



11. Soils and erosion

The Director General's Requirements (DGRs) relating to soils and geology include the following:

- ▶ Detail how erosion and sedimentation would be managed during construction and operation of the project.
- ▶ Assess soil quality in particular potential disturbance and subsequent management of Acid Sulfate Soils or Potential Acid Sulfate Soils during construction.
- ▶ Assess the potential for salinisation of the Murray River and associated waterways as a result of the project's operation including implications on the productivity of the Murray River and subsequent mitigation and or management measures.

This chapter addresses these requirements, assesses the potential impacts during construction and operation; and provides measures to mitigate impacts.

11.1 Existing environment

11.1.1 Topography

The landform within the Forest is an extensive floodplain dominated by an extensive network of creeks, gullies and disjointed lagoons.

The Murray River is the major water body in the landscape and runs along the southwestern border of the Forest. Within the Forest, a number of lagoons and several other smaller water bodies exist, including Swan Lagoon, (refer to Figure 9-3).

The Forest is at RL 84m at the upstream end to approximately RL 74m at the downstream end of the Forest. The topography in the Forest has a low relief; the average upstream slope is about 1:4,600 while in the downstream reaches, the average slope is about 1:7,300. This generally implies that surface water runoff would be low and the likelihood for soil erosion would be low, even if the erosion potential of the soils is high.

11.1.2 Soils

Six soil units dominate the area where construction would be undertaken. Table 11-1 lists the soil units and underlying geology.

Table 11-1 Soil units and underlying geology

Soil unit	Underlying geology
Bonum	Sand substrate and parent material
Bullock Head	Alluvium substrate and parent material
Fence Trail	Alluvium and/or sand substrate and parent material
Rusty gate	Alluvium substrate, with alluvium, colluvium parent material



Soil unit	Underlying geology
Iron Punt	Alluvium substrate and parent material
Burrumbury	Alluvium substrate and parent material

Soil infiltration

An area weighted infiltration rate of 25 mm/day was estimated for the entire Forest floodplain (DECC *et al* 2008). This implies that soils in the area have poor structure that limits drainage capacity or have a high clay content which also reduces drainage capacity or have a combination of both. Low infiltration rates can also lead to soils becoming waterlogged which can limit soil nutrient availability and lead to long term negative impacts on vegetation and vegetation growth.

Low infiltration rates were common for most profiles, with the exception of the Bonum soil unit, where clay layers prevent vertical water movement (Jenkins *et al.* 2006). Infiltration during flooding conditions is anticipated to be between 5-20 mm/day across the areas likely to be inundated.

Soil chemistry

Baseline soil chemistry data is limited, however, basic soil chemistry results from ground auguring indicates that soils are mildly to slightly acidic (Table 11-2).

Table 11-2 Soil pH values

Soil Unit	Soil pH
Bonum	Ranges from 7.0 (neutral) to 9.6 (alkaline)
Bullock Head	Ranges from 5.5 (slightly acidic) to 7.8 (slightly alkaline)
Fence Trail	4.5 (acidic) to 8.8 (slightly alkaline)
Rusty Gate	4.9 (acidic) to 8.6 (slightly alkaline)
Iron Punt	5.7 (slightly acidic) to 6.7 (neutral)
Burrumbury	5.4 (slightly acidic) to 7.2 (neutral)

Acid Sulfate Soils

Acid Sulfate soils (ASS) have long been recognised as a problem in coastal regions. More recently, ASS have been identified in inland waterways, including wetlands in the Murray-Darling Basin, with more than 20% of wetlands assessed as having evidence of sulfidic sediments at levels that could lead to ecological damage (Hall *et al.* 2006).

Sulfidic sediments can form wherever anaerobic conditions and elevated sulfate concentrations are present in water. These requirements can be met in inland wetlands receiving irrigation return water, groundwater or recycled water containing elevated sulfate levels (Baldwin *et al.* 2007).



In an assessment of wetlands throughout the Murray Darling Basin, Hall et al. (2007) identified Horseshoe Lagoon, Perricoota as 'probably containing sulfidic sediment'. The geotechnical investigations undertaken during development of the concept design did not identify the presence of ASS at the location of the structures.

Soil salinity

The washing of salts during flood events is considered the most influential process in the delivery of salt to the Murray River via flooding of the Forest (Salient Solutions 2007). Salt occurs in the subsoils of the Forest at varying depths, indicating the long-term average depth of wetting as a result of a series of floods (Jenkins *et al* 2006).

