# Regional waste strategy - western wheatbelt Shires

## Towards zero waste



Prepared for the Shire of Northam

By Essential Environmental

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essential environmental

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**Client: Shire of Northam**

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# 1 INTRODUCTION

The Shires of Chittering, Victoria Plains, Moora, Wongan-Ballidu, Dalwallinu, Goomalling, Toodyay and Northam (the "Shires") have agreed to work together to develop a coordinated approach to the management of waste across the Shires.

The *Strategic Direction for Waste Management in Western Australia* (Waste Management Board, 2004) outlines the Vision for waste management as that "we move as a community towards zero waste in Western Australia".

Key principles in the movement towards zero waste are:

- Prevention - avoid the creation of waste
- Recovery – to efficiently recover, retreat and reuse all wastes
- Disposal – to responsibly manage waste into the environment

This strategy focuses on two of the three foundation principles and aims to reduce the amount of waste disposed of to landfill through increased recycling, recovery and reuse of wastes via the formulation of a strategic and collaborative approach to waste management across all the Shires.

## 1.1 Purpose of the strategy

This regional waste strategy aims to provide waste management advice to the Shires as a collective. The strategy identifies options for strategic waste management, making recommendations for the future management of waste across the Shires to increase levels of recycling and provide for the long term security of meeting waste management needs including landfill.

This strategy will provide guidance regarding priority actions required to move the Shires towards zero waste.

## 1.2 Policy background

The management of waste should be in accordance with the *Waste Avoidance Resource and Recovery Act 2007*. Part 6 of this Act allows for waste services to be provided by local governments and supersedes the waste services formerly in the *Health Act 1911*.

The *Waste Avoidance Resource and Recovery Levy Act 2007* set a levy for waste disposal. The levy is payable on waste received at Metropolitan landfills, as well as on waste generated within the Metropolitan area and disposed of outside this area. The amount payable is dependent on the type of waste. Monies from the levy are used by the Waste Authority for priority waste initiatives.

Although there is no recent formal Government policy on waste, guidance is provided by the *Draft II Waste Strategy for Western Australia* (Waste Authority, 2010) and *Towards Zero waste-Recycling in Western Australia 2008/09*.

Other relevant references to waste management are contained in the *State Planning Strategy* (WAPC, 1997) and the *Wheatbelt Land Use Planning Strategy: draft for public comment* (WAPC, 2011).

## 1.3 Implementation of the strategy

This strategy complements the existing strategic waste management plans relevant to the Shires including:

- *Strategic waste management plan for the Central Midlands Voluntary Regional Organisation of Councils*, prepared by Cardno, 2008
- *Strategic waste minimisation plan 2008-2013* for the Avon Group of Councils prepared by IwProjects, 2008
- Shires of Goomalling and Dowerin, 2008, *Strategic waste plan*
- Shire of Moora, 2010, *Strategic Waste Management Plan: Shire of Moora 2011 – 2025*.

This strategy is to be implemented by the Shires through their commitment to partnerships and the delivery of cost effective regional solutions to waste management. It may be used to support applications to the Waste Authority's Regional Funding Program 2011-2016 for funding to plan and implement the identified strategic projects.

# 2 WASTE CHARACTERISTICS OF THE REGION

This strategy focuses primarily on the management of municipal solid waste (MSW), because in regional areas, MSW is the primary source of waste. Commercial and Industrial (C&I) waste is often collected with MSW, as is Construction and Demolition (C&D) waste, since this is not always segregated at landfills and so it is often disposed of by landfill.

The Shires of Chittering, Victoria Plains, Moora, Wongan-Ballidu, Dalwallinu, Goomalling, Toodyay and Northam currently operate a total of 16 landfill sites of varying type and capacity. Of these sites only two (one each within the Shires of Northam and Moora) are estimated to receive greater than 5000 tonnes of waste per annum and 11 are estimated to receive less than 1000 tonnes per annum (figure 1).

Some Shires have segregation and stockpiling of C&D waste at landfill sites but very little information is available regarding quantities received and/or recycled. Many of the sites are unmanned, unfenced and do not currently comply with Department of Environment and Conservation license conditions. Only Northam has a weighbridge.

Nine of the existing sites have less than five years of remaining capacity however these sites only account for approximately 25% of the collective annual waste yield. Northam alone accounts for approximately 55% of the collective annual yield and has over 20 years of estimated remaining capacity.

All of the Shires except Chittering provide a kerbside collection service although not all communities within each shire are necessarily included. Typically it is estimated that between 10 and 60% of total received waste is 'dropped-off' at each landfill site (table 1). However because there are no weighbridges and many sites are unmanned, it is impossible to verify these figures.

There is limited recycling activity within the Shires with approximately 6% of the collective annual waste yield recycled overall, approximately 4% of which is scrap metal recycling. However, some Shires report recycling of up to 21% of total annual yield.

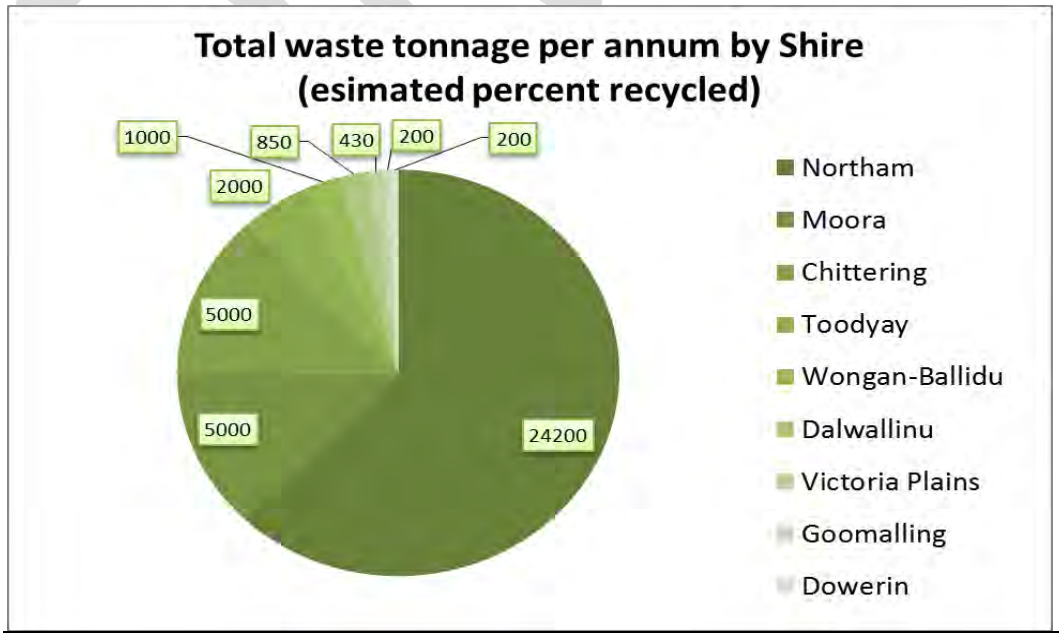


**Figure1- Total waste tonnage per annum by Shire**

**Table 1 – Drop-off, kerbside and recycled waste by Shire**

| Shire | Estimated annual tonnage | Total waste dropped off | Total waste collected at kerbside | Total waste to landfill | Total waste recycled |
|---|---|---|---|---|---|
| Northam | 24,200 | 36% | 64% | 95% | 5% |
| Moora | 5,800 | 22% | 78% | 95% | 5% |
| Chittering | 5,000 | 100% | 0% | 93% | 7% |
| Toodyay | 2,000 | 7% | 93% | 83% | 17% |
| Wongan-Ballidu | 1,000 | 20% | 80% | 94% | 6% |
| Dalwallinu | 850 | 17% | 83% | 79% | 21% |
| Victoria Plains | 430 | 64% | 36% | 93% | 7% |
| Goomalling | 200 | 60% | 40% | 85% | 15% |
| Dowerin | 200 | Unknown | Unknown | 84% | 16% |
| Total | 39,680 | 41% | 59% | 94% | 6% |

Based on information gathered from existing publications and anecdotal evidence from staff at the individual Shires, a summary of the status of each of the existing landfill sites is presented below.

## 2.1 Shire of Chittering

| Muchea | |
|---|---|
| Municipal waste collected | 3500 tpa |
| Municipal waste diverted from landfill | 7% |
| Estimated remaining landfill capacity | 30 years |

| Bindoon | |
|---|---|
| Municipal waste collected | 2300 tpa |
| Municipal waste diverted from landfill | 7% |
| Estimated remaining landfill capacity | 5 years |

There is no kerbside waste collection service currently provided by the Shire of Chittering.

It is estimated that the introduction of kerbside collection services and improved segregation at landfill sites could potentially increase the lifespan of the Bindoon landfill to 6 years, and the Muchea landfill to 40+ years. Assuming that the Bindoon landfill is then closed and all waste diverted to Muchea the resultant Muchea lifespan would be of the order of 28 years.

## 2.2 Shire of Moora

| Moora | |
|---|---|
| Municipal waste collected | 5000 tpa |
| Municipal waste diverted from landfill | 5% |
| Estimated remaining landfill capacity | 4-6 years |

| Watheroo | |
|---|---|
| Municipal waste collected | 600 tpa |
| Municipal waste diverted from landfill | 4% |
| Estimated remaining landfill capacity | 5-7 years |

The Shire of Moora currently provides a kerbside waste collection service and has two recycling drop-off centres. The Shire of Moora recently implemented a kerbside recyclables collection. All kerbside recyclables for processing are transported 172km to Perth. This is estimated to potentially increase the lifespan of the Moora and Watheroo landfill sites by up to 5 years each. Due to the recent introduction of kerbside recycling, its impact on the waste diversion rate is not yet known, however the overall recyclable diversion rate prior to initiation of the program was 5%.

The Shire of Moora is currently seeking approval from the Department of Environment and Conservation to increase the estimated lifespans of the landfills by filling above ground level. The proposal would increase the lifespan at Moora by a further 15 years and an additional 5 years at Watheroo.

## 2.3 Shire of Dalwallinu

| Dalwallinu – Dalwallinu | |
|---|---|
| Municipal waste collected | 700 tpa |
| Municipal waste diverted from landfill | 21% |
| Estimated remaining landfill capacity | 50+ years |

| Dalwallinu – Kalannie | |
|---|---|
| Municipal waste collected | 100 tpa |
| Municipal waste diverted from landfill | 21% |
| Estimated remaining landfill capacity | 2-4 years |

Avon Waste currently provides kerbside collection services (including recyclables) in the Shire of Dalwallinu and currently achieves a diversion rate of 21% although much of this is attributed to scrap metal recycling.

Assuming that the Kalannie landfill is closed within 5 years and waste is diverted to Dalwallinu the resultant lifespan of Dalwallinu would remain greater than 50 years.

## 2.4 Shire of Victoria Plains

| Bolgart | |
|---|---|
| Municipal waste collected | 100 tpa |
| Municipal waste diverted from landfill | 20% |
| Estimated remaining landfill capacity | 3-5 years |

| Callingiri | |
|---|---|
| Municipal waste collected | 300 tpa |
| Municipal waste diverted from landfill | 7% |
| Estimated remaining landfill capacity | 2 years |

| Mogumber | |
|---|---|
| Municipal waste collected | 50 tpa |
| Municipal waste diverted from landfill | 20% |
| Estimated remaining landfill capacity | 1-2 years |

Avon Waste currently provides kerbside collection services in the Shire of Victoria Plains but this does not include recyclable collection. A diversion rate of 12% is achieved which is predominantly scrap metal.

The introduction of kerbside recyclable collections could extend the lifespan of each site by 1-2 years. However it is critical that a longer term solution is identified in the near future. This may involve the redevelopment of one of the existing landfill sites (possibly Calingiri) into a transfer station with effective segregation to facilitate increased recycling and allow waste to be redirected to an alternative landfill site.

## 2.5 Shire of Wongan-Ballidu

| Ballidu | |
|---|---|
| Municipal waste collected | 100 tpa |
| Municipal waste diverted from landfill | 5% |
| Estimated remaining landfill capacity | 5 years |

| Cadoux | |
|---|---|
| Municipal waste collected | 50 tpa |
| Municipal waste diverted from landfill | 4% |
| Estimated remaining landfill capacity | 5 years |

| Wongan Hills | |
|---|---|
| Municipal waste collected | 850 tpa |
| Municipal waste diverted from landfill | 6% |
| Estimated remaining landfill capacity | 30-40 years |

Avon Waste currently provides kerbside waste collection services (including recyclables) in the Shire of Wongan-Ballidu. This currently achieves a diversion rate of only 6%, primarily because a comparatively small quantity of scrap metal is recycled.

Assuming that the landfill sites at Ballidu and Cadoux are redeveloped to transfer waste to Wongan Hills within 5 years, the resulting lifespan of the Wongan Hills landfill is estimated to be approximately 30 years.

## 2.6 Shire of Goomalling

| Goomalling | |
|---|---|
| Municipal waste collected | 200 tpa |
| Municipal waste diverted from landfill | 15% |
| Estimated remaining landfill capacity | 100+ years |

Avon Waste currently provides kerbside collection services in the Shire of Goomalling but this does not include recyclable collection. A diversion rate of 15% is achieved predominantly by an independent fortnightly recyclable collection service run by the Lions (volunteers).

Given that the existing landfill site has an expected lifespan in excess of 100 years there is no urgent need to change waste management practices, however the introduction of a contracted kerbside recycling service is desirable since the existing service relies on community volunteers.

## 2.7 Shire of Dowerin

| Dowerin | |
|---|---|
| Municipal waste collected | 200 tpa |
| Municipal waste diverted from landfill | 16% |
| Estimated remaining landfill capacity | 30 years |

Avon Waste currently provides kerbside collection services in the Shire of Goomalling but this does not include recyclable collection. A diversion rate of 15% is achieved predominantly by a separate paper collection service and recyclable drop-off centre at the school, both of which are run by the Parents and Citizens Association.

The introduction of contracted kerbside recyclable collections could extend the lifespan of the landfill to 35 years and is desirable since the existing service relies on community volunteers.

## 2.8 Shire of Toodyay

Waste from the Shire of Toodyay is collected and/or dropped-off at the Toodyay transfer station where it is transferred to the Old Quarry Road landfill site in Northam. No kerbside collection of recyclables is provided.

## 2.9 Shire of Northam

| Northam – Old Quarry Road | |
|---|---|
| Municipal waste collected | 22000 tpa |
| Municipal waste diverted from landfill | 4% |
| Estimated remaining landfill capacity | 80+ years |

| Northam – Inkpen Road | |
|---|---|
| Municipal waste collected | 2000 tpa |
| Municipal waste diverted from landfill | 12% |
| Estimated remaining landfill capacity | 80+ years |

A proposal to expand the existing Old Quarry Road landfill site into the adjacent lot is expected to extend the lifespan of the site to approximately 80 years. For the purposes of this strategy, it has been assumed that this proposal is progressed and the commonage expansion goes ahead.

The Shires of Northam and Toodyay are currently renewing contracts for kerbside collections and are considering the inclusion of kerbside recyclable collection. The introduction of kerbside recyclable collections across both Shires could extend the lifespan of both landfill sites to 100+ years.

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# 3 CONSIDERATION OF OPTIONS

There are a number of options available for the strategic management of waste by the Shires. These include:

- Option 1 – Develop new local landfills as required
- Option 2 – Use of existing assets until capacity, followed by remote haulage
- Option 3 – New regional landfill facility
- Option 4 – New resource recovery facility

## 3.1 Option 1: Development of new local landfills

This option considers the development of new local landfills within each Shire, as required. Any new landfill facility would need to meet current standards and guidelines set by the Department of Environment and Conservation, which include requirements for environmental assessment, site layout, lining and leachate collection, construction management, water management, air quality, noise management, traffic considerations, site security and fencing, as well as operational management matters.

Based on the low waste tonnages, and the known cost of individual landfill site establishment and engineering, this option is likely to be cost-prohibitive. If it ultimately proved to be the only practicable option available, then the unit cost of waste disposal will be high as a result of the investigations, construction and operational requirements associated with the current licensing process for new landfill sites on the one hand, and on the other the very low base tonnages available to amortise costs.

## 3.2 Option 2: Use of existing assets then remote haulage

Under this option, existing landfill assets in the Shires would be used until the remaining capacity is exhausted in each landfill site. After that, waste would be diverted to an existing or new remote site, such as Northam or Red Hill. Adoption of this option would allow the Shires in the region to maximise their use of existing infrastructure with no additional capital outlay required until their landfill sites are full.

Implementation of this option would require the staged conversion of each "full" landfill to a transfer station where the waste would be sorted and stored until it was transported to an appropriate recycling or resource recovery centre or to landfill.

Based on the quantity of waste generated within the region, Northam could potentially serve as a disposal facility for all the Shires, with capacity for around 20 years. Increased recycling in the region could further extend the life of this landfill facility and could delay the need to convert some individual landfills into transfer facilities.

This option would delay significant capital expenditure and may be the most economically sensible option in the short to medium term, provided that the airspace is actually available. All Shires would incur additional transport costs as well as potentially the metropolitan landfill levy if Northam is not used and the waste is disposed of at a remote site within the Perth Metropolitan area.

The provision and operation of future transfer sites would need to consider the following factors:

- Location of facilities to optimise costs of transport both to and from the transfer site
- Size of transfer station catchment areas and appropriate sizing and servicing frequency for each facility
- Co-location of recycling facilities including clearly marked and segregated areas for recyclables and green waste which are easily accessible
- Consideration of a "Tip Store" which allows reuse of unwanted working items such as furniture and sporting equipment
- Cost recovery mechanism including fees for use
- Management arrangements which include management of access, monitoring of types and quantities of wastes and frequency of collection.
- Cost estimates for development of basic transfer station infrastructure (including an elevated ramp for vehicles with a concrete landing and retaining wall that accommodates sea containers) will vary due to the difference in existing infrastructure and conditions at each site and the number of containers required for segregation but are expected to be in the range of $50,000 to $250,000.

This option relies on the assumption that agreement can be reached for waste to be received by a remote site from each Shire in an incremental fashion and this may require the development of multiple waste disposal agreements. In reality it may only be possible to gain access to a remote site through a more global agreement involving multiple Shires at one time and this may prevent some Shires from making full use of their existing landfill (tip) capacity.

Estimating the comparative cost of this option is difficult given the dynamics of the market and the pricing strategies that particular facility owners might adopt. One possible approach might be to undertake an expression of interest process to get comparative prices from the market as a check in the event that remote haulage looks to be a commercial possibility.

## 3.3 Option 3: New regional landfill facility

Development of a regional waste facility is a substantial undertaking. It requires agreement between all Shires on an appropriate location and a strong commitment to its ongoing operation and management. The cost of the planning, design, construction and operation of a new facility is considerable. In order to support the identification of viable options for waste management for the Shires, cost modelling was undertaken at the conceptual model.

Modelling of a "generic" south-central landfill site was carried out using the NZMfE Landfill Full Cost Accounting Model, based on a number of key assumptions, set out in full in the cost modelling report (Appendix 1). Initial modelling utilised the following assumptions:

- As it is not possible to guarantee additional waste from outside the region, the base case was based on 40,000 tpa. The sensitivity of the costing to reducing to 20,000tpa or to a gradual increase to 60,000 and 100,000tpa was also assessed to provide a basis for assessing the business potential;
- Location is likely to be in Chittering or Victoria Plains. The cost of land purchase ranges from $4K to $25K per hectare. Site required is approx 250-300ha to provide 500m external buffer all round. Landfill location will be able to be identified within 1 km of a primary haul route;

- All landfill sites will close when the new site is operational and will become transfer stations (nuances around Moora or other airspace to be assessed at a later date);
- Model assumes that the site is a fully engineered putrescibles waste site capable of serving the region for a minimum of 30 years. Average waste depth is assumed as 15m. Model is based on a geocomposite liner, leachate drainage and evapo-transpiration cap.
- Model assesses the overall unit cost of disposal to enable comparison with market rates and includes the cost of construction, and an assessed average cost of operation;
- Available capital funding was factored in to initial development (assumed to be available only for construction of the first cell) and thereafter the capital funding was modelled commercially based on funding cost;
- Leachate disposal costs was based on the assumption of no biological treatment – recirculation or evaporation only;
- Cost of capital is at agreed Shire appropriate retail rate
- Tax and commercial considerations are excluded;
- It is noted that for such an enterprise to be viable, a partnership/governance arrangement will be required whereby all the Shires share the cost and responsibility for developing the site no matter where it is located. This will be critical to the success of this option, and may include provision for a host fee to facilitate host shire acceptance of the site;

- No locational analysis has been completed at this stage.

Whilst it may be desirable for individual Shires to delay transfer of waste to the shared facility to maximise the use of local landfill sites it should be noted that any new facility will require a certain minimum annual tonnage to be economically viable and so Shires may have to accept the early closure of some or all local facilities.

### Modelling results

The results of the modelling for four quantities of waste provided an indicative base cost of disposal (IBC) per tonne for the sub-regional landfill (table 2). The output summary for each tonnage input has been included with the main modelling report in Appendix 1.

**Table 2 Indicative Base Cost of Disposal for "generic" sub-regional landfill**

| Parameter | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 |
|---|---|---|---|---|
| Solid waste tonnage (tpa) | 40,000 | 100,000 | 60,000 | 20,000 |
| Total void required over lifetime ($Mm^3$) | 1.5 | 3.6 | 2.2 | 0.72 |
| Total footprint (ha) | 10.8 | 26.4 | 16.1 | 5.5 |
| Total site area assumed (ha) | 200 | 250 | 200 | 200 |
| IBC ($/tonne) | 76.48 | 51.70 | 64.25 | 118.05 |

Notes to Table 2:

1. All costs derived are based on the assumptions detailed in Appendix 1 of this report

2. Inflation is not included in the model. Hence the IBC needs to be reviewed and adjusted in line with the CPI over the life of the facility.

