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Water Corporation

Report for Mundaring Water Treatment Plant Site Selection

Preliminary Comparative Environmental Impact Assessment

July 2007



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Executive Summary

The Water Corporation is currently conducting a site selection process for the proposed Mundaring Water Treatment Plant (WTP). This process involves community-based consultation, and has included preliminary consideration of the environmental, social, technical and economic features of a number of site options.

As part of the site selection process GHD Pty Ltd (GHD) was commissioned by the Water Corporation to undertake preliminary environmental investigations on a number of the Mundaring WTP site options. This report presents the results of the preliminary comparative Environmental Impact Assessment (EIA) for the four short-listed sites. This report investigates the site to a level that allows the environmental impacts of each site to be compared, and thus to assist in the decision-making process. A more detailed site-specific EIA will be required once a preferred site has been selected. The four short-listed sites are

- » Site One;
- » Pine Plantation Site;
- » DEC Land (formerly 'CALM Land'); and
- » "O'Connor Site" (a new site proposed by members of the community group).

The preliminary design work has shown that a new pipeline will be required from the weir to the DEC Land, the Pine Plantation and the O'Connor Site. This pipeline, particularly in the area directly north of the weir, will be subject to a number of environmental and social constraints and may have significant impacts. If the WTP was located at Site One the existing pipelines from the weir can be utilised to carry the treated water from the weir to the site of the chlorine store and this site therefore avoids the impacts from the additional pipeline.

This preliminary comparative EIA assessed a number of environmental factors at each site, including:

- » Topography;
- » Geology and Soils (including ASS);
- » Contaminated Sites
- » Hydrology (including water source areas & catchments; and waterways);
- » Land use (including surrounding land and reserves & conservation areas);
- » Flora and Vegetation; and
- » Fauna.

This investigation also included an assessment of potential impacts and management of impacts for:

- » Impacts on Biodiversity (including vegetation clearing and impacts on fauna);



- » Land Degradation (including soil degradation and erosion; spread of weeds and dieback);
- » Alterations to Hydrology and Water Management;
- » Pollution and Waste Management;
- » Social Impacts (including impacts on aesthetics and land use conflicts)

Major aspects and issues identified are discussed below.

Flora and Fauna

Site One

Site One has been subject to a long history of disturbance. Most of the site is degraded with a high level of weed invasion. The site contains remnant scattered mature Flooded Gum and Marri trees. The granite system in the east and the riparian vegetation near Helena River are still in relatively good condition. The conceptual plant layout shows that the majority of these areas will be retained.

There may also be impacts on biodiversity depending on which of the other sites the chlorine store and drying beds will be located on.

According to the conceptual layouts the WTP at Site One will require clearing of the following amount of vegetation rated condition *Good* (4) or better:

- » *Site One plus Chlorine and drying beds at DEC Land: 2 ha* in condition *Good* (4) or better.
- » *Site One plus Chlorine and drying beds at Pine Plantation: 2.24 ha* in condition *Good* (4) or better.
- » *Site One plus Chlorine and drying beds at O'Connor Site: 5.68 ha* in condition *Good* (4) or better.

A Priority 3 flora species was recorded on the site but is outside the WTP footprint and impacts on this species can be avoided.

The value of the site for native fauna is limited due to its degraded nature.

DEC Land

A significant portion of the site has been cleared in the past, with most of the central section being highly degraded and containing predominantly introduced species. There are some areas of native vegetation remaining, with good quality vegetation in the north of the site (gully system and granitic herblands) and to the east of the site (Jarrah-Marri Forest).

The conceptual plant layout shows the WTP situated in the central area of the site where the vegetation is highly degraded. The layout impacts on 0.65 ha of vegetation rated condition *Good* (4) or better.

The majority of the site has been significantly altered due to the old settlement that was located on it and would provide little value as habitat to native fauna species. Some species, particularly bird species could utilise the introduced garden plants for foraging, but in general the disturbances on the site have reduced its value for fauna.



The northern section of the site has high habitat value as it contains a number of different habitat types, including granite outcrops and a gully system. The conceptual plant layout shows that this area can be retained.

Pine Plantation

The vegetation at this site is fairly uniform, with two main vegetation types occurring; a Jarrah-Marri forest in the north-west part of the site and a pine plantation in the south-east of the site. The pine plantation was generally Condition 5 (*Degraded*) as it contained predominantly introduced species, with some scattered natives.

The conceptual plant layout shows the WTP situated primarily in the pine plantation with very little impact on the areas of native vegetation. This layout impacts on only 0.52 ha of vegetation rated as condition *Good* (4) or better at the site. However, there will be impacts on native vegetation from the requirement to widen the access track into the site. This will require vegetation adjacent to the existing Allen Rd to be cleared over the almost 1km of track into the site.

The pine plantation offers limited value to native fauna, it provides some feeding habitat for species but is of less value than the native vegetation surrounding the plantation.

This site requires a substantial length of access road, as well as pipelines. This will result in clearing of native vegetation and may also impact on fauna linkages as the access track and pipelines may result in a substantial barrier to fauna movement.

O'Connor Site

The majority of the O'Connor Site supports Jarrah and Marri Forest. The site has been logged previously and the vegetation is regrowth.

Small sections of the site, particularly around the access track in the centre of the site are highly disturbed, and contain some planted non-native species. The condition of the vegetation improves away from the road and while there is disturbance evident in these areas the vegetation structure remains intact and the site retains the ability to regenerate to a better condition.

The conceptual plant layout shows the WTP centred around the access track, which is the most degraded section of the site. However, this layout will still require clearing of native vegetation. This layout impacts on 12.98 ha of vegetation rated as condition *Good* (4) or better at the site.

This site contains the largest contiguous area of native vegetation of all the sites. While this vegetation has been previously disturbed it still has the highest flora and fauna values of all the sites being considered in this assessment.

Land Degradation

Site One

Site One has been historically disturbed and is subject to a number of ongoing disturbances. Much of the site is cleared or contains weedy species and the potential for land degradation at this site is low in comparison to the other sites.



DEC Land

Some areas of the site are sloped and have the potential to lead to land degradation. While much of the vegetation at the site is introduced and it contains a number of weedy species, the clearing of this vegetation has the potential to lead to erosional impacts.

Pine Plantation

While the WTP layout at this site is primarily within pine plantation it is surrounded by native vegetation. Additionally, native vegetation will need to be cleared for the access track into the site.

Clearing of this site and the construction and operation of the WTP have the potential to cause land degradation of the areas of native vegetation adjacent to the site, particularly through the risk of the introduction of weed species and dieback.

O'Connor Site

This site is in the most natural condition of all the sites. It has the most complete native vegetation cover and has the least weed invasion. There is potential for construction and operation of the WTP to cause land degradation at this site.

Hydrology

Site One

Two waterways (drainage lines) pass through this site. One flows through the gully in the centre of the site and one flows through the western section of the site. Both waterways drain into the Helena River. The Helena River passes through the north-west corner of the site. The conceptual plant layout shows that impacts on the Helena River and the western drainage line can be avoided but the central waterway will be impacted by the WTP.

DEC Land

There are two waterways (drainage lines) through this site, within the two gully systems that run east-west. These drainage lines are tributaries of Bending Gully, which runs south-west through Fred Jacoby Park (to the west of the site).

The conceptual layout shows that the larger drainage line in the northern gully will not be impacted by the WTP. However, the smaller drainage line through the central gully will be impacted by the plant layout and the drainage in the central section of the site will be altered.

Pine Plantation

There is one waterway (drainage line) that flows south-west through the pine plantation site and drains to Mundaring Reservoir. This drainage line flows through the minor gully that is to the south of the central access track.

This site is situated within a Reservoir Protection Zone. The Department of Water has indicated that if the WTP is to be located here substantial drainage works will be required to engineer the site out of the catchment. This will require an artificial



drainage system that will drain the entire site to a sump. The drainage water would then need to be pumped out of the catchment area. This is a significant alteration of the hydrology of the site and will be very expensive to construct and operate. This process will also have ongoing energy requirements.

O'Connor Site

This site contains one waterway, in a gully along the southern boundary of the site. This waterway is a tributary of Bending Gully.

The conceptual plant layout for this site shows that impact on waterways at this site have been generally avoided, with only the access track impacting on the drainage line in the south of the site.

Pollution and Waste Management

These issues are not expected to have a major impact on the site selection process but will require implementation of management measures during the construction and operation of the WTP.

Social Impacts.

Site One

Given the site's close proximity to the tourist and heritage area, a WTP at this site would impact on visual aesthetics and on the use of this area for recreational and tourism purposes. Views from the weir wall, lookouts and picnic spots would include the WTP.

The chlorine store and drying beds for Site One would be located at one of the other three sites and this may be in conflict with the existing landuses of these sites, as discussed below.

DEC Land

The DEC Land currently contains the DEC offices, depot and some housing for DEC employees. These land uses are not compatible with a WTP at this site and would require relocation. DEC has indicated that they would consider relocation and the move may provide DEC with some positive benefits.

The Kattamoorda Heritage Trail, Kep Track and the Mundaring Loop Bike Trail all pass through the site and these trails could be directly and indirectly impacted by the WTP at this site. The trails may need rerouting if they are within the boundaries of the WTP. However, these trails have been situated to make use of the heritage values of the area and any rerouting will need to ensure that the heritage significance of these trails is not reduced. Additionally, the presence of the WTP may impact on the aesthetics of these trails, particularly through visual impacts.

