villages, cut areas and soil stockpiles or fill material as needed to minimize dust levels at areas close to housing areas.

- Stockpiles, work areas and dirt roads can be sprayed regularly with water which reduces dust development.

- Construction materials and storage piles can be sheeted.

**Sanitation**

The Contractor shall provide the necessary ablution facilities in sufficient number for all site personnel.
The Contractor shall supply an adequate number of chemical or other suitable and approved toilets throughout the site where construction personnel will be operating.

Toilets shall be easily accessible and where applicable shall be capable of being relocated. The toilets shall be secured to prevent them from blowing over, and the doors shall be provided with an external closing mechanism to prevent toilet paper from being blown out. Toilet paper dispensers shall be provided in all toilets. Toilets shall be cleaned and serviced regularly.

The Contractor shall ensure that any chemicals and/or waste from the toilets is not spilled on the ground at any time. The contractor will be required to provide a suitable and approved and to remove accumulations of chemicals and waste from the site and dispose of it at an approved waste disposal site or sewage plant base at their own expense.

Abluting anywhere other than in the toilets shall not be permitted. The Contractor shall be responsible for cleaning up any waste deposited by personnel.

**Site Restoration**

The Contractor shall ensure that all temporary structures, equipment, materials, waste and facilities used for construction activities are removed upon completion of the project. Any oil and fuel contaminated soil shall be removed and buried in waste disposal areas, soak pits and septic tanks shall be covered and effectively sealed off and the sites shall be grassed and the site shall be restored to a similar condition to that prior to the commencement of the works or to a condition agreed to with the owner of the land.

The Final EMP will also specify occupational health and safety measures to be followed during project construction and operation, including measures to raise awareness and to prevent the spread of HIV/Aids and other communicable diseases.

### Environmental Rules for Civil Works Contractor

The Civil Works Contractor shall inform all its workers and sub-contractors of **Chance Finds Procedures** for physical cultural resources that will need to be followed during every phase of project construction. Under these procedures, if any construction worker or other project-related employee or contractor discovers any potential archaeological relics, fossils, human remains, or other items or sites of potential cultural interest, they must immediately notify the Environmental Supervisor or other staff of the Supervising Engineer. The Supervising Engineer will promptly examine the evidence and, if warranted, (i) order the temporary suspension of construction activities that might otherwise harm the item or site in question and (ii) promptly notify the relevant Mozambican authority responsible for physical cultural resources, to obtain
further guidance regarding whether and how the item or site in question should be salvaged, protected, and/or documented.

The Civil Works Contractor (and any associated sub-contracts) shall enforce a **Workers’ Code of Conduct** to include the following prohibitions of the following activities:

- Cutting of trees for any reason outside the approved construction area;
- Hunting, fishing, wildlife capture and poaching, or plant collection;
- Buying of wild animals or their meat for food or any other purposes;
- Disturbance to anything with architectural or historical value;
- Building fires outside camp areas without being authorization;
- Carrying and use of firearms (except authorized security guards);
- Use of alcohol by workers during working hours;
- Washing car or machinery in streams or creeks;
- Doing maintenance (change of oils and filters) of cars and equipment outside authorized areas;
- Littering of the site and disposing trash in unauthorized places;
- Workers driving motorbikes without wearing helmets;
- Control construction plants or vehicles by unauthorized person;
- Driving at speeds exceeding limits;
- Having caged wild animals (including birds) in camps;
- Working without Personal Protection Equipment (PPE), including hardhats, boots, gloves, masks (where needed), etc.;
- Creating nuisances and disturbances in or near communities;
- Disrespecting local customs and traditions;
- The use of rivers and streams for washing of clothes and toilets;
• The use of welding equipment, oxy-acetylene torches and other bare flames where fires constitute a hazard;
• Indiscriminate disposal of rubbish or construction wastes or rubble;
• Spillage of potential pollutants, such as petroleum products;
• Collection of firewood;
• Going to the toilet outside of the designated facilities; and
• Burning of wastes and/or cleared vegetation.

3 Environmental Emergency Procedures
Prior to construction commencement, the contractor shall prepare an Environmental Emergency Plan specifying actions in the event of accidental leaks, spills or emissions. The plan shall be reviewed on regular basis and updated if necessary.

In the event that accidental leakage or spillage of diesel/chemicals/chemical wastes takes place, the following response procedures shall be followed immediately by the Contractor(s):

• The person who has identified the leakage/spillage shall immediately check if anyone is injured and shall then inform the Contractor’s Environmental Manager (EM);

• The EM shall ensure any injured persons are treated and assess what has spilled/leaked;

• Should the accident/incident generate serious environmental pollution (e.g. spillage/leakage of toxic or chemicals, large scale spillage/leakage, or spillage/leakage into the nearby water bodies which are used for irrigation/portable water), the Contractor should immediate inform DNA, ARA-Sul/the Environmental and Social Management Team, and the Supervising Engineer;

• In such cases, all personnel shall take immediate action to stop the spillage or leakage and divert the spilled or leaked liquid to nearby non-sensitive areas;
The Contractor shall arrange maintenance staff with appropriate protective clothing to clean up the chemicals/chemical waste. This may be achieved through soaking with sawdust (if the quantity of spillage/leakage is small), or sand bags (if the quantity is large); and/or using a shovel to remove the topsoil (if the spillage/leakage occurs on bare ground); and, depending on the nature and extent of the chemical spill, evacuation of the activity site may be necessary; and

Spilled chemicals must not be flushed to local surface drainage systems.