Due to the opportunity presented by Royalties for Regions funding, the effects of a 'cash injection' at the planning stage were also modelled. For each of the scenarios in Table 2, the effect of a cash injection of $0.5M, $1M, and $2M was modelled. The effect of this modelling on the IBC is given in Table 3, and presented in Figure 2.

**Table 3 Effect of cash injection on IBC**

| Cash injection | $0 | $0.5M | $1M | $2M | $4M |
|---|---|---|---|---|---|
| Scenario 1 (40,000tpa) | $76.48 | $72.86 | $69.24 | $62.00 | $47.53 |
| Scenario 2 (100,000 tpa) | $51.70 | $50.25 | $48.80 | $45.90 | $40.11 |
| Scenario 3 (60,000 tpa) | $64.25 | $61.84 | $59.43 | $54.60 | $44.95 |
| Scenario 4 (20,000tpa) | $118.05 | $110.81 | $103.57 | $89.09 | $60.14 |

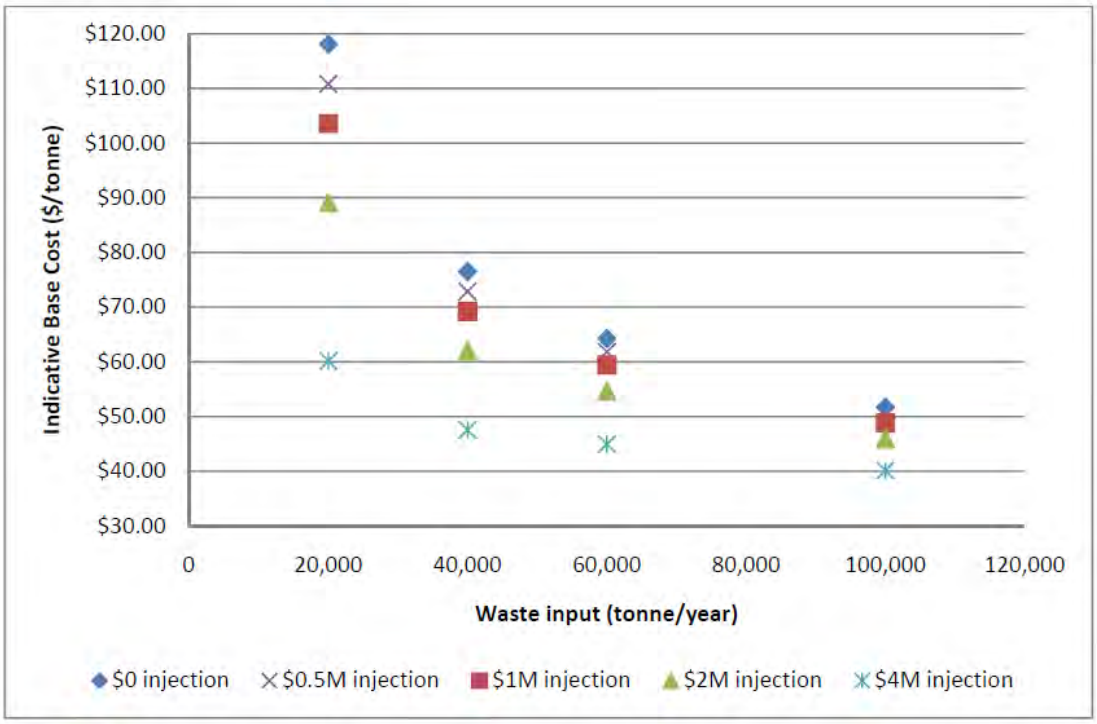



**Figure 2 Comparison of cost/tonne with annual waste volumes for "generic" landfill costing for the Wheatbelt shires, including the effects of an initial cash injection**

As can be seen from Figure 2, the introduction of a "cash injection" has the most impact for the lower tonnage cases. This is because the impact of the up-front cash on capital cost amortisation is most significant. A $4M cash injection potentially reduces the whole of life cost for the 20,000tpa case by the order of 50% ($120/t reduces to $60/t). At the higher tonnage end, the impact is less (around 20%).

### Modelling conclusions

At this stage of project development, the IBC costs are indicative only, but they clearly demonstrate the cost relativity between each scenario. While the costs are based on constant annual waste tonnage, they provide an indication of the likely range of whole of life landfill disposal costs for variable annual waste quantities, within the upper and lower bounds modelled.

The key conclusions that can be drawn from this are as follows:

1. For the current scenario of 40,000 tpa of residual waste the indicated base cost of disposal (that is the whole-of-life cost for the landfill to "break even" over its life without any commercial margin) is of the order of $70-$80/tonne of waste.

2. If the waste tonnage were to reduce due to ongoing disposal at the existing southeast site, then net tonnes would be nearer 20,000 and the whole-of-life cost for this scenario would rise significantly (almost double) to around $100-$120/tonne. If the tonnes transitioned between the two then the cost would lie somewhere between, but would likely be skewed towards the higher end of the range due to the effective deferral of the amortisation of up-front costs by the additional waste tonnes, received later under this scenario.

3. As the landfill size increases to 60,000 and 100,000tpa, the overall per tonne cost reduces, and as shown on Figure 1 this trends towards a base cost for 100,000tpa plus, of around $40/t. This appears to be a realistic figure given our knowledge of landfill cost structures.

4. The impact of an up-front "cash injection" is that this results in a reduction in the cost of disposal by up to $60 per tonne (for the 20,000 tpa case). For the base case, a cash injection of $4M may reduce the cost of disposal by around $30 per tonne to be in the order of $40 to $50/tonne of waste. The effect of a cash injection is more marked for the lower tonnage scenarios (50%+/-) and reduces to around 20% for the 100,000 tpa case

5. It is noted that the costings presented represent "break even" costs (i.e., there is no allowance for margin [profit]). That is, if an IBC indicates a whole-of-life cost of (say) $40/tonne, then the commercial gate rate might be in the range $60-$80/tonne, with flexibility to discount for bulk waste contracts.

## 3.4 Option 4: New resource recovery facility

In order to achieve significant reductions in waste to landfill a resource recovery facility could be established in the region over the longer term. The following provides a summary of some of the technologies that are available and have been adopted elsewhere in Western Australia and internationally and the landfill diversion rates they can achieve. A summary of materials and resource recovery facilities in Perth is provided in Appendix 2.

### *3.4.1 Aerobic composting*

Aerobic digestion converts organic material into compost in the presence of oxygen. The process is faster than comparative anaerobic technologies but do not usually result in useable fuel gasses. The processes can be either wet or dry. Because the process takes place in a sealed unit it is possible to remove any odours using a filter system and liquids are continuously recycled through the system. Typically reported diversion rates achieved by aerobic digestion systems are in the range of 50-70%.

The Bedminster aerobic digestion facility currently in operated in Canning Vale by the Southern Metropolitan Regional Council is reported to have cost of approximately $35 million, processes over 80,000 tonnes of waste per year and diverts 64% of waste from landfill.

#### Advantages of aerobic composting

- Reduces greenhouse gas emissions and waste going to landfill
- Produces marketable products (compost)
- Low risk of air and water pollution
- Low risk of odours
- Recovery of packaging materials
- Proven technology
- Minimal risk of health consequences
- Some Australian technical expertise

#### Disadvantages of aerobic composting

- Markets for compost derived from municipal solid waste in Western Australia are still being developed
- Restricted to treating organic materials - other materials are removed for recycling or disposal
- Exhaust gas from gas engines may need treatment
- Contamination of the organic material affects digester performance
- Biogas cleaning to avoid corrosion and odour can be problematic

#### Examples of aerobic digestion facilities

Aerobic facilities are operating successfully in Australia and overseas:

- Southern Metropolitan Regional Council (Bedminster) – Canning Vale, Perth, WA
- Mindarie Regional Council (Conporec) – Perth, WA
- SITA Environmental Solutions (Bedminster) – Raymond Terrace advanced resource recovery facility in Port Stephens, NSW
- BioMass Solutions – Coffs Harbour, NSW

### *3.4.2 Anaerobic digestion*

Anaerobic digestion is a process that converts organic material into compost and biogas (methane). The process uses biological organisms to digest or break-down the material in a sealed anaerobic or oxygen-free environment. Because the process takes place in a sealed unit it is possible to remove any odours using a filter system and liquids are continuously recycled through the system. Typically reported diversion rates achieved by anaerobic digestion systems are in the range of 60-80%.

The anaerobic digestion facility currently under construction in Shenton Park by the Western Metropolitan Regional Council is reported to have a cost of approximately $35 million, will process up to 55,000 tonnes of waste per year and will divert 60-80% of waste from landfill.

#### Advantages of anaerobic digestion

- Reduces greenhouse gas emissions and waste going to landfill
- Produces marketable products (energy and/or compost)
- Low risk of air and water pollution
- Low risk of odours
- Recovery of packaging materials
- Proven technology

- Minimal risk of health consequences
- Some Australian technical expertise

#### Disadvantages of anaerobic digestion

- Markets for compost derived from municipal solid waste in Western Australia are still being developed
- Restricted to treating organic materials - other materials are removed for recycling or disposal
- Exhaust gas from gas engines may need treatment
- Contamination of the organic material affects digester performance
- Biogas cleaning to avoid corrosion and odour can be problematic

#### Examples of anaerobic digestion facilities

Anaerobic facilities are operating successfully in Australia and overseas:

- ArrowBio anaerobic digestion facility at Macarthur Resource Recovery Park in Jack's Gully NSW
- WSN Environmental
- AnaeCo anaerobic digestion facility at Western Metropolitan Regional Council in Shenton Park, WA

### *3.4.3 Thermal processes*

There are several potential thermal processes which use very high temperatures to convert waste into energy-rich fuels under controlled conditions. These technologies typically result in around 90% diversion rate. Costs for thermal processing facilities are thought to be similar to digestion processes but the technologies and markets are not proven within Australia.

#### Gasification

Gasification occurs in a sealed low oxygen environment at between 400˚C and 800˚C, and produces synthesis gas (methane, hydrogen, carbon monoxide and carbon dioxide) and char residue.

Synthesis gas can be used directly in engines, combusted with air to make steam, or sold as a gas fuel similar to natural gas.

Char can be used as a solid fuel or as a nutrient additive to improve soils.

#### Pyrolysis

Pyrolysis is a process very similar to gasification, also working in a sealed but this time oxygen-free environment at 400˚C to 800˚C. Synthesis gas, pyrolysis liquid and solid char are produced.

In addition to the same potential uses for synthesis gas and char as described previously, the pyrolysis liquid can be used as a fuel or to make new products such as ethanol.

### Combustion

The combustion process differs from both gasification and pyrolysis by the use of an oxygen rich sealed environment to achieve temperatures between 1000˚C and 1100˚C. All carbon and hydrogen in the waste is converted into carbon dioxide and water (flue gas) which can then be used to generate electricity and heat for community and/or industrial purposes provided there is sufficient demand in close proximity to the facility.

### Plasma

Plasma technology transforms organic materials into synthesis gas at very high temperatures (approximately 5000˚C), can be used to convert hazardous wastes to non-hazardous, recyclable by-products and can enable the recovery of precious and ferrous metals. The technology is reportedly environmentally friendly and guarantees emissions well below European and US standards.

### Advantages of thermal technologies

- Reduces greenhouse gas emissions and waste going to landfill
- Produces a marketable product
- Low risk of water pollution
- Low risk of odours
- High recovery rate of resources
- Minimal risk of health consequences
- Commercially proven technology (gasification and combustion)

### Disadvantages of thermal technologies

- Technology is still evolving (pyrolysis and plasma)
- Energy efficiency affected by the ability to use the heat generated
- Organic waste must be cleaned to remove impurities before gasification
- Recovery and use of the char can be problematic
- Markets are yet to be developed for char product and pyrolysis liquids
- High capital and operating cost due to regulatory standards

### Examples of gasification facilities

There are a number of companies operating facilities around the world, particularly in Japan and Europe:

- Energos Ltd, Isle of Wight UK
- Refgas pilot plant, Manchester UK
- JFE, Japan (8 commercial plants)

### Examples of pyrolysis facilities

Pilot, demonstration and commercial plants have been developed by the following companies:

- Best Energies, Gosford NSW
- Ethos Energy, Avonmouth, Bristol UK

- Graveson Energy Management (GEM), UK
- Takuma, Japan
- TechTrade, Germany
- Thide Environment, France and Japan
- Mitsui, Japan

### Examples of combustion facilities

Combustion facilities are widely used in Asia and Europe:

- Four facilities in Singapore run by the National Environment Agency' facilities at Ulu Pandan, Tuas, Senoko and Tuas South.
- Several facilities in Japan including those engineered by JFE, eg Kasama, Ibaraki, Hamada and Shimane
- ASM - Brescia, Italy
- AEB - Amsterdam, Netherlands

### Examples of plasma facilities

- AlterNRG facilities in Pennsylvania, USA and two in Japan
- Plasco Energy Group facility in Ottawa, Canada
- Cogim reference plants in Japan, USA and Poland using Startech technology

# 4 REGIONAL WASTE STRATEGY

The development of a regional waste strategy supports the collaborative efforts of a number of local governments in the management of waste. It provides an opportunity for the achievement of multiple benefits by the local governments and the community. These benefits include increased recycling and diversion opportunities; a reduction in the amount of waste disposed in landfills; safer disposal practices and improved management of the environment; lower greenhouse gas emissions; better service standards for customers; and cost savings from improved planning and management of waste services.

This strategy aims to facilitate these benefits through the identification of priority strategies and actions to be delivered cooperatively by the Shires.

## 4.1 Strategy objectives

The primary objectives of this strategy are to:

- increase the amount of recycling across the Shires in order to reach the Towards Zero Waste target for recycling of 45% diversion from landfill by 2016; and
- ensure long term security of meeting collective landfill disposal needs.

## 4.2 Strategy priorities

There are a number of actions that can be taken to improve the management of waste across the Shires. This strategy focuses on the two priority objective areas of recycling and landfill.

### *4.2.1 Recycling*

The Towards Zero Waste target for recycling is to achieve a 45% diversion from landfill by 2016. Currently none of the Shires are achieving this target.

The establishment of kerbside collection services for recyclables will increase the level of recycling in an area as well as the proportion of waste diverted from landfill. Typical diversion rates achieved where a collection service is provided are in the range 15-35%, however it is considered that in rural areas, the achievable diversion rate would be at the lower end of this scale because of the large proportion of drop-off waste received at landfill sites and the high likelihood of on-property green waste disposal.

The only regular kerbside recyclable collection services currently operating within the region are provided by the Shire of Moora as well as by Avon Waste in Dalwallinu and Wongan-Ballidu. The quantity of recyclables collected by these services is reasonably consistent although the total percentage of waste diverted from landfill in the Shires is very different with 21% achieved in Dalwallinu and only 6% achieved in Wongan-Ballidu because significantly more scrap metal is recycled from Dalwallinu (100 tpa) than from Wongan-Ballidu (2 tpa).

The majority of green waste currently collected by the Shires is chipped, left at the landfill and burnt. Consideration should be given to improving the separation, processing and reuse of green waste from verge-side collections and also that which is deposited at the landfill site. This may require additional consultation and marketing to ensure community support for the

appropriate separation of green waste and also for the purchase and use of the resultant mulch material.

Potential exists for an increase in the recycling of non-standard recyclable materials such as household hazardous waste, fluorescent tubes/compact fluorescent globes, dry cell batteries, e-waste and used tyres. Opportunities should be sought for partnerships with relevant programs and agencies such as Chemclear, drumMUSTER, MobileMuster, and Cartridge for Planet Ark and the Shires should work with the Department of Environment and Conservation and the Western Australian Local Government Authority to develop an effective regional hazardous waste management program.

It is likely that substantial amounts of recyclables are disposed of in landfills. The completion of a waste audit to assess materials placed in landfill will be able to identify the origin of the waste and assist in the development of a strategy to facilitate greater recycling. The audit will also identify other potentially recyclable material which should then be incorporated into the program.

An increase in community recycling can be facilitated by the improved segregation and signage of recyclable materials at drop-off sites including for C&D waste and green waste. The establishment of an area for a "tip shop" may also effective in increasing recycling by allowing the community to reuse unwanted items such as furniture and exercise equipment. The use of compaction and baling equipment is also supported to optimise storage and transport efficiencies.

Other actions which will assist in recycling and the diversion of waste to landfill include the engagement of the community in recycling activities including source separation and correct use of bins, hazardous waste programs and individual solutions such as worm farms and home composters.

### *4.2.2 Landfill and remote haulage*

There are a number of landfill sites with five years or less remaining capacity (table 4). As it is not economically viable to develop new, replacement landfills and the findings of the cost modelling identified that the costs of developing a regional landfill were prohibitive, it is recommended that consideration is given to the rationalisation of practices at each individual landfill site to extend their lifespans as much as possible before converting them into transfer stations.

**Table 4 – Landfill sites with 5 years or less capacity remaining**

| Landfill Site | Estimated annual tonnage | Estimated remaining lifespan(years) |
|---|---|---|
| Bindoon | 2,000 | 5 |
| Moora | 5,000 | 4-6 |
| Watheroo | 600 | 5-7 |
| Kalannie | 100 | 2-4 |
| Bolgart | 100 | 3-5 |
| Calingiri | 280 | 2 |
| Mogumber | 50 | 1-2 |
| Ballidu | 100 | 5 |
| Cadoux | 50 | 5 |
| Total | 8,280 | |

Due to the capacity remaining and the quantities of waste generated across the Shires, Northam (Old Quarry Road) is identified as the preferred final destination for the region's waste,

however where individual Shires have capacity in other landfills, the most efficient option is to utilise that remaining airspace prior to the remote haulage of all waste to Northam. The recommended closure and redevelopment actions are outlined in Table 5 and figure 2.

**Table 5: Specific closure or redevelopment actions**

| Site | Action | Date |
|---|---|---|
| Bindoon | Transfer to Muchea | 2015 |
| Muchea | Transfer to Northam | after 2030 |
| Moora | Transfer to Northam | 2017 |
| Watheroo | Transfer to Dalwallinu<br>[subsequently Northam] | 2018<br>[after 2050] |
| Dalwallinu | Transfer to Northam | After 2050 |
| Kalannie | Transfer to Dalwallinu<br>[subsequently Northam] | 2014<br>[after 2050] |
| Mogumber | Closure (redirect to Calingiri) | 2014 |
| Calingiri | Transfer to Northam | 2014 |
| Bolgart | Closure (redirect to Calingiri) | 2015 |
| Ballidu | Closure (redirect to Wongan Hills) | 2016 |
| Cadoux | Closure (redirect to Wongan Hills) | 2015 |
| Wongan Hills | Transfer to Northam | after 2030 |
| Dowerin | Transfer to Northam | after 2050 |

Notes:
1. Diversion dates are based on assumption that other recommendations of this report are implemented and that a diversion rate of 35% is achieved within 3-5 years
2. Annual population growth rates have been applied to Northam (Old Quarry Rd - 5%, Inkpen Rd - 4%) for the next 20 years
3. Transfer dates assume that DEC approval of above ground landfill at Moora and Watheroo is received

On the basis of the information presented in section 2, landfill capacity will be exhausted in the Shire of Victoria Plains within the next few years. Assuming that the Shire of Victoria Plains begins transferring waste to Northam (Old Quarry Road) within two years and is entirely transferred within five years the resulting lifespan of Old Quarry Road landfill remains greater than 100 years.

Assuming that other transfers are initiated as capacity in existing landfills is exceeded as follows: Moora within 20 years, Chittering Wongan-Ballidu and Dowerin within 30-35 years and Dalwallinu in approximately 50 years, the resulting lifespan of Old Quarry Road landfill remains greater than 80 years

It should be noted that the review of the potential lifespan of each landfill site and prospective transfer dates outlined above and in Table 5 do not include consideration of expansion of recycling activity in the region beyond the provision of kerbside collections of standard recyclables.

Although there are a number of sites with more than 5 years capacity remaining (table 6), some of these do not currently comply with the *Environmental Protection (Rural Landfill) Regulations 2002* or the conditions of their licence. It is recommended, in these instances, that an assessment is undertaken of the risk, liability, environmental impact and amount of waste disposed of to landfill (rather than being recycled or recovered) and cost estimates prepared

for the necessary improvements to determine an appropriate course of action in relation to these sites. It may be appropriate to close them "early", convert them to transfer stations and commence remote haulage waste management.

**Table 6 – Landfill sites with more than 5 years capacity remaining**

| Landfill Site | Estimated annual tonnage | Estimated remaining lifespan (years) |
|---|---|---|
| Muchea | 3,000 | 30 |
| Dalwallinu | 750 | 50+ |
| Wongan Hills | 850 | 30-40 |
| Northam | 22,000 | 21 (80+)* |
| Wundowie | 2,200 | 83 |
| Goomalling | 200 | 100+ |
| Dowerin | 200 | 30+ |
| **Total** | **29,200** | |

*Expansion plans for Northam-Old Quarry Road will result in lifespan over 80 years

### 4.2.3 Resource recovery

This strategy recommends the establishment of kerbside recyclable collection services for Chittering, Victoria Plains, Goomalling, Dowerin, Toodyay and Northam. Although this relatively 'business as usual' approach meets the objective of collectively extending the lifespan of landfills in the region to beyond 2050, it does not make significant progress 'towards zero waste' to landfill.

The establishment of a regional resource recovery centre would make substantial progress towards the achievement of zero waste to landfill. As described in section 3.4, resource recovery facilities can achieve anywhere between 50 and 90% diversion of waste to landfill. This is dependent on the type of process and is influenced by the effective separation of recyclables at source and the level of contamination.

As noted in section 3.4, the development of a resource recovery facility is a major undertaking; however these facilities are becoming more common (see Appendix 2) and this is likely to lead to reduced costs and greater certainty of requirements and outcomes. It is recommended that the Shires investigate the feasibility of developing a regional resource recovery facility to service the region.

### 4.2.4 Other actions

There are a number of other actions that should be considered by the Shires, as these will assist in the improvement of waste management across the Shires. These are:

- Improved systems for the collection and recording of waste management information including origin, type and quantities of wastes.
- Community engagement in waste management including regular communication regarding waste management options and best practice recycling and reuse actions.
- Improved management and materials handling at all landfill sites including use of composters, baling equipment and storage bins as well as management of access and offsite impacts on the environment from stormwater, rubbish, odour and noise.
- Identification and promotion of local markets for recyclates.

