The World Bank

Red Sea-Dead Sea Water Conveyance Study Environmental and Social Assessment

Initial Assessment Report

March 2010

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Initial Assessment Report

March 2010

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Prepared by: Environmental Resources Management (ERM) Limited

For and on behalf of
Environmental Resources Management Limited

Approved by: Dr Eamonn Barrett

Signed:
Position: Partner
Date: 24th March 2010

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Note: The sections shown in grey do not form part of this initial assessment report (for reasons discussed in Section A1.1), but have been included for reasons of clarity in order to maintain the same structure as will form the Final ESA Report.

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<th>Full Form</th>
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<tbody>
<tr>
<td>ABO</td>
<td>Aqaba Bird Observatory</td>
</tr>
<tr>
<td>ACT</td>
<td>Aqaba Container Terminal</td>
</tr>
<tr>
<td>ADC</td>
<td>Aqaba Development Corporation</td>
</tr>
<tr>
<td>APA</td>
<td>Aqaba Ports Authority</td>
</tr>
<tr>
<td>APC</td>
<td>Arab Potash Company</td>
</tr>
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<td>ASEZ</td>
<td>Aqaba Special Economic Zone</td>
</tr>
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<td>ASEZA</td>
<td>Aqaba Special Economic Zone Authority</td>
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<td>BSSA</td>
<td>Bethlehem Water Supply and Sanitation Authority</td>
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<td>CBOs</td>
<td>Community Based Organizations</td>
</tr>
<tr>
<td>CDM</td>
<td>Clean Development Mechanism</td>
</tr>
<tr>
<td>CR</td>
<td>Critically Endangered</td>
</tr>
<tr>
<td>DSP</td>
<td>Desalination plant</td>
</tr>
<tr>
<td>DSW</td>
<td>Dead Sea Works</td>
</tr>
<tr>
<td>DZC</td>
<td>Development Zones Commission</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>EIS</td>
<td>Environmental Impact Statement</td>
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<td>EMP</td>
<td>Environmental Management Plan</td>
</tr>
<tr>
<td>EN</td>
<td>Endangered</td>
</tr>
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<td>EPP</td>
<td>Enhanced Productivity Program</td>
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<tr>
<td>ESA</td>
<td>Environmental and Social Assessment</td>
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<tr>
<td>ESMP</td>
<td>Environmental and Social Management Plan</td>
</tr>
<tr>
<td>EQA</td>
<td>Environmental Quality Authority</td>
</tr>
<tr>
<td>EWASH</td>
<td>Emergency and Water Sanitation Hygiene Group</td>
</tr>
<tr>
<td>FOEME</td>
<td>Friends of the Earth Middle East</td>
</tr>
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<td>FS</td>
<td>Feasibility Study</td>
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<td>GID</td>
<td>General Intelligence Department</td>
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<td>GoA</td>
<td>Gulf of Aqaba</td>
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<td>GOJ</td>
<td>Government of Jordan</td>
</tr>
<tr>
<td>GOI</td>
<td>Government of Israel</td>
</tr>
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<td>GSI</td>
<td>Geological Survey of Israel</td>
</tr>
<tr>
<td>GUVS</td>
<td>General Unions of Voluntary Services</td>
</tr>
<tr>
<td>HEP</td>
<td>Hydro Electric Power Plant</td>
</tr>
<tr>
<td>HGV</td>
<td>Heavy goods vehicle</td>
</tr>
<tr>
<td>HPP</td>
<td>Hydropower plant</td>
</tr>
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<td>IBA</td>
<td>Important Birds Area</td>
</tr>
<tr>
<td>IBRCE</td>
<td>International Birding &amp; Research Center in Eilat</td>
</tr>
<tr>
<td>IEMA</td>
<td>Institute of Environmental Management and Assessment</td>
</tr>
<tr>
<td>IFC</td>
<td>International Finance Corporation</td>
</tr>
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<td>IOLR</td>
<td>Institute of Oceanographic &amp; Limnological Research</td>
</tr>
<tr>
<td>IUED</td>
<td>Israeli Union for Environmental Defence</td>
</tr>
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<td>IUI</td>
<td>Inter University Institute (for Marine Science at Eilat)</td>
</tr>
<tr>
<td>JECC</td>
<td>Joint Environmental Experts Committee</td>
</tr>
<tr>
<td>JICA</td>
<td>Japanese International Cooperation Agency</td>
</tr>
<tr>
<td>JMA</td>
<td>Jordan Maritime Authority</td>
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<tr>
<td>Shortform</td>
<td>Full Form</td>
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<td>-----------</td>
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<tr>
<td>JOHUD</td>
<td>Jordan Hashemite Fund for Human Development</td>
</tr>
<tr>
<td>JPMC</td>
<td>Jordan Phosphate Mining Company</td>
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<tr>
<td>JREDs</td>
<td>Jordan Royal Marine Conservation Society</td>
</tr>
<tr>
<td>JRF</td>
<td>Jordan River Foundation</td>
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<tr>
<td>JRSWP</td>
<td>Jordan Red Sea Water Project</td>
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<tr>
<td>JUST</td>
<td>Jordan University of Science and Technology</td>
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<td>JVA</td>
<td>Jordan Valley Authority</td>
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<tr>
<td>LC</td>
<td>Least Concern</td>
</tr>
<tr>
<td>MoE</td>
<td>Ministry of Education</td>
</tr>
<tr>
<td>MoEnv</td>
<td>Ministry of Environment</td>
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<tr>
<td>MoMA</td>
<td>Ministry of Municipal Affairs</td>
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<td>MoPIC</td>
<td>Ministry of Planning and International Cooperation</td>
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<tr>
<td>MoSD</td>
<td>Ministry of Social Development</td>
</tr>
<tr>
<td>MPWH</td>
<td>Ministry of Public Works and Housing</td>
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<tr>
<td>MSBs</td>
<td>Migratory Soaring Birds</td>
</tr>
<tr>
<td>NAF</td>
<td>National Aid Fund</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-governmental organization</td>
</tr>
<tr>
<td>NHF</td>
<td>Noor Al Hussein Foundation</td>
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<tr>
<td>NIPs</td>
<td>National Implementation Plans</td>
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<tr>
<td>NPA</td>
<td>National Parks Authority</td>
</tr>
<tr>
<td>NRA</td>
<td>Nature Reserves Authority</td>
</tr>
<tr>
<td>NT</td>
<td>Near-threatened</td>
</tr>
<tr>
<td>PA</td>
<td>Palestinian Authority</td>
</tr>
<tr>
<td>PCBS</td>
<td>Central Bureau of Statistics</td>
</tr>
<tr>
<td>PCCP</td>
<td>Public Consultation and Communications Plan</td>
</tr>
<tr>
<td>PEAP</td>
<td>Palestinian Environmental Assessment Policy</td>
</tr>
<tr>
<td>PERSGA</td>
<td>Regional Organization for Conservation of Environment of the Red Sea and Gulf of Aden</td>
</tr>
<tr>
<td>PHG</td>
<td>Palestinian Hydrology Group</td>
</tr>
<tr>
<td>PM</td>
<td>Passage Migrant</td>
</tr>
<tr>
<td>POPs</td>
<td>Protocol on Persistent Organic Pollutants</td>
</tr>
<tr>
<td>PWA</td>
<td>Palestinian Water Authority</td>
</tr>
<tr>
<td>R</td>
<td>Resident, breeds</td>
</tr>
<tr>
<td>RB</td>
<td>Resident breeders</td>
</tr>
<tr>
<td>RSCN</td>
<td>Royal Society for the Conservation of Nature</td>
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<tr>
<td>RSDSC</td>
<td>Red Sea Dead Sea (Water) Conveyance</td>
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<tr>
<td>SARS</td>
<td>Severe Acute Respiratory Syndrome</td>
</tr>
<tr>
<td>SB</td>
<td>Summer Breeders</td>
</tr>
<tr>
<td>SCAs</td>
<td>Special Conservation Areas</td>
</tr>
<tr>
<td>SIZ</td>
<td>Southern Industrial Zone</td>
</tr>
<tr>
<td>SoA</td>
<td>Study of Alternatives</td>
</tr>
<tr>
<td>SPNI</td>
<td>Society for the Protection of Nature in Israel</td>
</tr>
<tr>
<td>SRO</td>
<td>Seawater Reverse Osmosis</td>
</tr>
<tr>
<td>STD</td>
<td>Sexually Transmitted Disease</td>
</tr>
<tr>
<td>STI</td>
<td>Sexually Transmitted Infection</td>
</tr>
<tr>
<td>SV</td>
<td>Summer visitor, breeds</td>
</tr>
<tr>
<td>SWM</td>
<td>Solid Waste Management</td>
</tr>
<tr>
<td>TBM</td>
<td>Tunnel Boring Machines</td>
</tr>
<tr>
<td>ToR</td>
<td>Terms of Reference</td>
</tr>
<tr>
<td>-----</td>
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</tr>
<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
</tr>
<tr>
<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organization</td>
</tr>
<tr>
<td>UNFCCC</td>
<td>United Nations Framework Convention on Climate Change</td>
</tr>
<tr>
<td>UNICEF</td>
<td>The United Nations Children’s Fund</td>
</tr>
<tr>
<td>UNRWA</td>
<td>United Nations Relief and Works Agency</td>
</tr>
<tr>
<td>VU</td>
<td>Vulnerable</td>
</tr>
<tr>
<td>WAIC</td>
<td>Water Authority of Israel</td>
</tr>
<tr>
<td>WB</td>
<td>West Bank</td>
</tr>
<tr>
<td>WMP</td>
<td>Waste Management Plan</td>
</tr>
<tr>
<td>WV</td>
<td>Winter Visitor</td>
</tr>
</tbody>
</table>
EXECUTIVE SUMMARY
EXECUTIVE SUMMARY

PREAMBLE

The Environmental and Social Assessment (ESA) Study of the proposed Red Sea Dead Sea Water Conveyance (RSDSC) will have a complete Executive Summary. This will provide an overview of scope and objectives of the Study, its potential environmental and social impacts; an analysis of the alternative conveyance routes, conveyance options, sites, and construction and operational methods; and an Environmental and Social Management Plan (ESMP). All of this will be based on a Regional Environmental and Social Assessment and a Project Specific Environmental and Social Assessment.

This document, the Initial Assessment Report (IAR), presents an initial and early assessment of impacts based on the initial design and technical studies provided by the parallel Feasibility Study to date. It does not consider impacts associated with technical studies that have not yet been completed by the Feasibility Study (e.g., hydrogeology, geology, and seismicity, climate), and in particular it does not consider impacts on either the Red Sea or the Dead Sea since the detailed studies (or ‘Additional Studies’) relating to these two seas have not yet begun. Moreover, each section will need to be revisited when the Feasibility Study Draft Sub-Studies Report is issued. It may be that these initial findings will cause the Feasibility Study Team to modify their designs and present new engineering options for mitigation. In this case further analysis will be needed. Only at this point will it be possible to begin work on the Environmental and Social Management Plan.

The assessment of the remaining impacts and the next phases of analysis will form part of the Preliminary Draft ESA Report (PDESAR) that is due for submission in January 2011. Similarly, the analysis of mitigation measures and the incorporation into an Environmental and Social Management Plan (ESMP), will be undertaken after the release of the Feasibility Study Draft Sub-Studies Report and reported in the PDESAR.

Since, at this stage, the assessment is incomplete in both scope and coverage, any summary of impacts and ESMP would be partial and might serve to mislead. Therefore, the following relates only to Part A of the IAR.

BACKGROUND AND CONTEXT

The Dead Sea water level has been dropping at an increasing rate for the last 30 years. Major environmental damage has resulted including changes to the landscape due to the loss of water surface, the development of sinkholes and increased incidence of dust storms. If the current situation is allowed to continue unchecked, the changes may become so great that the Dead Sea
region might lose much of its value as a tourism and recreational area, in addition to the threats to its status as a world cultural and religious symbol.

A Feasibility Study is underway to study the implications of constructing a water conveyance that would carry water from the Red Sea to the Dead Sea and, in so doing, stabilise or increase its water level (the "base case"). In addition the Feasibility Study will examine the provision of desalination and electricity generation capacity that, in conjunction with the conveyance, could be used to supply fresh water to users in Jordan, Israel and the Palestinian Authority (the 'base case plus').

In parallel with the Feasibility Study a full Environmental and Social Assessment (ESA) is being undertaken. This will involve a comprehensive review and assessment of all of the potential environmental and social impacts of the proposals generated by the Feasibility Study (both positive and negative) at both the regional and project-specific level.

**ESA INFORMATION SOURCES AND TIMING**

The areas and ecosystems potentially impacted by the scheme have been the subject of a number of studies over the past 25 years. The available materials from past studies have been supplemented with information generated for the Feasibility Study assessment and by consultations with stakeholder groups. In addition, specific studies have been conducted as part of the present assessment to gather any additional information required.

**DEFINITION OF THE SCHEME AND ITS AREA OF INFLUENCE**

The RSDSC scheme is defined so as to include all those actions and activities which are a necessary part of the development, including all related and ancillary facilities without which the scheme cannot proceed, and any other developments or activities which follow as a necessary consequence of the project.

Elements being assessed therefore include:

- An intake on the Gulf of Aqaba including a pumping station (except in the case of a gravity tunnel). Two potential sites have been considered;

- A seawater conveyance to carry Red Sea water to the Dead Sea Basin. A pipeline along the Wadi Arava/Arava Valley and a tunnel through the eastern mountains (two tunnel configurations were examined) have been considered;

- A desalination plant in the Dead Sea Basin. Two potential sites have been considered;
• A hydroelectricity power plant in the Dead Sea Basin, running on sea water from the conveyance and/or brine from the desalination plant;

• A conveyance and outfall to carry the sea water and or brine from the desalination and hydro power plants to the Dead Sea; and,

• Freshwater transmission pipelines, with associated pumping and energy supply infrastructure, to carry water from the desalination plant to population centres within the three Beneficiary Parties.

There will also be temporary infrastructure at sites associated with the permanent installations and at several other locations along the conveyance route including workers’ camps, construction sites and access roads.

The assessment also takes account of the influence of the scheme on the wider area of the Jordan Valley including its effect on international relations and transboundary patterns of future land use and development.

**IMPACT ASSESSMENT METHODOLOGY**

The assessment has considered both Positive and Negative impacts on all aspects of the Physical, Natural, Cultural, Social and Socio-Economic environment.

The assessment has addressed impacts with different temporal characteristics (permanent impacts, temporary impacts, long-term impacts) and both routine impacts and non-routine impacts (ie those arising from unplanned or accidental events or external events).

Induced impacts, ie those caused by stimulating other developments to take place are also considered in the assessment, as are cumulative impacts with other developments taking place in the area at the same time.

**Assessment of Impacts**

The assessment of impacts has proceeded through an iterative process considering five questions:

1. The baseline (‘do-nothing scenario’) what will the environment be like in the timescale of the project if the project does not proceed?

2. Prediction - What will happen to the baseline environment as a consequence of this scheme?

3. Evaluation - Does this impact matter? How important or significant is it?
4. Mitigation – If it is significant can anything be done to avoid or reduce adverse effects or enhance benefits?

5. Residual Impact – Is the impact still significant after mitigation?

Potentially significant impacts will be tabulated as a visual aid for document users. The table below shows how the potential impacts of the scheme might be summarised for each theme.

**Summary of Potential Impacts**

<table>
<thead>
<tr>
<th>Intake</th>
<th>Marine Water Conveyances</th>
<th>Outfall</th>
<th>DSP and HPP</th>
<th>Fresh water conveyances</th>
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</thead>
<tbody>
<tr>
<td>Marine and Coastal</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Dead Sea Limnology</td>
<td></td>
<td>X</td>
<td>--</td>
<td></td>
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<tr>
<td>Hydrology, Flood Risk and Surface Water Quality</td>
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<tr>
<td>Archaeology and Cultural Heritage</td>
<td>--</td>
<td>-</td>
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<td>--</td>
</tr>
<tr>
<td>Impacts on Communities (includes health)</td>
<td>--</td>
<td>--</td>
<td>-/+</td>
<td>--</td>
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<tr>
<td>Terrestrial ecology and natural heritage</td>
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<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Hydrogeology and Groundwater</td>
<td>--</td>
<td>--</td>
<td>++</td>
<td>-</td>
</tr>
<tr>
<td>Water Resources and Water Supply</td>
<td>--</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Meteorology/climate change</td>
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<td></td>
<td></td>
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<tr>
<td>Regional impacts</td>
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<td>--/+</td>
<td>--/+</td>
<td>-/+</td>
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<td>Economic Development</td>
<td>-</td>
<td>++</td>
<td>--/+</td>
<td>+</td>
</tr>
<tr>
<td>Geology, Seismology, Land Use and Soils</td>
<td>--</td>
<td>-</td>
<td>-/+</td>
<td>-</td>
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<tr>
<td>Environmental Quality</td>
<td>--</td>
<td>--</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Utilities and Infrastructure</td>
<td>-/+</td>
<td>-/+</td>
<td>-/+</td>
<td>++</td>
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</tbody>
</table>

**Legend**

- Potentially Negative Impacts
- Potentially Beneficial Impacts

<table>
<thead>
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<th>Symbols</th>
<th>Description</th>
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<tbody>
<tr>
<td>X</td>
<td>Critical</td>
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<tr>
<td>--</td>
<td>Major negative</td>
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<td>Major benefit</td>
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<td>Moderate negative</td>
</tr>
<tr>
<td>+</td>
<td>Moderate benefit</td>
</tr>
<tr>
<td>-/+</td>
<td>Slight negative</td>
</tr>
<tr>
<td>+/o</td>
<td>Slight benefit</td>
</tr>
</tbody>
</table>

**Mitigation**

Impact assessment is designed to ensure that decisions on developments are made in full knowledge of their likely impacts on the environment and society. But a vital step within the process is the identification of measures.
that can be taken to ensure impacts are as low as technically and financially feasible.

Where a significant impact is identified, a hierarchy of options for mitigation has been considered to identify the preferred approach:

- **Avoid at source** – remove the source of the impact, for example by relocating a component of the scheme to avoid a sensitive site;

- **Abate at source** – reduce the source of the impact, for example by controlling the emission of dust or noise;

- **Attenuate** – reduce the impact between the source and the receptor, for example by installing a noise barrier between the road and neighbouring houses;

- **Abate at the receptor** – reduce the impact at the receptor, for example by providing noise insulation in nearby buildings;

- **Remedy** – repair the damage after it has occurred, for example by cleaning up accidental spills during construction; and

- **Compensate / Offset** – replace a lost or damaged resource with a similar or a different resource of equal value, for example by resettling displaced businesses into new premises, or providing monetary compensation for loss of business.

Mitigation can also include measures to provide or enhance positive benefits from the scheme, so for example, a construction project can create employment opportunities, and the chances of these being available to local people may be improved by setting up training in the required skills.

Mitigation can be achieved by various means including:

- **Changes in the design of the scheme**, for example relocating structures, incorporating noise barriers into the design, and designing structures to minimise their visual impact;

- **Selection of particular approaches and methods for construction**, for example using bored rather than driven piling or electrical rather than diesel powered equipment; and

- **Adoption of measures to control impacts during construction**, such as covering of dusty materials, installation of oil interceptors, adoption of emergency spill plans, and traffic management.
Implementing Mitigation: The ESMP

To ensure that all the mitigation identified through the ESA is implemented all agreed measures are set out in an Environmental and Social Management Plan (ESMP) for the scheme.

The ESMP will be presented in Part D, following completion of the remaining components of the ESA as described above. The ESMP constitutes a critical link between the management and mitigation measures specified in the report and the proper implementation and management of the measures during the construction and operation of the project. It summarizes the anticipated environmental and social impacts and provides details on the measures responsibilities and scheduling to mitigate these impacts; the costs of mitigation; and, the ways in which implementation and effectiveness of the measures will be monitored and supervised.

In many areas, the project will have positive impacts on the quality of peoples' lives. Consistent with the scope of the project and the available resources, measures have been proposed that maximize these benefits. The RSDSC is basically an environmental improvement project. From first planning, its design has incorporated a significant number of measures directed specifically towards environmental protection and the minimization and/or mitigation of potential environmental impacts. However, there is still potential for some negative impacts due to the nature of project sites or the risk that design features will not be implemented. These have generally been addressed in three ways as follows:

- Additional prevention or abatement measures have been incorporated into the design of the facilities or into the specifications of equipment;
- Operating and management procedures will be enforced that specify how staff will carry out their duties at project sites; and,
- Capacity development and administrative measures have been developed to ensure the responsible institutions have the legal, administrative and human resources necessary to fulfill their functions.

The measures required by the ESMP will be incorporated in a series of documents that will be linked through the ESMP and the associated Monitoring Plan. These documents are as follows:

- Relevant provisions of the ESMP will be incorporated into the Contract Documents prepared for firms bidding to work on major project construction activities forming a binding contractual obligation that specifies not just design features but, where the ESMP so requires, management of workers, vehicles, machinery, operating times, methods of working, complaints management etc;
Relevant provisions of the ESMP will also be incorporated into the operational contracts (eg via a Register of Commitments). These binding contractual obligations will specify, where the ESMP so requires, site management and maintenance routines, employment practices, vehicle routes, operating times, methods of working, complaints management etc.

Relevant provisions of the ESMP will also be incorporated into the agreement of the entity created to manage the project. This will include: a monitoring plan for noise, dust, and water and a supervision plan to check the progress and effectiveness of the environmental and social mitigation measures; arrangements to implement the provisions of the (eventual) Resettlement Action Plan (RAP) (1); and, provisions to implement training.

Important parts of the ESMP include the following:

- The project Environmental and Social Policy;
- Definition of Responsibilities;
- Design Requirements which must be met by the detailed design;
- Code of Construction Practice to be implemented by the contractors including sub-plans on topics such as Noise, Waste, Spill Management etc;
- Resettlement Policy Framework to guide the process of expropriation of land and other assets in compliance with World Bank policy;
- Monitoring and Auditing Plan;
- Capacity Building Plan;
- Public Consultation and Communication Plan; and
- Grievance Process to be followed in the event of any complaints about the scheme.

Implementation and maintenance of the ESMP will be achieved through operation of a Project Environmental Management System in accordance with the requirements of the international standard for EMS, ISO 14001 (2).

(1) To be developed during detailed design, on the basis of the Resettlement and Land Acquisition Policy Framework developed in Annex X of the ESA (see Part D).
STRUCTURE OF THE REPORT

The Final ESA Report will be arranged in four Sections labelled A – D, where:

**Part A** is an overview of the ESA process and context, with four main sections describing:

- The approach and methodology of the ESA (this section);
- The components and an outline of the construction methods of the scheme under consideration;
- The legal, policy and administrative context in which the scheme is being developed; and
- The scope of the ESA study.

**Part B** is a Regional Impact Assessment with six main sections as follows:

- The first two sections describes the scope and approach taken to the regional assessment;
- The third and fourth sections describe the legal and policy context and regional environmental and social baseline;
- The fifth section describes how the most important potential impacts were identified and presents a list of key regional impacts; and
- The sixth sections (will) describe regional mitigation measures and how they should be integrated into project development to avoid, abate or manage negative impacts.

**Part C** contains the project specific analysis of impacts in 13 separate thematic sections, each structured as follows:

- Scope;
- Approach;
- Baseline; and
- Impacts and mitigation.

**Part D** will contain the ESMP in which the mitigation measures described in the preceding Regional and Project Specific sections are brought together in a comprehensive plan described in seven sections as follows:

- Land Acquisition Framework and Plan;
- Involuntary Resettlement Plan;
- Indigenous Peoples Development Framework and Plan;
- Plan for Control of Construction Activities;
- Plan for Operations Phase Mitigation and Monitoring;
- Capacity Development and Training; and
- Implementation Schedule and Cost Estimates.
Annexes: In addition, there will be 14 Annexes with background information and reference material that is considered too detailed to include in the main report. These will comprise the following:

Annex I. Public Consultation and Communication Report;
Annex II. Report on Strategic Alternatives (TSC);
Annex III. EA report preparers;
Annex IV. References used in study preparation;
Annex V. Record of Meetings (Governments, Agencies, etc.);
Annex VI. Public Consultation and Disclosure Plan for the Implementation Period;
Annex VII. Archaeological and Historical Sites Survey;
Annex VIII. Archaeological Chance Find Procedures;
Annex IX. Social Assessment;
Annex X. Resettlement and Land Acquisition Policy Framework;
Annex XI. Occupational Health and Safety Plan;
Annex XII. Health and HIV/AIDS Assessment and Management Plan;
Annex XIII. Detailed Corridor Location Maps for Baseline Data; and
Annex XIV. Detailed Corridor Location Maps for Mitigation Measures.
PART A

OVERVIEW
A1 INTRODUCTION

A1.1 PREAMBLE

The following document is the Initial Assessment Report (IAR) prepared as part of the Environmental and Social Assessment (ESA) Study of the proposed Red Sea Dead Sea Water Conveyance (RSDSC). As detailed in the next section, it presents an initial and early assessment of impacts based on the initial design and technical studies provided by the parallel Feasibility Study to date.

As described in the report itself (and indicated by the greyed-out items in the contents list) the document does not consider impacts associated with technical studies that have not yet been completed by the Feasibility Study (eg hydrogeology, geology and seismicity, climate), and in particular it does not consider impacts on either the Red Sea or the Dead Sea since the detailed studies (or ‘Additional Studies’) relating to these two seas have not yet begun. The assessment of these remaining impacts will form part of the Preliminary Draft ESA Report that is due for submission in January 2011.

A1.2 BACKGROUND AND CONTEXT

The Dead Sea water level has been dropping at an increasing rate for the last 30 years. Major environmental damage has resulted including changes to the landscape due to the loss of water surface, the development of sinkholes and increased incidence of dust storms. If the current situation is allowed to continue unchecked, the changes may become so great that the Dead Sea region might lose much of its value as a tourism and recreational area, in addition to the threats to its status as a world cultural and religious symbol.

A Feasibility Study is underway to study the implications of constructing a water conveyance that would carry water from the Red Sea to the Dead Sea and, in so doing, stabilise or increase its water level (the “base case”). In addition the Feasibility Study will examine the provision of desalination and electricity generation capacity that, in conjunction with the conveyance, could be used to supply fresh water to users in Jordan, Israel and the Palestinian Authority (the ‘base case plus’).

In parallel with the Feasibility Study a full Environmental and Social Assessment (ESA) is being undertaken. This will involve a comprehensive review and assessment of all of the potential environmental and social impacts of the proposals generated by the Feasibility Study (both positive and negative) at both the regional and project-specific level.
A1.3  **ESA Information Sources and Timing**

The areas and ecosystems potentially impacted by the scheme have also individually been the subject of a number of studies over the past 25 years, carried out by scientific or research organisations, specialised interest groups, local authorities and by prospective developers. These studies include an Interim Environmental Assessment conducted in 1996 – 1998 as part a prefeasibility study of what was then called ‘the Red Sea Dead Sea Canal Project.’

As a result, there exists a large amount of information and data that are available on the baseline conditions in the study area. Together these constitute a wealth of information that is far more detailed than that usually available for Environmental Assessment studies.

The available materials from past studies have been supplemented with information generated for the Feasibility Study assessment and by consultations with stakeholder groups including:

- Government ministries and departments;
- Local authorities;
- NGOs and interest groups;
- Research institutions and universities;
- Local communities/landowners; and
- Business/private sector groups.

Finally in some cases (archaeological and cultural property, social and economic status), specific studies have been conducted as part of the present assessment to gather additional information where required.

Following the approach set out in the study programme Terms of Reference (ToR), the ESA study is being carried out in close collaboration with the Feasibility Study Team, which has commissioned the necessary sub-studies defined in the ToR, and provide the data and technical analysis on the various issues covered by these sub-studies. Although we will conduct our own due diligence on the sub-studies, we will work on the understanding that the outputs provided by the Feasibility Study Team will provide the necessary level of detail and analysis at the project level for incorporation in the final ESA.

The added value of the ESA work will be to critique, then synthesise the technical output from the Feasibility Study team into a comprehensive Assessment, which provides recommendations on how the various environmental risks can be mitigated.

Ways of addressing the decline of the Dead Sea and the supply of desalinated water that do not involve transfer of Red Sea water have been termed “Strategic Alternatives” to the RSDSC. With regard to these, the study terms
of reference state, “The Technical Steering Committee shall provide the Consultant, for use in the Environmental and Social Assessment, with a report on alternatives/options that have been proposed, studied and/or are being undertaken under a variety of initiatives to arrest the decline of the Dead Sea.” A study - “Study of Alternatives” (SoA) - is being carried out independently from the ESA and is due to be completed in October 2010. The SoA will be annexed to this document and a summary of its findings will be presented at Section B7.

The ESA will take as a starting point the initial design and technical studies provided by the Feasibility study. These studies having, for the most part, been made available, at least in draft, the ESA has progressed as far as the initial assessment of impacts (shown within the context of the overall output delivery schedule in Table A1.1).

**Table A1.1  Delivery Schedule**

<table>
<thead>
<tr>
<th>Deliverable</th>
<th>Due date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inception Report</td>
<td>20/07/08</td>
</tr>
<tr>
<td>Public Communications and Consultations Plan (PCCP)</td>
<td>18/09/08</td>
</tr>
<tr>
<td>Annotated Outline of ESA Report</td>
<td>30/10/08</td>
</tr>
<tr>
<td>Joint Phase I Public Consultations Report</td>
<td>18/12/08</td>
</tr>
<tr>
<td>Scoping and Options Analysis Report</td>
<td>18/12/08</td>
</tr>
<tr>
<td><strong>Initial Assessment Report</strong></td>
<td>15/02/10</td>
</tr>
<tr>
<td>Preliminary Analysis of Preferred Technical Options</td>
<td>30/06/10</td>
</tr>
<tr>
<td>Preliminary Draft ESA Report and Environmental and Social Management Plan (ESMP)</td>
<td>31/01/11</td>
</tr>
<tr>
<td>Joint Phase II Public Consultations Report</td>
<td>31/01/11</td>
</tr>
<tr>
<td>Final Draft ESA Report and ESMP</td>
<td>15/04/11</td>
</tr>
<tr>
<td>Final ESA Report and ESMP</td>
<td>30/06/11</td>
</tr>
<tr>
<td>Joint Phase III Consultations Report</td>
<td>30/06/11</td>
</tr>
</tbody>
</table>

**A1.4  Definition of the Scheme and its Area of Influence**

The RSDSC scheme is defined so as to include all those actions and activities which are a necessary part of the development, including all related and ancillary facilities without which the scheme cannot proceed, and any other developments or activities which follow as a necessary consequence of the project.

At the feasibility stage, elements of the RSDSC to be studied include the project level alternatives still under study. Elements being assessed therefore include:

- An intake on the Gulf of Aqaba including a pumping station (except in the case of a gravity tunnel). Two potential sites have been considered.

- A seawater conveyance to carry Red Sea water to the Dead Sea Basin. A pipeline along the Wadi Araba/Arava Valley and a tunnel through the
eastern mountains (two tunnel configurations were examined, one of which includes two sections of canal) have been considered:

- A desalination plant in the Dead Sea Basin. Two potential sites have been considered.
- A hydroelectricity power plant in the Dead Sea Basin, running on sea water from the conveyance and/or brine from the desalination plant;
- A conveyance and outfall to carry the sea water and or brine from the desalination and hydro power plants to the Dead Sea; and,
- Freshwater transmission pipelines, with associated pumping and energy supply infrastructure, to carry water from the desalination plant to population centres within the three Beneficiary Parties.

There will also be temporary infrastructure at sites associated with the permanent installations and at several other locations along the conveyance route including workers’ camps, construction sites and access roads. Some of these may be maintained by third parties after the construction phase is complete.

The assessment also takes account of the influence of the scheme on the wider area of the Jordan Valley including its effect on international relations and transboundary patterns of future land use and development.

Impacts have been assessed for all phases of the scheme from initial site preparation and advance works, through construction, to operation of the conveyances. Decommissioning of the scheme is not assessed as it is envisaged to remain in place and in operation for the foreseeable future.

Impacts have been assessed throughout the Area of Influence of the RSDSC. The extent and boundaries of this area vary depending on the type of impact being considered, but in each case, it is defined to include all that area within which it is considered that significant impacts could occur. This takes into account:

- the physical extent of the proposed works, defined by the limits of land to be acquired or used temporarily or permanently for the construction and operation of the scheme;
- the nature of the baseline environment, the source of impact and manner in which the impact is likely to be propagated beyond the scheme boundary.

For example, effects on buried archaeological features are likely to be confined to those areas physically disturbed by construction works, whilst the effects of noise could be experienced at some distance, and air pollution may be
dispersed over long distances or even have regional or global effects. The area for each type of impact is defined in the later chapters of this report where each type of impact is assessed.

A1.5 IMPACT ASSESSMENT METHODOLOGY

A1.5.1 Types of Impact

The assessment has considered both Positive and Negative impacts on all aspects of the Physical, Natural, Cultural, Social and Socio-Economic environment. Positive or beneficial impacts are those, which are considered to present an improvement upon the situation without the scheme (the baseline) or to introduce a new desirable factor. Negative or adverse impacts are the reverse.

Aspects of the environment include:

• the physical environment including:
  • geology and soils;
  • land and topography;
  • hydrology and hydrogeology;
  • surface and ground water resources;
  • air;
  • noise, vibration, light and other forms of radiation;

• the biological or natural environment including:
  • aquatic and terrestrial habitats and ecosystems;
  • flora and fauna;
  • protected areas;

• the cultural environment including:
  • tangible and intangible sites and features of archaeological, historic, traditional, cultural, aesthetic or landscape interest;
  • cultural traditions, practices and events;

• the social and socioeconomic environment including:
  • people and their homes, lands and other resources;
  • the characteristics and structures of communities;
  • population and demographics:
  • human health, welfare, amenity, safety and security;
  • lifestyles including employment and incomes;
  • economic activities including industry and commerce, tourism, fisheries, agriculture and forestry;
  • community facilities such as schools, hospitals, leisure facilities;
  • utilities and infrastructure (power, water, sewerage, waste disposal, transport);
  • services such as health care, education and access to goods;
• local, regional and national economies.

When discussing different aspects of the environment we use the term ‘resources’ to describe features of the environment such as water resources, habitats, species, landscapes, etc which are valued by society for their intrinsic worth and/or their social or economic contribution. The term ‘receptors’ is used to define people and communities who may be affected by the scheme.

Timeframe

The assessment has addressed impacts with different temporal characteristics:

• *permanent impacts* that will arise from irreversible changes in conditions such as the removal of features;

• *temporary impacts* that will arise during short term activities such as construction; and

• *long-term impacts* that will arise over the operation of the scheme.

Short term, temporary impacts will cease on completion of the relevant activities although there may be a period before the environment returns to its previous condition. Long-term impacts will continue over the life of the project and may vary during this period, but will ultimately cease when the scheme ceases to operate. Again, the environment may take some time to recover. In the case of RSDSC, long-term impacts are assumed to continue indefinitely because decommissioning of the conveyances and the desalination is not envisaged to occur in the foreseeable future, but they are expected to change over time as levels of activity change and as patterns of land use, population and economic activity evolve. These factors are taken into account in the assessment in so far as is possible with available information.

Other temporal characteristics of impacts, such as whether they are continuous or intermittent, one-time-only or recurrent, and their frequency and timing (eg seasonality) are also taken into account.

Routine and Non-Routine Impacts

Water transference on such a large scale raises the potential for impacts to arise from both planned and unplanned events. The ESA has therefore assessed both:

• *routine impacts* resulting from planned activities within the scheme; and

• *non-routine impacts* arising from:
  • unplanned or accidental events within the scheme;
  • external events affecting the scheme such as seismic activity and flooding.
The impact of non-routine events is assessed in terms of the Risk i.e. taking into account both the consequence of the event and the probability of occurrence (Risk = probability x consequence).

**Direct, Indirect and Induced Impacts**

Impacts can also be characterised according to whether they are direct, primary impacts arising from activities associated with the scheme or indirect, secondary and higher order impacts that follow on as a consequence of these. So for example, construction can lead to emissions of dust with a direct effect on air quality. High levels of dust can then cause reductions in visibility with attendant effects on visual amenity and, possibly, increased risk of road accidents. They can also result in soiling of buildings and materials with effects on amenity for users and added costs for maintenance.

Projects can also have induced impacts by stimulating other developments to take place, which are not directly within the scope of, or essential to, the development of the scheme. So for example, road improvements may encourage people or businesses to move into an area, and as a result lead to building of new homes and other facilities, which will have their own impacts. Whilst these possible developments are not part of the scheme, they are caused at least in part by the scheme and they are therefore considered in the assessment.

**Cumulative Impacts**

The potential for this scheme to have cumulative impacts with other known or committed developments taking place in the area at the same time has been taken into account by incorporating them into the future baseline for the scheme (i.e. the ‘No Project’ situation against which the impacts of the scheme are assessed).

**A1.5.2 Assessment of Impacts**

The assessment of impacts has proceeded through an iterative process considering five questions:

1. The baseline (‘do-nothing scenario’) what will the environment be like in the timescale of the project if the project does not proceed?
2. Prediction - What will happen to the baseline environment as a consequence of this scheme?
3. Evaluation - Does this impact matter? How important or significant is it?
4. Mitigation – If it is significant, can anything be done to avoid or reduce adverse effects or enhance benefits?
5. Residual Impact – Is the impact still significant after mitigation?
Establishing a Baseline

In the RSDSC literature the term ‘baseline’ has been used in several ways (eg to mean the current conditions or the background information available). In the ESA the baseline conditions will always mean “Description of conditions predicted at the start of the project (2020) against which subsequent changes can be detected by monitoring.”

Hence, the baseline is equivalent to the ‘zero option’ (also called the ‘do-nothing scenario’ and the ‘business as usual scenario’) shown in Figure A1.1.

![Figure A1.1 Baseline Equivalent to Zero Option](image)

The baseline is predicted by extrapolating ongoing trends into the future, taking into account planned actions by the beneficiary parties that may affect conditions. Since there is considerable time between the conduct of baseline studies and the start of the project there will be some uncertainty in the prediction. One way to minimise this would be the use of alternative development scenarios, however this approach will not be taken. There are no coherent alternative development scenarios available that have a calculable probability of occurrence.

Instead, we note that the project is located within an area of historic political instability and that developments in the peace process may affect baseline conditions in some thematic areas. Where potential political changes might be sufficient to affect our conclusions, we deal with this and other sources of uncertainty by:

- broad-based consultation;
- sensitivity analysis (comparing a range of outcomes produced by adjusting key variables); and
• recommending ongoing monitoring up to project inception.

Predicting the Occurrence and Magnitude of Impacts

As noted above development activities may give rise to environmental and social impacts when physical changes caused by construction, operation or decommissioning of facilities interact with sensitive receptors: where sensitive receptors comprise those human beings and human systems or biological organisms and biological systems, that are liable to be disturbed, disrupted or destroyed by the change in question.

Table A1.2 shows potential sources of impacts from the RSDSC.

Table A1.2  Potential Sources of Impacts from the RSDSC

<table>
<thead>
<tr>
<th>SOURCES OF IMPACT</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td></td>
</tr>
<tr>
<td>Land take for worksites site accesses and access roads etc.</td>
<td>Flow of sea water</td>
</tr>
<tr>
<td>Employment</td>
<td>Employment</td>
</tr>
<tr>
<td>Site activities (excavation, tunnelling, construction, rehabilitation)</td>
<td>Use of services and utilities</td>
</tr>
<tr>
<td>Materials (including hazardous) import, manufacture and storage</td>
<td>Operation of pumping stations</td>
</tr>
<tr>
<td>Use of natural resources (water, sand etc, vegetation)</td>
<td>Maintenance of infrastructure and equipment</td>
</tr>
<tr>
<td>Workers’ accommodation and subsistence</td>
<td>Discharge of brine</td>
</tr>
<tr>
<td>Transport (workers, equipment, wastes; heavy/hazardous loads)</td>
<td>Manufacture of membranes</td>
</tr>
<tr>
<td>Waste disposal (spoil; &quot;domestic”; and hazardous)</td>
<td>Physical presence in the environment</td>
</tr>
<tr>
<td>Rehabilitation of work sites</td>
<td>Operation of the desalination plant</td>
</tr>
<tr>
<td>Use of services and utilities</td>
<td>Provision of potable water</td>
</tr>
<tr>
<td></td>
<td>Emergency response</td>
</tr>
<tr>
<td></td>
<td>Power generation</td>
</tr>
<tr>
<td></td>
<td>Hazardous materials storage</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential Secondary, and Cumulative Sources (other than addressed above)</td>
<td>Cumulative water abstraction from the Red Sea</td>
</tr>
<tr>
<td></td>
<td>Fragmentation of ecological habitats across the Jordan Valley</td>
</tr>
<tr>
<td></td>
<td>Secondary effects of Tourism</td>
</tr>
<tr>
<td></td>
<td>Secondary effects of Increased freshwater provision</td>
</tr>
</tbody>
</table>

Part A - Overview Initial Assessment Report
Within each theme, the sources of impact for each of the components of the scheme are identified and the potential for impact is considered, taking into account:

- known precedent;
- expert opinion; and
- the outcome of consultation.

It is important to note that the potential impact is the outcome of scoping. The extent to which the potential is real or is likely to be realised is determined in the next phase of analysis.

Potentially significant impacts will be tabulated as a visual aid for document users. Table A1.3 shows how the potential impacts of the scheme might be summarised for each theme.

**Table A1.3  Summary of Potential Impacts**

<table>
<thead>
<tr>
<th></th>
<th>Intake</th>
<th>Marine Water Conveyances</th>
<th>Outfall</th>
<th>DSP and HPP</th>
<th>Fresh water conveyances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marine and Coastal</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dead Sea Limnology</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Hydrology, Flood Risk and Surface Water Quality</td>
<td></td>
<td></td>
<td></td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Archaeology and Cultural Heritage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impacts on Communities (includes health)</td>
<td>--</td>
<td>--</td>
<td>-/+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terrestrial ecology and natural heritage</td>
<td>-</td>
<td>--</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrogeology and Groundwater</td>
<td>--</td>
<td>--</td>
<td>++</td>
<td>-</td>
<td>++</td>
</tr>
<tr>
<td>Water Resources and Water Supply</td>
<td>--</td>
<td>--</td>
<td>++</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Meteorology/climate change</td>
<td>-</td>
<td>--</td>
<td>-/+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Regional impacts</td>
<td>--</td>
<td>--/++</td>
<td>--/++</td>
<td>-/+</td>
<td>++</td>
</tr>
<tr>
<td>Economic Development</td>
<td>-</td>
<td>++</td>
<td>--/++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Geology, Seismology, Land Use and Soils</td>
<td>--</td>
<td>-</td>
<td>-/+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Environmental Quality</td>
<td>--</td>
<td>--</td>
<td></td>
<td>--/++</td>
<td>-</td>
</tr>
<tr>
<td>Utilities and Infrastructure</td>
<td>-/+</td>
<td>-/+</td>
<td>-/+</td>
<td>-/+</td>
<td>++</td>
</tr>
</tbody>
</table>

**Legend**

Potentially Negative Impacts

- **X** Critical
- **--** Major negative
- **-** Moderate negative
- **-/0** Slight negative

Potentially Beneficial Impacts

+ + Major benefit
+ Moderate benefit
+/o Slight benefit
A textual explanation of the entry in each cell will be presented. Where the various alternatives to a component examined by the Feasibility Team (e.g., low-level tunnel versus high level tunnel versus pipeline) are thought to give rise to a different set of potential impacts, extra columns will allow the alternatives to be considered alongside each other.

Each potentially significant impact is then studied, the magnitude and probability of occurrence predicted and the effect assessed against baseline conditions. Where mitigation is indicated, necessary measures are developed, in consultation with the Feasibility Team’s engineers, the impacts are reassessed taking into account the effects of the mitigation measures, (including any impacts that may arise as a result of these measures) and the residual impact is described.

The mitigation measures, along with the monitoring and other control systems necessary to ensure that they are effective, are incorporated into an ESMP, which will describe the measures, along with the details of their implementation (timing, costs, institutional responsibilities, preparations needed, especially if capacity development is required).

The impact assessment has set out to describe what will happen to the environment and society by predicting the magnitude of impacts and quantifying this to the extent practicable. The term “magnitude” is used here as shorthand to encompass various possible dimensions of the predicted impact (the ‘what will happen’) including:

- the nature of the change (what is affected and how);
- its size, scale or intensity;
- its geographical extent and distribution;
- its duration, frequency, reversibility, etc; and
- where relevant, the probability of the impact occurring as a result of accidental or unplanned events.

It also includes any uncertainty about the occurrence or scale of the impact (1).

Magnitude therefore describes the actual change that is predicted to occur in a resource or receptor (e.g., the area and duration over which air or water become polluted and the increase in concentration of the pollutant; the degree and probability of impact on the health or livelihood of a local community; the probability of injuries or deaths as the result of an accident).

Magnitude has been predicted using a range of different methods depending on the nature of the impact: so for example, noise and air quality impacts are predicted using standard mathematical models developed for calculating the

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(1) A distinction is made here between the probability of impact arising from a non-routine event such as a seismic event or fire, and the uncertainty about predicted impact. For example, it may not be certain that health will be affected by air emissions or that jobs will be obtained by local people. This is different from estimating the probability of an unplanned event occurring. Uncertainty can be expressed by describing the predicted outcome using a range rather than a single value, placing confidence limits around the prediction, or estimating the likelihood of the prediction being correct.
effects of traffic on noise levels and concentrations of air pollution; impacts on
the scenic quality of views are predicted using visualisations; and some
impacts which are less amenable to mathematical or physical representation
are predicted using the professional knowledge and experience of experts in
areas such as ecology and archaeology.

To assist in the next step of evaluating significance (see below), the magnitude
of certain impacts has been graded taking into account all the various
dimensions to determine whether an impact is of negligible, small, medium or
large magnitude. This scale is defined differently according to the type of
impact and a more or less detailed scale may be used for particular impacts
depending on the circumstances. For quantifiable impacts such as noise,
numerical values are used whilst for other topics a qualitative classification is
necessary.

The details of how magnitude is predicted and described for each impact are
presented in the relevant later chapters of the report.

_evaluation of significance_

The next step in the assessment is to take the information on the magnitude of
impacts, and explain what this means in terms of their importance to society
and the environment, so that decision-makers and stakeholders understand
how much weight to give to the issue in deciding on their view of the scheme.
This is referred to as Evaluation of Significance.

There is no statutory or agreed definition of significance; however, for the
purposes of this assessment, the following practical definition is used:

> an impact is significant if, in isolation or in combination with other impacts, it
should, in the judgement of the ESA team, be reported in the ESA Report so that it
can be taken into account in the decision on whether or not the scheme should
proceed and if so under what conditions.

This recognises that evaluation requires an exercise of judgement and that
judgements may vary between parties involved in the process (regulators,
funders, assessors, affected people, and the general public). The evaluation of
impacts that is presented in this report is based on the judgement of the
ESA Team, informed by reference to legal standards, government policy,
current good practice and the views of stakeholders as expressed through the
consultation process.

Criteria for assessing the significance of impacts are clearly defined for each
type of impact taking into account whether the scheme will:

- cause legal or accepted environmental standards to be exceeded – eg air,
  water or soil quality, noise levels – or make a substantial contribution to the
  likelihood of standards being exceeded;
or:

- adversely affect protected areas or features or valuable resources – these include protected nature conservation areas, rare or protected species, protected landscapes, historic features, important sources of water supply;

or:

- conflict with established government or international policy eg to reduce CO$_2$ emissions, recycle waste, improve health, protect human rights.

Where standards are not available or provide insufficient information on their own to allow evaluation of impacts, significance has been evaluated taking into account the magnitude of the impact and the value or sensitivity of the affected resource or receptor. Magnitude is defined across the various dimensions described in the previous section. The value of a resource is judged taking into account its quality and its importance as represented, for example, by local, regional, national or international designation, its importance to the local or wider community, or its economic value. The sensitivity of receptors, for example a household, community or wider social group, will take into account their likely response to the change and their ability to adapt to and manage the effects of the impact.

Magnitude and value/sensitivity are looked at in combination to evaluate whether an impact is significant and if so its degree of significance. The principle is illustrated in Table A1.4.

**Table A1.4 Magnitude and Value/Sensitivity**

<table>
<thead>
<tr>
<th>Sensitivity/Value of Resource/Receptor</th>
<th>Magnitude of Impact</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Not Significant</td>
<td>Minor</td>
<td>Moderate</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>Minor</td>
<td>Moderate</td>
<td>Major</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>Moderate</td>
<td>Major</td>
<td>Critical</td>
<td></td>
</tr>
</tbody>
</table>
The definition of these degrees of significance may be expressed in terms of design response as follows:

- **Critical**: The effect on a sensitive receptor is unacceptable (either because it breaches standards or norms relating to human health and livelihood, or causes irreversible damage to a valuable asset or resource) and mitigation is unlikely to change this;

- **Major**: The effect on a sensitive receptor must be mitigated (either because it breaches relevant standards, norms, guidelines or policy, or causes long-lasting damage to a valuable or scarce resource);

- **Moderate**: Some effect on a sensitive receptor may be discernable, the effect is either transient or mainly within currently accepted standards etc, but should be mitigated where cost-effective measures are available;

- **Minor**: The effect on a sensitive receptor is unlikely to be significant but measures should be taken to ensure that the effect does not become significant by virtue of cumulation or poor management; and

- **Not Significant**: The effect is temporary, of low magnitude, within accepted standards etc, and of little concern to stakeholders.

The specific criteria used to evaluate significance of impacts are discussed as relevant in the later chapters of the report.

*Mitigation*

Impact assessment is designed to ensure that decisions on developments are made in full knowledge of their likely impacts on the environment and society. But a vital step within the process is the identification of measures that can be taken to ensure impacts are as low as technically and financially feasible.

This has been done by identifying where significant impacts could occur and then working with the Feasibility Assessment team to identify practical and affordable ways of mitigating those impacts as far as possible.

Where a significant impact is identified, a hierarchy of options for mitigation has been considered to identify the preferred approach:

- **Avoid at source** – remove the source of the impact, for example by relocating a component of the scheme to avoid a sensitive site;

- **Abate at source** – reduce the source of the impact, for example by controlling the emission of dust or noise;
• Attenuate – reduce the impact between the source and the receptor, for example by installing a noise barrier between the road and neighbouring houses;

• Abate at the receptor – reduce the impact at the receptor, for example by providing noise insulation in nearby buildings;

• Remedy – repair the damage after it has occurred, for example by cleaning up accidental spills during construction; and

• Compensate / Offset – replace a lost or damaged resource with a similar or a different resource of equal value, for example by resettling displaced businesses into new premises, or providing monetary compensation for loss of business.

Mitigation can also include measures to provide or enhance positive benefits from the scheme, so for example, a construction project can create employment opportunities, and the chances of these being available to local people may be improved by setting up training in the required skills.

Mitigation can be achieved by various means including:

• changes in the design of the scheme, for example relocating structures, incorporating noise barriers into the design, and designing structures to minimise their visual impact;

• selection of particular approaches and methods for construction, for example using bored rather than driven piling or electrical rather than diesel powered equipment; and

• adoption of measures to control impacts during construction, such as covering of dusty materials, installation of oil interceptors, adoption of emergency spill plans, and traffic management.

All these types of measures have been considered in this assessment and proposals have been discussed and costed with the assistance of the Feasibility Team, so that they form part of total cost of the alternatives being assessed. Arrangements for their implementation will be suggested and a monitoring plan will be part of the Environmental and Social Management Plan for the scheme.

Assessing Residual Impacts

Following development and incorporation of feasible mitigation, the ESA team re-assessed the impacts. Where significant residual impacts remained after mitigation, further options were examined and impacts re-assessed, in consultation with the design team, until they were considered to be as low as is technically and financially feasible for the scheme. The significant residual
impacts remaining at the end of this process are described in this report with commentary on why further mitigation is not feasible. The degree of significance attributed to residual impacts is related to the weight the ESA team considers should be given to them in reaching decisions on the scheme.

- Any residual **major** impacts, whether positive or negative, are considered to warrant substantial weight, when compared with other environmental, social or economic costs and benefits, in deciding whether or not the scheme should proceed. Conditions should be imposed to ensure adverse major impacts are strictly controlled and monitored and beneficial impacts are fully delivered.

- Residual **moderate** impacts are considered to be of reducing importance to the decision, but to still warrant careful attention to conditions regarding mitigation and monitoring, to ensure best available techniques are used to keep adverse impacts as low as reasonably practicable, and to ensure beneficial impacts are delivered.

- **Minor** impacts should be brought to the attention of the decision-maker but are identified as warranting little if any weight in the decision. Adequate mitigation should be achieved using normal good practice and monitoring should be carried out to confirm that impacts do not exceed predicted levels.

*Implementing Mitigation: The ESMP*

To ensure that all the mitigation identified through the ESA is implemented all agreed measures are set out in an Environmental and Social Management Plan (ESMP) for the scheme.

The ESMP will be presented in Part D, following completion of the remaining components of the ESA as described above. The ESMP constitutes a critical link between the management and mitigation measures specified in the report and the proper implementation and management of the measures during the construction and operation of the project. It summarizes the anticipated environmental and social impacts and provides details on the measures responsibilities and scheduling to mitigate these impacts; the costs of mitigation; and, the ways in which implementation and effectiveness of the measures will be monitored and supervised.

In many areas, the project will have positive impacts on the quality of peoples’ lives. Consistent with the scope of the project and the available resources, measures have been proposed that maximize these benefits. The RSDSC is basically an environmental improvement project. From first planning its design has incorporated a significant number of measures directed specifically towards environmental protection and the minimization and/or mitigation of potential environmental impacts. However, there is still potential for some negative impacts due to the nature of project sites or the risk that design
features will not be implemented. These have generally been addressed in three ways as follows.

- Additional prevention or abatement measures have been incorporated into the design of the facilities or into the specifications of equipment.

- Operating and management procedures will be enforced that specify how staff will carry out their duties at project sites.

- Capacity development and administrative measures have been developed to ensure the responsible institutions have the legal, administrative and human resources necessary to fulfill their functions.

The measures required by the ESMP will be incorporated in a series of documents that will be linked through the ESMP and the associated Monitoring Plan. These documents are as follows.

- Relevant provisions of the ESMP will be incorporated into the Contract Documents prepared for firms bidding to work on major project construction activities forming a binding contractual obligation that specifies not just design features but, where the ESMP so requires, management of workers, vehicles, machinery, operating times, methods of working, complaints management etc.

- Relevant provisions of the ESMP will also be incorporated into the operational contracts (eg via a Register of Commitments). These binding contractual obligations will specify, where the ESMP so requires, site management and maintenance routines, employment practices, vehicle routes, operating times, methods of working, complaints management etc.

Relevant provisions of the ESMP will also be incorporated into the agreement of the entity created to manage the project. This will include: a monitoring plan for noise, dust, and water and a supervision plan to check the progress and effectiveness of the environmental and social mitigation measures; arrangements to implement the provisions of the (eventual) Resettlement Action Plan (RAP) (1); and, provisions to implement training.

Important parts of the ESMP include:

- The project Environmental and Social Policy;

- Definition of Responsibilities;

- Design Requirements which must be met by the detailed design;

(1) To be developed during detailed design, on the basis of the Resettlement and Land Acquisition Policy Framework developed in Annex X of the ESA (see Part D).
• A Code of Construction Practice to be implemented by the contractors including sub-plans on topics such as Noise, Waste, Spill Management etc;

• a Resettlement Policy Framework to guide the process of expropriation of land and other assets in compliance with World Bank policy;

• a Monitoring and Auditing Plan;

• a Capacity Building Plan;

• a Public Consultation and Communication Plan; and

• a Grievance Process to be followed in the event of any complaints about the scheme.

Implementation and maintenance of the ESMP will be achieved through operation of a Project Environmental Management System in accordance with the requirements of the international standard for EMS, ISO 14001 (1).

A1.6 STRUCTURE OF THE REPORT

The Final ESA Report will be arranged in four Sections labelled A – D, where:

Part A is an overview of the ESA process and context, with four main sections describing:

• the approach and methodology of the ESA (this section);
• the components and an outline of the construction methods of the scheme under consideration;
• the legal, policy and administrative context in which the scheme is being developed; and
• the scope of the ESA study.

Part B is a Regional Impact Assessment with six main sections as follows:

• the first two sections describes the scope and approach taken to the regional assessment;
• the third and fourth sections describe the legal and policy context and regional environmental and social baseline;
• the fifth section describes how the most important potential impacts were identified and presents a list of key regional impacts; and
• the sixth sections (will) describe regional mitigation measures and how they should be integrated into project development to avoid, abate or manage negative impacts.

Part C contains the project specific analysis of impacts in 13 separate thematic sections, each structured as follows:

- scope;
- approach;
- baseline; and
- impacts and mitigation.

Part D will contain the ESMP in which the mitigation measures described in the preceding Regional and Project Specific sections are brought together in a comprehensive plan described in seven sections as follows:

- Land Acquisition Framework and Plan;
- Involuntary Resettlement Plan;
- Indigenous Peoples Development Framework and Plan;
- Plan for Control of Construction Activities;
- Plan for Operations Phase Mitigation and Monitoring;
- Capacity Development and Training; and
- Implementation Schedule and Cost Estimates.

Annexes: In addition, there will be 14 Annexes with background information and reference material that is considered too detailed to include in the main report. These will comprise the following:

- Annex I Public Consultation and Communication Report;
- Annex II Report on Strategic Alternatives (report of separate study);
- Annex III EA report preparers;
- Annex IV References used in study preparation;
- Annex V Record of Meetings (Governments, Agencies, etc.);
- Annex VI Public Consultation and Disclosure Plan for the Implementation Period;
- Annex VII Archaeological and Historical Sites Survey;
- Annex VIII Archaeological Chance Find Procedures;
- Annex IX Social Assessment;
- Annex X Resettlement and Land Acquisition Policy Framework;
- Annex XI Occupational Health and Safety Plan;
- Annex XII Health and HIV/AIDS Assessment and Management Plan;
- Annex XIII Detailed Corridor Location Maps for Baseline Data; and
- Annex XIV Detailed Corridor Location Maps for Mitigation Measures.

As described earlier, this IAR presents our initial findings in relation to Parts A to C only based on the available information at the present time. It does not consider or include impacts associated with technical studies that have not yet been completed by the Feasibility Study (eg hydrogeology, geology and seismicity, climate), and in particular it does not consider impacts on either the Red Sea or the Dead Sea since the detailed studies (or ‘Additional Studies’) relating to these two seas have not yet begun. The assessment of these remaining impacts, and the resulting ESMP and associated annexes will...
form part of the Preliminary Draft ESA Report that is due for submission in January 2011.
A2 DESCRIPTION OF THE SCHEME

A2.1 INTRODUCTION

This section describes the physical infrastructure and engineering works that will be necessary to implement the RSDSC scheme. Full details of engineering design features and schematic diagrams are included in the Feasibility Study. The information presented here is intended to give an overview of the scheme, its design, construction and operation, such that the potential environmental and social impacts can be identified and assessed.

The structure of the remainder of this Section is as follows.

• A project summary describes the purpose of the scheme and presents its main components.

• An overview is presented of the types of construction activities, the quantities and types of equipment, materials and labour and the approaches that will be used to manage the construction phase(s).

• Each of the project components is described, together with the main variants considered by the Feasibility Study and any aspects of construction that are particular to that component of variant.

A2.2 Purpose and Components of the Scheme

A2.2.1 Purpose of the RSDSC

The overall purpose of the RSDSC is to take seawater from the Red Sea and carry it north to the Dead Sea basin so that it can be used to alleviate the declining water level in the Dead Sea and, after desalination, to supply potable water to Jordan, Israel and the Palestinian Authority (the beneficiary parties).

An intake will be established in the Gulf of Aqaba from which between 1,000 Mm$^3$ and 2,000 Mm$^3$/year of seawater will be conveyed along the Wadi Araba/Arava Valley. The conveyance will be either a tunnel (one variation of which includes canal sections) through the hills to the east or a buried pipeline along the valley floor. Both alignments lie entirely within Jordanian territory. The conveyance will carry the seawater for around 200 km northwards where it will terminate just south of the evaporation ponds, which now constitute the southern basin of the Dead Sea.

The seawater will then be directed through a desalination plant and/or a hydropower plant (HPP) located in the vicinity of Ghor Fifa. Initially, most of the water will be channelled through the hydropower plant into the Dead Sea, with a smaller fraction being diverted to a reverse osmosis desalination plant.
to produce potable water. Current thinking (according to the Feasibility Study Options Screening Report of January 2009) is that the capacity of the desalination plant will be expanded in phases until eventually all the water will be desalinated. At this point (some 40 years into the project) in the variant where all the flow goes through a low-level desalination plant, there will be insufficient head left to generate hydropower and the HPP would become defunct. The brine from the desalination process will be discharged to the Dead Sea.

The HPP is included to make use of the difference in level between the Red Sea and the Dead Sea (ie from sea level, 0m, to around -420m at the Dead Sea shore) to provide energy. However, over the lifetime of the project there will be no net production of power: the energy required (mainly for pumping) will exceed that which is generated.

Freshwater conveyances will be constructed to take the potable water from the desalination plant to population centres in Jordan, Israel and the Palestinian Authority. It is not yet known how much fresh water will be supplied to beneficiaries. For the purposes of this document, we have followed the Feasibility Study, Options Screening Report, which uses notional figures for water supply that then allowed them to make assumptions about the size and configuration of the freshwater conveyance facilities.

The sizes of the conveyances will have to be revisited when the distribution of freshwater becomes known as, in consequence, will the environmental and social effects.

A2.2.2 Project Components

The main elements of permanent infrastructure will include the following.

- **An intake on the Gulf of Aqaba** including a pumping station (except in the case of a gravity tunnel). Two potential sites have been considered.

- **A seawater conveyance** to carry Red Sea water to the Dead Sea Basin. A pipeline along the Wadi Araba/Arava Valley and a tunnel through the eastern mountains (two tunnel configurations were examined, one of which, includes two sections of canal) have been considered.

- **A desalination plant** in the Dead Sea Basin. Two potential sites have been considered.

- **A hydroelectricity power plant** in the Dead Sea Basin, running on sea water from the conveyance and/or brine from the desalination plant;

- **A conveyance and outfall** to carry the sea water and or brine from the desalination and hydro power plants to the Dead Sea; and
• **Freshwater transmission pipelines**, with associated pumping and energy supply infrastructure, to carry water from the desalination plant to population centres within the three Beneficiary Parties.

There will also be temporary infrastructure at sites associated with the permanent installations and at several other locations along the conveyance route including workers’ camps, construction sites and access roads. Some of these may be maintained by third parties after the construction phase is complete.

The following sections describe the project as a series of components, with each section including any variations in component design or alignment that has so far been considered in the Feasibility Study. The tunnel and pipeline conveyances have been treated as separate components because the types of impact and the areas affected by these alternatives are so different.

Further details of the project components and an indication of options preferred on engineering or cost grounds will become available as the Feasibility Study progresses.

An initial description of the construction processes and methods that are implied by the preliminary project design has been provided. In addition, construction activities associated with each component have been indicated. Although these are still highly provisional (dependent upon the final design decisions), there is sufficient information to identify areas of potentially significant environmental or social impact.

### A2.3 Project Construction and Operation

#### A2.3.1 Introduction

At the current stage of project development, there is uncertainty about construction arrangements and methods. The uncertainty is of two kinds: firstly the exact equipment needs, sites, and physical characteristics of the work areas cannot be known until detailed design is completed; and secondly, the successful bidders for construction contracts will have some leeway to select the working methods and equipment that they will use; based on their own preferences as well as price and availability at the time the contract is let.

Some general principles and approaches that will guide the construction of the project can however, be set out. These, together with descriptions of plant and equipment that might typically be used in such circumstances are sufficient to indicate the likely nature and extent of the main environmental and social effects associated with construction of the RSDSC. This ESA will then be able to indicate the methods, procedures and codes of practice that contractors should be required to use to avoid, reduce or compensate for such impacts. These measures can be incorporated into the bidding documents and the contractual conditions for construction.
The following sections describe elements of the construction of RSDSC in general terms and how each element is likely to be addressed, focusing on those aspects of most relevance to the ESA. Special variations from this general background, which may be needed for specific components of the scheme or at particular construction sites, are addressed in the relevant sections of the project description.

A2.3.2 Duration and Timing

The time from the beginning of construction until commissioning of the RSDSC and restitution of the temporary sites will be six to seven years. Duration of construction depends largely on the conveyance type selected, since this is the project component that will take longest to construct - around four years for a pipe and six years for a tunnel. Construction of other components and provision of services can be phased in such that the total duration, including testing, should not far exceed the time needed for the conveyance.

A2.3.3 Plant and Equipment

Whichever variant is eventually selected, the RSDSC will be a conventional civil engineering project that will not require unusual equipment or construction techniques. The major items of plant needed include:

**Table A2.1 List of Plant and Equipment**

<table>
<thead>
<tr>
<th>Item</th>
<th>Estimated Number</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temporary Production Facilities</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floating plant (barge)</td>
<td>1</td>
<td>Water intake (all variants)</td>
</tr>
<tr>
<td>Batch plant for concrete mixing (at each tunnel adit)</td>
<td>6</td>
<td>Conveyance (all variants)</td>
</tr>
<tr>
<td>Pipeline manufacturing plant</td>
<td>1</td>
<td>Conveyance (pipeline)</td>
</tr>
<tr>
<td>Aggregate production plant</td>
<td>6</td>
<td>Conveyance (tunnel options)</td>
</tr>
<tr>
<td>Concrete segmenting plants</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>Major Pieces of Equipment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bulldozer</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Heavy Excavator</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Spoil removal trucks</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>Cranes (large, heavy lift)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Standby generators</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Tunnel Boring Machine</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Excavator</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Rockbreakers</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>
A2.3.4 Permanent and Temporary Land Take

Permanent Land Take

Land will be acquired to site permanent project structures and to allow for operations, maintenance and emergency access throughout the operational life of the project. Areas above buried pipe may also be purchased or rights acquired so as to prevent incompatible development on the land surface.

A major criterion of the preliminary project design has been that, as far as practicable, permanent infrastructure should be sited on unused land of no particular ecological or cultural value. Where this has not been achievable, effort has still been made to avoid land on which there are dwellings or public infrastructure or which is of high value for agriculture.

Temporary Land Take

During construction, land will be needed for:

- workers’ accommodation;
- access roads and site access;
- construction sites including storage and parking;
- temporary infrastructure (eg tunnel portal worksites, pipeline manufacturing plant, administration buildings, wells, aggregate production plants, concrete segment factories).

The location of construction sites can usually be adjusted to accommodate any environmental or social constraints there may be in the surrounding area. In general, locations will be preferred that comprise undeveloped and unused land, mainly desert or mountainous terrain, and are owned by the government. There are certain to be some areas, however, where land will be needed that is currently in use. In such cases, arrangements will be made to preserve essential access and rights of way during the construction period and to compensate owners and users for any economic losses they may suffer.

After use for construction, most sites will be restored to their original condition. Exceptions may be accepted where, after consultation with the relevant authorities and stakeholders, a decision is made to hand over the facility (for example a road, well, or building) to be maintained for the use of the local population.

A2.3.5 Employment and Management of Workers

It is likely that some or all of the components of the RSDSC will be constructed by different contractors, working to different timescales independently of each other; or that a single component will be constructed by two or more contractors working in collaboration. Each contracting company may have its own pools of professional employees and preferred sources of workers.
Numbers of workers required will not be known until detailed design is completed and contractors have developed methodologies. Approximate indications of numbers of workers needed on each component and the duration of employment are shown in Table A2.2.

**Table A2.2 Approximate Numbers of Workers Needed for Each Component**

<table>
<thead>
<tr>
<th>Component</th>
<th>Duration of Construction (years)</th>
<th>Number of Workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intake</td>
<td>0.5</td>
<td>30</td>
</tr>
<tr>
<td>Conveyance (tunnel)</td>
<td>6.0</td>
<td>1,500</td>
</tr>
<tr>
<td>Conveyance (pipe)</td>
<td>4.0</td>
<td>500</td>
</tr>
<tr>
<td>Desalination Plant*</td>
<td>2.0</td>
<td>200</td>
</tr>
<tr>
<td>Hydropower Plant</td>
<td>2.0</td>
<td>200</td>
</tr>
<tr>
<td>Outfall</td>
<td>0.5</td>
<td>50</td>
</tr>
<tr>
<td>Jordan Freshwater Conveyance</td>
<td>1.0</td>
<td>200</td>
</tr>
<tr>
<td>Israel Freshwater Conveyance</td>
<td>0.5</td>
<td>50</td>
</tr>
<tr>
<td>PA Freshwater Conveyance</td>
<td>0.5</td>
<td>50</td>
</tr>
</tbody>
</table>

*First phase. It is likely that the DSP will be constructed in several phases depending on water demand

Where desired, the project proponent can require, or indicate a preference for, approaches to employment to be adopted by contractors. At this stage, it is likely that such requirements and preferences would include the following.

**Local Preferences in Hiring:** Criteria for hiring should include the local and national origin of workers. Where practicable, it may be desirable to give preference to employees from the local area and then to nationals of beneficiary parties.

**Worker Health and Safety Standards:** Internationally recognised procedures to assure the health and safety of the workforce will be adopted along with the necessary equipment and training to make these effective.

**Workers’ Accommodation:** Where the work force cannot be lodged in a major city (ie Amman or Aqaba) worker camps will be established near the work sites. Camps will be self-contained facilities that provide a complete living environment (lodging, food plus essential domestic and recreational facilities) for workers. They will purchase services (electricity, water, telecommunications, solid and liquid waste disposal) from local authorities where available or supply their own. Each camp will be securely fenced and provided with 24-hour security.

**Construction Activities’ Interaction with the Environment:** The contractors will provide all equipment and materials from designated off-site sources. They will also provide for all their workers’ needs. Work will only take place within demarcated and fenced areas. Vehicles will move only within sites, on site roads or following agreed routes on the public road network.
**Social and Economic Interactions:** Contractors will be responsible for providing work sites with all the materials that they require. There may be, however, some scope for local service providers and small-scale merchants or vendors to do business around the sites. The sites may also be able to allow local residents to access to some facilities that they maintain but are not readily available in the local area (on-site health care, for example). Access to all sites will be strictly controlled, but allowances will be made for such interactions in accordance with contractual obligations and agreements to be negotiated with local stakeholders.

**A2.3.6 Management and Use of Natural Resources and Materials**

No construction materials will be gained from work sites or the surrounding environment other than where specifically approved in advance by the responsible authority. Water for construction will be obtained from specially constructed wells, where sufficient water of adequate quality is available from local aquifer. A licence will be obtained from the Water Authority of Jordan. Otherwise, water will be purchased from the local water company.

Sand and aggregate will be obtained from local designated quarries. If a tunnel option is adopted, tunnel spoil will be used to produce aggregate wherever practicable.

Where excavation disturbs topsoil, the first metre or so of excavated material will be stored separately so that it can be replaced on the surface when the excavated area is restored.

**A2.3.7 Services and Utilities**

Where sites are established close enough, and there is sufficient capacity, services and utilities (i.e. water supply, wastewater and sanitation services, electricity supply, potable water supply, and solid waste management) will be purchased from local suppliers. Local utilities will be commissioned to extend transmission lines or water pipes to worksites. Where local capacity is insufficient, contractors will establish their own site facilities.

**A2.3.8 Transportation and Traffic**

Construction of RSDSC will generate a great deal of traffic for a number of years at the port of Aqaba; on public roads along the seawater conveyance alignment; and, close to the worksites. A lesser volume of traffic for a shorter time period will be generated around the freshwater conveyances.

An analysis of equipment that will needed for construction and operation of the RSDSC, most of which will be brought through the port, is being conducted as part of the feasibility study. This will analyse the capacity of the port, including its unloading and storage capacities, and the capacity of the road network to accommodate heavy and bulky loads. The findings will be
used to phase the delivery of equipment and to optimise the size of equipment load: balancing the cost of breaking down loads against the costs of road network upgrading (widening, upgrading junctions, strengthening bridges, culverts, etc).

In general, site access will be via roads specially constructed for the project. Construction vehicles will only be allowed to use local roads that are paved, have sufficient capacity and where it has been shown that local users will not be unduly inconvenienced.

**A2.3.9 Waste Handling and Disposal**

Waste generated during construction will be classified into four categories for disposal as follows.

**Inert construction wastes**: These include the earth (not including excavated material that is destined to be backfilled when the area is restored), building rubble, unused construction material etc generated during preparing and restoring worksites. These wastes poses no risk of pollution, but may be unsightly and need to be disposed of at a controlled disposal site. Dredged material from the area of the Gulf of Aqaba selected for the seawater intake may be inert sand or gravel or may be contaminated due to past pollution. Such waste will be classified when it is generated, either as inert construction waste or special waste (see below).

**Tunnel spoil**: The tunnel options will generate large volumes of spoil in the form of lumps of granitic rock ranging from around 20 cm in diameter to pieces the size of gravel. Some of this can be converted into aggregate for use in construction. The remainder can be discarded into the environment provided sensitive sites are avoided.

**Domestic waste**: The offices and administration buildings associated with the worksites (as well as the workers’ camps) will generate small amounts of ‘domestic’ type of waste (ie food waste, paper and packaging etc). This will be transported to a controlled municipal waste disposal site.

**Oily and special wastes**: There will inevitably be wastes generated during construction that need special handling and treatment. These will include the oily wastes associated with vehicle maintenance (waste oil, material collected from waste water interceptors etc); unused or waste chemicals, paints and solvents; materials excavated from contaminated sites (if any); and, any other wastes, sludge or debris that is unsuitable for disposal in a municipal type landfill. Such wastes will be segregated for collection and disposal by specialist contractors at sites that are equipped and approved for such wastes.
A2.4  **PROJECT ELEMENTS AND MAIN VARIANTS (BASE CASE PLUS)**

A2.4.1  **Component: Seawater Intake**

A number of sites were initially considered for an intake from which water can be extracted from the Gulf of Aqaba/Eilat and delivered into the water conveyance. The Feasibility Study considers two alternatives in detail.

- The Eastern Intake refers to the permanent infrastructure that would be established at a site along the eastern shore of the Gulf of Aqaba.
- The Northern Intake refers to the permanent infrastructure that would be established at a site on Aqaba’s northern coastline.

**Location of Intake**

**Eastern Intake:** The site for the Eastern Intake is located at the site of the old Aqaba Thermal Power Plant, around 5 km south of Aqaba, as shown on Figure A2.1. The identified site is around a hectare in area which will be ample for the site facilities, even if the high-level tunnel option is selected (which would require a pumping station on the site).

The shoreline here is steeply sloping and rocky, but the site itself is a flat area carved out of the mountains, bounded on all sides by the mountains except to the west where the main Aqaba port road runs between the site and the shoreline.

**Northern Intake:** The site under investigation for the Northern Intake is located in the confined stretch between the Ayla Tourism development, and the Jordanian border, as shown on Figure A2.1. The shoreline here is a smoothly sloping sandy beach.

**Figure A2.1  Intake Sites on the Gulf of Aqaba**

All maps produced as a part of this study are being checked by the World Bank Map Design Unit. An approved set of maps will be included in the Preliminary Assessment Report

Source: RSDSC Feasibility Study

**Description of the Intake Station**

The purpose of the intake station is to receive seawater, carry out some pre-treatment (to prevent deposition in the conveyance), and control its introduction into the conveyance. There will be a permanent station for
monitoring and control of the operation and some office and storage facilities. The elements of the station are therefore as follows.

- A submerged offshore seawater inlet with pipes through which the seawater will flow by gravity along the sea bed and to the mouth of the conveyance;

- Facilities for pre-treatment and control of water entering the conveyance, including a system for dosing the seawater with anti-fouling agents, mesh screens to prevent large solid objects from entering the conveyance and control gate(s) to allow the flow to the conveyance to be reduced and/or shut off;

- Other infrastructure including administration and office facilities (likely be housed in a low-level single story building), facilities for receiving and storage of anti-fouling chemicals and fuel, a backup-generator for low-level power (eg mixing, control gates, emergency failsafe lighting, etc. but not sufficient to supply power for water pumping), parking and vehicle access areas.

- A pumping station to raise the water to the level of the conveyance (not needed for the zero-level tunnel).

- A road access into the site.

*The Inlet*

**Eastern Site:** The inlet structure will be a submerged vertical cylindrical structure with a cover to permit water to enter from the sides, as shown in Figure A2.2. The inlet structure itself will likely be concrete, with a velocity cap and a radial inlet. A screen with likely mesh size 100 mm, will be installed to prevent floating material from entering the intake. The positioning of the inlet, depth and distance from the shore, will be determined after the results of the Additional Study on the Red Sea become available.
The conveyance from the inlet to the shoreline will be via three pipelines laid on the seabed and protected by rip-rap (confined rock boulders in a cage) to prevent erosion. The diameters of these pipes will range from 2.5 – 3.3 m depending on the final flow rates. In order to reach the necessary depth of intake, the inlet at the Eastern Intake could be as little as 50 m from the shore, unless additional depth is required to improve the quality of water taken in, or specifically to avoid effects on the marine environment.

Water will flow by gravity through the intake pipeline to the entrance of the conveyance.

**Northern Site:** The inlet structure at the Northern site will be the same as at the Eastern site except for differences caused by the topography and the limited area available for construction at the shore. In addition, the pipeline corridor close to the shore in this area must have minimum permanent surface works, since it lies within the floodway that diverts floodwater from the eastern hills around the developments to the north of Aqaba. Most of the onshore pipeline construction will therefore be by mechanized tunnelling.
rather than by deep trench construction. Main differences from the Eastern intake can be summarised as follows.

- In order to reach the necessary depth of intake, the inlet at the Northern Intake will be located 170 – 190 m offshore.

- There is insufficient land area available at the northern site for a pumping station. Once onshore, therefore, the water will be conveyed to a pumping station situated around 12 km from the shoreline, northwest of King Hussein International Airport.

- To convey sea water from the shore to the pumping station, pipes will be laid and buried in an excavated trench stretching around 1 km north from the shore. The trench depths will range from 3.6 m at the shoreline to 8.6 m inland. There will be three pipes, ranging from 2.5 – 3.3 m diameter, depending on the final flow rate required. The remaining 11 km will be a circular tunnel of around 6.0 – 6.5 m internal diameter, excavated underground by a tunnel boring machine. A 16 m diameter reinforced concrete vertical transition shaft will transfer the flow from the pipelines into the tunnel. At the pumping station, the base of the tunnel will be around 4 m below sea level. Since the ground level is around 20 – 25 m above sea level, the tunnel depth will be up to 30 m.

**The Pre-Treatment and Control Facilities**

The conveyance will need some form of protection against the growth of organisms in the sea water leading to the formation of deposits on the inside of the conveyance structure. Macro-fouling occurs when crustaceans such as barnacles and mussels are allowed to grow unchecked. They may restrict the flow through the conveyance and even, eventually, cause blockages. Micro-fouling is the deposition of micro organisms – mainly algae – in the form of slime on surfaces, potentially accelerating corrosion. For protection against bio-fouling chemical biocides or growth retardants may be added to the water before it enters the conveyance. Alternatively, application of a coating to the inside of the conveyance may be an option.

The method of anti-fouling has not yet been determined. If a chemical such as chlorine is used (in the form of sodium hypochlorite solution) an arrangement could be made to feed a regulated flow of hypochlorite from a tank into the sea water before it enters the conveyance. Using the case of hypochlorite as an example, it is known that the effective dose is around 1 – 2 mg per litre. This implies a requirement for up to 4,000 tonnes of hypochlorite per year. Assuming 1 month’s supply is kept on site, storage facilities are required for 35 tonnes. Alternatively, chlorine gas could be generated on site from the electrolysis of sea water.
In addition there will be steel mesh screens to prevent solid objects larger than can pass through around 50 – 100 mm mesh from entering the conveyance.

Control gate(s) at the entrance of the conveyance (typically steel, backed up by concrete slabs), will allow the flow to the conveyance to be reduced and/or shut off.

**The Pumping Station**

**Location:** Unless the sea level tunnel is chosen, a pumping station will be needed to lift the water from sea level to the maximum height of the conveyance. If the Eastern Intake is selected, a pumping station will be established at the shoreline, close to the Intake, on the site of the disused Aqaba Thermal Power station.

The Northern Pumping Station will be located at the point PS1, north west of King Hussein International Airport, as shown on Figure A2.3. This site is around 12 km from the Aqaba shoreline, with a ground level of around 25 m above sea level.

**Figure A2.3 Location of the Northern Pumping Station**

All maps produced as a part of this study are being checked by the World Bank Map Design Unit. An approved set of maps will be included in the Preliminary Assessment Report

Source: RSDSC Feasibility Study

**Configuration of the Pumping Station:** The structure of the pumping station will be determined by the required flow rate. Examples of the pumping configurations that may be needed are given in Table A2.3.

**Table A2.3 Examples of the Pumping Configurations**

<table>
<thead>
<tr>
<th>Throughput (Mm$^3$/year)</th>
<th>Pipeline</th>
<th>High Level Tunnel</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No of duty pumps</td>
<td>Rating (MW)</td>
</tr>
<tr>
<td>2,000</td>
<td>TBD</td>
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<td>1,500</td>
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<td>1,000</td>
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</tbody>
</table>
The pumps will likely be submersible pumps, immersed in the pump water intake pit, but could also be conventional, horizontal, split-casing centrifugal pumps. The pumps would discharge into a common piping main that will connect to the rising main.

One complete standby pump will also be included in each scenario. Each pump would be capable of being isolated from the live flow, on both upstream and downstream sides, and being removed for maintenance.

**Structure of the Pumping Station:** For the High Level Tunnel, the rising main will consist of a short tunnel beginning at the Eastern Intake site, entering into the rock, and rising at a gradient of approximately 5% for a distance of around 5 km, until the beginning of the gravity tunnel. The rising tunnel will be lined with 15 mm thick steel, and the gap between the steel lining and the rock face filled with concrete grout.

For the pipeline conveyance, the entire first 80 km length will act as the riser main as described in Section A2.4.2.

**Construction Aspects Particular to the Intakes**

Work will be required in the Gulf of Aqaba to locate, install and secure the intake and discharge infrastructure and associated pipelines. Floating plant – possibly a barge or pontoon - will carry the inlet infrastructure and the pipeline sections to the required location. The barge will be anchored in place for the duration of construction. Flags and light signals will be set up as agreed with the navigational authorities to alert maritime traffic. The sections will be let down from the barge using cables, and located and secured using divers. Once located, the pipeline sections will be fitted together, sealed, and covered with boulders and/or rip rap, which will also be let down from the barges and placed by divers.

Construction of a pumping station will be a fairly typical operation whereby the pumphouse, pumps and associated facilities will be erected on site. It is unlikely that particularly specialized or oversized plant will be required. One aspect of note will be the deep excavation into bedrock, which will likely require blasting. Power supply will be taken to the site, most likely by overhead cabling.

**Duration and Timing:** The time required for construction will depend on the length of pipeline needed to convey water from the inlet to the shore. It will in any case be a short term operation (approximately 1 - 2 months for a 50 m pipeline), which can be undertaken at any time during the project construction period.

**Plant & Equipment:** The plant will include a floating barge or pontoon, equipped with an excavator and winches. Divers and support vessels will also be required. Trucks and cranes will be required to transport the pipe sections
from the plant and load them onto barges. For the Eastern Inlet, barges may be loaded at the main port, or at the intake site itself.

**Temporary land take:** The precast concrete pipe sections will be manufactured at one of the concrete segmenting plants (in the case of the tunnel option) or at an existing concrete plant in Jordan (in the case of the pipeline option). Some loading equipment will be required at a nearby berth to load the pipe sections. Otherwise, work will be offshore, under the ground, or within the site perimeter.

**Employment and Labour:** Construction of the inlet and associated pipelines will be a short term operation (approximately 1 - 2 months for a 50 m pipeline), and will require of the order of 30 personnel, including divers. Workers can be housed in temporary workers’ accommodation associated with the project. The pumping station will require approximately 2 – 3 years for construction and of the order of 150 personnel. Workers will be housed in temporary workers accommodation set up for the pump station.

**Use of Resources and Materials:** The installation will require cement and aggregate (or steel) for the pipe sections and the intake structure, and an amount of rip rap or boulders for protection of the pipe.

**Transportation and Traffic:** Transportation of the pipe sections and the inlet structure will be required i) from the manufacturing plant by road to a suitable berth, ii) from the berth by barge to the final location. Since the largest potential pipe diameter (3.5 m) can be accommodated by currently available vehicles and infrastructure, no special transportation arrangements will be needed.

The pipelines from the intake to the mouth of the conveyance will pass beneath an access road to the port. During construction this may be reduced to one operating lane.

**Waste Arisings and Disposal:** The pipes will either be laid in an excavated and backfilled trench under the sea bed or laid directly on the sea bed and covered with aggregate or other suitable material. At this stage, it cannot be estimated how much waste, if any, will be generated, but any dredged material would be transported to shore and transferred to one of the project waste disposal sites.

The Eastern intake site will have to be cleared and levelled. It is uncertain whether the disused power station will be dismantled and removed prior to the beginning of construction. If not the project will need to dispose of the waste materials (this option will be addressed by the ESA).

The Northern Intake will require the excavation of a tunnel of length approximately 11 km with the associated production of a large volume of tunnel spoil.
### Water Conveyance Component: Pipeline Option

**Alignment:** A pipeline water conveyance would deliver water from the Red Sea intake to the desalination plant and the HPP, via a series of buried steel pipelines installed in the Wadi Araba/Arava Valley.

The pipeline alignment is shown in yellow on Figure A2.4. It is on the Jordanian side and substantially follows the Dead Sea Highway. The first 80 km of this pipeline will be pressurized, as the water is pumped from sea level to the high point at Gharandal, 220 m above sea level. From here it will descend by gravity through the remainder of the pipeline.

The conveyance will likely begin at the Northern Pumping Station – discussed in the previous section. There will be a balancing tank at Gharandal to allow the pressure pipeline to discharge into the gravity conveyance. The tank will be a cylindrical steel construction with dimensions of around 5m high x diameter 10m. It may be buried or on the surface depending on the nature of the soils.

The actual site at which the pressurized pipeline will end and the gravity flow will begin has not been determined yet. Any flat area of unoccupied land along the pipeline route within 5 km of the crest high point could be suitable.

**Structure and Appearance:** The conveyance will consist of 3 – 4 steel pipes, each around 3.5 m in diameter, laid in parallel in an excavated trench around 10 m apart. The trench will be backfilled with the excavated material. The width of land needed for the operation, including some working room, will therefore be up to 60 m. The length will be around 167 km. A road will be established alongside the pipes for the whole length of the conveyance. This will be used by construction vehicles but will be retained during operation to facilitate maintenance and inspection.

The maximum water velocity will be around 2 m/s. The pressurized section of the conveyance will be equipped with air release valves every 4 – 5 km (ie around 20 at most over the 80 km). These will take the form of vertical pipes of perhaps 1 m diameter, sealed with a manhole cover. They will be housed within secure concrete structures with a footprint of around 8 m² and a total height of around 2 m, so that 0.5 – 1 m will protrude above ground. The visual appearance of the above ground portion will be that of a concrete cube.

**Operation and Maintenance:** During operation, flow rates will be carefully monitored to detect and respond to any leakages, and a programme of corrosion prevention and control will be carried out. Further details will be provided in the next phase of assessment.
Construction Aspects Particular to the Pipeline Conveyance

**Process Summary:** The construction of the pipeline over a 180 km length will be a major operation. The pipes will be laid into an excavated trench and covered. Operations will be carried out by separate teams of workers spread over a section of the route about 50 km long. These teams will each undertake one operation in a sequence that will include i) surveying of the route, ii) preparing the working corridor, including establishing a temporary access road for the entire length of the route, iii) excavating the trench for the pipeline and storage of the soil nearby, iv) laying the steel pipe sections, welding each section and pressure testing the welds, v) backfilling the trench, and vi) reinstating the ground.

**Plant & Equipment:** Required plant will include excavators, dozers, cranes, and trucks for transportation of the pipe sections. Means for hydrostatic pressure testing the pipes will also be needed, including significant supplies of groundwater. Testing will likely occur in 40 km sections.

**On Site Temporary Infrastructure:** Temporary construction sites will be set up at 2 or 3 points along the pipe route. These will include storage for plant, pipe sections and materials, and workers’ housing. Power supply and waste services (wastewater, solid waste, etc) will be required. A temporary access road 5 - 6 m wide, unpaved, will be created along the length of the pipeline route. This road may remain during pipeline operation to allow for maintenance access.

**Off Site Temporary infrastructure:** There will be a pipeline manufacturing plant established off-site, at which imported steel sheets will be rolled and welded to form pipeline sections. The sections will then be treated with corrosion protection. It is likely that this plant will be located in Aqaba in one of the industrial areas. Transportation of the pipe sections from this plant to the final location will be by truck.

**Labour:** This operation will last of the order of 3 – 5 years, and require approximately 150 workers. As noted, workers will likely be housed in temporary accommodation camps established at points along the route. The number of camps will be fixed so that workers can be accommodated within
40 - 50 km of the work sites at which they are needed. Three to four camps will likely suffice.

Other Resources and Materials: Approximately 900,000 tonnes of steel will be required. This will likely be imported via the port at Aqaba in rolled sheet form.

Transportation: There will be significant transportation along the pipe route, i) of the labour and plant, ii) of the steel pipeline sections, and of the excavation spoil although this will be stored close to the trench, ready for backfilling. Each pipeline section will be around 8 m length and could be up to 2.2 tonnes in weight.

Waste: Most of the excavated spoil will be used to backfill the trenches. Excess spoil will likely be spread out and contoured along the route. Wastewater and solid waste from the workers’ camps will also be produced.

A2.4.3 Water Conveyance Component: Tunnel Options
The Tunnel Options

Two tunnel options following a similar alignment along the rock hills to the east of the Wadi Araba/Arava Valley are still being considered by the Feasibility Study. The options demonstrate the advantages and disadvantages of tunnel elevations beginning at 220 metres above sea level (High Level Tunnel Conveyance with canal sections) and one beginning at sea level (Low Level Tunnel Conveyance).

Tunnel Conveyance Alignments

High Level Tunnel Conveyance: For the High Level Tunnel conveyance water would be pumped from the intake site in Aqaba, through a rising tunnel, to an elevation of +220 m at a point around 80 m from the intake. The tunnel would be around 8 m in diameter. From there, the tunnel would gradually descend with a slope of 1:5,000 (ie 20 cm per km).

Where the local topography and geology is suitable (ie where there are long stretches of fairly flat open land, at the right elevation underlain by stable ground) the conveyance can take the form of an open canal. This is a potential advantage of the High Level option because a canal is far cheaper to construct than an equivalent length of tunnel.

When the tunnel starts at 220 m elevation, there will be two sections of the conveyance where canals can be integrated into the conveyance. The first section of canal will begin around 58 km from Aqaba, and will be 29 km long. The second section will begin around 112 km from Aqaba, and be 28 km long (see Figure A2.4).
At these points water will exit from the tunnel via a portal in the rock face, and flow through an open canal before entering the tunnel again through a second portal.

The open sections will be concrete lined trapezoidal channels, around 20 m wide and 3-4 m deep. The velocity of water through the canals will be around 1.5 m/s. Screens will be placed where the open channels enter and exit the rock to prevent entry of people or animals.

There may be repeat dosing with antifouling agents at this stage – this will be ascertained from the Feasibility Study.

