

ENVIRONMENTAL ASSESSMENT

WOODLAWN EXPANSION PROJECT

VOLUME 2 – APPENDICES

AUGUST 2010

URS

VEOLIA ENVIRONMENTAL SERVICES

Director-General's Requirements

Appendix A

Major Projects Assessment

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Our ref: Q91/00233

Doug Dean
Managing Director
Veolia Environmental Services (Aust) Pty Ltd
Level 4, 65 Pirrama Road
PYRMONT NSW 2009

Dear Mr Dean

The Woodlawn Waste Expansion Project MP10_0012
Director-General's Requirements

I refer to your application for the Woodlawn Waste Expansion Project at Tarago in the Goulburn Mulwaree and Palerang Local Government Areas.

I have attached a copy of the Director-General's requirements for the project. These requirements have been prepared based on the information you have provided to date..

Please note that the Director-General may alter these requirements at any time.

If the project is likely to have a significant impact on matters of National Environmental Significance, it will require an approval under the Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act). This approval is in addition to any approvals required under NSW legislation. It is your responsibility to contact the Department of Environment, Water, Heritage and the Arts in Canberra (6274-1111 or http://www.environment.gov.au) to determine if the proposal requires an approval under the EPBC Act. If it is subsequently determined that an approval is required under the EPBC Act, please contact the Department immediately as supplementary Director-General's requirements may need to be issued.

I would appreciate it if you would contact the Department at least two weeks before you propose to submit the Environmental Assessment (EA) for the project. This will enable the Department to determine the:

- applicable fee (see Division 1A, Part 15 of the Environmental Planning and Assessment Regulation 2000); and
- number of copies (hard-copy or CD-ROM) of the EA that will be required for exhibition purposes.

Once the Department receives the EA, it will review it in consultation with the relevant agencies to determine if it adequately addresses the Director-General's requirements, and may require you revise it prior to public exhibition.

The Department is required to make all the relevant information associated with the project publicly available on its website. Consequently, I would appreciate it if you would ensure that all the documents you subsequently submit to the Department are in a suitable format for the web, and arrange for an electronic version of the EA to be hosted on a suitable website during the assessment process.

If you have any enquiries about these requirements, please contact Felicity Greenway on 9228-6338.

Yours sincerely

DKitto 1/3/10

David Kitto
Director
Mining & Industry
As delegate for the Director-General

Director-General's Requirements

Section 75F of the *Environmental Planning and Assessment Act 1979*

Application Number	MP10_0012
Project	The Woodlawn Waste Expansion Project, which includes: • increasing the volume of waste received at the Woodlawn Bioreactor from 500,000 tonnes per annum to 1.2 million tonnes per annum; • increasing the volume of waste received at the Crisps Creek Intermodal from 500,000 tonnes per annum to 1,180,000 tonnes per annum; • extending the hours of operation both at the Woodlawn Bioreactor and Crisps Creek Intermodal; and • increasing the equipment, personnel and associated infrastructure.
Location	Tarago in the Goulburn Mulwaree and Palerang Local Government Areas. The site comprises parts of the following land: Lot 19 DP 827588, Lot 25 DP 754919, Lot 30 DP 754919, Lot 88 DP 754919, Lot 91 DP 754919, Lot 1 DP 1045652
Proponent	Veolia Environmental Services
Date of Issue	March 2010
General Requirements	The Environmental Assessment (EA) must include: • an executive summary; • a detailed description of the following: - historical operations on the site; - existing and approved operations/facilities, including any statutory approvals that apply to these operations/facilities; - an assessment of the compliance of the existing operations against these statutory approvals; and - the existing environmental management and monitoring regime on site; • a detailed description of the project, including: - the alternatives considered, including detailed justification for the preferred alternative (ie. the project); and - plans of any proposed building or upgrade works. • a risk assessment of the potential environmental impacts of the project, identifying the key issues for further assessment; • a detailed assessment of the key issues specified below, and any other significant issues identified in the risk assessment (see above), which includes: - a description of the existing environment, using sufficient baseline data; - an assessment of the potential impacts of all stages of the project, including any cumulative impacts, taking into consideration any relevant laws, policies, guidelines, and plans; and - a description of the measures that would be implemented to avoid, minimise and if necessary, offset the potential impacts of the project including detailed contingency plans for managing any significant risks to the environment; • a summary of the management plans and monitoring programs at the facility, and a description of the proposed changes to these plans/programs to accommodate the proposal; • a statement of commitments, outlining the proposed environmental management and mitigating measures; • a conclusion justifying the project, taking into consideration: the

	suitability of the site; the economic, social and environmental impacts of the project as a whole; and whether it is consistent with the objects of the *Environmental Planning and Assessment Act 1979*; and • a signed statement from the author of the environmental assessment certifying that the information contained in the report is neither false nor misleading.
Key Issues	• **Waste** - including: - an analysis of whether there is justifiable demand for the project in accordance with the Infrastructure SEPP; - the measures that would be implemented to ensure that the project is consistent with the aims, objectives, and guidance in the *NSW Waste Avoidance and Resource Recovery Strategy 2007*, *DECCW's Guidelines for Solid Waste Landfills* and *Composting and Related Organics Processing Facilities*; - accurate estimates of quantities, and details of the input rates and nature of waste to be transported and landfilled for both the Woodlawn Bioreactor and Crisps Creek Intermodal facilities; and - details on landfill cell design and integrity. • **Air -** including a quantitative assessment of the potential air quality impacts of the project. • **Odour** - including a quantitative assessment of the potential odour impacts of the project; • **Greenhouse Gas** - including: - a quantitative assessment of scope 1,2 and 3 greenhouse gas emissions of the project and a qualitative assessment of the potential impacts of these emissions on the environment; and - an assessment of all reasonable and feasible measures that could be implemented to minimise the generation of greenhouse gas emissions associated with the project. • **Traffic and Transport** - including: - accurate predictions of the traffic volumes likely to be generated during construction and operation; - a detailed assessment of the potential impacts of this traffic on the capacity, efficiency and safety of the surrounding road network; - a detailed assessment of the potential impacts, capacity and efficiency of the rail network and intermodal facility; - details of any proposed road upgrade works; and - details of the proposed access and parking arrangements on site. • **Soil and Water -** including: - details of the proposed erosion and sediment controls (during construction), the stormwater and leachate management system (during operations), flooding, potential offsite drainage impacts, and water supply and efficiency measures; - detailed modelling of the potential surface and groundwater impacts of the project; and - a site water balance for the project, including a description of the measures that would be implemented to minimise water use on site and any water licensing requirements for the project; • **Hazards -** including a Preliminary Hazard Analysis (PHA) of the project including a detailed assessment of the potential on-site and off-site risks such as; - fire risk and management - from gases produced by land filling; - from the storage of any hazardous materials; and - details of procedures for the assessment, handling, storage, transport and disposal of all hazardous and dangerous materials at the site; • **Rehabilitation and Final Landform** - including - detailed description (including plans and RLs) of how the site

	would be progressively rehabilitated and integrated into the surrounding landscape. • **Noise** - including a quantitative assessment of the potential construction, operational and traffic noise impacts of the project; and • **Social and economic** - including an assessment of the costs and benefits of the project as a whole and whether it would result in a net benefit to the NSW community.
References	The Environmental Assessment must take into account relevant State government technical and policy guidelines. While not exhaustive, guidelines which may be relevant to the project are included in the attached list.
Consultation	During the preparation of the Environmental Assessment, you should consult with the relevant local, State and Commonwealth government authorities, service providers, community groups and affected landowners. In particular you must consult with: • Department of Environment, Climate Change and Water; • Roads and Traffic Authority; • Goulburn Mulwaree Council; and • Palerang Council.
Deemed Refusal Period	90 days

Guidelines, Policies and Plans

Aspect	Policy/Methodology
Waste	
	Waste Avoidance and Resource Recovery Strategy 2007 (DECC)
	Waste Classification Guidelines (DECC)
	Environmental Guidelines: Solid Waste Landfills 1996 (DECC)
	Environmental Guidelines: Composting and Related Organics Processing Facilities (2004)
	Composts, soil conditioners and mulches (Standards Australia, AS 4454)
	State Environmental Planning Policy (Infrastructure) 2007
Air Quality	
	Protection of the Environment Operations (Clean Air) Regulation 2002
	Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW (DEC)
	Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (DEC)
Odour	
	Technical Framework: Assessment and Management of Odour from Stationary Sources in NSW (DEC)
	Technical Notes: Assessment and Management of Odour from Stationary Sources in NSW (DEC)
Greenhouse Gas	
	National Greenhouse Accounts (NGA) Factors 2008
	Guidelines for Energy Savings Action Plans (DEUS)
Traffic and Transport	
	Guide to Traffic Generating Development (RTA)
	Road Design Guide (RTA)
Soil and Water	
Soil	Acid Sulfate Soil Manual (ASSMAC)
	Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC & NHMRC)
	National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC)
	State Environmental Planning Policy No. 55 – Remediation of Land
	Managing Land Contamination - Planning Guidelines SEPP 55 – Remediation of Land (DUAP and EPA)
	Rural Land Capability Mapping
	Agricultural Land Classification
Surface Water	National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems - Effluent Management (ARMCANZ/ANZECC)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems - Use of Reclaimed Water (ARMCANZ/ANZECC)
	~~National Water Quality Management Strategy - Guidelines For Water Recycling:~~

	Managing Health And Environmental Risks (Phase1) (EPHC, NRMMC & AHMC)
	Using the ANZECC Guideline and Water Quality Objectives in NSW (DEC)
	National Water Quality Management Strategy - Guidelines For Water Recycling: Managing Health And Environmental Risks (Phase1) (EPHC, NRMMC & AHMC)
	Managing Urban Stormwater: Treatment Techniques (EPA)
	Managing Urban Stormwater: Source Control. Draft (EPA)
	Managing Urban Stormwater: Soils & Construction (Landcom)
	Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (DEC)
	NSW State Wetlands Management Policy (DWE)
	NSW State Floodplain Management Manual (DWE)
	NSW State Farm Dams Policy (DIPNR)
	Floodplain Risk Management Guideline: Practical Consideration of Climate Change (DECC)
	Technical Guidelines: Bunding & Spill Management (DECC)
	Environmental Guidelines: Use of Effluent by Irrigation (DECC)
Groundwater	National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC)
	NSW State Groundwater Policy Framework Document (DLWC)
	NSW State Groundwater Quality Protection Policy (DLWC)
	NSW State Groundwater Quantity Management Policy (DLWC)
	NSW State Groundwater Dependent Ecosystem Policy(DLWC)
	Murray-Darling Basin Commission. Groundwater Flow Modelling Guideline (Aquaterra Consulting Pty Ltd)
	Guidelines for the Assessment and Management of Groundwater Contamination (DECC) Draft
Hazards and Risks	
	AS/NZS 4360:2004 Risk Management (Standards Australia)
	HB 203: 203:2006 Environmental Risk Management – Principles & Process (Standards Australia)
	State Environmental Planning Policy No 33– Hazardous and Offensive Development (SEPP 33)
	Applying SEPP 33: Hazardous And Offensive Development Application Guidelines (DUAP)
	Planning Advisory Paper No. 6 – Guidelines for Hazardous Analysis (DUAP)
	Planning Advisory Paper No. 4 – Risk Criteria for Land Use Safety Planning (DUAP)
	Planning for Bush Fire Protection (NSW Rural Fire Service)
Noise	
	NSW Industrial Noise Policy (DECC)
	Environmental Criteria for Road Traffic Noise (NSW EPA)
	Environmental Noise Control Manual (DECC)
	Draft Construction Noise Guideline 2008 (DECC)
Social & Economic	
	Draft Economic Evaluation in Environmental Impact Assessment (DOP)
	Techniques for Effective Social Impact Assessment: A Practical Guide (Office of Social Policy, NSW Government Social Policy Directorate)

Environmental Risk Analysis

Appendix B

Workplace Risk Assessment Worksheet / Record

Workplace:	Crisps Creek Intermodal Facility (IMF)	Assessed By:	Group Services & Resource Recovery Divisions	Reviewed By:	Site Manager / Operation and Environmental Manager
Task / Area Description:	Crisps Creek IMF operations	Status:	Current		
Work Instruction / Procedure Reference	Woodlawn Bioreactor operations			Entered:	EM

Step #	Task / Process Steps or Work Area	Hazards	Risk Level - Before Controls			Hazard / Risk Control Measures (Existing and New)	Residual Risk Level - After Controls		
			L	C	R		L	C	R
	Break the task / process down into logical steps or describe area / location	*Against each step or location list the hazards that people could be exposed to – Refer prompts on back page*	*Likelihood x Consequence = Risk Level*			*For each hazard / risk list the existing or required control measures to be applied – Refer Hazard Control Hierarchy on back page*	*Likelihood x Consequence = Risk Level*		
1	Use and Storage of Container Handlers onsite.	Leaks of oil/leachate on hardstand/road, rupture of hydraulic hose or fuel tank. Stormwater pollution, breach of VES Environment Policy, Objectives and Targets.	1	15	15	High Risk ▪ All Operators to be inducted/trained in spill control measures. ▪ A fully stocked spill kit is to be stored onsite at all times.	0.5	15	7.5
2	Servicing of Container Handlers onsite.	Leaks of oil on hardstand, uncontrolled capture of waste oils/lubrications, inappropriate disposal of materials (eg oil filters). Stormwater pollution, breach of environmental legislation, breach of VES Environment Policy, Objectives and Targets.	3	15	45	Extreme Risk ▪ All service contractors onsite must be inducted/trained regarding the relevant site procedures. ▪ All waste oils/filters etc generated from the servicing must be transported and disposed in an appropriate manner. ▪ All servicing must be done in a dedicated, controlled and safe area onsite. ▪ All service and disposal dockets must be retained at Woodlawn.	1	15	15
3	Use and Operation of a Compost Toilet.	Release of odours into the atmosphere, improper disposal of the treated material. Odours (air pollution) , land contamination, breach of VES Environment Policy, Objectives and Targets.	3	15	45	▪ All conditions of the Operating Ilcence must be complied with. ▪ All service/maintenance of the system must be documented and retained on file.	1	15	15
4	Use and operation of a First Flush System (FFS).	Release of First Flush Waters to stormwater. Irrigation of First Flush Waters in grassland. Stormwater pollution, breach of environmental legislation, breach of VES Environment Policy, Objectives and Targets.	10	15	150	▪ FFS must be maintained to ensure that after each rain event, the FFS is emptied for preparation for the next rain event. ▪ The First Flush (FF) and sediment ponds must be inspected on a regular basis to ensure that they are operating effectively and maintenance of the ponds are recorded and acted upon (eg removal of sediment). ▪ The extracted material from the ponds and FF must be tested to ensure that the water is not contaminated prior to irrigation – a history of results need to be established. Sediment also needs to be tested prior to disposal. All records to be retained onsite. Application of FF waters must be done so in an appropriate manner. ▪ Monitoing of the FFS is conducted in accordance with the EPL and results submitted to DECCW in the Annual Return.	1	15	15
5	Container handling on hardstand and transfer onto trucks.	Release of oil/fuel from trucks. Release of odours from the containers. Stormwater pollution, air pollution, breach of VES Environment Policy, Objectives and Targets.	3	15	45	▪ Spill kit to be installed and fully stocked onsite ▪ Operators to be inducted/trained in spill control measures ▪ Containers must not be opened at IMF – Operators to note if there are any defects with containers or other issues at the IMF then they are to log this down. ▪ Regular maintenance of the Container handler must be conducted to ensure	1	15	15

Step #	Task / Process Steps or Work Area	Hazards	Risk Level - Before Controls			Hazard / Risk Control Measures (Existing and New)	Residual Risk Level - After Controls		
			L	C	R		L	C	R
						that the exhaust and fuel systems are performing effectively. Maintenance must be documented.			
6	Transportation of full containers from the IMF to Bioreactor by road.	Release of waste into the environment due to a spill or accident, leaking seals, container falls off. Stormwater pollution, potential impact on native flora and fauna, breach of VES Environment Policy, Objectives and Targets.	3	15	45	▪ All operators must be taken through Emergency Response procedures, including actions for the spillage of waste either at the IMF, Bioreactor or on the haulage road.	1	15	15
7	Operation as an IMF.	Release of materials as a result of an emergency event such as fire, oil, waste. Stormwater pollution, air pollution, impact on flora and fauna, breach of VES Environment Policy, Objectives and Targets.	3	15	45	▪ The emergency response plan for the site must be revised to include at least all of these parameters.	1	15	15
8	Storage of chemicals onsite (eg for general garden maintenance, cleaning).	Release of chemicals into the environment. Stormwater pollution, potential flora/fauna damage, breach of VES Environment Policy, Objectives and Targets.	3	7	21	▪ All chemicals stored onsite must be clearly labelled, be stored within dedicated bunds/drip trays. All MSDS's pertaining to the chemical must be filed onsite.	1	7	7
9	Heritage items – indigenous and non-indigenous items	Impact on heritage relics not previously discovered. Breach of legislation, breach of VES Environment Policy, Objectives and Targets	1	15	15	▪ All operators to undergo environmental training alerting to the past presence of the indigenous heritage items onsite. ▪ Refer to the Woodlawn Bioreactor Landfill Environmental Management Plan (LEMP).	0.5	15	7.5

1. Risk Tables

Score	CONSEQUENCE / SEVERITY	
1	INSIGNIFICANT	**No injuries**, no environmental harm, low financial cost
3	MINOR	**First aid injuries or illnesses only.** Release to environment immediately contained. Medium financial loss, disclosable event (i.e. to management), minor loss of production and/or service capacity,
7	MODERATE	**Medical treatment required, lost time injury or illness or temporary reversible illness with limited period of disability.** Release to environment contained with internal/external assistance, possibility of Appropriate Regulatory Authority action. Regulator intervention (no escalation but cost), high financial cost, minor publicity, internal and external cost, disclosable event (i.e. to VES Board), loss of production and/or service capacity, contract dispute.
15	MAJOR	**Extensive injuries – Permanent partial disability or severe lost time injuries or illnesses.** Release to environment contained with internal/external assistance. Major financial loss, loss/suspension of licence, loss of major contract, reasonable intimation of court proceedings/ARA action, publicity, internal and external cost (both high), disclosable event (ie - in respect of VE stock exchange listing), substantial loss of production and/or service capacity, loss of production capability.
40	CATASTROPHIC	**Death, or irreversible severe disability or impairment.** Pollution event with detrimental effect. Huge financial loss, significant publicity, corporate criminal penalties, substantial fine (>$.5 mill), loss of major contract before contract termination date.

Score	FREQUENCY / LIKELIHOOD	
10	ALMOST CERTAIN	Is expected to occur in most circumstances
6	LIKELY	Will probably occur in most circumstances
3	POSSIBLE	Will probably occur at some time
1	UNLIKELY	May occur at some time
0.5	RARE	May occur only in exceptional circumstances

RISK LEVEL MATRIX

		Consequences				
	Score	1	3	7	15	40
Frequency	10	**High-10**	**High-30**	**Extreme-70**	**Extreme-150**	**Extreme-400**
	6	**Moderate-6**	**High-18**	**High-42**	**Extreme-90**	**Extreme-240**
	3	**Low-3**	**Moderate-9**	**High-21**	**High-45**	**Extreme-120**
	1	**Low-1**	**Low-3**	**Moderate-7**	**High-15**	**High-40**
	0.5	**Low-0.5**	**Low-1.5**	**Low-3.5**	**Moderate-7.5**	**High-20**

Risk Level / Priority for Action Guide – Note: all hazards must be controlled - Risk level provides a 'priority for action'	
Extreme: Significant and immediate control actions required	**High:** Significant control actions required as soon as possible
Moderate: Control actions as soon as possible	**Low:** May not require immediate action. Monitor situation and schedule control action
When determining appropriate hazard / risk control measures apply the **ALARP** principle: Reduce the level of risk to **A**s **L**ow **A**s **R**easonably **P**racticable	

2. Prompts for Identifying Hazards

• Can anyone be struck / contacted by anything?	• Can anyone strike against anything?	• Can anyone fall in any way?	• Can anyone be exposed to electricity, gas, heat, fumes, pressure, chemicals, asbestos, radiation, noise, biological hazards?
• Can anyone strain themselves?	• Can anyone slip or trip on anything?	• Can damage to equipment occur?	
• Can anyone be caught in, or between anything?	• Can anyone injure another person?	• Can pollution to the environment occur?	

3. Hazard Controls - Apply the following **Hierarchy of Controls** when determining hazard / risk control measures

Step 1	**Step 2**	**Step 3**	**Step 4**	**Step 5**	**Step 6**
First try to **ELIMINATE** the hazard. If this is not possible, prevent or minimise exposure to the hazard by one or a combination of the following steps	Consider **SUBSTITUTING** a less hazardous material, process or equipment	Consider **ENGINEERING / REDESIGNING** equipment or work processes to reduce risk	Consider **ISOLATING** the hazard – place barriers between the hazard and people	Apply relevant **ADMINISTRATIVE CONTROLS** – ie, work instructions, pre-start checks, training, job organisation, supervision, warning signs, limited exposure time etc.	Finally provide **PERSONAL PROTECTIVE EQUIPMENT –** The use of PPE for protection against a hazard is the least preferred option. All other methods of control should be applied first

Workplace Risk Assessment Worksheet / Record

Workplace:	Woodlawn Bioreactor	Assessed By:	Group Services & Resource Recovery Divisions	Reviewed By:	Site Manager / Operations and Environment Manager
Task / Area Description:	Woodlawn Bioreactor operations for EIP	Status:	Current		
Work Instruction / Procedure Reference	Woodlawn Bioreactor operations			Entered:	EM

Step #	Task / Process Steps or Work Area	Hazards	Risk Level - Before Controls			Hazard / Risk Control Measures (Existing and New)	Residual Risk Level - After Controls		
			L	C	R		L	C	R
	Break the task / process down into logical steps or describe area / location	*Against each step or location list the hazards that people could be exposed to – Refer prompts on back page*	*Likelihood x Consequence = Risk Level*			*For each hazard / risk list the existing or required control measures to be applied – Refer Hazard Control Hierarchy on back page*	*Likelihood x Consequence = Risk Level*		
1.	Receipt of waste into the facility for disposal.	Receipt of non-conforming waste. Breach of site EPL, breach of VES Environment Policy, Objectives and Targets.	3	15	45	▪ All operators must be trained in non-conforming waste procedures ▪ All non-conforming wastes identified at the facility must be appropriately separated and handled. ▪ All non-conforming wastes identified must be recorded on the non-conforming waste form.	1	15	15
2.	Wheel wash operations.	Release of dirty water into the environment. Inadequate washing of wheels leading to tracking of mud onto Collector Road. Uncontrolled water management, breach of EPL, tracking of mud on road, breach of VES Environment Policy, Objectives and Targets.	6	15	90	▪ After unloading, and pending void haul road conditions, container trucks will need to travel through the wheelwash prior to leaving the site. ▪ Drivers are to be reminded of procedures in training/inductions. ▪ Follow procedure and checklist for the wheel wash operations. ▪ Weekly and or monthly checking of the facility through site inspection checklists would enable the formal monitoring of the system.	1	15	15
3.	Washbay – containers, vehicles, equipment.	Release of wash-water, litter, sediment into the environment, overflow. Uncontrolled process, failure to reuse a source of water, Stormwater pollution, breach of VES Environment Policy, Objectives and Targets, Stormwater pollution.	3	15	45	▪ Consideration must be given to adequately bunding the truck wash area and also the potential overflow of the wastewater holding tank/sump (eg use of float level switches). ▪ Follow procedure and checklist for the truck washing process.	1	15	15
4.	Container maintenance	Release of oils/paint into the environment. Uncontrolled operation. Stormwater pollution, air pollution, breach of VES Environment Policy, Objectives and Targets	3	15	45	▪ Container maintenance operations must be done so in a controlled manner and in a dedicated area; spray painting must not be conducted in the open area. ▪ All spills/leaks must be cleaned up immediately. No chemicals, oils are to be left in the open hardstand area overnight. ▪ Follow the container maintenance procedure.	1	15	15
5.	Operation of Gas Flare	Poor operation of flare leading to odours, potential explosions. Air pollution, complaints, breach of VES Environment Policy, Objectives and Targets, breach of EPL.	3	15	45	▪ Procedure for operation, testing and maintenance of the flare must be followed. ▪ The landfill gas flaring system is ONLY to be operated by members of Veolia and contracted Service Engineers whom are deemed competent to do so by the Woodlawn Bioreactor-Engineering & Design Manager. ▪ All records to be available onsite	1	15	15
6.	Water imported into the void for bioreactor operation.	Failure to record the quantities of liquid imported into the void (first flush, raw water dam waters). Breach of EPL, breach of VES Environment Policy, Objectives and Targets.	1	15	15	▪ If water is imported from other areas (for dust suppression purposes), water volume must be calculated to ensure accurate water balance.	0.5	15	7.5

Step #	Task / Process Steps or Work Area	Hazards	Risk Level - Before Controls			Hazard / Risk Control Measures (Existing and New)	Residual Risk Level - After Controls		
			L	C	R		L	C	R
7.	Septic waste and irrigation system.	Release of offensive odours, contamination of soil and stormwater. Breach of Council Approval to Operate Septic System and Environmental Legislation, breach of VES Environment Policy, Objectives and Targets.	3	15	45	▪ Follow procedure and checklist for the WB Sewerage Treatment System. ▪ All documentation pertaining to servicing needs to be retained on file. ▪ When the system is pumped out, the transporter and disposal facility must be known prior to the service to ensure that they are licenced to do so. All records to be retained onsite.	1	15	15
8.	Onsite maintenance of plant and equipment.	Inappropriate storage of chemicals. Release of chemicals into the environment. Stormwater pollution, air pollution, breach of EPL, breach of VES Environment Policy, Objectives and Targets.	3	15	45	▪ All liquid chemicals must be stored within bunded areas/trays. ▪ All spills cleaned up ▪ All chemicals must be clearly labelled. If the chemicals are Dangerous Goods, then the appropriate placard must also be displayed (eg "flammable liquid"). ▪ All gasses must be chained in stowage and appropriately segregated (so as to avoid mixing of incompatible gasses). ▪ All chemicals used onsite must have current MSDS's. The MSDS's should be stored in a dedicated folder onsite in the office and in key locations of use. A hazardous substances register must also be established for those substances.	1	15	15
9.		Disposal of waste chemicals/oils from the site, lack of paperwork. Unlawful disposal, breach of environmental legislation, breach of VES Environment Policy, Objectives and Targets.	3	15	45	▪ All paperwork in relation to servicing and disposal of the parts wash waste needs to be filed onsite. ▪ An appropriate licensed contractor must be engaged. ▪ All dockets for the supply of the diesel needs to be retained on site – MSDS's need to also be obtained. ▪ Waste oil collection undertaken by an appropriate licenced contractor.	1	15	15
10.	Use of heavy machinery on site.	Release of excessive smoke emissions, oil/fuel spills on roads. Stormwater, soil contamination, air pollution, breach of VES Environment Policy, Objectives and Targets.	3	7	21	▪ All heavy machinery/vehicles used on site must be subjected to regular maintenance. All servicing records are to be retained onsite. ▪ All Operators to be trained in spill control measures.	1	7	7
11.	Use of mobile tanker.	Release of diesel into the environment from a leak or spill. Stormwater pollution, potential flora/fauna impact, breach of VES Environment Policy, Objectives and Targets.	3	7	21	▪ The mobile tanker must contain an appropriate spill control kit and must be subject to regular maintenance.	1	7	7
12.	Use and presence of 70kL diesel aboveground storage tank.	Inappropriate storage of the AGST. Contravention of approved plans to Workcover, breach of VES Environment Policy, Objectives and Targets.	10	15	150	▪ Placards with labels "Diesel" and "Combustible Liquid" must be prominently displayed on the sides of the tank.	0.5	15	7.5
13.		Release of diesel fuel into the environment – spills/overflows. Uncontrolled process, stormwater pollution, breach of VES Environment Policy, Objectives and Targets.	6	7	42	▪ Spill Control Kit must be stored adjacent to the tank in an obvious and prominent location. ▪ The hose must always be positioned within the drip tray. ▪ All operators must be taken through the clean-up and management of any spills in the inductions/training.	1	7	7
14.	Onsite storm water/leachate and groundwater management – pumping water to various ponds onsite.	Failure of pump/hoses/level switches transferring the liquid between nominated ponds. Release of odours. Leak of liquids (some contaminated) into the	3	15	45	▪ Pumps, float level switches and hoses must be checked on a regular basis by a dedicated person and documented to ensure that the system's integrity is maintained. ▪ Ponds must be checked on a regular basis to determine whether	1	15	15

Step #	Task / Process Steps or Work Area	Hazards	Risk Level - Before Controls			Hazard / Risk Control Measures (Existing and New)	Residual Risk Level - After Controls		
			L	C	R		L	C	R
		environment, air emissions. Failure to provide a proper and competent system, breach of VES Environment Policy, Objectives and Targets.				maintenance/clean-out is required. This must be documented.			
15.	Landfilling Operations	Windblown litter, odours Stormwater pollution, air emissions, breach of EPL, breach of VES Environment Policy, Objectives and Targets	3	15	45	▪ Alternate daily cover is currently being trialed. A response on the results of the trial will be submitted to DECCW. ▪ Monthly documented inspections would identify any actual windblown litter resulting from the operations (weekly visual inspections are also conducted).	1	15	15
16.		Gas generation. Air emissions, explosions, breach of VES Environment Policy, Objectives and Targets.	3	15	45	▪ Monitoring of gas as per EPL requirements. ▪ Follow the WBE monthly calculation procedure for Renewable Electricity Certificates New South Wales Greenhouse Abatement Certificates (NGAC's).	1	15	15
17.	Heritage items – indigenous and non-indigenous relics	Impact of heritage items not previously discovered. Breach of legislation, breach of VES Environment Policy, Objectives and Targets	1	15	15	▪ All operators to undergo environmental training alerting to the past presence of the indigenous heritage items onsite. ▪ Refer to LEMP.	0.5	15	7.5
18.	Presence of the vulnerable orchid - buttercup double tail	Impact on the buttercup double tail due to lack of identification, control and management. Breach of legislation, breach of VES Environment Policy, Objectives and Targets	6	15	90	▪ The location of the buttercup double tail has been identified as referred to in the Consent and managed.	0.5	15	7.5
19.	Attraction of vermin	Spread of disease and litter Breach of EPL, breach of VES Environment Policy, Objectives and Targets	3	15	45	▪ Follow requirements set out in the LEMP. ▪ All records pertaining to pest management services must be retained onsite.	0.5	15	7.5
20.	Bioreactor operations	Release of materials into the environment as a result of an emergency event (eg fire). Stormwater, soil, air, groundwater pollution, lack of emergency preparedness, breach of VES Environment Policy, Objectives and Targets.	3	15	45	▪ The emergency response plans existing for the site need to be revised to be updated and incorporate all possible emergency events. ▪ All Operators must be trained in Emergency Response procedures.	1	15	15
21.		Poor document keeping. Lack of due diligence demonstration, potential breach of environmental legislation, breach of VES Environment Policy, Objectives and Targets.	6	15	90	▪ All documentation required under the EPL, Consent, LEMP, Septic Approvals need to be filed onsite. All documents must be easily retrievable and traceable.	1	15	15
22.		Failure to update LEMP. Lack of up-to-date written operational plan. Breach of VES Environment Policy, Objectives and Targets	6	15	90	▪ LEMP needs to be reviewed at least on an annual basis and where activities on site change.	0.5	15	7.5
23.	Use of Contractors onsite	Environmental harm, release of substances into the environment, improper assessment of environmental risk. Breach of EPL, breach of Act, breach of VES Environment Policy, Objectives and Targets	3	15	45	▪ All contractors must undergo site inductions, complete contractor assessment forms prior to work commencing to ensure adequate training and awareness/assessment of environmental aspects and impacts. *(Ref. document PRO-NSW-218-022-9 NSW Woodlawn Bioreactor & IMF - Site Rules for Employees, Contractors, Sub-contractors and Visitors)* ▪ All records to be retained onsite.	1	15	15
24.	Generation of waste from site activities	Improper transport and disposal of waste. Breach of POEO Act, breach of VES Environment Policy, Objectives and Targets	1	15	15	▪ Waste must be appropriately classified prior to disposal against DECCW Waste Guidelines (December, 2009). ▪ Transporter and disposal location must be licenced with the DECCW, if required –this must be verified in advance.	0.5	15	7.5

Step #	Task / Process Steps or Work Area	Hazards	Risk Level - Before Controls			Hazard / Risk Control Measures (Existing and New)	Residual Risk Level - After Controls		
			L	C	R		L	C	R
						▪ Waste disposal matrix to be devised.			
25.	Transfer of material/oils etc onsite	Release of materials into the environment Potential environmental harm, breach of VES Environment Policy, Objectives and Targets	3	7	21	▪ All materials transferred/transported around the site must be done in an appropriate manner – away from sensitive environments. ▪ All spills of oil/fuel/daily cover must be cleaned up immediately. ▪ All incidents reported and logged in NIMS i.e. Hippo Station.	0.5	7	3.5
26.	Inheritance of old mine	Rehabilitation of dams, tailing, release of materials into surrounding areas, contamination. Breach of POEO Act, EPL, breach of VES Environment Policy, Objectives and Targets	3	15	45	▪ Continuation of rehabilitation and implementation of controls as per EPL, Consent and Mines requirements. ▪ All documentation in relation to authority correspondence etc to be retained on file.	1	15	15
27.	Environmental monitoring	Failure to conduct monitoring or to review the results Breach of EPL conditions, breach of legislation, breach of VES Environment Policy, Objectives and Targets	3	15	45	▪ Follow the environmental monitoring calendar and prompts. ▪ All results need to be reviewed against EPL or other legislative requirements.	0.5	15	7.5
28.	Inappropriate application of Alternate Daily Cover (ADC)	Vermin, windblown litter, inappropriate use of daily cover . Breach of EPL, breach of VES Environment Policy, Objectives and Targets	1	15	15	▪ Alternate Daily Cover (ADC) must be applied as per EPL – all information in relation to the ADC must be retained onsite and a final report submitted to DECCW.	0.5	15	7.5
29.	Compaction of waste	Failure to compact waste Windblown litter, potential for fires/explosions, reduce life of bioreactor, breach of VES Environment Policy, Objectives and Targets	0.5	15	7.5	▪ All operators to be taken through environment refresher training. ▪ Procedure on spreading and compacting waste to be conveyed to operations.	0.5	15	7.5

Risk Level / Priority for Action Guide – Note: all hazards must be controlled - Risk level provides a 'priority for action'	
Extreme: Significant and immediate control actions required	**High:** Significant control actions required as soon as possible
Moderate: Control actions as soon as possible	**Low:** May not require immediate action. Monitor situation and schedule control action
When determining appropriate hazard / risk control measures apply the **ALARP** principle: Reduce the level of risk to **A**s **L**ow **A**s **R**easonably **P**racticable	

2. Prompts for Identifying Hazards

• Can anyone be struck / contacted by anything?	• Can anyone strike against anything?	• Can anyone fall in any way?	• Can anyone be exposed to electricity, gas, heat, fumes, pressure, chemicals, asbestos, radiation, noise, biological hazards?
• Can anyone strain themselves?	• Can anyone slip or trip on anything?	• Can damage to equipment occur?	
• Can anyone be caught in, or between anything?	• Can anyone injure another person?	• Can pollution to the environment occur?	

3. Hazard Controls - Apply the following **Hierarchy of Controls** when determining hazard / risk control measures

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
First try to **ELIMINATE** the hazard. If this is not possible, prevent or minimise exposure to the hazard by one or a combination of the following steps	Consider **SUBSTITUTING** a less hazardous material, process or equipment	Consider **ENGINEERING / REDESIGNING** equipment or work processes to reduce risk	Consider **ISOLATING** the hazard – place barriers between the hazard and people	Apply relevant **ADMINISTRATIVE CONTROLS** – ie, work instructions, pre-start checks, training, job organisation, supervision, warning signs, limited exposure time etc.	Finally provide **PERSONAL PROTECTIVE EQUIPMENT –** The use of PPE for protection against a hazard is the least preferred option. All other methods of control should be applied first

1. Risk Tables

Score	CONSEQUENCE / SEVERITY	
1	INSIGNIFICANT	**No injuries**, no environmental harm, low financial cost
3	MINOR	**First aid injuries or illnesses only.** Release to environment immediately contained. Medium financial loss, disclosable event (i.e. to management), minor loss of production and/or service capacity,
7	MODERATE	**Medical treatment required, lost time injury or illness or temporary reversible illness with limited period of disability.** Release to environment contained with internal/external assistance, possibility of Appropriate Regulatory Authority action. Regulator intervention (no escalation but cost), high financial cost, minor publicity, internal and external cost, disclosable event (i.e. to VES Board), loss of production and/or service capacity, contract dispute.
15	MAJOR	**Extensive injuries – Permanent partial disability or severe lost time injuries or illnesses.** Release to environment contained with internal/external assistance. Major financial loss, loss/suspension of licence, loss of major contract, reasonable intimation of court proceedings/ARA action, publicity, internal and external cost (both high), disclosable event (ie - in respect of VE stock exchange listing), substantial loss of production and/or service capacity, loss of production capability.
40	CATASTROPHIC	**Death, or irreversible severe disability or impairment.** Pollution event with detrimental effect. Huge financial loss, significant publicity, corporate criminal penalties, substantial fine (>$.5 mill), loss of major contract before contract termination date.

Score	FREQUENCY / LIKELIHOOD	
10	ALMOST CERTAIN	Is expected to occur in most circumstances
6	LIKELY	Will probably occur in most circumstances
3	POSSIBLE	Will probably occur at some time
1	UNLIKELY	May occur at some time
0.5	RARE	May occur only in exceptional circumstances

RISK LEVEL MATRIX						
		Consequences				
Frequency	Score	1	3	7	15	40
	10	**High-10**	**High-30**	**Extreme-70**	**Extreme-150**	**Extreme-400**
	6	**Moderate-6**	**High-18**	**High-42**	**Extreme-90**	**Extreme-240**
	3	**Low-3**	**Moderate-9**	**High-21**	**High-45**	**Extreme-120**
	1	**Low-1**	**Low-3**	**Moderate-7**	**High-15**	**High-40**
	0.5	**Low-0.5**	**Low-1.5**	**Low-3.5**	**Moderate-7.5**	**High-20**

Leachate Management at Woodlawn Bioreactor

Appendix C



Report

Leachate Management at Woodlawn Bioreactor

JULY 2010

Prepared for

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Date: **July 2010**
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Table of Contents

1 Introduction 1

2 Water Management History 2

3 Leachate Management 4

3.1 Operational Leachate Management 4

3.2 Protection of Environmental Integrity 5

3.3 Water Management Measures 6

4 Water Balance 7

4.1 Water Balance Model 7

4.2 Model Inputs 8

4.3 Model Calibration 9

4.3.1 Waste Elevations 9

4.3.2 Leachate Elevations 10

4.4 Calibration Results 10

4.5 Relative Proportions of the Water Balance Elements 11

4.5.1 Inflows 11

4.5.2 Outflows 12

4.5.3 Change in Storage 13

5 Water Balance Predictions 15

5.1 Water Management Measures 15

5.2 Prediction Scenario 1 – Increased Waste with Average Climate 15

5.3 Prediction Scenario 2 – Increased Waste with Two Successive Wet Years 15

5.4 Conclusions of Water Balance Predictions 16

6 Impact on Groundwater 19

6.1 Scope 19

6.2 Hydrogeological Conditions 19

6.3 Impact of Increased Input Rate 19

6.4 Previous Modelling Results 19

6.5 Impact of Increased Input Rate 22

7 Leachate Characteristics 24

7.1 Leachate Quality 24

7.2 Leachate Volumes 25

Table of Contents

8 Conclusions....26
9 References....27
10 Limitations....29

Tables

Table 4-1 Water Balance September 2004-January 2010.... 11
Table 4-2 Components of Inflow.... 12
Table 4-3 Components of Outflow.... 12
Table 7-1 Leachate Dam Monitoring Results.... 24
Table 7-2 Recirculated Leachate Monitoring Results.... 25
Table 7-3 Leachate Volumes - Woodlawn Bioreactor.... 25

Figures

Figure 4-1 Leachate Recirculation.... 8
Figure 4-2 Water Balance - Calibration.... 14
Figure 5-1 Predicted Waste and Leachate Levels - Waste increasing to 1.13 Mt/year over 10 years.... 17
Figure 5-2 Predicted Waste and Leachate Levels - Waste increasing to 1.13 Mt/year over 10 years with 2 successive wet years.... 18

Charts

Chart 4-1 Waste Elevations Correlation.... 9
Chart 4-2 Leachate Elevations Correlation.... 10

Appendices

Appendix A Water Balance Details
Appendix B Predictive Model Inputs

1

Introduction

URS was commissioned by Veolia Environmental Services (Australia) Pty Ltd to prepare a review of the leachate and water management systems for the Woodlawn Expansion Project. This proposal seeks to increase the input of waste received at the facility from the currently assessed maximum 500,000 tonnes per annum (tpa) to 1.13 million tpa. Simultaneously, Veolia seeks an increase in the maximum throughput rate at the Crisps Creek IMF to 1.18 million tpa.

This report provides an assessment of the impact of increasing the filling rate to 1.13 million tpa on the leachate levels within the Bioreactor, and the leachate management changes that the increased waste disposal would require, in accordance with the Director-General Requirements (DGRs).

The Woodlawn Bioreactor is located on the Collector Road at Tarago in New South Wales. It currently receives 400,000 tonnes of waste per year, transported in sealed containers by rail from Sydney to the Crisps Creek Intermodal and then by trucks into the Bioreactor. The Bioreactor is a large former open cut base metal mine covering an area of about 39 hectares (ha) at the top and less than 5,000m^2 at the base, with a capacity of 25 million m3.

It has an engineered basal liner but, because of the low intrinsic permeability of the rock mass, a side liner was not required (Woodward-Clyde 1997). The main relevant conclusions of that report were:

1. The bulk permeability of the rock mass is very low (in the range 1 x 10^{-8} to 1 x 10^{-9} m/sec);
2. The level of inflow of groundwater to the mine pit (1 to 2 L/sec) is consistent with the low permeability;
3. The geochemical nature of the orebody, and its presence within the rock mass also indicates that groundwaters in the sequence are largely isolated from the regional recharge and discharge regime;

The Bioreactor began receiving waste in September 2004 and the opening of the facility coincided with high rainfall events in the area. Water management, and particularly leachate management, has always been a key environmental issue at the site.

Since inception, the Bioreactor has received over 2 million tonnes of waste (last update February 2010 as reported by Veolia), which is an average daily rate of about 1,356 tonnes. The volume of the void that this mass of waste occupied was calculated to be 1.76 million m^3. A survey conducted on 14 December 2009 determined the net void space consumed to be 1,709,225 m^3. These values both indicate a density of waste of 1.13 t/m^3.

On the basis of this density, the proposed increased filling rate to 1.13 million tpa will mean that airspace will be filled within about 23 years.

Monitoring of leachate and groundwater levels and quality including the volume of leachate pumped has been carried out in the Bioreactor since filling began in September 2004. A water balance has been established for the Bioreactor which enables leachate levels to be predicted based on the anticipated waste loads, climatic conditions and management arrangements. This water balance will be used to assess the leachate levels under the new filling regime.

2

Water Management History

The Woodlawn Bioreactor currently is licensed to receive 400,000 tpa of putrescible waste, transported in sealed containers by rail from Sydney to the Crisps Creek Intermodal and then by trucks into the Bioreactor. The Bioreactor is a large former open cut base metal mine covering an area of about 39 ha at the top and less than 5,000m^2 at the base. It has an engineered basal leachate collection liner but, because of the low intrinsic permeability of the rock mass, it required no side liners.

The Bioreactor began receiving waste in September 2004 and the opening of the facility coincided with high rainfall events in the area. High rainfall events combined with groundwater inflows placed a surcharge of water inflows to the waste mass and subsequently permission was sought to store excess leachate at the adjacent evaporation pond, ED3. Control of leachate is required to encourage and facilitate methane generation.

Monitoring of leachate and groundwater levels and volume of leachate pumped has been carried out at the Bioreactor since filling began and URS has developed a water balance model which enables leachate levels to be predicted based on the anticipated waste loads, climatic conditions and management arrangements. This water balance will be used to assess the leachate levels under the regime of an increased filling rate.

The quarry void, with a surface area of 39 ha, has its own catchment and captures inflows of surface water from rainfall as well as ongoing inflows of groundwater. Management of water at the site has been important for Veolia to ensure that the leachate level does not rise too quickly and that there are suitable moisture conditions within the waste to promote biodegradation and optimise generation of landfill gas. The water balance demonstrates the effectiveness of liquid management protocols.

The water balance simulates the rise of the leachate level, having regard to the various inputs and outputs of water into the void. The derivation of the water balance is described in detail in Appendix A.

3

Leachate Management

While the intention of leachate management is to improve gas production, the methods adopted to achieve this can vary depending on the short and long term objectives of the project. Moisture control is a key parameter in promoting successful bioreactor operation (Reinhart, McCreanor, Townsend, 2002) and at Woodlawn leachate management consists of extraction of organically rich leachate from within the waste and recirculation of this leachate into areas of less degraded waste. Monitoring of leachate quantity and quality within the bioreactor is also an important part of leachate management and decision making. Any water source that comes into contact with the waste must be treated as leachate.

3.1 Operational Leachate Management

In the context of this report, leachate management refers to the infrastructure and processes undertaken to control moisture levels in and around the waste mass. While the intention of leachate management is to improve gas production, the methods adopted to achieve this can vary depending on the short and long term objectives of the project. Leachate management includes extraction of organically rich leachate from within the waste and recirculation of this leachate into areas of less degraded waste to facilitate the degradation process. Monitoring of leachate quantity and quality within the bioreactor is also an important part of leachate management and decision making at Woodlawn.

Operational leachate management measures, including the associated infrastructure, are utilised at Woodlawn to optimise control over moisture content within the waste and improve gas production. These measures are summarised below.

- Leachate extraction wells (LE) are an important part of the leachate management on site. The number of extraction wells available determines the ability to extract larger volumes of leachate over shorter periods of time and enables leachate levels within the waste to be reduced or maintained at the desirable level. The leachate is recirculated in areas of newer less degraded waste.
- Leachate surface recirculation facilitates the management of leachate volumes as well as the activation of degradation of new waste. The use of sprinklers to spread the leachate evenly over an area allows for the even distribution of leachate on the waste surface, a reduction in liquid volume through evaporation and absorption and the ability to manage large volumes within a relatively small area.
- Leachate extraction from horizontal gas blankets opens up gas flows through the system. All horizontal blankets are graded at low slopes (e.g. 1:20) and leachate and condensate from within the gas lines drain to a series of Knock Out Pots (KOP), equipped with a pneumatic pump inside which extracts leachate. The ability to remove leachate from these systems improves the overall management of leachate in the bioreactor.
- Waste Activation Sumps/Cells operate separately within the waste. The sumps are clay lined and filled with drainage material. Wells are constructed into the drainage material and are extended as the waste level rises throughout the void. This creates a leachate collection point with a fast recharge rate, and more powerful electric pumps are used. This enables extraction of large volumes of leachate in a short period of time allowing for improved de-saturation of the waste and gas collection. Gas production improves by managing leachate within smaller controlled areas within the greater waste mass.

- Absorption trenches are used to recirculate volumes of leachate into areas of fresh waste to assist in activating the area. They improve the movement of leachate and gas through the waste mass, drainage is installed as increasing the hydraulic conductivity improves the ability to remove leachate and gas from the waste. Leachate is injected directly into the trenches to saturate the fresh waste. These areas are targeted in future drilling programs to access the LFG and the excess leachate that has not been absorbed by the waste is extracted.
- Drainage trenches used initially to recirculate volumes of leachate and moisten new waste are being placed strategically in areas where future drilling will take place. This enables quick and effective de-saturation of the area, and the trench lines will be used to increase the catchment area for gas extraction.
- The Leachate Treatment Pond is located within the void and has capacity to store and treat up to 12 ML of leachate pumped directly from the void, if required, such as after extreme rainfall events.
- Treated Leachate Storage Pond has a potential to store up to 20ML of treated leachate if required. This storage capacity would only be used as a contingency plan in case of any highly unusual events.
- Sludge remaining upon the completion of treatment within the treatment pond is returned to the waste in the bioreactor. The sludge is high in organics and is worked into the fresh waste improving its degradation and gas productivity.

3.2 Protection of Environmental Integrity

The Woodlawn Bioreactor provides a number of levels of protection for adjacent groundwater, surface water and soil from leachate. Protection is afforded by the following attributes of the site and engineering controls:

1. Groundwater flow is directed into the mine pit and this is anticipated to continue for many years after the bioreactor closes;
2. Leachate levels are maintained within the waste mass at an elevation below the elevation of the natural groundwater levels;
3. Accelerated biodegradation of the waste mass ensures that waste degradation will stabilise more quickly than conventional landfilling because the moisture content of the waste is maintained at optimum levels;
4. The rock mass has a low intrinsic permeability that will not allow for migration of leachate away from the facility, even under conditions of positive leachate head;
5. Management measures are designed to provide additional protection to the adjacent environment. These measures include:
    a. Leachate recirculation facilitates rapid degradation of waste and minimises time required for stabilisation of waste mass;
    b. Leachate recirculation also promotes and enhances evaporative disposal and reduces the volume of leachate returned to the waste mass;
    c. Detailed monitoring of leachate levels, leachate quality and groundwater quality in adjacent bores enables identification of any breaches of environmental integrity should they occur and facilitates the early adoption of remedial measures; and
    d. Minimisation of stormwater inflows to reduce the volumes of leachate generated.

These measures ensure that the Woodlawn Bioreactor minimises its environmental footprint.

3.3 Water Management Measures

Veolia has implemented a number of actions that have led to improvements in managing leachate levels within the waste, including:

- the removal and treatment of leachate;
- groundwater dewatering;
- the extraction and recirculation of leachate; and,
- the enhancement of evaporation.

Leachate extraction is currently managed through evaporation over the surface of the waste mass. Leachate extraction capacity is increased as the area of waste increases, between June 2007 and July 2010 the number of wells have increased from 18 to 60. The area of waste as at July 2010 is 6.9 ha.

Groundwater dewatering commenced in May 2007 via the dewatering sump system which consists of two bores, OSW1 and a back up bore OSW2. These bores were constructed in the Northern end of the void in a high recharge area.

The dewatering sump system is important to the overall management of water within the Bioreactor and assists in reducing the volume of leachate generated, stored and or treated on site.

4

Water Balance

4.1 Water Balance Model

The water balance model is based on the following relationship:

Liquid out = Liquid in +/- Liquid contributing to Change in Storage

The output components of the water balance ("liquid out") comprise groundwater removed from the groundwater sump and pumped from bore OSW01, evaporation, intercepted stormwater runoff, extracted leachate and loss to unsaturated storage.

The input components of the water balance ("liquid in") comprise groundwater inflow, direct rainfall, stormwater runoff, recirculated leachate and "added water". Added water refers to additional water brought into the Bioreactor, including water used to extinguish any landfill fires. Reportedly all leachate extracted from the leachate sumps was recirculated until August 2007. Since then leachate has been both recirculated on the waste and removed to be stored prior to treatment and evaporation.

"Liquid in storage" is the leachate occupying void space in the waste and the change in storage (Δ S) leads to the change in leachate levels in the waste.

It should be noted that values for default moisture content and field capacity of the waste have been incorporated in the model, to account for change of storage within the waste. These components are not part of the inflow or outflow model. Storage in the waste is used to calculate leachate volume, saturated waste volume and, ultimately, leachate elevation. The formulas are referenced in Appendix A. The effect of compression is calculated by the model and used for determining of calculating the consolidated waste height and saturated waste volume.

It is assumed that the portion of water associated with the methanogenesis and gas extraction was negligible in the water balance model.

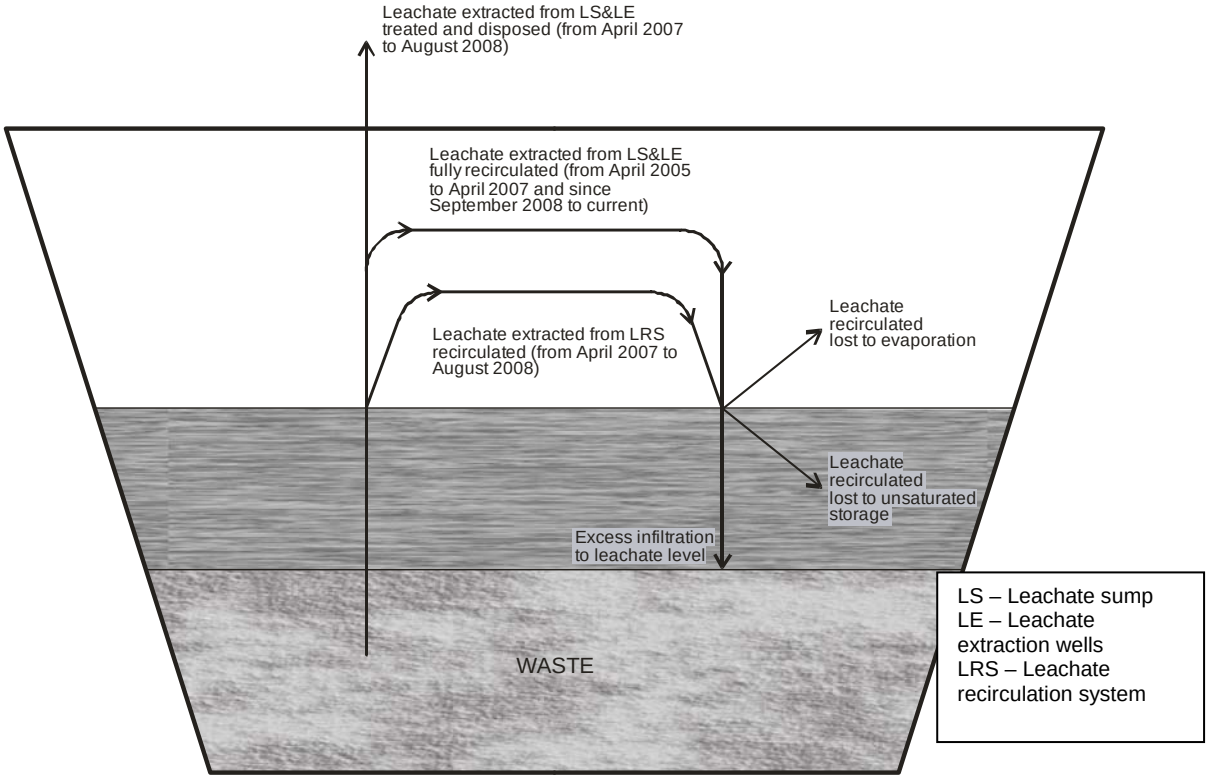
Dealing with leachate recirculation

The water balance equation applies to the amount of liquid removed or added to the saturated zone of the waste. Therefore, any leachate removed from the waste is counted as a withdrawal. When removed leachate is irrigated over the waste, it is counted as addition and becomes an input to the equation. The major loss occurs to evaporation followed by loss to absorption in unsaturated storage.

This is demonstrated in Figure 4-1.

4 Water Balance

Figure 4-1 Leachate Recirculation



4.2 Model Inputs

The input site-specific data provided by Veolia includes:

- Rainfall, measured on site;
- Evaporation, Goulburn TAFE meteorological station;
- Volumes pumped from the pit to ED3;
- Volumes of dewatering below liner (sump(s));
- Volumes of extracted leachate (sump(s) and leachate bores);
- Volumes of recirculated water/leachate;
- Volumes of water added;
- Waste mass;
- Monitoring records for the leachate sump, groundwater sump and bores and the leachate observation bores; and
- Waste volumetric survey data including cumulative gross and net volumes, mass and compaction ratios recorded bi-annually.

4.3 Model Calibration

The model calibration was described in detail in the URS 2008 report. During 2008 and 2009 the model was updated on a regular basis (last updated to 19 January 2010).

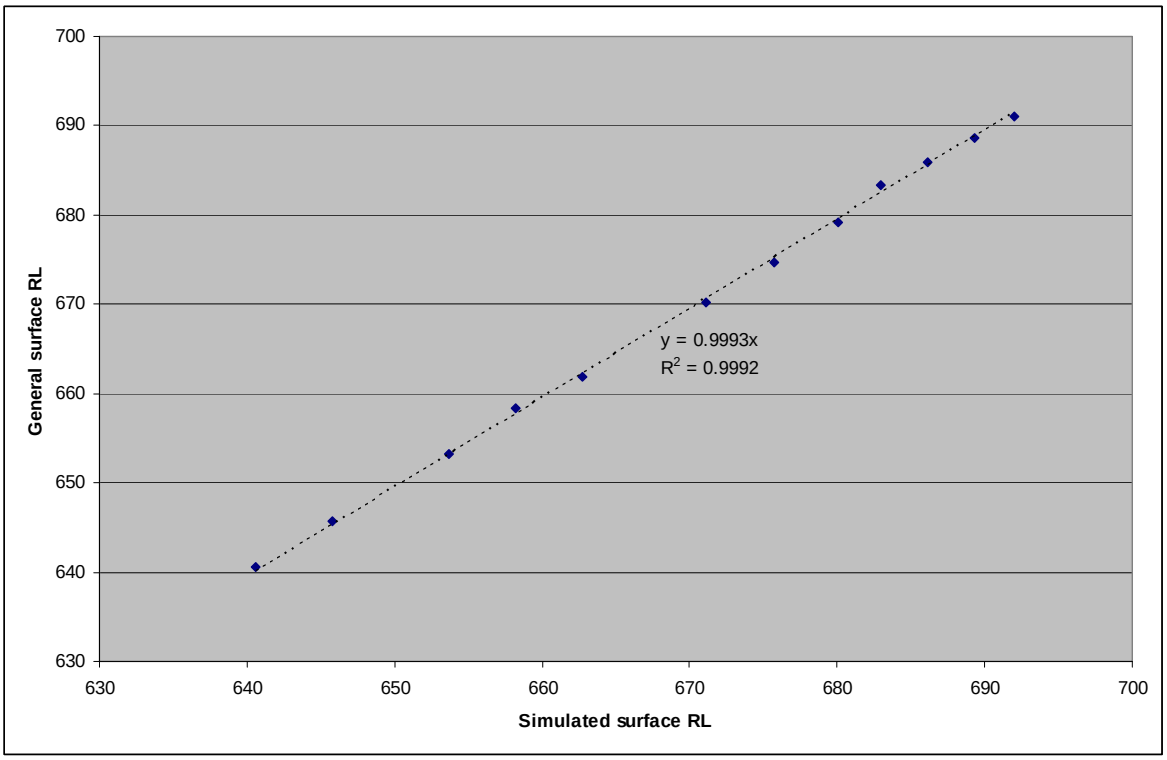
Data provided by Veolia allowed calibration of both simulated landfill surface and leachate elevations. Due to non-uniform heights of waste in the void, and therefore leachate elevations (also influenced by intermittent leachate extraction from individual wells), a qualitative calibration approach continued to be used in order to match observed and simulated landfill surface and leachate elevations.

The simulated leachate levels and actual levels are plotted in Figure 4-2.

4.3.1 Waste Elevations

The reported waste volumetric survey results (the reported net void space consumed) were used to calculate average waste heights and elevations (using the volume versus height relationship – Appendix A, Eq. 1 and 2). The correlation between the predicted surface level of the waste and the actual waste level, as measured in the void, represents the primary calibration target for the model. The model assumes a uniform filling rate based on the number of trucks delivering waste to the site on a daily basis. The relationship between the simulated levels and the actual levels is illustrated in Chart 4-1. The plot shows a 1:1 correlation with a correlation R^2 of 1.

Chart 4-1 Waste Elevations Correlation



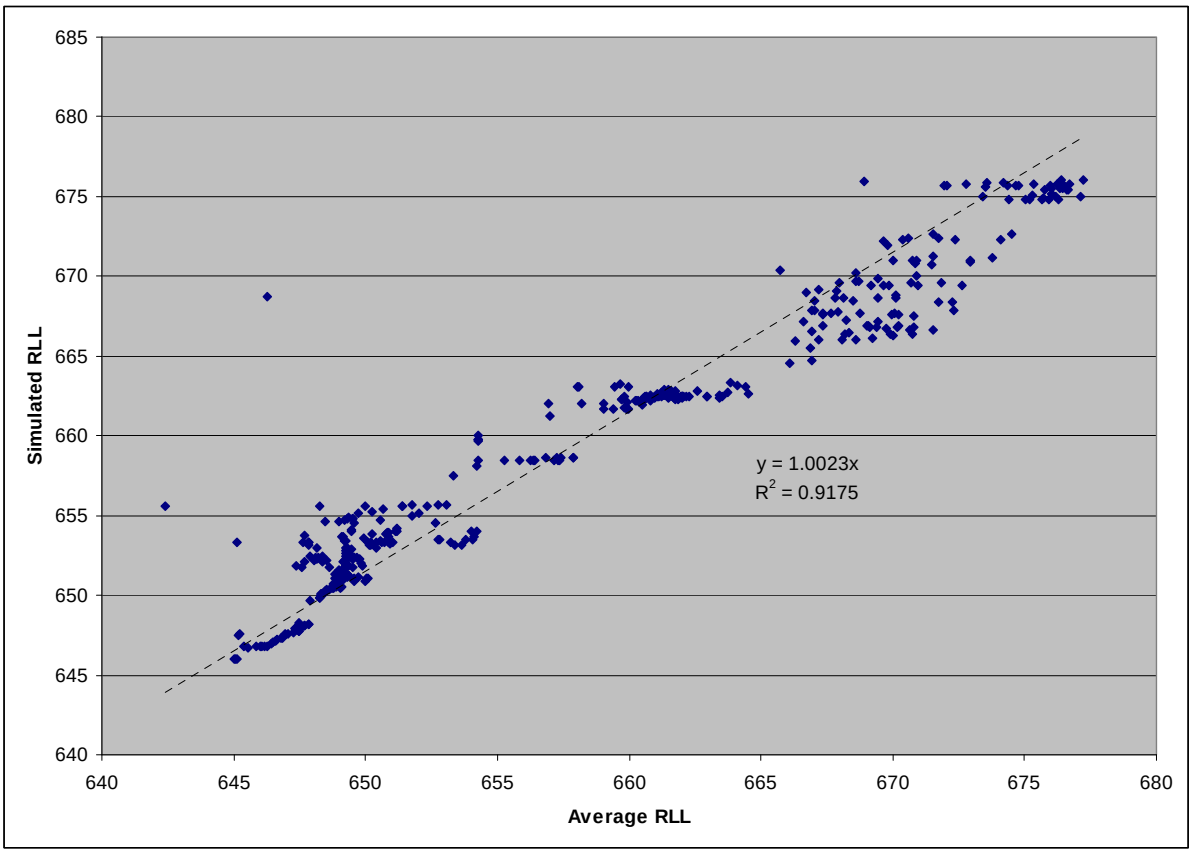
4 Water Balance

4.3.2 Leachate Elevations

The leachate elevations reported throughout the landfill history were used to calculate the average leachate elevation. Since there are a large number of leachate monitoring wells across the surface of the Bioreactor, leachate levels were averaged to reduce the amount of noise in the plot. Leachate levels were converted to elevations to provide a common basis for comparison with surface levels.

The primary calibration target of the leachate level simulations was the correlation between the simulated leachate levels and the average measured leachate elevations. The correlation plot is illustrated in Chart 4-2 below and Figure 4-2 shows the measured and simulated leachate levels plotted against time over the operating life of the Bioreactor. The plot indicates a strong correlation between the actual and the predicted leachate levels, with a correlation R^2 of 0.92.

Chart 4-2 Leachate Elevations Correlation



4.4 Calibration Results

Waste Elevations

The simulated waste elevation curve showed an acceptable correlation with average landfill elevations using the range of densities between 0.8 t/m^3 and 1.2 t/m^3 and a terminal thickness of about 10 - 15 m. As waste is placed in a landfill, the density increases as the waste is compressed and compacted by the overlying material. The terminal thickness is the thickness of waste at which density doesn't change.

4 Water Balance

Leachate Elevations

The simulated leachate elevations were influenced by variations in waste properties and water balance inputs.

An acceptable correlation between observed and simulated leachate elevations was achieved using waste densities between 0.9 t/m^3 and 1.2 t/m^3, a terminal thickness of 10 m, waste porosity decreasing from 0.5 to 0.25, fillable unsaturated storage of 5% (i.e. storage capable of being filled with liquid), indirect rainfall runoff factors of 0.2 (small) and 0.7 (large) with cut off value of 20 mm and groundwater inflow of 1 L/sec.

As shown in Figure 4-2, current leachate management practices resulted in leachate elevations in the waste being maintained at an average of 12 to 18 m depths. Note that currently some measured leachate levels in individual wells are being maintained to depths of 30m.

4.5 Relative Proportions of the Water Balance Elements

The determination of relative proportions of major water balance components was based on the calibrated model and input data provided by Veolia through to 19 January 2010, including reported volumes of water extracted from the pit void and pumped out to ED3. Rainfall/runoff was calculated based on calibrated infiltration rates and actual precipitation since September 2004. The calibrated groundwater inflow rate was 1 L/sec.

Note that loss to evaporation is calculated for the components of direct rainfall and recirculated leachate (water entering the waste from the surface) before the water enters the waste. Inflow volumes presented below have been adjusted for evaporation (refer Appendix A).

The major components of the water budget are summarized below in Table 4-1.

Table 4-1 Water Balance September 2004-January 2010

Component	% of Total Inflow
Total Inflows – including groundwater inflows, direct rainfall on waste, indirect runoff from pit walls, recirculated leachate and added water	100
Total outflows – including dewatering below liner, leachate extraction and loss to unsaturated storage	70
Change in Storage – reflected in rise in leachate level	30

4.5.1 Inflows

Total INFLOW to the pit, 665,561m^3, includes groundwater, direct rainfall, indirect rainfall, added water and recirculated leachate.

Based on data reported, the groundwater inflow made up about 21% of total water inputs into the pit, direct rainfall contribution increased from about 9% to about 13%, indirect rainfall contribution decreased from about 68% to about 63% and added water comprised less than 1%. The recirculated leachate comprised about 2% of total liquid inputs.

In summary, the components of the inflows are summarised in Table 4-2.

4 Water Balance

Table 4-2 Components of Inflow

Component Inflows	% of Total Inflow
Groundwater inflow	21
Rainfall, direct onto the waste	13
Indirect rainfall (on the sides of the pit):	63
Added water	<1
Recirculated Leachate	2

4.5.2 Outflows

Total OUTFLOW from the pit/waste was 465,641 m^3, or 70% of INFLOW. It comprised intercepted runoff (45% of total liquid out), extracted groundwater (31% of total liquid out), extracted leachate (13% of total liquid out) and loss to unsaturated storage (11% of total liquid out).

Volumes pumped to ED3 consisted of intercepted runoff (72%) and dewatering removed from the sump below the liner (28%, until August 2007). Since August 2007 dewatering has taken place from a second sump, OSW01, at an average rate of about 50m^3/day (0.58 L/sec).

The estimated amount of indirect rainfall continued to significantly exceed that of the rainfall falling directly onto the waste surface, which comprised about 17% of the total rainfall into the pit. This is consistent with current proportions of the landfill area relative to the total pit area (18%). The runoff that by-passed interception comprised about 39% of the total calculated indirect rainfall amount, with about 61% being intercepted by the haul road drain and discharged into ED3.

In volumetric terms, the leachate extracted from the waste was 58.7ML (13% of total liquids out). All extracted leachate was recirculated with the exception of a period between April 2007 and August 2008. During that time about 14.7ML of leachate was extracted, treated and disposed out of the pit under the EPA agreement (up to 40ML of leachate are allowed to be extracted out of the void) and about 10.3ML of leachate was extracted and recirculated through the leachate recirculation system (LRS).

The components of outflow are summarised in Table 4-3.

Table 4-3 Components of Outflow

Outflows	% of Total Outflow
Dewatering below liner	31
Intercepted stormwater	45
Leachate extracted	13
Loss to unsaturated storage	11

4 Water Balance

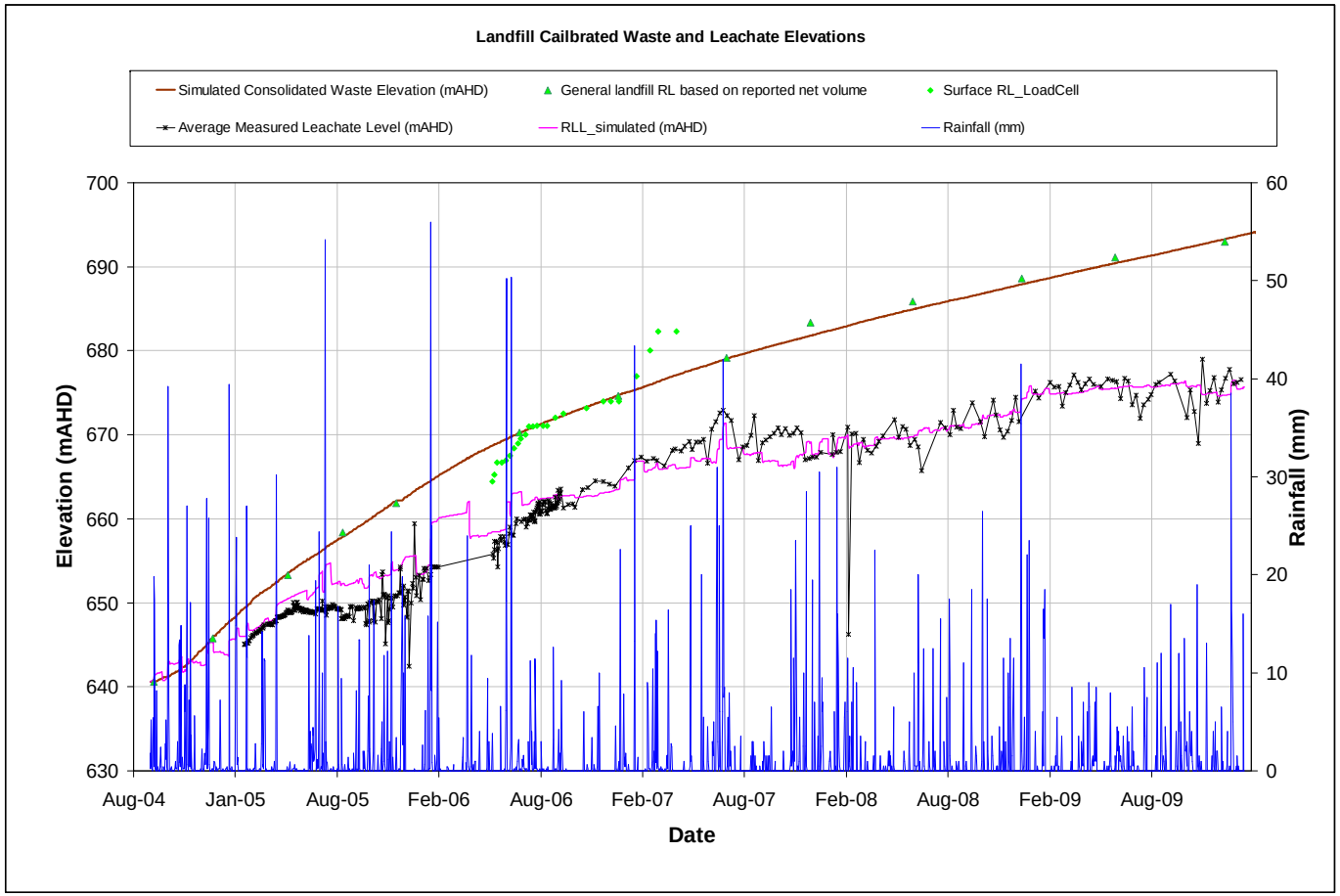
4.5.3 Change in Storage

The CHANGE IN STORAGE is calculated to be 199,921 m^3, or 30% of the INFLOW. The change in storage is manifested by the rise in leachate level in the pit. Since landfilling began, the leachate level has risen 36m in the waste mass while the waste mass itself has risen more than 50m. Increasing the moisture content of the waste mass, both saturated and unsaturated, is beneficial from the viewpoint of landfill gas generation and this is the point of differentiation between a bioreactor landfill and a normal landfill.