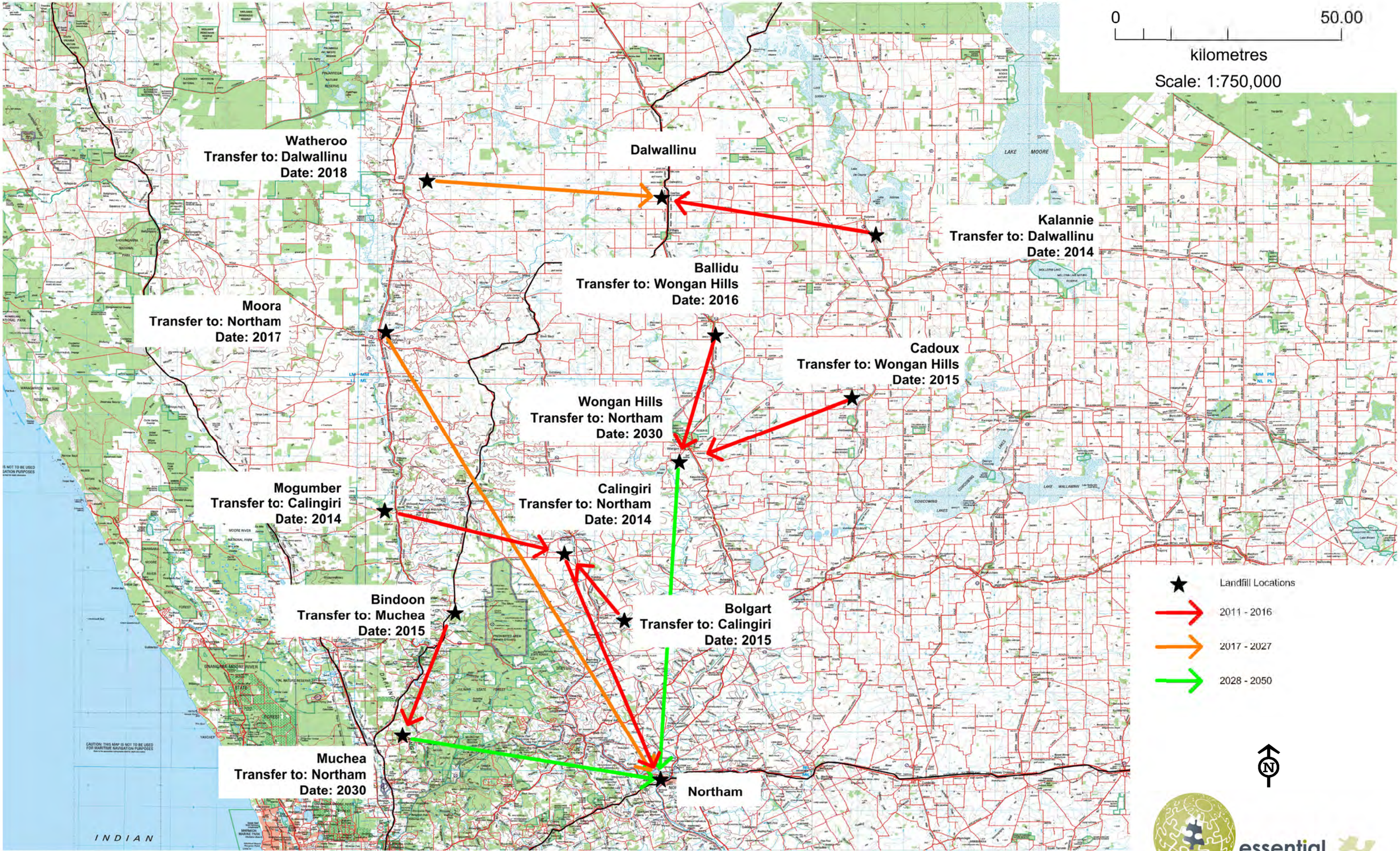
## 4.3 Recommended actions

The following priority actions are recommended to be implemented collectively and cooperatively by the Shires.

- Staged closure of landfill and conversion to transfer sites utilising available airspace at neighbouring facilities with eventual transfer to Northam as indicated in Table 5. Consideration should be given to "early" closure of landfill sites that require substantial modification to meet licence conditions and regulatory requirements.
- Provision of kerbside recycling collections in Chittering, Victoria Plains, Goomalling, Dowerin, Toodyay and Northam through the establishment of a regional program to deliver economies of scale and reduce transport trips to Perth.
- Development of improved segregation and signage at all existing sites with particular focus on segregation of C&D, green waste and "tip shop" items.
- Source separation of all green waste which is then mulched and stored for use by the Shires and the community. Strategic locations for processing facilities should be determined on the basis of volumes, transport requirements and available technical knowledge, plant and equipment.
- Development of a hazardous waste management program in partnership with agencies and other programs.
- Undertake a waste audit to establish more accurately the nature and quantities of waste generated and collected within the Shires.
- Development of a business case for the development of a regional resource recovery facility.

# Shire of Northam - Regional waste strategy

## Figure 3: recommended closure and redevelopment actions






Data source: Custodians, Created by: H Brookes. Projection: MGA50: zone 50.

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# APPENDIX 1 – COST MODELLING REPORT

# REPORT

**Whole of life costing study for a sub-regional landfill**

**Report prepared for:**

**Essential Environmental Consultants Pty Ltd**

**Report prepared by:**

**Tonkin & Taylor Pty Ltd**

**Distribution:**

| | |
|---|---|
| **Essential Environmental Consultants** | **12 copies** |
| **Tonkin & Taylor Pty Ltd (FILE)** | **1 copy** |

**March 2011**

**T&T Ref:750840**

# Table of contents

# 1 Introduction

Due to current opportunities for funding presented by the Royalties for Regions fund, a collective of Wheatbelt Shires (the Shires) northeast of Perth is investigating the potential for developing a sub-regional putrescible waste landfill facility. This facility would serve the waste disposal needs of the shires, as well as having the potential to attract waste from the metropolitan area of Perth to improve long term economics, and to reduce the nett disposal cost to the Shires. The concept is based on the progressive closure of existing smaller landfills and tips throughout the area, their replacement with a modern landfill facility and appropriate network of transfer stations, an appropriate mode of waste consolidation and haulage, and appropriate resource recovery and recycling systems.

As a starting point for developing a business case for a single sub-regional landfill facility, it was agreed that the option of a new regional landfill should be assessed and costed on a generic basis, initially to provide the input data required to evaluate and prepare a business case. Following a workshop held on 17 February 2011, Tonkin & Taylor Pty Ltd was engaged to undertake this work as a subconsultant to Essential Environmental Consultants Pty Ltd, in accordance with our letter of engagement dated 15 March 2011.

In accordance with our engagement, the modelling of a generic south-central located landfill site has been carried out using the New Zealand Ministry for the Environment Landfill Full Cost Accounting Model. The modelling is based on a number of key assumptions as set out below.

The key objectives of the modelling are:

1. To evaluate the likely overall “whole-of-life” cost for a new facility to enable comparison with current levels of cost for residual waste disposal to existing facilities (“calibration”)
2. To assess the sensitivity of the whole-of-life cost to possible variations in waste tonnage
3. To evaluate the impact of an up-front “cash injection” from the Royalties for regions fund on the whole-of-life costs.

As a result of this assessment, a decision on the possible viability of proceeding with a sub-regional landfill concept will be able to be better evaluated, and the costs derived can be compared with other options open to the Shires as input to that decision process.

# 2 Model input costs and values

## 2.1 Full Cost Accounting Model

This section details the modelled input costs and values of parameters associated with predevelopment, development, operation, closure, and aftercare of a sub-regional landfill to serve the needs of the Shires for a minimum of 30 years. Costs and values of parameters are estimated on the basis of a **generic landfill** that would be developed in accordance with modern landfill practices.

Before the results of this model are used for other than indicative purposes, a more detailed assessment of some key input parameters would be needed. That is, the rates used and the derived **Indicative Base Cost (IBC)** are for guidance only and are likely to alter based on relevant market and economic parameters, as well as site-specific data once a specific landfill site has been selected. The actual cost of developing a specific site, taking into account site specific constraints, may vary significantly from the cost developed from this generic model.

The model used has been prepared based on the verified model algorithm prepared for New Zealand conditions. Hence the model detail does not align with Australian terminology in some instances. We are unable to change the terminology in the model output due to copyright constraints. However, the model is applicable in any country of the world, provided the correct input data are used and it is suitable for use in this particular application.

## 2.2 Approach

The quantities of materials have been estimated assuming a generally “square” shaped landfill, and based on our experience of specific requirements for leachate collection systems, stormwater drainage, and similar infrastructure required for landfill development and operation.

Four scenarios have been modelled, and these are outlined in Table 2-1. It has been assumed for each scenario that the waste input remains constant throughout the life of the landfill.

**Table 2-1 Scenarios modelled**

| Parameter | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 |
|---|---|---|---|---|
| Solid waste tonnage (tonnes/yr) | 40,000 (base case) | 100,000 | 60,000 | 20,000 |
| Total solid waste disposed over lifetime (Mt) | 1.2 | 3 | 1.8 | 0.6 |

We have assumed the landfill will be constructed in stages, each stage having an approximate operating life of 2 to 10 years, depending on the scenario (typically 5 years for the base case of 40,000 tonnes/year).

We have also allowed for the purchase of a 500 m external buffer on all sides of the landfill, requiring a total site area of approximately 200 - 250ha. We have assumed that a suitable landfill site can be located within 1 km of a primary haul route, and have thus (conservatively) allowed to provide a 1 km access road from the main highway. We have assumed that the land in the buffer zone can be leased back for agricultural use during the life of the facility, with a lease back value assumed as 50% of the value of the land, spread over the life of the landfill.

Costing information is based on our experience at similar landfills, with specific local rates determined for some key items.

The model input pages for the base case have been included in Appendix A.

## 2.3 General input parameters

The framework and key design criteria for the generic landfill, for all scenarios, is listed below.

- Situation – development of a new site i.e., a greenfields site
- Project commencement date – 1 July 2012
- Operation commencement date – 1 July 2016
- Pre-development period – 4 years
- Time of land purchase – 1st year of predevelopment
- Consented operating life – 30 years (hence Sunset Date is 1 July 2046)
- Aftercare period – 30 years
- Annual waste growth rate – 0 percent per annum.
- Assumed compacted waste density (excluding cover) – 1.0 t/$m^3$.
- Target total cover to waste ratio of 1:5 (hence volume utilisation of 1.2 $m^3$/t)

## 2.4 Geometric input data

The geometric input data for all scenarios includes the following:

- Leachate Generation – 430 $m^3$/ha/yr active landfill, and 215 $m^3$/ha/yr post closure (based on 10% and 5% respectively of historical rainfall data for the south central zone from the Bureau of Meteorology)
- Assumed in-situ topsoil depth – 0.15m
- Liner – composite liner consisting of a 1.0m thick compacted clay layer (permeability < $1x10^{-9}$m/s) and 1.5mm HDPE geomembrane (based on Victoria BPEM requirements)
- Final Cover layer – consisting of 0.1m thick topsoil, 0.3m thick sub-topsoil layer, 0.9m thick low permeability compacted clay layer (permeability < $1x10^{-7}$m/s)
- Main landfill access road – 1km
- No leachate pre-treatment – leachate disposal system installed 1 year after commencing landfill operation, comprising pond, pump, pipeline, and irrigation system
- Net Airspace required for 30 years, with main stages every 5 years for the base case, and similar sized stages for all other cases
- Required cut equals material required for construction of the landfill liner, daily cover material, and construction of intermediate and final capping layers
- Unsuitables volume – none assumed
- Landfill configuration assumed as square with side slopes of 1V:4H. Average depth of fill of approximately 15m
- Stormwater open drains assumed to be installed with perimeter road

- Subsoil drainage based on installing a central drain through each cell
- Leachate collection sump – 1 No. assumed
- Landfill gas flare station – 1 No. enclosed flare assumed

The geometric data specific to each Scenario is outlined in Table 2-2.

**Table 2-2 Geometric data specific for each scenario modelled**

| Parameter | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 |
|---|---|---|---|---|
| Solid waste tonnage (tonnes/yr) | 40,000 (base case) | 100,000 | 60,000 | 20,000 |
| Boundary fence length (m) | 2600 | 1600 | 2000 | 1400 |
| Landfill perimeter access road (m) | 935 | 2200 | 1365 | 500 |
| Leachate collection system | | | | |
| Primary leachate drain (m) | 935 | 1221 | 1221 | 506 |
| Secondary leachate drains (m) | 3325 | 7825 | 4900 | 1750 |
| Cleanout ports (No.) | 3 | 6 | 3 | 2 |
| Gas management system | | | | |
| Vertical extraction wells (m) | 540 | 1350 | 720 | 270 |
| Ring header (m) | 300 | 750 | 450 | 150 |
| Laterals (m) | 600 | 1500 | 900 | 300 |
| Condensate traps (No.) | 3 | 8 | 5 | 2 |

## 2.5 Cost input data

Costs input to the model are listed below. Any items not listed have not been allowed for.

**Planning and pre-development**

- Project Management - $150,000 ($37,500 per year for 4 years of pre-development)
- Consultation - $150,000
- Land pre-purchase/ pre-leasing agreements - $20,000
- Survey and preliminary design - $150,000
- Geotechnical and groundwater investigations - $150,000
- Other detailed studies (i.e. noise, traffic, visual, archaeological, etc.) - $80,000
- Baseline monitoring - $100,000
- Landfill licensing process – AEE and consent application - $150,000, Draft landfill management plan - $20,000, Legal fees - $50,000, Hearing - $120,000, and Appeal - $200,000
- Land Acquisition and other associates costs - $4000/ha, including purchase of external buffer

**Base costs**

- Engineering – detailed design and documentation – 8%
- Construction Management – 6.5%
- Contractors Preliminary and General – 12.5%

**Development – site access**

- Intersection upgrade (main road or state highway) - $350,000
- Landfill access road (i.e. main road to footprint) - $450,000 for approximately 1000m of road (earthworks, stormwater drainage, roading (metal course and seal))
- Special structures (diversions, bridges, etc.) - $100,000

**Development – site amenities**

- Site Entrance – $10,000
- Administration Building – $50,000
- Weighbridge and gatehouse/kiosk – estimated cost $200,000
- Machinery shed/maintenance facility – estimated cost $100,000
- Power and Phone – estimated cost $30,000
- Sewerage – estimated cost $20,000
- Water Supply – estimated cost $30,000
- General civil works ( amenities area, earthworks, sealing, parking) – estimated cost $60,000
- Wheelwash /washdown facility– estimated cost $100,000
- Fencing - $40/m
- Landscaping – included in operations costs

**Development – cell construction (earthworks, liner, leachate collection)**

- Sediment Control Structures and measures – $5,000 per phase or $35,000 total for the 30 years
- Clearing - $1.80/$m^2$
- Clearing bush - $12/$m^2$
- Perimeter road - $400/m
- Topsoil – cut to stockpile - $6/$m^3$
- Sub-topsoil – cut to stockpile - $6/$m^3$
- Low permeability material – cut to stockpile - $15/$m^3$, stockpile to liner - $30/$m^3$, cut to fill as liner - $30/$m^3$, and borrow to fill as liner $30/$m^3$
- Structural material – cut to stockpile - $15/$m^3$, stockpile to fill - $15/$m^3$, cut to fill - $15/$m^3$, and borrow to fill $15/$m^3$
- Groundwater control/subsoil drainage - $100/m

- Preparation of subgrade for laying liner - $2/m^2$
- Geomembrane liner supply and installation - $18/m^2$
- Liner protection layer - $6/m^2$
- Leachate Collection: Leachate collection header pipes (including fittings, aggregate surround, etc.) - $200/m, auxiliary leachate collection pipes (including fittings, etc.) - $80/m, leachate collection sump - $10,000 each, clean-out ports - $5,000 each, automated pumpstation (pumps, valves, fittings and electrical) - $50,000, and leachate collection layer $22/$m^2$
- Leachate Disposal system - $350,000 (pond, pump, pipework, irrigation system)

**Development – stormwater management system**

- Open drains - $50/m
- Stabilised drains/ flumes - $75/m
- Piped drains - $150/m
- Stormwater treatment – pond -$550,000

**Development – gas management system**

- Vertical extraction wells - $200/m
- Ring header (below grade) - $400/m
- Laterals to vertical wells (above grade) - $70/m
- Condensate traps - $5,000 each
- Flare stations – interim -$250,000 and final - $1,000,000

**Development – final cover system**

- Topsoil – stockpile to final cover -$5/$m^3$
- Sub-topsoil – stockpile to final cover - $6/$m^3$, borrow to final cover - $6/$m^3$
- Low permeability material - stockpile to final cover - $30/$m^3$, cut to final cover - $30/$m^3$, borrow to final cover - $30/$m^3$
- Vegetation (grassing) - $0.50/$m^2$

**Operations** (for 20,000 tonnes/year to 100,000 tonnes/year)

- Refuse placement - $15.00 to $13.50/tonne depending on tonnage. This is a significant cost item, but is a non-capital expenditure item and hence has no financing/interests costs associated with it. Any decrease or increase in the operation cost will result in a directly equivalent decrease or increase in the indicative base cost of disposal (IBC)
- Daily cover - $0.25/tonne of refuse placed
- Nuisance control (litter, odour, birds, vectors) - $20,000 to $35,000/year
- General maintenance - $100,000 to $130,000/year
- Salaries wages and overhead – onsite management, gate control and fee collection, audit fees, secretarial fees, accounting fees, legal, consultants, insurance, waste acceptance and inspection, and health and safety - $150,000 to $180,000/year

- Intermediate cover - $0.25/tonne of refuse placed
- Temporary/cell roading - $0.75/tonne
- Leachate treatment and disposal – trucking prior to treatment installation - $40/$m^3$, operation after treatment installation - $1.50/$m^3$, trade waste discharge for untreated leachate - $5/$m^3$, and trade waste charge for treated leachate - $5/$m^3$
- Gas control - $2,800/ha/year once interim flare station installed
- Stormwater maintenance - $10,000/year
- Monitoring – stormwater, groundwater, leachate, landfill gas, local ecology) - $20,000/year
- Environmental Compliance - $40,000/year
- Rates - $4,000/year
- Return from land leasing (of excess purchased land for farming) – 50% of total land purchase cost spread over landfill life (30 years)

**Closure**

- Removal of facilities - $100,000
- Modifications to site stormwater, leachate, landfill gas and other systems – final cover – 1% of construction cost, landfill gas system – 1% of construction cost, leachate management – 1.5% of construction cost, onsite surface water control system – 1.5% of construction cost, and design/ engineering – 6% of construction cost

**Aftercare**

- Administration - $10,000/year
- Department of Environment and Conservation Liaison – $7,500/year
- Site inspection - $100/ha/year
- Final Cover System – maintenance - $500/ha/yr, and vegetation maintenance - $2000/ha/year
- Leachate System maintenance – leachate disposal $1.00/$m^3$, system maintenance - $500/ha/year, electricity - $1000/ha/year
- Gas system maintenance – maintenance and replacement $500/ha/year each, electricity $1000/ha/year
- Environmental monitoring system – $500/ha/year for each of the following: groundwater, landfill gas, leachate, and stormwater
- Removal of remaining facilities - $50,000
- End of post closure certification - $20,000

**Contingencies**

- Predevelopment – 25% of predevelopment cost
- Development – 20% of development cost
- Operations – 10% of operations cost

- Closure – 10% of closure cost
- Aftercare – 5% of aftercare cost

# 3 Financial output

## 3.1 Results

Financial modelling of the proposed District Landfill was undertaken utilising the *MfE Landfill Full Cost Accounting Guide for New Zealand* which accounts for the full cost of waste disposal s over the full life of the landfill, including the aftercare period.

For those variables that require dollar value estimates, the model inputs the value in **today's** dollars, even if this variable is applicable to a future period.

There is no need to account for inflation in providing these estimates. The model automatically accounts for dollar value inputs being in today's dollars, and produces output in today's dollars. That is, **inflation is not incorporated into the model.**

The results of the modelling for each of the four scenarios in terms of the indicative base cost of disposal (IBC) per tonne for the sub-regional landfill are given in Table 3-1. The output summary for each model has been included in Appendix B.

**Table 3-1 Indicative Base Cost of Disposal for "generic" sub-regional landfill**

| Parameter | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 |
|---|---|---|---|---|
| Solid waste tonnage (tonnes/yr) | 40,000 (base case) | 100,000 | 60,000 | 20,000 |
| Total void required over lifetime ($Mm^3$) | 1.5 | 3.6 | 2.2 | 0.72 |
| Total footprint (ha) | 10.8 | 26.4 | 16.1 | 5.5 |
| Total site area assumed (ha) | 200 | 250 | 200 | 200 |
| IBC ($/tonne) | 76.48 | 51.70 | 64.25 | 118.05 |

Notes:

1. All costs derived are based on the assumptions detailed in Sections 1, 2 and 3 of this report
2. Inflation is not included in the model. Hence the IBC needs to be reviewed and adjusted in line with the CPI over the life of the facility.

Note that these IBC figures do not include for:

- Recycling / waste reduction levies or landfill levies
- Refuse collection costs (kerbside)
- Transfer station costs
- Greenwaste/ composting costs
- Education/ waste minimisation costs
- Risk
- Profit/ margin

## 3.2 Cash injection

We have also modelled the effects of a 'cash injection' into the project at the planning stage. For each of the scenarios in Table 2-2, we have modelled the effect of a cash injection of $0.5M, $1M, and $2M (to model the RFR scheme). The effect of this modelling on the IBC is given in Table 3-2, and presented in Figure 1.