The tunnel sections will generally be situated above the ground water table and will include precautions to control the leakage of salt water. These may include secondary containment in areas of weak ground; drains below the main tunnel; and, a monitoring system. The gravity tunnel sections will be approximately circular in section, with a free flowing surface. At maximum design operating capacity, the tunnel will run at around 80% full.

**Low Level Tunnel Conveyance:** A Low Level Tunnel conveyance would deliver water from the Red Sea intake to the desalination plant and the HPP via an underground tunnel, excavated in the rock hills to the east of the Wadi Araba/Arava Valley, following almost the same alignment as the High Level Tunnel, but at a lower elevation. The tunnel would begin at the intake location at sea level, and fall gradually until it terminates at the desalination plant at around 45 m below sea level. There will be no pumping, and no rising tunnel. All water flow will be by gravity. The tunnel diameter would be around 8 m.

Because of the lower elevation, this entire tunnel lies below ground level, and there is no opportunity for economizing by using open canal sections. The tunnel will be generally situated below the ground water table. Water exchange between the tunnel and the surrounding ground will be more likely to flow from the groundwater into the tunnel. The total length of tunnel is around 161.5 km. The type of tunnel lining used will depend on the rock formation at that location. A simplified lining will be used for crystalline rock formations, in order to avoid rock bolting (ie the need to reinforce the rock with bolts) where these conditions are encountered.

**Construction Aspects Particular to the Tunnel Conveyances**

**Process Summary:** The construction of tunnel conveyances will be contracted out to large international contractors with experience of tunnelling through the kind of terrain likely to be encountered. One of the first tasks upon award of the contract will be for a preliminary drilling programme, with investigation boreholes drilled along the tunnel route. This will require around 15 people, water and power supply, and logistical support. During this time, the tunnel boring machines (TBMs) will be built off-site.
The feasibility study envisions that around seven access portals will be created from the surface to the tunnel alignment; one at the start of the tunnel in Aqaba, one at the finishing point near the Desalination Plant site, as well as 5 intermediate accesses portals (for the High Level Tunnel these will include four at the entrances and exits of the two canal sections).

A TBM will create these portals. In the case of the low level tunnel, two working faces will be established at each intermediate access portal, one in each direction. Together with the start and end faces, there will be 11 working faces in total, each with a dedicated TBM working simultaneously. The TBM will create the excavation, and produce spoil (excavated rock) which will be taken to the surface via the access portals. Once the excavation has been created, concrete lining segments will be lowered into place and fixed by mortar. Some TBMs install and mortar concrete tunnel casing “as they go”, with the lining segments delivered by train following the TBM.

Each working face should be operational two years after the contractor begins, with the first 2 years needed for investigation, construction of the TBMs, establishment of the construction sites, and creation of the access portals to the required depth. It is estimated that a total construction period of around six years will be required, from beginning to end.

For the High Level Tunnel, the two canal sections will be excavated by conventional methods, using excavators, and lined in situ with concrete. It is expected that excavator-mounted rock breakers will be sufficient to form the channels, without the need for blasting, although this has to be confirmed.

**Plant & Equipment:** The TBM’s will likely be large, self contained units of around 100 m length, including the ‘backup train’ (sledges with equipment, conveyors to take away spoil and associated components). An example of such an arrangement is shown in *Figure A2.5*. The components of the TBM will be shipped in manageable sections and assembled in situ. The void excavated will be 8 m in diameter. Heavy 20 tonne excavators and other standard equipment will be used for the canal sections.
On-site Temporary Infrastructure: Each access portal can be considered as a sub-project, and will be served by the following infrastructure.

- Storage and preparation zone for prefabricated concrete units (around ½ tonne, manufactured off-site and delivered to the access portal by truck).
- Excavated spoil handling zone for temporary storage before final disposal.
- Mortar preparation zone (in areas where the tunnel will pass through weak or sedimentary rock mortar will be prepared to seal the excavation).
- Storage for drainage and impervious membranes, if any.
- Concrete plant for secondary lining.
- Workshops for maintenance of plant and equipment and storage of tools.
- Groundwater wells supplying several hundred m$^3$/day of water for concrete production, mortar fabrication, dust reduction and drinking.
- Administration building
- Reinforced concrete batch plant to provide concrete for the canal sections

In addition, workers’ housing facilities will also likely be established at most (maybe all) portals. An estimated 1,260 people will be accommodated in total (camp size will range from 150 – 350 persons). Each camp will be self contained with arrangements for managing the solid waste and wastewater (estimated at 15 m$^3$/day/site) produced at the site. A septic tank will most
likely be established to collect wastewater, with sludge pumping offsite. The estimated area needed for all the above is around 4 ha.

**Off-site Temporary Infrastructure:** In addition to the infrastructure at the access portals, three other areas will likely be established during the construction period, although the final details will depend on the contractor’s own work plan.

- Main administration building for control of the construction that may include a visitor and reception centre for the project.
- Two Aggregate Production Plants using around 10% of the construction spoil granite as a source of aggregate rock. Locations could be close to Aqaba and close to the 2nd or 3rd access portals.
- Two Concrete Segment Factories, situated close to the aggregate plants.

**Labour:** Construction at each face will be based on three 8-hour working shifts, each with approximately 90 people at the face and an additional 15 for concrete and support. Each access portal with two working faces will then require around 210 people. For 11 working faces, this is a total of 1260 people. The aggregate plants, segment factories and central administration centre will require around 120 additional people. The total number of workers and staff required during construction could therefore be around 1,380. The total construction period will be around 5 – 6 years.

**Other Resources and Materials:** The project’s power demand during construction is as follows: 3 MW per TBM, 2 MW per aggregate plant, 3 MW for each concrete segment factory, and additional 2 MW per access portal. This is a total of 60 MW for the bulk of the construction period. This could come from a new transmission line along the Wadi Araba, or from individual large generator plants (5 – 8 MW in size) established at the construction camps.

The Feasibility Study Team estimates that daily water consumption will be around several hundred m$^3$/day per worksite, most of which need not be potable. This may be taken from groundwater wells located close to the access portals.

In all, assuming no secondary lining is needed, 1.4 Mm$^3$ of concrete will be required, corresponding to around 1.4 Mtonnes of aggregate, 1.4 Mtonnes (0.84 Mm$^3$) of sand, 0.5 Mtonnes of cement, and 0.28 Ml of water.

**Transportation:** Aside from the initial and final transportation of the plant and equipment to and from the sites, there will be significant transportation requirements. The figures below are based on an assumption of tunnel construction lasting around six years, with simultaneous working at all work faces. An average truck capacity of 30 tonnes is assumed:
• Concrete manufactured at site; 1200 m$^2$/day;

• Sand transported from quarry to concrete plant; 1200 tonnes/day (40 trucks/day);

• Aggregate transported from spoil to concrete plant; 1200 tonnes/day (40 trucks/day);

• Cement transported from Aqaba to concrete plant; 422 tonnes/day (14 trucks/day);

• Waste spoil from site to final disposal site(s) 15,000 m$^3$/day (833 trucks/day); and

• Concrete segment from factory to site; 101 trucks/day.

This is a total of 1,028 truck trips/day if the return journey is empty, spread over the 7 sites, ie an average of 150 trips/day/site. The distances of these trips will vary greatly.

**Waste:** The anticipated quantities of spoil for each access portal are as follows, although the number of portals may change with more design consideration:

• Portal 0 (eastern intake) - 1.54 Mm$^3$;
• Portal 1 - none (access only);
• Portal 2 - 2.98 Mm$^3$;
• Portal 3 - none (access only);
• Portal 4 - 2.79 Mm$^3$;
• Portal 5 - 2.24 Mm$^3$;
• Portal 6 - 1.86 Mm$^3$;
• Portal 7 - 1.54 Mm$^3$; and
• Portal 8 (desalination plant) - 2.00 Mm$^3$.

In addition, 15m$^3$/day of wastewater and typical amounts of domestic solid waste will be produced by each of the workers’ camps, as well as construction waste possibly including batteries, tyres and other material needing special arrangements.

**A2.4.4 Desalination Plant**

**Location of the DSP**

**Alternatives Considered:** The desalination plant (DSP) will remove salt from the Red Sea water to produce potable water. Desalinated water will then be pumped via a pipeline to the beneficiaries’ demand centres. Brine effluent, produced as a waste product, will be discharged to the Dead Sea.

The Feasibility study has confirmed that, for the low level DSP, it will always be preferable, in terms of energy efficiency, to use the pressure head of the sea.
water to drive the desalination process rather than for electricity generation. It may be, however, that if the DSP is at a high level, the reject brine could still be used to generate hydro electricity. In addition, the higher the level at which potable water is produced, the lower the energy needed to pump it to the principle end users (i.e., Amman at elevation +765 m MSL).

Two options for locating the DSP are being considered. The DSP could be located close to final tunnel portal at an elevation around or slightly higher than MSL: the High Level DSP. Alternatively, it could be located on low ground close to the Dead Sea: the Low Level DSP.

**Level and Configuration:** A High Level DSP would be situated in the hills above Tilah Castle, at an elevation of MSL +180 m (for the high level tunnel) or MSL -45 m (for the low level tunnel). Both locations are within Zone C as shown in Figure A2.6.

![Figure A2.6 Potential Sites for a Desalination Plant](source: RSDSC Feasibility Study)

All maps produced as a part of this study are being checked by the World Bank Map Design Unit. An approved set of maps will be included in the Preliminary Assessment Report.

A Low Level DSP would be located at a site at Ghor Fifa at around MSW -350 m, marked as Zone A on Figure A2.6.
Configuration of DSP and HPP

Figure A2.7 shows the High Level DSP in relation to the HPP. Initially in this configuration, part of the flow passes through the DSP for desalination, and part flows uninterrupted to the HPP. In the longer term, as demand for potable water grows, all the flow could pass through the DSP. In this case, booster pumps would be needed to develop the full pressure necessary for the desalination process. As well as direct Red Sea water, the reject brine may also be diverted to the HPP to increase the flow available to it.

Figure A2.7 Configuration for High Level Desalination Plant

Source: RSDSC Feasibility Study

Figure A2.8 shows the Low Level DSP in relation to the HPP. Initially in this configuration, part of the flow passes through the DSP for desalination, and part flows uninterrupted to the Hydropower Plant. In the longer term, all flow will pass through the DSP. The available head is sufficient to be used directly for the desalination process without additional pumping. The reject brine passes directly into the outfall channel, without passing through the HPP, since its head has been expended.
Desalination Plant Details

**Site Area and Layout:** The footprint of the DSP site will be around 50 ha. The plant will include a pre-treatment plant, the desalination area itself, a post treatment area, and storage, maintenance and administration areas. The plant itself will be modular, enabling its capacity to be increased with additional treatment modules when necessary. It is likely that the design output capacity will begin around 400 - 450 Mm³/year, and increase to 850 Mm³/year during the life of the project. The facility will be fenced with the facilities in a number of ordinary warehouse type buildings. To restrict the space needed the building housing the desalination equipment may rise to two storeys.

**Pre-treatment:** A pre-treatment process will be employed to reduce the silt density of the water in advance of the desalination stage. The pre-treatment process will likely include a 2-stage dual or multi-media filtration process using sand or a combination of granular media to reduce the amounts of silt in the water. The media filters can be large open top chambers through which the seawater will flow by gravity. This phase has significant space

Source: RSDSC Feasibility Study
requirements. Membranes are beginning to replace granular media for pre-treatment, but are currently not being considered in the FS. Depending on the quality of the water, additional pre-treatment steps may be needed, including the removal of organic materials or hydrocarbons, most likely using dissolved air flotation (DAF) or other similar flotation method.

Desalination: For the main desalination process, the Seawater Reverse Osmosis (SWRO) method is the most likely technological option. SWRO separates water from dissolved salts by passing the feedwater through a semi-permeable membrane at a pressure greater than the osmotic pressure caused by dissolved salts. Individual RO membranes are usually provided as tubes of around 1.2 m length and 0.25 m diameter each of which contains a 1.2 m long spiral wound element. Each membrane element produces a nominal 20-25 m$^3$/day under ideal conditions, which suggests that around 100,000 membranes will be required at maximum capacity.

The RO plant will be configured as a two pass design to meet the WHO Guidelines for Drinking Quality. The first pass reduces the saline content, while the second reduces the boron levels. There may be a need for remineralisation of the water to increase the calcium carbonate content. A disinfection stage is then required, using either chlorine, ozone or UV treatment, or a combination. It is likely that chlorination only will be used in this case.

Construction

Process Summary: Construction of the DSP will be a straightforward operation whereby the plant and associated facilities will be established at the site. Excavation to create a level ‘bench’ for the facilities will be a major cut and fill operation. Other operations will include excavation for piping, site preparation and foundations, and erection of buildings, and installation of equipment. An access road will need to be established from the main highway, able to handle the heavy loads from the trucks transporting the pipe sections and equipment. A power supply will be taken to the site, most likely by overhead cabling. The downstream penstocks and pipes will be a major component, and will consist of steel pipes laid in an excavated channel.

Plant & Equipment: Typical construction plant will be required – cranes, excavators, dozers, etc. A batch plant for concrete manufacture will be established. It is unlikely that particularly specialized or oversized plant will be required.

Temporary Infrastructure: The access road needed for construction will become a permanent feature, serving the completed plant.
**Labour:** The construction period will be around 3 – 4 years, and will require of the order of 500 - 1000 personnel. It is likely that the plant will be constructed in phases as the demand for potable water grows. Workers will be housed in temporary accommodation somewhere close to the site.

**Other Resources and Materials:** The installation will require construction of the plant and installation of equipment. Steel pipe sections will be required for the penstocks. A significantly quantity of RO units will be required for this plant. Depending on the phasing of the plant’s construction and operation, the project demand for RO units may have a significant effect on the global demand and supply of the RO membranes.

**Transportation:** A new permanent access road from the main highway will be established. All plant and materials will be taken to the site by road.

**Waste:** There will be a certain amount of excavation waste that will likely be reused on site. Wastewater and solid waste will also ensue from the construction site and workers’ camp.

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**A2.4.5 Hydropower Facility**

**General**

For most of the operating period, much of the flow from the conveyance will be used to generate electricity. Depending on the final design and configuration of the conveyance and the DSP, flow into the HPP could include the total discharge of the conveyance; the fraction of water remaining after the DSP feed has been removed; brine discharge from the desalination plant; or a combination of these three.

**Hydropower Plant Location**

A site for the hydropower plant has been selected near the village of Fifa at an elevation of around MSL -355 m where the side-slopes of the Dead Sea basin flatten close to the Dead Sea itself. The lowest suitable site was chosen so as to obtain the greatest head available for power generation. The location is shown in Figure A2.9. The site is adjacent to the farm units on the west side of the main Highway. The site is sandy with tamarisk trees scattered throughout, and lies around 6 km to the south of the Arab Potash Company’s solar evaporation ponds.
Hydropower Plant Main Characteristics

Details of the plant will be developed during the feasibility study. The facility will consist of a head-pond at the end of the water conveyor, which will feed a headrace structure consisting of aerial penstocks. These will likely consist of a group of 3 steel pipes, of diameter between 2.0 m and 2.8 m and thickness between 15 and 40 mm, depending on the flow and detailed design. The length of penstock will be 12.1 km for the Low Level Tunnel, and 14.3 km for the High Level Tunnel.

The volume of water available for the hydropower plant will depend on other aspects of the scheme design, and will decrease during the course of the project, as the amount of water desalinated increases. The plant itself will be a 3-machine plant, but no details are available on the individual components such as the turbines, auxiliaries or generator transformer and high voltage substation. Both Francis and Pelton type turbines are possible alternatives, although given the likely extremely long headrace structures to the hydropower plant and possible risks from quick shutdowns, Pelton turbines will likely be selected.

The plant will be a facility with a footprint of around 30,000 m², including administration, maintenance and storage buildings, and a sub-station. Overhead power lines will connect the plant to the grid and other facilities. The facility will be fenced and secured.

Construction

Process Summary: Construction of the hydropower plant will be a straightforward operation whereby the plant and associated facilities will be established at the site. Operations will include excavation for piping, site preparation and foundations, and erection of buildings, and installation of equipment. The access road will be strengthened from the main highway. Power supply cabling and a sub-station will be established at the site, most likely overhead.

Plant & Equipment: Typical construction plant will be required – cranes, excavators, bulldozers, etc. It is unlikely that particularly specialized or oversized plant will be required.
Temporary Infrastructure: The access road needed for construction will become a permanent feature, serving the completed plant.

Labour: The construction period will be around 2 – 3 years, and will require of the order of 100 – 150 personnel. Workers will be housed in temporary accommodation somewhere close to the site.

Other Resources and Materials: The installation will require construction of the plant and installation of equipment. No special materials are anticipated.

Transportation: A new permanent access road from the main highway will be established. All plant and materials will be taken to the site by road.

Waste: There will be a certain amount of excavation waste that will likely be reused on site. Wastewater and solid waste will also ensue from the construction site and workers camp.

A2.4.6 Potable Water Transmission – Jordan

This freshwater transmission line will deliver potable water from the desalination plant to Amman, likely terminating near Abu Alanda on the southern outskirts. As stated above, it is not yet known how much fresh water will be supplied to beneficiaries. For the purposes of this document, we have followed the Feasibility Study, Options Screening Report, in using a notional range of between 220 and 560 Mm$^3$/year to Jordan.

Freshwater Transmission Alignment

Three routes are currently being studied. These are illustrated in Figure A2.10. Each alignment stretches eastwards from the desalination plant location, up the escarpment into the eastern highlands and onto the flat plan, stretching eastwards to the Desert Highway. All 3 routes follow the same alignment running northwards to a terminal point at Abu Alanda in the southern suburbs of Amman. The final will selection will depend on the results of a topographic and geological survey of the routes, which is currently underway. With same variants, each alignment could be used with each of the 3 desalination plant sites.
Alternative 1 begins at the desalination plant and runs in a south-easterly direction, bypassing the populated areas and villages south of Tafila, before heading east to cross the Desert highway. At 150 km length, this is the longest alignment option but runs along relatively easier terrain compared with the other two alternatives, avoiding populated areas.

Alternative 2 runs in a northerly direction from the desalination plant along the east side of the Dead Sea, then turns east and continues east passing to the north of Mu’tah village, until it reaches the Desert Highway. This is the shortest alignment option, with a length of 122.5 km, but traverses more difficult terrain, and passes closer to the scattered population near Mu’tah.

Alternative 3 crosses difficult terrain and passes through a sparsely populated area to the south of Tafila. Its length is also around 150 km.

Once the pipeline reaches the Desert Highway, it will travel northwards in the road corridor. No further details are available on the route or the final destination.

**Freshwater Transmission Details**

Whichever alignment is chosen, the transmission pipeline will consist of twin pipes of around 2.75 m diameter. Maximum velocity in the pipe will be 1.5 m/s. The pipes will be steel, and will be pressurized throughout their length. All three potential alignments are over rugged terrain, with steeply rising and
falling gradients. The pipes will be laid in excavated channels, and backfilled, where practicable. There will be some sections, however, up to a total of not more than 7km (Feasibility Team estimate) where the pipes will have to be above ground, on concrete pillars (2 per 8m pipe section).

Water will be pumped from pumps located at the desalination plant, and from booster pumps located along the line. Significant energy will be required – (current estimates are initial installed capacity at 187 MW and energy demand 1,216 GW/yr. At full capacity the corresponding figures are 334 MW and 2,925 GW/yr) and may be supplied via the electricity supply grid or a dedicated power station. Electricity from the national grip could be supplied via a 400 kV transmission line from Aqaba to Amman, following the Wadi Araba. This line will be developed provided the Red Dead project is to go ahead. A branch will be developed from this line, in parallel with the water pipelines, to supply the sub-stations, and booster pump stations along the route. Alternatively, a new 400 MW power plant is planned to be constructed at Qatraneh on the Desert Highway that could supply power for the northward sections of the alignment, along the Desert Highway.

**Construction**

**Process Summary:** The construction of the freshwater transmission system from the Fifa area to Amman will be a major operation. The transmission will be of the order of 190 km long, much of which will be over difficult terrain up the escarpment from the Dead Sea Basin, until reaching the highland plain. The last section of the transmission system will likely follow the approximate corridor of either the Disi – Amman water pipeline, or the Desert Highway. The pipeline will consist of two steel pipelines, laid into an excavated trench and covered. Where the topography of the terrain makes burying the pipes impractical, the pipelines may be suspended or put on to concrete supports.

Operations will include i) surveying of the route, ii) preparing the working corridor, including establishing a temporary access road for the entire length of the route, iii) excavating the trench for the pipeline and storage of the soil nearby, iv) laying the steel pipe sections, welding each section and pressure testing the welds, v) backfilling the trench, and vi) reinstating the ground. For 3 – 4 steel pipes of 3.5 m diameter, the spacing between them will be around 10 m, and the operation will require a working corridor of up to 60 m in width. Part of the conveyance may be in tunnel.

**Plant & Equipment:** Required plant will include excavators, rockbreakers, dozers, cranes, and trucks for transportation of the pipe sections. Means for pressure testing the pipes will also be needed.

**On Site Temporary Infrastructure:** Temporary construction sites will be set up at 2 or 3 points along the pipe route. These will include storage for plant, pipe sections and materials, and workers’ housing. Power supply and waste services (wastewater, solid waste, etc) will be required. A temporary access
road will be created along the length of the pipeline route. This road will remain during pipeline operation to allow for maintenance access. The road up the escarpment will be particularly difficult to form.

**Off Site Temporary infrastructure:** As noted earlier, if the tunnel conveyance is selected, a pipeline manufacturing plant will be established off-site, at which the steel sheets will be rolled and welded to form pipeline sections, and treated with corrosion protection. Depending on the contracting arrangements, this plant would also likely make the pipe sections for the freshwater route. If a tunnel option was selected, the pipes are more likely to be imported, although a contractor could also elect to set up a manufacture these in Jordan. Transportation of the pipe sections from the manufacturing plant to the final location will be by truck.

**Labour:** This operation will last of the order of 3 – 4 years, and require approximately 200 workers. As noted, workers will likely be housed in temporary accommodation camps established at points along the route.

**Other Resources and Materials:** Significant amounts of steel pipe will be required. This will likely be imported via the ports at Aqaba. No details are available yet on the tonnage of rolled steel that will be required.

**Transportation:** There will be significant transportation along the pipe route, i) of the labour and plant, ii) of the steel pipeline sections, and of the excavation spoil although this will be stored close to the trench, ready for backfilling. Each pipeline section will be around 8 m length.

**Waste:** Most of the excavated spoil will be used to backfill the trenches. Excess spoil will likely be deposited in a formed rise along the route. Wastewater and solid waste from the workers’ camps will also be produced.

### A2.4.7 Potable Water Transmission – Israel

As stated above, it is not yet known how much fresh water will be supplied to beneficiaries. For the purposes of this document we have followed the Feasibility Study, Options Screening Report in using a notional figure of 60Mm$^3$/yr to Israel. A freshwater conveyance in Israel that could supply up to around 60 Mm$^3$/year of water would probably supply low-lying domestic, tourism and industrial demand centres in Israel between Ein Gedi and Ein Khatseva.

**Freshwater Transmission Alignment**

The conveyance would comprise a single off take from the desalination plant running northwards across the border to a node south-west of the Dead Sea Works evaporation ponds. From this node, a spur would run northwards for 63 km approximately paralleling the road along the western shore of the Dead Sea, to a terminal point at Ein Gedi. A branch line 20 km long running
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westwards from a second node on this spur would supply water as far as the municipality of Arad, at an elevation of 520 m. A second spur line would run from the node southwards for approximately 35 km to Ein Khatsev, again paralleling the main road. These alignments are illustrated in Figure A2.11.

Figure A2.11  Alignment of Potable Water Transmission System in Israel

Source: RSDSC Feasibility Study

Conveyance Details

More detail on this conveyance will be developed later in the study.

Construction

Process Summary: The construction of the freshwater conveyance from the Fifa area to the Israeli demand areas will be a major operation, and will cross the international border. The conveyance will be of the order of 130 km long, although much will be in the low-lying, flat areas of the Dead Sea Basin. Most sections of the conveyance will likely follow existing road corridors. The conveyance will consist of a steel pipeline, laid into an excavated trench and covered. Operations will include i) surveying of the route, ii) preparing the working corridor, including establishing a temporary access road for the entire length of the route, iii) excavating the trench for the pipeline and storage of the soil nearby, iv) laying the steel pipe sections, welding each section and pressure testing the welds, v) backfilling the trench, and vi) reinstating the ground.

Plant & Equipment: Required plant will include excavators, rockbreakers, dozers, cranes, and trucks for transportation of the pipe sections. Means for pressure testing the pipes will also be needed.
**On Site Temporary Infrastructure:** Temporary construction site(s) may be set up on along the pipe route. These will include storage for plant, pipe sections and materials, and workers’ housing. Power supply and waste services (wastewater, solid waste, etc) will be required. A temporary access road will be created along the length of the pipeline route. This road will remain during pipeline operation to allow for maintenance access.

**Off Site Temporary infrastructure:** It is likely that these pipeline sections will be imported. Transportation of the pipe sections from the port to the final location will be by truck.

**Labour:** This operation will last of the order of 2 years, and require approximately 200 workers. As noted, workers will likely be housed in temporary accommodation camps established at points along the route.

**Other Resources and Materials:** Around 48,000 tonnes of steel will be required for the section in Israel.

**Transportation:** There will be significant transportation along the pipe route, i) of the labour and plant, ii) of the steel pipeline sections, and of the excavation spoil although this will be stored close to the trench, ready for backfilling. Each pipeline section will be around 8 m length and could be up to 2.2 tonnes in weight.

**Waste:** Most of the excavated spoil will be used to backfill the trenches. Excess spoil will likely be deposited in a formed rise along the route. Wastewater and solid waste from the workers’ camps will also be produced.

**A2.4.8 Potable Water Transmission – Palestinian Authority**

As stated above, it is not yet known how much fresh water will be supplied to beneficiaries. For the purposes of this document, we have followed the Feasibility Study, Options Screening Report, in using a notional supply of up to around 30 Mm³/year of water to low elevation demand centres in the Palestinian Authority most likely in the Jericho area.

**Freshwater Transmission Alignment**

This conveyance alignment is illustrated in *Figure A2.12*. The route stretches westwards from the desalination plant and across the border, before following the west coast of the Dead Sea running northwards towards Jericho and beyond. One option is to combine the water for Israel and the Palestinian Authority into the same conveyance as far as Ein Gedi, with flow monitoring and controls as required. An alternative, more expensive option, is to transmit the water destined for Israel and the Palestinian Authority in two separate pipes, but following the same corridor where relevant.
Figure A2.12 also shows a possible eastern alignment stretching eastwards from the desalination plant, around the southeast corner of the Dead Sea and up the east coast from where it would cross the border and the Jordan River into the Palestinian Authority towards Jericho and beyond. This would remove the need for the pipeline to the Palestinian Authority from having to travel through Israeli territory, but will likely be prohibitively expensive and difficult to construct.
Freshwater Transmission Details

The total Length of conveyance from the desalination plant to Jericho would be around 140 km, with the stretch from Ein Gedi to Jericho being around 65 km. A combined pipeline would be 1.6 m at the desalination plant, reducing to 900 mm between Ein Gedi and Jericho.
**Construction**

**Process Summary:** The construction of the freshwater conveyance from En Gedi to the Jericho area will be a major operation, and will cross the green line from Israel into the Palestinian Authority. The conveyance will mostly follow the road corridor along the Dead Sea coastline. The conveyance will consist of a steel pipeline, laid into an excavated trench and covered. Operations will include i) surveying of the route, ii) preparing the working corridor, including establishing a temporary access road for the entire length of the route, iii) excavating the trench for the pipeline and storage of the soil nearby, iv) laying the steel pipe sections, welding each section and pressure testing the welds, v) backfilling the trench, and vi) reinstating the ground.

**Plant & Equipment:** Required plant will include excavators, rockbreakers, dozers, cranes, and trucks for transportation of the pipe sections. Means for pressure testing the pipes will also be needed.

**On Site Temporary Infrastructure:** Temporary construction site(s) may be set up on along the pipe route. These will include storage for plant, pipe sections and materials, and workers’ housing. Power supply and waste services (wastewater, solid waste, etc) will be required. A temporary access road will be created along the length of the pipeline route. This road will remain during pipeline operation to allow for maintenance access. It may be that the works will be carried out separately on each side of the border.

**Off Site Temporary infrastructure:** It is likely that these pipeline sections will be imported. Transportation of the pipe sections from the port to the final location will be by truck.

**Labour:** This operation will last of the order of 2 years, and require approximately 200 workers. As noted, workers will likely be housed in temporary accommodation camps established at points along the route.

**Other Resources and Materials:** Significant amounts of steel will be required. This will likely be imported in rolled sheet form. Around 55,000 tonnes of rolled steel will be required for the section in Israel and the PA combined.

**Transportation:** There will be significant transportation along the pipe route, i) of the labour and plant, ii) of the steel pipeline sections, and of the excavation spoil although this will be stored close to the trench, ready for backfilling. Each pipeline section will be around 8 m length and could be up to 2.2 tonnes in weight.

**Waste:** Most of the excavated spoil will be used to backfill the trenches. Excess spoil will likely be deposited in a formed rise along the route. Wastewater and solid waste from the workers’ camps will also be produced.
Dead Sea Discharge Works

The discharge works allow water to be discharged from the conveyance into the Dead Sea. The discharge has to be designed to accommodate the entire capacity of the seawater conveyance, i.e., up to 2,000 MCM/year (this is necessary in case the DSP has to shut down in case of emergency). Depending on project configurations, up to three discrete streams of water may be discharged, as follows:

- Reject brine from the desalination plant
- Discharge from the hydropower plant tail race – could be either Red Sea water, or a combination of Red Sea water and reject brine
- Red Sea water which has by-passed the hydropower plant and the desalination plant

These streams would be combined into a single conveyance, immediately downstream of the desalination plant and hydropower facility.

Alignment of Discharge Conveyance and Location of Discharge Works

The likely location of the discharge to the Dead Sea is at the head of the bay to the east of the Lissan Peninsula, as shown in Figure A2.13. This location will be confirmed following the results of the Additional Study on the Dead Sea.

In this case, the discharge conveyance will include the following:

- an 8 km long open canal running northwards from the hydropower plant, linking with the Truce Canal.
- a 35 km long open canal running within the alignment of the Truce Canal.
- a 12 km long open canal running due east across the neck of the Lissan Peninsula towards the discharge location.

The canal sections will likely take the form of concrete lined trapezoidal channels, with dimensions of the order of 20 m wide and 3 - 4 m deep. Other alignments have been shown on the figure, but will only be examined further if the preferred alignment is shown to have significant difficulties.

Discharge Works Details

The discharge facility could take a number of forms (see Figure A2.13). These include; i) an open channel discharging to the Dead Sea at the shoreline, ii) discharge into an enclosed lagoon to enable pre-mixing, iii) discharge through a bellmouth on a submerged offshore pipeline below the surface, or iv) discharge through an array of submerged diffusers along a length of
submerged pipe. The final form of discharge infrastructure, including dimensions, will be confirmed later in the study.

**Figure A2.13  Proposed Dead Sea Discharge Location**

Source: RSDSC Feasibility Study
**Construction**

**Process Summary:** The construction of the discharge conveyance from the hydropower plant at Fifa area to the Dead Sea will be a major operation. The conveyance will be of the order of 60 km long. Most sections of the conveyance will likely follow existing road corridors. The conveyance will consist of steel pipelines, laid into an excavated trench and covered. Part of the conveyance route may follow the Truce Canal, running along the international border between Jordan and Israel. Operations will include i) surveying of the route, ii) preparing the working corridor, including establishing a temporary access road for the entire length of the route, iii) excavating the trench for the pipeline and storage of the soil nearby, iv) laying the steel pipe sections, welding each section and pressure testing the welds, v) backfilling the trench, and vi) reinstating the ground.

Work will be required in the Dead Sea to locate, install and secure the outfall infrastructure and associated pipelines. Floating plant – barge or pontoons - will carry the inlet infrastructure and the pipeline sections to the required location. The sections will be let down from the barge using cables, and located and secured using divers. Once located, the pipeline sections will be fitted together, sealed, and covered with boulders and/or rip-rap, which will also be let down from the barges and placed by divers.

**Plant & Equipment:** Plant required for the excavation will include excavators, dozers, cranes, and trucks for transportation of the pipe sections. Floating plant will be required to construction and place the outlet structure in the Dead Sea, including a floating barge or pontoon, equipped with an excavator and winches. Divers and support vessels will also be required.

Any engineering work within the Dead Sea requires specialised techniques and materials, because of the corrosive quality of the Dead Sea water and the tendency of salt to precipitate on and encrust equipment. More work is needed to determine the appropriate construction methods.
A3 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

A3.1 INTRODUCTION AND OVERVIEW

A3.1.1 Legal and Policy Context

The large majority of worksites and permanent structures envisioned as part of the RSDSC will be located in Jordan but the scheme will also involve physical works in the other beneficiary parties for the transmission of fresh water. The scheme also involves operations in two international water bodies: seawater and reject brine transfer into the Dead Sea, which is a lake in which all the three beneficiary parties have a riparian interest; and some construction within and water abstraction from the Gulf of Aqaba/Eilat, which is bounded by Egypt and Saudi Arabia as well as the beneficiaries, and is a part of the Red Sea.

A scheme as large as the RSDSC will almost certainly require external finance from one or more sources such as international financing organisations, multilateral or bilateral donors and private consortia. Such entities will usually be bound by policies or covenants that direct how the environmental and social issues associate with their investments should be addressed.

There are thus several sources of environmental and social law and policy that are applicable to the scheme:

- The legislation enacted within each of the beneficiary parties to control domestic development and to implement international conventions;
- The international conventions and agreements that govern the use and management of shared regional water bodies and natural resources; and
- The policies and operational procedures of international funding organisations and financial intermediaries.

The overall framework for financing, and implementing the scheme will synthesise and reconcile the provisions of these diverse laws and policies to create a system that satisfies each of the relevant jurisdictions.

A3.1.2 Applicable Policy and Legislation

The preeminent tool for ensuring that control of environmental and social consequences is integrated into the planning of major construction projects is Environmental Impact Assessment (EIA). In most jurisdictions, including all three of the beneficiary parties, the potential impacts examined in EIA will include social impacts. The current ESA is so named to emphasise to stakeholders the fact that a social assessment is integrated into the EIA process. This ESA will have two overall objectives. It will fulfil the functions
of an EIA at this stage in the project cycle (feasibility assessment) by providing decision makers with information on the critical impacts and the costs of managing these. It will also provide a framework for the compliance of the scheme with relevant policy and permitting conditions, although the specific standards may be set later in project development (eg during detailed design).

The following sections describe the environmental and social policy and legislative framework applicable to RSDSC and the institutional settings within which these are administered. A summary section then describes a potential integrated procedure that could be adopted should the RSDSC be implemented.

A3.2  INTERNATIONAL LEGISLATIVE AND POLICY FRAMEWORK

A3.2.1 The World Bank Group

The World Bank is coordinating the development of the RSDSC. The World Bank screens projects based in their possible environmental impacts, in order to classify them on a sliding scale of potential significance as A, B or C, A being of greatest potential concern. A development on the scale of RSDSC would be classified as Category A, owing to the potentially significant adverse environmental and social impacts, and this triggers a full environmental assessment. Detailed advice and guidance on the conduct of environmental assessment is provided publicly by the World Bank in its Environmental Assessment Sourcebook (1).

The Bank has identified ten key policies that are critical to ensuring that potentially adverse environmental and social consequences are identified, minimized, and mitigated. These are:

- OP 4.01 on Environmental Assessment;
- OP 4.02 on Environmental Action Plans;
- OP 4.04 on Natural Habitats;
- OP 4.07 on International Waterways;
- OP 4.09 on Pest Management;
- OP 4.10 on Indigenous Peoples;
- OP 4.11 on Physical Cultural Resources;
- OP 4.12 on Involuntary Resettlement;
- OP 4.36 on Forests;
- OP 4.37 on Safety of Dams;
- OP 7.50 on International Waterways;
- OP 7.60 on Disputed Areas, and;
- BP 17.50 Public Disclosure.

The most relevant to the ESA is OP 4.01 on Environmental Assessment (EA). EA evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation. The provisions of other OPs, as far as they are relevant to RSDSC, will be incorporated into the ESA.

Also relevant to RSDSC are the World Bank's Operational Policies and of particular importance in the context of the ESA is the Policy on Disclosure of Information (2002), which sets out the Bank's policy for disclosing and sharing information. This requires, amongst other things, that the draft EA report is made available at a public place accessible to project-affected groups and local NGOs for at least 60 days (for a category A project) before formal appraisal of the project begins.

### A3.2.2 World Bank EA Requirements

There are some general requirement and some EIA specific requirements (see Table A3.1 and Table A3.2). The general requirements relate to the following:

#### Table A3.1 World Bank General EIA Requirements

<table>
<thead>
<tr>
<th>Ref</th>
<th>Requirement</th>
<th>Description / Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>Institutional capacity.</td>
<td>If the borrower has insufficient capacities to carry out the key EIA functions, then</td>
</tr>
<tr>
<td></td>
<td></td>
<td>the project must include a component for capacity building and / or strengthening.</td>
</tr>
<tr>
<td>15</td>
<td>Public consultation.</td>
<td>Project affected groups must be consulted, NGOs, local communities, etc. At least 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>such public consultations must take place, one before the TOR for the EIA are finalised</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and the other one once the draft EIA report is prepared.</td>
</tr>
<tr>
<td>17</td>
<td>Disclosure.</td>
<td>Executive summary of the draft EIA to be published and made available at a public place</td>
</tr>
<tr>
<td></td>
<td></td>
<td>accessible to project affected groups and NGOs.</td>
</tr>
<tr>
<td>20</td>
<td>Implementation.</td>
<td>The borrower reports to the World Bank on the project implementation and the realisation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>of any measures agreed with the bank (EMP), the status of mitigation measures and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>monitoring findings.</td>
</tr>
</tbody>
</table>

Specifically related to the EIA, the following mandatory requirements must be fulfilled.

(1) Numbering refers to the section of the OP 40.1
Table A3.2  World Bank Specific EIA Requirements

<table>
<thead>
<tr>
<th>Ref (1)</th>
<th>Requirement</th>
<th>Description / Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Report must be in English.</td>
<td></td>
</tr>
<tr>
<td>2 (b)</td>
<td>Policy, legal and administrative framework.</td>
<td>Describes the relevant policy, administrative and legal environment, including any international treaties to which the beneficiary party is a member.</td>
</tr>
<tr>
<td>2(c)</td>
<td>Project description.</td>
<td>This chapter describes the proposed project, its geographic, ecological, social and temporal context as well as any off site structures required (pipelines, temporary housing, etc); if applicable, it also indicates the need for resettlement.</td>
</tr>
<tr>
<td>2(d)</td>
<td>Baseline data.</td>
<td>Description of the physical, biological and socioeconomic conditions and any changes under way. Also, outlines other development activity within the project area. Indicates source and reliability of data.</td>
</tr>
<tr>
<td>2(e)</td>
<td>Environmental impacts.</td>
<td>Assessment of the project’s positive and negative impacts. Discusses mitigation measures and residual negative impacts. Explores opportunities for environmental enhancement. Identifies data gaps and uncertainties.</td>
</tr>
<tr>
<td>2(f)</td>
<td>Analysis of alternatives.</td>
<td>Comparison of project alternatives (site, technology, design and operation), as well as the “no project” option vis-a-vis the potential environmental impact. Reviews the impact mitigation concerning capital and recurrent costs, suitability to local conditions and institutional, training and monitoring requirements. States economic values where possible. Justification of project design and emission levels; approaches to pollution prevention.</td>
</tr>
<tr>
<td>2(g)</td>
<td>Environmental management plan.</td>
<td>Deals with mitigation measures, monitoring and institutional strengthening.</td>
</tr>
<tr>
<td>2(h)</td>
<td>Appendices.</td>
<td>List of authors of EIA drafters. References. Tables and NGOs involved, list of associated reports.</td>
</tr>
</tbody>
</table>

A3.2.3  The Equator Convention

The Equator Principles have been adopted by financial institutions in an attempt to harmonise and ensure socially responsible and environmental sound management principles are applied in project finance ventures. These principles apply to any project worth more than US$ 10 Million and loan facilities will only be made available if the Equator Principles are met (in their entirety). The financing institutions having signed up to the Equator Convention are referred to as Equator Principle Finance Institutions (EPFI).

(1) Numbering refers to Annex A of OP 40.1
The Equator Principles are:

- EP1: Review and Categorisation;
- EP 2: Social and Environmental Assessment;
- EP 3: Applicable Social and Environmental Standards;
- EP 5: Consultation and Disclosure;
- EP 6: Grievance Mechanism;
- EP 8: Covenants;
- EP 9: Independent Monitoring and Review; and
- EO 10: EPFI Reporting.

The EPs are essentially based on World Bank/IFC performance standards, and therefore utilise the same categorisation of projects (Categories A, B and C) in determining the level of assessment to be applied.

**A3.2.4 Regional Obligations**

*The ‘ESPOO Convention’*

The ‘Convention on Environmental Impact Assessment in a Transboundary Context (Espoo, 1991)’ entered into force in 1997, with its primary aim to bring together stakeholders for transboundary projects. None of the beneficiary parties is member of the Espoo convention, but Jordan is implementing a policy of harmonisation of environmental law with the European Union and Espoo is implemented by the EU through the ‘EIA Directive’.

The Espoo Convention establishes the obligations of its members to assess the environmental impact of certain activities in the planning phase and obliges members to notify and consult with each other on all major projects under consideration that are likely to have a significant adverse environmental impact across boundaries. It establishes a notification procedure for this.

The Convention also regulates transboundary cooperation; the member carrying out the EIA is obliged to share its findings with other potentially affected members once the EIA has been completed. Joint monitoring bodies may be established.

*Regional Convention for the Conservation of the Red Sea*

The Regional Convention for the Conservation of the Red Sea and the Gulf of Aden (and the protocols) was signed in 1982 by Egypt, Jordan, Saudi Arabia and others (Palestine represented by the Palestine Liberation Organization, Djibouti, Somalia, Sudan and Yemen).

These are in effect re-enforcing the provisions of other Conventions dealing with Marine Pollution. Under the Convention, Jordan is obliged to take
measures that actively prevent, abate and combat the pollution of the Red Sea and Gulf of Aden marine environment from pollutants like petroleum (and its associated products) as well as other hazardous substances.

There are two main institutions, the Council and the Secretariat, which monitor and report on compliance of the member states with the convention and ensure cooperation on joint matters. The council represents the member states externally and consults with non member states on matters with a potential impact on the Red Sea or the Gulf of Aden.

If the intake structures, the water abstraction from the Gulf of Aqaba/Eilat or any other aspect of project construction or operation would appear to present a threat to the marine environment, the Council in Jeddah would need to be informed and any mitigating measures notified to the Council.

A3.3 JORDAN

A3.3.1 Introduction

The Hashemite Kingdom of Jordan will be the focal point for most activity in the proposed project. This section provides an overview of the key policies and legislation relevant to the environment, health and safety issues that would impact the project’s construction and operation while also describing the key institutions that are of potential relevance.

A3.3.2 International / Bilateral Conventions, Treaties and Agreements

Jordan lies in an ecologically important and sensitive region of the world. Jordan government policy acknowledges the importance of its natural and cultural heritage and has become a signatory to a number of International and Regional Conventions, Treaties and Agreements to protect and conserve such assets. Such instruments enable multilateral coordination, cooperation and action in tackling environmental issues that are of international cross-boundary, regional or global interest.

At the regional and international levels, the Jordan has ratified the following conventions of potential relevance to RSDSC.

- Convention on Biological Diversity (UNCBD) in 1993: Governments are required to develop national biodiversity action plans, and to integrate these into broader national plans for environment and development.
- Convention to Combat Desertification (UN CCD) in 1996: to combat desertification and mitigate the effects of drought through long-term integrated strategies that focus on improved productivity of land, and in the overall rehabilitation, conservation and sustainable management of land and water resources.
• Convention on Wetlands of International Importance ('the Ramsar Convention') in 1977: This focuses on the importance of wetlands as ecosystems and for the well-being of human communities. Contracting Parties are required to designate ‘Ramsar Sites’ and maintain their ecological character, as well as promoting wetland management, training and research, and consulting with other Parties about the implementation of the Convention.

• Convention of Migratory Species (CMS) in 2000: This Convention (also known as the Bonn Convention) aims to conserve migratory species throughout their range by coordinated multilateral conservation, management and research activities.

• World Heritage Convention (WHC) in 1972: This Convention identifies sites that can be considered for inclusion in the World Heritage List and establishes duties for their protection/preservation.

• Framework Convention on Climate Change (UNFCCC) in 1992: “to achieve stabilization of greenhouse gas concentrations in the atmosphere at a low enough level to prevent dangerous anthropogenic interference with the climate system”. Jordan is eligible to take part in Cleaner Development Mechanism (CDM) projects whereby high income countries with a greenhouse gas reduction commitment invest in emission reducing projects in developing countries as an alternative to more costly emission reductions at home.

Jordan is also party to the IUCN and the UNESCO Man and Biosphere Programme through a national committee.

The Ministry of Environment is the Jordanian government’s representative body for most of the international environmental conventions.

A3.3.3 Institutional Setting

Introduction/General Policy Direction

Jordan has well developed and functioning policy and institutional frameworks for the management of environment and natural resources. The main instruments are as follows.

• The 1995 Environmental Law which gave force to a National Environment Strategy (NES) and National Environmental Action Plan (NEAP);

• The National Agenda (2006-2015), which set a national goal to “protect and sustain the environment” through an operational action plan which is being implemented by various Ministries and monitored by the Prime Ministry.

• The Environment Strategy 2007-2010 that was formulated based on best international practices and aims to enhance environmental integration into
other sectors. It integrates policy objectives, the National Agenda initiatives, and obligations under regional and international multilateral environmental agreements.

The National Agenda acknowledges, however, that enforcement of environmental legislation has occasionally been undermined by overlapping mandates resulting in scattered and uncoordinated efforts at the national level.

The Ministries and Institutions with mandates most directly related to environmental issues that may arise in connection with RSDSC are briefly described below.

**Ministry of Environment (MoE)**

Ministry of Environment (MoE) is the responsible body for protecting the environment through setting policies and legislation as well as ensuring proper enforcement through licensing, monitoring and inspection processes. It is responsible for designating and supervising the management of national parks, reserves and other protected areas although it may delegate these tasks to other bodies (see below). The Ministry is also responsible for developing relevant information management programmes, raising public awareness, and promoting co-operation with relevant national, regional and international parties.

The MoE chairs two national committees that are in charge of project planning and approval decisions, namely: the central licensing committee and the EIA committee.

In 2006, MoE established the Environmental Rangers (Police) department to spearhead enforcement of environmental regulation.

**Other National Level Bodies**

**Natural Resources Authority (NRA):** The NRA is responsible for policies to investigate, develop and exploit energy and mineral resources. As part of this, the NRA issues permits and licences for mining and quarrying.

**Ministry of Agriculture (MoA):** The Ministry of Agriculture is responsible for managing public rangelands and forests, protecting soil resources, pasture-land and flora, permitting pesticides, protecting and managing wildlife, issuing fishing and hunting licenses, determining capacity and setting ‘take’ limits.

**Royal Society for the Conservation of Nature (RSCN):** The RSCN is one of the most well established environmental NGOs in Jordan. It is empowered to establish and manage protected areas under the supervision of the MoE. One such protected area related to the project is the Dana nature reserve, which
borders the rift valley; the pipeline or tunnel of the project might run alongside or under parts of the Dana reserve.

**Ministry of Water and Irrigation (MWI)** including the **Water Authority of Jordan (WAJ)** (MWI also includes JVA – see below): MWI and WAI work in determining National Water policy, monitoring and protecting water against pollution, in addition to studying water supplies, irrigation and sewerage. Groundwater, aquifer management and abstraction monitoring and licensing are the responsibility of WAJ. RSDSC is identified as one of the key water projects of the MoWI’s strategy and action plan.

**Ministry of Planning and International Cooperation (MoPIC):** The objectives of MoPIC are the coordination and formulation of social and economic development plans; and the implementation thereof, in coordination with other stakeholders. The ministry is also responsible for enhancing cooperation with international partners including maximizing the benefits from foreign assistance (grants, soft loans, and technical assistance) to finance developmental programmes and projects.

**Ministry of Municipal Affairs (MoMA):** MoMA monitors the financial, administrative and organizational performance of the municipalities and supports them in dealing with all aspects of planning and supervision of infrastructure development within their boundaries. There is a decentralisation programme underway in Jordan. This will allocate more responsibilities to MoMA, which will be renamed the Ministry of Local Government, and to the municipalities to implement development projects directly.

**The Higher Planning Council (HPC):** A national land-use master plan for Jordan has been prepared to ensure that development considers factors such as the physical environment, population distribution and proper management of agriculture and natural resources. The HPC is chaired by the Minister of MoMA and is responsible for promulgation of the master plan, approval of regional planning proposals and licensing of land development.

**Jordanian Armed Forces:** The military owns some of the land in the rift valley, through which the RSDSC may run. It is also responsible for the security of the Jordan-Israel border, which runs alongside or close to the potential routes of the RSDSC and controls access to sensitive areas abutting the border. Activities within such areas need prior consent from the military, who may coordinate with their counterparts on the Israeli side of the border.

**Sub-National Administration**

**Aqaba Special Economic Zone Authority (ASEZA):** ASEZA and the Aqaba Special Economic Zone (ASEZ) were established in 2001 to attract and facilitate investment in Aqaba in the areas of tourism development, industry, port development, infrastructure, utilities and commercial services. ASEZA
has six governing Commissioners, one of whom is dedicated to the Environmental Management of the Zone, and a Department for Environment and Health Control is responsible for environmental management and protection of the terrestrial and marine resources of the area.

One important aspect of ASEZA’s regime is the prohibition of any discharges to the marine environment. This ‘zero-discharge policy’ was designed to ensure that only brine from desalination works, cooling water of the same quality as the Gulf sea-water, and storm water are discharged to the Gulf. No wastewater treatment discharges, or other industrial discharges are permitted. ASEZA also established and manages the Aqaba Marine Park - a 7 km long specially protected reserve area.

Governorates: There are 12 regional Governorates in Jordan. Within these Governorates, the Greater Amman Municipality, and the Aqaba Special Economic Zone have power to set laws and regulations in some areas, including environmental management. The other Governorates are mainly concerned with coordinating the implementation of national legislation and providing support and advice to municipalities, particularly with regard to public safety, public health and long-term sustainability issues.

Jordan Valley Authority (JVA): The JVA was established in 1977 before the creation of MWI, with a mandate of comprehensive development of the Jordan Valley but it is now within MWI. It is responsible for the development and utilization of water resources in the Jordan Valley, irrigation, water resources protection and conservation, distribution networks, tourism planning and development and hydroelectric power generation. JVA has owned and managed significant land assets in the Jordan Valley most of which are unoccupied, but some are leased to farmers. Recently (2009) the government has announced that the Development Zones Commission (see below) will take responsibility for the development of the areas around the Dead Sea shore.

Development Zones Commission: Established in 2009, the DZC was created to replicate the successes of the ASEZA model in other strategic areas of the country. Currently, the only Development Zone in the study area is the Dead Sea Zone). The mandate of DZC includes:

- policy formulation;
- planning regulation and permitting (including EIA approvals);
- regulation of municipal affairs; and
- protection of the environment, water and natural resources.

Further, it issues all business related licenses, permits and approvals within a development zone and can draft regulations.

Dead Sea Development Zone: The Dead Sea Development Zone was created in 2009, stretching over an area of 40 km² from the Jordan River to the Wadi
Mujib. This Zone aims at stimulating the economy through providing incentives and exemptions to attract investment. It will focus on entertainment and tourism projects and several development schemes. As part of this initiative, a Comprehensive Land Use Plan was prepared covering 13,300 ha, the majority of which is owned by the Government of Jordan. In recent years, the Government offered for concession 680 ha to private tourism developers and investors, nearly all on the Dead Sea shore. A major goal of the Master Plan is to deliver integrated community development benefits from tourism industry to local residents.

**Joint Service Councils (JSCs):** JSCs may be established by MoMA to take charge of affairs that concern more than one municipality, or of affairs outside the boundaries of municipalities (such as waste dumping sites, etc). At the time of writing, 22 such entities have been established, most of which (16) are concerned with Solid Waste Management.

**Local Administration**

Besides the federal (and regional) administration, there are 93 municipal councils and 142 village councils in Jordan. These municipalities rely upon the national government for most revenues.

A new Municipal Law was enacted in February 2007, under which the mayors and councils of all municipalities will be elected, except in Amman where half the members of the council will continue to be appointed by the government.

Municipalities have a set agenda of competencies within their municipal boundaries, including the issuing of building permits and licences, implementing the land acquisition actions, expropriation and resettlement actions according to the implementation plans.

**A3.3.4 Legal Framework**

**Introduction**

In accordance with a Cooperation Agreement between Jordan and the European Union (EU) signed in 2002, Jordan has embarked on a programme to bring its environmental legal framework into line with the EU’s ‘Environmental Acquis’ (ie the total body of EU environmental legislation): a process known as ‘approximation’. Such initiatives between the EU and third countries have the general goal of creating a unified legal environment for market relations and favourable conditions for access of that country’s producers and services providers to EU markets as well as markets of the many other countries that accept EU standards.

To begin the approximation process, a legal gap analysis and an upgrading Master Plan were prepared with support from the European Commission. The Master Plan is currently being implemented by the MoE.
The Legal Framework that applies to the environmental and social management of RSDSC may be summarised as five types of legal instrument as follows.

• Environmental Framework legislation, secondary regulations and standards;
• Sectoral and Regional legislation relating to the environment;
• Protection of Sensitive Areas and Biodiversity;
• Land Use Controls; and
• Land Acquisition and Resettlement Regulations.

These are briefly described in the following sub-sections.

Environmental Framework Legislation, Secondary Regulations and Standards

The Environmental Protection Law (No. 52, 2006) is the highest level framework for environmental protection and grants the MoE its strong mandate as the responsible body for protecting the environment. Secondary legislation to implement this Law includes the following.

Environmental Impact Assessment Regulation No.37 of 2005: The EIA Regulation sets out the process for conducting an Environmental Impact Assessment (EIA) and the items that should be included in the study, as well as the correct procedure for environmental clearance. Any project that may have a significant impact on the environment, must have a comprehensive EIA carried out, by the investor, before permission to operate (or license to begin construction) can be given. At the MoE, an EIA committee has been established which determines the scope of the EIA report to be compiled and reviews the EIA report when it is submitted (see Figure A3.1).
Soil Protection Regulation No. 25 of 2005: MoE, in coordination MoA and any other relevant institution, is empowered to establish and run special zones for the protection, development and propagation of certain types of wild plants in order to stabilize the soil. Soil maps from the national project for soil mapping and land use shall be used by the relevant body to determine the degree of suitability of an area for agriculture, grazing and other human activities.

Air Protection Regulation No. (28) of 2005: Any facility shall ensure that no leak or emission of air pollutants occurs beyond the allowable limits. Regulators should ensure that the location where a project is being built is appropriate for its activities, that the permissible limits for air pollutants are not exceeded, and, in all cases, that the total pollution from facilities in the specific area do not exceed the permissible limits.

The Protection of the Environment from Pollution in Emergency Situations Regulation No. (26) of 2005: Any facility should designate an officer who will be responsible to the relevant local operation committee for presenting and implementing a contingency plan for the facility. Each facility should meet protection requirements such as necessary manpower, tools and equipment, ready for use in any emergency situation.

Regulation concerning Solid Waste Management No. (27) of 2005: The objective of this Regulation is to ensure the management of solid waste in a way that maintains environment protection and public health. Among others,
it lists responsibilities and tasks to be undertaken including observing and collecting operations, transportation of wastes, permitting, supervising, scheduling and archiving of solid waste quantities. It also outlines the tasks and responsibilities for each entity active in the SWM sector.

**Regulation concerning Hazardous Waste Management and Handling No. (43) of 1999:** Although in existence before the Environmental Law of 2003 & 2006, this regulation still comes under its general umbrella by setting general procedures for hazardous waste producers for storing, handling, collecting, transporting and disposing of hazardous wastes.

**Sectoral and Regional Legislation Relating to the Environment**

**Water Authority Law No. 18 and its Amendments of 1988:** This law established the Water Authority and granted it a mandate to research, develop and manage all aspects of water resource use except irrigation. This entails the development of water resources in the Kingdom and their exploitation for domestic and municipal use ('municipal' includes all waters that are used for domestic, commercial, industrial and touristic purposes that are supplied through the public networks) including springs & wells, treated and desalinated waters.

**Jordan Valley Development Law:** Pursuant to Law No. 19/1988 and its Amendments in 2001, the JVA was created as a financially and administratively independent organisation to develop and improve on the economic and social status of the Jordan Rift Valley. The law gives JVA full authority over the valley area including control and protection of water resources, making decisions on the use and distribution of water for irrigation, household usage, etc. Also relating to water resources, the JVA is expected to conduct and implement projects to improve on the quality of water and to combat and prevent water pollution. These activities may include the preparation of water quality standards and issuance of permits to engineers and licensed professionals to perform public water and wastewater works. It is also part of JVA’s mandate to ensure “the development, protection and improvement of the environment in the valley and to perform necessary works to achieve this”, and “the development of land resources, and the distribution of land parcels for agricultural and residential purposes”.

**Groundwater Control Regulation No. 85, 2002, issued pursuant to articles 6 and 32 of Water Authority Law No.18, 1988:** It is herein confirmed that groundwater is owned and controlled by the State and its abstraction or utilization is prohibited except by license issued under this regulation. The regulation also stipulates the requirements for obtaining licenses as well as the fees and service charges associated with licensing.

**ASEZ Law No. 32 of the year 2000:** This law establishes the legal basis for the establishment of ASEZ and ASEZA, and the powers of ASEZA to control economic activities, levy taxes and duties, control land and coastal
development and protect the environment. According to Article 52, the Commissioners shall assume the powers of MoE for the purpose of protecting and maintaining the environment in the Zone and for ensuring sustainable development. In particular, Article 6 of the Law stipulates that all legislation in force in the Kingdom shall apply to the Zone unless superseded by contradiction by the provisions of ASEZ legislation. This means, that more stringent legislation in the ASEZ area will supersede (weaker) national legislation.

**ASEZ Environmental Protection Regulation No. 21 of 2001:** This provides the basis for ASEZ’s regulation of the environment. It contains a number of provisions regarding pollution control, use of seawater, and protection of the biological environment. It also assigns ASEZA the responsibility for regulation and monitoring of groundwater resources, and licensing and drilling of wells. Moreover, the Regulation grants ASEZA the right to require environmental impact assessment for new projects, and to suspend the work of any activity that poses a threat to the environment.

**ASEZ Regulation for the Aqaba Marine Park, No 22 of 2001:** This regulation prevents any activities that could have an adverse effect on the Aqaba Marine Park. The Aqaba Marine Park Committee, inter alia, establishes an environmental monitoring programme within the Park and oversees its implementation.

**The Agriculture Law no. 44 of 2002:** This provides that the Ministry of Agriculture (MoA) is responsible for overseeing the “Agricultural Sector” in its entirety, which includes wide-ranging environmental aspects such as managing forests, regulating hunting, the protection of wildlife and licensing the commercial exploitation of wildlife.

**The Antiquities Law, No. 12, 1988, as amended by Law No.23, 2004:** This is the key legal act for the protection of antiquities in Jordan. Article 13 requires that significant archaeological sites should be documented and protected by a buffer zone of 5 m to 25 m. In addition, it states: “it is prohibited to set up any dangerous industry, lime furnaces and stone quarries at a distance less than 1 km from the location of the antique site”. The Department of Antiquities gives permits for any fieldwork necessary to identify archaeological sites that may be impacted by a development, beginning with the archaeological survey of the project land. Any sites discovered at this stage must be assessed by the DoA as to their significance, and what measures need to be taken to record, conserve or preserve in situ.

These measures may include thorough mapping, test excavation and/or full-scale excavation. Equally, sites discovered during building and mining operations must be reported to the Department for a decision on whether the site is significant enough to be studied or protected.
Protection of Sensitive Areas and Endangered Species

The Natural Reserves & National Parks Regulation no. 29 of 2005: The establishment or amendment of any natural reserve or national park boundaries is the decision of the Council of Ministers based on a recommendation by MoE. The Ministry in coordination with the competent authorities organizes placement related to the purchase, rental or easement of owned lands within the boundary of the natural reserve or the national park. Otherwise, the owners of these lands have the right to use their land so long that it does not interfere with the objectives of protection and the management plan of the natural reserve or national park. The Minister of Environment may consider any site as a habitat for the revival of the rare plant, animal or aesthetically pleasing landscape, whatever the area, and declaring the latter of special significance in order to regulate matters relating to the protection and management under the instructions issued by the minister for this purpose. Subject to the provisions of any other legislation, it is unlawful for any person, without obtaining the required approval, to engage in any activities within the boundary of the natural reserve or the national park, including the exploitation of any natural resources in it.

Land Use

The Zoning of Cities and Villages Law, No. 79 of 1966: This sets out the detailed procedures for the preparation of physical plans for all settlements. In general, land use is controlled by the HPC as described above, using a national master plan in conjunction with municipal and regional master plans prepared by MoMA. The HPC declares planning areas, MOMA then prepares land use zoning plans and master plans and the regional and local levels of government review and comment.

The law describes three levels of planning: a structural plan that should be prepared every 10 years showing land uses, infrastructure, areas for economic development, provision for social services and utilities, and protected areas; a detailed plan that might cover part of a structural planning area and show public buildings, land to be expropriated for public use, and development control measures; and, regional plans that are to be prepared for new towns or villages or to restrict the growth of existing towns or villages and show the main areas for industry, commerce, residential areas and utilities and infrastructure. MoMA must authorise any amendment to a master plan, most of which were prepared in the 1980s, while within any declared planning area any proposed development of land is licensed by the local planning authority.

In accordance with the Land Use Planning Regulation No. (6) / 2007, no entity can change or transfer the status of any land use except in accordance with the instructions issued by the Council of Ministers based on a recommendation by the Council. Lands are classified as suitable for agriculture, as set out in the land-use map to the following sectors:
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- Agricultural areas sector;
- Rural areas sector;
- Marginal areas sector;
- Desert areas sector; and
- Forests sector.

Land Acquisition

Jordanian law allows for the appropriation of land for the public benefit conditional on fair and just compensation. Any potential land acquisition is undertaken in accordance with Decree (12) of 1987, commonly referred to as the Land Acquisition Law (LAL) and its amendments, and must be approved by the Council of Ministers. The Department of Lands and Surveys (DLS) has been established to oversee the acquisition, compensation payment and ultimate registration of the land.

The Council of Ministers requires demonstration of the public interest (benefits), evidence that the purchasing authority has the capability to pay and agreement between contracting parties on the issue of appropriate compensation. In the event that an agreement cannot be reached, or dispute over payment of money promised, the case would be referred to the Primary Court that has jurisdiction in the area, and to higher courts if necessary.

The process of acquisition involves a number of actions and steps, as follows:

- Publication by the DLS of the intent to acquire land in the public interest;
- Submittal of a request for approval from the Prime Ministry to acquire the land (15 days after the announcement date);
- A committee led by the DLS determines the value of the land and fair compensation (considering the market price on the day of publication of intent to acquire the land and the value of nearby sites);
- Appeals procedure (if the owner disagrees with the estimated cost, and arbitration fails, the courts will take up the issue and must reach a resolution within three months); and
- Payment by the relevant Government department to DLS, which in turn pays the owner and finalizes the registration of land for the Ministry.

Resettlement

Jordan employs a resettlement policy, which is based on the World Bank OP 4.12, following any land acquisitions (see above). In outline, a Resettlement Policy Framework (RPF) is prepared which outlines overall resettlement objectives and principles as well as funding mechanisms and
organizational arrangements. Any resettlement plan is governed by the following principles.

- Involuntary resettlement is avoided wherever feasible, or minimised, exploring all viable alternative project designs.

- Where it is not feasible to avoid involuntary resettlement, activities are conceived and executed as sustainable development programmes, providing sufficient investment resources to enable people adversely affected by the project to share project benefits. Displaced persons are to be meaningfully consulted and have opportunities to participate in the planning and implementing of resettlement programmes affecting them.

- Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living, or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

There are examples where Jordan has drawn up comprehensive resettlement plans, for example for the Amman Ring Road.

A3.3.5 Required Permits, Approvals and Licenses

Large projects must receive environmental clearance from MoE (or from ASEZA if they are located within the ASEZ) before the license to begin construction works can be given. This environmental clearance takes into consideration the EIA report, plus the comments and conditions of the EIA committee, all of which must be incorporated into a revised Environmental Management Plan (EMP). Other permitting authorities are represented on the EIA committee and have an opportunity to attach additional conditions to the approval. When granted, therefore, the environmental clearance will incorporate all of these other related major permits and authorisations (such as, for example water abstraction, road closures, planning permissions, excavations for minerals, waste disposal etc) required to execute the project.

A3.4 ISRAEL

A3.4.1 Introduction

Israel’s environmental legislation is wide ranging. It covers the entire expanse of environmental issues, uses all forms of legislative instruments - laws, regulations, administrative orders and bylaws - and is linked to international environmental law.

Israel’s environmental legislation encompasses laws for the protection of nature and natural resources (air, water and soil), for the abatement and prevention of environmental nuisances (prevention of air, noise, water and
marine pollution), and for the safe treatment of contaminants and pollutants (hazardous substances, radiation and solid and liquid waste).

Alongside laws and regulations dealing with specific environmental issues, Israel’s legislation includes comprehensive laws, such as the Planning and Building Law and the Licensing of Businesses Law, which provide a framework for controlling the use of resources and promoting sustainable development.

A3.4.2 International / Bilateral Conventions, Treaties and Agreements

International cooperation with both organizations and states is an important component of Israel’s environmental agenda. Over the years, Israel has reinforced its efforts and strengthened its commitment to active participation in global and regional programmes and agreements on behalf of the environment. Its contribution, within the context of different international organizations, spans all areas of the environment - marine protection, combating desertification, water resource protection and development, biodiversity conservation and development of environmental technologies, to name but a handful. At the same time, Israel has ratified nearly all of the major environmental conventions including the following:

- UN Convention on Climate Change;
- Vienna Convention and Montreal Protocol for the Protection of the Ozone Layer;
- Convention for the Protection of the Marine Environment;
- Convention for the Protection of the Coastal Region of the Mediterranean;
- Convention on Oil Pollution Preparedness, Response and Cooperation;
- Convention for the Prevention of Pollution of the Sea by Oil;
- Convention for the Prevention of Pollution from Ships;
- Convention for the Protection of Biological Diversity;
- The Biosafety Protocol, also known as the Cartagena Protocol;
- Ramsar Convention on Wetlands;
- Convention on the Conservation of Migratory Species of Wild Animals;
- Convention Concerning the Protection of the World Cultural and Natural Heritage;
- Convention for the Protection of New Varieties of Plants; and
- Convention to Combat Desertification.

In addition, Israel’s has concluded 18 bilateral agreements for environmental cooperation. The relevant ones to RSDSC are the agreements with Jordan including the following.

Israel Jordan Peace Treaty Annex II (Water): This Annex allocates water from the Yarmouk and Jordan rivers and regulates the abstraction of groundwater in the rift valley (Article I). In Article I.3, both Parties agree to undertake joint efforts to find additional water resources. This effort will be supported by the
establishment of a Joint Water Committee (Articles VI and VII) and to share relevant information.

**Israel Jordan Peace Treaty Annex IV (Environment):** This Annex relates to environmentally sensitive areas, to the need for conservation of natural resources, protection of biodiversity and the imperative of attaining economic growth based on sustainable development principles. The rift valley, the Wadi Araba/Arava Valley, the gulf of Aqaba and the Dead Sea are identified as potential areas of cooperate. Also stipulated is the principle of cooperation in the conduct of an EIA.

**Israel Jordan Peace Treaty, Article 6,** establishes a cooperation of the two countries for earth sciences in the Rift Valley (and Wadi Araba) concerning, inter alia, geological plans and programmes and agree on the exchange of data (article 8).

**Memorandum of Understanding** signed by both states to implement the Red Sea Marine Peace Park Cooperative Research, Monitoring and Management Programme (RSMPP).

**Memorandum of Understanding (2003)** between the Ministry of the Environment on behalf of Israel and the ASESZA on behalf of Jordan for transboundary cooperation of the parties regarding the Gulf of Aqaba National Monitoring Programme.

### A3.4.3 Institutional Setting

#### Introduction/General Policy Direction

In Israel, responsibility for environmental issues is distributed among many government ministries and their many units. At least sixteen out of the twenty-two government ministries are legally authorized to handle environmental issues. About three quarters of Israel’s environmental laws involve six government ministries: Interior, Agriculture, Transportation, Health, Environmental Protection and Infrastructure.

Each ministry’s specialization and expertise affects the way it relates to and handles the environmental issues for which it is responsible. Since most environmental issues are multi-faceted, if the environmental aspect were considered the most important, all the authority for these issues would be transferred to an Environmental Ministry, as has occurred in some countries.

### A3.4.4 Ministry of Environmental Protection (MEP)

This is the only ministry dedicated to environmental protection. The Ministry has authority over thirty-three environmental laws, which deal with a wide variety of topics, including nature and landscape protection, water quality, oceans and coastlines, toxic substances, solid waste, and air quality. Relative to other ministries with authority over many environmental laws (such as the
Ministry of Transportation and the Ministry of Agriculture) MEP is relatively young: it was established in 1989. At that time most of Israel’s environmental laws already existed, but half of the laws under the MEP authority were passed after it was established.

Several additional government ministries share the MEP’s authority even over the recently enacted laws, mostly the Ministries of Interior, Health, and Agriculture.

Although the Ministry’s budget has grown by a factor of six since its establishment, the budget still makes up only about 0.1% of the total government budget, and is much lower than the allotment awarded to most ministries. The Ministry of Environment’s budget has been relatively unstable, in comparison to the total government budget, which makes long term planning more difficult. The Ministry’s budget was cut in 2001, and continues to drop, absolutely and in relation to the total government budget. This finding stands in contrast to the increase in public support for environmental protection and the growing recognition of its importance.

Other National Level Bodies

**Ministry of Construction and Housing:** This Ministry has partial authority over the environment mostly relating to nature and landscape protection. The administrative units directly concerned are the programmes department; the department of urban planning and construction; and, the rural construction administration.

**Ministry of Health:** The Ministry of Health is concerned with 'environmental health', which includes areas of human health that are affected by physical, chemical, and biological agents in the environment. Its major environmental responsibilities relate to drinking water quality, food quality, water quality in rivers at recreation areas, wastewater treatment, quality of recycled wastewater used for agriculture, and toxic waste from hospitals. It also has a unit dealing with worker health and safety issues.

**Ministry of Agriculture and Rural Development:** This Ministry has authority over many aspects of the environment that relate to the productive use of natural (biological) resources including forestry; plant protection services; aquaculture and fisheries; ocean agriculture; ocean fishing unit. Other environmental concerns relate to the protection of soils and agriculturally productive uses of land through the department of drainage and soil protection; department of engineering and drainage; department of land preservation; open land unit; department of grazing; department of land purpose mapping and remote sensing; plant consolidation unit; and, the station for run-off research.
Ministry of Interior: The Government has determined that “all of the Ministry of Interior’s activity related to environmental protection will be transferred to the Ministry of Environmental Protection”. However, the Ministry of Interior retains interests through the planning administration; national council for planning and construction; the committee for ocean water; committee for agricultural land and open land protection; national unit for construction supervision; local authority administration; local authorities auditing unit; water economy in local authorities administration; licensing authority; emergency services and special services; centre for business licensing; licensing and supervision department; and licensing security factories unit.

National Planning and Building Board: This is Israel’s foremost planning agency. It enacts national level master plans, reviews regional master plans and serves as an appeal board for decisions taken at the regional level. The national level includes two special statutory committees: the Committee for Protection of Agricultural Lands and Open Spaces, responsible for protecting lands of agricultural value and open spaces, and the Coastal Waters Committee, responsible for approving offshore and coastal structures.

Ministry of Tourism: The Ministry of Tourism shares authority with the Ministry of Interior for the National Outline Plan Number 12, which contains the Ministry’s environmental policy. This contains among other things a commitment to sustainable development and environmental protection, development of ecotourism; and, an undertaking to promote the construction and management of environmentally friendly hotels.

Ministry of Industry and Trade: The Ministry has joint responsibility for the implementation of legislation dealing with oceans and coastlines, toxic substances, air quality, nature and landscape protection, and solid waste. It is responsible for declaring Israel’s industrial environmental (emission and performance) standards.

Ministry of National Infrastructure: The Ministry has administrative units that deal with environmental issues arising from activities such as the provision of energy (electricity, petroleum fuels and natural gas administrations) and the management of sewage infrastructure.

Water Commissioner: Although the Minister of National Infrastructure is responsible for the Commissioner’s activities, the Commissioner is not subordinate to any government ministry. The Commissioner has responsibility for preserving water resource quality; setting guiding principles for the management of water resources and the way it relates to environmental considerations. The administrative units that deal with environmental issues and include: hydrological service unit, hydrometry department, consumption management unit, water and wastewater quality unit, and the development unit.
Sub-National Administration

The Southern Region regional planning committee is located in Beer-Sheva at the premises of the Ministry of Interior. It is the regional planning and building committee superior to the local committees that are along the route of the RSDSC (Eilot, Arava, Tamar). The local committees are entitled to pass issues to the upper committees in certain circumstances.

The following local councils might be affected by the route of the RSDSC:

- Eilat Municipality.
- Eilot (Southern Arava) regional council.
- Central Arava regional council; this council has extensive areas of natural reservations.
- Tamar regional council; this includes the Dead Sea Works industrial complex.
- Megilot regional council; this comprises 6 settlements beyond the Green Line with boundaries along the north-west coast of the Dead Sea, neighbouring with the Palestinian Authority. It is subject to Israeli law.

Most of these have their own laws and bylaws (except Eilot), although these are likely to have little direct relevance to the RSDSC. All have a local planning committee that issues building permits.

A3.4.5 Legal Framework

Environmental Framework Legislation, Secondary Regulations and Standards

As stated above, responsibility for environmental issues is distributed among many government ministries. This is mostly because there is no single framework law that acts as an umbrella for the whole of environmental legislation. Instead, each ministry retains at least partial responsibility for regulating those areas of its mandate that have implications for the environment. Less than 10% of the legislative instruments controlling aspects of environmental management are actually under the control of the MEP.

Sectoral and Regional Legislation Relating to the Environment

The Water Law of 1959: Although this aims primarily to establish a framework for the control and protection of Israel’s water resources, it is a key piece of environmental legislation. Since it was amended in 1971 it has included prohibitions against direct or indirect water pollution, regardless of the state of the water beforehand. MEP is authorized to promulgate regulations on these issues. Other regulations promulgated pursuant to the Water Law include the following:
• Prohibitions on the rinsing of containers, used for spraying of chemical and biological substances, into water sources.

• Prohibitions on aerial spraying of chemical and biological agents for agricultural purposes near surface water sources.

• Restrictions on the use of cesspools and septic tanks; conditions for the establishment and operation of gas stations to prevent fuel leaks.

• Requirements for evaporation ponds and reservoirs.

• Regulations on the reduction of salt use in industrial water-softening processes and on the discharge of brines.

• Regulations on protecting water sources from heavy metals and other pollutants by limiting the volume of wastewater discharged from pollution sources and reducing pollutant concentrations.

• Regulations on sewage disposal from vessels, which are largely aimed at preventing pollution in Lake Kinneret.

• Regulations on the pH values of industrial sewage, which are aimed to prevent the pollution of water sources from the impacts of corrosion.

• Regulations on the use of sludge aimed at preventing pollution as a result of improper treatment of sludge.

Public Health Ordinance of 1981: This provides a framework within which the Ministry of Health can exercise its responsibility for the quality of drinking water. Regulations under this ordinance establish conditions for drilling water wells; set standards for drinking water and specify requirements for sampling and testing; and, specify the treatment required for wastewater, and list the crops suitable for effluent irrigation in accordance with the treatment level.

Streams and Springs Authorities Law, 1965: This empowers the MEP to establish an authority for a particular stream or part of a stream, spring, or other water source. The functions of such authorities include nuisance abatement and pollution prevention. Authorities for the Yarkon and Kishon rivers have been established under this law.

Business licensing regulations, 2003: Extensive use is made of the Licensing of Businesses Law to implement requirements on industrial effluent treatment in industry. Business licensing regulations on salt concentrations in industrial sewage set threshold values for chlorides, sodium, fluorides and boron on effluents being discharged to wastewater treatment plants.
Model Local Authorities By-Law (Discharge of Industrial Sewage into the Sewage System), 1981, sets requirements on the treatment and disposal of industrial sewage into the sewage system.

Abatement of Nuisances Law of 1961: This is the principal legislative instrument for controlling air pollution. The law states that a person shall not cause pollution of the air if it disturbs, or is likely to disturb anyone nearby. In a similar manner, the law deals with odour nuisances. The law authorizes MEP to promulgate appropriate regulations. A comprehensive Clean Air Law will come into effect in January 2011. This law will replace the provisions on air quality in the Abatement of Nuisances Law.

Protection of Sensitive Areas and Endangered Species

The National Parks, Nature Reserves, National Sites and Memorial Sites Law, first enacted in 1963 and revised in 1992 and 1998, provides the legal structure for the protection of natural habitats, natural assets, wildlife and sites of scientific, historic, architectural and educational interest in Israel. The 1998 law established a united Nature and National Parks Protection Authority, to replace the previously separate entities of the Nature Reserves Authority (NRA) and National Parks Authority (NPA).

The law provides the Authority and its organs with a wide range of administrative and enforcement powers which include: declaration, establishment and maintenance of nature reserves and national parks; declaration of fauna and flora outside the confines of nature reserves as ‘protected natural assets’; appointment of inspectors; and administrative powers to prevent harm to and to protect natural assets. A National Parks, Nature Reserves and National Sites Council, composed of all relevant stakeholders and appointed by the Minister of the Environment, advises the Authority and the relevant ministers on matters related to implementation of the law.

Israel’s National Parks, Nature Reserves, Memorial Sites and National Sites Law of 1992 relates, inter alia, to the declaration of ‘protected natural assets’, defined as flora, fauna or minerals, which, in the opinion of the Minister of Environmental Protection, are valuable for protection and are at risk of extinction. The law prohibits destroying, possessing or trading in these protected natural assets.

The new declaration updates the initial list of protected natural assets that was published in 1979. Scientists in the Nature and Parks Authority in cooperation with academic experts prepared the updated list on the basis of many years of scientific surveys and research, including the information compiled for Israel’s Red Data Book on vertebrates and its Red List of wild plants. The entire Red List of endangered plants in Israel (some 400 plants) has been added to the new declaration. The list is based on five major criteria: rarity, extinction rate and habitat vulnerability, attractiveness, endemism and peripherality.
Protection of nature is also reflected in the National Masterplan for National Parks, Nature Reserves and Landscape Reserves and the National Masterplan for Forests and Forestation. Together with environmental impact assessment regulations, these laws and masterplans are the basis of a preventive policy whose goal is to anticipate and prevent land use and development activities that threaten to harm Israel’s natural habitats and/or its biodiversity.

Biodiversity conservation is a central aim of the Israel Nature and Parks Authority. Policy documents published by the Science Division of the Authority (Shkedy and Sadot) propose that in order to conserve biodiversity, the Authority should act on two levels:

- To promote the conservation of rare species and threatened species and ecosystems that represent the biodiversity of nature in Israel, especially aquatic ecosystems and sand and kurkar ecosystems along the Mediterranean Sea; and

- To promote the preservation of large and continuous areas (corridors) that allow the well-being of large populations that exchange genetic material with neighbouring populations.

Ecological corridors are proposed in order to connect statutorily protected spaces and open spaces and may thus connect different types of open landscapes including nature reserves, forests, agriculture and rural settlements. The idea is to direct building and development to spaces outside these corridors and to encourage countryside recreation and open agriculture in corridor areas that are not protected statutorily, while taking account of protected areas. The corridors would provide conduits for the passage of animals and plants in a fragmented landscape.

Based on comprehensive surveys of open spaces in Israel, four major axes were recommended for protection as ecological corridors, preferably within the framework of biosphere reserves, one of which is the Syrian-African Rift Valley, a unique biological and geomorphological unit that should be preserved, preferably in cooperation with the Kingdom of Jordan.

**Land Use**

**Planning and Building Law, 1965:** The Planning and Building Law of 1965 established a comprehensive framework that regulates all building and land-use activities in Israel, public and private, within a three-level hierarchy: national, regional and local. It vests development rights in the state so that public and private developers cannot build without the state’s permission. The planning process has provided for the incorporation of environmental considerations into sectoral master plans, national, regional and local plans as well as major development projects.
Planning and Building Regulations (EIA), 2003: These are aimed to incorporate environmental considerations in early stages of the planning and decision making processes and to incorporate sustainable development principles into planning. The regulations, are based on the experience gained in Israel over the past two decades and on a review of EIA systems in other countries.

Israel’s regulations call for EIAs to be prepared according to guidelines prepared by the MEP. The ministry invests special efforts in the preparation of appropriate plan-specific guidelines to ensure that the EIA, when submitted, will be a useful tool to decision makers. It is believed that specifically tailored guidelines produce useful reports that are not marred by generalized, irrelevant data.

The EIA must include five chapters, as follows:

- Description of the environment to which a plan relates prior to plan implementation;
- Presentation of alternatives and specifications of the reasons for preference of the proposed site;
- Description of the plan and of the activities resulting from implementation of the proposed plan;
- Assessment of anticipated environmental impact and the means necessary to prevent or abate negative impacts; and
- Conclusions and recommendations for integration in the regulatory provisions of the plan.

EIAs are required by the planning authorities prior to approvals for land use. MEP experts evaluate each EIA and issue an opinion that includes a summary of the main findings of the EIA, conclusions and recommendations for the planning authority. When the plan is deposited, both the EIA and the ministerial opinion are open to the public along with the plan documents.

Master Plans: Some 30 comprehensive and sectoral master plans determine policy and designate land use on a national level. Sectoral master plans relate, inter alia, to engineering infrastructure including electricity production, water, sewage and desalination, transport of natural gas and liquefied petroleum gas (LPG); and natural resources including national parks and nature reserves, forests and coasts, tourism and recreation.

Guidelines on Environmental Planning: A compendium on planning principles that focuses on plans for residential and industrial areas, gasoline stations, tourism, national infrastructures, mixed uses, earthworks and landscape rehabilitation, and drainage systems for rivers.
Land Acquisition

Israeli land acquisition, possession and ownership laws have been shaped by the legacy of the different laws systems of the Levant region in the last century – namely the Ottoman, the British and the Israeli law. The Jewish National Fund (JNF) was created, to purchase land for the resettlement of Jews. With the establishment of Israel in 1948, the government took responsibility for the state-owned lands and property formerly belonging to Arab refugees. The government transferred some of this land to the JNF and retained the rest.

In 1960, the Israeli parliament passed the ‘Basic Law Israel Lands’ earmarking both government-owned and JNF-owned land both as ‘Israel lands’. It reiterated the principle that these lands would only be leased, not sold (to anyone). Also created in 1960 was the Israel Land Administration (ILA), which administers all Israeli lands.

Today 80.4 percent of the Israeli land is owned by the government, 13.1 percent is privately owned by the JNF, and 6.5 percent is evenly divided between private Arab and Jewish owners; meaning the ILA administers 93.5 percent of the land in Israel.

The four most commonly used laws in the Israeli with regards to land acquisition are as follows.

- **The Land (Acquisition for Public Purposes) Ordinance of 1943;** originally written under British mandate, then annexed by Israeli legislation, the ordinance establishes the legal framework for confiscation of lands for government and public purposes.

- **The Land Acquisition Law, 1953,** sets the legal framework in which land is acquired by the state for purposes of “essential development, settlement or security”.

- **The Israel Land Administration Law, 1960,** mandates the Israeli Land Administration (ILA) to act as a manager of all public (state-owned and other) lands amounting for the mentioned 93.5% of all available land in Israel (1).

- **The Planning and Construction Law of 1965** sets the parameters under which confiscation of land for public use purposes will (or will not) be compensated by the state. Generally, the acquisition of land by the state for development purposes in the public interest requires that:

  - The Minister of Treasure or a public authority on his/her behalf – endorses the land acquisition and the public interest;

(1) This does not apply to the West Bank, in which the land is managed by the Supervisor of State Property in with cooperation with the Ministry of Defense.
• The ILA negotiates the acquisition of the land from its owner(s). Compensation or a land offset is offered in exchange for the land required by the state;

• If neither compensation nor a land offset are accepted by the owner(s), the minister can exercise his/her authority to confiscate the land in the public interest and impose compensation as prescribed in the Planning and Construction Law. However, the Planning and Construction Law does not always foresee fair and adequate compensation;

• The landowners have the right to appeal to the Israeli High Court of Justice in case they believe that the ILA/minister’s decision was arbitrary or the process itself was flawed.

Resettlement

Israel’s experience of resettlement has been mixed due to the difficult circumstances in which much resettlement has become necessary. In principle, the current planning policies acknowledge the community should take part in the resettlement process. It is now common to have active Public Participation Programmes that enable the planners and public officials to identify knowledge gaps and diffuse tensions in advance. In addition, the state has experience of offering compensation for simply withdrawing an ownership claim, even without proving an actual ownership in courts. This policy has been very effective - albeit controversial - in settling land claims outside court.

Required Permits, Approvals

The planning hierarchy in Israel consists of 3 levels: the national, the regional and the local. Each level contains specific planning mechanism requiring a specific level of detail. The most important license required by the RSDSC will be a building license. An application for this could be submitted at any of the three planning levels as long as it contains the appropriate detail, as set out in the EIA regulations. Additionally, if the proposals necessitate changes in higher level plans there would be an approval procedure for the change.

A3.5 PALESTINIAN AUTHORITY

A3.5.1 Introduction

The area of the Palestinian Authority that may be affected by RSDSC has been subject to a number of legal systems in recent history, each of which has left traces that may be applicable to aspects of the RSDSC, particularly with regard to topics not fully covered by more modern legal instruments. Ottoman rule of the region was succeeded by the British Mandate in 1919. Britain evacuated
the Palestinian Territories in 1948 and the area became managed by the Jordanian government, which incorporated the area into the Jordanian national and local governance framework. In 1967 the area was militarily occupied by Israel and subject to Israeli Civil Administration, which was modified in 1995 by the Oslo Peace Accord.

Therefore, several differing legal systems have been applied to the area in rapid succession, which may be characterised as follows:

- Ottoman ‘Civil Law’;
- British Mandate legislation (1919 to 1948);
- Jordanian legislation (1948 and 1967);
- Israeli Military orders and Civil Administration (1967 to present);
- Oslo I and II Agreements (1993 to present); and
- Palestinian Authority legislation (1995 to present).

### A3.5.2 International / Bilateral Conventions, Treaties and Agreements

#### The Oslo II Accord

The Israeli – Palestinian Interim Agreement on the West Bank and Gaza Strip of 1995 (Oslo II Accord), transferred powers and competencies to the Palestinian Authority to undertake environmental management activities in the West Bank and Gaza Strip (Article 12 of Annex I).

The Oslo II Accord created three territorial zones in the West Bank:

- **Areas A**, where the Palestinian Authority has responsibility for civil affairs and internal security;
- **Areas B**, where the Palestinian Authority assumes responsibility for civil affairs for Palestinians, while Israel controls internal security; and
- **Areas C**, where Israel maintains exclusive control.

In addition, Israel also exercises exclusive control over borders, external security, Jerusalem and the settlements. The institutional remit of the PA is restricted in accordance with these agreements.

Under the accord, Israelis and Palestinians agreed to cooperate, on the basis of mutual understanding and shared responsibility, in virtually all areas of environmental protection. Of particular relevance to RSDSC, the parties agreed, pursuant to their environmental and developmental policies to:

- prevent damage to the environment and take measures to ensure that activities in areas controlled or managed by one party do not cause environmental damage to areas controlled or managed by the other party;
• adopt, apply and comply with internationally recognized environmental standards concerning emissions and effluents;

• prevent uncontrolled discharge of wastewater and effluents to water bodies and promote proper treatment of wastewater, solid and hazardous wastes;

• ensure that a comprehensive environmental impact assessment (EIA) is conducted for all major development programmes specified in the Accord;

• take precautions to prevent water and soil pollution as well as other environmental safety hazards;

• cooperate in the implementation of internationally accepted principles and standards of global environmental concern, such as protection of the ozone layer, endangered species of fauna and flora, conservation of migratory species, and preservation of existing forests and natural resources; and

• develop jointly a mechanism for mutual notification and coordination to respond to events or accidents likely to generate environmental pollution, damage or hazards.

To ensure effective collaboration on the environmental issues identified, the parties established a Joint Environmental Experts Committee (JEEC) and other environment-related collaborative committees, eg the Joint Water Committee. These committees met and cooperated well until the outbreak of the second intifada in September 2000. Most of the formal environmental cooperation has effectively been suspended since that time, although the Joint Water Committee continues to meet.

Other International Conventions and Treaties

Article 77 of the Palestinian Environmental Law stipulates that international conventions, where Palestine is a signatory party, are considered as a complementary to law provisions being in force in the PA. The PA has signed the major international environmental conventions; however, since the conventions apply to sovereign states, the PA has observer status pending final resolution of the peace process.

A3.5.3 Institutional Setting

Introduction/General Policy Direction

A Palestinian Environmental Strategy (PES), was published in October 1999. The PES was later developed into a National Environmental Action Plan (NEAP) and supplemented with an Environmental Assessment Policy. The Environmental Assessment Policy, together with the NEAP, has, inter alia, the following goals:
to conserve the social, historical and cultural values of the Palestinian people and their communities;

• to ensure an adequate quality of life, health, safety and welfare for the Palestinian people;

• to preserve natural processes;

• to maintain the sustainable use and the long-term ability of natural resources to support human, plant and animal life;

• to conserve bio-diversity and landscapes;

• to avoid irreversible environmental damage from development activities; and

• to ensure that the basic needs of the people affected or likely to be affected by a development activity are not jeopardized.

**Israeli Civil Administration**

The Civil Administration is part of the Coordinator of Government Activities in the Territories (COGAT), which is a unit in the Israeli Ministry of Defence that engages in coordinating civilian issues between the Government of Israel, the Israel Defence Forces, international organizations, diplomats, and the Palestinian Authority. It is based in Tel Aviv.

The Civil Administration has its headquarters in Beit-El with District Coordination Liaison offices (DCL) in each of the major districts of the West Bank, and one for the Jerusalem periphery area. The DCLs control development of lands in Area C. Any construction planned in these areas must have approval of the DCL, which may call for and administer an EIA process that conforms to Israeli law.

**Ministry of Environment / Environmental Quality Authority**

After the establishment of the PA, environmental responsibilities were gradually consolidated into a Ministry of Environmental Affairs, formed in 1999. In 2002, the Environmental Quality Authority (EQA) was established by presidential decree to inherit the Ministry, with the same powers and mandate.

The responsibility of the EQA is to promote a sustainable environmental development of the Palestinian society. It should ensure that environmental goals are met by the development of the policy, legislation and environmental planning, monitoring, licensing and enforcement.
The EQA is responsible for the implementation the Environmental Assessment Policy and, therefore, for the approval and assessment of environmental considerations in relation to proposed developments. It is also responsible for developing standards, norms and guidelines for creating environmentally sustainable conditions.

