# KTK LANDFILL LTD

**Brownstown/Carnalway**
**Kilcullen,**
**County Kildare**

## SPECIFIED ENGINEERING WORKS
## Condition 3.2 and Schedule B and C

***Supplementary Report***
***On***
***- Proposed Gas Utilisation Plant -***

## Waste Licence Register No. 81-2



**Prepared by:**

**Environment & Resource Management Ltd.**
**No. 3 Tara Court,**
**Naas, Co. Kildare.**

**October 2004**

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## Drawings

Drawing KTK/838 REV. C – Location of Proposed Gas Utilisation Plant Compound

Drawing KTK/839 REV. E – Proposed Gas Utilisation Plant Compound

Drawing KTK/840 REV. D – Sections through Gas Utilisation Plant Compound

Drawing KTK/846 REV. A – Critical Receptor Locations

## 1.0 INTRODUCTION

A Specified Engineering Works (SEW) proposal, in relation to a landfill gas utilisation plant, was submitted to the Agency on the 8 April 2004.

The Agency responded verbally to the SEW proposal during a site visit at the KTK Landfill on the 28th July 2004. Following from this site visit the Agency issued correspondence dated 30 August 2004 (*Ref: WL81-2/GEN021MMcD*) which indicated the following further requirements for the SEW:

- *"Submit a report on air dispersion modelling of the emissions from the proposed LFG Utilisation engines and omitted details required under Schedule C.5 of the Waste Licence to the Agency for agreement."*

It is noted that the licensee applied for a planning permission for the proposed landfill gas utilisation plant in April 2004. A Planning Permission (Register No. 04/861) was granted by the Kildare County Council on the 7th September 2004. This permission is subject to 9 conditions.

This supplementary SEW report describes the development works now approved by Kildare County Council in relation to the proposed gas utilisation plant at the site and further discusses air dispersion modelling and the plant emissions as specified in Schedule C.5 of the Waste Licence Register No 81-2. The proposed compound is outlined on attached *Drawing KTK/839 Rev. E*.

## 2.0 PROPOSED SPECIFIED ENGINEERING WORKS

The licensee envisages development of the proposed gas utilisation plant at the facility as follows:

### 2.1 Description of the Proposed Gas Utilisation Plant

The proposed gas utilisation plant will be located within the existing footprint of the landfill at a point furthest away from all of the facility's neighbours – refer to *Drawings KTK/839 Rev. E* and *KTK/846 Rev. A* for location.

The gas utilisation plant comprises three engines, three transformers and an ESB substation. Furthermore an enclosed ground flare is currently located in this area of the facility. The key components of the proposed plant are described in more detail as follows.



### 2.1.1 Gas Utilisation Plant

Three separate, purpose built and environmentally controlled containers enclosing a landfill gas engine each capable of generating 1MW of power. The engines (Type - *TBG 620 V16 K*) are manufactured by Deutz Energy GmbH in Mannheim, Germany. According to the manufacturer each engine will utilise, at a 50% Methane ($CH_4$) concentration, 650 $m^3$/hr of landfill gas. The stack (diameter 0.5 metres) height of each container is approximately 5 metres

from ground level. Refer to *Drawing KTK/840 Rev. D* for a cross section of the proposed utilisation compound.

The transformers are located in three separate, purpose built and environmentally controlled, containers. There will be no emissions from the transformers.

The ESB switch room building will be constructed according to ESB standard requirements. A link to the ESB national grid will be connected via the switch room to the existing grid connection at the Kildare Co. Co. Silliot Hill Landfill.

The proposed landfill gas utilisation plant will generate an estimated 2.5 - 3.5MW of electricity, for input into the National Grid for a period of up to 25 years. The timing for the completion of works is autumn/winter 2004. Emission points i.e. stack locations are depicted on *Drawing KTK/839 Rev. E.*

### 2.1.2 Enclosed Flare Compound

A state of the art, fully enclosed, high temperature HAASE landfill gas ground flare is currently located adjacent to the proposed gas utilisation plant compound. The following manufacturer's information is available for the flare: flow rate 1,500 $m^3$/hr, stack height 8.6 metres, stack diameter 1.3 metres and output temperature 1,000-1,200°C. Refer to *Drawing KTK/839 Rev. E* for the location.

## 2.2 Emissions

### 2.2.1 Emissions from Gas Utilisation Plant

Emission values (for parameters as per Schedule C.5 of Waste Licence Register No 81-2) for the proposed gas utilisation engines are depicted in the following Table 1. These emission values are compared against emission limit values specified in TA Luft (2002), Waste Licence Register No 81-2 and some recently issued EPA Waste Licence ELV's for Gas Utilisation Plant (i.e. WL 4-2 and WL 26-2).

Table 1 indicates that the ELV's for Carbon Monoxide, TA Luft Class 1-3 parameters and Hydrocarbons would require alteration as per more recently issued Waste Licence Register No 4-2 and 26-2. The licensee intends to submit a separate letter report to the Agency on that issue.