Pine Plantation

The majority of the Pine Plantation site is not currently used, except the Bibbulmun Track that passes through the north-west corner of the site. Direct impacts on this track can be avoided as the conceptual layout shows the plant contained in the south-



east corner of the site. However, this track may need rerouting to comply with the chlorine buffer or if the plant has aesthetic (ie visual) impacts on this walking trail.

To the south of the site is DEC's landing ground. The requirement for a chlorine buffer at the site may be in conflict with the use of the landing ground; however, this can be managed by locating the chlorine store at an appropriate distance from this area.

O'Connor Site

The O'Connor Site has been used in the past for logging and firewood collection but at present it is used only for recreation. The Kattamoorda Heritage Trail, Kep Track and the Mundaring Loop Bike Trail all pass along the western boundary of the site and these trails could be indirectly impacted by the WTP at this site. The trails may need rerouting if they are within the boundaries of the chlorine buffer zone; however, these trails have been situated to make use of the heritage values of the area and any rerouting will need to ensure that the heritage significance of these trails is not reduced. Additionally, the presence of the WTP may impact on the aesthetics of these trails, particularly through visual impacts.

The WTP at this site may have indirect impacts, particularly impacts on aesthetics, on adjacent landuses (residences) on adjacent private properties.



1. Introduction

1.1 Background

The Water Corporation proposes to improve the quality and security of water supplies to the Eastern Hills areas of Perth and to the Goldfields and Agriculture regions. The \$55 million Mundaring Water Supply Improvement Project was announced in 2002, and involved the first stage construction, over about six years, of a 50 megalitre water tank and a 150 megalitres per day capacity Water Treatment Plant (WTP) at Sawyers Valley Tank site. Two more stages were planned and by 2030 it was projected that a total of three 50 megalitre water tanks would be constructed on the site and the WTP capacity would be increased to 250 megalitres per day.

However, strong community objections emerged against the location of the WTP at Sawyers Valley. Due to these community objections the Water Corporation decided to withdraw the application to the EPA to build the water treatment plant at Sawyers Valley and a commitment was made to undertake a more detailed site selection process, with the involvement of the community. The Water Corporation's application to the EPA to build one 50 megalitre water tank remained active.

The current site selection process commenced in mid 2005 and is a community based consultation process, which involved reconsidering all previous site options and including any other potentially suitable options. This process has involved preliminary consideration of the environmental, social, technical and economic features of a number of options. A shortlist of four site options has been decided upon; Site One, O'Connor Site, Pine Plantation and Department of Environment and Conservation (DEC) (previously CALM) Land. A preliminary environmental impact assessment (EIA) is being undertaken on the four short-listed sites to aid in the final selection process.

1.2 Scope

The scope of work of this investigation is to prepare a preliminary comparative EIA for the four short-listed sites for the Mundaring Water Treatment Plant. This includes desktop and field investigations. The preliminary EIA is designed to aid site selection process and should not be considered a full EIA. Rather this report investigates the site to a level that allows the environmental impacts of each site to be compared, and thus to assist in the decision-making process. A more detailed site-specific EIA will be required once a preferred site has been selected.

Water Corporation has provided conceptual plant layouts to assist in the site selection process; these are included in Appendix B. These plant layouts assist in site selection through showing the potential footprint of the WTP within the site allowing assessment of the major issues. These layouts are only conceptual at this stage and will be refined during the detailed design phase. This preliminary EIA has provided information on the environmental impacts at the whole site but has also taken into consideration these conceptual plant layouts.



The preliminary design work has shown that a new pipeline will be required from the weir to the DEC Land, the Pine Plantation and the O'Connor Site. This pipeline, particularly in the area directly north of the weir, will be subject to a number of environmental and social constraints and may have significant impacts. If the WTP was located at Site One the existing pipelines from the weir can be utilised to carry the treated water from the weir to the site of the chlorine store and this site therefore avoids the impacts from the additional pipeline.

The following environmental aspects have been assessed in separate reports and will not be included in this preliminary EIA:

- » Aboriginal Heritage
- » European Heritage
- » Risk Assessment
- » Energy requirements (including pumping requirements and embedded energy of the infrastructure)

Issues that will be relevant for all sites were not considered in this assessment (such as fire and access control), as the purpose of this report is to differentiate between sites. These impacts were not assessed in detail at this stage but they will need to be addressed in detail at a later stage in the process.

1.2.1 Desktop Assessment

An initial desktop assessment was conducted to determine the key environmental aspects that may impact this project. This included accessing known databases and records to determine potential environmental issues and constraints at the site.

1.2.2 Preliminary Field Investigations

Preliminary field investigations have been conducted at the four sites. These included an assessment of environmental aspects and potential constraints at the site, including hydrology and landscapes and landforms as well as a preliminary flora and fauna assessment.

The preliminary flora and fauna assessments on the DEC land and the Pine Plantation were conducted in September 2006 and the assessments on Site One and the O'Connor site were conducted in June 2007. These assessments were designed to highlight major flora and fauna issues and to determine the ecological value of the site. The surveys including the following aspects:

- » A broadscale vegetation assessment, including assessment of vegetation types, vegetation condition, dominant species and potential presence of diseases such as dieback, and weeds. The vegetation type and condition was mapped;
- » A targeted search for any Declared Rare and Priority Flora that occur in the area;
- » An assessment of habitat potential, including the assessment of the significance of habitat trees; and
- » A targeted opportunistic fauna search, particularly for any significant fauna species.



The full flora and fauna assessments have been reported in separate reports and are summarised in this preliminary EIA.

1.3 Site Location

Site One

Site One was one of the initial two sites considered and was previously rejected by the government.

Site One is located on a Water Corporation reserve directly below Mundaring Weir, bounded by Mundaring Weir Road on the west and south of the site and by Helena River to the north of the site. Most of the site is currently unused but there is a Western Power sub-station in the centre of the site and picnic sites and public areas in the east of the site.

Site One is constrained in size and additional land will be required for drying beds. Additionally, it will not be possible to store chlorine at Site One and a second site will be required for the chlorine storage building and associated infrastructure. The drying beds and the chlorine store will be located together on the same site but this location is yet to be determined. Three options are being examined, the Pine Plantation site, DEC Land and the O'Connor Site. Therefore, the environmental issues associated with these sites may also be an issue if Site One is chosen.

DEC (CALM) Land

The DEC Land is a 20 ha site located at the current DEC depot to the east of Mundaring Weir Rd. The site is located on State Forest and Freehold land owned by DEC.

The Site is across Allen Rd from the Hills Forest Discovery Centre (approximately 100 m) and across Mundaring Weir Rd from Fred Jacoby Park. Approximately 300 m to the west of the site is the Munda Bidli Trail and approximately 50 m to the south of the site is the Bibbulmun Track. A number of other walking and cycling tracks pass through the site and there is a picnic table in the north of the site.

The Site is approximately 550 m to the northeast of the picnic sites associated with Mundaring Weir and the start of the Site is about 500 m from Mundaring Weir Hotel.

Pine Plantation Site

The Pine Plantation site is a 20 ha site located in State forest on Allen Rd to the north of Mundaring Weir, off Mundaring Weir Rd, WA. This site is a pine plantation next to the DEC Airstrip north of Mundaring Weir and also includes some adjacent native vegetation.

This site is very close to the Bibbulmun Track, which passes through the north-west corner of site.



O'Connor Site

The O'Connor site is a 39.7ha site located in State forest at the junction of Mundaring Weir Road and Firewood Road, north of the weir. The site has been previously logged and the vegetation is all regrowth.

This site is close to a number of residential properties that are located along Mundaring Weir Road.

1.4 Limitations

The purpose of this preliminary EIA is to aid in the site selection process and to assess the sites at a level that allows the environmental impacts of each site to be understood and compared. However, this provisional EIA is not a substitute for a more detailed EIA study, which will be required once a preferred site has been selected.

The investigation focused on the site of the WTP and detailed investigations of the access routes was not undertaken. However, the potential access routes were assessed generally to determine any major environmental constraints.

The field flora and vegetation assessment is dependent on a number of factors, including flowering times for the significant species, and hence cannot be a completely comprehensive search. Further fieldwork may be required once the final site has been selected to determine the potential presence of any significant flora species at that site.

Desktop investigations on fauna species were conducted at the regional level; to determine species that are present in the general area and that have the potential to occur at the site. While this does not allow comparison between sites the information on fauna habitat obtained during the survey provides some indication of the likelihood of fauna species occurring at the site and of the value of the site as fauna habitat.



2. Existing Environment

2.1 Topography

Site One

Site One is relatively flat, sloping gently from south-east to north-west, ranging from 100-125m AHD. The eastern corner of the site is somewhat sloped, as it is adjacent to a minor gully that runs through the site. Additionally, the western corner of the site is sloped towards the Helena River. From the conceptual plant layout provided by Water Corporation it appears that these areas will not be required for the footprint of the WTP. The conceptual plant layout shows the WTP positioned primarily within the central flat section of the site.

DEC Land

The site generally slopes from east to west, ranging from 200-240m AHD, with the southern section of the site, adjacent to Allen Rd being the flattest area of the site. There are two gully systems in the site, one in the north of the site and one running through the central area of the site. The central gully is more gently sloped than the northern one.

The conceptual plant layouts provided by Water Corporation indicate that the footprint of the WTP will avoid impacts on the northern gully system but will impact on the minor gully in the centre of the site.

Pine Plantation

The south-western corner of the Pine Plantation site is the lowest point of the site, at 220 m AHD. From this point the site slopes up in a northerly and north-easterly direction to reach 265 m AHD on the northern boundary and 260 m AHD in the north-eastern corner of the pine plantation. There is a minor gully system that generally follows the access track through the site in a north-easterly direction.