The EQA coordinates its activities closely with the Ministry of Health in the setting of standards related to the conservation and protection of the environment, including the following:

- disposal of treated sewage and untreated industrial waste waters; and
- disposal of brine from the desalination plants.

**Other National Level Bodies**

**The Palestinian Water Authority:** The Palestinian Water Authority (PWA) is responsible, according to Law No.2/1996, for management of the available water resources in the Palestinian Authority and to achieve the balance between available water and the needs of the Palestinian people in the present and the future. Therefore, the PWA conducts strategic planning of water resources and has the authority to develop, enhance and allocate the water resources among the various sectors and water user groups.

The role of PWA encompasses:

- Environmental Regulation: aims at controlling the utilization of water resources and wastewater disposal and/or reuse in a sustainable manner and optimizes the benefits;

- Water Quality Regulation: aims at controlling the drinking water quality by setting standards for the service providers in line with the requirements of the Ministry of Health (MOH);

- Economic Regulation: aims at reviewing the tariffs for water, ensuring a balance of affordability and cost coverage.

The other major institutions functioning at national level and related to the EIA process are specified in the Palestinian Environmental Assessment policy, Article 6 and include the following:

**Ministry of Planning (MOP):** The MOP took the initiative to develop an (Emergency) Natural Resources Protection Plan through their former Environmental Protection Directorate (EPD) and the Regional Development Plans through their Directorate for Urban and Rural Planning (DURP). The EDP has now been absorbed by the EQA. The development objectives of MOP are to:

- institutionalize the strategic planning process at the national level;
• support the participation of the all ministries and agencies of the PNA in the preparation and implementation of the three - five years plans ‘Palestinian Development Plan’;

• coordinate the development at the national level between environment, socio-economic and physical sectors in a sustainable manner; and

• coordinate donor funds.

Ministry of Local Government: Historically, local governments have been the cornerstone of Palestinian public governance and are key providers of public goods and services in the West Bank and in Gaza. Municipalities have traditionally well-established service delivery and regulatory functions including electricity, water supply, sanitation, solid waste management, local roads, libraries, parks and recreation facilities, slaughterhouses, markets, land use planning, building and development approval and business and professional licensing.

Ministry of Health: The MOH pays an important role in the water industry regulation. This covers setting the standards, which are related to the public health such as:

• drinking water quality;

• disposal of treated sewage in bathing waters;

• disposal of treated sewage in environments which affects the quality of some products like fish;

• treated wastewater reuse for irrigation, which may affect the agricultural products;

• disinfection and drinking water storage.

Environmental Health Department: EHD is a central department in the Ministry of Health. One of the main objectives of EHD is promote research and information exchange related to health and environment (water, air, hazardous waste, vectors, and toxic materials).

Ministry of Agriculture: The Ministry of Agriculture plays an important role in managing the agricultural resources in the Palestinian Authority. Its objectives and functions are, inter alia, as follows:

• establishing cooperation with the Palestinian Water Authority to achieve rehabilitation of water sources, their protection from pollution, and promotion of their rational and economic use for agricultural production;
• enacting legislation controlling the expansion of urban areas at the
affecting agricultural areas and to ensure sustainable development;

• establishing methodologies for conservation of biological diversity and
for sustainable use of resources by utilizing legislation, rules, procedures,
budgetary allocations and other regulatory measures;

• promoting public awareness concerning the advantages of biodiversity
nature conservation and sustainable development.

Ministry of Labour: The Ministry of Labour has a Department of
Occupational Safety, responsible for:

• performing periodical visits to work places and giving instruction
regarding workers and equipment safety;

• monitoring chemical, physical and biological impacts on workers
otherwise affected people; and

• keeping records and monthly reports.

Energy Authority: The objectives of the authority, inter alia and here relevant,
are to further develop existing electricity generation sources and to develop
new sustainable and cost-effective sources, minimising the emission of air
pollutants. This can be achieved by full adoption of the actions specified in the
National Environmental Action Plan to protect human health and the
environment.

Ministry of Tourism and Antiquities (MoTA): The ministry has, inter alia,
the following responsibilities:

• to protect antiquities;

• to work with other institutions in establishing specialized programmes to
protect ancient sites, cemeteries and monuments.

Ministry of Public Works and Housing (MPWH): The relevant main
responsibilities of the Ministry of Housing and Public Works are:

• to complete and upgrade the infrastructure required for economic
development and social activities and to improve the quality of public
buildings;

• to ensure the use of high-quality construction materials to improve safety
standards; and

• to concentrate on issues that has a direct impact on the environment such
as air pollution and wastewater treatment and disposal.
Ministry of Religious Affairs: The ministry is responsible for management of the religious issues in the West Bank and Gaza Strip. Ministry approval of the use of (Islamic) Waqf lands (1) land for public use is required. They may rent the land or agree on the use terms with the competent authorities who then issue the licenses needed. Some of these lands may be rented out to other ministries to implement a public facility, so in the case of RSDSC, a long term lease could be established between the MRA and the project authorities to use Waqf designated land. This would not apply to Christian Waqf land for which the relevant Churches would have to be consulted.

Land Registration Department: The Land Registration department documents the ownership of land and property and collects property taxes.

Sub-National Administration

Governorates: The Palestinian Authority areas that may be directly affected by the RSDSC are within the Governorates of Bethlehem, Jericho and Jerusalem. The areas of Bethlehem and Jerusalem that could be affected are, however, within Area C, so most attention will be given to Jericho.

The national administration and institutions (above) have directorates at the regional governorates at working level. They represent the Ministry and assume functions on regional level in the respective governorate.

For example, the EQA has regional offices in all six West Bank regions and one in Gaza. Effectively, the regional governorates support their respective local councils in their planning and implementation of planning efforts and submit required documentation on behalf of their municipalities to the relevant national institutions and Ministries.

Local Administration: Municipalities and Village councils are the local authorities in charge of managing and deciding on all issues within their jurisdictions. According to the Local Authorities Law No 1/1997, municipalities were given full authority to manage and decide on all issues related to the provision of services within their areas including the provision of licenses. They receive support from the regional governorates.

Joint Service Councils (JSCs): JSCs may be established under the Local Government Law of 1997 to take charge of affairs that concern more than one municipality, or of affairs outside the boundaries of municipalities (such as waste dumping sites, etc).

(1) Waqf land ownership has a special status under Ottoman land laws that were continued under British and Israeli law. Waqf land is land under religious or family trust. Waqf land in mandatory times was administered by the Supreme Muslim Council. Though it was theoretically inalienable, the Jewish Agency had acquired tracts of Waqf land during Ottoman times.
A3.5.4 Legal Framework

Environmental Framework Legislation, Secondary Regulations and Standards

The Palestinian Environmental Law of 1999 is a framework law that sets out the objectives and mechanisms for protection of the environment. It also indicates which bodies should set standards, enforce the law and monitor compliance. For example, Article 5 mandates the protection of water, land and air against any pollution; Article 19 requires that adequate standards should be maintained to eliminate air pollution from any project or industry; Articles 5 and 44, ensures the protection of the cultural heritage. The necessary secondary legislation (regulations, standards, guidelines) are, however, for the most part, still under preparation.

There is a Draft Environmental Assessment Policy that describes clearly how major developments should be assessed. The form of EIA under Palestinian Policy is similar to that of the World Bank (see details above). It requires a comprehensive EIA for projects likely to have significant impacts and an Initial Environmental Evaluation (IEE) for projects where significant impacts are uncertain, or where compliance with environmental regulations must be ensured. Completion of an IEE may necessitate the conduct of a comprehensive EIA.

Responsibility for the implementation of the EAP lies with the EQA (Article 5). The EAP also requires the EQA to establish and manage the required implementation & compliance procedures, providing advisory and technical guidance to affected parties and establish procedures to monitor and evaluate the implementation of the policy. The EQA is entitled to charge a fee for reviewing and considering the Environmental Approval of a particular project.

The issue of Transboundary Environmental Impacts is dealt with in Article 9 of the EAP and refers to projects inside or outside the Palestinian Authority that potentially have a wider Environmental Impact than the national level. This is the case for transnational projects such as the RSDSC. Article 9 provides for the negotiating of reciprocal agreements between the Palestinian Authority (represented by the EQA) with neighbouring countries to ensure that the EA conducted help to mitigate any adverse environmental effects. The agreements to be concluded by the Palestinian Authority in this respect must be consistent with the principles set-out in the Espoo Convention.

In addition, Article 77 of the Environmental Law provides that all international agreements and conventions, to which Palestine is a party, are considered applicable in Palestinian Territory. However, the implementation of such conventions is difficult because of the current political situation.
**Sectoral and Regional Legislation Relating to the Environment**

The Jordanian Tourism Law No 45 /1965, which is still applicable in the Palestinian Areas on the West Bank, provides under Article 4 for the protection and maintenance of cultural and archaeological sites. The Criminal Law No 16 /1960, Article 443, considers causing any damage to the cultural and historic sites as a crime that may be penalised with fines or even imprisonment.

**Protection of Sensitive Areas and Endangered Species**

**Natural Habitats (protected areas):** Environmental Law, Articles 2, 40 and 44 and Agricultural Law No 2 /2003, Articles 9 and 13 ensure the protection of nature reserves and protected areas. Water Law No 3 /2002, Article 7 also defines areas that are sensitive in terms of water resources and prohibits certain activities potentially causing harm. These laws encourage both the EQA and the Ministry of Agriculture to coordinate among them and with other relevant competent Authorities, in order to ensure the preservation and protection of nature protection areas.

The implementation of such laws may be difficult due to the fact that most of the nature reserves and protected areas are located in area ‘C’, which is completely controlled by Israel. Accordingly, the regulations that are still legally valid in the West Bank are the Israeli Military Orders issued prior to Oslo Interim Agreement and even continued after Oslo, which include the following:

- Military Order on the Conservation of Nature (Amendment No. 19) (No. 1119) in 1984;
- Military Order on the protection of nature (Amendment No. 18) (No.894) in 1981;
- Military Order on the protection of natural areas (Amendment 15) (West Bank) (No. 803) in 1979;
- Military Order on the protection of natural areas (Amendment 7) (West Bank) and (No. 554) 1974;
- Military Order on the protection of natural areas (Amendment No. 2) (West Bank) and (No. 415) in 1971;
- Military Order on the protection of natural areas (West Bank) (Amendment) (No. 402) in 1970; and

**Endangered Species:** Articles 41, 42 and 43 of the Environmental Law provide the legal provisions to protect the biodiversity, define the species that needs to be protected and prohibits the hunting of some animal and bird species.
**Land Use**

Article 6 of the environmental Law No 7/1999, dictates the need to prepare land use policies in a way protecting natural resources and sensitive areas. Article 17 empowers the EQA in cooperation with the Ministry of Agriculture, to change the land use in order to prevent soil erosion and desertification. In addition, The Natural Resources Protection Plan was adopted by the Higher Planning Council, which has the authority to adopt and implement regional plans with accompanying regulations under the city, village and Building Law No 79 Articles 15 to 18 and 27.

The purpose of the Natural Resources Protection Plan is to protect the most valuable environmental and natural resources, including water recharge areas, surface and groundwater, agricultural areas, forests, cultural heritage areas, biodiversity, and landscape, from undesirable land use, pollution and development, with the aim to facilitate sustainable socio-economic development and to preserve and create the best environmental conditions.

The Protection Plan consists of two legal documents: The protection Plan Regulation and the Land Use Zone Map. The Protection Plan is valid for A, B, and C areas according to Oslo II Agreement. Built-up areas are exempt from the Plan, with the exception of cultural heritage issues, which will, are protected by the Plan in all areas.

**Land Acquisition**

The valid law is the (former) Jordanian Law; no laws related to land acquisition have been issued by the Palestinian Authority. The following system applies:

Land Ownership is registered in the land registration department. Each governorate has such a land registration department, which identifies the owners of a respective land. Some of the registry entries are computerized; others are hard copies and maps.

If Land needs to be acquired a ‘Condemner’ attempts to sequestrate ‘condemned property’. These terms have the following meaning:

- **Condemners**: The Government, any municipal or local council, or any private body such as a company, organization, society or individual implementing or attempting to implement a project each is called a ‘Condemner’.

- **Condemned property**: Land including any fixtures, any portion of the sea, coast or river including the right to freely manage and benefit from the property is referred to as ‘condemned property’.
The Land Acquisition Process undergoes a series of steps and actions; these are (in this order):

- publication of a notice in the Official Gazette clearly announcing the intent of putting a request to the Cabinet (Council of Ministers) related to the acquisition of property strictly for public use (public interest), allowing for a period of 15 days to launch any appeals;

- if the Condemner is a Governmental body or a municipal/local council it has the right to acquire one-fourth of the land area without compensating the owner;

- after the expiry of the announcement period, the Condemner files an official request to the Cabinet appending a site map for the condemned property and providing adequate evidence of the ability to implement the project;

- the Cabinet returns its ruling to the Chairman of the Palestinian Authority which assumes the role of the Jordanian King (as stipulated in Law No. 5 Transfer of Power and Authorities of year 1995);

- the Condemner submits copies of the ruling to the ‘Registrar of Titles’ for the persons to be notified (the land owners) and a list of their names. The Registrar in turn informs the land owners of the ruling and its consequences;

- after the ruling has been distributed, the Condemner submits a copy of the documents with a map indicating the condemned land. Any other transactions concerning the condemned land are forthwith frozen;

- the Condemner then purposes an offer to purchase (or lease) the property from the (former) owner.

**Compensation:** If the compensation negotiations are unsuccessful, the Condemner/owner may proceed with filing a formal complaint. The Court must (*inter alia*) take into consideration the following.

- The value of the land parcels adjacent to the condemned land that are of the same type.

- Just compensation is to be determined on the basis of the fair market value of the condemned land if it were to be sold on the date of first publishing the notice.

- When estimating leasehold fees to be paid to the owner, the Court approximates the yearly rental at the time the official notification is made.
• Any reduction in value of parts of the land that are not acquired must be valued and the owner should be compensated accordingly.

• The accrued amount is only paid to those concerned after the Registrar of Titles issues a certificate confirming that no mortgage obligations or other titles are held against the land or property.

Finally, after the compensation has been paid to the (former) land owners and to the State Treasury, regardless of whether the amount has been agreed or has been estimated by the Court, the title deed to the property is transferred to the Condemner by the Head of Land and Survey Department.

**Resettlement:** There is no regime for resettlement.

**A3.5.5 Required Permits, Approvals and Licenses**

Environmental Law No 7/1999, Articles 46, 47 and 48, empower the EQA to issue licenses for any project that may have negative impacts on the environment and also calls for other relevant bodies not to issue licenses without the prior approval of the EQA. The Water Law No 3/2002, Article 7, gives the PWA the right to license any water related activity or project at national level.

If the project is implemented within the jurisdictions of a local authority (municipality or local council) then a local license must be obtained. If the project is passing through Waqf, land the Ministry of Religious Affairs is the competent licensing authority that should provide the license.

In area ‘C’ and in accordance with the Oslo II Accord, to implement a project, a license should be obtained from the Israeli Civil Administration. The later have issued a new military order in 2001 related to the conduct of environmental impact assessments for projects that will be implemented in area ‘C’.

**A3.6 Overview and Consideration of Regional Policy and Administrative Framework for RSDSC**

**A3.6.1 Preamble**

The RSDSC Project is a venture that concerns three beneficiary parties: Jordan, Israel and the Palestinian Authority. Most of the structures and sites will be on Jordanian territory, though (depending on the final Scheme design) some may fall in other jurisdictions. At the time of drafting this report, the routes on all three territories have not been defined and the sites of the structures such as the desalination plant, pumping stations, etc have also not been defined.
Some of the issues addressed by the legal analysis might therefore not be applicable if, for example, routes are chosen that will not affect indigenous people. Nevertheless, this report assumes that to an undefined extent such groups and habitats are affected and outlines the applicable legal framework for environmental and social management of potential impacts in all three beneficiary parties. Any shortfalls are identified vis-a-vis good international practice, which is predominantly World Bank policy, with some local specific elements added.

Since most if not all of the structures will be located on Jordanian territory, the “main” EIA will also be on Jordanian territory, with participation of the other two beneficiary parties. The Jordanian EIA system is fully compatible with good international practice, with some minor modifications necessary to accommodate otherwise legally unprotected groups. This is not per se an omission, since Jordan has conducted a number of EIAs and has frequently adjusted procedure to accommodate good international practice.

The involvement of the other two beneficiary parties to the EIA taking place under a Jordanian jurisdiction will be crucial. Clearly, both of the other beneficiary parties may conduct EIAs to assess the scheme elements within their boundaries, depending on the magnitude and type of any such structures.

Even if there are no structures apart from those in Jordan, given the legitimate interests of other beneficiaries in the Red Sea and the Dead Sea and the expectations of good international practice, close involvement of the other two beneficiary parties (Israel and Palestinian Authority) into the Jordanian EIA will be required. There are ample entry points and examples for bilateral cooperation, which could be expanded to tri-lateral cooperation, or the existing Steering Group for this project could continue and assume a role in the EIA.

Other important points are the timing of the EIA. In all three beneficiary parties, EIAs must be conducted in the planning phase. Insofar, there is homogeneity. However, the timing of the planning as such needs to be coordinated, so that the planning phases begin on the beneficiary territories in a manner that allows for timely and coordinated execution of the EIAs. Jordan too will have an interest in the EIAs on the territories of the other beneficiary parties, since the outcome of any of those may well have an impact on the overall execution of the project (delays, modifications, etc). Therefore, Jordan should be involved in the EIAs, to the extent those are carried out, on the territory of the other two beneficiary parties.

The following sections suggest and outline a compatible process for all three beneficiary parties, indicate timing when the EIAs should be conducted, suggest a policy for project affected people and highlight the shortfalls of any of the jurisdictions of the three beneficiary parties. This process will be
discussed with the beneficiaries and refined as necessary during the next phase of the assessment.

A3.6.2 Compatible Process For All three Beneficiary Parties

Since the main EIA will be conducted under the Jordanian jurisdiction, main focus is on the applicable system in Jordan. However, as mentioned above, the other two beneficiary parties will most likely conduct their own appropriate clearance procedures and therefore the compatibility and coordination of these systems with each other is therefore important.

The three system are all largely in line with good international practice and have great similarities. As a result, an EIA procedure for RSDSC based on the Jordanian EIA system would be compliant in all three jurisdictions and would meet World Bank guidelines, if a few modifications and clarifications were accepted as follows.

- Institutionalisation of information sharing with the other Beneficiary Parties; for example the steering group could be used;
- Involvement of the other two beneficiary parties in the decisions making process;
- Involvement of the Jordanian side in the EIAs on the territories of the other two beneficiary parties, to the extent any decision bears a potential impact on the Jordanian side;
- Application of the World Bank involuntary resettlement policy; and
- Coordination of EIAs on the beneficiary parties territories.

In addition, the Jordanian applicable system for EIA should be clarified to the extent which public body or organisation conducts the EIA (MoE, ASEZA, etc) and based on which ‘overriding’ empowerment (enabling legislation or Prime Ministerial order).

A3.6.3 Project Affected People

If RSDSC is implemented, the residents, users and landowners of areas through which the project may pass and whose livelihood or wellbeing may be affected are Project Affected People. Most of these will be subject to the jurisdiction of a local council and enjoy the benefits of the applicable legal system. There may be, however, other groups that for either social or geographical reasons may not protected, such as indigenous people, gender related groups and other socially disadvantaged persons.

None of the three jurisdictions has a clear legal environment regarding indigenous people. All three jurisdictions have a satisfactory system for
mainstream people within the boundaries of a local council. Jordan and Israel have a proven record of developing resettlement plans, in accordance with the World Bank policy and Israel applies a special policy for Bedouins. Israel has also representatives of NGOs and women groups in the highest planning authority. The Palestinian Authority has little experience with resettlement, but has agreed to apply the policies in line with good international practice should that be required.

Regarding the acquisition and prompt and adequate compensation of land, all three beneficiary parties have an adequate system in place, where the public interest must be determined before any sequestration of land can be initiated. The Palestinian system could benefit from a reform process, since the applicable system it is based on a historic Jordanian law but has not been updated (as has the Jordanian).

None of the jurisdictions has laws or regulations in place that would contradict the respective World Bank Operational Practices. Thus, the World Bank Operational Practices that relate to these issues, OP 4.12 on ‘Involuntary Resettlement’, OP 4.10 on ‘Indigenous People’, under the umbrella of OP 4.01 on ‘Environment Assessment’ should apply.

A3.6.4 Timing of EIA

Of particular importance is the timing of EIA. All three beneficiary parties have stipulated in their jurisdictions that an EIA has to be conducted at the planning phase. In Jordan and the Palestinian Authority, this is a legal requirement and expressly so stated. The ASEZA system actually goes further and requires EIAs on an ongoing basis, during planning, construction and operation of a project.

In addition, coordination of the respective EIAs could facilitate institutionalised information sharing and help avoid duplication of work.

A3.6.5 Other Issues to be Addressed

Implementation and Enforcement

All three beneficiary parties have strong laws (the environmental law/s) but the extent to which these are supported by sub-normative legislation and enforcement capacities varies widely.

The level of effort needed for implementation and monitoring of RSDSC related environmental and social controls greatest in Jordan. In recent years, Jordan has embarked on an environmental police programme, where around 700 individuals have been trained and equipped as “Environmental Rangers”, charged with safeguarding the environment and monitoring compliance with environmental laws and standards. These form an important reservoir of skilled personnel that could be expanded for the purposes of RSDSC.
Israel too has access to good capacities; to which extent Israel will need capacities on the ground will depend on the route of the pipelines (the one to Israel and the one to the PA) and any accompanying potentially polluting structures.

The Palestinian Authority has a modern Environmental Law and has enacted Regulations for the implementation but as yet, there are insufficient human resources to fill all existing administrative positions necessary to implement the law effectively. The Palestinian Authority nevertheless manages to keep the system operational. This requires that most of the senior officers in the EQA assume more than one role, and it is unlikely that the effort can be sustained in the medium term. If the final configuration of RSDSC demands substantial input from EQA therefore, capacity development and other kinds of support will be needed.

Cooperation and Coordination

A project of this magnitude and in such a highly sensitive area, geologically and biologically as well as politically will require good and efficient international cooperation and coordination. This is required by most of the conventions and treaties listed in this report. Most of the bilateral arrangements establish some kind of cooperation body. Between Israel and the Palestinian Authority, examples are the Joint Water Committee, or the Joint Environment Expert Commission, or the committees to be set up under the Oslo Accord II (specifically asking to cooperation in environmental matters).

Between Israel and Jordan, also various cooperative bodies have been established, cooperating and coordinating their agendas in various degrees of intensity. One of the examples is the Red Sea Marine Peace Park cooperative Research, Monitoring and Management Programme.

In any event, it is recommended to build on the success of a cooperative body, involving all three beneficiary parties, for example the steering group for this project.

Other Countries

Other countries, such as Egypt and Saudi Arabia might need to be involved, to the extent that, the design and the construction of the intake has any potential for environmental damage to the Red Sea. In this case, any such activity might fall under the provisions of the Regional Convention for the Conservation of the Red Sea and the Gulf of Aden (and the protocols) and the respective council in Riyadh will have to be notified and involved.

Multiple Jurisdictions

The issue with the applicable jurisdictions is not only that three beneficiary parties are involved, but also that a variety of jurisdictions is likely to apply within the territory of each beneficiary party. It must be appreciated and
reiterated that, at the time of drafting this report, neither the routes nor locations are defined, nor are the technologies.

In Jordan the following administrations, organisations and other governing bodies claiming jurisdictions and competencies in one way or the other are likely to be directly affected:

- MoE;
- MWI;
- AZESA;
- RSCN (Dana nature reserve, and other protected and proposed protected areas);
- DZC (Dead Sea shore and possibly others);
- JVA;
- WAJ; and
- Municipalities and regional governments.

In addition, there will be a range of other governmental bodies and ministries who will be involved into this.

The way to solve this within Jordan will be either ‘enabling legislation’, similar to the one enacted for the development zones, or Prime Ministerial order and guidance on the coordination of efforts. For example, if and when the EIA will be conducted, the interests of exclusivity claiming administrations (MoE, AZESA and, to an extent the development zones) should be combined into one comprehensive effort, where the most stringent, standards should be applied, if there is a choice.

Enabling legislation could pave the way for a coordination body, reporting to the Prime Minister as does, for example, the DZC. The legislation should be of coordinative nature, with overriding principles, ensuring that any existing legislation to the counter of the (to be drafted) enabling legislation does not lead to legal challenges and undue delays of the project implementation.

The Palestinian Authority faces the zoning dilemma, with full control only over ‘A’ zones, reduced control over ‘B’ zones and no control over ‘C’ zones, settlements and military zones. In this particular case, a coordinating body with Israel should be established, to ensure effective and coordinated implementation of the efforts. However, since neither the route nor the ultimate recipient of the Palestinian water is finalised, this issue will need to be addressed once the route becomes clear and following this, the crossing of the various zones within the West Bank.
Similarly, for Israel, the issue of the applicable jurisdictions (within Israel) will become clear and will need to be addressed once the final destination of the Israeli part of the water has been identified. Should the Israeli pipeline cross areas under the control of the Palestinian Authority, then a similar mechanism as has been proposed for the Palestinian Authority will be required.

**Land Ownership**

Land ownership will need to be determined once the routing of the pipelines and the location of the structures are clear. In all three beneficiary parties’ jurisdictions, ownership is a constitutionally guaranteed right and there are multiple options for land ownership.

In Jordan, land can be owned by the public and by privates. Public can be municipal or national ownership, with the military being the owner of wide parts of the land in the rift valley. Ownership is further restricted by legal regimes, such as the banning of any kind of discharge into the Red Sea or into the nature reserves.

Jordan has a land register, which identifies the rightful owner of land and once the routing and the structure locations are clear, then a survey must be carried out and the rightful owners of the affected lands must be identified. This survey should attempt to construct the conveyance and associated structures on public land as far as is practicable.

The Palestinian Authority too has a land survey department, where rightful owners of land are identified. The problem in the areas of the Palestinian Authority are the obvious ones, lack of jurisdiction over zones B and C and the lack of enforcement (in these zones).

In Israel (excluding the West Bank), 93.5 percent of the land is publicly owned and administered by the ILA. The reminder is privately owned; consequently, in Israel full cooperation with the ILA must be sought, at an early stage to determine if and how land can be made available.

**Land Acquisition**

All three jurisdictions follow modern principles in the land acquisition, requiring public interest and offering fair and adequate compensation. The Jordanian system is probably the most modern and effective system, offering (mandatory) fair and adequate compensation, if land is nationalised in the public interest.

The Palestinian Authority has a somewhat older system, which it inherited from the Jordanians. Whilst this system has been modernised in Jordan, it has not in the Palestinian Authority. Examples of shortfalls are the timing applicable in the Palestinian Authority. It would appear that expropriated owners (if there is a financial commitment on the land) have to wait for
unduly long periods before they get compensated. This should be changed if and to the extent that private lands are concerned in the areas controlled by the Palestinian Authority and to the extent that private lands are required.

There is a reform process under way in Israel, and this is an opportunity to firmly establish the system of fair, prompt and adequate compensation. For the avoidance of doubt, this system is already applicable in Israel, but there is a law allowing to bypass this (the Planning and Construction Law from 1965). The current reform process (regarding the privatisation of the management of state owned land) could accommodate this. In any case, there is a grievance procedure in Israel and the high court can be addressed if land is expropriated unfairly or without due compensation.
A4 SUMMARY OF SCOPE OF THE ASSESSMENT

A4.1 SOURCES OF IMPACT

A4.1.1 Activities that Give Rise to Impacts

Development activities may give rise to environmental and social impacts when physical changes caused by construction, operation or decommissioning of facilities interact with sensitive aspects of the receiving environment, where the receiving environment comprises human beings and human systems plus biological organisms and biological systems.

In the case of the RSDSC there is potential for significant impacts to arise during construction and operation. Concern has also been expressed that the proposals could give rise to cumulative impacts and to induced impacts. The potential causes of each of these impact categories are described in the following sections.

The social and environmental impacts of the Project will be predicted for each relevant environmental and social topic (eg ecology, protected areas, waste etc) by comparing baseline conditions (ie the situation without the Project) with the conditions that would prevail were the Project to be constructed and operated.

The environmental and social impacts of the Project will be predicted in relation to environmental and social receptors, that is, natural resources (eg protected areas and species) and people (eg residents of communities, land use, etc).

A4.1.2 Construction Impacts

Construction of the RSDSC would be a major engineering undertaking lasting up to eight years, involving hundreds of workers and many items of heavy equipment. Depending on the character of the receiving environment, the area of land effected and the duration of the change, there may be significant social, biological and economic effects. At the current stage of design, the major aspects of RSDSC construction that will give rise to temporary or permanent physical changes in the environment include the following.

Influx of workers: Hundreds of manual workers will be needed for the construction. Recent precedent suggests that many of these will be foreign migrants who will be accommodated in temporary workers’ villages outside towns. Potential impacts arise from social and health effects (including HIV/AIDS) of locating the workers’ community amongst local residents; taking land for workers’ facilities and, effects of the wastes etc from workers’ habitations on the surrounding locations.
Use of Roads and Sea Lanes: Construction of the RSDSC will require the import of large items of machinery and equipment, which may be carried on specialised wide, slow-moving vehicles. Construction will also involve large numbers of heavy vehicle movements to transport materials and remove spoil. There is potential for congestion, safety issues, and disturbances (noise, dust, disruption of leisure activities). At the Red Sea coast, construction of the intake, particularly if it extends far into the channel, may disrupt normal shipping or movement of small boats and leisure craft.

Physical Presence in the Environment: Construction will require land for worksites, equipment and materials storage, construction of roads, parking and offices and accommodation. Some land will be vacated after construction is completed and some will be needed for the lifetime of the project. There may also be effects on landform and hydrology, due to the need to excavate, or build temporary and permanent structures.

Residues and emissions associated with activities: Construction of the RSDSC will involve much tunnelling and/or excavation with the use of heavy machinery generating noise, emissions to air, spoil, and other wastes and residues arising from maintenance of the machinery and the workforce.

Storage and use of fuel and chemicals: Apart from the land needed for storage, fuel and chemicals will be stored for use during construction. These present hazards such as fire, explosion and groundwater contamination.

A4.1.3 Operational Impacts

The principal activities that will be ongoing throughout the operation of the conveyance will be the extraction and pumping of water from the Red Sea; the mixing of Red Sea and Dead Sea Waters; the desalination of water and discharge of brine to the Dead Sea; the generation of electricity to pump desalinated water to end users; and, the transfer of fresh water from the desalination plant to end users in Jordan, Israel and the Palestinian Authority.

Each of these will give rise to the type of impact mentioned above under construction impacts. In addition, these will be impacts associated with:

- Permanent landtake;
- Risk associated with breaches or failure of the conveyance;
- Inputs needed to operate and maintain the conveyance and other facilities;
- Physical presence of the conveyance and other structures; and
- Residues and emissions associated with operation.

A4.1.4 Cumulative Impacts

Cumulative impacts are those which are not necessarily significant when considered in isolation, but may become important if, when considered alongside other activities impacting the same receiving environment, combine
to produce a more severe effect. In the case of RSDSCP the potential for cumulative impacts arises where there increased activity is predicted in areas already subject to rapid development (Gulf of Aqaba/Eilat coastal zone) or where increased pressure may be put on vulnerable ecosystems that are already significantly degraded (Wadi Araba/Arava Valley).

**A4.1.5 Induced Impacts**

Induced impacts may be experienced where the construction or operation of one development encourages the siting or growth of other developments in the same area. In the case of RSDSCP a concern are that, simply as a result of its presence, a precedent may be set for permitting more development of the Wadi Araba/Arava Valley. It may also be that greater availability of fresh water may promote development of tourism infrastructure in the Valley, especially close to the Dead Sea.

**A4.2 Key Stakeholder Concerns**

As reported in the RSDC Study’s *Phase 1 Stakeholder Consultation Report* (December 2008), public concerns during the first phase of consultation varied markedly between the three beneficiary parties. The key concerns may be summarised as follows:

**Palestinian Authority:** There were technical concerns related to the mixing of the two waters and the impacts on ecology and of seismic/flood risk in the Wadi Araba. However, most concerns related to the current lack of Palestinian access to the Dead Sea, and on Palestinian water rights and control of water resources, and on the implications of this study and the project on those.

**Israel:** By far the most consistent issue was the lack of a study of alternatives that would address whether other strategic solutions were preferable to the RSDSC. Technical concerns related to the mixing of the two waters and induced development of the desert areas. There was also interest in the governance and control of the proposed project, and in the cooperation of the three beneficiaries during the study phase.

**Jordan:** A key interest in Jordan is in the freshwater to be produced – the quantities and its distribution and allocation. There was interest in the precise route, the nature and duration of disturbance during construction, resumption of land distribution halted in anticipation of this project, local employment opportunities from this project, leakage risks, and Jordan’s role in a joint project.
Finally, previous studies, consultations with stakeholders and field work carried out as part of the current ESA scoping phase have identified the following as key issues that will demand special attention in the study.

**Impacts on Corals and the Marine Environment**

The coral reefs in the Gulf of Aqaba/Eilat represent the only areas of coral available to Israel or Jordan. They have very high biodiversity and are the northernmost reefs of this type in the world. The continuous withdrawal of seawater from the Red Sea may affect local circulation patterns and has the potential to impact the coral reefs in the north end of the Gulf. Differences in evaporation rates in the shallower parts of the gulf cause small local variations in salinity. Changes in circulation patterns may therefore change salinity over part of the reefs. Such alterations may affect the health of the coral reefs. Circulation changes may redirect inflowing water, including effluents. Any change in water quality that significantly affects algal growth, in nutrient levels for example, may in turn affect the corals.

**Impacts on the Ecology of the Wadi Araba/Arava Valley**

Impacts caused by the construction of the conveyance with the associated disturbance, landtake and influx of workers, plus the long-term impacts of the physical presence of the conveyance, which will vary with the form of the final design. The conveyance will extend for approximately 180 km through the Wadi Araba. Areas of land will be taken temporarily, for construction sites and activities, and permanently for the conveyance as well as structures needed for access and maintenance. The area includes important conservation areas and sites used by migratory birds. Recent degradation of the environment and encroachment into sensitive habitats has left the remaining areas more fragile and relatively more valuable. Any landtake inside protected areas risks fragmenting habitats beyond their capacity to persist. The effect on movement of people and animals and on east-west ecological connectivity depends greatly on the alignment and form of the conveyance. Designs with large stretches of above surface pipeline or canal present more serious ecological dangers than do solutions involving mainly tunnel.

**Impacts on the Social Fabric of the Region**

The project will create many jobs in the region, during construction and, potentially throughout its operational lifetime and beyond. Jobs will benefit the local and national economies but the presence of numerous workers additional, some of who may be non-nationals, may cause social stresses. It is expected that the project will assist the drive to expand tourism in the area and indirectly promote the construction of tourist facilities and associated infrastructure (water supply, wastewater treatment, roads, electricity supply etc). Residents of the areas are concerned variously that the social and economic character of the area will change for the worse, that traditional
lifestyles will be threatened, and that the they will not benefit fully from the economic opportunities. Particular attention will be paid to the Bedouin who are in any case struggling to reconcile tradition pastoralism with the political and natural resource constraints prevalent in the region.

**Adverse Impacts on the Dead Sea**

Impacts caused by the mixing of the Red Sea and Dead Sea Waters and, depending on the outcome of mixing and the level of the Dead Sea, the assortment of positive and negative consequences of stabilising the level of the Dead Sea on the ecological, heritage and tourism value of the Dead Sea the shoreline, the aquifers, the micro-climate and the social values.

**Impacts on Groundwater**

Under current conditions, the groundwater aquifers are being drained at an accelerated rate due, in part at least, to the falling water level of the Dead Sea. There is evidence that freshwater springs on the hill slopes around the Dead Sea have dried up due to the fall of the groundwater level. Furthermore, dewatering of these aquifers seems to result in collapse of surface and subsurface geological structures, causing numerous sinkholes and general land subsidence, with accompanying destruction of roads, culverts, buildings, etc. A major issue to be evaluated is the specific hydrogeological relationship between the water level of the Dead Sea and the behaviour of groundwater aquifers around it.

**Impacts on Archaeological and Cultural Assets**

The proposed project area has a long history of human activity and habitation. The project components could all encroach upon sites with cultural and religious significance and on sites that hosted byzantine, roman and pre-historic towns and villages, miners and travellers. The ESA will produce maps showing the most sensitive areas, but even after the selection of worksites has taken these into account sites or artefacts of archaeological significance are almost certain to be encountered during construction. Exploration be done in advance of construction to ensure that valuable cultural resources are not damaged or destroyed. Induced impacts from the Project could also have significant adverse impacts on archaeological and historical sites in the area around the Gulf of Aqaba/Eilat, Wadi Araba and Dead Sea. In addition, procedures need to be put in place to address ‘archaeological chance finds’ if buried sites are uncovered during the course of construction activities.

In addition to the above issues, the assessment will also address the general and wider impacts on:

- coastal fisheries, navigation, recreation, tourism and marine waste disposal;
• local and regional air quality and visibility – energy and traffic emissions, construction dust, and dust, aerosol and other emissions from the Dead Sea;

• carbon dioxide and other greenhouse gas emissions;

• geology, land stability and soils;

• hydrogeology, groundwater quality and use of groundwater resources;

• surface watercourse hydrology, sedimentation and erosion, water quality, ecology and uses of water resources;

• Dead Sea hydrology, limnology, water quality, ecology and uses of water resources (including therapeutic uses);

• land use and effects on communities, agriculture, tourism and industry;

• terrestrial habitats and species, including ecological connectivity;

• genetic, population and species diversity;

• material assets – buildings and infrastructure;

• landscape resources and the aesthetic/visual environment;

• local population demographics, community fragmentation and severance;

• indigenous peoples and their resources, local practices and traditions;

• public and community health and welfare;

• economic activities (including impact on commercial and subsistence agriculture, local businesses, tourism and recreation, and the Dead Sea chemical industries);

• regional development;

• natural resources – water, soils, energy and materials;

• natural hazards; and

• occupational health and safety.
PART B

Regional Environmental and Social Assessment
This part of the report assesses the regional impacts of the RSDSC (‘the Scheme’). We have defined regional impacts in accordance with The Terms of Reference (page 54) as those impacts with “broader environmental and social impacts with reference to both existing and future conditions”. The Scheme could have regional impacts as a result of the following:

- the sheer magnitude of the Scheme;
- the regional and global geo-political context;
- the unique cultural context of the region; and
- the context of severe water scarcity in the region.

In this assessment, regional impacts are those impacts of the Scheme which arise from the presence of the Scheme itself, or which have a bearing on the broader context of the region. Impacts which can be considered as arising from one particular project component, or whose extent is confined to the geographic area close to the source of impact, are considered to be project-specific impacts and are dealt with in the appropriate project-specific thematic section in Part C of the report. Impacts that have a local transboundary effect have not been considered to have regional impact solely because an effect is transboundary. A summary of Regional Alternatives, produced by a separate independent study, is also included in this section.

This part of the ESA draws on information that was available at the point of compiling this initial assessment report. Further data collection, consultation and assessment are still required in order to finalize this analysis as part of the final ESA report. Gaps where further data collection or assessment is required are clearly highlighted in placeholders within the individual sections.

The remainder of Part B is structured as follows:

- Section B2 - approach to the regional assessment;
- Section B3 - legal and policy context;
- Section B4 - regional baseline;
- Section B5 - regional impact assessment;
- Section B6 - mitigation of Regional Impacts;
- Section B7 – Regional Alternatives; and
- Section B8 - list of sources and references.
The regional assessment was conducted in parallel to the project-specific assessment, whereby thematic issues were considered at a project specific level before determining the extent to which there was a regional issue to be considered. Consultations with a number of experts in the three Beneficiary Parties were held to identify the issues that would be considered at the regional level.

The thematic areas of relevance to the regional assessment were determined to include:

- regional relations and the political context with respect to the Beneficiary Parties;
- national economies and development policies, including those related to tourism, agriculture and industry;
- the water sector, including water resource scarcity and cooperation between the Beneficiary Parties;
- the regional physical and biological context; and
- cultural heritage.

A workshop was then held with representatives from ERM, Coyne & Bellier (the FS consultants), and experts from each of the Beneficiary Parties to discuss data sources, the developing baseline and potential impacts at a regional level.

A programme of data collection and review of source material was then begun, and a description of the regional baseline was developed.

The impacts were identified and discussed with the relevant thematic experts, with occasional input from other commentators, and with reference to written source material where relevant. The list of source material used is provided in Section B7.

The assessment that follows should be regarded as provisional. Some of the thematic topics require further data collection and/or further analysis. Further consultations on all aspects of this provisional assessment will be held with stakeholders in the three Beneficiary Parties during the coming year before finalizing this discussion as part of the final ESA report.
This section will be finalized later in the assessment and presented as part of the Preliminary Draft ESA Report.
B4 REGIONAL ENVIRONMENTAL AND SOCIAL BASELINE CONDITIONS

B4.1 OVERVIEW: THE JORDAN RIFT VALLEY AND DEAD SEA BASIN

As shown earlier in Figure A2.4, the study area is centred around the stretch of the Syrian/African Rift Valley between the Gulf of Aqaba and the Dead Sea Basin. The Rift Valley runs north to south from Lake Tiberias/Kinneret in the north, through the Jordan River Valley, through the Dead Sea basin, and along the Wadi Araba/Arava Valley, until it meets the Gulf of Aqaba. Elevations in the Jordan River Valley drop from around 210 m below seal level at Lake Tiberias/Kinnaret to 421 m below sea level, at the surface of the Dead Sea.

The Dead Sea is supplied by several side wadis and springs, notably the Zarqa-Main and the Mujib on the east, and the Arogot and Tamara to the west. To the south of the Dead Sea, the valley floor rises out of the basin south of Fifa, and climbs onto the desert floor of the Wadi Araba/Arava Valley, which rises to 220 m above sea level at Gharandal, before falling again to seal level at the Gulf of Aqaba/Eilat. To the east, the valley rises into a range of hills running from north (peaking at over 1,300 m in the hills around Ajloun) to south (peaking at over 1,600 m at Ras an Naqab). These hills are primarily of sedimentary origin (limestone and some sandstone) in the north and volcanic rock (granite) in the south. To the west, the topography is less elevated, with peaks in the Palestinian Authority around 800 and 900 m. Elevations to the west of the Wadi Araba/Arava valley typically reach 400 or 500 m, with peaks of over 700 m (eg above Yotvata). The escarpments to the east and west are cut by wadis (river basins), created from the flood flows which drain from the highlands into the valley floor. Wide and dramatic alluvial fans have been formed at the mouths of these wadis. The major wadis include: Wadi Hasa; Wadi Finan; Wadi Dana; Wadi Heimer; Nahal Arod; Nahal Hazeva; Nahal Neqarot; and Nahal Hiyyon.

The Wadi Arava/Arava Valley floor is characterized by an alluvial dune-field, sandy over much of its length, becoming more stony in some areas. There is some sparse natural vegetation along the valley floor, concentrated along the paths of the flood flows from the wadis. Vegetation levels increase in the wadi entrances.

The main settlements in the study area are Aqaba and Eilat on the Gulf coast, Ein Bokek and Ghor Safi in the Dead Sea basin, and Jericho to the north of the Dead Sea. There are a number of villages dotted along the Jordanian side of the valley floor, with a number of agricultural settlements and farm areas on the Israeli side.

The rainfall varies significantly, decreasing from north to south, and from west to east. The semi-arid valley floor lies at 400 m below sea level and rises to Mediterranean climates at elevations of over 1,000 m. Annual average
rainfall varies from less than 75 mm in the Dead Sea basin to over 600 mm in Jerusalem and Salt. Average daily temperatures vary seasonally from 19 to 40°C on the floor of the valley to 0 to 30°C at Karak.

The area acts as a globally critical land bridge between Africa, Europe and Asia which supports diverse habitats of international importance, and acts as a pathway for millions of migrating birds moving between the continents each year. Because the low-lying valley floor is surrounded on three sides by higher elevations, and by the sea on the fourth, it acts as an ecological trap whereby many terrestrial species in the area are semi-isolated from other habitats and communities.

The region has historically been of strategic economic importance, providing land trade routes between Africa, Europe and Asia. In the past, the area acted as a frontier between the empires of Egypt, Assyria and Babylonia, and the Nabateen civilization grew rich from serving and exploiting the trade through the area.

The history and cultural importance of the area is significant, even on a global scale. The area contains many places and features important to the three Abrahamic religions. Jerusalem is an important site to Judaism, Islam and Christianity, and many sites in the study area are associated with important events in the stories of all three religions.

The Dead Sea itself is a globally unique site, both as the lowest place on earth, and as the saltiest natural body of water on earth. Its mineral make up has been associated with health and wellness, and tourism – health, cultural and religious - makes a very important contribution to the economies of the area. The mineral content of the Dead Sea has led to the development of industries that extract and export large amounts of minerals from the Dead Sea. The revenue from this, together with the employment provided makes them highly significant contributors to the GDP of Jordan and Israel, an issue that will be explored later in the assessment.

Until the First World War, the area was part of the Ottoman Empire. One of the dominant characteristics of the area today is the difficult political relationships between the current jurisdictions, which has geopolitical significance out of proportion to the physical and economic size of the area. This has a resulting effect on land use, water resources, and economic development. Agriculture is one of the main land uses in both the valley and the highlands, and the resulting water demands of each nation, coupled with the politically derived division and allocation of water resources makes water one of the most politically charged issues in the region.

A combination of the extraction of water from the river system, both by abstractions in the upstream catchment and by the damming of the main tributaries of the river system, as well as the process of evaporation by the chemical companies to produce the marketable minerals, has resulted in the
significant reduction of inflow to the Dead Sea, leading to an imbalance between inflow and evaporation, and causing the surface level to drop at an increasing rate.

It is within this context that the RSDSC Scheme is derived. The Scheme addresses both the growing water demands of the populations in the area, the unique cultural importance of the Dead Sea, and the need for cooperation and improved relations between the parties.

B4.2 Political Context of Sharing the Resources of the Jordan Valley

The Jordan Valley, Dead Sea Basin and Wadi Araba are now divided into a number of different political jurisdictions:

• the Hashemite Kingdom of Jordan stretches east of the lowest part of the valley;

• the western side is divided into the State of Israel, and the Palestinian Authority, which is currently under Israeli occupation, pending political settlement;

• Syria and Lebanon are riparian states with respect to the wider catchment area, but outside the immediate area of interest of this study.

Saudi Arabia and Egypt are also riparians to the Gulf of Aqaba/Eilat.

B4.2.1 Israel and the Palestinians

The relations between Israel and the Palestinian Authority and its people are complex. Following World War I, Britain was given a Mandate by the League of Nations to govern the land to the west of the Jordan River/Dead Sea, then known as Palestine. When Britain withdrew from the Mandate in 1948, the area was partitioned into two zones. Following a brief war, the State of Israel came into existence within defined borders, and the area now known as the West Bank became administered by the Jordanian government. In 1967, Israel occupied the West Bank, and the area remains under Israeli occupation.

Following the signing in 1993 and 1995 of the ‘Interim Agreement on the West Bank and the Gaza Strip’ – known as the Oslo Accords – a body was formed to oversee Palestinian interests in the West Bank and Gaza Strip. This entity is henceforth referred to as the ‘Palestinian Authority’. Other interim agreements were made, but a final political settlement was postponed to a future date.
The Oslo Accords recognized three territorial zones in the West Bank, as follows:

- Area A where the Palestinian Authority has responsibility for civil affairs and internal security;
- Area B where the Palestinian Authority assumes responsibility for civil affairs for Palestinians while Israel controls internal security; and
- Area C where Israel maintains exclusive control. In addition, Israel also maintains exclusive control over the borders of the West Bank, external security, Jerusalem (including) and settlements.

In our study area, the town of Jericho is Area A, while most of the rest of the area is Area C. A significant proportion of the international community continues to regard the West Bank as occupied, and is working with all parties to agree a peaceful political settlement to the situation.

**B4.2.2 Israel and Jordan**

After years of existing in a technical state of war, Jordan and Israel signed a Peace Treaty in 1994, and continue to hold full diplomatic relations, although economic, trade, social and cultural links remain weak and undeveloped. Annex II of the Israel-Jordan Peace Treaty deals with cooperation and technical arrangements over water resources, and a Joint Water Committee was created which meets periodically.

**B4.2.3 Jordan and the Palestinian Authority**

Jordan’s relationship with the Palestinian leadership has evolved since its disengagement with the West Bank, and Jordan now works closely with the Palestinian Authority, and supports it in its negotiations with Israel and relations with the international community. The relationship is characterized by the fact that many Jordanian citizens are of Palestinian origin.

**B4.2.4 Sharing of Resources**

Management and sharing of the physical environmental resources of the Rift Valley must be understood within this overall political context. Water, land use and agriculture are some of the key issues. The catchment of the upper Jordan is shared between Lebanon, Syria and Israel. The Yarmouk catchment (to the east and northeast) is shared by Jordan and Syria. Both these river systems run into the Jordan River, which today includes Israel, Jordan and the Palestinian Authority as riparians. In such an arid environment, where agriculture is an important political priority of each party, sharing of the water resource is a key political issue, and often a source of contention between the parties.
In the 1950s, the United States put forward the Johnston Plan as a means of sharing all the water resources of the Jordan-Yarmouk catchment. This proposal included storage facilities to control the flows of the Jordan and Yarmouk rivers and their tributaries, and proposed allocations of water between Syria, Jordan (which was also administering the West Bank at that time) and Israel. The allocation included shares from the upper Jordan, the Yarmouk, Lake Tiberias/Kinneret, and the side wadis of the Jordan River to its east and west. Subsequently, Jordan established an irrigation system feeding water from the Yarmouk and rainwater from the side wadis into an elaborate irrigation network covering most of the eastern floor of the Jordan Valley. Israel developed its National Water Carrier, which takes water from Lake Tiberias/Kinneret southwards along the populated coastal stretch of Israel, and into the southern desert. For Jordan, this allowed the transformation of the Jordan Valley into productive agricultural land, and for Israel, it supported both irrigated agriculture and supplied drinking water to the growing urban areas. One of the results of the abstraction of water from the catchment, however, was that the base flow in the Jordan River reduced significantly.

With Israel’s occupation of the West Bank in 1967, and Jordan’s disengagement from legal and administrative ties with the West Bank in 1988, control over the Palestinians’ access to water resources passed to the Israeli authorities. Since 1995, water governance in the West Bank has been subject to the Oslo agreements. A Joint Water Committee (JWC) was created to oversee management of all the West Bank’s water and sewage systems serving Palestinian communities. However, day-to-day management and operation of the systems remained with the West Bank Water Department (WBWD), a pre-Oslo entity. Supply to Israeli settlers is managed directly by the Israeli Water company Mekorot, which also operates wells within Israeli settlements. The Palestinian Water Authority (PWA) was established to be the main regulation and planning body for water supply to Palestinians. The PWA oversees and coordinates donor-funded projects. Through the JWC, Israel has a veto over new projects, and final permission for the development of wells and supply infrastructure in Area C areas still ultimately lies with the Israeli Civil Administration, with Oslo effectively putting off specifying the rights of Palestinians until the final status negotiations. The end result is that supply of water to Palestinian communities in Palestinian areas is still constrained, and is significantly less than to other neighbouring areas.

With regard to the Dead Sea itself, the Dead Sea basin is shared by three riparians – Jordan, Israel, and the Palestinian Authority. However, all of the shoreline within the Palestinian Authority area lies in Area C, which is fully under the control of the Israeli authorities, and Palestinians have little or no free access to access or develop the shoreline. Jordan has developed a tourism area on the northeast shoreline, while Israel’s tourism is centred on the southern basin at Ein Bokek, with one spa and several smaller amenities on the northern basin.
There appear to be no bi-lateral or tri-lateral agreements specifically relating to the Dead Sea. There is no cross border transport across the sea, and no meaningful cooperation on tourism or other cultural aspects of the sea, or on scientific research. Despite the interest and uniqueness, the Dead Sea is not listed as a UNESCO World Heritage site or even as a tentative site, although the basin contains important cultural sites such as Masada, Qumran, Jericho, Lots Cave and Calihero.

Extraction of minerals from the Dead Sea began in 1933, during the Mandate era. This was expanded by Israel following the 1948 war. Jordan began to develop its own extraction industry in 1956. The industry on both sides has developed intensely, and now contributes significantly to both the economies of each country, and to the overall decline in water level of the Dead Sea.

The international border between Jordan and Israel lies roughly along the lowest point of the Wadi Araba/Arava Valley. There are no east-west transit points across this border, except for the crossing at Aqaba-Eilat. However, the Jordan-Israel Peace Treaty does include provision for Israel to continue to pump from wells in the Wadi Araba/Arava Valley, which it drilled when it occupied a portion of the valley now restored to Jordanian control. Although lying within Jordanian territory, these wells are operated and maintained by Israel.

**B4.3 GEOLGY, SEISMOLOGY, LAND STABILITY AND CLIMATE**

The major physiographic zones in the study area are the Jordan Rift Valley, the Jordan Highlands and Plateau, and the Palestinian Mountain Belt. Each of these is dominated by geologic processes of tectonism and volcanism, further shaped by weathering, erosion and deposition. Geologically, the Jordan Rift is a strike-slip fault zone, which forms the northern extension of the African-Syrian rift system, and is the north-western limit of the Arabian plate. A horizontal displacement of 105-112 km since the Miocene period has been observed, with the eastern side offset northwards relative to the western side. Vertical displacement of the faults has resulted in the development of downthrown blocks or grabens, infilled with Quaternary sediments. The valley floor is a mixture of marl, clay and evaporates, with more soil, sand and gravel close to the riverbed itself.

The eastern and western escarpments of the Rift Valley consist of a layer of limestone/dolomite/marl/shale layer, which rises up from the valley floor. This which is around 300 m thick on the eastern side where it is known as the Ajloun group, and is up to 600 m deep on the western side, where it is known as the Judea group. This is underlain by the Kurnub group of sandstone/ dolomite/mark/sand/shale with some sandy limestone. Below this are limestone, dolomite and sandstone layers, all of which act as aquifers. These layers continue into the highlands on each side. Elevations are highest
adjacent to the Dead Sea basin, falling off gradually to the south, although both ranges continue to the Gulf coast.

In terms of climate, a Mediterranean-type climate characterized by a hot, dry summer and cool winter, with short transitional seasons predominates in the northern, central and western parts of the region. The eastern and southern parts of the region have a semi-arid to arid climate. Annual rainfall decreases from north to south and from west to east, and exceeds 800 mm in the far north of Israel, dropping to less than 50 mm in the Dead Sea basin, Negev desert and Wadi Araba. Rainfall in the highlands in the Palestinian Authority can reach 500 mm, and is around 300 – 400 mm in the Jordanian highlands around Karak and Tafila. An annual rainfall of less than 200 mm constrains the development of rain fed agriculture in about half the area on the western side, and 90% of the area on the eastern side. Rainfall occurs mainly during the winter, which begins around mid-November. The summer season is June - September.

B4.4 LAND USE

The predominant land use in the Jordan Valley is irrigated agriculture. Around 340,000 people live on the Jordanian side of the valley, predominantly working in agriculture. On the west, the Israeli areas to the north utilize the relatively high rainfall and flat, fertile terrain to conduct intensive agriculture. Further south in the Palestinian Authority area, the topography is more rugged and less fertile. There is some agriculture – owned by both Israelis and Palestinians - but to a much lesser extent than on the Jordanian side. The main towns in the Jordan Valley are Deir Alla, Sweimeh and North and South Suneh (in Jordan) and Beth Shan (in Israel). Other towns in Jordan include Masharee, Kraimeh, Sawalha, Muaddi and Karameh.

The Dead Sea basin is much more arid. There is an agricultural area on the Jordanian side stretching from Ghor Haditha to Ghor Fifa, which supports a community of around 40,000 people. The agriculture here is irrigated by rainwater supplied from sources in the highlands. Tourism resorts have been developed along the north-eastern coast at Sweimeh in Jordan, and at Ein Bokek on the southern basin in Israel. There are some smaller tourism facilities on the shores of the northern basin, eg at En Gedi in Israel, and Wadi Mujib in Jordan. The southern basin is characterized by the chemical works on each side – the Arab Potash Company and its associates at Ghor Assal on the Jordanian side, and the Dead Sea Works near Sedom on the Israeli side. The entire southern basin of the sea is taken over by evaporation ponds, and is effectively part of the works of these companies. The main towns in the northern basin are Jericho and the towns of South Shona and Sweimeh. The Southern Ghors area contains the Jordanian agricultural communities of Haditha, Mazra’a, Safi and Fifa.
Moving south into the Wadi Araba/Arava Valley, the area is sparsely populated, with a number of small settled Bedouin villages on the Jordanian side, and some more developed intensive agricultural settlements on the Israeli side. Moving east and west out of the Wadi Araba/Arava Valley, much of the escarpment on either side is steep, rocky terrain and is inaccessible from the valley floor, although on the Jordanian side of the Wadi Araba, some of the higher parts of the valley floor, and some of the side wadis are used for informal agriculture by local Bedouin. On the Jordanian side, once the elevation levels off onto the plain, there are some towns and villages stretching eastwards towards the Desert Highway. These areas have some groundwater resources and there are both pastoral and agricultural activities.

In the south, the towns of Aqaba and Eilat sit on the Gulf of Aqaba/Eilat coast and are both major urban centres serving both tourism and ports industries.

### B4.5 REGIONAL ECONOMIC DEVELOPMENT

#### B4.5.1 Baseline Overview

Jordan is a low-middle-income country with a small economy, important skilled human resources and limited natural resources. The country relies heavily on external resources including foreign aid, remittances from nationals working abroad and loans. Annual real GDP growth has averaged 6% since 2000 (1), supported by the implementation of sound policies and widespread structural reforms. Real GDP growth reached 5.6% (20.01 US$ billion at current $US) in 2008. Nominal GDP per capita was about 3,400 US$ (see Table B4.1).

### Table B4.1 Trends in Gross Domestic Product and Inflation

<table>
<thead>
<tr>
<th></th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP at Market Prices (US$ bn)</td>
<td>11.74</td>
<td>13.02</td>
<td>14.66</td>
<td>17.05</td>
<td>21.27</td>
</tr>
<tr>
<td>Real GDP Growth Rate (%)</td>
<td>8.6</td>
<td>8.1</td>
<td>8.0</td>
<td>8.9</td>
<td>7.9</td>
</tr>
<tr>
<td>GDP per Capita at Current Prices (US$)</td>
<td>2,561</td>
<td>2,620</td>
<td>3,027</td>
<td>2,975</td>
<td>3,630</td>
</tr>
<tr>
<td>GDP Deflator</td>
<td>118.4</td>
<td>121.0</td>
<td>130.2</td>
<td>139.0</td>
<td>160.8</td>
</tr>
<tr>
<td>Inflation (% in CPI)</td>
<td>2.64</td>
<td>3.49</td>
<td>6.26</td>
<td>4.74</td>
<td>13.97</td>
</tr>
</tbody>
</table>

*Source: Published on The Ministry of Planning and International Cooperation website http://www.mop.gov.jo Date: 2009*

The dynamics of growth of the Jordanian economy comes from services (67%) and industry (29%). Over the last decade, Jordan’s economy has seen a flattening of the service sector’s contribution to GDP and an increasing trend for the industrial sector’s contribution, while the agricultural sector’s direct contribution has decreased and is expected to remain around 3% for the coming 20 years.

(1) IMF Country Report No. 09/159, 2009 International Monetary Fund; Public Information Notice (PIN) No. 09/59, May 15, 2009
Economic activity was expected to slow significantly in 2009, reflecting the much weaker global and regional outlook. Real GDP growth was projected to slow to 3%. Average inflation will continue to decline to 4%, reflecting lower world food and fuel prices. Over the medium term, growth is expected to pick up as the global recovery sets in, eventually rising to about 5%. Inflation is projected to ease further to 2%, roughly equal to the average over the past decade.

Israel is a small advanced economy with a strong connection to the global economy. The last Israeli business cycle began with a boom in 1999–2000 and was followed by a recession as a result of the conjunction of the bursting of the hi-tech bubble and the start of the second Intifada. The cycle continued with five years of rapid growth that ended at the end of 2008 and during which the economy increased its dependency on the global trade. GDP is now around 200 billion UD (2009), which is 28,400 USD/capita, over 5 times higher than Jordan’s.

The share of exports in GDP, excluding diamonds, grew up from 12.4% in 1968 to 41.6% in 2008, reaching $56.64 billion. In 2007, most of Israel’s exports were destined for the European Union (34.47%) and North America (30.51%) with the rest going to Asia (14.95%), the rest of Europe (6.38%), Africa (3.03%) and others (10.65%). This dependency to US and EU trade became problematic with the decline of the global economy in the last 2 years, where export to the US has declined sharply. Trade with the developing-country markets has been increasing slowly, changing partially the composition of the Israeli trade reflecting the global movement, ie the declining contribution of developed countries in global GDP and the accelerated growth in the developing countries. The composition of Israel’s GDP by sector for 2008 was about 2.7% agriculture, 31.7% industry and 65.6% services.

With regard to the Palestinian Authority, following the Oslo Accords, a programme of reform and institution building was initiated. Initially, revenues mainly came from customs (collected by the Israeli authorities) and from donor support. Considerable progress was made until the outbreak of the Intifada in 2000. There was then a modest recovery between 2003 and 2005, but Palestinian economy suffered another decline in 2006, as a result of domestic and international political difficulties. Between 2006 and 2008, real GDP fell by an average of 4 percent per year, ending at around 4,650,000 USD in 2008. The rate of unemployment remains very high (about one fifth of the labour force in the West Bank and over one third in Gaza). Currently, the economic development in the Palestinian Authority is heavily influenced by political events.

Contributions to the Palestinian Economy are summarized in Table B4.2 below.

(1) A withdrawal of Palestinians from ‘normalization’ of economic relations with Israel, including some popular uprising, which began in 2000
(2) According to the World Economic Outlook 2008, the contribution of the developed countries to the growth in global GDP fell from a peak of about 60 percent at the beginning of the 1990s to only about 25 percent in recent years
Table B4.2  Contribution of Sectors to GDP, Palestine

<table>
<thead>
<tr>
<th>Economic Activity</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture and fishing</td>
<td>7.1%</td>
<td>5.2%</td>
<td>5.6%</td>
<td>5.6%</td>
</tr>
<tr>
<td>Mining Manufacturing Electricity and Water Supply</td>
<td>17.1%</td>
<td>17.0%</td>
<td>15.0%</td>
<td>13.8%</td>
</tr>
<tr>
<td>Construction</td>
<td>5.7%</td>
<td>6.8%</td>
<td>7.2%</td>
<td>6.2%</td>
</tr>
<tr>
<td>Wholesale and retail trade</td>
<td>9.8%</td>
<td>9.4%</td>
<td>9.6%</td>
<td>9.2%</td>
</tr>
<tr>
<td>Transport</td>
<td>6.1%</td>
<td>5.8%</td>
<td>6.6%</td>
<td>7.5%</td>
</tr>
<tr>
<td>Financial intermediation</td>
<td>3.6%</td>
<td>4.4%</td>
<td>4.3%</td>
<td>5.2%</td>
</tr>
<tr>
<td>Services</td>
<td>22.8%</td>
<td>23.0%</td>
<td>19.6%</td>
<td>22.2%</td>
</tr>
<tr>
<td>Public administration and defence</td>
<td>14.3%</td>
<td>14.1%</td>
<td>15.7%</td>
<td>13.9%</td>
</tr>
<tr>
<td>Other**</td>
<td>13.6%</td>
<td>14.4%</td>
<td>16.4%</td>
<td>16.4%</td>
</tr>
<tr>
<td>Gross domestic produce, million USD</td>
<td>4198.4</td>
<td>4559.5</td>
<td>4322.3</td>
<td>4535.7</td>
</tr>
</tbody>
</table>

Source: Palestine in Figures – 2008, PCBS, 2009-11-17

In 2007, the service sector contributed most to GDP (22.2%), with public administration and defence contributing 13.9%. Mining, manufacturing, electricity and water supply accounted for 13.81%. The importance of the contribution of the agriculture sector to GDP fell from 10% in 2000 to 5.6%. In times of difficulty, the agricultural sector acts as a buffer that can absorb large numbers of unemployed people who lost their jobs in Israel or other local sectors of the economy.

Contributions of sector to GDP will continue to be cyclically related to political issues. In such cases, it is not easy to analyse the Palestinian Authority’s economy in terms of trend. Under a baseline scenario with optimistic assumptions and policy expectations, real GDP growth is projected to increase from about 2% in 2008 to 5% in 2009, 6.5% in 2010, and 7.5% in 2011. Although trade with Israel could be affected by the global slowdown, Palestinian growth prospects are much more strongly influenced by the easing of restrictions in travel and trade. The tourism sector in particular has the potential for growth, dependant on the political and security climate. For example, the Palestinian Authority has proposed several ambitious tourism plans around the northern and western Dead Sea Shores that could be implemented very quickly once travel and access restrictions were lifted.

B4.5.2 Agriculture

The contribution of Jordan’s agricultural sector dropped from 7% of GDP in 1994 to currently around 3%. Agricultural export earnings declined by 30% between 1993 and 2003, while agricultural imports increased by about 20%. Paradoxically, the share of people working in the agricultural sector increased from 10% in 1994 to 13% 2003, illustrating that the agricultural sector is becoming less competitive. At that time, agriculture accounted for some 75% of total water consumption in Jordan. This share has since declined to about 63%.
While the sector does not currently contribute heavily to Jordan’s GDP, it is an important sector of the economy in some areas (See Table B4.3), although the only region of the Scheme area within Jordan where agriculture is a significant component is the Southern Ghors (just south of the Dead Sea, and part of the Karak Governorate). The labour market in the agricultural sector is male dominated. 84% of the workers are Jordanian family workers and 16% are hired labour. 72% of the hired workers are foreigners. The data collected does not indicate where the foreign workers come from, but they are known anecdotally to be mostly Egyptian or Syrian.

Table B4.3  Jordan: Number of Family Labour and Hired Permanent Labour in Agricultural Holdings by Nationality, Sex and Governorate, 2007

<table>
<thead>
<tr>
<th></th>
<th>Hired Permanent Labour</th>
<th>Family Labour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-Resident Jordanian</td>
<td>Non-Resident</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>Amman</td>
<td>19</td>
<td>1316</td>
</tr>
<tr>
<td>Balqa</td>
<td>13</td>
<td>6768</td>
</tr>
<tr>
<td>Zarqa</td>
<td>2</td>
<td>1549</td>
</tr>
<tr>
<td>Madaba</td>
<td>6</td>
<td>610</td>
</tr>
<tr>
<td>Irbid</td>
<td>3</td>
<td>2301</td>
</tr>
<tr>
<td>Mafraq</td>
<td>12</td>
<td>1273</td>
</tr>
<tr>
<td>Jarash</td>
<td>2</td>
<td>254</td>
</tr>
<tr>
<td>Ajloun</td>
<td>1</td>
<td>119</td>
</tr>
<tr>
<td>Karak</td>
<td>2</td>
<td>456</td>
</tr>
<tr>
<td>Tafiela</td>
<td>-</td>
<td>148</td>
</tr>
<tr>
<td>Ma’an</td>
<td>-</td>
<td>138</td>
</tr>
<tr>
<td>Aqaba</td>
<td>-</td>
<td>75</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>15007</td>
</tr>
</tbody>
</table>


To be viable and sustainable over the long-term, the sector needs to shift towards more appropriate water use and cropping patterns.

Agriculture in Israel is also important, although in 2008, the sector accounted for only 2.7% of GDP, (down from 6% in 1985). In 1995, there were 43,000 farm units with an average size of 13.5 hectares. 19.8% of these were smaller than 1 hectare, 75.7% were 1 to 9 hectares in size, 3.3% were between 10 and 49 hectares, 0.4% were between 50 and 190 hectares, and 0.8% were larger than 200 hectares. Of the 380,000 hectares under cultivation in 1995, 20.8% was under permanent cultivation and 79.2% under rotating cultivation. Agriculture was based mainly in the northern coastal plains, the hills of the interior, and the upper Jordan Valley. Nonetheless, agriculture is still of major importance in the Arava Valley and the Jordan Valley where it provides livelihood for much of the local population and it has a great cultural importance for people seeking an agrarian lifestyle. Table B4.4 summarizes the distribution of cropped areas.
Table B4.4  Agriculture Crop Areas in Israel, by Regional Council, 2006

<table>
<thead>
<tr>
<th>Total (Thousand dunums)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern and Haifa Districts</td>
<td>1 020.1</td>
</tr>
<tr>
<td>Central and Tel Aviv Districts</td>
<td>392.6</td>
</tr>
<tr>
<td>Jerusalem and Southern Districts</td>
<td>1 346.3</td>
</tr>
<tr>
<td>West Bank -</td>
<td>70.8</td>
</tr>
<tr>
<td>GRAND TOTAL</td>
<td>2 830.0</td>
</tr>
</tbody>
</table>

1000 dunums = 100 hectares

Source: Data were gathered from Central Bureau of Statistics (CBS), Israel, 2009

In 2000, approximately 72,000 people were involved in farming. The number of people involved with farming declined to 48,000 in 2008 (1), constituting about 2% of the country's workforce. Non-Israeli workers, mostly Palestinians, represent almost 26% of the workforce in Israel. Note that some of these figures may also cover Israeli-controlled agriculture the Palestinian Authority area, since not all figures are clearly differentiated.

Currently (in 2008), agriculture accounts for 4% of Israeli exports, compared to 30.3% during the 1960s. Vegetables are the main outputs, accounting for around 24% of total agricultural output. Flowers make up around 4%, field crops around 7%, fruit (other than citrus) around 16%, and citrus fruit around 5%. 38.1% of agricultural output is for domestic consumption, 35.9% for domestic manufacturing, and 17.8% for direct export. 37% of all vegetables products are exported, 12% of flowers, 16% of field crops, 8% of fruits other than citrus, and 13% of citrus fruits are exported.

Despite the decline in its importance relative to other economic sectors, (industry and services) agriculture still plays an important role in Israel, in addition to providing employment for 48,000 people. ‘Greening the desert’ and contributing to food security, were important planks of the early economy of the newly established state, and they still hold an important place in the cultural values of Israel. The kibbutz movement was established largely around agricultural activity.

There is significant agricultural activity in the Scheme area - the Arava and Sedom Valley have a population of 6,000 (2006) gathered in 8 moshavim (family-owned cooperatives) and 12 kibbutzim (community-owned cooperatives) (2). The area comprises 6% of the land area of Israel but has only 0.04% of the population. Around 2,500 hectares is used for agriculture in the Arava and Sodom Valley, most of which uses groundwater. The relative land areas used for different produce in the Central Arava and Sodom Valley in 2007/8 are as follows:

(2) Development of Desert Agriculture, UN-CSD 16, May 6, 2008, Alon Gadiel, Arava R&D, ISRAEL
• Vegetable 2,300 ha;
• Cut flowers 150 Ha;
• Fruits trees 250 Ha;
• Bio-Organic farming 240 Ha;
• Aquaculture 10 units; and
• Dairy products producers 20 units.

Future rural development and extension of the villages in the region depends on the ability to provide suitable land for new growers. Development of the area is also limited by the available water.

Agriculture is an important sector of the Palestinian Authority’s economy, generating over 5.6% of the Gross Domestic Product of the West Bank and Gaza. In times of difficulty, the agricultural sector has acted as a buffer that absorbs large numbers of unemployed people who lost their jobs in Israel or other local sectors of the economy. Statistical data from the Central Bureau of Statistics (CBS) of the Palestinian Authority indicates that agriculture’s contribution to employment rose from 12.7% in 1995 to 16% in 2006. The agricultural sector also makes an important contribution to food security for Palestinian families, and quite a number of families depend on this sector for family needs. However, agricultural production faces a number of constraints including water availability, feasibility of agricultural production, lack of infrastructure, production inputs and soil salinity. Marketing of farm products and their distribution to local and external markets is also one of the major obstacles facing Palestinian farmers. Selling Palestinian agricultural products within Israel requires special permits to be issued by the Israeli authorities. Transporting products from/to north to south in the West Bank has become difficult as well and introduces an additional cost. Movement of agricultural products between the West Bank and Gaza Strip is also subject to Israeli control. Competitiveness with Israeli produce in the local markets is also a challenge. Also, the lack of available water recently forced many farmers in Jericho district to leave their agricultural land in Jericho city and the surrounding area.

B4.5.3 Tourism

The tourism sector is an important element of the Jordanian economy, directly employing about 30,000 Jordanians and contributing 10% to the Jordan’s GDP (1). The main tourist sites are Petra, Wadi Rum, Karak and Jerash, the Aqaba region and the Dead Sea, as well as Mt Nebo and the Baptism site. Tourism in Jordan increased rapidly in the last decade, following the signing of the Peace Treaty with Israel in 1994 - the number of tourists grew at an annual average of 20% between 1993 and 1995, reaching the one million in 1995 and two million in 2002. Most tourists (some 70%) come from Arab countries or are Jordanians expatriates.

(1) According to the central bank of Jordan, tourism sector generated US$1.1 billions in the first seven month of 2009, 2.3% more than 2008 at the same period. Jordan Times, 28-08-09

Part B – Regional Environmental and Social Assessment

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Table B4.5  Number of Rooms and Hotels Available in Jordan

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of hotel rooms</th>
<th>Number of hotel beds</th>
<th>Number of tourist arrivals (1000)</th>
<th>Tourism expenditures (US$ Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>---</td>
<td>34,433</td>
<td>1,580</td>
<td>387</td>
</tr>
<tr>
<td>2001</td>
<td>---</td>
<td>37,385</td>
<td>1,672</td>
<td>420</td>
</tr>
<tr>
<td>2002</td>
<td>19,389</td>
<td>37,289</td>
<td>2,384</td>
<td>504</td>
</tr>
<tr>
<td>2003</td>
<td>19,698</td>
<td>37,859</td>
<td>2,353</td>
<td>503</td>
</tr>
<tr>
<td>2004</td>
<td>19,945</td>
<td>38,658</td>
<td>2,853</td>
<td>585</td>
</tr>
<tr>
<td>2005</td>
<td>20,827</td>
<td>40,480</td>
<td>2,987</td>
<td>653</td>
</tr>
<tr>
<td>2006</td>
<td>21,609</td>
<td>42,029</td>
<td>3,225</td>
<td>698</td>
</tr>
<tr>
<td>2007</td>
<td>21,587</td>
<td>42,140</td>
<td>3,431</td>
<td>---</td>
</tr>
<tr>
<td>2008</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

Source: Available online at [http://www.sesrtcic.org/index.php](http://www.sesrtcic.org/index.php) and Jordan Board of Tourism.

The government’s National Tourism Strategy (NTS) was developed in 2004 to guide the sector through to 2010, and aimed to double tourism revenues during the period and to increase tourism-related jobs. The strategy identified seven priorities: cultural heritage (archaeology); religious; ecotourism; health and wellness; adventure; meetings, incentives, conventions and exhibitions; and cruises. Between 2004 and 2007, the total number of people employed in the sector rose from 23,000 to 35,000 (1).

All Dead Sea tourism developments in Jordan are concentrated in Sweimeh, at the northern end of the Dead Sea. This area is a stop-off for 75% of tourists on a classical cultural heritage tour, which includes Madaba, Mount Nebo, Karak and Petra. The typical length of stay is less than 2 nights with USD 100 typical daily expenditure. The area suffers from a lack of visitor activities because insufficient effort has been made to develop markets, activities and other services (restaurants, shopping, entertainment, handicrafts, recreational equipment, etc) to retain tourists. Currently, about 1,020 four and five star rooms are available to tourists in the Dead Sea area. The Development Plan for the area (2) shows the number of rooms expected to increase to 5,500 by 2017, all committed to high-end international tourists.

(2) Jordan Valley Master, Plan Project, Phase 1, North East Dead Sea Basin, 2008. Baseline Assessment
### Table B4.6 Existing rooms and projected expansions in the Jordanian Dead Sea area

<table>
<thead>
<tr>
<th></th>
<th>Existing hotels (2008)</th>
<th>Number of rooms</th>
<th>Number of employees</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5 stars</td>
<td>901</td>
<td>1,663</td>
</tr>
<tr>
<td></td>
<td>4 stars</td>
<td>120</td>
<td>175</td>
</tr>
<tr>
<td></td>
<td>Expansion within the next 12 months</td>
<td>775</td>
<td>---</td>
</tr>
<tr>
<td>Projected (2017)</td>
<td>5 stars</td>
<td>3,303</td>
<td>5,615</td>
</tr>
<tr>
<td></td>
<td>4 stars</td>
<td>1,160</td>
<td>1,740</td>
</tr>
</tbody>
</table>


Despite developments planned in the short term in Sweimeh, supply over the next 10 years will not meet the demand, unless additional important infrastructure is developed. However, the area has now been incorporated into the Dead Sea Development Zone, under the auspices of the newly created Development Zones Commission (DZC), an act likely to increase both the investment in the area, and the degree of planning and regulation.

A Dead Sea Panoramic Complex has been developed in the eastern hills overlooking the Dead Sea, which features the Dead Sea Museum, and the archaeological site at Lot’s Cave above Ghor Safi will also contain a museum and interpretive centre, both of which will provide an additional Dead-Sea linkage for tourists. The Aqaba area is also a very important tourism destination, known for its beach and diving. There are several coral dive sites along the coastline. The area is managed by the Aqaba Special Economic Zone Authority (ASEZA), which has developed the area to increase the number of tourists. The Aqaba Special Economic Zone (ASEZ) is a 375 square kilometre area launched in 2001 as a duty-free, low tax multi-sectoral development zone encompassing the entire Jordan coastline (27 kilometres), the seaports of Jordan, King Hussein International Airport and the historic city of Aqaba. The population of Aqaba city is expected to grow from a level of around 100,000 (in 2008) to an estimated 250,000 by the year 2020.

The tourism sector in Israel is linked strongly to religious and cultural sites. In 2007, Israel’s income from tourism was 2.4 billion dollars, a 26% increase compared to 2006. In 2008, tourism accounted for around 2.5% of the GDP involving 144,000 working people in hotels and catering services. Around half of visitors to Israel come for pilgrimage and touring, while 36% come to visit relatives. From the first half of 2006 to the first half of 2007 44% of visitors were Jewish tourists, and 55% of tourists were on a return visits. Figure B4.1 breaks down the purpose of the visits.
Tourism in Israel is extremely dependant on the political and security situation. As recorded by the Central Bureau of Statistics, and reported by the Bank of Israel, the contribution of tourism services to total exports (excluding diamonds), fell from an average of 13.2% prior to the 2001 Intifada to 4.1% in 2008. The first half of 2009 showed a significant drop in incoming tourism in Israel as a result of the global financial crisis. According to the Israeli Airports Authority (Hareetz, 29/06/09), 15% fewer passengers came to Israel than in the same period in the previous year, and 22% fewer came through overland border crossings. The biggest slump was experienced at the Taba Crossing between Israel and Egypt, where 38% fewer passengers crossed in the first 6 months of 2009, compared with the first half of 2008.

The United Nations World Tourism Organization (UNWTO) expects (1) that the global slowdown will continue through 2009. Joint marketing across Israeli, Palestinian ad Jordanian tourism authorities and operators, ie on a regional level, could potentially increase the attractiveness of the whole region as a tourist destination.

Israeli tourism in the Dead Sea region has two distinct components; one based on the health properties of the Dead Sea waters, and the other on leisure and cultural (religious) tourism. The health sector is mainly concentrated at Ein Gedi and En Bokek. Other attractions include the Massada and Qumran National Parks and the Ein Gedi Nature Reserve, which reportedly receives 500,000 visitors per year (according to personal information provided by employees at the site). These attractions close to the Dead Sea shore suggest that tourism in the area has a multi-destination characteristic, meaning that visitors to the Dead Sea shoreline view it as one of a number of attractions to visit in the region.

(1) Source: GDP uses and practical industries, Bank of Israel, Annual report, 2008
### Table B4.7  
**Israel, Dead Sea Area: General Tourism Indicators**

<table>
<thead>
<tr>
<th>Year</th>
<th>Rooms(1)</th>
<th>Beds(1)</th>
<th>Total</th>
<th>Tourists</th>
<th>Total</th>
<th>Tourists</th>
<th>Total US$ million</th>
<th>Tourists</th>
<th>% tourists</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>3,295</td>
<td>7,128</td>
<td>570.4</td>
<td>127.1</td>
<td>1,565.5</td>
<td>418.4</td>
<td>123.8</td>
<td>33.1</td>
<td>26.7</td>
</tr>
<tr>
<td>2001</td>
<td>3,478</td>
<td>8,062</td>
<td>619.5</td>
<td>48.3</td>
<td>1,679.8</td>
<td>216.2</td>
<td>116.4</td>
<td>15.4</td>
<td>13.3</td>
</tr>
<tr>
<td>2002</td>
<td>3,882</td>
<td>9,337</td>
<td>628.5</td>
<td>27.8</td>
<td>1,789.0</td>
<td>142.4</td>
<td>107.6</td>
<td>9.4</td>
<td>8.8</td>
</tr>
<tr>
<td>2003</td>
<td>4,014</td>
<td>9,517</td>
<td>767.6</td>
<td>40.3</td>
<td>1,763.8</td>
<td>155.9</td>
<td>115.2</td>
<td>11.7</td>
<td>10.2</td>
</tr>
<tr>
<td>2004</td>
<td>4,014</td>
<td>9,548</td>
<td>755.1</td>
<td>69.2</td>
<td>1,946.8</td>
<td>225.1</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2005</td>
<td>4,014</td>
<td>9,298</td>
<td>780.8</td>
<td>102.5</td>
<td>2,008.2</td>
<td>311.9</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2006</td>
<td>4,011</td>
<td>9,412</td>
<td>832.4</td>
<td>103.6</td>
<td>2,144.5</td>
<td>314.8</td>
<td>167.3</td>
<td>27.1</td>
<td>16.2</td>
</tr>
<tr>
<td>2007</td>
<td>4,011</td>
<td>9,612</td>
<td>794.8</td>
<td>135.3</td>
<td>2,114.9</td>
<td>414.2</td>
<td>187.0</td>
<td>38.4</td>
<td>20.5</td>
</tr>
</tbody>
</table>


Table B4.7 shows that in 2007 there were 15 hotels with over 4,000 hotel rooms on the Israeli side of the Dead Sea, mostly concentrated at Ein Bokek, with over 135,300 guest visits recorded. Although the hotels in the Dead Sea region account for roughly 8.5% of the total number of hotel rooms in Israel, they account for only 5% of the total number of guests in hotels in Israel. Also, while Israeli tourists account for 40% of the hotel revenues in Israel, they account for only 20% of the revenue in the Dead Sea area, indicating that most of the guests in the Dead Sea hotels are foreign tourists visiting Israel (*Figure B4.2*).

**Figure B4.2**  
**Person-nights of Israelis and Tourists in Major Localities, %, 2007**

Source: Central Bureau of Statistics, Tourism in Israel 2007, Statistilite 86, Ministry of Tourism
Tourism in Eilat is the major source of employment (7,000 jobs) and revenue (1). There were almost 11,000 hotel rooms in Eilat in 2007 (Table B4.8), corresponding to 15% of the total Israeli capacity, although Eilat only accounted for 5.4% of total person-nights in Israel. The percentage of non-Israeli’s contribution to total hotel revenue in Israel (15%) suggests that domestic tourism is much stronger in Eilat.

Table B4.8  *Israel, Red Sea area: General Tourism Indicators*

<table>
<thead>
<tr>
<th>Year</th>
<th>Rooms(1)</th>
<th>Beds(1)</th>
<th>Total</th>
<th>Tourists</th>
<th>Total</th>
<th>Tourists</th>
<th>Total US$ million</th>
<th>Tourists % tourists</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>10,124</td>
<td>27,485</td>
<td>1,896.9</td>
<td>401.9</td>
<td>6,166.1</td>
<td>1660.7</td>
<td>347.6</td>
<td>100.6</td>
</tr>
<tr>
<td>2001</td>
<td>10,707</td>
<td>29,705</td>
<td>1,979.1</td>
<td>154.1</td>
<td>5,926.4</td>
<td>750.2</td>
<td>320.3</td>
<td>46.5</td>
</tr>
<tr>
<td>2002</td>
<td>11,063</td>
<td>30,497</td>
<td>2,081.8</td>
<td>88.8</td>
<td>6,088.2</td>
<td>484.1</td>
<td>286.5</td>
<td>30.0</td>
</tr>
<tr>
<td>2003</td>
<td>10,925</td>
<td>30,721</td>
<td>1,985.7</td>
<td>93.9</td>
<td>5,811.5</td>
<td>468.9</td>
<td>305.9</td>
<td>35.6</td>
</tr>
<tr>
<td>2004</td>
<td>10,927</td>
<td>31,018</td>
<td>2,088.0</td>
<td>145.7</td>
<td>6,145.8</td>
<td>614.9</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2005</td>
<td>10,835</td>
<td>30,317</td>
<td>2,157.2</td>
<td>195.7</td>
<td>6,313.0</td>
<td>765.0</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2006</td>
<td>10,841</td>
<td>30,148</td>
<td>2,285.0</td>
<td>231.5</td>
<td>6,651.6</td>
<td>767.8</td>
<td>409.3</td>
<td>61.1</td>
</tr>
<tr>
<td>2007</td>
<td>10,842</td>
<td>30,601</td>
<td>2,299.8</td>
<td>243.8</td>
<td>6,539.2</td>
<td>760.1</td>
<td>452.2</td>
<td>68.6</td>
</tr>
</tbody>
</table>


In order to diversify the economy of rural communities in the Arava Valley, the State, in cooperation with local NGOs and the regional councils of the Arava Valley have developed locally-themed tourist attractions such as the Nabatean Trail, Park Timna and other sites which have helped to establish a small but tangible boutique-style accommodation in the rural area.

As of the end of 2007, there were 215 accommodation rooms with more than 1,000 beds, as well as an additional 1,000 organized outdoor sleeping spaces. Annual average occupancy is 30% and the main tourist season is September to May. More than 70 families have a tourism-based income.

Tourism in the Palestinian Authority is highly dependent on the political situation in the region. According to the Peres Center for Peace (2007), the recent years following the 2000 Intifada were devastating for the Palestinian tourism sector. Revenues were practically zero in 2001-2004, and although there were signs of a recovery since 2005, revenues and tourist arrivals in 2005-2006 only represented 20% of their pre-2000 level. Given the sensitivity of this sector to conflicts, the political atmosphere and movement restriction, a continuation of the current situation would take the sector back to the level of activity in 2001-2002, i.e. tourist numbers would be no more than a few tens of thousands per year and revenues would be almost zero, and eventually ruin the sector. Recent indicators are shown in Table B4.9.

**Table B4.9** 
**Palestinian Authority: General Tourism Indicators**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Hotels</td>
<td>75</td>
<td>80</td>
<td>77</td>
<td>79</td>
<td>82</td>
<td>86</td>
</tr>
<tr>
<td>Number of Beds</td>
<td>6,62</td>
<td>7,575</td>
<td>7,923</td>
<td>8,863</td>
<td>8,901</td>
<td>8,985</td>
</tr>
<tr>
<td>Number of Rooms</td>
<td>3,05</td>
<td>3,554</td>
<td>3,691</td>
<td>4,14</td>
<td>4,094</td>
<td>4,229</td>
</tr>
<tr>
<td>Number of Guests</td>
<td>62,812</td>
<td>100,184</td>
<td>131,908</td>
<td>151,801</td>
<td>315,866</td>
<td>446,122</td>
</tr>
<tr>
<td>Number of Guest Nights</td>
<td>199,275</td>
<td>268,695</td>
<td>350,219</td>
<td>383,603</td>
<td>673,458</td>
<td>1,127,122</td>
</tr>
<tr>
<td>Room Occupancy (%)</td>
<td>11.7</td>
<td>13.5</td>
<td>15.5</td>
<td>15.8</td>
<td>25.1</td>
<td>27.6</td>
</tr>
</tbody>
</table>

Source: PCBS, 2008

There were 86 operating hotels in the Palestinian Authority in December 2008, with average number of rooms of 4,229, and average number of beds of 8,985. Many other hotels are temporarily closed.

**Table B4.10** 
**Palestinian Authority: Other Tourism Related Activity**

<table>
<thead>
<tr>
<th>Tourism Activity</th>
<th>N° of Establishments</th>
<th>N° of persons engaged</th>
<th>Compensation of employees</th>
<th>Output</th>
<th>Intermediate consumption</th>
<th>Value added</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handicrafts and Traditional Goods Factories</td>
<td>112</td>
<td>414</td>
<td>1,368</td>
<td>3,49</td>
<td>1,585</td>
<td>1,905</td>
</tr>
<tr>
<td>Souvenir Shops</td>
<td>536</td>
<td>1,127</td>
<td>1,935</td>
<td>13,226</td>
<td>3,502</td>
<td>9,724</td>
</tr>
<tr>
<td>Hotels Establishments</td>
<td>82</td>
<td>1,263</td>
<td>7,988</td>
<td>163,297</td>
<td>26,424</td>
<td>136,87</td>
</tr>
<tr>
<td>Tourism Restaurants</td>
<td>290</td>
<td>1,956</td>
<td>7,376</td>
<td>38,127</td>
<td>18,923</td>
<td>19,204</td>
</tr>
<tr>
<td>Travel Agencies</td>
<td>218</td>
<td>1,247</td>
<td>8,835</td>
<td>46,2</td>
<td>13,213</td>
<td>32,987</td>
</tr>
<tr>
<td>Car Agencies</td>
<td>38</td>
<td>137</td>
<td>612</td>
<td>3,755</td>
<td>1,002</td>
<td>2,753</td>
</tr>
<tr>
<td>Total</td>
<td>1,2</td>
<td>6,1</td>
<td>28,1</td>
<td>268,1</td>
<td>64,6</td>
<td>203,4</td>
</tr>
</tbody>
</table>

The above table shows the contribution of other tourism related activities. The value of these activities in 2007 amounted to US$ 268.1 million, with the value added estimated at US$ 203.4 million. 6,144 workers were recorded in these activities in 2007, of whom 4,361 were salaried and wage workers.

**B4.5.4 Industry**

Jordan’s industrial sector is mainly composed of ‘mining and quarrying’, and ‘manufacturing’. Mining and quarrying includes potash and phosphate, and accounted for 2.1% of GDP in 2008 while manufacturing contributed 17.1% of Jordanian GDP. Within the industrial sector, ‘micro-enterprises’ (1) constituted 87% of the total number of enterprises operating, employing 21% of the total industry labour force, and accounting for 5.5% of the sum of industrial registered capital in 2006 (2). ‘Industrial Enterprises’ constitute 13.1% of the total number of enterprises operating in Jordan Industrial Sector, employing

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(1) Enterprises are classified according to the number of employees. The micro-enterprises are those that have less than 10 Jordanians employees. Those with 10 or more employees are called Industrial enterprises.

(2) Jordan Chamber of Industry, at http://www.jci.org.jo/

---
79.3% of the total industry labour force. The combined industrial sector (1) generates some 29% of the GDP and some 14% of the employment. About 18% of GDP comes from the manufacturing and 2% from the mining sector. According to the Ministry of Industry, industrial exports for year 2005 totalled about JD 2,379 million, representing 93.5% of total national exports.