**Table 1: Emissions and ELV's from the Gas Utilisation Plant in mg/m³.**

| Parameter | Deutz 620 [5] | Emission Limit Values (ELV) | | | |
|---|---|---|---|---|---|
| | | TA Luft 2002 | WL 81-2 | WL 4-2 | WL 26-2 |
| **$NO_2$** | 400 | 1,000 | *500* | 500 | 500 |
| **CO** | 610 | 1,000 | *650* | 1,400 | 1,400 |
| **$PM_{10}$** | 0.4 | - | *130* | 130 | 130 |
| **TA Luft Class 1** | 45 [1] | n/a [2] | *20* | 1,000 [3] 75 [4] | 1,000 [3] 75 [4] |
| **TA Luft Class 2** | | | *100* | | |
| **TA Luft Class 3** | | | *150* | | |
| **Hydrogen Chloride** | 1.9 | - | *50* | 50 | 50 |
| **Hydrogen Fluoride** | 0.7 | - | *5* | 5 | *5* |
| **Hydrocarbons** | n/d | - | *10* | n/a | n/a |

*n/d = No data available / n/a = Not Applicable*

*1) TA Luft Class 1-3 (non-Methane Organic Compounds).*

*2) TA Luft (2002) does not specify ELV's for Class 1-3 Organic compounds for combustion plants.*

*3) ELV for Total Volatile Organic Compounds (VOC).*

*4) ELV for non-Methane VOC's.*

*5) Submitted by the Manufacturer Deutz Energy GmbH.*

### 2.2.2 Emissions from Gas Flare

The manufacturer (HAASE) has indicated that the 1,500m³/hr enclosed high temperature flare at the KTK Landfill facility meets all existing emission requirements set by the Irish EPA: CO<50mg/m³, $NO_x$<150mg/m³, 0.3 sec. retention time and a burning temperature of 1,000 – 1,200 °C.

The following Table 3 indicates the emission values for the 1,500m³ enclosed high temperature HAASE flare. These emission values are compared against TA Luft (2002), Waste Licence Register No 81-2 and some recently issued EPA Waste Licence ELV's for flares (WL 4-2 and WL 26-2).

**Table 3: Emissions from the flare in mg/m³.**

| Parameter | HAASE Flare | Emission Limit Values (ELV) | | | |
|---|---|---|---|---|---|
| | | TA Luft 2002 | WL 81-2 | WL 4-2 | WL 26-2 |
| **$NO_2$** | < 150 [3] | 150 | *250* | 150 | 150 |
| **CO** | < 50 [3] | 50 | *50* | 50 | 50 |
| **$PM_{10}$** | n/a | - | *130* | n/a | n/a |
| **TA Luft Class 1** | n/a | n/a | *20* | n/a | n/a |
| **TA Luft Class 2** | | | *100* | | |
| **TA Luft Class 3** | | | *150* | | |
| **Hydrogen Chloride** | 20.4 [1] | - | *50* | 50 | 50 |
| **Hydrogen Fluoride** | 8.1 [2] | - | *5* | 5 | 5 |
| **Hydrocarbons** | n/d | - | *10* | n/a | n/a |
| **Total Organic Carbon** | n/d | - | *n/a* | 10 | 10 |

*n/d = No data available / n/a = Not Applicable*

*1) Represents analytical data for total Chloride. Data obtained by GAS Energy Ltd in March 2004.*

*2) Represents analytical data for total Fluoride. Data obtained by GAS Energy Ltd in March 2004.*

*3) Information supplied by the Manufacturer (HAASE).*

## 3.0 AIR DISPERSION MODEL

The computation software used for the preparation of an air dispersion model i.e. calculation of ground level emissions at the critical receptor locations was *GasSim Ver. 1.5*.

*GasSim* is a probabilistic model, which uses the Monte Carlo simulation technique to select randomly from a predefined range of possible input values to create parameters for use in the model calculations. Repeating the process many times gives a range of output values, the distribution of which reflects the uncertainty inherent in the input values and enables the user to ascertain the likelihood of the estimated output levels being achieved.