Average soil salinity for Forest soils at 10 cm below the surface was 100 $\mu\text{Sm/cm}$ (1:5 extract), or approximately 100 kg/ha (Salient Solutions 2007). A number of soil profiles were saline at depth including Bullock Head and Fence Trail.

Soil stability

Table 11-3 presents information on soil erosion potential and indicates that whilst no significant erosion has been recorded against the soil units in the Forest, the potential for erosion ranges from slight to high. The Bonum and Burrumbury soil units were noted to be associated with high to very high erosion hazard.

The Bonum, Rusty Gate and Burrumbury soil units displayed sandy material at the ground surface, while Bullock Head, Fence Trail and Iron Punt soil units consisted of predominant clay material throughout the soil profile (depth of less than 2m from the surface). Sand-dominated materials are larger grained than clay-dominated materials and would be more prone to erosion and weathering.

A number of sites have dispersive soils that are structurally unstable and disperse easily in water into their basic particle types (i.e. sand, silt and clay). These soils tend to be highly erodible and present many problems in relation to the management of earth works, particularly on flood plains (DPI 2009). These sites are:

- ▶ Inlet channel (Fence Trail and Bullock Head soil units);
- ▶ Swan Lagoon regulators (Burrumbury soil unit);
- ▶ River Road bridge (Fence Trail soil unit); and
- ▶ Downstream levee (mostly Fence Trail soil unit).

Table 11-3 Soil erosion potential (Jenkins *et al.* 2006)

Soil Unit	Soil Erosion Potential
Bonum	High erosion hazard, no erosion recorded
Bullock Head	Slight to moderate erosion hazard, no erosion recorded
Fence Trail	Slight to high erosion hazard, no erosion recorded



Soil Unit	Soil Erosion Potential
Rusty gate	Slight erosion hazard, no erosion recorded
Iron Punt	Slight erosion hazard, no erosion recorded
Burrumbury	High to very high erosion hazard, no erosion recorded

Soil sodicity

A sodic soil, generally indicated by soils with greater than 6% exchangeable sodium percentage, suggests soil instability and potential high soil dispersion (Jenkins *et al* 2006). Most soil profiles within the Forest fall into the 'may be sodic' or 'sodic' categories, particularly with depth from the surface. In most cases, sodicity directly influences the stability of the soil. Rusty Gate, Iron Punt, Bonum, Bullock Head and Fence Trail soil units showed a potential trend of increasing sodicity with depth.

Contaminated land

The presence of contaminated land within the vicinity of the work sites was investigated based on a review of historical aerial photographs, site inspections and a search of various databases of known contaminated land locations. No physical investigations involving soil or groundwater sampling and analysis were undertaken.

These investigations did not identify the presence of any contaminated sites. As some of the Forest has historically been used as farmland and for logging practices, potential contaminated areas may be located within the Forest.

Potential contaminated land may exist in the area surrounding Swan Lagoon due to the presence of current stock yards, potential farm landfill sites, a large pile of timber boards and tyres, and an abandoned jetty or bridge on the bank of the Murray River.

11.1.3 Geomorphology

The Murray River

The Murray River is an unconfined anabranching river system that flows through valleys and across large floodplains. Evidence of the anabranching morphology is found in the many palaeochannels, many of which now form flood channels within the Forest. The channels are generally comprised of fine muds, silts and clays in their bed and banks but generally lack depositional and erosional geomorphologic features such as bars, benches and riffles which indicate that there has been a lack of regular overland flow.

Some channels contain a pool-run sequence where the runs are comprised of silt and clay with some limited deposits of sand. All of the channels contain large woody debris which maintain the morphology of the channel and create important opportunities for in-stream habitat. The channels within the Forest are stable with limited incision and expansion.

For much of the last 10 to 12 years the Forest has been relatively dry and as a consequence, the channels do not contain water. During times of flood, the flood channels including Barbers



Creek, Cow Creek and Calf Creek, convey flow through the Forest and distribute water downstream to the Wakool River. It is these flood events that have the potential to instigate changes in the morphology of the channels.

The Forest

The annual average rainfall in the Forest is between 300 – 400 mm. Annual rainfall of this volume would produce only very small rills which are unlikely to produce high sediment run-off rates. Combined with a very low gradient between the top end of the Forest and the bottom end of the Forest, erosion of topsoils due to rainfall and the deposition of sediments in the Forest is expected to occur infrequently under current conditions.

When overland flood flows do occur, the landscape within the Forest would act as a zone of sediment deposition. Under current hydrological conditions, the transportation of sediments into downstream watercourses is expected to occur only under higher flood events, when flow concentrations and stream power are of sufficient velocity.