Two of the most significant natural resource extraction industries in Jordan are potash and phosphate. Mineral production is dominated by two companies and their subsidiaries - Jordan Phosphate Mines Company p.l.c. (JPMC) and Arab Potash Company Ltd. (APC). JPMC employed 3,870 people in 2007, a decrease of 3.7% from the number employed in 2006 and a decrease of 13.7% from the number employed in 2003. APC employed more than 2,000 people in 2007 (2).

APC and its subsidiaries are located at the Dead Sea where one of the main extractions if potash, used for the production of fertilisers by APC. The APC and its subsidiaries (3) produced 2 million tons of potash in 2008. The company’s revenues increased from JD 368.3 million in 2007 to JD 692.6 million in 2008. The company’s consolidated net income was JD 311.4 million after tax. APC employed more than 2,000 people in 2007. Its contribution to the Jordanian economy and to the global supply of potash is significant and will be quantified in the next stage of the assessment.

There several large national and multi-national companies manufacturing and exporting fertilizer in Aqaba, using the phosphate and potash extracted elsewhere in Jordan. These include the Jordan Phosphate Mining Company (JPMC), Jordan Fertilizer Industry Company (JFIC) and the Nippon Jordan Fertilizer Company (NJFC). Annual production is shown in Table B4.11. According to the ASEZ’s master plan 2001-2020, the zone targets 13% of investments in heavy industry and 7% in light industry.

---

(1) There 10 sectors are : Leather and Garments, Therapeutics and Medical Sector, Chemical and Cosmetics Sector, Plastic and Rubber Sector, Engineering, Electrical Industries and Information Technology Sector, Furniture and Wooden Sector, Construction Sector, Food, Supplies, Agricultural and Livestock Sector, Packing, Packaging, Paper, Cartoon and Stationeries Sector, Mining


(3) The seven APC subsidiaries are: the Arab Fertilizers and Chemical Industries – Kemapco; Jordan Bromine Company; Jordan Dead Sea Industries Company – JODICO; Jordan Magnesia Company; Numeria Mixed Salts & Mud Company; Nippon Fertilizers Company and Jordan Safi Salt Company
Table B4.11  Structure of the Mineral Industry at Aqaba, 2007

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Major operating companies</th>
<th>Location of main facilities</th>
<th>Annual Capacity (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminium fluoride</td>
<td>Jordan Phosphate Mines Company p.l.c. (JPMC)</td>
<td>Aqaba</td>
<td>14,000</td>
</tr>
<tr>
<td>Phosphatic fertilizers</td>
<td>Jordan Phosphate Mines Company p.l.c. (JPMC)</td>
<td>Aqaba</td>
<td>650,000</td>
</tr>
<tr>
<td>Phosphoric acid</td>
<td>Jordan Phosphate Mines Company p.l.c. (JPMC)</td>
<td>Aqaba</td>
<td>350,000</td>
</tr>
<tr>
<td>Potassium nitrate</td>
<td>Arab Fertilizers and Chemicals Industries Ltd. APC</td>
<td>Aqaba</td>
<td>150,000</td>
</tr>
<tr>
<td>Sulphuric acid</td>
<td>Jordan Phosphate Mines Company p.l.c. (JPMC)</td>
<td>Aqaba</td>
<td>1,100,000</td>
</tr>
</tbody>
</table>

Source: USGS, 2007 Mineral Year Book, The Jordan mineral industry

Aqaba is strategically important to Jordan as it is the country’s only seaport, at the junction of trading routes between 3 continents (Europe, Asia, and Africa) and 4 countries (Iraq, Israel, Saudi Arabia, and Syria.). It is Jordan’s most important import/export hub. Because of its multi-modal transport system, it emerged in the 1980s as the third-largest Red Sea port after Suez in Egypt and Jeddah in Saudi Arabia. By the late 1990s, the port’s importance had fallen in the face of stiff competition from Latakia, Beirut, and Dubai. Its low usage masked the terminal’s poor management and underinvestment in soft and hard infrastructure. The congestion compelled some local traders and shipping lines serving Iraq to use ports in more distant Lebanon and Syria. The cost to the Jordanian economy from such congestion was an estimated $120 million a year.

The current port consists of the Main Port, the Aqaba Container Terminal (ACT) and the industrial port. The Main Port is used for handling General Cargo, Grain, Phosphate export and Lighter Traffic. The ACT is Jordan’s only container port and has recently expanded significantly with additional expansions planned in the near future. The various industrial terminals are used for cement export, as a passenger terminal and for other industrial (mostly fertilizer-related) cargo. The Main Port will be relocated to the Southern Port area in 2013, in order to free up prime waterfront land suitable for high-end real estate development in the centre. This support is expected to increase tourism. A new industrial port will be developed in the south, with improved port facilities and management and significantly increased capacity.

Israel plays a major role in the world’s production of bromine, magnesium metal, phosphate rock, and potash. For 2006, the country’s share of the world’s bromine production amounted to 36%; potash, 6%; magnesium metal, 4%; and phosphate rock, 2% (1). According to the Israel CBS, total exports for year 2008 were around $US 61.3 billion, of which mining and quarrying accounted for $US 1.9 billion; and non-metallic mineral products, 0.7%, so that

the mining and quarrying and non-metallic mineral products sectors each accounts for about 0.5% of GDP. The manufacture of iron, steel, and other metals represent about 0.3%. The remainder of the manufacturing sector, including diamond cutting and polishing, fertilizer production, and petroleum refining, accounted for 15.9% of the GDP. The non-metallic minerals sector employed about 9,300 workers, and the mining and quarrying sector, about 5,000 workers (2008). Israel's total exports amounted to $45.9 billion in 2007, of which diamond accounted for 23.9%; mining and quarrying, 1.8%; and non-metallic mineral products, 0.7%.

ICL (1) is a global company that owns the exclusive concessions to explore the minerals in the Israeli side of the Dead Sea and the mining of the Negev desert. ICL produces potash, compound potash and phosphate fertilizers, food grade phosphoric acid, elemental bromine and magnesium. The company is divided in three main segments: fertilizers, industrial products and performance products (speciality based on phosphates, alumina and other chemicals). ICL's sales were about $US6.9 billion for 2008, 57% for the fertilizers, 21% for the performance product, and 18% for the industrial products. The fertilizers segment generated for 2008 about $US 4.3 billion of revenues, 62% from the sales of potash and 38% from fertilizers and Phosphates (2), ICL currently employs approximately 5,000 people, 2,000 of them in ICL Fertilizers. Indirect employment is evaluated in 20,000 people in Israel and its subsidiaries in Spain and Britain.

In the near future, it can be expected that demand will continue to be higher than supply for both potash and phosphate fertilizers, given increasing demand from developing countries such as China and Brazil. ICL is expecting a strong rebound of their target markets on the earliest stages of the general economic recovery. As the market of fertilizers is driven by the growth of population and the limited availability of arable area, on the one hand; and the conjunction of supply constraints and increasing demand, on the other hand, prices of potash and phosphates are likely to rise in near future. The potential impacts of the Scheme on the chemical industries are a major concern for Israel, Jordan and the Palestinian Authorities who could all benefit from the Dead Sea mineral extraction.

Eilat is a town of 50,000 inhabitants with a shoreline of 12km in the south of Israel, connected to the rest of Israel by two main roads, by air and by the sea. The city is the only urban city in the Negev and has a seaport that is smaller than its Israeli counterpart of Haifa and Ashdod. The port has been managed by the IPC (Israel Ports Company) since 2005 and enjoys a fair share of traffic, mostly imports from Asia and Africa and exported Minerals. A major user of the port is the Eilat-Ashdod Oil Pipeline. The port hosts a modern bulk phosphate and potash transport system. Adjacent to the port there is a crude oil factory operated by Eilat Ashkelon Pipeline Company. In 2008, 2.57 million tons were transported through the port. Another user is the army, which

(1) ICL is an integrated fertiliser and chemicals company with headquarters in Tel Aviv.
(2) ICL Annual report, 2008
operates an independent Military Port within the port’s compound. Currently, there are no major passenger or cruise lines coming to/from Eilat’s port.

Recently, the World Bank (1) stressed the effects of Israel’s land administration policies and restriction of Palestinians’ access to water as two major constraints for industrial development in the Palestinian Authority. Palestinian construction for investment purposes in Area C is extremely limited due to Israeli permitting restrictions. Permits to construct facilities and associated infrastructure in Area C are rare and difficult to obtain. “They are prevented from expanding and establishing the most efficient layouts for factories, there is a severe problem of waste disposal and the cost of shipping is increased because trucks have to negotiate small urban roads that were not designed for shipping goods.”

The Palestinian Industrial Estates and Free Zones Authority (PIEFZA) is the Palestinian agency mandated with the establishment of industrial areas, has been working on the development of four major industrial parks located in various parts of the West Bank. The World Bank reported that while planning the development of four industrial parks, which require clear public or private title or ownership, PIEFZA is not able to move forward with these projects. One of the industrial estates was earmarked for the Jericho area.

**B4.5.5 Energy**

The discussion on the energy sector and related issues will be completed following further review of the supply and demand projections from the Feasibility Study and the Beneficiary Parties.

**B4.5.6 Water Resources and Demand**

Water Management in Jordan – Balancing Supply and Demand

The Jordanian water sector is characterized by a critical and growing supply-demand imbalance. In 2007 demand exceeded supply by about 565 Mm$^3$/year and the supply exceeded the resources by 73 Mm$^3$ (2). The table below breaks down the demand. Water allocation to the agriculture sector is about 64% of the total supply, the municipal sector takes 31% and the industrial sector 5%.

<table>
<thead>
<tr>
<th>Table B4.12 Water Balance in Jordan (2007)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Supply, Mm$^3$</td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>Jordan Valley Irrigation</td>
</tr>
<tr>
<td>Highland Irrigation</td>
</tr>
<tr>
<td>Industrial</td>
</tr>
<tr>
<td>Tourism</td>
</tr>
<tr>
<td>Municipal</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>


(1) West Bank and Gaza - The Economic Effects of Restricted Access to Land in the West Bank, The World Bank, 2008
(2) Source: Jordan Water Strategy 2008-2022
Note that ‘demand’ as used here is not an economic demand in the usually understood sense, but is a requirement based on available land and cropping patterns (for agriculture) or an annual allocation for households (for municipal use). Economic demand for water for irrigation uses would be significantly reduced if the opportunity cost of the water were used, rather than the subsidized rate (1).

Water Resources and Supply - Jordan

Jordan supplies its water needs in a number of ways. It taps surface water from the Yarmouk, which supplies the King Abdullah Canal that provides irrigation water to the Jordan Valley. A series of 10 dams was built in the highlands to capture surface water from the side wadis, mostly for irrigation, but also for drinking water. Groundwater is abstracted from the various well fields, and the network now includes inter-basin transfers to centres of higher demand. Water from the Azraq basin and some of the Dead Sea side wadis are now also used. Irrigation in the highlands is mostly by abstracted groundwater. Water is also supplied from the Jordan/Yarmouk catchment in accordance with the Jordan – Israel Peace Treaty. Recent developments include the construction of dams to capture water from the Dead Sea side wadis of Mujib and Zara-Ma’in, and the recently begun Disi Pipeline to transfer non-renewable groundwater from the Disi field to Amman. Table B4.13 below summarizes the available water resources.

Table B4.13 Water Resources in Jordan (2007)

<table>
<thead>
<tr>
<th>Resource Mm$^3$</th>
<th>Resources %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-renewable groundwater (Jafr + Lajjoun)</td>
<td>25</td>
</tr>
<tr>
<td>Non-renewable groundwater (Disi + Hisban)</td>
<td>66</td>
</tr>
<tr>
<td>Safe Yield groundwater</td>
<td>275</td>
</tr>
<tr>
<td>Artificial recharge</td>
<td>55</td>
</tr>
<tr>
<td>Desalinated water (Abu Zeighan + Aqaba)</td>
<td>10</td>
</tr>
<tr>
<td>Treated wastewater (irrigation)</td>
<td>87</td>
</tr>
<tr>
<td>Treated wastewater (industry)</td>
<td>4</td>
</tr>
<tr>
<td>Developed surface water</td>
<td>295</td>
</tr>
<tr>
<td>Peace treaty</td>
<td>50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>867</strong></td>
</tr>
</tbody>
</table>


The supply-demand deficit is currently being met in a number of ways. First, groundwater is abstracted at around 160% of the sustainable yield. This is leading to the depletion and salination of groundwater aquifers. Non-renewable sources also being exploited: non-renewable groundwater is extracted from Jafr, Lajjoun, Disi and Hisban and contributes about 91 Mm$^3$, representing some 11% of the total water supply.

Second, the municipal demand is undersupplied, with water pumped only intermittently (usually weekly) to customers. The result is that the domestic per capita daily consumption is around 91 L, compared with figures of 161 L for Cyprus, 278 L for Israel and 198 L for Lebanon (1). The industrial sector is currently fully served and its share has grown from 3.4% of the total supply in 1985 (22 Mm$^3$) (2), to 5% (49 Mm$^3$) in 2007.

Third, the agriculture sector is not supplied with the amounts of irrigation water it requires. Table B4.13 illustrates that the sector receives less than 50% of the water it requires. Domestic demand is supplied first, and then the industrial sector. The agriculture sector is the most affected by the lack of water availability and has the least priority in water allocation.

The deficit has also prompted the authorities to develop non-conventional sources. Brackish groundwater and domestic wastewater are both treated for reuse in agriculture, mostly in the Jordan Valley. In 2009, there were around 45 groundwater desalination plants in operation. The main wastewater plant serving Amman was upgraded in 2007 and now supplies over 50 Mm$^3$ of irrigation water to the Jordan Valley. Also, efforts have begun to restrict irrigated agriculture in the highlands, with a Regulation to license and control abstraction issued in 2002, although the authorities are having difficulty in enforcing this and reducing the use of groundwater for agriculture.

Jordan’s traditional approach to water management has been to develop new supplies, with several new supplies tapped in the last few years (eg the Zar-a-Ma’in and Mujb systems, and the Wihdi Dam). The latest is the construction of the Disi Pipeline to supply 100 Mm$^3$ of water from the non-renewable aquifer at Disi to Amman. Jordan has stated its intention to move away from a purely water supply strategy to looking at demand management, which would include more efficient water pricing, especially for the agriculture sector. There is also an opportunity to exploit reduction in water waste and leakage as the quickest and least expensive means of augmenting water supply. For example, non-revenue water -NRW- has declined from 51% in 2000 to 46% in 2007. Around half of this is due administrative losses (ie illegal connections, faulty meters, unmetered connections, poor meter reading and billing, etc) and the remainder to physical losses.

Future Water Demand - Jordan

The water demand from the municipal sector, domestic and non-domestic, are essentially driven by the population’s growth. Three scenarios for the water demand in the municipal sector relying on different population forecasts have been developed by the ESA team. Assumptions of the forecasts for the water demand will be supplied in the next phase of the assessment.

(1) According to a survey done using the Euro Mediterranean Information System on the Know How in the Water Sector (EMWIS) platform
(2) MWI, JWS, 2008_2022
Jordan’s population is today about 5.72 million (Jordan’s Department of Statistics, 2009). Population forecasts are given for a high level, a medium level and a low-level scenario for a period ranging from 2007 to 2020 and 2060, as shown in Table B4.14. These estimates are broadly consistent with those prepared by other agencies, eg the UN and the Jordan Water Strategy.

### Table B4.14  Jordan Population Growth from 2030 to 2060

<table>
<thead>
<tr>
<th>Year</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>7.35</td>
<td>7.83</td>
<td>8.44</td>
</tr>
<tr>
<td>2060</td>
<td>8.44</td>
<td>10.97</td>
<td>15.01</td>
</tr>
</tbody>
</table>

Growth from 2007 | 28% | 37% | 48%

Source: Jordan Department of Statistics, 2009

Based on the above population projections, Table B4.15 and Table B4.16 show forecasts for water demand in the municipal sector in 2020 and 2060 respectively. These are based on low, medium and high levels of domestic water consumption of 118, 131, and 145 litres/capita/day (lcd) respectively, noting that the Water Strategy aims to reach 140 lcd by 2020.

### Table B4.15  Forecasts of the Water Demand for the Municipal Sector in 2020

<table>
<thead>
<tr>
<th>Forecasts for 2020</th>
<th>Low level</th>
<th>Medium level</th>
<th>High level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (in millions)</td>
<td>7.35</td>
<td>7.83</td>
<td>8.44</td>
</tr>
<tr>
<td>Domestic Water Consumption per capita (lcd)</td>
<td>118</td>
<td>131</td>
<td>145</td>
</tr>
<tr>
<td>Non Domestic Water Consumption (lcd)</td>
<td>21</td>
<td>24</td>
<td>26</td>
</tr>
<tr>
<td>Municipal Water Consumption (Mm$^3$)</td>
<td>373</td>
<td>443</td>
<td>529</td>
</tr>
<tr>
<td>Municipal Water Demand (Mm$^3$)</td>
<td>474</td>
<td>562</td>
<td>672</td>
</tr>
<tr>
<td>Growth from 2007 reference level</td>
<td>57%</td>
<td>87%</td>
<td>123%</td>
</tr>
</tbody>
</table>


### Table B4.16  Forecasts of the Water Demand for the Municipal Sector in 2060

<table>
<thead>
<tr>
<th>Forecasts for 2060</th>
<th>Low level</th>
<th>Medium level</th>
<th>High level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (in million)</td>
<td>8.44</td>
<td>10.97</td>
<td>15.01</td>
</tr>
<tr>
<td>Domestic Water Consumption per capita (lcd)</td>
<td>127</td>
<td>153</td>
<td>182</td>
</tr>
<tr>
<td>Non Domestic Water Consumption (lcd)</td>
<td>23</td>
<td>27</td>
<td>33</td>
</tr>
<tr>
<td>Municipal Water Consumption (Mm$^3$)</td>
<td>462</td>
<td>721</td>
<td>1177</td>
</tr>
<tr>
<td>Municipal Water Demand (Mm$^3$)</td>
<td>545</td>
<td>852</td>
<td>1389</td>
</tr>
<tr>
<td>Growth from 2007 reference level</td>
<td>81%</td>
<td>183%</td>
<td>362%</td>
</tr>
</tbody>
</table>


The Feasibility Study team has calculated water deficits in Jordan, as well as the deficit in the areas that could be supplied easily from the project (ie the governorates of Amman, Zarqa, Madaba and Karak) - see Table B4.17.
**Table B4.17** Indication Water Deficits for Jordan, Project Area and North West Governorates 2020-2060 (m³ million)

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual (Mm³)</th>
<th>Daily Average (Mm³)</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Jordan</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>582</td>
<td>611</td>
<td>648</td>
<td>1.59</td>
<td>1.67</td>
<td>1.77</td>
</tr>
<tr>
<td>2030</td>
<td>590</td>
<td>642</td>
<td>719</td>
<td>1.62</td>
<td>1.76</td>
<td>1.97</td>
</tr>
<tr>
<td>2040</td>
<td>562</td>
<td>643</td>
<td>763</td>
<td>1.54</td>
<td>1.76</td>
<td>2.09</td>
</tr>
<tr>
<td>2050</td>
<td>564</td>
<td>687</td>
<td>874</td>
<td>1.55</td>
<td>1.88</td>
<td>2.09</td>
</tr>
<tr>
<td>2060</td>
<td>571</td>
<td>735</td>
<td>1,006</td>
<td>1.56</td>
<td>2.01</td>
<td>2.75</td>
</tr>
<tr>
<td>Project Area</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>152</td>
<td>176</td>
<td>201</td>
<td>0.42</td>
<td>0.48</td>
<td>0.55</td>
</tr>
<tr>
<td>2030</td>
<td>207</td>
<td>247</td>
<td>303</td>
<td>0.57</td>
<td>0.68</td>
<td>0.83</td>
</tr>
<tr>
<td>2040</td>
<td>231</td>
<td>294</td>
<td>386</td>
<td>0.63</td>
<td>0.81</td>
<td>1.06</td>
</tr>
<tr>
<td>2050</td>
<td>271</td>
<td>370</td>
<td>520</td>
<td>0.74</td>
<td>1.01</td>
<td>1.42</td>
</tr>
<tr>
<td>2060</td>
<td>313</td>
<td>446</td>
<td>673</td>
<td>0.86</td>
<td>1.22</td>
<td>1.84</td>
</tr>
<tr>
<td>North West Governorates</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>532</td>
<td>560</td>
<td>597</td>
<td>1.46</td>
<td>1.53</td>
<td>1.64</td>
</tr>
<tr>
<td>2030</td>
<td>542</td>
<td>591</td>
<td>666</td>
<td>1.48</td>
<td>1.62</td>
<td>1.82</td>
</tr>
<tr>
<td>2040</td>
<td>515</td>
<td>593</td>
<td>709</td>
<td>1.41</td>
<td>1.62</td>
<td>1.94</td>
</tr>
<tr>
<td>2050</td>
<td>519</td>
<td>637</td>
<td>819</td>
<td>1.42</td>
<td>1.75</td>
<td>2.24</td>
</tr>
<tr>
<td>2060</td>
<td>528</td>
<td>686</td>
<td>950</td>
<td>1.45</td>
<td>1.88</td>
<td>2.60</td>
</tr>
</tbody>
</table>

Source: Feasibility Study

It is expected that these water deficits will be met by the Scheme. It is not yet determined how the Scheme will allocate freshwater between the three beneficiary parties, but the scenario used for planning purposes in the Feasibility Study has also been used in the ESA, as reproduced in **Table B4.18**.

**Table B4.18** Possible Water Allocation from Scheme (Mm³)

<table>
<thead>
<tr>
<th>Year</th>
<th>Jordan</th>
<th>Israel</th>
<th>PA</th>
<th>To be Allocated</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>230</td>
<td>30</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>2060</td>
<td>560</td>
<td>60</td>
<td>30</td>
<td>200</td>
</tr>
</tbody>
</table>

**Water Management in Israel**

Water shortage is not a new challenge for Israel, and the country has experienced a growing gap between water supply and water demand since 2002. The situation has developed into a crisis with difficulties in supplying municipal and domestic water requirements. The Water Authority reports that the supply of fresh water in 2008 reached an all-time low of 725 million cubic meters (Mm³) - only 62% of the multiannual freshwater supply over the past 15 years, while demand for fresh water reached 1400 Mm³\(^{(1)}\). Israel’s water scarcity problem has led Israel’s policy makers to introduce regulations, standards, administrative tools and economic incentives in order to manage the demand side more efficiently.

\(^{(1)}\) Tackling Israel’s Water Crisis, Israel Environment Bulletin, vol 32, 2009
The main sources of potable water are:

- Surface water from Lake Kinneret, which provided around 30% of drinking water supply in 2006 (242 Mm³);
- Ground water from the coastal aquifer along Israel’s coastlines and the inland mountain aquifer (2,800 wells) which supplies 36% (700 Mm³) of the drinking water delivered by Mekorot;
- Natural springs, around 34%;
- 31 desalination plants supplying 140 Mm³ (including 110 Mm³ from the Ashkelon desalination plant and 30 Mm³ from Palmachim);
- Reservoirs operated by Mekorot.

This discussion will be developed further in the next phase of the assessment.

**Water Management in Palestinian Authority**

Note – the discussion in this section is particularly provisional and will be developed following further consultations with stakeholders in the Palestinian Authority.

The total water use in the Palestinian Authority including Gaza ranges from 250 - 260 Mm³/year. The current total water supply in the West Bank is nearly 135 Mm³/year and in Gaza 110 Mm³/year. However, this supply does not represent the actual water demand, due to various limitations imposed on the supply to the Palestinians. This problem is likely to grow with the increase in population and the associated increase in the demand. The table below summarizes the supply and availability.

<table>
<thead>
<tr>
<th>Table B4.19 Water Balance in the Palestinian Authority, 2004-2007</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual Available Water Quantity</strong></td>
</tr>
<tr>
<td><strong>Annual Pumped Quantity from Groundwater Wells</strong></td>
</tr>
<tr>
<td><strong>Annual Discharge of Spring Water</strong></td>
</tr>
<tr>
<td><strong>Annual Quantity of Water Purchased from Israeli Water Company (Mekorot) for Domestic Use</strong></td>
</tr>
<tr>
<td><strong>Annual Quantity of Supply for Domestic Sector</strong></td>
</tr>
<tr>
<td><strong>Percentage of Households Connected to the Water Network</strong></td>
</tr>
</tbody>
</table>

Measurement Annual Quantity: Mm³/year
Source: Palestinian Bureau of Statistics, 2009

Water pumped in the Palestinian Authority in 2007 reached 241.2 Mm³ for domestic and agricultural uses, while the average of annual discharges of springs was 44.8 Mm³. The quantity of water purchased from Israeli Water Company (Mekorot) was 49.4 Mm³. The volume of water supplied for domestic use in the Palestinian Authority was 175.6 Mm³.
Since Oslo, the overall supplied quantity has increased. Access to the network water supplied by Mekorot has increased to almost 50%, with an increased reliance on water purchased from Mekorot. About 45% of M&I water for West Bank Palestinians is now supplied by the Israeli Water Authority.

In the West Bank area of the Palestinian Authority, water resources are not efficiently used. Scarce resources are wasted because of high rates of physical losses in conveyance and network supply systems. Wastewater reuse in agriculture is currently limited to a small scale. Actual household use in the Palestinian Authority (after deducting losses and industrial use) averages around 50 lc/d (1). Per capita domestic supply is very variable and discontinuous, with highly intermittent supplies in some areas.

Many households claim quality problems in their drinking water supply. The governance system established by Article 40 of the Annex 2 of the Oslo Agreement requires the approval by Israeli authorities of any proposed Palestinian management measure or infrastructure project within the Palestinian Authority. This particular restriction gives Israeli authorities control over the allocation and management of West Bank water resources.

This discussion will be further developed in the next phase of the assessment and, if necessary and appropriate, extended to include the following topics where these have regional – as opposed to project-specific – implications:

- Archaeology & Cultural Heritage;
- Ecology;
- Marine & Coastal Environment;
- Meteorology & Climate;
- Dead Sea Limnology; and
- Other Environmental Quality Issues.

B5 IDENTIFICATION OF KEY POTENTIAL REGIONAL IMPACTS

B5.1 SOURCES OF IMPACT

The sources of project specific impacts of the Scheme will derive from the construction and operation of the various Scheme components, together with their interaction with the baseline environment. These will be documented within each thematic section in Part C of the report. However, at a regional level, the sources of impacts are as follows.

- The magnitude of the scheme. Such a multi-billion dollar Scheme, having possibly more than 300 km of steel pipeline, or 180 km of tunnel, as well as the largest desalination plant envisaged to date, may give rise to regional and/or cumulative impacts purely as a result of its size, cost and complexity.

- The regional and global geo-political context, whereby a tri-lateral Scheme involving the cooperation of the three Beneficiary Parties will cause an impact on the bilateral relations between the parties, and introduce a level of third party (donor countries and/or institutions) involvement at the financing and possibly design, construction and operation stages.

- The unique cultural context of the region, whereby the area within which the Scheme will operate has high cultural and political significance on an international level, both for historico-religious reasons, and also arising from the physical uniqueness of the Dead Sea and surrounding basin.

- The context of severe water scarcity in the region, which affects the baseline economic context within which the Scheme will operate, and which also heightens the impacts of the generation of large amounts of additional freshwater.

B5.2 KEY POTENTIAL IMPACTS

By taking account of the issues raised during the three public meetings held prior to the study commencement in 2007, those raised during the Study Programme’s consultation process itself, and also by reviewing literature published on the Scheme, a list of the perceived regional impacts was developed. Table B5.1 below groups and summarizes these, and so represents the outcome of the scoping process, with regard to regional impacts.
### Table B5.1 Regional Issues Identified During Scoping

<table>
<thead>
<tr>
<th>Issue/Receptor</th>
<th>Potential Impacts (positive or negative)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large-scale alteration to water circulation patterns, salinity, evaporation rates and water quality in the Gulf of Aqaba/Eilat and coastal region.</td>
<td>Effects on tourism and leisure, navigation, fisheries and other economic users of the Gulf of Aqaba/Eilat</td>
</tr>
<tr>
<td>Social and political consequences of undertaking a multi-billion dollar construction project in the region.</td>
<td>Improvement in relations between the Beneficiary Parties through technical cooperation, institutional arrangements to implement and administer the project.</td>
</tr>
<tr>
<td></td>
<td>Job creation and economic development</td>
</tr>
<tr>
<td></td>
<td>Social impacts of an influx of construction workers</td>
</tr>
<tr>
<td></td>
<td>Potential effect on Palestinian water rights issues</td>
</tr>
<tr>
<td>Cumulative outcome of additional disturbances in highly stressed areas that are already developed or being considered for future development</td>
<td>Further fragmentation of vulnerable ecosystems</td>
</tr>
<tr>
<td></td>
<td>Interference with the routes of migratory birds</td>
</tr>
<tr>
<td></td>
<td>Impacts on the character and appearance of urban and natural landscapes</td>
</tr>
<tr>
<td></td>
<td>Further loss of cultural and archaeological sites</td>
</tr>
<tr>
<td>Major hazards or risks of large scale damage to human health and wellbeing, security or the environment</td>
<td>Risks of conveyance breach due to seismic activity, natural disaster, flash floods or sabotage (and, as a consequence, sudden cessation of water supply, spill of seawater into agricultural or domestic aquifers).</td>
</tr>
<tr>
<td></td>
<td>Ongoing sea water leakage from conveyance</td>
</tr>
<tr>
<td></td>
<td>Contamination due to leakage from stored fuel and chemicals</td>
</tr>
<tr>
<td>Induction of further development in the Wadi Araba/Arava Valley as a result of additional water availability</td>
<td>Disruption to traditional lifestyles</td>
</tr>
<tr>
<td></td>
<td>Further degradation of the ecology</td>
</tr>
<tr>
<td></td>
<td>Employment and income generation</td>
</tr>
<tr>
<td>Physical changes associated with the construction and continuing presence of large physical structures in the environment</td>
<td>Destabilization of the land surface</td>
</tr>
<tr>
<td></td>
<td>Aesthetic and landscape impacts</td>
</tr>
<tr>
<td></td>
<td>Displacement of and access restrictions on people</td>
</tr>
<tr>
<td></td>
<td>Impacts on natural habitats, animal movement and behaviour</td>
</tr>
<tr>
<td>Construction activities taking place at locations throughout the study area for periods of up to eight years</td>
<td>Pressure on the transport link between Amman and Aqaba due to vehicle movements and road closures</td>
</tr>
<tr>
<td></td>
<td>Social and environmental impact of construction workers activities and camps (pollution, pressure on services, impacts on tourism, social disturbance, disturbance of flora and fauna)</td>
</tr>
<tr>
<td>Regional issues related to stabilisation of the Dead Sea with Red Sea water and brine from desalination</td>
<td>Impacts on tourism industry in Jordan, Israel, and potential future impacts on Palestinian Authority (positive and negative)</td>
</tr>
<tr>
<td>Risks to tourism and heritage values from changes to the characteristics of Dead Sea</td>
<td>Changes in appearance of the Dead Sea (whitening, algal blooms), Reduced density of the surface layer</td>
</tr>
<tr>
<td></td>
<td>Increased turnover rate, with possible turbidity, odours.</td>
</tr>
</tbody>
</table>
### Issue/Receptor | Potential Impacts (positive or negative)
---|---
Mixing the sea waters or raising the water level impacting the operations and profitability of the chemical extraction industry | Impacts on the economies of Jordan and Israel
The hydrology of the area around the Dead Sea caused by stabilising of raising the water level | Changes in ground water flows
Increased demand on electricity supply and network depending on how the project meets its power requirements | Potential power shortages in population centres
Risks and benefits to health and social and economic development, related to the availability of additional potable water | Additional water availability in urban areas
Impacts from growth in the tourism industry | Expansion of tourism infrastructure, impacts from the movement and provisioning of additional tourists, social impacts of additional tourism (particularly increased non-national work force)

This list of impacts was used to define the scope of the regional baseline characterization that was presented in Section B4. During the assessment, some of the above issues were deemed to be project specific only, with no regional significance, and are therefore dealt with in the relevant thematic section in Part C. The remainder of this section discusses the impacts deemed to have significance at a regional level.

In this section, impacts are categorized only as positive or negative. The degree of significance (minor, major, etc) has been determined only provisionally, and is pending future consideration and assessment in all areas.

#### B5.3   RELATIONS BETWEEN BENEFICIARY PARTIES

#### B5.3.1   Closer Cooperation between the three Beneficiary Parties

The ToR indicates that the Scheme could “build a symbol of peace and cooperation in the Middle East”, and “constitute a major breakthrough in relationship-building in the region” (p1). It also notes (pp 38, 39) that a joint regional Scheme could increase cooperation between the conflicted stakeholders.

Relations between the Beneficiary Parties can be considered at three separate though interrelated levels; at a political level, at the level of technical cooperation, and at a ‘street’ level. Stakeholders hold various opinions about
the impacts of the Scheme on regional relations. The Scheme’s supporters emphasise the benefits arising from the requirement for the three parties to work together on the financing, development, construction and operation of the Scheme, noting that the Scheme has been put forward as a possible model for Arab-Israeli cooperation. The Israeli Presidency considers that ‘this earthshaking enterprise can help maintain peace and establish mutual and long term interests’ (1), and other Israeli officials have made similar statements. When the Jordanian and Israeli Governments formally announced the Scheme at the World Summit on Sustainable Development in 2002, it was marketed as a project that would require the cooperation of Jordan and Israel and bring about enhanced ties between the countries. Observers consider that creating shared economic interests will inevitably bind the various parties together, and others argue that even if the Scheme is never built, it has already brought Israel and Jordan closer together in water issues.

The relationships between Israel and the Palestinian Authority are dominated by the political realities. These include travel restrictions for Palestinians within the Palestinian Authority, including to the Dead Sea shoreline. Development of new Palestinian enterprises (agriculture, tourism, industry, other infrastructure development) in Areas B and C is severely restricted, as is access to and development of water resources, including groundwater. Implementation of the Scheme as a technical project will not, of itself, affect these issues. Israel-Palestinian political relations are therefore less likely to be affected by the Scheme’s implementation. Indeed, some observers have noted that the implementation of such large-scale technical project without addressing the political realities of the occupation, only serves to strengthen the status quo. Other observers have pointed out that the very involvement of the Palestinian Authority as a member of the Technical Steering Committee (TSC) on an equal footing with Jordan and Israel is a significant recognition of Palestinian Authority rights over the Dead Sea, and is a significant accomplishment (2).

The above arguments largely relate to the political level of relations. At a technical level, there is already cooperation between all three parties regarding water resources and supply, and through the Joint Water Committee (JWC). Israel regulates water abstractions in the Palestinian Authority areas, and supplies water to the West Bank Water Department through Mekorot. Through the Peace Treaty, Israeli and Jordanian officials also coordinate regarding water allocations from the Yarmouk and Tiberias. Water officials from the three parties have been coordinating and meeting in recent years over the development of the Terms of Reference for the RSDSC Study and its financing and implementation. Further development of the Scheme will require more of this cooperation, which will become more involved once details of financing, procurement, supply of equipment, construction and finally implementation of the Scheme and the allocation and delivery of water. It is likely that international actors will be involved in many

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(1) Shimon Peres, The New Middle East, Element Book Ltd, 1993, p. 144
(2) Abitol, 2009
of these steps. The magnitude of the Scheme is such that regular and close coordination will be necessary. As the TOR indicates, this will bind the parties together in mutual dependency, which can only promote better understanding and ties.

At a ‘street level’, the Scheme has many detractors. Anti-normalization groups in Jordan have denounced the Scheme as a further example of the normalization of ties between Israel and Jordan, to which they are opposed. Some in Israel have voiced concern about Israel being involved in such a large cross-border Scheme that provides so little fresh water to Israel. Palestinian people and international observers on the region have raised concerns over the implication of Palestinian involvement in the Scheme, and questioned whether this affects Palestinians’ ongoing attempts to regain rights over the water resources that underlie the Palestinian Authority (West Bank). Some have pointed out the irony of Palestinian participation in a Scheme involving the Dead Sea, when much of the shoreline within Palestinian Authority jurisdiction is not accessible to Palestinians.

It has long been observed in the region that any individual or group’s assessment of a particular event will be coloured by their pre-existing political stance, rather than by the nature of the event itself. With regard to the Scheme, it seems apparent that it will initially have little immediate influence on popular opinion. However, due to the magnitude of the Scheme, and the amounts of fresh water that it will produce, this may change in the longer term. Once it is established that the joint Scheme is, in fact, contributing significant additional water to the region, popular opinion (particularly in Jordan) may soften, even though this is likely to be dominated by other events in the wider political arena.

Similarly, if the Scheme provides significant additional freshwater for Palestinians, attitudes to the Scheme itself may soften, although attitudes towards Israel will probably continue to be determined primarily by other political considerations.

In conclusion, the Scheme may give rise to small improvements in relations between Jordan and Israel at the political and technical levels, and in relations between Israel and the Palestinian Authority at a technical level. The Scheme may also contribute to a small improvement in relations at a street level gradually in the longer term, but these will continue to be dominated by the wider political context.

These are likely to be minor to moderate positive impacts.

An important determinant of the effect of the Scheme will be the nature of the arrangements put in place to oversee financing, procurement, construction and operation of the facilities. A joint body for the legislative oversight of the scheme, day-to-day management and decision making on the sharing of benefits might constitute a model for wider cooperation. This topic will be the
subject of further research and consultation throughout the remainder of this study.

**B5.3.2 Implications on the Rights of Palestinians**

Through Oslo, Israel effectively has control over water abstractions and development over new sources in the Palestinian Authority, and also over Palestinians’ access to areas outside Area A, including the Dead Sea shoreline. Oslo recognizes Palestinian water rights in the West Bank, but defers specifying exactly what these are until the final negotiations. Concerns have been raised that if the involvement of the Palestinian Authority in the RSDSC Scheme does not explicitly address the issue of water and access rights, it may be taken as an approval of or perpetuation of the status quo. In addition, many Palestinians are worried that acceptance of water from a Scheme which is dependent on operation of infrastructure which is not under Palestinian Authority control and which may be very expensive, should not be seen as a substitute for regaining the rights to abstract groundwater.

This is a very important issue, with potentially major significance, but its impact and mitigation is linked with the wider political settlement, which is outside the scope this study.

**B5.3.3 Implications from the Engagement of Other Actors**

One additional potential benefit of the Scheme is that its size will necessitate the involvement of actors from outside the region, either states acting as donors or lenders, private sector investors, or other agencies (eg NGOs) with an interest in social, political or environmental issues. The water sector in both Jordan and the Palestinian Authority has had significant technical, policy and financial input from donors including the United States, the European Union, the Federal Republic of Germany and Japan, as well as the World Bank. Increased involvement of extra-regional players is likely to be a benefit to the region, since such actors tend to encourage stronger cooperation and improved relations between the parties, as well as coordinated decision making, in addition to the additional financing and technical know how they bring.

This is a minor to moderately significant and positive regional impact.
**B5.4 NATIONAL ECONOMIES AND ECONOMIC DEVELOPMENT**

**B5.4.1 Benefits from the Availability of Additional Freshwater**

Jordan’s water demand and supply projections in the absence of this Scheme were discussed earlier. The water supplied to Jordan by the Scheme – say 560 Mm$^3$ per year, will allow this deficit to be met, at least up until the year 2060.

A number of practical effects of this could arise, although it is difficult to evaluate these in detail without access to planning information from the Jordanian water sector, which is not available. One of the effects is to allow an increase in water supply to the municipal sector in Jordan, by eliminating rationing. This could permit an increase in the per capita supply and consumption of water, currently around 90lcd. Jordan’s Water Strategy envisages this to rise to 140lcd. Continuous supply will significantly improve reliability of the water supply and reduce water quality problems and infrastructure issues (eg pressure fluctuations, meter problems, air and water ingress).

Supply from the Scheme will relieve pressure on unsustainable groundwater abstractions, and allow the recovery of those aquifers affected.

An increase in water availability will also allow the development of additional residential areas, and tourism developments, and industrial developments. While such developments are not presently constrained by lack of water (due to over pumping of the aquifers, and constraints in supply to agriculture), they will be by the time the Scheme is implemented. There is therefore a potential increased economic return from new industrial and tourism projects as a result of the Scheme.

One possible negative impact of the water availability is the reduction of the supply constraint to the agricultural sector in Jordan, which may lead to increased inefficiencies in agriculture, where the returns on agricultural produce are less than the cost of the water to the sector. This is particularly likely given the political strength of the agricultural sector in Jordan, and the place it holds in the cultural fabric of the region. One means to mitigate this is for the funders of the Scheme to require water allocation restrictions to the agricultural sector, eg prohibiting any of the Scheme’s water to supply irrigation. Water use incentives (eg a significant rise in the price of irrigation water) and more regulation of cropping would also increase the efficiency of water used in agriculture.

At this stage, plans for water supply to Israel and the Palestinian Authority are tentative, but include delivery of around 60 Mm$^3$ to low lying areas around Hatseva, Arad and En Gedi in Israeli, and 30 Mm$^3$ to the Jericho area in the Palestinian Authority. Commentators have noted that while Israel has significantly higher per capita domestic supply, and the option of producing desalinated water from the Mediterranean coast, the availability of freshwater...
from the Scheme will not be a major benefit to Israel. The supply of water to Jericho will be a more significant benefit, given the lower per capita supply in that area.

Overall, this is likely to be one of the main significant benefits of the Scheme.

B5.4.2 Risk to the Extraction Industries at the Dead Sea

There is a risk that a change in water quality taken in by the extraction industries in both Israel and Jordan will reduce profitability to the extent that tax revenue and/or employment are significantly impacted. Given the contribution that these industries makes to the national economies of Israel and Jordan – to be quantified and analysed further - and the political influence of these industries, this could be considered a major or critical regional impact.

Any cost implications for the industries, for example in altering their intakes to cope with the change in levels, should be balanced against the no-Scheme scenario, which will also require periodic investment from the industries to extend their outfalls to account for the decreasing levels over time. This will be discussed separately as a project specific impact.

The long term issue of the increasing scarcity of the raw materials being mined from the Dead Sea is not affected by the Scheme, although the economics of mining the increasingly scarce resource may be.

These issues, and the degree to which the location and design of either the RSDSC discharge or the industries’ intakes will mitigate this, will be determined by the Additional Study on the Dead Sea.

B5.4.3 Impacts of Job Creation

Table A2.2 provided estimates for the labour force required during construction. This will be considered as a project-related impact, since despite the length of the construction and the size of the workforce and potential supply needs, the increased employment will not be significant on a national scale, in any of the Beneficiary Parties.

B5.4.4 Impacts Arising from the Energy Demand of the Scheme

The majority of the energy demand for the Scheme will be on the Jordanian grid, since all the salt water pumping and the vast majority of the freshwater pumping will be carried out in Jordan. The current installed capacity of the Jordanian system is 2,300 MW. Energy demand from the Scheme may be of the order of 600 – 900 MW and will therefore constitute a significant additional demand for energy, which will be in addition to the baseline growth in demand from population growth and development. This will entail additional generation capacity – ie additional power stations. The Jordanian electricity authorities are aware of the Scheme’s likely energy needs and are factoring this into their planning, together with other planned large-demand
schemes. The impact of this future load on a properly planned and executed generation and transmission network is not likely to cause significant problems for the supply of electricity, and is therefore not considered a significant regional impact.

However, depending on the choice of supply – oil, gas and nuclear are all possibilities - there may be a resultant increase in GHG emissions. This increase in emissions could be considered a regional impact, with implications on the climate as well as on Jordan’s national GHG emissions. Unless the source of energy for electricity generation is renewable, the energy production will cause non-renewable resource depletion (oil, gas or nuclear fuel). At this stage, no data is available on how Jordan proposes to meet the Scheme’s energy demand. This issue will be addressed in more detail in next phase of the study, and mitigation recommendations made.

The cost of pumping is one of the main operational costs of the Scheme, and will be taken into account in the financial feasibility study.

The pumping requirements on the western freshwater route are small by comparison, and the impact of the Scheme on the electricity sectors of either the Palestinian Authority or Israel will be minimal.

**B5.5 REGIONAL PHYSICAL AND BIOLOGICAL ENVIRONMENT**

**B5.5.1 Regional and Local Climatic Effects**

There are concerns that a change in salinity of the surface water of the Dead Sea will alter evaporation rates, causing a knock on effect on the moisture content of the air, which may influence wind and local weather patterns. This will be examined further following output from the Additional Study on the Dead Sea.

**B5.5.2 Change in Groundwater Conditions**

The possible raising of water table conditions in the Dead Sea Basin may lead to the reduction of sinkhole formation (and consequent reduced risk to health and property), increased land stability and viability, and improved ecological conditions in some of the side wadis. These issues will be assessed following production of the relevant FS and Additional Study reports on hydrogeology and the Dead Sea.

**B5.5.3 Interference with Bird Migration between Africa, Asia, and Europe**

The Jordan Rift Valley and the Dead Sea area are unique as they lie within the second most important flyway in the world and the most important route of the Africa-Eurasia flyway system. Birds use this route as a corridor between their breeding grounds in Europe and West Asia and wintering areas in Africa. Nine globally threatened and near-threatened species are known to
pass through the area. The Jordan Rift Valley and Dead Sea area provide shelter and a source of food from through the area’s vegetation, including acacia trees, desert vegetation and agricultural areas. In recognition of this, the Jordan Rift Valley has a number of individual environmental protection projects in which areas have been designated as nature reserves (on the national and international levels), Important Bird Areas (designated by BirdLife International) while others are proposed to be included within the above designations. These are described in more detail in the thematic section, together with an identification of the impacts caused by each project component.

The construction and implementation of the Scheme sits in the southern Jordan Rift Valley and Dead Sea Basin. The combined effect of the six-year construction period will create disturbance to migratory birds for a number of reasons. The increased levels of noise and/or dust emissions will create a nuisance to birds and may cause them to avoid seeking temporary shelter and refuelling for their journey at sites they have used previously. Since some ecologically important areas within the flyways will be damaged, and vegetation in the wadis lost (especially if a tunnel conveyance is constructed), the ability to host migratory birds will be reduced. Concerns have also been raised that the presence of new open water bodies (the canals) within the area may mislead migrating birds, causing them to land for refuelling at freshwater habitats, only to find that the saltwater does not support suitable vegetation.

To the extent that the Scheme causes a partial reduction in successful migrations along this route, or an alteration of their migratory paths, this will be a regional impact, with effect outside the study area. It significance will be minor.

**B5.5.4 Risk to the Terrestrial Ecological Balance in the Wadi Araba/Arava Valley**

Concerns were raised that since the terrestrial ecology of the Wadi Araba/Arava Valley basin was partially separated bio-climactically from similar areas (being surrounded by higher ground or water on all sides), significant impacts in the valley basin may have global significance, due to the loss of species or reduction in populations in this area. However, the ecological assessment (*Section C7*) has determined that, although there will be some permanent loss of habitat and some temporary disturbances during construction, neither the magnitude of these nor the vulnerability of the systems disturbed, warrant its consideration as a regional issue. The project-specific impacts related to the construction of each project component, can be mitigated adequately either by siting alterations, construction controls or post-construction rehabilitation, to the extent that no significant regional impact arises.

There are no aspects of the long term operation of the Scheme that will give rise to regional terrestrial ecological impacts.
**B5.6 LAND USE AND SOCIAL SITUATION IN THE ARABA/ARAVA VALLEY**

**B5.6.1 Risks to the Desert Character and Traditional Lifestyles**

Concerns have been raised that implementation of the Scheme in such a rural area (particularly the Wadi Araba, and parts of the Tafila governorate in Jordan) would impact the rural ‘ethos’ or ‘feel’ of the area.

The noise, dust, traffic, and other nuisance issues caused by the construction of the Scheme will not be regionally significant. There will be some disturbance and loss of vegetation in particular areas during construction, most particularly at the side wadis on the eastern side of the Wadi Araba used for the tunnel adits. However, there will be no significant cumulative effect on a wider scale from these. No important populations will be significantly affected, and no terrestrial ecological impacts are envisaged. Cumulative effects on bird migration have been discussed elsewhere.

The Scheme itself, although of a large magnitude and cost, will effectively be mostly buried, when complete, and therefore will not alter the “feel” of the area. The main pieces of above-ground infrastructure that will remain in the longer term (ie post construction) in rural, undeveloped areas will be:

- the six tunnel adit openings, which will be set into the hillsides to the east of the Wadi Araba floor. These relate to the tunnel conveyance options;
- the canal sections, which will be established in the Wadi Araba in the high level tunnel option;
- the desalination plant (high level or low level); and
- the hydropower plant.

The social, ecological and visual impacts of these components are addressed in the project-specific assessment. Most of the impacts are confined in area, and are not considered regional impacts. Those issues deemed to have a regional aspect are discussed below.

**B5.6.2 Cumulative Change to the Ethos of the Area**

The presence of the Scheme’s individual components in the undeveloped areas of the Wadi Araba will combine to create a change to the feel of the area. The high level desalination plant will be visible from the main highway. The access road alongside the pipeline route will be an additional visual breach to the desert. The openings and permanent access facilities at the tunnel adits may be visible locally. Individually, the above aspects will have a minimal

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1 Significant work will be carried out at these sites during construction (including construction and assembly of TBMs, construction of access railway to the portal, concrete plants, etc.)
impact. Even combined, their cumulative impact will likely be low. The component, which would introduce the most invasive new element into the area, is the presence of open canal sections if the high level tunnel option were to be selected. The canal sections will be around 20 m wide and 29 and 28 km long, respectively. The northern section will be in the hills to the east of the main highway, and may not be a highly visible element. The background landscape is a non-mixture mixture of rocky scree and dry wadis beds, and some vegetation. However, the southern section will sit in the sandy floor of the southern Wadi Araba, in a stretch where the sandy floor is particularly dramatic, and is set against the background of the exposed desert rock to the east. This canal stretch will also be closer to the main highway, and will cross it in two places. It will therefore have a visual impact on the landscape, and would constitute a moderately significant change into the visual fabric of the area.

The stretches of open water will also be a novelty in the area, and could allow the local communities to take advantage of the new recreational opportunities. This would constitute the introduction of new local customs, albeit minor in effect. In addition, given the Jordanian government’s drives to stimulate the economy of the area, it is likely that the rural conservatism of this area will be affected by other elements, even in the no-Scheme scenario, so the canals themselves are not considered to be a significant detrimental impact.

B5.6.3 Induced Development Around the Canals

There is risk that the presence of the canals will induce or encourage other development that is not currently part of the Scheme. There has been informal mention of using the canal bodies as the centre pieces of new rural tourism developments. The Jordanian Government, in its promotional material to the Jordan Red Sea Project (JRSP) has promoted the idea of creating significant recreational developments in the southern Araba, centred on salt water lakes that would be created in the JRSP. The Israeli private sector has also produced promotional material that envisages a major cross border urban and recreational development, centred on salt water lakes developed as a spin-off to a Red Sea Dead Sea Water Conveyor. Such developments, whether major or minor, are clearly a possibility if the Scheme were to go ahead. Even minor tourism developments in the Wadi Araba would generate an influx of tourists and incomers to the area, who will have different social values from the local communities. The desert “feel” will be disturbed. In addition, depending on location and linkage with the existing communities, any large scale developments in the area will lead in the long term to an erosion of the rural conservative ethos.

This issue could be one of the most significant social and cultural impacts of the Scheme, although since there are no firm plans for such developments, it is difficult to assess them to any level of detail.
B5.6.4 Mitigation

The best way to mitigate the above is to select the low level tunnel conveyance, which will not have open have canal sections. This will minimize the changes to the look and feel of the Wadi Araba. If the canal sections are part of the recommended Scheme, they should be designed to be less intrusive, e.g. with no raised lips or structures, and ensuring that any fabricated elements are finished with colours that blend with the surroundings.

Mitigation of the social risks of induced development should be an important aspect of any plans to create new developments in the area. Such plans would require a separate environmental and social assessment. Involvement of the local communities in the designs and decisions of the new developments would be an important means of minimizing cultural clashes, although this is probably unlikely to occur. It may be that creating physical disconnects between the local communities and the new developments is the best way to protect the local customs in the short term, if this is deemed to be desirable. A clear public communications programme should be implemented as part of any planned development, possibly with advice centres and a grievance mechanism. If such developments come under the responsibility of the Development Zones Commission (as is likely), the DZC is instigating strong requirements for developers on social integration and economic development of communities local to any development projects, which will be significantly stronger than others in Jordan.

B5.6.5 Residual Impacts

The social impacts of induced developments around the canal sections will remain significant, since these are unlikely to be mitigated in the implementation of the new developments. This is an important issue that must be dealt with by the planners and developers at the time.

The visual impacts of the southern canal section will likely remain moderately significant, as these canal sections will remain a visible feature in the sandy part of the Wadi, and will be seen from the road, and from viewpoints on the Israeli side.

B5.6.6 Risks to Groundwater-Irrigated Agriculture

Possible damage to the aquifers and groundwater in the area, and the implications for well-irrigated agriculture in the Wadi Araba/Arava Valley will be examined following submission of the Sub-Study Report on Hydrogeology.
B5.7  CULTURAL AND ARCHAEOLOGICAL HERITAGE OF THE REGION

B5.7.1 Benefits to Regional Tourism

Tourism numbers in all three Beneficiary Party areas are dominated by fluctuations in the political and security situation in the region. For example, Jordan witnessed an increase in tourism numbers following the signing of the Peace Treaty in 1994. However, the tourism sector is unlikely to be dramatically boosted by implementation of the Scheme itself, unless other changes occur in regional relations. Tourism would be stimulated by any warming of regional relations and ease of travel from an improved security situation, which may be associated with the Scheme’s implementation. In particular, if regional relations improve during the Scheme’s implementation, the Dead Sea and the region in general could be marketed in a more integrated fashion, leading to significantly increased tourism numbers. This is more likely to be an indirect effect associated with warming in regional relations, rather than as a direct impact of the Scheme, since integrated marketing of the Dead Sea or the region does not require the Scheme to go ahead.

Any benefit to local tourism along the Dead Sea shoreline as a result of the stabilization of water levels, and the reduction of the risk of sinkholes, is considered as a project-specific impact.

B5.7.2 Risk to Tourism at the Dead Sea

The risk to the tourism at the Dead Sea from actual or perceived changes in visual appearance or health benefits as a result of the introduction of Red Sea water is a concern that will be examined further following completion of the Additional Study on the Dead Sea. Such an impact would affect both the Israel and Jordan tourism sectors, and also a potential future Palestinian tourism industry.

Implementation of the Scheme will benefit tourism facilities along the shoreline of the northern basin (ie the Jordanian resort at Sweimeh, and the Israeli spa at En Gedi, as well as smaller facilities along the Palestinian Authority coastline), as they will avoid the cost of new investment for adaptation to the declining levels.

The significance of this impact is still to be determined.

B5.7.3 Risk to Regional and International Perception of the Dead Sea as a Unique Heritage Site

Aside from the impacts on tourism, the perception of the Dead Sea as a unique heritage and religious site could be at risk from the Scheme. It is difficult to determine the significance of this risk. The Feasibility Study is currently conducting a contingent valuation survey that will inform on international perception of the Dead Sea. The Additional Study on the Dead Sea will also
determine the degree to which water quality and visual changes will arise due to the Scheme. This issue will be addressed following completion of these studies.

The significance of this impact is still to be determined.

**B5.7.4 Risk to Tourism in the Gulf of Aqaba/Eilat**

The risk to the tourism industry on the Gulf of Aqaba/Eilat from possible disturbance to the coral reefs, coral growth, changes to circulation patterns, changes in salinity, evaporation, or other actual or perceived changes as a result of the water extraction will be examined further following completion of the Additional Study on the Red Sea. Impacts on tourism related to the Scheme’s construction will be examined as a project-specific impact.

The significance of this impact is still to be determined.

**B5.8 SUMMARY OF REGIONAL IMPACTS**

Table B5.2 provides a summary of the regional impacts discussed, and an estimation of their significance, provided that they are mitigated in accordance with the recommendations made above. Note that consultations and further analysis is required to finalise this section.

**Table B5.2 Summary of Regional Impacts**

<table>
<thead>
<tr>
<th>Issue/receptor</th>
<th>Potential Impact</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relations between beneficiary parties</td>
<td>Closer cooperation between beneficiary parties</td>
<td>+/0</td>
</tr>
<tr>
<td>Implications of the Scheme on the rights of Palestinians over control of water resources and access to land including the Dead Sea shoreline</td>
<td>NK</td>
<td></td>
</tr>
<tr>
<td>Engagement of other countries and institutions in the development, financing and operation of the Scheme</td>
<td>+/0</td>
<td></td>
</tr>
<tr>
<td>National economies and economic development</td>
<td>Benefits from the availability of additional freshwater</td>
<td>+++</td>
</tr>
<tr>
<td>Risk to the extraction industries at the Dead Sea from a change in water quality at their intakes</td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td>Job creation during materials supply and construction phase</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Impacts of energy demand for project, including resource depletion and air emissions</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Issue/receptor</td>
<td>Potential Impact</td>
<td>Significance</td>
</tr>
<tr>
<td>----------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Regional physical and biological environment</td>
<td>Change in micro-climate and regional effects from a change in evaporation and air quality in Dead Sea basin.</td>
<td>TBD</td>
</tr>
<tr>
<td></td>
<td>Change in groundwater flows and possible raising of water table in Dead Sea basin, leading to reduction of sinkhole formation, reduced risk to human life, increased land stability and viability, and benefitting the ecology in the side wadis</td>
<td>TBD</td>
</tr>
<tr>
<td></td>
<td>Interference with bird migration between Africa, Asia and Europe as a result of noise and/or dust emissions and/or disturbance to habitats during project construction</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Risk to the terrestrial ecological balance in the Wadi Araba/Arava Valley</td>
<td>-/0</td>
</tr>
<tr>
<td>Land use and social well being of residents of the Wadi Araba/Arava Valley</td>
<td>Risk to the ‘desert ethos’, appearance and character of the landscapes, and to the traditional lifestyles of the Wadi Araba/Arava Valley</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Risk to groundwater-irrigated agriculture in the Wadi Araba/Arava Valley</td>
<td>TBD</td>
</tr>
<tr>
<td>Cultural &amp; archaeological heritage of the region</td>
<td>Benefits to regional tourism in the region</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Risk to tourism industry at the Dead Sea</td>
<td>TBD</td>
</tr>
<tr>
<td></td>
<td>Risk to regional and international perception of the Dead Sea of a unique heritage site</td>
<td>TBD</td>
</tr>
<tr>
<td></td>
<td>Risk to tourism industry on the Gulf of Aqaba/Eilat</td>
<td>TBD</td>
</tr>
</tbody>
</table>

**Key**

- Major negative
- Moderate negative
- Slight negative
+ Major benefit
+ Moderate benefit
+/- Slight benefit
A section discussing means to mitigate the regional impacts will be produced in the next phase of the assessment, following additional consultations, and presented in the *Preliminary Draft ESA Report*.

Some of these mitigation measures may take the form of institutional or policy recommendations which will fall outside of the narrow scope of the development of the Scheme, but which the Beneficiary Parties might wish to consider. Others may relate to the governance and institutional framework of the Scheme’s development, as well as to monitoring and capacity building measures.
A separate, independent Study of Alternatives has been commissioned by the World Bank. The summary of this study will be appended at this point.
PART C

Project Specific Environmental and Social Assessments
C1 INTRODUCTION

C1.1 THEMATIC ARRANGEMENT OF IMPACT AREAS

The project-level environmental and social assessment has been structured according to a range of thematic areas as follows (those shown in grey are omitted from this initial assessment for reasons discussed in Part A1):

- Section C2: Marine and coastal environment
- Section C3: Dead Sea limnology
- Section C4: Hydrology, flood risk and surface water quality
- Section C5: Archaeology and cultural heritage
- Section C6: Impacts on communities (includes health)
- Section C7: Terrestrial ecology and natural heritage
- Section C8: Hydrogeology and groundwater
- Section C9: Water resources and water supply
- Section C10: Meteorology/climate change
- Section C11: Economic development
- Section C12: Geology, seismology, land-use and soils
- Section C13: Landscape and Visual
- Section C14: Environmental quality (atmospheric, noise and vibration, traffic and transport)
- Section C15: Utilities and infrastructure

C1.2 STRUCTURE OF THEMATIC SECTIONS IN PART C

Each of the thematic impact sections broadly addresses the following:

- The scope of the chapter, ie the impacts that will be addressed and the components of the development that are relevant – including reference to components/Scheme areas and live alternatives covered in the assessment;

- The approach to the assessment, eg existing sources of information used, baseline studies undertaken, methods of impact prediction, evaluation criteria, any relevant info with respect to consultations and their influence on scope, evaluation and mitigation;

- Description of the baseline conditions including history of how these have evolved to present day conditions where relevant (eg in Dead Sea) and how they are expected to develop in the future without the Scheme (including future No Scheme scenarios) – overall regional baseline, individual Beneficiary Parties (BPs) and immediate Scheme area;

- Description and discussion of predicted impacts by Scheme component/Scheme area and alternatives where relevant; evaluation of their potential significance; discussion of mitigation already integrated into the proposals
and options/recommendations for further mitigation, how this will avoid or reduce greater impacts and/or deliver benefits; evaluation of the significance of residual impacts after mitigation (all mitigation measures to be recorded individually for carrying forward into the ESMP);

- (Where relevant) a summary and discussion of cumulative/regional level impacts.

**C1.3 TERMINOLOGY USED FOR PART C**

Some specific terminology used in this part of the report is explained as follows:

- **The Region** – that is the territories of the three BPs and further afield if impacts extend that far (eg possibly to Egypt if the Red Sea is affected);

- **The territory of each Beneficiary Party (BP) – Jordan, PA and Israel;**

- **Sub-regions** – the broad area of the Scheme is sometimes considered in further geographic units:
  - **Gulf of Aqaba/Aqaba/Eilat** – the gulf and its surrounding coastal area including the cities;
  - **Wadi Araba/Arava Valley** – the wadi valley up to the hydro and desalination plants;
  - **The Dead Sea Basin** – the area from the hydro/desalination plants up to and around the shores of the Dead Sea;
  - **The eastern freshwater conveyance route;**
  - **The western freshwater conveyance route;**

- **Scheme Affected Areas** – these are the areas affected by a specific impact from a particular component of the Scheme. The extent of a SAA will vary according to the component in question and the type of impact. So for example noise from a pumping station along a freshwater conveyance will affect an area of a few 100 m from the site; the benefits of improved supply of water for health will extend over the whole area to be supplied by each FW conveyance; the environmental impacts of induced development stimulated by the Scheme may extend further afield;

- **The Scheme Route** – that is the area immediately around the scheme components that could be directly affected by physical intrusion. This could comprise the footprint of each scheme component plus a buffer area around it of a few hundred metres;
• The *Scheme Components* are:
  • The intake from the Gulf of Aqaba and pumping station;
  • The saltwater conveyance – pipeline, tunnel, or tunnel and canal;
  • The desalination and hydroelectric plants;
  • The brine canal and outfall into the Dead Sea;
  • The eastern and western freshwater conveyances.
The assessment of impacts relating to this thematic area will be carried out when the relevant information from the associated detailed FS sub-studies and Additional Studies is made available later in 2010. The results will form part of the Preliminary Draft ESA Report that is due for submission in January 2011.
The assessment of impacts relating to this thematic area will be carried out when the
relevant information from the associated detailed FS sub-studies and Additional
Studies is made available later in 2010. The results will form part of the Preliminary
Draft ESA Report that is due for submission in January 2011.
C4 HYDROLOGY, FLOOD RISK AND SURFACE WATER QUALITY

C4.1 SCOPE OF ASSESSMENT

The following chapter addresses the potential impacts of the Scheme on surface water resources in the Scheme area. The analysis is confined to freshwater resources only (potential impacts on Red Sea and the Dead Sea are covered elsewhere in the report) and, since there are no perennial streams or surface water bodies in the immediate study area other than the two seas, the assessment is primarily focussed on seasonal flood risk. Moreover, water quality impacts are limited to those associated with surface flooding; the potential impacts on groundwater reserves are considered elsewhere in the report.

The assessment itself is based on the findings presented in the draft Hydrology Report that was produced by the RSDSC FS contractor in December 2009 (hereafter referred to as the FS Hydrology Report). The scope of that report only covers the potential flood risk to the infrastructure associated with the marine conveyance, and does not at this stage address the freshwater conveyance routes, nor does it contain an analysis of the flow capacity of any of the drainage structures themselves since these have not yet been designed. The scope of this assessment is therefore similarly confined at this stage to a general consideration of impacts associated with flood risk along the marine water conveyance route that will need to be considered during design. It will need to be extended to address the freshwater conveyance routes as and when detailed hydrological investigations have been completed for them.

C4.2 APPROACH TO ASSESSMENT

Since the assessment of potential surface water impacts is based on the findings presented in the aforementioned FS Hydrology Report, it therefore adopts the various data sources, approaches and methods employed in that report for estimating and analysing surface water flooding in the Scheme area. These are necessarily based on estimated rainfall-runoff calculations since few observed stream-flow data exist in the Scheme area.

For a detailed discussion of the various methods and data sources the reader is referred to the FS Hydrology Report itself. In summary, the approach taken to determine flooding characteristics in the Scheme area was as follows:

(1) There are some perennial streams that drain into the eastern side of the Dead Sea that may be indirectly affected by the Project (e.g. through return flows) which are considered in the chapter.
• Daily rainfall data were extracted from 14 meteorological stations in and around the Scheme area, with records ranging from 6 to 85 years in length (the latter was at Amman Airport). In total, 577 years of data were available for analysis.

• Standard statistical treatments were applied to the rainfall data to derive design storm profiles for the various wadi catchment areas of relevance to the Scheme. Flood hydrographs were then derived for the various catchment areas using the US Soil Conservation Service (US SCS) unit hydrograph method (a widely used rainfall-runoff estimated method) combined with standard (Muskingham) hydrologic routing methods to combine floods from different wadis where necessary.

• For the purposes of validation, derived floods were compared with the few observed data that have been collected for historical flood events (e.g. the 2006 floods in the Aqaba area) and a number of previous flood studies that have been carried out in and around the Scheme area (e.g. the Tannur Dam studies in the 1990s, the Truce Line Channel studies in 1994 and more recent engineering reports produced by ACE, GSI, MWH and Yodfat (1)).

It should be noted that the FS Hydrology Report does not address the potential impacts of future climate change on flood characteristics in the Scheme area. Since the design lifetime for the scheme is understood to be of the order 50 years, such effects will need to be considered during subsequent phases of the design. The FS is currently producing a climate change study that may address this issue in more detail.

C4.3 SURFACE WATER BASELINE

C4.3.1 General Characteristics

The stretch of land between the Gulf of Aqaba/Eilat and the Dead Sea basin is known in Jordan as the Wadi Araba, and in Israel as the Arava Valley. Part of the Jordan Rift Valley, it consists of a valley running approximately north-south, which separates ranges of sandstone hills to the east and west. The valley floor is characterized by a sandy dune-field over much of its length, which becomes more stony in some areas, with varied vegetative cover. The climate is mostly hyper-arid, with annual average rainfall in the valley bottom below 50 mm. To the east, however, rainfall increases steadily as the steep eastern wall is ascended, until at the top, the climate is Mediterranean, with annual precipitation (sometimes including snowfall) of 300-400 mm.

(1) See page iii of the FS Hydrology Report for details of all these studies.
Figure C4.1 shows the main drainage (hereafter referred to as ‘wadi’) basins in the Araba/Arava valley. There are no perennial streams or surface water bodies in the valley itself, although there are some that flow into the eastern side of the Dead Sea, most notably Wadis Zarqa Ma’in and Wala/Mujib.

**Figure C4.1**  **Main Drainage Basins in the Araba / Arava Valley**

All maps produced as a part of this study are being checked by the World Bank Map Design Unit. An approved set of maps will be included in the Preliminary Assessment Report.

At the southern end of the valley, in the Gulf of Aqaba/Eilat and its surrounds, the runoff from the eastern and western wadis flows to the Gulf. On the eastern side, the Wadi Yutum drainage system delivers sediment onto an extensive alluvial fan area to the north of Aqaba. The drainage systems that pass through the urban centres discharge via outfalls into relatively shallow area of the upper end of the Gulf, while the coastal wadis either discharge directly into deep water in the Gulf or pass through relatively short drainage channel or closed drainage systems in route to the Gulf. In addition, there is a significant sediment input to the northern Gulf from wind-blown sediment during sandstorms. However, there is some evidence that increasing urbanization is reducing natural sediment discharges to the Gulf, either from wind-borne or water-borne sources, leading to a reduction in the natural replenishment of beaches near the urban areas.

The wadis that flow into the Araba/Arava valley itself originate in the surrounding hills and mountains where their channels are typically well defined, steeply inclined and deeply incised into the barren hillsides and base rock (*Figure C4.2*). Their floods are generally of very short duration with high flow velocities and carry with them large amounts of suspended sediments into the lower valley. These poorly sorted sediments (including rocks and other large debris) are then deposited in characteristic alluvial fans at the foot of the escarpment where the flows spread out and velocities reduce in the flat valley bottom (*Figure C4.3*). The wadi channels separate here into numerous, shifting smaller channels where the smaller flows rapidly infiltrate into the ground. During large floods these channels become deeply eroded and are usually overtopped such that shallow ‘sheet flow’ can occur across wide areas.
The following sections provide some specific information about the flood characteristics of the wadis in the main areas of interest to the Scheme. As discussed earlier, the flood calculations presented do not take account of the
potential effects of future climate change in the Scheme area, although it is assumed that these effects would be considered during any subsequent drainage calculations during detailed engineering design.

C4.3.2 Floods in the Aqaba/Eilat Area

Figure C4.4 shows the main wadi basins that drain north to south along the valley towards Aqaba and Eilat and into the Red Sea.

Figure C4.4 Main Wadi Basins Draining Towards the South

All maps produced as a part of this study are being checked by the World Bank Map Design Unit. An approved set of maps will be included in the Preliminary Assessment Report

The largest of these is Wadi Yutum, at 4,465 km², which gave rise to a significant flood event on 12th February 2006 that inundated large parts of Aqaba. Several people were drowned in the event, and the Aqaba wastewater treatment plant was put out of operation for several weeks. It has subsequently been estimated that the flood peak during the event was about 550 m³/s. No other wadis in the area flooded at the time, i.e., the storm event was centred on Wadi Yutum alone.

Making use of rainfall data from Aqaba and elsewhere in the region, and using the rainfall/runoff calculation methods described earlier in Section C4.2, it is possible to simulate rainfall/runoff events for Wadi Yutum and therefore estimate the return period (or probability) of the 2006 flood event. The precise results will depend on the particular characteristics of the storm event itself, e.g., its spatial coverage and intensity profile during the day, none of which is known since the rainfall stations only recorded daily totals at specific locations. However, certain standard assumptions can be made that enable an approximation to be made.

Table C4.1 details the results of the analysis carried out for the present FS Hydrology Report, compared to the results produced by another 2007 study (1) that used slightly different assumptions about rainfall patterns. As can be seen, the earlier report suggests that the return period of the 2006 event was in the range 10 to 20 years, whereas the current study estimates it to be somewhere between 20 and 50 years. Neither study can be said to be ‘correct’, since both rely on assumptions about the rainfall characteristics that were not

(1) MWH, 2007, Aqaba Storm Water Master Plan Report
recorded. However, both results suggest that the 2006 flood was both a significant and rare flood event.

Table C4.1  Estimated Floods for Wadi Yutum

<table>
<thead>
<tr>
<th>Return Period (years)</th>
<th>Estimated Peak Flow (m³/s)</th>
<th>RSDSC FS</th>
<th>2007 drainage study(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>118</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>338</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>330</td>
<td></td>
<td>528</td>
</tr>
<tr>
<td>20</td>
<td>460</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td>880</td>
</tr>
<tr>
<td>50</td>
<td>640</td>
<td></td>
<td>1,100</td>
</tr>
<tr>
<td>100</td>
<td>780</td>
<td></td>
<td>1,370</td>
</tr>
<tr>
<td>500</td>
<td>1,140</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,000</td>
<td>1,310</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5,000</td>
<td>1,710</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10,000</td>
<td>1,890</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probable Maximum Flood (PMF)</td>
<td>6,780</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As shown in Figure C4.4, the total catchment area draining to Aqaba/Eilat amounts to 4,935 km² since it includes 12 smaller wadis in addition to Wadi Yutum itself. Therefore, in order to estimate the flood profile for the total catchment area a similar rainfall/runoff method was applied to all of the contributing areas and the flows from each area were then combined by routing them all to a single point at the Red Sea (using the hydrologic routing method described in Section C4.2). The same approach was carried out using two different storm profiles – one with a storm centred on the Yutum catchment area, and one with a storm centred on the valley - since the results may be sensitive to these conditions.

As shown in Figure C4.5 and Figure C4.6, the resulting flood hydrographs are double-peaked events, with the first peak coming from the Arava/Araba corridor, and the second later peak arriving from Wadi Yutum. As shown in Table C4.2 the results are not markedly different for the different rainfall scenarios, although the storm event centred on the Yutum catchment area produces higher flood peaks.
**Figure C4.5** Derived Flood Hydrographs for Aqaba/Eilat – Storm Centred on Yutum

![Aqaba/Eilat Global Flood Hydrographs - Storm Centered on Yutum](image)

Source: RSDSC FS Draft Hydrology Report, Coyne et Bellier, Dec 2009

**Figure C4.6** Derived Flood Hydrographs for Aqaba/Eilat – Storm Centred on Arava

![Aqaba/Eilat Global Flood Hydrographs - Storm Centered on Arava](image)

Source: RSDSC FS Draft Hydrology Report, Coyne et Bellier, Dec 2009
Table C4.2  Estimated Floods for Total Aqaba/Eilat Catchment Area

<table>
<thead>
<tr>
<th>Return Period</th>
<th>Estimated Peak Flows (m3/s)</th>
<th>Group A (area 182 km²)</th>
<th>Group B (area 123 km²)</th>
<th>Group C (area 165 km²)</th>
<th>Yutum (area 4,465 km²)</th>
<th>Total combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm centered on Yutum:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 years</td>
<td>53</td>
<td>52</td>
<td>74</td>
<td>775</td>
<td>777</td>
<td></td>
</tr>
<tr>
<td>1,000 years</td>
<td>115</td>
<td>115</td>
<td>166</td>
<td>1,302</td>
<td>1,304</td>
<td></td>
</tr>
<tr>
<td>10,000 years</td>
<td>189</td>
<td>193</td>
<td>275</td>
<td>1,882</td>
<td>1,886</td>
<td></td>
</tr>
<tr>
<td>PMF</td>
<td>859</td>
<td>896</td>
<td>1,264</td>
<td>6,744</td>
<td>6,755</td>
<td></td>
</tr>
<tr>
<td>Storm centered on Arava:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 years</td>
<td>134</td>
<td>135</td>
<td>194</td>
<td>744</td>
<td>747</td>
<td></td>
</tr>
<tr>
<td>1,000 years</td>
<td>251</td>
<td>257</td>
<td>367</td>
<td>1,250</td>
<td>1,254</td>
<td></td>
</tr>
<tr>
<td>10,000 years</td>
<td>379</td>
<td>392</td>
<td>557</td>
<td>1,807</td>
<td>1,813</td>
<td></td>
</tr>
<tr>
<td>PMF</td>
<td>1,424</td>
<td>1,488</td>
<td>2,092</td>
<td>6,474</td>
<td>6,492</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
- All wadi floods routed at assumed velocity of 10 km/h to Red Sea
- 12 intermediate catchments analysed as three sub-groups (A, B and C)

Source: RSDSC FS Draft Hydrology Report, Coyne et Bellier, Dec 2009

C4.3.3  Floods in the Central and Northern Araba/Arava Valley

There are two aspects of the flood characteristics in the central and northern Araba/Arava valley that are of particular interest for this Scheme, as follows:

- The proposed marine conveyance route crosses a number of wadis that drain from east to west into the valley, and will therefore potentially affect their drainage characteristics where overland routes are considered. Tunnel adits and other associated infrastructure may also be located in wadi drainage paths;

- The Scheme infrastructure situated in the northern part of the valley (eg low-level desalination and hydroelectric plants and canal/conveyance infrastructure) may be affected by large floods emanating from the Arava/Arava valley itself.

In terms of the cross drainage issue, whilst the majority of the conveyance will be below-ground, the proposed over-ground canal sections intersect with an estimated 141 wadi basins in three particular groups:

- A first group located upstream of Ghor Safi area;
- A second group located in the area between Shoubaq and Wadi Musa; and
- A third group located between Wadi Musa and Ras El Naqab.

Of these, the FS Hydrology Report has identified a total of 17 catchment areas that would have the potential to cause significant flood risk to the canal sections of the conveyance structure. The area in question is shown on Figure C4.7, and the macro-catchments are shown, although the 17 sub-catchment areas are not yet delineated on this Figure (the information will be provided in the next phase of the assessment).
Figure C4.7  Catchment Areas Draining Across Conveyance Route

All maps produced as a part of this study are being checked by the World Bank Map Design Unit. An approved set of maps will be included in the Preliminary Assessment Report.

Applying the previously described rainfall/runoff methods to these catchments, the potential flood peaks for a range of return period flood events were derived as shown in Table C4.3.
### Table C4.3  Estimated Design Flood Peaks for Canal Wadi Crossings (m³/s)

| Catchment ref (see Figure C4.5) | A (km²) | Q-2  | Q-5  | Q-10 | Q-50  | Q-300 | Q-500 | Q-1000 | Q-4000 | Q-5000 | Q-10000 | PMF |
|---------------------------------|--------|-----|-----|-----|------|------|------|-------|-------|-------|-------|------|-----|
| **Ghor Safi Area**              |        |     |     |     |      |      |      |       |       |       |       |      |     |
| 4                              | 85     | 27  | 69  | 102 | 178  | 264  | 289  | 321   | 390   | 401   | 433   | 1 214 |     |
| 5                              | 161    | 15  | 48  | 75  | 147  | 179  | 235  | 261   | 296   | 367   | 378   | 420  | 1 248 |
| 6                              | 35     | 8   | 24  | 37  | 71   | 84   | 109  | 121   | 137   | 168   | 173   | 190  | 562 |
| 7                              | 186    | 16  | 47  | 76  | 149  | 182  | 239  | 266   | 304   | 381   | 393   | 439  | 1 345 |
| **Catchments between Shoubak and Wadi Musa** |        |     |     |     |      |      |      |       |       |       |       |      |     |
| 14                             | 17     | 12  | 22  | 29  | 45   | 52   | 63   | 68    | 75    | 89    | 91    | 98   | 239 |
| 19                             | 15     | 12  | 22  | 29  | 45   | 52   | 62   | 67    | 74    | 88    | 90    | 97   | 238 |
| 22                             | 11     | 10  | 18  | 23  | 37   | 42   | 51   | 55    | 61    | 72    | 74    | 79   | 198 |
| 37                             | 79     | 33  | 66  | 91  | 150  | 175  | 218  | 238   | 265   | 318   | 326   | 356  | 895 |
| 59                             | 11     | 9   | 18  | 23  | 37   | 42   | 51   | 55    | 60    | 72    | 74    | 79   | 197 |
| 74                             | 65     | 16  | 43  | 44  | 106  | 127  | 159  | 173   | 195   | 238   | 245   | 265  | 728 |
| 89                             | 149    | 21  | 63  | 101 | 202  | 244  | 323  | 360   | 407   | 507   | 523   | 572  | 1 710 |
| **Catchments between Wadi Musa and Ras En Naqab** |        |     |     |     |      |      |      |       |       |       |       |      |     |
| 93                             | 147    | 3   | 18  | 35  | 83   | 105  | 148  | 168   | 200   | 262   | 272   | 302  | 1 090 |
| 115                            | 59     | 5   | 25  | 40  | 85   | 108  | 141  | 156   | 181   | 223   | 230   | 252  | 797 |
| 122                            | 74     | 4   | 20  | 38  | 85   | 111  | 151  | 169   | 193   | 247   | 256   | 281  | 943 |
| 123                            | 263    | 4   | 22  | 48  | 121  | 159  | 227  | 259   | 298   | 397   | 413   | 465  | 1 737 |
| 133                            | 34     | 3   | 15  | 26  | 57   | 65   | 87   | 97    | 112   | 140   | 144   | 160  | 518 |
| 141                            | 54     | 4   | 23  | 40  | 81   | 102  | 134  | 149   | 169   | 211   | 218   | 241  | 753 |

Source: RSDSC FS Draft Hydrology Report, Coyne et Bellier, Dec 2009
In terms of flood characteristics at the northern end of the valley (at the entrance to the ‘Truce Canal’), the catchment area draining to this point is formed from a number of different wadis and totals approximately 13,800 km$^2$ (see northern valley section in Figure 1.1).

Using the previously described rainfall/runoff methodology coupled with hydrologic routing between the various sub-catchments, the *FS Hydrology Report* has derived the estimated flood characteristics for the northern section of the valley as shown in Table C4.4. It should be noted that in determining the catchment characteristics used for the rainfall/runoff calculation, reference was made to previous studies $^{(1)}$ that have been carried out in the same area, including some isolated flow measurements, and runoff characteristics were ‘calibrated’ by the FS experts accordingly.

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$^{(1)}$ These included the Truce Line Channel - Hydrology Study (Gibbs, 1994) and an earlier 1879 flood study by the Institute of Hydrology, Wallingford.
Table C4.4  Estimated Design Flood Peaks for Arava/Araba Valley at Truce Canal (m3/s)

<table>
<thead>
<tr>
<th>Return Period (years)</th>
<th>C0</th>
<th>C4 (Hasa)</th>
<th>C2</th>
<th>C5</th>
<th>C3</th>
<th>C1a</th>
<th>C1b</th>
<th>C1c</th>
<th>Total at Truce Canal</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>24</td>
<td>59</td>
<td>39</td>
<td>15</td>
<td>57</td>
<td>29</td>
<td>62</td>
<td>22</td>
<td>164</td>
</tr>
<tr>
<td>5</td>
<td>63</td>
<td>153</td>
<td>97</td>
<td>45</td>
<td>121</td>
<td>70</td>
<td>146</td>
<td>55</td>
<td>275</td>
</tr>
<tr>
<td>10</td>
<td>88</td>
<td>237</td>
<td>150</td>
<td>74</td>
<td>232</td>
<td>107</td>
<td>215</td>
<td>84</td>
<td>364</td>
</tr>
<tr>
<td>50</td>
<td>187</td>
<td>472</td>
<td>295</td>
<td>161</td>
<td>452</td>
<td>211</td>
<td>399</td>
<td>164</td>
<td>604</td>
</tr>
<tr>
<td>100</td>
<td>229</td>
<td>584</td>
<td>361</td>
<td>204</td>
<td>551</td>
<td>259</td>
<td>496</td>
<td>200</td>
<td>723</td>
</tr>
<tr>
<td>500</td>
<td>359</td>
<td>893</td>
<td>543</td>
<td>322</td>
<td>822</td>
<td>379</td>
<td>716</td>
<td>300</td>
<td>1 040</td>
</tr>
<tr>
<td>1 000</td>
<td>416</td>
<td>1 045</td>
<td>630</td>
<td>379</td>
<td>949</td>
<td>441</td>
<td>833</td>
<td>353</td>
<td>1 194</td>
</tr>
<tr>
<td>5 000</td>
<td>583</td>
<td>1 413</td>
<td>849</td>
<td>523</td>
<td>1 247</td>
<td>588</td>
<td>1 055</td>
<td>478</td>
<td>1 592</td>
</tr>
<tr>
<td>10 000</td>
<td>654</td>
<td>1 584</td>
<td>943</td>
<td>591</td>
<td>1 383</td>
<td>673</td>
<td>1 203</td>
<td>535</td>
<td>1 781</td>
</tr>
<tr>
<td>PMF</td>
<td>1 677</td>
<td>3 962</td>
<td>2 340</td>
<td>1 591</td>
<td>3 293</td>
<td>1 650</td>
<td>2 712</td>
<td>1 344</td>
<td>4 417</td>
</tr>
<tr>
<td>A (km²)</td>
<td>932</td>
<td>2 502</td>
<td>1 662</td>
<td>419</td>
<td>1 959</td>
<td>1 408</td>
<td>3 608</td>
<td>1 283</td>
<td>13 773</td>
</tr>
</tbody>
</table>

Source: RSDSC FS Draft Hydrology Report, Coyne et Bellier, Dec 2009
C4.4 IMPACT ASSESSMENT

As previously noted, this chapter does not address the potential impacts of the Scheme on conditions in either of the two seas; only freshwater issues are considered. In this respect, the surface water related issues that were determined as potentially significant during the scoping phase of the study, and therefore warranting further assessment, are as follows:

- Potential impacts on local surface water drainage systems and associated sedimentation and erosion patterns and water quality due to excavation and construction works;

- Potentially more permanent impacts on local hydrological regimes due to the interaction between above-ground sections of the marine and freshwater conveyance structures and various wadis along their routes, and other associated works (eg tunnel adits, access roads, desalination and hydroelectric plants etc);

- Risk of seawater conveyance breaches due to inadequate or poorly designed cross-drainage structures at above-ground wadi crossing points (ie canal sections) and the consequent risk of seawater spillage and intrusion into downstream agricultural or domestic aquifers.

- Potential impacts on surface spring-flows around the shores of the Dead Sea due to the specific hydro-geological relationship between the water level of the Dead Sea and the behaviour of the aquifers that surround it. Additionally, potential secondary impacts on water resources in Amman and other areas receiving supply from freshwater conveyance(s) due to reduced pressure on current resources and/or return flows from water supply system, eg perennial wadis flowing into eastern shoreline of Dead Sea.

An assessment of the last point will await the results of the detailed investigation of the Dead Sea that has recently been commissioned by the World Bank as part of the RSDSC study programme. Table C4.5 summarises the remaining impacts in relation to their relevance to the different components of the Scheme, and the following sections examine the potential significance of each issue.
Table C4.5  Relevance of Hydrological Issues to Scheme Components

<table>
<thead>
<tr>
<th>Potential impacts on local surface water drainage systems and water quality due to construction works (including secondary impacts on ecology and other receptors).</th>
<th>Intake (N)</th>
<th>Intake (E)</th>
<th>Pipeline</th>
<th>Tunnel</th>
<th>Desalination Plant</th>
<th>Hydroelectric Plant</th>
<th>Freshwater Conveyance Jordan</th>
<th>Freshwater Conveyance Israel/PA</th>
<th>Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential impacts on wadi hydrological regimes due to cross-drainage structures and major infrastructure located in drainage pathways (including secondary impacts on ecology and other receptors).</td>
<td>√</td>
<td>√</td>
<td></td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Risk of marine conveyance breaches due to flash floods at above-ground wadi cross-drainage points.</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential impacts on surface water (spring-flow) regime around Dead Sea due to changing sea levels.</td>
<td>Impacts not considered in this report (awaiting results of additional study of Dead Sea).</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The analysis has been presented by geographical area for reasons of clarity since this lends itself both to the hydrological ‘units’ that subdivide the Scheme area, and to the different components of the Scheme itself. The potential significance of surface water impacts is therefore summarised for each area.

C4.4.1  Aqaba/Eilat Urban and Coastal Areas

The potential surface water impacts in this area are largely associated with the construction of the inlet structure and any associated works. They relate to the potential for localised flooding and/or soil erosion (and subsequent deposition in coastal receiving waters) if floods occur during the construction period and either local drainage networks are altered or impeded, or excavation materials and/or disturbed soils are left exposed and unprotected adjacent to drainage channels. Similarly, there is also potential for downstream contamination if hazardous materials or wastes from construction activities are left in exposed locations close to or within drainage channels. All of these factors may impact upon sensitive local receptors, in particular they may present health and safety risks for nearby residents and property, and may also lead to high sediment loads and potential hazardous chemicals entering the receiving waters of the Gulf.

As shown in Section C4.3.2, although flood events from some of the larger surrounding wadis may only reach the urban areas on occasion (most infiltrating into the valley soils before they reach that far), storms in the areas
immediately surrounding the urban centres could readily generate surface flows in and around the construction areas, and more significant floods from the upper catchment can also reach the waters of the Gulf (1).

Although potentially significant, given the proximity of the urban population and sensitive coastal habitats in the Gulf, these impacts can all be mitigated very effectively at source by the implementation of standard best practices in terms of environmental controls and management practices during construction, particularly during seasonal rainfall periods. These would be detailed in subsequent environmental management plans prepared for the FS, but would include the provision of adequate site drainage facilities, silt traps, oil interceptors etc.

In summary, the significance of the surface water impacts in this area given the design and implementation of effective mitigation measures is therefore determined as ‘minor, not significant’.

**Residual Impact Significance (post mitigation)**

<table>
<thead>
<tr>
<th>Sensitivity/Value of Resource/Receptor</th>
<th>Magnitude of Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>Small</td>
</tr>
<tr>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
</tr>
</tbody>
</table>

C4.4.2 **Wadi Araba/Arava Valley**

The potential surface water impacts in the Araba/Aqaba valley are as follows:

- Potential impacts on local surface water drainage systems and associated sedimentation and erosion patterns and water quality due to excavation and construction works associated with the pipeline/tunnel routes and desalination/hydroelectric plants and any associated works, eg chlorination facilities, access roads, tunnel adits and worker camps;

---

(1) This would be a particular issue for the northern intake option, since the catchment area draining to this point is much larger than for the eastern intake option (see Figure C4.4).
- Potentially more permanent impacts on local hydrological regimes due to infrastructural drainage works and in particular the lateral crossings of wadis by the canal sections of the tunnel option, and subsequent secondary impacts on sensitive downstream receptors (1);

- Potential contamination of downstream land and water resources (groundwater) from a seawater conveyance breach at the aforementioned wadi cross-drainage structures, or inundation of operational infrastructure and/or facilities in the northern wadi area.

The potential surface water impacts due to the construction activities are fairly generic and essentially the same as described in Section C4.4.1. As previously stated, these can all be mitigated very effectively at source by the implementation of standard best practices in terms of environmental controls and management practices during construction, particularly during seasonal rainfall periods. Moreover, the majority of these construction activities will take place well away from habitations or sensitive aquatic habitats such that their impacts post-mitigation are likely to be minor to insignificant.

The post-construction impacts on hydrological regimes in the valley due to the physical infrastructure itself have the potential to be more significant since, as shown in Section C4.3.3, the various wadis that cross the conveyance route can generate significant flood events under certain rainfall conditions. In large flood events (greater than the design flood capacity of the structure) localised flooding may occur upstream of the crossing points as floodwaters accumulate behind cross-drainage structures, and in extreme events the structures themselves may become overtopped or undermined such that a structural breach may occur. In addition to the obvious risk to health and safety and potential damage to land and property this would cause as debris and sediment are washed downstream, it could also result in a spillage of seawater from the conveyance that may thereafter contaminate downstream agricultural land or ecosystems and infiltrate into downstream aquifers.

The potential significance of localised flooding at these canal cross drainage points is judged at this stage to be minor, since it is assumed that the cross drainage structure will in the first place be adequately designed to accommodate design floods of a reasonably high return period (typically 1 in 100 years or above for a structure of this importance (2), and also there are unlikely to be any habitations or sensitive receptors in the immediate vicinity of the structures that would be directly affected by the flooding since they are to be situated in remote locations. However, this will need to be verified once the detailed location and design capacity of all of the crossing points is known. Moreover, as recognised in the FS Hydrology Report, the process of

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(1) It is assumed that most other physical works, eg access roads and tunnel adits etc will either be aligned parallel to main drainage pathways, or located away from wadi channel bottoms, such that they do not have any significant potential to disrupt local drainage conditions.