**Table 3-2 Effect of cash injection on IBC**

| Cash injection | $0 | $0.5M | $1M | $2M |
|---|---|---|---|---|
| Scenario 1 (40,000tpa) | $76.48 | $72.86 | $69.24 | $62.00 |
| Scenario 2 (100,000 tpa) | $51.70 | $50.25 | $48.80 | $45.90 |
| Scenario 3 (60,000 tpa) | $64.25 | $61.84 | $59.43 | $54.60 |
| Scenario 4 (20,000tpa) | $118.05 | $110.81 | $103.57 | $89.09 |

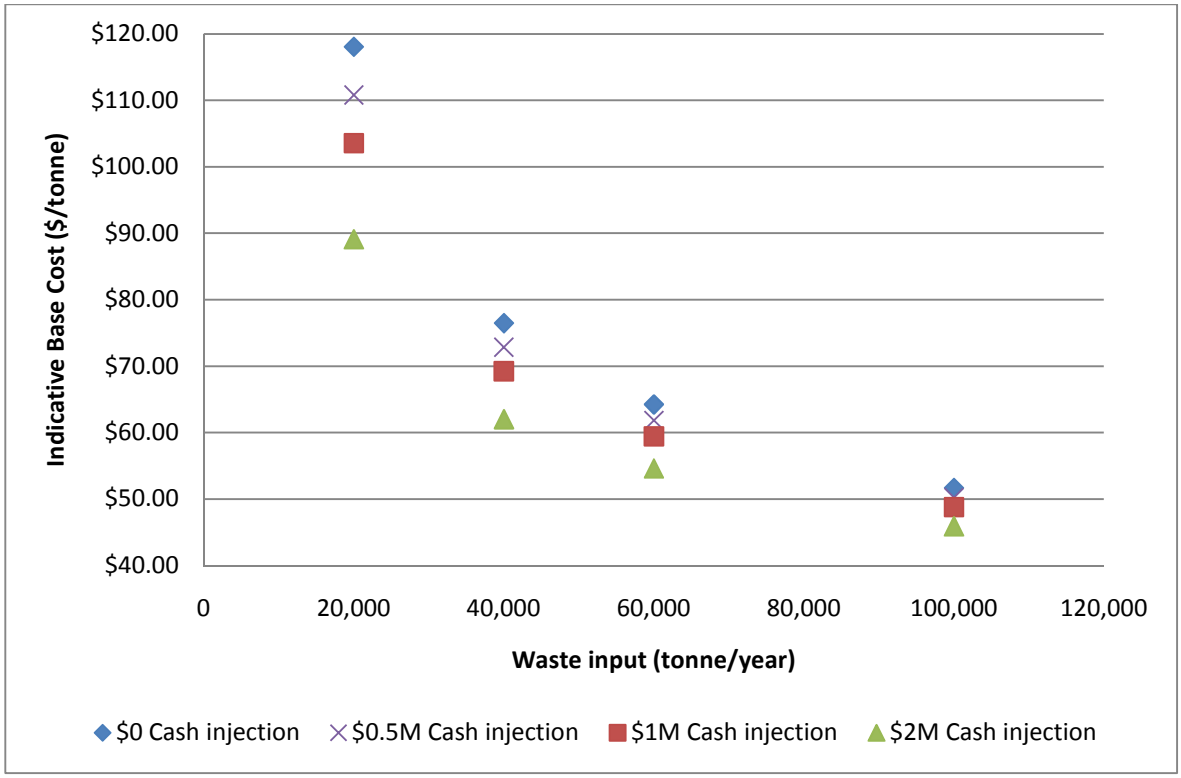


*Figure 1 Comparison of cost/tonne with annual waste volumes for "generic" landfill costing for the Wheatbelt shires, including the effects of an initial cash injection*

As can be seen from Figure 1, the introduction of a "cash injection" has the most impact for the lower tonnage cases. This is because the impact of the up-front cash on capital cost amortisation is most significant. A $2M cash injection potentially reduces the whole of life cost for the

20,000 t/yr case by the order of 25% ($120/t reduces to $90/t). At the higher tonnage end, the impact is less (around 10%).

# 4 Conclusions

At this stage of project development, the IBC costs are indicative only, but clearly they demonstrate the cost relativity between each scenario. While the costs are based on constant annual waste tonnage, they provide an indication of the likely range of whole of life landfill disposal costs for variable annual waste quantities, within the upper and lower bounds modelled.

The key conclusions that can be drawn from this are as follows:

1. For the current scenario of 40,000 t/yr of residual waste the indicated base cost of disposal (that is the whole-of-life cost for the landfill to "break even" over its life without any commercial margin) is of the order of $70-$80/tonne of waste.
2. If the waste tonnage were to reduce due to ongoing disposal at the existing southeast site, then nett tonnes would be nearer 20,000 and the whole-of-life cost for this scenario would rise significantly (almost double) to around $100-$120/tonne. If the tonnes transitioned between the two then the cost would lie somewhere between, but would likely be skewed towards the higher end of the range due to the effective deferral of the amortisation of up-front costs by the additional waste tonnes, received later under this scenario.
3. As the landfill size increases to 60,000 and 100,000t/yr, the overall per tonne cost reduces, and as shown on Figure 1 this trends towards a base cost for 100,000t/yr plus, of around $40/t. This appears to be a realistic figure given our knowledge of landfill cost structures.
4. The impact of an up-front "cash injection" is that this results in a reduction in the cost of disposal by up to $30 per tonne (for the 20,000 t/yr case). For the base case, a cash injection of $2M may reduce the cost of disposal by around $15 per tonne to be in the order of $60 to $70/tonne of waste. The effect of a cash injection is more marked for the lower tonnage scenarios (25%+/-) and reduces to around 10% for the 100,000 t/yr case.
5. It is noted that the costings presented represent "break even" costs (i.e., there is no allowance for margin [profit]). That is, if an IBC indicates a whole-of-life cost of (say) $40/tonne, then the commercial gate rate might be in the range $60-$80/tonne, with flexibility to discount for bulk waste contracts.

# 5 Applicability

This report has been prepared for the benefit of Essential Environmental Consultants with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

Tonkin & Taylor Pty Ltd

Environmental and Engineering Consultants

| Report prepared by: | Authorised for Tonkin & Taylor Pty Ltd by: |
|---|---|
| ..... | ..... |
| Erica Olesson | Tony Kortegast |
| Civil Engineer | Project Director |

EEM

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# Appendix A: Model input (base case)

# MfE Landfill Full Cost Accounting Model

## General Input

| | |
|---|---|
| Project Name | **"Generic" landfill costing** |
| Project Location | Wheatbelt shires |
| Scenario Number | 1 |
| Scenario Description | Base case - 40,000t/yr for 30yrs |

### SITUATION

- (•) GreenFields Site — Choose this option for a site which has not yet been developed
- ( ) BrownFields Site — Choose this option for a site already in use

### DATES

| | | | |
|---|---|---|---|
| Project Commencement Date | 1/07/2012 | | |
| Operation Commencement Date | 1/07/2016 | ☑ Allow for Appeal | |
| Predevelopment Period (Includes Initial Development Year, Rounded Down) | 4.0 | years | |
| Time of Land Purchase | 1 | st year of Predevelopment Period | |
| Time of Excess Land Sale | 30 | th year of Operation | |
| Sunset Date | 1/07/2046 | | |
| Consented Landfill Operating Life | 30.0 | years | |
| Actual Landfill Operating Life (Rounded Up) | 30.0 | years | Closure due to Sunset Date (30/06/46) |
| Aftercare Period | 30 | years | |

### WASTE

( ) Custom Waste Tonnages - See Waste Input Sheet  (•) Generated Waste Tonnages - See Below

| | | | |
|---|---|---|---|
| Annual Waste Tonnage at Start of Operation | | 40,000 | t/year |
| Annual Waste Tonnage Growth Rate | | + 0. | % |
| Minimum Allowable Annual Waste Tonnage | Must be greater than | 5,000 | t/year |

**Waste Stream**

| | | |
|---|---|---|
| General Refuse | 100% | of annual waste tonnage |
| Special Refuse | 0% | of annual waste tonnage |
| Cleanfill | 0% | additional to annual waste tonnage |

**Waste Charging**

| | | |
|---|---|---|
| General Refuse | 100% | = IBC |
| Special Refuse | 150% | of IBC |
| Cleanfill | 50% | of IBC |

| | | |
|---|---|---|
| Assumed Compacted Waste Density (Excluding Cover) | 1.00 | t/m³ |
| Target Cover to Waste Ratio (Daily and Intermediate) | 1 : 5 | |
| Volume Utilisation | 1.200 | m³/t |

### FINANCIAL

**Cost of Capital**

| | | | |
|---|---|---|---|
| Planning And Consenting | Stage 1 | 25.0% | |
| Construction | Stage 2 | 25.0% | |
| Operation | Stage 3 | 10.0% | = Internal Rate of Return |
| Aftercare | Stage 4 | 10.0% | |
| Interest Rate (Risk Free Rate plus 0.5%) | | 6.0% | = interest rate on 10 year Govt. Bonds + 0.5% |

(•) Apply Real Annual Movement to IBC over Whole Operating Life  ( ) Ramp IBC from Initial (known) Value to Final (unknown)Value over a Set Period

IBC Real Annual Movement + 0.0%

*Version 3.2h*

# MfE Landfill Full Cost Accounting Model

## Geometric Input

**"Generic" landfill costing**

Scenario No. 1

Volumes in Mm³

Areas in Ha

**SITE CONSTANTS**

Leachate Generation

| | | | |
|---|---|---|---|
| Typical for Region | Waikato | Active | 1114 m³/ha/annum |
| Location: | | Post Closure | 972 m³/ha/annum |
| Annual Precipitation: | | | |
| Custom Values | | Active | 430 m³/ha/annum |
| | | Post Closure | 215 m³/ha/annum |

| | | | |
|---|---|---|---|
| Assumed Insitu Topsoil Depth | | 0.150 | m |
| Depth of Sub-Topsoil Layer to be Recovered | Don't Recover from Fill Zone | 0.300 | m |
| Liner - Depth of Low Permeability Material in Liner | (Default Liner) Liner Type 1 | 1.00 | m |
| | Liner Type 2 | | m |
| | Liner Type 3 | | m |
| | Liner Type 4 | | m |
| | Liner Type 5 | | m |
| | Liner Type 6 | | m |
| Final Cap - Depth of Topsoil Layer | | 0.100 | m |
| Final Cap - Depth of Unsuitables Layer | | | m |
| Final Cap - Depth of Sub-Topsoil Layer | | 0.300 | m |
| Final Cap - Depth of Low Permeability Layer | | 0.900 | m |
| Access Road Length | | 1 | km |
| Length of Boundary Fence | | 1600 | m |
| Leachate Pretreatment Facility | Don't Install | 0 | |
| Leachate Disposal System | Install in | 1 | st year of Operation |
| Flare Station - Interim | Install | 25% | of way through landfill life |
| Flare Station - Final | Install | 75% | of way through landfill life |

Only enter depths for liner types which are to be used

Usually only one or other required

**DEVELOPMENT PROGRAMME**

Cell Construction Staged in Equal Annual Amounts

Cell Construction Completed in Single Year

1) Area of Liner Type 1 = Footprint less area of Liner Types 2,3,4,5, & 6.
2) Each liner area defines the area of clay, synthetic liner, liner protection, and leachate collection for that liner type.

These include the area both inside and outside of the footprint

These are for the area of each type of liner which is to be placed in the zone where fill is required to achieve basegrade levels

| | Total | Cell 1 | Cell 2 | Cell 3 | Cell 4 | Cell 5 | Cell 6 | Cell 7 | Cell 8 | Cell 9 | Cell 10 | Cell 11 | Cell 12 | Cell 13 | Cell 14 | Cell 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Net Airspace (excluding Final Cap) | 3.6 Mm³ | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 |
| Footprint Area | 26.38 Ha | 2 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.5 |
| Liner Type 2 Area | 0 Ha | | | | | | | | | | | | | | | |
| LIner Type 3 Area | 0 Ha | | | | | | | | | | | | | | | |
| Liner Type 4 Area | 0 Ha | | | | | | | | | | | | | | | |
| Liner Type 5 Area | 0 Ha | | | | | | | | | | | | | | | |
| Liner Type 6 Area | 0 Ha | | | | | | | | | | | | | | | |
| Disturbed Area | 29.018 Ha | 2.2 | 1.936 | 1.936 | 1.936 | 1.936 | 1.936 | 1.936 | 1.936 | 1.936 | 1.936 | 1.936 | 1.936 | 1.936 | 1.936 | 1.65 |
| Area of Fill Zone | 0 Ha | | | | | | | | | | | | | | | |
| Area of Liner Type 1 in Fill Zone | 0 Ha | | | | | | | | | | | | | | | |
| Area of Liner Type 2 in Fill Zone | 0 Ha | | | | | | | | | | | | | | | |
| Area of Liner Type 3 in Fill Zone | 0 Ha | | | | | | | | | | | | | | | |
| Area of Liner Type 4 in Fill Zone | 0 Ha | | | | | | | | | | | | | | | |
| Area of Liner Type 5 in Fill Zone | 0 Ha | | | | | | | | | | | | | | | |
| Area of Liner Type 6 in Fill Zone | 0 Ha | | | | | | | | | | | | | | | |
| Area to be Cleared | 21.104 Ha | 1.6 | 1.408 | 1.408 | 1.408 | 1.408 | 1.408 | 1.408 | 1.408 | 1.408 | 1.408 | 1.408 | 1.408 | 1.408 | 1.408 | 1.2 |
| Area of Bush to be Cleared | 7.914 Ha | 0.6 | 0.528 | 0.528 | 0.528 | 0.528 | 0.528 | 0.528 | 0.528 | 0.528 | 0.528 | 0.528 | 0.528 | 0.528 | 0.528 | 0.45 |
| Area of Specialised Subgrade Treatment | 0 Ha | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Area of Liner Protection Layer | 0 Ha | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Final Cap Area | 26.38 Ha | 0 | 2 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 |
| Required Cut (E.G. to Basegrade) | 0.82392 Mm³ | 0.04 | 0.058 | 0.05584 | 0.05584 | 0.05584 | 0.05584 | 0.05584 | 0.05584 | 0.05584 | 0.05584 | 0.05584 | 0.05584 | 0.05584 | 0.05584 | 0.05584 |
| Useable Liner to be Removed from Cut Zone | 0.2638 Mm³ | 0.02 | 0.0176 | 0.0176 | 0.0176 | 0.0176 | 0.0176 | 0.0176 | 0.0176 | 0.0176 | 0.0176 | 0.0176 | 0.0176 | 0.0176 | 0.0176 | 0.015 |
| Required Fill (E.G. to Basegrade) | 0 Mm³ | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Useable Liner to be Removed from Fill Zone | 0 Mm³ | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unsuitables Volume | 0 Mm³ | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Proportion of Unsuitables in Fill Zone | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| **Topsoil** | | | | | | | | | | | | | | | | |
| Cut to Stockpile | 0.0435 Mm³ | 0.0033 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0029 | 0.0025 |
| Stockpile to Final Cover | 0.0108 Mm³ | | 0.0020 | 0.0018 | 0.0018 | 0.0018 | 0.0018 | 0.0018 | | | | | | | | |
| Import Topsoil to Final Cover | Mm³ | | | | | | | | | | | | | | | |
| **Unsuitables** | | | | | | | | | | | | | | | | |
| Cut to Stockpile | Mm³ | | | | | | | | | | | | | | | |
| Stockpile to Final Cover | Mm³ | | | | | | | | | | | | | | | |
| Shortfall - make up with Sub-Topsoil | Mm³ | | | | | | | | | | | | | | | |
| **Sub-Topsoil** | | | | | | | | | | | | | | | | |
| Cut to Stockpile | 0.0871 Mm³ | 0.0066 | 0.0058 | 0.0058 | 0.0058 | 0.0058 | 0.0058 | 0.0058 | 0.0058 | 0.0058 | 0.0058 | 0.0058 | 0.0058 | 0.0058 | 0.0058 | 0.0050 |
| Stockpile to Final Cover | 0.0324 Mm³ | | 0.0060 | 0.0053 | 0.0053 | 0.0053 | 0.0053 | 0.0053 | | | | | | | | |
| Borrow to Final Cover | Mm³ | | | | | | | | | | | | | | | |
| **Low Permeability Material** | | | | | | | | | | | | | | | | |
| Cut to Stockpile | Mm³ | | | | | | | | | | | | | | | |
| Stockpile to Liner | Mm³ | | | | | | | | | | | | | | | |
| Stockpile to Final Cover | Mm³ | | | | | | | | | | | | | | | |
| Cut to Fill as Liner | 0.2638 Mm³ | 0.0200 | 0.0176 | 0.0176 | 0.0176 | 0.0176 | 0.0176 | 0.0176 | 0.0176 | 0.0176 | 0.0176 | 0.0176 | 0.0176 | 0.0176 | 0.0176 | 0.0150 |
| Cut to Fill as Final Cover | Mm³ | | | | | | | | | | | | | | | |
| Borrow to Fill as Liner | Mm³ | | | | | | | | | | | | | | | |
| Borrow to Fill as Final Cover | 0.0972 Mm³ | | 0.0180 | 0.0158 | 0.0158 | 0.0158 | 0.0158 | 0.0158 | | | | | | | | |
| **Structural Material** | | | | | | | | | | | | | | | | |
| Cut to Stockpile | 0.4097 Mm³ | 0.0301 | 0.0013 | | | | | | 0.0471 | 0.0471 | 0.0471 | 0.0471 | 0.0471 | 0.0471 | 0.0471 | 0.0484 |
| Stockpile to Fill | Mm³ | | | | | | | | | | | | | | | |
| Stockpile to Daily Cover | 0.0044 Mm³ | | 0.0009 | 0.0009 | 0.0009 | 0.0009 | 0.0009 | | | | | | | | | |
| Cut to Fill | Mm³ | | | | | | | | | | | | | | | |
| Cut to Daily Cover | 0.2836 Mm³ | 0.0480 | 0.0471 | 0.0471 | 0.0471 | 0.0471 | 0.0471 | | | | | | | | | |
| Borrow to Fill | Mm³ | | | | | | | | | | | | | | | |
| Borrow to Daily Cover | Mm³ | | | | | | | | | | | | | | | |
| Length of Perimeter Access Road | 2200 m | 220 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 121 |
| Subsoil Drainage | 2200 m | 220 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 121 |
| Leachate Header Pipework | 1221 m | 220 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Leachate Collection Pipework | 7825 m | 700 | 525 | 525 | 525 | 525 | 525 | 525 | 525 | 525 | 525 | 525 | 525 | 525 | 525 | 300 |
| Leachate Collection Sumps | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Leachate Cleanout Port/Manhole | 6 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| Leachate Pumpout Equipment | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stormwater Open Drains | 2200 m | 220 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 143 | 121 |
| Stormwater Stabilised Drains/Flumes | 0 m | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stormwater Piped Drains | 0 m | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Horizontal Collection Pipework | 0 m | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Vertical Extraction Wells | 1350 m | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 |
| Gas Main Header Pipe | 750 m | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Gas Laterals to Vertical Wells | 1500 m | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Gas Condensate Traps | 8 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| | | Cell 1 | Cell 2 | Cell 3 | Cell 4 | Cell 5 | Cell 6 | Cell 7 | Cell 8 | Cell 9 | Cell 10 | Cell 11 | Cell 12 | Cell 13 | Cell 14 | Cell 15 |

# MfE Landfill Full Cost Accounting Model

## Cost Input

**"Generic" landfill costing**

Scenario No. 1

Note: Leave cost fields blank for any items which are not required

| | | | | |
|---|---|---|---|---|
| **SUNK COSTS** | | | | |
| Sunk Costs | | 0 | $ | |
| **PLANNING AND PREDEVELOPMENT** | | | | |
| Project Management | | 150,000 | $ | |
| Site Selection | | | $ | |
| Consultation | | 150,000 | $ | |
| Land Pre-Purchase / Pre-Leasing Agreements | | 20,000 | $ | |
| Survey and Preliminary Design | | 150,000 | $ | |
| Geotechnical & Groundwater Investigations | | 150,000 | $ | |
| Other Detailed Studies (I.e. Noise, Traffic, Visual, etc) | | 80,000 | $ | |
| Baseline Monitoring | | 100,000 | $ | |
| Resource Consent Process | | | | |
| AEE and Consent Application | | 150,000 | $ | |
| Draft Landfill Management Plan | | 20,000 | $ | |
| Legal | | 50,000 | $ | |
| Hearing | | 120,000 | $ | |
| Appeal | | 200,000 | $ | |
| Land Acquisition & Associated/ Set Up Costs | | 800,000 | $ | |
| Proceeds from Disposal of Excess Land | | | $ | |
| Custom 1 | | | $ | In year of Project |
| Custom 2 | | | $/yr | Spread over Predevelopment Period |
| **BASE COSTS** | | | | |
| Engineering | | | | |
| Detailed Design and Documentation (%) | | 8.0% | | |
| Construction Management (%) | | 6.5% | | |
| Contractors P & G (%) | | 12.5% | | |
| **DEVELOPMENT** | | | | |
| **Site Access** | | | | |
| Intersection Upgrade | | 350,000 | $ | |
| Other Roading Network Upgrades/ Contributions | | 0 | $ | |
| Access Road - Intersection to Footprint | | 450,000 | $/km | |
| Special Structures : Diversions, Bridges, etc) | | 100,000 | $ | |
| **Site Amenities & Services** | | | | |
| Site Entrance | | 10,000 | $ | |
| Administration Building | | 50,000 | $ | |
| Weighbridge & Kiosk | | 200,000 | $ | |
| Machinery Shed, Maintenance Facility | | 100,000 | $ | |
| Power & Phone | | 30,000 | $ | |
| Sewerage | | 20,000 | $ | |
| Water Supply | | 30,000 | $ | |
| General Civil Works (Sealing, Parking) -Administration | | 60,000 | $ | |
| Washdown Facility/Wheelwash | | 100,000 | $ | |
| Fencing | | 40 | $/m | |
| Landscaping | | | $ | |
| Custom 3 | | | $ | In Initial Development Year |
| **Cell Construction - Earthworks, Liner, Leachate** | | | | |
| Sediment Control Structures and Measures | | | $ | |
| Clearing | | 1.80 | $/m² | |
| Clearing Bush | | 12.00 | $/m² | |
| Perimeter Access Road | | 400.00 | $/m | |
| Topsoil | | | | |
| Cut to Stockpile | | 6.00 | $/m³ | |
| Unsuitables | | | | |
| Cut to Stockpile | | | $/m³ | |
| Sub-Topsoil | | | | |
| Cut to Stockpile | | 6.00 | $/m³ | |
| Low Permeability Material | | | | |
| Cut to Stockpile | | 15.00 | $/m³ | |
| Stockpile to Liner | | 30.00 | $/m³ | |
| Cut to Fill as Liner | | 30.00 | $/m³ | |
| Borrow to Fill as Liner | | 30.00 | $/m³ | |
| Structural Material | | | | |
| Cut to Stockpile | | 15.00 | $/m³ | |
| Stockpile to Fill | | 15.00 | $/m³ | |
| Cut to Fill | | 15.00 | $/m³ | |
| Borrow to Fill | | 15.00 | $/m³ | |
| Groundwater Control/ Subsoil Drainage | | 100.00 | $/m | |
| Prepare Subgrade for Laying Liner | Liner Type 1 | 2.00 | $/m² | Leave cost blank for any liner type to which this feature does not apply |
| | Liner Type 2 | | $/m² | |
| | Liner Type 3 | | $/m² | |
| | Liner Type 4 | | $/m² | |
| | Liner Type 5 | | $/m² | |
| | Liner Type 6 | | $/m² | |
| Specialised Subgrade Treatment | | | $/m² | |