### 3.1 Conceptual Model

In the *GasSim* model the user is allowed to enter individual inputs, which can be entered as probability density functions (PDF's). This model assumes the following (user input data):

- Landfill area is 100,000 $m^2$;
- Annual rainfall at the site is 860mm;
- Details for the waste stream (composition breakdown) that are based on waste characterisation studies carried out at the site (ERML);
- Waste deposition within the site occurs during the period 1999 – 2008 i.e. the period of waste disposal is estimated to last 10 years;
- Waste density varies between 0.7-0.8 $t/m^3$;
- Current cap comprises 0.5m clayey material and the base liner comprises a single liner with specific hydraulic properties;
- Landfill gas flare is operational at the site since August 2003 with a flaring capacity varying between 300 – 1,600 $m^3$/hr. Further the flare stack height is 8.6 metres, the orifice diameter is 1.3 metres and the stack output temperature 1,100 °C;
- 3 No Landfill gas utilisation engines will operate at the site from 2005, 2005 and 2006 respectively. The stack height has been set to 5 metres, orifice diameter to 0.5 metres and the stack output temperature at 523 °C;
- Wind direction data from Casement Aerodrome (2003) was used for the Atmospheric Dispersion module;
- The model was prepared to calculate the emission concentration at two 'critical' receptor locations – Receptor 1 located 350 metres to the West (270° from North) and Receptor 2 located 650 metres to the Southeast (100° from North) – see *Drawing KTK/846 Rev. A*;



The following sections present more detailed information about the input data used for the model preparation. The main areas of data input comprise: infiltration, waste composition (breakdown), waste quantity, age of waste, site filling rate, wind direction data (Casement 2003), detailed analytical data of engine and flare emissions (where available).

### 3.1.1 Infiltration

This represents the amount of water entering the landfill through the capped and uncapped areas annually. The average rainfall at the site is 860mm. Using the GasSim default assumption that the infiltration on capped sites is 10% of annual rainfall, a normal distribution mean 86mm (±8.6mm) was used.

### 3.1.2 Source Inputs / Waste Composition

The waste composition survey data was used to specify the waste stream for the site. The waste breakdown consisted of Commercial and Industrial Wastes (C&I) assuming that from 2003 the ratio was/is 80 to 20 respectively.

The following Table 5 indicates the waste quantities as placed at the site to date (up to 2003) and further estimates up to 2008:

**Table 5: Waste Quantities for KTK Landfill used in the *GasSim* Model.**

| Year | Waste Quantity in tonnes | Ratio Commercial to Industrial Waste |
|---|---|---|
| **1999** | 136 | 100 / 0 |
| **2000** | 233,252 | 89.5 / 10.5 |
| **2001** | 298,406 | 90.9 / 9.1 |
| **2002** | 253,803 | 77.1 / 22.9 |
| **2003** | 248,700 | 80 / 20 |
| **2004** | 225,000 to 275,000 | 80 / 20 |
| **2005** | 225,000 to 275,000 | 80 / 20 |
| **2006** | 225,000 to 275,000 | 80 / 20 |
| **2007** | 225,000 to 275,000 | 80 / 20 |
| **2008** | 225,000 to 275,000 | 80 / 20 |

A more detailed waste composition breakdown is included in the model. It allows the breakdown of specific waste groups i.e. Commercial and Industrial (C&I) waste, to be categorised in more detail – see Table 6 below for details.

**Table 6: Waste Composition Breakdown used in the *GasSim* model.**

| Component | Waste Composition Breakdown in % | |
|---|---|---|
| | Commercial | Industrial |
| **Paper / Card** | 10 | 14 – 22 |
| **Textiles** | 55 | 4 – 6 |
| **Putrescible** | - | 32 – 49 |
| **Non-Degradable** | 35 | 35 – 40 |
| **TOTAL** | 100 | 85 - 100 |



### 3.1.3 Landfill Characteristics

The model allows the entry of site-specific data i.e. the length and width of the site – a number of 100,000 $m^2$ was given for the KTK Landfill site. A hydraulic conductivity of 1.0E-10 to 1.0E-9 was designated to the capping layer (0.5-metre clay layer). Furthermore a hydraulic conductivity of 1.0E-14

to 1.0E-12 was assumed for the existing base liner. This input data influences the surface and lateral emissions, and the percentage of generated gas being collected for the flare and engine plant.

### 3.2 Locations of Off-Site Receptors

The two closest off-site human receptors are indicated on *Drawing KTK/846 Rev. A*:

- Receptor 1 is a two storey residence located approximately 350 metres in a westerly direction from the proposed LFG utilisation plant.
- Receptor 2 is a large country house located approximately 650 metres in a south-easterly direction from the proposed LFG utilisation plant.

No other human receptor locations, other than the offices on site, were identified in the immediate environs of the proposed LFG utilisation plant and the existing flare stack.

Ground level concentrations at the two identified closest receptor locations were compared against existing air emission standards (refer to Section 3.4 of this report for results).

### 3.3 Existing Air Emission Standards

The Air Quality standards referred in this section are guide values set as a long term precautionary measure for the protection of human health and the environment.

The following Table 7 indicates the available national and international ambient air quality standards. It is noted that the parameters used for the comparison are from *Schedule C.5* of the Waste Licence Register No 81-2.