(2) As discussed earlier it is assumed that these design flood calculations would also take full account of potential future climate change over the design lifetime of the project (likely to be 50 years).
determining the design flood capacities for the structures should also include
a site investigation of any observed or apparent flood levels in the relevant
wadis in order to verify/calibrate the design calculations to observed
conditions wherever possible.

The potential significance of a structural breach in the canal would necessarily
depend on the amount of seawater that was released into the surface drainage
system, and the ‘dilution’ effect of the floods that caused it. As a very
preliminary estimate, if we assume that a breach releases 30 m$^3$/s of seawater
from the conveyance at its peak (which gradually diminishes until the breach
flow is halted), and that the breach is caused by a 100 year flood peak of 140
m$^3$/s (i.e. mid-range for the wadis shown in Table C4.3), then the dilution
effect would be almost 1 part in 5 at its peak. Under these conditions, the
potential downstream impacts of the breach on water quality are unlikely to
be significant, particularly if the volume of seawater released is limited by
emergency shutdown mechanisms as will likely be the case. However, this
scenario will need to be further explored during subsequent phases of the
Scheme as more details about the precise location and design of wadi cross
drainage structures and breach response mechanisms become available (1).

Finally, given the potential size of the floods that can occur at the northern
end of the valley (see Table C4.4) careful consideration will need to be given to
the siting of the proposed hydroelectric plant and lower desalination plant in
order to minimise/avoid any flood risk at these sites, and any consequent risk
of inundation and release of contaminants (eg hazardous chemicals or waste
materials stored on site) into the surface water environment. The same would
also apply to the proposed siting of the chlorination facilities at the various
canal re-entry points. Such a flood risk assessment would normally be
routinely carried out as part of the detailed engineering design process, and as
above, would necessarily include a site investigation of any observed or
apparent flood levels in the vicinity of the sites in order to verify/calibrate the
design calculations to observed conditions.

In summary, the significance of the surface water impacts in the valley given
the design and implementation of effective mitigation measures (including the
adequate engineering design of all flood and cross-drainage structures) are
therefore determined at this stage as ‘minor’. However, as detailed above,
further analysis will be required during subsequent phases of the study to
confirm this rating.

(1) It is unlikely that this level of detail will be provided during the feasibility study, in which case the issue would need to
be further investigated as part of detailed design.
Residual Impact Significance (post mitigation)

<table>
<thead>
<tr>
<th>Sensitivity/Value of Resource/Receptor</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Not significant</td>
<td>Minor</td>
<td>Moderate</td>
</tr>
<tr>
<td>Medium</td>
<td>Minor</td>
<td>Moderate</td>
<td>Major</td>
</tr>
<tr>
<td>High</td>
<td>Moderate</td>
<td>Major</td>
<td>Critical</td>
</tr>
</tbody>
</table>

C4.4.3 Freshwater Conveyance Routes

Since the FS Hydrology Report does not at this stage consider the potential flood conditions along the freshwater conveyance routes, they have not yet been considered by this study. Further details will therefore be provided in the final ESA report.
C5 ARCHAEOLOGY AND CULTURAL HERITAGE

C5.1 SCOPE OF THE ASSESSMENT

This section will be developed and completed once the ongoing field survey is finished.

C5.2 APPROACH TO THE ASSESSMENT

The potential impacts to archaeological sites from large scale developments such as the RSDSC arise mainly from the permanent occupation of land and from disturbance to land during construction activities, particularly where such land has lain unused for many years.

At the scoping stage of the ESA it became clear that the RSDSC might involve significant construction on unused land on the eastern side of the Wadi Araba/Arava Valley and in the Dead Sea basin. Significant disturbance of a land corridor east of the DSP was also expected to carry the large volume of freshwater over the escarpment to meet up with the corridor of the Disi pipeline leading to Amman. The other areas of construction are associated with the freshwater conveyances to Israel and the Palestinian Authority. These, while not being precisely defined, are expected to convey much smaller volumes of water and to pass through an existing road corridor.

An initial assessment of archaeologically sensitive areas in Jordan was carried out, based on the review and mapping of over 540 sites that have been published, with co-ordinates, between Aqaba and the southern end of the Dead Sea, and many more that do not have co-ordinates. This pre-existing field data has been produced by many different teams working on various development projects or undertaking research over the years. Inevitably, there have been a variety of approaches to the definition of sites and the interpretation of findings. The information was therefore, reanalysed and refined with the aid of discussions with relevant ministries and individual scholars, and, where necessary, supplemented with a field-based survey undertaken specifically for the study. It is also noted that although there has been considerable archaeological work carried out in the study area there remain large stretches in the Wadi Araba/Arava valley, especially on the eastern side, that remain unexplored.

A number of reliable surveys have been conducted in the areas where freshwater conveyances to Israel and the Palestinian Authority are expected to be sited. Given this, and the fact that pipeline routes are not yet defined but expected to be within the corridors of recently constructed paved roads, no additional field work in these areas is considered necessary at this stage.

The main focus of the archaeological survey will therefore be on the land that lies within Jordan. In an arid landscape the most predictable clusters of
human occupation tend to occur around water sources. Many of the wadis have traces of early water-harvesting installations in the form of channels, aqueducts and reservoirs. Ancient roads and tracks also tended to follow water sources for the use of the travellers and their pack animals. There are also numerous cemeteries, found particularly along the south eastern edges of the Dead Sea basin; the siting of which is not constrained by the availability of water. The survey will pay particular attention to any such areas that might be impacted by the Scheme.

C5.3 Structure of the remainder of this section

This section sets out the context and scope of the archaeological investigations. The following sections are present:

- an overview of the assessment methodology, including sources and techniques used to obtain the data, survey methodology and the criteria for evaluation and mitigation (Section C5.4);

- an outline of the existing legislation protecting cultural heritage in each of the beneficiary parties (Section C5.5);

- the archaeological and cultural heritage baseline, in general and for each of the impacted regions, per project component (Section C5.6);

- the impacts on the archaeological heritage of each project component and the proposed mitigation measures (Section C5.7);

- a detailed overview of mitigation measures and their implementation prior to and during construction (Section C5.8);

- a summary of the most significant impacts identified to date (Section C5.9).

In addition, the following supporting annexes will eventually be included in Part D of the final ESA report:

- Annex VII - Archaeological and Historical Sites Survey Report, including a set of detailed maps showing all the sites that are potentially impacted and need mitigating measures; a set of tables accompanying the maps, and providing details of the shown sites, including coordinates; a bibliography; and, (on CD) the ArcGIS maps and the linked database (in Access).

- Annex VIII - Archaeological Chance Find Procedures to be included in the contractors’ construction environmental management plans.
C5.4  **ASSESSMENT METHODOLOGY**

C5.4.1  **Sources of Information**

The assessment was carried out using both previously published (and in some cases unpublished) data and the results of a field survey that was undertaken in December 2009 and February 2010 (and is ongoing at the time of writing).

Each of the beneficiaries involved had their own approach to the storage of archaeological information. Most of which is available in various databases, controlled and managed by the respective Departments of Antiquities (DoA).

The main databases obtained from these sources have been integrated into one. However, additional, more extensive information about individual sites and survey regions is provided for most sites by the original researchers, in published reports. Therefore, additional information about sites, and additional sites not in the databases provided, have been added to our master database and used as the basis of this present study.

Sources of information used include the following:

- **Jordan**: For Jordan the JADIS database contains basic information about most recorded archaeological sites in the country. Additional sources used are the published reports of relevant surveys (details will be added when the survey has been completed).

- **Palestinian Authority**: The main source of information for the segment of the desalinated water pipeline in the PA is *Israeli Archaeological Activity in the West Bank, 1967-2007: A Sourcebook*, by R. Greenberg and A. Keinan. For information before 1967 and after 2007 the Palestinian Department of Antiquities has been contacted.

- **Israel**: The Israel Antiquities Authority (IAA) controls the database of archaeological excavations and surveys in Israel and has made this available to the project.

C5.4.2  **Field Survey of Potentially Affected Areas**

**Introduction**

Large areas of Jordan have been the subject of archaeological surveys in the past, but the coverage of these varies considerably. The aim of the present field survey was to inspect those areas that have not been previously surveyed, and to fill in some gaps in previously surveyed areas within the area impacted by the Scheme. To this end, a field survey was carried out to determine the presence of archaeological remains in certain Scheme areas. By combining the results of this field survey with the study of previous and published fieldwork, a reasonably complete picture emerges of what sites lay in the line of the Scheme.
The scoping of the study suggested which areas should be surveyed during the present field work, and how priority areas should be identified. Survey methods for each area were also adjusted according to terrain; the existence and findings of previous research; the likelihood of finding archaeological remains; and, the likely requirements of the Scheme in the vicinity (either a 100m linear corridor, or a block of land).

*Table C5.1* below details all archaeological periods dating from ~1.7m until the Islamic period at present and includes all periods found in Jordan.

**Table C5.1  Archaeological Periods in Jordan**

<table>
<thead>
<tr>
<th>Period</th>
<th>Abbreviation</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palaeolithic</td>
<td>Paleo</td>
<td>~1.7m-21,000 BC</td>
</tr>
<tr>
<td></td>
<td>Upper Pal</td>
<td></td>
</tr>
<tr>
<td>Epi-Palaeolithic</td>
<td>Epipal</td>
<td>~21,000-10,100 BC</td>
</tr>
<tr>
<td>Neolithic</td>
<td>Neo</td>
<td>10,100-5000 BC</td>
</tr>
<tr>
<td>Pre-pottery Neolithic</td>
<td>PPNNeo</td>
<td></td>
</tr>
<tr>
<td>Pre-pottery Neolithic A</td>
<td>PPNA</td>
<td></td>
</tr>
<tr>
<td>Pre-pottery Neolithic B</td>
<td>PPNB</td>
<td></td>
</tr>
<tr>
<td>Pottery Neolithic</td>
<td>PN</td>
<td></td>
</tr>
<tr>
<td>Pottery Neolithic A</td>
<td>PNA</td>
<td></td>
</tr>
<tr>
<td>Pottery Neolithic B</td>
<td>PNB</td>
<td></td>
</tr>
<tr>
<td>Chalcolithic</td>
<td>Chalco</td>
<td>5000-3600 BC</td>
</tr>
<tr>
<td>Early Bronze Age</td>
<td>EB</td>
<td>3600-2000 BC</td>
</tr>
<tr>
<td></td>
<td>EB I</td>
<td>3600-3000 BC</td>
</tr>
<tr>
<td></td>
<td>EB II</td>
<td>3000-2700 BC</td>
</tr>
<tr>
<td></td>
<td>EB III</td>
<td>2700-2300 BC</td>
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<tr>
<td></td>
<td>EB IV</td>
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<td>Middle Bronze Age</td>
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<td>2000-1550 BC</td>
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<td></td>
<td>MB I</td>
<td>2000-1800 BC</td>
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<td></td>
<td>MB II</td>
<td>1800-1550 BC</td>
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<tr>
<td></td>
<td>MB III</td>
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<td></td>
<td>LB I</td>
<td>1550-1400 BC</td>
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<tr>
<td></td>
<td>LB II</td>
<td>1400-1200 BC</td>
</tr>
<tr>
<td></td>
<td>LB III</td>
<td></td>
</tr>
<tr>
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<td>IA</td>
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<tr>
<td></td>
<td>IA I</td>
<td>1200-1000 BC</td>
</tr>
<tr>
<td></td>
<td>IA II</td>
<td>1000-539 BC</td>
</tr>
<tr>
<td>Persian Period</td>
<td>Per</td>
<td>539-332 BC</td>
</tr>
<tr>
<td>Hellenistic Period</td>
<td>Hel</td>
<td>332-63 BC</td>
</tr>
<tr>
<td>Roman</td>
<td>Rom</td>
<td>63BC-AD324</td>
</tr>
<tr>
<td>Nabataean</td>
<td>Nab</td>
<td></td>
</tr>
<tr>
<td>Byzantine</td>
<td>Byz</td>
<td>AD 324-640</td>
</tr>
<tr>
<td>Islamic</td>
<td>Isl</td>
<td>AD 640-today</td>
</tr>
</tbody>
</table>
Nature of the Terrain

The study area is very sparsely populated with very limited temporary Bedouin camp sites and no permanent dwellings visible in or around the sites at the time of the survey. In the Wadi Araba, the landscape is hilly and mountainous (generally granitic rocks with some sandstone) to the east and flat sandy desert to the west. In mountainous areas crossed by the freshwater conveyance going east, the bedrock at the western, bottom end is sandstone, and becomes mostly limestone going east. In the mountainous areas wadi terraces are the most likely places to find occupation remains, and hilltops often have burials, hill forts or watch towers, while the hillsides are usually devoid of remains. Targeted walking survey in these landscapes therefore focused on wadi bottoms and hilltops.

Some mountainous landscapes are defined by sheer cliffs and therefore are unlikely to have archaeological remains. They are also difficult and dangerous to access and therefore these areas have not been surveyed, neither by previous, nor the present survey.

Other areas that were extremely difficult of access included mountainous or hilly areas, and others that take unreasonable amounts of time to reach (i.e. very far from the nearest point accessible by car). The few such locations within the study area were mostly associated with the first 30-40 kilometres of the freshwater conveyance – the stretch between the Dead Sea Highway and the town of Tafila. Such areas have not been surveyed by the present project, even though they may have archaeological remains. These areas are particularly recommended for monitoring directly prior to and/or during construction.

The flat, sandy areas that are very prevalent in the southern portion of the seawater conveyance route may well have archaeological remains, but these are often buried layers under wind-blown sand, and therefore invisible. Consequently, only relatively recent and/or large structures will be visible during surface surveys. Systematic walkovers of targeted areas were undertaken to provide the best coverage of these areas.

Techniques Used

The techniques used were:

- systematic walkover survey;
- drive-over survey;
- targeted sample survey.

The survey areas subject to systematic walkovers were the proposed component areas demarcated on the plans provided by the Feasibility Team including:
• long narrow stretches of land proposed for canals or dug-in pipelines;

• rectangular blocks of land proposed as alternative desalination and hydropower plant sites;

• rectangular blocks of land around the surface entrances of proposed tunnel portals.

The long narrow stretches were walked lengthwise with three to five people spaced, on average, 20 m apart, thus covering a corridor of 80-100 m. This method ensures finding most sites, including structures, graves and sherd/flint scatters.

The blocks of land, for tunnel adits and factory sites were sampled either by systematic walkover (when flat) or by targeted walkovers, depending on the terrain, as described above.

Some stretches, primarily the long narrow sections of the saltwater pipeline route, with a low likelihood of sites but accessible via tracks, were surveyed using a 4x4 vehicle. Such areas were traversed slowly (maximum 20 km/h) while the terrain was scanned by two independent observers. Any suspected archaeological remains were investigated on foot and confirmed sightings were recorded.

Certain stretches of the saltwater pipeline route were not surveyed at all because they were either crossing a dune field (which would obscure any sites present) or where the route crosses an area where there is still a possibility of live land mines.

Areas Surveyed

In Jordan, some stretches of the Scheme areas have been the subject of research in the past, and sites were recorded in various databases, most of which have been collected in the JADIS database, property of the Department of Antiquities of Jordan (DoA). Because of this previous research, these areas were given a lower priority. Where the previous survey has been thorough, the area has not been covered again, even though there is still the possibility of finding (minor) sites. In areas where the previous survey has not been thorough (as deduced from the reports or from communication with the researcher) the line has been resurveyed and all accessible areas that have not been previously surveyed were surveyed subject to the restraints outlined above.

All the sites recorded during this survey should be revisited and the exact juxtaposition to the final route alignment recorded. If they are to be removed as a result of any construction associated with the Scheme, the decision can then be made as to whether they need to be excavated (see mitigation below).
C5.4.3 Methods of Impact Prediction and Evaluation Criteria

With regard to archaeological remains the potential impacts of the Scheme are the same for all its stages. If a site occurs within the right of way of the Scheme, the impact upon it is total; in other words any site will be subject to destruction during the construction of the Scheme, unless this site is avoided by re-alignment of the relevant Scheme component (see mitigation below). For archaeology there are no temporary impacts, only permanent ones (see impact assessment below).

If a site occurs near to the Scheme area, it may not be impacted directly. There is, however, the possibility of incidental (deliberate) damage to visible sites or accidental damage because of construction or workers’ activities in the vicinity of sites. Areas adjacent to, or on a route between sites may, therefore, need some protection.

Thus the impact on sites is either total (within the Scheme area) or potential (nearby the Scheme area), and the chance of the impact occurring is largely based on its geographical location relative to the project area.

C5.4.4 Consultation

The DoA have been joint partners in the archaeological field survey undertaken, and have been consulted on the evaluation of the importance of the sites that have been recorded by the survey. The results of this are presented below.

The Israel Antiquities Authority has given access to its archaeological archives, and been cooperative throughout. The Palestinian Department of Antiquities has been approached but has so far not responded to requests for information.

Many individual researchers and institutions have been approached and almost all have been cooperative. A list of institutions and scholars is provided in Annex VII (to be included in preliminary draft ESA report).

C5.4.5 Evaluation and Assessment of Archaeological Sites

The evaluation of the importance of archaeological sites has been determined by a combination of the following factors:

- site condition;
- type of remains present;
- period of site;
- site size; and
- site context.
Each site was evaluated based on these factors and given an assessment value on a scale from 1 to 6, where each number on the scale corresponded to the measures recommended to mitigate any potential damage (see Section C5.7).

C5.5 **LEGAL AND POLICY CONTEXT**

C5.5.1 **Jordan**

Cultural heritage in Jordan is protected under the Antiquities Law of 1988, No. 21, amended by Law No. 23 of 2004. According to Article 13a of this law it is prohibited to license the establishment of any structure, including buildings and walls, unless it is about 5 to 25 meters away from any antiquities, against fair compensation.

Under Article 13b, it is permissible, by a decision of the Minister on the recommendation of the Director, to increase the distance mentioned in Paragraph ‘a’ of this article if necessity requires in any of the following cases:

- protection or maintenance of the antique site;
- expansion of the antique site;
- to secure that the antique site is not obscured by any construction.

Under Article 13c it is prohibited to set up any heavy or dangerous industries, lime furnaces or stone quarries at a distance less than one kilometre from the location of the antique sites. In all cases, prior approval of the Department shall be given before inviting offers or awarding tenders for engineering services, designs and sketches and preparing the documents of public and private project tenders.

C5.5.2 **Israel**

The Antiquities Law of Israel dates from 1978 and contains the following relevant excerpts:

- 28.(a) The Director [of the Department of Antiquities] may declare a particular place to be an antiquity site.

- 28.(b) When the director declares as aforesaid, a note to such effect shall be entered in the Land Register and notice shall be given to the owner and the occupier of the place, if their identity or addresses are known, and to the District Planning and Building Commission.

**Prohibition of operations on antiquity site**

- 29.(a) A person shall not carry out, or allow to be carried out, any of the following on an antiquity site, save with the written approval of the Director and in accordance with the conditions thereof:
(1) building, paving, the erection of installations, quarrying, mining, drilling, flooding, the clearing away of stones, ploughing, planting, or interment;

(2) the dumping of earth, manure, waste or refuse, including the dumping thereof on adjoining property;

(3) any alteration, repair or addition to an antiquity located on the site;

(4) the dismantling of an antiquity, the removal of part thereof or the shifting thereof;

(5) writing, carving or painting;

(6) the erection of buildings or walls on adjoining property;

(7) any other operation designated by the Director in respect of a particular site.

(b) Notice of the designation of an operation under paragraph (7) of subsection (a) shall be published in Reshumot.

(c) When an antiquity site is used for religious requirements or devoted to a religious purpose, the Director shall not approve digging or any of the operations enumerated in subsection (a) save with the approval of a Committee of Ministers consisting of the Minister as chairman, the Minister of Religious Affairs and the Minister of Justice.

Saving of Law

• 30. The provisions of this Law shall not derogate from the requirement of a permit under the Planning and Building Law, (5725-19652)

Restoration to previous condition

• 31. A person who has carried out one of the operations specified in section 29 without approval or in contravention of the conditions of the approval, shall take action, in accordance with the directions of the Director, to restore the antiquity site of the antiquities situated thereon to its or their former condition; but the Director may, after giving the person written notice, himself take all the steps required for that purpose and recover from him the expenses incurred.

C5.5.3 Palestinian Authority

In the Palestinian Authority the Ministry of Tourism and Antiquities, and the Ministry of Culture share the responsibility for the protection of archaeological sites, but there is no unified legal code for the Palestinian Authority.
Different laws are applicable in different areas. In the area that may be affected by aspects of the RSDSC, the basis of the law is formed by the Jordanian Law of Antiquities of 1966. The Palestinian Basic Law of 2003 contained a paragraph relevant to Heritage Protection; the President swears, “[...] to be faithful to the homeland and holy places, to the people and its national heritage [...].” This is currently the only reference to heritage, limited as it is, in the draft constitution. Since there is not yet an approved Palestinian constitution, the protection of cultural and natural heritage remains, until today, without a solid constitutional basis.

C5.6 BASELINE

C5.6.1 Overview of the RSDSC Area

Archaeological sites in the area of the Scheme can be broadly categorised as sites of major or of minor interest. The former usually have substantial structural remains and therefore, constitutes major tourist attractions. Jerash, Petra and Umm Qais are the obvious examples, in Jordan, of such sites and this class of site is, in the future, likely to be the subject of increased interest, from the scholarly point of view as well as for the development of Jordan’s cultural heritage. Figure C5.1 shows some of the major sites in the study area. More maps and photographs will be provided in the Preliminary Final ESA Report following completion of the ongoing survey.

Figure C5.1 Major Cultural Sites

All maps produced as a part of this study are being checked by the World Bank Map Design Unit. An approved set of maps will be included in the Preliminary Assessment Report.

In the PA the site of Qumran is of international, as well as national, interest and in Israel the sites of En Gedi and Masada, (the latter having UNESCO world heritage status) are of international importance. Increased interest in such major sites and cultural heritage in general in the future is likely to lead to increased interest and awareness of all archaeological sites and the wish to study and preserve them where possible.

Sites of minor or limited interest, which constitute the vast majority of recorded archaeological sites are, nevertheless, generally not likely to change in the foreseeable future. There will be exceptions, of course, because some sites will be excavated as part of specific archaeological research projects, others as part of rescue projects prior to destruction through development,
and others still will be destroyed either deliberately or otherwise, with no record being made of them.

There will also certainly be survey projects in the future for various parts of the countries involved, but the location of these cannot be predicted.

Regarding the sites and areas in the vicinity of the Scheme in Jordan, there are no major projects currently foreseen for the long-term future. However, currently there are several large projects conducting seasonal excavations and surveys. Three are in the Wadi Finan area, and these will continue for a few more years (Khirbet Nahass and WF16 excavations, Barka survey). Further south, in the area of Bir Mathkour, there is currently a seasonal field survey project and the likelihood of further work in this area is reasonably high. In addition there are some limited excavations at the small site of Gharandal.

Furthermore, there have been moves to nominate the area of Wadi Finan as a World Heritage site (to be attached to the Dana Reserve which is adjacent to it) and, recently, interest has been expressed to undertake more excavations of some of the major sites in this wadi.

In Israel the Archaeological Survey of Israel is a systematic survey project covering the whole country in 10x10 km squares, which is still ongoing. Most of the Scheme area still needs to be surveyed, and this project will be ongoing for the foreseeable future.

Given this general status of archaeological sites, sites that occur within the whole region of the Scheme will not be affected one way or the other by the presence or absence of the Scheme, with the exception of the direct impact on any sites that lie within the path of the Scheme. Thus, if the Scheme is granted approval, these sites will need to be handled according to the mitigation measures outlined below, and if the Scheme does not go ahead, these same sites will be left as they are today.

Figure C5.2 below illustrates the important archaeological sites found within the Jordanian, Israeli and Palestinian Jurisdictions.

**Figure C5.2 Main Sites Close to Scheme Components**

All maps produced as a part of this study are being checked by the World Bank Map Design Unit. An approved set of maps will be included in the Preliminary Assessment Report.

The following sections provide an overview of the archaeology of the geographical sub-divisions.
C5.6.2 Western Freshwater Pipeline Route

Palestinian Authority

From the Palaeolithic to Neolithic Era (see table of archaeological periods above), Lake Lissan covered the area in which the western freshwater pipeline is projected, with the exception of parts of the plain south of Jericho.

The earliest evidence of human activity in the general area dates from the middle Kebaran, within the Epi-Palaeolithic period and consists of worked flint, mostly microliths of a specific type.

During the Epi-Palaeolithic, around 12,000 BC the Kebaran culture was replaced by the Natufian culture, characterised by round houses as well as extensive use of caves for occupation, stone sickle blades, worked and decorated bone and stone tools, and a rich funerary culture. No Kebaran or Natufian sites have been found in the Jericho Plain, but several were found to the north and east of it and it is possible that further fieldwork in the area reveals site from these periods.

The Neolithic Era (10,000-5,000 BC) saw the beginnings of agriculture and pastoralism in the entire near east, and consequently led to a significant increase in settlement. It is subdivided into two main periods: the Pre-Pottery Neolithic and the Pottery Neolithic. The Neolithic period is most prominently represented in the region by Tell es-Sultan, ancient Jericho. Tell es-Sultan is in fact just outside the area of study, north of the modern town of Jericho. However, four caves in the Qumran area have revealed Neolithic remains, and it is possible that other caves along the shoreline likewise have Neolithic remains.

The Chalcolithic (5,000-3,600 BC) is the first period in which people mastered the art of working copper, albeit still on a small scale, and generally for cultic purposes. The Chalcolithic is represented at a number of sites along the entire Dead Sea shore, mostly caves and rock shelters.

The Bronze Age (3,600-1,200 BC) is the first period for which written sources exist, and consequently more is known about this period. The Bronze Age is subdivided into three main periods: the Early Bronze Age (3,600-2,000 BC), the Middle Bronze Age (2,000-1,550 BC) and the Late Bronze Age (1,550-1,200 BC).

During the first half of the Early Bronze Age settlement continued to increase in most of the region, as witnessed by various finds in caves. However, during the latter half of the Early Bronze Age occupation in the area declined and so far no sites have been found with Middle and Late Bronze Age remains.

During the Late Bronze Age the region was part of the Egyptian Empire, during which occupation was concentrated mostly in the north and west of the country. After the decline of the Egyptian Empire the region became
politically fragmented, and new, small kingdoms arose, notably Israel, Ammon, Moab and Edom. This period known as the Iron Age (1,200-539 BC), is subdivided into IA I and 2. A large number of new settlements were established, but most of these were in the north of the country, outside the area of study (many of the sites designated as ‘IA’ in the table are undetermined Iron Age and may belong to either of the two major periods).

During the latter half of the Iron Age the region again fell under the supremacy of an external empire, the Assyrian, and later the Babylonian Empire. The number of settlements expanded further in this period, and many sites are found along the Dead Sea shores and in the region south of Jericho.

No sites dating to the Persian period have been found, but recent research has shown that in the mountainous part of the region (eastern Palestine and Transjordan) the material culture remained virtually unchanged from the Babylonian to the Hellenistic period, so that Persian sites may have remained unrecognised.

Hellenistic period finds again come mostly from caves, but there are some multi-period fortresses along the shore that had some Hellenistic objects.

Near Wadi Qumran a religious settlement has been excavated, remains of which stretched along the north-western shore of the Dead Sea for a length of about 6 km. It dates to the Hellenistic – Roman period. The site consists of a main building complex with secondary buildings on the coast, an irrigation system and a complex of caves, in which the famous Dead Sea scrolls were found. Two sites to the south of it, Ein Feshka and Ein Ghuweir, formed part of the original community. The site is presently under the auspices of the Israeli National Park Authority, in spite of the fact that it is in the Palestinian Authority. As it is a site of international importance it will have to be avoided.

The Byzantine period was a time of economic prosperity in the region. Scholars generally agree that there was a peak in population in this period. Many of the sites from this period are religious: either churches or synagogues. Most of these are found in the Jericho plain, north of the Dead Sea.

During the occupation of the Palestinian Authority by Israel, numerous survey and excavation projects were carried out in the area. These have been recently collected in a database by R. Greenberg and A. Keinan (1) which is used here as the basis for the study. Several areas have been surveyed intensely, but not all surveys have been published, and of those that have been, many are in Hebrew.

The Jericho plain, north of the Dead Sea has been surveyed by Sion (1997), but so far only a small map of his sites has been published, with little detail.

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Further south survey has generally focused on the many caves that border the Dead Sea shoreline. These have revealed occupation from every period from Neolithic onwards, until modern times.

Israel

(This section will be reviewed/completed once the ongoing field survey is finished)

Further to the south, still on the shores of the Dead Sea, in Israeli territory, is the site of En Gedi. En Gedi is a major oasis and was a Jewish community from the 7th century BC until the 5th century AD. It was a centre of balsam production, and houses the restored remains of a synagogue from the Byzantine period, with extensive mosaics. It is an Israeli National Park of international importance.

At the southern end of the Dead Sea is the World Heritage site of Masada, which was destroyed in 74 AD by the Romans and which has become a symbol of Jewish resistance against Roman occupation. The site consists of the fortress of Masada itself and the surrounding area of the Roman camps. Both these sites would need to be avoided by the Scheme.

Dead Sea Basin

(This section will be reviewed/completed once the ongoing field survey is finished)

At about 23,000 BC, the level of the Dead Sea (known as Lake Lissan, see above) reached up to a maximum level of about 180m below sea level and filled the whole of what is now the Jordan Valley from the area about 40km south of the southern end of the Dead Sea today up to Lake Tiberias. From about 13,000 BC onwards, the lake has been gradually drying up (a phenomenon that has been greatly increased in modern times by the forced evaporation of the potash factories in both Jordan and Israel and by the many water diversion systems put in place). In terms of archaeology, this means that there will be no sites earlier than 23,000 BC found below an altitude of ~180m, and nothing earlier than 14,000 BC below ~260m.

However, subsequent to the shrinking of the lake, the well-watered areas surrounding it have proved ideal for human habitation and use, and there are many sites on the flat areas along the old eastern lake margins, particularly near to fresh water springs.

The RSDCS Scheme Zone A (see Part A) lies at the southern end of the Dead Sea basin, in a flat area of deep sands.
Wadi Araba/Arava Valley

(This section will be reviewed/completed once the ongoing field survey is finished)

Studies have shown that the southern part of the Araba valley floor is covered with a variety of deposits which can be summarised as: Holocene to Pleistocene alluvial fans at the mouths of wadis composed of sediments that have washed down from the mountains, mudflats (in which the water from any seasonal flow in the wadis accumulates), and sand dunes (from eroded sandstone mountains). It seems that the arid and difficult climate of today has been less severe at various times in the past, which is illustrated by the presence of sites from certain periods and not others.

There are very few sites from the Palaeolithic to Neolithic Era times so far recorded. This may in part be because there are, indeed very few sites, and/or that sites from these periods have been buried under more recent deposits. In fact some sites have been found under up to 6 metres of deposits.

Chalcolithic to Early Bronze Age sites are relatively frequent, as are sites from the Roman/Nabataean period, suggesting that these periods were wetter than at other times. A few of the sites from these periods suggest permanent settlement, perhaps associated with agricultural exploitation, which could have been possible, with the use of water-harvesting techniques, in a slightly wetter environment than today’s. Some sites also seem to have been settled for much longer periods.

Although direct evidence for Neolithic sites in the valley itself is not forthcoming, it is clear that the valley was used by trade routes, since green beads from Sinai have been found at a number of sites in the hills to the east of the rift (Basta east of Petra, Beidha near Petra and ’Ain Ghazal in Amman).

In the northern part of the valley, Palaeolithic sites are also virtually absent, again, perhaps either because they are buried, or eroded away.

Copper mining and smelting was very important in two main locations in the valley – Finan (in Jordan) and Timna (in Israel) and so there is a concentration of sites in these areas.

In Finan there is evidence of copper exploitation, and associated settlements, from the Chalcolithic and Early Bronze Age, Iron Age, Roman and Byzantine and Islamic times. Permanent springs in several of the wadis have provided water for an extensive system of agricultural fields that seems to date back to the Neolithic Era. Near the wadi mouth there are two important excavated sites: one that dates back to the Epi-Palaeolithic (WF 16), and one that dates to the Neolithic (Wadi Ghuweir 1). It seems, therefore, that the Finan area, thanks to its springs and copper ore, has been more or less continuously inhabited, to a greater or lesser extent, from at least the Neolithic Era onwards. These early sites are of regional significance since they document the very beginnings of settled and agricultural societies. One of the Scheme elements,
the northern stretch of the 220m canal, and/or an adit for the 0m tunnel, goes through this sensitive area, which will need to be avoided.

At Timna, the mines were exploited by the Egyptians in the Late Bronze Age. There is some archaeological evidence of contacts with the Midianites of Saudi Arabia (in the form of Midianite pottery at Timna) and thus there must have been trade routes passing through the Wadi Araba linking the two regions.

Qasr Telah area is regionally significant because it comprises a major ancient field system, one of the better preserved Roman forts in the Araba valley and a large reservoir and channel system. There have been no excavations in the area apart from a small excavation of the channel directly adjacent to the reservoir. The whole complex is generally thought to date to the Nabataean and Roman periods; there is documentary evidence suggesting that it was the place of a Late Roman garrison. Zone C stands on the hills directly above and to the south-east of this significant site and the penstock route passes very close to it.

**East–West Routes**

There are several areas that have from ancient times until the recent past (before the political situation made access impossible) been used as east–west crossings. These passes are often marked by the presence of fortresses, caravanserais and burial sites, as well as smaller remains, such as tent camps, enclosures and sherd scatters. The main passes (from north to south) are:

- The crossing through Wadi Dahal.
- The crossing through Wadi Finan to En Hatzeva.
- During Nabataean times, there was a route linking Petra, in the eastern highlands, with the coastal port of Gaza, crossing the Wadi Araba past Bir Mathkour. This route has a number of caravanserais and way stations along it and it is clear that was in use from about the 3rd century BC at least until Byzantine times.
- The crossing past the fort of Gharandal through Wadi Gharandal.

(*The following will be completed once the ongoing field survey is finished*)

The adits are mostly sited on old alluvial fans, at the mouths of wadis flowing down from the eastern mountains that border the Wadi Araba. The southern 220m canal section crosses mostly flat land in the wadi bottom, on which there are many small sand dunes. The northern 220m canal section crosses old alluvial fans and areas of large boulder fields at the foot of the mountains. The salt water conveyance pipeline will run down the centre of the Wadi Araba, crossing areas of deep sand, mudflats, sand dunes and some low hills.
Aqaba/Eilat Urban/Industrial Area

(This section will be reviewed/completed once the ongoing field survey is finished)

The history of this area stretches at least as far back as the days of early settlements. There are some major sites belonging to the Chalcolithic and Iron Ages, followed by the Nabataean, Roman, Byzantine and early Islamic towns of Aila/Ayla and finally the Mamluk-Ottoman fort on the coast, in what is now the modern town of Aqaba.

In ancient times, as today, the ports of Aqaba and Eilat connected this area with the world, offering a route for trade, particularly with Africa and the Far East.

In Jordan, the earliest evidence of sedentary occupation in the area published thus far comes from excavations at Tell Magass, which lies ca. 4 km north-east of Aqaba airport. This Chalcolithic site consists of a single period of occupation, dating to the mid-fourth millennium BC. Hujayrat al-Ghuzlan is another excavated Chalcolithic site located just 1.5 km to the east of Tell Magass. These sites lie on low alluvial terraces along small tributary wadis that flow down across the Wadi Araba.

Following the Chalcolithic period it seems that there is a gap in the occupation in Aqaba that lasted from the fourth millennium until the eight century BC (Iron Age), at which time Tell al-Khalifeh was founded. This Tell is virtually on the modern borderline and situated much nearer to the present coastline than the Chalcolithic sites. Excavations at the site showed that it was a copper producing and commercial centre.

Strategically situated on ancient trade routes, Aqaba saw much activity in the Nabataean/Roman and Byzantine period. The sites of this era are situated on the valley floor, close to the sea. Various segments of the area covered by these sites have excavated and many structures related to the Nabataean/Early Roman and Byzantine period towns have been found.

During the second century AD the via nova Traiana was built, connecting Damascus with Aqaba, and during the fourth century a structure was built that is believed to be the earliest purpose-built church. Aqaba continued to be occupied during the Islamic period and there are two important sites of this period. The first is the Early Islamic Ayla, dating from the 7th–12th centuries AD, located just south of the Movenpick Hotel, and the second is the Late Islamic castle dated to the 13th–19th centuries. Both these sites have been excavated and preserved in recent years and are one of the attractions for visitors to Aqaba.

From the recent past there is the house of Sherif Hussein bin Ali, which stands beside the castle and has been turned into the Aqaba Museum.
The modern town of Aqaba has developed around the ancient fort and has now expanded far beyond the limits of any of its more ancient predecessors.

The present Scheme physically avoids the modern town of Aqaba, and therefore the archaeology of this area will not be affected by it.

C5.6.3 Eastern Freshwater Pipeline Route

The surveys that have been conducted previously in the areas crossed by the proposed pipeline route (MacDonald, Clark, Fiema (1)) found many sites, with a significant proportion of Palaeolithic sites that, in the highlands and plateaux, become more dense as one moves eastwards. With regard to all subsequent periods, sites were found from all other periods, with the notable exception that there is virtually no Persian material.

The Western Section

The western section of the freshwater conveyance alternative 3 starts at the Desalination Plant above Wadi Telah, and runs northwards through the lowest foothills of the eastern margins of the Rift Valley. This is broken country of bare rocks, consisting mostly of sandstones. The line then turns east rising steeply up through very rugged landscape of sandstone cliffs and deeply dissected wadis and up into the limestones towards the plateau. (See central section, below.)

This stretch of the pipeline runs through the area that has been surveyed by the Southern Ghors and Northeast Araba Survey (SGNAS), and where the pipeline joins the Feifeh – Tafileh road, it enters into an area that has been surveyed by the Ghor Feifeh-Tafileh Survey (GFTS). Sites from a variety of periods have been noted.

The Central Section

The underlying geology of this area consists of the Ajlun and Balqa Groups, Cretaceous formations, composed predominantly of limestones and marls. This forms a high plateau area.

The pipeline crosses the survey area of the Tafileh-Buseira archaeological survey (TBAS). This survey found many sites, with a significant proportion of Palaeolithic sites, which becomes denser as one moves eastwards. Research suggests that these sites were concentrated around ancient lakes that have now completely disappeared. Sites were found from all subsequent periods, with the notable exceptions being a total lack of Middle and Late Bronze Age material, and virtually no Persian or Hellenistic material.

Where the pipeline crosses the Tuwana road, it enters an area that has been previously surveyed (Tuwana survey), following the Via Nova Traiana.

(1) Reference details will be provided in the Preliminary Draft ESA Report
The Eastern End – Wadi Hasa

Wadi Hasa is the only perennial stream that flows down from the central Jordanian plateau down to the Rift Valley. Because of the availability of water, occupation along the Hasa spans the whole of human history, from the Palaeolithic through to today.

In its upper reaches (where the eastern end of the freshwater pipe will cross), the Wadi Hasa crosses the remnant plain of a former lake bed that was formed by the damming of the wadi, probably in the Upper Palaeolithic era (c. 26,000 years ago). This lake may have been in existence, during wet periods, until about 20,000 years ago. However, by about 7000 BC, the plain consisting of the former lake bed was dissected by many small, incised tributary wadis that extend up onto the deflated upland plateau and are still the major feature in today’s landscape.

Previous surveys in the Wadi Hasa area (Wadi Hasa Survey WHS), Wadi Hasa North Bank Survey WHNBS) have found a vast number of sites, covering all periods (except the Persian period (539-332BC). All surveys report a high level of background lithics (i.e. flint artefacts dating largely to the Palaeolithic period). This same ubiquitous flint scatter was observed by our field survey, across the whole landscape. All other periods are almost all surprisingly well represented, and it is clear that the Wadi Hasa, no doubt because of its permanent water, has been much used throughout human existence.

C5.7 IMPACTS AND MITIGATION

C5.7.1 Sources of Impact

As mentioned earlier, for the potential impact to archaeological sites the main concern will be physical disturbance. Such impacts will all occur at the construction stage of the Scheme, regardless of its particular components, and are all by default permanent impacts for those sites that lie directly in the Scheme area, including access roads. These impacts will come mainly from earth removal, construction and dumping of waste rock.

Permanent impacts (i.e. partial or total destruction of a site) will be caused by the disturbance of the ground as a result of:

- the construction of the work camps and any areas that will have temporary or permanent structures;
- temporary and permanent roads for access and maintenance;
- areas where rock from the tunnel construction will be dumped;
- trenching for laying pipelines; and
• re-flooding of the Dead Sea may, eventually, mean that a few lake-shore sites may be under water. Ain Zara, on the eastern shore, is one such site, which in any case, had been under water until the recent reductions in the level of the sea.

Temporary impacts that may arise from potential leakage (either slow leaks or flooding) are not of concern for the archaeological sites, since there are no significant organic remains preserved on most sites in the arid environment of the Araba.

For sites that lie close by the Scheme area, there is always the danger of accidental or deliberate damage. Accidental damage could easily occur, for instance, by large machinery driving over a site. Deliberate damage usually occurs either when people take stones from ancient structures to reuse them or carry out illegal excavations in the hopes of buried treasure.

C5.7.2 Determining Site-Specific Impacts and Mitigation

Our assessment of the impact on specific archaeological sites is based on the ‘concept’ routes and adit locations as set out by the Feasibility Study team in December 2009. The routes and adits may be constructed at slightly or very different locations depending on the outcome of detailed design. Similarly the precise locations of access roads, work sites and spoil disposal sites cannot be known at this stage. Nevertheless, the findings of the survey will help determine the areas that should be avoided by re-routing or relocating the relevant Scheme component so that any sites of major significance can be left intact.

If the actual location of the routes and adits changes, the survey and background research should provide a very good sample of the type of sites that might be encountered in any particular area. Thus, the survey will help project decision makers, developers and eventual construction contractors to understand the archaeological context of each area and give a good idea of what may be found in the different areas in which construction activities are planned. It will also indicate the value of such sites and describe how damage should be prevented.

One major benefit of the archaeological survey and of any further archaeological work that will be carried out as part of the Scheme, is the additional knowledge provided. As it adds new information that helps to present the archaeology of the area in its context and that can, for example, be used to enhance interpretation of sites for presentation to the public.

Once the construction contract is awarded, and the real locations of the open canal sections, adits, or pipeline and construction camps (workers’ accommodation, access roads and site access, construction sites including storage and parking) and temporary infrastructure sites (e.g. tunnel portal worksites, pipeline manufacturing plant, administration buildings, wells,
aggregate production plants, concrete segment factories are known, those specific sites will need to be surveyed, if they lie outside the areas in the current fieldwork stage. Also all other areas that will be impacted by any construction or earth moving by the Scheme, that has not been previously surveyed, will need to be surveyed as part of a detailed Chance Find Procedure plan.

Any sites that have been assessed as needing further work, that lie within the impact area, will need to have the work carried out according to the requirements based on the assessment of the importance of the site (see below for assessment categories). This work will be carried out in cooperation with the Department of Antiquities of the relevant country.

C5.7.3 Site-Specific Impacts

Following is a brief review of the sites found in each component area that highlights the most important sites. The complete data for all the sites can be found in Appendix VII (to be included in Preliminary Draft ESA Report). Sites are shown on the overview maps shown below, and, in addition, for each section in which known archaeological remains occur, a detailed map set has been provided in Appendix VII (to be included in Preliminary Draft ESA Report).

The detailed maps show the sites, published and found during the recent survey, with their ID number. On the detailed maps only sites that need further work if/when impacted are shown (ie Assessment categories 2-6). The ID numbers on each map set correspond to the ID numbers on the accompanying tables. These tables give detailed information of each site: the number assigned by the excavator/surveyor of the site, name where applicable, its location in UTM coordinates, size and elevation where known, the source of information, a short description of the site, its historical dating(s), topographical location in the landscape, and the assessment code (see below). The assessment code also corresponds to the colour coding on the maps.

Eastern Intake and Associated Pumping Station

No archaeological sites were previously known and none were found by the present field project in the area of the eastern intake. Most of the area is currently covered by a disused electricity plant. The area directly adjoining the east side of this plant consists of a deep, steep sided wadi, the bottom of which is already heavily disturbed by bulldozer trenching.

The proposed site of the pumping station, north of the airport, stands on sands in the central wadi Araba contains no published sites.

(This section will be completed once the ongoing field survey is finished)
Sea Water Conveyance Pipeline

(Table I, Map set I, to be included in Preliminary Draft ESA Report)

The sea water conveyance pipeline runs through the bottom of the Wadi Araba. Archaeological research in this area has been limited because it is a border area. However, some surveys have been conducted in parts of the area, which show that archaeological sites are most likely found on the alluvial wadi fans on the east edge of the impact area.

One of the reasons for the lack of sites in the wadi bottom is that it is covered in layers of wind-blown sand and mud flats, and possible archaeological sites are likely to have been covered. The only way to find covered archaeological remains in this area is through monitoring during construction.

Various east–west routes were used in different periods of the long history of the region. These east–west passes will need intensive monitoring during construction because of the higher likelihood of archaeological finds. They are, from north to south:

- The crossing through Wadi Dahal;
- The crossing from Finan to En Hatzeva through Wadi Finan;
- The crossing from Petra past Bir Mathkour to the west; and
- The crossing past the fort of Gharandal through Wadi Gharandal.

Sea Water Conveyance Tunnel (Including Adits and Canal Sections)

(Table II, Map set II, to be included in Preliminary Draft ESA Report)

The complex of Finan, in the Wadi Finan is a multi-period site complex centred around the extensive copper industry and field system in the Wadi. It consists of copper mines, smelting sites, field and water harvesting systems, occupation and cemeteries, and there are moves to nominate it as a UNESCO world heritage site. This whole area needs to be avoided.

Several extensive Roman fortresses, guarding the east-west crossings through the Wadi Araba, namely Gharandal (site 524), Bir Mathkour (503) and Qaa es-Sa’idiyin (599) are also of major importance and should be either fully excavated or avoided.

High Level Desalination Plant

(Table III, Map set III, to be included in Preliminary Draft ESA Report)

This area had not been previously surveyed and there were no recorded sites in it. The area was surveyed by the current field project, which located four archaeological sites, consisting of graves, pottery scatters and one enclosure.
**Low Level Desalination Plant**

(Table III, Map set III, to be included in Preliminary Draft ESA Report)

This area had not been previously surveyed and there were no recorded sites in it. The area was surveyed by the current field project, which located 8 archaeological sites, consisting mostly of cemeteries and pottery scatters, probably representing temporary camp sites much like those of the modern Bedouin, who still use the area today.

This area stands just above the important site of Qasr Telah (1389), and its associated field system, so any access roads to the desalination plant will have to be strictly adhered to.

**Hydropower Plant**

This area had not been previously surveyed and there were no recorded sites in it. The present field survey walked the area and found two sites which appear to be a relatively recent, interconnected water channelling system. The significance of these sites will be examined in the next phase of the assessment.

**Discharge to the Dead Sea**

No archaeological surveys have previously covered this area and there are no known sites in the area of impact. This area is very close to the present border and access is restricted for security reasons. This proposed line was, therefore, not included in the current survey.

**Eastern Freshwater Pipeline**

(Table IV, Map set IV, to be included in Preliminary Draft ESA Report)

The route of this pipeline crosses very varied terrain, from the hills at the edge of the Wadi Araba, up the steep slopes to the plateau highlands and the gently sloping desert plateau to the east. It also crosses a number of areas that have been the subject of previous archaeological surveys.

There are many sites along the proposed route, known from both the previously published surveys and as a result of the present field survey project. In the western section, there are a total of 39 sites found by the SGNAS, GFTS surveys, with an additional 10 new sites found by the present field project.

In the central section, across the highlands south of Tafileh, 30 sites were recorded by previous projects (TBAS, Tuwana survey). With the exception of Tuwana itself, which is a major settlement site of the Nabataean and later periods, most of these sites were encampments and/or sherd scatters. Tuwana
itself lies ca. 750 m to the south-west of the pipeline and should be protected, or avoided if a new alignment comes closer to it.

*Details of this segment of the line will be added once ongoing survey is completed.*

In the *eastern segment*, the line passes across the Wadi Hasa, an area that has been previously surveyed by two projects (WHS, WHNBS) that found numerous sites. A total of 217 sites have been recorded, including the 15 sites found by the present survey. While a large number of these sites date to the Palaeolithic, there are sites from virtually all periods represented.

**Western Freshwater Pipeline**

*Results for the area south of the Green line - legal border between Israel and Palestine - will be added once ongoing survey is completed.*

(Table V, Map set V to be included in Preliminary Draft ESA Report)

The area north of the Green line sits in the Palestinian Authority. Extensive surveys have been executed in parts of these areas, mostly by Israeli archaeologists, between 1967 - 2006. Publication of these results, however, is limited, and often difficult of access, which limits the reliability of the data in the table. The present field project did not do any work in this area.

Three sites bordering the Dead Sea on the west are of national and international importance, and must be avoided. These are the World Heritage site of Masada, the Israel National park of En Gedi, and the National Park and internationally important site complex of Qumran, find spot of the Dead Sea Scrolls. In addition, in the plain south of Jericho, a number of early synagogues and churches have been found with remains of mosaic floors. The present state of these remains is unknown, and they should be revisited once the pipeline alignment is final, to assess the state of the mosaics, and where possible and necessary, lift them.

One site (1198) has been identified as an Essene cemetery. Excavation of cemeteries in Israel and Palestine is a sensitive issue, and can lead to political/religious disturbances. It may therefore be preferable, should the site be on the pipeline route, to find a way to avoid it.

A large number of sites have been classified by previous surveys merely as ‘site’. Based on the known results of the current survey these ‘sites’ have been assumed to be sherd scatters, and consequently classified as ‘no further work necessary’ (assessment category 1). However, once the definitive freshwater line has been defined, this assumption needs to be checked for affected sites.

Because the coastal plain is narrow on the west side of the Dead Sea, many of the sites within the project area are caves. These will be impacted if the
pipeline construction involves digging through the limestone mountains bordering the plain.

C5.8 **Management and Monitoring During Construction**

*(This section is presented in preliminary form only for the purposes of this initial assessment. More detail will be provided in the Preliminary Draft ESA Report.)*

Because of the nature of archaeological sites – not always visible on the surface, or the real size and importance may not be evident from surface research – monitoring during construction is imperative for the whole project. There should, therefore, be a watching brief, in co-operation with the Department of Antiquities of each country. If any sites are located by the watching brief during construction, then a chance finds procedure must be in place which meets the legal requirements of each beneficiary party.

C5.8.1 **For All Pipelines that Involve Deep Trenching**

A watching brief could consist of one archaeologist surveying the land for the presence of sites with the survey team that is laying out the line; and one archaeologist who is watching the bulldozers and earth-moving machines that are actually cutting the trenches. If any site is located, then the archaeologists must be given an agreed amount of time and back-up personnel to record the site, and if it is significant, to undertake a rescue excavation immediately. The reason for watching the trenching is that there is the possibility of buried sites in many places.

C5.8.2 **For All Construction Sites (Adits, Desalination and Hydropower Plant Sites)**

Assuming that an updated survey has been carried out where necessary in the exact areas of the construction, then a watching brief by one archaeologist who will look for buried sites wherever foundations or trenches are made, will be sufficient. Again, if anything is found then the archaeologist must be given an agreed amount of time and back-up personnel to record the site, and if it is significant, to undertake a rescue excavation immediately. The need for a watching brief for these areas will cease once all earth moving has finished; in other words, there is no need to watch during the actual building of structures etc.

(The cost of running such a watching brief, with two people, might be in the order of 275 JD per day, including a 4 x 4 vehicle rent, fuel, accommodation - probably with the construction crew- food, miscellaneous expenses and wages for the Department of Antiquities personnel. The cost of running a rescue excavation during construction, again assuming two archaeologists from the DoA, might be in the order of 300 JD per day.)
C5.8.3 Mitigation for Sites Near the Project Area

During the construction phase, there is a danger of impact to archaeological sites in the surrounding areas that are not directly implicated by the construction itself. In order to avoid any damage to these, various mitigation measures should form part of a code of practice that is within the contracts of the contractors. These mitigation measures should include:

- restricting the movement of all vehicles (particularly heavy machinery) to designated access roads and work areas and prohibiting their use for anything other than work;
- monitoring the dumping of domestic and work waste to ensure that it occurs only in designated areas;
- education of the work force in the field about the importance and value of the national heritage and of archaeological sites;
- any known site of significance that is close by the construction should be fenced temporarily to avoid accidental damage.

In order to ensure that all such requirements are being adhered to correctly, it is important that some system of monitoring is established. Thus, regular inspections by the Department of Antiquities personnel, or other officially approved persons, should be carried out both during the earth-moving and construction stages as part of a Chance Find Procedure plan that will be developed for the Preliminary Draft ESA Report.

C5.8.4 Management and Monitoring During Operation

Once the Scheme is operational, there is no longer any impact to archaeological sites, and therefore further monitoring will not be necessary.

C5.9 SUMMARY

(This section is presented in preliminary form only for the purposes of this initial assessment. More detail will be provided in the Preliminary Draft ESA Report).

Table C5.2 below illustrates some of the most important sites in Jordan which lie close to the Scheme elements and should be avoided. It also presents a description of each site and its assessment.)
### Table C5.2  Summary of Most Important Archaeological Findings in Jordan

<table>
<thead>
<tr>
<th>ID number</th>
<th>Site number</th>
<th>Site name</th>
<th>Description</th>
<th>Element of scheme</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1389</td>
<td>1802019</td>
<td>Qasr Telah</td>
<td>Nabataean fortress and large field system</td>
<td>penstock and access to Zone C</td>
<td>Relocate at least ca 500m further west, to avoid site and field system. Make sure access roads avoid the main site elements</td>
</tr>
<tr>
<td>500</td>
<td>1900001, 1900010-1900026</td>
<td>Wadi Finan Network of sites including copper exploitation, and associated settlements, from the Chalcolithic and Early Bronze Age, Iron Age, Roman and Byzantine and Islamic times</td>
<td>220 m tunnel, northern canal section</td>
<td>Relocate canal to at least 1km away from the complex of sites.</td>
<td></td>
</tr>
<tr>
<td>1897002</td>
<td></td>
<td>Bir Mathkour</td>
<td>Major caravan station with settlement on the ancient spice route. Occupied Hellenistic to Byzantine</td>
<td>220 m tunnel, northern canal south section</td>
<td>Relocate canal 1km north or south to avoid site. Intensive survey prior to construction.</td>
</tr>
<tr>
<td>524</td>
<td>1694001</td>
<td>Gharandal</td>
<td>Caravan seray, with paved road, Nabataean/Roman and Byzantine, part of the east-west trade route.</td>
<td>220 m tunnel, southern canal</td>
<td>Make sure that access roads and stone dumps avoid the site.</td>
</tr>
<tr>
<td>529</td>
<td>1695001, 1695004</td>
<td>Sa’idiyin Nabataean/Roman fortress and additional structures, village</td>
<td>220 m tunnel, southern canal</td>
<td>Make sure that access roads avoid the site.</td>
<td></td>
</tr>
<tr>
<td>1047</td>
<td></td>
<td>Qumran and Ain Feshka Essene settlement from the Hellenistic period, village with field system and burial site. Surrounded by caves in which the Dead Sea scrolls were found.</td>
<td>Freshwater pipeline west</td>
<td>Avoid the settlement. Follow the existing road as closely as possible to minimize damage. Close monitoring during construction.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>En Gedi</td>
<td>Jewish settlement, centre of balsam production, synagogue with very fine mosaics. Part of nature reserve</td>
<td>Freshwater pipeline west</td>
<td>Avoid the settlement. Follow the existing road as closely as possible to minimize damage. Close monitoring during construction.</td>
</tr>
<tr>
<td>ID number</td>
<td>Site number</td>
<td>Site name</td>
<td>Description</td>
<td>Element of scheme</td>
<td>Mitigation</td>
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</tr>
<tr>
<td>Masada</td>
<td></td>
<td>fortress during the roman period, surrounded by roman campsites. Jewish national symbol. World heritage site.</td>
<td>Freshwater pipeline west</td>
<td>Avoid the settlement. Follow the existing road as closely as possible to minimize damage. Close monitoring during construction.</td>
<td></td>
</tr>
<tr>
<td>(Wadi Araba)</td>
<td></td>
<td>east-west wadi crossings in the Wadi Araba/Arava valley used by travellers throughout the long history of the region. Includes some forts and caravanserais, for example at Bir Mathkour and Gharandal</td>
<td>Tunnel Adits and saltwater conveyance pipeline</td>
<td>Relocate project element, or excavation of main sites. Intensive monitoring during construction of areas</td>
<td></td>
</tr>
<tr>
<td>Wadi Dahal; Finan to En Hatzeva through Wadi Finan; Petra past Bir Mathkour to the west; the fort of Gharandal through Wadi Gharandal</td>
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<td></td>
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</tbody>
</table>

Part C – Project Specific Environmental and Social Assessments

Initial Assessment Report

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C6 IMPACTS ON COMMUNITIES

C6.1 SCOPE OF THE REPORT

This section presents the findings of the community (hereafter referred to as ‘social’) impact research and analysis undertaken for the Scheme. The objectives of this section are as follows:

- to provide a baseline summary of current social and socio-economic characteristics in the study area, within the context of the three beneficiary parties;
- to outline the positive and negative social, health and economic impacts that are expected to arise from the proposed Scheme; and
- to identify measures to enhance any social benefits and mitigate or compensate for any negative impacts.

This remainder of Section C6 is structured as follows:

- Section C6.2- Approach to the social impact assessment;
- Section C6.3- Social and socio-economic baseline;
- Section C6.4- Social and socio-economic impact assessment; and
- Section C6.5 – Mitigation Measures.

C6.2 APPROACH TO THE ASSESSMENT

C6.2.1 Introduction

This section provides the socio-economic context to the proposed Scheme. It provides a concise description of the socio-economic conditions that would prevail in the absence of the Scheme and aims to provide sufficient information to:

- identify the key socio-economic conditions in areas potentially affected by the Scheme and highlight those that may be vulnerable to the development;
- describe and where necessary/possible quantify their characteristics (nature, condition, quality, extent, etc) now and in the future in the absence of the Scheme;
- provide data to aid the prediction and evaluation of possible impacts; and
to inform judgements about the importance, value and sensitivity/vulnerability of resources and receptors.

**C6.1.1 Study Area**

The study area for the social impact assessment is considered at two levels: a broad level; and a Scheme-specific level.

**The Broad Study Area**

Given the size of the proposed Scheme, there will be impacts experienced within each of the three Beneficiary Party jurisdictions: Jordan, Israel and the Palestinian Authority *(Figure C6.1)*. Much of the secondary data collected pertains to this area, and provides a comparison with the local area and context for the impact assessment.

**Figure C6.1 Baseline Study Area (Broad Study Area)**

All maps produced as a part of this study are being checked by the World Bank Map Design Unit. An approved set of maps will be included in the Preliminary Assessment Report.

**Scheme Specific Study Area**

Many of the social and socio-economic issues occur at a more localised level and as such the baseline is also described at the Scheme-specific level. These various areas are considered according to their location with regards to different components of the Scheme *(see Figure C6.2)*:

- Area 1: Aqaba/Eilat Urban/Industrial Area;
- Area 2: Wadi Araba/Arava Valley;
- Area 3: Dead Sea Basin;
- Area 4: Eastern Freshwater Pipeline Route (Jordan); and
- Area 5: Western Freshwater Pipeline Route (Israel/Palestinian Authority).

**Figure C6.2 Baseline Study Area (Immediate Scheme Areas)**

All maps produced as a part of this study are being checked by the World Bank Map Design Unit. An approved set of maps will be included in the Preliminary Assessment Report.
C6.2.2 Methodology

The main source of baseline information for this section was the Social Assessment Sub Study produced by the Feasibility Study (with assistance from the ESA team) and the outputs of stakeholder consultations carried out between June 2008 and December 2009. A description of all stakeholder engagement undertaken to date is provided in the Public Consultation and Communications Plan (PCCP) which is issued under separate cover and periodically updated for the Study Programme.

The sub study can be referred to for information on the data collection methods used, but in summary it drew on a combination of primary data sources, including systematic social surveys targeting the regions of interest and secondary data sources, previous studies related to the proposed Scheme, and national and regional data. The data collection in Israel and the Palestinian Authority, and along the freshwater route in Jordan, was desk-based only and did not involve site surveys. This was because at the time of the assessment, Coyne & Bellier have not yet identified a detailed alignment for the conveyance and it was felt that community consultations on a yet to be defined alignment could be misleading and lead to unwarranted concern on the part of local residents, or to land speculation.

In compiling this section, additional secondary data have been drawn on but no additional primary data collection was undertaken. Further field research and stakeholder consultation is planned as part of the social impact assessment studies to further understand and assess the impacts likely to result from the proposed Scheme. Any data gaps that have been identified at this stage have therefore been highlighted in the report and will be filled as the ESA study progresses.

As introduced in Part A, potential impacts from the Scheme across all topic areas have been assessed using an approach that considers the sensitivity/ vulnerability of receptors and the magnitude of the impact, to define the degree of significance that a potential impact may have. For the social impact assessment, the concept of ‘vulnerability’ is used to categorise the individuals or communities that may be subject to impacts from the Scheme.

This assessment currently focuses on vulnerability at a community level, rather than individual or household, due to the scale of the current assessment and the nature of the data collected. This assessment of vulnerability will be refined during later stages of the ESA, as further assessment and consultation are undertaken.

Vulnerable groups are individuals or communities who are less able to cope with sudden changes or economic shocks and are therefore particularly susceptible to marginalisation. This may be for reasons of sex, age, gender, race, religion, disability, livelihood or location.
Communities in the study area have currently been assessed against several vulnerability factors, which can be broadly grouped into demographics, livelihoods and economy and infrastructure and services. Box C6.1 provides a list of criteria that have been considered for communities in the study area.

**Box C6.1 Criteria for Considering Community Vulnerability**

<table>
<thead>
<tr>
<th>Demographics:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Gender imbalance.</td>
</tr>
<tr>
<td>• Population age – communities with very old/young.</td>
</tr>
<tr>
<td>• Community size – small communities have less ability to diversify economically and tend to be more closed, insular and/or traditional.</td>
</tr>
<tr>
<td>• Ethnic groups that are distinct from dominant groups in the community and may therefore be marginalised.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Livelihoods and Economy:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Subsistence farming – dependency on land, lack of livelihood alternatives.</td>
</tr>
<tr>
<td>• Dependency on natural resources (eg grazing land or on natural water resources), lack of livelihood alternatives.</td>
</tr>
<tr>
<td>• Permanent crops - economic dependence on long term crops such as fruit trees/olives.</td>
</tr>
<tr>
<td>• Remittances – access to additional sources of income outside the study area.</td>
</tr>
<tr>
<td>• Reliance on social aid – living below minimum age/living in poverty.</td>
</tr>
<tr>
<td>• Lack of livelihood alternatives, unable to diversify economic activities.</td>
</tr>
<tr>
<td>• Reliance on agriculture as main economic activity – unable to diversify.</td>
</tr>
<tr>
<td>• Reliance on animal husbandry as main economic activity – unable to diversify.</td>
</tr>
<tr>
<td>• Land availability – limited access to land in an area reliant on agricultural activities.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Infrastructure and services:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Access to water resources.</td>
</tr>
<tr>
<td>• Reliance on water resources for economic activity (eg agriculture).</td>
</tr>
<tr>
<td>• Access to electricity.</td>
</tr>
<tr>
<td>• Road access – community isolation resulting in limited employment opportunities and difficulty accessing services.</td>
</tr>
<tr>
<td>• Access to education and health care – skills and/education.</td>
</tr>
</tbody>
</table>

Box C6.2 shows how these criteria can be used to guide the identification of communities in the Scheme area that are highly vulnerable, or of medium or low vulnerability.
Box C6.2  Criteria for Identifying Vulnerable Communities

<table>
<thead>
<tr>
<th>Highly vulnerable community:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• poor access to water</td>
</tr>
<tr>
<td>• reliance on water for main economic activity</td>
</tr>
<tr>
<td>• subsistence farming</td>
</tr>
<tr>
<td>• no alternative livelihoods</td>
</tr>
<tr>
<td>• isolation</td>
</tr>
<tr>
<td>• no road access</td>
</tr>
<tr>
<td>• limited / no access to services</td>
</tr>
<tr>
<td>• high population dependency/imbalances</td>
</tr>
<tr>
<td>• many vulnerable groups in the community</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Medium vulnerability community:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• poor access to water</td>
</tr>
<tr>
<td>• reliant on a single economic activity (particularly agriculture)</td>
</tr>
<tr>
<td>• reliance on water for economic activity (ie agriculture)</td>
</tr>
<tr>
<td>• road access, however may be located a long way from major towns</td>
</tr>
<tr>
<td>• limited / no access to services in the immediate locality</td>
</tr>
<tr>
<td>• some population dependency/imbalances</td>
</tr>
<tr>
<td>• some marginalised/vulnerable groups in the community.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Low vulnerability community:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• urban location</td>
</tr>
<tr>
<td>• diverse economic activity</td>
</tr>
<tr>
<td>• road access</td>
</tr>
<tr>
<td>• mixed population</td>
</tr>
<tr>
<td>• no significant vulnerable groups</td>
</tr>
</tbody>
</table>

Using these criteria, the communities have tentatively been categorised into the vulnerability groupings defined in Table C6.1. The criteria are not fixed, but used as a guide to identify the likely sensitivity of communities to potential impacts, which in turn provides a means of assessing the significance of the potential impact.

The criteria used to determine the vulnerability of social receptors have been defined at this stage using expert knowledge within the assessment team. However, this assessment of vulnerability will be further refined and quantified as necessary during the next phase of the assessment.

C6.2.3  Study Limitations

The findings of this report represent the views of stakeholders consulted and are supported by various secondary data sources and limited field based surveys. There are, however, some limitations in the study to date that need to be considered as part of this assessment.

This is an initial assessment report and further data collection and stakeholder consultation is required to provide a fully robust assessment. Field survey data has been drawn solely from the aforementioned FS Social Assessment Sub Study and additional social surveys will be required in order to provide a full
social and socio-economic baseline for the ESA. Information from the Additional Studies is also not yet available.

These additional studies and surveys, combined with additional stakeholder consultation, are required to refine the analysis of potential impacts. Village profiles will be developed as part of the next stage of assessment and interviews held with key informants to gain a better understanding of the communities in the study area. This stage of assessment will specifically look at diversity amongst the communities and will look to refine the current assessment of vulnerable groups.

In particular, some of the key data gaps at this stage include:

- Information on gender and an analysis of issues particularly affecting women;
- Health data and quality of service;
- Education data and quality of service; and
- Information on marine-based activities, such as fishing and navigation.

<table>
<thead>
<tr>
<th>Vulnerability</th>
<th>Area</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>No communities</td>
<td>No communities are totally isolated, totally reliant on subsistence farming or completely made up of ‘vulnerable’ groups, however there are some pockets of vulnerable groups within communities ranked as medium or low vulnerability.</td>
</tr>
<tr>
<td>Medium</td>
<td>Jordan Wadi Araba communities</td>
<td>These communities are geographically relatively remote, primarily reliant on agriculture or herding for their livelihood, however with no formal water supply for agricultural purposes. They tend to have limited access to infrastructure and services, the area is classified as one of Jordan’s poverty pockets, and women are a key vulnerable group in these community structures that stem from Bedouin traditions, with a traditionally less inclusive role or a voice in community issues.</td>
</tr>
<tr>
<td></td>
<td>Palestinian Authority communities in Jericho city and surrounds</td>
<td>The Palestinian communities in this area operate within a context of political instability, with many key decisions over their lives (e.g. related to travel, access to land and water resources, economic development) taken by the Israeli authorities. The communities tend to be reliant on agriculture and tourism, but are not geographically isolated. Their access to decision makers outside of Jericho is very limited.</td>
</tr>
<tr>
<td>Vulnerability</td>
<td>Area</td>
<td>Rationale</td>
</tr>
<tr>
<td>---------------</td>
<td>------</td>
<td>-----------</td>
</tr>
<tr>
<td>Low-medium</td>
<td>Jordan Dead Sea communities</td>
<td>Whilst this area of Jordan is classified as a poverty pocket, these communities are less geographically remote than communities in the Wadi Araba. They also however have limited access to infrastructure and services, but tend to have more diverse livelihoods and have formal provision of water from the government for agriculture. Women in these communities traditionally have a more inclusive role.</td>
</tr>
<tr>
<td></td>
<td>Jordan freshwater route – Tafila Governorate</td>
<td>Whilst the Tafila area is not a formal poverty pocket, these communities are heavily reliant on agriculture, and high unemployment rates and high dependency populations are rife. These communities are however not isolated geographically in the sense that the communities in the Wadi Araba are.</td>
</tr>
<tr>
<td>Low</td>
<td>Israel Arava Valley, Dead Sea and freshwater route communities</td>
<td>Israeli communities are not areas of poverty in the sense that the communities in Jordan in the same region are. These communities have more diverse livelihoods, and whilst dependent on a large extent on agriculture, agricultural practices are more formalised and in addition the tourism industry is another key source of livelihood for these people.</td>
</tr>
<tr>
<td></td>
<td>Jordan freshwater route – Desert Highway and south Amman</td>
<td>Closer to Amman and the services provided, these communities have more access to diverse livelihoods than further south on the route.</td>
</tr>
<tr>
<td></td>
<td>Aqaba and Eilat</td>
<td>Urban, diverse livelihoods</td>
</tr>
</tbody>
</table>

C6.3 SOCIAL AND SOCIO-ECONOMIC BASELINE

C6.3.1 Introduction

This section provides a baseline against which the impacts of the Scheme can be assessed, providing a description of the social and socio-economic conditions that will prevail in the absence of the Project. The baseline includes information on the receptors and resources that were identified during scoping as having the potential to be significantly affected by the proposed Scheme.

The aim of this baseline is to aid the prediction and evaluation of possible impacts and, as such, it is focussed on providing the context for the key issues identified during scoping. These were as follows:

- **Issues associated with employment and the economy**: job provision associated the construction and operational phases of the Scheme, as well as the potential impacts on the local economy. Tourism, and potential
induced development around the Scheme during its operation, is also discussed.

- **Issues associated with local communities’ livelihoods**: potential impacts to agricultural and other livelihoods. The potential issues around resettlement are also briefly considered, but there is a separate work stream focusing specifically on these aspects, which is currently ongoing and not captured within this report.

- **Social structure, ways of life and community relations**: potential impacts of the Scheme on community relations, cohesion and structure, for example from the influx of workers from outside the area and in attitudes of local communities to the Scheme. This discussion also includes a consideration of the ways in which the Scheme in its operation may impact the fabric of local communities and their traditional ways of life.

- **Public health, wellbeing and community safety**: Issues surrounding public health and consideration of issues such as HIV/AIDS and other communicable diseases. Safety issues to local communities from the construction and operation of the Scheme are also considered.

There are a number of aspects that are covered briefly within this section, but covered in more detail elsewhere, which are:

- Community wellbeing and health, resulting from changes to environmental quality (impacts from dust, noise etc) – see Section C14;

- Visual impacts of the Scheme – see Section C13;

- Resettlement and loss of land – see Section C11 and Part D;

This baseline section starts by providing a brief overview of the three beneficiary parties, before describing each of the Scheme specific study areas in turn.

### C6.3.2 Overview of the three Beneficiary Parties

**Key social and socio-economic summary statistics are being compiled for each of the three beneficiary parties and will be presented in the Preliminary Draft ESA Report.**

#### Jordan Overview

**Population and Demographics**

Jordan is classified as an emerging market with a free market economy (1). It has a total population of 5.8 million in 2008 (DoS, 2009) and GDP per capita of $3,766 (2). Jordan’s fertility rate is around 3.7% and its annual population growth rate is...
growth is around 2.3% (DoS, 2008). The population is distributed unevenly with 70% of the population being concentrated in Amman, Zarqa and Irbid Governorates. Most of the settled population has historically been located in the highland strip which runs from north to south separating the low lying rift valley from the desert plans which sweep eastwards towards Iraq and Saudi Arabia. These highlands are where the main urban areas are located.

Population forecasts for a medium level scenario suggest that in 2060, the population could be expected to approximately double to 10.97 million. This is both as a result of natural growth and immigration, for example from Iraq. This population growth has created imbalances between the demand and supply of social services, which has impacted the quality of service provision. In addition, Jordan’s scarcity of natural resources, particularly its chronic shortage of water, has worsened the situation. This is particularly apparent in the Governorates with the highest population concentrations which are consequently considered water deficit areas and depend on water importation from other areas.

Jordan’s demographic profile is characterised by a young population, high literacy rate and increasing life expectancy. More than 90 percent of the population is educated (the state provides primary and secondary education to all citizens) and the life expectancy at birth is 72.3 years (DoS, 2007).

The majority of Jordan’s population are Arabs descending from various tribes, who have migrated to the area over the years. Among these are the Bedouin nomads and semi-nomads of the desert and steppe areas. Jordan’s population also includes many Palestinians who entered the country in 1947/8 and 1967, and reside mainly in the country’s urban areas. In addition, around 1% of the population is Armenian and 1% is Circassian. There are also small Kurd, Druze, and Chechen minorities. More than 92% of Jordanians are Sunni Muslims, and about 6% are Christians, living mainly in Amman, Madaba, Karak and Salt. Several small Shi’a and Druze populations are also found. However, the past decades have seen a constant influx of migrants from Iraq and Palestine. The inhabitants of the Scheme area in Jordan speak Arabic as their first language.

Economy

Since 1999 Jordan has witnessed consolidated reform efforts and several initiatives have been launched to promote economic development. These reform initiatives contributed to a better economic performance where real GDP growth averaged around 7.6 between 2004 and 2007. However, a gradual slowdown in GDP occurred after 2004, which was the result of slowdowns in the agriculture, manufacturing and construction sectors (DoS, 2007 and MoPIC, 2008 & MoPIC, ASEZA, et al 2007).

Noticeably, the rapid rising fuel and food prices worldwide has put pressure on the fiscal and external accounts, eventually leading to a rapid growth in the
rate of inflation from 4.7 percent in 2007 to 14.8 percent in 2008. Moreover, the increase in prices, particularly in petroleum products over the past few years and the further erosion of the purchasing power of these segments, has adversely impacted the poor and vulnerable groups in the country. Thus, a large segment of society is economically unproductive and, each year the state has to create around 60,000 jobs for new entrants to the labour market. Official unemployment therefore persists at 13.1% at the national level (1). The number of people unemployed in Jordan is roughly the same as the number of registered guest workers.

Despite the high and sustained economic growth which occurred between 2002 and 2008, the impact has been minimal on the poor segments of society. Jordan has and still relies heavily on foreign aid and, due to its political and strategic importance, receives large flows of aid mainly from the United States and the European Union. According to the Jordan Human Development Report 2004, the overall Human Development Index (HDI) for Jordan was 0.743, ranking 90th in the world and classifying the kingdom as a developing country in the year 2003. A Household Income Survey conducted by the Department of Statistics in 2006 indicated that Jordan had succeeded in lowering poverty rates from 21.3% in 1997 to 14.2% in 2002 and to 13% in 2006. Nevertheless, there remains a wide gap between the rich and the poor clearly reflected in the pockets of intense poverty in Jordan.

According to an overview of the economy of Jordan, being carried out as part of the RSDSC Regional Assessment, Jordan’s economy is not expected to move towards being a high-income country in the near future. The country will continue to rely on external resources such as foreign aid, remittances from nationals working abroad and loans, albeit perhaps less heavily than at present.

In recent years, the growth of the Jordanian economy has been coming from services (67%), industry (29%) and agriculture for about (3%). Over the next 10 years (ie until 2020), the contribution of agriculture to the economy is expected to decrease with the growing stress on agricultural water availability. The services sector, especially tourism, is expected to be developed in the Dead Sea area and in Aqaba. The government’s National Tourism Strategy (NTS), established in 2004 to handle the sector through 2010, aimed to double tourism revenues during the period and to increase tourism-related jobs. However, this development plan would need more investment in public infrastructure. The industrial sector is expected to grow at the same rate as the last decade – ie at a rate of growth between 2% and 3% per year.

Utilities, Services and Infrastructure

Generally, utility infrastructure in Jordan is good. An estimated 99.9 % of the population has mains electricity supply (NEFCO, 2009). The service level of

water supply is considered fairly high with 97% of the urban areas and around 83% of the rural areas served by piped supply (Jordan Water Strategy, 2009), whereas 62% of Jordan’s population are served by sewerage systems (ibid). Areas not connected to a sewerage network generally have septic tanks which are periodically pumped out by tanker.

Health

The total expenditure on health of GDP in 2007 was 9.4%. It was found that Jordan enjoys an adequate coverage of treatment for certain acute diseases including Polio (OPV3), DPT3 and Hepatitis where it had 98% coverage. HIV/AIDS Incidence rates were less than 1/1000 and 6 incidences of TB were found in 2007. However, diseases such as HIV and AIDS are usually underestimated at the national level, and accurate data at Governorate level is not available. Nonetheless, the health sector within Jordan is faced by many challenges including the increasing demands and expectations of people for effective, accessible and quality health care as well as the rapid changes in technology and the rising of health care costs.

Israel

Population and Demographics

The State of Israel has a technologically advanced market economy and despite its limited natural resources, has intensively developed its agricultural and industrial sectors over the past 20 years (1). Israel has a population of 7.2 million a growth rate of 1.671% and a GDP per capita of $29,671 (2). The average life expectancy is 80 years and the country’s literacy rate is 97% (Human Development Reports, 2008). The majority of the population of the State of Israel are Jewish; however there is a large non-Jewish community made up mostly of Christian and Muslim Arabs, which comprises about 40% of the population. Israel has two official languages, Hebrew and Arabic.

Economy

Israel possesses a technologically advanced, resource-limited (in water, minerals, and arable land) market economy. Major imports include grain, petroleum, and uncut diamonds, and exports include cut diamonds, technology and related equipment, military hardware, and some fruits and vegetables. 32.5% of its exports reach the US, with 7.5% going to Belgium and 6.7% to Hong Kong (2008) (3). Tourism is an important component of the economy; in 2007, Israel’s income from tourism was 2.4 billion dollars, a 26% increase compared to 2006. In 2008, tourism accounted for around 2.5% of the GDP involving 144,000 working people in hotels and catering services. Half of

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(1) CIA World Fact Book.
(2) International Monetary Fund estimate for 2009.
(3) CIA World Fact Book 2009.
the tourists come for pilgrimage and touring, and 36% of them come to visit relatives (1).

Infrastructure and Utilities

Israel's infrastructure is modern and well developed. It is well served with a national road network and main highways connect all major urban centres. Israel also has a well-connected inter-city rail system that serves most of the large urban centres, from Beer Sheva in the south to Nahariya in the north.

Israel's electricity comes mostly from coal and natural gas. The two largest power stations are located in Ashkelon in the south and Hadera in the north. There are also plans for an additional coal powered plant for the city of Ashdod. Israel has set a target that 10% of its energy will be from renewable sources by 2020; at present it is less than 3%. Israel imports natural gas from Egypt and has recently discovered an off-shore gas field in the north. Coal is imported mainly from Indonesia and South Africa.

With a growing population and increased demand, expansion of Israeli's electricity grid is a key government objective. Israel Electric is a government company and is responsible for all electricity services in the country. Israel also has a national telecommunication company, Bezeq, which is currently undergoing privatization. Telecommunications are well developed in Israel with an efficient cellular network.

Israel has three main sources of water: surface water from Lake Kinnaret/Sea of Galilee catchment, groundwater from the mountain and coastal aquifers, and desalination from the Mediterranean Sea. Total national water supply is around 1,700 million cubic metres (mcm) and about 10% of this is from desalination. Supply has reduced recently as a result of drought and water demand is reportedly close to supply. Agricultural demand has been reduced slightly as a result of efficient water management and agricultural demand for freshwater is now around 50% of the total supply. Water distribution throughout most of the country is via the National Water Carrier and water leakage is estimated at 10 to 12 percent.

Health and Education

Data and analysis on health and education will be gathered in the next phase of assessment and presented in the Preliminary Draft ESA Report

Palestinian Authority

Population and Demographics (1)

The population of the Palestinian Authority areas (including both the West Bank and Gaza Strip) reached 3,761,646 inhabitants in 2007, a total of 646,755 families (2) with an average family size of 5.8 individuals in 2008. The Palestinian population has been growing at a rate of 3.3% annually for the past decade, with an increase of approximately 1 million people in 11 years. Such growth has resulted in a young population profile, with approximately 47% of the population below 15 years old in 2008.

The main ethnic composition of the population in the Palestinian Authority is Arab. The majority of the population is Muslim followed by the Christians with 1.4 – 2.3%. There is also a small Samaritan Jewish community of around (250 – 300) inhabitants just outside Nablus.

Economy

The Palestinian Authority has a GDP per capita of $2,999 (3), which is 80% of GDP per capita in the year 1999. The services sector constitutes the largest portion of GDP in the Palestinian Authority. Palestinian GDP witnessed an overall decrease of 3% in the fourth quarter of 2008 compared with the third quarter. Consequently, GDP per capita also decreased, by 3.7% for the same period. GDP in 2008 increased by 2.3% once compared to the previous year.

Unemployment rates in Gaza are higher than those recorded in the West Bank, reaching 37% in comparison to 16.3% in the year of 2009. It was found that 80% of the population in the Gaza Strip and around 46% of the West Bank are considered below the poverty line.

Infrastructure and Utilities

The infrastructure conditions in the Palestinian Authority can be described as moderate to poor in general. Main roads are often controlled by Israeli checkpoints and sometimes roads are closed to Palestinians. Agricultural unpaved roads are often used to move from one place to another. Even the paved roads between rural areas are not well maintained and their condition is deteriorating.

The electricity is not reliable in every part of the PA, but in and around the study area just about all communities have a connection to mains electricity.

The water and wastewater infrastructure is inadequate. More than 150 communities out of 620 are not connected to a water supply network while

(1) These figures do not include Israeli settlers living in the Palestinian Authority.
(2) PCBS, census 2007.
(3) This includes both the West Bank and Gaza for the year 2008.
almost none of the rural areas are connected to wastewater collection or treatment systems. Where there are networks, wastewater may not be treated to appropriate standards. One exception is Al Bireh which is functioning well and the efficiency of treatment is high; it generates the required quality effluent standards where COD is around 100 mg/l. Jenin has a collection system serving part of the population and a small treatment plant which is currently being upgraded.

The West Bank section of the Palestinian Authority has no sea ports or functioning accessible airport and all export and import is conducted through Jordan and Israel. There is no railway line.

**Health**

Health care services in the Palestinian Authority have developed substantially since the 1990s, but have been somewhat hampered by the political instability and travel restrictions imposed by the Israeli Military. The number of facilities has noticeably increased over the past decade, but there are some issues in capacity and the quality of service, with many facilities lacking key equipment and medication. This has resulted in patients needing to be transferred to Israeli hospitals.

Health insurance coverage has substantially increased over the past decade. The total coverage of governmental, military, UNRWA, welfare, and private insurance plans reached 60.5% of the Palestinian population in 2000, 74.7% in 2002, and has risen to nearly 99% in 2004. These insurance coverage plans have played a central role in improving the medical conditions of many households.

**C6.3.3 Area 1: Aqaba/Eilat Urban/Industrial Area**

The Aqaba/Eilat Urban/Industrial Area includes land around the city of Aqaba (in Jordan) and the city of Eilat (in Israel) as far north as King Hussein International Airport, and the Scheme’s proposed northern pumping station site. Aqaba is of strategic importance in Jordan because along a coastline of only 27 km lie the nation’s sea ports, an industrial zone geared largely to the export of fertilizers and related industries, and a growing tourist industry. Eilat is also a key asset for Israel; it is a tourism-centred city with an abundance of hotels and an airport. It also provides access to a southern shipping lane via the Red Sea.

**Aqaba**

**Population and Demographics**

Aqaba in Jordan is the largest city in this area, with an estimated population of approximately 127,500 (DoS, 2008). Aqaba has a fast growing economy and an annual population growth rate of 4.6% between the period of 2004 to 2007 (DoS, 2008, MoPIC, ASEZA et al, 2007). The Aqaba Special Economic Zone
was created in 2001, and a Master Plan published which foresees the population of Aqaba growing to 250,000 by 2020. The population influx into the Governorate of Aqaba has been partly influenced by the launch of the Aqaba Special Economic Zone (ASEZ), which encouraged migration from other parts of Jordan to profit from new opportunities in Aqaba. It has also been fuelled by an inflow of foreign workers, mainly Egyptians and Palestinians, which constitute around 21.7% of the population (Kardoush, 2005 & DoS, 2008). Palestinian refugees and returnees after the Gulf war have also added to the population of the area.

**Economic Activity and Poverty**

There are a number of ports in Aqaba that employ around 4,000 people. The main port is used for handling general cargo, grain, phosphate and light traffic. Other ports serve container traffic, ferries, and industry including petroleum products. The Southern Industrial Zone (SIZ) is situated in Jordan’s southernmost coastal stretch and consists of chemical industries related to the production of fertilizer products based around the supply of phosphate and potash. There are plans to develop this zone further. Tourism is also an important economic activity in Aqaba. Since 2001 major investment has been made in various projects, including the ongoing tourism developments of Tala Bay, Ayla and Saraya, as well as several major hotel facilities. Several other tourism developments are also underway.

Aqaba Governorate’s HDI (1) value for the year 2002 was 0.763, second only to Amman. Between 1997 and 2002, Aqaba experienced an overall increase in all three indicators used in the HDI measurement. However, there is a division between the old and new parts of Aqaba. The new part of the town, influenced by people coming in recently to work in the ports, and all it associated developments is far better off that the old part of the town which is still characterised by poverty.

**Infrastructure**

*Housing:* Aqaba’s real estate is expanding enormously, as the construction in the city has increased by 21% between 2004 and 2007 and reached around 12,109 buildings. All houses in Aqaba city have access to piped water, electricity and the sewage system, except parts of south Shalala and the old city (2).

*Water provision:* Water in Aqaba Governorate is pumped from groundwater in the Disi area, around 50 km to the north east of Aqaba. The Disi aquifer is part of a large non-renewable aquifer system which underlies a large part of southern Jordan and Saudi Arabia. 99% of the population of the town of Aqaba is connected to this source through a piped water network.

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(1) Human Development Index
Waste and Wastewater: Aqaba city has a sewage collection network that reaches around 90 percent of the city’s population. The remaining 10 percent of the population primarily resides in the city’s older, densely settled “Old Aqaba” and “Shalala” neighbourhoods, are required by the local building code to have operable septic tanks. Many households in the Shalala area lack such systems, and according to ASEZA, some untreated sewage still percolates into underlying groundwater. Sewage entering Aqaba’s sewage collection network is piped to the Aqaba Wastewater Treatment Plant.

Transport: Because of the ports and the southern industrial zone, road transportation routes to Aqaba are good, and there is some public transportation from Amman and other towns, via both the Dead Sea and Desert Highways.

Education

In Aqaba, with the development of the ASEZ, and the need to attract investors and professionals to the area, the authorities are aware of the need for better schooling provision. There are a small number of private schools, and the Aqaba International School has recently been expanded to serve more pupils. In Aqaba the illiteracy rate is lower than the national average (9.3%) and has reached 6.7% (1).

Health

In terms of health facilities Aqaba is well advanced, with the Princess Haya Military Hospital and the recently developed New Islamic Hospital. Public and private health care centres are also available, and Aqaba is the main healthcare base for most of the Wadi Araba.

Eilat

Population and Demographics

Eilat, in Israel, is the other main city in this area, with a population of 48,600 although there are large seasonal variations due to the tourism cycles. Eilat has a population growth rate of 1.6 % (2005). In Eilat, 86% of the population is Jewish and 14% are Israeli Arabs (2). The Arab population of Eilat is not, however, deemed a vulnerable group, as they are fairly well integrated into the community and the local economy.

Economic Activity and Poverty

Like Aqaba, Eilat’s economy is also based heavily on tourism and services with 52% of the workforce working in tourism and related services. 18% work in public services and only 3% in industry. The average income in Eilat is

comparable to the national annual average of ~$26,300 (1). Despite tourism being the main source of employment, Eilat has lost many of its foreign visitors to the resorts in nearby Aqaba and Sinai, which enjoy lower labour costs. The ongoing Israeli-Palestinian conflict has also impact on Eilat’s tourist numbers. This has, however, been partially offset in recent years by an increased number of Israelis coming to spend their annual holiday in Eilat (2). In addition to the tourism industry, 3,000 people are employed in other service industries throughout the city. These include the port, Eilat Ashkelon Crude Oil Pipeline, construction, communication and academia.

Utilities, Services and Infrastructure

**Housing:** Eilat housing is increasing; there are 14,650 residential units covering an area of 685 hectares. Another 3,800 residential units were planned (as of 2005) (3).

**Water provision:** Since 1965, the city of Eilat is completely dependent on desalinated water. The city water plant uses a Reverse Osmosis technology which uses both sea water and saline groundwater and produces 56,000 m$^3$/day.

**Waste and Wastewater Management:** In Eilat, all wastewater is treated by the wastewater treatment plant which came into operation in 2001. It is a tertiary activated sludge plant which delivers the treated effluent for agricultural use and storage reservoirs near the area of Timmna. Although current operations at the wastewater treatment plant are adequate, Eilat’s Master Plan details various engineering land requirements for development by 2020 (4).

**Transport:** In terms of transportation connections, currently most trips in the Eilat area are limited to private commuting due to the small and scattered settlement pattern. There are a few bus routes along road no. 90 with several daily routes going to Tel-Aviv, Be’er Sheba and Jerusalem. Eilat has a very active airport which supports both the tourism industry as well exports of local produce such as flowers and live fish which depend on fast delivery.

**Education**

\[\text{Information on the quality of education in the specific areas will be developed during the next stage of the assessment and presented in the Preliminary Draft ESA Report.}\]

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(2) Eilat Master Plan, by Farchi and Tzafrir Architects, pending Ministry of Interior approval, 2005.
(3) Eilat Master Plan, by Farchi and Tzafrir Architects pending approval Ministry of Interior, 2005.
(4) Eilat Master Plan, by Farchi and Tzafrir pending Ministry of Interior approval, 2005.
Health

In Eilat, Yoseftal Hospital opened in 1968. It is part of the Yoseftal Medical Centre and is Israel’s southernmost hospital. It provides a number of services particularly geared to the Red Sea region, including a hyperbaric chamber for the treatment of divers, and kidney dialysis facilities that are available to tourists as well as local residents. There are also nine Health Maintenance Organisations (HMO) (1) facilities in Eilat.

More information on the quality of health facilities in the specific areas will be collected during the next stage of the assessment and presented in the Preliminary Draft ESA Report.

C6.3.4 Area 2: Wadi Araba/Arava Valley

The Wadi Araba/Arava Valley area runs between the Dead Sea Basin and the Gulf of Aqaba/Eilat, and is divided by the border between Israel and Jordan. The communities identified in this area are shown in Figure C6.3 and discussed further in the following sections. This area includes the sea water pipeline route, tunnel routes (as far as but excluding the high level DSP sites and the HPP), and all areas in Jordan and Israel potentially impacted by the sea water conveyance. The Wadi Araba/Arava Valley area is sparsely populated, and comprises primarily an extensive area of desert sand-dunes, gravel outwash plains and mudflats.

Figure C6.3 Communities in the Wadi Araba / Arava Valley

All maps produced as a part of this study are being checked by the World Bank Map Design Unit. An approved set of maps will be included in the Preliminary Assessment Report.