The possibility exists for environmental emergencies of an unforeseen nature to occur during the course of the construction and operational phases of the project. By definition, the nature of such emergencies cannot be known. Therefore, the Contractor shall respond on a case-by-case basis to such emergencies and shall initiate event-specific measures in terms of notifications and reactions.

The Contractor shall prepare a report on the incident detailing the accident, clean-up actions taken, any pollution problems and suggested measures to prevent similar accidents from happening again in future.

### Environmental, Health and Safety Awareness Training

The Contractor should ensure that all concerned staff are aware of the relevant environmental requirements as stipulated in local environmental legislation and the Contract specifications. The Contractor is responsible for providing appropriate training to all staff, which should be tailored to suit their level of responsibility for environmental, health, and safety matters. The Contractor should also ensure that all site staff members are aware of the emergency response procedures. All staff should receive environmental, health and safety induction training and managerial staff should receive additional training.

All those responsible for the implementation, management and operation of any aspect of the EMP shall have the proper qualifications and be adequately trained for their role. Evidence of training should be maintained on site, for inspection and auditing purposes.

Training should be conducted for, as a minimum:
• Ensuring that all construction-related personnel clearly understand the provisions of the Workers’ Code of Conduct, as well as the penalties for non-compliance;

• Hazardous Substances Management and Emergency Procedures;

• All staff involved in the handling and use of chemicals, fuel and explosives must be trained in handling, spill and emergency procedures. Evidence of training should be kept for inspection/auditing purposes;

• Concrete management;

• All staff involved in the manufacturing, transport and handling of concrete and asphalt must be trained in handling, spill, dust, water management and emergency procedures. Evidence of training should be kept for inspection/auditing purposes;

• Sediment Control, and Control of Discharges. Training shall be provided by a third party, or provide evidence of previous training, for the construction, maintenance and monitoring of environmental protection and discharge treatment devices. Evidence of training should be kept for inspection/auditing purposes; and

• Traffic Management and Driver Education. Training shall be provided by a third party, or provide evidence of previous training, for the safe control and driving of heavy road-construction vehicles. Training shall also be provided for the management of traffic (including pedestrians) in and around the project construction areas, to ensure safe passage during and after working hours. Evidence of training should be kept for inspection/auditing purposes.

3 Community Relations
To enhance adequate community relations the Contractor shall:

• Inform the population about construction and work schedules, blasting schedules, safety and compensation rules, interruption of services, traffic detour routes and provisional bus routes, and demolition, as appropriate.

• Limit construction activities at night. When necessary ensure that night work is carefully scheduled and the community is properly informed so they can take necessary measures and mitigation measures for construction methods can be agreed to by all parties.
• Inform the local community as early as possible and repeat at least one day in advance of any service interruption (including water, electricity, telephone, and road access). The community must be advised through postings at the project site, at mosques and other meeting places, and in affected homes/businesses.

• All community infrastructure affected during construction--such as roads, bridges, water supply systems, micro-power generators, and irrigation systems - must be restored to the satisfaction of the communities and approved by the Supervising Engineer, in accordance with the recommendations of the accompanying Social Impact Assessment (SIA) Report.

• All local roads used or by-passed by the Contractor will need to be rehabilitated to their original conditions.

• Establish and maintain a unit to receive, process and reach resolution on community complaints arising from construction activities. Records of such complaints and their resolution must be kept.

o **Inundation Preparation Plan**

In preparation for inundation of the reservoir area behind the dam, the Environmental and Social Management Team will prepare an Inundation Preparation Plan (IPP). This will be prepared during Year 1 of the project and be fully implemented at least 6 months before impoundment. The plan will be based on the findings of the EIA and outline all activities that need to be completed prior to inundation. The Environmental and Social Management Team will assist ARA-Sul in the preparation and execution of the plan.

Based on the findings of the EIA, the Inundation Preparation Plan will include at a minimum the following component activities:

**Removal of Pollution Sources.** The main objective of this activity is to minimize any harm to reservoir water quality from the inundation of contamination sources such as latrines and rubbish dumps. The complete removal of polluted sites from the reservoir area is the only and most effective mitigation measure for the protection of water quality. The Inundation Preparation Plan will identify the specific location of each rubbish dump, latrine, or similar contamination source and include a schedule for their removal from the areas to be inundated by raising the Corumana Reservoir to the full supply
level (FSL). This will assist in mitigating the potential effects associated with nutrient influx and eutrophication of the reservoir on filling. The Environmental and Social Management Team will manage implementation of the IPP and contract the removal or capping of waste at each potential contamination source. This work will be carried out by a qualified sub-contractor.

**Vegetation Clearance.** In preparing the Inundation Preparation Plan, the Environmental and Social Management Team will facilitate a consultative process with stakeholders to assess whether it is advisable to remove any standing trees from the drawdown and future reservoir inundation zone. Based on the relatively low volume of biomass per hectare inundated and experience during the initial filling of the Corumana reservoir, the removal of trees or other biomass is not considered necessary, or important, from a water quality standpoint. Moreover, inundated trees provide a useful habitat for various species of birds above the water line, and for fish below the water line.