# MfE Landfill Full Cost Accounting Model

## Cost Input

**"Generic" landfill costing**

Scenario No. 1

Note: Leave cost fields blank for any items which are not required

| | | | | |
|---|---|---|---|---|
| Liner Supply & Installation (Synthetic) | Liner Type 1 | 18.00 | $/m² | Leave cost blank for any liner type to which this feature does not apply |
| | Liner Type 2 | | $/m² | |
| | Liner Type 3 | | $/m² | |
| | Liner Type 4 | | $/m² | |
| | Liner Type 5 | | $/m² | |
| | Liner Type 6 | | $/m² | |
| Liner Protection Layer | Liner Type 1 | 6.00 | $/m² | Leave cost blank for any liner type to which this feature does not apply |
| | Liner Type 2 | | $/m² | |
| | Liner Type 3 | | $/m² | |
| | Liner Type 4 | | $/m² | |
| | Liner Type 5 | | $/m² | |
| | Liner Type 6 | | $/m² | |
| Leachate Collection and Transmission System | | | | |
| Leachate Collection Header Pipes (including fittings and filter fabric) | | 200.00 | $/m | |
| Auxillary Leachate Collection Pipes (including fittings) | | 80.00 | $/m | |
| Leachate Collection Sump | | 10,000 | $ each | |
| Cleanout Ports/Manholes | | 5,000 | $ each | |
| Automated Pump Station (pumps, valves, fittings, and electrical) | | 50,000 | $ each | |
| Leachate Collection Layer | Liner Type 1 | 22.00 | $/m² | Leave cost blank for any liner type to which this feature does not apply |
| | Liner Type 2 | | $/m² | |
| | Liner Type 3 | | $/m² | |
| | Liner Type 4 | | $/m² | |
| | Liner Type 5 | | $/m² | |
| | Liner Type 6 | | $/m² | |
| Leachate Pre-treatment Facility | | | $ | |
| Leachate Disposal System | | 350,000 | $ | |

**Stormwater Management System**

| | | |
|---|---|---|
| Major Stormwater Diversion (E.g. Dams, Canal, etc) | | $ |
| Open Drains | 50.00 | $/m |
| Stabilised Drains / Flumes | 75.00 | $/m |
| Piped Drains | 150.00 | $/m |
| Stormwater Treatment Ponds | | |
| Ponds | 550,000 | $ |
| Instrumentation | 50,000 | $ |

**Gas Management System**

| | | |
|---|---|---|
| Horizontal Collectors | | $/m |
| Vertical Extraction Wells | 200.00 | $/m |
| Ring Header (below grade) | 400.00 | $/m |
| Laterals to vertical wells (above grade) | 70.00 | $/m |
| Condensate Traps | 5,000 | $ each |
| Flare Stations | | |
| Interim | 150,000 | $ |
| Final | 750,000 | $ |

**Final Cover - low permeability barrier layer placement**

| | | |
|---|---|---|
| Topsoil | | |
| Stockpile to Final Cover | 5.00 | $/m³ |
| Import Topsoil to Final Cover | | $/m³ |
| Unsuitables | | |
| Stockpile to Final Cover | | $/m³ |
| Shortfall - make up with Sub-Topsoil | | $/m³ |
| Sub-Topsoil | | |
| Stockpile to Final Cover | 6.00 | $/m³ |
| Borrow to Final Cover | 6.00 | $/m³ |
| Low Permeability Material | | |
| Stockpile to Final Cover | 30.00 | $/m³ |
| Cut to Fill as Cover | 30.00 | $/m³ |
| Borrow to Fill as Cover | 30.00 | $/m³ |
| Geosynthetic layer | | $/m² |
| Drainage layer | | $/m² |
| Vegetation | 0.50 | $/m² |

**Other**

| | | | | | |
|---|---|---|---|---|---|
| Custom 4 | | $ | In | | Year of Operation |
| Custom 5 | | $ | In | | Year of Operation |
| Custom 6 | | $ | For Cell No. | | |
| Custom 7 | | $/yr | For Cell No. | | |
| Custom 8 | | $/cell | For All Cells | | |
| Custom 9 | | $/yr | For All Cells | | |

**OPERATION**

| **Direct Costs & Indirect Costs** | 20,000 | 50,000 | 75,000 | 100000 | 200000 | 300000 | 500000 | t/yr |
|---|---|---|---|---|---|---|---|---|
| Refuse Placement | 15.00 | 14.50 | 14.00 | 13.50 | 13.00 | 12.50 | 12.00 | $/t |
| Daily Cover | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | $/t |
| Nuisance Control Litter, Odour, Birds, Vector | 20,000 | 25,000 | 30,000 | 35,000 | 40,000 | 45,000 | 50,000 | $/yr |
| General Maintenance | 100,000 | 110,000 | 120,000 | 130,000 | 140,000 | 150,000 | 160,000 | $/yr |
| Salaries, Wages & Overhead | 150,000 | 160,000 | 170,000 | 180,000 | 190,000 | 200,000 | 210,000 | $/yr |
| On-Site Management | | | | | | | | |
| Gate Control & Fee Collection | | | | | | | | |

# MfE Landfill Full Cost Accounting Model

## Cost Input

**"Generic" landfill costing**

Scenario No. 1

Note: Leave cost fields blank for any items which are not required

| | | | |
|---|---|---|---|
| Audit Fees | | | |
| Secretarial Fees | | | |
| Accounting Fees | | | |
| Legal | | | |
| Consultancy | | | |
| Insurance | | | |
| Waste Acceptance and Inspection | | | |
| Health & Safety | | | |
| Aftercare Levy | 0.33 | $/t | Calculates Last |
| Royalty & Host Fee | | $/t | |
| Intermediate Cover | 0.25 | $/t | |
| Roading (Temporary) | 0.75 | $/t | |
| Leachate Tmt & Disposal | | | |
| Trucking Off Site (Prior to Disposal System Installation) | 40.00 | $/m³ | |
| Operation of Disposal System | 1.50 | $/m³ | |
| Trade Waste Charge - Untreated Leachate (For Trucked Leachate) | 5.00 | $/m³ | |
| Trade Waste Charge - Treated Leachate (For Trucked Leachate) | 5.00 | $/m³ | |
| Gas Control | 2,800 | $/ha/yr | Once Interim Flare Installed |
| Stormwater Maintenance | 10,000 | $/yr | |
| Monitoring - Stormwater, Groundwater, Leachate, Landfill Gas, Local Ecolog | 20,000 | $/yr | |
| Environmental Compliance | 40,000 | $/yr | |
| Bond | 0 | $/yr | |
| Regional Council Costs | | $/yr | |
| Rates | 4,000 | $/yr | |
| Water Charges | | $/yr | |
| Electricity Charges | | $/yr | |
| Land Leasing | -13,000 | $/yr | |
| Custom 10 | | $/t | |
| Custom 11 | | $/yr | |

**CLOSURE**

**General**

| | | |
|---|---|---|
| Removal of Facilities | 100,000 | $ |
| Modifications to site stormwater, leachate, landfill gas and other systems | | |
| Final Cover | 1.0% | of construction cost |
| Landfill Gas Management System | 1.0% | of construction cost |
| Leachate Management System | 1.5% | of construction cost |
| Onsite Surface Water Control System | 1.5% | of construction cost |
| Design Consultants/ Third Party Engineering | 6.0% | of construction cost |

**AFTERCARE**

| | | |
|---|---|---|
| Administration | 10,000 | $/yr |
| Regional Council Liaison | 7,500 | $/yr |
| Site Inspection | 100 | $/ha/yr |
| Final Cover System | | |
| Final Cover maintenance | 500 | $/ha/yr |
| Vegetation maintenance | 2,000 | $/ha/yr |
| Leachate System maintenance | | |
| Leachate Disposal | 1.00 | $/m³ |
| System maintenance | 500 | $/ha/yr |
| Electricity | 1,000 | $/ha/yr |
| Gas Management System | | |
| Maintenance | 500 | $/ha/yr |
| Replacement | 500 | $/ha/yr |
| Electricity | 1,000 | $/ha/yr |
| Environmental Monitoring System | | |
| Groundwater | 500 | $/ha/yr |
| Landfill Gas | 500 | $/ha/yr |
| Leachate | 500 | $/ha/yr |
| Stormwater | 500 | $/ha/yr |
| Removal of Remaining Facilities | 50,000 | $ |
| End of Post Closure Certification | 20,000 | $ |
| Custom 12 | | $/yr |
| Custom 13 | | $/ha/yr |

**CONTINGENCIES**

| | | |
|---|---|---|
| Predevelopment | 25.0% | of predevelopment cost |
| Development | 20.0% | of development cost |
| Operations | 10.0% | of operations cost |
| Closure | 10.0% | of closure cost |
| Aftercare | 5.0% | of aftercare cost |

## Appendix B: Model summaries

# MfE Landfill Full Cost Accounting Model

## Summary

| | | | |
|---|---|---|---|
| **DESCRIPTION** | | | |
| Project Name: | **"Generic" landfill costing** | | |
| Project Location: | Wheatbelt shires | | |
| Scenario No: | 1 | | |
| Scenario Description: | Base case - 40,000t/yr for 30yrs | | |
| **DESIGN PLANNING PARAMETERS (From 1 July 2016)** | | | |
| Project Commencement Date | 1 July 2012 | | |
| Operation Commencement Date | 1 July 2016 | | |
| Actual Landfill Operating Life (Rounded Up) | 30 | years | Closure due to Sunset Date (30/06/46) |
| Consented Landfill Operating Life | 30 | years | Sunset Date = 1 July 2046 |
| Aftercare/ Post Closure Period | 30 | years | |
| Number of Phases/Stages/Cells | 6 | | Each cell construction completed in single year |
| Annual Waste Tonnage at Start of Operation | 40,000 | t/year | |
| Annual Waste Tonnage Growth Rate | + 0. | % | |
| Minimum Allowable Annual Waste Tonnage | 5,000 | t/year | |
| Annual Waste Tonnage at Close of Operation | 40,000 | t/year | |
| Total Tonnes Placed in Landfill | 1,200,000 | t | = 40% of Design Tonnage (3,000,000 t) |
| Average Waste Tonnage | 40,000 | t/year | |
| Target Cover to Waste Ratio (Daily and Intermediate) | 1 : 5 | | |
| Volume Utilisation | 1.20 | m³/t | |
| Actual Footprint Area | 10.8 | Ha | = 41% of Design Footprint Area (26.38 Ha) |
| Waste Volume | 1,200,000 | m³ | |
| Daily And Intermediate Cover | 240,000 | m³ | |
| Net Airspace | 1,440,000 | m³ | = 40% of Design Net Airspace (3,600,000 m³) |
| Final Cover | 117,520 | m³ | |
| Gross Airspace | 1,557,520 | m³ | |
| **FINANCIAL PARAMETERS** | | | |
| **Cost of Capital** | | | |
| Planning And Consenting (Stage 1) | 25% | | |
| Construction (Stage 2) | 25% | | |
| Operation (Stage 3) | 10% | | |
| Aftercare (Stage 4) | 10% | | |
| Interest Rate (Risk Free Rate plus 0.5%) | 6% | | |
| **COSTS SUMMARY** | | | |
| Sunk Costs | $ 0 | | |
| Planning / Pre-development | $ 2,140,000 | | |
| Base Costs | $ 4,492,797 | | |
| Development | $ 17,195,070 | | |
| Operation | $ 30,571,535 | | |
| Closure | $ 209,138 | | |
| Contingency on Capital Costs | $ 4,893,487 | | |
| Contingency on Operational Costs | $ 3,057,153 | | |
| **Total (excluding Cost of Capital)** | **$ 62,559,181** | | |
| Total Start-up Costs | $ 13,019,281 | | |
| Total Capital Expenditure | $ 28,930,493 | | |
| Total Operational Expenditure | $ 33,628,688 | | |
| Aftercare Fund at Closure | $ 1,066,315 | | Based on Total Footprint Area of 10.8 ha ($112,667/annum + $73,500 in Final Year) |
| Average Whole of Life (AWL) Costs | $ 52.13 | /t | $ 43.44 /m³ of net airspace |
| Net Present Value (NPV) Costs | $ 0.00 | /t | $ 0.00 /m³ of net airspace |
| **INDICATIVE COST OF LANDFILL DISPOSAL** | | | |
| **Indicative Base Cost (IBC) at Start of Operation** | **$ 76.48** | **/t** | $ 63.73 /m³ of net airspace |
| Mark Up | $ 0 | | |
| **Indicative Gate Rate at Start of Operation** | **$ 76.48** | | |
| IBC Real Annual Movement | + 0.0% | | (IBC at Close of Operation = $76.48/t) |
| **TOTAL SOLID WASTE MANAGEMENT SYSTEM COSTS** | | | |
| **Other Management System Costs** | | | |
| Refuse Collection Costs (Kerbside, etc) | | | |
| Transfer Station Costs | $ 0 | /t | |
| Freight Costs | $ 0 | /t | |
| Recycling Costs | $ 0 | /t | |
| Greenwaste/Composting Costs | $ 0 | /t | |
| Education/Waste Minimisation Costs | $ 0 | /t | |
| Other Costs | $ 0 | /t | |
| **Total** | $ 0.00 | /t | |
| Landfill Indicative Gate Rate at Start of Operation | $ 76.48 | /t | |
| **Total Solid Waste Management Cost** | **$ 76.48** | **/t** | |

*Version 3.2h*

# MfE Landfill Full Cost Accounting Model

## Summary

| | | | |
|---|---|---|---|
| **DESCRIPTION** | | | |
| Project Name: | **"Generic" landfill costing** | | |
| Project Location: | Wheatbelt shires | | |
| Scenario No: | 2 | | |
| Scenario Description: | Upper bound - 100,000t/yr for 30yrs | | |
| **DESIGN PLANNING PARAMETERS (From 1 July 2016)** | | | |
| Project Commencement Date | 1 July 2012 | | |
| Operation Commencement Date | 1 July 2016 | | |
| Actual Landfill Operating Life (Rounded Up) | 30 | years | Closure due to airspace filled + Sunset Date (30/06/46) |
| Consented Landfill Operating Life | 30 | years | Sunset Date = 1 July 2046 |
| Aftercare/ Post Closure Period | 30 | years | |
| Number of Phases/Stages/Cells | 15 | | Each cell construction completed in single year |
| Annual Waste Tonnage at Start of Operation | 100,000 | t/year | |
| Annual Waste Tonnage Growth Rate | + 0. | % | |
| Minimum Allowable Annual Waste Tonnage | 5,000 | t/year | |
| Annual Waste Tonnage at Close of Operation | 100,000 | t/year | |
| Total Tonnes Placed in Landfill | 3,000,000 | t | = 100% of Design Tonnage (3,000,000 t) |
| Average Waste Tonnage | 100,000 | t/year | |
| Target Cover to Waste Ratio (Daily and Intermediate) | 1 : 5 | | |
| Volume Utilisation | 1.20 | m³/t | |
| Actual Footprint Area | 26.38 | Ha | = 100% of Design Footprint Area (26.38 Ha) |
| Waste Volume | 3,000,000 | m³ | |
| Daily And Intermediate Cover | 600,000 | m³ | |
| Net Airspace | 3,600,000 | m³ | = 100% of Design Net Airspace (3,600,000 m³) |
| Final Cover | 323,440 | m³ | |
| Gross Airspace | 3,923,440 | m³ | |
| **FINANCIAL PARAMETERS** | | | |
| **Cost of Capital** | | | |
| Planning And Consenting (Stage 1) | 25% | | |
| Construction (Stage 2) | 25% | | |
| Operation (Stage 3) | 10% | | |
| Aftercare (Stage 4) | 10% | | |
| Interest Rate (Risk Free Rate plus 0.5%) | 6% | | |
| **COSTS SUMMARY** | | | |
| Sunk Costs | $ 0 | | |
| Planning / Pre-development | $ 2,340,000 | | |
| Base Costs | $ 9,815,700 | | |
| Development | $ 36,919,923 | | |
| Operation | $ 58,626,858 | | |
| Closure | $ 326,108 | | |
| Contingency on Capital Costs | $ 9,964,735 | | |
| Contingency on Operational Costs | $ 5,862,686 | | |
| **Total (excluding Cost of Capital)** | **$ 123,856,010** | | |
| Total Start-up Costs | $ 13,635,004 | | |
| Total Capital Expenditure | $ 59,366,466 | | |
| Total Operational Expenditure | $ 64,489,544 | | |
| Aftercare Fund at Closure | $ 2,348,612 | | Based on Total Footprint Area of 26.38 ha ($248,692/annum + $73,500 in Final Year) |
| Average Whole of Life (AWL) Costs | $ 41.29 | /t | $ 34.40 /m³ of net airspace |
| Net Present Value (NPV) Costs | $ 0.00 | /t | $ 0.00 /m³ of net airspace |
| **INDICATIVE COST OF LANDFILL DISPOSAL** | | | |
| **Indicative Base Cost (IBC) at Start of Operation** | **$ 51.70** | **/t** | $ 43.08 /m³ of net airspace |
| Mark Up | $ 0 | | |
| **Indicative Gate Rate at Start of Operation** | **$ 51.70** | | |
| IBC Real Annual Movement | + 0.0% | | (IBC at Close of Operation = $51.70/t) |
| **TOTAL SOLID WASTE MANAGEMENT SYSTEM COSTS** | | | |
| **Other Management System Costs** | | | |
| Refuse Collection Costs (Kerbside, etc) | | | |
| Transfer Station Costs | $ 0 | /t | |
| Freight Costs | $ 0 | /t | |
| Recycling Costs | $ 0 | /t | |
| Greenwaste/Composting Costs | $ 0 | /t | |
| Education/Waste Minimisation Costs | $ 0 | /t | |
| Other Costs | $ 0 | /t | |
| **Total** | $ 0.00 | /t | |
| Landfill Indicative Gate Rate at Start of Operation | $ 51.70 | /t | |
| **Total Solid Waste Management Cost** | **$ 51.70** | **/t** | |

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# MfE Landfill Full Cost Accounting Model