Upstream structures

The upstream structures are shown on Figure 6-2. The structures lie within the south eastern corner of the Forest and include physical features such as the inlet regulator and channel, River Road Bridge and regulators at Swan Lagoon.

Inlet regulator and fish passage

The inlet regulator would be located approximately 200m away from the Murray River upstream from the Torrumbarry Weir. This area is popular with water skiers and boat users and bank erosion from wash is evident on the right hand bank, adjacent to the location of the inlet channel.

The banks of the Murray River are comprised of clay and much of the aquatic vegetation in the surrounding area has been removed, which is probably due to disturbance from launching boats. Although some bank erosion is evident, the Murray River at this location is stable with expansion or incision unlikely to occur from flood events

Inlet channel

The inlet channel would follow a small streamline into the Forest away from the Murray River. The current flood runner is approximately 0.6 m wide and up to 0.2 m deep. The soils in this area are comprised of alluvium which is poorly to moderately drained with a moderate erosion hazard.

The alignment of the inlet channel would most likely follow a floodway that is only engaged when the Forest is in flood. It consists of a number of depressions and small streamlines which vary in depth and width with varying soil composition and vegetation structure. At one point, approximately 3 km downstream from the inlet regulator, an eroded gully approximately 1 m deep and 2 m wide occurs for a distance of approximately 100 m.

Swan Lagoon regulators

The Swan Lagoon regulators would to be located on a former meander bend of the Murray River which has over time been cut off to form a lagoon. The purpose of the regulators would be



to hold water in the lagoon and surrounding Forest area until such time that it may be released back into the Murray. The Lagoon displays stable, graded to convex banks comprised of silt. Successional vegetation up to 10 m tall has emerged within the channel due to the lack of flushing events and permanent water. Both the east and west ends of Swan Lagoon at the intersection of the Murray River display depositional features consisting of sand and fine silts and are raised approximately 3 m above the bed of the lagoon. The depositional zone is approximately 20 m long and 4 m wide.

Deposition is likely to occur during overtopping events from the Murray, as water moves into the entrance to the lagoon where velocity decreases and the suspended sediment load is deposited, creating a depositional feature and a natural barrier to flows both entering and exiting Swan Lagoon. At the downstream Swan Lagoon regulator, deposition of sediment appears to have been aided by a large log, approximately 0.6 m in diameter, which is present in the bed of the deposition zone. The upstream and downstream entrances to Swan Lagoon both contain large scour pools immediately after the depositional feature. The scour pool at the upstream Swan Lagoon regulator is approximately 5 m deep to top of bank and 16 m wide, with a large amount of woody debris present in the bed and banks. The scour pool at the downstream Swan Lagoon regulator is smaller, at approximately 4 m in depth to top of bank and 12 m wide.

Thule Creek regulator

Thule Creek is a flood channel located on the northern boundary of the Forest and is connected to the Wakool River. Some water was observed in small pools during the field assessment. The channel is approximately 8 m wide and 3 m deep to top of bank with the left hand bank higher than the right hand bank. A pool-run morphology is present within the channel with approximately 5 m between the pools. The bed and banks are comprised of medium to heavy clays that are likely to have slow to very slow infiltration rates and appear impermeable.

The steep convex banks are cohesive and are comprised of silt and clays. They are well vegetated with large River Red Gum trees and the channel contains large woody debris. Some disturbance and erosion to the banks has occurred where animals, most likely kangaroos, have accessed the steep banks of the creek for water.

Downstream structures

The downstream structures are shown on Figure 6-5 and include physical features such as the stop log regulators; the internal floodway; the return channel and regulator; Calf, Cow and Barbers Creeks.

Internal floodway and return channel

The floodway would increase the proportion of flows within the forest that can be returned directly to the Murray River by encouraging flood water to the Crooked Creek system. The return channel would deliver water from Crooked Creek to a regulator within the return channel.

Stop log regulators

Stop log regulators at Runner A, Barbers Creek, Cow Creek, Calf Creek and Thule Creeks to control downstream flows and protect surrounding property and infrastructure from flood waters during scheme operation.



Return Channel Regulator

The return channel regulator would have a gated regulator structure and drop down structure at the intersection of the return channel with the Murray River. It would be located on the right hand bank of the Murray River on the outside bank of a large bend in the river. The river at this point is approximately 80 m wide and 4 m deep. The banks, comprised of sandy clay, are steep and in some places eroded with some undercutting of the bank exposing tree roots. The top of banks are well vegetated with River Red Gums, while the remainder of the banks are devoid of vegetation.

