Chapter 10 – Hazard Analysis and Risk Assessment (Unplanned Events)

Contents

10 Hazard Analysis and Risk Assessment (Unplanned Events)

10.1 Introduction

The technical surveys that have been undertaken to establish baseline conditions and enable impact assessments are dealt with in the previous sections of this report, but these deal with potential impacts under normal construction and operational conditions. They assume that there will be management systems and controls in place and that uncontrolled releases to the environment cannot take place. This section considers the potential impacts of unplanned events such as fires, major spills, etc. Typically, although the likelihood of such events is very low, the potential consequences can be very significant.

10.2 Potential Accidents and Incidents

The potential accidents and incidents that can be reasonably foreseen for a facility such as this are shown in *Figure 10.1* overleaf. It should be noted that these are highly unlikely but potentially possible scenarios and whilst there is not an expectation that they will occur, the impact of such an occurrence needs to be considered. The matrix that follows *Figure 10.1* discusses in more detail each possible scenario and how it might affect the identified media. Where there is the potential for the media to be affected adversely by the described event, the cell is shaded orange. Where there is unlikely to be any notable impact from the incident or occurrence described the cell is not shaded. The shaded cells thus effectively summarise the full range of impacts that could be reasonably foreseen in the event of one of the major incident or abnormal operation scenarios being realised on the site.