Leachate levels do, however, need to be controlled to ensure that biodegradation is not inhibited by early flooding of degrading organic matter. Appropriate management measures need to be adopted to control inflows of water to the maximum advantage of waste degradation and stabilisation in the Bioreactor. The water balance indicates that such measures have been taken (Figure 4-2).

4 Water Balance

Figure 4-2 Water Balance - Calibration



5

Water Balance Predictions

5.1 Water Management Measures

The predictive simulations were based upon the adoption of the current water management arrangements for the future development of the facility. These measures include:

- Diversion of rainfall runoff from the sides of the pit before it comes in contact with the waste – the water balance has calculated the proportion of runoff diversion to be 68% of the indirect runoff in the pit;
- Extraction of leachate at a rate of 60 m^3/day and recirculation on top of the waste, ensuring maximum evaporative discharge capacity;
- Dewatering from the sump below the liner is discharged outside of the pit to ED3.

The stormwater management measures (runoff interception) will continue to minimise the amount of stormwater runoff entering the waste.

5.2 Prediction Scenario 1 – Increased Waste with Average Climate

The scenario modelled with the water balance represents the case where the waste input rate increases from the current rate of 1,356 t/day (based on licence to receive 400,000 t/year) to 1.13Mt/year over a 10 year period from 2010 to 2020, assuming average monthly rainfall and evaporation for the predictive scenarios (based on Goulburn 1971-2009 statistics (BoM), averages presented in Appendix B of this report). After that time, the rate remains at 1.13 Mt/year.

The hydrograph of the predicted leachate level under the increasing filling rate scenario is shown in Figure 5-1.

The model predicts that by the end of 2030, the volume of waste in the void will be 19.4 Mm^3 and the waste elevation will be at 802.5 mAHD. The leachate level at that time is predicted to be at 702.5 mAHD, indicating the leachate level will be 100m below the top of the waste.

The model was run for 20 years to simulate 10 years of growing waste inputs followed by 10 years of constant waste input at the maximum rate, which approximates the end of the landfill life. The end of model height is around 800 mAHD which is approximately the lower height of the rim.

It is recognised that filling will proceed above the height of the rim to account for settlement and placement of the engineered cap in accordance with the original approvals for the facility, but the filling rate will not exceed the maximum rate.

5.3 Prediction Scenario 2 – Increased Waste with Two Successive Wet Years

This scenario is considered a worst case situation where there are two successive 90th percentile (based on BoM Goulburn 1971-2009 statistics) wet years within the 10 year timeframe. The resulting leachate saturation level is shown in Figure 5-2., assuming that the wet years are 2023 and 2024. The resulting plot shows that the leachate level is expected to rise by up to 20m over the two year timeframe if there is no additional leachate recycling.

If high rainfall years occur early in the filling cycle, the leachate level would be reduced by additional leachate recycling.

5.4 Conclusions of Water Balance Predictions

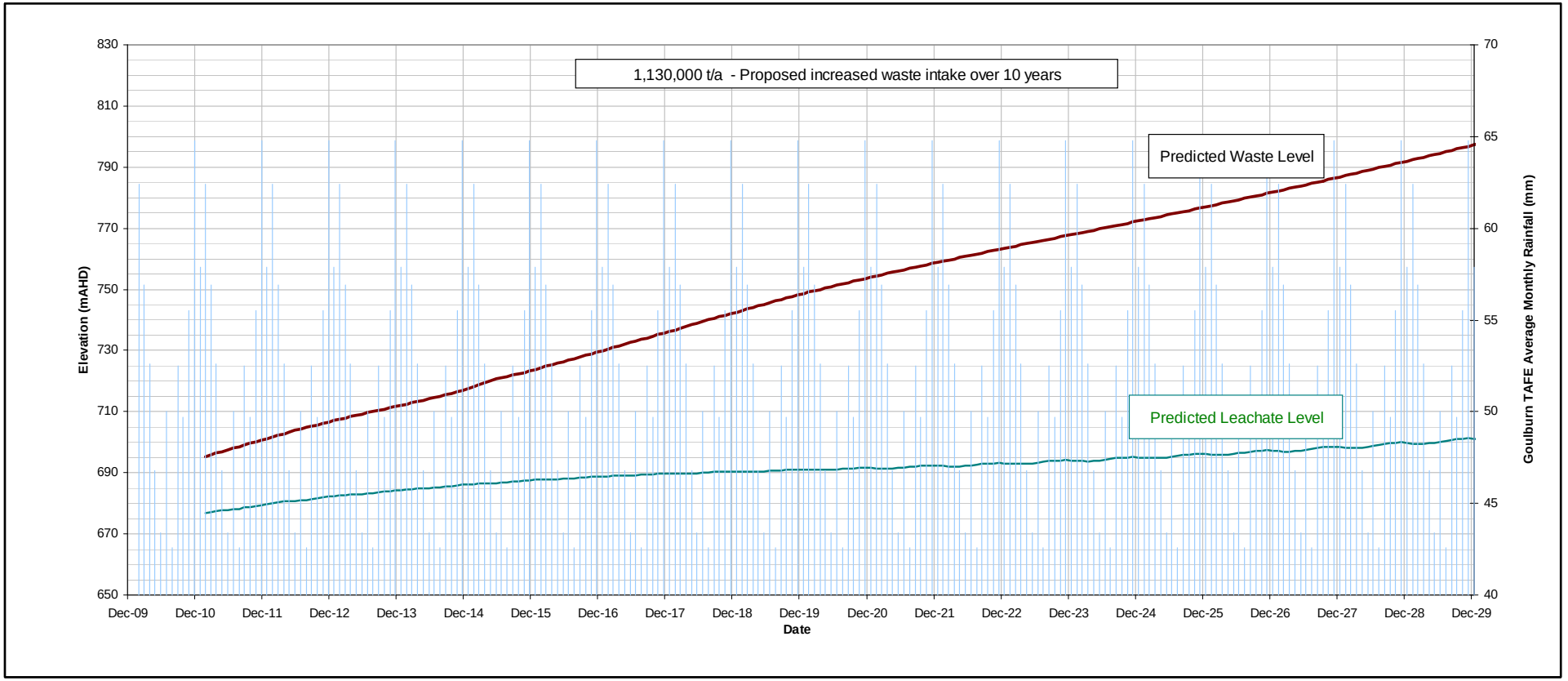
The increase of the maximum waste input rate to 1.13 million tpa will reduce the time taken for the facility to fill and, as the simulated predictive levels shows, the increased input rate will lead to more unsaturated storage becoming available. This will be beneficial in terms of containment of leachate within the waste mass without the need for any offsite disposal.

If two successive 90th percentile wet years were to occur during the filling stage, the leachate level would rise up to 20m. In this case the leachate level would be reduced by additional leachate recycling.

The water balance modelling confirms the effectiveness of existing water management measures in managing leachate levels within the waste. Regardless of the time taken to implement the increased input rate, the water balance modelling shows that the impact of increased filling will be beneficial in keeping the rate of leachate level rise below the level of the waste under average climatic conditions. Wet years would add a surcharge on the leachate level which may need to be controlled by additional recycling, but as the thickness of the waste mass increases, the need for additional leachate extraction reduces.

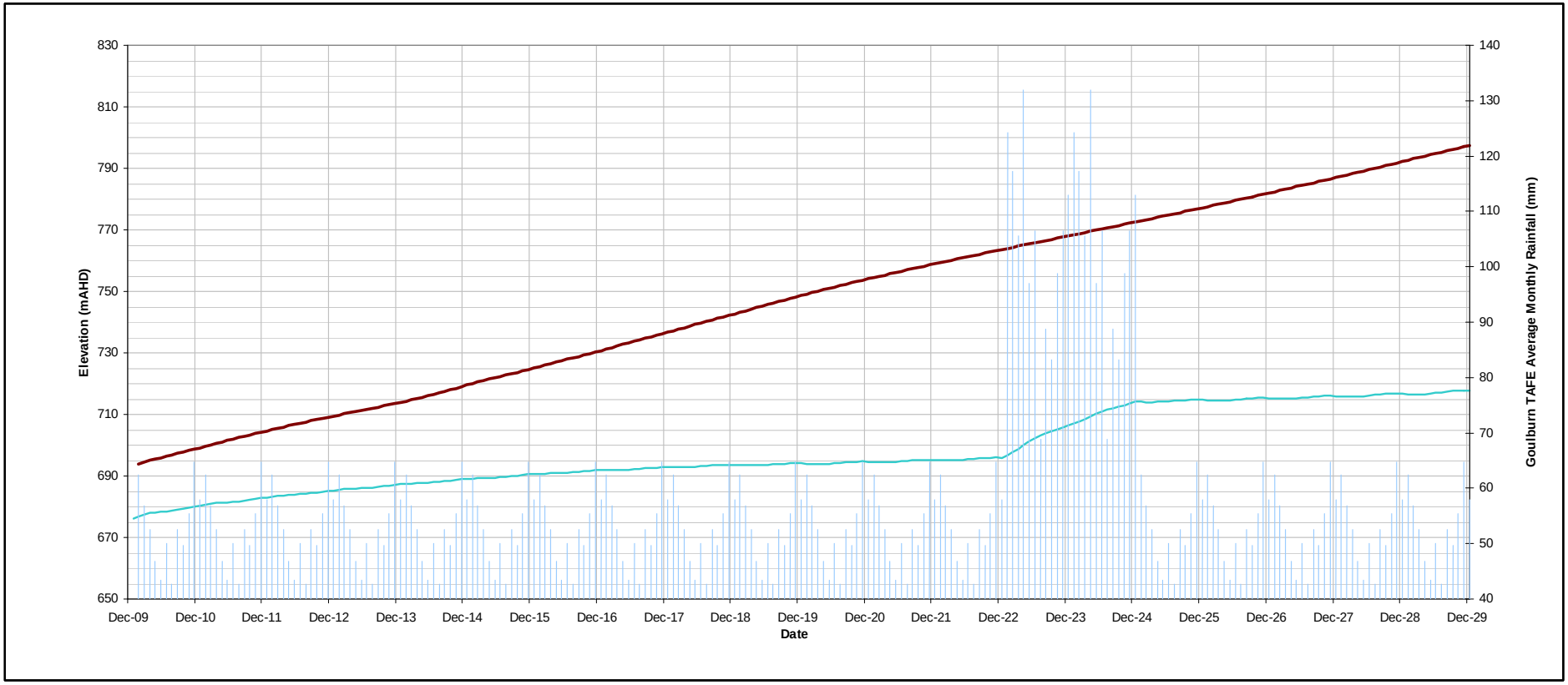
5 Water Balance Predictions

Figure 5-1 Predicted Waste and Leachate Levels - Waste increasing to 1.13 Mt/year over 10 years



5 Water Balance Predictions

Figure 5-2 Predicted Waste and Leachate Levels - Waste increasing to 1.13 Mt/year over 10 years with 2 successive wet years



6

Impact on Groundwater

6.1 Scope

This section examines the potential impact that the increased filling rate may have on the groundwater quality in the adjacent hydrogeological environment, particularly the Crisps Creek catchment.

6.2 Hydrogeological Conditions

The Woodlawn open cut mine was excavated into low permeability rock. The low permeability of the rock can be inferred from the following information:

1. The presence of the ore-body in the rock mass testifies to the fact that the regional hydrogeology has a very low permeability since it has not been transported away by regional groundwater movement since the uplift of the rock more than 2 million years ago.
2. The groundwater flow rate into the base of the pit, when it was open, was observed to be very low (< 1 L/sec), indicating low permeability conditions.
3. The steep hydraulic gradients into the mine pit could only be simulated with very low permeabilities in the rock (refer Woodward-Clyde 1997, Site Hydrogeological Evaluation, Woodlawn Mines, NSW).
4. The hydrochemistry around the site indicates that groundwaters that have been in contact with the sulphide ore body for more than 2million years, have not impacted the background groundwater quality to any significant degree.
5. Packer testing conducted by Woodward-Clyde prior to development of the landfill indicated the majority of the site has a permeability at or below 1×10^{-9} m/sec (Woodward-Clyde 1997).
6. The hydraulic gradient will be directed into the pit and the landfill for an extended period of time until the level of saturation exceeds the water table level in the surrounding rock, by which time the leachate will not pose a threat to human health or the environment.

6.3 Impact of Increased Input Rate

Increasing the waste input rate from the maximum assessed rate of 500,000 tpa to 1.13 million tpa is likely to have two significant effects:

- Reduction in time to fill the void. The volume of the void is approximately 25 million m^3. A filling rate of 400,000 tpa (assuming an average compaction density of 1.13 m^3/t) equates to a volumetric rate of 452,000 m^3/year. On this basis, and if filled at a regular rate, the void would be filled in just over 55 years. If the input rate increases to 1.13 million tpa, then the void would be filled in about 23 years.
- Rate of saturation would increase as a result of consolidation within the waste mass.
- Unsaturated storage would increase as a result of the additional waste mass.

6.4 Previous Modelling Results

The modelling carried out by Woodward-Clyde for the Commission of Inquiry into the Woodlawn Waste Management Facility in 1999 simulated four hydrogeological conditions. The simulations were based on an assumption that a head of leachate will gradually build up over time within the site under the influence of recirculation and inflows from incident rainfall, groundwater and runoff from the open cut walls.

6 Impact on Groundwater

In the modelling carried out in 1999 the potential seepage rate was calculated for different porous media to assess the potential for leachate migration through the host rock compared with migration through a liner with hydraulic conductivity based on the EPA benchmark of 900mm at 1 x 10^{-9} m/sec. The method used an analytical seepage model based on the Darcy equation where seepage is proportional to the product of hydraulic gradient and hydraulic conductivity.

A number of cases were modelled to assess potential offsite impacts of the proposed final Bioreactor, once it is capped and at a time when the level of leachate saturation might rise above the natural water table level. This modelling assumed that a final leachate level was 30m above the natural water table level and is a worst case modelling scenario not representative or reflective of leachate management protocols at the site. The unit seepage rates for different permeabilities are provided in the table below and they have been converted to seepage rates from the entire facility.

Modelled Scenario	Estimated unit seepage rate at 30m head of leachate (m^3/m/day)	Estimated total seepage rate from entire landfill (m^3/day)	Estimated seepage rate of leachate from entire landfill over 1000 years (m^3)
900mm at 1 x 10^{-9} m/sec	3.3 x 10^{-8}	1.1 x 10^{-5}	4.0
100m at 1 x 10^{-9} m/sec	2.0 x 10^{-9}	6.7 x 10^{-7}	0.2
100m at 1 x 10^{-8} m/sec	1.2 x 10^{-8}	4.0 x 10^{-6}	1.5
500m at 1 x 10^{-7} m/sec	1.6 x 10^{-7}	5.3 x 10^{-5}	19.5

The table shows that for the range of hydraulic conductivities (permeabilities) encountered at the site, the potential for seepage of leachate is very low. Since this analysis was carried out for the situation after closure of the landfill, the results are not dependent on the rate of filling.

Note that the occurrence of greater fracture intensity in the upper profile of the rock mass may create more permeable hydraulic conditions, and this was the basis for the conservative modelling scenario of 500m of fractured rock with a relatively high hydraulic conductivity of 1 x 10^{-7} m/sec. Such a value is higher than any of the packer test results which were reported in Woodward-Clyde (1997). The result of this scenario is that the rate of leachate migration from the entire facility is predicted to be very low - 5.3 x 10^{-5} m3/day or 19.5 m^3 over a thousand years.

These results were confirmed by another set of models that simulated movement of solute (i.e. contaminants) away from the Bioreactor. Again, the conditions for escape of leachate through the low permeability fractured rock do not exist until the head of leachate in the Bioreactor recovers to above the level of the natural water table (i.e. the water table level that existed prior to the commencement of mining on the site more that 30 years ago).

The analysis was carried out using the SEEP and CTRAN computer modelling programs which simulate flow of fluids and contaminants through the unsaturated and saturated zone of an aquifer system. The results of cross-section modelling indicated conclusively that contaminants will not migrate from the landfill to the regional groundwater system at Crisps Creek over the 50 year timeframe required for the leachate to establish a benign state, and that the contaminant plume will travel no more than 150m from the edge of the Bioreactor over that time, even under worst case (i.e. highest conceivable permeability conditions).

6 Impact on Groundwater

The assumptions of the models were as follows:

1. The fractured rock aquifer between the landfill and Crisps Creek behaves as a porous medium of uniform hydraulic conductivity (or permeability). Three models were set up - simulating saturated permeabilities of 1 x 10^{-8} m/sec, 1 x 10^{-9} m/sec and 1 x 10^{-10} m/sec.
2. The waste was simulated as a porous medium with a permeability of 4 x 10^{-6} m/sec.
3. The flow conditions between the landfill and Crisps Creek were simulated as steady state conditions with a drop of 10m in head over a distance of 450m.
4. The solute transport was simulated as advective flow with no adsorption and a coefficient of diffusion of 1 x 10^{-9} m^2/sec.
5. The solute transport was simulated over a 50 year time frame, with a constant concentration of 10,000 mg/L in the landfill. This represents the highest concentration of salinity that is envisaged in the landfill for the maximum period of time. After this period of time, the degradation processes will have ceased and leachate will be benign.

The material properties were assigned as follows:

- Longitudinal Dispersivity 1 m^{-1}
- Transverse Dispersivity 0.1 m^{-1}
- Volumetric Water Content (rock) 3 percent
- Volumetric Water Content (waste) 34.7 percent
- Diffusion Coefficient 1 x 1^{-9} m^2/sec

The results of the simulations indicated that the greatest migration would occur in the highest permeability medium, but that the extent of the contaminant front, represented by the 1,000 mg/L contour, would not move more than 100m from the edge of the landfill over the 50 year time frame.

It should be noted that this modelling was excessively conservative for the following reasons:

a) Adsorption was not taken into account. Adsorption is the process whereby contaminants are bound into the lattice structure of clayey minerals through a process of cation exchange. The fractures in the rock at Woodlawn are plugged with clayey minerals that are expected to have a high adsorption potential.

b) Because groundwater flow will be directed into the landfill mass throughout its life, there will no potential for migration of contaminants towards Crisps Creek until the water table level has completely recovered. This is predicted to not occur for hundreds of years after the landfill is closed.

The results indicate conclusively that contaminants will not migrate from the landfill to the regional groundwater system at Crisps Creek over the 50 year time frame required for leachate to establish a benign state.

6.5 Impact of Increased Input Rate

The increased rate of filling means that the void will fill in about half the time that was originally anticipated. The recovery of the water table level will be dependent on the rate of rise in leachate level within the waste mass. The modelling of the impact of leachate in Crisps Creek was carried out from the time the leachate mound was established after landfilling ceased, and the conditions were simulated for 50 years after that time.

The change in the maximum input rate will not result in a change in the configuration of the final leachate profile post-closure, since this is dependent on the characteristics of the capping profile and the climatic conditions of the site. Therefore, there will be no adverse impacts in the Crisps Creek catchment beyond what was previously determined with the SEEP and CTRAN models, which was a negligible impact.

7

Leachate Characteristics

7.1 Leachate Quality

Leachate from the leachate dam at the Woodlawn Bioreactor is monitored on a regular basis for a number of analytes, and the laboratory results are summarised in Table 7-1.

Table 7-1 Leachate Dam Monitoring Results

Date	Total Dissolved Solids mg/L	Volatile Acids mg/L	pH	Total Organic Carbon mg/L	Nitrogen (ammonia) mg/L
20/10/2005	24,800	13,800	5.2	10,900	826
9/11/2005	20,800	10,900	5.15	10,700	700
21/11/2005	21,500	11,200	5.09	9,900	697
28/11/2005	19,000	11,500	6.94	10,900	696
8/12/2005	18,700	10,200	5.03	8,800	642
21/12/2005	18,800	10,100	5	7,910	664
3/01/2006	22,100	8,870	4.84	4,150	260
17/01/2006	16,800	8,090	4.93	5,930	638
9/03/2006	23,000	10,300	4.85	9,240	680
3/04/2006	22,700	9,830	4.82	9,820	870
11/05/2006	17,800	10,300	4.86	992	787
22/06/2006	21,000	7,300	5	6,500	730
24/10/2006	25,000	5,900	4.6	8,700	910
7/11/2006	25,000	6,100	4.6	7,700	910
27/12/2006	29,000	13,000	4.8	10,200	1,200
4/01/2007	28,000	10,000	4.7	8,000	950
15/01/2007	28,000	12,000	4.7	8,100	
9/05/2007	28,000	13,000	5.1	9,700	1,200
28/05/2007	30,000	17,000	5.2	9,700	1,200
26/07/2007	23,000	16,000	4.9	9,400	
16/08/2007					910
10/06/2008*	17,000	440	7.9	48,000	1,100
17/03/2009	24,490	600	8.3	4,300	1,000
29/09/2009	66,000	44,000	6.5	34,000	3,500
30/11/2009	24,000	470	8.3	2,700	670

Note: * From June 2008 the analytical results for treated leachate have been reported. Elevated volatile acids concentration reported in September 2009 is for the sample collected from new (fresh from the void) leachate batch.

The TDS, Volatile Fatty Acids and Total Organic Carbon concentrations are elevated as a result of decomposition of the biomass and ammonia nitrogen concentrations have remained elevated. The results signify that the waste mass is still undergoing biological degradation. The changing pH conditions are a reflection of the leachate treatment process.

7 Leachate Characteristics

From mid-2007 to mid-2009, a leachate recirculation system was operating and the untreated leachate analysis results are shown in Table 7-2.

Table 7-2 Recirculated Leachate Monitoring Results

Date	Total Dissolved Solids mg/L	Volatile Acids mg/L	pH	Total Organic Carbon mg/L	Nitrogen (ammonia) mg/L
9/05/2007	86,000	44,000	5.3	54,000	2,600
10/06/2008	66,000	34,000	5.7	1,500	3,800
17/03/2009	78,263	43,000	5.7	50,000	3,400

The observed increasing landfill gas flow rate also reflects the increasing methanogenic decomposition of the waste mass.

7.2 Leachate Volumes

The volumes of leachate extracted have been measured at the site since 2005 and the data are presented in Table 7-3.

Table 7-3 Leachate Volumes - Woodlawn Bioreactor

	Date	Reported total extracted leachate (m^3)	Estimated total recirculated leachate (adjusted for evaporation loss) (m^3)
Record started	31/08/2004		
Year_1	31/08/2005	989	635
Year_2	31/08/2006	6,179	993
Year_3	31/08/2007	16,964	2,196
Year_4	31/08/2008	12,367	5,250
Year_5	31/08/2009	12,036	3,395
Last update of the water balance model	19/01/2010	10,202	1,592
Total volumes	19/01/2010	58,737	14,062

Leachate is recirculated across the landfill with no offsite discharge.

8

Conclusions

Veolia has, since the start of operations at Woodlawn, developed appropriate measures to manage and control leachate levels within the waste. These measures include:

- Diversion of rainfall runoff from the sides of the pit before it comes in contact with the waste – estimated to be 68% of the indirect runoff in the pit;
- Extraction of leachate at a rate of 60 m^3/day and recirculation on top of the waste, ensuring maximum evaporative discharge capacity, estimated to be 20% of the volume;
- Dewatering from below the liner and discharge outside of the pit to ED3 at a rate of 50 m^3/day (0.58 L/sec).

The water balance modelling which has been successfully carried out on the Woodlawn Bioreactor and calibrated for the last 5 years provides a robust tool for predicting leachate behaviour within the Bioreactor under various leachate management approaches.

The predictive simulation over a 20 year period shows that the increase of the maximum waste input rate to 1.13 million tpa will result in a reduction in the rate of rise of leachate level because of the greater volume of unsaturated storage becoming available. Existing leachate management measures are also predicted to be effective in managing leachate levels.

Simulations of the extreme weather conditions indicated that if two successive 90th percentile wet years were to occur during the filling stage, the leachate level would rise by up to 20m. If high rainfall years occur early in the filling cycle, the leachate level would be reduced by additional leachate recycling.

Diversion of rainfall runoff, extraction, recirculation and evaporative disposal of leachate in the pit and groundwater extraction will ensure that the leachate level will be controlled and any surface water impacts outside of the pit will be negated.

The change in the maximum input rate will not result in a change in the configuration of the final leachate profile post-closure, since this is dependent on the characteristics of the capping profile and the climatic conditions of the site. Therefore, there will be no adverse impacts in the Crisps Creek catchment beyond what was previously determined with the SEEP and CTRAN models, which was a negligible impact.

9

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Woodward-Clyde 1997: Site Hydrogeological Evaluation, Woodlawn Mines, NSW. Woodward-Clyde 1997,

Reinhart, McCreanor, Townsend, 2002. "The bioreactor landfill: Its status and future." Waste Management and Research, 20, 172-186, D.Reinhart, P.McCreanor, T.Townsend, 2002.

10

Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Veolia Environmental Services (Australia) Pty Limited and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between January 2010 and July 2010 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

A

Appendix A Water Balance Details

Appendix A

Waste

The simulated surface elevation of the waste is based on the reported waste mass (M), the waste density and the assumed rate of waste consolidation with depth and time. The consolidated waste elevations (W) are estimated based on polynomial relationship between volume (V) and elevation, derived from an original ENTEC analysis of the void volume. The relationship was adjusted for early and later times (equation 1and equation 2 respectively used), the change occurring at a crossover volume (4,258,514 m^3):

$W = -1.5E\text{-}37V^6 + 2.45E\text{-}30V^5 - 1.5E\text{-}23V^4 + 4.8E\text{-}17V^3 - 8.2E\text{-}11V^2 + 8.8E\text{-}05V + 6.4E+02$ Eq.1

$W = 7.1E\text{-}42V^6 - 6.1E\text{-}34V^5 + 2E\text{-}26V^4 - 2E\text{-}19V^3 + 1.9E\text{-}12V^2 + 3.2E\text{-}06V + 6.9E+02$ Eq.2

Here V represents the cumulative consolidated volume of the waste at a given time, estimated as a ratio of cumulative waste mass and consolidated density, unless this ratio exceeds 25,000,000 m^3 which is the total airspace volume of the void (then consolidated volume remains 25,000,000 m^3).

It is assumed that at a certain thickness the waste reaches terminal density (Dt) and does not consolidate any further. This thickness is referred to as “terminal thickness” (Ht). Prior to reaching the terminal thickness the density of waste is assumed to be constant (original waste density (Do). The volume (V) of a consolidated height of waste (H) at any given time was estimated as following:

- If H is less than Ht $V = M / Do$
- If H is greater than Ht $V = M * (Ht / H) / Do)]^{(1)} + \{M * (1 - Ht / H) / Dt]^{(2)}$,

Where (1) accounts for upper portion of waste (above waste at terminal height) and (2) accounts for portion of the waste equal/greater than the terminal height.

Original waste density, terminal consolidation waste density and terminal thickness were varied as calibration parameters. The changes of waste density estimates based on the load cell data (installed in the northern portion of the site in April 2006, data recorded between May 2006 and April 2007) showed that waste density increased by 20% to 40% with waste height increase of approximately 18 m.

The height of consolidated waste was calculated as a difference between estimated consolidated waste elevation W and the elevation of the base of the landfill (640.5 mAHD) and was used in calculations of saturated leachate volumes and, subsequently the leachate elevations.

The cumulative consolidated volume of the waste was used to estimate the surface area of the landfill at a given time, which in turn was used to estimate the volumes of rainfall entering the waste mass. The surface area of the landfill (A) at a given time was estimated using the volume versus area polynomial equation, based on original ENTEC analysis of the void volume (Equation 3):

$A = -2.6E\text{-}38V^6 + 2.1E\text{-}30V^5 - 6.6E\text{-}23V^4 + 1.0E\text{-}15V^3 - 8.3E\text{-}09V^2 + 4.8E\text{-}02V + 5.8E+03$ Eq.3

Here V represents the consolidated volume of waste at a given time estimated as a ratio of cumulative waste mass to consolidated density.

Appendix A

Water

Summary of Water Balance Elements

Element	Definition
Groundwater inflow (GW)	Groundwater entering the waste mass from the bottom/sides of the landfilled space. It is assumed that groundwater inflow will not exceed the rates reported prior to landfilling commenced (2 L/sec reported from field observations). Since flow is directly proportional to head, groundwater inflow estimation is based on reported inflow rates (Q), varied within the reported range as calibration parameter) adjusted for the head differences between reported local standing water level (SWL, 140 m) and estimated leachate levels (SLL, m): GW = (SWL - SLL) / SWL * Q, where SLL = RLL – 640.55 With RLL (reduced leachate level, mAHD) estimated using a polynomial relationships (refer Equations 1 and 2) for leachate volume versus leachate height and 640.55 mAHD the elevation of the base of the landfill.
Rainfall direct (Rd)	Volume of rainfall infiltrating the landfill surface directly. Estimation based upon reported meteorological (rainfall (R) and evaporation (E) data, assumed evaporation coefficient (0.8) and estimated landfill surface area (A): Rd = (R – 0.8E) * A If evaporation exceeds rainfall, the Rd is set to 0.
Indirect Rainfall (iR)	Volume of rainfall reaching the waste from the slopes above the landfill surface as runoff (RO). The slopes area is calculated as a difference between the final top area of the bioreactor (Af) and landfill surface area (A) at a given time. Different runoff factors are specified for small and large amount of rainfall (runoff factors varied as calibration parameters). The general equation for calculation of total indirect rainfall is: iR = R * (Final top area – A) * runoff factor, with iR varied between small indirect rainfall, assumed to occur if total rainfall is less than the cut off value (calibration parameter), and large indirect rainfall, assumed to occur if total rainfall exceeds the cut off value. The runoff is being intercepted by a series of drains and is eventually discharged to evaporation dam (ED3).
Intercepted Runoff	The intercepted runoff was estimated as a difference between the reported volume of liquid pumped to evaporation dam (ED3) and the volume extracted out of the groundwater sump. The reported volume pumped to ED3 comprised intercepted runoff from the void slopes and volumes extracted from groundwater sump and bore OSW01 (30/05/2007 to 3/08/2007). RO intercepted = ED3 – GWextr Or (since OSW1 water disposed through leachate treatment/disposal system) RO intercepted = ED3
Bypassed Runoff	The volume of indirect rainfall reaching the waste (bypassed runoff) is estimated as the difference between total indirect rainfall (iR) and intercepted runoff: RO bypassed = iR – RO intercepted, or RO bypassed = iR – ED3 + GWextr.
Added water (Wadd)	Volumes of water added (January 2006, December 2006).
Evaporation	Evaporation was included into direct rainfall calculations.
Groundwater extraction (GWextr)	Volumes extracted from the original groundwater sump (active until late November 2005) disposed via the stormwater disposal system; Volumes extracted from OSW01 active since June 2007 and disposed through the stormwater disposal system (up to 3/08/07). Since then volumes pumped from OSW01 were disposed through the leachate treatment/disposal system.

Appendix A

Element	Definition
Leachate extraction (Lextr)	Volumes extracted from the leachate sump(s) and leachate wells (commenced in May 2007).
Leachate recirculation (Lrecirc)	Volumes extracted from the leachate sump(s) that have been fully recirculated or volumes recirculated through a separate leachate recirculation system (LRS1 and LRS2). Estimation based upon reported volumes of extracted leachate (Lsump) and evaporation data, assumed evaporation coefficient (0.8) and estimated landfill area (A): Lrecirc = Lextr – 0.8E * A If evaporation exceeds the amount of extracted leachate per landfill area, the Lrecirc is set to 0.
Loss to unsaturated storage	Portion of water entering unsaturated waste (e.g. rainfall, runoff, added water, recirculated leachate) lost to unsaturated storage prior to contributing to leachate. Loss to unsaturated storage is assumed to occur if volume of water entering the unsaturated waste exceeds the fillable unsaturated storage.

The daily change of storage in the waste was calculated as following:

$$\Delta S = GW + Rd + Wadd + RO\ bypassed + Lrecirc – GWextr – Lextr,$$

if RO bypassed = iR – RO intercepted = iR – ED3 + GWextr, then

$$\Delta S = GW + Rd + Wadd + iR - ED3 + GWextr + Lrecirc – GWextr - Lextr$$

or simplified

$$\Delta S = GW + Rd + Wadd + iR - ED3 + Lrecirc – Lextr,$$

Where direct rainfall (Rd), indirect rainfall (iR), added water (Wadd) and recirculated leachate were adjusted for loss to unsaturated storage, as described below.

Fillable unsaturated storage (S_unsat) was estimated based upon unsaturated waste volume (UWV) and available unsaturated porosity and assumed to be available only if total waste volume (Vt) exceeds saturated waste volume (SWV). UWV was defined as waste above the leachate level and calculated as a difference between the accumulated waste volume (V) and saturated waste volume (SWV). Available unsaturated porosity was defined as porosity filled prior to gravity drainage and calculated as difference between field capacity (FC) of the waste material and initial moisture content (IMC).

$$S_unsat = UWV * (FC - IMC).$$

where

$$UWV = Vt – SWV.$$

Volumes of direct rainfall (Rd), indirect rainfall (iR), added water (Wadd) and recirculated leachate were adjusted for loss to unsaturated storage as:

$$Water\ In = iR + Rd + Wadd + Lrecirc – S_unsat,$$

Assuming that if no fillable unsaturated storage is available, all water goes to leachate and if volume of water entering the unsaturated waste is less than fillable unsaturated storage then it goes to unsaturated storage and does not contribute to the leachate.

Leachate Elevations

The simulated leachate elevations were estimated equations 1 and 2. Saturated waste volume or SWV (ratio of accumulated leachate volume to porosity at a given time) was used as volume V in the equations.

The accumulated leachate volume was calculated using the Δ S relationships above.

Appendix A

It was assumed that until a terminal consolidated density of waste is reached at a certain waste thickness (terminal thickness), the porosity remains as a pre-compressed (Po). When the terminal thickness (Ht) is reached the porosity remains at a certain value (compressed porosity Pt).

The saturated waste volume (SWV) of a consolidated thickness of waste (H) at any given time was estimated as following:

- If waste thickness is less than terminal thickness:

$$SWV = \Delta S / Po$$

- If waste thickness is greater than terminal thickness:

$$SWV = [\Delta S * (Ht / H) / Po)]^{(1)} + [\Delta S * (1 - Ht / H) / Pt]^{(2)},$$

Where (1) part of the equation accounts for upper portion of waste (above waste at terminal thickness) and (2) part of equation accounts for portion of the waste equal/greater than the terminal thickness.

The values of terminal height, original porosity and terminal porosity were varied as calibration parameters.

Calibration Parameters

Waste Characteristics:		Groundwater Inflow	1 L/sec
Pre-compressed Waste Density	0.9 t/m^3	Head of groundwater into base of pit	140 m
Terminal Compressed Waste Density	1.2 t/m^3		
Depth at Terminal Density	10 m	Runoff and Rainfall Infiltration Factors:	
Porosity (pre-compressed)	0.5	Rainfall Cutoff	20 mm
Porosity (compressed)	0.25	"Small" Runoff Factor	0.2
Field Capacity	0.2	"Large" Runoff Factor	0.7
Initial Moisture Content	0.15		
		Evaporation Factor	0.8
Bioreactor Dimensions:			
Bottom Area	3,505 m^2		
Top Area	393,434 m^2		

The simulated waste elevations and leachate levels were most sensitive to variations in waste density, terminal thickness and porosity. The range of variations and degree of uncertainty associated with each of these parameters are summarised below:

- Waste density - uncertainty associated with unknown original waste density and changes due to consolidation with time, was varied over a range from original waste density to terminal compacted density based on published data (0.6 t/m^3 – 1.7 t/m^3) and site-specific reported values (0.9 t/m^3 – 1.6 t/m^3) ;
- Waste thickness at which terminal density occurs - great uncertainty associated with unknown range, varied between 10 m and 100 m;
- Porosity - uncertainty associated with unknown original waste porosity and changes due to consolidation with time, was varied over a range from original waste porosity (0.2 – 0.6) to compressed porosity (0.1 – 0.2) based on published data, field capacity and initial moisture content were varied within the range of published data;
- Groundwater inflow rate - varied within a range based on pre-landfilling data (0.5 L/sec – 1.5 L/sec); and
- Rainfall runoff factors - great uncertainty associated with unknown range and variability with time, varied between 0.01 and 0.2 (small indirect rainfall) and between 0.1 and 0.8 (large indirect rainfall).

B

Appendix B Predictive Model Inputs

Appendix B

Basic monthly input parameters for the predictive simulations are summarised below:

Month	Goulburn TAFE, mean rainfall, mm	Goulburn TAFE, decile 9 rainfall, mm	Goulburn TAFE, mean daily evaporation, mm	Monthly evaporation based on daily mean, mm	Waste Mass (t) (for the first year)
Jan	62.4	124.3	6.4	198.4	41,667
Feb	56.9	117.3	5.4	151.2	45,455
Mar	52.6	105.6	4.1	127.1	49,242
Apr	46.8	131.9	2.6	78	53,030
May	43.4	97.0	1.6	49.6	56,818
Jun	50	106.5	1.1	33	60,606
Jul	42.6	68.8	1.2	37.2	64,394
Aug	52.5	88.8	1.9	58.9	68,182
Sep	49.7	83.2	2.8	86.8	71,970
Oct	55.5	98.7	3.9	117	75,758
Nov	64.8	106.5	5.0	155	79,545
Dec	57.9	113.0	6.1	183	83,333

Waste tonnage achieved in December (83,333 t) remained constant for the further predictive simulations, resulting in annual waste intake of 1,000,000 t/year.

Constant parameters that had to be adjusted for the monthly input frequency included rainfall cut off value (increased from 20 mm to 50 mm) and evaporation factor (from 0.8 to 0.3).



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Surface Water Monitoring Data | Appendix C2

Reference: Earth2Water Pty Ltd, 2009. *EPL Annual Assessment of Woodlawn Bioreactor and Intermodal Facility Monitoring Data.*

Table 1. Pond 2

Date	pH	Sulphate	Conductivity	Total Organic Carbon	Total Iron	Total Zinc	Nitrogen (ammonia)
		mg/L	*uS/cm*	*mg/L*	*mg/L*	*mg/L*	*mg/L*
31/03/2003	3.04		3640				
3/09/2003	2.85		5210				0.11
26/11/2003	2.77		7970				
17/03/2004	2.56	16100	10550	6			0.26
21/06/2004	4.81	2060	5360	2	45.1	21.1	0.86
13/09/2004	2.76	2050	6960	6	366	1020	1.38
1/11/2004	2.78	10100	8650	12		953	0.7
13/12/2004	2.83	12200	11200	14	153	1380	1.02
21/01/2005	2.85	3350	4280	1	139	302	0.7
14/03/2005	3.43	14700	11000	730	575	1600	31
15/04/2005	3.16	4550	5210	268	376	582	17.5
29/06/2005	4.1	9600	9730	2920	994	1270	144
12/09/2005	4.17	5550	5680	1350	348	452	102
21/11/2005	4.61	8590	16500	6000	1080	816	514
24/02/2006	4.2	11900	12700	1580	1660	976	332
7/03/2006	4.16	10300	13900	1220	1540	881	242
20/03/2006	4.11	1840	7390	1920	425	594	140
7/04/2006	4.23	8830	11100	2210	619	432	603
11/05/2006	4.24	12300	8710	1520	853	710	421
16/06/2006	3	6900	7600	160	310	130	30
28/11/2006	3.6	10600	11900	54	1300	730	26
16/01/2007	3.8	10900	11500	210	1400	700	46
15/06/2007	2.9	3100	3800	30	180	270	5.5
14/08/2007	4.3	15000	16000	440	2600	260	330
23/10/2007	4.4	14000	21000	440	1100	63	780
14/12/2007	6.1	9300	14000	2200	12000	310	770
4/03/2008	6.7	7700	17000	340	440	20	730
10/06/2008	5.1	4700	8500	910	20	250	270
25/09/2008	2.8	5100	5700	9	180	130	10
16/02/2009	4.3	3600	5000	640	190	120	59
18/06/2009	4	6300	8300	45	510	140	170
14/08/2009	3	4800	6100	22	100	100	57

Table 2 Pond 3

Date	pH	Sulphate	Conductivity	Total Organic Carbon	Total Iron	Total Zinc	Nitrogen (ammonia)
		mg/L	*uS/cm*	*mg/L*	*mg/L*	*mg/L*	*mg/L*
31/03/2003	3.39		3460				
3/09/2003	3.2		2930				0.01
26/11/2003	2.89		4520				
17/03/2004							
21/06/2004							
13/09/2004	2.9	2110	6040	6	204	650	1.33
13/12/2004	3.04	15400	14500	9	27.2	2300	6.9
21/01/2005	2.89	3630	4630	2	104	484	1.01
14/03/2005	3.17	11500	9000	417	522	1200	18.8
15/04/2005	3.01	3040	3900	83	231	506	1.6
20/06/2005	3.37	3000	3880	61	86.3	438	5.09
12/09/2005	4.25	5440	5090	1250	245	408	96.8
8/11/2005	4.31	4540	5380	1380	292	403	115
7/04/2006	4.5	2699	3500	45	206	468	12
11/05/2006	4.9	4620	3600	67	132	531	5.09
16/06/2006	4.5	6000	4960	196	200	500	50
28/11/2006	3.4	17000	16000	67	1300	1000	26
16/01/2007	3.5	9500	10300	39	500	680	26
15/06/2007	3.3	3100	4000	260	130	310	37
14/08/2007	4.2	11100	13000	960	1500	390	230
23/10/2007	5.5	11900	19000	530	1200	73	610
14/12/2007	5.1	8400	14000	160	390	220	560
4/03/2008	6.5	7100	15000	330	140	110	730
10/06/2008	3.5	4300	6300	37	40	400	150
25/09/2008	2.9	4300	5000	6	120	130	8.6
16/02/2009	2.8	4700	5300	5	120	130	11
18/06/2009	3.8	4300	6400	38	16	130	140
14/08/2009	3.1	3600	5000	16	32	110	55

Table 3 Site 115

Date	Flow	pH	Sulphate	Conductivity	Total Organic Carbon	Total Iron	Total Zinc	Nitrogen (ammonia)
			mg/L	*uS/cm*	*mg/L*	*mg/L*	*mg/L*	*mg/L*
27/01/1998	Nil	7.2	330	2330				
9/02/1998	Nil	7.2	265	1930				
22/04/1998	Trickle	7.3	439	3360				
9/06/1998	Trickle	7.7	281	2560				
23/06/1998	High	7.1	265	850				
10/08/1998	Medium	7.8	103	682				
9/09/1998		7.6	168	737				
5/10/1998	Nil	7.7	726	2710				
6/11/1998	Trickle	7.5	324	1730				
29/01/1999	Trickle	7.6	286	1154				
22/03/1999	Trickle	7.53	236	1345				
1/06/1999	Nil	7.77	173	3240				
15/07/1999	Trickle	8.19	410	1860				
2/09/1999	/medium	8.18	495	1990				
5/10/1999	Low/medium	8.26	294	1370				
25/10/1999	Medium	7.12	40.2	247				
9/12/1999	Low	7.89	162	1740				
9/03/2000	Trickle	7.41	87.4	801				
6/04/2000	Nil	7.9	192	2280				
23/06/2000	Trickle	7.89	199	3280				
9/08/2000	Trickle	8.05	113	2010				
26/09/2000		8.13	140	2190				
19/10/2000		8.06	317	920				
14/11/2000		8.09	135	914				
5/02/2001		7.19	74.7	583				
8/06/2001	trickle	7.78	274	3390				
8/06/2001		7.78		3390				
11/07/2001		7.93	202	3100				
11/07/2001								
21/08/2001		7.76	199					
21/08/2001		7.94	188	2970				
28/08/2001	Low	7.5	78.4	405				
10/09/2001								
10/09/2001		7.98	138	1590				
20/09/2001		7.94	188	2970	24			0.01
20/09/2001								
12/10/2001		7.84	97.8	1970				
5/02/2002		7.05	35.7	174				
9/05/2002								
4/09/2002		7.98		2780				
11/12/2002		7.54		1530				

Date	Flow	pH	Sulphate	Conductivity	Total Organic Carbon	Total Iron	Total Zinc	Nitrogen (ammonia)
			mg/L	*uS/cm*	*mg/L*	*mg/L*	*mg/L*	*mg/L*
24/02/2003	trickle	7.96		1720				
31/03/2003	trickle	8.09		1000				
4/04/2003			246	3000	7			0.07
16/06/2003		7.32	232	2960				
3/09/2003	0	6.2	275	1773	11	0.11	0.13	
26/11/2003	trickle	7.82		1575				
17/03/2004								
21/06/2004	dry							
13/09/2004	dry							
5/10/2004	dry							
23/10/2004	dry							
6/11/2004	low	7.25	183	1670	11	0.1	0.057	0.07
13/12/2004	dry							
21/01/2005	very low	7.76	133	1020	24	0.1	0.082	0.26
14/03/2005	dry							
20/06/2005	dry							
1/07/2005	good flow	7.45	110	675	8	12.6	0.425	0.057
12/09/2005	good flow	6.49	214	1340	9	0.83	0.784	0.252
29/09/2005	good flow	8.01	137	838	13	1.55	0.052	0.067
8/11/2005	yes	7.4	106	849	10	1.27	0.976	0.019
29/12/2005	yes	6.1	149	1140	15	3.09	0.48	0.252
10/03/2006	yes	7.3	210	1240	10	0.8	0.84	0.2
2/06/2006	yes	7.3	40	250	11	0.91	0.33	0.93
16/06/2006	yes	7.4	67	600	4	0.04	0.14	0.01
15/09/2006	no	7.34	41	289	13	10.6	0.125	0.169
19/01/2007	good flow	7.5	110	730	17	3.6	0.12	0.37
30/04/2007	very low	6.7	350	2600		0.04	0.087	0.04
28/06/2007	High Flow							
14/08/2007	Low	8.6	360	2600	13	0.25	0.034	0.09
5/11/2007	Trickle	7.7	420	2600	16	0.1	0.12	0.16
14/12/2007	No Flow	8	140	2200	14	0.16	0.048	0.14
4/06/2008	No Flow	8	71	630	11	0.13	0.013	0.05
4/08/2008	Slow	7.8	630	3600	9	0.02	0.2	0.04
25/09/2008	No Flow	7.8	500	3100	10	0.14	0.3	0.09

Table 4 WM201

Date	Flow	pH	Sulphate	Conductivity	Total Organic Carbon	Total Iron	Total Zinc	Nitrogen (ammonia)
			mg/L	*mg/L*	*mg/L*	*mg/L*	*mg/L*	*mg/L*
21/08/2001		4.07	93.7					
21/08/2001		4.21	70	284				
10/09/2001	0							
20/09/2001		4.21	70	284	14			
9/05/2002		4.35	154	462	2		12.4	0.05
9/01/2003		3.94	201	1010	9			1.41
18/02/2003		4.18	232	1130	10			0.3
4/04/2003			112	438	12			0.04
16/06/2003		4.2	60	218				
3/09/2003	0	4.4	100	630	28	1.2	1.42	0.01
26/11/2003	no flow	7.12		787				
16/03/2004		5.8	98	789	26			
21/06/2004	no flow	7.61	184	1352	5	0.52	2.12	0.05
13/09/2004	no flow		197		8	0.3	2.57	0.05
1/10/2004	yes	7.72	54	374	13	0.6	1.43	0.03
23/10/2004	yes	7.35	160	949	20	1.1	2.2	0.06
5/11/2004	low	6.85	87	653	30	1	0.397	0.11
13/12/2004	yes	7.74	78	511	35	0.7	2.95	0.07
21/01/2005	low	7.34	256	1340	34	0.5	1.76	0.04
14/03/2005	no flow							
15/04/2005	low	6.06	153	521	8	1.41	2.92	0.067
20/06/2005	no flow							
1/07/2005	low	6.98	181	819	18	0.75	2.14	0.044
12/09/2005	no flow							
29/09/2005	low	6.99	134	663	22	2.75	2.73	0.051
29/12/2005	no flow							
10/03/2006	low	Small pudddle of water						
2/06/2006	no flow							
15/09/2006	no flow							
19/01/2007	Low	6.4	210	640	23	2.5	10	0.44
30/04/2007	Low	5.5	78	250		0.67	4.8	0.01
5/09/2007	No Flow	6.5	87	330	17	1.7	3.4	0.09
5/11/2007	no flow	6.3	200	800	16	2.4	5	0.06
14/12/2007	no flow	5.8	230	550	12	1.6	9.7	0.44
10/06/2008	low	4.6	160	440	29	25	22	0.19
4/08/2008	no flow	4.7	150	400	8	0.66	17	0.03
6/10/2009	low	7.2	43	210	15	0.52	2.6	0.03

Table 5 WM202 (ED3S)

Date	pH	Sulphate	Conductivity	Total Organic Carbon	Total Iron	Total Zinc	Nitrogen (ammonia)
		mg/L	*uS/cm*	*mg/L*	*mg/L*	*mg/L*	*mg/L*
30/06/1992	3	19800	13000				
16/10/1992	3	21800	16100				
4/10/1995	3	13900	13560				
18/10/1995	3	14900	15600				
5/12/1995	3	12800	12970				
4/03/1996	2.9	17500	14500				
4/06/1996	2.9	13950	13600				
11/09/1996	2.9	14500	13400				
3/12/1996	2.9	13610	13130				
4/03/1997	2.8	17200	15320				
24/06/1997	2.9	18900	16100				
3/12/1997	2.8	17600	17360				
5/03/1998	2.8	19340	15300				
10/06/1998	2.8	18284	16900				
7/09/1998	2.9	13780	12200				
1/12/1998	2.8	15310	13810				
3/02/1999	2.8	17900	14700				
7/05/1999	2.73	11730	14530				
4/08/1999	2.76	15810	18000				
5/11/1999	3.54	13800	14300				
3/02/2000	2.77	16200	15800				
1/05/2000	2.8	18300	17000				
31/07/2000	2.77	17800	16900				
6/11/2000	2.84	14300	17400				
2/02/2001	2.61	29800	23600				
1/05/2001	2.68	18800	19800				
1/05/2001	2.55	26100	24700				
1/05/2001	2.68	18800	19800				
1/05/2001	2.55	26100	24700				
3/08/2001	2.97	21700	18400				
21/08/2001	2.84	18600					
21/08/2001	2.72	20010	19000				
21/08/2001	2.66	25100	25600				
10/09/2001							
20/09/2001	2.72	20010	19900	24			6.62
5/02/2002	2.75	24300	18600				
7/05/2002	2.7	31300	20300				
13/08/2002							
21/08/2002	3		20400				
22/10/2002	4.02	28400	533	27			9.94
1/11/2002	2.66		26600				
9/01/2003	2.57	55300	33300	17			16.3

Date	pH	Sulphate	Conductivity	Total Organic Carbon	Total Iron	Total Zinc	Nitrogen (ammonia)
		mg/L	*uS/cm*	*mg/L*	*mg/L*	*mg/L*	*mg/L*
18/02/2003	2.75		32200				
4/04/2003		708	19600	18			9.81
16/06/2003	3.09	1140	20700				
3/09/2003	2.78	26600	1490	11	138	3860	10.4
26/11/2003	2.76		9890				
17/03/2004	2.61	23100	15260	6			3.49
21/06/2004	2.31	16600	19180	10	252	2730	3.46
13/09/2004	2.59	1460		7	258	2550	1.57
1/11/2004	2.77	16800	14800	11		1750	1.02
16/12/2004	2.82	4160	5170	7	103	442	1.3
21/01/2005	2.76	10400	12700	7	224	1610	2.94
14/03/2005	2.61	13900	11600	16	224	1770	2.58
15/04/2005	3.1	3490	4870	124	224	629	9.23
20/06/2005	2.96	11500	8300	169	360	1640	9.64
1/07/2005	2.93	10400	11000	235	334	1350	8.7
12/09/2005	3.97	13900	11400	606	366	1080	45.7
29/12/2005	4.1	10400	2150	929	368	1080	47.4
19/01/2006	4.05	9060	8170	640	384	1180	12.6
8/02/2006	4.04	10877	7330	861	474	1047	86.5
17/03/2006	4.08	13100	8470	1910	513	1520	100
27/03/2006	3.73	15200	13100	660	400	1690	66.7
2/06/2006	4.1	13000	13000	680	540	840	130
16/06/2006	3.4	6100	7400	3	220	130	54
1/09/2006							
1/12/2007							
19/01/2007	3.1	4300	5800	22	180	120	16
15/06/2007	3.2	7400	8400	34	210	860	42
14/08/2007	3.3	5800	6700	47	190	540	38
5/09/2007	3.5	6000	7100	55	260	150	42
14/12/2007	2.8		9200	28	140	130	94
4/03/2008	2.9	8100	10000	16	130	620	150
10/06/2008	2.9	9800	11300	11	66	810	180
23/07/2008	3	8100	9900	13	60	160	160
25/09/2008	3	9400	9700	11	77	130	130
18/06/2009	3	12000	13000	10	73	170	160
14/08/2009	2.9	11400	13000	9	60	150	150
1/09/2009	2.9	12000	12000	9	56	150	150
30/11/2009	2.9	14000	14000	8	47	140	180

Table 6 WM203 (ED3N)

Date	pH	Sulphate	Conductivity	Total Organic Carbon	Total Iron	Total Zinc	Nitrogen (ammonia)
		mg/L	*uS/cm*	*mg/L*	*mg/L*	*mg/L*	*mg/L*
3/08/2001	2.67	30000	22000				
21/08/2001	2.66	24700					
21/08/2001	2.58	25400	26000				
10/09/2001							
20/09/2001	2.58	25400	26000	17			9.32
5/02/2002	2.53	39000	27600				
21/08/2002	2.7		29000				
22/10/2002	3.33	39900	522	9			15.9
1/11/2002	2.51		40600				
9/01/2003	2.29	80000	48300	16			25.6
4/04/2003		27700		13			12.3
16/06/2003	2.82	744					
3/09/2003	2.68	49800		15	288	8340	15.5
26/11/2003	2.61						
17/03/2004	2.39	66910		14			22.4
21/06/2004							
13/09/2004	2.68	1340		6	100	3430	9.33
16/12/2004	2.81	3600	4770	8	203	476	1.23
21/01/2005	2.92	13700	19100	4	45.4	2600	5.78
14/03/2005	2.7	24200	17600	8	43.8	3570	10.5
12/09/2005	3.16	12100	8080	2	14.2	1200	4.56
29/12/2005	4.54	785	2150	4	2.56	53.2	1.4
19/01/2006	4.06	8130	7180	464	281	1050	13.5
27/03/2006	3.94	13500	9440	798	552	1450	75
2/06/2006	3.9	13000	14000	450	530	850	94
16/06/2006	4	6900	8400	3	160	140	48
24/10/2006	3.5	9300	12000	450	430	1400	99
24/10/2006	3.5	9800	12000	450	430	1400	98
16/01/2007	3.6	15000	16000	420	520	600	140
15/06/2007	3.5	14000	15000	270	450	1600	130
14/08/2007	3.6	16000	15000	350	540	1700	150
14/12/2007	3.6	16000	17000	310	470	150	310
4/03/2008	3.7	15000	18000	260	610	830	430
10/06/2008	3.7	15000	18000	260	370	170	470
23/07/2008	3.6	15000	18000	260	390	170	490
25/09/2008	4	16000	19000	300	290	150	520
18/06/2009	4.9	19000	2700	650	43	160	1200
14/08/2009	6.7	16000	26000	640	0.34	140	1100
01/09/2009	7.1	17000	26000	700	0.47	690	1100
30/11/2009	7.3	18000	29000	820	0.37	940	1400

Table 7 SITE 150

Date	pH	Sulphate	Conductivity (TC)	Total Organic Carbon (TOC)	Total Iron	Total Zinc	Ammonia (Nitrogen)
		mg/L	*uS/cm*	*mg/L*	*mg/L*	*mg/L*	*mg/L*
29/01/1999	7.8	65.7	873				
22/03/1999	7.69	73.6	500				
1/06/1999	7.42	70.8	905				
15/07/1999	8.07	68.1	941				
2/09/1999	7.79	136	1710				
5/10/1999	7.71	118	1500				
25/10/1999	6.65	30	370				
9/12/1999	7.93	64.9	1070				
9/03/2000	7.27	68.9	1050				
6/04/2000	7.67	49.8	877				
23/06/2000	7.93	54	832				
9/08/2000	7.72	124	1620				
26/09/2000	7.51	140	1850				
19/10/2000	7.42	117	1050				
14/11/2000	6.91	51.3	927				
5/02/2001	6.92	73.1	887				
8/06/2001	7.61	77	955				
8/06/2001	7.61		955				
11/07/2001	7.9	46.4	795				
11/07/2001							
21/08/2001	7.74	59	680	10			0.02
21/08/2001	8.28	136					
21/08/2001	8.26	120	1450				
28/08/2001	7.52	59.8	696				
28/08/2001	7.74		680				
10/09/2001							
10/09/2001	7.95	115	1300				
20/09/2001	8.26	120	1450	21			
20/09/2001							
12/10/2001	7.36	56.9	659				
5/02/2002	6.4	16.4	186				
6/02/2002							
15/04/2002	7.6		860				
17/06/2002	7.95	39.4	738				
4/09/2002	8.06		830				
22/10/2002	7.78	105	275	21			0.02
9/12/2002	8.22	45	1010	19			0.08
11/12/2002	7.57		1360				
18/02/2003	7.99	36	1050	3			0.2
24/02/2003	7.16		982				
31/03/2003	8.53		373				
4/04/2003		59	630	13			0.08

Date	pH	Sulphate	Conductivity (TC)	Total Organic Carbon (TOC)	Total Iron	Total Zinc	Ammonia (Nitrogen)
		mg/L	*uS/cm*	*mg/L*	*mg/L*	*mg/L*	*mg/L*
16/06/2003	7.36	55	640				
2/09/2003	3.89	108	1254	5			
3/11/2003	6.69		1010				
27/01/2004	7.02		994				
16/03/2004	6.06	107	1187	2			0.01
11/05/2004	7.6	86	1270	10	1.03	0.042	0.03
12/07/2004							
7/09/2004	6.75	87	1285	6	0.6	0.011	0.04
5/10/2004	8.26	105	868	9	0.1	0.019	0.01
23/10/2004	8.17	109	970	5	0.2	0.015	0.03
5/11/2004	8.51	83	841	5	0.2	0.008	0.09
5/01/2005	7.89	127	1160	2	3.13	6.69	0.078
15/03/2005	7.25	86	1080	4	0.74	0.067	0.073
30/05/2005	7.55	82	966	3	0.5	0.016	0.038
1/07/2005	7.18	40	454	12	0.98	0.112	0.052
12/09/2005	6.69	108	1230	13	0.65	0.138	0.261
8/11/2005	7.3	72	1210	14	0.77	0.809	0.198
9/02/2006				20	1.03	0.632	0.285
7/03/2006	7.05	98	1198	21	0.7	0.7	0.3
9/05/2006	7.7	110	1072	5	0.55	0.02	0.02
14/07/2006	8	63	738	5	0.05	0.035	0.01
19/01/2007	6.9	81	550	25	0.68	0.32	0.84
1/03/2007	7.8	90	940	36	0.24	0.014	0.03
30/04/2007	6.9	83	1100		0.65	0.011	0.01
18/05/2007	7.9	83	1100	5	0.89	0.018	0.04
15/06/2007	7.8	67	730	2	2	0.074	0.06
16/08/2007	8.2	90	1100	4	0.09	0.047	0.05
5/11/2007	7.3	36	590	20	0.68	0.088	0.01
7/02/2008	7.4	49	340	8	1.3	0.005	0.01
4/06/2008	7.6	70	1000	2	1.2	0.005	0.01
23/07/2008	8.1	51	810	4	0.18	0.076	0.03
28/08/2008	8.1	110	1300	5	0.07	0.03	0.02
25/09/2008	8.2	91	1100	5	0.09	0.017	0.01
21/11/2008	7.9	68	1100	2	0.34	0.006	0.04

Table 8 Site 110

Date	pH	Sulphate	Conductivity	Total Organic Carbon	Total Iron	Total Zinc	Ammonia (Nitrogen)
		mg/L	*mg/L*	*mg/L*	*mg/L*	*mg/L*	*mg/L*
1/04/1989	6.9	42					
2/04/1989	7.1	64					
3/04/1989	7.3	22					
4/04/1989		20					
5/04/1989	7.1	32					
6/04/1989	7.3	40					
7/04/1989	7.4	50					
8/04/1989	7.3	59					
9/04/1989	7.3	67					
10/04/1989	7.2	34					
11/04/1989	7.5	42					
12/04/1989	7.4	48					
13/04/1989		27					
14/04/1989		35					
15/04/1989		59					
16/04/1989		85					
17/04/1989		104					
18/04/1989		173					
19/04/1989		112					
20/04/1989		86					
21/04/1989		87					
22/04/1989		90					
23/04/1989		90					
24/04/1989		95					
25/04/1989		85					
26/04/1989		130					
27/04/1989		43					
28/04/1989		43					
29/04/1989		110					
29/04/1989		43					
30/04/1989		95					
1/05/1989		95					
2/05/1989		90					
3/05/1989		140					
4/05/1989		90					
6/05/1989		75					
7/05/1989		75					
8/05/1989		80					
9/05/1989		90					
10/05/1989		95					
11/05/1989		90					
12/05/1989		95					

Date	pH	Sulphate	Conductivity	Total Organic Carbon	Total Iron	Total Zinc	Ammonia (Nitrogen)
		mg/L	*mg/L*	*mg/L*	*mg/L*	*mg/L*	*mg/L*
13/05/1989		100					
14/05/1989		100					
15/05/1989		110					
16/05/1989		120					
17/05/1989		110					
18/05/1989		110					
19/05/1989		70					
20/05/1989		70					
21/05/1989		70					
22/05/1989		75					
23/05/1989		75					
5/06/1989		55					
14/06/1989		80					
12/07/1989		90					
4/08/1989		49					
14/08/1989		65					
13/10/1989		80					
13/11/1989	7.6	120	1000				
15/11/1989	7.5	90	1300				
17/11/1989	7.7	120	1000				
5/02/1990	7.2	140	1070				
20/04/1990	7.7	130					
8/06/1990	7.4	65					
13/07/1990		50					
17/08/1990	7.4	60					
31/08/1990	8	85					
14/09/1990	7.6	50					
28/09/1990	7.8	70					
19/10/1990	7.5	85					
16/11/1990	7.6	60					
11/06/1991	7.4	80	551				
12/06/1991	7	59	436				
14/06/1991	7.2	65	540				
8/07/1991	8	170	1910				
22/07/1991	7.8	65	820				
16/09/1991	8.2	110	1340				
29/10/1991	7.7	41	1060				
27/11/1991	7.5	70	950				
11/12/1991	7.6	440	770				
10/01/1992	7.5	95	1070				
4/03/1992	7.3	70	810				
22/05/1992	7.7	160	960				
3/06/1992	8	220	2460				

Date	pH	Sulphate	Conductivity	Total Organic Carbon	Total Iron	Total Zinc	Ammonia (Nitrogen)
		mg/L	*mg/L*	*mg/L*	*mg/L*	*mg/L*	*mg/L*
30/06/1992	8	280	2800				
7/08/1992	8.1	270	2630				
6/10/1992	8.2	230	3100				
2/11/1992	7.5	140	410				
8/03/1993	7.5	55	900				
31/05/1993	7.5	95	760				
26/07/1993	7.5	120	930				
9/09/1993	7.5	150	1730				
5/10/1993	7.5	100	1030				
15/11/1993	7.1	110	1330				
4/03/1994	6.9	110	910				
9/06/1994	7.4	170	1270				
16/11/1994	7.6	320	2630				
28/11/1994	7.5	115	1000				
30/11/1994	7.6	220	2000				
1/12/1994	7.6	190	1370				
20/01/1995	7.5	75	1030				
16/05/1995	7.4	140	1000				
23/05/1995	7.1	240	1000				
16/06/1995	7.6	190	2000				
19/07/1995	7.8	200	1510				
2/08/1995	7.9	190	1860				
6/09/1995	7.9	215	2430				
20/09/1995	7.7	180	2150				
27/09/1995	7.9	150	1340				
4/10/1995	7.7	145	920				
25/10/1995	7.9	120	1680				
8/11/1995	7.8	104	1610				
22/11/1995	7.6	74	1090				
28/11/1995		140					
28/11/1995	7.6	140	1960				
29/11/1995	7.5	125	2280				
1/12/1995	7.7	120	1630				
7/12/1995	7.7	150	740				
7/12/1995	7.7	150	740				
11/12/1995	7.6	90	900				
20/12/1995	7.6	75	820				
16/01/1996	7.5	180	1670				
22/01/1996	7.6	155	900				
5/02/1996	7.3	120	1030				
19/02/1996	7.5	97	1040				
4/03/1996	7.1	80	960				
18/03/1996	7.3	80	980				

Date	pH	Sulphate	Conductivity	Total Organic Carbon	Total Iron	Total Zinc	Ammonia (Nitrogen)
		mg/L	*mg/L*	*mg/L*	*mg/L*	*mg/L*	*mg/L*
1/04/1996	7.4	80	1450				
15/04/1996	7.6	80	930				
29/04/1996	7.5	90	910				
8/05/1996	7.3	180	850				
14/05/1996	7.6	190	1040				
27/05/1996	7.5	200	1140				
6/06/1996	7.7	230	1290				
11/06/1996	7.8	225	1290				
25/06/1996	7.8	230	2520				
25/06/1996	7.8	230	2520				
8/07/1996	7.6	205	1620				
23/07/1996	7.9	305	2390				
29/07/1996	7.5	110	890				
29/07/1996	7.5	110	890				
6/08/1996	7.7	150	1330				
23/08/1996	7.8	175	1800				
29/08/1996	7.9	210	2000				
2/09/1996	7.6	185	1190				
2/09/1996	7.6	185	1190				
17/09/1996	7.5	160	1660				
1/10/1996	7.2	45	370				
1/10/1996	7.2	45	370				
17/10/1996	7.7	90	1180				
21/10/1996	7.9	100	1200				
21/10/1996	7.9	100	1200				
31/10/1996	7.6	80	930				
6/11/1996	7.6	115	1290				
6/11/1996	7.6	115	1290				
12/11/1996	7.7	160	1580				
20/11/1996	7.5	140	1610				
29/11/1996	7.5	135	1310				
9/12/1996	7.7	95	1020				
20/01/1997	7.2	75	990				
4/02/1997	7.2	60	860				
17/02/1997	7.4	70	930				
3/03/1997	7.3	190	1200				
4/03/1997	7.2	150	1010				
29/04/1997	7.5	95	1120				
11/06/1997	7.6	105	960				
25/06/1997	7.6	110	910				
30/06/1997	7.3	55	450				
9/07/1997	7.7	110	900				
24/07/1997	7.5	130	1070				

Date	pH	Sulphate	Conductivity	Total Organic Carbon	Total Iron	Total Zinc	Ammonia (Nitrogen)
		mg/L	*mg/L*	*mg/L*	*mg/L*	*mg/L*	*mg/L*
24/07/1997	7.5	130	1070				
8/08/1997	7.8	180	1620				
21/08/1997	7.8	190	2120				
3/09/1997	7.2	220	1150				
22/09/1997	7.8	190	1260				
22/09/1997	7.8	190	1260				
15/10/1997	7.8	125	1100				
4/11/1997	7.5	65	860				
2/12/1997	7.2	64	890				
27/01/1998	7.2	190	1070				
9/02/1998	7.4	87	620				
22/04/1998	7.1	184	880				
9/06/1998	7.6	174	910				
23/06/1998	7	97	730				
10/08/1998	7.6	84.2	620				
9/09/1998	7.2	101	579				
5/10/1998	7.6	81.7	1190				
6/11/1998	7.1	102	1140				
29/01/1999	7.3	42	791				
22/03/1999	7.34	36.9	475				
1/06/1999	7.43	94.5	929				
15/07/1999	7.78	147	1990				
2/09/1999	7.77	251	2690				
5/10/1999	7.78	211	2390				
25/10/1999	7.09	45.4	392				
9/12/1999	7.41	57.3	907				
9/03/2000	7.48	68.5	811				
6/04/2000	7.57	90.3	903				
23/06/2000	7.71	127	1040				
9/08/2000	7.73	113	2140				
26/09/2000	7.57	227	2180				
19/10/2000	7.48	137	900				
14/11/2000	7.76	114	1633				
5/02/2001	7.14	62.7	7.96				
8/06/2001	7.61	72.2	786				
8/06/2001	7.61		786				
11/07/2001	7.59	127	962				
11/07/2001							
21/08/2001	7.64	76	818	9			
21/08/2001	7.73	224					
21/08/2001	7.89	198	2970				
28/08/2001	7.45	75.3	826				
28/08/2001	7.64		818				

Date	pH	Sulphate	Conductivity	Total Organic Carbon	Total Iron	Total Zinc	Ammonia (Nitrogen)
		mg/L	*mg/L*	*mg/L*	*mg/L*	*mg/L*	*mg/L*
10/09/2001							
10/09/2001	7.65	165	1780				
20/09/2001	7.89	198	2970	16			0.01
12/10/2001	7.69	127	1710				
5/02/2002	6.63	43	306				
6/02/2002							
15/04/2002	7.34		776				
17/06/2002	7.5	78.3	830				
4/09/2002	7.53		1080				
22/10/2002	7.37	129	261	15			
9/12/2002	7.22	92	928	13			0.33
11/12/2002	7.19		1080				
18/02/2003	7.58	97	931	5			0.56
24/02/2003	6.6		1050				
31/03/2003	7.91		542				
4/04/2003		105	794	13			0.16
16/06/2003	6.28	104	970				
2/09/2003	6.31	133	1255	9			
3/11/2003	6.73		1876				
27/01/2004	7.51		932				
16/03/2004	6.36	184	997	10			0.01
11/05/2004	7.22	156	1310	6	1.17	0.076	0.07
12/07/2004	6.79	140	905	13	1.61	1.4	0.14
7/09/2004	7.11	123	1228	9	0.3	0.639	0.01
5/10/2004	7.85	148	1090	8	0.4	0.109	0.01
23/10/2004	7.64	104	1040	13	2.8	0.226	0.04
5/11/2004	8.01	85	782	10	5.2	0.121	0.09
5/01/2005	7.79	100	1290	1	0.87	0.108	0.09
15/03/2005	7.15	69	1130	7	2.12	0.189	0.074
30/05/2005	7.27	56	970	4	0.78	0.044	0.027
1/07/2005	7.23	77	730	10	0.62	0.299	0.075
12/09/2005	6.83	220	2330	11	0.5	0.262	0.111
8/11/2005	7.38	85	1250	12	0.38	0.121	0.03
9/02/2006	6.5	54	419	19	4.17	0.091	0.034
7/03/2006	6.55	104	850	8	1.2	0.31	0.08
9/05/2006	7.54	124	2213	9	0.5	0.3	0.1
14/07/2006	8	49	729	5	0.05	0.041	0.012
19/01/2007	6.9	100	650	18	0.63	0.38	0.82
1/03/2007	7.3	60	660	20	0.6	0.19	0.07
30/04/2007	7.6	40	810		0.59	0.081	0.01
18/05/2007	7.3	23	190	5	3.8	1.3	0.34
15/06/2007	7.2	23	340	34	11	0.17	0.18
16/08/2007	7.6	140	1700	6	0.35	0.19	0.09

Date	pH	Sulphate	Conductivity	Total Organic Carbon	Total Iron	Total Zinc	Ammonia (Nitrogen)
		mg/L	*mg/L*	*mg/L*	*mg/L*	*mg/L*	*mg/L*
5/11/2007	7.4	58	910	26	0.45	0.18	0.04
7/02/2008	7.7	13	1000	13	0.87	0.016	0.06
4/06/2008	7.4	44	930	6	2	0.37	0.05
23/07/2008	7.6	97	900	7	0.31	0.071	0.2
28/08/2008	7.4	160	1600	5	0.41	0.072	0.01
25/09/2008	7.6	170	2000	8	0.33	0.043	0.02
21/11/2008	7.3	27	570	5	1.7	0.23	0.04
10/09/2009	7.6	150	1000	6	0.24	0.26	0.06
19/01/2010	7.3	85	650	12	0.42	0.1	0.08
16/02/2010	7.3	93	540	12	0.37	0.14	0.1
30/03/2010	7.3	45	780	10	1.9	0.24	0.05
27/05/2010	7.7	55	450	12	0.56	0.094	0.04