A small island is located off the bank which is probably a result of a former man-made structure such as a jetty or similar. Evidence of the structure was observed in the river including tyres, planks of wood and imported rocks and other course material. The island is now vegetated by trees up to 8 m tall which indicates that high flows have not played a significant role in any recent stream morphology.

Excavated outlet channel from Crooked Creek

The outlet channel to the Murray River would link with Crooked Creek approximately 1 km to the east of the Murray River. The proposed alignment is within the existing floodplain that contains few obvious geomorphic features.

Crooked Creek is a small flood channel that conveys water through the Forest. It flows 'backward' to the southeast into the Murray, upstream of the return channel. Crooked Creek is approximately 5 m wide and 1.5 m deep and contains a large volume of woody debris which suggests that the gradient is steep enough to support overland flows high enough to carry large debris and sediments.

Barbers Creek

Barbers Creek is the largest watercourse exiting the Forest. The channel is approximately 20 m wide with bank heights of about 3 m to 4 m. The banks are generally steep and well lined with trees. The channel is mostly featureless with some woody debris present and is vegetated with groundcovers and small shrubs.

The confluence of Barbers Creek and Cow Creek occurs approximately 3 km downstream from the Moulamein Road Bridge. At the confluence, the bed of Cow Creek is approximately 1.5 m lower than the bed of Barbers Creek. The Barbers Creek arm drops into a pool on Cow Creek. From this point on the main arm of Cow Creek is known as Barbers Creek.

There are four block bank structures (obstructions to flow) and one severe blockage due to the natural accumulation of debris in the Barbers Creek. These are located between 27 km and 52 km downstream of Moulamein Road. Three of the block bank structures are fitted with low capacity low level outlet pipes and one block bank structure has no low level pipe. The condition of the block bank structures was considered to be incapable of sustaining overtopping flows without significant erosion and washout.

Barbers Creek overflow is a small flood runner located to the south of Barbers Creek that appears to be only engaged during higher flow events. The channel is approximately 10 m wide and 1.5 m deep.



Cow Creek

Cow Creek displays morphology that suggests it has been subject to in-channel pulses of high flows that have shaped geomorphic features such as benches. The channel is approximately 10 m wide and 3 m deep, with concave banks. The bed and banks are largely comprised of clay with some silt and sand present in some depositional features.

The creek displays a dominant low flow channel which is approximately 2 m wide and 0.5 m deep, bounded by a bench on the left hand bank approximately 2 - 5 m wide throughout the reach just downstream of the regulator location.

Calf Creek

Calf Creek is the most easterly of the flood runners exiting the Forest that connects with Barbers Creek. At the regulator location, the creek is shallow and wide and does not display a distinct channel (evident of low flow conditions) but contains shallow intermittent depressions throughout its form.

There was no evidence of erosion in the area during the inspection and this is considered to be evidence of low flow conditions. However, flows had not occurred for a long period of time and this is evidenced by the presence of established vegetation in the channel.

Some large trees are present within the floodway which suggests Calf Creek does not regularly receive high velocity flows.

11.2 Impact assessment

11.2.1 Landform

The local landform is likely to be temporarily altered by construction of the project. The impact of construction is considered to be low to negligible. Construction would be undertaken in locations that are currently dry.

The approach to assessing potential impacts focuses on identifying whether the soil or landforms at the respective worksites have erosive characteristics, such as dispersive soils, that should be taken into consideration during development of the Construction Environmental Management Plan that would be implemented for the project.

During the nine month construction period, it is possible that large rain events upstream in the Murray River catchment may trigger a natural flood event that has the potential to inundate the construction sites. Should this occur, an advanced warning notice would be given to construction workers who would then act in accordance with the response procedures developed for the project.

Erosion and sedimentation

There is the potential for impacts to soils identified in Section 11.1.2 that have dispersive and erosional characteristics. Activities that would give rise to such impacts include excavation for footprints of structures and channels, sheet piles, tilting weirs, fish ways and culverts.

The most predictable impacts on soils during construction would include:



- ▶ Soil contamination during construction of site due to the spillage of chemicals, oils and/or liquids;
- ▶ Disturbance and oxidation of ASS soils during excavation works; and/or
- ▶ Construction of new haul roads, widening of existing haul roads and the operation of all haul roads is likely to result in soil disturbance which may lead to unforeseen erosion and sedimentation.