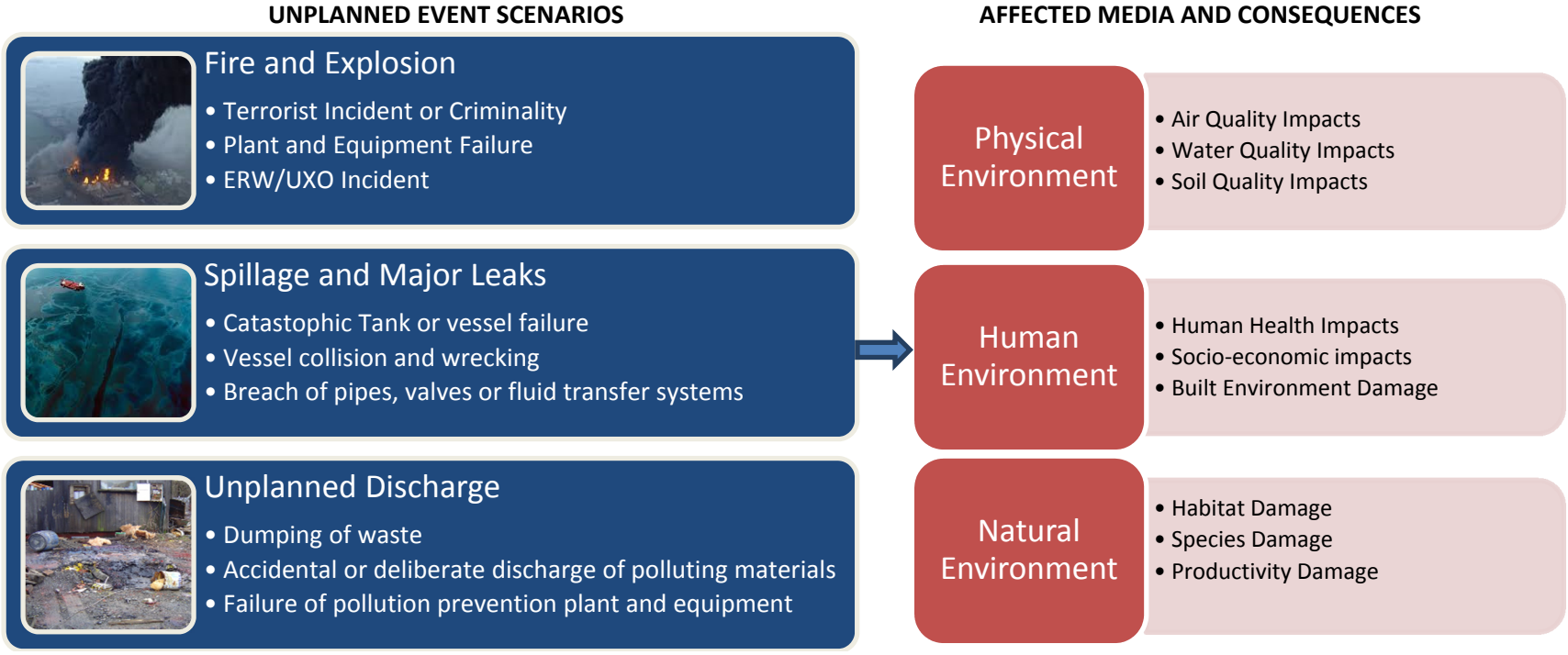

Figure 10.1: *Potential Unplanned Events and Consequences*

Overleaf the above Events and Consequences are set out in the risk analysis matrix.

Table 10.1: Events and Consequences Risk Matrix

Unplanned Major Event		Environmental and Social Consequence								
		Physical Environment			Human Environment			Natural Environment		
Event	**Scenario**	**Air Quality**	**Water Quality**	**Soil Quality**	**Heath Impact**	**Socio-economic Impact**	**Built Environment Impact**	**Habitat Damage**	**Species Damage**	**Productivity Damage**
Fire/Explosion	Large scale fire releasing plumes of smoke and fume to significant height.	All three media could be impacted by chemicals entrained in the smoke plume grounding and imparting the contaminants to the receiving media. A particular concern would be dioxins in a major hydrocarbon fire.			Any persons inhaling smoke and fume could suffer health impacts (in addition to those directly injured).	The damage to the affected facilities will have a financial impact and could lead to job losses.	Such an event is unlikely to have any notable impact on the off-site built environment.	The grounding of the smoke plume is unlikely to cause habitat damage & any coating effect will be temporary.	Species can evade the plume and are unlikely to be affected.	Biological productivity is unlikely to be affected by such an event.

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Large Scale Hydrocarbon Spillage	Major release from vessels & pipes inundating land area.	Air quality may temporarily be impacted by vapours from a major spill.	Groundwater quality can be severely impacted by such an event.	Soil quality could be severely impacted by such an event but contamination is likely to remain localised.	There are unlikely to be any direct health impacts as any persons involved should have PPE.	There could be substantial socio-economic impacts with direct job losses.	This event is unlikely to affect any off-site built environment assets.	The area of spill is likely to be within the project site where there will be no habitat so there is unlikely to be a significant impact.	Species can evade the spill and are unlikely to be present on the site or affected.	Biological productivity is unlikely to be affected by such an event.

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	Major release from vessels & pipes inundating water area.	Air quality may temporarily be impacted by vapours from a major spill.	Surface water quality can be severely impacted by such an event and could spread over substantial areas given the tides and wind.	Terrestrial soil quality is unlikely to be affected but sediments and inter-tidal soils could be severely impacted.	There are unlikely to be any direct health impacts as any persons involved should have PPE but people eating contaminated fish could suffer ill health.	There could be substantial socio-economic impacts with direct job losses and elimination of the local fishing industry.	There could be impacts at the ports and other riverside facilities if a large oil slick reaches them, coating facilities and infrastructure.	Habitats that are reached by any spill could be coated and severely impacted.	Benthic and inter-tidal species will be severely impacted where they come into contact with the spill and marine species could be affected by coating & longer term ingestion.	Severe contamination of the water body over a large area could inhibit or damage biological productivity.