## Summary

| | | | |
|---|---|---|---|
| **DESCRIPTION** | | | |
| Project Name: | **"Generic" landfill costing** | | |
| Project Location: | Wheatbelt shires | | |
| Scenario No: | 3 | | |
| Scenario Description: | Upper-mid bound - 60,000t/yr for 30yrs | | |
| **DESIGN PLANNING PARAMETERS (From 1 July 2016)** | | | |
| Project Commencement Date | 1 July 2012 | | |
| Operation Commencement Date | 1 July 2016 | | |
| Actual Landfill Operating Life (Rounded Up) | 30 | years | Closure due to Sunset Date (30/06/46) |
| Consented Landfill Operating Life | 30 | years | Sunset Date = 1 July 2046 |
| Aftercare/ Post Closure Period | 30 | years | |
| Number of Phases/Stages/Cells | 9 | | Each cell construction completed in single year |
| Annual Waste Tonnage at Start of Operation | 60,000 | t/year | |
| Annual Waste Tonnage Growth Rate | + 0. | % | |
| Minimum Allowable Annual Waste Tonnage | 5,000 | t/year | |
| Annual Waste Tonnage at Close of Operation | 60,000 | t/year | |
| Total Tonnes Placed in Landfill | 1,800,000 | t | = 60% of Design Tonnage (3,000,000 t) |
| Average Waste Tonnage | 60,000 | t/year | |
| Target Cover to Waste Ratio (Daily and Intermediate) | 1 : 5 | | |
| Volume Utilisation | 1.20 | m³/t | |
| Actual Footprint Area | 16.08 | Ha | = 61% of Design Footprint Area (26.38 Ha) |
| Waste Volume | 1,800,000 | m³ | |
| Daily And Intermediate Cover | 360,000 | m³ | |
| Net Airspace | 2,160,000 | m³ | = 60% of Design Net Airspace (3,600,000 m³) |
| Final Cover | 186,160 | m³ | |
| Gross Airspace | 2,346,160 | m³ | |
| **FINANCIAL PARAMETERS** | | | |
| **Cost of Capital** | | | |
| Planning And Consenting (Stage 1) | 25% | | |
| Construction (Stage 2) | 25% | | |
| Operation (Stage 3) | 10% | | |
| Aftercare (Stage 4) | 10% | | |
| Interest Rate (Risk Free Rate plus 0.5%) | 6% | | |
| **COSTS SUMMARY** | | | |
| Sunk Costs | $ 0 | | |
| Planning / Pre-development | $ 2,140,000 | | |
| Base Costs | $ 6,483,261 | | |
| Development | $ 24,570,056 | | |
| Operation | $ 41,354,552 | | |
| Closure | $ 252,708 | | |
| Contingency on Capital Costs | $ 6,770,934 | | |
| Contingency on Operational Costs | $ 4,135,455 | | |
| **Total (excluding Cost of Capital)** | **$ 85,706,965** | | |
| Total Start-up Costs | $ 13,041,519 | | |
| Total Capital Expenditure | $ 40,216,958 | | |
| Total Operational Expenditure | $ 45,490,007 | | |
| Aftercare Fund at Closure | $ 1,500,881 | | Based on Total Footprint Area of 16.08 ha ($158,765/annum + $73,500 in Final Year) |
| Average Whole of Life (AWL) Costs | $ 47.61 | /t | $ 39.68 /m³ of net airspace |
| Net Present Value (NPV) Costs | $ 0.00 | /t | $ 0.00 /m³ of net airspace |
| **INDICATIVE COST OF LANDFILL DISPOSAL** | | | |
| **Indicative Base Cost (IBC) at Start of Operation** | **$ 64.25** | **/t** | $ 53.54 /m³ of net airspace |
| Mark Up | $ 0 | | |
| **Indicative Gate Rate at Start of Operation** | **$ 64.25** | | |
| IBC Real Annual Movement | + 0.0% | | (IBC at Close of Operation = $64.25/t) |
| **TOTAL SOLID WASTE MANAGEMENT SYSTEM COSTS** | | | |
| **Other Management System Costs** | | | |
| Refuse Collection Costs (Kerbside, etc) | | | |
| Transfer Station Costs | $ 0 | /t | |
| Freight Costs | $ 0 | /t | |
| Recycling Costs | $ 0 | /t | |
| Greenwaste/Composting Costs | $ 0 | /t | |
| Education/Waste Minimisation Costs | $ 0 | /t | |
| Other Costs | $ 0 | /t | |
| **Total** | $ 0.00 | /t | |
| Landfill Indicative Gate Rate at Start of Operation | $ 64.25 | /t | |
| **Total Solid Waste Management Cost** | **$ 64.25** | **/t** | |

*Version 3.2h*

# MfE Landfill Full Cost Accounting Model

## Summary

| | | | |
|---|---|---|---|
| **DESCRIPTION** | | | |
| Project Name: | **"Generic" landfill costing** | | |
| Project Location: | Wheatbelt shires | | |
| Scenario No: | 4 | | |
| Scenario Description: | Lower bound - 20,000t/yr for 30yrs | | |
| **DESIGN PLANNING PARAMETERS (From 1 July 2016)** | | | |
| Project Commencement Date | 1 July 2012 | | |
| Operation Commencement Date | 1 July 2016 | | |
| Actual Landfill Operating Life (Rounded Up) | 30 | years | Closure due to Sunset Date (30/06/46) |
| Consented Landfill Operating Life | 30 | years | Sunset Date = 1 July 2046 |
| Aftercare/ Post Closure Period | 30 | years | |
| Number of Phases/Stages/Cells | 3 | | Each cell construction completed in single year |
| Annual Waste Tonnage at Start of Operation | 20,000 | t/year | |
| Annual Waste Tonnage Growth Rate | + 0. | % | |
| Minimum Allowable Annual Waste Tonnage | 5,000 | t/year | |
| Annual Waste Tonnage at Close of Operation | 20,000 | t/year | |
| Total Tonnes Placed in Landfill | 600,000 | t | = 20% of Design Tonnage (3,000,000 t) |
| Average Waste Tonnage | 20,000 | t/year | |
| Target Cover to Waste Ratio (Daily and Intermediate) | 1 : 5 | | |
| Volume Utilisation | 1.20 | m³/t | |
| Actual Footprint Area | 5.52 | Ha | = 21% of Design Footprint Area (26.38 Ha) |
| Waste Volume | 600,000 | m³ | |
| Daily And Intermediate Cover | 120,000 | m³ | |
| Net Airspace | 720,000 | m³ | = 20% of Design Net Airspace (3,600,000 m³) |
| Final Cover | 48,880 | m³ | |
| Gross Airspace | 768,880 | m³ | |
| **FINANCIAL PARAMETERS** | | | |
| **Cost of Capital** | | | |
| Planning And Consenting (Stage 1) | 25% | | |
| Construction (Stage 2) | 25% | | |
| Operation (Stage 3) | 10% | | |
| Aftercare (Stage 4) | 10% | | |
| Interest Rate (Risk Free Rate plus 0.5%) | 6% | | |
| **COSTS SUMMARY** | | | |
| Sunk Costs | $ 0 | | |
| Planning / Pre-development | $ 2,140,000 | | |
| Base Costs | $ 2,678,743 | | |
| Development | $ 10,479,552 | | |
| Operation | $ 20,292,973 | | |
| Closure | $ 168,718 | | |
| Contingency on Capital Costs | $ 3,183,531 | | |
| Contingency on Operational Costs | $ 2,029,297 | | |
| **Total (excluding Cost of Capital)** | **$ 40,972,815** | | |
| Total Start-up Costs | $ 13,005,242 | | |
| Total Capital Expenditure | $ 18,650,545 | | |
| Total Operational Expenditure | $ 22,322,270 | | |
| Aftercare Fund at Closure | $ 631,750 | | Based on Total Footprint Area of 5.52 ha ($66,569/annum + $73,500 in Final Year) |
| Average Whole of Life (AWL) Costs | $ 68.29 | /t | $ 56.91 /m³ of net airspace |
| Net Present Value (NPV) Costs | $ 0.00 | /t | $ 0.00 /m³ of net airspace |
| **INDICATIVE COST OF LANDFILL DISPOSAL** | | | |
| **Indicative Base Cost (IBC) at Start of Operation** | **$ 118.05** | **/t** | $ 98.37 /m³ of net airspace |
| Mark Up | $ 0 | | |
| **Indicative Gate Rate at Start of Operation** | **$ 118.05** | | |
| IBC Real Annual Movement | + 0.0% | | (IBC at Close of Operation = $118.05/t) |
| **TOTAL SOLID WASTE MANAGEMENT SYSTEM COSTS** | | | |
| **Other Management System Costs** | | | |
| Refuse Collection Costs (Kerbside, etc) | | | |
| Transfer Station Costs | $ 0 | /t | |
| Freight Costs | $ 0 | /t | |
| Recycling Costs | $ 0 | /t | |
| Greenwaste/Composting Costs | $ 0 | /t | |
| Education/Waste Minimisation Costs | $ 0 | /t | |
| Other Costs | $ 0 | /t | |
| **Total** | $ 0.00 | /t | |
| Landfill Indicative Gate Rate at Start of Operation | $ 118.05 | /t | |
| **Total Solid Waste Management Cost** | **$ 118.05** | **/t** | |

*Version 3.2h*

# MfE Landfill Full Cost Accounting Model

## Summary

| | | | |
|---|---|---|---|
| **DESCRIPTION** | | | |
| Project Name: | **"Generic" landfill costing** | | |
| Project Location: | Wheatbelt shires | | |
| Scenario No: | 1 | | |
| Scenario Description: | Base case - 40,000t/yr for 30yrs - $0.5M cash injection | | |
| **DESIGN PLANNING PARAMETERS (From 1 July 2016)** | | | |
| Project Commencement Date | 1 July 2012 | | |
| Operation Commencement Date | 1 July 2016 | | |
| Actual Landfill Operating Life (Rounded Up) | 30 | years | Closure due to Sunset Date (30/06/46) |
| Consented Landfill Operating Life | 30 | years | Sunset Date = 1 July 2046 |
| Aftercare/ Post Closure Period | 30 | years | |
| Number of Phases/Stages/Cells | 6 | | Each cell construction completed in single year |
| Annual Waste Tonnage at Start of Operation | 40,000 | t/year | |
| Annual Waste Tonnage Growth Rate | + 0. | % | |
| Minimum Allowable Annual Waste Tonnage | 5,000 | t/year | |
| Annual Waste Tonnage at Close of Operation | 40,000 | t/year | |
| Total Tonnes Placed in Landfill | 1,200,000 | t | = 40% of Design Tonnage (3,000,000 t) |
| Average Waste Tonnage | 40,000 | t/year | |
| Target Cover to Waste Ratio (Daily and Intermediate) | 1 : 5 | | |
| Volume Utilisation | 1.20 | m³/t | |
| Actual Footprint Area | 10.8 | Ha | = 41% of Design Footprint Area (26.38 Ha) |
| Waste Volume | 1,200,000 | m³ | |
| Daily And Intermediate Cover | 240,000 | m³ | |
| Net Airspace | 1,440,000 | m³ | = 40% of Design Net Airspace (3,600,000 m³) |
| Final Cover | 117,520 | m³ | |
| Gross Airspace | 1,557,520 | m³ | |
| **FINANCIAL PARAMETERS** | | | |
| **Cost of Capital** | | | |
| Planning And Consenting (Stage 1) | 25% | | |
| Construction (Stage 2) | 25% | | |
| Operation (Stage 3) | 10% | | |
| Aftercare (Stage 4) | 10% | | |
| Interest Rate (Risk Free Rate plus 0.5%) | 6% | | |
| **COSTS SUMMARY** | | | |
| Sunk Costs | -$ 500,000 | | |
| Planning / Pre-development | $ 2,140,000 | | |
| Base Costs | $ 4,492,797 | | |
| Development | $ 17,195,070 | | |
| Operation | $ 30,571,535 | | |
| Closure | $ 209,138 | | |
| Contingency on Capital Costs | $ 4,893,487 | | |
| Contingency on Operational Costs | $ 3,057,153 | | |
| **Total (excluding Cost of Capital)** | **$ 62,059,181** | | |
| Total Start-up Costs | $ 11,654,493 | | |
| Total Capital Expenditure | $ 28,430,493 | | |
| Total Operational Expenditure | $ 33,628,688 | | |
| Aftercare Fund at Closure | $ 1,066,315 | | Based on Total Footprint Area of 10.8 ha ($112,667/annum + $73,500 in Final Year) |
| Average Whole of Life (AWL) Costs | $ 51.72 | /t | $ 43.10 /m³ of net airspace |
| Net Present Value (NPV) Costs | $ 0.00 | /t | $ 0.00 /m³ of net airspace |
| **INDICATIVE COST OF LANDFILL DISPOSAL** | | | |
| **Indicative Base Cost (IBC) at Start of Operation** | **$ 72.86** | **/t** | $ 60.72 /m³ of net airspace |
| Mark Up | $ 0 | | |
| **Indicative Gate Rate at Start of Operation** | **$ 72.86** | | |
| IBC Real Annual Movement | + 0.0% | | (IBC at Close of Operation = $72.86/t) |
| **TOTAL SOLID WASTE MANAGEMENT SYSTEM COSTS** | | | |
| **Other Management System Costs** | | | |
| Refuse Collection Costs (Kerbside, etc) | | | |
| Transfer Station Costs | $ 0 | /t | |
| Freight Costs | $ 0 | /t | |
| Recycling Costs | $ 0 | /t | |
| Greenwaste/Composting Costs | $ 0 | /t | |
| Education/Waste Minimisation Costs | $ 0 | /t | |
| Other Costs | $ 0 | /t | |
| **Total** | $ 0.00 | /t | |
| Landfill Indicative Gate Rate at Start of Operation | $ 72.86 | /t | |
| **Total Solid Waste Management Cost** | **$ 72.86** | **/t** | |

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# MfE Landfill Full Cost Accounting Model

## Summary

| | | | |
|---|---|---|---|
| **DESCRIPTION** | | | |
| Project Name: | **"Generic" landfill costing** | | |
| Project Location: | Wheatbelt shires | | |
| Scenario No: | 2 | | |
| Scenario Description: | 100,000t/yr for 30yrs - $0.5M cash injection | | |
| **DESIGN PLANNING PARAMETERS (From 1 July 2016)** | | | |
| Project Commencement Date | 1 July 2012 | | |
| Operation Commencement Date | 1 July 2016 | | |
| Actual Landfill Operating Life (Rounded Up) | 30 | years | Closure due to airspace filled + Sunset Date (30/06/46) |
| Consented Landfill Operating Life | 30 | years | Sunset Date = 1 July 2046 |
| Aftercare/ Post Closure Period | 30 | years | |
| Number of Phases/Stages/Cells | 15 | | Each cell construction completed in single year |
| Annual Waste Tonnage at Start of Operation | 100,000 | t/year | |
| Annual Waste Tonnage Growth Rate | + 0. | % | |
| Minimum Allowable Annual Waste Tonnage | 5,000 | t/year | |
| Annual Waste Tonnage at Close of Operation | 100,000 | t/year | |
| Total Tonnes Placed in Landfill | 3,000,000 | t | = 100% of Design Tonnage (3,000,000 t) |
| Average Waste Tonnage | 100,000 | t/year | |
| Target Cover to Waste Ratio (Daily and Intermediate) | 1 : 5 | | |
| Volume Utilisation | 1.20 | m³/t | |
| Actual Footprint Area | 26.38 | Ha | = 100% of Design Footprint Area (26.38 Ha) |
| Waste Volume | 3,000,000 | m³ | |
| Daily And Intermediate Cover | 600,000 | m³ | |
| Net Airspace | 3,600,000 | m³ | = 100% of Design Net Airspace (3,600,000 m³) |
| Final Cover | 323,440 | m³ | |
| Gross Airspace | 3,923,440 | m³ | |
| **FINANCIAL PARAMETERS** | | | |
| **Cost of Capital** | | | |
| Planning And Consenting (Stage 1) | 25% | | |
| Construction (Stage 2) | 25% | | |
| Operation (Stage 3) | 10% | | |
| Aftercare (Stage 4) | 10% | | |
| Interest Rate (Risk Free Rate plus 0.5%) | 6% | | |
| **COSTS SUMMARY** | | | |
| Sunk Costs | -$ 500,000 | | |
| Planning / Pre-development | $ 2,340,000 | | |
| Base Costs | $ 9,815,700 | | |
| Development | $ 36,919,923 | | |
| Operation | $ 58,626,858 | | |
| Closure | $ 326,108 | | |
| Contingency on Capital Costs | $ 9,964,735 | | |
| Contingency on Operational Costs | $ 5,862,686 | | |
| **Total (excluding Cost of Capital)** | **$ 123,356,010** | | |
| Total Start-up Costs | $ 12,270,217 | | |
| Total Capital Expenditure | $ 58,866,466 | | |
| Total Operational Expenditure | $ 64,489,544 | | |
| Aftercare Fund at Closure | $ 2,348,612 | | Based on Total Footprint Area of 26.38 ha ($248,692/annum + $73,500 in Final Year) |
| Average Whole of Life (AWL) Costs | $ 41.12 | /t | $ 34.27 /m³ of net airspace |
| Net Present Value (NPV) Costs | $ 0.00 | /t | $ 0.00 /m³ of net airspace |
| **INDICATIVE COST OF LANDFILL DISPOSAL** | | | |
| **Indicative Base Cost (IBC) at Start of Operation** | **$ 50.25** | **/t** | $ 41.87 /m³ of net airspace |
| Mark Up | $ 0 | | |
| **Indicative Gate Rate at Start of Operation** | **$ 50.25** | | |
| IBC Real Annual Movement | + 0.0% | | (IBC at Close of Operation = $50.25/t) |
| **TOTAL SOLID WASTE MANAGEMENT SYSTEM COSTS** | | | |
| **Other Management System Costs** | | | |
| Refuse Collection Costs (Kerbside, etc) | | | |
| Transfer Station Costs | $ 0 | /t | |
| Freight Costs | $ 0 | /t | |
| Recycling Costs | $ 0 | /t | |
| Greenwaste/Composting Costs | $ 0 | /t | |
| Education/Waste Minimisation Costs | $ 0 | /t | |
| Other Costs | $ 0 | /t | |
| **Total** | $ 0.00 | /t | |
| Landfill Indicative Gate Rate at Start of Operation | $ 50.25 | /t | |
| **Total Solid Waste Management Cost** | **$ 50.25** | **/t** | |

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# MfE Landfill Full Cost Accounting Model

## Summary

| | | | |
|---|---|---|---|
| **DESCRIPTION** | | | |
| Project Name: | **"Generic" landfill costing** | | |
| Project Location: | Wheatbelt shires | | |
| Scenario No: | 3 | | |
| Scenario Description: | 60,000t/yr for 30yrs - $0.5M cash injection | | |
| **DESIGN PLANNING PARAMETERS (From 1 July 2016)** | | | |
| Project Commencement Date | 1 July 2012 | | |
| Operation Commencement Date | 1 July 2016 | | |
| Actual Landfill Operating Life (Rounded Up) | 30 | years | Closure due to Sunset Date (30/06/46) |
| Consented Landfill Operating Life | 30 | years | Sunset Date = 1 July 2046 |
| Aftercare/ Post Closure Period | 30 | years | |
| Number of Phases/Stages/Cells | 9 | | Each cell construction completed in single year |
| Annual Waste Tonnage at Start of Operation | 60,000 | t/year | |
| Annual Waste Tonnage Growth Rate | + 0. | % | |
| Minimum Allowable Annual Waste Tonnage | 5,000 | t/year | |
| Annual Waste Tonnage at Close of Operation | 60,000 | t/year | |
| Total Tonnes Placed in Landfill | 1,800,000 | t | = 60% of Design Tonnage (3,000,000 t) |
| Average Waste Tonnage | 60,000 | t/year | |
| Target Cover to Waste Ratio (Daily and Intermediate) | 1 : 5 | | |
| Volume Utilisation | 1.20 | m³/t | |
| Actual Footprint Area | 16.08 | Ha | = 61% of Design Footprint Area (26.38 Ha) |
| Waste Volume | 1,800,000 | m³ | |
| Daily And Intermediate Cover | 360,000 | m³ | |
| Net Airspace | 2,160,000 | m³ | = 60% of Design Net Airspace (3,600,000 m³) |
| Final Cover | 186,160 | m³ | |
| Gross Airspace | 2,346,160 | m³ | |
| **FINANCIAL PARAMETERS** | | | |
| **Cost of Capital** | | | |
| Planning And Consenting (Stage 1) | 25% | | |
| Construction (Stage 2) | 25% | | |
| Operation (Stage 3) | 10% | | |
| Aftercare (Stage 4) | 10% | | |
| Interest Rate (Risk Free Rate plus 0.5%) | 6% | | |
| **COSTS SUMMARY** | | | |
| Sunk Costs | -$ 500,000 | | |
| Planning / Pre-development | $ 2,140,000 | | |
| Base Costs | $ 6,483,261 | | |
| Development | $ 24,570,056 | | |
| Operation | $ 41,354,552 | | |
| Closure | $ 252,708 | | |
| Contingency on Capital Costs | $ 6,770,934 | | |
| Contingency on Operational Costs | $ 4,135,455 | | |
| **Total (excluding Cost of Capital)** | **$ 85,206,965** | | |
| Total Start-up Costs | $ 11,676,731 | | |
| Total Capital Expenditure | $ 39,716,958 | | |
| Total Operational Expenditure | $ 45,490,007 | | |
| Aftercare Fund at Closure | $ 1,500,881 | | Based on Total Footprint Area of 16.08 ha ($158,765/annum + $73,500 in Final Year) |
| Average Whole of Life (AWL) Costs | $ 47.34 | /t | $ 39.45 /m³ of net airspace |
| Net Present Value (NPV) Costs | $ 0.00 | /t | $ 0.00 /m³ of net airspace |
| **INDICATIVE COST OF LANDFILL DISPOSAL** | | | |
| **Indicative Base Cost (IBC) at Start of Operation** | **$ 61.84** | **/t** | $ 51.53 /m³ of net airspace |
| Mark Up | $ 0 | | |
| **Indicative Gate Rate at Start of Operation** | **$ 61.84** | | |
| IBC Real Annual Movement | + 0.0% | | (IBC at Close of Operation = $61.84/t) |
| **TOTAL SOLID WASTE MANAGEMENT SYSTEM COSTS** | | | |
| **Other Management System Costs** | | | |
| Refuse Collection Costs (Kerbside, etc) | | | |
| Transfer Station Costs | $ 0 | /t | |
| Freight Costs | $ 0 | /t | |
| Recycling Costs | $ 0 | /t | |
| Greenwaste/Composting Costs | $ 0 | /t | |
| Education/Waste Minimisation Costs | $ 0 | /t | |
| Other Costs | $ 0 | /t | |
| **Total** | $ 0.00 | /t | |
| Landfill Indicative Gate Rate at Start of Operation | $ 61.84 | /t | |
| **Total Solid Waste Management Cost** | **$ 61.84** | **/t** | |