However, submerged woody vegetation can also pose a safety hazard to motorboats, if the boating channels and fishing areas are not adequately demarcated. One stakeholder group, the Corumana Community Fishing Council has requested the removal of trees from certain areas of the expanded future reservoir, because their fishing nets can be snagged and torn by the submerged trees and roots. The specific areas proposed by the Council for tree removal are:

- The Jone fishing area stretches from the Hlane stream (032° 04’ 20.7’’; 25° 13’ 26.7’’) to the southern limit of the Sabie Game Park (032° 05’ 00.2’’; 25° 10’ 59.1’’);

- The Fungotine fishing area is located between the north of Babitine community (032° 08’ 12.1’’; 25° 09’ 16.6’’) and the east of Ndindiza community (032° 08’ 12.0’’; 25° 09’ 16.6’’).
In preparing the Inundation Preparation Plan, the Environmental and Social Management Team will assess the extent to which it might be desirable and cost-effective to remove trees from these areas of the reservoir prior to inundation, taking into account potential alternatives for assisting the reservoir-edge fishing communities and safety of navigation. No pre-impoundment tree felling would take place in areas adjacent to the Kruger National Park or Sabie Game Park, to (i) discourage unauthorized entry to these areas by boat, including by poachers and (ii) to avoid reducing the habitat available for various fish and wildlife species.

**Transplant Threatened Plant Species.** The EIA Report has identified three native plant species of conservation concern which might possibly occur within the future inundation zone of the Corumana Reservoir. These species are (i) *Adenium swazicum* (categorized as Endangered); (ii) *Ipomoea venosa* (Vulnerable); and (iii) *Turbina longiflora* (Vulnerable).

The Inundation Preparation Plan will detail the methodology and schedule for more extensive, inter-annual botanical surveys within the future reservoir area to confirm if these species are present in the reservoir area. This will increase the confidence prior to inundation regarding whether any of these threatened species occur within the future inundation zone. In the event that these species are found the IPP will include provisions for the live transplantation of any specimens found, whenever feasible.

The methodology will require a botanical survey team using GPS to record the locations of all threatened plant populations found. Any such plants that can feasibly be moved will be relocated to suitable representative habitat that is both (i) above the reservoir’s full supply level (FSL) and (ii) within some type of protected area, such as Sabie Game Park, the proposed Ingwe Game Park (if it is formally established), or the Kruger National Park (if the relevant Mozambican and South African authorities agree to this international translocation). All translocation of plants will be completed well in advance of raising the reservoir above the current FSL of 111 masl. The IPP will outline measures required for follow-up monitoring of any translocated plants for about two years after they are moved.

The Environmental and Social Management Team will manage this work, supported by expertise provided under the Technical Assistance as well as through partnerships with local institutions, to ensure well-qualified botanists and appropriate equipment are mobilized when needed.

**Salvage of Physical Cultural Resources.** The only area noted of historical significance in the vicinity of the Corumana Dam is that where the Massacre of Malengane took place during the civil war between 1976 and 1992. This was identified through input from the local community during the Social Impact Assessment and is documented in Volume 2 of the ESIA. Other sacred sites in the general vicinity of Corumana Dam include churches and mosques, specific wooded areas where local people gather medicinal plants, and cemeteries and family grave sites. Of these, the SIA indicates that the only sacred sites to be
affected by the rising reservoir are 25 family grave sites. These graves will be addressed as part of the Corumana Dam Resettlement Action Plan (RAP).

The Environmental and Social Management Team will undertake a complementary survey to identify any archaeological and paleontological resources that might be found within the future impoundment area. This will help to ensure that any potentially important sites or items not identified during the ESIA study will be identified and protected. Any significant archaeological objects or fossils found prior to impoundment will be salvaged in consultation with the National Directorate for Culture and in accordance with international best practice and the national requirements under Mozambican law and World Bank Safeguard Policy on Physical Cultural Resources (OP 4.11).

The Environmental Rules for Contractors to be applied during project construction as part of the EMP (Section 3.2.4) specify the Chance Finds Procedures that contractors and construction workers will need to follow in case they uncover any archaeological relics, fossils, human remains, or other items of cultural significance. These will also be included in the IPP.

Emergency Preparedness Plan (EPP). A draft EPP has been prepared during project preparation. The final text of the EPP and the First Impoundment Plan will be submitted not later than 12 months before impoundment. The ESMT will ensure that the EPP includes provisions to warn the population around the reservoir and downstream of the dam in case of severe flooding, large operational flood releases and emergency situations.

Reservoir Management Plan

The reservoir behind the Corumana Dam provides a resource for local fishing, nature based tourism, hydropower production, and the supply of water downstream for irrigation. It serves as an informal source of water supply for many of the surrounding local communities. Following completion of the dam, it will also provide a bulk water source for the Greater Maputo Metropolitan Area. It provides important habitats for fish and water birds, and water points for large mammals. Conservation agencies have expressed concern that the reservoir also provides access for illegal poachers.

Given the various, and sometimes competing demands, there is a need for a consultative and consensus lead process to agree on appropriate zoning of the reservoir to facilitate the multi-purpose utilisation and maximise the derived benefits. This is the responsibility of ARA-Sul as the dam operator. The Environmental and Social Management Team will assist in development and operationalisation of a Reservoir Management Plan that will include at minimum the following elements.

Measures for Monitoring and Management of Invasive Aquatic Plants – The Environmental and Social Management Team will assist ARA-Sul to prepare and implement measures to address the potential spread of non-indigenous aquatic
plants within the reservoir, in particular the species that are already present in small numbers such as Water Fern (Azolla filicida) and Water Lettuce (Pistia stratiotes). Measures shall include:

- Monitoring of invasive floating aquatic plants to detect a potential infestation. The methodology will be based on a visual assessment of weed growth by boat. Percentage cover of the different species shall be assessed. Monitoring will take place at a minimum 10 different sites and be carried out every second month for the first two years after completion of works. The frequency of monitoring would be reviewed and adjusted thereafter. Following the Environment and Social Management Team, ARA-Sul would assume full responsibility for recurrent monitoring and (if needed) control of invasive aquatic weeds; these tasks would be done either by ARA-Sul staff or contracted specialists.