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Unplanned Major Event		Environmental and Social Consequence								
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Event	**Scenario**	**Air Quality**	**Water Quality**	**Soil Quality**	**Heath Impact**	**Socio-economic Impact**	**Built Environment Impact**	**Habitat Damage**	**Species Damage**	**Productivity Damage**
Dumping of Waste	Dumping of solid and liquid waste on the land.	Air quality is unlikely to be affected by such an event.	Groundwater quality could be impacted if pollutants leach out of the wastes into the groundwater.	Soil quality could be directly impacted by such an event	Health impacts could occur if the public have access to the waste areas.	There are unlikely to be any socio-economic impacts from this event	There are unlikely to be any impacts on the built environment from this event.	If the wastes are dumped in a sensitive environment habitats could be damaged.	Species can evade the waste tipping operations and are unlikely to be affected.	Biological productivity is unlikely to be affected by such an event.
	Dumping of solid and liquid waste in water.	Air quality is unlikely to be affected by such an event.	Water quality could be directly impacted by such an event.	Soil quality is unlikely to be affected by such an event.	There are unlikely to be health effects from such an event.	There are unlikely to be any socio-economic impacts from this event	There are unlikely to be any impacts on the built environment from this event.	If the wastes are dumped in a sensitive environment habitats could be damaged e.g. the inter-tidal zone.	Species can evade the waste tipping operations and are unlikely to be affected.	Biological productivity is unlikely to be affected by such an event.

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Releases from Equipment Failure	Airborne emissions of pollutants.	Air quality may temporarily be impacted by such releases.	Water quality is unlikely to be impacted by such an event.	Soil quality is unlikely to be affected by such an event.	There are unlikely to be health effects from such an event.	There are unlikely to be any socio-economic impacts from this event	There are unlikely to be any impacts on the built environment from this event.	The grounding of the emissions is unlikely to cause habitat damage & any coating effect will be temporary.	Species are unlikely to be affected by such an event	Biological productivity is unlikely to be affected by such an event.
	Waterborne emissions of pollutants.	Air quality is unlikely to be impacted by such an event.	Water quality may temporarily be impacted by such releases.	Soil quality is unlikely to be affected by such an event.	There are unlikely to be health effects from such an event.	There are unlikely to be any socio-economic impacts from this event	There are unlikely to be any impacts on the built environment from this event.	The releases to water are unlikely to damage habitat.	Species could be impacted by toxic, nutrient rich or otherwise harmful releases.	Biological productivity could be impacted by long term releases of endocrine disrupters or toxins.

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Event	**Scenario**	**Air Quality**	**Water Quality**	**Soil Quality**	**Heath Impact**	**Socio-economic Impact**	**Built Environment Impact**	**Habitat Damage**	**Species Damage**	**Productivity Damage**
Release of debris from facility damage & destruction	Large scale damage to facility.	Air quality is unlikely to be impacted by such an event.	Water quality could be impacted where debris falls into the water.	Soil quality could be affected where debris is left on land.	There are unlikely to be health effects from such an event.	There are likely to be socio economic impacts from long term job loss.	The built environmental will be impacted by the loss of assets.	Habitats are unlikely to be affected as there are none on the established site.	Habitats are unlikely to be affected as there are none on the established site.	Biological productivity is unlikely to be affected by such an event.

Considering the above matrix the foreseeable environmental risk scenarios and consequences are summarised below in *Table 10.2*. This also presents the anticipated mitigation and control scenarios expected to be deployed by the operator to either eliminate or minimise the effects of such scenarios, should they be realised.

Table 10.2: Environmental Risk Scenarios and Mitigation

Incident Scenario	Affected Environment	Mitigation Measures
Fire Explosion	▪ Air, Water and Soil Quality ▪ Human Health impacts ▪ Socio Economic Impacts	The facility will be a modern materials handling and berthing terminal designed and built to international standards. The design will go through an Engineering design, Procurement and Construction process and will be subjected to HAZOP and HAZID reviews and Construction Quality Assurance programmes. This provides the opportunity to identify and design out many potential incident scenarios and where they cannot be designed out, protection measures will be employed which include: ▪ Total Site Security (controlled access) ▪ Fire Detection and Alarm System ▪ Firefighting Capability ▪ Preventive Maintenance Programme ▪ Modern Equipment ▪ Trained and Experienced Operatives ▪ Certified Management Systems ▪ Monitoring and Audit Programmes ▪ Emergency Response Plan
Large scale hydrocarbon release to land.	▪ Air, Land and Water Quality ▪ Socio-economic status	
Large scale hydrocarbon release to water.	▪ Air, Land and Water Quality ▪ Socio-economic status ▪ Human health ▪ Built environment ▪ Habitats, species and ecological productivity	
Dumping of Waste on Land	▪ Water and Soil Quality ▪ Human Health Impact ▪ Habitat Impact	
Dumping of Waste in Water	▪ Water Quality Impact ▪ Habitat Impact	
Plant & Equipment Failure	▪ Air Quality Impact ▪ Species Impact ▪ Ecological Productivity Impact	
Facility Debris from large scale damage	▪ Water and Soil Quality ▪ Socio-economic impact ▪ built environment impact	