Table 9 Site 130

Date	pH	Sulphate	Conductivity	Total Organic Carbon	Total Iron	Total Zinc	Ammonia (Nitrogen)
		mg/L	*uS/cm*	*mg/L*	*mg/L*	*mg/L*	*mg/L*
18/02/2003	7.88	11	556	7			0.08
4/04/2003		31	395	11			0.1
16/06/2003	6.65	70	525				
2/09/2003	6.29	60	520	5			
3/11/2003	6.91		626				
27/01/2004	7.28		478				
16/03/2004	6.16	28	580	10			0.01
11/05/2004	7.7	22	550	7	0.5	0.015	0.02
12/07/2004	6.79	38	689	5	0.39	0.009	0.01
7/09/2004	7.08	148	764	30	0.3	0.02	0.01
1/10/2004	7.98	55	487	8	0.7	0.01	0.03
23/10/2004	7.97	57	685	9	0.4	0.005	0.01
5/11/2004	7.92	34	574	4	0.2	0.005	0.07
5/01/2005	7.99	13	604	7	0.23	0.005	0.052
15/03/2005	7.53	10	646	12	0.57	0.05	0.035
30/05/2005	7.96	15	437	5	0.08	0.006	0.022
1/07/2005	7	13	151	13	1.21	0.019	0.055
12/09/2005	6.67	14	623	14	0.66	0.05	0.129
8/11/2005	7.57	1	618	9	0.5	0.035	0.02
9/02/2006	6.32	1	364	21	4.34	0.109	0.094
7/03/2006	7.53	12	323	9	2.4	0.005	0.022
9/05/2006	8.01	1	612	6	0.5	0.004	0.02
14/07/2006	7.73	37	515	6	0.05	0.017	0.015

Date	pH	Sulphate	Conductivity	Total Organic Carbon	Total Iron	Total Zinc	Ammonia (Nitrogen)
		mg/L	*uS/cm*	*mg/L*	*mg/L*	*mg/L*	*mg/L*
19/01/2007	8.1	56	880	17	0.5	0.009	0.04
1/03/2007	7.7	60	970	15	0.32	0.077	0.01
30/04/2007	8.1	45	700		0.46	0.005	0.01
18/05/2007	8	38	620	6	0.82	0.005	0.04
15/06/2007	7.3	52	590	6	1.2	0.033	0.04
16/08/2007	7.6	73	590	4	0.19	0.005	0.04
5/11/2007	7.3	14	270	17	0.91	0.008	0.02
7/02/2008	8	39	770	8	0.19	0.005	0.03
4/06/2008	7.5	18	530	5	0.11	0.005	0.01
23/07/2008	7.8	48	500	5	0.14	0.012	0.04
28/08/2008	7.8	37	520	5	0.16	0.005	0.02
25/09/2008	7.8	35	520	5	0.27	0.005	0.01
21/11/2008	8	13	510	8	0.37	0.005	0.01
10/09/2009	7.8	55	660	5	0.19	0.012	0.03

Chart 1. Pond 2 Surface Water Quality *

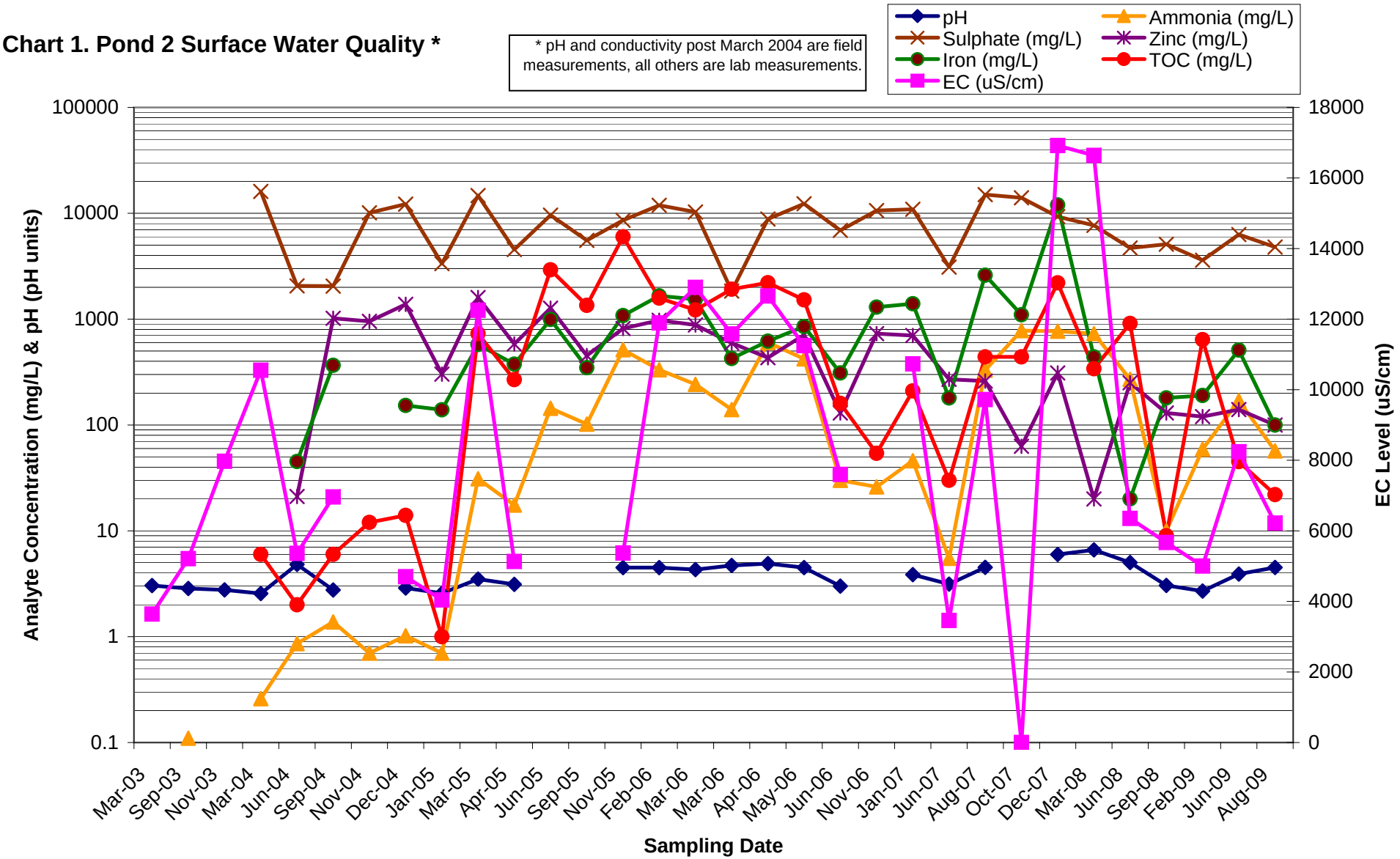


Chart 2. Pond 3 Surface Water Quality *

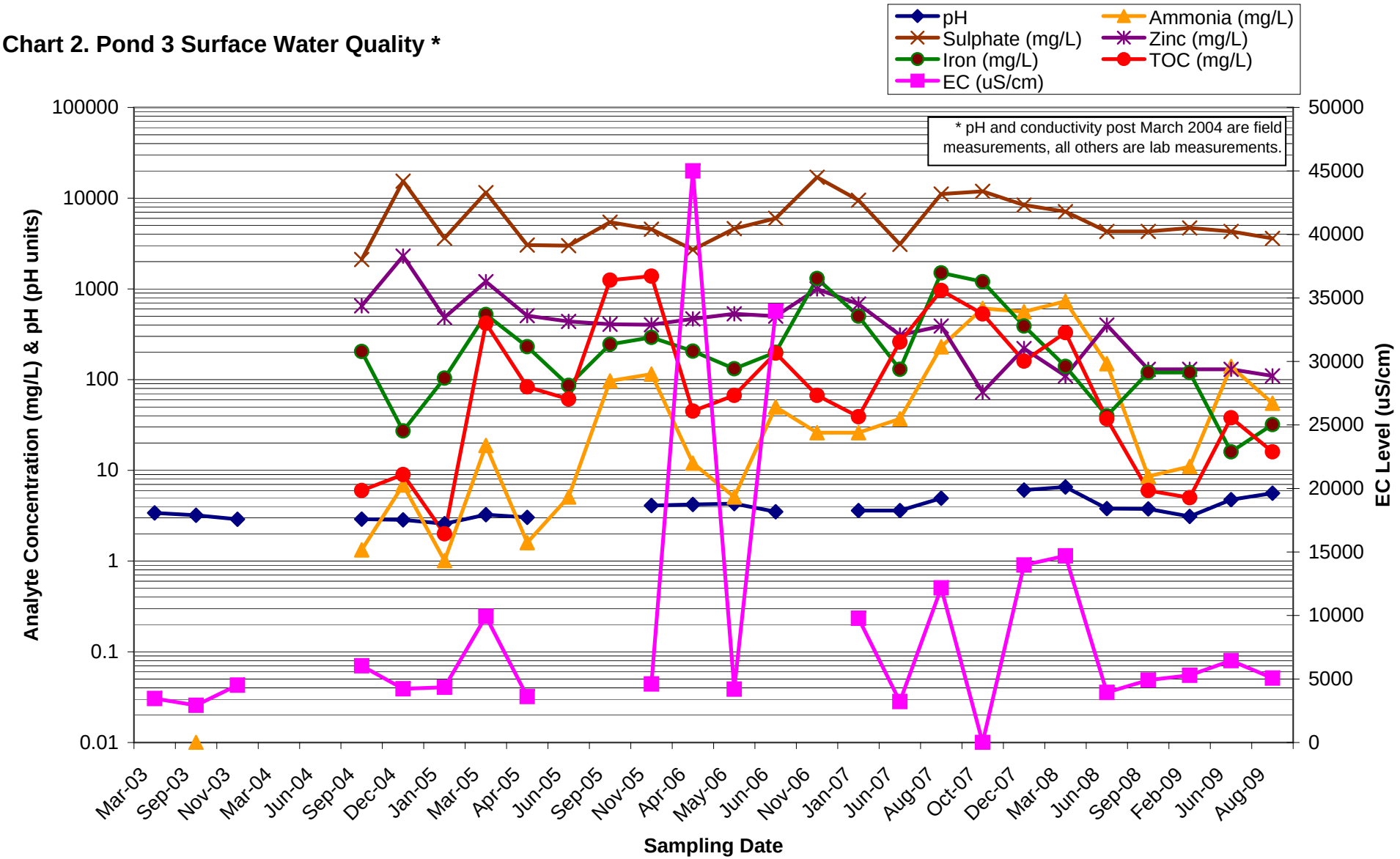


Chart 3. Site 115 Surface Water Quality *

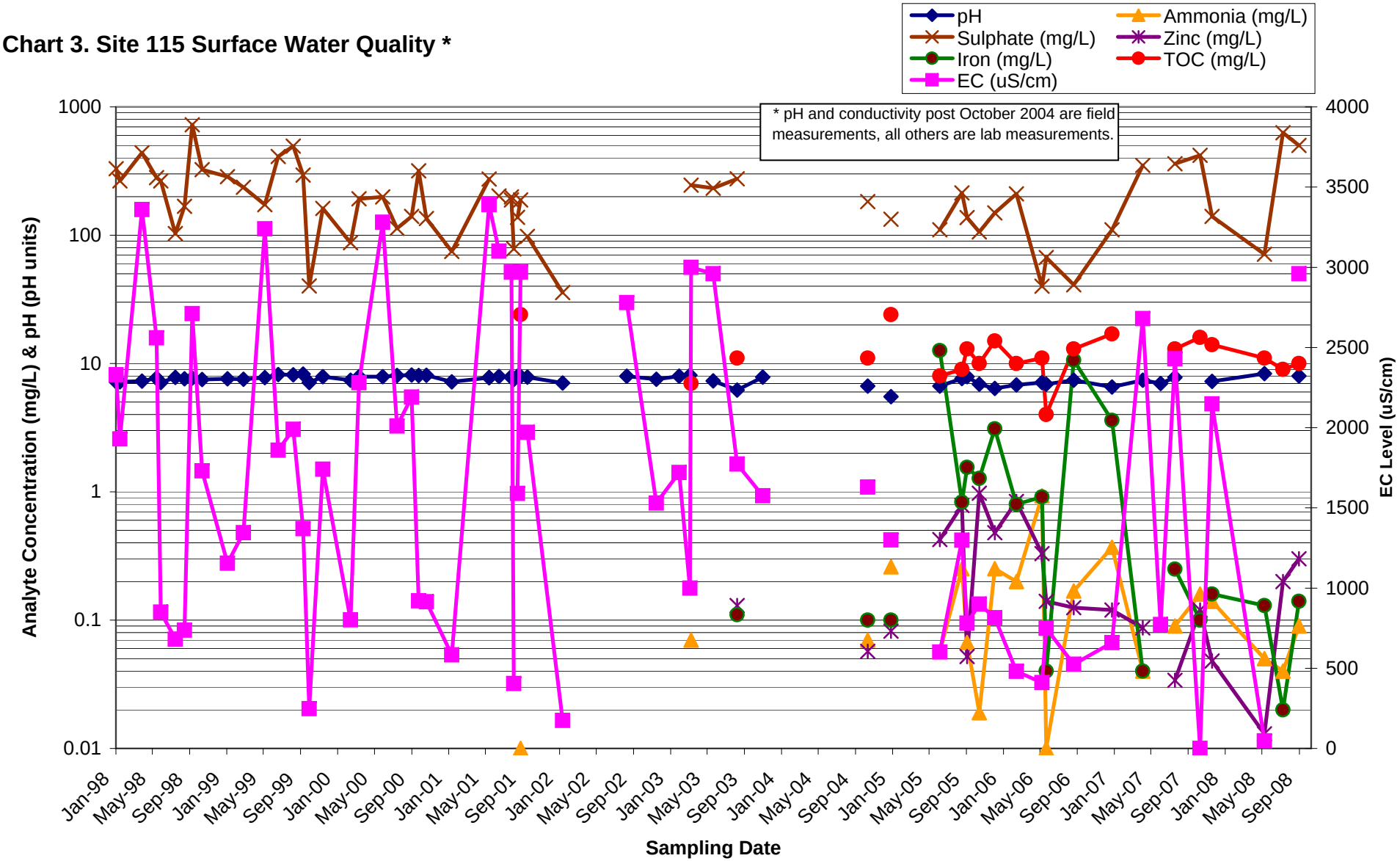


Chart 4. Spring 2 Surface Water Quality *

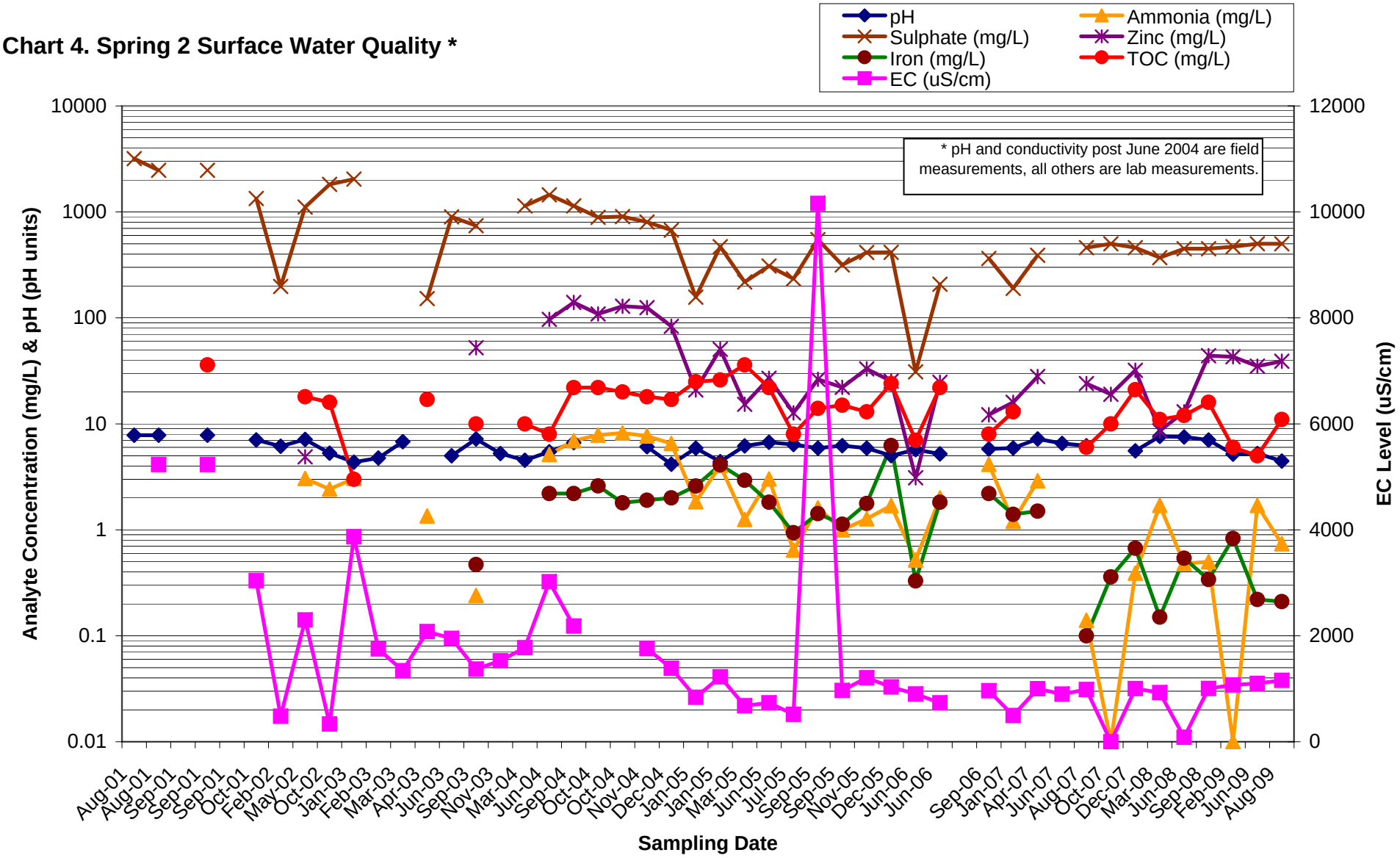


Chart 5. Site 105 Surface Water Quality *

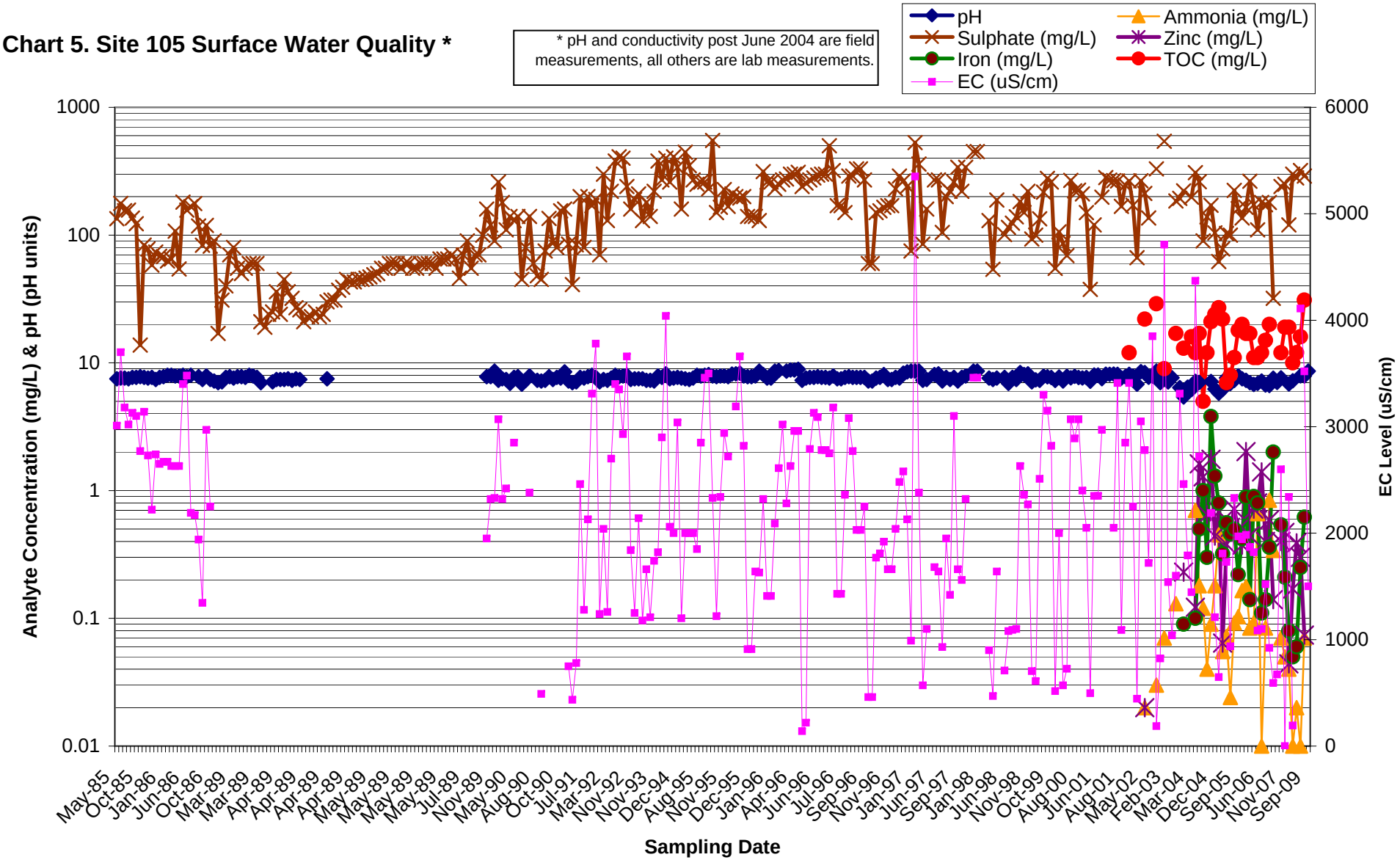


Chart 6. WM200 Surface Water Quality *

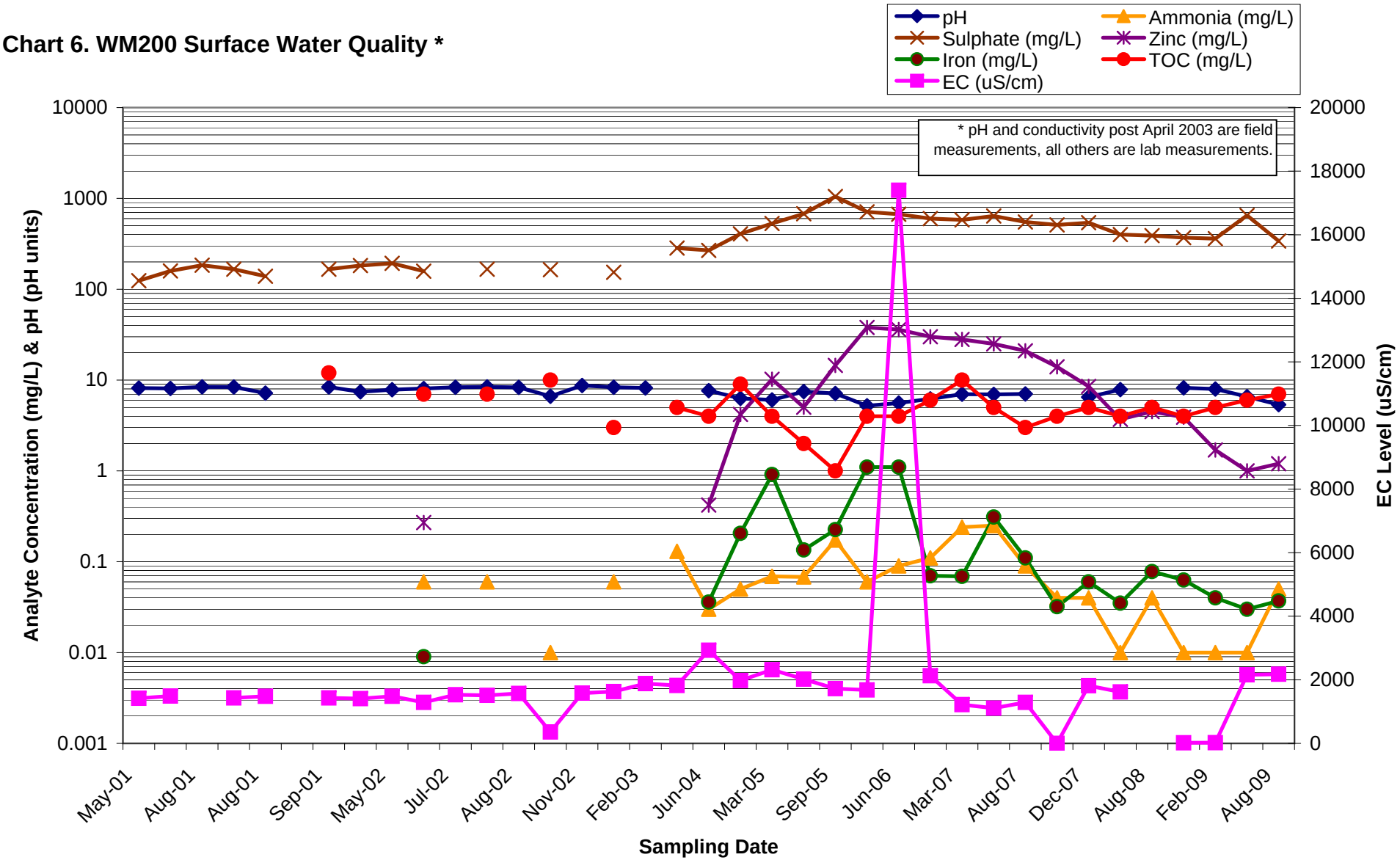
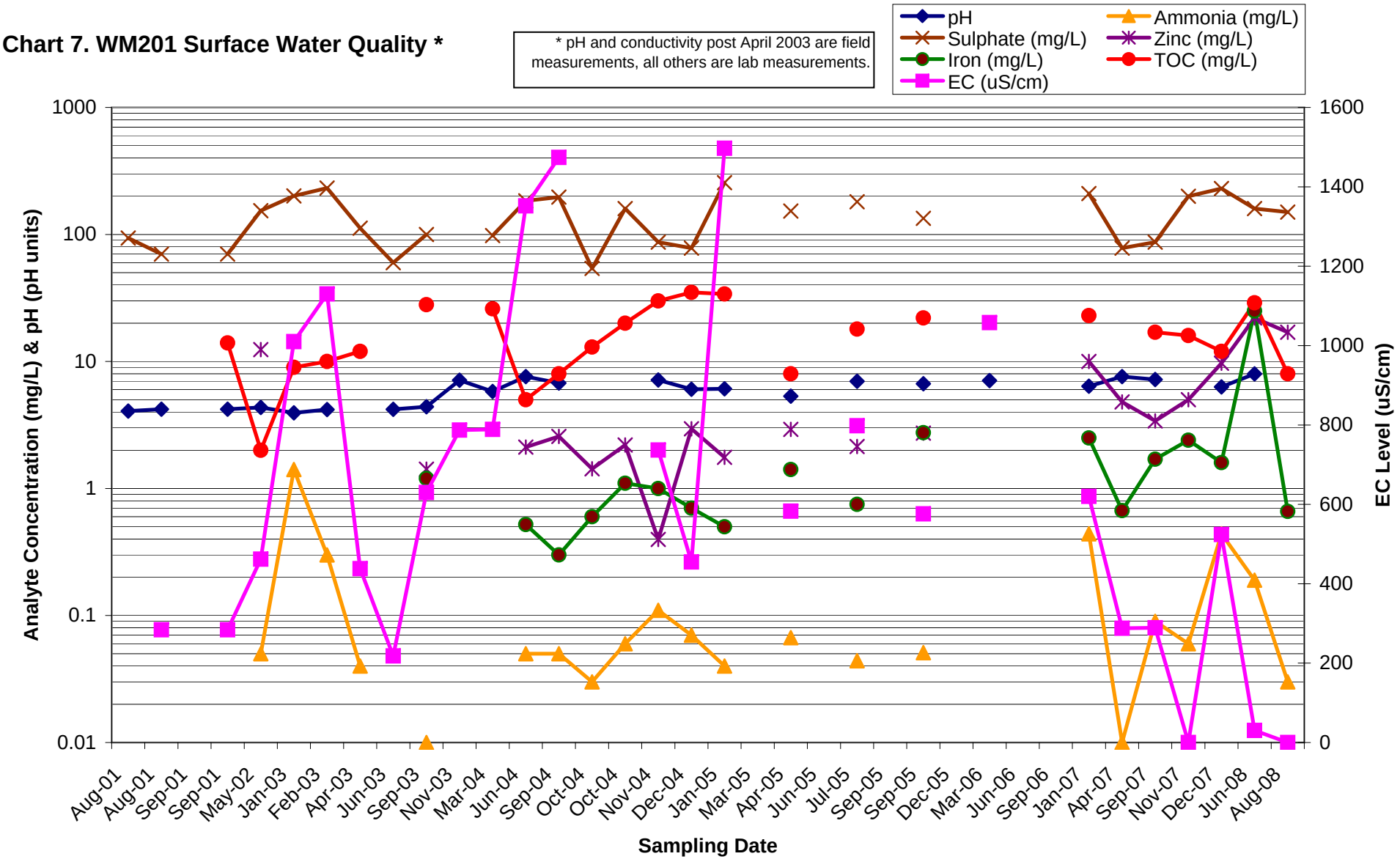


Chart 7. WM201 Surface Water Quality *



Cahrt 8. WM202 (ED3S) Surface Water Quality *

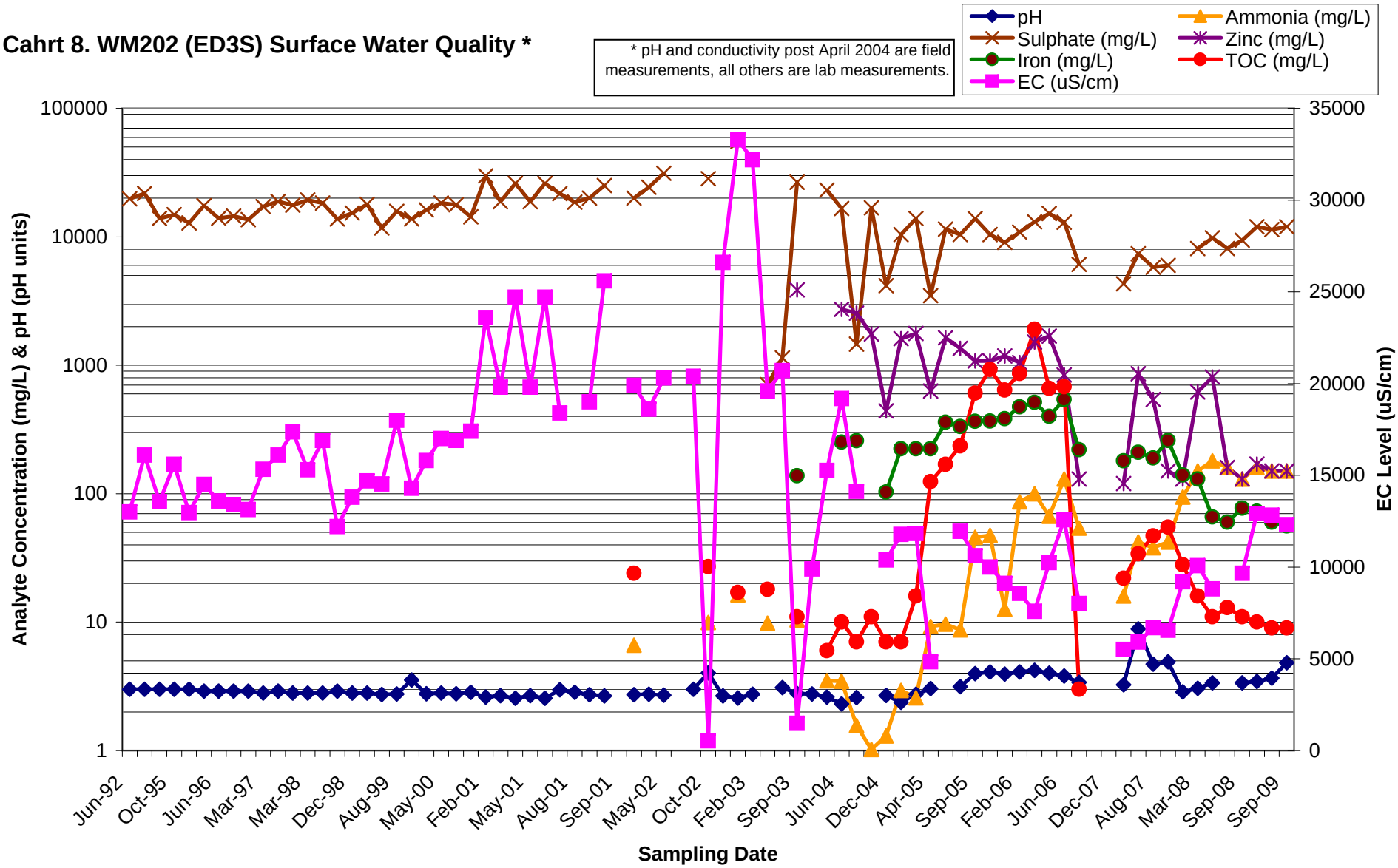
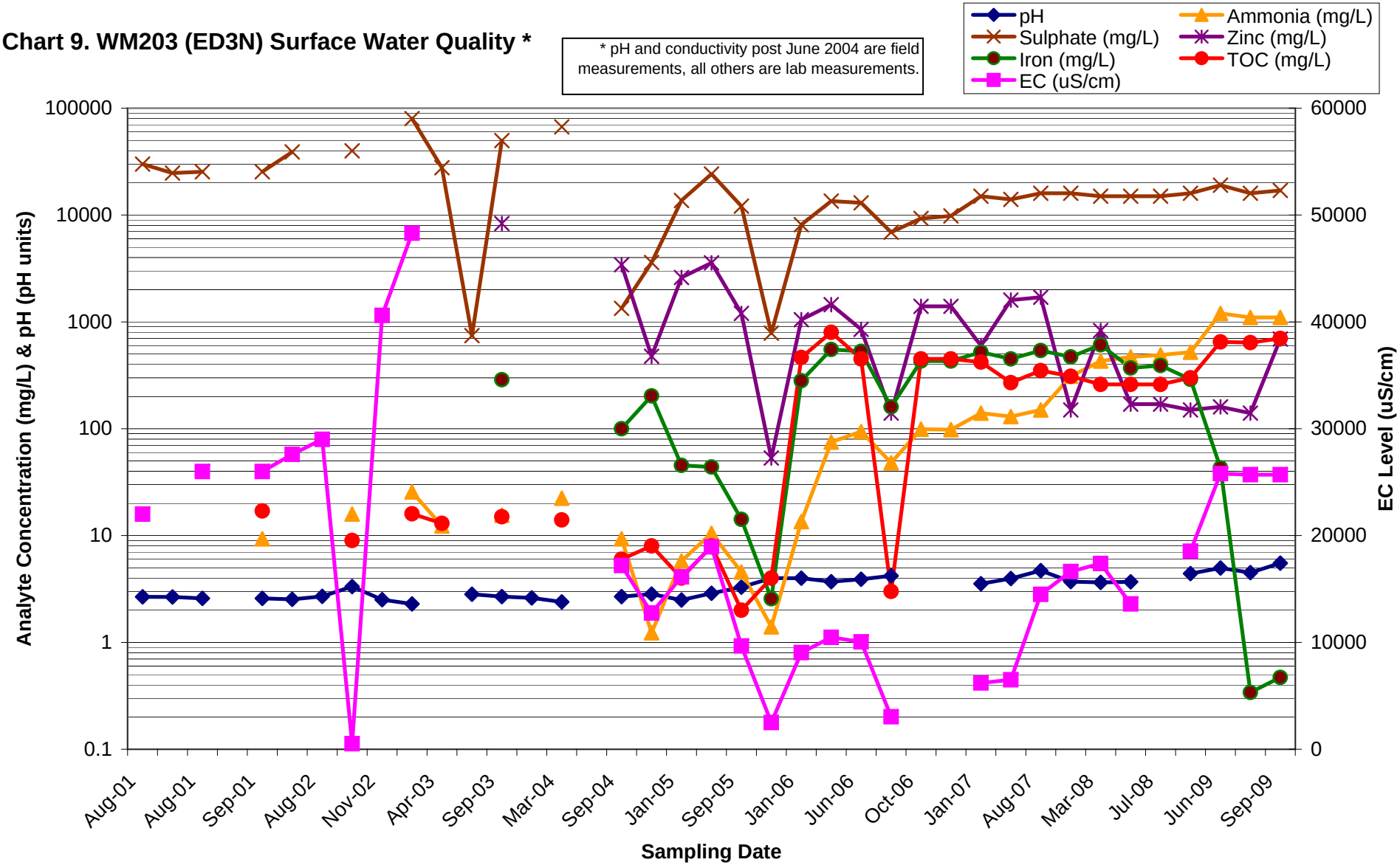


Chart 9. WM203 (ED3N) Surface Water Quality *



Cahrt 10. Site 150 Surface Water Quality *

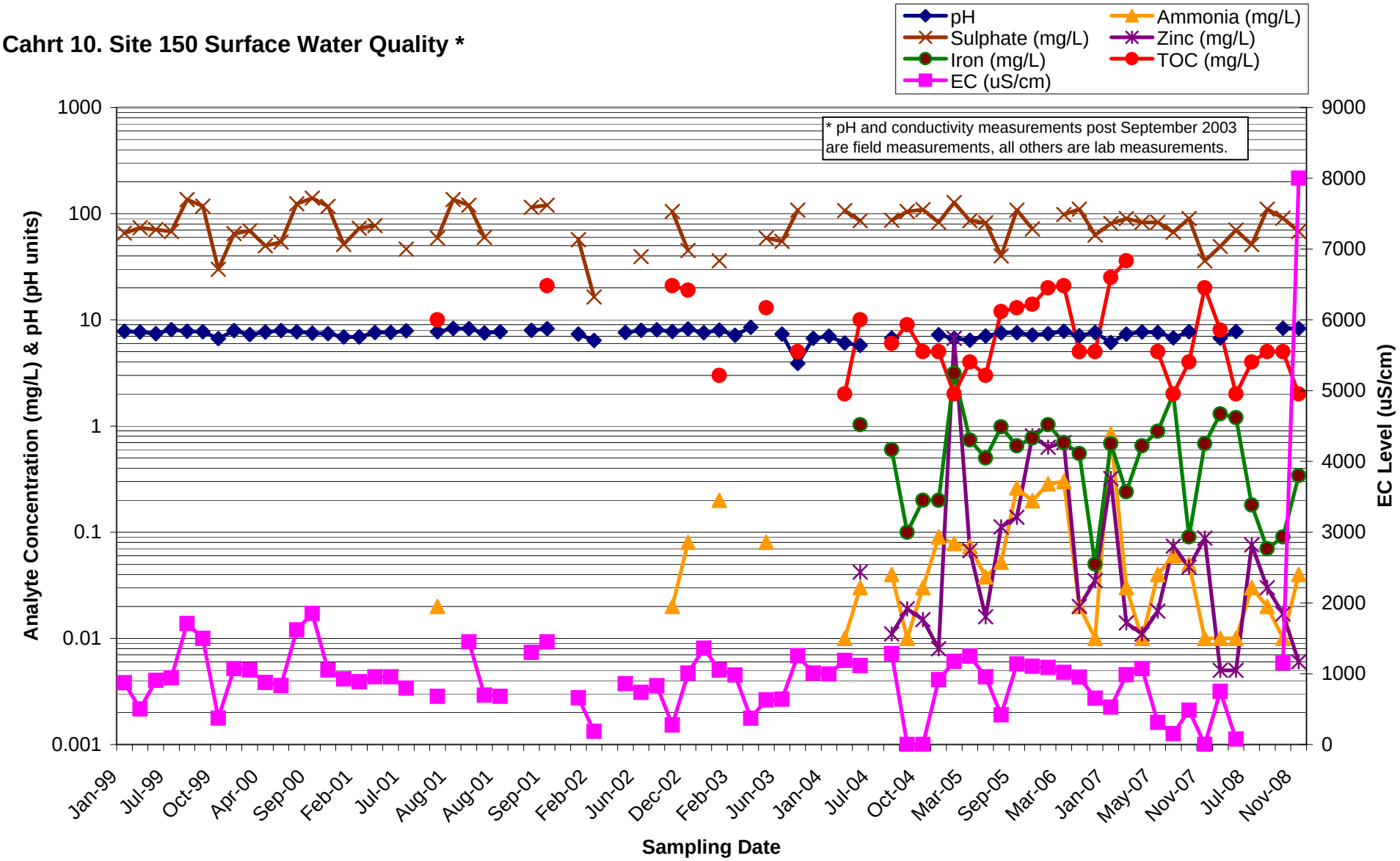


Chart 11

. Site 110 Surface Water Quality *

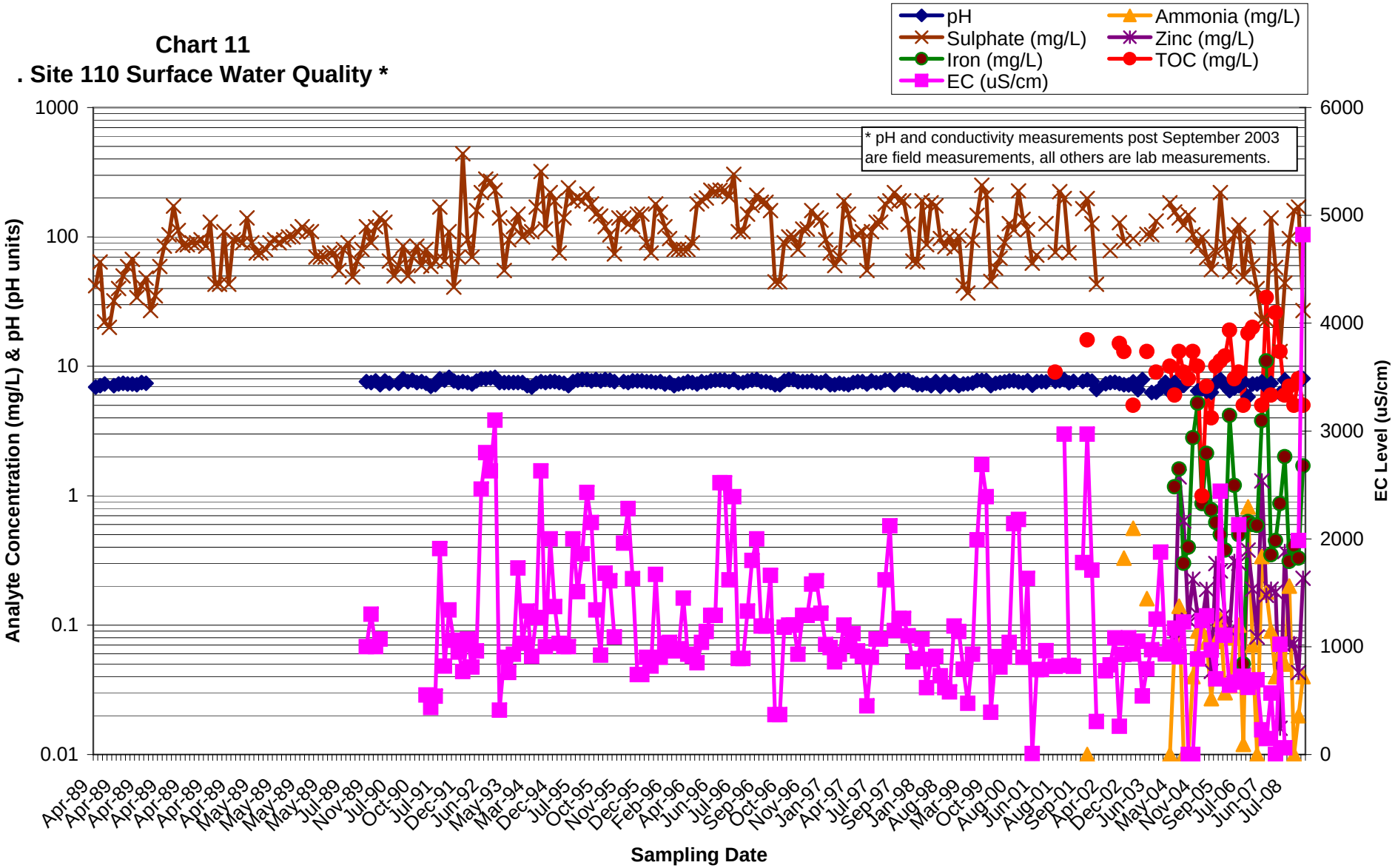
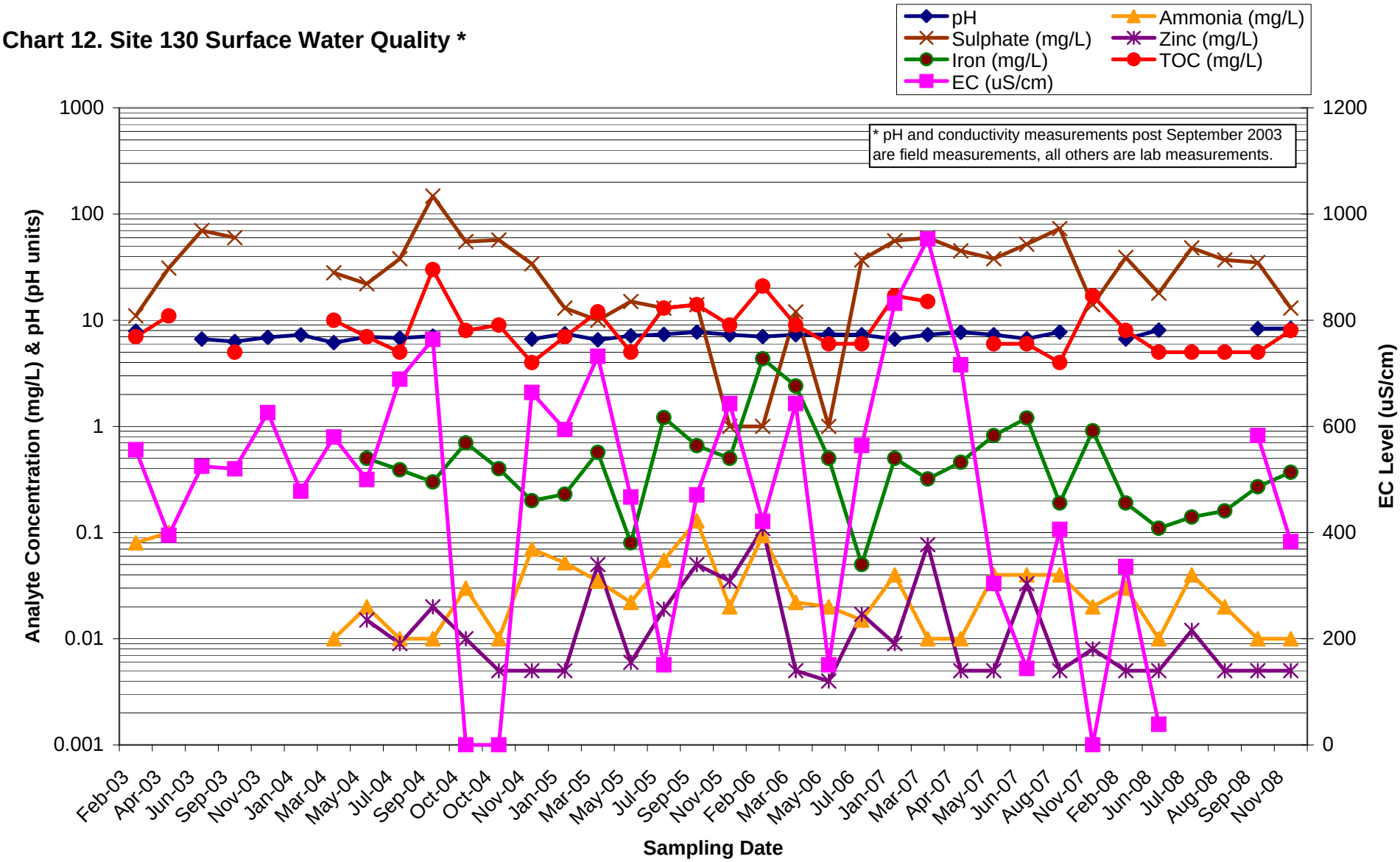


Chart 12. Site 130 Surface Water Quality *



Air Quality and Odour Assessment

Appendix D

HEGGIES

REPORT 30-2464-R2

Revision 5

Woodlawn Bioreactor
Odour and Dust Impact Assessment
Woodlawn Expansion Project

PREPARED FOR

Veolia Environmental Services (Australia) Pty Ltd
619 Collector Road,
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2 AUGUST 2010

HEGGIES PTY LTD
ABN 29 001 584 612

Woodlawn Bioreactor
Odour and Dust Impact Assessment
Woodlawn Expansion Project

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This document has been prepared in accordance with the requirements of that System.

DOCUMENT CONTROL

Reference	Status	Date	Prepared	Checked	Authorised
30-2464-R2	Revision 4	2 August 2010	Martin Doyle	Gary Graham	Martin Doyle
30-2464-R2	Revision 4	13 July 2010	Martin Doyle	Gary Graham	Martin Doyle
30-2464-R2	Revision 3	1 July 2010	Martin Doyle	Gary Graham	Martin Doyle
30-2464-R2	Revision 2	30 April 2010	Martin Doyle	Doug Boddy	Martin Doyle

EXECUTIVE SUMMARY

Introduction

Veolia Environmental Services Australia Pty Ltd (Veolia) operates a Bioreactor facility located within the 6,000 hectare Woodlawn Eco Precinct at Woodlawn, in the Southern Highlands of NSW. Prior to becoming a waste management facility, Woodlawn operated as a base metals mine site during the 1970s and 1990s. The Woodlawn Bioreactor is now located within a 25 million cubic metre void, which was created during the mining operations. Current approval conditions allow the processing of up to 400,000 tonnes of waste per year as per consent condition 4.

Veolia is seeking approval to receive and process 1.13 million tonnes of waste per year at the Woodlawn Bioreactor and 1.18 million tonnes of waste per year at the Crisps Creek Intermodal Facility. Heggies Pty Ltd (Heggies) has been engaged by Veolia to assess the potential odour and dust impacts on the surrounding environment associated with this increase in waste processing.

Assessment Criteria

Predicted impacts of the Woodlawn Expansion Project have been compared to NSW Department of Environment, Climate Change and Water (DECCW) criteria. These criteria are designed to minimise both health (particulate matter) and nuisance (odour and dust) impacts from projects.

The odour criterion adopted for this study is based on the surrounding population number as it is assumed that a lower population will have a lower number of sensitive individuals and therefore a higher odour concentration can be tolerated. An odour criterion of 6 odour units (OU) expressed as a 99th percentile of 1 second averages (6 OU not to be exceeded more than 3.6 days per year) has been calculated for use in this study, based on accepted NSW DECCW methodologies. NSW DECCW intends the odour criterion to be used as a management tool, to reduce the impact of odourous operations on surrounding communities. It is not intended to achieve 'no odour'. The use of the 99th percentile within the criterion reflects this intension.

The dust criteria adopted for use within this study are based on NSW DECCW guidance. Particulate matter with an aerodynamic diameter of less than 10 microns (PM_{10}) has been assessed alongside Total Suspended Particulate (TSP) and dust deposition. PM_{10} and TSP impacts are assessed against health based criteria whereas dust deposition is intended to provide an indication of the level of nuisance dust generated by the Project at the nearest residences surrounding the Woodlawn site. Concentrations of PM_{10} are not to exceed 50 micrograms per cubic metre ($\mu g/m^3$) in a 24 hour period or 30 $\mu g/m^3$ over the course of a year. TSP is not to exceed 90 $\mu g/m^3$ over the course of a year. Dust deposition is not to exceed 2 grams per square metre per month (g/m^2/month) as a result of the Project operations.

Emissions Estimation

In order to quantify potential odorous emissions from the Project, Heggies utilised a combination of site specific odour emission rate data and that derived from similar facilities (for the Alternative Waste Treatment Facility) to conduct a Level 3 odour impact assessment in accordance with the relevant guidance documents.

Emissions of dust from the Project operations were estimated using site operation characteristics and the Environment Australia National Pollutant Inventory (NPI) Document "*NPI Emission Estimation Technique Manual for Mining"* Version 2.3, 2001, and the "*NPI Emission Estimation Technique for Combustion Engines*" Version 3 June 2008.

EXECUTIVE SUMMARY

Pollutant Modelling

A gridded meteorological dataset incorporating a full year of 2005 monitoring data from the Woodlawn site was derived covering a full year of hourly varying observations (8,760 hours). This dataset was then used in the assessment of the transportation of pollutants from the Woodlawn site to the various locations of maximum impact. Contour plots showing the spatial distribution of these impacts were generated and are presented in the report. Land use and topographical variations across the modelling domain were incorporated into the modelling exercise, both in meteorological and pollutant dispersion modelling.

Results

The results of the odour modelling predicted that the 99th percentile 1-second average ground-level odour concentrations at the surrounding sensitive receptor locations ranged from 1.2 OU to 4.1 OU. The Project specific odour performance goal was assumed to be 6 OU and therefore the predicted odour concentrations were below the Project specific odour performance goal.

Particulate matter emissions associated with the proposed Woodlawn Expansion Project are not predicted to result in exceedances of the adopted criteria for the Project. Dust deposition levels are significantly below the adopted background level and are predicted to result in incremental increases of less than 0.07 g/m^2/month at all receptors. PM_{10} concentrations are predicted to be less than 13 µg/m^3 as a 24-hour maximum and 0.7 µg/m^3 as an annual average at all receptors, excluding background concentrations. Total suspended particulate concentrations are predicted to be less than 0.3 µg/m^3 as an annual average at all modelled receptors, excluding background concentrations. When the predicted incremental PM_{10} and TSP impacts are aggregated with worst-case background concentrations, the total impacts do not exceed any ambient air quality standards.

Current Environment

A range of waste management and odour control measures have been trialled since the commencement of operations. These measures include, but are not limited to, the trialling of a range of alternate waste cover systems and the management of leachate in temporary storage ponds. Veolia has been made aware that odour has been detected from time to time by residents along Taylors Creek Road and Tarago village. This feedback has been used in assessing the performance of site operations and waste management measures.

Veolia will continue to work with the local community to further improve waste management measures at the facility and relating operational updates as a function of the Woodlawn Community Liaison Committee.

The modelling results presented in **Section 6** of this report seek to represent off-site odour impacts associated with a likely worst case operational scenario for a current base case scenario and the 1.13 Mtpa waste expansion scenario.

Table of Contents

1 INTRODUCTION 7

1.1 Process Overview 7
1.1.1 Bioreactor 7
1.1.2 Crisps Creek Intermodal Facility 8
1.1.3 Alternative Waste Treatment Facility 9
1.1.4 Hours of Operation 11
1.1.5 Waste Management Strategies 11

1.2 Study Overview 11

1.3 Sensitive Receptors 12

1.4 Site Topography 12

2 AIR QUALITY / ODOUR CRITERIA 14

2.1 Particulate Matter 14
2.1.1 Goals Applicable to PM_{10} 14
2.1.2 Goal Applicable to TSP 14
2.1.3 Nuisance Impacts of Fugitive Emissions 14

2.2 Odour 14

3 EXISTING AIR QUALITY ENVIRONMENT 17

3.1 Background Odour Environment 17

3.2 Background Particulate Matter Environment 17
3.2.1 Background Dust Deposition 17
3.2.2 Background Particulate Matter 18

3.3 Background Air Quality Environment for Assessment Purposes 21

4 CLIMATE AND DISPERSION METEOROLOGY 22

4.1 Local Meteorology 22

4.2 Modelling Approach 22

4.3 Meteorological Model Configuration 25

5 DISPERSION MODELLING CONFIGURATION 27

5.1 Modelling Scenarios 27
5.1.1 Base Case Odour Scenario 27
5.1.2 Expansion Project Odour Scenario 27
5.1.3 Waste Expansion Project Particulate Scenario 28

5.2 Odour Emission Rate Definitions 28

5.3 Odour Emission Rates 28
5.3.1 Site Specific Monitoring 28
5.3.2 Derived Emissions Data 29
5.3.3 Adopted Odour Emission Rates 30
5.3.4 Odour Peak-to-Mean Ratios 31

5.4 Particulate Matter Emission Rates 32

5.5 Particulate Emission Inventory 33

6 AIR QUALITY IMPACT ASSESSMENT 34

6.1 Odour Impact Assessment 34

6.2 Particulate Matter / Dust Impact Assessment 36
6.2.1 Dust Deposition 36
6.2.2 Total Suspended Particulate 37

6.3 PM_{10} 38

6.4 Conclusions 40

Table 1 Description of Liquid Storage 7
Table 2 Potentially Affected Residences 12
Table 3 DECCW Goals for Allowable Dust Deposition 14
Table 4 NSW DECCW Impact Assessment Criteria for Complex Mixtures of Odorous Air Pollutants (nose-response-time average, 99th percentile) 16
Table 5 Background Dust Deposition, Woodlawn 17
Table 6 PM_{10} Monitoring Results – "Pylara" 19
Table 7 Background Air Quality Environment for Assessment Purposes 21
Table 8 Summary of Annual Wind Behaviour at Woodlawn, 2005 24
Table 9 Meteorological Parameters used for this Study 25
Table 10 Odour Monitoring Results – Leachate 29
Table 11 Odour Monitoring Results - Waste – 27 November 2009 29
Table 12 AWT Odour Sources and Properties 29
Table 13 Emission Rates Adopted for Modelling 30
Table 14 Particulate Emission Factors for Air Quality Dispersion Modelling 32
Table 15 Predicted 99th Percentile 1 Second Average Odour Concentration 34
Table 16 Background and Predicted Incremental Dust Deposition 36
Table 17 Background and Predicted Incremental Total Suspended Particulate 37
Table 18 Background and Predicted 24-Hour Average PM_{10} Concentrations 38
Table 19 Background and Predicted Annual Average PM_{10} Concentrations 39

Figure 1 Layout of Woodlawn Bioreactor and Liquid Storage / Management System 8
Figure 2 Proposed AWT Facility Layout 10
Figure 3 3-Dimensional Regional Topography Surrounding Project Site (Vertical Exaggeration 4) 13
Figure 4 Example of Spatially Varying Surface Flows Generated by CALMET for the Project Site 23
Figure 5 Annual Stability Class Distribution for the Woodlawn Site. 25
Figure 6 99th Percentile 1 Second Average Odour Concentration – Woodlawn Bioreactor – Base Case 35
Figure 7 99th Percentile 1 Second Average Odour Concentration – Woodlawn Bioreactor – Woodlawn Expansion Project and AWT Facility 36
Figure 8 Predicted Annual Average Incremental Dust Deposition (g/m²/month) – Woodlawn Bioreactor – Woodlawn Expansion Project and AWT Facility 37
Figure 9 Predicted Maximum 24-hour Incremental PM_{10} Concentration (µg/m³) – Woodlawn Bioreactor – Woodlawn Expansion Project and AWT Facility 39
Figure 10 Predicted Annual Average PM_{10} Incremental Concentration (µg/m³) – Woodlawn Bioreactor – Woodlawn Expansion Project and AWT Facility 40

Appendix A Annual and Seasonal Wind Roses for Project Site – 2005
Appendix B Seasonal Atmospheric Stability Class Distribution for the Project Site – 2005
Appendix C Particulate Emissions Inventory
Appendix D CALMET and CALPUFF INPUT FILES (Odour and PM_{10})

1 INTRODUCTION

Veolia Environmental Services Australia Pty Ltd (Veolia) operates a Bioreactor facility located within the 6,000 hectare Woodlawn Eco-Precinct at Woodlawn, in the Southern Highlands of NSW (the Project Site). Prior to becoming a waste management facility, Woodlawn operated as a base metals mine site during the 1970s to 1990s. The Woodlawn Bioreactor is now located within a 25 million cubic metre void, which was created during the mining operations. Current approval conditions allow the processing of up to 400,000 tonnes of waste per year.

Veolia is seeking approval to receive and process 1.13 million tonnes of waste per year at the Woodlawn Bioreactor and 1.18 million tonnes of waste per year at the Crisps Creek Intermodal Facility.

On the advice of the Department of Planning (DoP), Veolia has made a separate application to modify the existing development consent under Section 75W of the Environment Planning and Assessment Act 1979, to permit Woodlawn to receive up to 50,000 tonnes of waste per annum by road from surrounding regional Councils. The Section 75W modification is currently being assessed by the DoP.

1.1 Process Overview

1.1.1 Bioreactor

Waste material is currently transported in sealed containers via rail to the Crisps Creek Intermodal Facility, approximately 8 km to the southeast of the Woodlawn Bioreactor, then by road to the Bioreactor Site (refer **Section 1.1.2**). These containers are designed to reduce odour and dust impacts from the transport element of the project. Once at the site, trucks and containers are driven into the mine void, where waste is unloaded and spread by a dozer and compactor. Upon subsequent degradation, landfill gas containing methane (CH_4) is produced which is collected, transferred to the onsite generators and combusted to produce power.

Quantities of organic rich waters or leachate are produced during the waste degradation process, and this leachate is recirculated within the waste to further encourage biological activity and optimise bioreactor performance. However, during the initial phases of the project it has been necessary on occasions to store and treat excess leachate outside the void. Leachate is pumped directly out of the void and temporarily stored in ponds located in the Evaporation Dam area (ED3) (refer **Table 1** and **Figure 1**) prior to undergoing treatment to remove odorous components after which the treated leachate is also stored in the ED3 area to be evaporated.

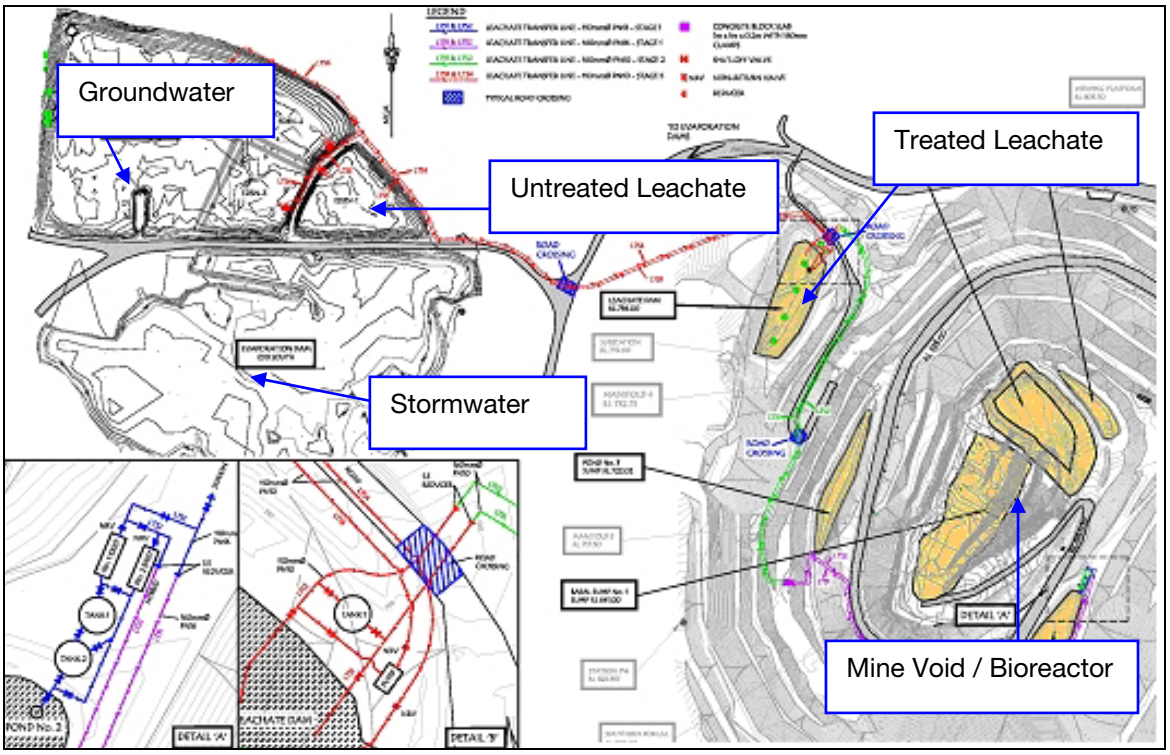
Table 1 Description of Liquid Storage

Pond/Dam	Contents	Area (ha)	Location
Leachate Dam	Treated Leachate	0.4	Immediate East of Main Void
ED3N-1	Untreated Leachate	0.7	Refer **Figure 1**
Evaporation Dam ED3 North	Groundwater	3.6	
Evaporation Dam ED3 South	Stormwater	6.7	

ED3N-2 and ED3N-3 (with a combined area of 1.3 ha) have been used previously to store leachate, however as the waste volumes increase so does the ability to absorb leachate within the waste and the hydraulic gradient reduces, thus the need to extract leachate from the void and storing in ED3. Veolia has implemented other operational solutions regarding leachate treatment and water management to reduce potential impacts from these sources including reducing the amount of stored leachate, improved treatment process and increasing evaporation capability. For the purposes of this report and in the interests of conservatism within the odour impact assessment, these ponds have been assumed to contain treated leachate.

Waste is stored in the Mine Void (refer **Figure 1**) with the daily tipping face currently occupying an area of approximately 0.64 ha, a 2 ha area of waste experiencing leachate recirculation has been assumed and covered waste in the remaining area of approximately 4.06 ha. It is noted that Veolia was granted approval to trial alternate daily cover materials on the fresh waste by the NSW Department of Environment Climate Change & Water (DECCW).

Figure 1 Layout of Woodlawn Bioreactor and Liquid Storage / Management System



Source: Veolia Woodlawn, 2009

Trucks delivering waste are driven from the Crisps Creek Intermodal Facility along sealed local roads, before arriving at the Woodlawn site. The main haul road on site is sealed up to the void, within the void this haul road is unsealed. Most of the secondary roads on site are unsealed. A water cart is used on site to control dust and protect the unsealed road surfaces.

1.1.2 Crisps Creek Intermodal Facility

The Crisps Creek Intermodal Facility (IMF) is located approximately 8 km to the southeast of the Woodlawn Bioreactor. Material is transported from the IMF to the Woodlawn Bioreactor by road.

Transport of waste to the IMF and subsequently to the Woodlawn Bioreactor occurs in sealed containers. This results in negligible odour emissions resulting from operations occurring at the IMF and during transport to Woodlawn.

In the case of dust, roads at the IMF are all sealed and therefore, assuming all roads are free of material, emissions of particulate will be limited to brake and tyre wear and vehicle exhaust emissions. It is considered that emissions of particulate from these sources will be negligible when compared to emissions from surrounding sources such as agricultural areas, or vehicles using the main road itself.

It is not considered that emissions of odour or dust from the IMF would form a material consideration in determining the impacts of the Project, and that a quantitative assessment of odour or dust from the IMF would not provide any meaningful information and is therefore not warranted. Given the above, the impacts of odour or dust from the IMF have not been considered further.

1.1.3 Alternative Waste Treatment Facility

Approval was granted to Veolia in November 2007 to construct and operate an Alternative Waste Technology (AWT) facility at the Woodlawn site incorporating the "Woodlawn Alternative Sorting and Processing" (WASP) facility and the "Composted Organics and Greenwaste" (WOCOG) facility, this would ultimately be used to produce compost for mine rehabilitation. Although the AWT has not been constructed yet, this assessment assumes that any current and future operations at the site include the AWT facility. Certain elements of the facility have the potential to generate dust and odour and these have been assessed quantitatively within this report.

Details of the AWT design have been referenced from the approval documents as submitted by Heggies in November 2006 (Report 30-1392R2R8 dated 2 November 2006). Details of waste throughputs have been referenced from the Preliminary Environmental Assessment, Woodlawn Bioreactor – Waste Expansion Project, January 2010.

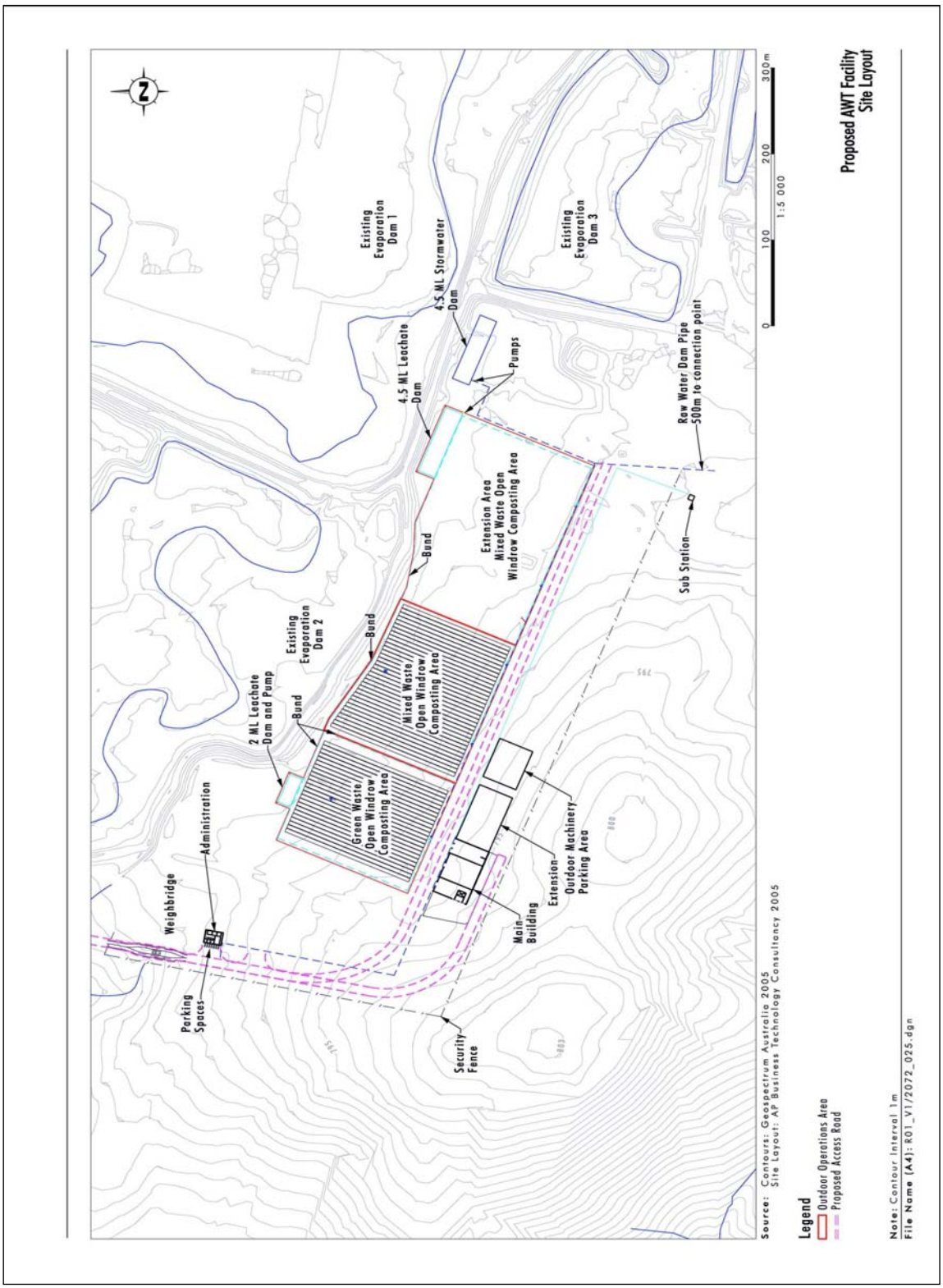
The AWT facility will be comprised of a range of processing and recycling technology which is modular in nature allowing for extension as required dependant on volumes received to the site. The waste processing building will have an initial total floor area of 0.27 ha with the potential to expand to 0.54 ha in total building size to accommodate for future growth.

The proposed processing capacity for the WASP will be 240,000 tpa. The WOCOG will have a processing capacity of 40,000 tpa.