**Table 7: Air Quality Standards in mg/m3 (annual average).**

| Parameter | WHO [1] | Irish [2] | UK [3] | Danish [4] |
|---|---|---|---|---|
| **$NO_2$** | 0.04 | 0.04 | 0.04 | - |
| **CO** | - | 10 | 10 | - |
| **$PM_{10}$** | 0.04 | 0.04 | 0.04 | - |
| **TA Luft Class 1** | - | - | - | - |
| **TA Luft Class 2** | - | - | - | - |
| **TA Luft Class 3** | - | - | - | - |
| **Hydrogen Chloride** | | - | - | *0.05* |
| **Hydrogen Fluoride** | - | - | - | *0.002* |
| **Hydrocarbons** | - | - | - | - |



*1) World Health Organisation (WHO): Air Quality Guidelines for Europe, Second Edition, 2000.*

*2) Irish Air Quality regulations (SI No. 271 of 2002)*

*3) UK Air Quality Limit Value Regulations 2003 (SI/UK No. 2121 of 2003)*

*4) Danish Industrial Air Pollution Guidelines. Danish industrial Air Pollution Guidelines specify a C-value, which is the value which must not be exceeded when expressed as the 99-percentile of 1-hour values.*

Table 7 indicates that there are no air emission standards (for the protection of human health) for the TA Luft Classes 1-3 parameters or for the hydrocarbons. It should be noted that:

- TA Luft Class 1, 2 and 3 organic parameters, as per Licence requirements (*Schedule C.5*), are from TA Luft (1986) for the control of combustion plant (engine) stacks emissions. TA Luft 2002 does not set limit values for the TA Luft classes 1-3 organic parameters for gas flares, instead it limits the total concentration of Formaldehyde at 60 $mg/m^3$ for combustion plants. The more recent EPA licences specify ELV's for VOC's and non-methane VOC's instead of TA Luft Organic parameters for combustion plants;

- Waste Licence Register No 81-2 defines an ELV for Hydrocarbons (flares and engines) at 10 $mg/m^3$. The more recent EPA licences have an ELV for TOC (Total Organic Carbon) emissions from the flares of 10 $mg/m^3$. Moreover no ELV's for Hydrocarbons are set for combustion plants.

## 3.4 Model Results

The results of the *GasSim* gas dispersion model indicate that the emissions will not exceed the relevant air quality standards at the two closest off-site receptors identified in this study.

The following Table 8 indicates the results of the model for both receptor locations. The results represent the median concentrations of the annual average results for the period of waste deposition within the site (1999 – 2008).

**Table 8: Results of the *GasSim* model for the Receptor locations in $mg/m^3$.**

| Parameter | Receptor 1 | Receptor 2 | Air Emission Standards |
|---|---|---|---|
| **$NO_2$** | 0.000254 | 0.000371 | 0.04 [1)] |
| **CO** | 0.000733 | 0.000702 | 10 [2)] |
| **$PM_{10}$** | 0.000008 | 0.000010 | 0.04 [1)] |
| **TA Luft Class 1** | - | - | - |
| **TA Luft Class 2** | | - | - |
| **TA Luft Class 3** | | - | - |
| **Hydrogen Chloride** | 0.000053 | 0.000068 | 0.05 [3)] |
| **Hydrogen Fluoride** | 0.000009 | 0.000011 | 0.002 [3)] |
| **Hydrocarbons** | - | - | - |



*1) This concentration represents the following Air Emission Standards: the World Health Organisation (WHO): Air Quality Guidelines for Europe, Second Edition, 2000; Irish Air Quality regulations (SI No. 271 of 2002) and UK Air Quality Limit Value Regulations 2003 (SI/UK No. 2121 of 2003).*

*2) This concentration represents the following Air Emission Standards; Irish Air Quality regulations (SI No. 271 of 2002) and UK Air Quality Limit Value Regulations 2003 (SI/UK No. 2121 of 2003).*

*3) Danish Industrial Air Pollution Guidelines. Danish industrial Air Pollution Guidelines specify a C-value, which is the value which must not be exceeded when expressed as the 99-percentile of 1-hour values.*