The conceptual plant layout shows the plant footprint in the area to the south and east of the access track, which means it is in the flatter section of the site, avoiding the steeper slope north of the track.

O'Connor Site

The site slopes from east to west, ranging from 305 to 255m AHD. The land slopes towards a gully that runs along Mundaring Weir. There is also a minor slope to the south, with a gully running along the southern boundary of the site, adjacent to Firewood Road.

The conceptual plant layout shows the footprint of the site generally following the 275 and 295 m AHD contours across the site.



2.2 Geology and Soils

The Geological Survey of Western Australia (GSWA) 1:250,000 map series was referred to, to determine specific geology and soil characteristics of the sites (Department of Industry and Resources, 2007). Specific landforms, such as gully systems and rock outcrops were assessed during the field survey.

Site One

The GWSA describes the site as “even-grained granitic rocks”. There are large granitic outcrops in the east of the site as well as isolated occurrences in the north-west corner, adjacent to the Helena River.

DEC Land

The GWSA describes the site as laterite, “chiefly massive but includes overlying pisolithic gravel and laterised sand” and even-grained granite rocks. (Department of Industry and Resources, 2007).

In the gully system in the north of the site, and in the small section of the site north of this gully there are areas of outcropping granites, which, as a landscape feature should be retained where possible. Additionally, outcropping granites generally have higher biodiversity values (See section 2.6 and 2.7)

Pine Plantation

The GWSA describes the site area as laterite, “chiefly massive but includes overlying pisolithic gravel and laterised sand” (Department of Industry and Resources, 2007).

O’Connor Site

The GWSA describes the majority of the site as laterite, “chiefly massive but includes overlying pisolithic gravel and laterised sand”. The remaining area within the site is comprised of even grained granite rocks. (Department of Industry and Resources, 2007).

2.2.1 Acid Sulphate Soils

In recent years there has been progress in the understanding of the impact of disturbing Acid Sulfate Soils (ASS) by development in areas containing these soils. The Western Australian Planning Commission (WAPC) has published a Planning Bulletin, Number 64 *Acid Sulfate Soils* (WAPC, 2003), which includes mapped information on the risk of occurrence of Potential and Actual ASS (PASS and AASS respectively). The mapping does not cover the area of Mundaring Weir, but on the eastern extent of the maps, along the Darling Scarp, the figures show “low to no risk of AASS and PASS occurring generally at depths of >3m”.

In the Perth region the ASS risk is greatest in the coastal plain soils. Generally, in the Darling Scarp ASS risk is low. However areas of wetland and saturated soils can still be a problem if dug up and exposed. In this region there can be an ASS risk associated with certain sulfidic rock types within the bedrock.



As the risk of ASS is low for the study area, this feature should not impact on the site selection process. Once the site has been decided, detailed environmental studies should include assessment of the risk of ASS, particularly if significant volumes of soil are to be disturbed.

2.3 Contaminated Sites

A search of the DEC's WIN Contaminated Sites database for the general Mundaring area was conducted. No contaminated sites are recorded within 5km of any of the short-listed sites. However, while there was no recorded contaminated sites there may still be some historical contamination at some of the sites and this will require further investigation once a preferred site has been determined.

In particular, the sites with a long history of use, such as Site One, which has been used for storage of chemicals and as a construction camp, and the DEC Land, which has been used as a settlement and in more recent times as a depot for DEC, have the potential to contain contamination and require further investigation. The potential presence of contamination at the sites will not be a major influencing factor on the site selection process and this issue can be managed during the detailed investigation stage.

The potential for contamination of the site from the WTP is considered further in Section 3.4.

2.4 Hydrology

2.4.1 Water Source Areas and Catchments

All of the sites are within proposed Priority 1 Public Drinking Water Source Area (PDWSA). PDWSAs include Water Reserves, Catchment Areas and Underground Water Pollution Control Areas, proclaimed under the *Metropolitan Water Supply Sewerage and Drainage Act, 1909* or the *Country Areas Water Supply Act, 1947*. Access to PDWSAs are governed by by-laws under the two Acts, which may restrict access to some areas and prohibit some activities within the PDWSA.

Priority 1 is the highest classification for PDWSAs and would typically comprise Crown land. Priority 1 source protection areas are defined to ensure there is no degradation of the water resource. They cover land normally owned by the State where the provision of the highest quality drinking water is the prime land use value. P1 areas are managed with the principle of risk avoidance. Drinking water treatment plants are "compatible with conditions" in Priority 1 areas.

Site One

Site One is within the Priority 1 area of the Middle Helena Catchment Area.

DEC Land

The DEC Land is within the Priority 1 area of the Middle Helena Catchment Area.

Pine Plantation



The Pine Plantation site is within the Priority 1 area of the Mundaring Weir Catchment Area and also within the Reservoir Protection Zone (RPZ). RPZs (or 'prohibited zones' as they are called in the by-laws) consist of a statutory 2 kilometre wide buffer area around the top water level of storage reservoirs in the Perth water supply area, and include the reservoir water-body. The RPZ apply over Crown land and prohibit public access to prevent contamination (physical, chemical and biological) of the source water. A WTP is not a compatible land-use within this zone.

O'Connor Site

O'Connor Site is within the Priority 1 area of the Middle Helena Catchment Area.

2.4.2 Waterways

Site One

Two waterways (drainage lines) pass through this site. One flows through the gully in the centre of the site and the centre flows through the western section of the site. Both waterways drain into the Helena River. Both have been impacted by disturbances at the site but some riparian vegetation remains, particularly on the waterway in the west of the site. The Helena River passes through the north-west corner of the site.

DEC Land

There are two waterways (drainage lines) through this site, within the two gully systems that run east-west. These drainage lines are tributaries of Bending Gully, which runs south-west through Fred Jacoby Park (to the west of the site). The northern waterway contains riparian vegetation and is still in relatively good condition, although it has been subject to some weed invasion. The shorter drainage line through the central section of the site has been impacted by previous land use at the site and is more degraded.

Pine Plantation

There is one waterway (drainage line) that flows south-west through the Pine Plantation site and drains to Mundaring Reservoir. This drainage line flows through the minor gully that is to the south of the central access track. This drainage line has been planted over with pine plantation.

O'Connor Site

This site contains one waterway, in a gully along the southern boundary of the site. This waterway is a tributary of Bending Gully.

2.5 Land use

2.5.1 Surrounding land

Site One

Site One is situated south of Mundaring Weir, it is bound by Helena River to the north of the site and Mundaring Weir Road to the west and east. North of Helena River is a



heritage and tourism area, containing a museum, memorial, walktrails and picnic areas. There are a number of walking trails, including the Bibbulmun Track, the Munda Biddi Trail and the Kattamorda Trail, that run very close to the site, both to the west and to the east along the weir wall. The Mundaring Hotel/ Mundaring Hall are located approximately 350m north from the site. This site has been proposed as a heritage-tourist precinct.

Within the site is a Western Power substation and a number of picnic and public recreation areas.

DEC Land

The DEC Land contains the current DEC offices and depot as well as housing for a number of DEC employees.

There are a number of tourist and educational facilities surrounding the DEC Land, including the Kookaburra Outdoor Cinema adjacent to the site, the Hills Forest Discovery Centre, about 100 across Allen Rd from the site, and Fred Jacoby Park, across Mundaring Weir Road.

A number of walking trails pass through or near to the site, including the Kattamorda Trail, Kep Track and the Mundaring Loop Bike Trail that pass along the western edge of the site and then through its northern corner. Additionally, other major trails in the near vicinity are the Mundi Biddi trail, approximately 300m west, and the Bibbulmun track, approximately 50m south. The Site is around 550m north-east of the picnic sites associated with Mundaring Weir and the Mundaring Weir Hotel is situated about 500m from the site.

Pine Plantation

This site is surrounded by state forest. It is removed from residences and the heritage and tourist precinct around Mundaring Weir. The DEC airstrip is situated approximately 50m below the site. The Bibbulmun track passes through the northwest corner of the site.

O'Connor Site

This site is surrounded by state forest and situated away from the recreational, tourism and heritage areas associated with the weir. However, the site is adjacent to Mundaring Weir Road and the Kattamorda Trail, Kep Track, Munda Biddi Trail and Mundaring Loop Bike Trail are all located along the western boundary of the site.

Several residential properties are located near the junction of Mundaring Weir Road and Firewood Road. The initial site design has been modified to allow a greater buffer between the properties and the site. The closest residence is approximately 150m from the site boundary. The conceptual plant layout indicates that the WTP will be situated in the centre of the site, which means that the nearest residential property would be approximately 350m from the structures of the WTP.



2.5.2 Reserves and Conservation Areas

There are several major land reserves located in the area that either impinge or abut the studied sites. These land reservations include:

State Forest: vested in the Conservation Commission and managed by DEC under the principles of ecologically sustainable forest management for many diverse values and industries. This includes nature conservation, tourism and recreation, water catchment protection and timber production.

National Park: reserve no. R47880 is National park vested to the Conservation Commission of WA. The park covers approximately 4617 hectares, located south of Mundaring townsite and extends eastward between Helena Valley and Sawyers Valley.

How these reserves and other existing land use reservations impact on each site is explained as follows:

Site One

Site One is within Reserve 5342. This reserve is vested in the Water Corporation for water supply. Reserve 39644 is also within Site One, and this reserve is for the purpose of the power sub station.

East of the site is the Mundaring reservoir and State forest. Surrounding land to the south and west of the site is national park.