The WASP and WOCOG facilities will each have open windrow composting areas comprising 6.4 ha and 2.24 ha respectively. Two leachate dams will control surface water run-off and leachate generated at the AWT facility.

The AWT facility is illustrated in **Figure 2**.

Figure 2 Proposed AWT Facility Layout



Source: Umwelt (Australia) Pty Limited (2006)

1.1.4 Hours of Operation

The proposed hours of operation at the approved AWT and Bioreactor are between 6.00 am to 10.00 pm six days per week with the exception of truck operations at the IMF, which would be between 7.00 am and 10.00 pm.

Current operating hours at the Woodlawn Bioreactor are from 6.00 am to 7.00 pm and 6 am to 6 pm at the Crisps Creek IMF, Mondays to Saturdays with the exception of truck operations at the IMF, which are be between 7.00 am and 6.00 pm. The approved hours of operation for the approved AWT are 6.00 am to 10.00 pm..

1.1.5 Waste Management Strategies

A range of waste management and odour control measures have been trialled since the commencement of operations. These measures include, but are not limited to, the trialling of a range of alternate waste cover systems and the management of leachate in temporary storage ponds. Veolia has been made aware that odour has been detected from time to time by residents along Taylors Creek Road and Tarago Village. This feedback has been used in assessing the performance of site operations and waste management measures.

Veolia will continue to work with the local community to further improve waste management measures at the facility and relating operational updates as a function of the Woodlawn Community Liaison Committee.

The modelling results presented in **Section 6** of this report seek to represent off-site odour impacts associated with a likely worst case operational scenario for a current base case scenario and the 1.13 Mtpa waste expansion scenario.

1.2 Study Overview

This report seeks to quantify the odour and dust/particulate impact at the nearest identified receptors resulting from the proposed Woodlawn Expansion Project.

To quantify any increase in generated odour, a 'base case' has been modelled, against which the increased waste processing scenario can be assessed. In the case of dust, a cumulative assessment of proposed operations and background concentrations of particulate have been modelled representing the Project operations.

It is assumed that processing of larger quantities of waste will result in increased odour being generated, mainly from the fresh tip face, rather than from leachate storage. The modelling undertaken as part of this assessment has assumed that all liquid storage areas are at capacity and the fresh tip face is currently 80 m by 80 m (projected to increase to approximately 100 m by 200 m (2 ha) under the increased waste processing scenario). It is considered that these assumptions represent a worst case scenario as leachate storage areas are not likely to be at capacity. It is also considered to be unlikely that Veolia would operate such a large tip-face.

As previously discussed, operation of an AWT facility has been granted approval for the Project Site but has not yet been constructed at the current time. However, potential emissions from the AWT have been quantitatively assessed within this report to allow the determination of the potential cumulative odour and dust impact from all approved and proposed odour and dust sources at the Woodlawn Bioreactor Site and Crisps Creek Intermodal Facility

In order to quantify potential odorous emissions from the Project, Heggies will utilise a combination of site specific odour emission rate data and data derived from similar facilities (for the AWT) to conduct a Level 3 odour impact assessment in accordance with the NSW Department of Environment, Climate Change and Water (DECCW) 2006 document *Technical Framework: Assessment and Management of Odour from Stationary Sources in New South Wales* (DECCW, 2006a), hereafter referred to as the Odour Framework. This assessment will involve the modelling of local meteorology and the dispersion of odorous emissions from the Project Site to predict the level of impact that may be experienced in the surrounding environment.

To quantify emissions of dust and particulate matter from the Project, Heggies will utilise emission factors as defined in the Australian Department of Environment "Emission Estimation Technique Manual for Mining version 2.3 (National Pollutant Inventory, 2001) and relevant United States Environmental Protection Agency (USEPA) AP-42 emission factors.

1.3 Sensitive Receptors

The nearest potentially affected residences are summarised in **Table 2**.

Table 2 Potentially Affected Residences

Property ID	Property Name	Distance to Project Site (m)	Easting (m)	Northing (m)	Elevation (m AHD)
1	"Woodlawn Farm"	1,600	734518	6118363	796
2	"Cowley Hills"	2,000	736673	6117689	794
3	"Pylara"	4,000	737493	6114373	742
4	"Torokina"	3,700	731287	6114653	720

The properties of "Woodlawn", "Cowley Hills" and "Pylara" are all Veolia-owned residences and as such, could be considered to be 'Project-related' residences. However, in the interests of minimising odour and dust impacts on the surrounding area, the odour and dust impact from both current and project operations have been assessed at *all* surrounding residences, project-related or not.

Due to the significant distances between the Project Site and the identified sensitive receptors, results for the receptors noted in **Table 2** can be considered to represent the odour and dust impacts across a wider area than at the individual receptor points themselves (e.g. at neighbouring properties within 100 to 200 m). Examination of the individual pollutant contour plots provided in **Section 6** can be examined to obtain more refined information on the spatial distributions of predicted pollutant impacts if required.

1.4 Site Topography

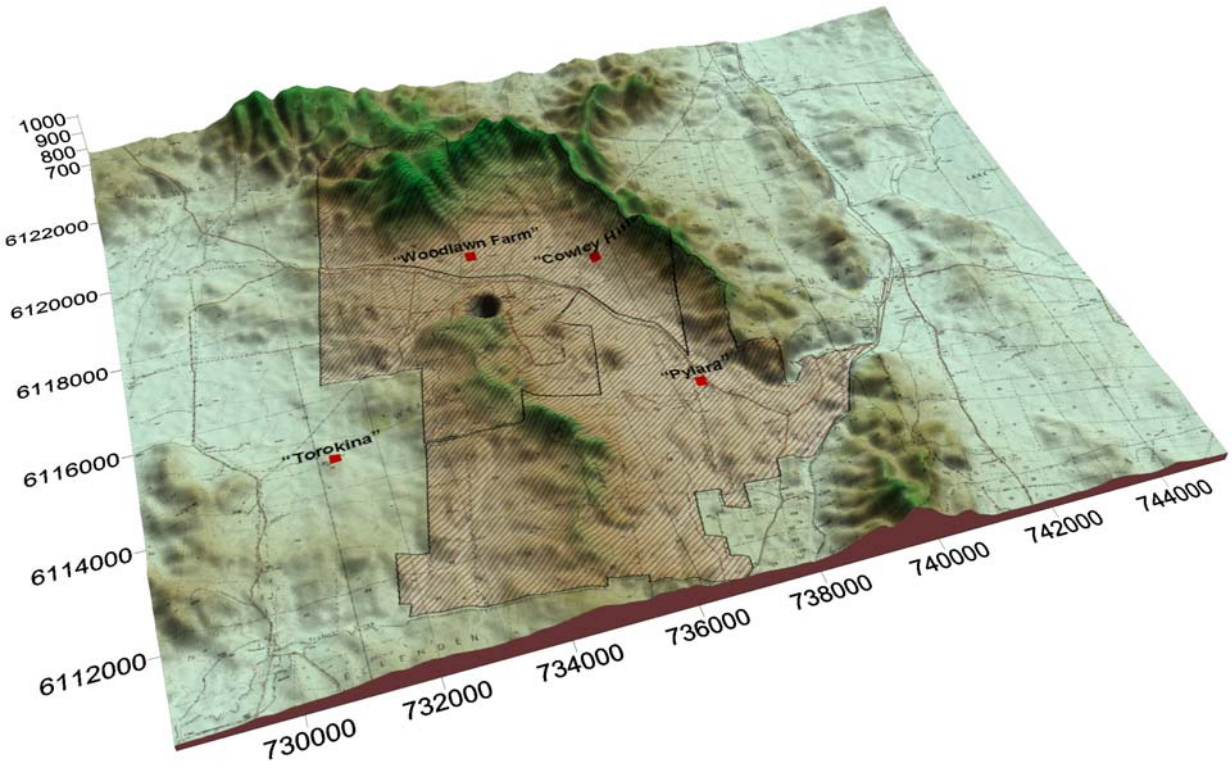
The project site and surrounding residences are located in undulating terrain. To the northeast of the site the topography rises to a high point of 1000 metres (m) AHD falling away to a height of 690 m AHD to the southwest. To the southeast of the approved AWT facility and directly south of the mine void, a topographic ridge extends to a height of 880 m AHD. Beyond this, the land falls away to a height of 740 m AHD.

The residences to the east of the facility ("*Woodlawn Farm*" and "*Cowley Hills*") are on a similar level to the approved AWT with no significant topographical features in-between. To the northwest and west of the approved AWT, the land falls away to a height of 700 m AHD.

Local atmospheric dispersion could be influenced by night-time katabatic drainage flows from elevated terrain or channelling effects in valleys or gullies around the site.

A three dimensional representation of the area is given in **Figure 3**, with a vertical exaggeration of four applied to emphasise terrain features.

Figure 3 3-Dimensional Regional Topography Surrounding Project Site (Vertical Exaggeration 4)



NOTE: Topography shown with vertical exaggeration of 4. Project Boundary indicated by hatched area.

2 AIR QUALITY / ODOUR CRITERIA

2.1 Particulate Matter

2.1.1 Goals Applicable to PM_{10}

PM_{10} is considered to be an important pollutant in terms of potential impact due to its ability to penetrate into the respiratory system.

The DECCW PM_{10} assessment goals as expressed in the Approved Methods are:

- a 24-hour maximum of 50 micrograms per cubic metre (µg/m^3);
- a 24-hour maximum of 150 µg/m^3 (Project and other sources); and
- an annual average of 30 µg/m^3 (Project and other sources).

The 24-hour PM_{10} reporting standard of 50 µg/m^3 is numerically identical to the "*Ambient Air Quality National Environment Protection Measure"* (NEPM) (National Environmental Protection Council, 1998) reporting standard except that the NEPM reporting standard allows for five exceedances per year.

2.1.2 Goal Applicable to TSP

The annual goal for TSP is given as 90 µg/m^3 (Project and other sources), as recommended by the National Health and Medical Research Council (NHMRC) at their 92nd session in October 1981. This goal has also been adopted in the Approved Methods.

2.1.3 Nuisance Impacts of Fugitive Emissions

The preceding sections are concerned in large part with the health impacts of particulate matter. Nuisance impacts need also to be considered, mainly in relation to dust. In NSW, accepted practice regarding the nuisance impact of dust is that dust-related nuisance can be expected to impact on residential areas when annual average dust deposition levels exceed 4 g/m^2/month.

Table 3 presents the DECCW impact assessment goals for dust deposition, showing the allowable increase in dust deposition level over the ambient (background) level which would be acceptable so that dust nuisance could be avoided.

Table 3 DECCW Goals for Allowable Dust Deposition

Averaging Period	Maximum Increase in Deposited Dust Level	Maximum Total Deposited Dust Level
Annual	2g/m^2/month	4g/m^2/month

Source: Approved Methods, DECCW 2005.

2.2 Odour

Impacts from odorous air contaminants are often nuisance-related rather than health-related. Odour performance goals guide decisions on odour management, but are generally not intended to achieve "no odour".

The detectability of an odour is a sensory property that refers to the theoretical minimum concentration that produces an olfactory response or sensation. This point is called the *odour threshold* and defines one odour unit per cubic metre (OU/m^3). An odour goal of less than 1 OU/m^3 would theoretically result in no odour impact being experienced.

In practice, the character of a particular odour can only be judged by the receiver's reaction to it, and preferably only compared to another odour under similar social and regional conditions. Based on the literature available, the level at which an odour is perceived to be a nuisance can range from 2 OU/m^3 to 10 OU/m^3 depending on a combination of the following factors:

- *Odour Quality*: whether an odour results from a pure compound or from a mixture of compounds. Pure compounds tend to have a higher threshold (lower offensiveness) than a mixture of compounds.
- *Population sensitivity:* any given population contains individuals with a range of sensitivities to odour. The larger a population, the greater the number of sensitive individuals it may contain.
- *Background level:* whether a given odour source, because of its location, is likely to contribute to a cumulative odour impact. In areas with more closely-located sources it may be necessary to apply a lower threshold to prevent offensive odour.
- *Public expectation:* whether a given community is tolerant of a particular type of odour and does not find it offensive, even at relatively high concentrations. For example, background agricultural odours may not be considered offensive until a higher threshold is reached than for odours from a landfill facility.
- *Source characteristics:* whether the odour is emitted from a stack (point source) or from an area (diffuse source). Generally, the components of point source emissions can be identified and treated more easily than diffuse sources. Emissions from point sources can be more easily controlled using control equipment. Point sources tend to be located in urban areas, while diffuse sources are more often located in rural locations.
- *Health Effects:* whether a particular odour is likely to be associated with adverse health effects. In general, odours from agricultural activities are less likely to present a health risk than emissions from industrial facilities.

Experience gained through odour assessments from proposed and existing facilities in NSW indicates that an odour performance goal of 7 OU/m^3 is likely to represent the level below which "offensive" odours should not occur (for an individual with a 'standard sensitivity' to odours). The NSW DECCW recommends within the Odour Framework that, as design goal, no individual be exposed to ambient odour levels of greater than 7 OU/m^3. This is expressed as the 99th percentile value, as a nose response time average (approximately one second).

Odour performance goals need to be designed to take into account the range in sensitivities to odours within the community, and provide additional protection for individuals with a heightened response to odours, using a statistical approach which depends on the size of the affected population. As the affected population size increases, the number of sensitive individuals is also likely to increase, which suggests that more stringent goals are necessary in these situations. In addition, the potential for cumulative odour impacts in relatively sparsely populated areas can be more easily defined and assessed than in highly populated urban areas. It is often not possible or practical to determine and assess the cumulative odour impacts of all odour sources that may impact on a receptor in an urban environment. Therefore, the proposed odour performance goals allow for population density, cumulative impacts, and anticipated odour levels during adverse meteorological conditions and community expectations of amenity.

Where a number of the factors above simultaneously contribute to making an odour "offensive", an odour goal of 2 OU/m^3 at the nearest residence (existing or any likely future residences) is appropriate, which generally occurs for affected populations equal or above 2000 people.

The equation used by the NSW DECCW to determine the appropriate impact assessment criteria for complex mixtures of odorous air pollutants, as specified in the Approved Methods, is expressed as follows:

Impact assessment criterion (OU) = ($\log_{10}$(population)-4.5)/-0.6

A summary of the impact assessment criteria given for various population densities, as drawn from the Approved Methods, is given in **Table 4**.

Table 4 NSW DECCW Impact Assessment Criteria for Complex Mixtures of Odorous Air Pollutants (nose-response-time average, 99th percentile)

Population of Affected Community	Impact Assessment Criteria for Complex Mixtures of Odours (OU)
Urban area (≥ 2000)	2.0
~300	3.0
~125	4.0
~30	5.0
~10	6.0
Single residence (≤ 2)	7.0

Source: The Approved Methods (DECCW, 2005)

The Approved Methods states that the impact assessment criteria for complex mixtures of odorous air pollutants must be applied at the nearest existing or likely future off-site sensitive receptor(s).

The incremental impact (predicted impact due to the pollutant source alone) must be reported in units consistent with the impact assessment criteria (OU), as peak concentrations (i.e. approximately 1 second average) and as the:

- 100th percentile of dispersion model predictions for Level 1 impact assessments, or
- 99th percentile of dispersion model predictions for Level 2 impact assessments.

Given the low number of sensitive receptor locations in the immediate vicinity of the Woodlawn site (four, **Section 1.3**) it is expected that an odour impact assessment criteria of 6 OU (expressed as the 99th percentile for a nose response average, i.e. 1-second average) would appropriately assess the odour performance of the Woodlawn Bioreactor.

3 EXISTING AIR QUALITY ENVIRONMENT

3.1 Background Odour Environment

The Woodlawn Bioreactor is the only source of similar odorous emissions in the local region. It is not considered likely that cumulative impacts between emissions from this and any other site in the surrounding region would occur.

Odour is currently generated by activities taking place at the Woodlawn Bioreactor, with the same activities occurring as part of this proposed increase in waste processing. Only odour generating activities occurring as part of the waste processing and management process have been assessed within this report.

3.2 Background Particulate Matter Environment

3.2.1 Background Dust Deposition

Background dust deposition monitoring has been conducted at the Woodlawn site at a number of locations since 2002 (i.e. before the bioreactor was operational). To determine the likely background dust levels under current operations of the Woodlawn Facility, dust deposition monitoring data from January 2007 to January 2010 is used in this assessment.

Background dust deposition monitoring conducted at three representative locations between January 2007 and January 2010 is presented in **Table 5**. Dust deposition gauge DG18 "Chinnery" was decommissioned in March 2007 on DECCW advice due to consistently low readings. Annual average total insoluble solids at this location were of the order of 2.2 g/m^2/month between August 2004 and February 2007.

Table 5 Background Dust Deposition, Woodlawn

Date	Insoluble Matter (g/m^2/month)		
	DG22 "*East Void*"	DG24 "*West Void*"	DG28 "*Pylara*"
Jan-07	1.2	2.4	1.5
Feb-07	1.9	1.9	0.9
Mar-07	1.6	1.5	1.1
Apr-07	1.4	0.5	0.7
May-07	5.5	1.1	1.6
Jun-07	1.6	0.7	1.6
Jul-07	2	0.7	0.3
Aug-07	1.4	0.7	0.7
Sep-07	2.6	0.8	1.2
Oct-07	0.9	0.9	2.6
Nov-07	0.7	1	1.8
Dec-07	3.6	2.1	1.6
Jan-08	1.3	2	1.9
Feb-08	0.6	0.5	0.7
Mar-08	1.1	1.1	1.1
Apr-08	1.8	1.6	1.5
May-08	0.9	0.5	0.5
Jun-08	3.5	1.3	1.4

Date	Insoluble Matter (g/m^2/month)		
	DG22 "*East Void*"	**DG24 "*West Void*"**	**DG28 "*Pylara*"**
Jul-08	1.7	0.4	0.8
Aug-08	5	1.2	0.3
Sep-08	11.6	12.5	7.3
Oct-08	2.1	1.1	2.8
Nov-08	3.9	2.6	6.2
Dec-08	4.4	3.8	1.6
Jan-09	7.4	7.8	14.3
Feb-09	2.1	1.9	2.5
Mar-09	2.4	2.5	4.1
Apr-09	3.8	3.4	1.7
May-09	2.8	2.4	1
Jun-09	2	1.6	2
Jul-09	0.8	1.3	2.2
Aug-09	4.3	2.9	1
Sep-09	25.8	26.8	19.6
Oct-09	2.3	2.3	0.9
Nov-09	4.6	5.5	2.5
Dec-09	2.8	2.7	2.2
Jan-10	5	10.2	1.4
Average	**3.5**	**3.1**	**2.6**

A conservatively high estimate of the background dust deposition rate (insoluble solids) in the vicinity of the Woodlawn facility for assessment purposes is assumed to be of the order of 3.5 g/m^2/month expressed as an annual average. This is the maximum of all the average deposition rates obtained from the three monitoring sites and contains a dust storm event which contributes to the high readings. However, it is considered to be appropriately conservative.

3.2.2 Background Particulate Matter

The term *"particulate matter"* refers to a category of airborne particles typically less than 50 microns (µm) in diameter and ranging down to 0.1 µm in size. Particles less than 10 µm and 2.5 µm in diameter are referred to in this report as PM_{10} and $PM_{2.5}$ particles respectively.

Background monitoring of PM_{10} has been conducted on a regular basis at the "*Pylara*" site since August 2004. Sampling was conducted using a High Volume Air Sampler (HVAS) in accordance with the NSW DECCW's "*Approved methods for the sampling and analysis of air pollutants in New South Wales*" 2005, specifically, AM-18 (AS 3580.9.6-1990 "*Particulate Matter* - PM_{10} - *high volume sampler with size-selective inlet*"). Sampling was conducted to coincide with the NSW DECCW standard one-day-in-six run cycle.

The results of the PM_{10} monitoring conducted at "*Pylara*" from 16 August 2004 to 18 November 2007 are given in **Table 6**. Data has only been collected up to 18 November 2007 as this site was decommissioned on the advice of NSW DECCW following a number of consistently low readings.

Table 6 PM_{10} Monitoring Results – "Pylara"

Date	PM_{10} (µg/m³)	Date	PM_{10} (µg/m³)	Date	PM_{10} (µg/m³)
18-11-2007	<1	16/07/05	<1	29/01/05	2
03-11-2007	<1	10/07/05	<1	23/01/05	<1
26-10-2007	<1	04/07/05	<1	17/01/05	11
18-10-2007	<1	28/06/05	<1	11/01/05	4
12-10-2007	<1	22/06/05	<1	05/01/05	5
02-10-2007	<1	16/06/05	<1	30/12/04	1
24-09-2007	<1	10/06/05	13	24/12/04	5
16-09-2007	<1	04/06/05	23	18/12/04	7
13-02-2006	<1	29/05/05	3	12/12/04	<1
07-02-2006	<1	23/05/05	4	06/12/04	11
01-02-2006	4	17/05/05	<1	01/12/04	39
23-01-2006	4	11/05/05	16	25/11/04	<1
17-01-2006	11	05/05/05	11	19/11/04	1
11-01-2005	<1	29/04/05	<1	13/11/04	1
03-01-2006	1	23/04/05	25	07/11/04	<1
19-12-2005	1	17/04/05	2	01/11/04	5
13-12-2005	1	11/04/05	5	26/10/04	3
26/09/05	<1	05/04/05	<1	20/10/04	5
20/09/05	<1	30/03/05	No Results	14/10/04	12
14/09/05	<1	24/03/05	No Results	08/10/04	5
08/09/05	<1	24/03/05	No Results	02/10/04	<1
02/09/05	<1	18/03/05	No Results	27/09/04	36
27/08/05	<1	12/03/05	No Results	21/09/04	8
21/08/05	<1	06/03/05	No Results	15/09/04	13
15/08/05	3	28/02/05	5	09/09/04	19
09/08/05	<1	22/02/05	<1	03/09/04	2
03/08/05	<1	16/02/05	7	28/08/04	10
28/07/05	<1	10/02/05	2	22/08/04	14
22/07/05	2	04/02/05	4	16/08/04	3
				Average	**9**

The above results indicate that PM_{10} monitoring conducted at the "*Pylara*" site near Woodlawn yielded 24-hour average PM_{10} concentrations below the NSW (DECCW) goal of 50 µg/m³ expressed as a 24-hour average. The maximum 24-hour average was 39 µg/m³ recorded on 1 December 2004. The results provide an indication of the background concentration of PM_{10} in the area surrounding the Woodlawn Site.

Examination of the NEPM Ambient Air Quality Report for NSW and the ACT for 2004 identifies that high PM_{10} and $PM_{2.5}$ concentrations were recorded at Monash (ACT) and within Sydney between 30 November 2004 and 1 December 2004. The NEPM report for the ACT identifies that ongoing drought conditions within this month resulted in exceedances of the NEPM Standard for PM_{10}. This is supported by the NSW NEPM report which identifies exceedances at Wagga Wagga on 30 November 2004 which were also attributed to "the continuing drought conditions experienced across NSW". Exceedances in the Sydney area were partially attributed to bushfire conditions.

It is clear that the unusually high PM_{10} concentration readings at the Woodlawn 'Pylara' monitoring station on 1 December 2004 were due to regional particulate events and driven by the continuing drought conditions. Using this PM_{10} concentration as a background concentration for assessment purposes would be highly conservative and does not reflect the usual distribution of particulate concentrations over the three year period of monitoring. Further analysis of the collected PM_{10} data shows the following statistics (assuming all <1 µg/m^3 readings are at the limit of detection of 1 µg/m^3):

- Mean: 5 µg/m^3
- Standard deviation: 7.4 µg/m^3
- 75th Percentile: 5 µg/m^3
- 90th Percentile: 13 µg/m^3
- 99th Percentile 36.6 µg/m^3
- Maximum: 39 µg/m^3

Comparison of the above statistics indicates that the recorded data predominantly shows low recorded 24-hour PM_{10} concentrations, e.g. the 90th percentile of the recorded data is 13 µg/m3. This demonstrates that values in excess of 13 µg/m^3 are recorded on only 10% of the duration of the monitoring exercise.

Further statistical analysis of the collated 24-hour PM_{10} monitoring data reports a skew value of +2.8 and a kurtosis of +8.8.

Skew is a statistical function that reports how evenly a population is distributed around the mean of that population. A positive skew represents a population that "tails off" towards the upper extents, and a negative skew represents a distribution tailing off towards the lower extents. Skew is dimensionless. The reported skew value of +2.8 value of indicates that the recorded data is typically low, but dominated by a small number of higher readings (i.e. representative of PM_{10} episodes, with much lower "standard" conditions).

Similarly, kurtosis is a statistical function that describes how flat or peaked a population is compared to a normal distribution. A positive value represents a distribution that is more peaked, and a negative value represents a distribution that is flatter than a normal distribution. The reported kurtosis value of +8.8 describes a distribution dominated by higher readings (i.e. representative of PM_{10} episodes).

These statistical functions support the assumption that the site typically experiences low 24-hour PM_{10} concentrations, with sporadic higher readings, which are typical of short-duration PM_{10} episodes.

Section 5.2 of the NSW DECCW document "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*" states that for Level 2 assessments, ambient monitoring data for at least one year of continuous measurements should be used in dispersion modelling.

However, in the absence of continuous hourly PM_{10} readings for a full year, the 99.9th Percentile PM_{10} concentration recorded at Woodlawn between 16 August 2004 and November 2007 (36.6 µg/m^3) has been taken as the background concentration of PM_{10} at Woodlawn.

This is considered highly conservative given the average PM_{10} concentration at the *"Pylara"* monitoring site is of the order of 9 µg/m^3 (excluding those results which are below the laboratory limit of detection) and recent results at the site have indicated PM_{10} concentrations below the laboratory limit of detection.

It is noted that the PM_{10} fraction is typically 50% of the total suspended particulate (TSP) concentration in the ambient air of regions where road traffic is not the dominant particulate source, such as rural environments (USEPA, 2001). In the absence of monitoring data for TSP, the annual average TSP concentration for the region may therefore be derived by multiplying the annual average PM_{10} concentration by a factor of two.

To predict a conservatively high background concentration of annual TSP, the annual average PM_{10} records at Woodlawn for the period August 2004 to September 2005 (9 µg/m^3) were multiplied by two to derive the annual average TSP concentration. This corresponds to a mean 24-hour background TSP concentration of 18 µg/m^3, which may be approximated to an annual mean value.

3.3 Background Air Quality Environment for Assessment Purposes

Based on the data and discussion in **Section 3.1** and **Section 3.2** the site specific background air quality levels adopted for the assessment of the Project are presented in **Table 7**.

Table 7 Background Air Quality Environment for Assessment Purposes

Air Quality Parameter	Averaging Period	Assumed Background Level
TSP	Annual	18 µg/m^3
PM_{10}	24-Hour	36.6 µg/m^3
	Annual	9 µg/m^3
Dust	Annual	3.5 g/m^2/month
Odour	Nose-Response Time (1s)	Negligible

4 CLIMATE AND DISPERSION METEOROLOGY

4.1 Local Meteorology

An assessment of wind conditions at the Woodlawn site has been undertaken using on-site weather data from 2005 and 2008. Wind speed and direction were recorded at two Wind Power prospecting weather stations during 2005, known as Woodlawn 13 Mast, at heights of 30 m and 45 m, and Collex Mast, at heights of 40 m and 65 m. In addition, a Veolia (formerly Collex) operated weather station recorded wind speed and direction at 10 m at the Woodlawn Bioreactor. This station changed location in 2008 and data for 14 February 2008 to 14 February 2009 (hereafter, '2008 data') has been obtained to compare to that from 2005.

A summary of the annual wind behaviour for 2005 and 2008 at each location is presented as wind roses in **Appendix A**. The wind roses indicate very little variation in wind direction with wind speeds increasing with height during 2005. 2008 data shows the dominant wind directions as observed within the 2005 dataset. It is therefore considered that the use of 2005 data is appropriate for use within this assessment. Additionally, the greater availability of meteorological observations at varying locations and heights during 2005 allows greater confidence to be placed in any generated meteorological dataset to be used in dispersion modelling of odour and particulate.

A meteorological input file was generated for incorporation into the atmospheric dispersion model using 2005 site specific monitoring data.

4.2 Modelling Approach

Gaussian plume dispersion models such as Ausplume assume that the meteorological conditions are uniform spatially over the entire modelling domain for any given hour. While this may be valid for some applications, in complex topographical situations illustrated in **Figure 3**, the meteorological conditions may be complex and be more accurately simulated using a wind field and puff model.

The Project Site is situated amongst significant topography, particularly to the north, east and southeast, where separate ridgelines dominate the region. It can be assumed that this topography will influence regional meteorology, particularly the generation of night-time katabatic drainage flows into the valley and the channelling of larger scale synoptic flows by regional terrain.

This phenomenon is displayed in the CALMET wind field presented in **Figure 4**, where channelling and intensifying of regional winds can be viewed through the surrounding valley.

In view of the foregoing, the topography of the area has been considered in the atmospheric dispersion model.

The current assessment utilises the CALPUFF (Version 6.1) modelling system. The CALPUFF modelling system comprises of three main components: CALMET, CALPUFF and CALPOST and a large set of pre-processing programs designed to interface the model to standard routinely available meteorological and geophysical databases.

In the simplest terms, CALMET is a meteorological model that develops ***hourly*** wind and other meteorological fields on a three-dimensional gridded modelling domain. Associated two dimensional fields such as mixing height, surface characteristics, and dispersion properties are also included in the file produced by CALMET. The interpolated wind field is then modified within the model to account for the influences of topography, as well as differential heating and surface roughness associated with different land uses across the modelling domain. These modifications are applied to the winds at each grid point to develop a final wind field. The final hourly varying wind field thus reflects the influences of local topography and land uses.

An example of the spatially varying surface flows generated by the CALMET meteorological model is presented in **Figure 4**.

Figure 4 Example of Spatially Varying Surface Flows Generated by CALMET for the Project Site

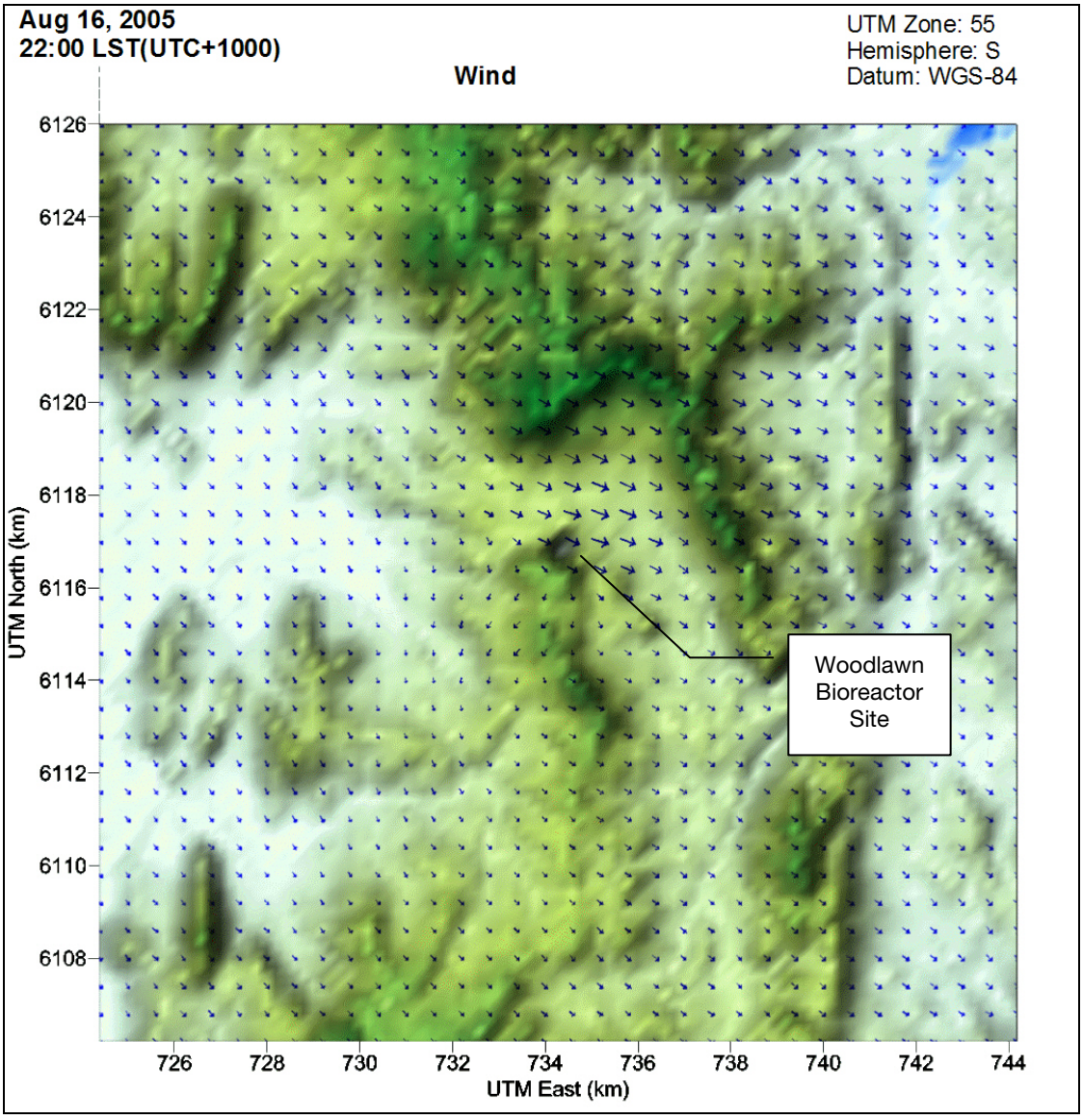


Figure 4 shows a wind field simulated by the CALMET model for one hour of stable night-time conditions during winter.

The CALPUFF model makes use of wind fields generated by the CALMET model, and is discussed further in **Section 4.3**.

The Air Pollution Model (TAPM) meteorological model Version 3 was used to generate upper air observations, which were subsequently used as input for the CALMET meteorological model.

TAPM software, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) is a prognostic model which may be used to predict three-dimensional meteorological data and air pollution concentrations, with no local data inputs required.

The model predicts wind speed and direction, temperature, pressure, water vapour, cloud, rain water and turbulence. The program allows the user to generate synthetic observations by referencing databases (covering terrain, vegetation and soil type, sea surface temperature and synoptic scale meteorological analyses) which are subsequently used in the model input to generate site-specific hourly meteorological observations.

Additionally, the TAPM model may assimilate actual local wind observations so that they can optionally be included in a model solution. The wind speed and direction observations are used to realign the predicted solution towards the observation values. This function of accounting for actual meteorological observations within the region of interest is referred to as "data assimilation".

Thus, direct measurements for 2005 of hourly average wind speed, wind direction and temperature, obtained at 10 m, 30 m, 40 m, 45 m and 65 m at the Woodlawn weather stations, and TAPM generated upper air data have been used in creating a meteorological input file for modelling purposes.

The prevailing wind directions and average wind speeds for each Woodlawn weather station are summarised in **Table 8**.

Table 8 Summary of Annual Wind Behaviour at Woodlawn, 2005

	Woodlawn Bioreactor	**Woodlawn13 Mast**		**Collex Mast**	
Observation Height	10 m	30 m	45 m	40 m	65 m
Frequency of Calms (%)	3.1	0.4	0.3	0.1	0.1
Average Wind Speed (m/s)	3.2	7.6	7.9	9.0	8.7
Dominant Wind Direction	WNW and W	WNW	WNW	WNW	WNW

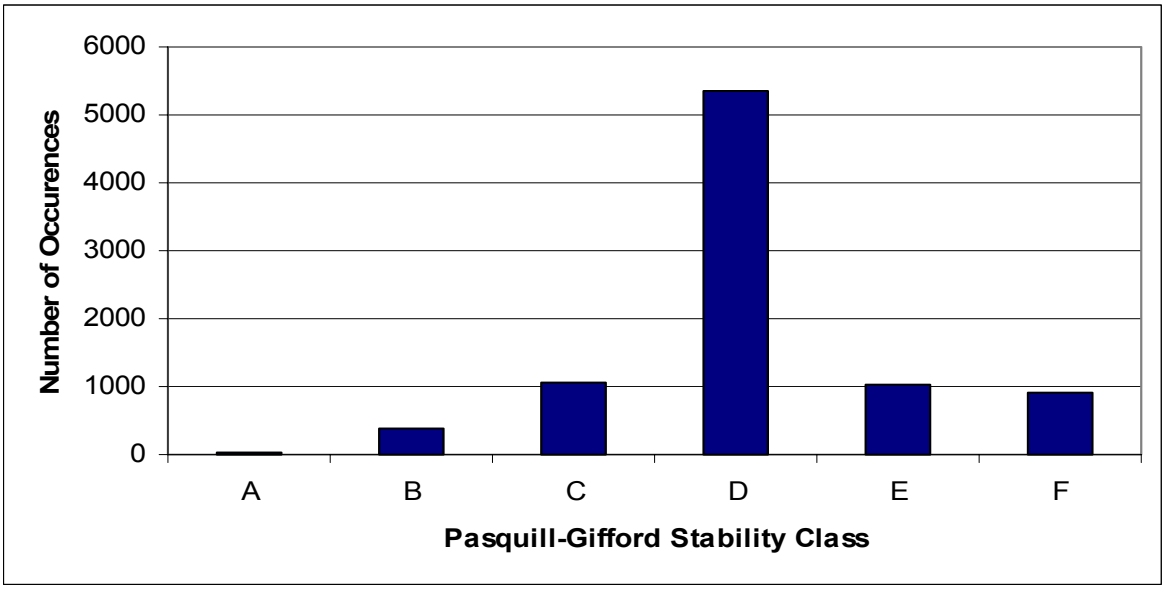
It is noted that typically the change in wind velocity with height (velocity profile) will be positive (i.e. wind speed increases with height). It is noted that the wind speeds recorded at the Collex Mast show a marginally lower average wind speed at 65 m than at 40 m. This anomaly may be explained due to the influence of the adjacent complex terrain on the velocity profile.

Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion. The Pasquill-Gifford-Turner assignment scheme identifies six Stability Classes, "A" to "F", to categorise the degree of atmospheric stability. These classes indicate the characteristics of the prevailing meteorological conditions.

Stability Class "A" represents highly unstable conditions that are typically found during summer, categorised by strong winds and convective conditions. Conversely, Stability Class "F" relates to highly stable conditions, typically associated with night-time clear skies, light winds and the presence of a temperature inversion. Classes "B" through to "E" represent conditions intermediate to these extremes.

The frequency of occurrence of each Stability Class for the year 2005, as predicted by the CALMET model, is presented in **Figure 5**. The results indicate a high frequency of conditions typical to Stability Class "D" throughout the year at the Project Site. This is indicative of neutral conditions, which will neither enhance nor impede atmospheric dispersion.

Figure 5 Annual Stability Class Distribution for the Woodlawn Site.



Appendix B illustrates the seasonal variation in atmospheric stability class at the Woodlawn Site. This data indicates that Stability Class "D" dominates in all seasons.

4.3 Meteorological Model Configuration

Table 9 details the parameters used in the meteorological modelling to drive the CALPUFF model.

Table 9 Meteorological Parameters used for this Study

TAPM (v 3.0)	
Number of grids (spacing)	5 (30 km, 10 km, 3 km, 1 km, 300 m)
Number of grids point	20 x 20 x 20
Year of analysis	2005
Centre of analysis	Woodlawn Bioreactor, Woodlawn (35°4' S, 149°34' E)
Data assimilation	Meteorological data assimilation using wind data from 5 onsite monitoring locations

CALMET (v 6.1)	
Meteorological grid domain	20 km x 20 km
Meteorological grid resolution	0.2 km
Surface meteorological stations	Woodlawn Weather Station (10 m) Woodlawn 13 Mast (30 m) Collex Mast (40 m)
Upper air meteorological stations	Data extracted from TAPM for Collex Mast weather station

In summary, meteorological data collected during 2005 at three locations at the Woodlawn site was used in the odour impact assessment. Data from 2008/2009 was also obtained from a meteorological monitoring station at the site to identify whether the data from 2005 was representative of the longer term wind environment. Data provided in **Appendix A** demonstrates that the 2005 data is indeed representative with westerly winds dominating across the year (25%). Easterly and north-easterly winds are important components of the wind environment at the site with observed frequencies of approximately 15% and 8% respectively. These components of the wind are more dominant in the summer months with frequencies of approximately 20% and 15% respectively.

Observed meteorological data from three locations for a full calendar year (2005) has been included within the CALMET model. The CALMET model has been used to derive a **spatially** (3-dimensional) and **hourly** varying meteorological input file which has taken into account the topography and land use between the Project site and all surrounding sensitive receptors.

5 DISPERSION MODELLING CONFIGURATION

CALPUFF is a transport and dispersion model that advects "puffs" of material emitted from modelled sources, simulating dispersion and transformation processes along the way. In doing so it typically uses the fields generated by CALMET, discussed in **Section 4**. Temporal and spatial variations in the meteorological fields selected are explicitly incorporated in the resulting distribution of puffs throughout a simulation period. The primary output files from CALPUFF contain either hourly concentration or hourly deposition fluxes evaluated at selected receptor locations. CALPOST is then used to process these files, producing tabulations that summarise results of the simulation (Scire et al, 2006).

Air pollutant concentrations were simulated for a regular Cartesian receptor grid covering a nested 5 km by 5 km computational domain, set within the CALMET modelling domain and centred on the Woodlawn Bioreactor, with a grid resolution of 200 m. Concentrations were also predicted at the sensitive receptors identified in **Table 2**.

5.1 Modelling Scenarios

5.1.1 Base Case Odour Scenario

The modelling scenario developed for the 'base case' assessment has been formulated to reflect current worst case operations as follows:

- All liquid storage areas have been assumed to be at full capacity.
- A (0.64 ha) area has been assumed to be active for fresh waste tipping.
- A large (4.06 ha) area of intermediate waste cover has been assumed.
- A 2 ha area of waste experiencing leachate recirculation has been assumed. (Leachate recirculation is an essential component of bioreactor performance).
- Operation of the AWT (yet to be constructed).

Emission source configurations were based on the layout provided by Veolia (2009) and illustrated in **Figure 1**. The number and surface area of the odorous sources included in each modelling scenario, based on the process layout, are identified in **Table 1**.

For the AWT, a likely layout has been adopted from a previous Heggies report (10-5410 R2 20070612). Further information is provided in **Section 5.3**.

All odour sources have been modelled as individual area / volume sources within CALPUFF.

5.1.2 Expansion Project Odour Scenario

The proposed Woodlawn Expansion Project (1.13 million tpa) has been assumed to affect the odour sources as follows:

- All liquid storage areas have been assumed to be at full capacity.
- A large (2 ha) area has been assumed to be active for fresh waste tipping.
- A large (39 ha) area of intermediate waste cover has been assumed – assumed top of void.
- A 2 ha area of waste experiencing leachate recirculation has been assumed. (Leachate recirculation is an essential part of bioreactor performance)

It is also noted that this scenario reflects waste operations at the top of the void and represents a worst case scenario in terms of odour source areas.

All other assumptions adopted for the 'base case' scenario remain unchanged as part of the Woodlawn Expansion Project scenario, including the operation of the AWT within the modelling scenario.

Due to the nature of the operations at the Project Site, increased quantities of waste received do not result in a linear increase in odour generation. Therefore, emissions of odour have been assumed to be worst case in terms of liquid storage, waste tipping and AWT operation (refer **Section 5.3**).

5.1.3 Waste Expansion Project Particulate Scenario

The modelling scenario for the Project reflects particulate matter emissions resulting from operation of the AWT and transport of material along unsealed roads to the mine void. Wind erosion of the cover material and windrows etc at the AWT has also been included. It is considered that this represents a worst case scenario in terms of particulate matter emissions, as for the Project odour scenario, all activities are assumed to occur on the void surface.

No base case scenario has been developed for particulate matter.

5.2 Odour Emission Rate Definitions

Odour concentration is measured in terms of odour units (OU). One OU is the concentration of odour-containing air that can just be detected by 50% of members of an odour panel (persons chosen as representative of the average population sensitivity to odour). This process is defined within Australian Standard AS4323.3 (2001) *Stationary Source Emissions – Part 3: Determination of Odour Concentration by Dynamic Olfactometry.*

An Odour Emission Rate (OER) is the product of the odour concentration (OU/m^3) and the volumetric flow rate (m^3/s or m^3/min), and is often annotated as $OU.m^3/s$, or $OU.m^3/min$. Alternatively, an odour emission rate can be thought of as the volume of clean air that would be required to dilute the concentration of odorous gas emitted per unit time down to 1 OU.

The Specific Odour Emission Rate (SOER) may be defined as the quantity of odour emitted per unit time from a unit surface area. The quantity of odour emitted is not determined directly by olfactometry, but is calculated from the concentration of odour (as measured by olfactometry) which is then multiplied by the volume of air passing through the measurement system per unit time. SOERs are often annotated as $OU.m^3/m^2/s$, or $OU.m^3/m^2/min$.

5.3 Odour Emission Rates

5.3.1 Site Specific Monitoring

Odour emission rates have been derived through site specific odour monitoring. Heggies has conducted a number of odour monitoring campaigns of the leachate and waste storage areas and at the Project Site between 2007 and 2009 with the most recent monitoring campaign being conducted in November 2009.

The results of the 2009 odour monitoring, expressed as Odour Units (OU), are given in **Table 10** and **Table 11** and are used to derive a specific odour emission rate (SOER) for each source. An SOER is an expression of odour flux, expressed as odour released per unit time over a given area, and is presented as:

$SOER\ (OU.m^3/m^2/s) = OC \times Q/A$

Where:

OC= odour concentration of compound from air in the chamber (OU)

Q = sweep gas flow rate into chamber (m^3/s)

A = sample source total surface (m^2)

Also presented in **Table 10** are results of previous monitoring undertaken on the leachate for comparison purposes.

Table 10 Odour Monitoring Results – Leachate

Sample	Odour Concentration (OU)	SOER (OU.$m^3/m^2/s$)	Odour Character
Monitoring 26 November 2009[1,2]			
Leachate Dam (Partially Treated Leachate)	6,750	4.2	Parmesan, landfill gas
ED3N-1 (Untreated Leachate)	8,030	5.0	Sharp, pungent
ED3 North (Groundwater)	528	0.3	Treated effluent, slight old garbage
ED3 South (Stormwater)	139	0.1	Dirty water, musty
Monitoring 6 June 2007			
ED3 North – Pond 1 (Untreated Leachate)	5,050	4.5	Sour, over-ripe fruit, garbage
ED3 North – Main Lagoon	104	0.1	Sour, body odour
ED3 South – Main Lagoon	512	0.5	Sour, manure
Leachate Pond (Treated Leachate)	4,100	3.6	Sour fruit

Note 1: Taken as the average of both samples
Note 2: Updated monitoring used a nitrogen flow rate of 7 L/min rather than 10 L/min which has impacts on the SOER calculated

Table 11 Odour Monitoring Results - Waste – 27 November 2009

Sample	Odour Concentration (OU)	SOER (OU.$m^3/m^2/s$)	Odour Character
Fresh Waste	1,120	0.7	Fresh garbage
Aged Waste (approximately 1 year)	512	0.3	Parmesan, dirty socks

5.3.2 Derived Emissions Data

Odour emission rates used in the modelling assessment for the AWT were based on a literature review of available odour assessments of AWT operations within NSW including Jacks Gully, Lucas Heights, Buttonderry, Bells Ridge, Eastern Creek and Blaxland Waste Management Facilities and the Camden Soil Mix Composting and Recycling Facility. Presented in **Table 12** are the sources and emission rates adopted for this assessment.

Table 12 AWT Odour Sources and Properties

Source	OER (OUV/s)	Source Dimensions	
VOLUME SOURCES		Horizontal Spread	Vertical Spread
WASP – MSW Storage /	5.65	20	2

Sorting / Processing			
WOCOG – Greenwaste Storage / Sorting / Processing	2.37	10	3.5
AREA SOURCES	**SOER (OUV/m²/s)**	**Area (m²)**	
AWT Recyclables Storage	5.65	~ 48	
AWT Rejects Storage	5.65	~ 48	
AWT Organics Storage	5.65	~ 60	
AWT Fresh Waste in Windrow	5.65	~ 4,000	
AWT Freshly Turned Waste in Windrow	4.915	~ 4,000	
AWT Composted Material in Windrow	0.11	~ 40,000	
AWT Final Product Storage	0.83	~ 9,000	

5.3.3 Adopted Odour Emission Rates

A total of seventeen odour sources have been selected for modelling with eight related to the Liquid Storage and Bioreactor sources and nine relating to the unbuilt AWT facility. The emission rates adopted for modelling are presented in **Table 13** for the Bioreactor sources and **Table 12** for the AWT sources.

Odour samples of the leachate undergoing treatment within the leachate dam were taken during November 2009. However, Veolia personnel noted that the leachate had not undergone complete treatment and may therefore be more odorous than completely treated leachate; examination of the results in **Table 10** provides confirmation of this. Therefore, for the purposes of this assessment, the odour emission rate from the completely treated leachate sampled in June 2007 has been used.

Although the ED3N-2 and ED3N-3 ponds were empty during the 2009 monitoring campaign, Veolia personnel have indicated that as a worst case, these ponds may contain treated leachate. Therefore, an odour emission rate applicable to treated leachate (from the June 2007 monitoring campaign) has been assigned to these ponds. Under normal operating conditions, no leachate is stored within these areas.

Within this assessment, all liquid storage areas have been assumed to be at maximum capacity and occupy the areas noted in **Table 1**.

As discussed in **Section 1.1**, waste is stored in the Mine Void (refer **Figure 1**) with fresh waste occupying an area of approximately 0.6 ha [2 ha] and leachate recirculation areas and covered aged waste occupying an area of approximately 2 ha [2 ha] and 4.06 ha [39 ha] respectively [numbers represent the expansion project]. The emission rate for fresh and aged waste has been taken from direct measurements at the site, sampled in November 2009. For covered aged waste, the emission rate for aged waste has been adopted.

Table 13 Emission Rates Adopted for Modelling

Source	Contents	Emission Rate Adopted (refer Table 10 and Table 11)	Notes
ED3-North	Groundwater	November 2009	-

Source	Contents	Emission Rate Adopted (refer Table 10 and Table 11)	Notes
ED3-South	Stormwater	November 2009	-
ED3N-2 / ED3N-3	Treated Leachate	-	Assumed to be Treated Leachate from June 2007 monitoring campaign
ED3N-1	Untreated Leachate	November 2009	-
Leachate Dam	Leachate Treatment	June 2007	November 2009 campaign did not capture completely treated leachate
Mine Void 1	Fresh Waste	November 2009	-
Mine Void 2	Treated Leachate	November 2009	Treated Leachate sprayed onto waste to encourage degradation
Mine Void 3	Covered Aged Waste	-	Assumed to be Aged Waste from November 2009 monitoring campaign

5.3.4 Odour Peak-to-Mean Ratios

The NSW DECCW document "*Technical Notes - Assessment and Management of Odour from Stationary Sources in New South Wales"*, (DECCW, 2006b – the Odour Notes) states that Peak-to-Mean ratios should be incorporated when conducting atmospheric dispersion modelling of odour.

It is commonly recognised that dispersion models such as CALPUFF need to be supplemented to accurately simulate atmospheric dispersion of odours. This is because the instantaneous perception of odours by the human nose typically occurs over a time scale of approximately one second but dispersion model predictions are typically valid for time scales equivalent to ten minutes to one hour averaging periods.

To estimate the effects of plume meandering and concentration fluctuations perceived by the human nose, it is possible to multiply dispersion model predictions by a correction factor called a "peak-to-mean ratio".

The peak to mean ratio (P/M60) is defined as the ratio of peak 1-second average concentrations to mean 1-hour average concentrations.

To estimate peak concentrations, this assessment has used data presented in Table 10.1 of the Odour Notes. Specifically, to establish a conservatively high estimate of peak odour concentrations, the following peak to mean ratio (P/M60) has been adopted, corresponding to near-field receptors for area sources:

- A Peak-to-Mean Ratio (P/M60) of 2.5 has been applied to the emission rate during periods where atmospheric stability class is between A and D.
- A Peak-to-Mean Ratio (P/M60) of 2.3 has been applied to the emission rate during periods where atmospheric stability class are E or F.

5.4 Particulate Matter Emission Rates

A review has been carried out of the potential for particulate generation during the operation of the Woodlawn Expansion Project (including the movement of waste on-site and the proposed 24 MW landfill gas combustion facility) as well as the AWT facility. The activities identified include:

- Mixed waste trucks/containers travelling to the void from the main road
- Wind erosion from covered waste
- Mixed waste trucks unloading to WASP bunker
- Green waste unloading to WOCOG bunker
- Loading Reject Storage Bins
- Loading Recyclables Storage Bins
- Loading Organic Material Storage Bins
- Organic Material Transfer from waste processing building to windrows
- Wind erosion from windrows
- Final Product Screening and Storage
- Combustion of landfill gas in 24 x 1 MW JE Genbacher Gas Engines

Table 14 presents the emission factors for the key atmospheric pollutants used in the dispersion modelling carried out for this assessment. These estimate the emissions expected under normal operating conditions. The ratio of the PM_{10} fraction of the total particulate emission ranges from 75% (e.g. screening) down to 25% (e.g. operation of dozers).

The proportion of the PM_{10} fraction for each activity was derived primarily from the Commonwealth Department of Environment and Heritage (DEH) (2001) document, "*Emission Estimation Technique Manual for Mining, Version 2.3*".

Table 14 Particulate Emission Factors for Air Quality Dispersion Modelling

Activity	Total Particulate Emission Factor [1]	PM_{10} Emission Factor	Emission Factor Units
Waste Truck Unloading	0.00004	0.00002	kg/t
Screening	0.08	0.06	kg/t
Wind Erosion	0.40	0.20	kg/ha/hr
Handling/Transferring/Conveying	0.005	0.002	kg/t
Dozer	0.117	0.015	kg/t
Loading Storage Bins	0.0004	0.0002	kg/t

Note 1: Total Particulate emission factor is used to derive the rate of dust deposition

In general, emission factors equations have been used as contained in Table 1 of "*Emission Estimation Technique Manual for Mining, Version 2.3*", (National Pollutant Inventory, 2001).

Emissions resulting from heavy vehicles travelling on unpaved roads have been derived using the USEPA AP42 emission factors (Wheel Generated Dust from Unpaved Roads (2003)) as outlined in Equation 1.

$$EF = k \times \left(\frac{s}{12}\right)^{0.7} \times \left(\frac{W}{3}\right)^{0.45} \times \left(\frac{281.9}{1000}\right) \times \left(\frac{365 - p}{365}\right) \quad \text{(kg/VKT)} \qquad \text{Equation 1}$$

where
k = 4.9 (TSP)
k = 1.5 (PM_{10})
s = silt content (%), W = vehicle gross mass (tonnes)
p = number of days in year with rainfall greater than 0.25mm

VKT = Vehicle Kilometre Travelled

Emissions from the combustion of landfill gas have been derived using the NPI Emission Estimation Technique for Combustion Engines Version 3 June 2008 (National Pollutant Inventory, 2008). Emission factors for PM_{10} are provided for uncontrolled landfill gas fired turbines either as kg/kWh, or kg/m^3. Emissions (g/s) based on both gas combustion (12,750 m^3/hr) and kWh capacity (24,000 kWh) have been calculated with emissions calculated to be 0.67 g/s and 0.65 g/s, respectively. In the interests of conservatism, the higher emission rate has been used, and divided between all 24 proposed units. Stack parameters (exit velocity, temperature etc have been sourced from monitoring reports for the existing engines). Details are provided within the emissions inventory provided as **Appendix C**.

5.5 Particulate Emission Inventory

The following assumptions have been made in deriving the emission inventory for the modelling exercise.

General

- To represent a worst case scenario, the haul road is assumed to originate at the main road and travel into the pit - a distance of approximately 2.6 km.
- It has been assumed that Level 1 watering controls (< 2 l/m^2/hr) are applied to the road and a 50% control factor has been applied accordingly.
- The silt content of the roads is assumed to be 5%.
- The moisture content of mixed waste is taken to be 32%.
- The moisture content of Green Waste is taken to be 30%.
- The moisture content of Organic Waste is taken to be 30%.
- Average 10 m wind speeds on site is taken to be 3 m/s (based on on-site meteorological measurements).
- Operations occurring within the shed are assumed not to generate fugitive particulate emissions. Given the high moisture content of MSW, particulate emissions are unlikely to be significant. All equipment with the potential for dust generation will be fitted with fabric filters or housed within the AWT facility.
- The emission factors used for unloading of waste (MSW and green waste) to the WASP and WOCOG bunkers and the unloading of organic material onto windrows were derived from the *"Emission Estimation Technique Manual for Mining Version 2.3"*. The factors correspond to unloading trucks (rear dumping).
- The emission factors for the loading of materials into the rejects bins, recyclables bins and organic waste storage area were derived from Table 1 of *"Emission Estimation Technique Manual for Mining Version 2.3*". The factors correspond to trucks dumping overburden.
- The emission factors for the transferring organic waste from the waste processing building to the windrow area were derived from Table 1 of *"Emission Estimation Technique Manual for Mining Version 2.3*". The factors correspond to Handling, Transferring and Conveying (High Moisture Content Ores).

- The emission factors for the unloading organic waste onto windrows were derived from Table 1 of *"Emission Estimation Technique Manual for Mining Version 2.3*". The factors correspond to unloading trucks (rear dumping).
- The emission factors for wind erosion from covered waste, windrows and final product storage were derived from Table 1 of *"Emission Estimation Technique Manual for Mining Version 2.3*". The factors correspond to Wind Erosion.
- The emission factors for the turning of windrows were derived from Table 1 of *"Emission Estimation Technique Manual for Mining Version 2.3*". The factors correspond to dozers working on material other than coal.
- The emission factors for final product screening / de-stoning were derived from Table 1 of *"Emission Estimation Technique Manual for Mining Version 2.3*". The factors correspond to screening.
- The background PM_{10} used in dispersion modelling was derived from PM_{10} concentrations recorded at the Woodlawn monitoring station at Pylara (refer **Section 3.2.2**).
- For both Scenarios, the entire Windrow Composting area is assumed to be at full capacity at all times.
- An optional alternative fuel processing module is assumed to be in operation. Particulate emissions from the alternative fuel processing module are assumed to be insignificant as the unit will be housed within the WASP building and fitted with a fabric filter. However storage and loading of the alternative fuel for transport off-site has the potential to generate particulate emissions. Accordingly, the emission factors for the alternative fuel loading was derived from Table 1 of *Emission Estimation Technique Manual for Mining Version 2.3*". The factors correspond to Handling, Transferring and Conveying (Low Moisture Content Ores).
- The WASP throughput is assumed to 240,000 tpa. The WOCOG throughput is assumed to be 40,000 tpa.
- The modelling assessment assumes the facility is in operation for 312 days per annum.
- To provide a worst-case conservative impact assessment, a silt content of 3% for the mixed waste and green waste material has been assumed for the site and used within emission factor equations.

A particulate emissions inventory is provided in **Appendix C**.

6 AIR QUALITY IMPACT ASSESSMENT

6.1 Odour Impact Assessment

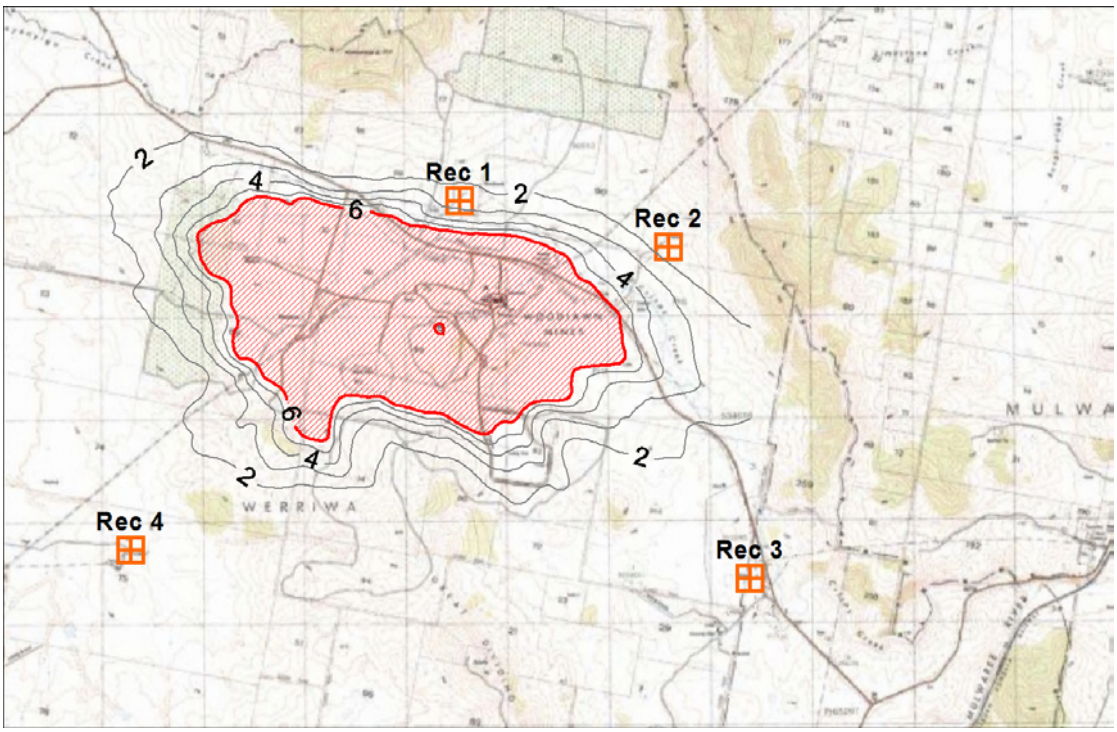
Table 15 presents the 99th percentile 1 second average odour concentrations at the surrounding sensitive receptor locations, as predicted by CALPUFF, for current ('base case') and proposed (Waste Expansion Scenario) operations at the Project Site. It can be seen that concentrations are predicted to range between 0.6 OU and 2.6 OU at all receptors for the base case (current) scenario, increasing to between 1.2 OU and 4.1 OU for the Project scenario. The corresponding isopleth plots of these dispersion modelling results are presented in **Figure 6** and **Figure 7**.

Table 15 Predicted 99th Percentile 1 Second Average Odour Concentration

Receptor ID	Predicted Odour Concentration (OU/m^3) – Base Case	Predicted Odour Concentration (OU/m^3) – Woodlawn Expansion Project
Receptor 1: "Woodlawn Farm"	2.6	4.1
Receptor 2: "Cowley Hills"	1.4	2.0

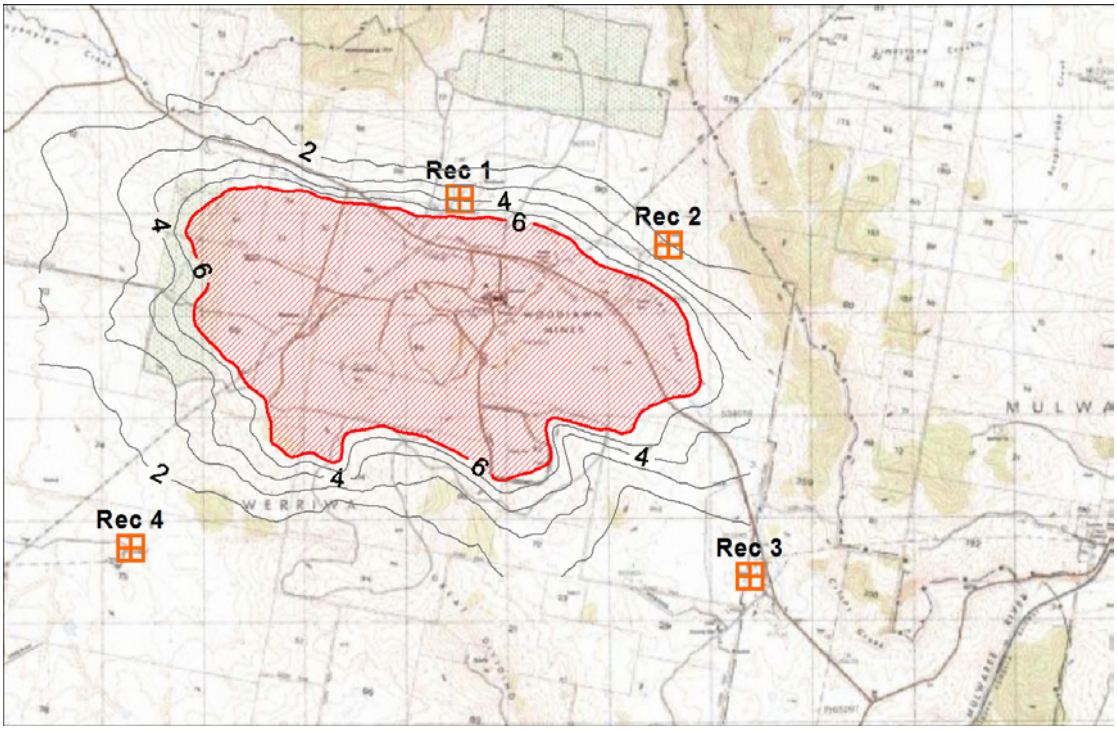
Receptor 3: “Pylara”	0.6	1.2
Receptor 4: “Torokina”	0.7	1.3

Figure 6 99th Percentile 1 Second Average Odour Concentration – Woodlawn Bioreactor – Base Case



2005 Meteorology, Emission Rates adopted from **Section 5.3**; Adopted Criterion – 6 OU

Figure 7 99th Percentile 1 Second Average Odour Concentration – Woodlawn Bioreactor – Woodlawn Expansion Project and AWT Facility



2005 Meteorology, Emission Rates adopted from **Section 5.3**; Adopted Criterion – 6 OU

It is predicted that under worst case operating conditions, odour concentrations will satisfy the Project odour criterion of 6 OU at all surrounding residences in both scenarios modelled, reflecting current and proposed operating conditions under the Woodlawn Expansion Project. Onsite management practices such as waste covering will act to minimise any impacts on all modelled receptors.

6.2 Particulate Matter / Dust Impact Assessment

6.2.1 Dust Deposition

Table 16 shows the results of the Ausplume predictions for dust deposition. The results show the average deposition rates predicted at the nearest receptor locations over a one year time frame. Background levels of dust deposition at these locations ranged from 1.5 g/m^2/month to 2.5 g/m^2/month. For assessment purposes, background levels have been conservatively assumed to be in the order of 2.5 g/m^2/month (refer **Section 3.2.1**).

A contour plot of the modelled dust deposition values obtained around the Woodlawn Site is presented in **Figure 8**.

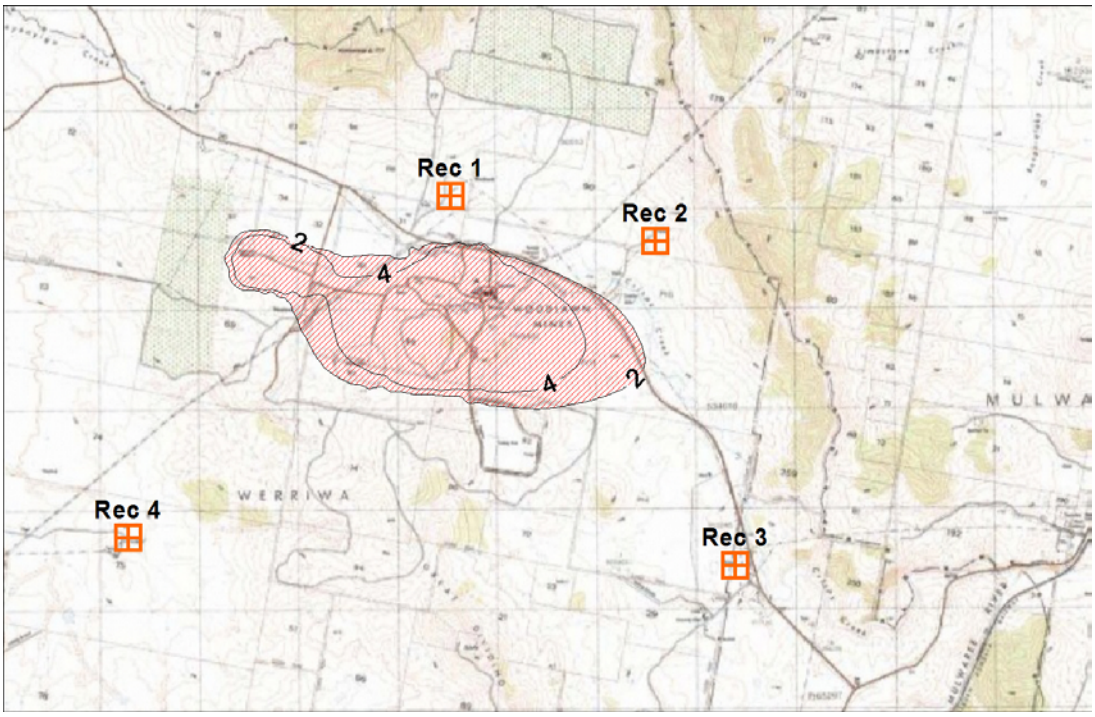
Table 16 Background and Predicted Incremental Dust Deposition

	Annual Average Dust Deposition (g/m^2/month)			
Residence	**Background**	**Increment**	**Background + Increment**	**Project Goal**
Scenario 1				
1. “Woodlawn Farm”	3.5	0.05	3.55	4.0
2. “Cowley Hills”	3.5	0.07	3.57	4.0

3. “Pylara”	3.5	0.04	3.54	4.0
4. “Torokina”	3.5	0.02	3.52	4.0

The results presented in **Table 16** and **Figure 8** show that increases in the annual average monthly dust deposition associated with the Woodlawn Expansion Project and the AWT Facility are predicted to be insignificant in comparison with current average background dust deposition levels. Annual average monthly dust deposition levels are predicted to comply with the project goal of 4 g/m^2/month even assuming worst case existing background dust levels.

Figure 8 Predicted Annual Average Incremental Dust Deposition (g/m^2/month) – Woodlawn Bioreactor – Woodlawn Expansion Project and AWT Facility



2005 Meteorology, Emission Rates adopted from **Section 5.3**; Adopted Criterion – 2 g/m^2/month

6.2.2 Total Suspended Particulate

Table 16 shows the results of the CALPUFF predictions for annual average TSP. The results show the average concentrations predicted at the nearest receptor locations over a one year time frame. Background levels of TSP are assumed to be 18 µg/m^3 (refer **Section 3.3**).

Table 17 Background and Predicted Incremental Total Suspended Particulate

	Annual Average TSP Concentration (µg/m^3)			
Residence	**Background**	**Increment**	**Background + Increment**	**Project Goal**
Scenario 1				
1. “Woodlawn Farm”	18	0.2	18.2	90
2. “Cowley Hills”	18	0.3	18.3	90
3. “Pylara”	18	0.1	18.1	90
4. “Torokina”	18	0.1	18.1	90

The results presented in **Table 16** show that increases in the annual average TSP concentration associated with the Woodlawn Expansion Project and the AWT Facility are predicted to be insignificant in comparison with current average background levels. Annual average TSP concentrations are predicted to comply with the project goal of 90 µg/m^3.

No contour plot has been provided of the incremental increase in annual average TSP concentrations due to the low concentrations predicted.