Jordan: the Wadi Araba

Population and Demographics

Family sizes in Wadi Araba are generally larger than in Aqaba with an average of 6.46 compared to 5.7 at the kingdom level. They typically have a high dependency rate as more than 40% of the population are either under the age of 15 or above the age of 64 (2). Each community cluster in Wadi Araba is

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(1) A form of health insurance combining a range of services. A group of doctors and other medical professionals normally offer care through the HMO for a flat monthly rate.

(2) MoPIC, 2008.
mainly from one family group or tribe\(^{(1)}\) and most of them are considered settled Bedouins (Table C6.2). However, Bedou Abu Khushibe settle either in Rahma or Rishe during the winter (September till May), as most of their children go to school and only in summer do they move to the mountains. Because of the degree of geographical segregation between family groups (which should not be overstated) social impacts or benefits to one community, may not necessarily have an effect on others, even if nearby.

**Table C6.2 Village Sizes in Wadi Araba**

<table>
<thead>
<tr>
<th>Community</th>
<th>Population</th>
<th>Tribe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rishe</td>
<td>1450</td>
<td>Al Se’adieen</td>
</tr>
<tr>
<td>Qreigera</td>
<td>2200</td>
<td>Al Se’adieen &amp; Al A’mareen</td>
</tr>
<tr>
<td>Rahma</td>
<td>1200</td>
<td>Al Ahyawat</td>
</tr>
<tr>
<td>Bir Mathkour</td>
<td>650</td>
<td>Al Se’adieen</td>
</tr>
<tr>
<td>Qatar</td>
<td>225</td>
<td>Al Kbaish</td>
</tr>
<tr>
<td>Finan;</td>
<td>700</td>
<td>Al Rashaydeh &amp; Al Azaymeh</td>
</tr>
<tr>
<td>Abu Khsaibeh</td>
<td>350</td>
<td>Bedouins of the tribes found in the area</td>
</tr>
</tbody>
</table>

(Source: MoPIC, 2008 & PEC, 2006)

Village profiles will be developed during the next round of social surveys and presented in the Preliminary Draft ESA Report.

**Economic Activity and Poverty**

Wadi Araba (along with the Southern Ghors area) is one of the pockets of poverty in the country with a poverty rate of 52.8%. In general job opportunities in Wadi Araba are low, as there are no major investments and most people do not have the necessary skills to enable them to enter the labour market in adjacent areas. The economic participation of the workforce is therefore relatively low in Wadi Araba, as the rate of crude economic participation (the ratio of workforce to the total population) is only 20.8% and the revised economic participation rate (the ratio of workforce to the population aged 15 years and over) is 30%. This is considerably lower than Aqaba city which has a relatively high crude economic participation rate reaching 25.8% and a revised economic participation ratio of 43.7%; in comparison to the 25.0% ratio of the kingdom’s crude economic participation and its 39.8% revised economic participation rate \(^{(2)}\).

Most of the people in Wadi Araba work in agriculture, animal rearing and in the public sector \(^{(3)}\), however there are vast arable areas that are not utilized due to the unavailability of water. Most of the residents in Wadi Araba do

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\(^{(1)}\) In this context, tribe refers to a self-defined extended multi-family grouping. Tribal distinctions are important in Jordan, particularly for families who originate from the ‘east bank’ of the rift valley, and are particularly important for Bedouin and nomadic groups.


not own agricultural land. There was a recent land distribution programme (whereby government held land is distributed to the local residents) but this has been reportedly suspended by the Government pending finalization of the routing and land requirements for the Scheme. The JVA has allocated land for agriculture to a number of households, but only 5,444 dunums (544.4 hectares) are cultivated. 25,000 dunums of allocated land lies unutilized due to the unavailability of water. There are, however, three large scale farms in Wadi Araba that are owned by cooperatives: The Seil Finan Society (67 hectares); the Amareen Society (5,500 hectares) and the Kaa’ Al-Saedine cooperative (20 hectares).

Al-Haq Farms operate agricultural facilities near Qatar and Rahma, Bir Mathkour, Rishe and Ma’amoura, which produce dates and other vegetables. The locations of the al Haq farms are shown on Figure C6.4.

**Figure C6.4** Location of Al Haq Farming Projects

All maps produced as a part of this study are being checked by the World Bank Map Design Unit. An approved set of maps will be included in the Preliminary Assessment Report

In order to address the poverty and lack of economic activity in the area, the Government of Jordan, through the Enhanced Productivity Programme initiated by the Ministry of Planning and International Cooperation (MoPIC), is implementing a poverty alleviation programme in the Wadi Araba and Ghor Safi. Both the Jordan River Foundation and Jordan Hashemite Fund for Human Development were commissioned by MoPIC to implement initiatives aimed at establishing income-generating activities, as well as establishing a microfinance portfolio targeting the poor, enhancing the infrastructure and building the capacity of the local community and local organizations. Both areas are also major recipients of the National Aid Fund (NAF) (1), More than one third of both Wadi Araba and Ghor Safi families depend on the national Aid Fund as reported by NAF in 2008 and with a total cash assistance of JD25,468 and JD91,669 per month in Wadi Araba and Ghor Safi respectively.

In terms of future development in the area, there are discussions about creating future development zones in the area. No details are currently available, but it is possible that one zone will be created around agriculture, with another around tourism at a later date. If these are established, they will

(1) The National Aid Fund is the government’s main poverty alleviation cash transfer programme
become the responsibility of the Development Zones Corporation (DZC), and will attempt to attract investment into the area. There is also potential for development around the historical, archaeological, and tourism sites along the historic mountain trails to Petra and Dana Reserve. A project to support the development of an archaeological and nature park at Bir Mathkoor is also potentially planned.

The Arab fund for Economic and Social Development is also currently funding the project on integrated development of Wadi Araba. The project is being overseen by ASEZA with the vision of expanding ASEZ to Wadi Araba. This is a new project and further data is not currently available. It is possible, however, that with the establishment of the Development Zones Corporation, and plans for a development zone in Wadi Araba, that these plans and projects will be combined.

The extent of high level government plans for the Wadi Araba area remains unclear. A Royal Court’s report into development of the area, produced by the Urban Workshop, has not been published. There has also been speculation in Israel, and in the international media about plans to develop the Valley, based on a series of lakes, around which large scale tourism facilities would be developed. The Israeli investor Tshuva is promoting this as a ‘Peace Valley’. A company called Horizon developed outline proposals in the mid 2000s for a multi-building high rise development at the southern most part of the Wadi Araba, close to Aqaba, but no further steps have been made. Most recently, there have been announcements from the Government regarding plans to develop major real estate projects in the Wadi Araba just north of Aqaba. More information on this will be gathered during the next phase of assessment. Such developments would require a significant freshwater supply, but the lakes could be created from sea water. It is not known if these represent Government-led plans to leverage development of the area on the back of the RSDSC, or are private investment proposals unrelated to the Scheme. If any were to be realized, even to a minimal degree, this would constitute a major alteration in the social and development fabric of the Wadi Araba. Significant concern has been raised in Israel over these ideas, given that some of them are explicitly cross-border projects. Real estate development would represent a major change to the area, and since it will require significant amounts of potable water, the linkage between these plans and the Scheme need to be explored. No details on these proposals have been published, and the status of them is unknown. Further data is being requested.

**Vulnerable Groups:** The groups considered the most vulnerable in the Wadi Araba are:

- **The unemployed:** The Wadi Araba has quite a high official unemployment rate. There is little formal employment outside the army and some public sector posts;

- **The poor:** Wadi Araba is classed as a poverty pocket in Jordan. Many of the villages are settled Bedouin, engaged mostly in herding and some informal agriculture. Agriculture is extremely limited due to the lack of water and fertile soil;
• **Female headed households:** Female-headed-households are a particularly vulnerable group, since public life in the Wadi Araba is very male dominated.

*Utilities, Services and Infrastructure*

The communities of Rishe, Qreigera, Rahma, Qatar and Finan tend to have permanent housing. These comprise one storey buildings, which are usually built on land allocated by the Jordan Valley Authority (JVA). These houses tend to have access to piped water and electricity, however none has access to a sewage system and most use septic tanks in their houses. In contrast, the communities of Bir Mathkour and Abu Khsaibeh in the same area tend to have a Bedouin (nomadic) lifestyle. Dwellings are scattered and are predominantly tents (57% in Bir Mathkour for example). The majority of the people in these largely nomadic communities rely on livestock grazing for a living.

Waste management is operated by the local municipalities. There are large formal landfill sites in Aqaba and Ghor Safi designated for waste dumping, and a smaller one at Abu Khsheibeh which is used by the surrounding areas. None of the landfill sites in the area are lined, or well managed, and the one at Aqaba is situated over the Wadi Yutum aquifer. None have capacity to accept hazardous or liquid wastes. Jordan’s only hazardous waste facility is at Swaqa on the Desert Highway, around 100 km south of Amman.

Most of the community clusters in the study area have access roads to their houses and means of transportation to other communities/schools; however stakeholder consultation highlighted that transportation is unavailable on a regular basis.

*Education*

According to MoPIC, 1,568 of the 2,000 (approx.) students in the area registered in schools. It is reportedly hard to recruit teachers in the area and the illiteracy rate is relatively high at 35% compared to 9.3% at the national level (1). There are 11 schools in the area; 6 high schools across Qweireh, Rahma, and Rishe (2 of the schools in Rishe and Rahma are for military education); 3 mixed schools across Qatar, Finan and the remaining 2 are located in Bir Mathkour.

*Health*

There are no hospitals in the area between Aqaba and Ghor Safi. However, there is one comprehensive health centre, two primary health centres and one sub-health, although these are rarely staffed by doctors. The Wadi Araba area also has six pharmacies, two maternity clinics, one dental clinic and six

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(1) MoPIC, 2008.
ambulances. The health services in Wadi Araba are considered to be of low quality. Local communities have complained about the unavailability of medicine and health practitioners, as they are only available in the clinic once a week.

More information on education and health facilities in the specific areas will be developed during the next stage of the assessment and presented in the Preliminary Draft ESA Report.

Israel: the Arava Valley

Population and Demographics

Much of the Arava Valley area is made up of military firing ranges and nature reserves and is therefore sparsely populated compared to central and northern parts of the country. The settlements running north through the Arava Valley tend to be small, rural, communal entities (kibbutzim and moshavim), with economies based on agriculture and/or tourism.

Table C6.3 provides a brief summary of the communities in the Arava Valley.

Village profiles will be developed during the next round of social surveys and provided in the Preliminary Draft ESA Report. These profiles will be provided in a systematic format for all communities.
### Table C6.3  
**Arava Valley - (Southern Arava – Hevel Eilot Regional Authority)**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Population</th>
<th>Main Livelihoods</th>
<th>Regional authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eilot</td>
<td>K</td>
<td>259</td>
<td>agriculture (dates, veggies, fruit, dairy) + tourism + industry (transformer cores)</td>
<td>Southern Arava – Hevel Eilot</td>
</tr>
<tr>
<td>Be’er Ora</td>
<td>CS</td>
<td>99</td>
<td>Residential</td>
<td></td>
</tr>
<tr>
<td>Elifaz</td>
<td>K</td>
<td>61</td>
<td>agriculture (Vegetables, dairy, dates, mangoes) and tourism</td>
<td></td>
</tr>
<tr>
<td>Samar</td>
<td>K</td>
<td>213</td>
<td>agriculture (organic dates, dairy, onions) and tourism</td>
<td></td>
</tr>
<tr>
<td>Yotvata</td>
<td>K</td>
<td>580</td>
<td>Milk industry (controls 63% of Israeli dairy market?)</td>
<td></td>
</tr>
<tr>
<td>Shacharut</td>
<td>CS</td>
<td>104</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grofit</td>
<td>K</td>
<td>343</td>
<td>agriculture, industry (reusable plastic), tourism</td>
<td>Regional authority</td>
</tr>
<tr>
<td>Ketura</td>
<td>K</td>
<td>454</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lotan</td>
<td>K</td>
<td>168</td>
<td>dairy cowshed, date plantations, ecological tourism, holistic medicine clinic</td>
<td></td>
</tr>
<tr>
<td>Neve Harif</td>
<td>K</td>
<td>121</td>
<td>Dairy, poultry, Catering, quarry</td>
<td></td>
</tr>
<tr>
<td>Yahel</td>
<td>K</td>
<td>238</td>
<td>Field agriculture + tourism</td>
<td></td>
</tr>
<tr>
<td>Neot Smadar</td>
<td>K</td>
<td>161</td>
<td>Organic agriculture</td>
<td></td>
</tr>
<tr>
<td>Paran</td>
<td>M</td>
<td>399</td>
<td>agriculture (flower and peppers for export, dairy), tourism</td>
<td>Central Arava</td>
</tr>
<tr>
<td>Tsafar/Tzfar</td>
<td>M</td>
<td>343</td>
<td>agriculture (mostly for export) , tourism</td>
<td>Arava</td>
</tr>
<tr>
<td>Sapir</td>
<td>CS</td>
<td>377</td>
<td>Housing for various professions</td>
<td>Tichona</td>
</tr>
<tr>
<td>Ein Yahav</td>
<td>M</td>
<td>612</td>
<td>Agriculture, tourism</td>
<td>Regional Authority</td>
</tr>
<tr>
<td>Hatzeva[1]</td>
<td>M</td>
<td>439</td>
<td>Agriculture</td>
<td></td>
</tr>
<tr>
<td>Idan</td>
<td>M</td>
<td>261</td>
<td>Agriculture, tourism</td>
<td></td>
</tr>
</tbody>
</table>

**Source:** CBS 2007 Data  
K = kibbutz; M = moshav; CS = community settlement
Box C6.2 Definitions of Israeli Communities

A kibbutz is a settlement traditionally arranged around socialist/communist ideals, with communal ownership of property, equality of pay, lack of stratification of labor (i.e. everyone works at required jobs, from agriculture to dining hall service), collective rearing and education of children, and an emphasis on community social interaction and participation. Changes in social outlooks and economic realities over the past few decades have led to increased privatization of property and the means of production, as well as stratification of wages based on occupation. The same trends have increased the emphasis on individualism and elevated the importance of the family unit rather than the kibbutz as a whole. Kibbutzim tend to be small in size, from several hundred to a thousand people.

A moshav is a cooperative agricultural settlement, wherein individual families each run their own farm but operate collectively to provide services and get better prices for required materials. Generally, farm plots for each family will be of the same size, and taxes will be equal for all, so those whose operations are more profitable will be better off than those whose are not (in other words, income is not equal, as in a kibbutz).

A community settlement is one in which membership must be granted in order for a new family to join. The communities are often based on some kind of social or religious ideology, and new applicants are judged by a committee and may be accepted or rejected based on their projected fit within the community. There is not usually any extensive economic cooperation associated with community settlements, as there is with kibbutzim and moshavim, and inhabitants there may work elsewhere. Community settlements tend to be small, numbering several hundred people.

Economic Activity

The economy of the Arava rural communities is largely based on agriculture, predominantly date plantations and some fruits and vegetables (tomatoes, peppers, melons, water melons, onion, eggplant, mango, and grapes), flowers and animal rearing, mostly for milk. Yotvata Dairies is a large regional dairy with national reach. The Arava communities are organized in a regional co-op – ‘Ardom’ - that deals with the organization and marketing of agricultural produce and provides different services such as a research station, computer services, transport etc. Most of the agricultural produce is for export.

There is no potable surface water available for these agricultural activities but despite the arid climate, agriculture remains viable in this area due to use of desalinized brackish groundwater and advanced farming techniques. Water is pumped from aquifers located at various depths beneath the surface of the Arava Valley; however, the system of aquifers is not well-understood, and their spatial extent and total volume are not known. Agreements exist between Israel and Jordan that allow for pumping of groundwater from the Jordanian side of the border, and as such some Israeli wells and farms are actually located on Jordanian land. The wells on the eastern side of the valley have the advantage of being easier to access (i.e., are shallower) \(^1\).

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\(^1\) Interview with Arava Tichona Regional Authority, October 2009.
Additional agricultural lands are available for development by the agricultural sector, but there is environmentalist opposition to expansion as well as a shortage of water (1).

The agricultural sector in the Arava Valley is heavily dependent on cheap, foreign labour, mostly of Thai nationals. Estimates are that their number is 2,000-4,000, with some seasonal variations, though the exact number is debated between the Immigration Authority, The Ministry of Agriculture and the Ministry of the Treasury.

In order to diversify the economy of rural communities, the State, NGOs and the local regional councils of the Arava valley have developed locally-themed tourist attractions such as the Nabatean Trail, Park Timna and other sites which have helped to establish a small but tangible boutique-style accommodation in the rural area. As of the end of 2007, there were 215 accommodation rooms with more than 1,000 beds, as well as an additional 1,000 organized outdoor sleeping spaces. Annual average occupancy is 30% and the main tourist season is September to May. More than 70 families have a tourism based income.

The southern Arava has plans for renewable energy initiatives, especially solar energy and biofuels from agricultural products and waste. The hope is that a strong economic base in renewable energy will attract new residents and companies to the region.

There are some ‘unrecognised settlements’ in the Arava Valley which are not served by government utilities or shown on official maps. These communities are potentially vulnerable but are likely to be further north of the study area and therefore not significantly impacted by the Scheme.

Utilities, services and infrastructure

Water Supply/Water Usage - Currently there are two pipe networks in the Arava Valley – a saline pipeline for general and agricultural uses and a fresh water (from various sources) system which connects residences. In 2009 Mekorot, the National Water Company started working on a new water network which will increase access to desalinated water. The water for this network will be mainly sourced from saline groundwater (which will require desalinisation). It is important to note that the largest consumer of water in this region is the agricultural sector which accounts for 54% of the water consumed in the Arava Valley.

In the settlements along the Arava Valley wastewater is treated in local wastewater treatment ponds.

**Education and Health**

There is one regional HMO at the regional authority complex in Yotvata and one regional health care centre and HMO nearby. There is one HMO clinic at Ein Bokek.

More information on the education and health in the specific areas will be developed during the next stage of the assessment and presented in the Preliminary Draft ESA Report.

**C6.3.5 Area 3: The Dead Sea Basin Area**

The Dead Sea Basin includes the entire basin of the Dead Sea in Jordan and Israel, encompassing the Lissan Peninsula, the HPP site and low level DSP site in Fifa, the penstocks and discharge pipeline, and all settlements, communities, road corridors, agricultural communities, industries and other developments potentially impacted by the project as far as the Jordan River, but excluding areas impacted only by the freshwater pipelines.

The Basin lies at an elevation of around 350 to 400 m below sea level. It encompasses the Dead Sea and its related industry and tourism activities. The Jordanian communities in this area typically rely on agriculture. In Israel, industry and tourism are the main economic sectors in the area, with the Dead Sea Works being a key industry extracting minerals from the Dead Sea. As well as the Dead Sea itself, the important tourist sites of Masada in Israel, and Lot’s cave on the Jordanian side are also found in this area.

The locations of the communities in the Dead Sea Basin area are indicated on Figure C6.5. The communities are then referred to in the following sections.

**Figure C6.5 Communities in the Dead Sea Basin**

All maps produced as a part of this study are being checked by the World Bank Map Design Unit. An approved set of maps will be included in the Preliminary Assessment Report.

**Jordan**

**Population and Demographics**

The Jordanian portion of the Dead Sea Basin includes the area from the River Jordan, north of the Dead Sea, along the east coast of the Sea, as far south as
the village of Ghor Fifa. The main communities in the area are shown on Figure C6.5. The Dead Sea Basin includes two sub-districts - Ghor Safi and Ghor Mazra’a. The village of Gweibeh is also included in this section even though it lies just outside the topographic Dead Sea Basin, since it is part of the same ‘Ghor Safi’ administrative Sub-District as the rest of the southern part of the basin. These communities are collectively known as the ‘southern Ghors’.

The population of Ghor Safi sub district is 26,644 divided into 4,648 families (1) of which 21,936 are concentrated in the main centre of Ghor Safi which is about 9.6% of the total population of the Karak Governorate. The majority of inhabitants in Ghor Safi are settled Bedouins, and they include the family groups of al-Ashoush, al-Bawat, al-Sha’ar and al-Khutabah. The tribes of the village clusters in Ghor Safi area are distributed as follows:

<table>
<thead>
<tr>
<th>Community</th>
<th>Population</th>
<th>Tribes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ghor Safi</td>
<td>21936</td>
<td>Al Ashoush, Al Bawat &amp; Al Sha’ar</td>
</tr>
<tr>
<td>Ghor Fifa</td>
<td>2978</td>
<td>Al Khutaba &amp; Al Bawat</td>
</tr>
<tr>
<td>Ma’amoura</td>
<td>1150</td>
<td>Al Se’adieen</td>
</tr>
<tr>
<td>Gweibeh &amp; Numeira</td>
<td>580</td>
<td>Al Azazmeh &amp; Al Se’adieen</td>
</tr>
<tr>
<td>Salmani &amp; Khnaizeer</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

Table C6.4 The Tribes of the Village Clusters in Ghor Safi Area

Village profiles will be developed during the next round of social surveys and provided in the Preliminary Draft ESA Report. These profiles will be provided in a systematic format for all communities.

The population of Ghor Mazra’a sub district is 13,630 divided into 1,763 family groups (2). Family sizes in the Southern Ghors (as in Wadi Araba) are characterized by larger family sizes than in Aqaba, with an average size of 7.4 people compared to 5.8 at the regional level and 5.7 in the kingdom (3). They also have a high dependency rate with more than 40% of the population either under the age of 15 or above the age of 64 (4).

Economic Activity and Poverty

The Ghor Safi sub-district is one of the pockets of poverty in the country with a poverty rate of 62.5%. In Ghor Safi, most of the people are either employed in the public sector, the armed forces or agriculture. As explained above, the majority of inhabitants in Ghor Safi are settled Bedouins. In both Ma’amoura and Ghweiba, most of the settled Bedouin population mainly depend on animal rearing. In addition, there are many local farmers who cultivate their

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lands with seasonal crops including tomatoes, watermelon, cantaloupe, beans and other vegetables (1). Most cultivated land is allocated by the Jordan Valley Authority (2).

In the agricultural area of the Southern Ghors, most local farmers do not own the land, although JVA has allocated around 25-40 dunums for use by each household. Some land reportedly also has some squatters, who do not have rights to the land. The main produce grown is tomatoes, eggplants, green peppers and chickpeas between September and May. Most of the lands are irrigated from piped water provided by JVA. Local people estimate that 70% of the lands in Ghor Safi are owned by landowners from Amman. According to the local communities, JVA has announced a second round of land allocation to local farmers in Ghor Fifa.

There are three major factories in the area that process potash, magnesium and bromine. The potash factory employs around 430 people from Southern Ghor District making up 18.6% of its 2,305 employees. The magnesium and bromine factories employ 60 local employees out of their 326 employees – a percentage of only 18%. The low economic participation rate of the locals in these enterprises is attributed to the lack of skills and experience (3).

As discussed previously in the description of the Wadi Araba, Ghor Safi is subject to a poverty alleviation programme by the Government of Jordan to encourage the establishment of income-generating activities, as well as establishing a microfinance portfolio targeting the poor, enhancing the infrastructure and building the capacity of the local community. As explained above the National Aid Fund provides JD 91,669 per month in Ghor Safi.

This area contains the Dead Sea Development Zone which was created in 2009. This area stretches over an area of 40 km² from the Jordan River to the Wadi Mujib and aims at stimulating the economy through incentives for investment. It will focus on entertainment and tourism projects and several development schemes. As part of this development, a Comprehensive Land Use Plan was prepared, covering 133,000 dunums, the majority of which is owned by the Government of Jordan. In recent years, the Government offered 6,810 dunums to private tourism developers and investors, nearly all on the Dead Sea shore. A major goal of the Master Plan is to deliver integrated community development benefits from tourism industry to local residents.

Utilities, Services and Infrastructure

Most houses in the area are one storey buildings, which are usually built on the allocated land from JVA. Although most of the houses have access to piped water supplied by the Water Authority, and electricity, none have

(2) ZENID, 2008.
(3) ZENID, 2008.
access to the sewage system and most of them use septic tanks in their houses (1).

Waste management is operated by the local municipalities. There are large formal landfill sites in Aqaba and Ghor Safi are designated for waste dumping, and a smaller one at Abu Khsheibeh which is used by the surrounding areas. None of the landfill sites in the area are lined, or well managed, and the one at Aqaba is situated over the Wadi Yutum aquifer. None have capacity to accept hazardous or liquid wastes. Jordan’s only hazardous waste facility is at Swaqa on the Desert Highway, around 100 km south of Amman.

Most of the community clusters in the study area have access roads to their houses and means of transportation to other communities/schools; however according to stakeholders consulted, transportation is unavailable on a regular basis.

Education

In Ghor Safi, the illiteracy rate is 21.4%, which is lower than in Wadi Araba, but much higher than the national average of 9.3% %. There are 15 schools of which 7 are for males and 8 for females, the distribution of the 4 high schools is concentrated in Ghor Safi with only one high school in Ghor Fifa. The remaining primary schools are distributed along Ghor Safi, Ghor Fifa, Ma'amoura and Gweibeh (2).

Health

The health service in Ghor Al Safi is considered low quality for the same reasons as described for Wadi Araba. During stakeholder consultation, communities complained about the unavailability of medicine and health practitioners, who are only available in the clinics once a week. However, there are two hospitals in Ghor Safi - the Ghor Safi hospital and the Potash private hospital which mainly serves employees of the extraction industries. The Ghor Safi hospital has 62 beds and 38 doctors. In addition there are three primary health centres and two sub-health centres. The sub-district also includes three pharmacies, two maternity clinics, one dental clinic and one ambulance (3).

More information on education and health in the specific areas will be developed during the next stage of the assessment and presented in the Preliminary Draft ESA Report.

(1) MoPIC, 2008.
The Regional Council of Tamar is populated by 1,300 residents. The communities in this area are illustrated on Figure C6.5 and information on their population and main livelihoods will be presented in the Preliminary Draft ESA Report.

Table C6.5  Information on Villages in Dead Sea Basin Area (Tamar Regional Council)

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Approx. Population</th>
<th>Main Livelihoods</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Kikar Sdom Moshavim</td>
<td></td>
<td>350</td>
<td>Ain Tamar and Naot Hkikar- population of 350 (100 families), 106 privately owned pieces of land out of 200 allocated; agriculture (winter vegetables, melons, peppers, dates, mangos, and figs, and herbs). Local bed and breakfast, local artist, and an event location. As of today the land is made up of 50 dunam (5 hectares) per property; 80 dunam (8 hectares) per property were allocated by the ministry of agriculture, but as of now there is not enough land.</td>
</tr>
<tr>
<td>Ein Gedi</td>
<td>K</td>
<td>589</td>
<td>Population of 589 people, 140 families and additional 50-100 permanent residents; Bed and Breakfast (150 guest rooms), restaurants, sulphur, botanical gardens, tour and hiking centre, gas station and restaurant, historical synagogue, water factory, plastic factory, agriculture (specifically mango, herbs and dates), elementary and middle school (used also by ‘Megillot’ regional council), regional culture centre.</td>
</tr>
<tr>
<td>Ein Hatzeva</td>
<td>M</td>
<td>61</td>
<td>Population 61; agriculture (winter vegetables, grapes, dates, cows for meat, house birds, house fish).</td>
</tr>
<tr>
<td>Ne’Ot Hakikar</td>
<td>M</td>
<td>239</td>
<td>Agriculture, tourism</td>
</tr>
<tr>
<td>Neve Zohar</td>
<td>CS</td>
<td>78</td>
<td>Population of 78 people (60 houses); regional education centre and an elementary school, regional council offices, small supermarket, and a location for rent for festivals, hotels and the region to run events.</td>
</tr>
<tr>
<td>Ein Tamar</td>
<td>M</td>
<td>163</td>
<td>Agriculture and tourism</td>
</tr>
<tr>
<td>Kibbutz Har Amsha</td>
<td></td>
<td>50</td>
<td>Population 50 (20 families); bed and breakfast, research centre.</td>
</tr>
<tr>
<td>Maleh Peres</td>
<td></td>
<td></td>
<td>A planned settlement above the Arava Cross road. The region strives to absorb 200 families.</td>
</tr>
</tbody>
</table>

Village profiles will be developed during the next round of social surveys and provided in the Preliminary Draft ESA Report. These profiles will be provided in a systematic format for all communities.

**Economic Activity and Poverty**

The main economic activities in the Dead Sea basin in Israel are tourism and industry, primarily at the Dead Sea Works. There is a significant tourist resort located at Ein Bokek and tourism is also a key activity at Tamar which hosts 14 hotels with 4,011 rooms. 5,000 people are employed in the tourism industry with roughly 4,000 hotel employees, and another 1,000 in the surrounding businesses. Most workers come from Arad, which is outside the scope of the study area \(^1\). Tamar has the Bar Yehuda Landing strip, which transports tourists to the area for archaeological tours. The tourism industry is likely to continue to grow with a number of potential plans in the pipeline. The coastal strip contains the main highway 90, which passes above Ein Bokek. The Ein Gedi Kibbutz and Spa are the northernmost areas of population in Israel. The historic site of Masada is a major tourism attraction, lying to the west of the southernmost edge of the Dead Sea’s northern basin. Masada brings 1.5 million guests a year to the Tamar area.

Masada is situated on a dramatic rock plateau on the eastern edge of the Judean Desert, overlooking the Dead Sea. It is the site of ancient palaces and fortifications, identified in 1842 and extensively excavated between 1963 and 1965. The site is one of the most important tourism sites in Israel, and is noted for its role in the First Jewish-Roman War where a group of Jewish zealots overcame the Roman guards of Masada. After the destruction of the Temple, Jewish rebels and their families fled Jerusalem and settled on the mountain top, using it as a base for raiding Roman settlements. However, in AD 72, the Roman governor marched against Masada laid siege to the fortress by troops of the Roman Empire led to the mass suicide of the Sicarii rebels. Today, the site is developed with tourist facilities, a cable car access to the plateau and a museum. Masada was declared a UNESCO World Heritage Site in 2001. Masada overlooks the Dead Sea basin, and the alignment of the freshwater line in Israel.

Industrial areas have been established on the east side of the Dead Sea basin near Sdom in Israel. The entire southern basin of the Dead Sea also consists of evaporation basins for mineral extraction. The largest industrial complex in the region is the Dead Sea Works, Ltd. It is the single largest employer in the Dead Sea basin, and directly employs over 2,000 individuals, with annual revenue of US$ 450 million \(^2\).

**Utilities, Services and Infrastructure**

**Water Supply/Water Usage:** The Dead Sea area is served by two water plants – the Ein Bokek Desalination Plant (which desalinates groundwater using the reverse osmosis method), which serves the Dead Sea Hotels area. Its

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maximum capacity is 13,000 m$^3$/day. In addition, the Jordan Valley Water Supply Plant is a series of small plants and drills along the Rift Valley as far north as Beit She’an. Total local consumption in the region is approximately 10.4 million m$^3$/p.a. of mainly saline water.

Health and Education

There is one regional HMO at the regional authority complex in Yotvata and one regional health care centre and HMO nearby. There is one HMO clinic at Ein Bokek.

More data and analysis on health and education will be gathered in the next phase of assessment and presented in the Preliminary Draft ESA Report.

C6.3.6 Area 4: Eastern Freshwater Pipeline Route (Jordan)

Overview of the Area

The Eastern Freshwater Pipeline Route (Jordan) includes the pipeline corridor in Jordan and associated impacted areas. Two alignments for the freshwater route were investigated in this study, although only one will be recommended by the Feasibility Study for more detailed development. Alignment ‘1’ passes through the Karak Governorate. With the exception of the town of Karak, this Governorate is primarily agricultural with the predominant livelihoods being farming and shepherding (agriculturists and pastoralists). The town of Karak itself has a population of 23,000 people. Alignment ‘2’ will pass through the Tafila Governorate. Both routes pass through Jordan’s southern highlands where the terrain rises steeply from the Dead Sea Basin, and flattens out over plateaus where the population lives in small villages and hamlets. Within Karak and Tafila lie some of the Kingdom’s identified ‘poverty pockets’.

The communities located in this area are shown on Figure C6.6 and Figure C6.7.

Figure C6.6 Communities Along the Eastern Freshwater Route (Southern Part)

All maps produced as a part of this study are being checked by the World Bank Map Design Unit. An approved set of maps will be included in the Preliminary Assessment Report.
Communities in the Karak and Tafila Governorates

Land Use and Economy

In Karak and Tafila, most of the rural land along the route remains unzoned and is used for agricultural purposes, or left vacant. Land is almost entirely owned by private owners with about 80% of farmers owning their own farms, with residents noting that there has been a gradual trend towards smaller farms. Tribal boundaries are especially important for determining water use from wells; and often tribe members have sole access to these water sources in agricultural areas.

Along the freshwater line within Karak the agricultural economy is based mainly on herding sheep and goats, and on wheat and barley production. While none of the villages directly along the route are classified within Jordan’s poverty pockets, Kathrubbah and Al-Iraq directly border one of these pockets. Most women of the Al-Iraq and Kathrubbah villages can be seen to produce ghee and Jameed at home, primarily for domestic consumption. Homes can also be seen to have apples and grapes within home gardens as well as a healthy stock of poultry. The Muatah, Madin and Mirwid villages along the route concentrate on olive tree farming for commercial consumption. Many homes do, however, have home gardens for fruit and vegetable for domestic use. In the surrounding areas of these villages there are also fields of wheat and barley for commercial production. Muatah is also home to a number of small handicrafts, furniture and apparel stores. There is also a population of immigrant workers within the village.

Within the Tafila section of the route, the Sinfaha village depends mainly on rain-fed agriculture for vegetable and grain crops. Most of the farms along the route are under 50 dunums and are planted close together with a variety of products but no fruit trees. Livestock can be seen in most villages. Within the An Namatah village agriculture, hunting and herding are the most common livelihoods due to the proximity to a water source (Ain al-Mour), especially amongst the older generation. Agricultural produce is concentrated on olive, fig and citrus fruit production. There are also a few chicken farms. The area surrounding the village is home to many larger farms with figs, grapes and pomegranate. Within the remaining villages (with the exception of Al Hessa) agriculture is commonly the major source of economic activity providing grain, wheat, beans and lentils, along with livestock. Tree
farms are also common – specifically olive, grape and citrus fruits; with the highest proportion of trees being olive trees.

While most of the villages along the route concentrate on agriculture, the Al Hessa village is a mining town and home to one of the Jordan Phosphate Mines Company (JPMC) sites – established in 1962. The JPMC is the largest employer in Tafila, with the mining sector employing 7.5% of the workforce. For the JPMC, Al Hassa and Al Abiad mines are located approximately 20 km apart, some 130 km south of Amman. Each of the mines has a railway terminal linking it to the port in Aqaba, 200 km to the south. The mines at Al-Hassa and Al-Abiad each cover an area of approximately 25 square km and were, until the development of Eshidiya in 1988, the main mining and production sites of JPMC. JPMC employs approximately 1254 people in the mines at Al-Hassa and Al-Abiad.

Within the Governorates of Karak and Tafila there are four defined poverty pockets. Karak and Tafila have both witnessed an incredible jump in their poverty levels, increasing by 9% of the population in each case from 2002 – 2006 to reach 21.7% and 19.1% respectively; with Karak ranking as the second poorest Governorate in Jordan. In contrast, Amman, as the capital, has the lowest poverty rates in Jordan at 9.4%.

Generally, the most vulnerable groups in Karak are:

- **The unemployed:** Karak has quite a high official unemployment rate, estimated by the Department of Statistics to be 17%, although it is thought that this could in fact be higher.
- **The poor:** Within Karak about 10% of the Governorate’s families receive aid from the central government.
- **The young:** The population of Karak is also predominantly young (48% under the age of 15), an especially vulnerable group for the Governorate when considering the growing number of people entering the labor market every year and the limited job opportunities offered in return.
- **Immigrant workers:** this group have been growing vastly in number within the Governorate (estimated at about 8,000 in 2004 or 6% of the total population in Karak) and in larger cities have become more predominant.

In Tafila Governorate vulnerable groups are:

- **The poor:** communities struggle due to the limited income generating activities outside of farming. Agricultural activities are also limited due to water constraints and poor soil with limited funding availability for agricultural activities, so potential for expansion is low.
- **The unemployed:** Tafila governorate has an unemployment rate of 14%, and low educational levels. Within the Tafila Governorate, 50% of families
depend – to varying extents - on agriculture for income. On average, within the Governorate; not more than 45% of family income on average is generated through wage employment; 20% from agriculture; 12% from animal wealth; 12% from national aid; and 11% from other sources.

- **Small-scale farmers:** Smaller farmers depending on the cultivation of rain-fed crops are an especially vulnerable group. Olive farmers are also a specific subset of farmers amongst the more vulnerable groups with the fluctuating prices of olive oil which have fallen this past year from 3.5 JD/kg to 2.5 JD/kg today.

- **Female headed households:** Finally, female-headed-households are identified as a particularly vulnerable group: 9% of families are female-headed with no land ownership. These women likely rely on support from family members.

In all major cities across Jordan formal lending institutions (banks) are available. In smaller villages and settlements, there is also access to non-private lending institutions such as the Noor Al-Hussein Foundation, the Agricultural Credit Cooperative and the Development and Employment Fund, all of whom have a presence as well. Limited markets in the smaller villages, especially for agricultural products mean that goods must be sent – oftentimes as far as Amman – to be sold. Residents through villages in Tafila and Karak band together, especially through cooperatives, to rent trucks and send goods, collectively, to main marketplaces. Purchasing power is highest in the capital.

**Utilities, Services and Infrastructure**

In Karak and Tafila, most of the community clusters in the study area have access roads to their houses and means of transportation to other communities and schools; however transportation is unavailable on a regular basis and residents noted that they are often of poor quality.

Most homes in villages along the route through Karak and Tafila are characterized by one-storey buildings, which are usually owned by the residents and built on small plots with attached gardens. Most of these homes have access to the public network for drinking water. However, stakeholder consultation revealed that while connections may be high, the quality of the water network is often low and considered to be in obsolete condition and in grave need of renovation.

Most homes also have septic tanks to dispose of their sewage, as they are not connected to the public network. All the villages have access to electricity and phone lines, although frequent disruptions to both are common complaints by the residents.
**Education**

In Tafila, most villages along the route reflect conditions typical of the Governorate in terms of education with lower educational levels for women, with almost 20% of females illiterate, compared to about 8% of males. Children of settlements along the route do have access to schools. Within smaller villages access to educational facilities is available – for example, An Namatah, with a population of 65, has a primary school. The Sinfaha village (population 602) has two schools; one for males until the 10th grade and one for females until the 9th grade. The village of Arafa has three schools (population 1,096), one for males from 4th-12th grade; two mixed schools up until the 4th grade; and one school for females until the 11th grade. In Karak, in terms of education, the settlements along the route reflect conditions similar to the overall Governorate. Illiteracy rates in the Governorate amongst females are 19.0% compared to 9.6% amongst males. Access to educational facilities is widespread. Even the smaller villages along the route such as Madin (population 1,301), have access to educational facilities with two primary and secondary schools (male and female). Mirwid (population 1,557) also has two primary and secondary schools (male and female), as well as a large health centre that serves surrounding villages as well.

**Health**

In Tafila, most of the larger villages have a health centre within the village itself, and smaller villages are designated health centres in villages close by. Residents along the route do complain of access to more sophisticated medical care, which can only be found in hospitals in the major cities. Most villages in Karak also have a small health centre (branch of the Mirwid Health Center).

**Communities in the Amman Governorate**

**Population and Demographics**

In Amman, the areas along the freshwater route have been part of the City of Amman since late 2006. The Metropolitan Growth Plan restricts urban growth in these areas and specifically prohibits expansion in rural and agricultural land outside of designated “Rural Growth Areas”. There is one designated growth area in proximity to the freshwater route, but is not directly along it. While most of the land is agricultural along the route there are pockets of industrial land and clusters of factories specifically within settlements within the sub-districts of Umm Rassass and Muwaqqar.

**Land Use, Economic Activity and Poverty**

The south of Amman has farms which are generally owned by investors, rather than residents. Along the freshwater route, scattered olive tree farms, orchards (citrus and apple trees mainly) and greenhouses can be seen. The Khan Az Zabayeb area is purely agricultural with scattered olive and melon
farms. The Az Zmeyla village is home to several olive and cattle farms, with goat and sheep herds, as well as chicken farms. About 15% of houses in the area have gardens for herbs, vegetables and chickens. Smaller villages such as Al Kuteifa, As Shammout, Al Hamam, and Al Ruqayba are surrounded by larger farms with olive trees and greenhouses.

The south of Amman is also known for its industry. Small workshops, car repair shops, and other light industrial factories can be seen scattered around the Jiza and Muwaqqar districts; especially within the Al Qnaytira, Mushatta, Dubaai, Salim, Al Kuteifa, and Zumaylat areas. In the Ad Damikhi village in Umm Rassas for instance, there are a couple of mines in the surrounding area, the Manasir Cement Factory, as well as the National Chicken Farms and a brick factory. In Rujm As Shami As Sharqi in the Muwaqqar District there are several quarries, as well as factories. The King Abdullah II Industrial City is in close proximity, and the village is relatively built up as a result.

Throughout the project area, there are ad-hoc industrial clusters that have emerged; and with additional industrial land zoned, and infrastructure upgrades designated, these clusters will grow in importance.

The average annual current income of a household and a household member in Amman was estimated at JD 7,411.9 – the highest rate in Jordan. Poverty rates are the lowest in Jordan at 9.4%, with lower-income communities concentrated in the south and east of the Governorate. The most vulnerable groups are generally the poor and the unemployed, and their various sub-groups including low-income renters, affordable housing tenants, the young (since approximately 35% of Amman’s population is under 15 years of age and 61.4% between the ages of 15 and 64) and immigrant workers, who have become quite numerous in the south of Amman, often living in poor housing conditions.

Utilities, Services and Infrastructure

Within Amman, 3 to 4-storey apartment buildings are common along the route, especially in more industrial villages (Al Qnaytira, Mushatta, Ad Damikhi, Rujm As Shami As Sharqi, Dubaai, Salim, Al Kuteifa, Zumaylat). One-storey homes can be more commonly seen in agricultural areas like Al Kuteifa, As Shammout, Al Hamam, and Al Ruqayba. The villages along the route are not connected to the public sewage system and most operate on a septic tank system. Roads are available, but local residents noted a lack of available public transport.

Education

The settlements in Amman have the highest educational rates, with most settlements within easy access of schools and health facilities. Illiteracy rates in the Governorate amongst females are 10.1% compared to 5.1% amongst
males. In the village of Ad Damikihi (population 861) in the Umm Rassass district there is one school. There is also a health center staffed with one nurse in the village.

Health

The village of Az Zmeyla (1,741) has a health center, a primary school and a secondary school. While access is not the issue, residents consulted noted the poor quality of these facilities, specifically due to a lack of teachers and problems regarding teacher accommodations.

C6.3.7 Area 5: Western Freshwater Pipeline Route (Israel/Palestinian Authority)

The Beneficiary Parties have not yet determined how much, if any, freshwater will be supplied to consumers in Israel or the PA. For planning purposes, the draft Feasibility Study reports produced so far have assumed that up to 90 Mm$^3$ may be channelled through pipelines on the west of the Dead Sea. The routes have not been fully determined, nor have designs, even in outline, been developed. The ESA baseline includes the area covered by this notional Western Freshwater Pipeline Route (Israel/Palestinian Authority) together with an assumed pipeline corridor in Israel and the Palestinian Authority and associated impacted areas.

In Israel, the city of Arad to which freshwater may be provided lies east of the Dead Sea between the Judea desert and the Negev. In the villages along the potential freshwater pipeline route (within Megiollot Regional Council area), population sizes tend to be modest (one to several hundred), with many communities relying on a mixture of agriculture and rural tourism to bring in revenues.

In the Palestinian Authority, water could be provided to the Jericho and Alaghwar Governorate, which includes Jericho City. According to the initial suggested routes for the freshwater pipeline, 16 communities/localities are identified in the Jericho and Alaghwar Governorate that could be recipients of fresh water; Jericho city is the largest and most populated. There are currently no communities located towards the south of the city. Note that along the proposed freshwater conveyance from En Gedi, along the Dead Sea shoreline, there are no Palestinian communities, so this assessment only considers the communities located in and around Jericho.

The communities in Israel and the Palestinian Authority within this area are shown on Figure C6.8.
All maps produced as a part of this study are being checked by the World Bank Map Design Unit. An approved set of maps will be included in the Preliminary Assessment Report.

Israel

Population, Demographics and Land Use

The Regional Council of Megillot, often referred to as the Megillot Dead Sea Regional Council, has a population of 1,000 residents. Located near the western shores of the Dead Sea, Megillot encompasses six Israeli settlements in the West Bank. Information on the villages along the freshwater pipeline route (within Megiollot Regional Council area) is provided below. Populations tend to be modest (one to several hundred), with many communities relying on a mixture of agriculture and rural tourism to bring in revenues. The communities that are along the route of the line, but which also lie within the Dead Sea Basin area, were discussed in that section.

Village profiles will be developed during the next round of social surveys and provided in the Preliminary Draft ESA Report. These profiles will be provided in a systematic format for all communities.
### Table C6.6  Population, Demographics and Land Use

<table>
<thead>
<tr>
<th>Name</th>
<th>Approx. Population</th>
<th>Main Livelihoods / other notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beit HaArava</td>
<td>87</td>
<td>Population 87; gas station, cafeteria rest stop, agriculture (field crops, dates, grapes, melons, onions, cucumbers and peppers).</td>
</tr>
<tr>
<td>Kfar Vered Jericho</td>
<td>180</td>
<td>Population 180 (52 families); guest rooms (70), agriculture (dates, grapes, figs), spa, free lanceurs.</td>
</tr>
<tr>
<td>Almog</td>
<td>192</td>
<td>Population 192; tourist resort (80 guest rooms), a beach, agriculture (dates, filed crops, dairy farm, chicken coops, bananas), archaeological site of Qumran and museum.</td>
</tr>
<tr>
<td>Kaliya/Kalia</td>
<td>274</td>
<td>Population 274; Agriculture, ‘mineral’ beach, Alternative treatments, ostrich farm, Archaeological and tourist sights (komena- about 270,000 visitors a year), guest house (80 guest rooms), restaurant, an elementary school, partnership in AHAVA factory.</td>
</tr>
<tr>
<td>Mitzpe Shalem</td>
<td>171</td>
<td>Population 171; tourist resort (50 guest rooms), ‘mineral’ beach which is threatened by the sinkhole phenomenon, partnership in the AHAVA factory, agriculture (dates, turkeys, and green houses).</td>
</tr>
<tr>
<td>Ovnat</td>
<td>100</td>
<td>Population 100, with an educational community including a boarding school for youth with special needs and a religious background. There are expansion plans to reach a population of 300 including families, staff and students. Additionally, there is also a plan for tourism and the building of 1000 guest rooms.</td>
</tr>
<tr>
<td><strong>Total Population</strong></td>
<td><strong>1004</strong></td>
<td></td>
</tr>
</tbody>
</table>


Arad is the city to which the freshwater will be routed. It is located mostly on the western and southwestern Kidod Range, and the Arad Plain which marks the southwestern end of the Judean Desert in southern Israel. The city is one of the largest municipal areas in Israel, even though its urban area is much smaller.

**Economic Activity and Poverty**

Of the 1,100 residents in the area of the freshwater route, 650 are currently employed, 300 of which work outside of the region. There are 2,300 workers who commute to the region, including 100 Thai workers and 1,700 Palestinians (1). Approximately 40% of Megillot residents work in agriculture, 40% work in tourism and 20% work at the AHAVA- Essential Dead Sea Treatment factory (2).

In terms of tourism in this area, more than 100,000 tourists visit Atraktzia Beach, Biyankini Beach, Neve Medbar Beach and Mineral Beach each year. The AHAVA factory also attracts 150,000 visitors a year.

**Figure C6.9 Tourism at Ein Bokek**

Metzukai Dargot boasts a modest tourism intake with a hotel of 110 rooms and future growth plans for another 50 rooms. There are also a number of companies with manufacturing plants in Arad. There are plans for a small shopping centre.

**Utilities, Services and Infrastructure**

Infrastructure is well developed on the western shore of the Dead Sea. The area is serviced by Road Number 90. Most of the infrastructure is hotels at the Ein Bokek site and the facilities of the Dead Sea Works, both located at the southern evaporation ponds. Along the shoreline of the Dead Sea itself is the tourist site of Masada and a number of kibbutzim devoted to agriculture and tourism. Kibbutz Ein Gedi is the largest kibbutz in the region. The main problem for infrastructure is the sink holes. These sink holes are a result of the declining water levels of the Dead Sea. The problem is such that no future development can take place along the Dead Sea unless the sink hole problem is solved and this can only be done if the sea’s water levels are stabilized. Sink holes will be the most severe problem to solve with regards the route of the proposed freshwater pipe line.
Health

In Almog, Kalia and Mitzphe Shalem there is a health care clinic and HMO with a visiting doctor and a nurse.

C6.4 PALESTINIAN AUTHORITY

C6.4.1 Population and Demographics

Jericho city has a population of 18,346, with roughly an equal proportion of men and women. Population growth is estimated to be 3.1%. Jericho city itself is located in Area A (1) and a large part of its surrounding land is located in Area C. There are no Area B zones in the vicinity. Moreover, Israeli settlements and bypass roads encircle the city from north, south and east leaving limited opportunity to grow in these directions at the time being. Indeed, the majority of the lands between Jericho city (excluding Area A) and the north of the Dead Sea are all classified as Area C and therefore restricted in terms of development potential for the Palestinian Authority.

As identified by the Palestinian Central Bureau of Statistics (PCBS), the Jericho and Alaghwar Governorate consists of 16 localities/communities, 4 of which are strictly religious sites with very small populations.

Table C6.7 provides demographic information about communities in the study area. Please note that no data or analysis of Israeli settlements in the Palestinian Authority has been undertaken (2).

---

(1) See Part A3 for an overview of the different land designations within the Palestinian Authority.
(2) Community profiles will be developed following the next round of social surveys and presented in the Preliminary Draft ESA Report.
<table>
<thead>
<tr>
<th>Community</th>
<th>Population</th>
<th>Livelihoods</th>
<th>No. Schools</th>
<th>No. clinics</th>
<th>Electricity network</th>
<th>Water network</th>
<th>Wastewater system</th>
<th>Roads and available transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marj Na’ja</td>
<td>554</td>
<td>Agriculture &amp; labor at the Israel farms in the Jordan valley</td>
<td>1</td>
<td>1</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Az Zubeidat</td>
<td>968</td>
<td>Agriculture &amp; labor at the Israel farms in the Jordan valley</td>
<td>1</td>
<td>1</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Marj al Ghazal</td>
<td>276</td>
<td>Agriculture</td>
<td>0</td>
<td>1</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Al Jiftlik</td>
<td>5177</td>
<td>Agriculture &amp; labor at the Israel farms in the Jordan valley</td>
<td>1</td>
<td>1</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Fasayil</td>
<td>648</td>
<td>Agriculture &amp; labor at the Israel farms in the Jordan valley</td>
<td>1</td>
<td>1</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Al `Auja</td>
<td>2894</td>
<td>Trade and agriculture</td>
<td>1</td>
<td>1</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>An Nuwei`ma</td>
<td>840</td>
<td>Agriculture &amp; labor at the Israel farms in the Jordan valley</td>
<td>1</td>
<td>1</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>`Ein ad Duyuk al Foqa</td>
<td>698</td>
<td>Agriculture &amp; labor at the Israel farms in the Jordan valley</td>
<td>1</td>
<td>1</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>`Ein as Sultan Camp</td>
<td>1469</td>
<td>Trade and Agriculture</td>
<td>1</td>
<td>2</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Jericho</td>
<td>18,346</td>
<td>Tourist, trade and agriculture</td>
<td>8</td>
<td>3</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Aqbat Jaber Camp</td>
<td>4881</td>
<td>Trade and Agriculture</td>
<td>3</td>
<td>2</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>An Nabi Musa</td>
<td>45</td>
<td>Livestock</td>
<td>0</td>
<td>0</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Table C6.8 illustrates the number of refugees who are living in the targeted area. These are Palestinian refugees from elsewhere in the region, mostly from areas now controlled by Israel – and formally registered by UNRWA. They are long-term displaced persons. A large proportion of the Governorate of Jericho is composed of refugee camps, established following the 1948 war. Jericho was one of many locations in the West Bank that absorbed that large numbers of displaced people. For this reason, a large segment of the Jericho population today holds UNRWA refugee status. This grants them the right to obtain humanitarian aid from UNRWA, but such aid is now extremely limited aiming at providing basic needs.

Table C6.8  
Palestinian Population by Locality and Refugee Status in the Study Area

<table>
<thead>
<tr>
<th>Locality</th>
<th>Number</th>
<th>Percentage</th>
<th>Number</th>
<th>Percentage</th>
<th>Number</th>
<th>Percentage</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al Jiftlik</td>
<td>1104</td>
<td>34.7%</td>
<td>2048</td>
<td>64.5%</td>
<td>25</td>
<td>0.8%</td>
<td>3177</td>
</tr>
<tr>
<td>Az Zubeidat</td>
<td>929</td>
<td>96%</td>
<td>16</td>
<td>1.7%</td>
<td>23</td>
<td>2.4%</td>
<td>968</td>
</tr>
<tr>
<td>Al 'Auja</td>
<td>721</td>
<td>24.9%</td>
<td>2119</td>
<td>73.2%</td>
<td>54</td>
<td>1.9%</td>
<td>2894</td>
</tr>
<tr>
<td>An Nabi Musa</td>
<td>44</td>
<td>97.8%</td>
<td>1</td>
<td>2.2%</td>
<td>-</td>
<td>0%</td>
<td>45</td>
</tr>
<tr>
<td>An Nuwe'imma</td>
<td>69</td>
<td>8.2%</td>
<td>771</td>
<td>91.8%</td>
<td>-</td>
<td>0%</td>
<td>840</td>
</tr>
<tr>
<td>'Ein ad Duyuk at Tahta</td>
<td>102</td>
<td>14.6%</td>
<td>590</td>
<td>84.5%</td>
<td>6</td>
<td>0.9%</td>
<td>698</td>
</tr>
<tr>
<td>'Ein ad Duyuk al Foqa</td>
<td>164</td>
<td>27.9%</td>
<td>424</td>
<td>72.1%</td>
<td>-</td>
<td>0%</td>
<td>588</td>
</tr>
<tr>
<td>Fasayil</td>
<td>201</td>
<td>31%</td>
<td>428</td>
<td>66%</td>
<td>19</td>
<td>2.9%</td>
<td>648</td>
</tr>
<tr>
<td>Aqbat Jaber Camp</td>
<td>4096</td>
<td>89.4%</td>
<td>477</td>
<td>10.4%</td>
<td>8</td>
<td>0.2%</td>
<td>4581</td>
</tr>
<tr>
<td>'Ein as Sultan Camp</td>
<td>1190</td>
<td>81%</td>
<td>279</td>
<td>19%</td>
<td>-</td>
<td>0%</td>
<td>1469</td>
</tr>
<tr>
<td>Marj al Ghazal</td>
<td>261</td>
<td>94.6%</td>
<td>14</td>
<td>5.1%</td>
<td>1</td>
<td>0.4%</td>
<td>276</td>
</tr>
<tr>
<td>Marj Na'ja</td>
<td>351</td>
<td>63.4%</td>
<td>196</td>
<td>35.4%</td>
<td>7</td>
<td>1.3%</td>
<td>554</td>
</tr>
<tr>
<td>Total</td>
<td>15625</td>
<td>49.7%</td>
<td>15466</td>
<td>49.2%</td>
<td>321</td>
<td>1%</td>
<td>31412</td>
</tr>
</tbody>
</table>

The table reveals that approximately half the population of Jericho is registered as being of refugee descent and holding UNRWA refugee cards, although most are now well established in the area, and engaged in the local economy.

There is also internal migration to these communities from other areas in the Palestinian Authority especially in from the southern West Bank. Such migrants are attracted by the agriculture and livestock work in the Jericho area and are not formally classified as refugees. There are no formal records of their numbers.
Economic Activity and Poverty

Agriculture is one of the main livelihoods in the Jericho Governorate.

Agricultural production in the Jericho Governorate is constrained by water management issues, lack of infrastructure, production inputs and soil salinity.

Marketing of farm products and distribution to local and external markets is difficult and is one of the major obstacles facing Palestinian farmers. Selling Palestinian agricultural products within Israel requires special permits to be issued by the Israeli authorities. Transporting products from/to north to south in the Palestinian Authority has become difficult introducing additional cost and the movement of agricultural products between the West Bank and Gaza Strip is also subject to Israeli control. Competitiveness with Israeli produce in the local markets is also a challenge. Drought has recently forced many farmers in the Jericho Governorate to leave their agricultural land. These factors have contributed to the decline of agricultural production in the area.

According to the PCBS (2008) - the average income level in Jericho Governorate is 400 JD per household per month (the average Palestinian household size is around 5.5). Figure C6.10 shows the poverty rates in the Governorate. The rate was highest during the year 2002 reflecting the political situation and closures where access to markets and areas was extremely restricted.

Figure C6.10  Poverty Rates in Jericho Gov. 1998-2007 (Percentage of Population) (1)

Jericho also relies on the service sector as a source of livelihood. Many of the residents in the Jericho Governorate also rely on tourism as an important source of income. Many local and international tourism companies have established hotels and other tourist facilities.

(1) Source: PCBS Census 2007 (report #11)
### Table C6.9  Distribution of Jobs in Jericho City (According to Gender)

<table>
<thead>
<tr>
<th>Type of Work</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>2,755</td>
<td>719</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>768</td>
<td>98</td>
</tr>
<tr>
<td>Construction</td>
<td>619</td>
<td>4</td>
</tr>
<tr>
<td>Whole sale and Retail</td>
<td>802</td>
<td>69</td>
</tr>
<tr>
<td>Tourism</td>
<td>275</td>
<td>23</td>
</tr>
<tr>
<td>Public Admin and Security</td>
<td>1209</td>
<td>277</td>
</tr>
<tr>
<td>Education, Health and Social work</td>
<td>333</td>
<td>527</td>
</tr>
</tbody>
</table>

Source of data from PCBS: [www.pcbs.org](http://www.pcbs.org)

Ain Fashcha is a tourist nature resort and archaeological sight with approximately 85,000 visitors a year. The baptism sight of Kasar El Yahod hosts 65,000 visitors a year (1).

In the Palestinian Authority, the vulnerable groups are:

- The poor and unemployed: Many Palestinian communities struggle due to the limited income generating activities outside of farming and limited tourism, and the limited employment opportunities and opportunities for travel and development, partly because of the depressed local economy, and partly from travel and other restrictions.

- Also, to some extent, all Palestinian people in the area could be regarded as vulnerable, since i) they have no normal recourse to decision makers outside of the civil and municipal government within Jericho, ii) have very limited means to expand businesses and develop the lands, iii) they are subject to travel and access restrictions from the Israeli Authorities.

**Utilities, Services and Infrastructure**

As shown in Table C6.10, none of the communities in the targeted area are connected to a wastewater network, except for Jericho city. Such communities use cesspits and septic tanks.

Most people in the area have concrete houses. All the communities in Jericho area are connected to main asphalt roads. However, internal roads in each community need maintenance. Table C6.10 presents water related data recently compiled from Jericho through the WaSH MP programme. This table shows that approximately all the communities in Jericho district are connected to the water network, although the network doesn't cover all the houses. Water losses are reportedly as much as 30 percent.

Education

In total, there are 19 schools in the study area serving approximately 35,000 inhabitants. Most communities in Jericho are considerably small in terms of population and area and some communities use schools in neighbouring localities. There are 2,430 schools in the Palestinian Authority - 972 kindergardens, 1615 primary schools, and 815 secondary schools.
## Table C6.10  Water Data for Jericho (Gathered through the WaSH MP Programme, which is Conducted by PHG and Financed by UNICEF)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Surveyed Communities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PHG Archive No.</strong></td>
<td>119 120 121 122 123 124</td>
</tr>
<tr>
<td><strong>Community Name</strong></td>
<td>Al ‘Auja Al Jiftlik Fasayil Az Zubeidat Marj al Ghazal Marj Na’ja</td>
</tr>
<tr>
<td><strong>Total Water Supply for domestic in summer (m$^3$/ month)</strong></td>
<td>48200 21000 13500 12700 1800 4400</td>
</tr>
<tr>
<td><strong>Total Water Supply for domestic in winter (m$^3$/ month)</strong></td>
<td>42300 21000 9150 12700 1800 4400</td>
</tr>
<tr>
<td><strong>Water Losses (%)</strong></td>
<td>55 40 40 40 40 40</td>
</tr>
<tr>
<td><strong>Domestic Water Consumption in summer (m$^3$/ month)</strong></td>
<td>21690 12600 8100 7620 1080 3160</td>
</tr>
<tr>
<td><strong>Domestic Water Consumption in winter (m$^3$/ month)</strong></td>
<td>19035 12600 5490 7620 1080 3160</td>
</tr>
<tr>
<td><strong>Per capita water use in Summer (liter)</strong></td>
<td>168 108 240 171 170 141</td>
</tr>
<tr>
<td><strong>Per capita water use in Winter (liter)</strong></td>
<td>148 108 163 171 170 141</td>
</tr>
<tr>
<td><strong>Average per capita water use (liter)</strong></td>
<td>158 108 202 171 170 141</td>
</tr>
<tr>
<td><strong>W Network Coverage (%)</strong></td>
<td>70 100 100 100 100 69</td>
</tr>
<tr>
<td><strong>Water Network rehabilitated?</strong></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Water Network rehabilitation year</strong></td>
<td>2005</td>
</tr>
<tr>
<td><strong>Water Network extended?</strong></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Water Network extension year</strong></td>
<td>2007</td>
</tr>
<tr>
<td><strong>Water Network Status</strong></td>
<td>Functioning Functioning Functioning Functioning Functioning Agric. is Functioning but domestic is not</td>
</tr>
<tr>
<td><strong>Water Network Type</strong></td>
<td>Domestic Domestic Domestic Domestic Domestic Domestic &amp; Agriculture</td>
</tr>
<tr>
<td><strong>Water Network Condition</strong></td>
<td>Bad Leaking Leaking Leaking Leaking Bad</td>
</tr>
<tr>
<td><strong>Average Price of water from network (NIS/m$^3$)</strong></td>
<td>3.5 3.5 2.6 2.6 2.6 0</td>
</tr>
<tr>
<td><strong>Average of HHH pay w bills (%)</strong></td>
<td>0 0 0 0 0</td>
</tr>
<tr>
<td><strong>Households with Cisterns (%)</strong></td>
<td>10 0 0 0 0 0</td>
</tr>
<tr>
<td><strong>Range of Water Tankers Price (NIS/m$^3$)</strong></td>
<td>5 N/A N/A N/A N/A N/A</td>
</tr>
<tr>
<td><strong>Average Price of Water Tankers (NIS/m$^3$)</strong></td>
<td>5 N/A N/A N/A N/A N/A</td>
</tr>
</tbody>
</table>
Health

Since Jericho has the lowest population of all Governorates in the Palestinian Authority, the number of health facilities is relatively low. The rates of reported communicable diseases including STIs are shown in Table C6.11 below. Due to issues of privacy as well as a general societal inclination towards a more conservative approach concerning sexually transmitted infections, it could be assumed that the values shown below represent an underestimation of people with STIs.

Table C6.11  Reported Cases of Communicable Diseases

<table>
<thead>
<tr>
<th>Disease</th>
<th>Jericho # of Cases</th>
<th>West Bank Total</th>
<th>Rate</th>
<th>Palestinian Authority Total</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Flaccid paralysis</td>
<td>0</td>
<td>12</td>
<td>1.14</td>
<td>16</td>
<td>0.93</td>
</tr>
<tr>
<td>Poliomyelitis</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>AIDS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>HIV Infection</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Cholera</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Diphtheria</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Food Poisoning</td>
<td>36</td>
<td>331</td>
<td>14.11</td>
<td>592</td>
<td>15.74</td>
</tr>
<tr>
<td>Measles</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Meningitis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meningococcal Meningitis</td>
<td>0</td>
<td>2</td>
<td>0.09</td>
<td>121</td>
<td>3.22</td>
</tr>
<tr>
<td>Hemophillus Influenza</td>
<td>0</td>
<td>1</td>
<td>0.04</td>
<td>4</td>
<td>0.11</td>
</tr>
<tr>
<td>Other Bacterial Diseases</td>
<td>1</td>
<td>165</td>
<td>7.04</td>
<td>352</td>
<td>9.36</td>
</tr>
<tr>
<td>Plague</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>H. Fever</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Rabies</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Tetanus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neonatal</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Yellow Fever</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Brucellosis</td>
<td>0</td>
<td>215</td>
<td>9.17</td>
<td>224</td>
<td>5.95</td>
</tr>
<tr>
<td>Chemical Poisoning</td>
<td>22</td>
<td>301</td>
<td>12.84</td>
<td>521</td>
<td>13.85</td>
</tr>
<tr>
<td>Encephalitis</td>
<td>0</td>
<td>1</td>
<td>0.04</td>
<td>1</td>
<td>0.03</td>
</tr>
<tr>
<td>Viral meningitis</td>
<td>0</td>
<td>217</td>
<td>9.25</td>
<td>1130</td>
<td>30.04</td>
</tr>
<tr>
<td>Hepatitis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hepatitis A</td>
<td>35</td>
<td>1046</td>
<td>44.60</td>
<td>1887</td>
<td>50.16</td>
</tr>
<tr>
<td>Hepatitis B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case</td>
<td>1</td>
<td>34</td>
<td>1.45</td>
<td>34</td>
<td>0.90</td>
</tr>
<tr>
<td>Carrier</td>
<td>38</td>
<td>1096</td>
<td>46.74</td>
<td>1508</td>
<td>40.09</td>
</tr>
<tr>
<td>Hepatitis C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case</td>
<td>0</td>
<td>1</td>
<td>0.04</td>
<td>1</td>
<td>0.03</td>
</tr>
</tbody>
</table>

(1) Source: Ministry of Health 2007
<table>
<thead>
<tr>
<th>Disease</th>
<th>Jericho # of Cases</th>
<th>Jericho Total</th>
<th>Jericho Rate</th>
<th>West Bank Total</th>
<th>West Bank Rate</th>
<th>Palestinian Authority Total</th>
<th>Palestinian Authority Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrier</td>
<td>6</td>
<td>85</td>
<td>3.62</td>
<td>127</td>
<td>3.38</td>
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</tr>
<tr>
<td>Leprosy</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
<td></td>
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</tr>
<tr>
<td>Leishmaniasis</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Cutaneous</td>
<td>62</td>
<td>180</td>
<td>7.68</td>
<td>180</td>
<td>4.79</td>
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<td></td>
</tr>
<tr>
<td>Visceral (Kalazar)</td>
<td>1</td>
<td>8</td>
<td>0.34</td>
<td>8</td>
<td>0.21</td>
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<td></td>
</tr>
<tr>
<td>Malaria</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pertussis</td>
<td>1</td>
<td>10</td>
<td>0.43</td>
<td>10</td>
<td>0.27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Susp. Rickettsial Disease</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>418</td>
<td>11.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rubella</td>
<td>0</td>
<td>1</td>
<td>0.04</td>
<td>1</td>
<td>0.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mumps</td>
<td>9</td>
<td>134</td>
<td>5.71</td>
<td>190</td>
<td>5.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S.T.D.s</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gonorrhea</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Syphilis</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>366</td>
<td>23407</td>
<td>998.12</td>
<td>23407</td>
<td>622.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tuberculosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulmonary</td>
<td>1</td>
<td>7</td>
<td>0.30</td>
<td>15</td>
<td>0.40</td>
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<td></td>
</tr>
<tr>
<td>Extrapulmonary</td>
<td>0</td>
<td>4</td>
<td>0.17</td>
<td>18</td>
<td>0.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typhoid &amp; Paratyphoid</td>
<td>0</td>
<td>3</td>
<td>0.13</td>
<td>327</td>
<td>8.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Salmonella</td>
<td>0</td>
<td>49</td>
<td>2.09</td>
<td>69</td>
<td>1.83</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Jericho contains one registered hospital, which is funded and run by the Palestinian Authority. This hospital is small compared to others in the area.

**C6.5 IMPACT ASSESSMENT**

**C6.5.1 Issues Identified During the Scoping Stage**

The issues that were identified during scoping as being of particular importance for the social and socio-economic assessment are summarised in Table C6.12.
### Table C6.12  Issues Identified during Scoping

<table>
<thead>
<tr>
<th>Sources of impact</th>
<th>Employment and micro economy</th>
<th>Livelihoods</th>
<th>Ways of life and community structure</th>
<th>Public health and community safety</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land take for worksites and access roads etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Site activities (excavation, tunnelling, construction, rehabilitation)</td>
<td></td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Materials (including hazardous) import, manufacture and storage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of natural resources (water, sand etc, vegetation)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workers' accommodation and subsistence</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Transport (workers, equipment, wastes; heavy/hazardous loads)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waste disposal (spoil; “domestic”; and hazardous)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rehabilitation of work sites</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of services and utilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Operation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flow of sea water</td>
<td></td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Employment</td>
<td></td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Use of services and utilities</td>
<td></td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Operation of pumping stations</td>
<td></td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Maintenance of infrastructure and equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharge of brine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacture of membranes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical presence in the environment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation of the desalination plant</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provision of potable water</td>
<td></td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Emergency response</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power generation (HPP)</td>
<td></td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Hazardous materials storage</td>
<td></td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Potential Secondary, and Cumulative Sources (other than addressed above)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cumulative water abstraction from the Red Sea</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fragmentation of ecological habitats across the Jordan Valley</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary effects of Tourism</td>
<td></td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Secondary effects of Increased freshwater provision</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### C6.5.2  Key Issues for Consideration in the Impact Assessment

Based on this initial scoping, some key issues can be identified either because they are likely to have a significant social effect, or they have been raised by stakeholders as having a perceived significant social effect, thus warranting consideration. Box C6.3 summarises the key issues.
Box C6.3  Key Issues for Consideration in the Impact Assessment

**Freshwater provision:** The provision of freshwater after desalination has a combination of issues associated with it. Whilst potentially reducing one of the constraints to health through improving water supply, the costs associated with the new supply of freshwater for local communities is an issue of concern to some. In addition, an increase in freshwater access could dissuading people from conserving water. All of these issues are complex and require appropriate consideration; some issues are discussed in this section and some in other report sections.

**Resettlement/land compensation:** The Scheme may result in some resettlement or requirement for land compensation. Although it is unlikely at this stage that any significant numbers of dwellings will require resettlement, this is a key issue that must be assessed in detail to an appropriate level and to appropriate standards to ensure that any affected people are appropriately and fairly compensated for any loss of land or access to land, taking into account customary or traditional use of land. It is important to note that there is a separate work stream focussing specifically on the aspect of resettlement, which is currently ongoing and not captured within this report.

**Employment and local economy:** Employment brings both negative and positive impacts. It is a potential positive impact since jobs may be provided for local people, however potential gaps between the skills required and the capacity of the local workforce to meet these requirements, or indeed their desire to do the jobs on offer, may result in a limited number of locals being employed by the Scheme. This in turn may result in a large number of foreign workers coming into the area, and the associated cultural and demographic changes, health impacts and so on that they may bring. The presence of a large workforce in the area, however, also has the potential for secondary positive impacts to the local economy associated with increased demand for local services. Finally the negative impacts that can befall communities once their source of employment or business ends at the end of the construction phase must be considered and appropriately planned for.

**Agriculture and water provision:** Many communities in the area, particularly in the Wadi Araba/Arava Valley and in the Dead Sea Basin and along the freshwater routes in all 3 Beneficiary Parties, rely on agriculture for their livelihood. Scheme impacts that will alter access to land or access to irrigation will need consideration. Concerns in relation to potential pollution of groundwater in the event of a conveyance leak, has been raised as a particular concern, by stakeholders.

**Public health and safety:** In addition to the potential positive impacts from the supply of freshwater to communities, potential negative impacts include and safety associated with traffic movements during construction, safety concerns in relation to the canals, and the issues surrounding interaction between communities and incoming (particularly foreign) workers such as the spread of HIV/AIDS and other communicable diseases. There are also risks from the storage and use of hazardous substances, such as antifouling chemicals along the conveyance, and others required for the DSP and HPP.

**Associated development and tourism:** With certain project configurations, namely the high tunnel option that includes the canals, some development around the canals would be possible which could have effects in terms of inducing development further in this area. This has both positive and negative implications from a social perspective depending on individual stakeholders’ particular context or opinion. A new feature such as the canals could constitute an impact to the traditional way of life, for example introducing the concept of water related tourism into the desert environment. Any induced development in the area could also have a secondary positive impact in encouraging investment in infrastructure and utilities in the area, for example water, sanitation or electricity supply which could then benefit local people.
Cultural and Tourist Sites: There are concerns that important cultural sites such as Bir Mathkour and Lots Cave (in Jordan) and Masada (in Israel) could be impacted by the project, either in relation to the views from these sites or environmental degradation (noise, dust, traffic movements). There could also be impacts from secondary development within the Wadi Araba/Arava Valley.

C6.5.3 Contents of the Impact Assessment

Taking into account these broad key issues, this impact assessment section goes on to discuss the following potential impacts in relation to the Scheme. These impact areas will be reviewed and refined as the assessment progresses.

Impacts to Employment and Local Economies

- Provision of employment during construction;
- Cessation of employment after construction;
- Benefits to the local and regional economy during construction;
- Impacts on the local and regional economy after construction is complete;
- Provision of employment during operation; and
- Benefits to the local economy during operation.

Impacts to Livelihoods

- Potential resettlement issues;
- Impacts to fishing and navigation during construction; and
- Impacts to farming during construction.

Impacts to Ways of Life and Community Structures

- Managing community expectations;
- Impacts to community structures and relations during construction (influx of workers);
- Impacts related to induced development and tourism; and
- Changes to ways of life and cultures during operation.

Public Health, Wellbeing and Community Safety

- Increased access to freshwater for recipients of desalinated water;
- Environmental quality impacts to communities (air quality, dust, traffic, noise) during construction;
- Health impacts to communities related to foreign workers during construction;
- Health impacts to communities from waste and wastewater during construction;
- Impacts to communities through the Scheme’s use of infrastructure and services;
- Traffic safety impacts to communities during construction; and
- Canal safety during operation.
C6.5.4 Employment and Local Economic Impacts

Provision of Employment during Construction

Employment opportunities to be provided during the construction phase will apply to all the Scheme components. Since all project components relate to the same types of impact, this section discusses the potential impacts for all components in one section.

<table>
<thead>
<tr>
<th>Increase in local employment opportunities during construction</th>
<th>Intake (N)</th>
<th>Intake (E)</th>
<th>Pipeline</th>
<th>Tunnel</th>
<th>Desalination Plant</th>
<th>Hydroelectric Plant</th>
<th>Freshwater Conveyance Jordan</th>
<th>Freshwater Conveyance Israel/Palestinian Authority</th>
<th>Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>

The extent of employment opportunities has been estimated as follows:

- 30 people over 1-3 months for construction of the inlet and 150 people over 2-3 years for construction of the pumping station.
- 250 – 500 people over 3-5 years for the pipeline option.
- 1380 workers over 6 years for the tunnel option.
- 500 – 1000 people over 3-4 years for construction of the desalination plant.
- 250 – 500 people over 2-3 years construction of the hydroelectric plant.
- 200 – 400 people over 3-4 years for construction of the freshwater conveyances.
- Employment of caterers, drivers etc to support the construction workforce.

In terms of the three Beneficiary Parties, this impact will potentially affect Jordan to a higher degree than Israel and the Palestinian Authority, because construction is taking place predominantly within Jordanian territory. However, the numbers of local people employed will in fact likely be small because the majority of workers will likely be employed from overseas. This is primarily because the local workforce may not have the specific skills required for this particular Scheme. It is also possible that local workers may simply not choose to take up any positions which they could otherwise fill.

More information will be collected and analysed on gender and employment and the issues surrounding women in the workforce, and presented in the Preliminary Draft ESA Report.
The potential receptors to this positive impact of employment across the entire study area range from low to medium sensitivity in that unemployment and job opportunities in some areas are higher than others; for example the communities in areas where unemployment is high (eg in the Wadi Araba) are of a higher sensitivity than those in other areas (eg Aqaba) where unemployment is lower. The magnitude of the potential positive impact is small since very few of the workforce will likely come from any of the three Beneficiary Parties, with the majority of the workforce being sourced from outside the Scheme area. The impact is therefore ranked as being of minor positive significance all project components.

The extent of the positive impact can be maximised by implementing the following enhancement measures:

- Provide clear information to the local community about upcoming job opportunities.
- Establish a local recruitment centre and provide appropriate training to equip local communities with required knowledge and skills (eg as part of the Megaprojects Unit under the Ministry of Labour) (this would require planning appropriately far in advance).
- Consider including preconditions in the bid documents for local content/procurement.
- Consider whether certain groups should be targeted for employment support, eg women (however further research around this is required).

Given the low numbers of jobs that are likely to be available for workers from each of the three Beneficiary Parties, the residual impacts to the local workforce following mitigation/enhancement remains not significant - minor positive significance, which takes into account the current gaps in knowledge on detailed sensitivities of individual communities.

<table>
<thead>
<tr>
<th>Sensitivity/Value of Resource/Receptor</th>
<th>Magnitude of impact</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Small</td>
</tr>
<tr>
<td>Low</td>
<td>Not significant</td>
</tr>
<tr>
<td>Medium</td>
<td>Minor</td>
</tr>
<tr>
<td>High</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

_Cessation of Employment after the Construction Period_

This issue will apply to all of the areas where employment was provided during the construction phase. Since all project components relate to the same types of impact, this section discusses the potential impacts for all components in one section.
Cessation of local employment opportunities after construction

<table>
<thead>
<tr>
<th>Intake (E)</th>
<th>Pipeline</th>
<th>Tunnel</th>
<th>Desalination Plant</th>
<th>Hydroelectric Plant</th>
<th>Freshwater Conveyance (Jordan)</th>
<th>Freshwater Conveyance Israel/Palestinian Authority</th>
<th>Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>

Cessation of employment at the end of the construction period will result in the workers that have been employed for construction of the Scheme becoming unemployed. This may negatively affect their livelihood/families, which have become reliant on the income. For the same reasons explained above, ie the limited numbers of jobs likely to go to the workforces within the three Beneficiary Parties, the vulnerability of the receptors is low to medium however the magnitude of impact is small due to the low numbers of jobs likely to be taken up by local people. Overall, this results in an impact of minor significance.

The extent of the negative impact can however be minimised by implementing the following types of mitigation measures:

- Clear communication about the length of the construction period.
- Ensure that the employment framework at the start has included information and support for the end of the construction period.

Given the low numbers of jobs that will likely be available for workers from each of the three Beneficiary Parties, the residual impacts to the local workforce, following mitigation remains minor negative significance.

<table>
<thead>
<tr>
<th>Sensitivity/Value of Resource/Receptor</th>
<th>Magnitude of impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Small</td>
</tr>
<tr>
<td></td>
<td>Not significant</td>
</tr>
<tr>
<td></td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
</tr>
<tr>
<td>Medium</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Major</td>
</tr>
<tr>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Major</td>
</tr>
<tr>
<td></td>
<td>Critical</td>
</tr>
</tbody>
</table>

**Benefits to the Local and Regional Economy during Construction**

The increased number of people during construction will provide opportunities for local businesses in the area, for example through the sale of goods and services. This will potentially apply to all parts of the Scheme, as the exact location of worker camps is still to be confirmed.
Local communities in the area are likely to see some level of benefit, and these could potentially be enhanced by:

- The creation of business opportunities for services such as food provision, carpentry and vehicle repair to local businesses;
- Providing training, for example to women, to increase capacity in the labour pool to run small businesses; and
- Develop a strategy to maximise the use of local businesses, where possible.

The residual impact will vary depending on the vulnerability of the communities in the areas that will be affected, and the magnitude of the impact i.e. the volume of services and goods sourced from those communities. Bearing these variables in mind, the potential impact before and after mitigation/enhancement is likely to range between *not significant* to *minor* positive significance.

<table>
<thead>
<tr>
<th>Sensitivity/Value of Resource/Receptor</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Not significant</td>
<td>Minor</td>
<td>Moderate</td>
</tr>
<tr>
<td>Medium</td>
<td>Minor</td>
<td>Moderate</td>
<td>Major</td>
</tr>
<tr>
<td>High</td>
<td>Moderate</td>
<td>Major</td>
<td>Critical</td>
</tr>
</tbody>
</table>

*Cessation of Positive Impacts to the Local and Regional Economy after Construction*

The corollary of the above is that when construction ends, the demand for these services will decline, which may impact the livelihoods of those reliant on business from the local workforce. This raises issues since, while a construction project usually ‘ramps up’ gradually, the end of the construction period is generally more abrupt. This issue will potentially apply to all parts of the Scheme and the potential impacts for all components are therefore discussed in one section.
The significance of this impact will vary depending on the vulnerability of the communities that will be affected (and their ability to change) and the magnitude of the impact *i.e.* the volume of services and goods that had been sourced from those communities and the degree to which people have diverted their livelihoods to respond to this demand. Bearing these variables in mind, the potential impact is likely to range between slight/negligible to minor negative significance. The impact will also vary from area to area, since construction activities will tend to focus in certain areas.

On completion of construction, all the assets that have been developed for the workforce (health clinics, catering units and other consumables items) could be transferred to local service providers. If this took place (and there is sufficient capacity) there could be a potential positive benefit to the local communities.

The residual negative impact is anticipated to range from not significant to minor negative significance, depending on the exact areas which will be affected and the scale of the demand for services.

<table>
<thead>
<tr>
<th>Sensitivity/Value of Resource/Receptor</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Not significant</td>
<td>Minor</td>
<td>Moderate</td>
</tr>
<tr>
<td>Medium</td>
<td>Minor</td>
<td>Moderate</td>
<td>Major</td>
</tr>
<tr>
<td>High</td>
<td>Moderate</td>
<td>Major</td>
<td>Critical</td>
</tr>
</tbody>
</table>

**Provision of Employment during Operation**

Employment opportunities will also be provided during the operation phase which will apply to the following Scheme components.

<table>
<thead>
<tr>
<th>Increase in local employment opportunities during operation</th>
<th>Intake (E)</th>
<th>Pipeline</th>
<th>Tunnel</th>
<th>Desalination Plant</th>
<th>Hydroelectric Plant</th>
<th>Freshwater Conveyance (Jordan)</th>
<th>Freshwater Conveyance Israel/ Palestinian Authority</th>
<th>Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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The extent of employment opportunities that will be provided during operation of the Scheme is much lower than during construction, and currently estimated as follows:

- 10 - 20 people employed at inlet and in association with the pipeline/tunnel during operation;
- 100 permanent staff at the desalination plant; and
- 50 permanent staff at the hydro-electric plant and freshwater transmission lines.

These workers are mostly likely to be Jordanian, due to the location of the facilities, and of high educational background. The potential receptors to this impact are unlikely to be vulnerable/highly sensitive and the magnitude of the potential positive impact is small in terms of the numbers of jobs likely to be available and the relatively skilled nature of the jobs that will be on offer. This impact is therefore identified as not significant for construction employment across all project components.

The extent of the positive impact can be maximised by implementing the mitigation measures that were discussed in the previous section on employment during construction. Given the low numbers of jobs that will be available for workers from each of the three Beneficiary Parties, the residual impact to the local workforce remains non significant.

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<th>Sensitivity/Value of Resource/Receptor</th>
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**Impacts to the Local and Regional Economy during Operation**

During operation there will be limited direct impacts to the local economy as a direct result of the Scheme, however there is the potential for induced development, which is currently discussed in more detail in the regional section of the report.

**C6.5.5 Impacts to Livelihoods**

**Resettlement**

Resettlement issues will apply in relation to the following Scheme components:
Resettlement is being addressed in much more detail through a separate study. The summary below provides an account of the current likely understanding of the nature of the issue; however, a more detailed study will be conducted to verify all of these statements and presented in the Preliminary Draft ESA Report.

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<tr>
<th>Resettlement</th>
<th>Intake (E)</th>
<th>Pipeline</th>
<th>Tunnel</th>
<th>Desalination Plant</th>
<th>Hydropower Plant</th>
<th>Freshwater Conveyance (Jordan)</th>
<th>Freshwater Conveyance Israeli/Palestinian Authority</th>
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A detailed study of the land use and ownership of lands that may be occupied by the Scheme has not yet been completed. However, at this stage in the Study, it appears that the vast majority of land take needed for permanent infrastructure in Jordan is public land, and that almost no resettlement of people will be needed related to the permanent infrastructure.

- The site to be used for the eastern intake is occupied by the disused thermal power station, and is fenced off and unused.

- Almost the entire seawater conveyance pipeline lies on land which is undeveloped and not being used, even for informal agriculture, and part of it is also in a military restricted zone.

- The locations of the tunnel adits and temporary workcamps are flexible within certain parameters, and there is no indication that any built-up area, dwellings or even areas of informal agriculture will be taken for these sites. The remainder of the tunnel itself will lie underground and will not require surface land take.

- The southern canal section related to the high level tunnel lies almost entirely in undeveloped land. The route of the northern section needs to be investigated in more detail as, despite this not passing through any dwelt areas, parts of it may impinge on some areas which are used by local families for informal and movable agriculture.

- The high level desalination plant site is on a hilly plateau not used for dwellings or agriculture, although some families from the village of Ghweibeh are accustomed to occupying this site in tents during the summer to allow goats to graze on the sparse vegetation.

- The low level desalination plant and hydropower plant sites are close to the agricultural areas west of Fifa village, but appear to be outside of areas which are currently cultivated.
• The proposed discharge channel route will pass firstly through a military area, and then into the ‘truce canal’ lying between the industrial facilities on each side of the border, finally passing across the Lissan peninsula which is part of the industrial area, but not currently used. The implications of this siting need to be investigated in more detail, but the canal can be designed in such a way as to cause no impacts on the industries’ discharge or other activities.

• The proposed freshwater pipeline route through the Tafila Governorate up to the Desert Highway will pass close to dwellings and fields which are used for agriculture during spring time. This route will be investigated in more detail, since there may be a small number of small dwellings which may be impacted by the construction of the pipeline, depending on the exact routing to be determined by the Feasibility Study.

• The proposed freshwater pipeline route from Hasa to Amman lies alongside the Desert Highway corridor, reportedly close to the corridor of the gas pipeline. The exact route has not yet been investigated in detailed. There are structures and facilities from time to time on the eastern side of the road. However, there is flexibility in the final location of the route which should allow significant facilities to be avoided. None of these are likely to be inhabited dwellings.

• A detailed routing proposal for the freshwater pipeline through Israel and the Palestinian Authority has not yet been proposed by the Feasibility Study. The route will pass alongside the western shoreline of the Dead Sea, where there is already a main road (Highway 90). It will pass close to the town of En Bokek, and other communities along the coastline. Depending on the exact route, there could be some implications for some of the economic activities along the shoreline, although the pipeline here will be a single line, of less than 1 m radius, and therefore could be sited close to the road corridor, depending on the topographical constraints which have yet to be investigated. There may also be some agricultural areas in Israel near Fifa, and in the Palestinian Authority near Jericho which will be impacted.

Throughout the construction period, there may be temporary access restrictions from time to time, and some temporary land take of lands which are being used for productive activities may be required. However, the extent of this is likely to be very minor and temporary.

It will be important to note that those who use the land may not necessarily be the owners of the land and traditional rights must also be considered in determining a fair and equitable compensation strategy. Any Resettlement Framework or Resettlement Action Plan (RAP) undertaken should be conducted to international best practice standards.
Impacts to Farming During Construction

Impacts to farming and farm productivity have been raised as a by a number of stakeholders. Their concerns are in relation to construction of the conveyance (whether the tunnel or pipeline option) are the potential impacts from dust, particularly in the Wadi Araba/Arava Valley. In addition stakeholders have raised concerns about the extent to which the Scheme could contaminate groundwater, or impact other water sources relied upon, such as the Abu Barga Dam.

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<tr>
<th>Impacts to farming during construction</th>
<th>Intake (E)</th>
<th>Pipeline</th>
<th>Tunnel</th>
<th>Desalination Plant</th>
<th>Hydroelectric Plant</th>
<th>Freshwater Conveyance (Jordan)</th>
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Impacts Related to Construction Dust and Farm Productivity

Crops at two Al Haq farms (at Rahma and near Rishe) are near to the conveyance route and potential tunnel adits and may be impacted by dust. In order to make a full assessment, further details about the farms will be acquired (eg what and how they farm, the number of people employed etc) in order to assess this potential impact further. Potential mitigation measures will also be discussed with Al Haq farms to understand the viability of potential measures, such as using temporary covers etc. which it is currently anticipated would reduce the significance of this potential impact to not significant to minor significance.

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<th>Sensitivity/Value of Resource/Receptor</th>
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Impacts Related to Water and Farm Productivity

Abu-Barga Dam is 2 km away from the southern canal section. The Dam is the main source of water for communities and farming in the area. A concern has been raised that the construction of the canal could potentially disturb the dam or the water supply which could negatively impact agriculture. More information on the exact utilisation of the dam is being acquired (eg how many farms it sources) before an assessment is made. However this impact is currently anticipated to be of minor significance, at most, since the canal will only require excavation in soft material, and some surface construction. No drilling or blasting is anticipated.
### Contamination of Groundwater during Operation, Affecting Farming

There is a potential (though very small) risk of leakage of sea water from the conveyance to the underground aquifer, which it is perceived could then affect wells, groundwater abstraction and therefore agriculture. This has been raised as a particular concern by Israeli stakeholders who use the groundwater in the Arava Valley more extensively than those communities on the Jordanian side of the border. This risk of contamination could either come from a slow leakage or from a sudden breach. This issue is dealt with in more depth in Section C8, following production of the Sub-Study report on hydrogeology. Mitigation that will reduce the likelihood of such a leak occurring could include the following.

- Establish leakage detection capability;
- Include failsafe/emergency shut down capability in the Scheme; and
- Monitoring of groundwater quality.

Section C8 should be referred to for more detail, but in summary, appropriate design of the pipeline will lower this risk. As such this impact is predicted to be *minor significance* at most.

### C6.5.6 Impacts to Ways of Life and Community Structure

#### Impacts Associated with Managing Community Expectations of the Scheme

This issue relates to the Scheme as a whole; however the issues are mainly around the conveyance components of the Scheme, so this section generally highlights issues around community expectations in the Wadi Araba about the Scheme’s impacts and benefits on the communities in this area.
Consultation to date has suggested that local people expect a direct benefit from the project, for example receipt of freshwater along the conveyance route. Local communities, especially in Wadi Araba have stated that they may not support the project, if some local benefits are not realized.

As a result, there may be an option available to make some water available to local communities along the conveyance route, in seawater form, which they could then desalinate using systems they could develop at the community level. If such a benefit were to be provided it would need to be agreed with the construction contractor, local communities and local authorities.

It will be important to manage community expectations throughout the project, through effective public consultation and their involvement in project planning. The following mitigation measures can be considered which apply to all people potentially concerned about the Scheme, whether located in the Wadi Araba or further afield; the extent to which each measure is appropriate for implementation in particular areas of the Scheme would require more detailed consideration:

- Orientation for local communities on the required needs and services;
- Build the capacity of the local communities to respond to these needs;
- Provide a grant for local community members or associates to start certain business to accommodate the emerging needs from these sites;
- Actively manage the expectations of the communities by communicating plans and activities regarding all community initiatives; and
- Monitor grievances and document how they have been resolved.