- A contingency plan for the removal of these invasive plants in case they become a problem will be developed by the Environment and Social Management Team. They will review existing mechanical and biological methods for control of invasive aquatic species and prepare a contingency plan to be implemented, in case the monitoring of weeds in the reservoir show that infestation is a problem.

- Training ARA-Sul personnel in the identification and control of invasive species. The Environment and Social Management Team shall ensure the training of ARA-Sul personnel in (i) identifying the different species of invasive aquatic weeds, (ii) recognizing when they might spread enough to pose environmental or other problems in the reservoir, and (iii) familiarity with different approaches for control and physical removal of these plants.

**Reservoir Zoning** – The reservoir provides important habitats for fish and water birds along with watering and grazing for large mammals. The local fishing communities have already established informal fish landing sites around the reservoir and have identified a number of areas suitable for further development. The Sabie Game Park and (to a lesser degree) Kruger National Park have also indicated that they are periodically entered by wildlife poachers who are brought in illegally via the reservoir by local fishermen. It is feared that if the water level rise, poachers will be able to penetrate further into the park and the problem will worsen. Other mitigation measures to be addressed through the appropriate zoning of the reservoir would be the potential impacts on aquatic species, facilitating the rapid establishment of floodplain grassland around the reservoir margins, and stimulating productive aquatic-terrestrial transition zone along the reservoir margins.

The Reservoir Management Plan will provide for a consultative process, led by ARA-Sul as the dam operator, to facilitate: (i) designating and, where possible, physically demarcating the Corumana reservoir for specific activities, including but not limited to fishing, controlled hunting and conservation; (ii) establishment
of community-based enforcement mechanisms; and, iii) consultative forums to assist in reservoir management. Where applicable, measures will be outlined to provide for routine boat patrols of these areas by ARA-Sul or other collaborating entities. Other mitigation activities should be land use zoning around the reservoir with the objective of maintaining good water quality in the reservoir, since it is a drinking water reservoir.

Development of the Reservoir Management Plan will be facilitated by the Environment and Social Management Team. They shall assist ARA-Sul in establishing a consultative forum that will contribute to joint development of the plan. This will include representatives from the local authorities, fishing communities, farmers, conservationists and local land holders.

**Patrolling** designated sections of the Corumana reservoir to reduce wildlife poaching risks, in collaboration with the conservation area managers and local fishing communities,

**Catchment management of the area around the reservoir in Mozambique** in order to protect the reservoir from excessive sedimentation, eutrophication in order to protect water quality.

**Reservoir fisheries development and management.** A program for the development and management of the reservoir fisheries, based on sustainable harvests of native fish species.

**Waterborne Diseases.** The ESMT will carry out a baseline survey on waterborne diseases in the wider project area, with a focus on intestinal and urinary bilharzias and malaria.

- **Environmental Water Releases Program**

The EIA has outlined and summarised a number of attempts to provide desktop estimates of the environmental flow requirements for the Incomati River basin. Support to the completion of the Corumana Dam under this project provides an opportunity to assist ARA-Sul in further developing internal capacity for the determination of environmental flows and establishment of a sustainable biomonitoring protocol for the lower Incomati River basin. It also provides an opportunity to revisit and refine the criteria used to determine water releases from the dam to help ensure adequate attention to environmental considerations.

Development of the biomonitoring framework and environmental requirements to be incorporated into the Operating Rules for water releases through the Corumana Dam will need to take into account environmental criteria that include: (i) limiting backwater flooding within the Kruger National Park; (ii) ensuring an adequate area of floodplain grasslands along the reservoir shoreline, to provide grazing for wildlife from Kruger National Park, the Sabie Game Park, and the proposed Ingwe Game Park; (iii) reducing impacts to downstream channel morphology, including river bank erosion; (iv) enhancing downstream water quality, along with the conditions for fish and other aquatic life; and (v) if
needed (based on monitoring data), improving reservoir water quality through periodic flushing.

The scope of work for the Technical Assistance supporting the Environmental and Social Management Team (ESMT) will include an assessment of the environmental water releases that would be needed to meet environmental quality targets, including those in the above paragraph (upstream as well as downstream of the Corumana Dam). Based on this assessment, the ESMT will make recommendations for environmental water releases as input to the revised Operating Rules for the Corumana Dam. These Operating Rules, including criteria and procedures for decision-making, will be prepared by the detailed design and supervision consultants during Project implementation. The Operating Rules will be approved by DNA and ARA-Sul prior to impoundment. They will include the recommended technical criteria and decision-making procedures for environmental flow releases, the monitoring schedule and stations, facilitate the purchase of appropriate equipment, and provide training and support during project implementation.

The scope of work for the Technical Assistance supporting the Environmental and Social Management Team will include provisions for specialist support in assessing the environmental water release requirements. This will include at minimum the following expertise: Hydrodynamics; Water Quality; Socio-Economics; Sedimentology; and Biodiversity, including fish species and macroinvertebrates, the latter which also serve as indicators of water quality.