## DRAWINGS

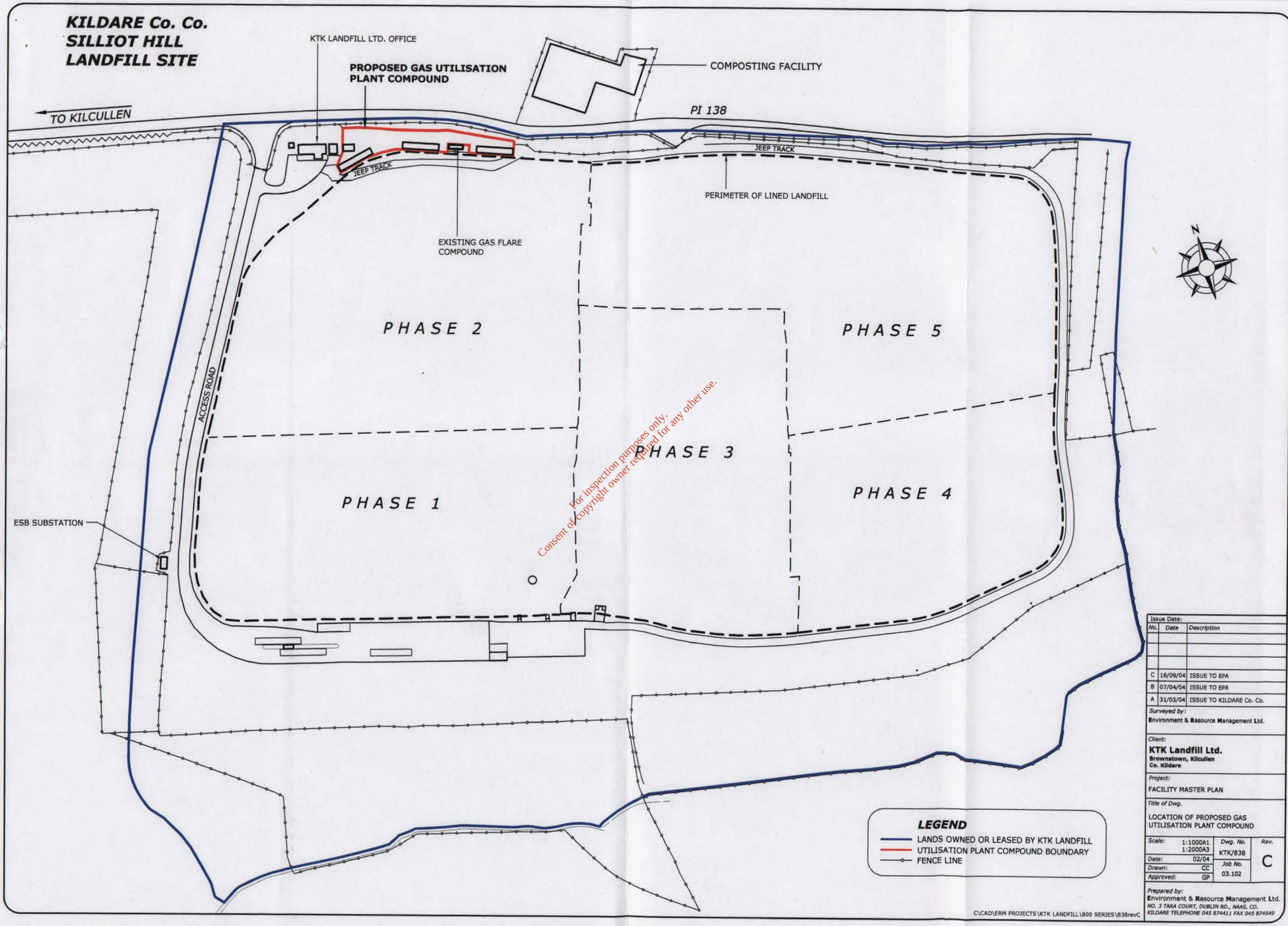
**Drawing KTK/838 Rev. C**

**Drawing KTK/839 Rev. E**

**Drawing KTK/840 Rev. D**

**Drawing KTK/846 Rev. A**

# KILDARE Co. Co.
# SILLIOT HILL
# LANDFILL SITE






**LEGEND**

- LANDS OWNED OR LEASED BY KTK LANDFILL
- UTILISATION PLANT COMPOUND BOUNDARY
- FENCE LINE

| Issue Date: | | |
|---|---|---|
| No. | Date | Description |
| | | |
| | | |
| | | |
| C | 16/09/04 | ISSUE TO EPA |
| B | 07/04/04 | ISSUE TO EPA |
| A | 31/03/04 | ISSUE TO KILDARE Co. Co. |

*Surveyed by:*
Environment & Resource Management Ltd.

*Client:*
**KTK Landfill Ltd.**
Brownstown, Kilcullen
Co. Kildare

*Project:*
FACILITY MASTER PLAN

*Title of Dwg.*
LOCATION OF PROPOSED GAS UTILISATION PLANT COMPOUND

| Scale: | 1:1000A1 1:2000A3 | Dwg. No. | Rev. |
|---|---|---|---|
| Date: | 02/04 | KTK/838 | C |
| Drawn: | CC | Job No. | |
| Approved: | GP | 03.102 | |

*Prepared by:*
Environment & Resource Management Ltd.
NO. 3 TARA COURT, DUBLIN RD., NAAS, CO. KILDARE TELEPHONE 045 874411 FAX 045 874549