DEC Land

While much of the site is owned by DEC, some areas of the site, and surrounding land in the east, are designated as state forest. Reserve 25155 is partially located within the north of the site. This reserve is vested in the Water Corporation for the purpose of water supply. Adjacent land west of the site is National park

Pine Plantation

The site and surrounding land is state forest.

O'Connor Site

The site and surrounding land to the east is State forest. Reserve 25155 is located south west of the site. This reserve is vested in the Water Corporation for the purpose of water supply. A small section of this reserve may be within the borders of the site. Surrounding land west of the site is National park

2.6 Flora and Vegetation

Flora and vegetation were assessed during preliminary field assessments of the sites and the results are summarised below.



2.6.1 Vegetation Type

Site One

The vegetation of the site has been highly altered by past disturbances and much of the original vegetation is no longer intact. The overstorey at the site is generally in better condition than the middle and under storey. The central section of the site is open woodland of Marri (*Corymbia calophylla*) and Flooded Gum (*Eucalyptus rudis*). The east of the site supports granite system community dominated by White Myrtle (*Hypocalymma angustifolium*). In the north-west corner of the site, adjacent to Helena River, an area of dense riparian vegetation exists. Some areas have been subject to previous rehabilitation works, with various species planted along road and gully edges. A full description of the vegetation types, photographs and inventory of vascular plants is provided in the Flora and Fauna Report (GHD, 2007a).

DEC Land

The site contains a number of different vegetation types, ranging from remnant Jarrah forest to granitic herblands. However, most of the site is disturbed and degraded apart from small patches of remnant vegetation, mainly at the edge of the site.

Being part of an old settlement area the site has been subject to a long period of disturbance. Much of the vegetation that occurs is introduced such as Pine (*Pinus radiata*) and *Acacia* and *Eucalyptus*. Even the remnant patches at the edges of the site have been severely impacted by disturbances from the old settlement and the current use as the DEC depot.

In the south of the site there are patches of remnant open forest of Jarrah-Marri. However, these remnants are scattered and have been disturbed by earthworks and subsequent weed invasion. To the east of the site there is an area of open forest of Jarrah-Marri that is in relatively good condition.

In the north of the site there is a gully containing a creekline and remnant native vegetation. The north side of the gully supports predominantly Wandoo and the south side supports predominantly Jarrah-Marri forest with occasional Wandoo. Much of the gully system has been disturbed and it contains a number of weed species, including substantial infestations of *Watsonia*, an invasive environmental weed species.

North of this creekline there is a small outcrop of granitic rocks that support open vegetation types. This includes a mosaic of herblands over outcropping granites and shrublands on the deeper soils. Adjacent to the granite outcrops is an area of Jarrah-Marri forest in excellent condition.

Pine Plantation

The vegetation at this site is fairly uniform, with two main vegetation types occurring; a Jarrah-Marri (*Corymbia calophylla*) forest in the north-west and a Pine plantation in the south-east.

The Jarrah-Marri forest in the north-west of the site is fairly uniform, but shows some variation between the upland areas (in the west of this vegetation) and the flatter



sections in the east. The upland areas contain scattered Bull Banksia (*Banksia grandis*) and Sheoak (*Allocasuarina fraseriana*), which are mainly lacking in the lower sections. There are patches of vegetation in this area that have evidence of disturbance, including scattered Pine trees, and a dominance of Parrot Bush (*Dryandra sessilis*). The dominant *Pinus radiata* of the plantation area is interspersed with introduced Golden Wattle (*Acacia pycnantha*) and scattered young *Eucalyptus* species.

A full description of the vegetation types, photographs and inventory of vascular plants is provided in the Flora and Fauna Report (GHD, 2007c).

O'Connor Site

The majority of the O'Connor Site supports Jarrah and Marri Forest. The site has been logged previously and the vegetation is regrowth. In some areas the previous logging activities have removed much of the overstorey resulting in the presence of a very open woodland. In these areas the understorey is generally intact with evidence of regeneration of the mid and overstorey. In the northern section of the study area Jarrah is dominant and there is less evidence of logging activities. On the uplands in the east and north of the site the overstorey cover increases and includes the additional species Sheoak and Bull Banksia amongst Jarrah and Marri.

Some sections of the site, particularly the area adjacent and east of the central track, are dominated by species such as Parrot Bush, a well known colonising species of disturbed areas.

Small sections of the site, specifically the access tracks and cleared patches that have been classified as vegetation "Degraded / Cleared / Planted". While many of these areas do not contain vegetation there are some planted with non-native species, including eastern states *Eucalyptus* and *Acacia* species.

A full description of the vegetation types, photographs and inventory of vascular plants is provided in the Flora and Fauna Report (GHD, 2007d)

2.6.2 Vegetation Condition

Flora and vegetation were assessed during preliminary field assessments of the sites and the results are summarised below. The vegetation condition was rated using the Bush Forever vegetation condition scale (Government of Western Australia, 2000), see **Table 2** for an explanation on this condition scale.

Site One

Site One has been subject to a number of historical disturbances, most notably the construction of Mundaring Weir adjacent to the site. Some native vegetation has recovered from major earthworks, and a number of mature native trees remain scattered throughout the site. However, there are ongoing disturbances that continually impact the remnant vegetation. This includes; the infrastructure works related to the weir, the Western Power substation and access tracks, bulldozing and burning for fire control and public use of the site. As in many areas with these levels of disturbance there is substantial weed invasion and understorey composition is



restricted to very few species as a result. However, there are some areas where the native vegetation has recovered fairly well, and has potential to recover further. The vegetation condition at the site was rated between Condition 3 (*Good*) and Condition 6 (*Completely Degraded*) on the Bush Forever vegetation condition scale.

DEC Land

The vegetation condition of the site was very variable, ranging from Condition 1/2 (*Pristine/Excellent*) in the remnant vegetation in the north of the study site, to Condition 6 (*Completely Degraded*) in the old settlement area on the Bush Forever vegetation condition scale. In general, the vegetation of the site has been highly disturbed and degraded. The eastern and northern edges of the site contain vegetation of best condition.

Pine Plantation

The Jarrah-Marri forest at this site is mainly Condition 2/3 (*Excellent/Very Good*). However, there are some patches of vegetation that are more highly disturbed, including an area that has been used as a dump which was Condition 6 (*Completely degraded*) on the Bush Forever vegetation condition scale. The Pine plantation was generally Condition 5 (*Degraded*) as it contained predominantly introduced species, with some scattered natives.

O'Connor Site

In the south-west of the O'Connor site there is evidence of previous disturbance factors, particularly near to the access tracks that occur throughout the site. Generally, the condition of the vegetation improves away from the road and in these areas the structure of the understorey is generally intact. Most of the south-west of the site was rated between Condition 3 (*Very Good*) to Condition 4 (*Good*) on the Bush Forever vegetation condition scale. While there is disturbance evident in these areas the vegetation structure remains intact and the site retains the ability to regenerate to a better condition. Additionally, away from the main access tracks the vegetation structure is still generally intact and there is less evidence of disturbance and these areas were rated Condition 2 (*Excellent*).

2.6.3 Weeds

Site One

The site contains a number of weed species and species that were historically planted in the area, such as introduced *Acacia* species. There are also a number of weeds present that have been Declared under the *Agriculture and Related Resource Protection Act 1976*. A number of the weeds present at the site are considered to be serious environmental weeds. Most of these weeds are present around the Helena River and may be spreading downstream. These weeds include Bridal Creeper (*Asparagus asparagoides*) and *Watsonia* sp.

This site is within close proximity to both National Park and State Forest. Construction works have the potential to introduce, spread, and exacerbate the growth of weeds and



should the project proceed a weed management plan would need to be implemented to ensure the impacts on these reserves are minimised.

DEC Land

This site contains a number of introduced species, which dominate large areas of the site. The site has a long history as an old settlement area and a number of introduced tree species were planted around the settlement, particularly Pines and introduced Eucalypts. Additionally, there are a number of garden plants located throughout the site, which have established from the old settlement gardens. One species, *Asparagus asparagoides* (Bridal Creeper), which was found in the area near the Kookaburra Outdoor Cinema, is a Weed of National Significance (WONS).

Pine Plantation

Weed species were most evident in the more disturbed areas of the site, these areas include the road that passes through the site, the pine plantation and an old dump site on the edge of the road. Construction works over a large area have the potential to introduce, spread, and exacerbate the growth of agricultural and environmental weeds.

Should the project proceed a weed management plan would need to be implemented.

O'Connor Site

Weed species were mostly evident along the road that passes through the site and in the old plantation in the south-east of the site. There was also some weed species scattered throughout the area of native vegetation. However, in general the number of weedy plants at the site was very low and the weed invasion of the native vegetation was limited.

2.6.4 Plant Pests and Diseases

The sites are all located in an area susceptible to the development of the pathogen, *Phytophthora cinnamomi*, commonly known as dieback. Large areas of forest in the Mundaring Weir area have been affected by dieback. Areas to the east of Mundaring Weir have been under quarantine as a "Disease Risk Area" in an attempt to control the spread of this pathogen. The preferred site for the WTP will need to be formally assessed for the presence of dieback by a DEC interpreter or equivalent, during further detailed field investigations. The occurrence of dieback was visually assessed during the preliminary field assessments.

Site One

There was little evidence to suggest that dieback was present within the Site, based on the health of indicator species.

DEC Land

There was no indication of the occurrence of dieback within the site, based on patterns of death of susceptible plants. However, as the site contained predominately introduced species there were few indicator plants and the presence of dieback could not be adequately determined.