The design control, management systems and equipment standards being applied should ensure that the facility and all aspects of it under WTPS control are adequately safeguarded against the incident scenarios described above.

Oil Spill Emergency Response Plan

Notwithstanding the control and mitigation measures outlined above, there is still a remote possibility that things can go wrong, such as a terrorist attack breaching the security provisions or a ship or other vehicle colliding with the Terminal (very remote possibility but not completely implausible). Furthermore, one area where the operator will not have any direct control is the vessels approaching the berth. If a vessel has an incident and a major leak of oils or petroleum products occurs on approach to the berth, or one of the incidents above occurs in the storage facility, this could develop into a major water pollution incident. The Khor Al-Zubair is tidal with strong currents and mixing. This means that an oil spill (which will be buoyant and initially float), if not rapidly contained could rapidly spread over a large area upstream and downstream of the incident and possibly extending to both shores. It could also be carried out of the channel into the Khor Abdullah and, ultimately, the Arabian Gulf (contaminating Iraqi and Kuwaiti beaches en-route).

It is essential therefore that there is a robust and competent emergency response plan in place. WTPS will (in conjunction with GCPI) operate an Oil Spill Emergency Response Plan (OSERP). This is both a contingency planning and emergency response plan. It will include:

- the provision of trained rapid response personnel (with a trained response leader always on duty);
- technical response equipment (booms, skimmers, holding tanks, dispersants and monitoring and cleaning equipment);
- deployment vessels for booms, skimmers, personnel, etc;
- trained clean-up teams (manual labour and mechanical plant) for shoreline response (clean-up, wildlife rescue, oil containment, etc); and
- regular training drills including personnel and equipment testing.

The objective of the OSERP will be to firstly contain the oil as close to the source of the spill as possible, to recover as much oil (free product) as possible and decant it to safe storage (land tanks or a vessel/barge) and to monitor and if necessary provide mechanical, chemical and biological intervention at impact sites to promote the assimilation and degradation of residual oil contamination.

10.3 Summary

On an industrial facility such as this where oils and petroleum products are being handled in bulk and transferred to and from ships via pipelines between storage vessels, there is a possibility of leakage or loss from these systems, either in terms of liquid spills or a fire/explosion related incident. Furthermore if environmental management and operational procedures are not followed correctly, there could be unauthorised discharges and disposals that could impact the environment. The mitigation of such events is based upon a three pronged approach:

1. Design out potential problems where possible before constructing and operating the facility;

2. Operate high quality well maintained equipment under formal audited management programmes and standard operating procedures using trained competent personnel; and

3. Provide alarms, monitoring and emergency response teams and equipment to respond rapidly and comprehensively to any incident.

Consequently, whilst such impacts are still possible, they are highly improbable and robust intervention measures should limit the consequences of such incidents should they occur.

The worst case scenario is a major oil release to the water, but one advantage of a long linear channel is that booms can be deployed upstream and downstream of the spill to contain it and prevent tidal spread of the slick, and both shores can be accessed by personnel and equipment to effect clean up. Where impact cannot be avoided by such an incident, the system is highly dynamic (tides and mixing), high environmental temperature (water temps of 35^{o}C+ and air temps of 50^{o}C+, biologically active (bacteria) and has strong persistent winds. These conditions will promote breakdown and degradation of the oil products and recovery of the natural environment. Finally, with the exception of wading birds in the inter-tidal area (which are in very low numbers around the project site), the receiving environment is of low ecological quality and less sensitive to impact than a highly productive ecologically diverse area.