*Version 3.2h*

# MfE Landfill Full Cost Accounting Model

## Summary

| | | | |
|---|---|---|---|
| **DESCRIPTION** | | | |
| Project Name: | **"Generic" landfill costing** | | |
| Project Location: | Wheatbelt shires | | |
| Scenario No: | 4 | | |
| Scenario Description: | 20,000t/yr for 30yrs - $0.5M cash injection | | |
| **DESIGN PLANNING PARAMETERS (From 1 July 2016)** | | | |
| Project Commencement Date | 1 July 2012 | | |
| Operation Commencement Date | 1 July 2016 | | |
| Actual Landfill Operating Life (Rounded Up) | 30 | years | Closure due to Sunset Date (30/06/46) |
| Consented Landfill Operating Life | 30 | years | Sunset Date = 1 July 2046 |
| Aftercare/ Post Closure Period | 30 | years | |
| Number of Phases/Stages/Cells | 3 | | Each cell construction completed in single year |
| Annual Waste Tonnage at Start of Operation | 20,000 | t/year | |
| Annual Waste Tonnage Growth Rate | + 0. | % | |
| Minimum Allowable Annual Waste Tonnage | 5,000 | t/year | |
| Annual Waste Tonnage at Close of Operation | 20,000 | t/year | |
| Total Tonnes Placed in Landfill | 600,000 | t | = 20% of Design Tonnage (3,000,000 t) |
| Average Waste Tonnage | 20,000 | t/year | |
| Target Cover to Waste Ratio (Daily and Intermediate) | 1 : 5 | | |
| Volume Utilisation | 1.20 | m³/t | |
| Actual Footprint Area | 5.52 | Ha | = 21% of Design Footprint Area (26.38 Ha) |
| Waste Volume | 600,000 | m³ | |
| Daily And Intermediate Cover | 120,000 | m³ | |
| Net Airspace | 720,000 | m³ | = 20% of Design Net Airspace (3,600,000 m³) |
| Final Cover | 48,880 | m³ | |
| Gross Airspace | 768,880 | m³ | |
| **FINANCIAL PARAMETERS** | | | |
| **Cost of Capital** | | | |
| Planning And Consenting (Stage 1) | 25% | | |
| Construction (Stage 2) | 25% | | |
| Operation (Stage 3) | 10% | | |
| Aftercare (Stage 4) | 10% | | |
| Interest Rate (Risk Free Rate plus 0.5%) | 6% | | |
| **COSTS SUMMARY** | | | |
| Sunk Costs | -$ 500,000 | | |
| Planning / Pre-development | $ 2,140,000 | | |
| Base Costs | $ 2,678,743 | | |
| Development | $ 10,479,552 | | |
| Operation | $ 20,292,973 | | |
| Closure | $ 168,718 | | |
| Contingency on Capital Costs | $ 3,183,531 | | |
| Contingency on Operational Costs | $ 2,029,297 | | |
| **Total (excluding Cost of Capital)** | **$ 40,472,815** | | |
| Total Start-up Costs | $ 11,640,454 | | |
| Total Capital Expenditure | $ 18,150,545 | | |
| Total Operational Expenditure | $ 22,322,270 | | |
| Aftercare Fund at Closure | $ 631,750 | | Based on Total Footprint Area of 5.52 ha ($66,569/annum + $73,500 in Final Year) |
| Average Whole of Life (AWL) Costs | $ 67.45 | /t | $ 56.21 /m³ of net airspace |
| Net Present Value (NPV) Costs | $ 0.00 | /t | $ 0.00 /m³ of net airspace |
| **INDICATIVE COST OF LANDFILL DISPOSAL** | | | |
| **Indicative Base Cost (IBC) at Start of Operation** | **$ 110.81** | **/t** | $ 92.34 /m³ of net airspace |
| Mark Up | $ 0 | | |
| **Indicative Gate Rate at Start of Operation** | **$ 110.81** | | |
| IBC Real Annual Movement | + 0.0% | | (IBC at Close of Operation = $110.81/t) |
| **TOTAL SOLID WASTE MANAGEMENT SYSTEM COSTS** | | | |
| **Other Management System Costs** | | | |
| Refuse Collection Costs (Kerbside, etc) | | | |
| Transfer Station Costs | $ 0 | /t | |
| Freight Costs | $ 0 | /t | |
| Recycling Costs | $ 0 | /t | |
| Greenwaste/Composting Costs | $ 0 | /t | |
| Education/Waste Minimisation Costs | $ 0 | /t | |
| Other Costs | $ 0 | /t | |
| **Total** | $ 0.00 | /t | |
| Landfill Indicative Gate Rate at Start of Operation | $ 110.81 | /t | |
| **Total Solid Waste Management Cost** | **$ 110.81** | **/t** | |

*Version 3.2h*

# MfE Landfill Full Cost Accounting Model

## Summary

| | | | |
|---|---|---|---|
| **DESCRIPTION** | | | |
| Project Name: | **"Generic" landfill costing** | | |
| Project Location: | Wheatbelt shires | | |
| Scenario No: | 1 | | |
| Scenario Description: | Base case - 40,000t/yr for 30yrs - $1M cash injection | | |
| **DESIGN PLANNING PARAMETERS (From 1 July 2016)** | | | |
| Project Commencement Date | 1 July 2012 | | |
| Operation Commencement Date | 1 July 2016 | | |
| Actual Landfill Operating Life (Rounded Up) | 30 | years | Closure due to Sunset Date (30/06/46) |
| Consented Landfill Operating Life | 30 | years | Sunset Date = 1 July 2046 |
| Aftercare/ Post Closure Period | 30 | years | |
| Number of Phases/Stages/Cells | 6 | | Each cell construction completed in single year |
| Annual Waste Tonnage at Start of Operation | 40,000 | t/year | |
| Annual Waste Tonnage Growth Rate | + 0. | % | |
| Minimum Allowable Annual Waste Tonnage | 5,000 | t/year | |
| Annual Waste Tonnage at Close of Operation | 40,000 | t/year | |
| Total Tonnes Placed in Landfill | 1,200,000 | t | = 40% of Design Tonnage (3,000,000 t) |
| Average Waste Tonnage | 40,000 | t/year | |
| Target Cover to Waste Ratio (Daily and Intermediate) | 1 : 5 | | |
| Volume Utilisation | 1.20 | m³/t | |
| Actual Footprint Area | 10.8 | Ha | = 41% of Design Footprint Area (26.38 Ha) |
| Waste Volume | 1,200,000 | m³ | |
| Daily And Intermediate Cover | 240,000 | m³ | |
| Net Airspace | 1,440,000 | m³ | = 40% of Design Net Airspace (3,600,000 m³) |
| Final Cover | 117,520 | m³ | |
| Gross Airspace | 1,557,520 | m³ | |
| **FINANCIAL PARAMETERS** | | | |
| **Cost of Capital** | | | |
| Planning And Consenting (Stage 1) | 25% | | |
| Construction (Stage 2) | 25% | | |
| Operation (Stage 3) | 10% | | |
| Aftercare (Stage 4) | 10% | | |
| Interest Rate (Risk Free Rate plus 0.5%) | 6% | | |
| **COSTS SUMMARY** | | | |
| Sunk Costs | -$ 1,000,000 | | |
| Planning / Pre-development | $ 2,140,000 | | |
| Base Costs | $ 4,492,797 | | |
| Development | $ 17,195,070 | | |
| Operation | $ 30,571,535 | | |
| Closure | $ 209,138 | | |
| Contingency on Capital Costs | $ 4,893,487 | | |
| Contingency on Operational Costs | $ 3,057,153 | | |
| **Total (excluding Cost of Capital)** | **$ 61,559,181** | | |
| Total Start-up Costs | $ 10,289,706 | | |
| Total Capital Expenditure | $ 27,930,493 | | |
| Total Operational Expenditure | $ 33,628,688 | | |
| Aftercare Fund at Closure | $ 1,066,315 | | Based on Total Footprint Area of 10.8 ha ($112,667/annum + $73,500 in Final Year) |
| Average Whole of Life (AWL) Costs | $ 51.30 | /t | $ 42.75 /m³ of net airspace |
| Net Present Value (NPV) Costs | $ 0.00 | /t | $ 0.00 /m³ of net airspace |
| **INDICATIVE COST OF LANDFILL DISPOSAL** | | | |
| **Indicative Base Cost (IBC) at Start of Operation** | **$ 69.24** | **/t** | $ 57.70 /m³ of net airspace |
| Mark Up | $ 0 | | |
| **Indicative Gate Rate at Start of Operation** | **$ 69.24** | | |
| IBC Real Annual Movement | + 0.0% | | (IBC at Close of Operation = $69.24/t) |
| **TOTAL SOLID WASTE MANAGEMENT SYSTEM COSTS** | | | |
| **Other Management System Costs** | | | |
| Refuse Collection Costs (Kerbside, etc) | | | |
| Transfer Station Costs | $ 0 | /t | |
| Freight Costs | $ 0 | /t | |
| Recycling Costs | $ 0 | /t | |
| Greenwaste/Composting Costs | $ 0 | /t | |
| Education/Waste Minimisation Costs | $ 0 | /t | |
| Other Costs | $ 0 | /t | |
| **Total** | $ 0.00 | /t | |
| Landfill Indicative Gate Rate at Start of Operation | $ 69.24 | /t | |
| **Total Solid Waste Management Cost** | **$ 69.24** | **/t** | |

*Version 3.2h*

# MfE Landfill Full Cost Accounting Model

## Summary

| | | | |
|---|---|---|---|
| **DESCRIPTION** | | | |
| Project Name: | **"Generic" landfill costing** | | |
| Project Location: | Wheatbelt shires | | |
| Scenario No: | 2 | | |
| Scenario Description: | 100,000t/yr for 30yrs - $1M cash injection | | |
| **DESIGN PLANNING PARAMETERS (From 1 July 2016)** | | | |
| Project Commencement Date | 1 July 2012 | | |
| Operation Commencement Date | 1 July 2016 | | |
| Actual Landfill Operating Life (Rounded Up) | 30 | years | Closure due to airspace filled + Sunset Date (30/06/46) |
| Consented Landfill Operating Life | 30 | years | Sunset Date = 1 July 2046 |
| Aftercare/ Post Closure Period | 30 | years | |
| Number of Phases/Stages/Cells | 15 | | Each cell construction completed in single year |
| Annual Waste Tonnage at Start of Operation | 100,000 | t/year | |
| Annual Waste Tonnage Growth Rate | + 0. | % | |
| Minimum Allowable Annual Waste Tonnage | 5,000 | t/year | |
| Annual Waste Tonnage at Close of Operation | 100,000 | t/year | |
| Total Tonnes Placed in Landfill | 3,000,000 | t | = 100% of Design Tonnage (3,000,000 t) |
| Average Waste Tonnage | 100,000 | t/year | |
| Target Cover to Waste Ratio (Daily and Intermediate) | 1 : 5 | | |
| Volume Utilisation | 1.20 | m³/t | |
| Actual Footprint Area | 26.38 | Ha | = 100% of Design Footprint Area (26.38 Ha) |
| Waste Volume | 3,000,000 | m³ | |
| Daily And Intermediate Cover | 600,000 | m³ | |
| Net Airspace | 3,600,000 | m³ | = 100% of Design Net Airspace (3,600,000 m³) |
| Final Cover | 323,440 | m³ | |
| Gross Airspace | 3,923,440 | m³ | |
| **FINANCIAL PARAMETERS** | | | |
| **Cost of Capital** | | | |
| Planning And Consenting (Stage 1) | 25% | | |
| Construction (Stage 2) | 25% | | |
| Operation (Stage 3) | 10% | | |
| Aftercare (Stage 4) | 10% | | |
| Interest Rate (Risk Free Rate plus 0.5%) | 6% | | |
| **COSTS SUMMARY** | | | |
| Sunk Costs | -$ 1,000,000 | | |
| Planning / Pre-development | $ 2,340,000 | | |
| Base Costs | $ 9,815,700 | | |
| Development | $ 36,919,923 | | |
| Operation | $ 58,626,858 | | |
| Closure | $ 326,108 | | |
| Contingency on Capital Costs | $ 9,964,735 | | |
| Contingency on Operational Costs | $ 5,862,686 | | |
| **Total (excluding Cost of Capital)** | **$ 122,856,010** | | |
| Total Start-up Costs | $ 10,905,429 | | |
| Total Capital Expenditure | $ 58,366,466 | | |
| Total Operational Expenditure | $ 64,489,544 | | |
| Aftercare Fund at Closure | $ 2,348,612 | | Based on Total Footprint Area of 26.38 ha ($248,692/annum + $73,500 in Final Year) |
| Average Whole of Life (AWL) Costs | $ 40.95 | /t | $ 34.13 /m³ of net airspace |
| Net Present Value (NPV) Costs | $ 0.00 | /t | $ 0.00 /m³ of net airspace |
| **INDICATIVE COST OF LANDFILL DISPOSAL** | | | |
| **Indicative Base Cost (IBC) at Start of Operation** | **$ 48.80** | **/t** | $ 40.67 /m³ of net airspace |
| Mark Up | $ 0 | | |
| **Indicative Gate Rate at Start of Operation** | **$ 48.80** | | |
| IBC Real Annual Movement | + 0.0% | | (IBC at Close of Operation = $48.80/t) |
| **TOTAL SOLID WASTE MANAGEMENT SYSTEM COSTS** | | | |
| **Other Management System Costs** | | | |
| Refuse Collection Costs (Kerbside, etc) | | | |
| Transfer Station Costs | $ 0 | /t | |
| Freight Costs | $ 0 | /t | |
| Recycling Costs | $ 0 | /t | |
| Greenwaste/Composting Costs | $ 0 | /t | |
| Education/Waste Minimisation Costs | $ 0 | /t | |
| Other Costs | $ 0 | /t | |
| **Total** | $ 0.00 | /t | |
| Landfill Indicative Gate Rate at Start of Operation | $ 48.80 | /t | |
| **Total Solid Waste Management Cost** | **$ 48.80** | **/t** | |

*Version 3.2h*

# MfE Landfill Full Cost Accounting Model

## Summary

**DESCRIPTION**

| | |
|---|---|
| Project Name: | **"Generic" landfill costing** |
| Project Location: | Wheatbelt shires |
| Scenario No: | 3 |
| Scenario Description: | 60,000t/yr for 30yrs - $1M cash injection |

**DESIGN PLANNING PARAMETERS (From 1 July 2016)**

| | | | |
|---|---|---|---|
| Project Commencement Date | 1 July 2012 | | |
| Operation Commencement Date | 1 July 2016 | | |
| Actual Landfill Operating Life (Rounded Up) | 30 | years | Closure due to Sunset Date (30/06/46) |
| Consented Landfill Operating Life | 30 | years | Sunset Date = 1 July 2046 |
| Aftercare/ Post Closure Period | 30 | years | |
| Number of Phases/Stages/Cells | 9 | | Each cell construction completed in single year |
| Annual Waste Tonnage at Start of Operation | 60,000 | t/year | |
| Annual Waste Tonnage Growth Rate | + 0. | % | |
| Minimum Allowable Annual Waste Tonnage | 5,000 | t/year | |
| Annual Waste Tonnage at Close of Operation | 60,000 | t/year | |
| Total Tonnes Placed in Landfill | 1,800,000 | t | = 60% of Design Tonnage (3,000,000 t) |
| Average Waste Tonnage | 60,000 | t/year | |
| Target Cover to Waste Ratio (Daily and Intermediate) | 1 : 5 | | |
| Volume Utilisation | 1.20 | m³/t | |
| Actual Footprint Area | 16.08 | Ha | = 61% of Design Footprint Area (26.38 Ha) |
| Waste Volume | 1,800,000 | m³ | |
| Daily And Intermediate Cover | 360,000 | m³ | |
| Net Airspace | 2,160,000 | m³ | = 60% of Design Net Airspace (3,600,000 m³) |
| Final Cover | 186,160 | m³ | |
| Gross Airspace | 2,346,160 | m³ | |

**FINANCIAL PARAMETERS**

| | |
|---|---|
| **Cost of Capital** | |
| Planning And Consenting (Stage 1) | 25% |
| Construction (Stage 2) | 25% |
| Operation (Stage 3) | 10% |
| Aftercare (Stage 4) | 10% |
| Interest Rate (Risk Free Rate plus 0.5%) | 6% |

**COSTS SUMMARY**

| | | |
|---|---|---|
| Sunk Costs | -$ 1,000,000 | |
| Planning / Pre-development | $ 2,140,000 | |
| Base Costs | $ 6,483,261 | |
| Development | $ 24,570,056 | |
| Operation | $ 41,354,552 | |
| Closure | $ 252,708 | |
| Contingency on Capital Costs | $ 6,770,934 | |
| Contingency on Operational Costs | $ 4,135,455 | |
| **Total (excluding Cost of Capital)** | **$ 84,706,965** | |
| Total Start-up Costs | $ 10,311,943 | |
| Total Capital Expenditure | $ 39,216,958 | |
| Total Operational Expenditure | $ 45,490,007 | |
| Aftercare Fund at Closure | $ 1,500,881 | Based on Total Footprint Area of 16.08 ha ($158,765/annum + $73,500 in Final Year) |
| Average Whole of Life (AWL) Costs | $ 47.06 /t | $ 39.22 /m³ of net airspace |
| Net Present Value (NPV) Costs | $ 0.00 /t | $ 0.00 /m³ of net airspace |

**INDICATIVE COST OF LANDFILL DISPOSAL**

| | | |
|---|---|---|
| **Indicative Base Cost (IBC) at Start of Operation** | **$ 59.43 /t** | $ 49.52 /m³ of net airspace |
| Mark Up | $ 0 | |
| **Indicative Gate Rate at Start of Operation** | **$ 59.43** | |
| IBC Real Annual Movement | + 0.0% | (IBC at Close of Operation = $59.43/t) |

**TOTAL SOLID WASTE MANAGEMENT SYSTEM COSTS**

| | |
|---|---|
| **Other Management System Costs** | |
| Refuse Collection Costs (Kerbside, etc) | |
| Transfer Station Costs | $ 0 /t |
| Freight Costs | $ 0 /t |
| Recycling Costs | $ 0 /t |
| Greenwaste/Composting Costs | $ 0 /t |
| Education/Waste Minimisation Costs | $ 0 /t |
| Other Costs | $ 0 /t |
| **Total** | $ 0.00 /t |
| Landfill Indicative Gate Rate at Start of Operation | $ 59.43 /t |
| **Total Solid Waste Management Cost** | **$ 59.43 /t** |

*Version 3.2h*

# MfE Landfill Full Cost Accounting Model

## Summary

| | | | |
|---|---|---|---|
| **DESCRIPTION** | | | |
| Project Name: | **"Generic" landfill costing** | | |
| Project Location: | Wheatbelt shires | | |
| Scenario No: | 4 | | |
| Scenario Description: | 20,000t/yr for 30yrs - $1M cash injection | | |
| **DESIGN PLANNING PARAMETERS (From 1 July 2016)** | | | |
| Project Commencement Date | 1 July 2012 | | |
| Operation Commencement Date | 1 July 2016 | | |
| Actual Landfill Operating Life (Rounded Up) | 30 | years | Closure due to Sunset Date (30/06/46) |
| Consented Landfill Operating Life | 30 | years | Sunset Date = 1 July 2046 |
| Aftercare/ Post Closure Period | 30 | years | |
| Number of Phases/Stages/Cells | 3 | | Each cell construction completed in single year |
| Annual Waste Tonnage at Start of Operation | 20,000 | t/year | |
| Annual Waste Tonnage Growth Rate | + 0. | % | |
| Minimum Allowable Annual Waste Tonnage | 5,000 | t/year | |
| Annual Waste Tonnage at Close of Operation | 20,000 | t/year | |
| Total Tonnes Placed in Landfill | 600,000 | t | = 20% of Design Tonnage (3,000,000 t) |
| Average Waste Tonnage | 20,000 | t/year | |
| Target Cover to Waste Ratio (Daily and Intermediate) | 1 : 5 | | |
| Volume Utilisation | 1.20 | m³/t | |
| Actual Footprint Area | 5.52 | Ha | = 21% of Design Footprint Area (26.38 Ha) |
| Waste Volume | 600,000 | m³ | |
| Daily And Intermediate Cover | 120,000 | m³ | |
| Net Airspace | 720,000 | m³ | = 20% of Design Net Airspace (3,600,000 m³) |
| Final Cover | 48,880 | m³ | |
| Gross Airspace | 768,880 | m³ | |
| **FINANCIAL PARAMETERS** | | | |
| **Cost of Capital** | | | |
| Planning And Consenting (Stage 1) | 25% | | |
| Construction (Stage 2) | 25% | | |
| Operation (Stage 3) | 10% | | |
| Aftercare (Stage 4) | 10% | | |
| Interest Rate (Risk Free Rate plus 0.5%) | 6% | | |
| **COSTS SUMMARY** | | | |
| Sunk Costs | -$ 1,000,000 | | |
| Planning / Pre-development | $ 2,140,000 | | |
| Base Costs | $ 2,678,743 | | |
| Development | $ 10,479,552 | | |
| Operation | $ 20,292,973 | | |
| Closure | $ 168,718 | | |
| Contingency on Capital Costs | $ 3,183,531 | | |
| Contingency on Operational Costs | $ 2,029,297 | | |
| **Total (excluding Cost of Capital)** | **$ 39,972,815** | | |
| Total Start-up Costs | $ 10,275,667 | | |
| Total Capital Expenditure | $ 17,650,545 | | |
| Total Operational Expenditure | $ 22,322,270 | | |
| Aftercare Fund at Closure | $ 631,750 | | Based on Total Footprint Area of 5.52 ha ($66,569/annum + $73,500 in Final Year) |
| Average Whole of Life (AWL) Costs | $ 66.62 | /t | $ 55.52 /m³ of net airspace |
| Net Present Value (NPV) Costs | $ 0.00 | /t | $ 0.00 /m³ of net airspace |
| **INDICATIVE COST OF LANDFILL DISPOSAL** | | | |
| **Indicative Base Cost (IBC) at Start of Operation** | **$ 103.57** | **/t** | $ 86.31 /m³ of net airspace |
| Mark Up | $ 0 | | |
| **Indicative Gate Rate at Start of Operation** | **$ 103.57** | | |
| IBC Real Annual Movement | + 0.0% | | (IBC at Close of Operation = $103.57/t) |
| **TOTAL SOLID WASTE MANAGEMENT SYSTEM COSTS** | | | |
| **Other Management System Costs** | | | |
| Refuse Collection Costs (Kerbside, etc) | | | |
| Transfer Station Costs | $ 0 | /t | |
| Freight Costs | $ 0 | /t | |
| Recycling Costs | $ 0 | /t | |
| Greenwaste/Composting Costs | $ 0 | /t | |
| Education/Waste Minimisation Costs | $ 0 | /t | |
| Other Costs | $ 0 | /t | |
| **Total** | $ 0.00 | /t | |
| Landfill Indicative Gate Rate at Start of Operation | $ 103.57 | /t | |
| **Total Solid Waste Management Cost** | **$ 103.57** | **/t** | |