Long term erosional and sedimentation impacts are not expected during operation of the project because the potential sediment concentration on the Forest floodplain that could be transported in a flow event is considered to be low and the erosion potential of most soils in the area is categorised as being slight. Even if all soils were classified as having a high erosion potential, the expected rate of flow and its potential transport limit is likely to be low, which reduces the potential for high soil erosion. The soils in the Forest have a constant delivery of leaf litter and organic matter which helps retain soil aggregate structure and so lower potential for soil erosion.

Spoil management

Soil excavated as part of the project would form construction spoil. Table 11-4 summarises excavation and deposition sites and expected spoil volumes. A spoil and waste management plan would be developed as part of the Construction Environmental Management Plan. This plan would detail the management measures to be implemented to maximise onsite reuse of spoil.

Table 11-4 Spoil management (source: MacMahon, 2009)

Excavation site	Deposition site	Approximate volume (cubic metres)
Return channel	Downstream levee	13,000
Borrow pits	Downstream levee	410,000 or 660,000
Floodway	Downstream levee	123,000
Inlet channel	Upstream disposal site	250,000
Local excavation for structures	Local disposal or levee	10,000

Excavation of the structures is not expected to be beyond five metres below ground level.

Long term adverse impacts are not expected to the physical and chemical structure and consistency of the Forest's soil units because the construction works would be limited to only specific sites and would occur for a relatively short period of time. Therefore, impacts to soils during construction of all structures are expected to be negligible.

As there are no known areas of soil contamination within the Forest, it is unlikely that construction of the structures would result in any short to long term soil contamination within the Forest. Section 6.3.10 and 6.3.11 outlines the measures to be implemented to ensure those chemicals used during construction are stored in accordance with relevant Australian Standards and guidelines. Section 6.3.14 also indicates that any contamination arising from chemical spills would be managed in accordance with the requirements of DECC's Waste Classification Guideline. This would involve removal and disposal of any contaminated spoil at an appropriately licensed facility.



Acid Sulfate Soils

As geotechnical investigations for the project did not identify the presence of ASS at the infrastructure locations, it is unlikely that ASS would be encountered during construction. However, if works do disturb ASS, the disturbance and oxidation of ASS soils may expose acids and soluble metals, resulting in acidity and elevated metal concentrations during flooding events which may be toxic to aquatic ecosystems. The consumption of dissolved oxygen may also occur from the rapid oxidation of highly reactive monosulfidic sediments. Potential impacts would be managed by implementing the recommended mitigation measures.

11.2.2 Operational impacts

Operational phase impacts are discussed in terms of their potential impacts on landform, soils and geomorphology.

Erosion and sedimentation

A small amount of soil and sediment erosion within channel and in some areas of existing embankments is anticipated when the project becomes operational (DWE & DPI 2008) as water is diverted into and released from the Forest at defined locations.

As a result of vegetation clearance, soils in these areas would be more susceptible to erosion, particularly if flood waters are to have prolonged flow and high velocities. Areas that are particularly susceptible to erosion would be river embankments on the inside bend of channel meanders, immediately downstream of stop-logs and weirs.

The majority of the soil units in the Forest (four out of six) have a slight level of erosion potential and the remaining two have a high erosion potential. The small amount of erosion and sedimentation that is predicted to occur is expected to result in short term adverse impacts on downstream rivers and watercourses. The significance of this impact is considered to be low because the volume of water to sediment ratio would be considerably high and dispersion of sediments is most likely to occur within the floodplain and not in downstream watercourses.

One of the key measures would be to control the volume and velocity of flow through major water courses to minimise the amount of potential soil loss within river banks. As detailed in Section 6.2, the structures have been designed to include erosion protection devices to minimise the potential for erosion of the bed and banks.

Acid Sulfate Soils

When wetlands containing sulfidic sediments or potential ASS (PASS) dry out, the sulfidic sediments may oxidise, producing sulfuric acid which results in low pH and leaching of metals. Re-flooding of wetlands containing actual ASS may mobilise the acids and soluble metals, resulting in acidity and metal concentrations that are toxic to aquatic ecosystems. Rapid oxidation of highly reactive monosulfidic sediments can also consume dissolved oxygen.

Geotechnical investigations for the project did not identify the presence of ASS within the Forest.

An extensive ground and surface water monitoring program would be implemented as part of the Operating Plan and would monitor a range of parameters, including pH, before, during and after flood events. This would include a procedure to be implemented should the monitoring



program indicate ASS conditions are present, including further investigations to identify the need for additional management measures.