6.3 PM_{10}

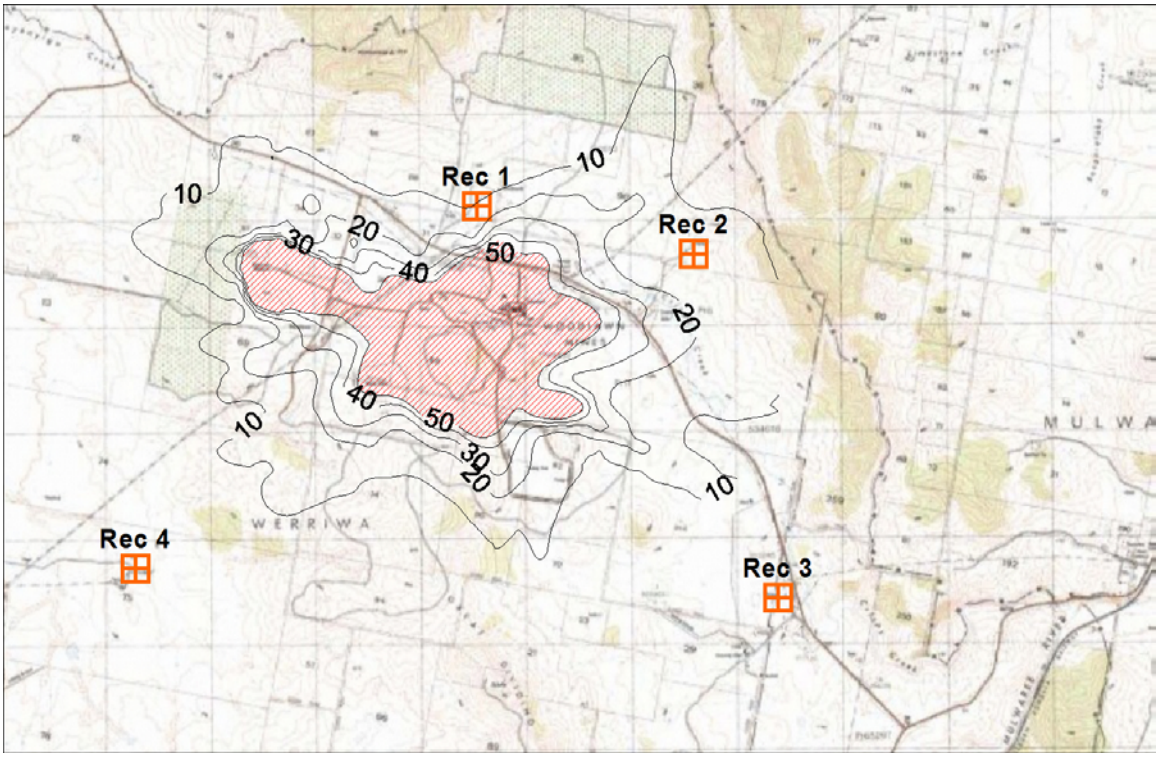
Table 18 shows the results of the CALPUFF predictions for the 24-hour average PM_{10} concentrations. The results show the maximum 24-hour average PM_{10} concentrations predicted at the nearest receptor locations surrounding Woodlawn site over a one year time frame.

A contour plot of the maximum 24-hour average PM_{10} concentrations is presented in **Figure 9**. The contour plots do not represent the dispersion pattern at any particular instant in time, but show the predicted maximum 24-hour average PM_{10} concentrations that occurred at each location. They therefore represent the concentrations that can possibly be reached under the conditions modelled.

Table 18 Background and Predicted 24-Hour Average PM_{10} Concentrations

	Maximum 24-Hour PM_{10} Concentrations (µg/m^3)			
Residence	**Background**	**Increment**	**Background + Increment**	**Project Goal**
Scenario 1				
1. “Woodlawn Farm”	36.6	10.5	47.1	50
2. “Cowley Hills”	36.6	12.5	49.1	50
3. “Pylara”	36.6	5.6	42.2	50
4. “Torokina”	36.6	3.3	39.9	50

Figure 9 Predicted Maximum 24-hour Incremental PM_{10} Concentration (µg/m³) – Woodlawn Bioreactor – Woodlawn Expansion Project and AWT Facility



2005 Meteorology, Emission Rates adopted from **Section 5.3**; Adopted Criterion – 50 µg/m³

The results presented in **Table 18** and **Figure 9** shows that at all receptor locations, the maximum 24-hour average concentration of PM_{10} (background plus increment) associated with the proposed Project is predicted to be below the project goal of 50 µg/m³ (24-hour average).

The contribution of the Project to total 24 hour PM_{10} concentrations is predicted to be low, with a maximum incremental 24-hour PM_{10} concentrations of 12.5 µg/m³ predicted at "Cowley Hills". Even assuming a high background PM_{10} concentration of 36.6 µg/m³ (the 99.9th percentile of three years of monitoring data), the total predicted PM_{10} concentration as a result of the Project is predicted to comply with the project goal.

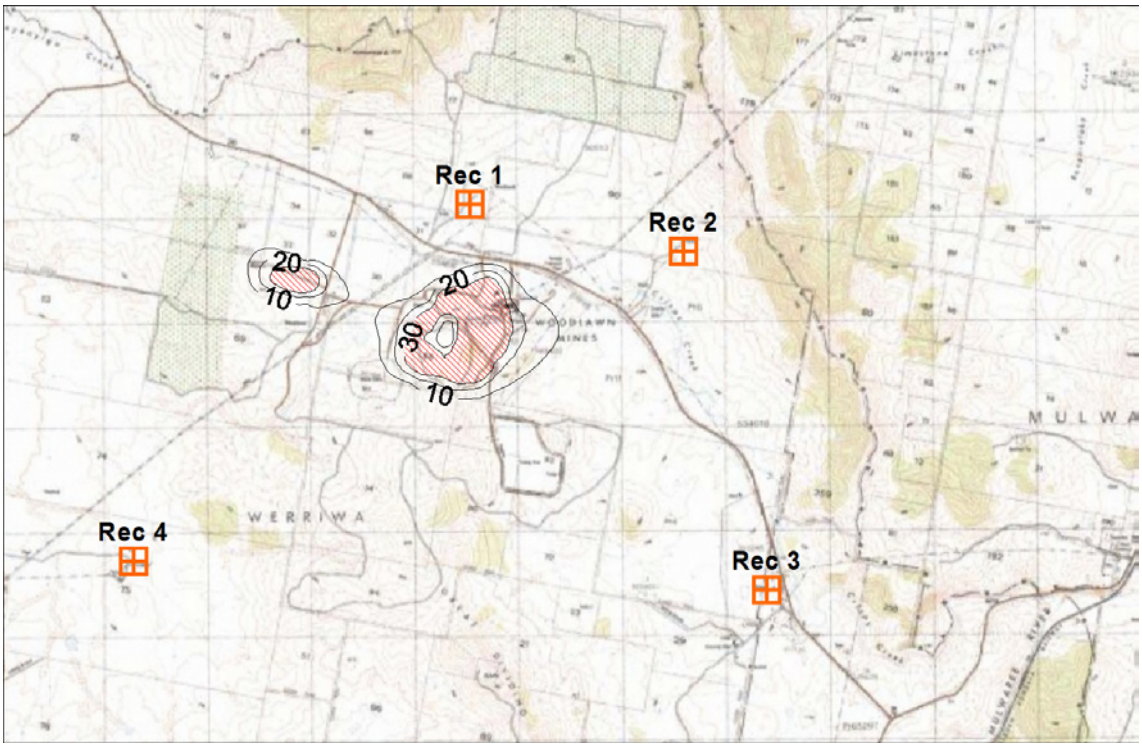
Table 19 shows the results of the CALPUFF predictions for annual average PM_{10}. The results show the predicted annual average PM_{10} concentration at the nearest receptor locations surrounding the Woodlawn Site over a one-year time frame.

A contour plot of the annual average PM_{10} concentrations is presented in **Figure 10**.

Table 19 Background and Predicted Annual Average PM_{10} Concentrations

	Maximum Annual Average PM_{10} Concentrations (µg/m³)			
Residence	**Background**	**Increment**	**Background + Increment**	**Project Goal**
Scenario 1				
1. "Woodlawn Farm"	9	0.5	9.5	30
2. "Cowley Hills"	9	0.6	9.6	30
3. "Pylara"	9	0.3	9.3	30
4. "Torokina"	9	0.2	9.2	30

Figure 10 Predicted Annual Average PM_{10} Incremental Concentration (µg/m³) – Woodlawn Bioreactor – Woodlawn Expansion Project and AWT Facility



The results presented in **Table 19** and **Figure 10** indicate that at each receptor location, the maximum annual average concentration of PM_{10} (background plus increment) associated with the Project is predicted to be significantly below the project goal of 30 µg/m³. The contribution of the Project to the total annual average PM_{10} concentrations is predicted to be insignificant with a maximum incremental annual average PM_{10} concentration of 0.6 µg/m³ predicted at "Cowley Hills".

6.4 Conclusions

Heggies Pty Ltd has been commissioned by Veolia Environmental Services (Australia) Pty Ltd to undertake an odour and dust impact assessment of the Woodlawn Bioreactor facility near Tarago, in the Southern Highlands of NSW. Veolia wish to increase the quantity of waste received at the facility to 1.13 million tonnes per annum and 1.18 million tonnes of waste per year at the Crisps Creek Intermodal Facility.

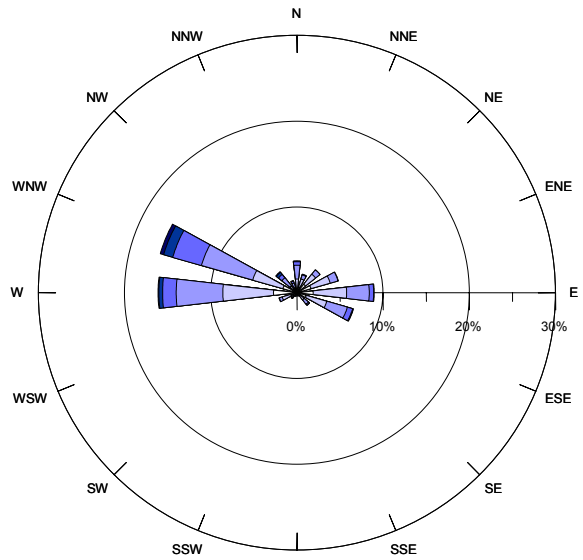
All odour sources at the Woodlawn Bioreactor and Crisps Creek Intermodal Facility have been identified and odour emission rates, based on site specific monitoring, have been applied. Atmospheric dispersion modelling of odour has indicated that at all surrounding residences, odour is predicted to be at concentrations less than 4.1 OU as a 99th percentile, 1 second average. The Project specific odour performance goal was assumed to be 6 OU. Comparison with a 'base case' scenario designed to reflect current operating conditions at the Woodlawn site has shown an increase in odour impact at surrounding receptors resulting from the increase in surface area of waste.

A worst case scenario has been modelled, with all liquid storage areas modelled at capacity and with an active waste tipping area of 2 ha. In reality, leachate (treated and untreated), groundwater and stormwater storage areas are unlikely to be at levels approaching capacity as leachate is used on the waste to encourage degradation of fresh waste. Excessive storage should not be required and an active waste tipping face of the modelled size should not be required in reality.

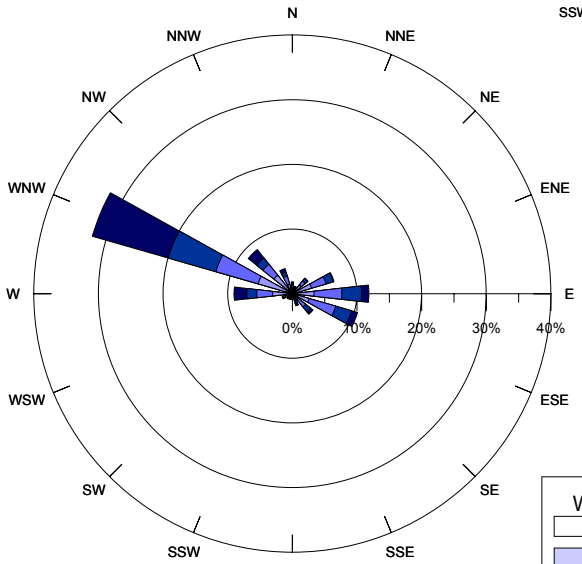
Based upon the results of this modelling assessment, it is not considered that the proposed Project will lead to an exceedance of the odour performance goal.

Cumulative particulate matter emissions associated with the proposed Woodlawn Expansion Project and the approved AWT Facility are not predicted to result in exceedances of the adopted criteria for the Project. Dust deposition levels are significantly below the adopted background level and are predicted to result in incremental increases of less than 0.07 g/m^2/month at all receptors. PM_{10} concentrations are predicted to be less than 13 $\mu g/m^3$ as a 24-hour maximum and 0.7 $\mu g/m^3$ as an annual average at all receptors. Total suspended particulate concentrations are predicted to be less than 0.3 $\mu g/m^3$ as an annual average at all modelled receptors.

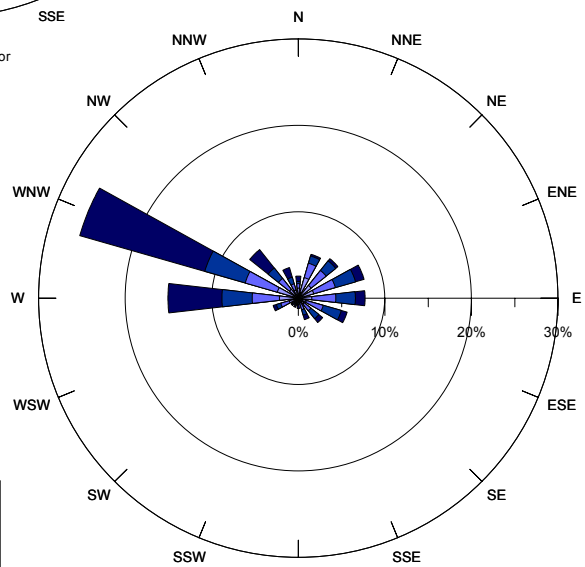
Annual and Seasonal Wind Roses for the Project Site - 2005



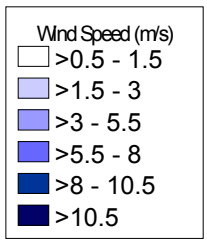
Woodlawn Bioreactor

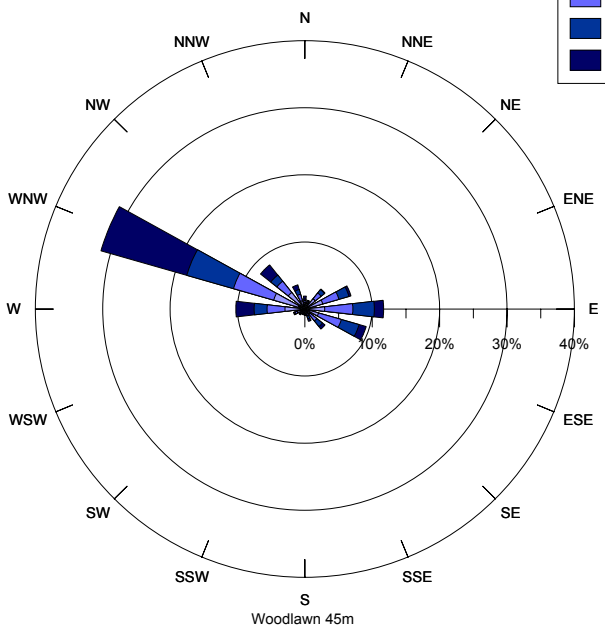


Woodlawn 30m

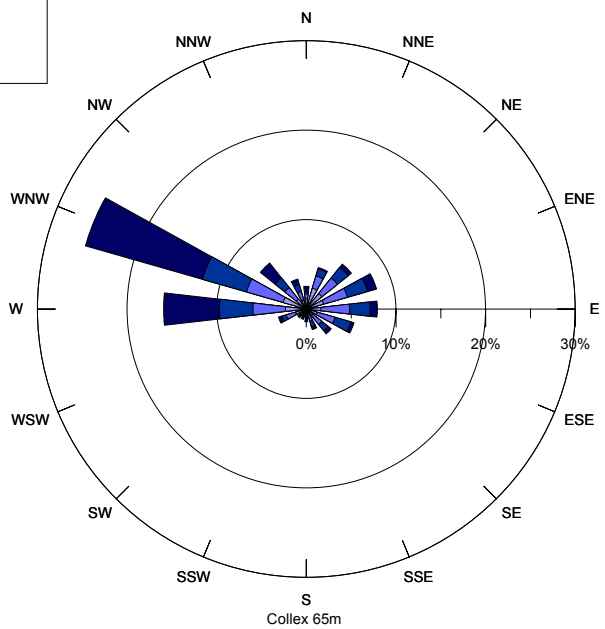


Collex 40m





Woodlawn 45m



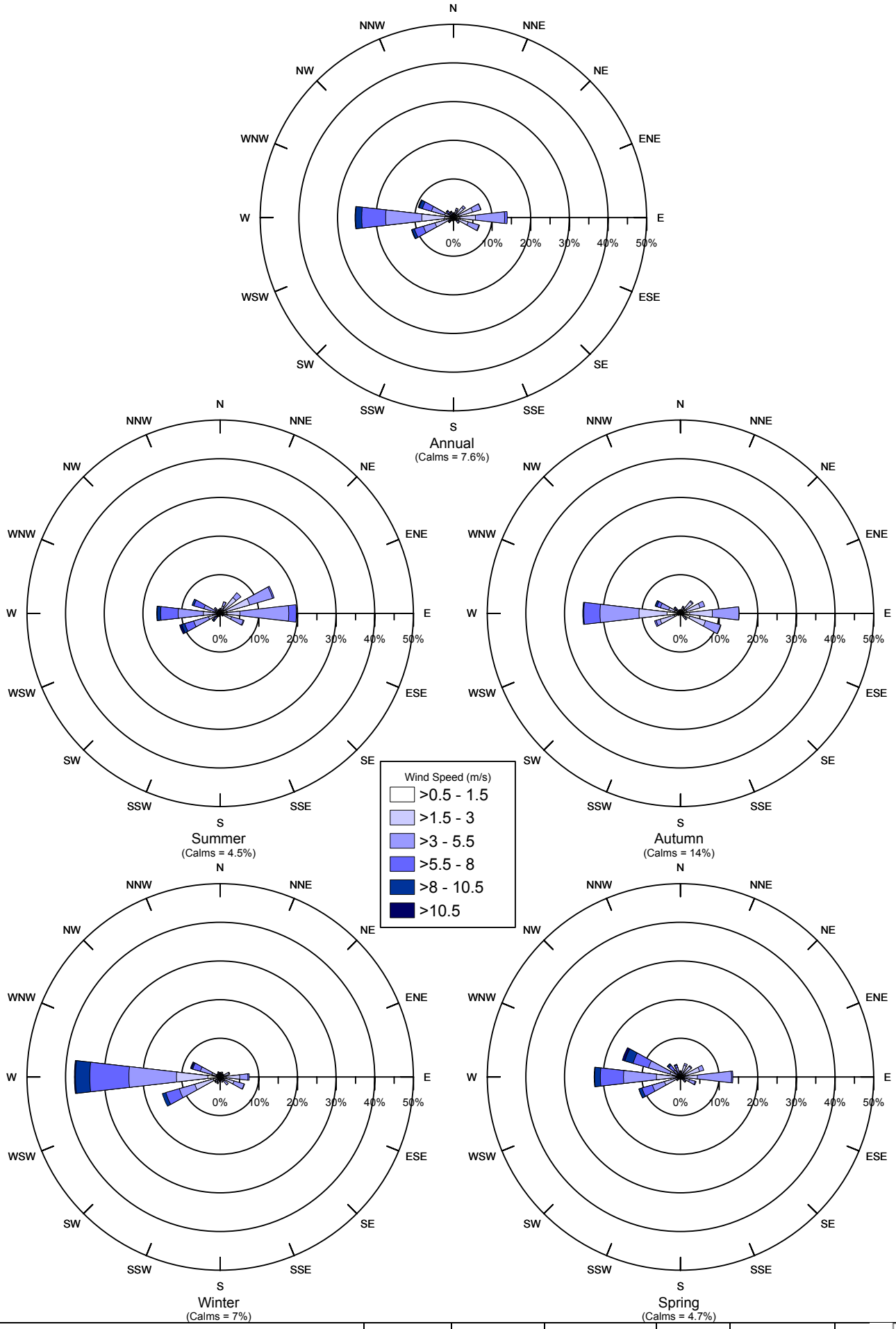
Collex 65m

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Consulting Engineers
Level 2, 2 Lincoln Street
Lane Cove NSW 2066 Australia
PO Box 176 Lane Cove NSW 1595
Telephone +612 9427 8100 Facsimile +612 9427 8200
Email Sydney@heggies.com.au

Designed by	Checked by	Approved by - date	Filename	Dated
RK	DR	DR – 09/06/06	30-1546	09/06/06

Appendix A: Annual Windroses for Woodlawn Weather Stations- 2005

Quality System
Quality Endorsed Company
ISO 9001 Lic 3236
Standards Australia



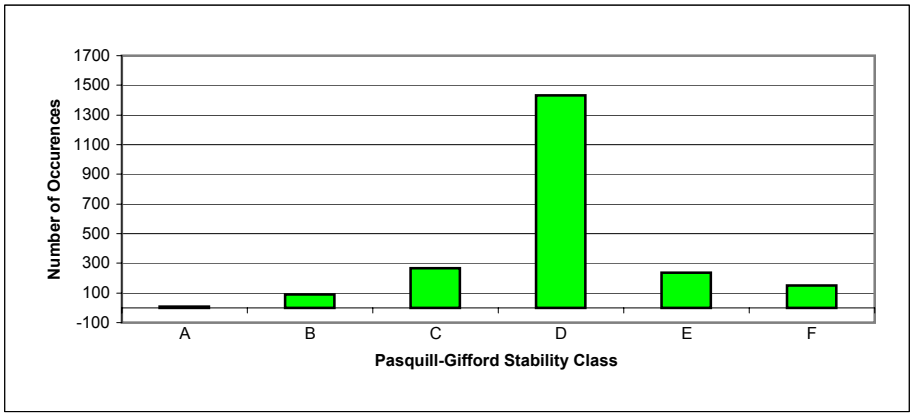
Heggies Pty Ltd
Consulting Engineers and Scientists
2 Lincoln Street
Lane Cove NSW 2066 Australia
PO Box 176 Lane Cove NSW 1595
Telephone +612 9427 8100 Facsimile +612 9427 8200
Email Sydney@heggies.com

Designed by	Checked by	Approved by - date	Filename	Dated
MD	SF	MD	10-5410	18/12/09

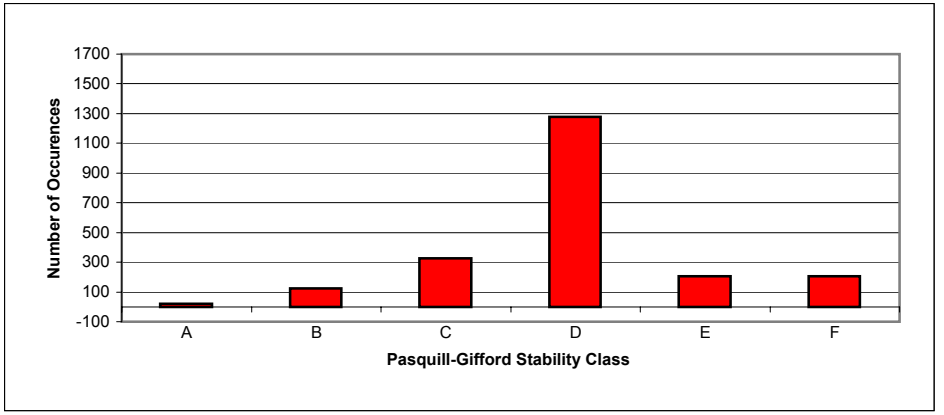
Appendix A: Woodlawn Seasonal Windroses
March 2008 – March 2009

Quality System
Quality Endorsed Company
ISO 9001 Lic 3236
Standards Australia

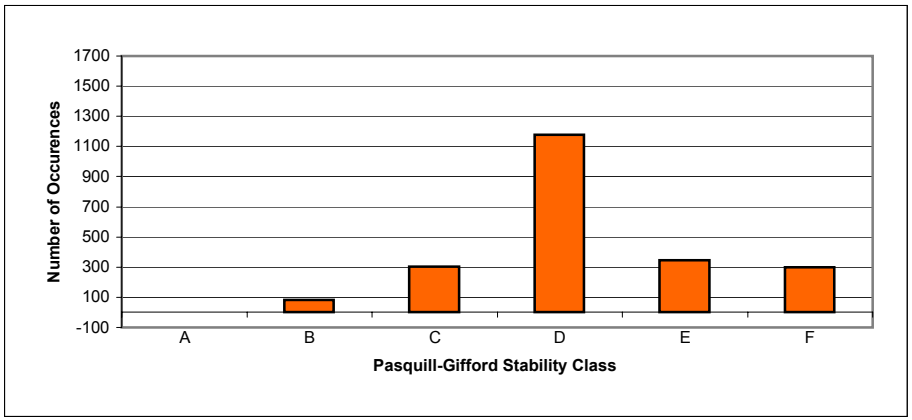
Seasonal Atmospheric Stability Class Distribution for the Project Site - 2005



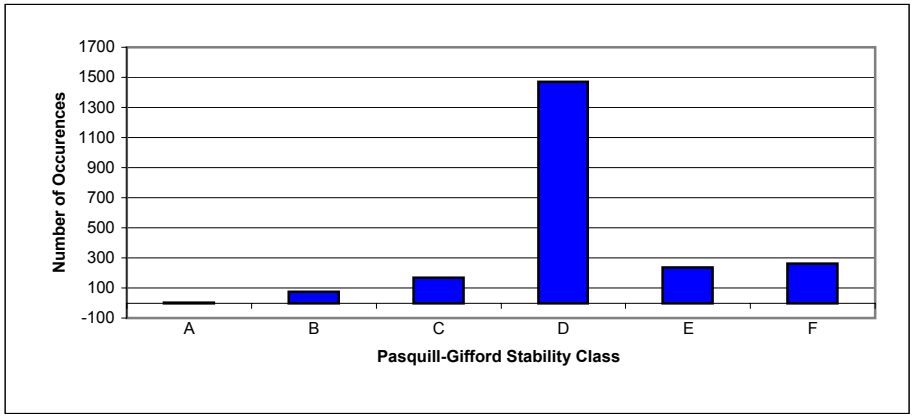
Spring



Summer



Autumn



Winter

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Designed by	Checked by	Approved by - date	Filename	Dated
SF	DR	31/08/2006		31/08/2006

Seasonal Stability Class Frequency Distribution for Woodlawn Site - 2005

Quality System
Quality Endorsed Company
ISO 9001 Lic 3236
Standards Australia

Appendix C

Particulate Emissions Inventory

Woodlawn Waste Expansion Project - Particulate Sources	**TSP Emission Factor**	**PM_{10} Emission Factor**	**Emission Factor Units**	**Throughput (tonnes per hour)**	**Number of Hectares of stockpile**	**Average number of kilometres per hour**	**Working days available**	**Working hours per day**	**TSP Emission Rate (mg/s)**	**PM_{10} Emission Rate (mg/s)**	**TSP Emission Flux ($mg/s/m^2$)**	**PM_{10} Emission Flux ($mg/s/m^2$)**
WASP and WOCOG Windrows												
MSW Trucks unloading to bunker (uload1)	0.00004	0.00002	kg/t	37	N/A	N/A	250	13	0.4	0.2	N/A	N/A
MSW Trucks unloading to bunker (uload1a)	0.00004	0.00002	kg/t	44	N/A	N/A	312	16	0.4	0.2	N/A	N/A
Loading Reject Storage Bins (Load1)	0.0004	0.0002	kg/t	3	N/A	N/A	312	16	0.3	0.1	N/A	N/A
Loading Recycling Storage Bins (Load2)	0.0004	0.0002	kg/t	2	N/A	N/A	312	16	0.2	0.1	N/A	N/A
Loading Organic Material Storage Bins (Load3)	0.0004	0.0002	kg/t	24	N/A	N/A	312	16	2.7	1.1	N/A	N/A
Organic Material Tranfer - WASP to OW (HTC1)	0.005	0.002	kg/t	24	N/A	N/A	312	16	33.3	13.3	N/A	N/A
Unloading Organic Material onto Windrow (uload2)	0.000040	0.000019	kg/t	24	N/A	N/A	312	16	0.3	0.1	N/A	N/A
Fluffer Unloading (HTC3)	0.060	0.0300	kg/t	14	N/A	N/A	N/A	N/A	233.3	116.7	N/A	N/A
WOCOG												
Green Waste Trucks unloading to bunker (uload3)	0.00004	0.00002	kg/t	12	N/A	N/A	312	16	0.1	0.1	N/A	N/A
Green Waste Transfer to OW (HTC2)	0.005000	0.002000	kg/t	12	N/A	N/A	312	16	16.7	6.7	N/A	N/A
Unloading Green Waste Material onto Windrow (uload4)	0.000040	0.000019	kg/t	12	N/A	N/A	312	16	0.1	0.1	N/A	N/A
Final Product Screening (MS1)	0.080	0.0600	kg/t	12	N/A	N/A	312	16	266.7	200.0	N/A	N/A
Wind sifter/destoner (sift)	0.080	0.0600	kg/t	12	N/A	N/A	312	16	266.7	200.0	N/A	N/A
Wind Erosion												
Open Waste Wind Erosion	0.400	0.2000	kg/ha/hr	N/A	15	N/A	365	24	N/A	N/A	0.011	0.006
WASP and WOCOG Windrows	0.400	0.2000	kg/ha/hr	N/A	6	N/A	365	24	N/A	N/A	0.011	0.006
Haul Road Wind Erosion per source (19)	2.654	0.682	kg/VKT	N/A	N/A	15.6	312	16	302.7	1555.6	N/A	N/A

Point Sources

	TSP Emission Factor	**PM10 Emission Factor**	**Emission Factor Units**	**m3/sec**	**Emission Factor Units**	**g/s**	**Temperature (K)**	**Velocity (m/s)**
24 x 1MW GE Jenbacher Engines	N/A	0.00019	kg/m3	3.5	m3/hr	0.7	410	46.3
	N/A	0.000098	kg/kWh	24	Mw	0.7		

Note: Sources provided in parentheses indicate source ID in CALPUFF INPUT file
Note: Both emission factors for PM10 from landfill gas fired engines provided to demonstrate no variation depending on measure used
Note: No TSP emission factor provided in the NPI for landfill gas fired engines.

```
------------

Default Name  Type          File Name

------------  ----          ---------

GEO.DAT       input    ! GEODAT=C:\CALPUFF\30-1546\GEO.DAT      !

SURF.DAT      input    ! SRFDAT=C:\CALPUFF\30-1546\WOODLA~1.DAT     !

CLOUD.DAT     input    * CLDDAT=            *

PRECIP.DAT    input    * PRCDAT=            *

WT.DAT        input    * WTDAT=             *


CALMET.LST    output   ! METLST=c:\calpuff\30-1546\CALMET.lst    !

CALMET.DAT    output   ! METDAT=c:\calpuff\30-1546\CALMET.DAT     !

PACOUT.DAT    output   * PACDAT=            *


All file names will be converted to lower case if LCFILES = T

Otherwise, if LCFILES = F, file names will be converted to UPPER CASE

      T = lower case      ! LCFILES = F !

      F = UPPER CASE


NUMBER OF UPPER AIR & OVERWATER STATIONS:


   Number of upper air stations (NUSTA)  No default     ! NUSTA =  1  !

   Number of overwater met stations

                     (NOWSTA) No default     ! NOWSTA =  0  !


NUMBER OF PROGNOSTIC and IGF-CALMET FILEs:


   Number of MM4/MM5/3D.DAT files

                     (NM3D) No default      ! NM3D =  0  !


   Number of IGF-CALMET.DAT files

                     (NIGF)   No default     ! NIGF =  0  !


                !END!

-------------------------------------------------------------------------------

Subgroup (b)

----------------------------------

Upper air files (one per station)
```

```
-----------------------------------

Default Name  Type      File Name

------------ ----      ---------

UP1.DAT       input     1  ! UPDAT=C:\CALPUFF\30-1546\COLLEX~2.DAT!    !END!

-------------------------------------------------------------------------------

Subgroup (c)

-------------------------------------------

Overwater station files (one per station)

-------------------------------------------

Default Name  Type      File Name

------------ ----      ---------

SEA1.DAT      input     1  * SEADAT=SEA_449.DAT *    *END*

-------------------------------------------------------------------------------

Subgroup (d)

---------------------------------------------------

MM4/MM5/3D.DAT files (consecutive or overlapping)

---------------------------------------------------

Default Name  Type      File Name

------------ ----      ---------

MM51.DAT      input     1  * M3DDAT=LSP2003.DAT *    *END*

-------------------------------------------------------------------------------

Subgroup (e)

---------------------------------------------------

IGF-CALMET.DAT files (consecutive or overlapping)

---------------------------------------------------

Default Name  Type      File Name

------------ ----      ---------

IGFn.DAT      input     1  * IGFDAT=CALMET0.DAT *    *END*

-------------------------------------------------------------------------------

Subgroup (f)

----------------

Other file names

----------------


Default Name  Type      File Name

------------ ----      ---------

DIAG.DAT      input     * DIADAT=                 *

PROG.DAT      input     * PRGDAT=                 *
```

```
TEST.PRT      output    * TSTPRT=              *
TEST.OUT      output    * TSTOUT=              *
TEST.KIN      output    * TSTKIN=              *
TEST.FRD      output    * TSTFRD=              *
TEST.SLP      output    * TSTSLP=              *
DCST.GRD      output    * DCSTGD=              *

------------------------------------------------------------------------------
NOTES: (1) File/path names can be up to 70 characters in length
       (2) Subgroups (a) and (f) must have ONE 'END' (surrounded by
           delimiters) at the end of the group
       (3) Subgroups (b) through (e) are included ONLY if the corresponding
           number of files (NUSTA, NOWSTA, NM3D, NIGF) is not 0, and each must have
           an 'END' (surround by delimiters) at the end of EACH LINE

                    !END!

------------------------------------------------------------------------------

INPUT GROUP: 1 -- General run control parameters
--------------

    Starting date:    Year   (IBYR) --    No default   ! IBYR  =  2005  !
                      Month  (IBMO) --    No default   ! IBMO  =  1  !
                      Day    (IBDY) --    No default   ! IBDY  =  1  !
    Starting time:    Hour   (IBHR) --    No default   ! IBHR  =  0  !
                      Second (IBSEC) --   No default   ! IBSEC =  0  !

    Ending date:      Year   (IEYR) --    No default   ! IEYR  =  2005  !
                      Month  (IEMO) --    No default   ! IEMO  =  12  !
                      Day    (IEDY) --    No default   ! IEDY  =  31  !
    Ending time:      Hour   (IEHR) --    No default   ! IEHR  =  23  !
                      Second (IESEC) --   No default   ! IESEC =  0  !

     UTC time zone        (ABTZ) -- No default      ! ABTZ= UTC+1000 !
       (character*8)
```

```
      PST = UTC-0800, MST = UTC-0700 , GMT = UTC-0000

      CST = UTC-0600, EST = UTC-0500


   Length of modeling time-step (seconds)

   Must divide evenly into 3600 (1 hour)

   (NSECDT)                    Default:3600    ! NSECDT =  3600  !

                          Units: seconds


   Run type          (IRTYPE) -- Default: 1      ! IRTYPE=  1  !


     0 = Computes wind fields only

     1 = Computes wind fields and micrometeorological variables

        (u*, w*, L, zi, etc.)

     (IRTYPE must be 1 to run CALPUFF or CALGRID)


   Compute special data fields required

   by CALGRID (i.e., 3-D fields of W wind

   components and temperature)

   in additional to regular          Default: T    ! LCALGRD = T !

   fields ? (LCALGRD)

   (LCALGRD must be T to run CALGRID)


     Flag to stop run after

     SETUP phase (ITEST)           Default: 2      ! ITEST=  2   !

     (Used to allow checking

     of the model inputs, files, etc.)

     ITEST = 1 - STOPS program after SETUP phase

     ITEST = 2 - Continues with execution of

              COMPUTATIONAL phase after SETUP


!END!


------------------------------------------------------------------------------


INPUT GROUP: 2 -- Map Projection and Grid control parameters

--------------


    Projection for all (X,Y):
```

Map projection

(PMAP) Default: UTM ! PMAP = UTM !

UTM : Universal Transverse Mercator

TTM : Tangential Transverse Mercator

LCC : Lambert Conformal Conic

PS : Polar Stereographic

EM : Equatorial Mercator

LAZA : Lambert Azimuthal Equal Area

False Easting and Northing (km) at the projection origin

(Used only if PMAP= TTM, LCC, or LAZA)

(FEAST) Default=0.0 ! FEAST = 0.000 !

(FNORTH) Default=0.0 ! FNORTH = 0.000 !

UTM zone (1 to 60)

(Used only if PMAP=UTM)

(IUTMZN) No Default ! IUTMZN = 55 !

Hemisphere for UTM projection?

(Used only if PMAP=UTM)

(UTMHEM) Default: N ! UTMHEM = S !

N : Northern hemisphere projection

S : Southern hemisphere projection

Latitude and Longitude (decimal degrees) of projection origin

(Used only if PMAP= TTM, LCC, PS, EM, or LAZA)

(RLAT0) No Default ! RLAT0 = 0N !

(RLON0) No Default ! RLON0 = 0E !

TTM : RLON0 identifies central (true N/S) meridian of projection

RLAT0 selected for convenience

LCC : RLON0 identifies central (true N/S) meridian of projection

RLAT0 selected for convenience

PS : RLON0 identifies central (grid N/S) meridian of projection

RLAT0 selected for convenience

EM : RLON0 identifies central meridian of projection

RLAT0 is REPLACED by 0.0N (Equator)

LAZA: RLON0 identifies longitude of tangent-point of mapping plane

RLAT0 identifies latitude of tangent-point of mapping plane

Matching parallel(s) of latitude (decimal degrees) for projection

(Used only if PMAP= LCC or PS)

(XLAT1) No Default ! XLAT1 = 0N !

(XLAT2) No Default ! XLAT2 = 0N !

LCC : Projection cone slices through Earth's surface at XLAT1 and XLAT2

PS : Projection plane slices through Earth at XLAT1

(XLAT2 is not used)

Note: Latitudes and longitudes should be positive, and include a

letter N,S,E, or W indicating north or south latitude, and

east or west longitude. For example,

35.9 N Latitude = 35.9N

118.7 E Longitude = 118.7E

Datum-region

The Datum-Region for the coordinates is identified by a character

string. Many mapping products currently available use the model of the

Earth known as the World Geodetic System 1984 (WGS-84). Other local

models may be in use, and their selection in CALMET will make its output

consistent with local mapping products. The list of Datum-Regions with

official transformation parameters is provided by the National Imagery and

Mapping Agency (NIMA).

NIMA Datum - Regions(Examples)

WGS-84 WGS-84 Reference Ellipsoid and Geoid, Global coverage (WGS84)

NAS-C NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27)

NAR-C NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR CONUS (NAD83)

NWS-84 NWS 6370KM Radius, Sphere

ESR-S ESRI REFERENCE 6371KM Radius, Sphere

Datum-region for output coordinates

(DATUM) Default: WGS-84 ! DATUM = WGS-84 !

Horizontal grid definition:

Rectangular grid defined for projection PMAP,

with X the Easting and Y the Northing coordinate

No. X grid cells (NX) No default ! NX = 100 !

No. Y grid cells (NY) No default ! NY = 100 !

Grid spacing (DGRIDKM) No default ! DGRIDKM = 0.2 !

Units: km

Reference grid coordinate of

SOUTHWEST corner of grid cell (1,1)

X coordinate (XORIGKM) No default ! XORIGKM = 724.277 !

Y coordinate (YORIGKM) No default ! YORIGKM = 6106.107 !

Units: km

Vertical grid definition:

No. of vertical layers (NZ) No default ! NZ = 8 !

Cell face heights in arbitrary

vertical grid (ZFACE(NZ+1)) No defaults

Units: m

! ZFACE = 0.,20.,40.,80.,160.,320.,700.,1300.,1700. !

!END!

```
------------------------------------------------------------------------------

INPUT GROUP: 3 -- Output Options

--------------


  DISK OUTPUT OPTION


    Save met. fields in an unformatted

    output file ?            (LSAVE)  Default: T    ! LSAVE = T !

    (F = Do not save, T = Save)


    Type of unformatted output file:

    (IFORMO)                      Default: 1    ! IFORMO =  1  !


       1 = CALPUFF/CALGRID type file (CALMET.DAT)

       2 = MESOPUFF-II type file     (PACOUT.DAT)



  LINE PRINTER OUTPUT OPTIONS:


    Print met. fields ?  (LPRINT)       Default: F    ! LPRINT = T !

    (F = Do not print, T = Print)

    (NOTE: parameters below control which

          met. variables are printed)


    Print interval

    (IPRINF) in hours                Default: 1    ! IPRINF =  1  !

    (Meteorological fields are printed

     every  1  hours)



    Specify which layers of U, V wind component

    to print (IUVOUT(NZ)) -- NOTE: NZ values must be entered

    (0=Do not print, 1=Print)

    (used only if LPRINT=T)       Defaults: NZ*0
```

! IUVOUT = 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 !

Specify which levels of the W wind component to print

(NOTE: W defined at TOP cell face -- 8 values)

(IWOUT(NZ)) -- NOTE: NZ values must be entered

(0=Do not print, 1=Print)

(used only if LPRINT=T & LCALGRD=T)

Defaults: NZ*0

! IWOUT = 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 !

Specify which levels of the 3-D temperature field to print

(ITOUT(NZ)) -- NOTE: NZ values must be entered

(0=Do not print, 1=Print)

(used only if LPRINT=T & LCALGRD=T)

Defaults: NZ*0

! ITOUT = 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 !

Specify which meteorological fields

to print

(used only if LPRINT=T) Defaults: 0 (all variables)

Variable Print ?

(0 = do not print,

1 = print)

--- ---

! STABILITY = 0 ! - PGT stability class

! USTAR = 0 ! - Friction velocity

! MONIN = 0 ! - Monin-Obukhov length

! MIXHT = 0 ! - Mixing height

! WSTAR = 0 ! - Convective velocity scale

```
! PRECIP    =        0        ! - Precipitation rate

! SENSHEAT  =        0        ! - Sensible heat flux

! CONVZI    =        0        ! - Convective mixing ht.



 Testing and debug print options for micrometeorological module


   Print input meteorological data and

   internal variables (LDB)       Default: F      ! LDB = F !

   (F = Do not print, T = print)

   (NOTE: this option produces large amounts of output)


   First time step for which debug data

   are printed (NN1)              Default: 1      ! NN1 =  1  !


   Last time step for which debug data

   are printed (NN2)              Default: 1      ! NN2 =  2  !


   Print distance to land

   internal variables (LDBCST)    Default: F      ! LDBCST = F !

   (F = Do not print, T = print)

   (Output in .GRD file DCST.GRD, defined in input group 0)


 Testing and debug print options for wind field module

 (all of the following print options control output to

  wind field module's output files: TEST.PRT, TEST.OUT,

  TEST.KIN, TEST.FRD, and TEST.SLP)


   Control variable for writing the test/debug

   wind fields to disk files (IOUTD)

   (0=Do not write, 1=write)      Default: 0      ! IOUTD =  0  !


   Number of levels, starting at the surface,

   to print (NZPRN2)              Default: 1      ! NZPRN2 =  1  !


   Print the INTERPOLATED wind components ?

   (IPR0) (0=no, 1=yes)           Default: 0      !  IPR0 =  0  !
```

```
      Print the TERRAIN ADJUSTED surface wind

      components ?

      (IPR1) (0=no, 1=yes)          Default: 0      ! IPR1 =  0  !


      Print the SMOOTHED wind components and

      the INITIAL DIVERGENCE fields ?

      (IPR2) (0=no, 1=yes)          Default: 0      ! IPR2 =  0  !


      Print the FINAL wind speed and direction

      fields ?

      (IPR3) (0=no, 1=yes)          Default: 0      ! IPR3 =  0  !


      Print the FINAL DIVERGENCE fields ?

      (IPR4) (0=no, 1=yes)          Default: 0      ! IPR4 =  0  !


      Print the winds after KINEMATIC effects

      are added ?

      (IPR5) (0=no, 1=yes)          Default: 0      ! IPR5 =  0  !


      Print the winds after the FROUDE NUMBER

      adjustment is made ?

      (IPR6) (0=no, 1=yes)          Default: 0      ! IPR6 =  0  !


      Print the winds after SLOPE FLOWS

      are added ?

      (IPR7) (0=no, 1=yes)          Default: 0      ! IPR7 =  0  !


      Print the FINAL wind field components ?

      (IPR8) (0=no, 1=yes)          Default: 0      ! IPR8 =  0  !


!END!



------------------------------------------------------------------------------


INPUT GROUP: 4 -- Meteorological data options

--------------
```

NO OBSERVATION MODE (NOOBS) Default: 0 ! NOOBS = 0 !

0 = Use surface, overwater, and upper air stations

1 = Use surface and overwater stations (no upper air observations)

Use MM4/MM5/3D for upper air data

2 = No surface, overwater, or upper air observations

Use MM4/MM5/3D for surface, overwater, and upper air data

NUMBER OF SURFACE & PRECIP. METEOROLOGICAL STATIONS

Number of surface stations (NSSTA) No default ! NSSTA = 3 !

Number of precipitation stations

(NPSTA=-1: flag for use of MM5/3D precip data)

(NPSTA) No default ! NPSTA = 0 !

CLOUD DATA OPTIONS

Gridded cloud fields:

(ICLOUD) Default: 0 ! ICLOUD = 0 !

ICLOUD = 0 - Gridded clouds not used

ICLOUD = 1 - Gridded CLOUD.DAT generated as OUTPUT

ICLOUD = 2 - Gridded CLOUD.DAT read as INPUT

ICLOUD = 3 - Gridded cloud cover computed from prognostic fields

FILE FORMATS

Surface meteorological data file format

(IFORMS) Default: 2 ! IFORMS = 2 !

(1 = unformatted (e.g., SMERGE output))

(2 = formatted (free-formatted user input))

Precipitation data file format

(IFORMP) Default: 2 ! IFORMP = 2 !

(1 = unformatted (e.g., PMERGE output))

(2 = formatted (free-formatted user input))

Cloud data file format

(IFORMC) Default: 2 ! IFORMC = 2 !

(1 = unformatted - CALMET unformatted output)

```
      (2 = formatted   - free-formatted CALMET output or user input)


!END!



------------------------------------------------------------------------------


INPUT GROUP: 5 -- Wind Field Options and Parameters

--------------



   WIND FIELD MODEL OPTIONS

      Model selection variable (IWFCOD)     Default: 1     ! IWFCOD =  1  !

        0 = Objective analysis only

        1 = Diagnostic wind module


      Compute Froude number adjustment

      effects ? (IFRADJ)                    Default: 1     ! IFRADJ =  1  !

      (0 = NO, 1 = YES)


      Compute kinematic effects ? (IKINE)   Default: 0     ! IKINE  =  0  !

      (0 = NO, 1 = YES)


      Use O'Brien procedure for adjustment

      of the vertical velocity ? (IOBR)     Default: 0     ! IOBR =  0  !

      (0 = NO, 1 = YES)


      Compute slope flow effects ? (ISLOPE) Default: 1     ! ISLOPE  =  1  !

      (0 = NO, 1 = YES)


      Extrapolate surface wind observations

      to upper layers ? (IEXTRP)            Default: -4    ! IEXTRP = -4  !

      (1 = no extrapolation is done,

       2 = power law extrapolation used,

       3 = user input multiplicative factors

          for layers 2 - NZ used (see FEXTRP array)

       4 = similarity theory used

       -1, -2, -3, -4 = same as above except layer 1 data
```

```
   at upper air stations are ignored


Extrapolate surface winds even

if calm? (ICALM)                  Default: 0      ! ICALM  =  0  !

(0 = NO, 1 = YES)


Layer-dependent biases modifying the weights of

surface and upper air stations (BIAS(NZ))

 -1<=BIAS<=1

Negative BIAS reduces the weight of upper air stations

 (e.g. BIAS=-0.1 reduces the weight of upper air stations

by 10%; BIAS= -1, reduces their weight by 100 %)

Positive BIAS reduces the weight of surface stations

 (e.g. BIAS= 0.2 reduces the weight of surface stations

by 20%; BIAS=1 reduces their weight by 100%)

Zero BIAS leaves weights unchanged (1/R**2 interpolation)

Default: NZ*0

                    ! BIAS =  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 !


Minimum distance from nearest upper air station

to surface station for which extrapolation

of surface winds at surface station will be allowed

(RMIN2: Set to -1 for IEXTRP = 4 or other situations

 where all surface stations should be extrapolated)

                              Default: 4.     ! RMIN2 = -1.0 !


Use gridded prognostic wind field model

output fields as input to the diagnostic

wind field model (IPROG)            Default: 0      ! IPROG =  0  !

(0 = No, [IWFCOD = 0 or 1]

 1 = Yes, use CSUMM prog. winds as Step 1 field, [IWFCOD = 0]

 2 = Yes, use CSUMM prog. winds as initial guess field [IWFCOD = 1]

 3 = Yes, use winds from MM4.DAT file as Step 1 field [IWFCOD = 0]

 4 = Yes, use winds from MM4.DAT file as initial guess field [IWFCOD = 1]

 5 = Yes, use winds from MM4.DAT file as observations [IWFCOD = 1]

 13 = Yes, use winds from MM5/3D.DAT file as Step 1 field [IWFCOD = 0]

 14 = Yes, use winds from MM5/3D.DAT file as initial guess field [IWFCOD = 1]

 15 = Yes, use winds from MM5/3D.DAT file as observations [IWFCOD = 1]
```

```
   Timestep (hours) of the prognostic
   model input data   (ISTEPPG)         Default: 1     ! ISTEPPG =  1   !

   Use coarse CALMET fields as initial guess fields (IGFMET)
   (overwrites IGF based on prognostic wind fields if any)
                              Default: 0     ! IGFMET =  0  !

RADIUS OF INFLUENCE PARAMETERS

   Use varying radius of influence       Default: F     ! LVARY =  F!
   (if no stations are found within RMAX1,RMAX2,
    or RMAX3, then the closest station will be used)

   Maximum radius of influence over land
   in the surface layer (RMAX1)         No default     ! RMAX1 = 4. !
                              Units: km
   Maximum radius of influence over land
   aloft (RMAX2)                  No default     ! RMAX2 = 2. !
                              Units: km
   Maximum radius of influence over water
   (RMAX3)                        No default     ! RMAX3 = 1. !
                              Units: km

OTHER WIND FIELD INPUT PARAMETERS

   Minimum radius of influence used in
   the wind field interpolation (RMIN)   Default: 0.1    ! RMIN = 0.1 !
                              Units: km
   Radius of influence of terrain
   features (TERRAD)              No default     ! TERRAD = 5. !

                              Units: km
   Relative weighting of the first
   guess field and observations in the
   SURFACE layer (R1)             No default     ! R1 = 0.4 !
   (R1 is the distance from an          Units: km
```

```
      observational station at which the
      observation and first guess field are
      equally weighted)

      Relative weighting of the first
      guess field and observations in the
      layers ALOFT (R2)                 No default     ! R2 = 0.4 !
      (R2 is applied in the upper layers    Units: km
      in the same manner as R1 is used in
      the surface layer).

      Relative weighting parameter of the
      prognostic wind field data (RPROG)    No default     ! RPROG = 0. !
      (Used only if IPROG = 1)              Units: km
      ------------------------

      Maximum acceptable divergence in the
      divergence minimization procedure
      (DIVLIM)                          Default: 5.E-6  ! DIVLIM= 5.0E-06 !

      Maximum number of iterations in the
      divergence min. procedure (NITER)     Default: 50     ! NITER =  50  !

      Number of passes in the smoothing
      procedure (NSMTH(NZ))
      NOTE: NZ values must be entered
          Default: 2,(mxnz-1)*4 ! NSMTH =
 2 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4 !

      Maximum number of stations used in
      each layer for the interpolation of
      data to a grid point (NINTR2(NZ))
      NOTE: NZ values must be entered       Default: 99.    ! NINTR2 =
 99 ,  99 ,  99 ,  99 ,  99 ,  99 ,  99 ,  99 !

      Critical Froude number (CRITFN)       Default: 1.0    ! CRITFN = 1. !

      Empirical factor controlling the
```

```
   influence of kinematic effects

   (ALPHA)                        Default: 0.1    ! ALPHA = 0.1 !


   Multiplicative scaling factor for

   extrapolation of surface observations

   to upper layers (FEXTR2(NZ))         Default: NZ*0.0

   ! FEXTR2 = 0., 0., 0., 0., 0., 0., 0. !

   (Used only if IEXTRP = 3 or -3)



BARRIER INFORMATION


   Number of barriers to interpolation

   of the wind fields (NBAR)            Default: 0     ! NBAR =  0  !


   Level (1 to NZ) up to which barriers

   apply (KBAR)                         Default: NZ    ! KBAR =  12  !


   THE FOLLOWING 4 VARIABLES ARE INCLUDED

   ONLY IF NBAR > 0

   NOTE: NBAR values must be entered     No defaults

      for each variable              Units: km


     X coordinate of BEGINNING

     of each barrier (XBBAR(NBAR))     ! XBBAR = 0. !

     Y coordinate of BEGINNING

     of each barrier (YBBAR(NBAR))     ! YBBAR = 0. !


     X coordinate of ENDING

     of each barrier (XEBAR(NBAR))     ! XEBAR = 0. !

     Y coordinate of ENDING

     of each barrier (YEBAR(NBAR))     ! YEBAR = 0. !



DIAGNOSTIC MODULE DATA INPUT OPTIONS


   Surface temperature (IDIOPT1)        Default: 0     ! IDIOPT1 =  0  !

     0 = Compute internally from
```

```
    hourly surface observations
  1 = Read preprocessed values from
    a data file (DIAG.DAT)

  Surface met. station to use for
  the surface temperature (ISURFT)   No default     ! ISURFT =  3  !
  (Must be a value from 1 to NSSTA)
  (Used only if IDIOPT1 = 0)
  ---------------------------

Domain-averaged temperature lapse
rate (IDIOPT2)                     Default: 0     ! IDIOPT2 =  0  !
  0 = Compute internally from
    twice-daily upper air observations
  1 = Read hourly preprocessed values
    from a data file (DIAG.DAT)

  Upper air station to use for
  the domain-scale lapse rate (IUPT) No default     ! IUPT   =  1  !
  (Must be a value from 1 to NUSTA)
  (Used only if IDIOPT2 = 0)
  ---------------------------

  Depth through which the domain-scale
  lapse rate is computed (ZUPT)      Default: 200.  ! ZUPT = 200. !
  (Used only if IDIOPT2 = 0)         Units: meters
  ---------------------------

Domain-averaged wind components
(IDIOPT3)                          Default: 0     ! IDIOPT3 =  0  !
  0 = Compute internally from
    twice-daily upper air observations
  1 = Read hourly preprocessed values
    a data file (DIAG.DAT)

  Upper air station to use for
  the domain-scale winds (IUPWND)    Default: -1    ! IUPWND = -1  !
  (Must be a value from -1 to NUSTA)
```

(Used only if IDIOPT3 = 0)

Bottom and top of layer through

which the domain-scale winds

are computed

(ZUPWND(1), ZUPWND(2)) Defaults: 1., 1000. ! ZUPWND= 1., 1000. !

(Used only if IDIOPT3 = 0) Units: meters

Observed surface wind components

for wind field module (IDIOPT4) Default: 0 ! IDIOPT4 = 0 !

0 = Read WS, WD from a surface

data file (SURF.DAT)

1 = Read hourly preprocessed U, V from

a data file (DIAG.DAT)

Observed upper air wind components

for wind field module (IDIOPT5) Default: 0 ! IDIOPT5 = 0 !

0 = Read WS, WD from an upper

air data file (UP1.DAT, UP2.DAT, etc.)

1 = Read hourly preprocessed U, V from

a data file (DIAG.DAT)

LAKE BREEZE INFORMATION

Use Lake Breeze Module (LLBREZE)

Default: F ! LLBREZE = F !

Number of lake breeze regions (NBOX) ! NBOX = 0 !

X Grid line 1 defining the region of interest

! XG1 = 0. !

X Grid line 2 defining the region of interest

! XG2 = 0. !

Y Grid line 1 defining the region of interest

! YG1 = 0. !

Y Grid line 2 defining the region of interest

! YG2 = 0. !

X Point defining the coastline (Straight line)

(XBCST) (KM) Default: none ! XBCST = 0. !

Y Point defining the coastline (Straight line)

(YBCST) (KM) Default: none ! YBCST = 0. !

X Point defining the coastline (Straight line)

(XECST) (KM) Default: none ! XECST = 0. !

Y Point defining the coastline (Straight line)

(YECST) (KM) Default: none ! YECST = 0. !

Number of stations in the region Default: none ! NLB = 0 !

(Surface stations + upper air stations)

Station ID's in the region (METBXID(NLB))

(Surface stations first, then upper air stations)

! METBXID = 0 !

!END!

INPUT GROUP: 6 -- Mixing Height, Temperature and Precipitation Parameters

---

EMPIRICAL MIXING HEIGHT CONSTANTS

Neutral, mechanical equation

(CONSTB) Default: 1.41 ! CONSTB = 1.41 !

Convective mixing ht. equation

(CONSTE) Default: 0.15 ! CONSTE = 0.15 !

Stable mixing ht. equation

(CONSTN) Default: 2400. ! CONSTN = 2400.!

```
   Overwater mixing ht. equation
   (CONSTW)                    Default: 0.16   ! CONSTW = 0.16 !
   Absolute value of Coriolis
   parameter (FCORIOL)         Default: 1.E-4  ! FCORIOL = 1.0E-04!
                               Units: (1/s)

SPATIAL AVERAGING OF MIXING HEIGHTS

   Conduct spatial averaging
   (IAVEZI)  (0=no, 1=yes)     Default: 1      ! IAVEZI =  1  !

   Max. search radius in averaging
   process (MNMDAV)            Default: 1      ! MNMDAV =  1  !
                               Units: Grid
                                      cells
   Half-angle of upwind looking cone
   for averaging (HAFANG)      Default: 30.    ! HAFANG = 30. !
                               Units: deg.
   Layer of winds used in upwind
   averaging (ILEVZI)          Default: 1      ! ILEVZI =  1  !
   (must be between 1 and NZ)

CONVECTIVE MIXING HEIGHT OPTIONS:
   Method to compute the convective
   mixing height(IMIHXH)       Default: 1      ! IMIXH =  1  !
     1: Maul-Carson for land and water cells
    -1: Maul-Carson for land cells only -
        OCD mixing height overwater
     2: Batchvarova and Gryning for land and water cells
    -2: Batchvarova and Gryning for land cells only
        OCD mixing height overwater

   Threshold buoyancy flux required to
   sustain convective mixing height growth
   overland (THRESHL)          Default: 0.05   ! THRESHL = 0.05 !
   (expressed as a heat flux   units: W/m3
    per meter of boundary layer)
```

```
   Threshold buoyancy flux required to
   sustain convective mixing height growth
   overwater (THRESHW)                 Default: 0.05   ! THRESHW = 0.05 !
   (expressed as a heat flux           units: W/m3
    per meter of boundary layer)



   Option for overwater lapse rates used
   in convective mixing height growth
   (ITWPROG)                           Default: 0     ! ITWPROG =  0  !
   0 : use SEA.DAT lapse rates and deltaT (or assume neutral
       conditions if missing)
   1 : use prognostic lapse rates (only if IPROG>2)
       and SEA.DAT deltaT (or neutral if missing)
   2 : use prognostic lapse rates and prognostic delta T
       (only if iprog>12 and 3D.DAT version# 2.0 or higher)

   Land Use category ocean in 3D.DAT datasets
   (ILUOC3D)                           Default: 16     ! ILUOC3D =  16  !
   Note: if 3D.DAT from MM5 version 3.0, iluoc3d = 16
         if MM4.DAT,          typically iluoc3d = 7



OTHER MIXING HEIGHT VARIABLES


   Minimum potential temperature lapse
   rate in the stable layer above the
   current convective mixing ht.       Default: 0.001  ! DPTMIN = 0.001 !
   (DPTMIN)                            Units: deg. K/m
   Depth of layer above current conv.
   mixing height through which lapse    Default: 200.   ! DZZI = 200. !
   rate is computed (DZZI)             Units: meters

   Minimum overland mixing height       Default:  50.   ! ZIMIN = 50. !
   (ZIMIN)                             Units: meters
   Maximum overland mixing height       Default: 3000.  ! ZIMAX = 3000. !
```

(ZIMAX) Units: meters

Minimum overwater mixing height Default: 50. ! ZIMINW = 50. !

(ZIMINW) -- (Not used if observed Units: meters

overwater mixing hts. are used)

Maximum overwater mixing height Default: 3000. ! ZIMAXW = 3000. !

(ZIMAXW) -- (Not used if observed Units: meters

overwater mixing hts. are used)

OVERWATER SURFACE FLUXES METHOD and PARAMETERS

(ICOARE) Default: 10 ! ICOARE = 10 !

0: original deltaT method (OCD)

10: COARE with no wave parameterization (jwave=0, Charnock)

11: COARE with wave option jwave=1 (Oost et al.)

and default wave properties

-11: COARE with wave option jwave=1 (Oost et al.)

and observed wave properties (must be in SEA.DAT files)

12: COARE with wave option 2 (Taylor and Yelland)

and default wave properties

-12: COARE with wave option 2 (Taylor and Yelland)

and observed wave properties (must be in SEA.DAT files)

Coastal/Shallow water length scale (DSHELF)

(for modified z0 in shallow water)

(COARE fluxes only)

Default : 0. ! DSHELF = 0. !

units: km

COARE warm layer computation (IWARM) ! IWARM = 0 !

1: on - 0: off (must be off if SST measured with

IR radiometer) Default: 0

COARE cool skin layer computation (ICOOL) ! ICOOL = 0 !

1: on - 0: off (must be off if SST measured with

IR radiometer) Default: 0

RELATIVE HUMIDITY PARAMETERS

```
 3D relative humidity from observations or

 from prognostic data? (IRHPROG)      Default:0       ! IRHPROG =  0  !


   0 = Use RH from SURF.DAT file

      (only if NOOBS = 0,1)

   1 = Use prognostic RH

      (only if NOOBS = 0,1,2)


TEMPERATURE PARAMETERS


 3D temperature from observations or

 from prognostic data? (ITPROG)       Default:0       ! ITPROG =  0  !


   0 = Use Surface and upper air stations

      (only if NOOBS = 0)

   1 = Use Surface stations (no upper air observations)

      Use MM5/3D for upper air data

      (only if NOOBS = 0,1)

   2 = No surface or upper air observations

      Use MM5/3D for surface and upper air data

      (only if NOOBS = 0,1,2)


 Interpolation type

 (1 = 1/R ; 2 = 1/R**2)               Default:1       ! IRAD =  1  !


 Radius of influence for temperature

 interpolation (TRADKM)               Default: 500.    ! TRADKM = 500. !

                              Units: km


 Maximum Number of stations to include

 in temperature interpolation (NUMTS)  Default: 5       ! NUMTS = 5  !


 Conduct spatial averaging of temp-

 eratures (IAVET)  (0=no, 1=yes)      Default: 1       ! IAVET =  1  !

 (will use mixing ht MNMDAV,HAFANG

  so make sure they are correct)


 Default temperature gradient         Default: -.0098  ! TGDEFB = -0.0098 !
```

```
      below the mixing height over         Units: K/m
      water (TGDEFB)

      Default temperature gradient         Default: -.0045   ! TGDEFA = -0.0045 !
      above the mixing height over         Units: K/m
      water (TGDEFA)

      Beginning (JWAT1) and ending (JWAT2)
      land use categories for temperature                ! JWAT1 =  999  !
      interpolation over water -- Make                   ! JWAT2 =  999  !
      bigger than largest land use to disable

   PRECIP INTERPOLATION PARAMETERS

      Method of interpolation (NFLAGP)      Default: 2      ! NFLAGP =  2  !
       (1=1/R,2=1/R**2,3=EXP/R**2)
      Radius of Influence  (SIGMAP)         Default: 100.0   ! SIGMAP = 100. !
       (0.0 => use half dist. btwn          Units: km
        nearest stns w & w/out
        precip when NFLAGP = 3)
      Minimum Precip. Rate Cutoff (CUTP)    Default: 0.01    ! CUTP = 0.01 !
      (values < CUTP = 0.0 mm/hr)           Units: mm/hr
!END!


------------------------------------------------------------------------------


INPUT GROUP: 7 -- Surface meteorological station parameters

--------------


    SURFACE STATION VARIABLES

    (One record per station --  3  records in all)



          1     2

      Name   ID           X coord.   Y coord.   Time   Anem.

                          (km)       (km)      zone   Ht.(m)

      ------------------------------------------------------------
```

```
! SS1  ='wood'    12456      734.922     6117.426    10    10 !

! SS2  ='wmas'    12457      733.777     6114.997    10    30 !

! SS3  ='coll'    12458      734.728     6113.590    10    40 !

--------------------

     1

      Four character string for station name

      (MUST START IN COLUMN 9)


     2

      Six digit integer for station ID


!END!



------------------------------------------------------------------------------


INPUT GROUP: 8 -- Upper air meteorological station parameters

--------------


    UPPER AIR STATION VARIABLES

    (One record per station --  1  records in all)


          1     2

       Name    ID      X coord.   Y coord.  Time zone

                     (km)       (km)

      ------------------------------------------------

! US1  ='coll'   54321    734.728   6113.590    10  !

--------------------

     1

      Four character string for station name

      (MUST START IN COLUMN 9)


     2

      Five digit integer for station ID


!END!
```

```
------------------------------------------------------------------------------

INPUT GROUP: 9 -- Precipitation station parameters

--------------

    PRECIPITATION STATION VARIABLES

    (One record per station --  0  records in all)

    (NOT INCLUDED IF NPSTA = 0)

          1        2

       Name   Station    X coord.  Y coord.

              Code       (km)      (km)

       ---------------------------------------



-------------------

     1

       Four character string for station name

       (MUST START IN COLUMN 9)

     2

       Six digit station code composed of state

       code (first 2 digits) and station ID (last

       4 digits)

!END!
```

```
Woodlawn Part 3a

1.2Mtpa

Feb 10 DUST

---------- Run title (3 lines) ------------------------------------------


              CALPUFF MODEL CONTROL FILE

              --------------------------


--------------------------------------------------------------------------------


INPUT GROUP: 0 -- Input and Output File Names


--------------

Default Name  Type          File Name

------------  ----          ---------

CALMET.DAT    input    ! METDAT = C:\CALPUFF\30-1546\WOODLA~1\CALMET.DAT !

   or

ISCMET.DAT    input    * ISCDAT = *

   or

PLMMET.DAT    input    * PLMDAT = *

   or

PROFILE.DAT   input    ! PRFDAT = PROFILE.DAT !

SURFACE.DAT   input    * SFCDAT = *

RESTARTB.DAT  input    * RSTARTB = *

--------------------------------------------------------------------------------

CALPUFF.LST   output   ! PUFLST = CALPUFF.LST !

CONC.DAT      output   ! CONDAT = CONC.DAT !

DFLX.DAT      output   ! DFDAT = DFLX.DAT !

WFLX.DAT      output   ! WFDAT = WFLX.DAT !


VISB.DAT      output   ! VISDAT = VISB.DAT !

TK2D.DAT      output   * T2DDAT = *

RHO2D.DAT     output   * RHODAT = *

RESTARTE.DAT  output   * RSTARTE = *

--------------------------------------------------------------------------------

Emission Files

--------------
```

PTEMARB.DAT input * PTDAT = *

VOLEMARB.DAT input * VOLDAT = *

BAEMARB.DAT input * ARDAT = *

LNEMARB.DAT input * LNDAT = *

Other Files

OZONE.DAT input * OZDAT = *

VD.DAT input * VDDAT = *

CHEM.DAT input * CHEMDAT = *

H2O2.DAT input * H2O2DAT = *

HILL.DAT input * HILDAT = *

HILLRCT.DAT input * RCTDAT = *

COASTLN.DAT input * CSTDAT = *

FLUXBDY.DAT input * BDYDAT = *

BCON.DAT input * BCNDAT = *

DEBUG.DAT output * DEBUG = *

MASSFLX.DAT output * FLXDAT = *

MASSBAL.DAT output * BALDAT = *

FOG.DAT output * FOGDAT = *

All file names will be converted to lower case if LCFILES = T

Otherwise, if LCFILES = F, file names will be converted to UPPER CASE

T = lower case ! LCFILES = F !

F = UPPER CASE

NOTE: (1) file/path names can be up to 70 characters in length

Provision for multiple input files

Number of CALMET.DAT files for run (NMETDAT)

Default: 1 ! NMETDAT = 1 !

Number of PTEMARB.DAT files for run (NPTDAT)

Default: 0 ! NPTDAT = 0 !

Number of BAEMARB.DAT files for run (NARDAT)

```
                    Default: 0      ! NARDAT =  0  !


   Number of VOLEMARB.DAT files for run (NVOLDAT)

                    Default: 0      ! NVOLDAT =  0  !


!END!


-------------

Subgroup (0a)

-------------


 The following CALMET.DAT filenames are processed in sequence if NMETDAT>1


Default Name  Type          File Name

------------  ----          ---------

 none         input    * METDAT=     *   *END*
```

```
INPUT GROUP: 1 -- General run control parameters

--------------


  Option to run all periods found

  in the met. file     (METRUN)   Default: 0      ! METRUN = 1 !


     METRUN = 0 - Run period explicitly defined below

     METRUN = 1 - Run all periods in met. file


  Starting date:    Year   (IBYR)  --    No default   ! IBYR = 2005 !

                    Month  (IBMO)  --    No default   ! IBMO = 1 !

                    Day    (IBDY)  --    No default   ! IBDY = 1 !

  Starting time:    Hour   (IBHR)  --    No default   ! IBHR = 0 !

                    Minute (IBMIN) --    No default   ! IBMIN = 0 !

                    Second (IBSEC) --    No default   ! IBSEC = 0 !


  Ending date:      Year   (IEYR)  --    No default   ! IEYR = 2005 !
```

```
              Month  (IEMO)  --    No default   ! IEMO = 12 !

              Day    (IEDY)  --    No default   ! IEDY = 31 !

Ending time:      Hour   (IEHR)  --    No default   ! IEHR = 23 !

              Minute (IEMIN) --    No default   ! IEMIN = 0 !

              Second (IESEC) --    No default   ! IESEC = 0 !


(These are only used if METRUN = 0)


Base time zone       (XBTZ) -- No default      ! XBTZ = -10 !

The zone is the number of hours that must be

ADDED to the time to obtain UTC (or GMT)

Examples: PST = 8., MST = 7.

        CST = 6., EST = 5.


Length of modeling time-step (seconds)

Equal to update period in the primary

meteorological data files, or an

integer fraction of it (1/2, 1/3 ...)

Must be no larger than 1 hour

(NSECDT)                    Default:3600     ! NSECDT = 3600 !

                      Units: seconds


Number of chemical species (NSPEC)

                      Default: 5      ! NSPEC = 2 !


Number of chemical species

to be emitted  (NSE)          Default: 3      ! NSE = 2 !


Flag to stop run after

SETUP phase (ITEST)           Default: 2      ! ITEST = 2 !

(Used to allow checking

of the model inputs, files, etc.)

     ITEST = 1 - STOPS program after SETUP phase

     ITEST = 2 - Continues with execution of program

              after SETUP


Restart Configuration:
```

```
 Control flag (MRESTART)     Default: 0      ! MRESTART = 0 !


    0 = Do not read or write a restart file

    1 = Read a restart file at the beginning of

       the run

    2 = Write a restart file during run

    3 = Read a restart file at beginning of run

       and write a restart file during run


 Number of periods in Restart

 output cycle (NRESPD)       Default: 0      ! NRESPD = 0 !


    0 = File written only at last period

   >0 = File updated every NRESPD periods


Meteorological Data Format (METFM)

                        Default: 1      ! METFM = 1 !


     METFM = 1 - CALMET binary file (CALMET.MET)

     METFM = 2 - ISC ASCII file (ISCMET.MET)

     METFM = 3 - AUSPLUME ASCII file (PLMMET.MET)

     METFM = 4 - CTDM plus tower file (PROFILE.DAT) and

              surface parameters file (SURFACE.DAT)

     METFM = 5 - AERMET tower file (PROFILE.DAT) and

              surface parameters file (SURFACE.DAT)


Meteorological Profile Data Format (MPRFFM)

      (used only for METFM = 1, 2, 3)

                        Default: 1      ! MPRFFM = 1 !


     MPRFFM = 1 - CTDM plus tower file (PROFILE.DAT)

     MPRFFM = 2 - AERMET tower file (PROFILE.DAT)


PG sigma-y is adjusted by the factor (AVET/PGTIME)**0.2

Averaging Time (minutes) (AVET)

                        Default: 60.0    ! AVET = 60 !

PG Averaging Time (minutes) (PGTIME)

                        Default: 60.0    ! PGTIME = 60 !
```

```
!END!


------------------------------------------------------------------------------


INPUT GROUP: 2 -- Technical options

--------------


    Vertical distribution used in the

    near field (MGAUSS)                 Default: 1     ! MGAUSS = 1 !

      0 = uniform

      1 = Gaussian


    Terrain adjustment method

    (MCTADJ)                            Default: 3     ! MCTADJ = 3 !

      0 = no adjustment

      1 = ISC-type of terrain adjustment

      2 = simple, CALPUFF-type of terrain

         adjustment

      3 = partial plume path adjustment


    Subgrid-scale complex terrain

    flag (MCTSG)                        Default: 0     ! MCTSG = 0 !

      0 = not modeled

      1 = modeled


    Near-field puffs modeled as

    elongated 0 (MSLUG)                 Default: 0     ! MSLUG = 0 !

      0 = no

      1 = yes (slug model used)


    Transitional plume rise modeled ?

    (MTRANS)                            Default: 1     ! MTRANS = 1 !

      0 = no  (i.e., final rise only)

      1 = yes (i.e., transitional rise computed)
```

Stack tip downwash? (MTIP) Default: 1 ! MTIP = 1 !