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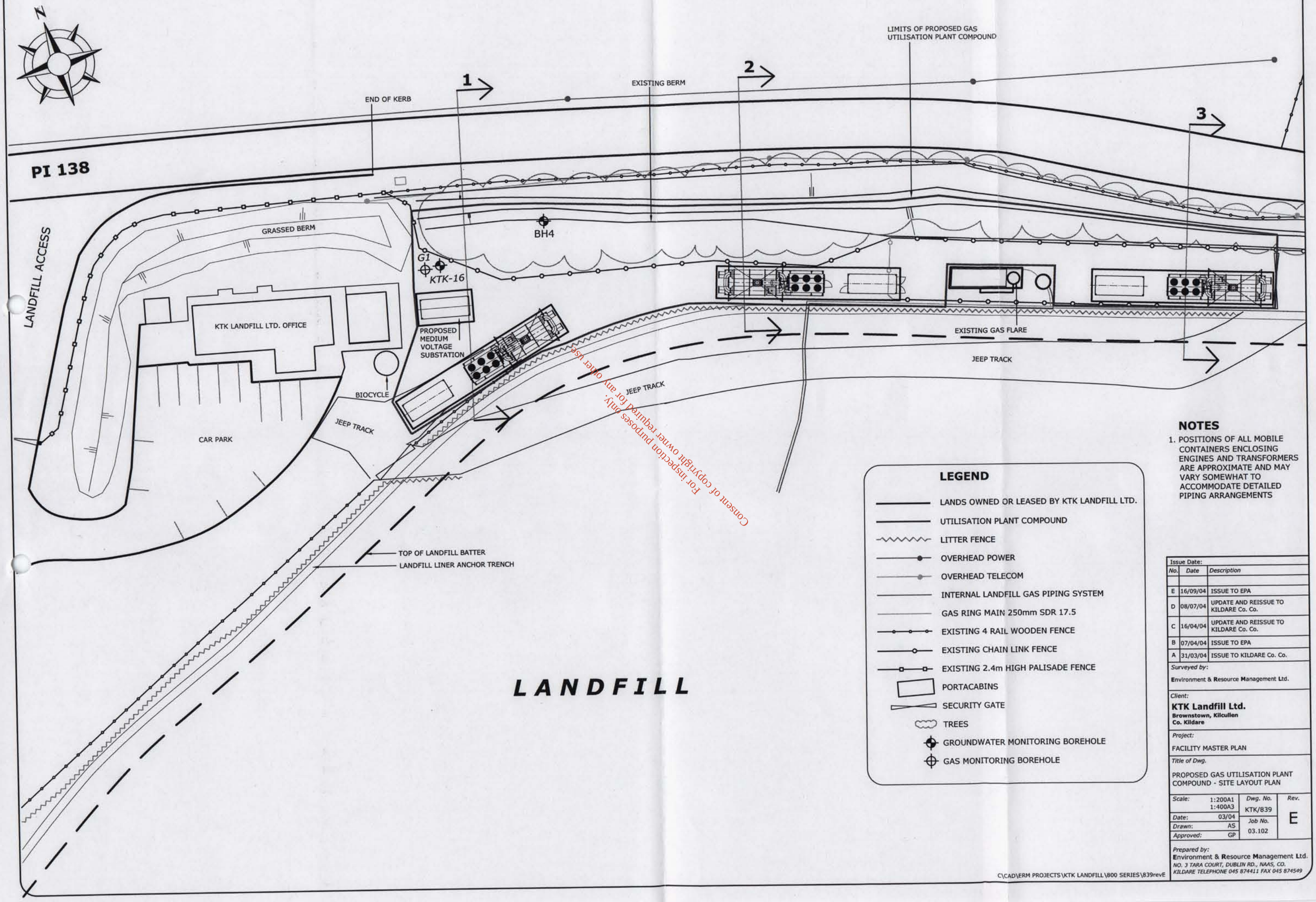




## NOTES

1. POSITIONS OF ALL MOBILE CONTAINERS ENCLOSING ENGINES AND TRANSFORMERS ARE APPROXIMATE AND MAY VARY SOMEWHAT TO ACCOMMODATE DETAILED PIPING ARRANGEMENTS

## LEGEND

- LANDS OWNED OR LEASED BY KTK LANDFILL LTD.
- UTILISATION PLANT COMPOUND
- LITTER FENCE
- OVERHEAD POWER
- OVERHEAD TELECOM
- INTERNAL LANDFILL GAS PIPING SYSTEM
- GAS RING MAIN 250mm SDR 17.5
- EXISTING 4 RAIL WOODEN FENCE
- EXISTING CHAIN LINK FENCE
- EXISTING 2.4m HIGH PALISADE FENCE
- PORTACABINS
- SECURITY GATE
- TREES
- GROUNDWATER MONITORING BOREHOLE
- GAS MONITORING BOREHOLE

Issue Date:

| No. | Date | Description |
|---|---|---|
| E | 16/09/04 | ISSUE TO EPA |
| D | 08/07/04 | UPDATE AND REISSUE TO KILDARE Co. Co. |
| C | 16/04/04 | UPDATE AND REISSUE TO KILDARE Co. Co. |
| B | 07/04/04 | ISSUE TO EPA |
| A | 31/03/04 | ISSUE TO KILDARE Co. Co. |

Surveyed by:
Environment & Resource Management Ltd.