The Environmental and Social Management Team will support ARA-Sul to define a representative monitoring system which is cost-effective and sustainable, and can be used to confirm the validity of existing environmental water releases and provide feedback mechanisms. Surveys will be carried out at least twice a year to include both low and high flow periods. Training will be an essential part of the program’s development and ARA-Sul shall identify counterpart staff to work with the Environmental and Social Management Team. These staff will be responsible for ongoing monitoring. The Environmental and Social Management Team will include provisions for both onsite and offsite support after conclusion of the formal survey. The survey will assist in the development of Key Performance Indicators and define a regular schedule for minimum monitoring requirements to allow revision of environmental flow requirements. This would include an assessment of the ecological, financial and socioeconomic consequences of different operational flow scenarios and recommend flow scenarios that optimize environmental goods and services.

- **Environmental Monitoring Plan**

The objective of the Environmental Monitoring Plan is to document the monitoring and reporting procedures for potential environmental impacts of the inundation and operation of the raised FSL capacity of the dam.
The Monitoring Plan does not include procedures for dam safety, flood warning systems, emergencies, structural integrity monitoring and other instrumentation monitoring as part of the scheme operations. These procedures are the responsibility of ARA-Sul as the dam operator. The following effects will be monitored:

1. Monitoring of water quality sedimentation, sediment quality and aquatic/riparian flora and fauna in the Sabie River upstream of the reservoir in collaboration with basin wide initiatives and other national programs, such as that of the Kruger National Park;

2. Monitoring of thermal stratification of water masses in the reservoir;

3. Monitoring of water quality, sediment quality and aquatic/riparian flora and fauna, including macroinvertebrates and snail-vectors for intestinal and urinary bilharzias (schistosomiasis), in the Sabie River downstream of the reservoir to assess impacts of reduced flow and increased erosion; and

4. Establishment of a baseline of intestinal and urinary bilharzias and malaria around the reservoir and downstream of the dam 6 months before inundation (prevalence rates). Prevalence rates will need to be monitored annually the first 10 years after inundation. In case of increased prevalence rates mass treatment with praziquantel will be needed annually for the treatment of bilharzias and distribution of impregnated bednets to control malaria.

The rationale for monitoring these effects are outlined in Table 0-3.

In addition, monitoring water quality on shallow water in the newly inundated area shall be monitored.

Table 0-3. Outline of rationale for the different elements of the monitoring plan.

<table>
<thead>
<tr>
<th>Monitoring</th>
<th>Background</th>
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<tbody>
<tr>
<td>1. Backwater effects and induced sedimentation resulting from raising the FSL of the dam</td>
<td>The raising of the FSL of Corumana Dam to 117 masl will have a backwater effect (cause increased inundation) and cause increased sedimentation in the Sabie River upstream the reservoir due to reduction in flow. Hydrological modelling carried out for the EIA has shown that the backwater effect of the FSL of 117 masl for the 1-in-200 year return period flood extends some 1,195 m into Kruger Park in South Africa. The modelling has shown that induced sedimentation could be expected up to 1,080 m into Kruger. The backwater effect and induced sedimentation may affect flora and fauna. The monitoring program shall be designed so that the extent of impacts on aquatic flora and fauna in the Sabie upstream the dam can be mitigated, such as through...</td>
</tr>
<tr>
<td>Water releases from the Corumana Dam.</td>
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<td>--------------------------------------</td>
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</table>

2) Thermal stratification of water masses in reservoir

In some reservoirs water may become thermally stratified and the bottom water may become deoxygenated. In the EIA for upgrading of the Corumana Dam it is assessed that the reservoir would probably not exhibit strong thermal stratification. The reservoir would probably exhibit weak thermal stratification during the daytime that would easily be broken down by light wind mixing or cooling during the evenings and the bottom water will probably not become deoxygenated.

The monitoring programme shall be designed so that this assessment of thermal stratification can be verified.

3) Effects of decreased flow and increased erosion downstream the dam.

The raising of the FSL of the dam may reduce the downstream flow by 5.1% and may cause increased erosion. That may further affect a riparian vegetation that may be described as Largely Modified, a macorinvertebrate fauna that is Seriously Modified and a fish fauna that is Moderately modified.

The monitoring plan shall be designed to elucidate any further impacts.

4) Potential increase in waterborne diseases such as intestinal and urinary bilharzia and malaria.

The increase of the size of the reservoir could lead to a further increase in the prevalence rates of intestinal and urinary bilharzia and malaria as observed in many other reservoirs in Africa. These are serious public health impacts that would need to be monitored and treated if they arise.

**Contents of the Monitoring Plan.** The Environmental Monitoring Plan shall detail methods and procedures for each part of the monitoring programme, including:

- Monitoring parameters;
- Methods for sampling, laboratory analysis and statistical analysis of data;
- Sampling locations;
- Sampling frequency;
- Reporting requirements;
- Timetable; and
Budgets.

**Specification of the Monitoring Plan**

The Monitoring Plan shall include detailed programmes for:

- Monitoring of water quality, sedimentation, sediment- and water quality and flora and fauna in Sabie upstream the reservoir including Kruger National Park to assess any backwater effects and induced sedimentation resulting from raising the FSL of the dam;
- Monitoring water quality on shallow water in the newly inundated area;
- Monitoring of stratification of water masses in the reservoir;
- Monitoring of water quality, sedimentation, sediment- and water quality and flora and fauna in Sabie downstream the reservoir to assess any effects of flow reduction and downstream erosion; and
- Monitoring of prevalence rates of intestinal and urinary bilharzias and malaria around the reservoir area and downstream of the dam.

The monitoring plan shall be prepared based on the specifications outlined below.