Geomorphology

A positive geomorphic impact may be that more frequent flows to dryland rivers would result in smaller 'pulse' inputs with each in-channel rise and fall in water level. In dryland rivers, where large overbank flows may only occur every seven or more years, these small 'pulse' inputs of organic material may well be vital for the integrity of the system (Sheldon and Thoms 2006).

It is unlikely that the proposed operating scheme would have long-term adverse impacts on the equilibrium and channel geometry of the Murray River. Beneficial impacts to the smaller creeks and flood runners may result due to more frequent floods of small to moderate magnitude.

During operation, flows of up to 250 ML/day would be released through the regulators of Barbers Creek. NSW Water Solutions (2008) assessed the hydraulic capacity of Barbers Creek downstream to the confluence with the Wakool River. This indicated that the bank full capacity of Barbers Creek at natural channel sections is in the order of 2,300 ML/day with average flow velocities of 0.28 m/s. This suggests that the proposed operational flows would be in the order of 10% of the natural bank full capacity of Barbers Creek and flow velocities would be much less than the 0.28 m/s for bank full flows.

Such flow velocities are well below thresholds for entrainment of unconsolidated silt and sand size sediments. Additionally, the increased frequency of flow within Barbers Creek is likely to enhance vegetation colonisation along the lower banks which would improve bank stability. As a result, the operational flows would not result in any significant geomorphic impacts on Barbers Creek and may improve channel stability.

NSW Water Solutions identified five locations where the natural channel capacity of Barbers Creek is reduced by the presence of earthen block banks (a total of four) and one woody debris accumulation. Apart from the woody debris accumulation, the stopbanks reduce the natural capacity to below 250 ML/day. Flows during operation of the project may overtop the block banks and erode them over time. To mitigate this impact, the project involves construction of bywashes to enable flows up to 250 ML/day to pass downstream without damaging the block banks. Concept designs for the block banks are provided in Appendix H.

Overall, erosion impacts during operation are likely to be minimal due to the presence of the erosion protection works including concrete training walls, apron, and grout matting. These engineered features have been specifically designed to reduce the potential for erosion to occur that may impact on the structural integrity of the regulator and fishway.

11.3 Mitigation measures

This report does not cover any specific mitigation and management measures for geomorphology of the Forest's watercourses during construction because there are no predicted impacts during this phase of the job. Geomorphological management measures for operation of the project are expected to be developed once the Operation Plan is in place. The initial flooding scenarios will be used to monitor and then recommend any necessary mitigation measure specific to geomorphology.



11.3.1 Construction phase

The predicted impacts are similar to those associated with other infrastructure projects involving earthworks and are able to be managed by implementing an erosion and sedimentation management plan as part of the Construction Environmental Management Plan. The Construction Environmental Management Plan for the project would include contingency measures to stabilise disturbed areas to minimise the potential for soil and sediment erosion.

The erosion and sedimentation management plan would involve a risk based approach to focus on those aspects and areas of the project that have the greatest potential to lead to environmental impacts during the construction phase. Specific measures to be implemented would depend on which work sites are active and the nature of the construction activities being undertaken.

Construction aspects for which careful soil and spoil management measures are required include vegetation management; construction compounds; borrow pits; haul roads; unforeseen floods; contaminated land and any other sensitive areas.

Topography

Construction of the inlet channel, the return channel and regulators would lower land levels and the construction of levees would raise land levels. The lowering and raising of the Forest's topography is a necessary component of the project. The construction footprint would be limited to that described in Section 6.3.1 to minimise the area of land required to build the structures.

Soils including Acid Sulfate Soils

An ASS Management Plan would be developed as part of the Construction Environmental Management Plan. This would define the procedures to be implemented in the event that ASS is identified during construction.

Contaminated land

If in the unlikely event contaminated soils are encountered during construction, works would cease and the appropriate environmental testing would be undertaken to identify the type of contamination and the appropriate method of disposal in accordance with DECC guidelines.

11.3.2 Operational phase

Soils including Acid Sulfate Soils

Erosion is a substantial risk that has the potential to adversely impact on the structural integrity of the infrastructure and compromise the functionality of the overall project. To avoid erosion during operation of the project, significant consideration has been given to this issue during the evolution of the design. A detailed Sediment and Erosion Management Plan would be prepared for each major works area.

Geomorphology

The Operating Plan would include a program to monitor areas in the vicinity of all structures constructed as part of the project to identify potential impacts on geomorphology. This would include a procedure to be implemented to investigate and respond to potential impacts.