Client:
**KTK Landfill Ltd.**
Brownstown, Kilcullen
Co. Kildare

Project:
FACILITY MASTER PLAN

Title of Dwg.
PROPOSED GAS UTILISATION PLANT COMPOUND - SITE LAYOUT PLAN

| Scale: | 1:200A1 1:400A3 | Dwg. No. | Rev. |
|---|---|---|---|
| Date: | 03/04 | KTK/839 | E |
| Drawn: | AS | Job No. | |
| Approved: | GP | 03.102 | |

Prepared by:
Environment & Resource Management Ltd.
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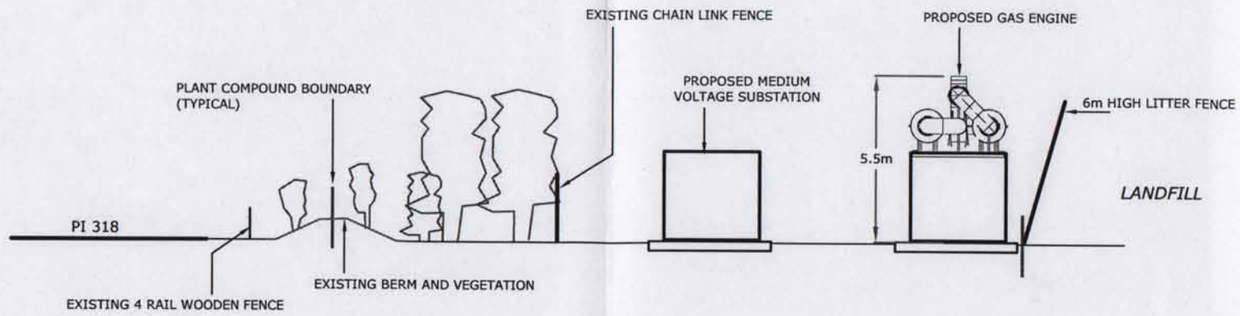


SECTION 1 *(1:100A1)*
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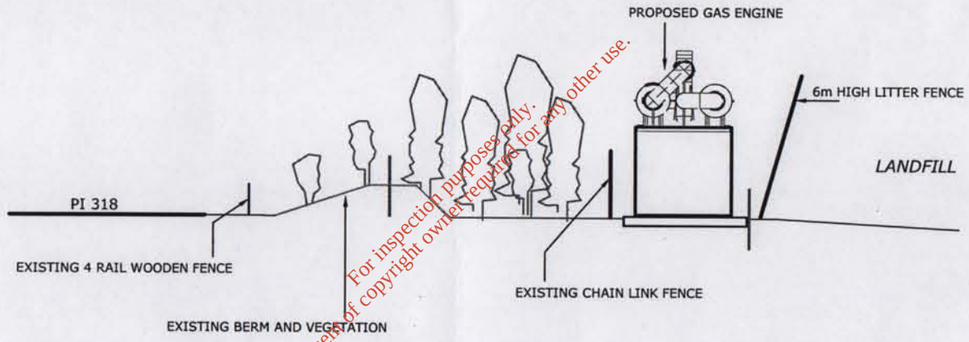


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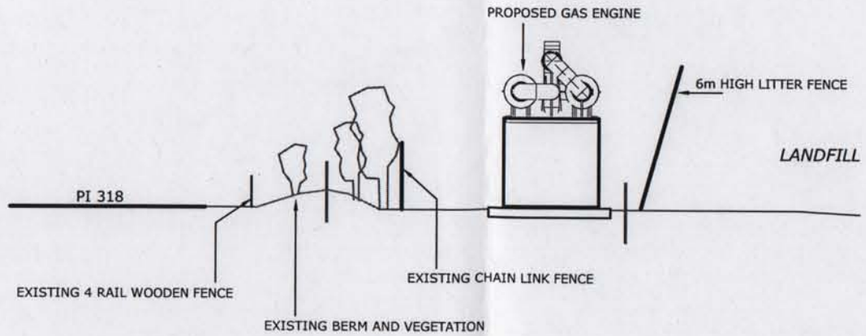


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| | | |
| | | |
| D | 16/09/04 | ISSUE TO EPA |
| C | 08/07/04 | UPDATE AND REISSUE TO KILDARE Co. Co. |
| B | 07/04/04 | ISSUE TO EPA |
| A | 31/03/04 | KILDARE COUNTY COUNCIL |

*Surveyed by:*
Environment & Resource Management Ltd.