**Monitoring Upstream of the Reservoir**

*Background*

Raising the FSL of Corumana Dam to 117 masl could result in a backwater effect caused by increased inundation. This could accentuate sedimentation in the Sabie River upstream of the reservoir due to reduction in flow velocities. Hydrological modelling carried out for the EIA has shown that the backwater effect of the FSL of 117 masl for the 1-in-200 year flood extends some 1,195 m into Kruger National Park in South Africa. The modelling has shown that induced sedimentation could be expected up to a distance of 1,080 m east of the border to South Africa at this level which could affect aquatic fauna.

The monitoring programme shall be designed so that this assessment of backwater effects and induced sedimentation can be verified and to monitor impact on flora and fauna.

*Methodology*

The monitoring shall include the following elements:

- River topography profiling and sediment monitoring;
- Water quality and water flow monitoring; and
Flora and Fauna Monitoring.

**River topography profiling and sediment monitoring**

Any induced sedimentation shall be monitored by:

- Measuring river channel cross sections using survey equipment to provide profiles of the entire transect of the bed (dry and wet areas), and the depth profile of the river; and
- Collection of sediment samples and analysis of grain size distribution and loss on ignition. The samples shall also be analysed for selected heavy metals.

**Water Quality and water flow monitoring**

**Parameters**

The following water quality parameters shall be measured:

- pH, temperature, electrical conductivity, turbidity, suspended solids, clarity, dissolved oxygen, BOD$_5$ (Biological Oxygen Demand), COD (Chemical Oxygen Demand), dissolved reactive phosphorus, nitrite, nitrate and ammoniac nitrogen.

**Methods:**

International standards for sampling, sample preservation and laboratory analysis for each parameter shall be applied. Unstable parameters, principally temperature, dissolved oxygen, pH and electrical conductivity, shall be determined in the field using portable equipment. Samples for the analysis of other parameters shall be collected in clean glass or polypropylene bottles for transport via chilled containers to the laboratory.

River flow rates shall be monitored based on existing stations, including upstream in South Africa through cooperative mechanisms under the Interim IncoMaputo Agreement.

Data available from the hydrometeorological station at the dam shall be collected.

**Flora and fauna monitoring**

The flora and fauna monitoring shall include:

- Any specimens of threatened plant species that were transplanted to avoid inundation by the expanding reservoir (as described above).
- Survey of riverine and riparian vegetation. The Level 3 version of the Vegetation Response Assessment Index (VEGRAI) for emergent aquatic vegetation and vegetation in the riparian zone shall be employed, producing
an ecological category, representing the Ecological Category for the riparian vegetation state.

- Sampling and identification of aquatic macroinvertebrates. The South African Scoring System (SASS5) shall be applied producing an Ecological Category for the instream macroinvertebrate fauna.

- Sampling and identification of fish species, abundance and length. The South African Fish Assemblage Integrity Index (FAII) shall be employed, which produces six classes for Biological Integrity based on the fish fauna.

- Monitoring of habitats for endangered species such as breeding places for crocodiles.

**Monitoring sites**

Monitoring of all these parameters could be carried out at five sites in the Sabie upstream the Corumana reservoir including three sites in Mozambique and two sites in Kruger National Park in South Africa (if supported by Park managers). One of the stations in Kruger National Park should be placed in an anastomosing reach, in the Northern Lebombo Bushveld, sufficiently distant from the area of impact. The monitoring results need to be statistically sound: this means the selection of monitoring stations needs to be based on an random selection of sites within a selected stratum.

The Environmental and Social Management Team will agree with ARA-Sul on final selection of sites in the Sabie River downstream of the dam. These will be integrated with the biomonitoring protocols and serve as the basis for long term monitoring within the context of ARA-Sul’s overall responsibilities.

**Monitoring frequency**

The monitoring of river topography and sediment quality shall be carried out annually. The water quality- and flora/fauna monitoring shall be conducted semi-annually. The monitoring shall be initiated prior to the construction works, carried out during the construction phase and continued until three years after the completion of the works. Prior to the conclusion of this project, the Environmental and Social Management Team will evaluate the monitoring findings to date and recommend which types of monitoring activities should continue beyond the life of this project-including on a recurrent basis-under the responsibility of ARA-Sul.

**Monitoring Water Quality in the Newly Inundated Areas**

**Methodology**

### Parameters

The following water quality parameters shall be measured:
pH, temperature, electrical conductivity, turbidity, suspended solids, clarity, dissolved oxygen, BOD$_5$ (Biological Oxygen Demand), COD (Chemical Oxygen Demand), dissolved reactive phosphorus, nitrite, nitrate and ammoniac nitrogen.

**Methods**

International standards for sampling, sample preservation and laboratory analysis for each parameter shall be applied. Unstable parameters, principally temperature, dissolved oxygen, pH and electrical conductivity, shall be determined in the field using portable equipment. Samples for the analysis of other parameters shall be collected in clean glass or polypropylene bottles for transport via chilled containers to the laboratory.

**Monitoring sites**

Monitoring of water quality shall be carried out at six sites in the newly inundated area and at a control site. See above for the methodology for the selection of monitoring sites.

**Monitoring frequency**

The monitoring shall be carried out annually and initiated prior to the construction works and continued until three years after the completion of the works. Subsequently, it shall be decided whether the monitoring shall continue.

**Monitoring of Thermal Stratification in the Reservoir**

**Background**

In some reservoirs water may become thermally stratified and the bottom water may become deoxygenated. The EIA assessed that the reservoir would probably not exhibit strong thermal stratification. The reservoir would probably exhibit weak thermal stratification during the daytime that would easily be broken down by light wind mixing or cooling during the evenings and the bottom water will probably not become deoxygenated. The monitoring programme shall be designed so that this assessment of thermal stratification can be verified.