Pine Plantation

This site is within the “Disease Risk Area” to the east of Mundaring and subject to quarantine in the past to try and control the spread of this pathogen. However, there was some evidence to suggest that dieback was present within the Site, based on patterns of death of susceptible plants in the section of native vegetation to the north of the access road.

O’Connor Site

There was some evidence to suggest that dieback was present within the Site, based on patterns of death of susceptible plants. There appears to be a “dieback-line” along a contour on the hillside in the east of the site. If this site is selected as the preferred site it would be recommended that the areas of the site impacted by dieback are used for the WTP in preference to any unaffected areas.

2.7 Fauna

Habitat values and fauna that could potentially occur at the site were assessed during preliminary field investigations and the results are summarised below. Further detailed surveys will be required once the preferred site has been selected.

Site One

A number of fauna species occur in the general vicinity of the site, including a number of protected species. However, the site is highly disturbed and few species would utilise the site regularly. The site offers some value to woodland birds and reptile species but few mammals would be expected to utilise the site regularly. In the eastern section of the site there is some outcropping granite that may support a variety of reptile species.

This site contains some native vegetation that may be used by native fauna species, particularly woodland bird species. However, the understorey is impoverished and contains only sparse cover that would provide very limited habitat for fauna species. Clearing of the vegetation would be expected to have a minimal impact on fauna species; particularly given the large areas of surrounding good quality habitat. The granites in the east of the study site and the remnant riparian vegetation along Helena River offer the highest habitat value for fauna and should be retained where possible.

DEC Land

The majority of the site has been significantly altered due to the old settlement and provides little value as habitat to native fauna species. Some, bird species such as honeyeaters, could utilise the introduced garden plants for foraging, but in general the level of disturbance means a reduced value to fauna. This site contains some plant species that are used by black cockatoos for foraging. These species are protected under the *Wildlife Conservation Act 1950* and the *EPBC Act*.

The northern section of the site has high habitat value as it contains a number of different habitat types, including granite outcrops and a gully system.



Pine Plantation

A number of species may use the pine plantation for foraging, and of significance, noted in the opportunistic survey, were Carnaby's Cockatoos, a species listed as Endangered under the *Wildlife Conservation Act 1950* and the *EPBC Act*. A number of other species could be expected to occur at the site, but this is difficult to determine without detailed assessment.

This site contains areas of native vegetation that may be used by native fauna species. However, there is a lack of habitat diversity and past disturbances significantly reduce the value of this site for fauna. The pine plantation may also be used by fauna species but is of less value than that of the surrounding native vegetation.

O'Connor Site

A number of species were observed during the opportunistic surveys, particularly woodland bird species. While the site has potential to support some significant fauna species it is unlikely to be considered as containing 'significant' habitat for these species. The habitat type is uniform across the site and is well represented in surrounding areas.

This site contains the largest contiguous area of native vegetation of all the sites studied. While remnant vegetation has been disturbed in the past it should be considered of high value for fauna, in comparison to the other sites being considered in this assessment.



3. Potential Impacts and Management

3.1 Impacts on Biodiversity

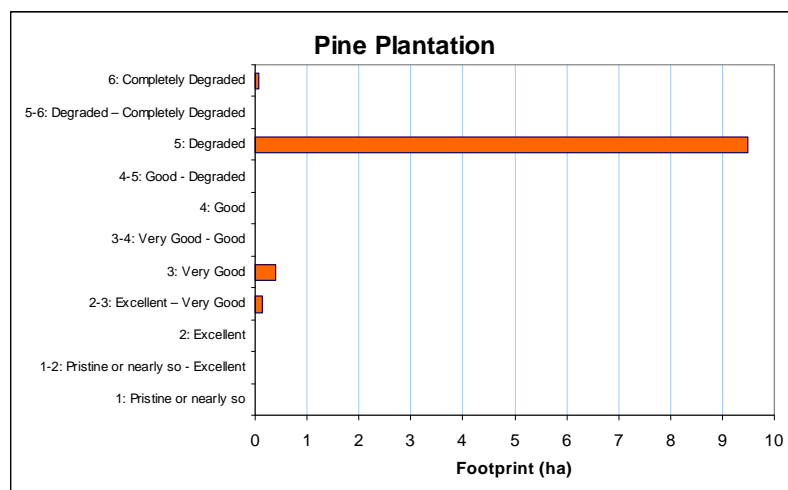
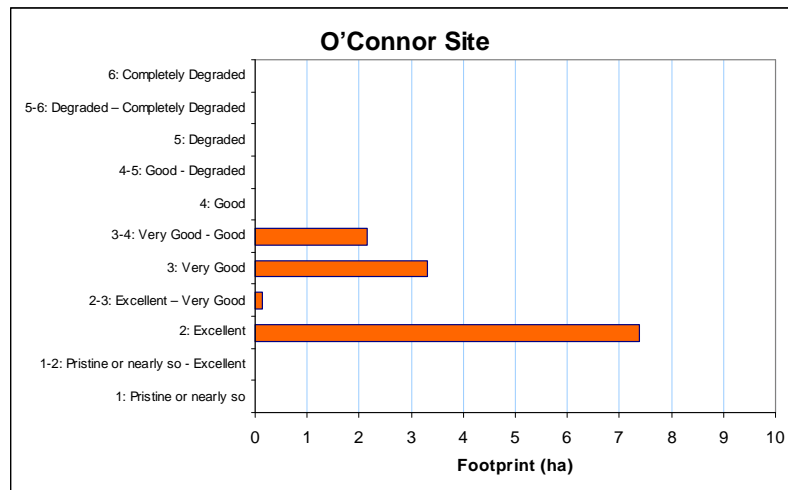
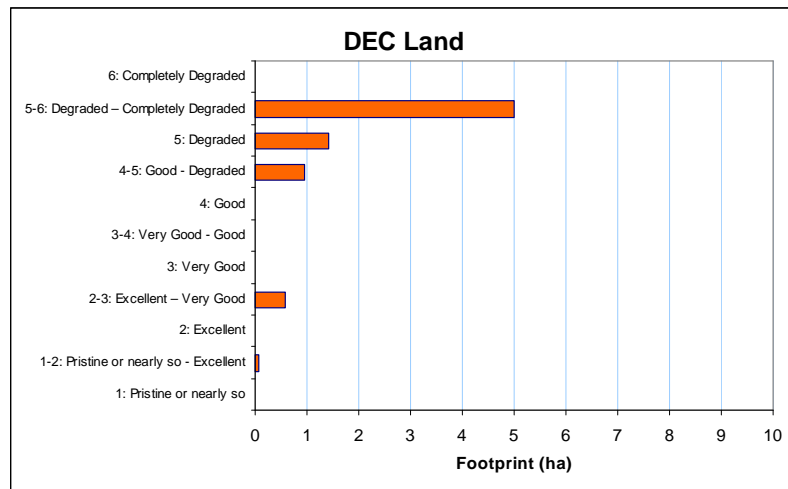
3.1.1 Vegetation Clearing

The conceptual plant layout has been overlain on the vegetation condition mapping (as mapped during the field surveys (GHD, 2007a, b, c, d)) to determine the area of clearing of native vegetation required. This is summarised in **Table 1**. For an explanation of the condition ratings see **Table 2, Appendix C**.

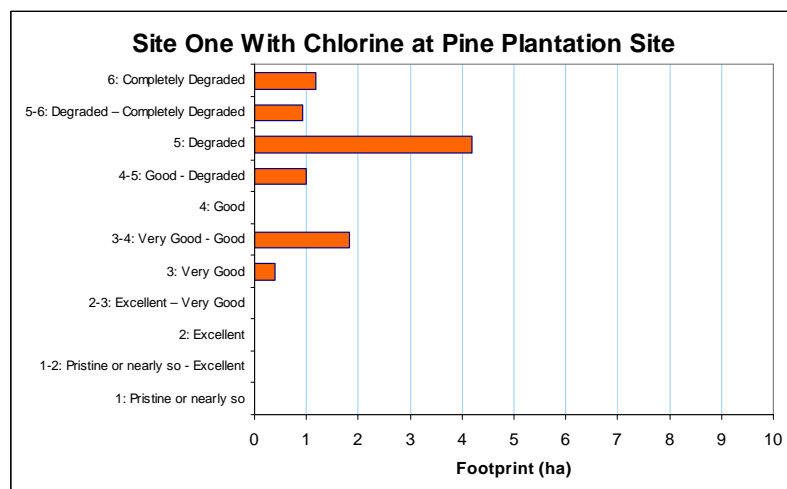
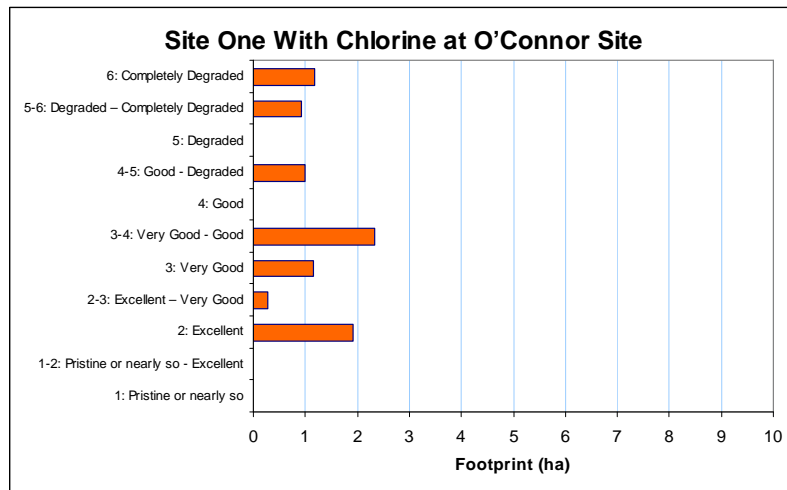
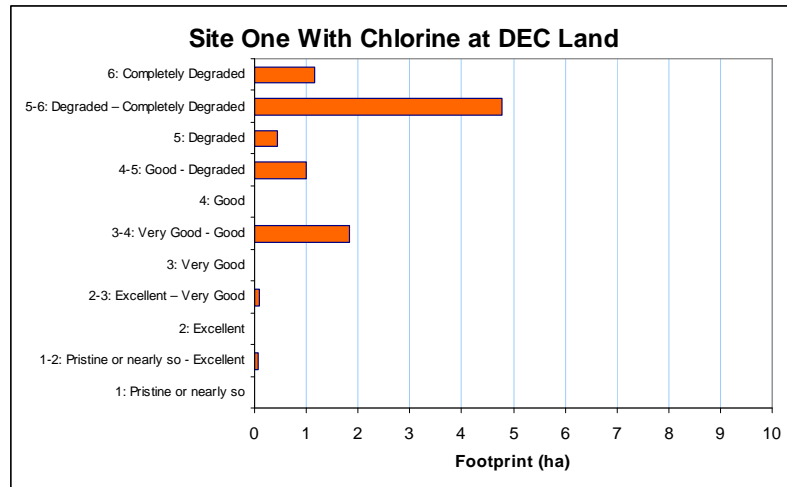