*Version 3.2h*

# MfE Landfill Full Cost Accounting Model

## Summary

**DESCRIPTION**

| | |
|---|---|
| Project Name: | **"Generic" landfill costing** |
| Project Location: | Wheatbelt shires |
| Scenario No: | 1 |
| Scenario Description: | Base case - 40,000t/yr for 30yrs - $2M cash injection |

**DESIGN PLANNING PARAMETERS (From 1 July 2016)**

| | | | |
|---|---|---|---|
| Project Commencement Date | 1 July 2012 | | |
| Operation Commencement Date | 1 July 2016 | | |
| Actual Landfill Operating Life (Rounded Up) | 30 | years | Closure due to Sunset Date (30/06/46) |
| Consented Landfill Operating Life | 30 | years | Sunset Date = 1 July 2046 |
| Aftercare/ Post Closure Period | 30 | years | |
| Number of Phases/Stages/Cells | 6 | | Each cell construction completed in single year |
| Annual Waste Tonnage at Start of Operation | 40,000 | t/year | |
| Annual Waste Tonnage Growth Rate | + 0. | % | |
| Minimum Allowable Annual Waste Tonnage | 5,000 | t/year | |
| Annual Waste Tonnage at Close of Operation | 40,000 | t/year | |
| Total Tonnes Placed in Landfill | 1,200,000 | t | = 40% of Design Tonnage (3,000,000 t) |
| Average Waste Tonnage | 40,000 | t/year | |
| Target Cover to Waste Ratio (Daily and Intermediate) | 1 : 5 | | |
| Volume Utilisation | 1.20 | m³/t | |
| Actual Footprint Area | 10.8 | Ha | = 41% of Design Footprint Area (26.38 Ha) |
| Waste Volume | 1,200,000 | m³ | |
| Daily And Intermediate Cover | 240,000 | m³ | |
| Net Airspace | 1,440,000 | m³ | = 40% of Design Net Airspace (3,600,000 m³) |
| Final Cover | 117,520 | m³ | |
| Gross Airspace | 1,557,520 | m³ | |

**FINANCIAL PARAMETERS**

| | |
|---|---|
| **Cost of Capital** | |
| Planning And Consenting (Stage 1) | 25% |
| Construction (Stage 2) | 25% |
| Operation (Stage 3) | 10% |
| Aftercare (Stage 4) | 10% |
| Interest Rate (Risk Free Rate plus 0.5%) | 6% |

**COSTS SUMMARY**

| | | |
|---|---|---|
| Sunk Costs | -$ 2,000,000 | |
| Planning / Pre-development | $ 2,140,000 | |
| Base Costs | $ 4,492,797 | |
| Development | $ 17,195,070 | |
| Operation | $ 30,571,535 | |
| Closure | $ 209,138 | |
| Contingency on Capital Costs | $ 4,893,487 | |
| Contingency on Operational Costs | $ 3,057,153 | |
| **Total (excluding Cost of Capital)** | **$ 60,559,181** | |
| Total Start-up Costs | $ 7,560,131 | |
| Total Capital Expenditure | $ 26,930,493 | |
| Total Operational Expenditure | $ 33,628,688 | |
| Aftercare Fund at Closure | $ 1,066,315 | Based on Total Footprint Area of 10.8 ha ($112,667/annum + $73,500 in Final Year) |
| Average Whole of Life (AWL) Costs | $ 50.47 /t | $ 42.05 /m³ of net airspace |
| Net Present Value (NPV) Costs | $ 0.00 /t | $ 0.00 /m³ of net airspace |

**INDICATIVE COST OF LANDFILL DISPOSAL**

| | | |
|---|---|---|
| **Indicative Base Cost (IBC) at Start of Operation** | **$ 62.00 /t** | $ 51.67 /m³ of net airspace |
| Mark Up | $ 0 | |
| **Indicative Gate Rate at Start of Operation** | **$ 62.00** | |
| IBC Real Annual Movement | + 0.0% | (IBC at Close of Operation = $62.00/t) |

**TOTAL SOLID WASTE MANAGEMENT SYSTEM COSTS**

| | |
|---|---|
| **Other Management System Costs** | |
| Refuse Collection Costs (Kerbside, etc) | |
| Transfer Station Costs | $ 0 /t |
| Freight Costs | $ 0 /t |
| Recycling Costs | $ 0 /t |
| Greenwaste/Composting Costs | $ 0 /t |
| Education/Waste Minimisation Costs | $ 0 /t |
| Other Costs | $ 0 /t |
| **Total** | $ 0.00 /t |
| Landfill Indicative Gate Rate at Start of Operation | $ 62.00 /t |
| **Total Solid Waste Management Cost** | **$ 62.00 /t** |

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# MfE Landfill Full Cost Accounting Model

## Summary

| | | | |
|---|---|---|---|
| **DESCRIPTION** | | | |
| Project Name: | **"Generic" landfill costing** | | |
| Project Location: | Wheatbelt shires | | |
| Scenario No: | 2 | | |
| Scenario Description: | 100,000t/yr for 30yrs - $2M cash injection | | |
| **DESIGN PLANNING PARAMETERS (From 1 July 2016)** | | | |
| Project Commencement Date | 1 July 2012 | | |
| Operation Commencement Date | 1 July 2016 | | |
| Actual Landfill Operating Life (Rounded Up) | 30 | years | Closure due to airspace filled + Sunset Date (30/06/46) |
| Consented Landfill Operating Life | 30 | years | Sunset Date = 1 July 2046 |
| Aftercare/ Post Closure Period | 30 | years | |
| Number of Phases/Stages/Cells | 15 | | Each cell construction completed in single year |
| Annual Waste Tonnage at Start of Operation | 100,000 | t/year | |
| Annual Waste Tonnage Growth Rate | + 0. | % | |
| Minimum Allowable Annual Waste Tonnage | 5,000 | t/year | |
| Annual Waste Tonnage at Close of Operation | 100,000 | t/year | |
| Total Tonnes Placed in Landfill | 3,000,000 | t | = 100% of Design Tonnage (3,000,000 t) |
| Average Waste Tonnage | 100,000 | t/year | |
| Target Cover to Waste Ratio (Daily and Intermediate) | 1 : 5 | | |
| Volume Utilisation | 1.20 | m³/t | |
| Actual Footprint Area | 26.38 | Ha | = 100% of Design Footprint Area (26.38 Ha) |
| Waste Volume | 3,000,000 | m³ | |
| Daily And Intermediate Cover | 600,000 | m³ | |
| Net Airspace | 3,600,000 | m³ | = 100% of Design Net Airspace (3,600,000 m³) |
| Final Cover | 323,440 | m³ | |
| Gross Airspace | 3,923,440 | m³ | |
| **FINANCIAL PARAMETERS** | | | |
| **Cost of Capital** | | | |
| Planning And Consenting (Stage 1) | 25% | | |
| Construction (Stage 2) | 25% | | |
| Operation (Stage 3) | 10% | | |
| Aftercare (Stage 4) | 10% | | |
| Interest Rate (Risk Free Rate plus 0.5%) | 6% | | |
| **COSTS SUMMARY** | | | |
| Sunk Costs | -$ 2,000,000 | | |
| Planning / Pre-development | $ 2,340,000 | | |
| Base Costs | $ 9,815,700 | | |
| Development | $ 36,919,923 | | |
| Operation | $ 58,626,858 | | |
| Closure | $ 326,108 | | |
| Contingency on Capital Costs | $ 9,964,735 | | |
| Contingency on Operational Costs | $ 5,862,686 | | |
| **Total (excluding Cost of Capital)** | **$ 121,856,010** | | |
| Total Start-up Costs | $ 8,175,854 | | |
| Total Capital Expenditure | $ 57,366,466 | | |
| Total Operational Expenditure | $ 64,489,544 | | |
| Aftercare Fund at Closure | $ 2,348,612 | | Based on Total Footprint Area of 26.38 ha ($248,692/annum + $73,500 in Final Year) |
| Average Whole of Life (AWL) Costs | $ 40.62 | /t | $ 33.85 /m³ of net airspace |
| Net Present Value (NPV) Costs | $ 0.00 | /t | $ 0.00 /m³ of net airspace |
| **INDICATIVE COST OF LANDFILL DISPOSAL** | | | |
| **Indicative Base Cost (IBC) at Start of Operation** | **$ 45.90** | **/t** | $ 38.25 /m³ of net airspace |
| Mark Up | $ 0 | | |
| **Indicative Gate Rate at Start of Operation** | **$ 45.90** | | |
| IBC Real Annual Movement | + 0.0% | | (IBC at Close of Operation = $45.90/t) |
| **TOTAL SOLID WASTE MANAGEMENT SYSTEM COSTS** | | | |
| **Other Management System Costs** | | | |
| Refuse Collection Costs (Kerbside, etc) | | | |
| Transfer Station Costs | $ 0 | /t | |
| Freight Costs | $ 0 | /t | |
| Recycling Costs | $ 0 | /t | |
| Greenwaste/Composting Costs | $ 0 | /t | |
| Education/Waste Minimisation Costs | $ 0 | /t | |
| Other Costs | $ 0 | /t | |
| **Total** | $ 0.00 | /t | |
| Landfill Indicative Gate Rate at Start of Operation | $ 45.90 | /t | |
| **Total Solid Waste Management Cost** | **$ 45.90** | **/t** | |

*Version 3.2h*

# MfE Landfill Full Cost Accounting Model

## Summary

**DESCRIPTION**

| | |
|---|---|
| Project Name: | **"Generic" landfill costing** |
| Project Location: | Wheatbelt shires |
| Scenario No: | 3 |
| Scenario Description: | 60,000t/yr for 30yrs - $2M cash injection |

**DESIGN PLANNING PARAMETERS (From 1 July 2016)**

| | | | |
|---|---|---|---|
| Project Commencement Date | 1 July 2012 | | |
| Operation Commencement Date | 1 July 2016 | | |
| Actual Landfill Operating Life (Rounded Up) | 30 | years | Closure due to Sunset Date (30/06/46) |
| Consented Landfill Operating Life | 30 | years | Sunset Date = 1 July 2046 |
| Aftercare/ Post Closure Period | 30 | years | |
| Number of Phases/Stages/Cells | 9 | | Each cell construction completed in single year |
| Annual Waste Tonnage at Start of Operation | 60,000 | t/year | |
| Annual Waste Tonnage Growth Rate | + 0. | % | |
| Minimum Allowable Annual Waste Tonnage | 5,000 | t/year | |
| Annual Waste Tonnage at Close of Operation | 60,000 | t/year | |
| Total Tonnes Placed in Landfill | 1,800,000 | t | = 60% of Design Tonnage (3,000,000 t) |
| Average Waste Tonnage | 60,000 | t/year | |
| Target Cover to Waste Ratio (Daily and Intermediate) | 1 : 5 | | |
| Volume Utilisation | 1.20 | m³/t | |
| Actual Footprint Area | 16.08 | Ha | = 61% of Design Footprint Area (26.38 Ha) |
| Waste Volume | 1,800,000 | m³ | |
| Daily And Intermediate Cover | 360,000 | m³ | |
| Net Airspace | 2,160,000 | m³ | = 60% of Design Net Airspace (3,600,000 m³) |
| Final Cover | 186,160 | m³ | |
| Gross Airspace | 2,346,160 | m³ | |

**FINANCIAL PARAMETERS**

| | |
|---|---|
| **Cost of Capital** | |
| Planning And Consenting (Stage 1) | 25% |
| Construction (Stage 2) | 25% |
| Operation (Stage 3) | 10% |
| Aftercare (Stage 4) | 10% |
| Interest Rate (Risk Free Rate plus 0.5%) | 6% |

**COSTS SUMMARY**

| | | |
|---|---|---|
| Sunk Costs | -$ 2,000,000 | |
| Planning / Pre-development | $ 2,140,000 | |
| Base Costs | $ 6,483,261 | |
| Development | $ 24,570,056 | |
| Operation | $ 41,354,552 | |
| Closure | $ 252,708 | |
| Contingency on Capital Costs | $ 6,770,934 | |
| Contingency on Operational Costs | $ 4,135,455 | |
| **Total (excluding Cost of Capital)** | **$ 83,706,965** | |
| Total Start-up Costs | $ 7,582,368 | |
| Total Capital Expenditure | $ 38,216,958 | |
| Total Operational Expenditure | $ 45,490,007 | |
| Aftercare Fund at Closure | $ 1,500,881 | Based on Total Footprint Area of 16.08 ha ($158,765/annum + $73,500 in Final Year) |
| Average Whole of Life (AWL) Costs | $ 46.50 /t | $ 38.75 /m³ of net airspace |
| Net Present Value (NPV) Costs | $ 0.00 /t | $ 0.00 /m³ of net airspace |

**INDICATIVE COST OF LANDFILL DISPOSAL**

| | | |
|---|---|---|
| **Indicative Base Cost (IBC) at Start of Operation** | **$ 54.60 /t** | $ 45.50 /m³ of net airspace |
| Mark Up | $ 0 | |
| **Indicative Gate Rate at Start of Operation** | **$ 54.60** | |
| IBC Real Annual Movement | + 0.0% | (IBC at Close of Operation = $54.60/t) |

**TOTAL SOLID WASTE MANAGEMENT SYSTEM COSTS**

| | |
|---|---|
| **Other Management System Costs** | |
| Refuse Collection Costs (Kerbside, etc) | |
| Transfer Station Costs | $ 0 /t |
| Freight Costs | $ 0 /t |
| Recycling Costs | $ 0 /t |
| Greenwaste/Composting Costs | $ 0 /t |
| Education/Waste Minimisation Costs | $ 0 /t |
| Other Costs | $ 0 /t |
| **Total** | $ 0.00 /t |
| Landfill Indicative Gate Rate at Start of Operation | $ 54.60 /t |
| **Total Solid Waste Management Cost** | **$ 54.60 /t** |

*Version 3.2h*

# MfE Landfill Full Cost Accounting Model

## Summary

| | | | |
|---|---|---|---|
| **DESCRIPTION** | | | |
| Project Name: | **"Generic" landfill costing** | | |
| Project Location: | Wheatbelt shires | | |
| Scenario No: | 4 | | |
| Scenario Description: | 20,000t/yr for 30yrs - $2M cash injection | | |
| **DESIGN PLANNING PARAMETERS (From 1 July 2016)** | | | |
| Project Commencement Date | 1 July 2012 | | |
| Operation Commencement Date | 1 July 2016 | | |
| Actual Landfill Operating Life (Rounded Up) | 30 | years | Closure due to Sunset Date (30/06/46) |
| Consented Landfill Operating Life | 30 | years | Sunset Date = 1 July 2046 |
| Aftercare/ Post Closure Period | 30 | years | |
| Number of Phases/Stages/Cells | 3 | | Each cell construction completed in single year |
| Annual Waste Tonnage at Start of Operation | 20,000 | t/year | |
| Annual Waste Tonnage Growth Rate | + 0. | % | |
| Minimum Allowable Annual Waste Tonnage | 5,000 | t/year | |
| Annual Waste Tonnage at Close of Operation | 20,000 | t/year | |
| Total Tonnes Placed in Landfill | 600,000 | t | = 20% of Design Tonnage (3,000,000 t) |
| Average Waste Tonnage | 20,000 | t/year | |
| Target Cover to Waste Ratio (Daily and Intermediate) | 1 : 5 | | |
| Volume Utilisation | 1.20 | m³/t | |
| Actual Footprint Area | 5.52 | Ha | = 21% of Design Footprint Area (26.38 Ha) |
| Waste Volume | 600,000 | m³ | |
| Daily And Intermediate Cover | 120,000 | m³ | |
| Net Airspace | 720,000 | m³ | = 20% of Design Net Airspace (3,600,000 m³) |
| Final Cover | 48,880 | m³ | |
| Gross Airspace | 768,880 | m³ | |
| **FINANCIAL PARAMETERS** | | | |
| **Cost of Capital** | | | |
| Planning And Consenting (Stage 1) | 25% | | |
| Construction (Stage 2) | 25% | | |
| Operation (Stage 3) | 10% | | |
| Aftercare (Stage 4) | 10% | | |
| Interest Rate (Risk Free Rate plus 0.5%) | 6% | | |
| **COSTS SUMMARY** | | | |
| Sunk Costs | -$ 2,000,000 | | |
| Planning / Pre-development | $ 2,140,000 | | |
| Base Costs | $ 2,678,743 | | |
| Development | $ 10,479,552 | | |
| Operation | $ 20,292,973 | | |
| Closure | $ 168,718 | | |
| Contingency on Capital Costs | $ 3,183,531 | | |
| Contingency on Operational Costs | $ 2,029,297 | | |
| **Total (excluding Cost of Capital)** | **$ 38,972,815** | | |
| Total Start-up Costs | $ 7,546,092 | | |
| Total Capital Expenditure | $ 16,650,545 | | |
| Total Operational Expenditure | $ 22,322,270 | | |
| Aftercare Fund at Closure | $ 631,750 | | Based on Total Footprint Area of 5.52 ha ($66,569/annum + $73,500 in Final Year) |
| Average Whole of Life (AWL) Costs | $ 64.95 | /t | $ 54.13 /m³ of net airspace |
| Net Present Value (NPV) Costs | $ 0.00 | /t | $ 0.00 /m³ of net airspace |
| **INDICATIVE COST OF LANDFILL DISPOSAL** | | | |
| **Indicative Base Cost (IBC) at Start of Operation** | **$ 89.09** | **/t** | $ 74.24 /m³ of net airspace |
| Mark Up | $ 0 | | |
| **Indicative Gate Rate at Start of Operation** | **$ 89.09** | | |
| IBC Real Annual Movement | + 0.0% | | (IBC at Close of Operation = $89.09/t) |
| **TOTAL SOLID WASTE MANAGEMENT SYSTEM COSTS** | | | |
| **Other Management System Costs** | | | |
| Refuse Collection Costs (Kerbside, etc) | | | |
| Transfer Station Costs | $ 0 | /t | |
| Freight Costs | $ 0 | /t | |
| Recycling Costs | $ 0 | /t | |
| Greenwaste/Composting Costs | $ 0 | /t | |
| Education/Waste Minimisation Costs | $ 0 | /t | |
| Other Costs | $ 0 | /t | |
| **Total** | $ 0.00 | /t | |
| Landfill Indicative Gate Rate at Start of Operation | $ 89.09 | /t | |
| **Total Solid Waste Management Cost** | **$ 89.09** | **/t** | |

*Version 3.2h*

# APPENDIX 2 – MATERIALS AND RESOURCE RECOVERY FACILITIES IN PERTH

In Western Australia the average diversion rate in 2008/09 was 27.8%, compared to a national average diversion rate of 35.75%. The majority of recycling and resource recovery activity in Western Australia is undertaken in the Perth Metropolitan area where the diversion rate in 2008/09 was 34.2%.

In the Perth metropolitan area there are various different approaches taken to diversion of waste from landfill. The greatest success in terms of the diversion rate is achieved by a combination of material recovery facilities and resource recovery facilities.

Material recovery facilities receive and separate recyclable materials which are then baled and sold to market. The majority of material recovery facilities at present in Western Australia primarily accept household recyclables but some receive commercial loads also.

Resource recovery facilities process waste into potentially useful products such as compost, soil conditioners or fuel for energy production through thermal, biological or mechanical means, reducing the amount of waste being required to be sent to landfill (DEC 2008). The types of waste that can be processed by resource recovery facilities depend on the technology used. In Perth, there are facilities existing and in construction that use biological processes to treat/recover the organic fraction of the domestic refuse stream.

The various approaches taken to materials and resource recovery in the Perth regional councils are summarised below.

## Western Metropolitan Regional Council

The Western Metropolitan Regional Council has five member councils; the City of Subiaco, Towns of Claremont, Cottesloe, Mosman Park and the Shire of Peppermint Grove. The Western Metropolitan Regional Council currently runs a two bin collection service and transfers all of its waste since there is no landfill site. A diversion rate of 34.8% is achieved currently at the JFR resource recovery facility which currently acts as a materials recovery facility but will be expanded to include a DiCOM anaerobic digestion system by March 2012. It is estimated that this facility will increase municipal solid waste diversion from 34.8% to 75.5%.

## Southern Metropolitan Regional Council

The Southern Metropolitan Regional Council has six member councils; the Cities of Cockburn, Fremantle, Melville and Rockingham and the Towns of East Fremantle and Kwinana. The council runs a three bin collection system to a regional resource recovery facility which incorporates; waste composting, materials recovery and green waste processing facilities. In the 2009/10 year the achieved diversion rate was 64%.

## Mindarie Regional Council

The Mindarie Regional Council has seven member councils; the Cities of Joondalup, Perth and Stirling, Towns of Cambridge, Vincent and Victoria Park and the Shire of Wanneroo. The council operates a resource recovery facility which achieved a 56% diversion rate in 2009/10, however

because of the small size of the facility it can handle less than 20% of waste generated in the member councils and so the overall diversion rate for the region in 2009/10 is only 9%. The member councils operate a mixture of single and two bin collection services.

## Rivers Regional Council

The Rivers Regional Council has seven member councils; the Cities of Armadale, Gosnells, Mandurah and South Perth and the Shires of Murray, Serpentine-Jarrahdale and Waroona. The council is currently investigating the feasibility of establishing a resource recovery facility for the region. This task is well advanced with two possible locations identified for the facility. Environmental Approvals and tender documentation for this facility are currently being progressed.

The Cities of Armadale and Mandurah and the Shire of Serpentine Jarrahdale run two bin collections.

The Cities of Gosnells and South Perth currently run two bin collections and send waste to the Southern Metropolitan regional resource recovery centre.

## Eastern Metropolitan Regional Council

The Eastern Metropolitan Regional Council has six member councils; the Cities of Bayswater, Belmont and Swan, Town of Bassendean and the Shires of Mundaring and Kalamunda. The council is currently planning to develop a resource recovery facility at the Red Hill Waste Management Facility. The technology options under consideration include anaerobic digestion, gasification, pyrolysis and combustion. A three bin collection system will be considered in conjunction with anaerobic digestion technology, otherwise a two bin system will be used, as recommended for thermal technology options.