0 = no (i.e., no stack tip downwash)

1 = yes (i.e., use stack tip downwash)

Method used to simulate building

downwash? (MBDW) Default: 1 ! MBDW = 1 !

1 = ISC method

2 = PRIME method

Vertical wind shear modeled above

stack top? (MSHEAR) Default: 0 ! MSHEAR = 0 !

0 = no (i.e., vertical wind shear not modeled)

1 = yes (i.e., vertical wind shear modeled)

Puff splitting allowed? (MSPLIT) Default: 0 ! MSPLIT = 0 !

0 = no (i.e., puffs not split)

1 = yes (i.e., puffs are split)

Chemical mechanism flag (MCHEM) Default: 0 ! MCHEM = 0 !

0 = chemical transformation not

modeled

1 = transformation rates computed

internally (MESOPUFF II scheme)

2 = user-specified transformation

rates used

3 = transformation rates computed

internally (RIVAD/ARM3 scheme)

4 = secondary organic aerosol formation

computed (MESOPUFF II scheme for OH)

Aqueous phase transformation flag (MAQCHEM)

(Used only if MCHEM = 1, or 3) Default: 0 ! MAQCHEM = 0 !

0 = aqueous phase transformation

not modeled

1 = transformation rates adjusted

for aqueous phase reactions

Wet removal modeled ? (MWET) Default: 1 ! MWET = 0 !

0 = no

1 = yes

Dry deposition modeled ? (MDRY) Default: 1 ! MDRY = 1 !

0 = no

1 = yes

(dry deposition method specified

for each species in Input Group 3)

Gravitational settling (plume tilt)

modeled ? (MTILT) Default: 0 ! MTILT = 0 !

0 = no

1 = yes

(puff center falls at the gravitational

settling velocity for 1 particle species)

Restrictions:

- MDRY = 1

- NSPEC = 1 (must be particle species as well)

- sg = 0 GEOMETRIC STANDARD DEVIATION in Group 8 is

set to zero for a single particle diameter

Method used to compute dispersion

coefficients (MDISP) Default: 3 ! MDISP = 3 !

1 = dispersion coefficients computed from measured values

of turbulence, sigma v, sigma w

2 = dispersion coefficients from internally calculated

sigma v, sigma w using micrometeorological variables

(u*, w*, L, etc.)

3 = PG dispersion coefficients for RURAL areas (computed using

the ISCST multi-segment approximation) and MP coefficients in

urban areas

4 = same as 3 except PG coefficients computed using

the MESOPUFF II eqns.

5 = CTDM sigmas used for stable and neutral conditions.

For unstable conditions, sigmas are computed as in

MDISP = 3, described above. MDISP = 5 assumes that

measured values are read

Sigma-v/sigma-theta, sigma-w measurements used? (MTURBVW)

(Used only if MDISP = 1 or 5) Default: 3 ! MTURBVW = 3 !

1 = use sigma-v or sigma-theta measurements

from PROFILE.DAT to compute sigma-y

(valid for METFM = 1, 2, 3, 4, 5)

2 = use sigma-w measurements

from PROFILE.DAT to compute sigma-z

(valid for METFM = 1, 2, 3, 4, 5)

3 = use both sigma-(v/theta) and sigma-w

from PROFILE.DAT to compute sigma-y and sigma-z

(valid for METFM = 1, 2, 3, 4, 5)

4 = use sigma-theta measurements

from PLMMET.DAT to compute sigma-y

(valid only if METFM = 3)

Back-up method used to compute dispersion

when measured turbulence data are

missing (MDISP2) Default: 3 ! MDISP2 = 3 !

(used only if MDISP = 1 or 5)

2 = dispersion coefficients from internally calculated

sigma v, sigma w using micrometeorological variables

(u*, w*, L, etc.)

3 = PG dispersion coefficients for RURAL areas (computed using

the ISCST multi-segment approximation) and MP coefficients in

urban areas

4 = same as 3 except PG coefficients computed using

the MESOPUFF II eqns.

[DIAGNOSTIC FEATURE]

Method used for Lagrangian timescale for Sigma-y

(used only if MDISP=1,2 or MDISP2=1,2)

(MTAULY) Default: 0 ! MTAULY = 0 !

0 = Draxler default 617.284 (s)

1 = Computed as Lag. Length / (.75 q) -- after SCIPUFF

10 <Direct user input (s) -- e.g., 306.9

[DIAGNOSTIC FEATURE]

Method used for Advective-Decay timescale for Turbulence

(used only if MDISP=2 or MDISP2=2)

(MTAUADV) Default: 0 ! MTAUADV = 0 !

0 = No turbulence advection

1 = Computed (OPTION NOT IMPLEMENTED)

10 <Direct user input (s) -- e.g., 300

Method used to compute turbulence sigma-v &

sigma-w using micrometeorological variables

(Used only if MDISP = 2 or MDISP2 = 2)

(MCTURB) Default: 1 ! MCTURB = 1 !

1 = Standard CALPUFF subroutines

2 = AERMOD subroutines

PG sigma-y,z adj. for roughness? Default: 0 ! MROUGH = 0 !

(MROUGH)

0 = no

1 = yes

Partial plume penetration of Default: 1 ! MPARTL = 1 !

elevated inversion?

(MPARTL)

0 = no

1 = yes

Strength of temperature inversion Default: 0 ! MTINV = 0 !

provided in PROFILE.DAT extended records?

(MTINV)

0 = no (computed from measured/default gradients)

1 = yes

PDF used for dispersion under convective conditions?

Default: 0 ! MPDF = 0 !

(MPDF)

0 = no

1 = yes

Sub-Grid TIBL module used for shore line?

Default: 0 ! MSGTIBL = 0 !

(MSGTIBL)

0 = no

1 = yes

Boundary conditions (concentration) modeled?

Default: 0 ! MBCON = 0 !

(MBCON)

0 = no

1 = yes, using formatted BCON.DAT file

2 = yes, using unformatted CONC.DAT file

Note: MBCON > 0 requires that the last species modeled
be 'BCON'. Mass is placed in species BCON when
generating boundary condition puffs so that clean
air entering the modeling domain can be simulated
in the same way as polluted air. Specify zero
emission of species BCON for all regular sources.

Individual source contributions saved?

Default: 0 ! MSOURCE = 0 !

(MSOURCE)

0 = no

1 = yes

Analyses of fogging and icing impacts due to emissions from
arrays of mechanically-forced cooling towers can be performed
using CALPUFF in conjunction with a cooling tower emissions
processor (CTEMISS) and its associated postprocessors. Hourly
emissions of water vapor and temperature from each cooling tower
cell are computed for the current cell configuration and ambient
conditions by CTEMISS. CALPUFF models the dispersion of these
emissions and provides cloud information in a specialized format

for further analysis. Output to FOG.DAT is provided in either

'plume mode' or 'receptor mode' format.

Configure for FOG Model output?

Default: 0 ! MFOG = 0 !

(MFOG)

0 = no

1 = yes - report results in PLUME Mode format

2 = yes - report results in RECEPTOR Mode format

Test options specified to see if

they conform to regulatory

values? (MREG) Default: 1 ! MREG = 0 !

0 = NO checks are made

1 = Technical options must conform to USEPA

Long Range Transport (LRT) guidance

METFM 1 or 2

AVET 60. (min)

PGTIME 60. (min)

MGAUSS 1

MCTADJ 3

MTRANS 1

MTIP 1

MCHEM 1 or 3 (if modeling SOx, NOx)

MWET 1

MDRY 1

MDISP 2 or 3

MPDF 0 if MDISP=3

1 if MDISP=2

MROUGH 0

MPARTL 1

SYTDEP 550. (m)

MHFTSZ 0

!END!

```
------------------------------------------------------------------------------

INPUT GROUP: 3a, 3b -- Species list

--------------------

------------

Subgroup (3a)

------------

 The following species are modeled:

! CSPEC =         TSP !          !END!

! CSPEC =        PM10 !          !END!

                                      Dry              OUTPUT GROUP

   SPECIES        MODELED        EMITTED      DEPOSITED              NUMBER

    NAME       (0=NO, 1=YES)   (0=NO, 1=YES)   (0=NO,              (0=NONE,

  (Limit: 12                          1=COMPUTED-GAS       1=1st CGRUP,

   Characters                         2=COMPUTED-PARTICLE  2=2nd CGRUP,

   in length)                         3=USER-SPECIFIED)    3= etc.)

!       TSP  =        1,             1,        2,              0  !

!      PM10  =        1,             1,        2,              0  !

!END!

 Note:  The last species in (3a) must be 'BCON' when using the
        boundary condition option (MBCON > 0).  Species BCON should
        typically be modeled as inert (no chem transformation or
        removal).

-------------
```

Subgroup (3b)

The following names are used for Species-Groups in which results

for certain species are combined (added) prior to output. The

CGRUP name will be used as the species name in output files.

Use this feature to model specific particle-size distributions

by treating each size-range as a separate species.

Order must be consistent with 3(a) above.

INPUT GROUP: 4 -- Map Projection and Grid control parameters

Projection for all (X,Y):

Map projection

(PMAP) Default: UTM ! PMAP = UTM !

UTM : Universal Transverse Mercator

TTM : Tangential Transverse Mercator

LCC : Lambert Conformal Conic

PS : Polar Stereographic

EM : Equatorial Mercator

LAZA : Lambert Azimuthal Equal Area

False Easting and Northing (km) at the projection origin

(Used only if PMAP= TTM, LCC, or LAZA)

(FEAST) Default=0.0 ! FEAST = 0 !

(FNORTH) Default=0.0 ! FNORTH = 0 !

UTM zone (1 to 60)

(Used only if PMAP=UTM)

(IUTMZN) No Default ! IUTMZN = 55 !

Hemisphere for UTM projection?

(Used only if PMAP=UTM)

(UTMHEM) Default: N ! UTMHEM = S !

N : Northern hemisphere projection

S : Southern hemisphere projection

Latitude and Longitude (decimal degrees) of projection origin

(Used only if PMAP= TTM, LCC, PS, EM, or LAZA)

(RLAT0) No Default ! RLAT0 = 0N !

(RLON0) No Default ! RLON0 = 0E !

TTM : RLON0 identifies central (true N/S) meridian of projection

RLAT0 selected for convenience

LCC : RLON0 identifies central (true N/S) meridian of projection

RLAT0 selected for convenience

PS : RLON0 identifies central (grid N/S) meridian of projection

RLAT0 selected for convenience

EM : RLON0 identifies central meridian of projection

RLAT0 is REPLACED by 0.0N (Equator)

LAZA: RLON0 identifies longitude of tangent-point of mapping plane

RLAT0 identifies latitude of tangent-point of mapping plane

Matching parallel(s) of latitude (decimal degrees) for projection

(Used only if PMAP= LCC or PS)

(XLAT1) No Default ! XLAT1 = 30N !

(XLAT2) No Default ! XLAT2 = 60N !

LCC : Projection cone slices through Earth's surface at XLAT1 and XLAT2

PS : Projection plane slices through Earth at XLAT1

(XLAT2 is not used)

Note: Latitudes and longitudes should be positive, and include a

letter N,S,E, or W indicating north or south latitude, and

east or west longitude. For example,

35.9 N Latitude = 35.9N

118.7 E Longitude = 118.7E

Datum-region

The Datum-Region for the coordinates is identified by a character

string. Many mapping products currently available use the model of the

Earth known as the World Geodetic System 1984 (WGS-84). Other local

models may be in use, and their selection in CALMET will make its output

consistent with local mapping products. The list of Datum-Regions with

official transformation parameters provided by the National Imagery and

Mapping Agency (NIMA).

NIMA Datum - Regions(Examples)

WGS-84 WGS-84 Reference Ellipsoid and Geoid, Global coverage (WGS84)

NAS-C NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27)

NAR-C NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR CONUS (NAD83)

NWS-84 NWS 6370KM Radius, Sphere

ESR-S ESRI REFERENCE 6371KM Radius, Sphere

Datum-region for output coordinates

(DATUM) Default: WGS-84 ! DATUM = WGS-84 !

METEOROLOGICAL Grid:

Rectangular grid defined for projection PMAP,

with X the Easting and Y the Northing coordinate

No. X grid cells (NX) No default ! NX = 100 !

No. Y grid cells (NY) No default ! NY = 100 !

No. vertical layers (NZ) No default ! NZ = 8 !

Grid spacing (DGRIDKM) No default ! DGRIDKM = 0.2 !

Units: km

Cell face heights

(ZFACE(nz+1)) No defaults

Units: m

! ZFACE = 0.0, 20.0, 40.0, 80.0, 160.0, 320.0, 700.0, 1300.0, 1700.0 !

Reference Coordinates

of SOUTHWEST corner of

grid cell(1, 1):

X coordinate (XORIGKM) No default ! XORIGKM = 724.277 !

Y coordinate (YORIGKM) No default ! YORIGKM = 6106.107 !

Units: km

COMPUTATIONAL Grid:

The computational grid is identical to or a subset of the MET. grid.

The lower left (LL) corner of the computational grid is at grid point

(IBCOMP, JBCOMP) of the MET. grid. The upper right (UR) corner of the

computational grid is at grid point (IECOMP, JECOMP) of the MET. grid.

The grid spacing of the computational grid is the same as the MET. grid.

X index of LL corner (IBCOMP) No default ! IBCOMP = 1 !

(1 <= IBCOMP <= NX)

Y index of LL corner (JBCOMP) No default ! JBCOMP = 1 !

(1 <= JBCOMP <= NY)

X index of UR corner (IECOMP) No default ! IECOMP = 100 !

(1 <= IECOMP <= NX)

Y index of UR corner (JECOMP) No default ! JECOMP = 100 !

(1 <= JECOMP <= NY)

SAMPLING Grid (GRIDDED RECEPTORS):

```
   The lower left (LL) corner of the sampling grid is at grid point
   (IBSAMP, JBSAMP) of the MET. grid.  The upper right (UR) corner of the
   sampling grid is at grid point (IESAMP, JESAMP) of the MET. grid.
   The sampling grid must be identical to or a subset of the computational
   grid.  It may be a nested grid inside the computational grid.
   The grid spacing of the sampling grid is DGRIDKM/MESHDN.


     Logical flag indicating if gridded
     receptors are used (LSAMP)        Default: T    ! LSAMP = T !
     (T=yes, F=no)

     X index of LL corner (IBSAMP)     No default    ! IBSAMP = 31 !
      (IBCOMP <= IBSAMP <= IECOMP)

     Y index of LL corner (JBSAMP)     No default    ! JBSAMP = 42 !
      (JBCOMP <= JBSAMP <= JECOMP)


     X index of UR corner (IESAMP)     No default    ! IESAMP = 64 !
      (IBCOMP <= IESAMP <= IECOMP)

     Y index of UR corner (JESAMP)     No default    ! JESAMP = 68 !
      (JBCOMP <= JESAMP <= JECOMP)


    Nesting factor of the sampling
     grid (MESHDN)                     Default: 1    ! MESHDN = 1 !
     (MESHDN is an integer >= 1)

!END!


------------------------------------------------------------------------------


INPUT GROUP: 5 -- Output Options

--------------

                              *                   *
```

FILE DEFAULT VALUE VALUE THIS RUN

---- ---------- ----------

Concentrations (ICON) 1 ! ICON = 1 !

Dry Fluxes (IDRY) 1 ! IDRY = 1 !

Wet Fluxes (IWET) 1 ! IWET = 0 !

2D Temperature (IT2D) 0 ! IT2D = 0 !

2D Density (IRHO) 0 ! IRHO = 0 !

Relative Humidity (IVIS) 1 ! IVIS = 0 !

(relative humidity file is

required for visibility

analysis)

Use data compression option in output file?

(LCOMPRS) Default: T * LCOMPRS = *

*

0 = Do not create file, 1 = create file

QA PLOT FILE OUTPUT OPTION:

Create a standard series of output files (e.g.

locations of sources, receptors, grids ...)

suitable for plotting?

(IQAPLOT) Default: 1 ! IQAPLOT = 1 !

0 = no

1 = yes

DIAGNOSTIC MASS FLUX OUTPUT OPTIONS:

Mass flux across specified boundaries

for selected species reported hourly?

(IMFLX) Default: 0 ! IMFLX = 0 !

0 = no

1 = yes (FLUXBDY.DAT and MASSFLX.DAT filenames

are specified in Input Group 0)

Mass balance for each species

reported hourly?

(IMBAL) Default: 0 ! IMBAL = 0 !

0 = no

1 = yes (MASSBAL.DAT filename is

specified in Input Group 0)

LINE PRINTER OUTPUT OPTIONS:

Print concentrations (ICPRT) Default: 0 ! ICPRT = 0 !

Print dry fluxes (IDPRT) Default: 0 ! IDPRT = 0 !

Print wet fluxes (IWPRT) Default: 0 ! IWPRT = 0 !

(0 = Do not print, 1 = Print)

Concentration print interval

(ICFRQ) in hours Default: 1 ! ICFRQ = 1 !

Dry flux print interval

(IDFRQ) in hours Default: 1 ! IDFRQ = 1 !

Wet flux print interval

(IWFRQ) in hours Default: 1 ! IWFRQ = 1 !

Units for Line Printer Output

(IPRTU) Default: 1 ! IPRTU = 3 !

for for

Concentration Deposition

1 = g/m**3 g/m**2/s

2 = mg/m**3 mg/m**2/s

3 = ug/m**3 ug/m**2/s

4 = ng/m**3 ng/m**2/s

5 = Odour Units

Messages tracking progress of run

written to the screen ?

(IMESG) Default: 2 ! IMESG = 2 !

0 = no

1 = yes (advection step, puff ID)

2 = yes (YYYYJJJHH, # old puffs, # emitted puffs)

SPECIES (or GROUP for combined species) LIST FOR OUTPUT OPTIONS

SPECIES /GROUP	---- CONCENTRATIONS ---- PRINTED?	SAVED ON DISK?	------ DRY FLUXES ------ PRINTED?	SAVED ON DISK?	------ WET FLUXES ------ PRINTED?	SAVED ON DISK?	-- MASS FLUX -- SAVED ON DISK?
TSP	1	1	1	1	0	0	0
PM10	1	1	0	1	0	0	0

Note: Species BCON (for MBCON > 0) does not need to be saved on disk.

OPTIONS FOR PRINTING "DEBUG" QUANTITIES (much output)

Logical for debug output

(LDEBUG) Default: F ! LDEBUG = F !

First puff to track

(IPFDEB) Default: 1 ! IPFDEB = 1 !

Number of puffs to track

(NPFDEB) Default: 1 ! NPFDEB = 1 !

Met. period to start output

(NN1) Default: 1 ! NN1 = 1 !

Met. period to end output

(NN2) Default: 10 ! NN2 = 10 !

!END!

INPUT GROUP: 6a, 6b, & 6c -- Subgrid scale complex terrain inputs

```
-------------------------


---------------

Subgroup (6a)

---------------

     Number of terrain features (NHILL)       Default: 0    ! NHILL = 0 !


     Number of special complex terrain

     receptors  (NCTREC)                      Default: 0    ! NCTREC = 0 !


     Terrain and CTSG Receptor data for

     CTSG hills input in CTDM format ?

     (MHILL)                             No Default    ! MHILL = 2 !

     1 = Hill and Receptor data created

        by CTDM processors & read from

        HILL.DAT and HILLRCT.DAT files

     2 = Hill data created by OPTHILL &

        input below in Subgroup (6b);

        Receptor data in Subgroup (6c)


     Factor to convert horizontal dimensions  Default: 1.0   ! XHILL2M = 1.0 !

     to meters (MHILL=1)


     Factor to convert vertical dimensions    Default: 1.0   ! ZHILL2M = 1.0 !

     to meters (MHILL=1)


     X-origin of CTDM system relative to      No Default    ! XCTDMKM = 0.0 !

     CALPUFF coordinate system, in Kilometers (MHILL=1)


     Y-origin of CTDM system relative to      No Default    ! YCTDMKM = 0.0 !

     CALPUFF coordinate system, in Kilometers (MHILL=1)


! END !


---------------

Subgroup (6b)

---------------
```

```
                1 **

  HILL information



HILL        XC      YC     THETAH  ZGRID  RELIEF    EXPO 1    EXPO 2   SCALE 1    SCALE 2    AMAX1     AMAX2

 NO.       (km)    (km)    (deg.)  (m)    (m)       (m)       (m)       (m)        (m)        (m)       (m)

----        ----    ----    ------  -----  ------    ------    ------   -------    -------    -----     -----



---------------

Subgroup (6c)

---------------

  COMPLEX TERRAIN RECEPTOR INFORMATION

              XRCT       YRCT       ZRCT       XHH

              (km)       (km)       (m)

              ------     -----      ------     ----

--------------------

1

   Description of Complex Terrain Variables:

      XC, YC  = Coordinates of center of hill

      THETAH  = Orientation of major axis of hill (clockwise from

           North)

      ZGRID   = Height of the  0  of the grid above mean sea

           level

      RELIEF  = Height of the crest of the hill above the grid elevation

      EXPO 1  = Hill-shape exponent for the major axis

      EXPO 2  = Hill-shape exponent for the major axis

      SCALE 1 = Horizontal length scale along the major axis

      SCALE 2 = Horizontal length scale along the minor axis

      AMAX    = Maximum allowed axis length for the major axis

      BMAX    = Maximum allowed axis length for the major axis



      XRCT, YRCT = Coordinates of the complex terrain receptors

      ZRCT    = Height of the ground (MSL) at the complex terrain
```

Receptor

XHH = Hill number associated with each complex terrain receptor

(NOTE: MUST BE ENTERED AS A REAL NUMBER)

**

NOTE: DATA for each hill and CTSG receptor are treated as a separate

input subgroup and therefore must end with an input group terminator.

INPUT GROUP: 7 -- Chemical parameters for dry deposition of gases

---

SPECIES NAME	DIFFUSIVITY (cm**2/s)	ALPHA STAR	REACTIVITY (s/cm)	MESOPHYLL RESISTANCE	HENRY'S LAW COEFFICIENT (dimensionless)
-------	----------	----------	----------	----------	----------

* DRYGAS = *

!END!

INPUT GROUP: 8 -- Size parameters for dry deposition of particles

---

For SINGLE SPECIES, the mean and standard deviation are used to

compute a deposition velocity for NINT (see group 9) size-ranges,

and these are then averaged to obtain a mean deposition velocity.

For GROUPED SPECIES, the size distribution should be explicitly

specified (by the 'species' in the group), and the standard deviation

for each should be entered as 0. The model will then use the

deposition velocity for the stated mean diameter.

SPECIES	GEOMETRIC MASS MEAN	GEOMETRIC STANDARD

```
      NAME          DIAMETER              DEVIATION
                    (microns)             (microns)
     -------     --------------------     ------------------
!       PM10 =        0.48,                   2   !
!        TSP =         30,                    2   !

!END!
```

```
INPUT GROUP: 9 -- Miscellaneous dry deposition parameters
--------------

    Reference cuticle resistance (s/cm)
    (RCUTR)                    Default: 30    ! RCUTR = 30 !
    Reference ground resistance  (s/cm)
    (RGR)                      Default: 10    ! RGR = 10 !
    Reference pollutant reactivity
    (REACTR)                   Default: 8     ! REACTR = 8 !

    Number of particle-size intervals used to
    evaluate effective particle deposition velocity
    (NINT)                     Default: 9     ! NINT = 9 !

    Vegetation state in unirrigated areas
    (IVEG)                     Default: 1     ! IVEG = 1 !
      IVEG=1 for active and unstressed vegetation
      IVEG=2 for active and stressed vegetation
      IVEG=3 for inactive vegetation

!END!
```

```
INPUT GROUP: 10 -- Wet Deposition Parameters

---------------


                Scavenging Coefficient -- Units: (sec)**(-1)


     Pollutant     Liquid Precip.      Frozen Precip.

     ---------     --------------      --------------

* WETDEPOS = *

!END!



------------------------------------------------------------------------------



INPUT GROUP: 11 -- Chemistry Parameters

---------------


   Ozone data input option (MOZ)     Default: 0          ! MOZ = 0 !

   (Used only if MCHEM = 1, 3, or 4)

     0 = use a monthly background ozone value

     1 = read hourly ozone concentrations from

         the OZONE.DAT data file


   Monthly ozone concentrations

   (Used only if MCHEM = 1, 3, or 4 and

    MOZ = 0 or MOZ = 1 and all hourly O3 data missing)

   (BCKO3) in ppb                Default: 12*80.

   ! BCKO3 = 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00 !


   Monthly ammonia concentrations

   (Used only if MCHEM = 1, or 3)

   (BCKNH3) in ppb               Default: 12*10.

   ! BCKNH3 = 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00 !


   Nighttime SO2 loss rate (RNITE1)

   in percent/hour               Default: 0.2        ! RNITE1 = 0.2 !
```

```
 Nighttime NOx loss rate (RNITE2)

 in percent/hour                Default: 2.0        ! RNITE2 = 2 !


 Nighttime HNO3 formation rate (RNITE3)

 in percent/hour                Default: 2.0        ! RNITE3 = 2 !


 H2O2 data input option (MH2O2)    Default: 0          ! MH2O2 = 0 !

 (Used only if MAQCHEM = 1)

   0 = use a monthly background H2O2 value

   1 = read hourly H2O2 concentrations from

       the H2O2.DAT data file


 Monthly H2O2 concentrations

 (Used only if MAQCHEM = 1 and

  MH2O2 = 0 or MH2O2 = 1 and all hourly H2O2 data missing)

 (BCKH2O2) in ppb               Default: 12*1.

 ! BCKH2O2 = 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00 !



--- Data for SECONDARY ORGANIC AEROSOL (SOA) Option

 (used only if MCHEM = 4)


 The SOA module uses monthly values of:

     Fine particulate concentration in ug/m^3 (BCKPMF)

     Organic fraction of fine particulate    (OFRAC)

     VOC / NOX ratio (after reaction)        (VCNX)

 to characterize the air mass when computing

 the formation of SOA from VOC emissions.

 Typical values for several distinct air mass types are:


   Month   1   2   3   4   5   6   7   8   9  10  11  12

           Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


 Clean Continental

   BCKPMF  1.  1.  1.  1.  1.  1.  1.  1.  1.  1.  1.  1.

   OFRAC  .15 .15 .20 .20 .20 .20 .20 .20 .20 .20 .20 .15

   VCNX    50. 50. 50. 50. 50. 50. 50. 50. 50. 50. 50. 50.
```

```
  Clean Marine (surface)

    BCKPMF  .5  .5  .5  .5  .5  .5  .5  .5  .5  .5  .5  .5

    OFRAC  .25  .25  .30  .30  .30  .30  .30  .30  .30  .30  .30  .25

    VCNX   50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.


  Urban - low biogenic (controls present)

    BCKPMF  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.

    OFRAC  .20  .20  .25  .25  .25  .25  .25  .25  .20  .20  .20  .20

    VCNX    4.  4.  4.  4.  4.  4.  4.  4.  4.  4.  4.  4.


  Urban - high biogenic (controls present)

    BCKPMF  60.  60.  60.  60.  60.  60.  60.  60.  60.  60.  60.  60.

    OFRAC  .25  .25  .30  .30  .30  .55  .55  .55  .35  .35  .35  .25

    VCNX   15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.


  Regional Plume

    BCKPMF  20.  20.  20.  20.  20.  20.  20.  20.  20.  20.  20.  20.

    OFRAC  .20  .20  .25  .35  .25  .40  .40  .40  .30  .30  .30  .20

    VCNX   15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.


  Urban - no controls present

    BCKPMF 100. 100. 100. 100. 100. 100. 100. 100. 100. 100. 100. 100.

    OFRAC  .30  .30  .35  .35  .35  .55  .55  .55  .35  .35  .35  .30

    VCNX    2.  2.  2.  2.  2.  2.  2.  2.  2.  2.  2.  2.


  Default: Clean Continental

  ! BCKPMF = 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00 !

  ! OFRAC = 0.15, 0.15, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.15 !

  ! VCNX = 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00 !



!END!



------------------------------------------------------------------------------



INPUT GROUP: 12 -- Misc. Dispersion and Computational Parameters
```

```
---------------

   Horizontal size of puff (m) beyond which

   time-dependent dispersion equations (Heffter)

   are used to determine sigma-y and

   sigma-z (SYTDEP)                    Default: 550.   ! SYTDEP = 550 !


   Switch for using Heffter equation for sigma z

   as above (0 = Not use Heffter; 1 = use Heffter

   (MHFTSZ)                            Default: 0      ! MHFTSZ = 0 !


   Stability class used to determine plume

   growth rates for puffs above the boundary

   layer (JSUP)                        Default: 5      ! JSUP = 5 !


   Vertical dispersion constant for stable

   conditions (k1 in Eqn. 2.7-3)  (CONK1)     Default: 0.01   ! CONK1 = 0.01 !


   Vertical dispersion constant for neutral/

   unstable conditions (k2 in Eqn. 2.7-4)

   (CONK2)                             Default: 0.1    ! CONK2 = 0.1 !


   Factor for determining Transition-point from

   Schulman-Scire to Huber-Snyder Building Downwash

   scheme (SS used for Hs <Hb + TBD * HL)

   (TBD)                               Default: 0.5    ! TBD = 0.5 !

     TBD <0   ==> always use Huber-Snyder

     TBD = 1.5 ==> always use Schulman-Scire

     TBD = 0.5 ==> ISC Transition-point


   Range of land use categories for which

   urban dispersion is assumed

   (IURB1, IURB2)                      Default: 10     ! IURB1 = 10 !

                                       19     ! IURB2 = 19 !


   Site characterization parameters for single-point Met data files ---------

   (needed for METFM = 2,3,4,5)
```

Land use category for modeling domain

(ILANDUIN) Default: 20 ! ILANDUIN = 20 !

Roughness length (m) for modeling domain

(Z0IN) Default: 0.25 ! Z0IN = .25 !

Leaf area index for modeling domain

(XLAIIN) Default: 3.0 ! XLAIIN = 3.0 !

Elevation above sea level (m)

(ELEVIN) Default: 0.0 ! ELEVIN = .0 !

Latitude (degrees) for met location

(XLATIN) Default: -999. ! XLATIN = -999.0 !

Longitude (degrees) for met location

(XLONIN) Default: -999. ! XLONIN = -999.0 !

Specialized information for interpreting single-point Met data files -----

Anemometer height (m) (Used only if METFM = 2,3)

(ANEMHT) Default: 10. ! ANEMHT = 10.0 !

Form of lateral turbulance data in PROFILE.DAT file

(Used only if METFM = 4,5 or MTURBVW = 1 or 3)

(ISIGMAV) Default: 1 ! ISIGMAV = 1 !

0 = read sigma-theta

1 = read sigma-v

Choice of mixing heights (Used only if METFM = 4)

(IMIXCTDM) Default: 0 ! IMIXCTDM = 0 !

0 = read PREDICTED mixing heights

1 = read OBSERVED mixing heights

Maximum length of a slug (met. grid units)

(XMXLEN) Default: 1.0 ! XMXLEN = 1 !

Maximum travel distance of a puff/slug (in

grid units) during one sampling step

(XSAMLEN) Default: 1.0 ! XSAMLEN = 1 !

Maximum Number of slugs/puffs release from

one source during one time step

(MXNEW) Default: 99 ! MXNEW = 99 !

Maximum Number of sampling steps for

one puff/slug during one time step

(MXSAM) Default: 99 ! MXSAM = 99 !

Number of iterations used when computing

the transport wind for a sampling step

that includes gradual rise (for CALMET

and PROFILE winds)

(NCOUNT) Default: 2 ! NCOUNT = 2 !

Minimum sigma y for a new puff/slug (m)

(SYMIN) Default: 1.0 ! SYMIN = 1 !

Minimum sigma z for a new puff/slug (m)

(SZMIN) Default: 1.0 ! SZMIN = 1 !

Default minimum turbulence velocities sigma-v and sigma-w

for each stability class over land and over water (m/s)

(SVMIN(12) and SWMIN(12))

---------- LAND ---------- --------- WATER ----------

Stab Class : A B C D E F A B C D E F

--- --- --- --- --- --- --- --- --- --- --- ---

Default SVMIN : .50, .50, .50, .50, .50, .50, .37, .37, .37, .37, .37, .37

Default SWMIN : .20, .12, .08, .06, .03, .016, .20, .12, .08, .06, .03, .016

! SVMIN = 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.37, 0.37, 0.37, 0.37, 0.37, 0.37 !

! SWMIN = 0.2, 0.12, 0.08, 0.06, 0.03, 0.016, 0.2, 0.12, 0.08, 0.06, 0.03, 0.016 !

Divergence criterion for dw/dz across puff

used to initiate adjustment for horizontal

convergence (1/s)

Partial adjustment starts at CDIV(1), and

full adjustment is reached at CDIV(2)

(CDIV(2)) Default: 0.0,0.0 ! CDIV = 0, 0 !

Minimum wind speed (m/s) allowed for

non-calm conditions. Also used as minimum

speed returned when using power-law

extrapolation toward surface

(WSCALM) Default: 0.5 ! WSCALM = 0.5 !

Maximum mixing height (m)

(XMAXZI) Default: 3000. ! XMAXZI = 3000 !

Minimum mixing height (m)

(XMINZI) Default: 50. ! XMINZI = 50 !

Default wind speed classes --

5 upper bounds (m/s) are entered;

the 6th class has no upper limit

(WSCAT(5)) Default :

ISC RURAL : 1.54, 3.09, 5.14, 8.23, 10.8 (10.8+)

Wind Speed Class : 1 2 3 4 5

--- --- --- --- ---

! WSCAT = 1.54, 3.09, 5.14, 8.23, 10.8 !

Default wind speed profile power-law

exponents for stabilities 1-6

(PLX0(6)) Default : ISC RURAL values

ISC RURAL : .07, .07, .10, .15, .35, .55

ISC URBAN : .15, .15, .20, .25, .30, .30

Stability Class : A B C D E F

--- --- --- --- --- ---

! PLX0 = 0.07, 0.07, 0.1, 0.15, 0.35, 0.55 !

Default potential temperature gradient

for stable classes E, F (degK/m)

(PTG0(2)) Default: 0.020, 0.035

! PTG0 = 0.02, 0.035 !

Default plume path coefficients for

each stability class (used when option

for partial plume height terrain adjustment

is selected -- MCTADJ=3)

(PPC(6)) Stability Class : A B C D E F

Default PPC : .50, .50, .50, .50, .35, .35

--- --- --- --- --- ---

! PPC = 0.5, 0.5, 0.5, 0.5, 0.35, 0.35 !

Slug-to-puff transition criterion factor

equal to sigma-y/length of slug

(SL2PF) Default: 10. ! SL2PF = 10 !

Puff-splitting control variables ----------

VERTICAL SPLIT

Number of puffs that result every time a puff

is split - nsplit=2 means that 1 puff splits

into 2

(NSPLIT) Default: 3 ! NSPLIT = 3 !

Time(s) of a day when split puffs are eligible to

be split once again; this is typically set once

per day, around sunset before nocturnal shear develops.

24 values: 0 is midnight (00:00) and 23 is 11 PM (23:00)

0=do not re-split 1=eligible for re-split

(IRESPLIT(24)) Default: Hour 17 = 1

! IRESPLIT = 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0 !

Split is allowed only if last hour's mixing

height (m) exceeds a minimum value

(ZISPLIT) Default: 100. ! ZISPLIT = 100 !

Split is allowed only if ratio of last hour's

mixing ht to the maximum mixing ht experienced

by the puff is less than a maximum value (this

postpones a split until a nocturnal layer develops)

(ROLDMAX) Default: 0.25 ! ROLDMAX = 0.25 !

HORIZONTAL SPLIT

Number of puffs that result every time a puff

is split - nsplith=5 means that 1 puff splits

into 5

(NSPLITH) Default: 5 ! NSPLITH = 5 !

Minimum sigma-y (Grid Cells Units) of puff

before it may be split

(SYSPLITH) Default: 1.0 ! SYSPLITH = 1 !

Minimum puff elongation rate (SYSPLITH/hr) due to

wind shear, before it may be split

(SHSPLITH) Default: 2. ! SHSPLITH = 2 !

Minimum concentration (g/m^3) of each

species in puff before it may be split

Enter array of NSPEC values; if a single value is

entered, it will be used for ALL species

(CNSPLITH) Default: 1.0E-07 ! CNSPLITH = 1E-7 !

Integration control variables ---

Fractional convergence criterion for numerical SLUG

sampling integration

(EPSSLUG) Default: 1.0e-04 ! EPSSLUG = 0.0001 !

Fractional convergence criterion for numerical AREA

source integration

(EPSAREA) Default: 1.0e-06 ! EPSAREA = 1E-6 !

```
      Trajectory step-length (m) used for numerical rise

      integration

      (DSRISE)                    Default:   1.0     ! DSRISE = 1 !


    Boundary Condition (BC) Puff control variables ----------------------


      Minimum height (m) to which BC puffs are mixed as they are emitted

      (MBCON=2 ONLY).  Actual height is reset to the current mixing height

      at the release point if greater than this minimum.

      (HTMINBC)                   Default:   500.    * HTMINBC = *


      Search radius (km) about a receptor for sampling nearest BC puff.

      BC puffs are typically emitted with a spacing of one grid cell

      length, so the search radius should be greater than DGRIDKM.

      (RSAMPBC)                   Default:   4.      * RSAMPBC = *


      Near-Surface depletion adjustment to concentration profile used when

      sampling BC puffs?

      (MDEPBC)                    Default:   1       * MDEPBC = *

        0 = Concentration is NOT adjusted for depletion

        1 = Adjust Concentration for depletion


!END!



--------------------------------------------------------------------------------



INPUT GROUPS: 13a, 13b, 13c, 13d -- Point source parameters

---------------------------------


---------------

Subgroup (13a)

---------------


    Number of point sources with

    parameters provided below     (NPT1)  No default  ! NPT1 = 24 !
```

```
    Units used for point source
    emissions below              (IPTU)  Default: 1  ! IPTU = 1 !
        1 =       g/s
        2 =      kg/hr
        3 =      lb/hr
        4 =     tons/yr
        5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
        6 =     Odour Unit * m**3/min
        7 =     metric tons/yr

    Number of source-species
    combinations with variable
    emissions scaling factors
    provided below in (13d)       (NSPT1) Default: 0  ! NSPT1 = 0 !

    Number of point sources with
    variable emission parameters
    provided in external file     (NPT2)  No default  ! NPT2 = 0 !

    (If NPT2 > 0, these point
    source emissions are read from
    the file: PTEMARB.DAT)

!END!


---------------
Subgroup (13b)
---------------
                              a
        POINT SOURCE: CONSTANT DATA
        -------------------------------
                                                 b        c
 Source     X UTM     Y UTM     Stack   Base     Stack    Exit  Exit    Bldg.  Emission
  No.     Coordinate Coordinate Height Elevation Diameter  Vel.  Temp.   Dwash   Rates
             (km)      (km)       (m)     (m)       (m)  (m/s) (deg. K)
 ------   ---------- ---------- ------  ------   -------- ----- -------- ----- --------
   1 ! SRCNAM = 1 !
```

1 ! X = 734.893, 6117.231, 2.6, 783.6, 0.35, 46.4, 748, 0.0, 2.70E+01 !

1 ! ZPLTFM = 0 !

1 ! FMFAC = 1 ! !END!

2 ! SRCNAM = 2 !

2 ! X = 734.891, 6117.221, 2.6, 783.7, 0.35, 46.4, 748, 0.0, 2.70E+01 !

2 ! ZPLTFM = 0 !

2 ! FMFAC = 1 ! !END!

3 ! SRCNAM = 3 !

3 ! X = 734.889, 6117.211, 2.6, 783.8, 0.35, 46.4, 748, 0.0, 2.70E+01 !

3 ! ZPLTFM = 0 !

3 ! FMFAC = 1 ! !END!

4 ! SRCNAM = 4 !

4 ! X = 734.887, 6117.201, 2.6, 784.7, 0.35, 46.4, 748, 0.0, 2.70E+01 !

4 ! ZPLTFM = 0 !

4 ! FMFAC = 1 ! !END!

5 ! SRCNAM = 5 !

5 ! X = 734.885, 6117.191, 2.6, 784.9, 0.35, 46.4, 748, 0.0, 2.70E+01 !

5 ! ZPLTFM = 0 !

5 ! FMFAC = 1 ! !END!

6 ! SRCNAM = 6 !

6 ! X = 734.893, 6117.181, 2.6, 784.4, 0.35, 46.4, 748, 0.0, 2.70E+01 !

6 ! ZPLTFM = 0 !

6 ! FMFAC = 1 ! !END!

7 ! SRCNAM = 7 !

7 ! X = 734.893, 6117.221, 2.6, 783.6, 0.35, 46.4, 748, 0.0, 2.70E+01 !

7 ! ZPLTFM = 0 !

7 ! FMFAC = 1 ! !END!

8 ! SRCNAM = 8 !

8 ! X = 734.891, 6117.211, 2.6, 783.7, 0.35, 46.4, 748, 0.0, 2.70E+01 !

8 ! ZPLTFM = 0 !

8 ! FMFAC = 1 ! !END!

```
 9 ! SRCNAM = 9 !

 9 ! X =  734.889, 6117.201,    2.6, 784.5,     0.35,  46.4,    748,  0.0, 2.70E+01 !

 9 ! ZPLTFM =       0 !

 9 ! FMFAC =       1 !   !END!


10 ! SRCNAM = 10 !

10 ! X =  734.887, 6117.191,    2.6, 784.7,     0.35,  46.4,    748,  0.0, 2.70E+01 !

10 ! ZPLTFM =       0 !

10 ! FMFAC =       1 !   !END!


11 ! SRCNAM = 11 !

11 ! X =  734.885, 6117.181,    2.6, 784.9,     0.35,  46.4,    748,  0.0, 2.70E+01 !

11 ! ZPLTFM =       0 !

11 ! FMFAC =       1 !   !END!


12 ! SRCNAM = 12 !

12 ! X =  734.896, 6117.231,    2.6, 783.4,     0.35,  46.4,    748,  0.0, 2.70E+01 !

12 ! ZPLTFM =       0 !

12 ! FMFAC =       1 !   !END!


13 ! SRCNAM = 13 !

13 ! X =  734.893, 6117.211,    2.6, 783.6,     0.35,  46.4,    748,  0.0, 2.70E+01 !

13 ! ZPLTFM =       0 !

13 ! FMFAC =       1 !   !END!


14 ! SRCNAM = 14 !

14 ! X =  734.891, 6117.201,    2.6, 784.4,     0.35,  46.4,    748,  0.0, 2.70E+01 !

14 ! ZPLTFM =       0 !

14 ! FMFAC =       1 !   !END!


15 ! SRCNAM = 15 !

15 ! X =  734.889, 6117.191,    2.6, 784.6,     0.35,  46.4,    748,  0.0, 2.70E+01 !

15 ! ZPLTFM =       0 !

15 ! FMFAC =       1 !   !END!


16 ! SRCNAM = 16 !

16 ! X =  734.887, 6117.181,    2.6, 784.8,     0.35,  46.4,    748,  0.0, 2.70E+01 !
```

16 ! ZPLTFM = 0 !

16 ! FMFAC = 1 ! !END!

17 ! SRCNAM = 17 !

17 ! X = 734.896, 6117.221, 2.6, 783.4, 0.35, 46.4, 748, 0.0, 2.70E+01 !

17 ! ZPLTFM = 0 !

17 ! FMFAC = 1 ! !END!

18 ! SRCNAM = 18 !

18 ! X = 734.900, 6117.231, 2.6, 783.2, 0.35, 46.4, 748, 0.0, 2.70E+01 !

18 ! ZPLTFM = 0 !

18 ! FMFAC = 1 ! !END!

19 ! SRCNAM = 19 !

19 ! X = 734.893, 6117.201, 2.6, 784.3, 0.35, 46.4, 748, 0.0, 2.70E+01 !

19 ! ZPLTFM = 0 !

19 ! FMFAC = 1 ! !END!

20 ! SRCNAM = 20 !

20 ! X = 734.891, 6117.191, 2.6, 784.5, 0.35, 46.4, 748, 0.0, 2.70E+01 !

20 ! ZPLTFM = 0 !

20 ! FMFAC = 1 ! !END!

21 ! SRCNAM = 21 !

21 ! X = 734.889, 6117.181, 2.6, 784.7, 0.35, 46.4, 748, 0.0, 2.70E+01 !

21 ! ZPLTFM = 0 !

21 ! FMFAC = 1 ! !END!

22 ! SRCNAM = 22 !

22 ! X = 734.898, 6117.221, 2.6, 783.3, 0.35, 46.4, 748, 0.0, 2.70E+01 !

22 ! ZPLTFM = 0 !

22 ! FMFAC = 1 ! !END!

23 ! SRCNAM = 23 !

23 ! X = 734.896, 6117.211, 2.6, 783.4, 0.35, 46.4, 748, 0.0, 2.70E+01 !

23 ! ZPLTFM = 0 !

23 ! FMFAC = 1 ! !END!

24 ! SRCNAM = 24 !

24 ! X = 734.904, 6117.232, 2.6, 783.0, 0.35, 46.4, 748, 0.0, 2.70E+01 !

24 ! ZPLTFM = 0 !

24 ! FMFAC = 1 ! !END!

---

a

Data for each source are treated as a separate input subgroup

and therefore must end with an input group terminator.

SRCNAM is a 12-character name for a source

(No default)

X is an array holding the source data listed by the column headings

(No default)

SIGYZI is an array holding the initial sigma-y and sigma-z (m)

(Default: 0.,0.)

FMFAC is a vertical momentum flux factor (0. or 1.0) used to represent

the effect of rain-caps or other physical configurations that

reduce momentum rise associated with the actual exit velocity.

(Default: 1.0 -- full momentum used)

ZPLTFM is the platform height (m) for sources influenced by an isolated

structure that has a significant open area between the surface

and the bulk of the structure, such as an offshore oil platform.

The Base Elevation is that of the surface (ground or ocean),

and the Stack Height is the release height above the Base (not

above the platform). Building heights entered in Subgroup 13c

must be those of the buildings on the platform, measured from

the platform deck. ZPLTFM is used only with MBDW=1 (ISC

downwash method) for sources with building downwash.

(Default: 0.0)

b

0. = No building downwash modeled

1. = Downwash modeled for buildings resting on the surface

2. = Downwash modeled for buildings raised above the surface (ZPLTFM > 0.)

NOTE: must be entered as a REAL number (i.e., with decimal point)

c

An emission rate must be entered for every pollutant modeled.

Enter emission rate of zero for secondary pollutants that are

modeled, but not emitted. Units are specified by IPTU

(e.g. 1 for g/s).

Subgroup (13c)

BUILDING DIMENSION DATA FOR SOURCES SUBJECT TO DOWNWASH

Source a

No. Effective building height, width, length and X/Y offset (in meters)

every 10 degrees. LENGTH, XBADJ, and YBADJ are only needed for

MBDW=2 (PRIME downwash option)

------ ---

---

a

Building height, width, length, and X/Y offset from the source are treated

as a separate input subgroup for each source and therefore must end with

an input group terminator. The X/Y offset is the position, relative to the

stack, of the center of the upwind face of the projected building, with the

x-axis pointing along the flow direction.

Subgroup (13d)

---

a

POINT SOURCE: VARIABLE EMISSIONS DATA

Use this subgroup to describe temporal variations in the emission

rates given in 13b. Factors entered multiply the rates in 13b.

Skip sources here that have constant emissions. For more elaborate

variation in source parameters, use PTEMARB.DAT and NPT2 > 0.

IVARY determines the type of variation, and is source-specific:

(IVARY) Default: 0

0 = Constant

1 = Diurnal cycle (24 scaling factors: hours 1-24)

2 = Monthly cycle (12 scaling factors: months 1-12)

3 = Hour & Season (4 groups of 24 hourly scaling factors,
where first group is DEC-JAN-FEB)

4 = Speed & Stab. (6 groups of 6 scaling factors, where
first group is Stability Class A,
and the speed classes have upper
bounds (m/s) defined in Group 12

5 = Temperature (12 scaling factors, where temperature
classes have upper bounds (C) of:
0, 5, 10, 15, 20, 25, 30, 35, 40,
45, 50, 50+)

---

a

Data for each species are treated as a separate input subgroup
and therefore must end with an input group terminator.

INPUT GROUPS: 14a, 14b, 14c, 14d -- Area source parameters

Subgroup (14a)

Number of polygon area sources with
parameters specified below (NAR1) No default ! NAR1 = 7 !

Units used for area source

emissions below (IARU) Default: 1 ! IARU = 1 !

1 = g/m**2/s

2 = kg/m**2/hr

3 = lb/m**2/hr

4 = tons/m**2/yr

5 = Odour Unit * m/s (vol. flux/m**2 of odour compound)

6 = Odour Unit * m/min

7 = metric tons/m**2/yr

Number of source-species

combinations with variable

emissions scaling factors

provided below in (14d) (NSAR1) Default: 0 ! NSAR1 = 0 !

Number of buoyant polygon area sources

with variable location and emission

parameters (NAR2) No default ! NAR2 = 0 !

(If NAR2 > 0, ALL parameter data for

these sources are read from the file: BAEMARB.DAT)

!END!

Subgroup (14b)

---

a

AREA SOURCE: CONSTANT DATA

---

b

Source Effect. Base Initial Emission

No. Height Elevation Sigma z Rates

(m) (m) (m)

------- ------ ------ -------- ---------

1 ! SRCNAM = COVW !

1 ! X = 0.0, 731.7, 0.1, 1.00E-02, 5.00E-03 !

!END!

2 ! SRCNAM = WR3 !

2 ! X = 0.0, 793.7, 2, 1.00E-02, 5.00E-03 !

!END!

3 ! SRCNAM = WR2 !

3 ! X = 0.0, 792.2, 2, 1.00E-02, 5.00E-03 !

!END!

4 ! SRCNAM = WR4 !

4 ! X = 0.0, 791.8, 2, 1.00E-02, 5.00E-03 !

!END!

5 ! SRCNAM = WR4_2 !

5 ! X = 0.0, 796.4, 2, 1.00E-02, 5.00E-03 !

!END!

6 ! SRCNAM = WR5 !

6 ! X = 0.0, 796.4, 2, 1.00E-02, 5.00E-03 !

!END!

7 ! SRCNAM = WR5_2 !

7 ! X = 0.0, 796.7, 2, 1.00E-02, 5.00E-03 !

!END!

---

a

Data for each source are treated as a separate input subgroup

and therefore must end with an input group terminator.

b

An emission rate must be entered for every pollutant modeled.

Enter emission rate of zero for secondary pollutants that are

modeled, but not emitted. Units are specified by IARU

(e.g. 1 for g/m**2/s).

Subgroup (14c)

COORDINATES (UTM-km) FOR EACH VERTEX(4) OF EACH POLYGON

Source a

No. Ordered list of X followed by list of Y, grouped by source

```
------    ------------------------------------------------------------------


  1 ! SRCNAM = COVW !

  1 ! XVERT = 734.128,734.370,734.463,734.735,734.629 !

  1 ! YVERT = 6116.962,6117.189,6117.157,6117.023,6116.724 !

!END!

  2 ! SRCNAM = WR3 !

  2 ! XVERT = 733.042,733.095,732.815,732.762 !

  2 ! YVERT = 6117.319,6117.438,6117.563,6117.444 !

!END!

  3 ! SRCNAM = WR2 !

  3 ! XVERT = 733.073,733.126,733.095,733.042 !

  3 ! YVERT = 6117.305,6117.424,6117.438,6117.319 !

!END!

  4 ! SRCNAM = WR4 !

  4 ! XVERT = 733.103,733.156,733.126,733.073 !

  4 ! YVERT = 6117.292,6117.410,6117.424,6117.305 !

!END!

  5 ! SRCNAM = WR4_2 !

  5 ! XVERT = 732.726,732.779,732.767,732.713 !

  5 ! YVERT = 6117.460,6117.579,6117.585,6117.466 !

!END!

  6 ! SRCNAM = WR5 !

  6 ! XVERT = 732.713,732.767,732.753,732.700 !

  6 ! YVERT = 6117.466,6117.585,6117.591,6117.472 !

!END!

  7 ! SRCNAM = WR5_2 !

  7 ! XVERT = 732.700,732.753,732.688,732.635 !

  7 ! YVERT = 6117.472,6117.591,6117.620,6117.501 !

!END!


--------

   a

    Data for each source are treated as a separate input subgroup

    and therefore must end with an input group terminator.


---------------
```

Subgroup (14d)

---

a

AREA SOURCE: VARIABLE EMISSIONS DATA

Use this subgroup to describe temporal variations in the emission

rates given in 14b. Factors entered multiply the rates in 14b.

Skip sources here that have constant emissions. For more elaborate

variation in source parameters, use BAEMARB.DAT and NAR2 > 0.

IVARY determines the type of variation, and is source-specific:

(IVARY) Default: 0

0 = Constant

1 = Diurnal cycle (24 scaling factors: hours 1-24)

2 = Monthly cycle (12 scaling factors: months 1-12)

3 = Hour & Season (4 groups of 24 hourly scaling factors,

where first group is DEC-JAN-FEB)

4 = Speed & Stab. (6 groups of 6 scaling factors, where

first group is Stability Class A,

and the speed classes have upper

bounds (m/s) defined in Group 12

5 = Temperature (12 scaling factors, where temperature

classes have upper bounds (C) of:

0, 5, 10, 15, 20, 25, 30, 35, 40,

45, 50, 50+)

---

a

Data for each species are treated as a separate input subgroup

and therefore must end with an input group terminator.

INPUT GROUPS: 15a, 15b, 15c -- Line source parameters

Subgroup (15a)

Number of buoyant line sources
with variable location and emission
parameters (NLN2) No default ! NLN2 = 0 !

(If NLN2 > 0, ALL parameter data for
these sources are read from the file: LNEMARB.DAT)

Number of buoyant line sources (NLINES) No default ! NLINES = 0 !

Units used for line source
emissions below (ILNU) Default: 1 ! ILNU = 1 !
1 = g/s
2 = kg/hr
3 = lb/hr
4 = tons/yr
5 = Odour Unit * m**3/s (vol. flux of odour compound)
6 = Odour Unit * m**3/min
7 = metric tons/yr

Number of source-species
combinations with variable
emissions scaling factors
provided below in (15c) (NSLN1) Default: 0 ! NSLN1 = 0 !

Maximum number of segments used to model
each line (MXNSEG) Default: 7 ! MXNSEG = 7 !

The following variables are required only if NLINES > 0. They are
used in the buoyant line source plume rise calculations.

Number of distances at which Default: 6 ! NLRISE = 6 !
transitional rise is computed

Average building length (XL) No default * XL = *

(in meters)

Average building height (HBL) No default * HBL = *

(in meters)

Average building width (WBL) No default * WBL = *

(in meters)

Average line source width (WML) No default * WML = *

(in meters)

Average separation between buildings (DXL) No default * DXL = *

(in meters)

Average buoyancy parameter (FPRIMEL) No default * FPRIMEL = *

(in m**4/s**3)

!END!

Subgroup (15b)

BUOYANT LINE SOURCE: CONSTANT DATA

---

a

Source No.	Beg. X Coordinate (km)	Beg. Y Coordinate (km)	End. X Coordinate (km)	End. Y Coordinate (km)	Release Height (m)	Base Elevation (m)	Emission Rates
------	----------	----------	---------	----------	-------	---------	---------

---

a

Data for each source are treated as a separate input subgroup

and therefore must end with an input group terminator.

b

An emission rate must be entered for every pollutant modeled.
Enter emission rate of zero for secondary pollutants that are
modeled, but not emitted. Units are specified by ILNTU
(e.g. 1 for g/s).

Subgroup (15c)

---

a

BUOYANT LINE SOURCE: VARIABLE EMISSIONS DATA

Use this subgroup to describe temporal variations in the emission
rates given in 15b. Factors entered multiply the rates in 15b.
Skip sources here that have constant emissions.

IVARY determines the type of variation, and is source-specific:
(IVARY) Default: 0

- 0 = Constant
- 1 = Diurnal cycle (24 scaling factors: hours 1-24)
- 2 = Monthly cycle (12 scaling factors: months 1-12)
- 3 = Hour & Season (4 groups of 24 hourly scaling factors, where first group is DEC-JAN-FEB)
- 4 = Speed & Stab. (6 groups of 6 scaling factors, where first group is Stability Class A, and the speed classes have upper bounds (m/s) defined in Group 12
- 5 = Temperature (12 scaling factors, where temperature classes have upper bounds (C) of: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 50+)

---

a

Data for each species are treated as a separate input subgroup

and therefore must end with an input group terminator.

INPUT GROUPS: 16a, 16b, 16c -- Volume source parameters

Subgroup (16a)

Number of volume sources with

parameters provided in 16b,c (NVL1) No default ! NVL1 = 32 !

Units used for volume source

emissions below in 16b (IVLU) Default: 1 ! IVLU = 1 !

1 = g/s

2 = kg/hr

3 = lb/hr

4 = tons/yr

5 = Odour Unit * m**3/s (vol. flux of odour compound)

6 = Odour Unit * m**3/min

7 = metric tons/yr

Number of source-species

combinations with variable

emissions scaling factors

provided below in (16c) (NSVL1) Default: 0 ! NSVL1 = 64 !

Number of volume sources with

variable location and emission

parameters (NVL2) No default ! NVL2 = 0 !

(If NVL2 > 0, ALL parameter data for

these sources are read from the VOLEMARB.DAT file(s))

```
!END!


---------------

Subgroup (16b)

---------------

                          a

       VOLUME SOURCE: CONSTANT DATA

       -------------------------------

                                                b

       X UTM     Y UTM     Effect.   Base    Initial   Initial   Emission

     Coordinate  Coordinate  Height  Elevation  Sigma y   Sigma z    Rates

       (km)      (km)       (m)      (m)       (m)       (m)

     ----------  ----------  ------   ------   --------  --------  --------


  1 ! SRCNAM = ULOAD !

  1 ! X =  732.635, 6117.414,    2.0,   797.3,      0.5,     0.25, 4.00E-01, 2.00E-01 !

!END!

  2 ! SRCNAM = ULOAD1 !

  2 ! X =  732.729, 6117.371,    2.0,   797.0,      0.5,     0.25, 4.00E-01, 2.00E-01 !

!END!

  3 ! SRCNAM = LOAD1 !

  3 ! X =  732.615, 6117.414,    2.0,   797.3,      0.5,     0.25, 3.30E-01, 1.40E-01 !

!END!

  4 ! SRCNAM = LOAD2 !

  4 ! X =  732.606, 6117.430,    2.0,   797.4,      0.5,     0.25, 2.20E-01, 9.00E-02 !

!END!

  5 ! SRCNAM = LOAD3 !

  5 ! X =  732.612, 6117.443,    2.0,   797.4,      0.5,     0.25, 2.67E00, 1.13E00 !

!END!

  6 ! SRCNAM = HTC1 !

  6 ! X =  732.607, 6117.449,    2.0,   797.4,      0.5,     0.25, 3.33E01, 1.33E01 !

!END!

  7 ! SRCNAM = ULOAD2 !

  7 ! X =  732.726, 6117.460,    2.0,   797.5,      0.5,     0.25, 3.00E-01, 1.00E-01 !

!END!

  8 ! SRCNAM = HTC3 !

  8 ! X =  732.618, 6117.458,    2.0,   797.2,      0.5,     0.25, 2.33E02, 1.17E02 !
```

```
!END!

  9 ! SRCNAM = ULOAD3 !

  9 ! X =  732.659, 6117.403,    2.0,   796.9,      0.5,     0.25, 1.00E-01, 6.00E-02 !

!END!

  10 ! SRCNAM = HTC2 !

  10 ! X =  732.659, 6117.403,    2.0,   796.9,      0.5,     0.25, 1.67E01, 6.67E00 !

!END!

  11 ! SRCNAM = ULOAD4 !

  11 ! X =  732.726, 6117.460,    2.0,   797.5,      0.5,     0.25, 1.30E-01, 6.00E-02 !

!END!

  12 ! SRCNAM = MS1 !

  12 ! X =  732.619, 6117.492,    2.0,   797.1,      0.5,     0.25, 2.67E02, 2.00E02 !

!END!

  13 ! SRCNAM = SIFT !

  13 ! X =  732.619, 6117.492,    2.0,   797.1,      0.5,     0.25, 2.67E02, 2.00E02 !

!END!

  14 ! SRCNAM = HR1 !

  14 ! X =  734.699, 6117.436,    2.0,   786.0,     25.0,     0.25, 1.55E03, 3.02E02 !

!END!

  15 ! SRCNAM = HR2 !

  15 ! X =  734.701, 6117.312,    2.0,   788.7,     25.0,     0.25, 1.55E03, 3.02E02 !

!END!

  16 ! SRCNAM = HR3 !

  16 ! X =  734.704, 6117.189,    2.0,   787.4,     25.0,     0.25, 1.55E03, 3.02E02 !

!END!

  17 ! SRCNAM = HR4 !

  17 ! X =  734.707, 6117.065,    2.0,   782.6,     25.0,     0.25, 1.55E03, 3.02E02 !

!END!

  18 ! SRCNAM = HR5 !

  18 ! X =  734.698, 6116.944,    2.0,   775.4,     25.0,     0.25, 1.55E03, 3.02E02 !

!END!

  19 ! SRCNAM = HR6 !

  19 ! X =  734.653, 6116.829,    2.0,   762.8,     25.0,     0.25, 1.55E03, 3.02E02 !

!END!

  20 ! SRCNAM = HR7 !

  20 ! X =  734.608, 6116.714,    2.0,   771.7,     25.0,     0.25, 1.55E03, 3.02E02 !

!END!

  21 ! SRCNAM = HR8 !
```

21 ! X = 734.531, 6116.621, 2.0, 797.6, 25.0, 0.25, 1.55E03, 3.02E02 !

!END!

22 ! SRCNAM = HR9 !

22 ! X = 734.441, 6116.535, 2.0, 810.2, 25.0, 0.25, 1.55E03, 3.02E02 !

!END!

23 ! SRCNAM = HR10 !

23 ! X = 734.340, 6116.507, 2.0, 822.1, 25.0, 0.25, 1.55E03, 3.02E02 !

!END!

24 ! SRCNAM = HR11 !

24 ! X = 734.224, 6116.549, 2.0, 828.2, 25.0, 0.25, 1.55E03, 3.02E02 !

!END!

25 ! SRCNAM = HR12 !

25 ! X = 734.108, 6116.590, 2.0, 829.1, 25.0, 0.25, 1.55E03, 3.02E02 !

!END!

26 ! SRCNAM = HR13 !

26 ! X = 734.086, 6116.693, 2.0, 812.1, 25.0, 0.25, 1.55E03, 3.02E02 !

!END!

27 ! SRCNAM = HR14 !

27 ! X = 734.095, 6116.817, 2.0, 775.2, 25.0, 0.25, 1.55E03, 3.02E02 !

!END!

28 ! SRCNAM = HR15 !

28 ! X = 734.157, 6116.902, 2.0, 764.0, 25.0, 0.25, 1.55E03, 3.02E02 !

!END!

29 ! SRCNAM = HR16 !

29 ! X = 734.271, 6116.950, 2.0, 742.1, 25.0, 0.25, 1.55E03, 3.02E02 !

!END!

30 ! SRCNAM = HR17 !

30 ! X = 734.382, 6116.935, 2.0, 715.7, 25.0, 0.25, 1.55E03, 3.02E02 !

!END!

31 ! SRCNAM = HR18 !

31 ! X = 734.491, 6116.879, 2.0, 727.0, 25.0, 0.25, 1.55E03, 3.02E02 !

!END!

32 ! SRCNAM = HR19 !

32 ! X = 734.489, 6116.775, 2.0, 736.3, 25.0, 0.25, 1.55E03, 3.02E02 !

!END!

---

a

Data for each source are treated as a separate input subgroup

and therefore must end with an input group terminator.

b

An emission rate must be entered for every pollutant modeled.

Enter emission rate of zero for secondary pollutants that are

modeled, but not emitted. Units are specified by IVLU

(e.g. 1 for g/s).

Subgroup (16c)

---

a

VOLUME SOURCE: VARIABLE EMISSIONS DATA

Use this subgroup to describe temporal variations in the emission

rates given in 16b. Factors entered multiply the rates in 16b.

Skip sources here that have constant emissions. For more elaborate

variation in source parameters, use VOLEMARB.DAT and NVL2 > 0.