Table 1 Area of each vegetation condition within the Conceptual Site Footprint – as provided by Water Corporation (vegetation condition rated using the Bush Forever condition scale (Government of Western Australia, 2000).

Vegetation Condition (Bush Forever Scale)	Area of Vegetation Condition within Conceptual Site Footprint (ha)					
	Site One			DEC Land	Pine Plantation	O'Connor Site
	With Chlorine at DEC Land	With Chlorine at Pine Plantation Site	With Chlorine at O'Connor Site			
1: <i>Pristine or nearly so</i>	0	0	0	0	0	0
1-2: <i>Pristine of nearly so - Excellent</i>	0.08	0	0	0.07	0	0
2: <i>Excellent</i>	0	0	1.92	0	0	7.39
2-3: <i>Excellent – Very Good</i>	0.1	0.008	0.28	0.58	.13	0.14
3: <i>Very Good</i>	0	0.4	1.15	0	.39	3.3
3-4: <i>Very Good - Good</i>	1.83	1.83	2.33	0	0	2.15
4: <i>Good</i>	0.005	0.005	0.005	0	0	0
4-5: <i>Good - Degraded</i>	1.00	1.0	1.0	.96	0	0
5: <i>Degraded</i>	0.44	4.2	0	1.42	9.5	0
5-6: <i>Degraded – Completely Degraded</i>	4.79	.92	.92	5	0	0
6: <i>Completely Degraded</i>	1.17	1.17	1.17	0	0.06	0



Graph 1: Area of Vegetation within Conceptual Site Footprint – DEC, O'Connor and Pine Plantation



Graph 2: Area of Vegetation within Conceptual Site Footprint – Site One and Chlorination Site Options



Site One

Site One is highly degraded and has been subject to a long history of disturbance. The site's degraded nature means that impacts on native flora and fauna at this site will generally be minimal.

If the WTP is located at this site there will be some clearing of native vegetation required, including clearing of a number of mature trees and disturbance to granite outcrops, which have value as fauna habitat and as areas of high biodiversity. Where possible riparian vegetation should be preserved.

However, the chlorine store and the drying beds cannot be located at this site and may require clearing of native vegetation for this infrastructure at one of the alternative site locations.

According to the conceptual plant layouts the WTP at Site One will require clearing of the following amount of vegetation rated in condition *Good* (4) or better:

- » *Site One plus Chlorine and drying beds at DEC Land: 2 ha* in condition *Good* (4) or better.
- » *Site One plus Chlorine and drying beds at Pine Plantation: 2.24 ha* in condition *Good* (4) or better.
- » *Site One plus Chlorine and drying beds at O'Connor Site: 5.68 ha* in condition *Good* (4) or better.

Site One will not require an additional pipeline, whereas all the other sites will require a pipeline from the weir up to the sites. This pipeline would require clearing of some native vegetation.

DEC Land

Although a significant portion of the site has been cleared, areas of native vegetation remain. The areas of good or better native vegetation are located in the northern section of the site and on adjacent land to the east. The conceptual plant layout (**Appendix B**) shows the WTP situated in the south of the site and this layout impacts on only 0.65 ha of vegetation rated as condition *Good* (4) or better.

Pine Plantation

The construction of the water treatment plant will require the clearing of native vegetation. To minimise environmental impacts clearing should primarily occur in the pine plantation and be kept to a minimum in the native vegetation. This site will also require vegetation to be cleared for upgrading and widening of the access road.

The conceptual plant layout (**Appendix B**) shows the WTP situated primarily in the pine plantation with very little impact on the areas of native vegetation. This layout impacts on only 0.52 ha of vegetation rated as condition *Good* (4) or better at the site. However, there will be impacts on native vegetation from the requirement to widen the access track into the site. This will require vegetation adjacent to the existing Allen Rd to be cleared over the almost 1km of track into the site.



O'Connor Site

The conceptual plant layout (**Appendix B**) shows the WTP centred around the access track, which is the most degraded section of the site. However, this layout will still require clearing of native vegetation. This layout impacts on 12.98 ha of vegetation rated as condition *Good* (4) or better at the site.

3.1.2 Impacts on Fauna

Any construction work has the potential to cause death or harm to fauna species. Vegetation clearing and vehicle movements are likely to result in an increased incidence of animal death or injury. Slower moving land animals (including mammals, reptiles and amphibians) are most at risk, as they are often unable to vacate disturbed areas of vegetation quickly enough to avoid harm. Animals may become disorientated following destruction of their current habitat ranges. Cleared, open areas can also contribute to making animals more susceptible to predation, as vegetation used as cover or camouflage would be absent. Vegetation clearing can also have significant effects on mobile animals, such as birds or tree dwelling animals that remain in trees that are felled or cleared. Indirectly, increased human presence within the study area has the potential to introduce rubbish and/or pollution that may contribute to animal sickness or death from ingestion of these materials.

Site One

The value of Site One for fauna is relatively low due to its disturbed nature. The conceptual plant layout is primarily over the most degraded section of the site and avoids the areas of higher value fauna habitat, including the riparian zone and granite outcrops. Impacts on fauna from the WTP at this site will be minimal.

DEC Land

The majority of the DEC Land that will be impacted by the WTP is degraded and contains introduced species. These areas hold some value for native fauna species, but this value is limited. The areas on the site with native vegetation, and thus higher value for fauna, have been retained in the conceptual plant layout.

Pine Plantation

The conceptual plant layout shows the impact on native vegetation at the site as low. The pine plantation offers some value to fauna species, particularly as feeding habitat for some bird species but this value is limited in comparison to that of native vegetation.

This site requires a substantial length of access road, as well as pipelines. This will result in clearing of native vegetation and may also impact on fauna linkages as the access track and pipelines may result in a substantial barrier to fauna movement.

O'Connor Site

This site contains the largest contiguous area of native vegetation of all the sites. While this vegetation has been previously disturbed it still has the highest fauna values of all the sites being considered in this assessment.



3.2 Land Degradation

Land degradation is a serious environmental and community problem in Western Australia. It is a major problem in relation to agricultural lands but is also an issue where clearing and changes to land use may change drainage and soil structure.

3.2.1 Soil degradation and erosion

Native vegetation serves an important role in the stabilisation of soil within the landscape. Removal of deep-rooted perennial vegetation and overstorey trees, particularly in areas of steep terrain, has the potential to cause appreciable land degradation. Soil loss can also contribute to siltation of water resources downslope of these erosional areas and has indirect impacts on water quality, riparian vegetation health and the health of fauna species reliant on these areas.

Site One

Site One is adjacent to the Helena River and there is potential for this waterway to be impacted by erosion. However, this site has been historically disturbed and is subject to a number of ongoing disturbances. Much of the site is cleared or contains weedy species and the potential for land degradation at this site is low in comparison to the other sites

Soil degradation and erosion is of greatest concern in the east of the site where large granite outcrops occur. If these outcrops will need to be blasted out there is potential for these major earthworks to lead to sedimentation and erosion.

DEC Land

Some areas of the site are sloped and have the potential to lead to land degradation. While much of the vegetation at the site is introduced and it contains a number of weedy species, the clearing of this vegetation has the potential to lead to erosional impacts.

Pine Plantation

While the area of the site that will be impacted is a degraded pine plantation the clearing of this stabilising vegetation may lead to erosion; however, these impacts can be managed.

O'Connor Site

This site is in the best natural condition of all the sites. It has the most complete native vegetation cover and clearing of this vegetation has the potential to lead to soil erosion and land degradation.

3.2.2 Spread of Weeds

Site One

Site One is very highly disturbed and dominated by weed species. This site contains a number of noxious and serious environmental weeds. As the site is already highly disturbed the construction and operation of the WTP here is not likely to exacerbate



the weed issues on site. However, careful management will be required to ensure the weeds from the site are not spread to less-disturbed areas, such as through earthworks.

Weed management of areas adjacent to the plant footprint, such as along Helena River, could be undertaken to enhance the environmental value of surrounding areas.