**Methodology**

Temperature and oxygen concentration in the water column shall be measured at regular intervals from the surface to the bottom using automatic *in situ* equipment to establish vertical profiles of temperature and oxygen.

**Monitoring sites**

Measurements shall be carried out at ten sites, distributed over the deepest parts of the reservoir.

**Monitoring frequency**

The monitoring shall be carried four times during the summer months and initiated prior to the construction works, carried out during the construction
phase and continued until three years after the completion of the works. Subsequently it shall be decided whether the monitoring shall continue.

**Monitoring Downstream of the Dam**

**Background**

The raising of the FSL of the dam may reduce the downstream flow by 5.1% and may cause increased erosion. That may further affect riparian vegetation that may be described as Largely Modified, a macorinvertebrate fauna that is Seriously Modified and a fish fauna that is Moderately Modified.

The monitoring programme shall be designed to elucidate any further impacts.

**Methodology**

The parameters and methodologies described for the “Monitoring Upstream of the Reservoir” shall be employed. River flow rates should also be monitored, as appropriate and feasible. Data from the hydrometeorological station at the dam shall be collected.

**Monitoring sites**

Two monitoring sites shall be established one immediately downstream the dam and one at the road bridge approximately 2 km downstream of the Corumana spillway. See above for the selection of monitoring sites.

**Monitoring frequency**

The monitoring of river topography and sediment quality shall be carried out annually. The water quality- and flora/fauna monitoring shall be conducted bi-annually. The monitoring shall be initiated prior to the construction works, carried out during the construction phase and continued until three years after the completion of the works. Subsequently, it shall be decided whether the monitoring shall continue.

— **Analysis and Reporting**

**Analysis and reporting**: The Environmental Monitoring Plan shall incorporate data collected from the project in to the existing databases within ARA-Sul. The process for interpreting and analyzing monitoring results and how the results, analysis and action plans will be reported, will be aligned to the existing reporting formats. The Environmental and Social Management Team will review and advise on any improvements that can be integrated in to these systems and outline a process for review and updating of data requirements.

— **Schedule and Budget for the EMP Activities**

The following table provides a summary of the schedule and frequency of mitigation measures and enhancement measures provided for in the EMP.
Responsibilities are assigned to respective institutions for implementation and oversight of the activities along with an indicative budget.

A large part of the EMP budget will be part of the Contractor’s CEMP and will be included in Contractor’s contract. Yet, most of the activities will be undertaken by the Environmental and Social Management Team as Technical Assistance to ARA-Sul during project implementation. This Technical Assistance will have experience in the development and implementation of similar programs and experience in the transfer of capacity and knowledge through formal and on-the-job training programs and thereby helping to integrate the recurrent operations into the ongoing management of the Incomati River basin as part of the responsibilities of ARA-Sul. The ToRs for this consultancy will be submitted to the World Bank for comments and non-objection prior to Project Effectiveness and procured within the first six months of implementation.

The Technical Assistance will include core members of the Environmental and Social management team under the leadership of a designated ARA-Sul staff member. The independent consulting firm for this assignment will include provisions to draw on a pool of expertise to support the short term measures and expert inputs required.

The Environmental and Social Management Team will prepare a detailed implementation schedule as part of the inception phase. The World Bank will need to provide comments and a non-objection on the Inception Report. The timing of each activity will be carefully coordinated in relation to the schedule for civil works construction and reservoir filling.

The project includes a specific component dedicated to implementation and oversight of the environmental and social aspects of the Corumana Dam completion. To ensure that this is fully financed, this component includes provisions for implementation of the EMP. It also includes support for implementation of the Resettlement Action Plan and the associated Community Livelihood Plan. These are detailed in the accompanying volume of the ESIA.
Table 3-5 Summary of Scheduling, Responsibilities, and Budget for the EMP Activities