IVARY determines the type of variation, and is source-specific:

(IVARY) Default: 0

0 = Constant

1 = Diurnal cycle (24 scaling factors: hours 1-24)

2 = Monthly cycle (12 scaling factors: months 1-12)

3 = Hour & Season (4 groups of 24 hourly scaling factors,

where first group is DEC-JAN-FEB)

4 = Speed & Stab. (6 groups of 6 scaling factors, where

first group is Stability Class A,

and the speed classes have upper

bounds (m/s) defined in Group 12

5 = Temperature (12 scaling factors, where temperature

classes have upper bounds (C) of:

0, 5, 10, 15, 20, 25, 30, 35, 40,

45, 50, 50+)

```
  1 ! SRCNAM = ULOAD !
  1 ! IVARY = 1 !    (24 Hours)
  1 ! TSP = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,1,1,0,0     !
!END!
  1 ! SRCNAM = ULOAD !
  1 ! IVARY = 1 !    (24 Hours)
  1 ! PM10 = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,1,1,0,0     !
!END!
  2 ! SRCNAM = ULOAD1 !
  2 ! IVARY = 1 !    (24 Hours)
  2 ! TSP = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,1,1,0,0     !
!END!
  2 ! SRCNAM = ULOAD1 !
  2 ! IVARY = 1 !    (24 Hours)
  2 ! PM10 = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,1,1,0,0     !
!END!
  3 ! SRCNAM = LOAD1 !
  3 ! IVARY = 1 !    (24 Hours)
  3 ! TSP = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,1,1,0,0     !
!END!
  3 ! SRCNAM = LOAD1 !
  3 ! IVARY = 1 !    (24 Hours)
  3 ! PM10 = 0,0,0,0,0,0,
```

```
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,1,1,0,0     !
!END!
  4 ! SRCNAM = LOAD2 !
  4 ! IVARY = 1 !   (24 Hours)
  4 ! TSP = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,1,1,0,0     !
!END!
  4 ! SRCNAM = LOAD2 !
  4 ! IVARY = 1 !   (24 Hours)
  4 ! PM10 = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,1,1,0,0     !
!END!
  5 ! SRCNAM = LOAD3 !
  5 ! IVARY = 1 !   (24 Hours)
  5 ! TSP = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,1,1,0,0     !
!END!
  5 ! SRCNAM = LOAD3 !
  5 ! IVARY = 1 !   (24 Hours)
  5 ! PM10 = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,1,1,0,0     !
!END!
  6 ! SRCNAM = HTC1 !
  6 ! IVARY = 1 !   (24 Hours)
  6 ! TSP = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,1,1,0,0     !
```

```
!END!

  6 ! SRCNAM = HTC1 !

  6 ! IVARY = 1 !   (24 Hours)

  6 ! PM10 = 0,0,0,0,0,0,

       1,1,1,1,1,1,

       1,1,1,1,1,1,

       1,1,1,1,0,0     !

!END!

  7 ! SRCNAM = ULOAD2 !

  7 ! IVARY = 1 !   (24 Hours)

  7 ! TSP = 0,0,0,0,0,0,

       1,1,1,1,1,1,

       1,1,1,1,1,1,

       1,1,1,1,0,0     !

!END!

  7 ! SRCNAM = ULOAD2 !

  7 ! IVARY = 1 !   (24 Hours)

  7 ! PM10 = 0,0,0,0,0,0,

       1,1,1,1,1,1,

       1,1,1,1,1,1,

       1,1,1,1,0,0     !

!END!

  8 ! SRCNAM = HTC3 !

  8 ! IVARY = 1 !   (24 Hours)

  8 ! TSP = 0,0,0,0,0,0,

       1,1,1,1,1,1,

       1,1,1,1,1,1,

       1,1,1,1,0,0     !

!END!

  8 ! SRCNAM = HTC3 !

  8 ! IVARY = 1 !   (24 Hours)

  8 ! PM10 = 0,0,0,0,0,0,

       1,1,1,1,1,1,

       1,1,1,1,1,1,

       1,1,1,1,0,0     !

!END!

  9 ! SRCNAM = ULOAD3 !

  9 ! IVARY = 1 !   (24 Hours)
```

```
  9 ! TSP = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,1,1,0,0     !
!END!
  9 ! SRCNAM = ULOAD3 !
  9 ! IVARY = 1 !    (24 Hours)
  9 ! PM10 = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,1,1,0,0     !
!END!
  10 ! SRCNAM = HTC2 !
  10 ! IVARY = 1 !    (24 Hours)
  10 ! TSP = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,1,1,0,0     !
!END!
  10 ! SRCNAM = HTC2 !
  10 ! IVARY = 1 !    (24 Hours)
  10 ! PM10 = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,1,1,0,0     !
!END!
  11 ! SRCNAM = ULOAD4 !
  11 ! IVARY = 1 !    (24 Hours)
  11 ! TSP = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,1,1,0,0     !
!END!
  11 ! SRCNAM = ULOAD4 !
  11 ! IVARY = 1 !    (24 Hours)
  11 ! PM10 = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
```

```
      1,1,1,1,0,0     !

!END!

 12 ! SRCNAM = MS1 !

 12 ! IVARY = 1 !    (24 Hours)

 12 ! TSP = 0,0,0,0,0,0,

      1,1,1,1,1,1,

      1,1,1,1,1,1,

      1,1,1,1,0,0     !

!END!

 12 ! SRCNAM = MS1 !

 12 ! IVARY = 1 !    (24 Hours)

 12 ! PM10 = 0,0,0,0,0,0,

      1,1,1,1,1,1,

      1,1,1,1,1,1,

      1,1,1,1,0,0     !

!END!

 13 ! SRCNAM = SIFT !

 13 ! IVARY = 1 !    (24 Hours)

 13 ! TSP = 0,0,0,0,0,0,

      1,1,1,1,1,1,

      1,1,1,1,1,1,

      1,1,1,1,0,0     !

!END!

 13 ! SRCNAM = SIFT !

 13 ! IVARY = 1 !    (24 Hours)

 13 ! PM10 = 0,0,0,0,0,0,

      1,1,1,1,1,1,

      1,1,1,1,1,1,

      1,1,1,1,0,0     !

!END!

 14 ! SRCNAM = HR1 !

 14 ! IVARY = 1 !    (24 Hours)

 14 ! TSP = 0,0,0,0,0,0,

      1,1,1,1,1,1,

      1,1,1,1,1,1,

      1,1,0,0,0,0     !

!END!

 14 ! SRCNAM = HR1 !
```

```
 14 ! IVARY = 1 !    (24 Hours)

 14 ! PM10 = 0,0,0,0,0,0,

       1,1,1,1,1,1,

       1,1,1,1,1,1,

       1,1,0,0,0,0     !

!END!

 15 ! SRCNAM = HR2 !

 15 ! IVARY = 1 !    (24 Hours)

 15 ! TSP = 0,0,0,0,0,0,

       1,1,1,1,1,1,

       1,1,1,1,1,1,

       1,1,0,0,0,0     !

!END!

 15 ! SRCNAM = HR2 !

 15 ! IVARY = 1 !    (24 Hours)

 15 ! PM10 = 0,0,0,0,0,0,

       1,1,1,1,1,1,

       1,1,1,1,1,1,

       1,1,0,0,0,0     !

!END!

 16 ! SRCNAM = HR3 !

 16 ! IVARY = 1 !    (24 Hours)

 16 ! TSP = 0,0,0,0,0,0,

       1,1,1,1,1,1,

       1,1,1,1,1,1,

       1,1,0,0,0,0     !

!END!

 16 ! SRCNAM = HR3 !

 16 ! IVARY = 1 !    (24 Hours)

 16 ! PM10 = 0,0,0,0,0,0,

       1,1,1,1,1,1,

       1,1,1,1,1,1,

       1,1,0,0,0,0     !

!END!

 17 ! SRCNAM = HR4 !

 17 ! IVARY = 1 !    (24 Hours)

 17 ! TSP = 0,0,0,0,0,0,

       1,1,1,1,1,1,
```

```
        1,1,1,1,1,1,
        1,1,0,0,0,0     !
!END!
 17 ! SRCNAM = HR4 !
 17 ! IVARY = 1 !    (24 Hours)
 17 ! PM10 = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,0,0,0,0     !
!END!
 18 ! SRCNAM = HR5 !
 18 ! IVARY = 1 !    (24 Hours)
 18 ! TSP = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,0,0,0,0     !
!END!
 18 ! SRCNAM = HR5 !
 18 ! IVARY = 1 !    (24 Hours)
 18 ! PM10 = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,0,0,0,0     !
!END!
 19 ! SRCNAM = HR6 !
 19 ! IVARY = 1 !    (24 Hours)
 19 ! TSP = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,0,0,0,0     !
!END!
 19 ! SRCNAM = HR6 !
 19 ! IVARY = 1 !    (24 Hours)
 19 ! PM10 = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,0,0,0,0     !
!END!
```

```
 20 ! SRCNAM = HR7 !
 20 ! IVARY = 1 !   (24 Hours)
 20 ! TSP = 0,0,0,0,0,0,
       1,1,1,1,1,1,
       1,1,1,1,1,1,
       1,1,0,0,0,0    !
!END!
 20 ! SRCNAM = HR7 !
 20 ! IVARY = 1 !   (24 Hours)
 20 ! PM10 = 0,0,0,0,0,0,
       1,1,1,1,1,1,
       1,1,1,1,1,1,
       1,1,0,0,0,0    !
!END!
 21 ! SRCNAM = HR8 !
 21 ! IVARY = 1 !   (24 Hours)
 21 ! TSP = 0,0,0,0,0,0,
       1,1,1,1,1,1,
       1,1,1,1,1,1,
       1,1,0,0,0,0    !
!END!
 21 ! SRCNAM = HR8 !
 21 ! IVARY = 1 !   (24 Hours)
 21 ! PM10 = 0,0,0,0,0,0,
       1,1,1,1,1,1,
       1,1,1,1,1,1,
       1,1,0,0,0,0    !
!END!
 22 ! SRCNAM = HR9 !
 22 ! IVARY = 1 !   (24 Hours)
 22 ! TSP = 0,0,0,0,0,0,
       1,1,1,1,1,1,
       1,1,1,1,1,1,
       1,1,0,0,0,0    !
!END!
 22 ! SRCNAM = HR9 !
 22 ! IVARY = 1 !   (24 Hours)
 22 ! PM10 = 0,0,0,0,0,0,
```

```
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,0,0,0,0     !
!END!
 23 ! SRCNAM = HR10 !
 23 ! IVARY = 1 !    (24 Hours)
 23 ! TSP = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,0,0,0,0     !
!END!
 23 ! SRCNAM = HR10 !
 23 ! IVARY = 1 !    (24 Hours)
 23 ! PM10 = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,0,0,0,0     !
!END!
 24 ! SRCNAM = HR11 !
 24 ! IVARY = 1 !    (24 Hours)
 24 ! TSP = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,0,0,0,0     !
!END!
 24 ! SRCNAM = HR11 !
 24 ! IVARY = 1 !    (24 Hours)
 24 ! PM10 = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,0,0,0,0     !
!END!
 25 ! SRCNAM = HR12 !
 25 ! IVARY = 1 !    (24 Hours)
 25 ! TSP = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,0,0,0,0     !
```

```
!END!

 25 ! SRCNAM = HR12 !

 25 ! IVARY = 1 !   (24 Hours)

 25 ! PM10 = 0,0,0,0,0,0,

       1,1,1,1,1,1,

       1,1,1,1,1,1,

       1,1,0,0,0,0    !

!END!

 26 ! SRCNAM = HR13 !

 26 ! IVARY = 1 !   (24 Hours)

 26 ! TSP = 0,0,0,0,0,0,

       1,1,1,1,1,1,

       1,1,1,1,1,1,

       1,1,0,0,0,0    !

!END!

 26 ! SRCNAM = HR13 !

 26 ! IVARY = 1 !   (24 Hours)

 26 ! PM10 = 0,0,0,0,0,0,

       1,1,1,1,1,1,

       1,1,1,1,1,1,

       1,1,0,0,0,0    !

!END!

 27 ! SRCNAM = HR14 !

 27 ! IVARY = 1 !   (24 Hours)

 27 ! TSP = 0,0,0,0,0,0,

       1,1,1,1,1,1,

       1,1,1,1,1,1,

       1,1,0,0,0,0    !

!END!

 27 ! SRCNAM = HR14 !

 27 ! IVARY = 1 !   (24 Hours)

 27 ! PM10 = 0,0,0,0,0,0,

       1,1,1,1,1,1,

       1,1,1,1,1,1,

       1,1,0,0,0,0    !

!END!

 28 ! SRCNAM = HR15 !

 28 ! IVARY = 1 !   (24 Hours)
```

```
 28 ! TSP = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,0,0,0,0     !
!END!
 28 ! SRCNAM = HR15 !
 28 ! IVARY = 1 !    (24 Hours)
 28 ! PM10 = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,0,0,0,0     !
!END!
 29 ! SRCNAM = HR16 !
 29 ! IVARY = 1 !    (24 Hours)
 29 ! TSP = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,0,0,0,0     !
!END!
 29 ! SRCNAM = HR16 !
 29 ! IVARY = 1 !    (24 Hours)
 29 ! PM10 = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,0,0,0,0     !
!END!
 30 ! SRCNAM = HR17 !
 30 ! IVARY = 1 !    (24 Hours)
 30 ! TSP = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
        1,1,0,0,0,0     !
!END!
 30 ! SRCNAM = HR17 !
 30 ! IVARY = 1 !    (24 Hours)
 30 ! PM10 = 0,0,0,0,0,0,
        1,1,1,1,1,1,
        1,1,1,1,1,1,
```

```
       1,1,0,0,0,0     !
!END!
 31 ! SRCNAM = HR18 !
 31 ! IVARY = 1 !    (24 Hours)
 31 ! TSP = 0,0,0,0,0,0,
       1,1,1,1,1,1,
       1,1,1,1,1,1,
       1,1,0,0,0,0     !
!END!
 31 ! SRCNAM = HR18 !
 31 ! IVARY = 1 !    (24 Hours)
 31 ! PM10 = 0,0,0,0,0,0,
       1,1,1,1,1,1,
       1,1,1,1,1,1,
       1,1,0,0,0,0     !
!END!
 32 ! SRCNAM = HR19 !
 32 ! IVARY = 1 !    (24 Hours)
 32 ! TSP = 0,0,0,0,0,0,
       1,1,1,1,1,1,
       1,1,1,1,1,1,
       1,1,0,0,0,0     !
!END!
 32 ! SRCNAM = HR19 !
 32 ! IVARY = 1 !    (24 Hours)
 32 ! PM10 = 0,0,0,0,0,0,
       1,1,1,1,1,1,
       1,1,1,1,1,1,
       1,1,0,0,0,0     !
!END!


--------
   a
    Data for each species are treated as a separate input subgroup
    and therefore must end with an input group terminator.


-------------------------------------------------------------------------------
```

INPUT GROUPS: 17a & 17b -- Non-gridded (discrete) receptor information

---

Subgroup (17a)

Number of non-gridded receptors (NREC) No default ! NREC = 4 !

!END!

Subgroup (17b)

---

a

NON-GRIDDED (DISCRETE) RECEPTOR DATA

Receptor No.	X UTM Coordinate (km)	Y UTM Coordinate (km)	Ground Elevation (m)	Height b Above Ground (m)	
1 ! X =	734.581,	6118.143,	783.5,	0.0 !	!END!
2 ! X =	736.674,	6117.689,	780.7,	0.0 !	!END!
3 ! X =	737.492,	6114.373,	744.5,	0.0 !	!END!
4 ! X =	731.286,	6114.654,	726.2,	0.0 !	!END!

---

a

Data for each receptor are treated as a separate input subgroup

and therefore must end with an input group terminator.

b

Receptor height above ground is optional. If no value is entered,

the receptor is placed on the ground.

Community Engagement and Consultation Materials

Appendix E

Tarago & District Progress Association Inc.

Keeping the community informed

During the week of the Tarago Show several residents approached TADPAI concerned about a development application Veolia was rumored to have lodged with council to increase the waste taken at their facility on Collector road. The stories varied from 50,000 tonnes of regional waste by road transport per annum to an extra train per day and extended hours of operation from 6am to 10pm six days per week increasing the annual intake to 1,200.000 tonnes.

TADPAI called a public meeting which was held at the community hall on Thursday 18th March. The purpose of this meeting was to determine the community feeling so that TADPAI could be sure of representing the majority view. The main complaint was the lack of community consultation causing confusion as to what exactly is being proposed. The outcome is that we have written to NSW Planning asking for an extension before any modification is approved, to allow the community to find out the facts and comment. This has been granted and so the process has started. We hope to report monthly through the Tarago times on our progress.

This week the AGM was held and the elected committee is: President Judy Alcock, Vice President Cid Riley, Secretary Ian Weekly, committee Geoff Burns and David Gock. As there were no nominations for treasurer Chris Burns has agreed to continue in the position until the end of April. Book keeping for TADPAI is very simple as we have few financial transactions in our operating year and so no previous experience apart from working with a spreadsheet is required. If you have a few hours to spare each month please contact us urgently as we need to fill the position of Treasurer to continue operation.

Our next meeting will be held on Monday 12th April starting at 7:30pm in the dining room of the Loaded Dog hotel. Everybody is welcome.

Judy Alcock President TADPAI

MeetingNotice

member service centre 1300 794 000 www.nswfarmers.org.au

NSW Farmers Association

NSW FARMERS' ASSOCIATION
invites all to attend Bungendore Branch
Ordinary General Meeting & Annual General Meeting
Date: Thursday, 18th April 2010
Venue: "Nardoo" 322 Taylors Creek Road, Tarago
Time: 7.30pm

FOR MORE INFORMATION CONTACT:

John Reardon Bungendore Branch Chair	4844 6222
Joan Limon Bungendore Branch Secretary	4844 6250
Liz Scarlett NSWFA Regional Team Manager	0428 411 218

"Together we're a force to be reckoned with."



Woodlawn Update

Woodlawn Bioreactor Update.

This past month saw the Woodlawn Bio-Energy project commission the 3rd biogas generator, taking the sites generation capacity to 3 Megawatts. This is an exciting time in the project as we move into our third year of power generation. Site Engineer Pablo Gonzalez has been busy coordinating the commissioning process, which involved extensive amount of electrical equipment and pipe work for the biogas. The generators are Jenbacher 20 cylinder engines, which we import from Austria. These particular engines are widely known in the industry for their efficiency utilizing biogas as a fuel. The focus for bioreactor now will be to optimise the biogas yields from the waste for all three generators.

Also during this month, a pilot aquaculture project is being installed, along with a greenhouse. The idea of these two projects is to utilize the heat from the cooling system of the generators to heat water for the fish tanks, and the green house plants are used in the Aquaculture process to help purify the water. Three 5000 litre tanks will be installed within the power station where 1000 silver perch fingerlings will be introduced. It is expected that the pilot projects will be completed and operational by the end of April.

Earlier this year the Woodlawn Bioreactor also passed a significant milestone, with the 2 millionth tonne of waste placed in the mine void. This comes after nearly 5 and half years of operation which started in September 2004. The current waste depth is 60 metres, with a waste surface area of 6.5 hectares. During the operation in excess of 30km of pipe work has been installed to extract biogas from the waste, this includes 60 wells individually constructed to manage leachate recirculation and gas extraction along with numerous horizontal gas extraction systems.

As many community members are aware, Veolia Environmental Services is looking to modify its current operations at Woodlawn, please read through the included fact sheet about our submission to the NSW Department of Planning. Veolia needs community feedback for the submissions to make sure all areas of concern are addressed.

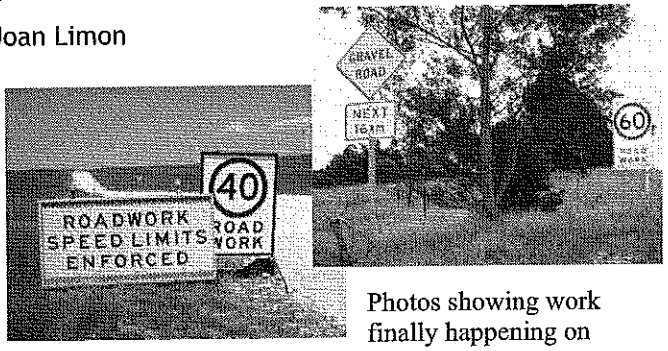
Henry Gundry
Environment and Operations Manager



TAYLORS CREEK ROAD

Looks like action is finally happening to seal the next 4 km of Taylors Creek Road. Capital Wind Farm agreed to donate over $2 million to seal the road up to Western Leg Road Corner. Work was due to commence when the Wind Farm was up and operating. This happened last November. As I understand it, the arrangement is for Palerang Council to seal 4 km a year until this work is complete. I, for one, cannot wait until the unsafe, washed-out, poorly maintained gravel road is sealed.

Joan Limon



Photos showing work finally happening on Taylors Creek Road

Live @ The Dog Preview
by Vicki Bowes

Band Review by Vicki Bowes

Paul Costa is back by popular demand. Paul last performed at the Dog in September last year and those that took my advice and came out to see him, were not disappointed. Sue Maas also mentioned that he was the best artist she has ever seen.

Paul started to make a name for himself in 2004 with the release of his debut album and has had a string of top 10 hits. Now with three albums under his belt, Paul is still in the limelight and by listening to him you will understand why.

2010 started off with a bang for Paul after he was a finalist for a golden guitar in three categories, Male artist of the year, APRA song of the year and Heritage song of the year. Paul also was the winner of the Trailblazer's heritage song of the year, at this year's Victorian and National Country Music Awards in March.

I know I have said this before, but I will say it again. Paul is really the complete package. He has the looks, the voice and a very sexy attitude, but most importantly he has the music to match.

If I have not convinced you to come along to see Paul at the dog on Saturday 17th April, then just ask Sue. I am sure she will also be happy to talk about how fantastic he was. I hope to see you there.

Veolia's plans prompt rethink on waste

By DAVID COLE

COUNCIL may soon have the opportunity to review its long-term waste management strategy if plans to increase the Woodlawn Bioreactor's capacity go ahead.

If Council can redirect the city's waste to Veolia Environmental Services' facility near Tarago, it could reduce its carbon footprint and allow it to use land adjacent to the current tip for other purposes.

The Goulburn Waste Management Centre only has about 16 to 20 years life left.

Council staff was advised at Goulburn Mulwaree Councils most recent meeting that Veolia was reviewing its planning consent and licensing conditions for the Woodlawn Bioreactor.

The current approval is for "up to 500,000 tonnes per annum" of putrescible waste to be transferred from the Clyde facility in southern Sydney to Woodlawn, but consent conditions limit the site to 400,000 tonnes initially.

Veolia representatives recently met with council staff to discuss their options.

A council report said Veolia was applying for two options to increase the amount of waste received at the Woodlawn site.

Option one is to increase the maximum amount of waste to one million tonnes per year.

Option two is to increase consent conditions by an extra 50,000 tonne per year, which would also allow waste from local sources to access Woodlawn directly, particularly from Palerang and Goulburn Mulwaree.

The Council disposes of 16,000 tonne of waste each year at the Goulburn Waste Management Centre.

Council staff noted there were potential benefits for council if access to the Woodlawn site was modified including creation of a disposal site for the city's waste beyond the Waste Management Centre's life.

"There is also an opportunity for council to review its waste management strategies," Goulburn Mulwaree Council's director of engineering services Terry Cooper said.

"This would include a more economic way to dispose of waste collected at the Tarago Waste Transfer Station and reducing potential risks to council with carbon trading legislation."

Councillors decided to give Veolia in-principle support for reviewing its existing consent and licensing agreements and expanding their planning and licensing arrangements to accommodate regional waste at Woodlawn.

Council staff will also continue working with Veolia on the possibility of future access to the Woodlawn site for waste disposal.

"We need to start thinking about what we will be doing with our waste stream over the long term," Mr Cooper said.

He said if Council could redirect the city's waste to Woodlawn, they would be able to use the land it owns adjacent to the current Waste Management Centre for other purposes.

Moscow Circus coming here

IN a major coup for Goulburn, The Moscow Circus has indicated it would like to set-up here for five days of shows in March 2010, possibly in Victoria Park.

A Goulburn Mulwaree council report to the Ordinary Meeting tomorrow night said the Moscow Circus would slot the shows in Goulburn in between shows they are performing in Canberra and Bowral.

The Circus would arrive for set-up on March 22 next year, with the shows to commence on March 24. The shows would run until pull-down on Sunday, March 28.

Moscow Circus management told council staff that its preferred location is in Victoria Park.

"This location is preferred as it is a highly visible site, with this visibility and the accompanying public awareness critical to the success of the circus."

The report said Council had also provided a range of other site options, including both Council managed sites and contacts for private sites.

"Carr Confoy oval was one of these options. Circus management has indicated that these options would generally not be satisfactory," the report said.

"Each show expects to have

Local arrests in alleged drug ring

A 32-year-old man and a 23-year-old woman from South Australia, who were allegedly linked to a drug ring, were arrested in Goulburn last Wednesday.

Their arrests led to a series of other arrests in the Southern Highlands and South Coast.

The pair were on their way to South Australia when they were stopped by police.

Kelly Travis, 32, from Cahill, South Australia did not enter a plea to possessing a commercial quantity of methyl-amphetamines, when he appeared in Goulburn Local Court last Thursday.

He was refused bail to re-appear by audio-visual link on February 10 next year.

Peta Anne-Marie Walters, 23, also from South



GOULBURN MULWAREE COUNCIL

Civic Centre 184-194 Bourke Street Goulburn NSW
Telephone: (02) 4823 4444 • Facsimile: (02) 4823 4456 • www.goulburn.nsw.gov.au
Correspondence to: Goulburn Mulwaree Council Locked Bag 22 Goulburn NSW 2580

Contact: Terry Cooper

Reference: TC:WAN 595046

14 December 2009

Mr J Houghton
Woodlawn Bioreactor
Site Manager
Veolia Environmental Services Pty Ltd
PO Box 141
GOULBURN NSW 2580

Dear Sir

Subject: Woodlawn Bioreactor – Local Waste Acceptance

Thank you for your letter dated 10 November 2009 regarding the acceptance of waste from the local and surrounding area.

This matter was dealt with at a recent Council meeting and Council resolved:

Resolved 09/716 **Cr Penning/Cr Sturgiss**

That:

A. Veolia be provided with in-principle support in reviewing its existing consent and licence agreements and expanding their planning and licensing arrangements to accommodate regional waste at their Woodlawn Bioreactor

B. Council staff continue to work with Veolia on the viability of future access to the Woodlawn site for waste disposal.

If you require any further information regarding the above please contact me during office hours on 4823 4464.

Yours faithfully

Terry Cooper
Director Engineering Services

Minutes from meeting of: ORDINARY COUNCIL

Held
Tuesday 17 November 2009
6.00pm
Council Chambers, Civic Centre
184 - 194 Bourke Street, Goulburn

Our Vision

A sustainable vibrant community protecting, enhancing and enjoying Goulburn Mulwaree's rich social, environmental and economic heritage.

Our Mission

To serve the Community

Our Values

Honesty • Openness • Ethics • Community Consultation • Fairness and Equity Accountability • Community Involvement • Transparency • Respect Community Inclusion

Minutes of the Ordinary Meeting of Council held Tuesday 17 November 2009 commencing at 6pm in the Council Chambers

Table of Content

Present 4

Also Present 4

Opening Prayer 4

Apologies 4

Disclosure of Interest 4

Calendar of Events 4

Mayoral Minute 4

Confirmation of Minutes 5

Other Committee Reports 5

Community Services Advisory Committee - 14 October 2009 5

Economic Development & Tourism Committee - 27 October 2009 7

General Purpose Committee - 4 November 2009 9

Recreation Area Committee Special Meeting – 9 November 2009 11

Other Committee Reports 12

Consideration of Motion of Which Due Notice has been Given 13

Executive Services

Item 1 Closed Session 17

Item 2 Department of Local Government Circulars 19

Item 3 Questions Without Notice & Task List Status Report 19

Item 4 Councillor Workshops, Briefing Sessions & Professional Development Program (Enclosure) 20

Item 5 Correspondence for Information / Attention (Enclosure) 20

Item 6 Goulburn-Crookwell Cycle Trail (Enclosure) 21

Item 7 Wind Renewable Energy Precinct Advisory Committee (Enclosure) 21

Item 8 Local Government Association Conference 2009 22

Item 9 Promoting Better Practice Review (Enclosure) 23

Item 10 Goulburn Airport 23

Item 11 Condolence Motion 25

Corporate Services

Item 1 Corporate Services Update 26

Item 2 Statement of Investments and Bank Balances (Attachment) 26

Item 3 Monthly Financial Report (Enclosure) 27

Item 4 Quarterly Budget Review (Attachment) 27

Item 5 Rates Outstanding Report 28

Item 6 Management Plan Quarterly Reports (Enclosure) 28

Item 7 2009/10 Loan Renewal Program 29

Item 8 Management Plan – Crown Land Licence Agreements (Attachment) 29

Item 9 Policy Review (Enclosure) 30

Planning and Community Services

Item 1 CBD Master Plan Workshop Outcomes (Attachment) 31

Item 2 Rezoning Request - Ridge Street, Shannon Drive and Bushs Lane, Goulburn (Enclosure) 33

Item 3 Significant Development Applications & Recent Decisions (Enclosure) 34

Item 4 Development Statistics 35

Item 5 Contaminated Land - 129 Lagoon Street, Goulburn (Enclosure) 36
Item 6 Quarries & Landfill Audit (Attachment) 37
Item 7 Gullen Range Wind Farm Appeal 38
Item 8 Regulatory Report 39
Engineering Services
Item 1 Engineering Services Update 40
Item 2 Roadside Weed Control October 2009 40
Item 3 Progress Report – Lumley Road Bridge Replacement, Tarago (Attachment) 41
Item 4 Aquatic Centre – Indoor Pool Annual Maintenance 41
Item 5 Street Closure Fee (Attachment) 42
Item 6 Airport Landing Fees (Attachment) 42
Item 7 Pool Hire Fees (Attachment) 43
Item 8 2009/10 Capital Works Program – Development Control Plan Funded Projects 44
Item 9 Regional and Local Community Infrastructure Program - Round 2 46
Item 10 Access to Woodlawn Bio Reactor 48
Water Services
Item 1 Water Supply Status Report – October 2009 49
Item 2 Water Services Update 49
Item 3 Highland Source Project 50
Petitions 50
Urgent Business / Late Items 50
Questions Without Notice 50
Closed Council 51
Executive Services
Item 1 Saleyards Sewer Charging 51
Task List 52

Item 10 Access to Woodlawn Bio Reactor

Reporting Officer

Director Engineering Services – Terry Cooper

Purpose of Report

To inform of recent discussion with Veolia representatives in relation to potential access to Woodlawn for regional waste.

Recommendation

That:

A. Veolia be provided with in-principle support in reviewing its existing consent and licence agreements and expanding their planning and licensing arrangements to accommodate regional waste at their Woodlawn Bioreactor

B. Council staff continue to work with Veolia on the viability of future access to the Woodlawn site for waste disposal.

Resolved 09/716 Cr Penning/Cr Sturgiss

That:

A. Veolia be provided with in-principle support in reviewing its existing consent and licence agreements and expanding their planning and licensing arrangements to accommodate regional waste at their Woodlawn Bioreactor

B. Council staff continue to work with Veolia on the viability of future access to the Woodlawn site for waste disposal.

WOODLAWN BIOREACTOR

NEW SOUTH WALES

Tarago Community Liaison Committee Meeting

25th March, 2010

Woodlawn Bioreactor Conference Room

Minutes

Opened: At 3.00pm

Closed: At 5.00pm

Present: Justin Houghton, Henry Gundry, Shaun Rainford, Evelyn Melinis (VES), Marianne Ronayne, Barbara Fairfax, Ken Vassel, (Local Residents), Cr Denzil Sturgis, Larry Meng (GMC)

Apologies: Clarice Beileiter, Mark Ryan, Colin Dennett (Local Residents) Cr Margaret O'Neill, Cr Nina Dillon (GMC)

,

Introduction: Henry Gundry

General Business:

a) Woodlawn Bioreactor and IMF update

- An up to date weight of rubbish that has been tipped into the void is 2.3 million tonnes.

b) Tony Favell

- The committee discussed writing a letter to Tony to thank him for his work with Woodlawn – VES to draft up letter on behalf of community

c) Power Generation

- Power generation is progressing well, with the 2 generator running 24 hours a day 7 days a week.
- The 3rd generator has been commissioned. Short term aim will be to operate all three engines at half load and increase output as more land fill gas come available.

d) Litter Control

- Con Cover application is part of the regular operations on site to cover the waste
- Intermediate cover, utilising soil as a means to cover areas where waste placement is not occurring for long periods is a practice adopted. This has helped to eliminate wind blown litter.

e) Leachate Treatment

- Considerable reduction in stored liquid volumes is now evident.
- Leachate extraction from the waste mass is kept at a minimum, currently no waste leachate is extracted to the Evaporation dam 3.
- Justin Houghton (JH) explained that there is a plan to incorporate much of the stored leachate at ED3, back into the waste. This will be undertake as part of the new waste sump being developed at the current storm water collection pond within the void – Pond 2

f) Odour Management

- VES sourced some information on large scale odour control applicators to be placed on the waste surface. Capital expenditure application has been put forward to purchase these units
- Barbara Fairfax (BF) outlined that there is no change in the type and frequency of the odours. She continues to smell the raw waste.

g) Mine Site Rehabilitation

- Henry Gundry (HG) mentioned that Golder have almost finalised the remediation action plan, which will outline the objectives for the plant area. Earthworks are being planned for 2010.

h) Wind Farm

- Infigen Energy are finalising the development proposal for the Woodlawn Wind farm.
- 20 Towers are planned for the project, construction looking to take place later in 2010 – September

i) SML 20 – Mine Lease

- Progression with the transfer of the mine lease has slowed, however Tri Origin Minerals are maintaining an interest in the project and the signing over of the lease.

j) WASP

- Progression of the project will be subject to tonnage increase application.

k) Woodlawn Tonnage Increase Application.

- JH mentioned to the group that considering the current situation with the application, that a representative from the TADPAI should be invited to the CLC meetings, and a future representative should be included in all future CLC matters. The group agreed on this. HG to contact TADPAI.

- JH mentioned that a time line will be developed for finalising the leachate management objectives
- BF suggested that the Heggies odour report in the EA was not sufficient, as it didn't identify the odour concerns around the Taylors Creek Rd, as it only focused on the Tarago region. SR said that they had since approached Heggies to reflect reality on odour modelling, and the cause and ways to address the concern. BF asked if this can be included in the updated EA.
- Shaun Rainford advised the group that the initial 50,000t, includes GMC, Queanbeyan, Bega and Palerang. However the part 3A application local waste acceptance will be 120,000, which is 70,000t on top of the 75W application. This gives scope for other council areas the option to use Woodlawn as a solution. JH advised that only GMC will come via road through Tarago.
- EM advised the group that Woodlawn will be an emergency contingency for the Bega Council, as they are looking to build their own facility.
- JH mentioned that truck movements from council areas have been based on a 19tonne payload. It will be the council's responsibility to get the waste to Woodlawn. VES will work with councils on a preferred type of truck and trailer to deliver waste.
- DS asked about leaking trucks from council areas and non conforming waste. JH mentioned that VES already have procedures in place to deal with such matters. Spill control measures and environmental awareness is already in place. SR said that VES would stipulate what type of waste and type of transport required transport it to Woodlawn. JH also said that councils obligation to ensure that their loads are sealed to prevent pollution, otherwise it would be a non compliance under the Pollution Act
- Marianne Ronayne, said that she wasn't concerned with the amount of truck movements, she expressed her continued concern with the truck movements from Canberra to the landfill on Oallen Ford Rd.
- Barbara Fairfax, expressed concern about the condition of the Bungendore road and that it wasn't suitable for trucks. JH said that the consultant would be asked again to assess the report and ask the RTA to comment on the road condition.
- BF asked about the spur rail line from Tarago to Woodlawn, considering the longevity of the project and if Tri Origin Minerals proceeds. SR mentioned that it would of costed $24 million in 1999, financial it would be not feasible to install such infrastructure.
- Ken Vassel, asked about the train blocking the level crossing at Tarago, he said that is aware that trains are not permitted to block the road at any time. HG said that he had not heard about this ruling. Contact with ARTC to be made to determine the ruling.
- MR and LM suggested that a letter should be written to the community addressing the concerns. JH advised that a fact sheet will be provided to all community members, this will be put in the April issue of the Tarago Times.
- BF mentioned that CLC member details should be documented in the Tarago Times. HG said that he would see that this would happen.

- DS mentioned that the Tarago progress Association TADPAI had ask palling to delay the S75W application until the 1.13 application had been finalised.

l) Other Matters

- No other matters were discussed

Meeting Closed
5.00pm

- **Next meeting will be held on the 22 April 2010 at 4 pm**

VEOLIA ENVIRONMENTAL SERVICES

WOODLAWN BIOREACTOR

NEW SOUTH WALES

Tarago Community Liaison Committee Meeting

25th February, 2010

Woodlawn Bioreactor Conference Room

Minutes

Opened: At 4.00pm

Closed: At 6.20pm

Present: Justin Houghton, Henry Gundry, Evelyn Melinis (VES), Luke O'Dwyer (URS) Clarice Beileiter, Marianne Ronayne, Barbara Fairfax, Ken Vassel, Mark Ryan (Local Residents), Cr Denzil Sturgis, Cr Margaret O'Neill, Larry Meng (GMC)

Apologies: Colin Dennett, Cr Nina Dillon

,

Introduction: Henry Gundry

General Business:

a) Woodlawn Bioreactor and IMF update

- An up to date weight of rubbish that has been tipped into the void is 2 million tonnes.

b) Tony Favell

- The committee discussed writing a letter to Tony to thank him for his work with Woodlawn – VES to draft up letter on behalf of community

c) Power Generation

- Power generation is progressing well, with the 2 generator running 24 hours a day 7 days a week.
- The 3rd generator is currently being installed with the aim to commission over the coming months. This ultimately it depends on gas production over the next few months. Short term aim will be to operate all three engines at half load and increase output as more land fill gas come available.

d) Litter Control

- Con Cover application is part of the regular operations on site to cover the waste
- Intermediate cover, utilising soil as a means to cover areas where waste placement is not occurring for long periods is a practice adopted. This has helped to eliminate wind blown litter.

e) Leachate Treatment

- Considerable reduction in stored liquid volumes is now evident.
- Leachate extraction from the waste mass is kept at a minimum, currently no waste leachate is extracted to the evaporation dam 3.
- Looking at equipment to further advance our treatment ability. Henry Gundry (HG) visited the VES liquid treatment facility in Sydney, where a Dissolved Air Floatation (DAF) unit may have become available.
- Justin Houghton (JH) explained that we have increased our capacity to draw liquid from the waste mass. This has been brought about by increasing the amount of wells (currently 60 operational) and by increasing the drainage medium in the waste has meant that liquid control is better managed within the void. The site is currently going through a transition period, with the redesign of storm water infrastructure and waste cell preparation which will also improve our leachate management.
- Justin Houghton (JH) – added that as a result of the improvements to leachate management we have reduced the leachate level within the waste and have increased gas extraction and this reduces the need to pump leachate out of the void.

f) Odour Management

- VES sourced some information on large scale odour control applicators to be placed on the waste surface.
- Barbara Fairfax (BF) outlined that there is no change in the type and frequency of the odours. She continues to smell the raw waste.
- Marianne Ronayne (MR) asked if VES felt that a solution to the odour will be feasible. Justin Houghton (JH) commented that the void provides a unique physical shape to take advantage of. VES plan to purchase de-odouriser units to be placed on the waste face. The incorporation of reducing the waste face size and covering the waste has enabled us to eliminate odour sources and we are now in a much better position to finalise our program to combat waste odours.
- Justin Houghton (JH) – also explained that our improvements in liquid management (as mentioned above) has enabled us to also reduce odour sources in relation to leachate and this will continue.

g) Mine Site Rehabilitation

- Henry Gundry (HG) mentioned that Golder have almost finalised the remediation action plan, which will outline the objectives for the plant area. Earthworks are being planned for 2010.

h) Wind Farm

- Infigen Energy are finalising the development proposal for the Woodlawn Wind farm.
- 20 Towers are planned for the project, construction looking to take place later in 2010 – September

i) SML 20 – Mine Lease

- Progression with the transfer of the mine lease has slowed, however Tri Origin Minerals are maintaining an interest in the project and the signing over of the lease.

j) WASP

- Progression of the project will be subject to tonnage increase application.

k) Woodlawn Tonnage Increase Application.

- Justin Houghton (JH) introduced Luke O'Dwyer (LO) from URS to the committee. LO provided a brief outline of his role and involvement in the Woodlawn waste expansion project.
- URS was engaged by VES before Christmas 2009 to carry out the Environmental Assessment (EA) for the waste expansion project which involves additional waste by rail from the Sydney Region and Regional Councils by road. URS commenced EA work in mid-January 2010. (note the original proposal was put through to Planning in 2007).
- The reason for this expansion is based on disposal capacity available within the Sydney Region and waste generation data (Eastern Creek Commission of Inquiry data).
- Luke O'Dwyer (LO) highlighted that the existing DA allow the facility to accept 500,000 tpa of putrescible waste from the Sydney Region by rail. However, this amount had been revised and scaled down in the conditions of consent. The original consent also allowed for up to 2 trains per day to transport the containers from Clyde to Crisps Creek IMF.
- Luke O'Dwyer (LO) stated that there would be no changes to the bioreactor size, type of waste accepted on site or to the facility as a whole, as a result of the Major Project application.
- It was mentioned, that the only significant change would be the total volume of waste received annually at the facility and operating hours at both Woodlawn and the Intermodal facility.
- Margaret O'Neill (MO) pointed out the 20 year operating life of the facility (an existing condition of consent) and asked whether it would be halved as a result of the proposed waste expansion. Evelyn Melinis (EM) explained that this condition would need to be changed if the project was approved, the existing DA would be replaced with a new consent issued by the Department of Planning (DoP).
- An additional change would be the total hours of operation, to allow two trains to transport the additional waste by rail. The proposed operating hours would be between 6 am to 10 pm.

- It was noted that current operating times at the Intermodal is between 7 am to 6 pm however, Justin Houghton (JH) pointed out these hours may temporaraly be altered with DECCW's approval.
- A number of committee members voiced their concerned with the blocking of the road by the trains in particular, for emergency vehicles. Mark Ryan (MR) suggested the option to construct an emergency access road. Committee members were encouraged to provide their comments, concerns and or suggestions to the DoP as part of the submissions process.
- Luke O'Dwyer (LO) ran through the consultation process which includes the feedback forms prepared specifically for the waste expansion project, exhibition period & public submission which provides an opportunity for the community to provide their feedback / issues in regards to the proposed project directly to the DoP.
- It was mentioned that the final Director-General's Requirements (DGRs) for the waste expansion project have not been issued by the DoP. Although work on the EA has been undertaken for the project based on the draft DGRs, the report can't be finalised until these requirements are received.
- Luke O'Dwyer (LO) presented to the committee some of the key issues mentioned in the draft DGRs which included: noise, air quality (odour & dust), traffic assessment, water management (leachate, surface water & groundwater) and hazard analysis.
- Larry Meng (LM) stated that Goulburn Mulwaree Council had received the Section 75 W Modification EA on 19 February and mentioned a few of the impact assessments undertaken for the proposed modification including a traffic assessment. LM outlined that as part of the local waste modification, up to 4 waste vehicles (with a load capacity of 19t) could pass through Tarago from Goulburn Mulwaree Council (to deliver waste to Woodlawn Bioreactor).
- It was mentioned that the local waste modification would provide an opportunity for local Councils surrounding the Woodlawn Bioreactor to dispose of their waste in the coming years if so required.
- Committee members raised strong concern with waste vehicles passing through Tarago Other issues raised for the major waste expansion project included, noise from trains and odour.
- A copy of the feedback form was tabled and issued to each committee member, Justin Houghton and Luke O'Dwyer stated these concerns should be communicated to Veolia by completing the feedback forms so that these issues can be taken into consideration and included in the EA report.
- It was also mentioned that any concerns relating to the modification application can be made directly to the DoP (through the website, in the form of a letter or email).
- The committee requested a one page summary of the major issues that could potentially affect the community. It was agreed that this document be prepared by Veolia and distributed to committee members and to the Tarago community in general.

- It was also mentioned that an article of the proposals (Regional waste modification and waste expansion project) be included in the local newspaper and Windellama News.
- Larry Meng (LM) offered to copy the section 75W report for Ken Vassel by 26th February. All members were advised that a copy of the report is also available on DoP's website (major projects).

l) Other Matters

- Serrated tussock management - an intensive spraying program took place at the end of 2009. The pine plantation was once again targeted in this program; much of the open area has been sprayed. This area is part of the annual weed control program.
- Marianne Ronayne (MR) asked about whether the general public is able to visit the site. JH mentioned the education centre is available to all. If pre arranged, a site tour can be organised.
- VES to organise a site tour for the committee.
- The committee asked about the Collector road turn off – the RTA and council are looking into a major redesign, however VES has still not been consulted with this. The committee commented on the way traffic was managed at the intersection.
- As per the previous meeting where discussions were held about the contaminated soils from Canberra. A neighbouring resident on Bungendore road complained to council that this material was coming to Woodlawn. Larry Meng (LM) advised to the complainant that this was not the case, He advised the committee, that he hadn't passed on the contact of the transport company.
- Denzil Sturgis (DS) asked about waste fire. Henry Gundry (HG) mentioned that a fire did occur in November 2009, which was detected by our surveillance equipment. Barbara Fairfax (BF) asked if VES had a procedure to notify the community of such events and asked what health and safety measures should be adopted to minimise the risk to the community. Justin Houghton (JH) mentioned that VES do not have a procedure in place, however this was an excellent suggestion and measures to notify the relevant neighbours will be put in place.

Meeting Closed
6.20pm

- **Next meeting will be held on the 25 March 2010 at 3 pm**

Improving the living environment

VEOLIA ENVIRONMENTAL SERVICES

March 2010

Woodlawn Consent Modification

Did you know Veolia Environment Services is seeking approval to change our current Development Consent to receive additional tonnages and also local waste at the Woodlawn Bioreactor?

What is the purpose of this fact sheet?

Further to the recent Community Liaison Committee meeting held on the 25th February 2010 a number of local residents have asked us for more information on our proposed changes. Veolia is keen to receive public feedback and as the approvals process can be complex the following is provided to help explain the proposal.

How many applications is Veolia submitting?

Veolia were originally submitting one Part 3A Major Project Application to accept local waste and to increase the overall tonnage received at Woodlawn. As Part 3A applications tend to take a significant time to be reviewed and processed, the Department of Planning (DoP) advised Veolia to split off a smaller portion to address local waste and submit that as a modification to the current consent conditions. This would allow the modification to be assessed separately to potentially allow for the nearest councils such as Goulburn Mulwaree and Palerang to access the site if required (provided approval for the modification is granted).

As such, two separate applications are required to be submitted for the Woodlawn Waste Expansion project:

1. Application to modify the current conditions of consent to receive up to 50,000 tonnes of local waste (Section 75W application).

2. Application to receive local and Sydney waste up to 1.2 million tonnes per year (Part 3A Major Project Application).

**Note these initial submissions are always in draft form as the final needs to have both governmental and community input.*

Why are local Councils looking to utilize the facility?

With regional council's costs to maintain landfills continuing to rise due to the pressure for more sustainable waste management practices, they are looking for other options. Veolia have invested heavily in Bioreactor technology and with greenhouse considerations now at the front of many peoples minds we have had queries from some local councils who are considering Woodlawn as a potential option.

Why is Veolia looking to increase overall volumes to the site?

The existing development consent for Woodlawn imposes a reduction in tonnage from this year on. Without amendment this will undoubtedly reduce the projects productivity. The current conditions were imposed (nearly 10 years ago) because the government believed, at the time, that waste volumes would reduce. This has not happened, and there is currently a need for highly engineered facilities such as Woodlawn.

What are the main changes to what we currently do?

The three main changes we are seeking are as follows:

- Amend volume restrictions and allow some local Councils to access the Woodlawn Bioreactor Facility (Section 75W Application).
- Increase overall tonnage limit for the facility – local and Sydney (Part 3A Application)
- Extension of operating hours at Crisps Creek and Woodlawn (Part 3A Application)



How is Veolia looking to address local Council access?

In order to allow local councils to access the Bioreactor, Veolia are applying to amend the current volume restrictions and to receive local waste (Section 75W application). This waste is proposed to be transported by road. Note that this does not obligate local Councils to transport the waste to Woodlawn, but gives them the option.

What about the extension of operating hours?

To accommodate an increase in waste it would be necessary to also extend the operating hours at both Crisps Creek and Woodlawn (Part 3A Application). The extended hours would be to 10.00pm. Note that recommended industrial noise limits are reduced between 6.00pm to 10.00pm.

Other than local waste how does Veolia intend to accommodate the increased waste inputs?

To allow for additional tonnages to be accepted into the facility, Veolia will apply for a higher overall limit of 1.2million tonnes (Part 3A application). In this submission some of the additional tonnage would be received either by road or rail from the local region. However, the main part of the increased tonnage would be coming by rail from Sydney as per the current operations.

What does the increase mean in terms of local traffic?

This means that most local waste will need to be transported by road. All potential routes will need to be outlined in the proposal and assessed prior to the DOP granting any approval. Note all roads are managed either by the RTA or local Councils.

What about trucks through Tarago itself?

The only trucks that would be proposed to come through Tarago would be the local Goulburn Mulwaree service. Goulburn Mulwaree Council currently generates 20,000tpa of waste and it is important to understand that at maximum capacity this averages at 4 trucks loads per day. This will be the case for transporting of waste through Tarago under both applications.

How would the waste increase impact on train movements?

At maximum capacity we would need to run two trains per day. We are currently not limited on how many trains we can run each day our limit is operating hours.

How and when can I make comment on the application?

The draft modification to the current development consent to accept up to 50,000 tonnes of local waste (Section 75W Application) has been submitted as requested by the DoP and they have already sent it out for comment. We have received a lot of feedback and submissions have been made to the DoP directly. The main issues raised are related to transport routes and odour management.

The draft application to increase the total tonnage, up to 1.2 million tonnes per annum, (Part 3A Major Project Application) is expected to be submitted to the DoP in April. Planning will then review the document, this could be another 4 to 8 weeks, and then they will put it out for public comment. *Note approval of this application would result in new conditions of consent being imposed on the Woodlawn operations and would supersede any existing conditions.

How do we get more information?

All residents will have the opportunity to comment on the development applications currently being assessed by the DoP, but in the meantime, if anyone has any questions or feedback they can contact their Community Liaison Committee members or Mr. Justin Houghton on 4844 6262 and we will attempt to answer any concerns.

For further information about the planning process, to view current applications or submit comments you can access the Department of Planning web page - www.planning.nsw.gov.au

Woodlawn Bioreactor Greenhouse Gas Assessment Woodlawn Expansion Project

Appendix F

HEGGIES

REPORT 30-2464-R3

Revision 2

Woodlawn Bioreactor
Greenhouse Gas Assessment
Woodlawn Expansion Project

PREPARED FOR

Veolia Environmental Services (Australia) Pty Ltd
619 Collector Road,
TARAGO NSW, 2580

13 JULY 2010

HEGGIES PTY LTD
ABN 29 001 584 612

Woodlawn Bioreactor
Greenhouse Gas Assessment
Woodlawn Expansion Project

PREPARED BY:

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TABLE OF CONTENTS

1 INTRODUCTION 4

1.1 Direct and Indirect Emissions (Emission Scopes) 5

1.2 Greenhouse Gas Calculation Methodology 6

2 GREENHOUSE GAS ASSESSMENT 6

2.1 Emissions Sources 6
2.1.1 Summary of Emission Sources 8
2.1.2 Summary of Emission Factors 8
2.1.3 Assumptions 9

2.2 Emissions Estimation Results 10

3 CONCLUSIONS 12

4 REFERENCES 13

Table 1 Summary of Potential WWEP Greenhouse Gas Emissions 8
Table 2 Summary of Emission Factors used in Greenhouse Gas Emission Estimation 9
Table 3 Greenhouse Gas Estimation Data Assumptions 9
Table 4 Greenhouse Gas Emission Estimation 10

Figure 1 Scope 1 Greenhouse Gas Emission Estimation (tonnes CO_2-e per annum) 11
Figure 2 Scope 2 Greenhouse Gas Emission Estimation (tonnes CO_2-e per annum) 11
Figure 3 Scope 3 Greenhouse Gas Emission Estimation (tonnes CO_2-e per annum) 12

APPENDIX A Plan of current network of extraction infrastructure
APPENDIX B Landfill Gas Generation at Woodlawn
APPENDIX C Methane Capture at Woodlawn
APPENDIX D GHD Gas Flux Testing Report

1 INTRODUCTION

A greenhouse gas assessment has been prepared for the Woodlawn Expansion Project (the 'Project').

The assessment quantitatively estimates the greenhouse gas impacts associated with Scope 1 and Scope 2 activities for the Project, as defined by the World Resources Institute (WRI) Greenhouse Gas Emissions Reporting Protocol and the National Greenhouse and Energy Reporting (NGER) Measurement Determination.

The assessment also semi-quantitatively estimates the greenhouse gas impacts from the major Scope 3 activities for the Project. Discussions with NSW DECCW (pers. comm. Matthew Riley, March 2010) have resulted in a request for the largest Scope 3 emissions sources to be identified and reported. A detailed Scope 3 assessment (upstream and downstream emissions associated with all waste sources) was deemed to be excessive and not required by NSW DECCW.

1.1 Bioreactor Overview

Woodlawn is operated as a bioreactor landfill; it is the deepest bioreactor type landfill of its kind in the world, with it being designed to accept over 25 million tonnes of putrescible waste. The basic concept in a bioreactor landfill, as opposed to standard landfill technology, is to accelerate the decomposition of the waste through actively controlling liquid and leachate recirculation; this enhances the growth of microbes responsible for waste decomposition and leads to an increased controlled yield of methane.

The landfill gas (LFG) extraction system is used to maximise the capture of methane with the principle aim of generating electricity. The active gas extraction system uses suction pressure to actively remove LFG from the waste mass through a system of wells and pipes. The wells and collection pipes within the waste mass enable transport the LFG to the purpose built power station.

Since the project began in September 2004, there have been around 65 leachate and gas extraction wells installed in the waste. A plan showing the current network of extraction infrastructure is given in **Appendix A**. These have been individually installed to optimise the capture of LFG. As the surface area of the waste mass increases, the ability to increase the number of wells is possible. With the principle aim of accelerating the decomposition of the waste, leachate recirculation is achieved by the removal of microbial rich liquid from the wells and subsequently recirculating on the fresh waste during daily land filling.

Horizontal gas extraction systems are also installed during the active landfilling phase. These systems are specifically designed to capture LFG as the natural degradation process takes place. These systems are constructed of HDPE perforated pipe, with a drainage medium covered to increase the zone of influence. Similar to the wells, these systems allow for leachate recirculation and LFG gas flow.

The LFG collection system is dynamic, and as a result its operation is closely monitored and adjusted to evaluate the conditions within the bioreactor to effectively maintain a continuous supply of landfill gas to the generator sets.

The Woodlawn Bioenergy project was officially opened by Veolia on the 14th of April 2008; although the first landfill generator was commissioned in February 2008. Up until that point, all LFG captured from the bioreactor was treated by thermal oxidation in a dedicated flare, which remains an Environmental Protection Licence requirement when the LFG is not used for power generation. The second generator was commissioned in November 2008 with the third in March 2010.

The Woodlawn Bioenergy project comprises of the existing three *GE Jenbacher* gas engines, gas conditioning equipment, High Voltage / Low Voltage systems, HAASE low emission flare-stack and a gas extraction booster system, which applies suction to the waste mass. The current power station is designed to house six engines and it is anticipated that, subject to gas supply, a total of four buildings will be completed over the coming years to accomodate 24 engines.

With the anticipated increase in annual waste tonnages to the Woodlawn Bioreactor, the installation of gas extraction systems remains a primary objective of the project. The Bioreactor processes can be maintained, with leachate recirculation practices still a core component of the accelerating the waste decomposition process. With the increase in waste volumes, this gives scope to access larger volumes of LFG capture over a shorter period of time.

1.2 Direct and Indirect Emissions (Emission Scopes)

The NGA Factors (DCC, 2009) defines two types of greenhouse gas emissions:

> ***Direct emissions*** *are produced from sources within the boundary of an organisation and as a result of the organisation's activities.*
>
> ***Indirect emissions*** *are emission generated in the wider economy as a consequence of an organisation's activities (particularly from its demand for goods and services), but which are physically produced by the activities of another organisation.*

The NGA Factors identifies three 'scopes' of emissions for greenhouse gas accounting and reporting purposes, defined as follows:

- *Direct (or point-source) emission factors give the kilograms of carbon dioxide equivalent (CO2-e) emitted per unit of activity at the point of emission release (i.e. fuel use, energy use, manufacturing process activity, mining activity, on-site waste disposal, etc.). These factors are used to calculate scope 1 emissions.*
- *Indirect emission factors are used to calculate scope 2 emissions from the generation of the electricity purchased and consumed by an organisation as kilograms of CO2-e per unit of electricity consumed. Scope 2 emissions are physically produced by the burning of fuels (coal, natural gas, etc.) at the power station.*
- *Various emission factors can be used to calculate scope 3 emissions. For ease of use, this workbook reports specific 'scope 3' emission factors for organisations that:*
  - *(a) burn fossil fuels: to estimate their indirect emissions attributable to the extraction, production and transport of those fuels; or*
  - *(b) consume purchased electricity: to estimate their indirect emissions from the extraction, production and transport of fuel burned at generation and the indirect emissions attributable to the electricity lost in delivery in the T&D network.*

1.3 Greenhouse Gas Calculation Methodology

Quantification of potential emissions from the WWEP has been undertaken in relation to both carbon dioxide (CO_2) and other non-CO_2 greenhouse gas emissions.

For comparative purposes, non-CO_2 greenhouse gases are awarded a "CO_2-equivalence" (CO_2-e) based on their contribution to the enhancement of the greenhouse effect. The CO_2-e of a gas is calculated using an index called the Global Warming Potential (GWP). The GWPs for a variety of non-CO_2 greenhouse gases are contained within the Intergovernmental Panel on Climate Change (IPCC), (1996) document "*Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*".

The GWPs of relevance to this assessment are:

- methane (CH_4): GWP of 21 (21 times more effective as a greenhouse gas than CO_2); and
- nitrous oxide (N_2O): GWP of 310 (310 times more effective as a greenhouse gas than CO_2).

The short-lived gases such as carbon monoxide (CO), nitrogen dioxide (NO_2), and non-methane volatile organic compounds (NMVOCs) vary spatially and it is consequently difficult to quantify their global radiative forcing impacts. For this reason, GWP values are generally not attributed to these gases nor have they been considered further as part of this assessment.

The greenhouse gas emissions associated with the project have been assessed in terms of direct (Scope 1) emission potential, indirect (Scope 2) emission potential and significant upstream/downstream (Scope 3) emission potential.

2 GREENHOUSE GAS ASSESSMENT

2.1 Emissions Sources

Scope 1: Direct Emissions

Fugitive Emissions – Methane Released from Landfill

The process of biological degradation results in emissions of CH_4 and CO_2 although only the CH_4 component should be considered (DCC, 2009).

Testing undertaken by GHD on behalf of Veolia indicates that the Woodlawn Bioreactor captures better than 80% (v/v) of the CH_4 produced within the landfill (see ***Emissions from Methane Combustion***). Further, 10% of the remaining 20% of CH_4 emitted from the landfill surface is subject to oxidation, as outlined in the NGER (Measurement) Technical Guidelines (2009).

The NGA Factors provides default emission factors for CO_2-e (as CH_4) resulting from fugitive emissions at landfill facilities. Table 42 of the NGA Factors (DCC, 2009) provides a default figure for Municipal Solid Waste (MSW) of 1 tonne CO_2-e per tonne of waste, including the oxidation factor discussed above.

Refer **Appendix B** for further information on the predicted gas production at Woodlawn over the Project Lifetime.

Emissions from Methane Combustion

The combustion of CH_4 in generators to produce electricity at Woodlawn results in the emission of CH_4 and N_2O. Based on an 80% recovery rate (refer **Appendix C**), it is estimated that 56 m^3 of CH_4 is captured for use for every tonne of MSW landfilled (waste emission factor for MSW / 21 x recovery rate of 80% x conversion from tonnes to m^3 of methane (assumed at $1.47x10^3$ m^3/tonne)).

Greenhouse gas (GHG) emissions attributable to the project from combustion are therefore calculated based on the amount of methane captured per tonne of waste disposed, the quantity of waste disposed, the energy content of methane (0.0377 GJ/m^3) and the emission factor for landfill biogas (Table 2 of the NGA Factors) 4.83 kg CO_2-e/GJ.

Diesel and Petrol Usage

Scope 1 GHG emissions attributable to diesel and petrol relate to the use of on-site fixed and mobile equipment, dust suppression vehicle, storm water pumps and leachate pumps.

The annual emissions of CO_2 and other greenhouse gases from these sources have been estimated using emission factors contained in Table 4 of the NGA Factors (DCC, 2009). It has been assumed that the energy content of diesel is 38.6 megajoules per litre (MJ/L) and 34.2 MJ/L for petrol (DCC, 2009).

Scope 2: Electricity Indirect Emissions

Scope 2 GHG emissions associated with the project relate to the consumption of purchased electricity. The NGA Factors provides Scope 2 emission factors for the consumption of purchased electricity by each state of Australia.

State emission factors are used because electricity flows between states are significantly constrained by the capacity of the inter-state interconnectors and in some cases there are no interconnections.

The emission factor for Scope 2 (0.89 kg CO_2-e/kWh as per Table 5 of the NGA Factors) covers emissions from fuel combustion at power stations associated with the consumption of purchased electricity in NSW.

Scope 3: Other Indirect Emissions

Transport via Road

Indirect emissions of greenhouse gases would occur from the transportation of waste from the Crisps Creek Intermodal Facility to the Woodlawn site in third party vehicles.

The annual emissions of CO_2 and other greenhouse gases from this source have been estimated using emission factors contained in Table 38 of the NGA Factors (DCC, 2009). It has been assumed that the energy content of diesel is 38.6 megajoules per litre (MJ/L) (DCC, 2009).

Transport via Rail

Indirect emissions of greenhouse gas would occur from the transportation of waste from Sydney to the Crisps Creek Intermodal Facility on third party rail stock.

The annual emissions of CO_2 and other greenhouse gases from this source have been estimated using Table 38 of the NGA Factors (DCC, 2009). It has been assumed that the energy content of diesel is 38.6 MJ/L (DCC, 2009).

Extraction, Production and Transport of Diesel Consumed at the Woodlawn Expansion Project

Scope 3 greenhouse gas emissions attributable to diesel and petrol used at the project relate to its extraction, production and transport.

The annual emissions of CO_2 and other greenhouse gases from this source have been estimated using Table 38 of the NGA Factors (DCC, 2009).

2.1.1 Summary of Emission Sources

A summary of the potential project greenhouse gas emission sources is provided in **Table 1**.

Table 1 Summary of Potential WWEP Greenhouse Gas Emissions

Project Component	Direct Emissions	Indirect Emissions	
	Scope 1	**Scope 2**	**Scope 3**
Fugitive Emissions	Uncontrolled emissions of CH_4 from methanogenesis of waste not collected and emitted through the surface of the waste.	N/A	N/A
Methane Combustion	Controlled emissions from the thermal oxidation of CH_4 generated through the methanogenesis of waste and collected through the gas harvesting system.	N/A	N/A
Petrol and Diesel	Emissions from the combustion of petrol and diesel at the project (plant and transport purposes).	N/A	Estimated emissions attributable to the extraction, production and transport of petrol and diesel consumed at the project.
Electricity Consumption	N/A	Electricity consumption associated with all activities.	N/A
Transport in 3rd Party Owned Vehicles	N/A	N/A	Estimated emissions attributable to the operation of non-Veolia owned vehicles (trucks and trains) which transport waste to Site.

Note: N/A = Not applicable

2.1.2 Summary of Emission Factors

Emission factors for the current assessment have been sourced from NGA Factors (DCC, 2009). A summary of the emission factor sources is provided in **Table 2**.

Table 2 Summary of Emission Factors used in Greenhouse Gas Emission Estimation

Project Component	Direct Emissions	Indirect Emissions	
	Scope 1	**Scope 2**	**Scope 3**
Fugitive Emissions	Table 42 of the NGA Factors	N/A	N/A
Methane Combustion	Tables 2 and 42 of the NGA Factors (assumed energy content of CH_4 of 0.0377 GJ/m^3 and emission factor of CH_4 + N_2O of 4.83 kg CO2-e/GJ)	N/A	N/A
Petrol and Diesel	Table 4 of the NGA Factors (assumed energy content of 34.2 GJ/kL for petrol and 38.6 GJ/kL for diesel)	N/A	Table 38 of the NGA Factors (assumed energy content of 34.2 GJ/kL for petrol and 38.6 GJ/kL for diesel)
Electricity Consumption	N/A	Table 5 of the NGA Factors.	N/A
Transport in 3rd Party Owned Vehicles	N/A	N/A	Table 38 of the NGA Factors (assumed energy content of 34.2 GJ/kL for petrol and 38.6 GJ/kL for diesel)

Note: N/A = Not applicable

2.1.3 Assumptions

The assessment is based upon the fuel consumption and waste data shown in **Table 3**, as provided by Veolia (for measured values).

Table 3 Greenhouse Gas Estimation Data Assumptions

Parameter	Measured Value (400,000 tonnes per annum)	Assumed Value (1,130,000 tonnes per annum)
Diesel consumption	554,657 litres	1,566,906 litres
Petrol consumption	13,238 litres	37,397 litres
Electricity consumption	1,181,140 kWh	3,336,721 kWh
Waste	400 ktpa	1.13 Mtpa
Methane capture rate	80%(v/v)	80%(v/v)

In addition to the assumptions listed in **Table 3**, further assumptions have been applied as follows:

- Assumed 10% oxidation of uncaptured methane at waste surface (in accordance with default figure provided in Appendix 4 of the NGA factors (DCC, 2009));
- Assumed train movement frequency of 4 per day (Sydney to Crisps Creek Intermodal Facility return x 2). Assumed distance of 240 km from Sydney to Crisps Creek via rail;
- Assumed truck movement frequency of 240 per day from Crisps Creek Intermodal Facility to the Woodlawn site return (assumed 60 containers per train x 2 trains per day). Assumed 10 km trip by road (one-way) from Crisps Creek to the Woodlawn site;
- Assumed fuel efficiency of 21 l/100km for trucks (assumed 300 horsepower engines); and,
- Assumed fuel efficiency of 0.064 l/tonne/km for rail freight (based on published US Class 1 Rail Freight data (Davis et al, 2009).

2.2 Emissions Estimation Results

Table 4 below provides a summary of the estimated greenhouse gas emissions from 1,130,000 tonnes per annum (tpa) waste, based upon the assumptions summarised in Table 3 and discussion in **Section 2.1**.

Table 4 Greenhouse Gas Emission Estimation

Scope	Parameter	Assumed Value (1,130,000 tpa)	Greenhouse Gas Estimation (t CO_2-e)
Scope 1	Diesel consumption	1,566,906 litres	4,228
	Petrol consumption	37,397 litres	89
	Methane combustion (80%)	1,130 ktpa	11,525
	Uncontrolled methane emissions (20%)	1,130 ktpa	226,000
	Oxidation of 10% of uncontrolled methane emissions	1,130 ktpa	2,260
	Subtotal		*244,102*
Scope 2	Electricity consumption	3,336,721 kWh	2,969
	Subtotal		*2,969*
Scope 3	Diesel consumption on site	1,566,906 litres	322
	Petrol consumption on site	37,397 litres	7
	Diesel consumption in trucks	177,828 litres	36
	Diesel consumption in Trains	7,084,800 litres	1,456
	Subtotal		*1,822*
TOTAL			**248,893**

These data are presented graphically in **Figure 1, Figure 2** and **Figure 3**.

Figure 1 Scope 1 Greenhouse Gas Emission Estimation (tonnes CO_2-e per annum)

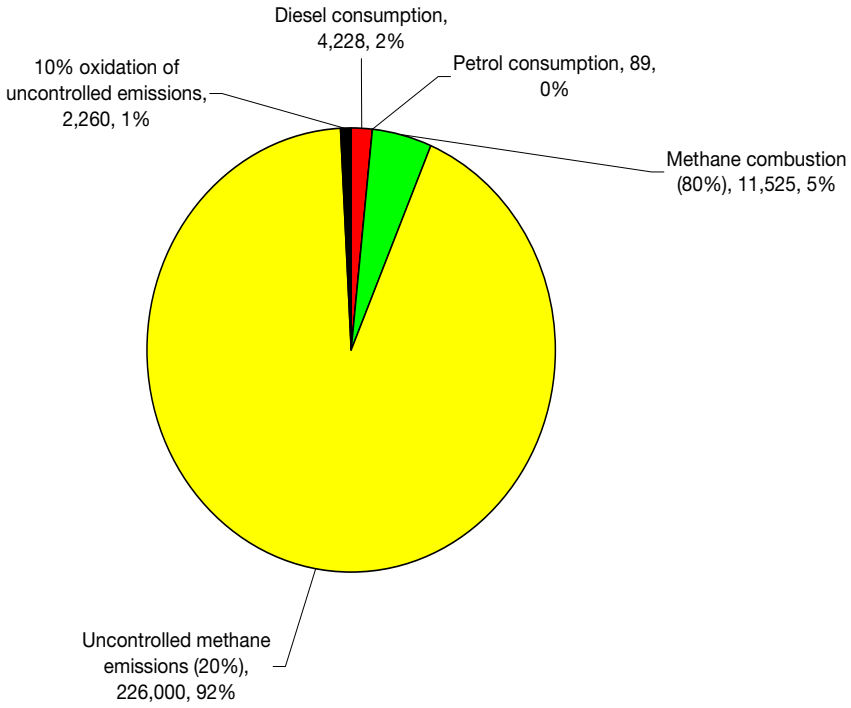


Figure 2 Scope 2 Greenhouse Gas Emission Estimation (tonnes CO_2-e per annum)

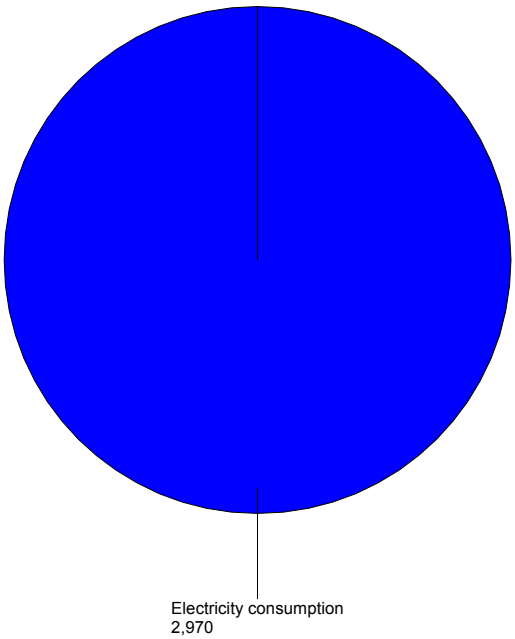
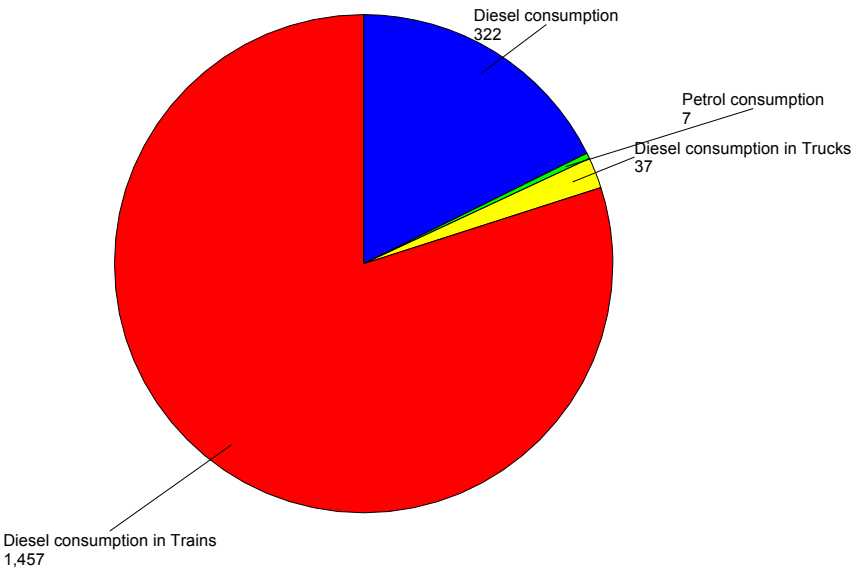


Figure 3 Scope 3 Greenhouse Gas Emission Estimation (tonnes CO_2-e per annum)



3 CONCLUSIONS

Based upon the assumptions indicated, the total CO_2-e emission from Scope 1 emissions is estimated to be 244 ktCO_2-e, which represents 98% of the total estimated emission of 249 ktCO_2-e.

The uncontrolled (or "fugitive") emission of methane from the waste represents approximately 92% of the total estimated emission. The impact of the combustion of approximately 80%(v/v) of the methane generated through the methanogenesis of the waste represents only 4.7% of the total estimated emission.

Scope 3 emissions are shown to represent approximately 0.7% of the total estimated emission from the Project.

The carbon intensity of the Scope 1, Scope 2 and Scope 3 emissions from the Woodlawn Expansion Project is estimated to be 0.22 ktCO_2-e/kt MSW (based upon 249 ktCO_2-e/1130 kt MSW).

It should be noted that in addition to the GHG emissions figures provided above, approximately 210,240 MWh of electricity will be generated as a result of disposal of 1,130,000 tpa of MSW in the year of maximum methane production at the Bioreactor.

As described in **Appendix B**, a theoretical model using first order decay principles (GasSimLite) has been used in order to assess the potential gas generation capacity of the site. This gives a modeled estimate only, as the actual generation of gas is extremely complex. Nevertheless the results can be used to estimate the energy generating capacity of the site, the gas yield from the site, and the time over which methane would be produced in the landfill. The year of modeled maximum gas generation (2036, 12,750 m^3/hr) is associated with a maximum electricity generation capacity of 24 MW per hour.

This renewable electricity represents a GHG offset of approximately 166,347 t CO2-e by replacing electricity generated from fossil fuels:

210,240 MWh = 756,864 GJ of energy (1 kWh = 3.6 MJ[1])

Emissions of CO_2-e if generated by coal combustion – ***187,114 t CO_2-e***
(210,240 MWh x 0.89 kg CO_2-e/kWh[2])

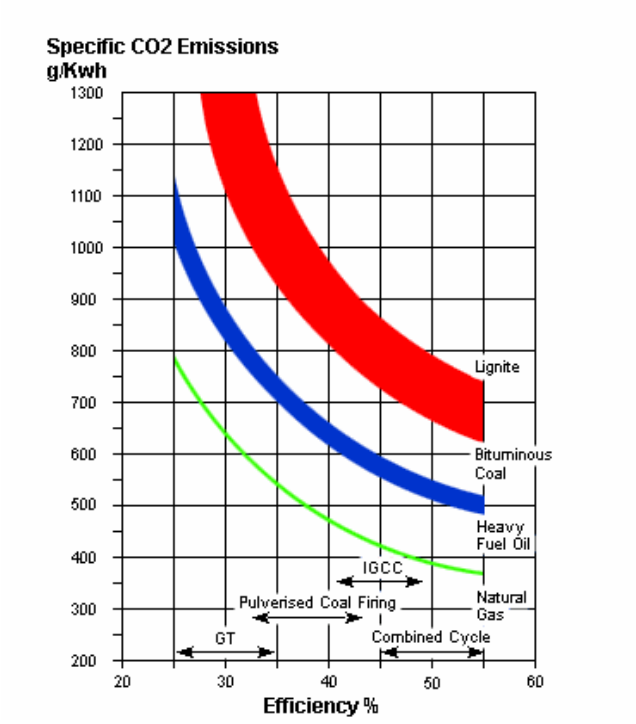
Emissions of CO_2-e if generated by landfill gas combustion – ***3,656 t CO_2-e***
(756,864 GJ x 4.83 kg CO_2-e/GJ[3])

Difference = 3,656 t CO2e – 187,114 t CO2e = **-183,458 tonnes CO_2-e**

Note 1: From Table 30 of the NGA Factors Workbook June 2009
Note 2: From Table 5 of the NGA Factors Workbook June 2009 (NSW and ACT). Scope 2 emission factors used as Scope 1 factors for black coal combustion are explicitly identified as not to be used for electricity generation .
Note 3: Sourced from Table 2 of the 2004 NGA Factors June 2009 (Landfill Biogas that is captured for combustion only)

Figure 4 below demonstrates the relative CO_2 efficiency of gas fired electricity when compared to coal fired electricity, for reference.