On the basis of these measures, potential problems from a disconnect between the community expectations and the Scheme itself can be minimised such that the residual impact is reduced to non significant to minor significance.
### Impacts to Community Structure and Relations During Construction

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<thead>
<tr>
<th>Impacts to community structure and relations during construction</th>
<th>Intake (E)</th>
<th>Pipeline</th>
<th>Tunnel</th>
<th>Desalination Plant</th>
<th>Hydroelectric Plant</th>
<th>Freshwater Conveyance Jordan</th>
<th>Freshwater Conveyance Israel/Palestinian Authority</th>
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A large number of foreign or non local workforce entering a community may cause tension between the communities that live there and the new workforce. A secondary impact is that further people may migrate to the communities to also try to benefit from the potential economic gains. This may all affect the structure of communities which, for example in the Wadi Araba, are traditional and based on a Bedouin lifestyle.

It will be important that a clear workforce management plan is developed for the Scheme to ensure that any impacts associated with the workforce are managed and mitigated. This plan would include a clear code of conduct for the workers.

Following implementation of mitigation measures this impact is predicted to be non significant to minor significance.

### Impacts Related to Induced Development and Tourism

<table>
<thead>
<tr>
<th>Impacts to induced development and tourism</th>
<th>Intake (E)</th>
<th>Pipeline</th>
<th>Tunnel</th>
<th>Desalination Plant</th>
<th>Hydroelectric Plant</th>
<th>Freshwater Conveyance Jordan</th>
<th>Freshwater Conveyance Israel/Palestinian Authority</th>
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Particular concern has been raised in relation to potential impacts to the culturally important sites of Masada, Lot’s Cave and Bir Mathkour. The visual impacts on these sites are discussed in Section C13 and has shown that none of the permanent Scheme infrastructure will be visible from Masada; however this issue is in a wider context of the potential impacts that the Scheme could have on the nature of the Dead Sea Basin in which Masada and Lot’s Cave are located. The regional implications of induced development and the regional impacts to tourism in the area are discussed separately in the regional assessment section of this report.

Changes to ways of life and cultures during operation

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<thead>
<tr>
<th>Changes to ways of life and cultures during operation</th>
<th>Intake (E)</th>
<th>Pipeline</th>
<th>Tunnel</th>
<th>Desalination Plant</th>
<th>Hydroelectric Plant</th>
<th>Freshwater Conveyance Jordan</th>
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If the canal option is selected, these features in the desert environment will potentially bring induced development which would alter the traditional ways of life in this desert area. The presence of canals, which may be landscaped or developed into tourism areas, could introduce very different cultures to the desert area, such as water based recreation. Bringing tourism into this area could potentially have an impact on the traditional ways of life of the local semi-nomadic Bedouins, who can be fairly vulnerable groups, already facing a number of challenges. Such impacts can be mitigated through appropriate consultation and community involvement in planning associated with development of areas local to communities. This issue is discussed further in the regional analysis.

C6.5.7 Impacts to Community Health and Safety

Increased access to freshwater for recipient communities

The Scheme as a whole will involve the provision of fresh desalinated water to certain localities (eg Amman, Jericho and Arad). This has a clear potential positive impact as a result of health and other benefits that more freshwater would bring. However, there are also other issues surrounding the provision of freshwater which have social implications and warrant consideration, for example, potential changes in water tariffs for recipients. This issue is discussed in more detail in the regional assessment section.
Changes in Environmental Quality (Air Quality, Noise, Traffic) to Communities during Construction

Disturbances to communities from changes in environmental quality have been discussed elsewhere in this report (see Section C14) and will be assessed in more detail once the sensitivity of communities is better understood. However, all potentially significant issues associated with noise, dust and traffic disturbance etc will be managed through the application of appropriate construction codes of practice to which construction contractors will be required to adhere. As such the resulting impacts to communities are anticipated to be *not significant* to *minor significance*.

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<th>Sensitivity/Value of Resource/Receptor</th>
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Public Health Impacts Associated with Foreign Workers during Construction

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<th>Cessation of local employment opportunities after construction</th>
<th>Intake (E)</th>
<th>Pipeline</th>
<th>Tunnel</th>
<th>Desalination Plant</th>
<th>Hydroelectric Plant</th>
<th>Freshwater Conveyance Jordan</th>
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Foreign workers potentially could bring in diseases such as HIV/AIDS or other communicable diseases such as SARS, avian flu etc. A number of measures can be undertaken to manage and mitigate these impacts, including the following:

- Undertake a health risk assessment for the Scheme;
- All workers are subject to health checks as part of their induction;
- Implementation of a code of conduct for workers; and
- An appropriate emergency response plan will be developed and include a response in the event of a contagious disease outbreak.

Appropriate management of these impacts is expected to reduce the residual impact to *minor significance*. 
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<th>Sensitivity/Value of Resource/Receptor</th>
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**Health Impacts to Communities from Waste and Wastewater during Construction**

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<thead>
<tr>
<th>Health impacts to communities from waste and wastewater during construction</th>
<th>Intake (E)</th>
<th>Pipeline</th>
<th>Tunnel</th>
<th>Desalination Plant</th>
<th>Hydroelectrical Plant</th>
<th>Freshwater Conveyance Jordan</th>
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<th>Discharge</th>
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| Worker camps will produce sanitary waste. Process wastewater will also be produced (eg from tunnelling). Sewage and wastewater will also be generated from construction activities; sewage will be generated by the workforce at accommodation camps and work sites along the route of the Scheme. If not managed properly, this could result in health impacts to local communities. However, standard management measures will ensure that these wastes are dealt with appropriately. Process wastewater will be treated and either reused or discharged to the ground, where appropriate. Mitigation measures will include:

- Septic tanks will be installed and used for the treatment of sewage generated at all of the Schemes’ work and accommodation sites;

- Human wastes will be disposed of safely in order that it does not: contaminate any drinking water supply; give rise to a public health hazard by being accessible to insects, rodents or other possible carriers that may come into contact with food or drinking water; pollute or contaminate any stream for public or domestic water supply purposes or for recreational purposes; or give rise to a nuisance due to odour or unsightly appearance;

- Wastewater from tunnel construction will be pumped out and passed through settling ponds to remove solids before any clean water is discharged to natural water courses.

Assuming that these mitigation measures are implemented, the residual impact is predicted to be *not significant*. 

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**Magnitude of impact**

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<tr>
<th>Health impacts to communities from waste and wastewater during construction</th>
<th>Intake (E)</th>
<th>Pipeline</th>
<th>Tunnel</th>
<th>Desalination Plant</th>
<th>Hydroelectrical Plant</th>
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**Infrastructure and Utilities during Construction**

Issues around infrastructure and utilities are discussed in a separate section (see Section C15). However, the social aspect of this is whether services such as water, electricity or waste provision services to local communities would be negatively impacted by the pressures placed on these services by the Scheme, particularly during construction.

In terms of the capacity of waste facilities:

- The capability and track record of public and private waste collectors will be assessed and confirmed with the regulatory agencies prior to the appointment of any contractors;

- Assessment of capacity of landfill sites in the area to deal with quantity and quality of expected wastes, before construction begins;

- In terms of appropriate sites for soil disposal, choose appropriate spoil disposal sites according to pre-defined site selection criteria.

In terms of water provision issues, an estimation of required volumes of water for construction and workers camps should be made, to negotiate with the Water Authority the best alternatives for accessing water for the project.

In terms of electricity, the project may need to consider using independent generators in rural areas during the construction period, where power is not accessible.

In terms of potential impacts to the existing social services, the following could be considered:

- Improve existing infrastructure and upgrade the quality level of service or build separate services within the working camp for workers.

- Involve local communities in identifying problems and solutions, by holding regular consultation sessions.

For potential impacts to the road network, the following could be considered:

- Some access roads and additional junction control may be needed during construction;
Heavy loads must meet the axle load restrictions in the Roads Regulation, or else be specifically approved by the Ministry of Public Works and Housing.

Such issues could result in cumulative impacts if not managed adequately. Given the other large construction projects that could potentially be happening at the same time, it may be necessary to establish a comprehensive coordination framework between the different contractors and Government of Jordan clients.

With appropriate mitigation and coordination, impacts to infrastructure and services are anticipated to be manageable to levels of minor significance.

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**Traffic Safety Impacts to Communities during Construction**

Traffic safety issues will mostly relate to the construction at the eastern intake, and in association with construction of the tunnel or pipeline options.

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<th>Traffic safety impacts to communities during construction</th>
<th>Intake (E)</th>
<th>Pipeline</th>
<th>Tunnel</th>
<th>Desalination Plant</th>
<th>Hydroelectric Plant</th>
<th>Freshwater Conveyance (Jordan)</th>
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At the eastern intake, any increases in traffic volumes will increase the risk of road accidents. The construction of the eastern intake and establishment of the pumping station on the site of the disused Aqaba Thermal Power Station will affect the coastal road leading to the major industries in the south ie phosphate and southern port; and the road to Mecca and Madina in Saudi Arabia, which is a route for road travellers to the Hajj-Islamic Pilgrimage coming from Egypt or the Palestinian Authority.

**For the Pipeline**

The pipeline will cross the main Dead Sea highway in seven locations, leading to potential injuries to people living in the local communities as a result of increased traffic in and around Aqaba/Eilat and the surrounding areas.
For the Tunnel

The access road to the construction site and tunnel entrances might be close to inhabited villages. The heavy use of trucks (around 1028 trucks/day) might increase the tendency for traffic accidents.

These impacts will be potentially of moderate significance due to the volumes of traffic. However, this can be managed through appropriate development and implementation of a Construction Traffic Management Plan which would include:

- A consultation and notification process will be developed to give residents and businesses advance warning of potential delays on the road network as a result of increased traffic and any abnormal loads;

- A traffic strategy would be developed that balances impacts upon other road users and communities along the route; avoiding truck trips on the highway during peak traffic flows and avoiding nuisance to communities, which may require no night time operation in certain areas;

- All abnormal loads will be suitably marked to warn other road users;

- Agreeing specific routes for construction traffic aiming to avoid residential areas and unsuitable parts of the network where possible, for example in Aqaba, Karak, Ein Bokek, Amman and Jericho;

- Minimal night construction in sensitive areas – ie for the plant associated with the conveyance.

- Construction personnel to be transported to and from the site each day by organised buses minimising addition vehicle trips;

- New roads to be routed away from sensitive communities and other receptors and to be surfaced and maintained so as to minimise dust generation;

- Before and after surveys of the condition of the road in relation to construction, with repairs where necessary; and

- Measures to reduce the potential for accidents due to the increase in road traffic eg warning signs to local residents, distribution of information materials to local residents, driver training/briefing for HGV construction drivers, speed restrictions and enforcement on approaches to villages.

Following implementation of these mitigation measures, the residual impact is anticipated to reduce to minor significance.
Canal Safety during Operation

This issue only applies to the high level tunnel option.

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<th>Canal safety during operation</th>
<th>Intake (E)</th>
<th>Pipeline</th>
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<th>Hydroelectric Plant</th>
<th>Freshwater Conveyance Jordan</th>
<th>Freshwater Conveyance Israel/Palestinian Authority</th>
<th>Discharge</th>
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Since the proposed canal option includes canals of approximately 20 m width and 4 m depth, with fast flowing water, health and safety risks associated with the canals are a concern to local communities for whom such water features do not generally exist in their environment. Open canals can therefore potentially be dangerous to local communities, shepherds, children and animals, particularly those that cannot swim. Since water bodies will be a new feature in the area they may initially be an attraction to local communities unused to water features. This issue could pose an impact of moderate negative significance since, although there is a low likelihood of the event occurring, the magnitude of any impact could be of high severity.

Measures to mitigate this impact could involve:

- Fencing the canal;
- Covering the canal; or
- Taking other security measures to keep people and livestock away from the open canals.

Any measures to avoid people accessing the canals could however have implications if the canals are to be developed into a feature to encourage recreation around the canals.

After appropriate mitigation measures have been implemented, for example assessing which measure will best work to avoid safety issues with the canal, and after these have been implemented, the residual impact is expected to be reduced to minor significance since the severity of the potential impact will have been reduced.
### C6.6 Mitigation of Impacts

Many of the mitigation measures discussed in this section are measures that will best be incorporated into construction and operation management plans as codes of practice for the construction and operational phases of the Scheme. As such, their implementation will be passed on to contractors and workers as commitments to be upheld.

In addition to the construction and operation management plans, a number of other specific management plans will be developed to mitigate potential impacts, including:

- stakeholder engagement and grievance management plan;
- resettlement action plan;
- emergency response plan; and
- health management plans, to name a few.

Other specific measures that may not specifically be covered under construction or operational codes of practice, or through other contractual or procedural means or formalised plans are summarised here:

- In order to enhance employment benefits to local communities, training or job advice schemes could be established for the communities. These schemes, if taken forward, should be set up well in advance of the project commencing to allow adequate capacity to be built. Similarly, if the Scheme will be providing grants *etc* for local community members or associates to start certain business to accommodate the emerging needs from these sites, this needs to be planned in advance. The implementation of some mitigation measures could be carried out in association with other bodies already operating in the affected areas (for example Government groups or NGOs), and an assessment would need to be undertaken to identify which groups are active already in the area and whether any institutional collaboration with such groups would be beneficial.

- Any mitigation surrounding measures to ensure the safety of communities in respect to the risks associated with the open canals as part of the high level tunnel option, would potentially be at high cost. The selection of an appropriate mitigation strategy would best be conducted in collaboration with the local communities that will be affected.

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<td>Minor</td>
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<td>Major</td>
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C6.1.2 **Palestinian Authority**

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- Listing of Organization in Jericho: Palestinian Ministry of Interior
- Development plans in Jericho: Jericho Municipality
- Archaeological Sites: Ministry of Tourism and Antiquities
- Land Use: Ministry of Tourism and Antiquities/PCBS/Field Visits
- Economic Activity: Palestine Economic Policy Resource Institute (MAS)/Palestinian Monetary Authority (PMA)/PCBS
- Project Impacts: PHG Team
- Health Information: Ministry of Health

World Health Organization Regional Office for Europe
C7 TERRESTRIAL ECOLOGY AND NATURAL HERITAGE

C7.1 SCOPE OF ASSESSMENT

The following section discusses the potential impacts on the terrestrial ecology within the area covered by the Scheme. The work builds on previous studies, consultations with stakeholders and experts and field work carried out thus far. A key source document was the Biophysical Sub Study produced in conjunction with the Feasibility Study. The process of scoping of the issues to be investigated is explained in Section C7.3, and included reviewing published literature, as well as consultations with technical stakeholders.

The following are key concerns identified in regards of terrestrial ecology.

- Impacts during the construction phase associated with increased nuisances on the estimated 1.2 million migratory birds that pass through the Dead Sea Basin, Wadi Araba/Arava Valley and the Gulf of Aqaba/Eilat area as part of their migration route, the African-Eurasia flyway system.

- Impacts associated with increased nuisances, land take and influx of workers within close proximity to protected areas (existing and proposed) that include: Dana Biosphere Nature Reserve; Fifa Proposed Protected Area; Qatar Proposed Protected Area; other Special Conservation Areas; and Important Bird Areas.

- The effects on ecological connectivity, especially in situations where east-west movement is limited due to construction activities or permanent structures such as the above surface pipeline or canal.

As these concerns are mostly situated within the Jordanian side of the Wadi Araba/Arava Valley, a more thorough approach to data collection was carried out for the Jordanian ecological environment.

C7.2 APPROACH TO ASSESSMENT

The terrestrial ecological baseline is taken largely from the Biophysical Sub-Study and related work. The methodology for data collection included:

- A Literature Review to collect previous ecological data covered by the area of the Scheme (see Section C7.9);

- Flora Field Work including a field survey to describe the vegetation types and habitats; enquire on the presence and absence of plant species; identify flora hotspots; and assess threats on species and habitats;
Fauna Field Work focusing on amphibians, reptiles, small mammals (mainly nocturnal species) and large mammals were surveyed by conducting line transects along the proposed routes of the conduit. Each transect was 1 km in length. Researchers documented large mammals’ tracks, spores, body remnants and dens.

Since the final freshwater line in Jordan had not been determined at the time of the field work, the survey covered all three alternative alignments. A differential assessment will be completed and produced in the discussion of project alternatives in the next phase of the assessment. In addition, the freshwater route in Israel and the Palestinian Authority has only been notionally identified, so only high level discussion of impacts was addressed at this stage.

C7.3 BASELINE

C7.3.1 General Characteristics

The general characteristics of the area covered by the Scheme are discussed in terms of ecosystems, biogeography, zoogeography, vegetation types, etc. It should be noted that more focus is given to the conveyance line and freshwater routes in Jordan, since more detail on the alignments is available.

C7.3.2 Ecosystems

The term ecosystem refers to flora and fauna communities within climatically and geographically defined areas of ecologically similar conditions. The area of the proposed Scheme covers three major ecosystems as follows.

Desert Ecosystem

This ecosystem covers the gently undulating plateau with elevations of between 500m and 900m above sea level. Four broad habitat types can be distinguished in this ecosystem: Hammada; Harrat; Extensive Sand Dunes deserts; and Clay pans lying at the bottom of close drainage basins in the desert.

This largely treeless ecosystem is dominated on its fringe, adjoining the Highlands ecosystem (discussed below) by Irano-Turanian species of small shrubs and bushes such as: Artemisia; Retama; Anabasis; and Ziziphus.

The quality of the Desert Ecosystem in Jordan has generally been deteriorating due to very heavy grazing and widespread ploughing for cultivation of rain fed barley. This has led to a loss of natural plant cover and an accelerated soil erosion and degradation.
**Scarp and Highland Ecosystem**

This ecosystem encompasses the escarpments and mountains, hills and undulating plateaus that extend mainly from the north and from the Rift Valley region to the Jordanian Desert in the east and Negev Desert in the west. The mountains in the south of this zone are higher on average, and some range between 1200 m and 1600 m high. Mediterranean woodland of pine and oak, with juniper and cypress are believed to have originally covered large tracts of the highlands, but human and climatic factors have resulted in high deforestation and replacement of natural vegetation by secondary species.

This ecosystem is dominated by *Quercus calliprinos* and *Q. ithaburensis* at lower elevations where the original pine-dominated woodland has been degraded.

**Sub-Tropical Ecosystem**

This ecosystem is called sub-tropical due to the Sudanian penetration in this zone. The Dead Sea rift follows the line of the fault which extends 370 km from the north of Jordan River in the north to the Gulf of Aqaba/Eilat, forming part of the African Rift Valley.

The northern part of the valley is defined by the drainage basin of the Dead Sea. The southern part of the valley, draining into the Gulf of Aqaba/Eilat, is the Wadi Araba/Arava Valley. The natural vegetation of the valley’s plain and lower scrap slopes has been greatly modified by cultivation and grazing, but is more intact in Wadi Araba. Tropical Sudanian species of trees and dwarf-shrubs are prominent including members of the following genera: *Acacia; Blanites; Tamarix; Calotropis; Maerua; Salvadora; Ochradenus;* and *Panicum.*

**C7.3.3 Bio-Geographical Zones (in Terms of Flora)**

A bio-geographical zone refers to the flora and fauna distribution over a specified geographical region often attributed to evolutionary history. The Scheme passes through three major bio-geographical zones described below.

**Mediterranean Zone**

This region is not covered by forests but rather contains shrubs and bushes with the leading plant species *Rhamnus palaestinus* and *Sarcopoterium spinosum.*

This zone is restricted to the highlands with an average altitude ranging from 700-1750 m above sea level. Rainfall ranges from 300-600 mm. Mean annual low temperatures range between 5 and 10°C, and the mean annual high temperatures range between 15 and 25°C. Soil type is dominated by the red Mediterranean soil, *Terra Rosa;* and the yellow Mediterranean soil, *Rendzina.* This suite of conditions is optimum for the forest ecosystem.
**Irano-Turanian Zone**

This zone is a narrow strip of variable width that surrounds the entire Mediterranean bio-geographic zone except at the north and is characterized by the presence of shrubs and bushes and the absence of tree vegetation. The strip’s variable width is dependent on the annual rainfall. The leading plant species include *Anabasis syriaca* and *Artemisia herba-alba*.

Altitudes usually range from 500-700 m and rainfall ranges from 150-300 mm. The mean annual minimal temperatures range from 5 to 20°C, and the mean annual maximum temperatures range from 15 to 25°C. The vegetation is dominated by chamaephytes.

**Sudanian Penetration Zone**

This zone is represented in Aqaba and Eilat and the largest area covered by the Scheme. Characterized by a sandy soil type, it resembles the vegetation type in Sudan and Ethiopia, where the leading plant species is the *Acacia spp.* The most important characteristic of this region is its altitude, containing some of the lowest terrain on earth. The altitude provides a unique environment and thus a unique ecosystem.

Rainfall in this zone ranges from 50-100 mm, mean annual minimal temperature ranges from 10 to 20°C, and mean annual maximal temperature ranges from 20 - 35°C. Vegetation is characterized by having tropical tree element such as *Ziziphus spina-christi* in addition to some shrubs and annual herbs.

### C7.3.4 Vegetation Types

Vegetation type refers to a community of vegetation that shares similar structure and composition and are often described by the dominant species. The main vegetation types that cover the area the Scheme passes through were identified as follows:

- Acacia;
- Rocky Sudanian;
- Saline Vegetation;
- Water Vegetation; and
- Rocky Vegetation.

### C7.3.5 Zoogeography

Zoogeography refers to the spatial distribution of animal species and their attributes. The Scheme passes through the following identified distinct zoogeographical zones.
Mediterranean Zoogeographic Zone

This is a distinct sub region within the Palearctic region (European Origin). It includes mountain areas that extend from the north of Jordan to the Naqab Mountains in the south. In the area covered by the Scheme, mammals that belong to this zone exist in the Naqab area and in the areas south of Amman, along the Desert highway corridor.

A list of important mammals, common reptiles and amphibians found in the Mediterranean geographical zone will be appended to the Terrestrial Ecology Annex (to be included in the Preliminary Final ESA Report).

Saharo – Sindian Zone (also referred to as the Saharo-Arabian)

This zone is located to the east of the mountain ranges and extends from the south of Jordan and Israel to the northeast of the Jordan and Negev of Israel. It is another sub region within the Palearctic region, and includes the Arabian Desert.

A list of important mammals, common reptiles and amphibians found in the Saharo-Sindian zoogeographical zone will be appended to the Terrestrial Ecology Annex (to be included in the Preliminary Final ESA Report).

Afrotropical Zone (also referred to Ethiopian)

Many mammal species in the southern regions of Jordan and Israel are of African origin and exist in the Africotropical zoogeographic zone, especially those in the Rift Valley and in the Aqaba/Eilat area.

A list of important mammals, common reptiles and amphibians found in the Africotropical zoogeographical zone will be appended to the Terrestrial Ecology Annex (to be included in the Preliminary Final ESA Report).

C7.3.6 Avi-Fauna

In terms of avi-fauna, the Jordan Rift Valley and the Dead Sea area are unique as they lie within the second most important flyway in the word and the most important route of the Africa-Eurasia flyway system. Birds use this route as a corridor between their breeding grounds in Europe and West Asia and wintering areas in Africa.

It is estimated that 1.2 million birds of prey and 300,000 storks migrate along this corridor each year. Thirty five species of migratory birds are recognized as using this flyway. These include a high percentage of the world population of: Levant Sparrow hawk, Accipiter brevipes, which pass along this flyway twice yearly; the Lesser Spotted Eagle, Aquila pomarina; Eurasian Honey Buzzard, Pernis apivorus; Short-toed Eagle, Circaetus gallicus; Booted Eagle, Hieraaetus pennatus; Egyptian Vulture, Neophron percnopterus; and the White
Stork, *Ciconia ciconia*. Six of these species are globally-threatened and three are globally near-threatened.

A list of major migratory birds will be appended to the Terrestrial Ecology Annex (to be included in the *Preliminary Final ESA Report*).

In recognition of the different topographical, climatic and biogeographical regions discussed above, the area has a highly diverse population of resident bird species with approximately 150 species recorded. The list of avi-fauna found within the project area will be appended to the Terrestrial Ecology Annex (to be included in the *Preliminary Final ESA Report*).

**C7.3.7 Areas of Particular Ecological Importance**

*Figure C7.1* shows the areas of particular ecological importance (existing and proposed) within the proximity area to be covered by the Scheme. These are discussed in detail below.

**Figure C7.1 Protected Areas (Existing and Proposed)**

All maps produced as a part of this study are being checked by the World Bank Map Design Unit. An approved set of maps will be included in the *Preliminary Assessment Report*.

**Jordan**

**Aqaba Important Bird Area (IBA):** This IBA is considered the first and the last resting and refuelling point for millions of birds after and before their crossing over the Great Sahara during the migration seasons. It attracts over 100,000 raptors and a significant number of waders, ducks and other species of birds. The designation of the area is recognised by the RSCN, a local NGO, and Birdlife International in 2000.

**Aqaba Bird Observatory (ABO):** The ABO is a designated area within the Aqaba IBA for bird watching and eco-tourism. This area is considered the only managed area for avifauna diversity outside the protected areas with special regulations developed for this purpose. The ABO is considered the core of the Aqaba IBA where more than 370 species of birds are recorded among which migratory birds constitute approximately 80% of the total number recorded (JSSD, 2006).
**Dana Nature Reserve**: Dana Nature Reserve has been recognised as a protected area in Jordan since 1988. In 1998, UNESCO declared the reserve the first Man and Biosphere Area in Jordan. The reserve extends from Edom Mountains down to the Jordan Valley at the north tip of Wadi Araba. The significant elevation difference has created a considerable diversity in habitats and species at the reserve, where four bio-geographic zones exist.

**Qatar Proposed Nature Reserve**: The significance of this area within this reserve has been recognised since 1998 following a review of areas that need to be protected in Jordan. In 2007, Qatar officially joined the national protected areas network and is expected to be established within the next 4 years. The area proposed to be covered within the reserve is approximately 50 Km² and is penetrated by the Aqaba-Wadi Araba road. Qatar is located at the southern parts of Wadi Araba within the subtropical bio-geographic zone. Recent studies on the biodiversity of the area have yielded the discovery of a species of spider new to science.

**Jabal Masuda Proposed Protected Area**: This area was proposed for protection since 1979 (Clarke, 1979) but recently has joined the national protected areas network (2008). This area extends from Edom Mountains in the highlands (1500 m above sea level) to the lower parts overlooking the Wadi Araba area at 350 m above sea level. Two bio-geographical zones characterize the area; the Mediterranean and Irano-Turanian. Five vegetation types are found within the protected area that include: Juniper Forest; Mediterranean non-forest; water vegetation; sand dune vegetation; and steppe vegetation.

**Wadi Araba IBA**: This IBA has a total area of 383 Km² extending from Qa’ As Sa’idyin to the south of Qatar. It has been designated as IBA due to its location on the migratory route of birds, with the following criteria: criteria 1, 2I (1% or more of water bird population in Middle East), 2III, 3, 4, 5II.

**Dana IBA**: The Dana IBA is confined to the area from the rugged Shara Mountains at 1,200 m down to the rift valley floor at sea level containing Wadi Dana amongst other wadis. Bare rounded mountains and sandstone cliffs occur at the head of the wadi giving way to metamorphic rock at the base of the escarpment where the wadi opens out onto a gravel outwash plain with mobile sand dunes. The IBA includes Dana Biosphere Reserve. The IBA can be divided into five parts:

- High mountains (Al Qadesiaha, Al Rashadyia, 640 m above sea level) that represent the Irano-Turanian vegetation type with penetration of some plants from the Mediterranean vegetation type;

- West Mountains (800-1250 m above sea level) consist of calcareous and sandy rocks and includes forests of oak. This part represents the Mediterranean zone with some elements of the Irano-Turanian zone;
• Low western mountains with Wadi streams (400-900 m above sea level) that represent the Saharo-Arabian vegetation;

• Mountains parallel to Wadi Araba (100-400 m above sea level) that represent the Saharo-Arabian and Sudanian vegetation types;

• Silt dunes in Wadi Araba with vegetation communities of Haloxylon persicum.

Dana IBA is considered one of the most important IBAs since it supports the presence of both resident and migrant species, some of which are regionally threatened and declining like the: Levant Sparrowhawk; Eurasian Griffon Vulture; European Honey Buzzard; Sooty Falcon; and Bearded Vulture (or Lammergeier). In addition to avifauna, the area is important for some rare and threatened mammalian species such as the Caracal, Nubian Ibex, Grey Wolf, and the Blanford Fox.

**Rahmeh SCA:** This area has been proposed by the Integrated Ecosystem Management Project in 2007, as an area of specific ecological, social and economic purposes. It is located south of Jabal Masouda proposed protected area and Qatar proposed protected area. This area is characterised by multi-ecological services and functions and is represented by two bio-geographic zones; Irano-Turanian and Sudanian Sub-Tropical zones.

The protection of the natural habitat at this site has considerable effect on the biodiversity of both bordering protected areas; it is meant to serve as an ecological corridor for wildlife and as a buffer zone for Masuda Protected Area.

**Fifa Proposed Protected Area:** The area covered by the protected area is 33.1 km² and is located along the Dead Sea, west of Fifa village, between Wadi Um Jufna in the north and Wadi Dahel in the south. It is part of the Sudanian biogeographical zone.

According to a tentative rapid assessment of the site by the Jordanian RSCN, Fifa includes at least seven plant species that are of national conservation importance that include: Salvador, *Salvadora persica*; Maru, *Maerua crassifolia*; Giant red, *Arundo donax*; Acacia or Shittim, *Acacia tortilis*; Sea-blight, *Suaeda monoica*; Date palm, *Phoenix dactylifera*; Acacia, *Acacia radianna*; and Short pricklegress, *Crypsis schoenoides*.

The assessment also identified over seven species of large mammals and around 100 species of birds in addition to several species of reptiles. The most important mammals recorded are: Caracal, *Caracal caracal*; Wolf, *Canis lupus*; Golden Jackal, *Canis aureus*; Red Fox, *Vulpes vulpes*; Striped Hyaena, *Hyaena hyaena*; Cape Hare, *Lupes capensis*; and Wild Boar, *Sus scrofa*.
The area is classified into two main vegetation types: saline vegetation, represented in the western part of the Jordanian borders characterized by a dense Tamarix forest; and the tropical vegetation type represented in the eastern part of the protected area with the leading species of *Salvadora persica*, *Calotropis procera* and *Zizphus spinosa-christi*. The tropical vegetation area of the site threatened by grazing activities; and is vulnerable as it is the only open wildlife movement in the area.

**Fifa IBA:** The Fifa IBA lies south of the Dead Sea and north of Wadi Araba. The area encompasses agricultural plains with sand and silt dunes covered with halophytic and subtropical vegetation. Several wadis run into the Dead Sea through this site and a number of water springs support the locally dense Tamarix scrub and reed stands. The area lies in the Sudanian bio-geographical zone at 100-400m below sea level. Wadis of significance at the site include: Wadi el Hasa; Wadi Khneizereh; and Wadi el Tafileh.

**Israel**

**Einot Samar:** An ecological complex similar to Einot Tzukim (Ein Fashka, discussed below) but rather on a smaller scale.

**Masiv Eilat Reserve:** This 390 Km² reserve contains the impressive Eilat Mountains and is known for its rich rock formation diversity and striking landscape. The Eilat Mountains are the most arid area in Israel and maintain a unique community composition and several rare and endemic species.

**Evrona Reserve:** This 6.5 Km² reserve is situated near Be’er Ora and is composed of a salt flat that is the largest and most preserved of the three salt flats located in southern Arava. It includes many unique communities with species such as: the caracal; hyena; wolf; and gazelle.

**Dom-Palm Reserve:** This small reserve, less than 1 Km², is located within the Evrona Reserve. The main purpose of the reserve is the protection of an extremely rare population of Dom Palms in which the area is the habitat of the world’s northern most population on the extreme edge of dispersal for this species. The closest sizable population are in Egypt and Sudan.

**Hai-Bar Yotvata:** Hai-Bar Yotvata is located north of Eilat with the main objective to foster breeding of animals mentioned in the Bible among other endangered desert animals. The reserve encompasses a variety of arid-land habitats including acacia groves, salt-flats and sand. Hai-Bar Yotvata is divided into three main sections: a 12 Km² open area where herds of desert herbivores live in conditions similar to the wild; a predator centre with enclosures containing large predators, reptiles and small desert animals; and a ‘dark room’ to view nocturnal animals when they are active.

**Samar Sand Dunes Reserve:** South of Yotvata salt flat, the Samar sand dunes are an Israeli extension of a larger area on the Jordanian side of the border.
These sand dunes are a refuge for many psammophile species and are an endangered habitat coveted by sand mining operations. The reserve protects only a small portion of the dunes (about 1 Km²).

**The Incense Route Reserve:** This part of the Incense Route that began in Obar, Oman crossing the Saudi Peninsula into Jordan and the Negev ends at the port of Gaza. It is a vast desert area abundant with impressive geological vistas, archaeological sites and wildlife. The edge of the reserve in the Arava Valley is located near Moa and Tzofar, but the bulk of the reserve is further west into the Negev Desert. The reserve protects the re-introduced endangered species of Wild Ass and Arabian Oryx.

**Nahal Sheizaf Reserve:** This 54 Km² reserve is located north of En Yahav and is composed of three sections containing important features of the desert ecosystem. The reserve has one of the last remnants of the sandy landscape with the Acacia trees with a high carrying capacity and a multitude of plant species. This reserve is especially important for the conservation and protection of reptiles as half of the desert species can be found here in a very small area.

**Neot HaKikar Reserve (proposed):** This proposed reserve intends to protect the remains of the local salt flat particularly around HaKikar spring.

**Ramat Mazar Reserve:** A 67 Km² reserve on both sides of the Arava road, located between Nahal Peres and Nahal Yerusha. This reserve has impressive geological structures that include the Lisan Badlands. Many species of mammals are also found, in particular Gazelles and Ibex which are ‘Umbrella species’ singled out for protection and conservation.

**Masada National Park – cultural site:** Masada, the ancient fortress built by King Herod the Great atop a lofty natural plateau overlooking the Dead Sea, was declared a UNESCO World Heritage Site in 2001.

**En Gedi Nature Reserve and National Park:** The spectacular En Gedi Nature Reserve is located west of the Dead Sea shore with two year-round streams: the David Stream in the north; and the Arugot Stream in the south. There are four springs that originate during the rainfall in the Judean Mountains with a total flow rate of some three million cubic meters of water per year. The combination of En Gedi’s location and its fresh water sources allows a wide variety of plant and animal species to thrive side by side. Flora includes the Acacia, the Christ-thorn and the Sodom apple, alongside streambed vegetation like giant reed and cattail, while the cliff walls are home to various types of moss and ferns, e.g. maidenhair.

Among the mammals in En Gedi are herds of ibex and groups of hyrax. Nocturnal animals include foxes, wolves, hyenas, and occasionally spotted leopard.
Fault Scarp Reserve: This reserve on the western side of the Dead Sea protects a prominent feature of the region – the scarp. The vertical structures of the interface of the Judean Desert and the Dead-Sea are impressive and unique. They harbour many archaeological sites, and supply an astonishing landscape. The nesting raptors, the leaping ibex and the lush flora render the edge a valuable habitat and an attractive feature for tourism.

Judea Desert Reserve: One of the biggest reserves in Israel, the Judea Desert Reserve stretches from En Gedi in the north to Hatzeva in the south – over 590 Km². This reserve harbours large mammals such as: leopards; gazelles; ibex; hyenas; and wolves. The Judea Desert Reserve protects important population of reptiles and raptors. Within this reserve, the Sdom Mountain is a unique and impressive geological phenomenon as it is the largest salt mountain in the world.

Palestinian Authority

Ein Fashka: Ein Fashka nature reserve stretches 6.5 km along the Dead Sea coastline with bathing facilities, fresh water springs and pools in the midst of unique tropical vegetation abounding with birds, fish and animals. Ein Feshka is an area of particular interest for biodiversity. It is a wetland marsh within an arid area on the north-west shore of the Dead Sea where there are many perennial springs and reed beds. Phragmites species grow where the water table permits while vegetations of the arid parts are dominated by Tamarix nilotica and Atriplex halimus. Ein Feshka was listed as a wetland of international importance by Carp (1980) and an IBA by Birdlife International in 1999.
En El Ghuweir and En El Turaba: These nature reserves are close to the coastal road where rare fauna and flora is present. The area is restricted to the public.

C7.4 OBSERVATIONS ALONG THE SCHEME ROUTE

C7.4.1 Aqaba/Eilat Area

The discussion below is mainly based on observations made in Aqaba as the component of the Scheme at this area will be entirely situated within the Aqaba terrestrial environment.

The area is generally characterised by the Acacia and Sudanian rocky vegetation confined to the granite mountain bases and to the rocky part of Wadi Araba, Aqaba and Wadi Al-Yutm.

Figure C7.3 shows the wadi behind the proposed Eastern Intake site. The site is already degraded with the disused Thermal Power Station on the site. A short dry wadi is located behind the site that drains a small catchment in the hills.
Figure C7.3  Eastern Area Intake for the Tunnel Option

Figure C7.4 below shows the site of the proposed pumping station. The site is flat, and lies close to the airport.

Figure C7.4  Site of the Northern Pumping Station

C7.4.2  Wadi Araba/Arava Valley

Wadi Araba is part of the Rift Valley in Jordan; hence the elevations vary from about 200 m or more below the sea level up to 100 m or more above the sea level. Three major soil types are present in Wadi Araba: saline soils; sandy
soils with some places of sand dunes; and hammada especially in the elevated areas.

In the Qatar Area, granite mixed soil is represented. This area is dominated by Acacia tortilis that occurs mostly on firm hard soils. Other bushes or low shrubs present at this site include: Anabasis articulata; Lycium shawii; and Hammada spp. A full list of floral species located at this site is appended to the Terrestrial Ecology Annex (to be included in the Preliminary Final ESA Report).

In the Rahma Area, sand dune vegetation type is represented mainly along the road; it is dominated by Haloxylon persicum associated with Retama raetam and Calligonum comosum (Figure C7.5).

In the stretch near Masuda Region, rocky Acacia vegetation type is represented and confined to the granite mountain bases. The vegetation is highly affected by man either through the grazing of goats and camels or directly by cutting of trees. A full list of floral species located at this site is appended to the Terrestrial Ecology Annex (to be included in the Preliminary Final ESA Report).

Dana Region includes a complex system of wadis and mountains with variation in elevations, two major vegetation types are found in the northern part of this region: Sand dune desert at low elevation and Acacia sub-tropical vegetation at high lands. A full list of floral species located at this site is appended to the Terrestrial Ecology Annex (to be included in the Preliminary Final ESA Report).
The Arava Valley baseline was based on SPNI’s (1) Survey and Evaluation Unit 2003 in which the following areas were designated as having “the highest value”.

The Shchoret Hills are an attractive viewpoint with special and interesting vegetation. The large riverbed harbours the following plant species: Acacia raddiana Savi; Acacia tortilis; Haloxylon salicornicum; Ochradenus baccatus; Panicum turgidum; and Lycium shawii. A number of rare plant species are noted in the area that include: Pteragaillonia calycoptera; Linz; Dichanthium foveolatum; and Aristida adscensionis.

The Evrona Salt flat landscape is composed of a sterile salt marsh and bands of plant growth bisected with small drains, rinsing the soil and allowing vegetation that is less salt-tolerant. Rare plant species in the area include: Hyphaene thebaica; Suaeda vermiculata; and Zygophyllum album.

(1) Society for the Protection of Nature in Israel
Samar Sand Dunes of the Arava are host to an abundant number of species that are adapted to sandy habitats. Among these is a recently discovered spider species. This is an important site for bird watching. Rare insect species include Buthacus yotvatensis and Cerbalus aravaensis.

Yotvata Salt flat is a salt marsh devoid of plant life (due to the high salinity of the soil). Most of this salt marsh is on the Jordanian side of the border, and is known as the Qa Watar Mudflat.

Eshet Aticline is the apex of a fractured anticline. The plant community of the area is distinct and abundant in the riverbeds and on the rocks. Rare plant species include: Pterogaillonia calycoptera; Fagonia scabra; and Phagnalon barbeyanum.

Halod Cliffs is a winding landscape of impressive cliffs found together with archaeological sites and large Acacia trees. The site has attractive vistas and high waterfalls that are mostly dry except during flood occasions with large trees and desert flora. On the cliffs themselves, little plant life can be found other than Capparis aegyptia.

Shilhav Hills are table-like hills with calcite cliffs interspaced by wide riverbeds and plains covered with flint. There are several springs and wells onsite. The hills of Shilhav are some of the most diverse landscapes in the Arava valley in terms of geology, flora, archaeology and geomorphology. Rare plant species at this site include: Erodium glaucophyllum; Erodium arborescens; Moricandia sinaica; Telephium sphaerospermum; and Hibiscus micranthus. Near the springs and the salt marshes rare plant species of Moricandia sinaica can be found.

Seizaf Hills are composed of the Sheizaf hills and Sheizaf sand dunes. The sand dunes of Sheizaf host a scatter of shrubs accompanied by perennial monocots with many annual species emerging during rainy years. The species richness and presence of several very rare species render this ecosystem the value of ‘highest’ priority for conservation and protection. Dominant plant species include: Haloxylon persicum; Haloxylon salicornicum; Stipagrostis ciliate; Stipagrostis obtuse; and Centropodia forskalii. Rare plant species noted in the area include: Ophioglossum polyphyllum; Dipcadi erythræum; and Convolvulus spicatus.

The Lisan Badlands compose a section of the Arava riverbed. The plant community in the area is dispersed along the main wadis, the peripheral wadis and hillslopes. The dominant species is Haloxylon persicum accompanied mainly by Tamarix nilotica, Calligonum comosum and Tamarix aphylla. Rare species identified at the site include: Centaurea scoparia Sprengel; Potamogeton berchtoldii; Tribulus binaucronatus; Allium sinaiticum; Astragalus intercedens; Astragalus trimestris; and Astragalus hauarensis. This are is one of the last sandy habitats in the Arava valley and supports various animal life that include the following bird species: Alaemon alaudipes; Ammonomanes cincturus; Eremalauda dunni; Eremophila bilopha; Sylvia nana; and Sylvia melanolophax.
C7.4.3  Dead Sea Basin

Fifa - Jordan

Generally this area is distinguished by tropical vegetation that occurs in the Sudanian region. Recorded species in this area are appended to the Terrestrial Ecology Annex (currently under preparation).

Jordan - Hydro Power Plant/ Low Level Desalination Plant Site

This area is covered with saline vegetation type that is mostly constricted in the southern end of the Dead Sea. It is composed of a dense structure of succulent high salt tolerant plants. The vegetation usually starts 50 - 100 m away from the sea shore with the highest salt tolerant species close to the water. The area is dominated by the following vegetation species: Suaeda vermiculata; Suaeda aegyptiaca; Mesembryanthemum nodiflorum; Juncus maritimus; and Tainarix spp.

Away from the water a different group of plants that are less salt tolerant appear salt such: Sonchus maritimus; Aaronsohnia factorovskyi; Rumex cypricus; Anabasis setfera; Limonium lobatum; Nitraria retusa; Ziziphus lotus; Ziziphus spinachristi; Acacia tortilis; Calotropis procera, Maerua crassifolia; and Saivadora persica.

Recorded species at the site are appended to the Terrestrial Ecology Annex (to be included in the Preliminary Final ESA Report).

Jordan - High level Desalination Plant Site

At the hills surrounding the Dead Sea the soil is highly poor and degraded due to erosion and grazing. The dominant species are bushy types such as Zygophyllum dumosum, Anabasis articulata, Astragalus spinosus, Noaea mucronata and Urginea maritima. In the shallow wadi systems and run-off places small shrubs of the rare plant Rhus tripartita are observed. A list of the recorded species is appended to the Terrestrial Ecology Annex (to be included in the Preliminary Final ESA Report).

Israel and Palestinian Authority

The western alignment of the Freshwater Pipeline of the Scheme is contained mainly within the Dead Sea Basin. Thus the discussion for Israeli and Palestinian Authority Freshwater alignment is included within this area.

Steep canyons run down to the Dead Sea form the western steep rocky shoreline. Along the coastline, there are several oases, some rocky, steppe and scrubby area and some agriculture (mainly date-palm and citrus plantations and melons). Around 40 seasonal natural wadis flow into the Dead Sea from the Green Line at Ein Gedi Area to the north of the Dead Sea. The main wadis include Wadi Qadroun, Wadi Al- Daraja, and Wadi Hazaza. These cross the main highway, mostly via culverts whose diameter ranges from 1 - 5 m. Open
spaces of water flow come with the surface of the main road ranging 1-30 m width.

*Wadi Draga* is a canyon-like gorge along the Dead Sea coastline with a breathtaking view. The river cascading into Dead Sea from this wadi drains the central Jerusalem Desert.

*Wadi Hajla* and the adjacent wadi that is 2 km north form a rich oasis to the east of Jericho with a high abundance of *Ziziphus spinia-christi*, *Eucolaptus*, and *Pinus halapensis*. The wadi is close to the border with Jordan, and acts as a corridor for the passing of the wild life west-east, allowing gazelle and wild rabbits to cross. Crows have also been seen in the area.

The area south of Jericho toward the Dead Sea contains savannah-like vegetation including grass species. The wadi to the north of Wadi el-Qelt also feeds Jericho and may contain important species diversity, especially in winter.

*Ein El-Sultan* and its surrounding area have a large biomass in comparison to the prevailing landscape of Jericho. The grass and bush species are of particular prominence due to the availability of water.

Unique microorganisms are also present in the area. A total of 78 species from 40 genera were isolated. The most prominent features of mycobiota were: (i) the prevailing number of melanin-containing micromycetes (46 species, 65.5% of the total isolate number); (ii) a large share of teleomorphic Ascomyceta (26 species, 18.5% of isolates); (iii) combination of true soil and plant surface inhabiting species; (iv) spatial and temporal variation of the mycobiota composition; (v) very low fungal density (nearly 500-fold lower than in the Judean Desert soil). These features are formed under the extremely stressful xeric and oligotrophic conditions in which the Dead Sea coastal micromycete community exists. Nine species (*Alternaria alternata*, *A. raphani*, *Aspergillus niger*, *Aureobasidium pullulans*, *Chaetomium globosum*, *Ch. murorum*, *Cladosporium cladosporioides*, *Penicillium aurantiogriseum*, and *Stachybotrys chartarum*) were considered a characteristic micromycete complex for the Dead Sea coastal habitat based on the spatial and temporal occurrence. Many of the micromycetes isolated, including almost all the species listed above, are known to be distributed worldwide occurring in different soil types.

**C7.4.4 Freshwater Pipeline (Jordan)**

The freshwater line starts at the dense Tamarsk forest at Ghor Fifa within a flat region, where 50% of recorded plant species are threatened with one rare recorded species. The vegetation cover is concentrated inside the wadis with mainly rare species of *Suaeda fruticosa* and *Phoenix dactylifera*, and the threatened species *Ziziphus spina-christi* and *Ochradenus baccatus*. 
With an exception of the area near the reservoir, the area has low vegetation cover with common species and 10% coverage, common elements for Irano-Turanian zone. However, the existence of rare and threatened species has been noted such as the Iris spp near water body and Crocus damascenes on steppes.

A list of flora and fauna found in this area will be appended to the Terrestrial Ecology Annex (to be included in the Preliminary Final ESA Report).

**C7.5 Impact Assessment and Mitigation**

The assessment of impacts and development of mitigation measures relating to terrestrial ecology and natural heritage is currently ongoing and will be completed and presented in the Preliminary Draft ESA Report.

**C7.6 Source Documents and References**

**C7.6.1 Jordan**

• Nassar, k., Turner, M., Al Khatib, N.; Crossing the Jordan, FoEME (2005)

C7.6.2 Israel

• Israel National Master plan #13 (The Dead-Sea and its shores). (in Hebrew) http://www.tama13.org.il/
• Ron M., Avner U. and Ramon U. (2004). The Arava highlands. SPNI’s Open Landscape Institute; Tel Aviv University; Israel Ministry of Environmental Protection; The Jewish National Fund; Israel Nature and...
Parks Authority; Society for the protection of Nature in Israel. (in Hebrew).


  http://www.deshe.org.il/?CategoryID=238&ArticleID=15

C7.1.1 Palestinian Authority


- UNEP. Desk Study on the Environment in the Occupied Palestinian Territories.
C8 HYDROGEOLOGY AND GROUNDWATER

The assessment of impacts relating to this thematic area will be carried out when the relevant information from the associated detailed FS sub-studies and Additional Studies is made available later in 2010. The results will form part of the Preliminary Draft ESA Report that is due for submission in January 2011.
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C13 LANDSCAPE AND VISUAL

C13.1 SCOPE OF ASSESSMENT

This section considers the landscape of the Scheme area and the predicted impacts of the proposed Scheme on the landscape character, view and visual amenity, broadly categorised as landscape and visual impacts.

In general terms, the conveyance aspect of the Scheme will not be a visible feature as the pipeline would be buried or the tunnel option would be underground. The parts of the conveyance that would be visible would be at certain points along it, such as intakes, pumping stations, tunnel entrances, or canals (with the high level tunnel option). In addition to the conveyance, other elements of the Scheme that will be visible during operation are discrete structures such as the desalination plant and hydropower plant. These permanent structures are the main focus for this assessment, but in addition, temporary impacts to the landscape and visual receptors that may occur during the construction phase of the scheme are also considered.

Scoping has not highlighted any significant landscape and visual concerns raised by local communities. Concerns raised during scoping have mainly been tourism-related with stakeholders noting that the assessment should adequately assess the extent to which the scheme could be visible from key touristic sites (e.g. from Masada in Israel, or Lot’s cave in Jordan). The broader issue associated with the extent to which the Scheme could impact the ‘desert ethos’, clearly a subject cross-cutting a number of sub-topics, also has a landscape and visual element, and as such this section also feeds into the wider regional analysis described in Part B of this document.

C13.2 ASSESSMENT APPROACH

C13.2.1 Basis for the Assessment

The main elements of permanent infrastructure which could have a permanent landscape or visual impact, will include the following.

- **An intake** on the eastern Gulf of Aqaba including a pumping station (except in the case of a gravity tunnel);

- **A sea water conveyance** to carry Red Sea water to the Dead Sea Basin. Both a pipeline along the Wadi Araba/Arava Valley and a tunnel through the eastern mountains (two tunnel configurations were examined) are under consideration;

- **A desalination plant** in the Dead Sea Basin. Two potential sites are considered;
• A hydroelectricity power plant in the Dead Sea Basin, running on sea water from the conveyance and/or brine from the desalination plant;

• A conveyance and outfall to carry the sea water and or brine from the desalination and hydro power plants to the Dead Sea; and

• Freshwater transmission pipelines, with associated pumping and energy supply infrastructure, to carry water from the desalination plant to population centres within the three beneficiary parties. These will mainly be buried but will be unburied in places.

There will also be temporary infrastructure at sites associated with the permanent installations and at several other locations along the conveyance route including workers’ camps, construction sites and access roads.

C13.2.2 Main Sources of Information

The main source of information for this assessment was the landscape input to the FS Biophysical Sub Study. For this preliminary landscape and visual study, an expert visited the region and described the visual and landscape context and the main visual receptors. An inspection was carried out at all sites for proposed project infrastructure, addressing a restricted area around the project elements in an area stretching from Wadi Karak to the Red Sea shoreline at Aqaba/Eilat, which helped the assessment area to be established. Given that most of the project infrastructure will like on the Jordanian side, the survey concerned mainly the Jordanian side of the Wadi Araba rift valley.

The work included an identification of the natural, cultural and historical richness, a description of the actual landscapes and ambiances of the Wadi Araba and the Dead Sea and Red Sea shorelines and an assessment of the project components visual impact. Visualization software was used to develop co-visibility impact maps, and a set of measures proposed to mitigate the identified negative effects of the project. Given the outline nature of the details available on the Scheme, this was a preliminary assessment, with a fuller assessment only becoming possible once more detail is available on the Scheme’s detailed design and the selected locations. This section uses that preliminary study, and also highlights where further ongoing work is still required.

C13.2.3 Significance Criteria

This section uses the landscape and visual work that was carried out as part of the sub study as a basis. Here, the assessment is developed further to introduce a clear distinction between impacts on landscape character and visual impacts, as described below. This acknowledges the fact that a landscape can be valued separately from whether anyone can see the site or not.
• *Landscape impacts* relate to the potential effects of the Scheme on the physical and other characteristics of the landscape and its resulting character and quality;

• *Visual impacts* relate to the effects on views from visual receptors (e.g., residents, workers, tourists etc) and on the amenity experienced by those people (sometimes referred to as visual impact receptors).

The significance of the potential landscape and visual impacts depends upon the sensitivity of the landscape or viewer to change, and on the magnitude of change. Definitions of receptor sensitivity and impact magnitude which are used in this assessment are presented in Table C13.1 and Table C13.2.

**C13.2.4 Evaluation of Receptor Sensitivity**

The sensitivity of the landscape depends upon its inherent nature, quality, condition and ability to accommodate change and on any specific values (such as landscape designations) that may apply. The sensitivity of viewers depends upon their duration and viewing opportunity and the extent to which they value the particular landscape impacted. Hence, a resident with a permanent view is considered to be of higher sensitivity than someone with a transient viewing opportunity and a person with a higher degree of interest in the landscape is of higher sensitivity than someone who places less value in the same landscape. Sensitivity is described as low, moderate or high.

**C13.2.5 Evaluation of Impact Magnitude and Significance**

The magnitude of impact on landscape or visual receptors depends upon the nature and scale of the development. The magnitude of impact is described as being imperceptible, small, medium or large.

Impact significance is determined by cross-referencing the sensitivity of the landscape or viewer, with the magnitude of change expected as a consequence of the development. Thus an impact of major or critical significance will usually occur where the sensitivity of the landscape or viewer is high and the magnitude of the impact is large. The assessment of impact significance also requires the application of professional judgement, experience and an understanding of the cultural context, as significance can be subjective. Each example is therefore assessed on a case-by-case basis.

As well as being critical, major, moderate, minor or not significant, impacts can be either positive or negative and short or long term. The definitions described in Table C13.1 and Table C13.2 are used in this assessment.

**C13.2.6 The Landscape and Visual Baseline**

The landscape and visual baseline has been described by discussing the landscapes and visual receptors that exist throughout the Scheme area, and attributing a sensitivity value to each of these. This baseline discussion is
provided according to natural geographical divisions related to different components of the scheme, using the following zones:

- Aqaba/Eilat Urban/Industrial Area
- Wadi Araba/Arava Valley
- Dead Sea Basin
- Eastern Freshwater Pipeline Route (Jordan)
- Western Freshwater Pipeline Route (Israel/Palestinian Authority)

Zones of Visual Influence for the main visible parts of the Scheme have been produced which indicate the potential visibility and these have been used primarily to help establish the appropriate scale to discuss the baseline and potential visual receptors, and also to aid in the assessment of the significance of any landscape and visual impacts.

**C13.3 LEGAL AND POLICY CONTEXT**

There is no legislation in Jordan which specifically protects visual intrusions. However, the existing protected areas of Wadi Rum and Dana are protected partially for their beauty, and their management plans do restrict certain activities. The new protected areas proposed for the Wadi Araba - to include Qatar, Jabal Mas’uda and Fifa – will likely have some requirements related to visual intrusion. This will be considered further in the next stage of assessment which will be presented in the *Draft ESA Report*. 
### Table C13.1  Levels of Significance of Landscape Impacts

<table>
<thead>
<tr>
<th>Magnitude of Change in Landscape caused by Proposed Development</th>
<th>Imperceptible</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>An imperceptible, barely or rarely perceptible change in landscape characteristics.</td>
<td>Not significant</td>
<td>Not significant</td>
<td>Minor</td>
<td>Minor to moderate</td>
</tr>
<tr>
<td>A small change in landscape characteristics over a wide area or a moderate change either over a restricted area or infrequently perceived.</td>
<td>Not significant</td>
<td>Minor</td>
<td>Moderate</td>
<td>Major</td>
</tr>
<tr>
<td>A moderate change in landscape characteristics, frequent or continuous and over a wide area or a clearly evident change either over a restricted area or infrequently perceived.</td>
<td>Not significant</td>
<td>Minor to moderate</td>
<td>Major</td>
<td>Major to critical</td>
</tr>
<tr>
<td>A clearly evident and frequent/continuous change in landscape characteristics affecting an extensive area.</td>
<td>Not significant</td>
<td>Minor to moderate</td>
<td>Major</td>
<td>Major to critical</td>
</tr>
</tbody>
</table>

*This table is a guide only. The descriptions of levels of magnitude and sensitivity are illustrative only. Each case is assessed on its own merits using professional judgement and experience, and there is no defined boundary between levels of impacts.*
<table>
<thead>
<tr>
<th>Sensitivity of Viewpoint</th>
<th>Magnitude of Change in View caused by Proposed Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Not significant</td>
</tr>
<tr>
<td>Small numbers of visitors with interest in their surroundings. Viewers with a passing interest not specifically focussed on the landscape eg workers, commuters.</td>
<td>Not significant</td>
</tr>
<tr>
<td>Medium</td>
<td>Not significant</td>
</tr>
<tr>
<td>Small numbers of residents and moderate numbers of visitors with an interest in their environment. Larger numbers of recreational travellers.</td>
<td>Not significant</td>
</tr>
<tr>
<td>High</td>
<td>Not significant</td>
</tr>
<tr>
<td>Larger numbers of viewers with proprietary interest and prolonged viewing opportunities such as residents and users of widely known and well-used recreational facilities.</td>
<td>Not significant</td>
</tr>
</tbody>
</table>

This table is a guide only. The descriptions of levels of magnitude and sensitivity are illustrative only. Each case is assessed on its own merits using professional judgement and experience, and there is no defined boundary between levels of impacts.
C13.4   **LANDSCAPE AND VISUAL BASELINE**

This section describes the significant visual and landscape features of the area in which the project will be constructed.

C13.4.1   **Overview of Landscape and Visual Receptors in the Scheme Area**

The study area is centred around the stretch of the Syrian/African Rift Valley between the Gulf of Aqaba and the Dead Sea Basin. The Rift Valley runs north to south from Lake Tiberias/Kinneret in the north, through the Jordan River Valley, through the Dead Sea basin, and along the Wadi Araba/Arava Valley, until it meets the Gulf of Aqaba. Elevations in the Jordan River Valley drop from around 210 m below seal level at Lake Tiberias/Kinnaret to 421 m below sea level, at the surface of the Dead Sea. To the south of the Dead Sea, the valley floor rises out of the basin south of Fifa, and climbs onto the desert floor of the Wadi Araba/Arava valley, which rises to 220 m above sea level at Gharandal, before falling again to sea level at the Gulf of Aqaba/Eilat.

To the east, the valley rises into a range of sandstone hills running from the north (peaking at over 1,300 m in the hills around Ajloun) to the south (peaking at over 1600 m at Ras an Naqab). To the west, the hills are less dramatic, with peaks in the Palestinian Authority around 800 and 900 m. Elevations to the west of the Wadi Araba/Arava valley typically reach 400 or 500, with peaks of over 700 (eg above Yotvata). The escarpments to the east and west are cut by wadis (river basins), created from the flood flows which drain from the highlands into the valley floor. Wide and dramatic alluvial fans have been formed at the mouths of these wadis.

The Wadi Araba/Arava Valley floor is characterized by an alluvial dune-field, sandy over much of its length, becoming more stony in some areas. There is some sparse natural vegetation along the valley floor, concentrated along the paths of the flood flows from the wadis. Vegetation levels increase in the wadi entrances. The freshwater transmission line in Jordan will climb up the face of the rocky escarpment from the valley floor and crosses some uneventful terrain before turning northwards to follow the line of the Desert Highway to Amman. In Israel, the freshwater line crosses some undeveloped plains before turning north to run alongside the shore of the Dead Sea, passing above the tourism centre of Ein Bokek and below the escarpments at Masada. Crossing into the Palestinian Authority, the route will cross a number of side wadis, and pass close to the Israeli –operated cultural site at Qumran.

In terms of visual receptors, the plain alongside the Jordan River hosts a number of villages and small towns on the eastern side, with some agricultural communities on the western side. The majority of the land on the Jordanian side is used today for intensive, irrigated agriculture. Towns in the river valley include Jericho and the town of South Shona. The Dead Sea basin itself has some settlements, including the Israeli resorts of En Gedi and En Bokek, and the developing tourism area at Sweimeh on the Jordanian side.
There are industrial areas on the southern basin of the Dead Sea which house the extraction industries of both Jordan and Israel. Between the northern and southern basin of the Dead Sea on the Jordanian side, there is an area known as the Southern Ghors which includes villages whose livelihoods include the Dead Sea industries and irrigated agriculture. Moving south out of the basin, there are some major agricultural settlements on the Israeli side, and some small scattered villages and some areas of more intensive agriculture on the Jordanian side.

Moving east and west out of the Wadi Araba/Arava Valley, much of the escarpment on either side is steep, rocky terrain and is inaccessible from the valley floor, although on the Jordanian side of the Wadi Araba, some of the higher parts of the valley floor, and some of the side wadis are used for informal agriculture by local Bedouin. On the Jordanian side, once the elevation levels off onto the plain, there are some towns and villages stretching eastwards towards the Desert Highway. These areas have some groundwater resources and there is both pastoral and agricultural activities. In the south, the towns of Aqaba and Eilat sit on the Gulf of Aqaba/Eilat coast and are both major urban centres serving both tourism and ports industries.

As well as the communities that live in this area, tourists are a further potential visual receptor in this region and much of the landscape value in the area is associated with its impact for tourism. Key tourism sites in the project area include Masada and Qumran on the Israeli Dead Sea shoreline, Lots Cave above the south eastern shoreline, Jabal Haroun in the hills above Petra. The Dead Sea itself is an important viewscape, with the resort areas at Sweimeh (in Jordan), and En Gedi and En Bokek (in Israel) as important view receptor points. The views from the Dana reserve and Wadi Finan are also important in relation to ecotourism in the area, and the parts of the Wadi Araba that are being developed for ecotourism activities (eg Wadi Heimer and the sand dune fields nearby) are also important. Aqaba and Eilat are also prime tourism destinations, where the viewscapes are important.

More information on the communities in the study area can be found in Section C6.

C13.4.2 Landscape and Visual Baseline in the Aqaba/Eilat Industrial Area

The following aspects of the scheme will be located in this area and the areas around these locations are therefore focused on in this baseline section:

- the intake (northern or eastern)
- the pumping station

The coastal towns of Aqaba and Eilat are nestled at the head of the Gulf of Aqaba/Eilat. They are separated by a border zone which interrupts the continuous built-up area for several hundred metres. Behind the two coastal towns, high arid mountains with mauve, ochre and grey coloured rock stand...
out against the intense blue sea. Aqaba contains industrial areas including a light industrial estate in the north of the town, and large port facility in the centre of the town, although this will be removed in the coming years and the site converted to tourism and commercial use. The town centre is lively, with carefully designed facilities and furnishings, and a number of luxury hotels. Ambitious tourism projects on the north coast (Ayla, Saraya, and Marsa Zayed) will further impact the visual fabric over the coming years.

C13.4.3 Landscape Baseline and Visual Receptors at the Northern Intake

The location of the northern intake is shown in Figure C13.1 and Figure C13.2. This is a pristine sandy shoreline with a shallow sloping beach, adjacent to the fenced border with Israel. The stretch of shoreline immediately to the east will become part of the new Ayla Project, a major tourism project. The coastline adjacent to the intake site will be dredged to form an entrance channel.

This initial assessment suggests that this area is a low-medium value landscape given the relative importance of the landscape from a tourism perspective, however noting that the overall character, land use, pattern and scale has the capacity to accommodate a degree of the type of change envisaged. The potential visual receptors to the northern intake would be local people and tourists provisionally categorised as being of low to medium sensitivity on the basis that Aqaba is a key tourist location, however noting that the area is already very developed.

Figure C13.1 Looking North Towards the Northern Intake Site

![Figure C13.1 Looking North Towards the Northern Intake Site](image)

Figure C13.2 Northern Intake Site Looking West

![Figure C13.2 Northern Intake Site Looking West](image)
C13.4.4 Landscape Baseline and visual receptors at the Site of the Eastern Intake

The location of the eastern intake is shown in Figure C13.3 and Figure C13.4. The intake will be situated at the site of the disused Aqaba Thermal Power Station, on an area of coastline which is dominated by the dual carriageway. This area is not valued in terms of its aesthetic quality and the existing land use, pattern and scale are tolerant of the type of change envisaged, this landscape has capacity to accommodate a degree of change. This initially assessment therefore characterises the area as a low value landscape.

Figure C13.3 Site of Eastern Intake Looking South Along Coastal Highway

Figure C13.4 Site of Eastern Intake Looking East from Coastal Highway

Figure C13.5 below illustrates the area (shown in purple) from where a building of 10 m height, situated at the eastern intake site would theoretically be noticeably visible (in the absence of more detailed design at this point). It appears that the main visual receptors in this zone would be the users of the dual carriageway who are provisionally characterised as low sensitivity receptors due to their temporary exposure to the visibility of the site and given their likely relatively minor interest in the site’s visual appearance given its current use.
C13.4.5 Landscape Baseline and visual receptors at the Site of the pumping station

Figure C13.6 shows the location of a proposed pumping station near Aqaba Airport. The area is in a flat part of the sandy desert with sandstone mountains to the east and west. The area is close to King Hussein International Airport, and the Aqaba Industrial Estate and the Dead Sea highway. The sensitivity of this landscape is provisionally classed as being of low sensitivity, because it is not generally valued for its scenic quality and because its character, existing land use, pattern and scale are tolerant of the type of change envisaged, with the capacity to accommodate change.

Figure C13.6 Location of a Proposed Pumping Station Near Aqaba Airport

Figure C13.7 shows the extent (in blue) to which a building of 10 m height would be visible (in the absence of more detailed design at this point). Visual receptors to the pumping station would include commuters using the Dead
Sea Highway, including local people and some tourists, which are classified as likely being of low sensitivity receptor due to their temporary viewing of the site, with this view not being their primary visual interest.

**Figure C13.7 Co-visibility Map for the Northern Intake Pumping Station**

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**C13.4.6 Landscape and Visual Baseline in the Wadi Araba/Arava Valley**

The aspect of the scheme may have a landscape or visual impact in this area is the conveyance (pipeline or tunnel options) including the canals that would be present with the high level tunnel option, tunnel openings and mixing tower).

The Wadi Araba/Arava Valley provides an opportunity to discover multiple facets of the desert aesthetic. Views can change several times in a short distance along the 180 km valley, from pale sand with dune formations, austere dark stone wildernesses, clay colonised with shrubs; but these vistas are always bordered by rocky mountains, either close or visible in the distance. The numerous facets of the wild mountain scenery bordering the valley comprise different types of rock, switching from limestone to sandstone to granite. An alteration of colours – dark greys, cream, light grey, ochre with red seams, black craggy outcrops, beginning to be surrounded by blond sand, changing in the different auras of daylight. The diversity is surprising – horizontal strata alternating with craggy highlands, rounded hills, gullies, gentle slopes and abrupt cliffs. However, the impression is never one of infinite desert; electricity lines and pylons stretch along the roadside with occasional relay aerials. Civilization and amenities are always present, making impossible any feeling of being ‘lost’ in the desert.
C13.4.7 Landscapes and Visual Receptors Across General Area of the Conveyance

The Wadi Araba/Arava Valley is a large area and the key landscape features of different types present in the area are summarised below:

- **General Wadi Araba landscape**: The majority of the wadi Araba area, as explained above, comprises a combination of dunes, shrubs, sand, cliffs and distant mountains is noted as being of moderate sensitivity recognising its unique features as explained above and its potential value for its landscape feature (e.g. as valued by tourists); however this is not an unusual or unique or small pocket of landscape; it is already developed to some extent, and in the majority of the area its character, land use, pattern and scale may have the capacity to accommodate a degree of the type of change envisaged. As noted above, the impression is never one of infinite desert. Electricity lines and pylons stretch along the roadside with occasional relay aerials. Civilization and amenities are always present, making impossible any feeling of being ‘lost’ in the desert.

- **Protected areas and sites of tourism interest**: Within this desert landscape, there are a number of areas that are proposed for protection for ecological reasons, and sites valued for tourism, with this value being very much based on the views of the wider wadi Araba area from these sites. These include the Dana Biosphere Reserve, and the proposed protected areas at Qatar, Jabal Mas’uda and Fifa which may achieve protected status in the near future. The key tourist sites in the area include Masada, Lot’s Cave and Bir Mathkour. Note that the proposed ecologically protected areas may become developed for ecotourism, and their visual attributes will become more relevant. One area noted as being potentially important for future eco tourism development is Wadi Heimer.

In terms of the visual receptors in this area, they are also varied and are summarised below:

- **Communities living in villages throughout the Wadi Araba**. These are considered potentially being of medium sensitivity given their permanent presence and local people travelling along the main road which are considered more likely to classify as low sensitivity receptors.

- **Tourists travelling by road**. These are considered low to medium sensitivity due to their temporary presence in the area, but noting that their tourism interest may place a particular value on the landscape.

- **Tourists in the area** visiting specific locations either in the Wadi Araba or to elsewhere in the wider region such as Petra, Karak, the Dead Sea, Masada. These are considered as potentially being of medium sensitivity given their particular interest in the landscape.
C13.4.8  **Landscape and Visual Receptors at the Site of the Canals**

The locations of the canals that would be present if the high level tunnel option was selected have been identified as particular places where the operation of the Scheme could have a particular visible feature in the Wadi Araba. The canals would be approximately 28 m and 29 m long and around 20 m wide, and will be fenced along both sides. An access road will be created alongside the fence.

*Figure C13.8 and Figure C13.9 illustrate two areas where open canal sections would be created in the High Level Tunnel Option. The northern section will lie towards the desert mountains, towards the raised sides of the desert floor. The southern section will lie in a sandy corridor alongside the mountain area. The views in this southern section, particularly in the area to the south of the village of Rishe, are particularly characteristic of a dramatic sandy desert, albeit a landscape that is widespread in this area.*

*Figure C13.8  Looking East Towards Site of Proposed Canal Section*

![Figure C13.8](image1)

*Figure C13.9  Looking North Towards Site of Proposed Canal*

![Figure C13.9](image2)

*Figure C13.10 and Figure C13.11 show the proposed locations of two of the canal mouths, where the conveyance will exit from the high level tunnel into a stretch of open canal. In terms of their value these landscapes are noted provisionally as being of medium value, recognising their value culturally and*
aesthetically, but noting the large expanse of this landscape and its ability to accommodate a degree of landscape change to the degree anticipated from this part of the Scheme.

Figure C13.10 Proposed Location of one of the Canal Mouths

Figure C13.11 Proposed Location of one of the Canal Mouths

Figure C13.12, Figure C13.13 and Figure C13.14 are visibility plots from three points on the canals, showing approximately where the canal could be visible from within a 5 km radius. Figure C13.14 is particularly important, since this plots the visibility of an elevated conduit which may be established to carry the canal section across a lower lying wadi fan. From this analysis, it appears that the southern canal will be more visible from the main road (the thick red line on the plot). Visual receptors to the canals are therefore likely to comprise users of the road, who are noted as likely being of low sensitivity.
Figure C13.12 Co-visibility Map for the Southern Canal

Figure C13.13 Co-visibility Map for the Northern Canal
**C13.4.9 Landscape and Visual Receptors at the Tunnel Openings**

The tunnel openings are a further feature of the conveyance part of the Scheme where there will be some visibility during operation. *Figure C13.15* shows the views into the Edom mountains towards areas where five of the tunnel openings portals have been proposed. There are six proposed tunnel openings, mostly in areas where rainfall has cut a valley through the rock. These openings are characterised by alluvial fans stretching out from the wadi into the desert. In terms of their value these landscapes are also ranked as being of *medium* value, recognising their value culturally and aesthetically, but noting the large expanse of this landscape and its ability to accommodate a degree of landscape change to the degree anticipated from this part of the Scheme.
C13.4.10 Landscape and Visual Baseline in the Dead Sea Basin Area

The aspects of the scheme that have been identified as having a landscape or visual impact in this region of the Scheme are the various proposed configurations of the Desalination plant (DSP) and hydropower plant (HPP). Note that the construction and presence of the tunnel or pipeline options in general in this area has been discussed in the wadi Araba section.

The landscape in this area is divided into the plains that surround the shoreline, and the escarpments that rise up from the plans. The Dead Sea itself dominates the view in most places, especially on higher ground, and is a key feature of this landscape, highly valued for its landscape and cultural significance.

The types of landscape to be identified separately and their respective sensitivity are:

- **Landscapes that can be seen from touristic high view points such as from Masada:** this is classified provisionally as a medium level sensitivity landscape as it is culturally important, and valued for tourism etc, but the area is somewhat developed already, power lines etc so can include a degree of change.

- **The Dead Sea landscape:** Towards the north, the surrounding topography of the long narrow, steep sided valley emphasises its role as a terminal lake, draining all surrounding areas. Solid blue, with a white fringe of salt deposits, it is huddled in an austere landscape of rock, often with a halo of mist above it. The light can be blinding, but softens towards the end of the day, highlighting the colours in the surrounding cliffs. The rocky hills are
closer to the shore on the Jordanian side, while the drop in levels affects a wider strip on the eastern shore, leaving the effects of the drop in level more apparent. The landscape here may be ranked as medium to high sensitivity due to the value placed on the Dead Sea landscape by locals and tourists.

C13.1.1 Landscape Baseline and Visual receptors in the DSP and HPP areas

In this area, the DSP and HPP, once operational will be visible permanent features. Figure C13.16 and Figure C13.17 show views of the proposed location of the high level desalination plant, in the hills above the village of Gweira. This is provisionally noted as being a medium sensitivity landscape since it is moderately valued but widespread, and given that its character, land use, pattern and scale may have the capacity to accommodate a degree of the type of change envisaged.

Figure C13.16 Proposed location of the high level desalination plant

The desalination plant will be large and will be obvious in the immediate area. Figure C13.18, Figure C13.19 and Figure C13.20 illustrate the visibility of infrastructure 15 m high, sited at the 3 platform levels (using approximations given the absence of detailed design at this stage). The co-visibility analysis shows that facilities on platform 130m and 180m are more visible than those on the lower platform (~45m). Broadly speaking, any 10 m high structure at this site will be visible from a wide area, including in Israel.
Figure C13.18 Co-visibility Map for High Level Desalination Infrastructure at 180 m Platform

Figure C13.19 Co-visibility Map for High Level Desalination Infrastructure at 130 m Platform
Visual receptors here would therefore primarily be those using the Jordanian highway leading down from Wadi Araba directly above the site, and potentially also receptors in Israel. The DSP will also be visible from the villages of Fifa and Safi. These are ranked at this stage as medium sensitivity receptors due to the permanence of these communities.

*Figure C13.20 Co-visibility Map for High Level Desalination Infrastructure at -45 m Platform*  

*Figure C13.21 Looking South Towards Hydropower Plant Site*  

*Figure C13.21 and Figure C13.22 show the location of the low level desalination and the hydropower plant near Ghor Fifa, in the Dead Sea basin. This is provisionally noted as a medium sensitivity landscape given the fact it is not unique, and widespread.*
As shown in the co-visibility analysis in Figure C13.23, infrastructure (taken to be 35 m high for this analysis) at this site could be visible from the Jordanian highway leading down from Wadi Araba directly above the site, and also from Israel. It will also be visible from the villages of Fifa and Safi. The visual receptors could be of medium sensitivity since they would include users of the Dead Sea Highway with only passing environment in this specific part of the landscape but also permanent residents in the area.

Figure C13.23 Co-visibility Map for 35 m High Structure at Hydropower Plant/Low Level Desalination Plant Site
C13.4.11 Landscape and Visual Receptor Baseline around the Dead Sea

The Dead Sea landscape at a general level is noted as being a medium to high sensitivity landscape in that the Dead Sea landscape and general appearance, however it has the capacity to accommodate the types of changes envisaged from the Scheme. However more analysis is required in the next phase of the assessment to assess what the variability of these values may be within the area.

Key visual receptors are primarily local people travelling past the Dead Sea, and tourists visiting the site. The Jordanian tourism developments are concentrated on the north east shoreline, and only a scattering of Israeli and one Palestinian development on the north western shoreline. The Spa at En Gedi is the main Israeli tourism development on the northern basin. The former southern basin of the sea is now a set of artificially maintained evaporation ponds serving the extraction industries on both side of the border. Industrial factories dominate the landscape at Potash City on the eastern side, and Sedom on the west. The tourist development of En Bokek is situated on one of artificially maintained evaporation ponds where visibility is low due to a haze of moisture-laden air.

C13.4.12 Landscape and Visual Baseline along the Eastern Freshwater Pipeline Route

Figure C13.24 and Figure C13.25 show views where the freshwater transmission line will rise up the escarpment on its way eastwards onto the high level plains. These are barren, rocky mountains. This is noted as likely ranking as a low value landscape since it is not valued for its scenic quality or where its character, existing land use, pattern and scale are tolerant of the type of change envisaged, and the landscape has capacity to accommodate change. The sensitivity of the viewpoints are also likely to be low due to viewers with a passing interest not specifically focussed on the landscape eg workers, commuters.

Figure C13.24 Typical View from Dead Sea Highway Looking East Towards Route of Freshwater Pipeline
Figure C13.25 Typical View from Dead Sea Highway Looking Southeast Towards Route of Freshwater Pipeline

C13.4.13 Landscape and Visual Baseline along the Western Freshwater Pipeline Route (Israel/Palestinian Authority)

The southern part of the route lies in flat terrain leading south towards the developed agricultural area of Hatseva. It then moves north along the shoreline of the Dead Sea, probably in the existing road corridor, and likely passing above the town of En Bokek. By Masada, the plain widens, although the pipeline will likely continue along the road corridor. The views across the Sea from Masada are striking, and viewed by tourists and visitors from the cable car vantage point. Further north, into the Palestinian Authority, the corridor between the Sea and the cliffs narrows considerably, before widening out again along the plain towards Jericho.

Most of the areas south of the Dead Sea are noted as low value landscapes since it is not valued for its scenic quality or where its character, existing land use, pattern and scale are tolerant of the type of change envisaged, and the landscape has capacity to accommodate change (once constructed the freshwater line would be buried, so the key sources of impact here are only during construction). However, the sensitivity of the Dead Sea shoreline, and the plans below Masada viewpoints would be classified as medium to high value, since these views are observed by the many visitors to En Bokok and the Dead Sea area, and particularly from the vantage points on the Masada escarpment.

C13.5 IMPACT ASSESSMENT

C13.5.1 Potential Sources of Impact

Project infrastructure will be sited at various locations, some of which will be exposed and visible; there will also be some associated visible activity connected to the construction activities in respect to this infrastructure, for example traffic movement, stored excavated spoil etc.
The ESA scoping report assessed the potential for certain sources of impact from the Scheme to interact with certain receptors. The issues that were scoped as being of particular importance for the landscape and visual assessment are summarised in Table C13.3.

**Table C13.3  Issues of Particular Importance for the Landscape and Visual Assessment**

<table>
<thead>
<tr>
<th>Sources of impact</th>
<th>Potential landscape and visual impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction</strong></td>
<td></td>
</tr>
<tr>
<td>Land take for worksites site accesses and access roads etc.</td>
<td>√</td>
</tr>
<tr>
<td>Employment</td>
<td></td>
</tr>
<tr>
<td>Site activities (excavation, tunnelling, construction, rehabilitation)</td>
<td>√</td>
</tr>
<tr>
<td>Materials (including hazardous) import, manufacture and storage</td>
<td>√</td>
</tr>
<tr>
<td>Use of natural resources (water, sand etc, vegetation)</td>
<td>√</td>
</tr>
<tr>
<td>Workers’ accommodation and subsistence</td>
<td>√</td>
</tr>
<tr>
<td>Transport (workers, equipment, wastes; heavy/hazardous loads)</td>
<td>√</td>
</tr>
<tr>
<td>Waste disposal (spoil; “domestic”; and hazardous)</td>
<td>√</td>
</tr>
<tr>
<td>Rehabilitation of work sites</td>
<td>√</td>
</tr>
<tr>
<td>Use of services and utilities</td>
<td>√</td>
</tr>
<tr>
<td><strong>Operation</strong></td>
<td></td>
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<tr>
<td>Flow of sea water</td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td></td>
</tr>
<tr>
<td>Use of services and utilities</td>
<td>√</td>
</tr>
<tr>
<td>Operation of pumping stations</td>
<td>√</td>
</tr>
<tr>
<td>Maintenance of infrastructure and equipment</td>
<td>√</td>
</tr>
<tr>
<td>Discharge of brine</td>
<td>√</td>
</tr>
<tr>
<td>Manufacture of membranes</td>
<td>√</td>
</tr>
<tr>
<td>Physical presence in the environment</td>
<td>√</td>
</tr>
<tr>
<td>Operation of the desalination plant</td>
<td>√</td>
</tr>
<tr>
<td>Provision of potable water</td>
<td>√</td>
</tr>
<tr>
<td>Emergency response</td>
<td>√</td>
</tr>
<tr>
<td>Power generation (HPP)</td>
<td>√</td>
</tr>
<tr>
<td>Hazardous materials storage</td>
<td>√</td>
</tr>
<tr>
<td>Potential Secondary, and Cumulative Sources (other than addressed above)</td>
<td>√</td>
</tr>
<tr>
<td>Cumulative water abstraction from the Red Sea</td>
<td>√</td>
</tr>
<tr>
<td>Fragmentation of ecological habitats across the Jordan Valley</td>
<td>√</td>
</tr>
<tr>
<td>Secondary effects of Tourism</td>
<td>√</td>
</tr>
<tr>
<td>Secondary effects of Increased freshwater provision</td>
<td>√</td>
</tr>
</tbody>
</table>

**C13.5.2 Key Issues for Consideration in the Impact Assessment**

Based on this initial scoping, and considering the issues in more depth, a number of key issues have been identified, either because they are likely to have a significant landscape and visual effect, or they have been raised by stakeholders as having a perceived significant landscape and visual, thus warranting consideration. *Box C13.1 summarises the key issues.*
Box C13.1  Key Landscape and Visual Issues

Visual changes related to the new levels of the Dead Sea: There will be a degree of visual change in the Dead Sea if the levels drop or rise significantly from their present day levels. Note that this will be most dramatic in the long term, in the ‘no-project scenario’.

Views from key viewpoints for tourism: Concern has been raised in particular about views from viewpoints such as Masada, Lot’s Cave and the Dead Sea Panorama, and from the lower level tourism facilities on the Dead Sea shoreline.

General feeling of the desert landscape value and character: in particular associated with the southern Wadi Araba, with particular concerns over the canals that would be constructed as part of the high level tunnel option, and/or any induced development as a result of the Scheme going ahead.

Views during construction: Temporary, not really raised as a concern, but is a significant undertaking so needs consideration.

C13.5.3 Landscape and Visual Impacts in the Aqaba/Eilat Area

Construction at the Northern Intake

In the Gulf of Aqaba/Eilat, the town of Aqaba is currently subject to several large building projects in the same area close to the north intake location. Because it is a port town, impacts from the temporary infrastructure required for the construction works at sea (floating plant, possibly a barge or pontoon with excavator and winches) will be slightly reduced by the presence of the large number of cargo ships (mostly phosphate vessels) and other vessels off the northern shore. Although the main port will be relocated around 2013, the northern shoreline will remain the anchoring location for vessels waiting for their turn to be loaded at the new southern port. Traffic from transportation of materials, dust from works will generate some additional nuisance on top of ongoing building works.

The level of visual impact during the construction works will be higher for the northern intake site, since this is located in the middle of the Gulf shoreline, between the two towns and closer to the tourism developments and hotel beaches. However, significant construction for both the Ayla and Saraya developments is currently underway at the shoreline. Depending on the time of construction of the northern intake, the potential landscape and visual (and other disturbance) impacts may be an addition to already existing impacts, rather than a new disturbance to a calm, tourism area.

The sensitivity of the landscape has been rated provisionally as *low to medium*. During the construction phase, the magnitude of the change to landscape is noted as being *small* so the temporary visual impact at the northern intake has been evaluated provisionally as *minor* significance. The sensitivity of the visual receptors has been rated as *low to medium*. During construction the magnitude of change to visual receptors’ views has been noted as being small, resulting in changes in view for a short duration. The overall significance for
visual receptors is therefore determined at this stage of the assessment to be of minor significance.

**Construction at the Eastern Intake**

Impacts from the temporary infrastructure required for the construction works at sea (floating plant, possibly a barge or pontoon with excavator and winches) will be slightly reduced by the presence of the large number of cargo ships and other vessels in the Gulf. Traffic from transportation of materials, dust from works (including the blasting sequences at the eastern site) will generate some additional nuisance on top of ongoing building works.

The eastern intake location is situated out of the town, on the eastern coastline, on a narrow stretch of road where the cliffs are degraded and the landward views are not pleasant. Construction impacts here will be less noticeable.

The sensitivity of the landscape has provisionally been rated as low. During the construction phase, the magnitude of the change to landscape is noted provisionally as being small so the temporary visual impact at the northern intake has been evaluated as not significant. The sensitivity of the visual receptors has been provisionally rated as low. During the construction phase the magnitude of change to visual receptors’ views has been noted as being small, resulting in changes in view for a short duration. The overall significance for visual receptors is therefore determined at this stage of the assessment to be not significant.

**Permanent Landscape and Visual Impacts from Northern Intake**

At the northern intake site on the coastline, the intake will consist of a submerged offshore seawater inlet, which enters an underground pipeline. There will be a permanent access road along the pipeline route. All other infrastructure - the facilities for pre-treatment and control of water entering the conveyance, administration and office facilities, pumping station - will be situated at the site of the north intake pumping station, 12 km to the north. The northern intake infrastructure will be entirely underground, except for the access road running along the existing military access road at the border. Despite being constructed in an already dense urban network and are located in the confined stretch between the future Ayla Tourism development and the Jordanian border, the visual impact will be minimal.

The sensitivity of the landscape in this area has been defined as medium due to the tourism in the area, however the area is already developed, with buildings and infrastructure and the landscape has a degree of being able to accommodate the degree of change it would bring. Therefore the magnitude of the impact to the landscape here will be imperceptible to small due to the limited infrastructure here that will actually be visible above ground. As a result the significance of the potential impact on landscape in this area is minor. The sensitivity of the visual receptors has been rated as low to medium. During the operation of the Scheme the magnitude of change to visual
receptors’ views has been noted as being small, resulting in changes in view for a short duration. The overall significance for visual receptors is determined as minor significance.

**Permanent Landscape and Visual Impacts from the Eastern intake**

At the eastern intake, the permanent infrastructure will include a submerged offshore seawater inlet, facilities for pre-treatment and control of water entering the conveyance, infrastructure including administration and office facilities, a pumping station to raise the water to the level of the conveyance (not needed for the zero level tunnel), and a new road junction into the site. Facilities will be erected at the site of the disused Aqaba Thermal power plant around 5 km south of the town in a site carved out in the mountain. The site is currently fenced, with a multi-storey industrial structure on it which will be removed. The new intake site will likely require a smaller building, and may even improve the aesthetics of the site.

The sensitivity of the landscape has been rated as low. During the operational phase, the magnitude of the change to landscape is noted as being imperceptible to small due to the limited infrastructure here that will actually be visible above ground and the possible improvement to the site. As such the temporary visual impact at the northern intake has been evaluated as not significant. The sensitivity of the visual receptors has been rated as low. During the operation of the Scheme the magnitude of change to visual receptors’ views is likely to be imperceptible given the current view at the site. The overall significance for visual receptors is determined as not significant.

**Permanent Landscape and Visual Impacts from the Northern Intake pumping Station**

The facilities for pre-treatment and control of water entering the conveyance, administration and office facilities, and the pumping station - will be situated at the site of the north intake pumping station, 12 km to the north. As described earlier, this site is in a flat, exposed area of sand, close to the King Hussein International Airport and the Aqaba Industrial Estate. Although no details are available of the infrastructure, for illustration purposes. This new feature may be a minor significance change to the landscape because there may be a medium change in landscape characteristics, comprising a clearly evident change over a restricted area, however the view will be attenuated by the airport in the immediate vicinity. The sensitivity of the landscape is low sensitivity and can accommodate an element of change.

(Consideration will be given to developing a visualisation of these feature for the Preliminary draft ESA report.)
C13.5.4 Landscape and Visual Impacts in the Wadi Arabal/Arava Valley

Pipeline Construction in the Wadi Arabal/Arava Valley

The most significant visual impact during the construction phase of the pipeline option will arise from the quantity of dust generated by the works and traffic in dry, sandy desert area. Dust hazes are likely to be widely visible from both sides of the border. Another impact will be generated by establishment and operation of the worker camps and construction yards at different places along the pipeline route and at different times during the construction phase. The exact siting of temporary construction yards and camps has not yet been identified, but once available this aspect will be further assessed in order to reduce the visual impact as far as possible.

The landscape in this area was ranked provisionally as medium significance. The magnitude of landscape change would provisionally be potentially medium due to the area being covered and the clearly evident change. However, this will be temporary. The temporary visual impact from pipeline construction in this area has been evaluated as moderate significance, although this will be temporary. Visual receptors in this area are provisionally noted as being of medium potential sensitivity (although this will be confirmed in the subsequent phase of assessment). The magnitude of changes to view could be medium due to there being perceptible changes in views at intermediate distances. The resulting significance is moderate, albeit temporary.

Tunnel Construction in the Wadi Arabal/Arava Valley

The major visual impact during the construction phase for both the tunnel options will also be due to dust from the construction plant, and works associated with the opening of temporary access roads to tunnel opening portals, and from transportation of plant and materials along the valley. Transportation and disposal of the tunnel spoil in the valley will generate potentially significant visual impacts depending on the dump sites chosen, and the routes. Further assessment of the proposed spoil sites will be necessary once sites are identified. At this point, given that the landscape in the area is medium sensitivity, and the magnitude of change to landscape will be small due to the changes being for a short duration, landscape impacts during construction of the tunnel are anticipated to be minor significance. The sensitivity of visual receptors in this area is provisionally medium and the magnitude of change to their views small due to the changes being for a short duration. The impact is therefore likely to provisionally be of minor significance, although this will be confirmed during the subsequent phase of assessment.

Permanent Landscape and Visual Impacts From the Pipeline

For the pipeline option and along the Wadi Arabal valley, the only really noticeable facilities will be the pumping station; other than this there will be an intermediate reservoir – near the village of Gharandal – this will be an
additional facility in the desert floor. However, this could be partially buried, or located behind some higher ground. This reduces the visual impact of the reservoir from the road and from the village of Risha. The sensitivity of the existing landscape and view is provisionally moderate; the change to landscapes and to receptor views would however be small, resulting in a provisional impact (to be confirmed during the next phase of assessment) of minor significance.

(Consideration will be given to developing a visualisation of these feature for the Preliminary draft ESA report.)

Permanent Landscape and Visual Impacts from the High Level Tunnel

The most visible elements of the high level tunnel will be the two sections of open canal and the access portals to the tunnel. Given that the landscape in the area is provisionally medium sensitivity, and the magnitude of change to landscape will be small since this will be a moderate change over a restricted area that is part of a wider landscape, landscape impacts during operation due to the access portals are anticipated provisionally to be minor significance. The sensitivity of visual receptors in this area is medium and the magnitude of change to their views small due to the changes affecting only a small portion of the wider landscape. The impact is therefore likely to be of minor significance.