DEC Land

Site One is very highly disturbed and dominated by weed species. As the site is already highly disturbed the construction and operation of the WTP here is not likely to exacerbate the weed issues on site. However, careful management will be required to ensure the weeds from the site are not spread to less-disturbed areas, such as through earthworks.

As an offset to any environmental issues at the site weed management of areas adjacent to the plant footprint, such as the gully in the northern section of the site could be undertaken to enhance the environmental value of surrounding areas.

Pine Plantation

The majority of the area to be impacted in the conceptual plant layout is almost completely covered by introduced species (Pine trees and introduced *Acacias*). If the impact is restricted to the pine plantation and weed management and rehabilitation plans implemented then there will be some benefit in terms of removal of introduced species.

While the site already contains introduced species, weed management will still be required to prevent any further spread of weeds in adjacent areas of native vegetation during the construction and operation of the WTP.

O'Connor Site

The O'Connor Site is relatively weed free. While there are some planted and introduced species around the disturbed areas the majority of the site, and the native vegetation remains free of major weed infestations. There is the potential for the construction and operation of the WTP to increase the presence of weeds both at the site and into the adjacent bushland. Weed management will be of a high concern if this site is selected as the preferred site for the WTP.

3.2.3 Dieback

The presence of dieback in an area results in the death of susceptible plant species. Dieback infestations spread through bushland either naturally, through soil water movement, or artificially through vector movement of soil on vehicles, during fencing or firebreak track maintenance and occasionally via foot traffic. Given that considerable movement of both soil and vegetation will occur as a result of the WTP construction, the potential for the pathogen, if present, to spread is high. Stringent hygiene measures will be required during construction to ensure that dieback is not moved on construction machinery or through the movement of soil.



Site One

This site is currently a high visitation area and the risks associated with dieback spread at this site will be low. However, hygiene management measures will still be required.

DEC Land

This site is currently a high visitation area and the risks associated with dieback spread at this site will be low. However, hygiene management measures will still be required.

Pine Plantation

The pine plantation is in an area that has been quarantined in the past due to the risk of spread of dieback. If this site is selected for the WTP the native vegetation in the general area of the plant may be subject to an increased risk of the spread of dieback throughout the construction and operation of the plant.

O'Connor Site

This site shows evidence of dieback infestation and the risks associated with dieback spread at this site will be low. However, hygiene management measures will still be required.

3.3 Alterations to Hydrology and Water Management

The WTP has the potential to impact on the natural hydrology of the site in a number of ways. The clearing, earthworks and addition of infrastructure on the site will impede the natural drainage lines within the site and construction of an artificial drainage system will be required. The addition of hardstand areas and artificial surfaces in the plant will reduce the infiltration of rainwater into the ground and run-off will be increased. This increased run-off has the potential to cause soil erosion and to increase sedimentation downstream. Additionally, management measures may be required to ensure run-off from the site does not contain contaminants. Stormwater management will be required to prevent discharge direct to sensitive ecosystems.

A drainage system may be required to be implemented to manage run-off from the site. Potential management measures include sumps and infiltration basins to capture stormwater and promote direct infiltration and the addition of drainage swales, erosion controls and sediment traps if required.

Site One

The site slopes down towards the Helena River to the north of the site, and all the drainage of the site runs to this waterway. Runoff from the WTP at this site has the potential to cause erosion and sedimentation in the riparian zone. Management measures will be required to ensure that the surface water runoff from the WTP hardstand is managed.

The conceptual plant layout indicates that the drainage line in the west of the site and Helena River itself will not be impacted, but the drainage line that runs through the center of the site will be impacted. Artificial drainage will be required for this waterway.



DEC Land

The conceptual layout shows that the larger drainage line in the northern gully will not be impacted by the WTP. However, the drainage line through the central gully will be impacted by the plant layout and the drainage in the central section of the site will be altered.

Pine Plantation

This site is situated within a RPZ. A WTP is not a compatible land-use within this zone and the Department of Water has indicated that if the WTP is to be located here substantial drainage works will be required to engineer the site out of the catchment. This will require an artificial drainage system that will drain the entire site to a sump. The drainage water would then need to be pumped out of the catchment area. This is a significant alteration of the hydrology of the site and will be very expensive to construct and operate. This process will also have ongoing energy requirements.

O'Connor Site

The conceptual plant layout for this site shows that impact on waterways at this site have been generally avoided, with only the access track impacting on the drainage line in the south of the site. Stormwater management will be required to prevent impacts from run-off, erosion and sedimentation on the areas downhill from the plant, including Bending Gully adjacent to Mundaring Weir Road.

3.4 Pollution and Waste Management

The construction and operation of the WTP will result in the production of a number of waste products and potential pollutants. These wastes will require management to ensure that they are correctly disposed of, to prevent contamination of land and water. The sites will all require pollution and waste management and this is therefore not a significant issue in relation to the site selection process. However, if there are sensitive environments within or close to the potential sites this may need consideration on possible impacts from accidental waste releases. Stringent waste management measures will be required to prevent any impacts on these sensitive environments.

Potential impacts from hazardous chemicals at the site and potential impacts on human health are not considered here as it is discussed in a separate Risk Assessment.

Site One

This site is adjacent to Helena River and the Mundaring National Park.

DEC Land

The site drainage runs into Bending Gully and is across Mundaring Weir Road from Mundaring National Park.



Pine Plantation

The major issue with this site will be potential releases into the Mundaring RPZ, this is discussed in relation to water management (Section 3.3).

O'Connor Site

Mundaring National Park is adjacent to the site boundary; however, the conceptual plant layout shows a buffer of vegetation between the plant and the park.

3.5 Social Impacts

3.5.1 Impacts on Aesthetics

Construction of the WTP will cause an increase in noise, dust and vibration in the short-term during construction of the plant. The operational aesthetics impacts will be less than those caused by construction but the operation may still result in visual and noise impacts. Given the close proximity of sensitive receptors these issues are likely to impact upon visitors and tourists in the area.

Measures to minimise aesthetic impacts will need to be considered in the design phase. For all sites, screening may aid in minimising visual impact and native vegetation should be used for screening where possible.

Site One

Given the site's close proximity to the tourist and heritage area, a WTP at this site would impact on visual aesthetics. Views from the weir wall, lookouts and picnic spots would include the WTP. Screening would assist in reducing the visual impact of the WTP at this site; however, as the site is lower than a number of the public access areas (particularly the lookouts and the weir wall) the WTP will be very visible and screening potential will be limited.

DEC Land

The DEC Land is located in a relatively high- use area, being close to Fred Jacoby Park, the Kookaburra Outdoor Cinema, walking trails and the Hills Forest Discovery Centre. There is some existing native vegetation at the site and the conceptual plant layout shows a buffer of vegetation will be retained between some of the public access (particularly the Kookaburra Outdoor Cinema and the Hills Forest Discovery Centre) areas and the site. Additional screening, particularly planting of native vegetation, will assist in reducing visual impact; however, complete screening may not be possible.

Pine Plantation

This site is relatively removed from the high use tourism and recreation areas around Mundaring Weir and impacts on aesthetic amenity should be relatively low. However, a WTP site at this site may cause visual impacts on users of the Bibbulmun Track, which runs through the north-west corner of the site.



O'Connor Site

A WTP at the O'Connor Site may have aesthetic impacts on users of Mundaring Weir Road, residents and users of the walking and cycling trails close to the site. Potential aesthetic impacts have been minimised by providing distance between adjacent private properties and Mundaring Weir Road, including a buffer of vegetation between these areas and the plant. Some sections of the vegetation buffer between Mundaring Weir Road and the plant are quite thin and would not provide very effective screening; however, native vegetation could be planted in this section that would improve the screening of the plant at this site.

3.5.2 Land Use conflicts

Site One

If the WTP is situated on Site One it will be within a proposed heritage-tourist precinct. The site is currently used for recreation and contains picnic areas, a children's playground and is close to walking trails. These landuses would be constrained by the WTP at this site.

The transport route for Site One is likely to be the Mundaring Weir Road, including the steep, winding section near the weir. This may cause conflict with both tourist and local traffic.

The chlorine store and drying beds for Site One would be located at one of the other three sites and this may be in conflict with the existing landuses of these sites, as discussed below.

DEC Land

The DEC Land currently contains the DEC offices, depot and some housing for DEC employees. These land uses are not compatible with a WTP at this site and would require relocation. DEC has indicated that they would consider relocation and the move may provide DEC with some positive benefits.

The Kattamoorda Heritage Trail, Kep Track and the Mundaring Loop Bike Trail all pass through the site and these trails could be directly and indirectly impacted by the WTP at this site. The trails may need rerouting if they are within the boundaries of the WTP. However, these trails have been situated to make use of the heritage values of the area and any rerouting will need to ensure that the heritage significance of these trails is not reduced. Additionally, the presence of the WTP may impact on the aesthetics of these trails, particularly through visual impacts.

Pine Plantation

The majority of the Pine Plantation site is not currently used, except the Bibbulmun Track that passes through the north-west corner of the site. Direct impacts on this track can be avoided as the conceptual layout shows the plant contained in the south-east corner of the site. However, this track may need rerouting to comply with the chlorine buffer or if the plant has aesthetic (ie visual) impacts on this walking trail.



To the south of the site is DEC's landing ground. The requirement for a chlorine buffer at the site may be in conflict with the use of the landing ground; however, this can be managed by locating the chlorine store at an appropriate distance from this area. There may also be height restrictions on some sections of the site to comply with safety requirements of the landing ground. If this site is selected as the preferred site further investigations should include consultation with the Civil Aviation Safety Authority to ensure that the site layout complies with height restrictions.