*Client:*
**KTK Landfill Ltd.**
**Brownstown, Kilcullen**
**Co. Kildare**

*Project:*
FACILITY MASTER PLAN

*Title of Dwg.*
SECTIONS THROUGH GAS UTILISATION PLANT COMPOUND

| *Scale:* AS SHOWN | *Dwg. No.* KTK/840 | *Rev.* D |
|---|---|---|
| *Drawn:* CC | *Job No.* 03.102 | |
| *Approved:* GP | | |

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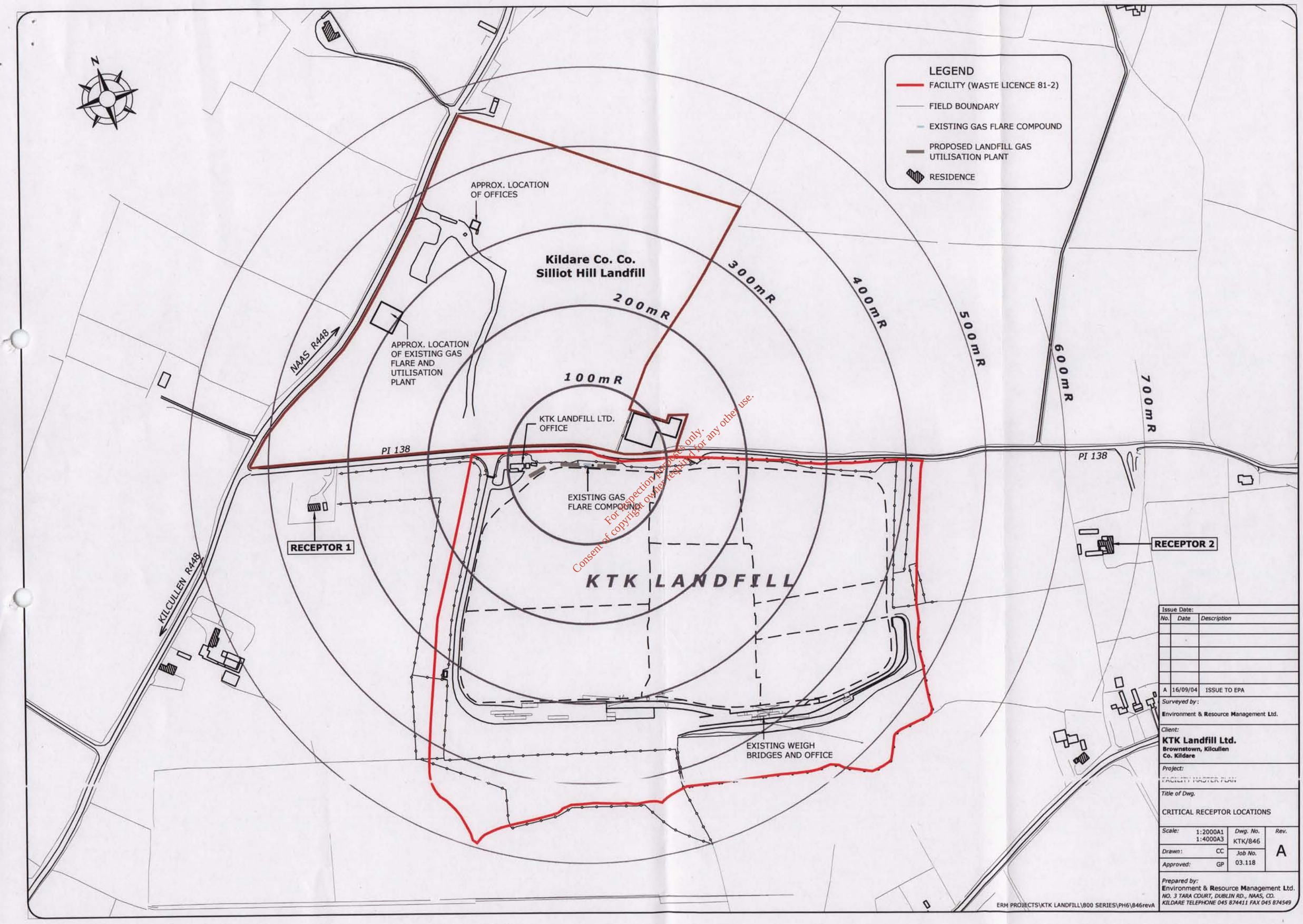
C\CAD\ERM PROJECTS\KTK LANDFILL\800 SERIES\840revD






| Issue Date: | | |
|---|---|---|
| No. | Date | Description |
| | | |
| | | |
| | | |
| | | |
| | | |
| A | 16/09/04 | ISSUE TO EPA |

Surveyed by:
Environment & Resource Management Ltd.

Client:
**KTK Landfill Ltd.**
Brownstown, Kilcullen
Co. Kildare

Project:
FACILITY MASTER PLAN

Title of Dwg.
CRITICAL RECEPTOR LOCATIONS

| Scale: | 1:2000A1 1:4000A3 | Dwg. No. | Rev. |
|---|---|---|---|
| Drawn: | CC | KTK/846 | A |
| Approved: | GP | Job No. 03.118 | |

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