Permanent Landscape and Visual Impacts from the Canals

The canal sections will be 25 metres wide, and built to emerge slightly above ground level. They will therefore be visible from higher ground at a distance because they will create a line crossing the landscape. They will be particularly noticeable where they cross the highway.

(Consideration will be given to developing a visualisation of these feature for the Preliminary draft ESA report.)

In terms of landscape impact, the landscape in this area is rated as being of medium sensitivity and the potential magnitude of the landscape impact may be medium, because this will be a clearly evident change in the landscape albeit in a relatively limited area and relatively infrequently perceived. This is therefore a potential impact of moderate significance.

An open channel canal in the desert environment will be a visual interruption to the original landscape. The southern canal section may be more intrusive as it passes through a more characteristic dune field, and will be more visible from the road. It is possible that developments will be attracted in the vicinity of these canal sections, which would introduce further disruptions to the landscapes. Some may view this as positive. The visual impact from the canal sections is evaluated as moderate due to the low sensitivity of receptors using the road, however noting that the localised change in view from the canal would be of medium to high magnitude. However it may be more significant in areas if the importance of the sandy dune field landscapes in the southern
Araba are taken into account. Other projects likely to be built on or around the open canals, may introduce additional significant landscape and visual impacts.

**Permanent Landscape and Visual Impacts from the Tunnel Adits**

The tunnel adits (access portals) will be built close to or inside the wadi openings and generally at places visually protected from the main receptor (the highway) by the surrounding topography. Provided these are designed sensitively, they may not be noticeable from a distance. The access roads to them will be permanent and may be more intrusive than the portals themselves. The impact of the portals themselves and the access roads is likely to be not significant in a visual sense, due to the low sensitivity of the receptors (using the road) and the small changes in view from a long duration. The impact could be minor from a landscape perspective, because of the moderate rating given to the landscape in this area.

**Permanent Landscape and Visual Impacts From Low Level Tunnel**

For the reasons described above, the impact of the tunnel adits themselves and the access roads is likely to be not significant in a visual sense, due to the low sensitivity of the receptors (using the road) and the small changes in view from a long duration. The impact could be minor from a landscape perspective, because of the provisionally moderate rating given to the landscape in this area.

(Consideration will be given to developing a visualisation of these feature for the Preliminary draft ESA report.)

C13.5.5 **Landscape and Visual Impacts in The Dead Sea Basin**

**During Construction**

In the Dead Sea basin, the construction of the hydropower and desalination plants may generate negative visual impacts due to formation of access roads and traffic, dust, presence of the workers and workshops in the surroundings of the construction site, and the visual impact of the reshaping works in the mountain area. The visual impact in this area has been evaluated as potentially moderate during the construction phase due to the medium sensitivity of visual receptors and the medium magnitude of landscape change which will be clearly perceptible at intermediate distances. The landscape impact is also moderate, although temporary.

**Permanent Landscape and Visual Impacts from High Level Desalination Plant, Zone C**

The desalination plant will be large and will be obvious in the immediate area, but will only be partially visible from the main highway, and may only be visible in the far distance from Israel. The actual dimensions and location
within the topographical context could significantly reduce the visibility. In
addition, simple design criteria such as colour and materials requirements for
the outward structures could reduce the impact to moderate or low levels. In
addition, the penstocks, if they are sited above ground, will be visible in parts
from the main highway and may be conspicuous against the mountainside for
some stretches. Many of these intrusions will be easily mitigated. In the
absence of more detail on the structures, the visual impact of the zone C plant
is rated as potentially of minor to moderate significance.

Hydropower Plant (and Low Level Desalination Plant) at Ghor Fifa

The hydropower plant (and the low level desalination plant, if this is selected)
will be located in the flat plains to the west of the agricultural area at Ghor
Fifa. This area is in the Dead Sea basin, although the sea is not visible at
ground level. The area is open and has no visual obstacles other than some
fairly dense vegetation in this area.

As shown earlier in Figure C13.23, the infrastructure (taken to be 35 m high for
this analysis) at this site will be visible from the Jordanian highway leading
down from Wadi Araba directly above the site, and also from Israel. It will
also be visible from the villages of Fifa and Safi. The visual impact of this
structure has therefore been evaluated as potentially of moderate significance
due to the moderate sensitivity of the receptors and the medium to high local
landscape change. The landscape significance is similarly determined as
moderate significance.

The visual and landscape impact assessment in the Dead Sea area is only provisional
at this stage, and will be finalised once the detailed studies of the Dead Sea are
completed. The results will be presented in the Preliminary Draft ESA Report.

C13.5.6 Landscape and Visual Impacts Along the Freshwater Conveyance Routes

During Construction

Along the freshwater conveyance routes like the work along the pipeline in
the Wadi, dust, traffic, presence and operating of the temporary
infrastructures and worker camps and workshops are the main negative
impacts that can be anticipated during this phase. The landscape value here is
provisionally low and the magnitude to landscape small and temporary
resulting in a landscape impact of non significance. Similarly the visual
receptors here are low sensitivity and the change to their view small, also
resulting in a likely impact that is likely to be ranked not significant.

During Operation

In the Dead Sea basin, depending on the route selected, the transmission lines
run along the main road through a man-made landscape with a high amount
of human activities where industry is predominant (tanks and factories for the
potash industry). The lines will be buried. There is already a high voltage
electricity line along part of the route so the new impacts will add to the existing ones within a very industrial landscape.

Where the pipelines rise up the escarpment, these are likely to be only partially buried. Even once construction is complete, the construction corridor will remain visible from the basin and the roads and villages. Visual impacts from this stretch will be more significant.

On the highlands, the pipes will be mostly buried. Much of the route in the highlands will be in areas not visible from roads or settlements. The visual impact here will vary depending on the location, but will generally be low to absent.

*Figure C13.26* shows the visibility (marked in blue) of a point on the freshwater line (alignment alternative No 3, at ‘Zone B’, at a point where a junction may be established). The plot shows that the topography effectively hides this point from view outside the wadi in which it is situated. The important tourism sites of Lot’s Cave (Jordan, and Masada (Israel) are shown. According to this plot, the freshwater pipeline (at the point illustrated) will not be visible from either of these receptors.
The permanent visual impact from the freshwater routes is evaluated as not significant to minor, although once the exact route and final form of the freshwater lines are known, there may be areas where the visual impact is locally moderate. However, it seems that no significant areas of tourism interest will be significantly impacted.

*No assessment of the western freshwater route has yet been made.*
C13.6 **Mitigation of Impacts**

The visual and landscape analysis is still underway and will be completed for presentation in the *Preliminary Draft ESA Report*. Mitigation measures will be developed, and are likely to include the design of permanent facilities to take account of colour and form of surrounding environment. A summary table showing the significance of each impact before and after mitigation will be also be presented.

However, at this stage it is noted that the canal sections in particular will need further consideration in conjunction with stakeholders (local community, local government, tourism developers, RSCN, *etc*) to determine the significance of their visual impact, and means to reduce this.
C14 ENVIRONMENTAL QUALITY

C14.1 SCOPE OF THE ASSESSMENT

This section of the report assesses the impacts on environmental quality in the area affected by the Scheme. The scope of the consideration of environmental quality issues includes issues related to air quality, noise, waste management, and traffic. These issues are discussed in one section because they stem from many of the same sources, and are managed through the same sorts of mechanisms, for example codes of construction practice.

The remainder of this section is structured as follows:

- Section C14.2 - Approach to the assessment;
- Section C14.3 - Legal and policy context;
- Section C14.4 – Baseline;
- Section C14.5 - Impact assessment;
- Section C14.6 – Mitigation of impacts.

C14.2 ASSESSMENT APPROACH

The assessment has been carried out to identify potential impacts related separately to air quality, noise, traffic and waste. However, at the end of the section, the cumulative issues relating to all of these issues are also discussed. The assessment approaches for each of the separate analyses are summarised below. Given the outline nature of the details available on the Scheme, these are all preliminary assessments only, with a fuller assessment only becoming possible once more detail is available on the Scheme’s detailed design and the selected locations.

Ongoing discussions were held with the Feasibility Study team throughout the assessment to derive information on the Scheme and its construction. Personnel from the ESA team then made an assessment, in cooperation with the work carried out under the FS Biophysical Sub-Study.

C14.2.1 Air Quality Assessment

An analysis of air quality impacts was carried out based on a review of available information on the environmental baseline, and examination of the detailed description of the Scheme. Impacts were determined using data, professional judgement and experience of similar projects. In assessing the magnitude of a potential impact to air quality, the assessment considered the extent of any potential impact (geographical area, size of affected population, proportion of resource affected), its duration and frequency, its probability of occurrence, and whether the potential impact is positive or negative or indirect or secondary.
C14.2.2 Noise Assessment

A noise assessment was carried out using a qualitative approach to evaluate likely noise and vibration impacts arising from the Scheme. The analysis of noise impacts included the description of the environmental changes caused, induced or increased by the Scheme, along with any potential cumulative impacts on a single area caused by multiple sources of noise. Where the potential for significant noise and/or vibration impacts was identified, measures to mitigate these significant impacts were proposed for consideration in the Scheme design in the coming months. Significance was determined by considering the characteristics of the Scheme, the environmental sensitivity of the location and the characteristics of any potential impacts.

The assessment of potential noise and vibration impacts considered both those that may arise from the construction of the proposed Scheme affecting existing noise or vibration sensitive receptors nearby and those from the operation of the proposed Scheme affecting surrounding existing receptors.

C14.2.3 Traffic Assessment

An analysis of traffic impacts was carried out by developing a description of the environmental changes caused, induced or increased by the Scheme. There are various ways of interpreting whether or not an impact (or effect) is significant and the following guidance is given in the IEMA Guidelines for the Environmental Assessment of Road Traffic (1):

‘For many effects there are no simple rules or formulae which define the thresholds of significance and there is, therefore a need for interpretation and judgement on the part of the assessor, backed up by data or quantified information wherever possible. Such judgements will include the assessment of the numbers of people experiencing a change in environmental impact as well as the assessment of the damage to various natural resources’.

For this Scheme, significance was determined by considering the characteristics of the study area, the environmental sensitivity of the location and the characteristics of any potential impacts, taking into account factors such as the existing and additional Scheme traffic flows, road infrastructure quality, vehicle types and respective operating speeds and the proximity of communities to the road.

(1) Guidelines for the Assessment of Road Traffic produced by the Institute of Environmental Assessment (IEA, 1993) now the Institute of Environmental Management and Assessment (IEMA)
C14.2.4 Waste Assessment

A waste expert was commissioned to identify the wastes likely to arise from the construction and operation of the Scheme and potential environmental impacts associated with the handling and disposal of waste. Given the uncertainty in the method of conveyance of the water from the Dead Sea to the Red Sea, the exact amounts of waste arisings, specifically the excavated spoil, is uncertain. The different potential construction methods have therefore each been considered in this assessment.

C14.3 Legal and Policy Context

The legal and policy context for the following environmental quality assessment is primarily that defined in Section A3 of this report. The final ESA report will include an additional summary of those provisions that relate specifically to air quality, noise, traffic and waste management.

C14.4 Environmental Quality Baseline

This section discusses the baseline conditions of the scheme area for each of the environmental quality topics discussed.

C14.4.1 Air Quality

Much of the Scheme is located in a desert area with a sparse population. The main air quality receptors are the villages along the route of the Scheme between the two seas, of which there are approximately 32 within 5 km of either the proposed Pipeline and/or Tunnel route options. (Villages beyond this distance are not likely to experience any impacts from dust emissions. It is highly probable that impacts will not occur at lesser distances, but this distance has been taken as an extreme criterion). These villages are located in a generally linear pattern along Wadi Araba/Arava Valley, and are served by Routes 90 and 65.

For the purposes of this assessment it has been assumed - based on observation and local expert knowledge - that the baseline air quality environment is good with respect to concentrations of pollutants derived from combustion sources, although there are no primary data to confirm this. The arid environment will cause concentrations of PM\textsubscript{10} to be naturally elevated and it is conceivable that annual average concentrations of PM\textsubscript{10} could be above those that define, for example, the EU air quality standard of 40 µg m\(^{-3}\). Short term concentrations of PM\textsubscript{10} will almost certainly be above the daily average concentration of 50 µg m\(^{-3}\) when dust storms occur. The EU limit value standard is for no more than 35 days in any year exceeding this value.
C14.4.2 Noise

Almost all the proposed Scheme is located within a sparsely populated, rural area. For this initial study baseline noise surveys have not been undertaken and it has been assumed that the baseline noise environment is low as, from observation, the ambient noise levels are known to be generally characteristic of such undisturbed environments. Outside the towns and villages, the few non-natural sources of noise are the Dead Sea Highway and the Desert Highway (Jordan), Highway 90 (Israel and the Palestinian Authority), King Hussein International airport (Aqaba), and Eilat Airport, and the industrial areas near the Dead Sea in both Israel and Jordan. There are a number of several lightly travelled local roads.

The main noise sensitive receptors are:

- The villages along the route of the Scheme between the Red Sea and the Dead Sea of which there are several which are within 5km of either the proposed Pipeline and/or Tunnel route options. These villages are located in a general linear pattern in line with the Wadi Araba/Arava Valley, and are served by Routes 90 and 65.

- The villages and hamlets along the freshwater transmission line to the west of the Desert Highway.

The likely future developments in the study area are described in Section C11.

The activities relevant to the impact of noise and vibration predicted in the years leading up to construction and operation of the scheme include the following:

- Greater development in Aqaba, with resultant intensification of road and port traffic, extension of industrial areas and relocation and development of the ports;

- More or less stasis in the Wadi Araba, in terms of population and industry on the Jordanian side, on the Israeli side there are plans to expand the population gradually up to around double the present;

- Infrastructure development in the Wadi Araba including plans to convert the Dead Sea highway to a dual carriageway; plans to run a 400kV transmission line from Aqaba down the valley; a proposal to relocate the airport in Eilat; a (very preliminary) proposal to relocate the port in Eilat into an inland marina;

- More ongoing projects to develop hotels and tourism in the Dead Sea Basin, leading to more movements of tour buses up and down the highways north to Amman and south to Petra, Wadi Rum and Aqaba (via the Dead Sea Road and the Tafila road);
The imminent construction of a freshwater pipeline along the route of the Desert Highway to Amman to carry water from the Disi aquifer.

All of the above will affect the ambient noise background, although in some cases only temporarily. The potential alteration of the baseline environment within which each of these is located has been taken into account in assessing the significance of RSDSC impacts and the potential for cumulative effects.

Traffic

The area affected by the Scheme in Jordan includes Aqaba and the ports area, the Wadi Araba/Arava Valley and the Desert Highway corridor between Hasa and Amman. In Israel and the Palestinian Authority, the main area affected is the Dead Sea Basin as far north as Jericho. Existing route infrastructure in Jordan includes the Dead Sea Highway and the Desert Highway, which are paved carriageways and are likely to be the principal routes for traffic generated by the Scheme, and the minor road from Ghor Safi through Karak to the Desert Highway at Qatraneh. In Israel and the Palestinian Authority, the main route is Highway 90 along the Dead Sea as far as Jericho.

The main traffic sensitive receptors are the numerous small villages and hamlets located along the routes. Traffic surveys indentifying existing road use for the main roads in the area not yet available, thus preventing quantitative assessment of the traffic impacts as a result of Scheme. On the assumption that the Dead Sea Highway, the Desert Highway and the Routes 90 in Israel and the Palestinian Authority will be used by the Scheme, we recommend that the following traffic survey is undertaken as part of the design process:

- traffic flow variation along the relevant lengths of road, by time of day and between days;
- other temporal variation (eg holiday and seasons);
- vehicle type (so highway use and time sensitivity can be inferred); and
- vehicle speeds.

In addition to the above traffic surveys, we recommend that key parameters of highway capacity and operating capability are identified. This will enable the confirmation that the highway is suitable for the additional traffic arising within the impact assessment stage.
C14.4.4 Waste

Waste collection, transportation and disposal in Jordan is handled by local municipalities. Sometimes, groups of smaller municipalities combine forces into a Common Services Council to manage a disposal site. There are around 20 landfill sites in Jordan, recognized by the Ministry of Municipal Affairs. In the study area, these include:

- Aqaba Landfill Site;
- Ghor Safi Landfill Site; and
- Karak Landfill Site.

There are also smaller disposal sites in the Wadi Araba, operated by local municipalities. The main one appears to be at Abu Khusheba which serves the villages of the central Wadi Araba. With the exception of the Ghabawi site in Amman, none of the landfill sites in Jordan are lined. Few are well managed, and some are sited badly. For example the site at Aqaba is sited over the Wadi Yutum aquifer.

C14.5 Environmental Quality Impact Assessment

C14.5.1 Issues Identified During the Scoping Stage

The issues that were scoped as being of particular importance for the environmental quality assessment are summarised in Table C14.1 and discussed in the following sections.

<table>
<thead>
<tr>
<th>Sources of impact</th>
<th>Air Quality</th>
<th>Noise</th>
<th>Traffic</th>
<th>Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land take for worksites site accesses and access roads etc. Employment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site activities (excavation, tunnelling, construction, rehabilitation)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Materials (including hazardous) import, manufacture and storage</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Use of natural resources (water, sand etc, vegetation)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workers' accommodation and subsistence</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Transport (workers, equipment, wastes; heavy/hazardous loads)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Waste disposal (spoil; &quot;domestic&quot;; and hazardous)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Rehabilitation of work sites</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Use of services and utilities</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Operation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Flow of sea water Employment</td>
<td></td>
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</tbody>
</table>

Table C14.1 Issues of Particular Importance for the Environmental Quality Assessment
### Sources of impact

<table>
<thead>
<tr>
<th>Sources of impact</th>
<th>Air Quality</th>
<th>Noise</th>
<th>Traffic</th>
<th>Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of services and utilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation of pumping stations</td>
<td></td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Maintenance of infrastructure and equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharge of brine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacture of membranes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical presence in the environment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation of the desalination plant</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provision of potable water</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency response</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power generation (HPP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hazardous materials storage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### C14.5.2 Air Quality

**Impacts During Construction**

During construction, emissions could be substantial and could have the potential to cause a significant impact. In particular, construction could release large amounts of dust into the atmosphere, causing nuisance to receptors within approximately 1-2 km and causing localised increases in airborne PM$_{10}$ concentrations (i.e., those dust particles likely to cause breathing difficulties and damage the health of affected people).

A quantitative assessment of any air quality impacts during construction would require a precise knowledge of the location and strength of any emissions. Such an assessment would not be feasible or appropriate for the present project, even with more extensive knowledge of the construction activities, because there are too many variables that affect the rate at which dust is emitted. The most important factor to consider is the separation of dust source from receptor and the management of dust generating activities, as discussed in the following sections.

The primary pollutant to consider is the emission of dust. The source with the largest potential contribution to dust emissions will be the movement of vehicles along unmade roads or roads with a dry surface layer of dust. Heavy goods vehicles will cause re-suspension of dust particles through the action of the vehicle’s wheels pulverising the particles making up the road and projecting these particles into the air. The turbulent vehicle wake adds to the upward momentum of the particles. Experimental work in the south west of the USA has determined that large heavy vehicles travelling on unmade roads can emit particles at the rate of 1-10 kg km$^{-1}$, depending on the vehicle size and speed \(^{(1)}\). Estimates for the number of heavy goods vehicle (HGV)

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\(^{(1)}\) Williams DS et al (2008) Particulate matter emission by a vehicle running on an unmade road Atmospheric Environment 42 3899 - 3905

movements required for the transportation of building materials and waste spoil during construction of the tunnel/canal is approximately 1000 day\(^{-1}\). Therefore, if these movements take place on unmade roads, it is conceivable that the scheme will be emitting dust (including the PM\(_{10}\) fraction) at the rate of several tonnes day\(^{-1}\). A more accurate estimate will depend on the cumulative distance travelled.

In comparison, most other potential sources are minor. The construction activity at sites for the Desalination Plant, the Hydro Electric Power Plant and surface workings associated with the pipeline or the tunnel/canal will have the potential to cause dust emission through disturbance of the ground, but the magnitude of any such emissions will be small in comparison to those caused by vehicles moving over dry ground or unmade roads. In addition, the locations for the Desalination Plant and the Hydro Electric Power Plant are sufficiently far from receptors that construction activity relating to these components of the scheme ought not to cause an impact, given good site management practices.

Some construction activity taking place in Aqaba. Whilst this has the potential to cause some nuisance for receptors in urban areas, good site management ought to minimise dust emissions.

The tunnel options incorporate concrete batching plants for the in situ construction of segments. These will represent a source of dust.

There is an option for power to be generated at the construction compounds for the tunnel options through the use of large generators (5-8MW) as an alternative to using electricity from the grid. In this scenario, there will be additional emissions of NO\(_x\), PM\(_{10}\) and possibly SO\(_2\) from the combustion of diesel oil or a similar fuel.

A major source of dust will be excavation and/or ground levelling in the desert. The material is fine and easily lifted; moreover, once the desert crust is broken, dust is continually eroded from the disturbed surface.

**Potential Impact Significance Before Mitigation**

The critical factor in assessing the significance of an impact arising from dust emission is the physical separation between the source and the receptor. In an arid environment, it might be expected that the dust particles could travel as much as 2 km before deposition on the ground, depending on the state of the atmosphere at the time. Studies of the Dead Sea suggest that dust storms are most frequent in spring and autumn \(^{(1)}\). Any dust emitting activities undertaken during these seasons will add further to the natural exposure to airborne dust for receptors in close proximity to the Scheme.

Areas of human habitation and crop production areas are relatively scarce in the valley and so the potential for impact is limited. Most such areas are close to the main road. For most of its route, the Pipeline option is closest to the road and possible receptors. Relative to the Tunnel options, the Pipeline has substantially fewer HGV movements associated with it and total emissions of dust should be lower. However, the proposal is to build an unmade dirt road adjacent to the Pipeline and this will give rise to dust emission during the construction phase. The excavation of the trench for the pipeline will create some dust, but this would be a minor source in comparison with HGV movements over dusty ground.

As noted above, the Tunnel options will be associated with approximately 1000 daily HGV movements. This activity could generate a large quantity of dust emitted to atmosphere if unmade haul roads are used. In these circumstances, the Scheme will cause an impact on people living nearby or crops growing within approximately 1-2 km. Within 100 m, any such impacts will be very significant.

The impact on people affected by dust emissions will be to cause nuisance and to increase exposure to airborne particles, which could exacerbate any pre-existing respiratory diseases.

Crops might be affected by large quantities of dust accumulating on leaves, causing cosmetic damage or, in the extreme, inhibiting photosynthesis. It is noticeable that there are some areas of cultivation alongside stretches of the main road running up the valley. These will be vulnerable to the effects of substantial increases of HGV traffic using this road.

Examination of the available maps and satellite imagery indicates that within 5 km of either the pipeline or tunnel route there are 12 villages or areas of human habitation in Israel and 20 in Jordan (Table C14.2). These possible receptors are not equally vulnerable and it is not possible to be more precise about the extent of impact without clarity on the whereabouts of haul routes to be used by construction traffic, the nature of these roads and the numbers of vehicles.

Most of these are sufficiently distant from the intended routes that it is likely that they will not be affected by dust emissions. Possible exceptions to this are al Haq Farm IV and Rahmeh, because the former is close to the pipeline route (with its unmade dirt road) and the latter, which is in the vicinity of a potential tunnel entrance.
Table C14.2  Villages within 5km of Conveyance

<table>
<thead>
<tr>
<th>Village</th>
<th>Approx. Distance from Pipeline (km)</th>
<th>Approx. Distance from Tunnel (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Jordan</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Custo</td>
<td>0.5</td>
<td>-</td>
</tr>
<tr>
<td>Military Point</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Qatar</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Rahmeh</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Haq Farm V</td>
<td>3.5</td>
<td>1.5</td>
</tr>
<tr>
<td>End</td>
<td>3.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Gharandal</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Abu Burqa Dam</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Haq Farm IV</td>
<td>0.5</td>
<td>4.5</td>
</tr>
<tr>
<td>East Risheh</td>
<td>1.5</td>
<td>-</td>
</tr>
<tr>
<td>Settled Bedouin</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Risheh</td>
<td>2.5</td>
<td>5</td>
</tr>
<tr>
<td>Entrance Abu Ksheibeh</td>
<td>3.5</td>
<td>4</td>
</tr>
<tr>
<td>Al Haq III</td>
<td>3.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Bir Mathkoor</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Haq Farm II</td>
<td>3</td>
<td>3.5</td>
</tr>
<tr>
<td>Finan Entrance</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Gweibeh East South</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Gweibeh Farms</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Squatted Land</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td><strong>Israel</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eilat</td>
<td>2.5</td>
<td>-</td>
</tr>
<tr>
<td>Eliot</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Be’er Ora</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Elifaz</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Samar</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>Yotvata</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Grofit</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>Lotan</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Yahel</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Ein Yahav</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Ne’Ot Hakikar</td>
<td>3.5</td>
<td>-</td>
</tr>
<tr>
<td>Ein Tamar</td>
<td>5</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: Google Maps & Satellite Imagery

**Mitigation**

The principal means of mitigation must be to ensure that any unmade haul roads for HGVs are constructed such that they are as far away as is feasible from residences or cultivated areas. It has been assumed that they will need to connect with the main road running along the valley and it will be these connections that will be of most importance in this respect.

Paving roads would be an expensive option, but following a more detailed assessment, may need to be considered in limited locations close to habitation to reduce emissions of dust during construction and operation. The alternative option, of using ‘binding agents’ to make haul roads less friable, will not be as effective as building a ‘made’ road and will introduce potential contamination into the environment. Damping down with freshwater is
clearly not an option in this environment, although it is understood that treated wastewater is already used for road-side irrigation in some parts of Aqaba and so this may be an option within the city boundaries.

For any construction taking place in the urban areas, good site management practices of a conventional type should be observed. This could include such measures as the use of ‘hoarding’ to shelter and screen construction areas and where possible the use of water (eg ‘grey’ water) to damp down surfaces, especially those used by vehicles.

*Residual Impact Significance (post mitigation)*

The scheme has limited potential for causing air quality impacts to humans and agriculture, provided that sensible planning with regard to the location of haul roads is adopted. Generation of dust is inevitable during the construction period and counter measures involving the use of fresh water are not feasible in this arid environment. Therefore, the siting of construction activity around tunnel entrances, for example, becomes important when avoiding impacts to the nearest receptor, particularly in the choice routes of for unmade haul roads. Ideally, these should be 1 km or more from habitation. In general, the Scheme design should take into account the proximity of human and agricultural receptors. Given that the Scheme design has yet to be fully developed, the opportunity exists for the avoidance of the most significant impacts on these receptors.

*Impacts During Operation*

The scheme will have very few sources of emissions to the atmosphere once operational. The only direct emissions at this point will be those from vehicles connected with maintenance activities. These will be a very minor source of air pollution and are considered insignificant for the purposes of this assessment.

*C14.5.3 Noise and Vibration*

*General Impacts During Construction*

There are three main options for the conveyance of water from the Read Sea to the Dead Sea, which are as follows; the pipeline option and the high and low level tunnel options. The pipeline construction will span a total of three to five years, with the peak construction period being years three and four, while both tunnel options will span six years and peak between years three and five. The main sources of noise during the construction of the any of the Scheme options can be attributed to:

- road traffic and people noise from worker camps;
- construction vehicles (lorries, excavators, bulldozers *etc*);
- concrete segmenting and batch plant;
- rockbreakers;
• pipeline manufacturing plant (for pipeline option only); and
• tunnel boring machines, TBM, (for the low and high tunnel options only).

Whichever conveyance option is chosen, it is likely to generate considerable additional lorry traffic on the local roads. This has the potential to produce temporary noise disturbance, this will be investigated in further detail as the numbers and routing of the construction traffic is defined.

Construction of Pipeline

The pipeline option will require a pipeline manufacturing plant which will most likely be located near the Gulf of Aqaba/Eilat. Pipe material will be transported from this plant to various locations as the pipeline progresses. The 180 km pipeline will be constructed in 50 km sections by teams. The construction of the pipeline will have temporary noise impacts on nearby populated areas along the route.

Construction of High Level Tunnel

For the High Level Tunnel excavation into the Wadi Araba/Arava Valley will be required, with the conveyance eventually consisting of both tunnel and open canal sections, with the tunnel section located above the ground water table. A TBM will be used to create the tunnel via seven access portals. Two working faces will be created for each of the three intermediate access portals (created by a TBM), there will be 11 working faces with a dedicated TBM working in each simultaneously. The TBM will create the excavation and produce spoil which will be taken to the surface via the access portals. Concrete lining segments will be lowered and fixed into place. The TBM support sites at ground level (which could operate 24hrs), along with the excavator mounted rock breakers and other plant that will be used for the canal sections will have temporary noise impacts on near by populated areas. Groundborne noise and vibration impacts from the TBM operations below ground could cause some temporary and limited disturbance.

Construction of Low Level Tunnel

The Low Level Tunnel will also require excavation into the Wadi Araba/Arava Valley and will generally follow the same alignment as the High Level Tunnel, however it will be at a lower elevation, with no canal sections. The 161.5 km tunnel would have seven access portals, but will have five intermediate access portals again created with a TBM. There will be 11 working faces with a dedicated TBM working in each simultaneously. The TBMs will create the excavation and produce spoil which will be taken to the surface via the access portals. Concrete lining segments will be lowered and fixed into place. The TBM support sites at ground level (which could operate 24 hrs a day), will have temporary noise impacts on nearby populated areas.
Given the tunnels’ depth, noise and vibration impacts from general TBM activities are unlikely except where the tunnel rises to ground level and if blasting of other mining techniques are used to form adits or cross tunnel.

Construction of Intake and Pumping Station

There are two options for the location of the Intake at the Gulf of Aqaba/Eilat, which are described in the Project Description with the pumping station location dependant on the location of the Intake. Construction for both the Intake and the Pumping Station will span up to three years with both on and off site construction and will have temporary noise impacts on the nearby populated areas.

Construction of Desalination Plant

The desalination plant will be elevated between 130 m – 180 m above sea level (High Level Tunnel), or 45 m below sea level (Low Level Tunnel) and will be constructed over a 3 – 4 year period. There will be a requirement for some excavation work to be carried out and all plant and associated facilities will be established at the site. The construction of the desalination plant will also require the establishment of a major road to carry the heavy loads of the pipe sections and equipment required on site. This construction is likely to cause some temporary noise impacts on nearby populated areas.

Construction of Hydro-Electric Powerplant (HEP)

The HEP will be located 355 m above sea level near the village of Fifa, and 6 km to the south of the Arab Potash Company’s solar evaporation ponds, and will be constructed over a 2 – 3 year period. As with the desalination plant, there will be a requirement for some excavation work to be carried out with all plant and associated facilities and substation established at the site. The access road will be strengthened to allow for construction of the HEP. This construction is likely to cause some temporary noise impacts on nearby populated areas.

Construction of Fresh Water Transmission Lines

The transmission line in Jordan will consist of up to three steel pipes, with one steel pipe for the lines in Israel and the Palestinian Authority. Excavation will be required for all three transmission lines to allow the pipes to be place in channels and then back filled. The pipeline sections are likely to be imported for all three lines and therefore negate the noise impact associated with pipeline manufacturing. A temporary construction road will also be established for all three lines. The construction of the three Freshwater Transmission Lines is likely to cause temporary noise impacts on nearby populated areas.

It is predicted that there will be some level of disruption during the construction period, namely from the construction of various elements of the

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Scheme and also from movement of various construction and delivery vehicles. However, the severity of this disruption following mitigation is predicted to be only moderate as the disruption will be temporary and largely located away from populated areas. With the relevant mitigation measures (described later), the impact will be further reduced to minor.

**General Impacts During Operation**

During the operation, all Scheme elements will operate on a 24 hour basis, however maintenance will only be carried out during day time hours. The long term impacts of this Scheme related to the service facilities that will be operating as a result of the conveyance are discussed below.

**Operation/Maintenance Personnel and Vehicles**

The road that will be established along the pipeline routes and towards the tunnel access portals during the construction phase of the Scheme will be retained and used for the operation and maintenance of the various facilities. Road traffic changes due to the operation of this Scheme are expected to result in a slight noise increase during the expected morning and evening peak traffic periods. Road traffic noise is therefore not expected to increase existing noise levels significantly in the wider area as a result of the Scheme. Changes in road traffic noise associated with the operation of the Scheme are predicted to have no adverse impact as there will be few in number and frequency.

**Operation of Pumping Station/Desalinisation Plant/Hydro Electric Power Plant/Freshwater Transmission Lines**

The operation of the additional equipment associated with the water conveyance will require large scale noisy plant to be located at various facilities of the study area. These various plant could create noise disturbance and as all these facilities will be operational over a 24 hour period, mitigation measures will be required to ensure the noise impacts experienced by those living in near by populated areas are not significantly affected.

There has been some concern that the operation of the DSP could be very noisy. The source of the concern may be the experience that DSP plants in the region that have used distillation methods sometimes have very noisy heat exchangers. The technology used here will be Seawater Reverse Osmosis (SRO). The technique has no particularly noisy operations and plant can be designed they do not make detectable noise beyond the site perimeter.

Pumping stations and pressurised pipes can give rise to ‘water hammer effects’ a loud, low-pitched thumping sound that arises in the pipes when air is trapped. Air reservoirs to reduce the potential for water hammer have been incorporated into the design.

*Table C14.3 outlines the approximate distance of the major plant facilities from populated areas.*
Plant that is located further than 5km from a populated area is considered to be far enough away to eliminate the likelihood of operational noise impacts, and as such is predicted to have no adverse impact.

Noise propagation may be interrupted by the mountainous terrain, reducing noise levels to nearby properties. To mitigate the potential noise impacts created by plant that is located within 5 km of populated areas, plant design should aim to ensure they do not significantly increase background noise levels above local and IFC thresholds, or the relevant Jordanian, Israeli or Palestinian standards, and where practicable will be housed in buildings along with other measures such as fan silencers and fitting mufflers on relevant plant to provide noise insulation. Low frequency noise could be a particular challenge if the large pumping facilities are located close to populated areas. Ongoing monitoring of noise levels will also be undertaken to ensure noise levels remain acceptable. Following the mitigation (including but not limited to), set out below, it is considered that there may be a minor level of noise nuisance in some localised areas.

**Mitigation**

Best practical means will be used to minimise construction and operational noise where practicable. In particular, the following noise control measures will be implemented:

- using equipment with lower sound power levels;
- installing silencers for fans;
- hoarding around the site perimeter will be used to screen noise where necessary;
- installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m² in order to minimise the transmission of sound through the barrier. Barriers should be located as close to the source as possible or to the receptor location to be effective;
- where practicable, off-site pre-fabrication will be undertaken.

### Table C14.3 Approximate distance of Plant Equipment from Populated Areas

<table>
<thead>
<tr>
<th>Plant</th>
<th>Approximate Distance from Populated Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumping Station</td>
<td>&lt;5km</td>
</tr>
<tr>
<td>Pre Treatment Plant</td>
<td>&lt;5km</td>
</tr>
<tr>
<td>Desalination Plant /Fresh Water Transmission Lines</td>
<td>&gt;5km</td>
</tr>
<tr>
<td>Hydro Electric Power Plant</td>
<td>&lt;5km</td>
</tr>
</tbody>
</table>
• proper use of plant with respect to minimising noise emissions and regular maintenance - all vehicles and mechanical plant will be fitted with effective exhaust silencers and be maintained in good efficient order;

• selection of inherently quiet plant where appropriate;

• all ancillary plant such as generators and pumps will be positioned so as to cause minimum noise disturbance - if necessary, acoustic enclosures should be provided;

• TBM support sites, especially if operating on a 24 hour basis should be located well away from residential areas;

• noise complaints (with a dedicated point of contact available to members of the public) to be investigated, recorded and where appropriate reported to the Local Authority; and

• reducing project traffic routing through populated areas where practicable and avoid night time movements.

For the operational phase, locating the major plant well away from residential areas is a key measure.

**Cumulative Impacts**

The noise sources expected in the baseline scenario are mostly transient and/or geographically separated from the RSDSC components. There is therefore little potential for additive effects of noise from different activities, which might otherwise create cumulative impacts. There are not expected to be any cumulative noise impacts.

**Residual Impact Significance (post mitigation)**

The route from the Gulf of Aqaba/Eilat to the Dead Sea, and from Fifa to the final destinations in Jordan, Israel and the Palestinian Authority has been designed to avoid populated areas where practicable, and as such during the construction period there are few instances where villages will be disrupted, and as such it is considered that there will only be a temporary moderate impact during the construction of this Scheme.

Potential sources of noise associated with the operation of the Scheme are mainly from the operation of large plant equipment. While all components of the Scheme will operate on a 24 hour basis the maintenance of plant equipment will be limited to day time hours only. Plant equipment will be designed and housed in such a manner to meet IFC and Local noise standards. The design of the Scheme has taken into consideration the location of villages and other populated areas along the Scheme corridor and has avoided located noisy plant within close vicinity where practicable. Although these facilities
can and will be designed to reduce environmental noise emissions, it will be important to ensure that their final locations are chosen to be well separated from residential areas in order to avoid any long term significant noise impacts.

Plant that is located greater than 5 km from a populated area is predicted to have no adverse impact.

Following mitigation, the impact arising from noise associated with the operation of the plant within 5km of a populated area is predicted to be minor.

Table C14.4 Summary of Impacts Pre and Post Mitigation

<table>
<thead>
<tr>
<th>Noise Source</th>
<th>Impact without Mitigation</th>
<th>Residual Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Sites</td>
<td>Moderate</td>
<td>Minor</td>
</tr>
<tr>
<td>Construction Traffic</td>
<td>Moderate</td>
<td>Minor</td>
</tr>
<tr>
<td>Pumping Station Operation</td>
<td>Moderate</td>
<td>Minor</td>
</tr>
<tr>
<td>Pre Treatment Plant Operation</td>
<td>Moderate</td>
<td>Minor</td>
</tr>
<tr>
<td>Desalination Plant / Fresh Water</td>
<td>Moderate</td>
<td>Minor</td>
</tr>
<tr>
<td>Transmission Lines Operation</td>
<td>Moderate</td>
<td>Minor</td>
</tr>
<tr>
<td>Hydro Electric Power Plant Operation</td>
<td>Moderate</td>
<td>Minor</td>
</tr>
</tbody>
</table>

C14.1.1 Traffic Impacts

The Scheme will result in additional traffic arising from delivery of materials or equipment, spoil removal and staff commuting during the construction and operational phases. This will include vehicle loading and unloading at the port of Aqaba.

Additional traffic could potentially result in the following impacts upon other road users or communities located along existing highways:

- reducing capacity for other traffic and potential delay through congestion;
- increased levels of road accidents between vehicles or between vehicles and pedestrians and livestock;
- increased level of highway infrastructure degradation; and
- increased levels of noise, vibration and air pollution.

It is assumed that analysis relating to the ability of excess vehicle loads to be accommodated by existing highways (entitled a ‘swept path analysis’) will be carried out during the detailed Scheme design phase, when more information is available.
Traffic Arising During Construction

Traffic impacts during construction of the Scheme will comprise:

- materials and equipment deliveries to all construction sites;
- spoil removal; and
- worker access to these construction sites.

This traffic will use the Dead Sea Highway from Aqaba, and the Safi-Karak road in Jordan, as well Route 90 in Israel and the Palestinian Territories and new access roads from these highways to enable deliveries, equipment, personnel and spoil removal to access/egress the working areas and construction sites. These new access roads will be retained for use during Scheme operation for maintenance. It is assumed that these roads will be private roads, which are not accessible to the general public.

At the time of writing, the known vehicle movements for the scheme elements are set out in Table C14.5 below.

<table>
<thead>
<tr>
<th>Scheme Elements and Options</th>
<th>Number of delivery of spoil removal trips (Truck Trips per Day)</th>
<th>Staff commuting (Vehicle Trips per Day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipeline</td>
<td>Not yet available</td>
<td>Not yet available</td>
</tr>
<tr>
<td>High level tunnel</td>
<td>300</td>
<td>Not yet available</td>
</tr>
<tr>
<td>Low level tunnel</td>
<td>300</td>
<td>Not yet available</td>
</tr>
<tr>
<td>Intake and pumping station</td>
<td>Not yet available</td>
<td>Not yet available</td>
</tr>
<tr>
<td>Desalination Plant</td>
<td>Not yet available</td>
<td>Not yet available</td>
</tr>
<tr>
<td>Hydro Electric Power Plant</td>
<td>Not yet available</td>
<td>Not yet available</td>
</tr>
<tr>
<td>Fresh Water Transmissions lines</td>
<td>Not yet available</td>
<td>Not yet available</td>
</tr>
</tbody>
</table>

Although staff numbers are known, vehicle occupancy and shift patterns are not yet known. Therefore, it is not possible to determine the actual number of vehicle trips per day at this stage. It is assumed that staff commuting will use buses, which will minimise additional vehicle trips. In addition, current information for truck trips detailed in the table does not include spoil removal.

To enable quantitative assessment of the construction traffic impacts of the Scheme during the next phase of the assessment, the following construction trip information will need to be identified:

- The respective origin and destinations of trips;
- The duration and number of deliveries for each element and option from the respective bill of materials;

(1) Loaded and empty trips are single trips, each delivery corresponds 2 trips (1 loaded and 1 empty)
The duration and number of trips for spoil removal for each element and option;

The number of commuting construction workers, duration of construction period and nature of transport (vehicle types and load factor); and

The number of trips which will take place concurrently due to the construction of multiple scheme elements at the same time, i.e. this will identify the maximum foreseeable additional number of trips and traffic flow for the Scheme.

The maximum foreseeable additional traffic flow for the Scheme can then be compared to the highway capacity and capability and superimposed over the baseline flow to identify the severity of traffic impacts. Based on the above figures, for a typical working day (10 hours duration), current maximum known values for construction of a single element of the scheme (not including spoil removal) will result in one additional truck in either direction of the highway every 4 minutes. Simultaneous construction of more than one site, and including spoil removal, could increase truck frequency considerably, which could result in a significant effect on generated truck traffic.

**Impacts of Generated Traffic**

**Road User Delay:** In international highway terms, the level of generated truck traffic with simultaneous construction of more than one site and including spoil removal could result in a significant amount of generated traffic. At this stage, until mitigation measures have been fully clarified, it is anticipated that this disruption, if unmitigated has the potential to be temporarily significant due to the numbers of HGVs/vehicles that will be required. With the appropriate mitigation measures in place, detailed below, it is considered that this impact could be reduced to *moderate*.

**Road User Impacts – Safety:** Due to the increase in construction traffic there is a potential for increases in road accidents between vehicles or between vehicles and pedestrians or livestock; and increased level of overtaking as a large proportion of the additional traffic will be slower moving trucks. These issues should be managed proactively. Mitigation measures to reduce accident risk are set out in the next section. To enable quantitative assessment of the construction traffic impacts of the Scheme, current accident data (including accident type) would need to be provided for the Dead Sea Highway, the Desert Highway, the Safi-Karak-Qatraneh Road, and Routes 65 and 90. It is not yet known whether these data would be collected at feasibility or detailed design stage.

**Highway Infrastructure Degradation:** Traffic volume and certain vehicle parameters, e.g., axle-load and spacing as well as infrastructure quality are the key determinants of infrastructure degradation. To enable quantitative
assessment of infrastructure capability and potential degradation, arising traffic volume and appropriate vehicle parameters would need to be identified and compared with design criteria for the highways concerned. As above, it is not yet known whether these data would be collected at feasibility or detailed design stage.

**Increased Levels of Noise, Vibration and Air Pollution:** Traffic volume, vehicle types, operating speeds as well as proximity to receptors are key determinants of these impacts. For further details, please refer to the appropriate sections within this chapter.

**Long Term Impacts During Operation**

During the operation, all Scheme elements will operate on a 24 hour basis, with routine maintenance only undertaken during daytime hours. The operation of the Scheme will result in the trip generation, which is set out in Table C14.6 below.

**Table C14.6 Operational Staff and Estimated Trip Frequency**

<table>
<thead>
<tr>
<th>Scheme Component</th>
<th>Staff numbers</th>
<th>Vehicle trips per day (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intake &amp; Pumping Station</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>Desalination Plant</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>Hydro Electric Power Plant</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Freshwater Transmission Lines</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

In international highway terms, the level of generated traffic during operation is relatively small and is predicted to have *no adverse impact.*

**Mitigation**

Best practical means will be used to minimise construction and operational traffic impacts. Appropriate measures for construction and operations phases are set out in the following sections.

The majority of the construction mitigation measures should be included in a *Construction Traffic Management Plan.* Measures would be expected to include:

- A consultation and notification process will be developed to give residents and businesses advance warning of potential delays on the road network as a result of increased traffic and any abnormal loads;

- A traffic strategy should be developed that balances impacts upon other road users and communities along the route; avoiding truck trips on the highway during peak traffic flows and avoiding nuisance to communities, which may require no night time operation in certain areas;

(1) Based upon 2 trips per day per car and 1 person per car
• All abnormal loads will be suitably marked to warn other road users;

• Agreeing specific routes for construction traffic aiming to avoid residential areas and unsuitable parts of the network where possible, for example in Aqaba, Karak, Ein Bokek, Amman and Jericho;

• Minimal night construction in sensitive areas – *ie* for the plant associated with the conveyance;

• Construction personnel to be transported to and from the site each day by organised buses minimising addition vehicle trips;

• New roads to be routed away from sensitive communities and other receptors and to be surfaced and maintained so as to minimise dust generation;

• Before and after surveys of the condition of the road in relation to construction, with repairs where necessary; and

• Measures to reduce the potential for accidents due to the increase in road traffic – *eg* warning signs to local residents, distribution of information materials to local residents, driver training/briefing for HGV construction drivers, speed restrictions and enforcement on approaches to villages.

When applied, these combined traffic mitigation measures are likely to significantly reduce the severity of the impact created during construction.

Given the relatively low level of traffic that will be generated during the operational phase, no operational mitigation is considered to be required.

*Residual Impact Significance (post mitigation)*

Additional traffic has the potential to result in the following impacts upon other road users or communities located along existing highways:

• Reduced capacity for other traffic and potential delay through congestion;
• Increased levels of road accidents between vehicles or between vehicles and pedestrians and livestock;
• Increased level of highway infrastructure degradation; and
• Increased levels of noise, vibration and air pollution.

The level of generated truck traffic with simultaneous construction of more than one site and including spoil removal could result in a significant amount of additional traffic. However, assuming the application of standard mitigation measures, it is anticipated that transport impacts during construction has the potential to be of *moderate* (though temporary) significance due to the numbers of trucks trips required.
This small increase in traffic during operation is predicted to have no adverse impact.

Table C14.7  Summary of Impacts Pre and Post Mitigation

<table>
<thead>
<tr>
<th>Source of Impact</th>
<th>Impact without Mitigation</th>
<th>Residual Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Vehicles – Staff</td>
<td>Temporary Moderate</td>
<td>Temporary Moderate to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slight</td>
</tr>
<tr>
<td>Construction Vehicles – Deliveries</td>
<td>Temporary Moderate</td>
<td>Temporary major to</td>
</tr>
<tr>
<td>and Equipment &amp; Waste Removal</td>
<td></td>
<td>Moderate</td>
</tr>
<tr>
<td>Operational Vehicles – Staff</td>
<td>Slight or None</td>
<td>Slight or None</td>
</tr>
<tr>
<td>Operational Vehicles – Deliveries and</td>
<td>Slight or None</td>
<td>Slight or None</td>
</tr>
<tr>
<td>Maintenance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C14.5.4  Waste

This section identifies the wastes that are likely to arise from the construction and operation of the Scheme and potential environmental impacts associated with the handling and disposal of waste. Given the uncertainty at this point in the precise method of conveyance of the water from the Dead Sea to the Red Sea, the exact amounts of waste arisings, specifically the excavated spoil, is also uncertain. The different potential construction methods have therefore each been considered in this assessment, and the optimum waste management solutions are set out. These will be assessed further during preparation of the Draft ESA Report.

Main Types of Waste

Excavation Spoil

By far the largest quantity of waste arising from the Scheme will be spoil; either from the excavation of trenches for the pipelines or from the drilling of tunnels (depending on which method of conveyance is adopted).

It is understood that if the option of utilising pipelines to convey the water is adopted, then any spoil which is excavated in creating the trenches will be backfilled into the trench and the excess spoil will simply be spread out and contoured along the length of the pipeline route. As such there will be little or no spoil to be disposed with this option.

However, if the tunnel option is pursued, a total of approximately 15 million m$^3$ of spoil is expected to be generated by the tunnelling operations. This will arise at the various tunnel portals, as listed below, and will need to be transported to appropriate disposal sites.

The anticipated quantities of spoil for each tunnel access portal are as shown in Table C14.8. These are the same whether the low level or high level option is adopted, although the number of portals may change during the design process:
Table C14.8  Anticipated Spoil Quantities

<table>
<thead>
<tr>
<th>Portal</th>
<th>Quantity (Mm$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portal 0</td>
<td>1.54 Mm$^3$ (eastern intake)</td>
</tr>
<tr>
<td>Portal 1</td>
<td>none (access only)</td>
</tr>
<tr>
<td>Portal 2</td>
<td>2.98 Mm$^3$</td>
</tr>
<tr>
<td>Portal 3</td>
<td>none (access only)</td>
</tr>
<tr>
<td>Portal 4</td>
<td>2.79 Mm$^3$</td>
</tr>
<tr>
<td>Portal 5</td>
<td>2.24 Mm$^3$</td>
</tr>
<tr>
<td>Portal 6</td>
<td>1.86 Mm$^3$</td>
</tr>
<tr>
<td>Portal 7</td>
<td>1.54 Mm$^3$</td>
</tr>
<tr>
<td>Portal 8</td>
<td>2.00 Mm$^3$ (desalination plant)</td>
</tr>
</tbody>
</table>

Demolition Waste

The Eastern intake site will have to be cleared and levelled. It is uncertain at this stage whether the disused power station will be dismantled and removed prior to the beginning of construction. If not the Scheme will need to dispose of the waste materials, which will comprise inert materials such as concrete but also potentially hazardous wastes such as PCBs (from old transformers), oils and asbestos.

Construction Waste

This will comprise a variety of non-hazardous materials including wood (used timber), excess concrete, vehicle tyres and packaging materials (plastic, card etc), together with a small amount of hazardous wastes such as used oils (from vehicles and machinery), paints, vehicle batteries, fluorescent light bulbs and contaminated containers (old paint tins etc).

General Refuse

General refuse, similar in nature to domestic waste, will be generated by the construction workforce; both at the accommodation camps and at the various work sites. This will comprise a range of mainly non-hazardous materials including food, paper, used containers (bottles, cans etc), packaging and broken furniture.

During operation, general refuse will be generated by the staff responsible for the operation and maintenance of the facilities. This will comprise general domestic waste (food, packaging etc) and office waste (mainly paper). The quantities of general waste generated during the operation will be relatively small because far fewer staff will be employed.

Sewage/Wastewater

Again, this will be generated by the workforce at accommodation camps and work sites along the route of the Scheme and at the sites of permanent employment during the operation. Septic tanks will be installed and used for
the treatment of sewage generated at all of the Schemes’ work and accommodation sites.

The tunnelling machines, if used, will require water for cooling. This will be treated and re-circulated (reused) as far as practical although very small quantities of wastewater contaminated with dust may be generated. There may also be some wastewater generated when the low level tunnel (if this option is adopted) is drilled through water bearing strata before the tunnel sections are put in place and grouted. In both cases, this water will be pumped out and passed through settling ponds to remove solids before any clean water is discharged to natural water courses.

Process Waste

During the operation of the pipeline and associated facilities, there will be very little process waste generated. This will comprise mainly debris collected by the screens at the sea water intake and along the canal, and sludge/scale from pre-treatment prior to the reverse osmosis desalination plant and from cleaning of the membranes. The exact form of the pre-treatment is yet to be determined but is likely to comprise multi-media filtration to remove particulates and possibly air flotation to remove organics. The membranes will be cleaned with acid and/or detergents. The resulting sludges and effluents will be dried by evaporation with the scale and deposited to appropriate landfill (the availability of such landfill will be assessed further, for the Drfat ESA Study).

In addition, the pipeline and canals will generate sludge (sand and algae) which will need to be cleaned out periodically.

A small amount of hazardous wastes, such as used oils (from vehicles and machinery), paints, vehicle batteries and old fluorescent light bulbs, will be generated through maintenance and repair activities.

The approximate quantities of the different types of waste are as estimated in Table C14.9. Where the quantities of waste that are likely to arise are not yet known, these have been estimated based on the number of workers involved in the construction and typical rates of waste generation for such projects.
<table>
<thead>
<tr>
<th>Zone A: Red Sea and Intake (E/N) on the Gulf of Aqaba (with pumping station)</th>
<th>Zone B: Conveyance Route – B1 (pipeline)</th>
<th>Zone B: Conveyance Route – B2 Tunnel (high level)</th>
<th>Zone B: Conveyance Route – B2 Tunnel (low level)</th>
<th>Zone C: Dead Sea (desalination plant)</th>
<th>Zone C: Dead Sea (HEP plant)</th>
<th>Zone D: Fresh water transmission lines</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction Phase:</strong></td>
<td></td>
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<tr>
<td>Dredged material - up to 10,000m³.</td>
<td>Spoil from pipeline excavation.</td>
<td>Rock spoil waste. Total of approx. 14.95 million m³.</td>
<td>Rock spoil waste. Total of approx. 14.95 million m³.</td>
<td>Small amount of excavation waste, likely to be re-used on site</td>
<td>Small amount of excavation waste, likely to be re-used on site</td>
<td>Most of the excavated spoil will be used to back fill the trenches. Excess spoil likely to be deposited along the route</td>
</tr>
<tr>
<td>Disposed to Scheme waste disposal site.</td>
<td>75% will be used as backfill and the rest spread across the top.</td>
<td>About 10% likely to be re-used as aggregates.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Approx. 100t/year For 2-3 years</td>
<td>Approx. 85t/year For 3-5 years</td>
<td>Approx. 760t/year For 8 years</td>
<td>Approx. 760t/year For 8 years</td>
<td>Approx. 275-550t/year For 3-4 years</td>
<td>Approx. 55-85t/year For 2-3 years</td>
<td>Approx. 110 tonnes/year For 3-4 years</td>
</tr>
<tr>
<td>Approx 18m³/day</td>
<td>Approx 15m³/day</td>
<td>Approx 140m³/day</td>
<td>Approx 140m³/day</td>
<td>Approx 50 – 100m³/day</td>
<td>Approx 10 – 15m³/day</td>
<td>Approx 20m³/day</td>
</tr>
<tr>
<td>The existing power station may need to be dismantled and removed resulting in concrete and other inert debris.</td>
<td>Used shuttering, wood, metal etc from trenching and pipe installation</td>
<td>Excess concrete, used form work, metal etc from tunnel fabrication</td>
<td>Excess concrete, used form work, metal etc from tunnel fabrication</td>
<td>Excess construction materials including concrete and wood</td>
<td>Excess construction materials including concrete and wood</td>
<td>Used shuttering, wood, metal etc from trenching and pipe installation</td>
</tr>
<tr>
<td>PCBs, oil and asbestos from old power station. (1)</td>
<td>Vehicle batteries, fluorescent strip lights, oil waste from equipment maintenance, empty fuel/chemical containers</td>
<td>Vehicle batteries, fluorescent strip lights, oil waste from equipment maintenance, empty fuel/chemical containers</td>
<td>Vehicle batteries, fluorescent strip lights, oil waste from equipment maintenance, empty fuel/chemical containers</td>
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<tr>
<td><strong>Operation Phase</strong></td>
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<td><strong>Operation Phase</strong></td>
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<td><strong>Operation Phase</strong></td>
<td><strong>Operation Phase</strong></td>
<td><strong>Operation Phase</strong></td>
</tr>
<tr>
<td>Approx 8 t/year</td>
<td>Approx 11t/year</td>
<td>Approx 5t/year</td>
<td>Approx 5t/year</td>
<td>Approx 55t/year</td>
<td>Approx 27t/year</td>
<td>Approx 27t/year</td>
</tr>
<tr>
<td>Approx 1.5m³/day</td>
<td>Approx 2m³/day</td>
<td>Approx 1m³/day</td>
<td>Approx 1m³/day</td>
<td>Approx 10m³/day</td>
<td>Approx 5m³/day</td>
<td>Approx 5m³/day</td>
</tr>
<tr>
<td>Small quantities of vehicle batteries, fluorescent strip lights, oil waste from equipment maintenance, empty fuel/chemical/paint containers</td>
<td>Small quantities of vehicle batteries, fluorescent strip lights, oil waste from equipment maintenance, empty fuel/chemical/paint containers</td>
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</tr>
<tr>
<td>Debris from the screens at the water intake points</td>
<td>Sludges (sand and algae)</td>
<td>Debris from canal screens</td>
<td>Backwash from RO plant [may have trace metals]. Expect to blend with reject brine. Sludge/scale from pre-treatment (filtration) and cleaning of membranes. RO filter cartridges (fibre)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes
1. Unless the power station is removed prior to commencement of the Scheme
2. Assumes 1.5kg/person/day
3. Assumes 100litre/person/day
Potential Impacts

Most types of wastes have the potential to cause pollution and/or health impacts if not adequately managed and properly disposed.

As noted above, in the case of this particular scheme, by far the largest volume of waste will be the spoil excavated to form the trenches for the pipes that will convey the water or from the tunnelling operation if this option is adopted. Although the spoil will be inert, it has the potential to cause nuisance due to the creation of dust and there will be impacts from its transport to disposal sites. The air quality impacts of the Scheme and other environmental impacts due to vehicles are discussed elsewhere in the chapter. This section will focus on specific impacts relating to the wastes that will be generated and the following section explains what measures will be taken to minimise the impacts.

In the case of impacts from wastes generated by the Scheme, it is difficult to determine the significance of the impacts, since without specific information about which disposal sites will be used for the wastes it is not possible to determine the sensitivity of likely receivers. Several assumptions have therefore had to be made in estimating the likely significance of the different potential impacts.

Excavated Spoil

The excavated spoil itself will be inert in nature and hence unlikely to cause problems of pollution (of groundwater for example) when disposed. The major impacts are therefore likely to relate to the following.

Dust: There may be local nuisance due to dust from the excavated material itself – during loading and unloading onto trucks for its transport and during transport (if not properly contained) and at the place of deposition, and there may be dust nuisance due to the large number of vehicle movements required – along the route to the disposal site. As mentioned above, air quality impacts are addressed elsewhere in this report.

Visual intrusion: If the excavated spoil is spread out along route, as proposed in the case of pipeline construction, the slight mounding will cause alteration to natural contours of the ground. If done carefully, this impact will be minimised. If one of the tunnel options is adopted, the spoil will arise at a small number of discrete locations (tunnel portals) along the conveyance route. The spoil will therefore need to be transported to one or more disposal sites. In addition to the impacts associated with handling and transporting the spoil, as discussed above, there is the potential for visual intrusion caused by the deposition of up 15 million m$^3$ of material at the dump sites. The visual intrusion will be greatest in the event that the excavated material is a different colour from the surrounding rock at the place of deposition.
Physical intrusion: Deposits of excavated spoil have the potential to cause a number of impacts due to their physical presence (particularly because of the large volumes involved in this project) if due precautions are not taken. These potential impacts include: blockage of flood drainage paths including wadis – causing diversion of water and potential flooding of land; barriers to movement of wildlife impeding their natural migration; and covering of archaeological sites.

The inert components of any construction and demolition waste will have similar impacts to those of the excavated spoil – with the main consideration being the creation of dust. Some components of the demolition waste may be more hazardous, such as PCBs from transformers in the existing power station if this has to be demolished as part of the Scheme.

General Refuse and Other Solid Wastes

Inappropriate handling or disposal of general refuse can give rise to a number of potential health impacts and adverse effects on the environment. These include:

- the lighter fractions such as paper are prone to being blown by the wind potentially causing a litter nuisance over a wide area;

- food waste attracts vermin and other disease carriers;

- if inappropriately dumped, food waste can also attract wildlife, possibly leading it into areas where there is the risk of attack from predators or, even if such hazards aren’t a risk, there is still the potential of upsetting the natural balance of the food chain which, given the resource-poor arid environment, is finely balanced;

- gaseous emissions, either direct or from uncontrolled burning of combustible items, can be potentially toxic and/or create nuisance due to odours;

- pollution of water courses/drinking water supplies – either direct from waste materials or from degradation products; and

- health impacts through direct contact with toxic components or uptake through the food chain (e.g., heavy metals, or organic compounds).

Hazardous Wastes

The environmental impacts of many so called hazardous wastes are similar to those of general refuse except that the effects or consequences are more severe or more immediate. Oily wastes, for example, have the potential for pollution of land and water and the consequences are more serious than pollution by, say, food waste. Other hazardous wastes present very specific health or
environmental dangers that need to be avoided by ensuring the waste is appropriately isolated from the environment and treated/disposed to remove the hazard. Examples of such wastes include acids (e.g. from vehicle batteries) and some organic wastes which are toxic. Small quantities of potentially hazardous clinical waste will arise from the health clinics that are to be provided for the workforce. Typically these will comprise syringes, soiled bandages (from treatment of minor injuries etc) and possibly expired drugs. Clinical wastes need to be carefully managed to avoid transmission of infectious diseases and to avoid aesthetic nuisance. Given the nature of this scheme, the volumes of hazardous waste will be quite small and very few, if any, particularly hazardous wastes will be generated.

Sewage

Domestic sewage contains a variety of pathogens as well as having a high loading of organic pollutants, nutrients (N and P) and suspended solids. Discharge of untreated sewage can therefore have a considerable impact on receiving water bodies and the local environment – potentially causing serious health impacts to the local population and contamination of water supplies.

These potential negative impacts include: depletion of dissolved oxygen due to degradation of organic matter or the organic fraction of suspended solids; aesthetic problems due to it unsightly appearance as well as odour; turbidity as a result of presence of suspended solids; eutrophication i.e. the proliferation of one species at the expense of the other species, thereby causing an imbalance in the ecosystem. Public health issues related to disease transmission due to the presence of pathogens may also result.

Safe disposal of domestic sewage is therefore essential to protect public health and to prevent the occurrence of certain nuisances. Human wastes should be disposed of safely in order that they do not contaminate any drinking water supply; give rise to a public health hazard by being accessible to insects, rodents or other possible carriers that may come into contact with food or drinking water; pollute or contaminate any stream for public or domestic water supply purposes or for recreational purposes; and give rise to a nuisance due to odour or unsightly appearance.

Mitigation

Management Systems and Procedures

Procedures will be put in place to ensure that specific measures identified for waste management are implemented. Principally, prior to commencement of the works, a detailed Waste Management Plan (WMP) will be drawn up covering all of the more specific measures outlined below. The WMP will be disseminated to all sites and camps and to all sub-contractors working on the Scheme and personnel at an appropriate level of seniority will be nominated to be responsible for good site practices and arrangements for collection and
effective disposal of all wastes generated by the Scheme. As well as staff with Scheme-level responsibilities for waste management, each site/camp will have one or more staff with responsibility for implementing the waste management procedures detailed in the WMP. All personnel will be trained in proper waste management procedures as appropriate to their level of responsibility and duties. This will include training in concepts of site cleanliness and on appropriate waste management procedures, including waste reduction, reuse and recycling. As part of the waste management system, a system will be developed to record the amounts of the different types of waste that are generated/recycled and disposed.

Waste Minimisation

The waste management hierarchy ranks the different generic methods of waste management in order of general preference from an environmental perspective and shows that priority should be given to avoidance and minimisation of waste generation followed by recovery, reuse and recycling. The least preferred option being disposal (e.g. landfill or incineration). A second internationally accepted principle of waste management is the ‘Proximity Principle’ which states that waste should be managed as close to the point of generation as is practicable. This can be illustrated in the form of a hierarchy with treatment/disposal at source being the most preferred option and export being the least preferred option. Minimising the amount of all waste types that are generated will be achieved by not over-ordering materials and careful control over stock.

The volume of excavated spoil that needs to be transported and disposed will be minimised by reusing it as part of construction works wherever possible. In particular, the tunnel spoil will be of a grain size and composition (mostly granite) that is well suited to road building and it is already planned that tunnel spoil will be used as aggregate for roads associated with the Scheme. It is expected that this will account for 10-15% of the spoil to be generated. It is also anticipated that the Jordanian Ministry of Public Works and Housing (MPWH) will build another carriageway on the Desert Highway sometime during the life of the project. Such a project could use all of the tunnel spoil and discussions should be held with MPWH so that provision can made to make the spoil available to it at suitable times and locations. Any deposits of excavated spoil would therefore only be temporary in nature and these would be located to avoid or at least reduce the potential for the physical impacts discussed above.

Waste Segregation and Recycling

For wastes which are unavoidable, the next priority will be their proper containment, to prevent uncontrolled release into the environment, and segregation of different waste types to ensure the maximum potential for reuse and recycling. There may be opportunities to return some unused materials, which are surplus to requirements, to the original suppliers and this
option will be adopted wherever possible. There are likely to be local markets for prime recyclables such as metals, cardboard and, potentially, plastics but no suitable facilities for more sophisticated recovery/recycling such as would be required for dry cell batteries, lead-acid batteries, fluorescent light tubes etc. Local recycling companies will be contacted to arrange for the recycling of as many waste types as possible. It is envisaged that the following materials will be collected separately for recycling from each of the Scheme’s sites/camps:

- Ferrous metal (construction sites only);
- Non-ferrous metals (construction sites only);
- Wood (construction sites only);
- Plastic bottles (all sites);
- Waste oils (all sites where vehicles are based); and
- Paper (and card) (all sites).

Discussions should be held with recycling companies to determine the exact list of materials that can be recycled and also in what form (e.g., baled, compacted) they should be presented to maximise their value. Collection and storage arrangements can then be implemented accordingly. Those wastes which cannot be reused or recycled will be treated or disposed in the most environmentally sound manner. This will reduce all of the potential impacts associated with the disposal of wastes as discussed above.

**Measures for Management of Waste at Individual Sites/Camps**

**Excavated Spoil**

Any potentially dusty materials will be damped down and all vehicles will be covered to minimise dust nuisance during storage, loading, transport and unloading. If there is a scarcity of water for this purpose, priority will be given to damping down materials where there are nearby receptors that could otherwise suffer a nuisance due to the creation of dust. In the case of the pipeline option, the visual intrusion caused by the deposit of the excavated spoil will be minimised by spreading and carefully landscaping the excess material along the route of the pipeline. The amount of excess spoil will amount to the volume of the pipes and assuming that there will be 3-4 pipes each of 3.5 m diameter this equates to a total cross-sectional area of 29 –38 m². Thus, if this material is spread across the entire 60m wide corridor to be established for the pipeline this equates to an average depth of 0.5 - 0.65m. In the case of the tunnelling option, the excavated spoil will be deposited at sites approved by the local environmental regulatory authorities. The optimum locations for these sites are currently being investigated.

**General/Non-hazardous Wastes**

The non-recyclable refuse will be placed in bags and stored in enclosed bins, and disposed of on a daily basis. This will avoid the occurrence of wind-blown litter, odour, water quality impacts and vermin nuisance. The open
burning of any waste at construction sites, permanent Scheme sites or workers’ accommodation camps will be prohibited. General refuse will be transported directly to local, approved landfill or to a Scheme incinerator as indicated in the WMP. The nominated staff at each site/camp will complete a waste consignment note to detail waste leaving the site. All loads of waste removed from the site/camp will be accompanied by a waste consignment note and the details will be recorded and retained on site. Where a sub-contractor is used to transport waste he will be approved by the nominated person with overall responsibility for waste management and will have all necessary permits/licences. All waste will be transported in roadworthy, dedicated vehicles and all waste will be suitably covered during transport to avoid windblown litter. All sites/camps will have sufficient, clearly labelled containers for separation of general refuse; ferrous metals; non-ferrous metals; plastic bottles; and any specific hazardous wastes that arise at the particular site. The requirement for additional containers will be regularly reviewed by the personnel responsible for waste management at the Scheme and site level based on the potential for recycling different materials and/or the need to store particular waste types.

**Hazardous Wastes**

Any hazardous wastes that are generated at any of the sites will be stored safely and securely for later disposal. The key objectives will be to ensure no possibility of hazardous waste entering the non-hazardous waste stream and no risk to human and environmental health. Storage areas for hazardous wastes will be clearly labelled and used solely for the storage of hazardous wastes and will be enclosed on at least three sides. Containers used for the storage of hazardous wastes will be suitable for the substance they are holding, resistant to corrosion, maintained in a good condition, and securely closed, display a label in Arabic and English to state clearly the nature of the waste, any hazards which it may pose and contact numbers of persons that can provide additional information in the case of an emergency and display any international hazard warning sign as appropriate. In the case of liquid hazardous wastes, storage areas will have an impermeable floor and bunding, of capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in that area, whichever is the greatest, be adequately ventilated, and will be covered to prevent rainfall entering (water collected within the bund and will be arranged so that incompatible materials are appropriately separated.

All hazardous wastes will be collected by suitably approved waste collectors and disposed at a facility licensed to receive the specific types of waste. The capability and track record of waste collectors will be assessed and confirmed with the regulatory agencies prior to the appointment of any contractors. As for non-hazardous wastes, recycling will be the preferred option if this can be undertaken safely. It should be feasible for recycle waste oils and larger batteries, for example. Sewage and other wastewater from the accommodation camps and Scheme sites will be collected and treated in septic tanks before
discharge to avoid contamination of the surrounding areas. The condition of the septic tanks will be checked regularly and the accumulated sludge will be pumped out and disposed to an appropriate landfill site as required. A regular cleaning and maintenance programme for drainage systems, sumps and oil interceptors will be implemented at all Scheme sites.

Treatment and Disposal of Non-Recyclable Wastes

There are currently limited facilities that are suitable for the disposal of most waste types other than inert wastes. There are various domestic waste landfill sites in Jordan although the standards of design and operation of these sites is variable. For example, none of the landfill sites in the project area are lined. The site in Aqaba is particularly problematic as it is situated on the Wadi Yutum aquifer, and is unlined. The landfill sites that are closest to the various Scheme components should be reviewed to determine their suitability for disposal of the range of wastes that will be generated. Exact disposal arrangements will be determined as the Scheme design progresses and following the assessment of existing disposal sites. The specific arrangements for the transport and disposal of the different waste types will be detailed in the Waste Management Plan (WMP). The main options that will be considered for the disposal of general refuse are as follows:

- **Utilise existing landfill sites** - As noted above, the suitability of the existing sites will need to be assessed before the works commence. This option may also involve transporting waste considerable distances.

- **Develop new landfill(s)** - By developing its own landfill site(s), the Scheme’s operator would be able to ensure design and operation to international standards (eg EU Landfill Directive) and, providing a suitable location can be found, could avoid transporting the waste potentially long distances. This may be the only feasible option for the large quantities of excavated spoil that will require disposal if the tunnelling option is adopted. Any new landfill sites would be developed in accordance with the local planning and permitting requirements and with close liaison with the local regulatory agencies.

- **Incineration** – The advantage of incinerating the general refuse is that the resulting ash will have a much smaller volume than the original waste and it will be essentially inert thereby enabling disposal in a wider range of landfill sites. Portable (containerised) incinerators could be utilised during the construction phase of the Scheme when the greatest volume of refuse will be generated.
Treatment and Disposal of Hazardous Wastes

As noted above, it should be feasible to recycle waste oils. It may also be possible to recycle larger batteries (to reclaim the lead). Whether or not this is feasible in practice will depend on there being local recycling companies that operate to health and safety and environmental standards that are sufficiently high to meet the requirements of the Scheme. This will be determined through inspection of the facilities concerned and discussion with the operators and regulatory agencies to assess their suitability. If on-site incinerator(s) are used for the treatment of the general refuse generated during the construction phase, it should be possible to utilise these for the disposal of some of the more hazardous wastes such as oily rags, paint residues and clinical wastes. Incinerators will be specifically chosen to provide as much flexibility as possible in terms of the range of wastes that can be burned.

Those wastes which cannot be recycled or incinerated on site should be transported to the closest suitable disposal site. This will depend on the individual type of waste. There is one operational hazardous waste treatment facility at Swaqa in Jordan and this will be assessed during the detailed design stage to determine the range of wastes that it may be used to treat. In the case of any hazardous wastes that are expected to be generated and which cannot be treated at the Swaqa facility, alternative treatment options will be investigated in neighbouring countries. It is expected that, if required at all, this will be necessary only for very small quantities of some very specific waste types. The WMP will detail the preferred treatment options for all of the expected types of waste and will also include a procedure for determining how any other wastes, not expected at this stage but which arise during the Scheme, will be treated.

Selection of Spoil Disposal Sites

The following criteria should be taken into account when selecting sites for the disposal of the spoil excavated from tunnelling, if this option is adopted:

Proximity to Source of Waste: There are always benefits in disposing of waste close to its point of arising. This is known as the ‘proximity principle’. In this case the spoil will arise at the tunnel portals where the spoil will be brought to the surface. Minimising the distance travelled from the portal to the disposal site not only reduces the cost to the operator, it will also reduce the environmental impacts associated with the vehicles transporting the spoil including vehicle emissions and creation of dust.

Ease of Access: This is closely related to proximity in that environmental impact, as well as cost, is likely to be minimised if there is easy access from the points at which the waste arises to the final disposal sites. Ease of access in the context of the spoil disposal for this project primarily means the existence of roads suitable for the trucks that will need to transport the spoil material.
**Proximity to Sensitive Receptors:** The disposal of the spoil has the potential to cause significant nuisance to any sensitive receptors close to the disposal site. In particular, any people living, working or travelling close to the disposal site could be adversely affected by the dust that may be created and the noise of the vehicles delivering the spoil to the site and machinery operating on the site. They may also be impacted by the increase in traffic due to the vehicles using the local roads. A second likely sensitive receiver is ecology. In this case, wadi mouths and other flow paths (even if intermittent) should be avoided. Bird migration routes and seasons and bird breeding seasons should be part of the consideration. Disposal sites therefore need to be selected to avoid proximity to any sensitive receivers and to ensure that vehicles delivering spoil to the site do not cause an adverse nuisance.

**Visual Impact:** As noted elsewhere in this report, one of the most significant potential impacts associated with the disposal of the large quantities of spoil that will arise if the tunnelling option is adopted will be the visual impact of the spoil material at the disposal site. This will be particularly the case if the spoil is of a very different colour from the rocks surrounding the disposal site. It is therefore important that disposal sites are chosen and/or operated so as to minimise such visual intrusion. This can be achieved in various ways including selection of a site that is not visible from villages/settlements or main roads – either because of its remote location and/or due to natural screening because of the local topography; or use of landscaping to ‘hide’ the site from settlements and main roads – this would obviously need to be done carefully to so as to create a ‘natural effect’. In practice, given the large volume of spoil involved, it is quite likely that a combination of the two methods will be required; a site should be chosen which provides as much natural screening as possible but it may be necessary to supplement this with additional landscaping.

**Surface and Groundwater Pollution:** The excavated spoil will be virtually ‘inert’ in terms of biological and chemical reactivity. Its disposal should therefore have little or no potential to cause pollution although run-off from the site(s) where it is disposed will have the potential to cause a variety of problems, including silting up of drainage ditches and ‘smothering’ of adjacent land, if not adequately controlled. Disposal sites should therefore be selected where such impacts are unlikely to cause problems and should be operated to avoid run-off.

**Surface Water Drainage:** Disposal site(s) should be selected such that the deposited spoil does not cause a problem due to the drainage of surface water from surrounding land. Specifically, each site needs to be selected so that the spoil deposit does not cause blockage of flood drainage paths, such as wadis (even if seasonal), or diversion of the water such that there is localised flooding or, conversely, such that areas that need water for irrigation do not receive water.
**Creation of Physical Barriers:** Spoil disposal sites need to be chosen so that they do not create barriers to the movement of people or animals e.g. impeding the natural migration of wildlife. Potential sites should therefore be surveyed across all seasons to ensure such routes taken by people and wildlife are not adversely impacted.

**Burial of Sensitive Habitats or Important Archaeology:** The spoil should not be deposited on land which is an important or sensitive habitat for local species of flora or fauna or which is archaeologically important.

**Residual Impact Significance (post mitigation)**

The assessment of potential impacts due to wastes arising from the Scheme has been based on details of the proposed Scheme available at this stage of the design. It has outlined what impacts could arise and indicated what measures will be taken to avoid or reduce these impacts. The expected impacts, covering both construction and operation, are summarised in *Table C14.10*.

**Table C14.10  Summary of Waste Management Impacts & Mitigation**

<table>
<thead>
<tr>
<th>Nature of Impact</th>
<th>Mitigation</th>
<th>Residual Impact</th>
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<tr>
<td>Dust</td>
<td>Damping down</td>
<td>Slight</td>
</tr>
<tr>
<td>Visual impact</td>
<td>Reuse to minimise volumes</td>
<td>Slight</td>
</tr>
<tr>
<td></td>
<td>Careful landscaping</td>
<td></td>
</tr>
<tr>
<td>Dust</td>
<td>Damping down</td>
<td>Slight</td>
</tr>
<tr>
<td></td>
<td>Covering of vehicles used to transport waste</td>
<td></td>
</tr>
<tr>
<td>Visual impact</td>
<td>Reuse to minimise volumes</td>
<td>Slight</td>
</tr>
<tr>
<td></td>
<td>Disposal at authorised landfill sites</td>
<td></td>
</tr>
<tr>
<td>Public health</td>
<td>Waste minimisation measures</td>
<td>Slight</td>
</tr>
<tr>
<td>Windblown litter</td>
<td>Implementation of WMP</td>
<td></td>
</tr>
<tr>
<td>Odour</td>
<td>Provision of adequate containers</td>
<td></td>
</tr>
<tr>
<td>Vermin</td>
<td>Segregation of different waste types</td>
<td></td>
</tr>
<tr>
<td>Pollution of groundwater</td>
<td>Recycling of materials</td>
<td></td>
</tr>
<tr>
<td>Gaseous emissions</td>
<td>Disposal of residues at approved landfill or on-site incinerator(s)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Audit of disposal sites to check adequacy</td>
<td></td>
</tr>
<tr>
<td>Direct health/safety impacts (toxic/corrosive/flammable/infectious/aesthetic - depending on specific waste)</td>
<td>Waste minimisation measures</td>
<td>Slight</td>
</tr>
<tr>
<td></td>
<td>Implementation of WMP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Provision of adequate containers with proper labelling, secure storage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Segregation of different waste types</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Recycling (eg oils) where feasible</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Disposal at appropriate sites - Audit of disposal sites to check adequacy</td>
<td></td>
</tr>
<tr>
<td>Groundwater pollution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public health</td>
<td>Use of septic tanks with proper monitoring/disposal of sludge</td>
<td>Slight</td>
</tr>
<tr>
<td>Aesthetic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundwater pollution</td>
<td></td>
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</tbody>
</table>
In summary, provided that appropriate measure are taken to adequately contain, transport and dispose of the different types of waste, there should be only minimal impacts as a result of the wastes generated by the Scheme.

The biggest waste management challenge for the Scheme will be to identify suitable local treatment and disposal sites that are able to manage the different wastes, particularly the waste spoil from the tunnel excavation. Some wastes may need to be transported to more distant sites and very small quantities of the more hazardous wastes may need to be exported. If the tunnelling option is adopted, there will be very large quantities of inert waste to be disposed. This waste will not be polluting but could lead to a dust nuisance if not handled with appropriate precautions and a suitable location will need to be found for the large volume of material to be deposited without causing visual intrusion.

The options for disposal of the excavated spoil if the tunnelling option is adopted are currently being investigated. As part of a more detailed assessment, contractors and facilities that could be utilised for the management of the various waste streams would be audited to determine their capabilities and experience and to confirm that they hold the necessary licences/permits. This would include assessment of:

- potential waste collectors/transporters;
- local waste recovery/recycling contractors and facilities; and
- local waste treatment/disposal facilities.

Depending on the outcome of these assessments, the geographical area of this investigation would be extended to include contractors and facilities in neighbouring countries and, if necessary, would be widened further to include international contractors.

**C14.6 CUMULATIVE ENVIRONMENTAL QUALITY IMPACTS**

Many of the aforementioned impacts to environmental quality come from a small number of sources (for example construction traffic and construction activities occurring at the same site) so will impact the same receptors. Therefore as well as considering each of these aspects separately, it is important to consider the impacts from their occurring and impacting the same receptors. There are also some parallels in how to mitigate these impacts that can be drawn so as to align the considerations of air, noise, traffic mitigation etc.

These areas of cumulative impacts to environmental quality impacting on particular communities will occur for example impacting communities sited close to tunnel entrances. Here there would be relatively intense activities, including traffic movement that would give rise to air quality and dust issues, general disturbance from traffic, and noise from construction. Communities
that have been identified as being particularly exposed to such areas of relatively intense disturbance are:

- Aqaba, communities close to northern intake (if it is used);
- Tourist receptors mostly to Ayla development;
- Rahma, close to workers camp and tunnel adit;
- Rishe, close to pipeline and canal section;
- Bir Mathkour, close to pipeline and canal, and also adit on high level tunnel;
- Finan close to canal;
- Gweibeh close to pipeline;
- Fifa;
- Safi & communities between Safi and Dead Sea, including APC workers housing;
- Villages along freshwater stretch west of Desert Highway;
- Along Desert Highway;
- In south Amman.

The impact to these communities could be minor to moderate before mitigation depending on community sensitivity and their particular proximity to construction activities. Mitigation in relation to these impacts could include:

- Siting of worksites and workers’ camps more than 5 km from villages or settled areas. Where possible, site camps and access roads to the south of the existing settlements (eg Rahma) to reduce impacts from dust and noise;

- Close examination of all pipeline routes to avoid settled areas where possible;

- Management of construction works to reduce noise, dust, to control working hours (see specific mitigation in the Biophysical Report for individual issues). Depending on the location of access roads, limits to the permitting working hours for vehicle transportation to the site should be set, prohibiting transport of spoil between 11 pm and 7 am, and on Friday until 13:00.

Such mitigation is standard and managed by codes of construction practice and it is envisaged that the residual impact would then be reduced to minor significance (see Table C14.11 below).
### Table C14.11  Cumulative Impact Significance Pre and Post Mitigation

<table>
<thead>
<tr>
<th>Potential Impact</th>
<th>Potential Significance of Impact Before Mitigation</th>
<th>Significance after Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic impacts to communities from congestion, delay, and increased risk of road accidents.</td>
<td>Moderate negative</td>
<td>Minor negative</td>
</tr>
<tr>
<td>Noise impacts to communities during construction of the project</td>
<td>Moderate negative</td>
<td>Minor negative</td>
</tr>
<tr>
<td>Impacts associated with waste transportation and disposal.</td>
<td>Moderate negative</td>
<td>Minor negative</td>
</tr>
<tr>
<td>Impacts to communities, birds or other receptors from dust arising from construction of scheme components.</td>
<td>Moderate negative</td>
<td>Minor negative</td>
</tr>
<tr>
<td>Cumulative impacts from environmental quality aspects (noise, air quality, traffic) to communities in intense construction areas</td>
<td>Moderate negative</td>
<td>Minor negative</td>
</tr>
<tr>
<td>Cumulative impacts from environmental quality aspects (noise, air quality, traffic) to communities in less intense construction areas</td>
<td>Minor negative</td>
<td>Minor negative</td>
</tr>
<tr>
<td><strong>Operation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise impacts during operation will be minor within 5 km of pumping stations, and negligible in all other cases.</td>
<td>Moderate negative</td>
<td>Minor negative</td>
</tr>
</tbody>
</table>

For communities in areas of less intense construction activity, i.e. those communities generally lying along any of the pipeline routes, or close to access roads, the potential impact before mitigation would be minor, and appropriate mitigation would include general principles to manage construction sites to reduce noise, dust, to control working hours, as explained in more detail in the mitigation sections of the topic specific discussion above, and as summarised below that explains the principles of managing and mitigation environmental quality impacts.
C14.7 Mitigation of Impacts

C14.7.1 Updating the Analysis Prior to Project Inception

This analysis was carried out in 2009 in conjunction with the FS sub studies. It is unlikely that construction will begin before 2012 or that the Scheme can begin operation before 2020. As explained above, due to the current state of the Scheme’s design, detailed assessments have not been possible. In addition there are aspects of the scheme which can be properly considered only after detailed site plans are known. Periodic monitoring should be undertaken in the period leading up to construction and this should inform the design of any additional investigations that will be needed later in the project development cycle before construction begins. In terms of environmental quality aspects this may include additional studies such as conducting a survey of traffic on the Dead Sea highway between Aqaba and Ghor Fifa and verifying the actual distances between site boundaries and the nearest sensitive receptors (especially habitations), based on the finally selected conveyance type, routing and locations of other fixed infrastructure.

C14.7.2 Approach to Planning and Management

A detailed Environmental and Social Management Plan (ESMP) will be developed by the ESA team and presented in the Final ESA Report. The ESMP will constitute a critical link between the management and mitigation measures specified in the report and the proper implementation and management of the measures during the construction and operation of the project. It will summarize the anticipated environmental and social impacts and provide details on the measures responsibilities and scheduling to mitigate these impacts; the costs of mitigation; and, the ways in which implementation and effectiveness of the measures will be monitored and supervised. The measures required by the ESMP will be incorporated in a series of documents that will be linked through the ESMP and the associated Monitoring Plan. These documents are as follows.

- Relevant provisions of the ESMP will be incorporated into the Contract Documents prepared for firms bidding to work on major project construction activities forming a binding contractual obligation that specifies not just design features but, where the ESMP so requires, management of workers, vehicles, machinery, operating times, methods of working, complaints management etc.

- Relevant provisions of the ESMP will also be incorporated into the operational contracts. These binding contractual obligations will specify, where the ESMP so requires, site management and maintenance routines, employment practices, vehicle routes, operating times, methods of working, complaints management etc.
• Relevant provisions of the ESMP will also be incorporated into the agreement of the entity created to manage the project. This will include: a monitoring plan for noise, dust, and water and a supervision plan to check the progress and effectiveness of the environmental and social mitigation measures; arrangements to implement the provisions of the resettlement action plans, if any are needed; and, provisions to implement institutional capacity development for the regional entities created to supervise or monitor the thematic aspects of the scheme as well as national and local government officials.

C14.7.3 Design Issues

The mitigation measures described in this document were developed to address residual impacts predicted to arise from the scheme as described in the Feasibility Study’s Options Screening and Evaluation Report, with any additional mitigation described by the Feasibility Study team during the preparation of the report. Elements of design may change as the project cycle advances. Where appropriate, therefore, the mitigation measures suggested above that relate to engineering design and operations, selection of abatement technologies, treatment etc are in the form of Design Principles: ie a set of good practice approaches to environmentally and socially sensitive aspects of design (such as site selection, routing of vehicles, management of sites and workers, performance standards of selected equipment etc). These should be included into the Feasibility Study recommendations to be carried forward and elaborated as the design is refined.

C14.7.4 General Construction Issues

Many of the issues relating to environmental quality are particularly relevant during the construction phase of the Scheme. A Construction Management Plan (CMP) will be implemented, whereby every main contractor (and by their sub-contractors) has its performance monitored by the client (ie the relevant beneficiary agency), or an independent entity acting on their behalf (eg the supervising engineer, or a qualified professional organisation or NGO). The requirement to implement the CMP, and meet the standards therein, should be a contractual obligation on the contractor. The CMP will cover, inter alia:

• Workforce and local residents’ health and safety;

• ‘Good housekeeping’ site management practices (eg erosion control, materials storage, maintenance of silt traps and oil separators, waste management, etc);

• Flow regimes during construction (particularly during diversion);

• Emergency response to significant accidents/pollution incidents;
- Siting of temporary structures/work locations/materials sourcing (e.g. for sand dredging);
- Timing of certain activities (e.g. to avoid the rainy season, or the breeding seasons or migratory movements of animals);
- Site clean-up and restoration of all areas temporarily affected by construction activities, and decommissioning of all construction-related facilities;
- Management of camps and workers;
- Management of work sites, site accesses and construction vehicles;
- Water supply and wastewater disposal;
- Criteria for disposal of excavated material (preliminary identification of potential sites); and
- Public communications and complaints management.

**C14.7.5 Monitoring**

A monitoring regime should commence as soon as project financing is in place. Some elements in and around the project area will be monitored from a date prior to construction, to allow a baseline to be established against which changes during construction, and on into operation, can be assessed. Some of the monitoring will be included in the ongoing activities of government agencies already active in the project area; some will be the responsibility of the contractors; and some should be carried out by the agency (or agencies) responsible for development and operation of the project, or organisations appointed by them. The monitoring programme will include monitoring of environmental quality at and around sites that are sensitive to aspects of project construction and operation (noise, air quality, traffic volume and traffic safety). The monitoring programme will establish effective feedback mechanisms so that the performance and effectiveness of the various elements of the ESMP can be evaluated, and necessary corrective actions can be implemented. A formal audit, review and feedback system for the overall ESMP will be implemented.
The assessment of impacts relating to this thematic area will be carried out when the relevant information from the associated detailed FS sub-studies and Additional Studies is made available later in 2010. The results will form part of the Preliminary Draft ESA Report that is due for submission in January 2011.
PART D

Environmental and Social Management Plan
The ESMP will form part of the Preliminary Draft ESA Report that is due for submission in January 2011. The outline contents for the ESMP will be as follows:

D1. Land Acquisition Framework and Plan

D2. Involuntary Resettlement

D3. Indigenous Peoples Development Framework and Plan

D4. Plan for Control of Construction Activities
   D4.1 Public Consultation and Communications
   D4.2 Monitoring Arrangements
   D4.3 Archaeology/Cultural Resources
   D4.4 Construction Spoils Management
   D4.5 Erosion and Sediment Control
   D4.6 Fugitive Dust Control
   D4.7 Noise Control
   D4.8 Wadi Crossing
   D4.9 Protected Areas
   D4.10 Tree Planting and Restoration of Natural Habitats
   D4.11 Traffic Control
   D4.12 Occupational Health and Safety
   D4.13 Health and HIV/AIDS Management

D5. Plan for Operations Phase Mitigation and Monitoring
   D5.1 Introduction: Monitoring activities, objectives and reporting
   D5.2 The Upper Gulf of Aqaba/Eilat.
   D5.3 The Ecological Status of the Wadi Araba
   D5.4 Wadi Crossings
   D5.5 Protected Areas
   D5.6 Habitat Restoration Programme
   D5.7 Dead Sea Environmental and Social Mitigation
   D5.8 Desalination and Power Generation Sites
   D5.9 Freshwater Transmission Routes

D6. Capacity Development and Training
   D6.1 Assessment of the capability of environmental oversight
   D6.2 Description of required institutional oversight
   D6.3 Required enhancements/organizational changes and costs
   D6.4 Draft ToR for Institutional Strengthening

D7. Implementation Schedule and Cost Estimates
Annexes

Annex I. Public Consultation and Communication Report
Annex II. Report on Strategic Alternatives (TSC)
Annex III. EA report preparers
Annex IV. References used in study preparation.
Annex V. Record of Meetings (Governments, Agencies, etc.)
Annex VI. Public Consultation and Disclosure Plan for the Implementation Period
Annex VII. Archaeological and Historical Sites Survey
Annex VIII. Archaeological Chance Find Procedures
Annex IX. Social Assessment
Annex X. Resettlement and Land Acquisition Policy Framework
Annex XI. Occupational Health and Safety Plan
Annex XII. Health and HIV/AIDS Assessment and Management Plan
Annex XIII. Detailed Corridor Location Maps for Baseline Data
Annex XIV. Detailed Corridor Location Maps for Mitigation Measures