O'Connor Site

The O'Connor Site has been used in the past for logging and firewood collection but at present it is used only for recreation. The Kattamoorda Heritage Trail, Kep Track and the Mundaring Loop Bike Trail all pass along the western boundary of the site and these trails could be indirectly impacted by the WTP at this site. The trails may need rerouting if they are within the boundaries of the chlorine buffer zone; however, these trails have been situated to make use of the heritage values of the area and any rerouting will need to ensure that the heritage significance of these trails is not reduced. Additionally, the presence of the WTP may impact on the aesthetics of these trails, particularly through visual impacts.

The WTP at this site may have indirect impacts, particularly impacts on aesthetics, on adjacent landuses (residences) on adjacent private properties.



4. Conclusions

GHD was commissioned by the Water Corporation to undertake preliminary environmental investigations on the four short-listed sites for the Mundaring WTP. This preliminary comparative EIA assessed a number of environmental factors at each site, including:

- » Topography;
- » Geology and Soils (including ASS);
- » Contaminated Sites
- » Hydrology (including water source areas & catchments; and waterways);
- » Land use (including surrounding land and reserves & conservation areas);
- » Flora and Vegetation; and
- » Fauna.

This investigation also included an assessment of potential impacts and management of impacts for:

- » Impacts on Biodiversity (including vegetation clearing and impacts on fauna);
- » Land Degradation (including soil degradation and erosion; spread of weeds and dieback);
- » Alterations to Hydrology and Water Management;
- » Pollution and Waste Management;
- » Social Impacts (including impacts on aesthetics and land use conflicts)

Major aspects and issues identified are discussed below.

Flora and Fauna

Site One

Site One has been subject to a long history of disturbance. Most of the site is degraded with a high level of weed invasion. The site contains remnant scattered mature Flooded Gum and Marri trees. The granite system in the east and the riparian vegetation near Helena River are still in relatively good condition. The conceptual plant layout shows that the majority of these areas will be retained.

There may also be impacts on biodiversity depending on which of the other sites the chlorine store and drying beds will be located on.

According to the conceptual layouts the WTP at Site One will require clearing of the following amount of vegetation rated condition *Good* (4) or better:

- » *Site One plus Chlorine and drying beds at DEC Land: 2 ha* in condition *Good* (4) or better.
- » *Site One plus Chlorine and drying beds at Pine Plantation: 2.24 ha* in condition *Good* (4) or better.



- » *Site One plus Chlorine and drying beds at O'Connor Site: 5.68 ha* in condition Good (4) or better.

A Priority 3 flora species was recorded on the site but is outside the WTP footprint and impacts on this species can be avoided.

The value of the site for native fauna is limited due to its degraded nature.

DEC Land

A significant portion of the site has been cleared in the past, with most of the central section being highly degraded and containing predominantly introduced species. There are some areas of native vegetation remaining, with good quality vegetation in the north of the site (gully system and granitic herblands) and to the east of the site (Jarrah-Marri Forest).

The conceptual plant layout shows the WTP situated in the central area of the site where the vegetation is highly degraded. The layout impacts on 0.65 ha of vegetation rated condition *Good* (4) or better.

The majority of the site has been significantly altered due to the old settlement that was located on it and would provide little value as habitat to native fauna species. Some species, particularly bird species could utilise the introduced garden plants for foraging, but in general the disturbances on the site have reduced its value for fauna.

The northern section of the site has high habitat value as it contains a number of different habitat types, including granite outcrops and a gully system. The conceptual plant layout shows that this area will be retained.

Pine Plantation

The vegetation at this site is fairly uniform, with two main vegetation types occurring; a Jarrah-Marri forest in the north-west part of the site and a pine plantation in the south-east of the site. The pine plantation was generally Condition 5 (*Degraded*) as it contained predominantly introduced species, with some scattered natives.

The conceptual plant layout shows the WTP situated primarily in the pine plantation with very little impact on the areas of native vegetation. This layout impacts on only 0.52 ha of vegetation rated as condition *Good* (4) or better at the site. However, there will be impacts on native vegetation from the requirement to widen the access track into the site. This will require vegetation adjacent to the existing Allen Rd to be cleared over the almost 1km of track into the site.

The pine plantation offers limited value to native fauna, it provides some feeding habitat for species but is of less value than the native vegetation surrounding the plantation.

This site requires a substantial length of access road, as well as pipelines. This will result in clearing of native vegetation and may also impact on fauna linkages as the access track and pipelines may result in a substantial barrier to fauna movement.

O'Connor Site



The majority of the O'Connor Site supports Jarrah and Marri Forest. The site has been logged previously and the vegetation is regrowth.

Small sections of the site, particularly around the access track in the centre of the site are highly disturbed, and contain some planted non-native species. The condition of the vegetation improves away from the road and while there is disturbance evident in these areas the vegetation structure remains intact and the site retains the ability to regenerate to a better condition.

The conceptual plant layout shows the WTP centred around the access track, which is the most degraded section of the site. However, this layout will still require clearing of native vegetation. This layout impacts on 12.98 ha of vegetation rated as condition *Good* (4) or better at the site.

This site contains the largest contiguous area of native vegetation of all the sites. While this vegetation has been previously disturbed it still has the highest flora and fauna values of all the sites being considered in this assessment.

Land Degradation

Site One

Site One has been historically disturbed and is subject to a number of ongoing disturbances. Much of the site is cleared or contains weedy species and the potential for land degradation at this site is low in comparison to the other sites.

DEC Land

Some areas of the site are sloped and have the potential to lead to land degradation. While much of the vegetation at the site is introduced and it contains a number of weedy species, the clearing of this vegetation has the potential to lead to erosional impacts.

Pine Plantation

While the WTP layout at this site is primarily within pine plantation it is surrounded by native vegetation. Additionally, native vegetation will need to be cleared for the access track into the site.

Clearing of this site and the construction and operation of the WTP have the potential to cause land degradation of the areas of native vegetation adjacent to the site, particularly through the risk of the introduction of weed species and dieback.

O'Connor Site

This site is in the most natural condition of all the sites. It has the most complete native vegetation cover and has the least weed invasion. There is potential for construction and operation of the WTP to cause land degradation at this site.

Hydrology

Site One

Two waterways (drainage lines) pass through this site. One flows through the gully in the centre of the site and one flows through the western section of the site. Both



waterways drain into the Helena River. The Helena River passes through the north-west corner of the site. The conceptual plant layout shows that impacts on the Helena River and the western drainage line can be avoided but the central waterway will be impacted by the WTP.

DEC Land

There are two waterways (drainage lines) through this site, within the two gully systems that run east-west. These drainage lines are tributaries of Bending Gully, which runs south-west through Fred Jacoby Park (to the west of the site).

The conceptual layout shows that the larger drainage line in the northern gully will not be impacted by the WTP. However, the smaller drainage line through the central gully will be impacted by the plant layout and the drainage in the central section of the site will be altered.

Pine Plantation

There is one waterway (drainage line) that flows south-west through the pine plantation site and drains to Mundaring Reservoir. This drainage line flows through the minor gully that is to the south of the central access track.

This site is situated within a Reservoir Protection Zone. The Department of Water has indicated that if the WTP is to be located here substantial drainage works will be required to engineer the site out of the catchment. This will require an artificial drainage system that will drain the entire site to a sump. The drainage water would then need to be pumped out of the catchment area. This is a significant alteration of the hydrology of the site and will be very expensive to construct and operate. This process will also have ongoing energy requirements.

O'Connor Site

This site contains one waterway, in a gully along the southern boundary of the site. This waterway is a tributary of Bending Gully.

The conceptual plant layout for this site shows that impact on waterways at this site have been generally avoided, with only the access track impacting on the drainage line in the south of the site.

Pollution and Waste Management

These issues are not expected to have a major impact on the site selection process but will implementation of management measures during the construction and operation of the WTP.

Social Impacts.

Site One

Given the sites' close proximity to the tourist and heritage area, a WTP at this site would impact on visual aesthetics and on the use of this area for recreational and tourism purposes. Views from the weir wall, lookouts and picnic spots would include the WTP.



The chlorine store and drying beds for Site One would be located at one of the other three sites and this may be in conflict with the existing landuses of these sites, as discussed below.

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The DEC Land currently contains the DEC offices, depot and some housing for DEC employees. These land uses are not compatible with a WTP at this site and would require relocation. DEC has indicated that they would consider relocation and the move may provide DEC with some positive benefits.

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The WTP at this site may have indirect impacts, particularly impacts on aesthetics, on adjacent landuses (residences) on adjacent private properties.



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Appendix A

Figures

Figure 1 Environmental Constraints



Appendix B

Conceptual Plant Layouts Provided by Water Corporation



Appendix C
Vegetation Condition Scale



Table 2 Government of Western Australia (2000) Vegetation Condition Scale

Assigned Number	Classification	Description
1	<i>Pristine or nearly so</i>	No obvious signs of disturbance
2	<i>Excellent</i>	Vegetation structure intact, disturbance affecting individual species, and weeds are non-aggressive species
3	<i>Very Good</i>	Vegetation structure altered, obvious signs of disturbance
4	<i>Good</i>	Vegetation structure significantly altered by very obvious signs of multiple disturbance, retains basic vegetation structure or ability to regenerate it
5	<i>Degraded</i>	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.
6	<i>Completely Degraded</i>	The structure of the vegetation is no longer intact and the area is completely or almost without native species



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