<table>
<thead>
<tr>
<th>EMP Mitigation / Enhancement Measures</th>
<th>Frequency/Schedule</th>
<th>Responsibility</th>
<th>Budget Estimate (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction and Workers Camp Management Plan</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plan included in bid documents for main civil works</td>
<td>Prior to launch of bids</td>
<td>Supervising Engineer</td>
<td>Engineering Contract</td>
</tr>
<tr>
<td>Implementation of the Plan</td>
<td>Continuous</td>
<td>Contractor</td>
<td>Bid Lump Sum</td>
</tr>
<tr>
<td>Monitoring compliance with the Plan</td>
<td>Monthly</td>
<td>Supervising Engineer</td>
<td>Engineering Contract</td>
</tr>
<tr>
<td>Environmental awareness training</td>
<td>Prior to site access</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td><strong>Inundation Preparation Plan</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plan finalised</td>
<td>Project year 1</td>
<td>ESM Team</td>
<td>TA Contract</td>
</tr>
<tr>
<td>Identification of potential sources of water contamination (i.e. garbage dumps and latrines)</td>
<td>Completed 12 months prior to impoundment</td>
<td>ESM Team / ARA-Sul</td>
<td>TA Contract</td>
</tr>
<tr>
<td>Removal of potential sources of water contamination (i.e. garbage dumps and latrines)</td>
<td>Completed 6 months prior to impoundment</td>
<td>Sub-contractor</td>
<td>50,000</td>
</tr>
<tr>
<td>Survey for threatened plant species within the reservoir inundation area</td>
<td>Undertaken at least 24 months prior to completion; Completed 18 months prior to impoundment</td>
<td>ESM Team</td>
<td>TA Contract</td>
</tr>
<tr>
<td>Transplant any identified threatened plant species as required</td>
<td>Completed 6 months prior to impoundment</td>
<td>ESM Team</td>
<td>50,000</td>
</tr>
<tr>
<td>Survey of physical cultural resources within the reservoir inundation area</td>
<td>Completed 6 months prior to impoundment</td>
<td>ESM Team</td>
<td>TA Contract</td>
</tr>
<tr>
<td>Salvage of any identified physical cultural resources as required</td>
<td>Completed 6 months prior to impoundment</td>
<td>ESM Team</td>
<td>50,000</td>
</tr>
<tr>
<td>EMP Mitigation / Enhancement Measures</td>
<td>Frequency/Schedule</td>
<td>Responsibility</td>
<td>Budget Estimate (US$)</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------</td>
<td>------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td><strong>Reservoir Management Plan</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plan finalised</td>
<td>By end of Project Year 2</td>
<td>ESM Team</td>
<td>TA Contract</td>
</tr>
<tr>
<td>Environmental zoning consultative process</td>
<td>Project Years 1-2</td>
<td>EMS Team</td>
<td>25,000</td>
</tr>
<tr>
<td>Consultative reservoir management forum established and meeting</td>
<td>Quarterly, beginning Project Year 2</td>
<td>ARA-Sul</td>
<td>20,000</td>
</tr>
<tr>
<td>Reservoir patrols to reduce poaching</td>
<td>Recurrent, beginning Project Year 2</td>
<td>ARA-Sul / Conservation entity</td>
<td>15,000</td>
</tr>
<tr>
<td>Reservoir fisheries management plan (equipment, workshops etc.)</td>
<td>First two years of project</td>
<td>ARA-Sul / ESM Team</td>
<td>60,000</td>
</tr>
<tr>
<td>Reservoir fisheries surveys</td>
<td>Annually</td>
<td>EMS Team</td>
<td>140,000</td>
</tr>
<tr>
<td>Invasive Aquatic Plant Survey</td>
<td>Once per year</td>
<td>EMS Team</td>
<td>15,000</td>
</tr>
<tr>
<td>Invasive Aquatic Plant Control measures</td>
<td>As needed</td>
<td>ARA-Sul</td>
<td>Subject to survey</td>
</tr>
<tr>
<td>Monitoring causes of waterborne disease and remedial actions</td>
<td>Baseline study in Project Year 1; recurrent monitoring thereafter, with remedial actions as needed</td>
<td>ARA-Sul/EMS Team</td>
<td>50,000</td>
</tr>
<tr>
<td>Boat and associated operating costs</td>
<td>Start of project</td>
<td>DNA / ARA-Sul</td>
<td>30,000</td>
</tr>
<tr>
<td><strong>Environmental Water Releases Program</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish proposed regime for environmental water releases (EWR), including decision-making criteria and procedures, and environmental quality targets</td>
<td>Prior to launching bids for main civil works</td>
<td>EMS Team</td>
<td>TA Contract</td>
</tr>
<tr>
<td>Bio-monitoring surveys of EWR sites</td>
<td>Semi-annually</td>
<td>ARA-Sul / EMS Team</td>
<td>650,000</td>
</tr>
<tr>
<td>EMP Mitigation / Enhancement Measures</td>
<td>Frequency/Schedule</td>
<td>Responsibility</td>
<td>Budget Estimate (US$)</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------</td>
<td>-------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Integrate EWR estimates in design works for the dam</td>
<td>Prior to launching bids for main civil works</td>
<td>Design Engineer</td>
<td>TA / Engineering</td>
</tr>
<tr>
<td>Provide feedback mechanisms for the operating rules</td>
<td>Prior to completion</td>
<td>ARA-Sul</td>
<td>TA / Engineering</td>
</tr>
<tr>
<td><strong>Environmental Monitoring Plan</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>River topography profiling &amp; sediment monitoring</td>
<td>Annually</td>
<td>ARA-Sul / EMS Team</td>
<td>TA Contract</td>
</tr>
<tr>
<td>Reservoir water quality, including thermal stratification</td>
<td>Quarterly</td>
<td>ARA-Sul / EMS Team</td>
<td>TA Contract</td>
</tr>
<tr>
<td>Water quality monitoring upstream and downstream</td>
<td>Semi-annually</td>
<td>ARA-Sul / ESM Team</td>
<td>TA Contract</td>
</tr>
<tr>
<td>River discharge monitoring</td>
<td>At least monthly</td>
<td>ARA-Sul</td>
<td>TA Contract</td>
</tr>
<tr>
<td>Flora and fauna monitoring</td>
<td>Semi-annually</td>
<td>ARA-Sul / ESM Team</td>
<td>TA Contract</td>
</tr>
<tr>
<td>Water quality monitoring equipment</td>
<td>Acquire in Project Year 1</td>
<td>DNA / ARA-Sul</td>
<td>80,000</td>
</tr>
<tr>
<td><strong>Consultation, Participation and Management</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training, capacity building, study tours and workshops</td>
<td>As needed</td>
<td>DNA</td>
<td>120,000</td>
</tr>
<tr>
<td>Technical Assistance</td>
<td>6 mths of effectiveness</td>
<td>DNA</td>
<td>1,500,000</td>
</tr>
<tr>
<td>Vehicles</td>
<td>Effectiveness</td>
<td></td>
<td>90,000</td>
</tr>
<tr>
<td><strong>Total Cost Estimate</strong></td>
<td></td>
<td></td>
<td><strong>2,945,000</strong></td>
</tr>
</tbody>
</table>