Figure 4 Specific CO_2 Emissions versus Combustion Process Efficiency



Taken from Zevenhoven and Kilpinen – Greenhouse Gases, Ozone Depleting Gases in Control of Pollutants in Flue Gases and Fuel Gases, Helsinki University of Technology, 2001

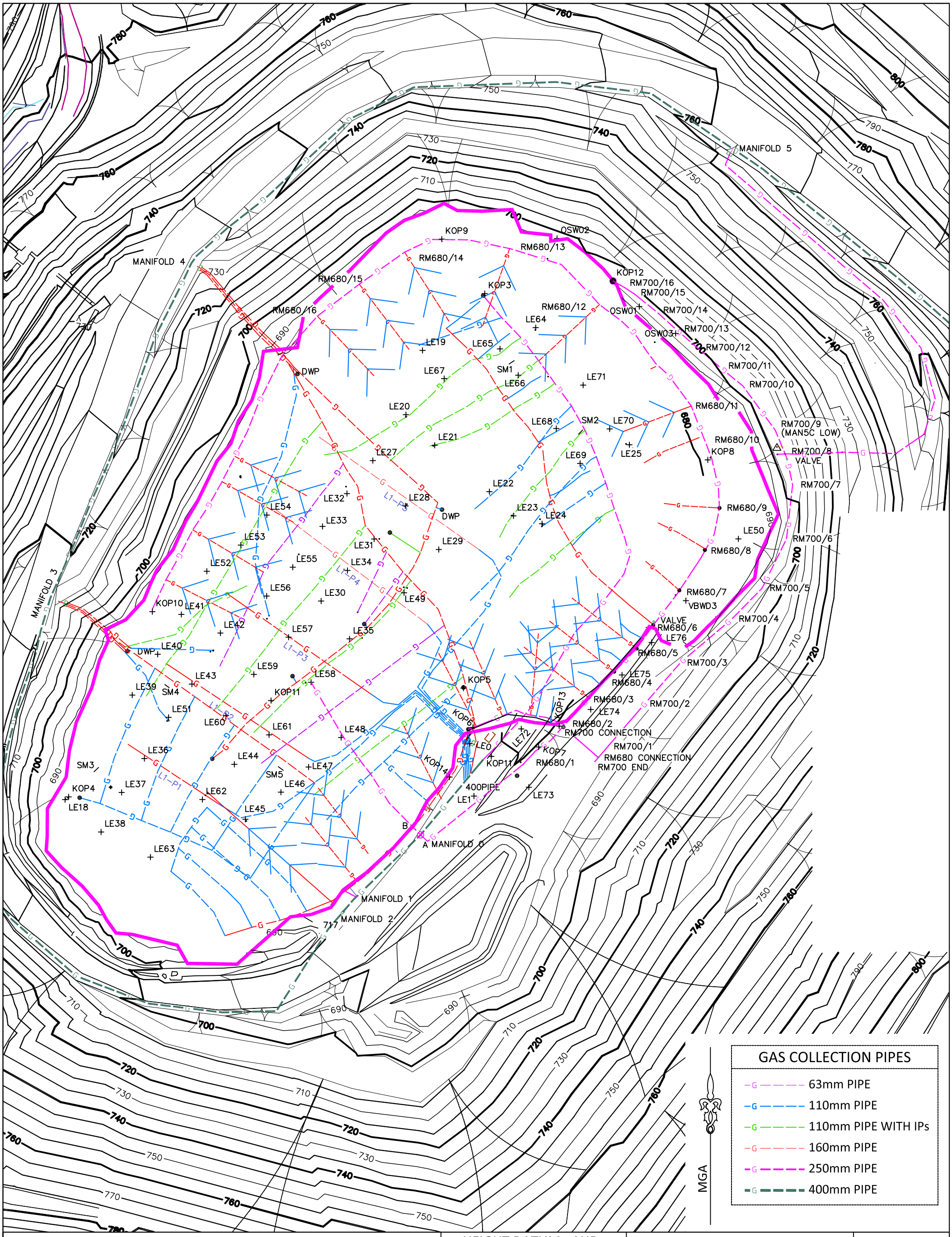
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Appendix A

Report 30-2464-R330-2464-R3



VEOLIA ENVIRONMENTAL SERVICES

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HEIGHT DATUM : AHD
CONTOUR INTERVAL : 5m

0 15 30 45 60
METRES

REDUCTION RATIO 1:1500

PLAN

WOODLAWN BIOREACTOR
GAS EXTRACTION
SYSTEM

SHEET No. 1

DRAWN:
S. McDonald

DATE: 02/07/10

Ref. No: 16700

Landfill Gas Generation at Woodlawn

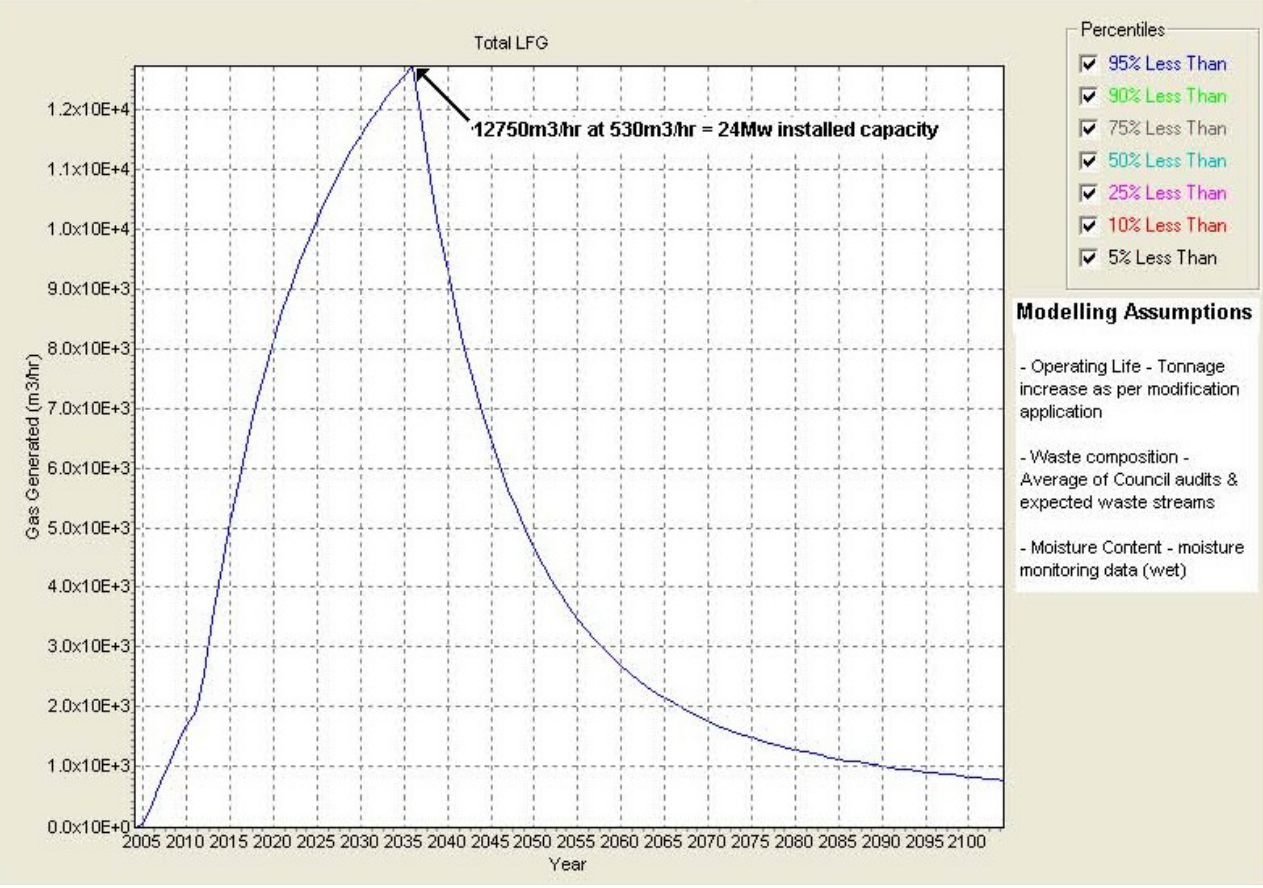
A theoretical model using first order decay principles (GasSimLite) has been used in order to assess the potential gas generation capacity of the site. This gives a modeled estimate only, as the actual generation of gas is extremely complex. Nevertheless the results can be used to estimate the energy generating capacity of the site, the gas yield from the site, and the time over which methane would be produced in the landfill. Methane generated at Woodlawn is utilised in landfill gas generation engines, or flared.

The results of the modelling are shown in **Figure B1** below. As can be seen methane gas production will likely continue for over a hundred years, and this will be utilized by gas to energy infrastructure to provide energy to the grid. The gas will tail off as indicated in **Figure B1**.

At a peak landfill gas (LFG) output of 12,750m3/hr as indicated by the model this would equate to approximately 24Mwh of capacity (at the close of the site). Woodlawn currently has 3Mw installed capacity, and provides this to Energy Australia under the 'Green Power' scheme. The facility is eligible to create Renewable Electricity Certificates (REC's) and New South Wales Greenhouse Abatement Certificates (NGACS).

Methane gas is captured in the extensive gas extraction network installed as waste is placed in the landfill (refer **Section 1.1**).

Figure B1 GasSimLite Model Output – Woodlawn Bioreactor



Methane Capture at Woodlawn

A major benefit of adopting Bioreactor principles to landfill operations is that methane is generated in economically viable concentrations early in the life of the landfill, thus justifying earlier harvesting for energy generation and avoiding emissions.

For Woodlawn Bioreactor electricity generation capacity was installed very early in the life of the facility (with active flaring from 7 months). This results in minimizing the emissions over the life of the facility because gas is collected as the site is filled rather than awaiting capping (as in the case of a conventional landfill).

One of the primary aims at Woodlawn is electricity generation, so in order to calculate the efficiency of the landfill gas extraction systems VES engaged the services of GHD Consultants to evaluate the emission of landfill gas from the surface of the Woodlawn Bioreactor, so that the proportion of gas that is collected by the gas extraction system could be assessed. The findings of this study are shown in **Appendix D**, the conclusions of which are repeated below.

Summary of Report Conclusions

GHD undertook closed flux chamber testing at Veolia Environmental Service's Woodlawn Bioreactor Landfill to evaluate the emission of landfill gas through the surface of the landfilled waste. The flux chamber testing was undertaken over a 2 day period and involved undertaking 17 flux tests over an area of 7,700m2 of the landfilled waste surface (which represented at that time approximately 20% of the current landfilled waste surface).

The results of the evaluation show that methane emissions through the surface of the landfilled waste were low and generally below the limit of the flux test method. If the results are extrapolated across the whole of the then current landfill surface, the total methane emission rate through the surface of the landfilled waste was less than 15.6m3/hr (or < 8.3% of the volume of methane being extracted via the active gas extraction system (188.5 m^3/hr)). Such a methane emission rate is equivalent to the rate of landfill gas generated by a small rural landfill receiving 5,000 tonnes of waste per year.

Consequently, it was concluded that methane emissions from the surface of the landfilled waste at the Woodlawn Bioreactor landfill were low (<0.3 g CH_4/m^2/hr, which is less than 8.3% of the methane being extracted at the site), and the low emissions can be attributed to the active extraction of landfill gas during the landfilling process and the occurrence of microbial methane oxidation in the upper layers of the landfilled waste.

Commentary on 80% figure quoted in Section 2.1

As it was noted that the evaluation presented in the report can only by its nature provide a snapshot and estimate of landfill gas emissions occurring at the site (17 flux tests over 7,700m2 of landfilled waste being approximately 20% of the landfill surface area), VES have discounted the >91.7% collection efficiency inferred here to a figure of 80%.

This is an approximation only and is of course subjective, but when compared to actual direct testing carried out by GHD in the report detailed above it indicates that this lower figure of 80% is likely to be significantly bettered in the field.

GHD Report

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Veolia Environmental Services

Report for Woodlawn Bioreactor

Gas Flux Testing

June 2007



INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

Contents

1. Introduction 1

2. Description of the Site 2

3. Description of Testing Undertaken 5

4. Results and Discussion 8

   4.1 Flux Testing 8

   4.2 Gas Profile Testing 11

   4.3 Climatic conditions during testing 12

5. Conclusions 13

6. References 15

Table Index

Table 1 Summary of flux testing results 8

Table 2 Summary of gas profile testing 11

Figure Index

Figure 1: Location of Woodlawn Bioreactor Landfill (source: Veolia Environmental Services) 2

Figure 2: Woodlawn Bioreactor Landfill void 3

Figure 3: Landfill surface to south of access road 5

Figure 4: Flux Testing Set Up 6

Appendices

A Drawings

B Field Test Results

C Flux Curves

D Results of GC Analysis

1. Introduction

Veolia Environmental Services (VES) operates the Woodlawn Bioreactor Landfill, which has now been in operation for a few years. The depth of landfilled waste at the site has reached approximately 40m and the waste is generating a significant quantity of landfill gas. A primary function of the bioreactor landfill operation is the capture of landfill gas, which is achieved by the progressive installation and operation of an active landfill gas collection system.

VES engaged GHD to evaluate the emission of landfill gas (methane and carbon dioxide) from the surface of the Woodlawn Bioreactor Landfill, so that the proportion of landfill gas that is captured by the gas extraction system could be assessed.

This report provides a brief description of the Woodlawn Bioreactor Landfill, a description of the testing undertaken to assess landfill gas emissions at the site, the results of the testing, and GHD's conclusions.

2. Description of the Site

The Woodlawn Bioreactor Landfill is located at the disused Woodlawn Mine site, near the township of Tarago, about 30 km south-west of Goulburn, NSW (see Figure 1).

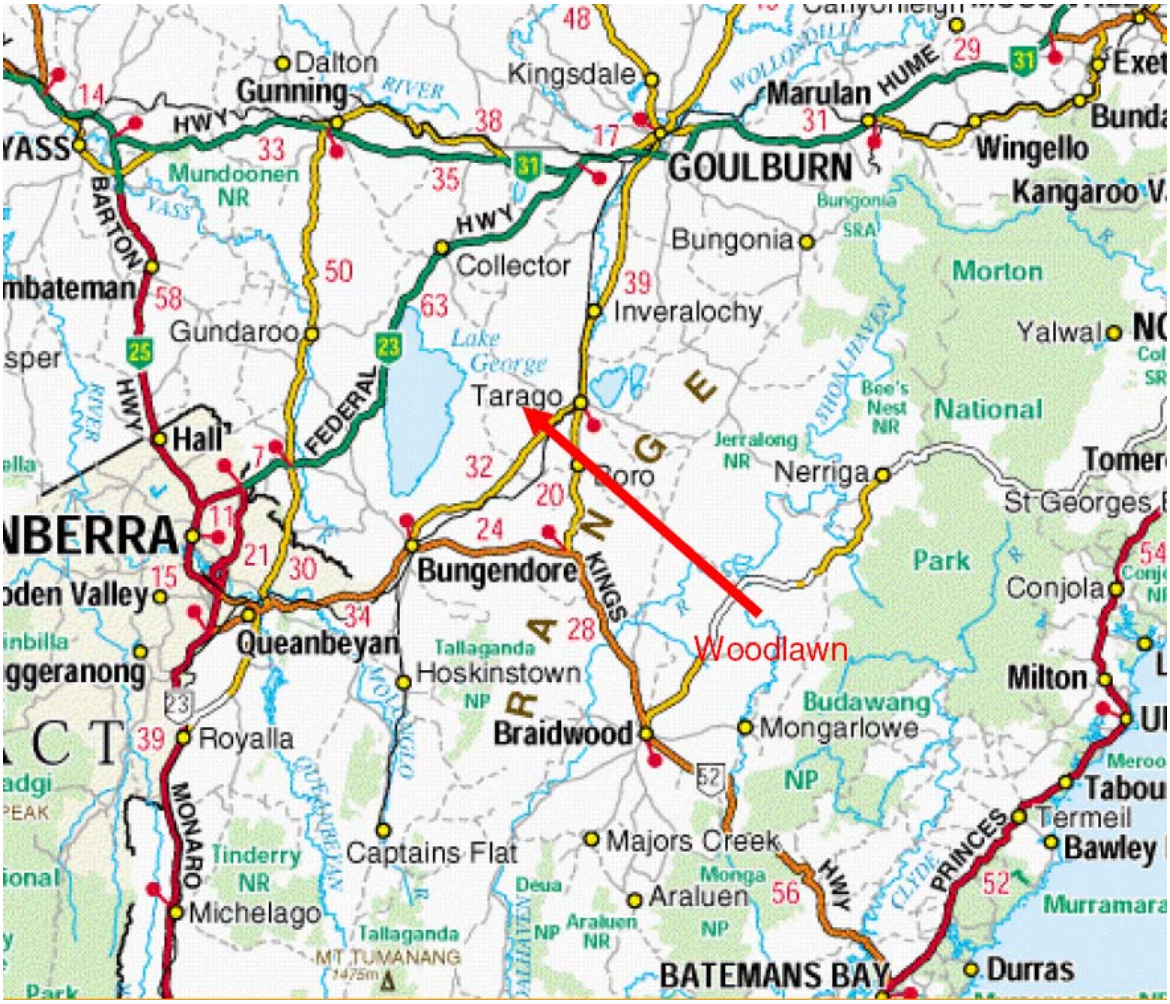


Figure 1: Location of Woodlawn Bioreactor Landfill
(source: Veolia Environmental Services)

In the latter stages of the life of the mine, the Cu/Pb/Zn mine site was operated by Denehurst Ltd, and was closed in 1998 when the company went into administration. VES now owns and operates the site as an engineered waste management facility, gas to energy facility, and working farm (Pylara).

The Woodlawn site occupies approximately 300 ha and the Bioreactor Landfill has been developed within the mine void on the site. The mine void is conical in shape and approximately 250m deep (from the lowest point on the rim of the void). The landfill capacity of the void is approximately 25 million cubic metres.

Landfilling operations commenced at the site in September 2004. VES transports up to 400,000 tonnes of domestic and commercial solid waste to the site per year (from the Sydney region). Waste is

transported by rail to the Crisps Creek intermodal facility, located approximately 8 km from the site, and the waste is then transferred to the site via truck. To date the site has accepted approximately 930,000 tonnes of solid waste and the level of waste is approximately 40 metres above the base of the former mine void. Figure 2 shows a recent photograph of the landfilling operation.



Figure 2: Woodlawn Bioreactor Landfill void

The Woodlawn Bioreactor Landfill differs from a conventional sanitary landfill in that microbiological processes within the landfilled waste are actively enhanced to accelerate biodegradation of the landfilled waste, which leads to the following benefits:

- More rapid stabilisation of the landfilled waste; and
- Increased landfill gas generation, which can be recovered for renewable energy generation.

The microbiological processes are enhanced by controlling moisture levels within the landfilled waste, which is achieved by recirculating nutrient rich leachate and by monitoring pH and temperature levels.

Leachate recirculation is carried out by direct application at the active face of the landfill via spraying, and by injection in other areas where necessary.

To maximise the capture of landfill gas (and minimise fugitive emissions) an active gas extraction system has been progressively installed and operated at the site as landfilling has occurred. The system comprises a combination of horizontal trenches, gravel drainage blankets, and vertical gas collections wells connected to an extraction system, landfill gas flare and energy generation system. Appendix A contains a plan that shows the current landfill gas extraction system.

Currently landfill gas is being flared, however, once sufficient landfill gas is being generated the gas will be used to generate electricity, which will be fed into the state power grid. VES envisage that up to 20 MW of electrical power will be generated at the site. In addition, a significant amount of waste heat will be available from the 20 generator sets and it is planned that this will be utilized in adjacent infrastructure.

3. Description of Testing Undertaken

To evaluate emissions from the surface of the landfilled waste flux testing was undertaken at 16 selected locations over the surface of the landfilled waste (see Appendix A) over 2 days (21 and 22 May 2007).

Figure 3 shows the area of the landfill surface tested to the south west of the access road.



Figure 3: Landfill surface to south of access road

The flux testing was undertaken using a 450 mm diameter 18.0L stainless steel flux chamber, a Geotechnical Instruments GA2000 landfill gas analyser, and a Omegaette HH306 Digital Thermometer / Data logger. The flux chamber was placed on the surface of the landfilled waste and sealed around the perimeter using soil. The set up of the equipment and instruments is shown in Figure 4. The composition and temperature of gas within the flux chamber was recorded every 30 seconds for 15 minutes. At selected locations a sample of the gas within the flux chamber was collected in 4 mL vacuettes. These samples were tested using a Perkin Elmer Autosystem Gas Chromatograph (GC), fitted with a thermal conductivity detector, to confirm the methane and carbon dioxide concentrations measured by the GA2000.

The limit of reading of the GA2000 landfill gas analyser is 0.1% methane and 0.1% carbon dioxide, and when used to calculate flux the lower limits of the flux testing method are 0.3g CH_4/m2/hr and 0.9g CO_2/m2/hr. It should be noted that flux testing using a closed chamber provides an indication only of the flux from the surface being tested as only a small proportion of the surface is tested. In this case flux testing was undertaken at selected locations 20 – 25 m apart across the surface of the landfill. In total 16 flux tests were undertaken over an area of approximately 7,700m^2, which represents approximately 22% of the current landfill surface (35,000m^2). This coverage (1 every 480m^2) was considered appropriate to provide a reasonable estimate of the flux from the surface of the landfilled waste. It should be noted that the spacing of the flux testing was generally consistent with the NSW EPA guidelines for testing surface emissions from a landfill capping layer i.e. testing on a 25m grid (1 every 625m^2).



Figure 4: Flux Testing Set Up

The climate during the flux testing was monitored using a Nielsen Kellerman Kestrel 4000 Pocket Weather Station, which measures and records atmospheric temperature, humidity, pressure and wind speed.

To provide an understanding of subsurface gas conditions at the site gas profile testing was undertaken using a gas sampling probe and the Geotechnical Instruments GA2000 landfill gas analyser. The gas sampling probe was driven into the landfilled waste and the composition of gas within the waste tested at various depths (up to 400 mm). A malfunction of the gas sampling probe limited the results to only 3 tests. However, the results of 3 tests provided an indication of the methane, carbon dioxide, oxygen, carbon monoxide and hydrogen sulphide concentrations in the upper layers of the landfilled waste.

The Geotechnical Instruments GA2000 landfill gas analyser was checked and calibrated prior to use by the equipment provider (Enviroequip) and the instrument calibration was checked at the start of each day of testing and at the end of each day of testing using a range of calibration gas mixtures:

- Calgaz 1: 50.0 % methane (v/v), 50.0% nitrogen (v/v);
- Calgaz 2: 10.0% carbon dioxide (v/v), 12.0% oxygen (v/v), 78.0% nitrogen (v/v); and
- Calgaz 3: 0.5% methane (v/v), 99.5% air (v/v)

During the calibration checks the GA2000 readings were found to be within 5% of the calibration gas values for all tests.

During flux testing the landfill gas extraction system at the site was operating (except during tests 1, 2 and 3 when the system “tripped out”). According to information from the Haase flare records provided to GHD by VES the rate of landfill gas extraction during the flux testing was 325 m3/hr and the composition of the landfill gas being extracted was 58.0% methane (v/v), 38.0% carbon dioxide (v/v), and 5.2% oxygen (v/v). It is noted that the landfill gas components add up to 101.2%, which is normal and within the limit of accuracy of the instrument (typically +/- 5 %)

It is noted that if the landfill gas currently being extracted and flared was not being collected the emission rates through the surface of the landfilled waste would be 3.7 g $CH_4/m^2/hr$ and 6.6 g $CO_2/m^2/hr$ (assuming minor/nil landfill gas emissions through the base and sides of the landfill), which are significantly greater than the lower limits of the flux test method (0.3 g CH_4/m2/hr and 0.9 g $CO_2/m^2/hr$) and therefore the flux test method is sufficiently sensitive to detect significant emissions of landfill gas from the surface of the landfilled waste.

4. Results and Discussion

4.1 Flux Testing

The results of the methane and carbon dioxide flux testing are summarised in Table 1 (see Appendix A for the location of the testing). The flux results are presented as grams of methane and carbon dioxide per square meter of the landfill surface per hour. Copies of the field results are provided in Appendix B and copies of the flux curves (used to calculate the flux) are provided in Appendix C.

Table 1 Summary of flux testing results

Location	Methane Flux ($g/m^2/hr$)	Carbon Dioxide Flux ($g/m^2/hr$)
1[1]	< 0.3	16.8
2[1,2]	0.15	6.3
3[1,2]	0.15	6.8
4	< 0.3	4.6
5[2]	0.46	6.3
6	< 0.3	7.3
7	< 0.3	8.5
8	< 0.3	25.6
9	< 0.3	25.8
9b	< 0.3	6.5
10	< 0.3	4.3
11	< 0.3	24.7
12	< 0.3	< 0.9
13	< 0.3	8.4
14[2]	0.26	25.3
15	< 0.3	12.8
16	< 0.3	25.7
Maximum	0.46	25.8
Average	-	13.5
Minimum	<0.3	<0.9
Std Deviation	-	8.9

1. Landfill gas extraction system was not operating.
2. Results confirmed by GC analysis of flux gas sample

The results of the GC analysis are provided in Appendix D. The results generally correspond well to the field readings and confirm the field readings. It is noted that the field methane reading at location 14 did flicker to 0.1% v/v during the testing.

From the results in Table 1 it can be seen that the flux of methane from the surface of the landfilled waste is low and generally <0.3 g CH_4 /m^2/hr, whilst the flux of carbon dioxide varied from <0.9 to 25.8 g CO_2/m^2/hr (average 13.5 g CO_2/m^2/hr). It is noted that emissions from the landfilled waste were not noticeably different during flux tests 1, 2, and 3 when the landfill gas extraction system was not operating. This is not surprising given the short period of time the flare was off (several hours).

Extrapolating the flux testing results to the full surface of the landfilled waste (approximately 35,000m^2 at the time of the flux testing) gives the following total emissions:

- Methane: <10.5 kg/hr (~ <15.6 m^3/hr)
- Carbon dioxide: 475 kg/hr (~ 255 m^3/hr)

From the gas extraction system data the quantities of landfill gas being extracted were:

- Methane: 188.5 m^3/hr
- Carbon dioxide: 123.5 m^3/hr
- Oxygen: 16.9 m^3/hr

Comparing the flux estimates with the gas extraction data indicates that methane emissions from the surface of the landfilled waste were less than 8.3% of the volume of methane being extracted via the landfill gas extraction system.

Interestingly and in contrast, the volume of carbon dioxide being emitted through the surface of the landfilled waste is significantly greater than the volume of carbon dioxide being extracted via the landfill gas extraction system (255 m^3/hr compared to 123.5 m^3/hr). There are several possible explanations for this:

- Carbon dioxide is being generated in the upper layers of the landfilled waste via aerobic degradation of the landfilled waste;
- Methane is being microbially oxidised in the upper layers of the landfilled waste, generating carbon dioxide;
- A combination of the above

Aerobic degradation of waste within the upper layers of the landfill is possible and likely as conditions within the upper layers are suitable i.e. there is readily biodegradable waste present, there is oxygen (see results of gas profile testing below) and the waste is moist (from leachate recirculation). From published data typical rates of carbon dioxide production during aerobic decomposition of solid waste range from 2 to 20 g CO_2/kg of volatile solids/day. Considering the age of the waste over which the flux testing occurred (>2-3 months) and assuming a carbon dioxide generation rate of 5 g CO_2/kg of volatile solids / day, a 0.25m layer of waste (containing 25% volatile solids) undergoing aerobic degradation would generate approximately 450 kg CO_2/hr, which is comparable to the flux measured at the site. Thus aerobic decomposition of the upper waste layer could explain the measured carbon dioxide flux.

The University of NSW and GHD (2006) have been investigating microbial methane oxidation in biofilters treating landfill gas over the past 3 years, and have measured microbial methane oxidation rates of up to 8 g/m^2/hr in biofilters made from composted garden organics, and in more recent trials up to 15 g

$CH_4/m^2/hr$ (data yet to be published). The microbial methane oxidation process is dependent on a number of factors including the presence of methane, oxygen, moisture, and nutrients in an environment suitable for growth of the methanotrophs. Considering the situation at the Woodlawn Bioreactor landfill, the upper layers of the landfilled waste would likely provide an environment suitable for microbial methane oxidation:

- Both methane and oxygen are present. The gas profile testing undertaken at the site indicates the presence of methane and the penetration of atmospheric gases including oxygen beyond 400 mm depth in the waste (see below);
- The landfilled waste is kept moist via recirculation of leachate; and
- The waste contains a high level of organic matter and other materials, which would help to maintain moisture levels and provide other necessary nutrients.

In addition, the landfilled waste under the areas tested was 2 – 3 months old, which is considered to be sufficient time for methanotrophs to establish themselves.

Thus microbial oxidation of methane in the upper layers of the landfilled waste is certainly possible. It is worth noting that a microbial methane oxidation rate of 4g $CH_4/m^2/hr$ across the surface of the current landfill surface, which is well below those measured by UNSW and GHD (2006) and therefore possible, would result in a carbon dioxide generation rate of 75 – 135 m^3/hr. When combined with the fugitive carbon dioxide emissions (associated with the 4g $CH_4/m^2/hr$ being oxidised) the total carbon dioxide flux from the surface of the landfilled waste would be 240 m^3/hr, which is comparable with the measured carbon dioxide flux (255 m^3/hr). Thus microbial methane oxidation can explain the measured flux of methane and carbon dioxide from the surface of the landfilled waste.

A common indicator used to identify the occurrence and degree of methane oxidation in a landfill cover layer or landfill gas biofilter is the ratio of methane to carbon dioxide. If the methane / carbon dioxide ratio in gas being emitted from a landfill cover layer (or landfill gas biofilter) is lower than that of the raw landfill gas then it indicates that the proportion of methane in the gas has reduced, or the proportion of carbon dioxide has increased, or both. At the Woodlawn Bioreactor Landfill, the ratio of the methane flux to carbon dioxide flux is 0.06 (on a volumetric basis), which is significantly lower than the ratio of methane to carbon dioxide in the raw landfill gas (1.5). This reduction in the methane / carbon dioxide ratio indicates the following

- Carbon dioxide is being generated in the upper layers of the landfilled waste via aerobic degradation of the landfilled waste; or
- Methane is being microbially oxidised in the upper layers of the landfilled waste, generating carbon dioxide; or
- A combination of the above

Considering the conditions within the upper layer of the landfilled waste at the Woodlawn Bioreactor Landfill it is likely that both aerobic degradation of the landfilled waste and microbial methane oxidation are occurring, however, the level of each process cannot be determined from the data collected. The occurrence of methane oxidation could be confirmed by collecting samples from the upper layers of the landfilled waste and undertaking either DNA extraction and analysis for methanotrophs, or by undertaking methane oxidation batch testing on the samples.

4.2 Gas Profile Testing

The results of the 3 gas profile tests are presented in Table 2.

Table 2 Summary of gas profile testing

Depth	Methane (% v/v)	Carbon Dioxide (% v/v)	Oxygen (% v/v)	Balance (Nitrogen) (% v/v)
Location 1				
0	0.0	0.2	20.6	79.2
200	1.4	16.0	9.7	72.9
300	2.3	21.9	4.7	71.1
400	6.2	22.4	4.6	66.8
Location 2				
0	0.1	0.2	20.6	79.1
200	1.8	14.0	9.0	75.2
300	1.2	26.3	1.5	71.0
Location 3				
0	0.1	0.2	20.4	79.3
200	5.3	37.0	1.0	56.7
300	10.0	48.5	0.6	40.9

From the results in Table 2 it can be seen that the concentrations of methane in the upper layers of the landfilled waste are quite low (1.2 – 10.0% v/v), whilst the carbon dioxide levels are much higher (14.0 – 48.5% v/v). The low methane concentrations (compared to carbon dioxide) are consistent with the flux testing results, but are not consistent with the high levels of methane in the raw landfill gas (58% v/v) compared to carbon dioxide (38% v/v).

The ratio of methane to carbon dioxide in the landfill gas in the upper layers of the landfilled waste ranged from 0.05 to 0.28, which is substantially lower than the ratio of methane to carbon dioxide in the raw landfill gas (1.5, as measured in the gas extraction system). The methane to carbon dioxide ratio also generally shows a declining trend as the landfill gas rises to the surface of the landfilled waste. These results indicate the following:

- Carbon dioxide is being generated in the upper layers of the landfilled waste via aerobic degradation of the landfilled waste; or

- Methane is being microbially oxidised in the upper layers of the landfilled waste, generating carbon dioxide; or
- A combination of the above

As discussed above the conditions within the upper layers of the landfilled waste are suitable for both aerobic degradation of the landfilled waste and for microbial methane oxidation and it is considered that likely that both these processes would be occurring.

The results of the gas profile testing also showed high levels of balance gas (nitrogen) in the upper layers of the landfilled waste, indicating penetration of atmospheric gas (including oxygen) into the landfilled waste.

4.3 Climatic conditions during testing

The climatic conditions during testing are summarised below:

Parameter	Minimum	Average	Maximum
Atmospheric Temperature (°C)	7.8	11.6	17.5
Atmospheric Pressure (hPa)	932.8	934.8	936.8
Wind speed (ms^{-1})	-	1.6	6.7

Details of the climate during each test are recorded with the field data in Appendix B.

Six (6) mm of rainfall occurred overnight on Monday night.

From the climate data the following observations are made:

- The atmospheric temperature ranged from cold to cool;
- The atmospheric pressure was relatively steady over the 2 days of testing;
- It was quite windy. However, good sealing of the flux chamber prevented the wind having an adverse impact on the flux testing (as evidenced by the stable gas readings within the flux chamber).

5. Conclusions

GHD undertook closed flux chamber testing at Veolia Environmental Service's Woodlawn Bioreactor Landfill to evaluate the emission of landfill gas through the surface of the landfilled waste. The flux chamber testing was undertaken over a 2 day period and involved undertaking 17 flux tests over an area of 7,700m2 of the landfilled waste surface (which represents approximately 20% of the current landfilled waste surface).

The results of the evaluation show that methane emissions through the surface of the landfilled waste were low and generally below the limit of the flux test method (0.3 g $CH_4/m^2/hr$). If the results are extrapolated across the whole of the current landfill surface, the total methane emission rate through the surface of the landfilled waste is less than $15.6m^3/hr$ (or < 8.3% of the volume of methane being extracted via the active gas extraction system (188.5 m3/hr)). Such a methane emission rate is equivalent to the rate of landfill gas generated by a small rural landfill receiving 5,000 tonnes of waste per year.

The flux of carbon dioxide from the surface of the landfilled waste varied and was greater than the methane flux (range: <0.9 – 26 g $CO_2/m^2/hr$, average: 13.5 $CO_2/m^2/hr$). If these results are extrapolated across the total surface of the landfilled waste, the emission of carbon dioxide equates to approximately 255m3/hr, which is greater than the quantity of carbon dioxide being extracted via the landfill gas extraction system (123.5m3/hr).

The difference in the methane and carbon dioxide flux rates and the substantial difference (reduction) in the methane / carbon dioxide ratio of the gas being emitted (0/06) compared to the raw landfill gas (1.5) indicates the following:

- Carbon dioxide is being generated in the upper layers of the landfilled waste via aerobic degradation of the landfilled waste; or
- Methane is being microbially oxidised in the upper layers of the landfilled waste, generating carbon dioxide; or
- A combination of the above

The results of gas profile testing (within the upper layers of the landfilled waste) confirm the reduction in the methane / carbon dioxide ratio in the landfill gas being emitted from the surface of the landfilled waste, and consequently also indicate the above processes are occurring.

An evaluation of both aerobic waste degradation and microbial methane oxidation indicates that conditions within the upper layers of the landfilled waste are suitable for both processes to occur and can explain the measured methane and carbon dioxide fluxes. The level of aerobic waste degradation and microbial methane oxidation occurring cannot be determined from the data collected during this study, however, it is considered likely that both processes are occurring in the upper layers of the landfilled waste.

Consequently, it is concluded that methane emissions from the surface of the landfilled waste at the Woodlawn Bioreactor landfill are low (<0.3 g $CH_4/m^2/hr$, which is less than 8.3% of the methane being extracted at the site), and the low emissions can be attributed to the active extraction of landfill gas during the landfilling process and the occurrence of microbial methane oxidation in the upper layers of the landfilled waste.

It should be noted that the evaluation presented in this report provides only a snapshot and an estimate of the landfill gas flux occurring at the site. The flux testing was undertaken over a 2 day period only and involved conducting 17 flux tests over 7,700m^2 of landfilled waste, which represented approximately 20% of the landfill surface area.

6. References

Tchobanoglous G, Thiesen H, Vigil S, 1993. Integrated Solid Waste Management: Engineering Principles and Management Issues, McGraw-Hill Inc

University of New South Wales and GHD Pty Ltd, 2006. Passive Drainage and Biofiltration of Landfill Gas using Recycled Materials. Project Report for the Department of Environment and Conservation, Sustainability Programs Division.

Appendix A

Drawings

MANIFOLD 4
MANIFOLD 3
MANIFOLD 2
MANIFOLD 1
KOP3
(KNOCK OUT POT 3)
DWP
DWP
DWP
(DEWATERING POT)
DWP
DWP
LE6
LE11
LE12
LE5
LE10
L1–P5
LDW7
LE9
L1–P4
LE4
LE3
LE17
LDW5
LE13
LE8
L1–P3
LDW3
LE7
L1–P2
LE2
LE16
LE14
LDW1
LE1A
L1–P1
LE15
MAN3BW3
MAN3BW2
MAN3BW1
730
720
700
690
680
670
710
MGA

GAS COLLECTION PIPES

- 110mm PIPE
- 110mm PIPE WITH IPs
- 160mm PIPE
- 250mm PIPE
- 400mm PIPE

VEOLIA
ENVIRONMENTAL SERVICES

Kells
Land Development Solutions

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36 Montague Street
PO Box 1040
GOULBURN NSW 2580
Ph: (02) 4821 1033
Fax: (02) 4821 7258

BRAIDWOOD
5 Village Terrace
Lascelles Street
BRAIDWOOD NSW 2622
Ph: (02) 4842 2456
Fax: (02) 4842 1994

Email: office@kellsurveyors.com.au

HEIGHT DATUM : AHD
CONTOUR INTERVAL : 5m

0 10 20 30 40
METRES

REDUCTION RATIO 1:1000

PLAN

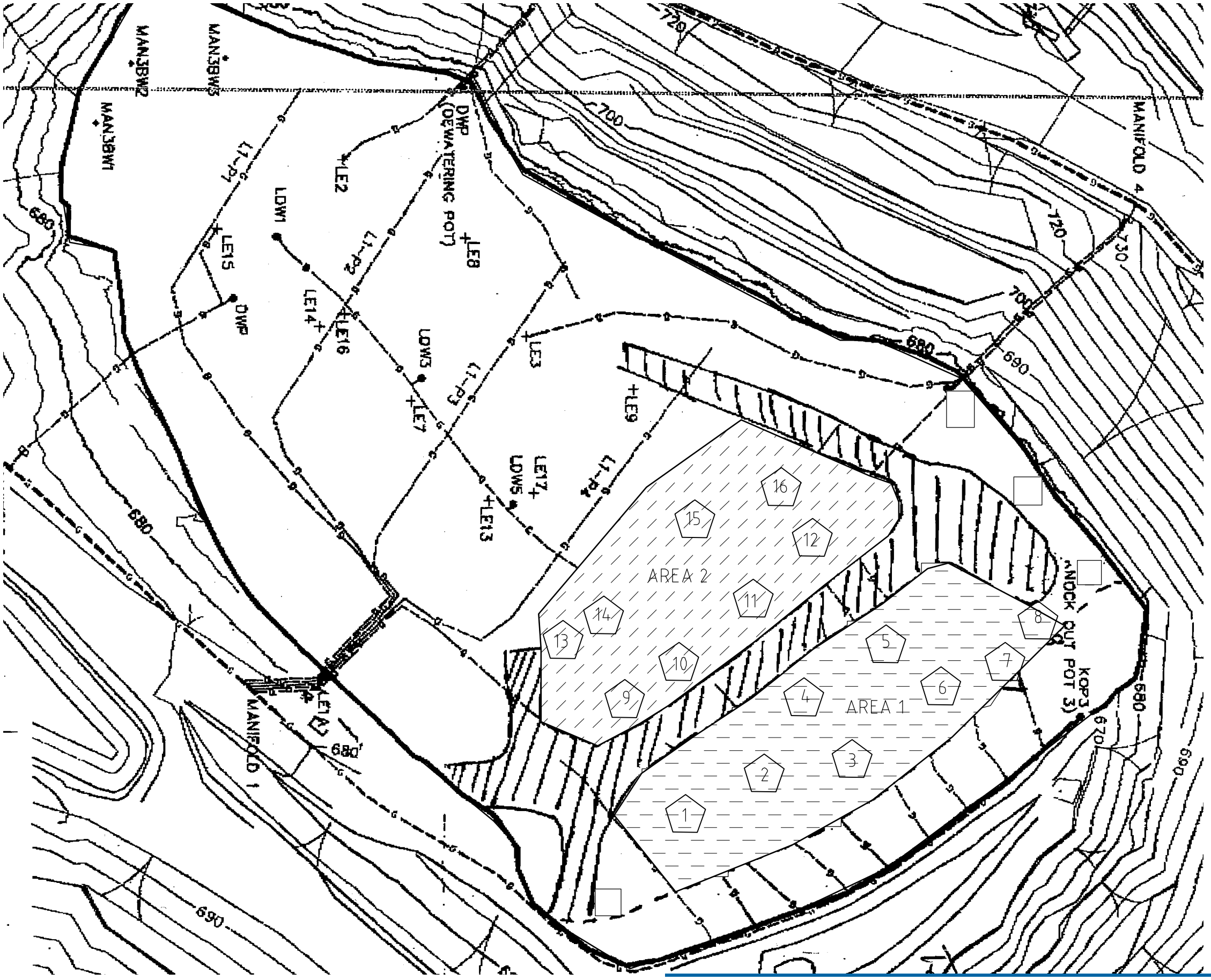
WOODLAWN BIOREACTOR GAS EXTRACTION SYSTEM

SHEET No. 1

DRAWN: B. RAWLINSON

DATE: 22/1/07

Ref. No: 16700



GHD CLIENTS | PEOPLE | PERFORMANCE

VEOLIA ENVIRONMENTAL SERVICES
WOODLAWN BIOREACTOR
GAS FLUX TESTING
LOCATIONS & SITE MAP
scale | NTS for A3 date | MAY 2007

job no. | 21-15916
rev no. | A

Figure 01

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Appendix B

Field Test Results

Flux Testing

Client: Veolia
Site: Woodlawn
Date: 21/5/07 & 22/5/07

Undertaken by: S. Dever / A. Roberts

Flux chamber details: 450mm – 18.0L

Weather:
21/5, 12.45pm Fine. Cool. Scattered cloud
22/5, 10.00. Cold. scattered cloud. ~~Rain~~ Rain overnight (6mm)

General notes:

1. Check GA2000 calibration: @ 12.45pm.
Calgas ③ CH_4 = 0.5 ✓ (0.5) ✓
CO_2 = 0.0 ✓
O_2 = 21.3 ✓
H_2S = 0.0 ✓
CO = 0. ✓

2. Check GA2000 calibration @ ~~5~~ pump
Calgas ③ CH_4 = 0.5 ✓ 0.5%.
CO_2 = 0.0 ✓
O_2 = 21.6 ✓
H_2S = 0.0
CO = 0

3. Flare / gas extraction system not on until after ~~test #3~~ ie from ~2-30pm

4. Flare / gas extraction system, sunny all day on 22/5/07

Attachments

22/5/07

Check calibration of GA 2000 – 9.35am

Calgas ① CH_4 = 49.4% (50.0) CO_2 = 0.0 O_2 = 0.1% (0.0)

Atmosphere Rdg: CH_4 = 0.0, CO_2 = 0.2, O_2 = 20.5, H_2S = 0, CO = 0

Calgas ② CH_4 = 0.4 / 0.2% (0.0) O_2 = 11.8 (12.0)

CO_2 = 10.8% (10.0)

All OK.

CHECK CALIBRATION OF GA2000 – 10.40 am.

Calgas ③ CH_4 = 0.05 (0.05) CO_2 = 0.1 O_2 = 21.1

Flux Testing

Client: Veolia
Site: Woodlawn
Date: 21/5/07 – 12.55pm.
Location / test: (1)

Climatic conditions:	Min.	Avg.	Max
Temperature (oC)	13.5	13.9	14.7
Humidity (%)	49.8	51.3	54.6
Atm. Pressure (hPa)	933.8	934.0	934.3
Wind speed (m/s)		1.1	3.8

Time (min)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	Comment
0.00	14.8	0.0	0.1	21.0	0	
0.50	14.7	0.0	0.1	21.0	0	
1.00	15.0	0.0	0.2	21.0	0	
1.50	15.3	0.0	0.3	20.9	0	
2.00	15.7	0.0	0.3	20.7	0	
2.50	16.0	0.0	0.3	20.6	0	
3.00	16.5	0.0	0.4	20.7	0	
3.50	16.7	0.0	0.4	20.5	0	
4.00	17.0	0.0	0.4	20.4	0	
4.50	17.2	0.0	0.5	20.5	0	
5.00	17.4	0.0	0.5	20.4	0	
5.50	17.7	0.0	0.5	20.3	0	
6.00	17.8	0.0	0.5	20.4	0	
6.50	18.0	0.0	0.5	20.3	0	
7.00	18.1	0.0	0.6	20.3	0	
7.50	18.2	0.0	0.6	20.2	0	
8.00	18.3	0.0	0.6	20.2	0	
8.50	18.4	0.0	0.6	20.1	0	
9.00	18.6	0.0	0.7	20.1	0	
9.50	18.7	0.0	0.7	20.0	0	
10.00	18.7	0.0	0.7	20.0	0	
10.50		0.0				
11.00						
11.50						
12.00						
12.50						
13.00						
13.50						
14.00	19.1	0.0	0.9	19.6	0	
14.50	19.2	0.0	0.9	19.6	0	
15.00	19.2	0.0	1.0	19.6	0	

Notes:

Flux Testing

Client:
Site:
Date: 29/5/07 ~1.25pm.
Location / test: (2)

Climatic conditions:	Min.	Avg.	Max
Temperature (oC)			
Humidity (%)			
Atm. Pressure (hPa)			
Wind speed (m/s)			

Time (min)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	Comment
0.00	14.8	0.0	0.1	21.1	0	
0.50	14.7	0.0	0.1	21.0	0	
1.00	14.6	0.0	0.1	20.9	0	
1.50	14.6	0.0	0.1	21.0	0	
2.00	14.6	0.0	0.2	20.9	0	
2.50	14.7	0.0	0.2	21.1	0	
3.00	14.9	0.0	0.2	20.9	0	
3.50	14.9	0.0	0.3	20.9	0	
4.00	15.0	0.0	0.3	20.8	0	
4.50	15.0	0.0	0.3	20.9	0	
5.00	15.1	0.0	0.3	20.8	0	
5.50	15.1	0.0	0.3	20.8	0	
6.00	15.2	0.0	0.4	20.7	0	
6.50	15.2	0.0	0.4	20.6	0	
7.00	15.2	0.0	0.4	20.6	0	
7.50	15.3	0.0	0.4	20.6	0	
8.00	15.4	0.0	0.4	20.6	0	
8.50	15.6	0.0	0.4	20.5	0	
9.00	15.7	0.0	0.4	20.6	0	
9.50	15.9	0.0	0.4	20.5	0	
10.00	16.0	0.0	0.5	20.4	0	
10.50						
11.00						
11.50						
12.00						
12.50						
13.00						
13.50						
14.00	17.0	0.0	0.5	20.3	0	
14.50	17.0	0.0	0.5	20.3	0	
15.00	17.0	0.0	0.5	20.4	0	

Notes:

Flux Testing

Client:
Site:
Date: 21/5/07 – 1.50pm.
Location / test: (3)

Climatic conditions:	Min.	Avg.	Max
Temperature (oC)	13.3	14.5	16.7
Humidity (%)	46.9	50.9	54.6
Atm. Pressure (hPa)	933.2	933.7	934.3
Wind speed (m/s)		–	–

– @ 2-35pm.

Time (min)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	Comment
0.00	–	0.0	0.1	21.1	0	
0.50	18.4	0.0	0.1	21.2	0	
1.00	18.4	0.0	0.1	21.2	0	
1.50	18.4	0.0	0.1	21.1	0	
2.00	18.4	0.0	0.2	21.1	0	
2.50	18.5	0.0	0.2	21.0	0	
3.00	18.7	0.0	0.2	21.0	0	
3.50	18.7	0.0	0.2	21.1	0	
4.00	18.9	0.0	0.3	21.0	0	
4.50	18.9	0.0	0.3	20.8	0	
5.00	19.0	0.0	0.3	20.8	0	
5.50	19.0	0.0	0.4	20.7	0	
6.00	19.0	0.0	0.4	20.7	0	
6.50	19.1	0.0	0.4	20.7	0	
7.00	19.1	0.0	0.4	20.6	0	
7.50	19.1	0.0	0.4	20.7	0	
8.00	19.1	0.0	0.4	20.7	0	
8.50	19.1	0.0	0.4	20.6	0	
9.00	19.1	0.0	0.5	20.6	0	
9.50	19.1	0.0	0.5	20.5	0	
10.00	19.2	0.0	0.5	20.6	0	
10.50						
11.00						
11.50						
12.00						
12.50						
13.00						
13.50						
14.00	19.2	0.0	0.5	20.5	0	CH4 – Flickered on 0.1
14.50	19.3	0.0	0.5	20.6	0	CO=1
15.00	19.4	0.0	0.5	20.7	0	CH4= Flickered 0.1

Notes:

Flux Testing

Client:
Site:
Date: 21/5/07 – 2.45pm
Location / test: (4)

Climatic conditions:	Min.	Avg.	Max
Temperature (oC)	12.9	13.6	15.7
Humidity (%)	46.6	52.2	57.6
Atm. Pressure (hPa)	933.2	933.4	934.1
Wind speed (m/s)		2.1	6.7

@ 3.15pm

Time (min)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	Comment
0.00	–	0.0	0.1	21.3	0	
0.50	14.5	0.0	0.2	21.3	0	
1.00	14.5	0.0	0.2	21.3	0	
1.50	14.5	0.0	0.2	21.3	0	
2.00	14.5	0.0	0.2	21.3	0	
2.50	14.5	0.0	0.2	21.3	0	
3.00	14.5	0.0	0.3	21.1	0	
3.50	14.5	0.0	0.3	21.3	0	
4.00	14.5	0.0	0.3	21.2	0	
4.50	14.6	0.0	0.3	21.1	0	
5.00	14.6	0.0	0.3	21.1	0	
5.50	14.6	0.0	0.3	21.1	0	
6.00	14.7	0.0	0.4	21.1	0	
6.50	14.7	0.0	0.4	21.1	0	
7.00	14.8	0.0	0.4	21.0	0	
7.50	14.8	0.0	0.4	20.9	0	
8.00	14.9	0.0	0.4	21.0	0	
8.50	14.9	0.0/0.0	0.4	21.0	0	Flicker to 0.1 CH4
9.00	14.9	0.0	0.4	20.9	0	
9.50	15.0	0.0	0.4	20.9	0	
10.00	15.0	0.0	0.4	20.8	0	
10.50						
11.00						
11.50						
12.00						
12.50						
13.00						
13.50						
14.00	15.3	0.0	0.5	20.7	0	Flicker to 0.1 CH4
14.50	15.3	0.0/0.1	0.5	20.8	0	
15.00	15.3	0.0	0.5	20.7	0	

Notes:

LFG flare – now on. Not on for ~~Art~~ 3 ~~tests~~.

Flux Testing

Client: Veolia
Site: Woodlawn
Date: 21/5/07
Location / test: (5)

Climatic conditions:	Min.	Avg.	Max
Temperature (oC)	12.7	13.2	15.7
Humidity (%)	46.6	55.7	61.7
Atm. Pressure (hPa)	933.2	933.3	934.1
Wind speed (m/s)		0.7	3.0

— @ 3.45pm

Time (min)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	Comment
0.00	13.9	0.0	0.1	21.3	0	
0.50	13.7	0.0	0.1	21.4	0	
1.00	13.8	0.0	0.1	21.4	0	
1.50	14.0	0.0	0.1	21.3	0	
2.00	14.1	0.0	0.2	21.3	0	
2.50	14.3	0.0	0.2	21.3	0	
3.00	14.5	0.0	0.2	21.3	0	CO = 2
3.50	14.7	0.0	0.3	21.2	0	CO = 3
4.00	14.7	0.0	0.3	21.1	0	"
4.50	15.0	0.0	0.3	21.2	0	CO = 5
5.00	15.1	0.0	0.3	21.1	0	CO = 7
5.50	15.2	0.0	0.3	21.0	0	CO = 8
6.00	15.4	0.0	0.4	21.0	0	"
6.50	15.5	0.0	0.4	21.0	0	CO = 7
7.00	15.6	0.0	0.4	20.9	0	"
7.50	15.7	0.0	0.4	20.9	0	CO = 8
8.00	15.8	0.0	0.5	20.8	0	CO = 9
8.50	15.8	0.0	0.5	20.6	0	"
9.00	15.9	0.0	0.5	20.6	0	CO = 7
9.50	15.9	0.0	0.5	20.6	0	CO = 9
10.00	16.0	0.1	0.5	20.7	0	"
10.50						
11.00						
11.50						
12.00						
12.50						
13.00						
13.50		0.1				
14.00	16.5	0.0 0.1	0.7	20.2	0	CO = 11
14.50	16.5	0.1	0.7	20.2	0	CO = 10
15.00	16.6	0.1	0.8	20.1	0	CO = 12
16.00	16.7	0.1	0.8	20.2	0	11 CH4 flicking to 0.2
17.00	16.7	0.1	0.9	20.1	0	12 " " "
18.00	16.8	0.1	0.9	19.9	0	13
19.00	16.8	0.1	1.0	19.9	0	11. Syringe Sample
20.00						

Notes:

Flux Testing

Client: Veolia
Site: Woodlawn.
Date: 21/5/07 — 3.45pm
Location / test: (6)

Climatic conditions:	Min.	Avg.	Max
Temperature (oC)	11.7	12.9	15.7
Humidity (%)	46.6	60.3	77.6
Atm. Pressure (hPa)	933.1	933.3	934.1
Wind speed (m/s)		—	—

4.10pm
12.3
68.2
933.3

Time (min)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	Comment
0.00	—	0.0	0.1	21.3	0	CO=0
0.50	13.1	0.0	0.1	21.4	0	
1.00	13.0	0.0	0.1	21.4	0	
1.50	13.0	0.0	0.1	21.4	0	
2.00	13.0	0.0	0.1	21.4	0	
2.50	13.0	0.0	0.2	21.3	0	
3.00	13.0	0.0	0.2	21.2	0	
3.50	13.1	0.0	0.3	21.2	0	
4.00	13.1	0.0	0.3	21.2	0	
4.50	13.2	0.0	0.3	21.1	0	
5.00	13.3	0.0	0.3	21.1	0	
5.50	13.3	0.0	0.3	21.2	0	
6.00	13.4	0.0	0.3	21.2	0	
6.50	13.5	0.0	0.3	21.1	0	
7.00	13.5	0.0	0.3	21.1	0	
7.50	13.6	0.0	0.3	21.0	0	
8.00	13.6	0.0	0.3	21.0	0	
8.50	13.7	0.0	0.3	21.1	0	
9.00	13.8	0.0	0.3	21.0	0	
9.50	13.8	0.0	0.4	21.0	0	
10.00	13.8	0.0	0.4	21.0	0	
10.50						
11.00						
11.50						
12.00						
12.50						
13.00						
13.50						
14.00	13.9	0.0	0.4	20.8	0	
14.50	14.0	0.0	0.5	20.8	0	
15.00	14.1	0.0	0.5	20.8	0	

Notes:

Flux Testing

Client: Veolia
Site: Woodlawn
Date: 21/5/07
Location / test: (7)

Climatic conditions:	Min.	Avg.	Max	4:33pm
Temperature (oC)	12.1	12.3	12.5	12.1
Humidity (%)	62.3	63.8	64.7	64.9
Atm. Pressure (hPa)	933.0	933.2	933.4	932.9
Wind speed (m/s)		0.6	2.8	—

Time (min)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	Comment
0.00	—	0.0	0.1	21.4	0	
0.50	13.1	0.0	0.1	21.4	0	
1.00	13.1	0.0	0.1	21.4	0	
1.50	13.3	0.0	0.2	21.4	0	
2.00	13.4	0.0	0.2	21.3	0	
2.50	13.5	0.0	0.2	21.3	0	
3.00	13.6	0.0	0.3	21.2	0	
3.50	13.7	0.0	0.3	21.1	0	
4.00	13.8	0.0	0.3	21.1	0	
4.50	13.9	0.0	0.3	21.1	0	
5.00	14.0	0.0	0.3	20.9	0	
5.50	14.0	0.0	0.4	20.9	0	
6.00	14.1	0.0	0.4	20.9	0	
6.50	14.1	0.0	0.4	20.7	0	
7.00	14.2	0.0	0.4	20.7	0	
7.50	14.2	0.0	0.4	20.7	0	
8.00	14.3	0.0	0.4	20.6	0	
8.50	14.3	0.0	0.5	20.7	0	
9.00	14.4	0.0	0.5	20.5	0	
9.50	14.4	0.0	0.5	20.5	0	
10.00	14.5	0.0	0.5	20.5	0	
10.50						
11.00						
11.50						
12.00						
12.50						
13.00						
13.50						
14.00	14.8	0.0	0.6	20.2	0	
14.50	14.8	0.0	0.7	20.1	0	
15.00	14.8	0.0	0.7	20.1	0	

Notes:

Flux Testing

Client: Veolia
Site: Woodlawn
Date: 21/5/07
Location / test: (8)

Climatic conditions:	Min.	Avg.	Max	4:55pm.
Temperature (oC)	11.2	11.9	12.5	11.8.
Humidity (%)	62.3	64.9	68.4	66.0
Atm. Pressure (hPa)	932.8	937.1	937.4	932.9
Wind speed (m/s)		0.7	4.3	

Time (min)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	Comment
0.00	–	0.0	0.1	21.4	0	
0.50	11.7	0.0	0.2	21.3	0	
1.00	11.8	0.0	0.2	21.3	0	
1.50	11.9	0.0	0.2	21.3	0	
2.00	12.1	0.0	0.2	21.4	0	
2.50	12.2	0.0	0.3	21.3	0	
3.00	12.3	0.0	0.3	21.4	0	
3.50	12.4	0.0	0.3	21.2	0	
4.00	12.5	0.0	0.3	21.2	0	
4.50	12.6	0.0	0.3	21.2	0	
5.00	12.7	0.0	0.3	21.2	0	
5.50	12.8	0.0	0.3	21.1	0	
6.00	13.0	0.0	0.4	21.2	0	
6.50	13.1	0.0	0.4	21.1	0	
7.00	13.2	0.0	0.4	21.0	0	
7.50	13.3	0.0	0.4	21.1	0	
8.00	13.4	0.0	0.4	21.0	0	
8.50	13.5	0.0	0.4	21.0	0	
9.00	13.6	0.0	0.4	20.9	0	
9.50	13.6	0.0	0.4	20.9	0	
10.00	13.6	0.0	0.4	20.9	0	
10.50						
11.00						
11.50						
12.00						
12.50						
13.00						
13.50						
14.00	13.7	0.0	0.5	20.7	0	
14.50	13.7	0.0	0.5	20.7	0	
15.00	13.7	0.0	0.6	20.6	0	

Notes:

Flux Testing

Client: Veolia
Site: Woodlawn
Date: 22/5/07 – 10.45am
Location / test: (9)

Climatic conditions:	Min.	Avg.	Max
Temperature (oC)	7.8	8.5	11.6
Humidity (%)	65.0	69.2	70.7
Atm. Pressure (hPa)	936.3	936.6	936.8
Wind speed (m/s)		2.7	6.5

11.05am Rdg
9.5
63.2
936.6

> 100. Sensor "whacked" from profile testing

Time (min)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	Comment
0.00	9.1	0.0	0.1	21.1	–	CO = 10 ppm. Resiched from profile testing
0.50	9.2	(0.1)	0.2	21.1	=	
1.00	9.2	0.0	0.2	21.1	=	10
1.50	9.3	0.0	0.2	21.1	–	
2.00	9.4	0.0	0.2	21.1	–	10
2.50	9.5	0.0	0.2	21.0	–	
3.00	9.6	0.0	0.2	21.0	–	
3.50	9.7	0.0	0.2	21.1		
4.00	9.9	0.0	0.2	21.0		
4.50	10.0	0.0	0.3	20.9		
5.00	10.1	0.0	0.3	20.9		12.
5.50	10.1	0.0	0.3	20.9		
6.00	10.2	0.0	0.3	21.0/20.9		
6.50	10.3	0.0	0.3	20.9		
7.00	10.4	0.0	0.3	21.0		
7.50	10.6	0.0	0.3	20.9		
8.00	10.7	0.0	0.3	20.9		
8.50	10.8	0.0	0.3	21.0		
9.00	10.9	0.0	0.3	20.9		
9.50	10.9	0.0	0.3	20.9		
10.00	11.0	0.0	0.3	21.0		
10.50						
11.00						
11.50						
12.00						
12.50						
13.00						
13.50						
14.00	11.5	0.0	0.3	20.9		Flicker CH4 = 0.1?
14.50	11.5	0.0	0.3	20.9		
15.00	11.6	0.0	0.3	20.9		

Notes: Quite windy.

Wind affected?

Flux Testing

Client: Veolia
Site: Woodlawn
Date: 22/5/07 — 11.15am
Location / test: (10)

Climatic conditions:	Min.	Avg.	Max	11.40am
Temperature (oC)	8.6	9.8	10.7	10.0
Humidity (%)	58.0	61.1	64.9	65.7
Atm. Pressure (hPa)	935.7	936.5	936.9	936.1
Wind speed (m/s)		1.6	5.1	—

Time (min)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	Comment
0.00	10.4	0.0	0.1	21.1		CO = 8
0.50	10.4	0.0	0.1	20.9		
1.00	10.4	0.0	0.1	20.9		
1.50	10.5	0.0	0.1	21.0		
2.00	10.5	0.0	0.1	21.0		CO = 10
2.50	10.5	0.0	0.1	21.0		
3.00	—	0.0	0.2	21.0		
3.50	10.6	0.0	0.2	21.0		CO = 9
4.00	10.6	0.0	0.2	20.9		
4.50	10.7	0.0	0.2	20.9		
5.00	10.7	0.0	0.2	20.9		CO = 7
5.50	10.8	0.0	0.2	20.9		
6.00	10.8	0.0	0.2	21.0/20.9		
6.50	10.9	0.0	0.2	20.9		
7.00	10.9	0.0	0.2	20.8		
7.50	10.9	0.0	0.2	20.9		
8.00	10.8	0.0	0.2	21.0		
8.50	10.8	0.0	0.2	20.8		
9.00	10.8	0.0	0.2	20.9		
9.50	10.9	0.0	0.2	20.8		
10.00	10.9	0.0	0.2	20.9		
10.50						
11.00						
11.50						
12.00						
12.50						
13.00						
13.50						
14.00	—	—	—	—		
14.50	11.3	0.0	0.2	20.7		
15.00	11.3	0.0	0.2	20.8		

Notes:

A wind affected?

Flux Testing

Client: Veolia
Site: Woodlawn
Date: 22/5/07 — 11.45am
Location / test: (11)

Climatic conditions:	Min.	Avg.	Max	1200 noon
Temperature (oC)	9.5	11.0	13.4	11.3
Humidity (%)	55.3	58.7	62.5	60.4
Atm. Pressure (hPa)	934.9	935.5	936.1	935.2
Wind speed (m/s)		2.1	5.0	—

Time (min)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	Comment
0.00	—	0.0	0.1	20.9		
0.50	14.9	0.0	0.7	20.8		
1.00	15.4	0.0	0.3	20.8		
1.50	15.9	0.0	0.4	20.7		
2.00	16.5	0.0	0.4	20.7		
2.50	16.9	0.0	0.4	20.7		
3.00	17.2	0.0	0.5	20.6		
3.50	17.5	0.0	0.4	20.6		
4.00	17.9	0.0	0.4	20.7		
4.50	18.1	0.0	0.4	20.6		
5.00	18.3	0.0	0.4	20.6		
5.50	18.7	0.0	0.4	20.7		
6.00	18.9	0.0	0.4	20.6		
6.50	19.3	0.0	0.4	20.6		CO=35
7.00	19.6	0.0	0.5	20.6		
7.50	20.1	0.0	0.5	20.6		CO=46
8.00	20.6	0.0	0.6	20.4		
8.50	20.6	0.0	0.6	20.3		
9.00	20.9	0.0	0.6	20.4		
9.50	21.0	0.0	0.6	20.5		
10.00	21.1	0.0	0.6	20.5		CO=47
10.50						
11.00						
11.50						
12.00						
12.50						
13.00						
13.50						
14.00	22.8	0.0	0.6	20.4		CO=51
14.50	23.3	0.0	0.6	20.3		
15.00	23.7	0.0	0.6	20.3		CO=56

Notes:

~~Work affected~~ ↑ Some CO flux

Flux Testing

Client: Veolia
Site: Woodlawn
Date: 22/5/07
Location / test: (12)

Climatic conditions:	Min.	Avg.	Max	12.22 pm
Temperature (oC)	9.3	11.1	14.2	13.0
Humidity (%)	51.8	58.2	64.7	52.9
Atm. Pressure (hPa)	934.7	934.9	935.3	934.7
Wind speed (m/s)		—	—	—

Walk in again

Time (min)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	Comment
0.00	—	0.0	0.1	20.9		CO.
0.50	11.7	0.0	0.1	21.0		
1.00	11.7	0.0	0.1	21.1		
1.50	11.8	0.0	0.1	21.1	3	CO = 15
2.00	11.8	0.0	0.1	21.2	3	17
2.50	11.8	0.0	0.1	21.2	4	20
3.00	11.8	0.0	0.1	21.1	4	19
3.50	11.8	0.0	0.1	21.2		
4.00	11.8	0.0	0.1	21.2		
4.50	11.8	0.0	0.1	21.1	5	19
5.00	11.7	0.0	0.1	21.1		
5.50	11.7	0.0	0.1	21.2	5	23
6.00	11.7	0.0	0.1	21.1		
6.50	11.7	0.0	0.1	21.3	5	22
7.00	11.7	0.0	0.1	21.3	6	23
7.50	11.7	0.0	0.1	21.3		
8.00	11.7	0.0	0.1	21.4		
8.50	11.7	0.0	0.1	21.3	6	22
9.00	11.7	0.0	0.1	21.3		
9.50	11.7	0.0	0.1	21.3		
10.00	11.7	0.0	0.1	21.3	6	24
10.50						
11.00						
11.50						
12.00						
12.50						
13.00						
13.50						
14.00	11.7	0.1	0.1	21.4		
14.50	11.7	0.0	0.1	21.3		
15.00	11.8	0.0	0.1	21.4	7	28.

Wnd affected?

Sim CO flux H_2S av

Notes:

Check GA2000 calibration — 12.25pm.

Calgas ③ $CH_4 = 0.5\%$ ✓ (0.5) ✓ $CO_2 = 0.0\%$ $O_2 = 21.6$ ✓

Flux Testing

Client: Veolia
Site: ~~2~~ Woodlawn
Date: 22/5/07 – 1:35pm.
Location / test: (13)

Climatic conditions:	Min.	Avg.	Max	1.57pm
Temperature (oC)	12.3	14.3	17.5	14.3
Humidity (%)	50.8	52.5	54.1	45.2
Atm. Pressure (hPa)	935.3	935.6	936.0	935.5
Wind speed (m/s)		2.2	5.3	

Time (min)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	Comment CO
0.00	15.6	0.0	0.1	21.2	16	4
0.50	15.5	0.0	0.1	21.3	14	5
1.00	15.4	0.0	0.1	21.2	14	3
1.50	15.3	0.0	0.2	21.2	14	4
2.00	15.2	0.0	0.2	21.1	14	5
2.50	15.2	0.0	0.2	21.1	14	6
3.00	15.2	0.0	0.2	21.0	13	5
3.50	15.1	0.0	0.2	21.0	13	6
4.00	15.1	0.0	0.2	21.0	13	6
4.50	15.1	0.0	0.2	21.0	13	5
5.00	15.1	0.0	0.2	21.0	13	6
5.50	15.2	0.0	0.3	21.0	13	6
6.00	15.1	0.0	0.3	20.9	12	6
6.50	15.2	0.0	0.3	20.9	12	5
7.00	15.2	0.0	0.3	20.7	12	6
7.50	15.3	0.0	0.3	20.7	12	8
8.00	15.3	0.0	0.4	20.7	12	5
8.50	15.3	0.0	0.4	20.7	11	5
9.00	15.3	0.0	0.4	20.6	11	7
9.50	15.3	0.0	0.4	20.6	11	6
10.00	15.3	0.0	0.4	20.6	11	8
10.50						
11.00						
11.50						
12.00						
12.50						
13.00						
13.50						Flickered up to 0.1 CH4
14.00	15.4	0.0	0.4	20.6	10	6
14.50	15.4	0.0	0.4	20.6	11	7
15.00	15.5	0.0	0.4	20.4	10	9

Notes: Less windy? – but not according to data?

↑ some CO flux

Flux Testing

Client: Veolia
Site: Woodlawn
Date: 22/5/07 – 2:00pm.
Location / test: (14)

Climatic conditions:	Min.	Avg.	Max	2-20pm
Temperature (oC)	10.4	11.5	12.5	11.9
Humidity (%)	47.3	55.2	58.7	54.0
Atm. Pressure (hPa)	935.7	935.8	935.9	935.7
Wind speed (m/s)		1.4	3.9	–

Time (min)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	Comment CO
0.00	14.4	0.0	0.1	20.9	9	3
0.50	14.4	0.0	0.1	20.9	9	7
1.00	14.4	0.0	0.3	20.8	9	13
1.50	14.5	0.0	0.4	20.8	9	17
2.00	14.6	0.0	0.5	20.6	9	25
2.50	14.8	0.0	0.5	20.5	9	29
3.00	14.9	0.0	0.6	20.4	8	33
3.50	15.1	0.0	0.7	20.4	8	40
4.00	15.3	0.0	0.7	20.2	8	44
4.50	15.4	0.0	0.8	20.2	8	48
5.00	15.5	0.0	0.8	20.2	8	51
5.50	15.6	0.0	0.9	20.0	8	55
6.00	15.9	0.0	1.0	20.0	8	56
6.50	16.0	0.0	1.0	20.0	8	57
7.00	16.1	0.0	1.0	19.9	8	62
7.50	16.2	0.0	1.1	19.9	8	64
8.00	16.3	0.0	1.1	19.9	8	68
8.50	16.3	0.0	1.2	19.9	8	68
9.00	16.5	0.0	1.2	19.8	8	70
9.50	16.6	0.0	1.3	19.8	7	69
10.00	16.6	0.0	1.3	19.7	7	71
10.50	|	|	|	|	|	|
11.00	|	|	|	|	|	|
11.50	|	|	|	|	|	|
12.00	|	|	|	|	|	|
12.50	|	|	|	|	|	|
13.00	|	|	|	|	|	|
13.50	|	|	|	|	|	|
14.00	16.5	(0.1)	1.6	19.6	7	67
14.50	16.6	0.0	1.67	19.6	7	79
15.00	16.5	0.0	1.7	19.5	7	80

Notes:

↑ Definite CO plume

Flux Testing

Client: Veolia
Site: Woodlawn
Date: 22/5/07 — 2:25pm
Location / test: (15)

Climatic conditions:	Min.	Avg.	Max	2.45 pm
Temperature (oC)	8.9	10.0	11.4	9.3
Humidity (%)	54.0	59.5	64.5	58.9
Atm. Pressure (hPa)	935.4	935.6	936.1	935.3
Wind speed (m/s)		1.7	6.1	—

Time (min)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	Comment CO
0.00	—	0.0	0.1	21.2	6	8
0.50	13.0	0.0	0.1	21.2	—	—
1.00	13.0	0.0	0.2	21.1	7	26
1.50	12.8	0.0	0.2	21.0	7	30
2.00	12.7	0.0	0.3	21.0	7	34
2.50	12.8	0.0	0.3	20.9	7	42
3.00	13.0	0.0	0.3	20.9	6	45
3.50	12.8	0.0	0.4	20.9	7	48
4.00	12.8	0.0	0.4	20.8	7	49
4.50	13.1	0.0	0.4	20.9	6	51
5.00	13.6	0.0	0.4	20.8	6	56
5.50	14.0	0.0	0.4	20.7	6	57
6.00	14.1	0.0	0.4	20.7	7	55
6.50	14.4	0.0	0.4	20.7	6	52
7.00	14.1	0.0	0.4	20.8	6	52
7.50	13.9	0.0	0.4	20.9	6	47
8.00	13.6	0.0	0.4	20.8	6	47
8.50	13.6	0.0	0.5	20.8	5	46
9.00	13.4	0.0	0.5	20.7	6	42
9.50	13.8	0.0	0.5	20.6	5	49
10.00	13.8	0.0	0.5	20.7	5	53
10.50						
11.00						
11.50						
12.00						
12.50						
13.00						
13.50						
14.00	14.7	0.0	0.4	20.8	5	40
14.50	14.7	0.0	0.5	20.7	5	41
15.00	15.1	0.0	0.5	20.7	5	41

Notes:

A
CO flux

Flux Testing

Client: Veolia
Site: Wood lawn
Date: 22/5/07 — 2:50pm
Location / test: (16)

Climatic conditions:	Min.	Avg.	Max	3:04
Temperature (oC)	8.4	8.6	9.0	9.2
Humidity (%)	61.8	64.4	66.0	63.3
Atm. Pressure (hPa)	935.3	935.6	936.0	935.9
Wind speed (m/s)		2.3	6.0	—

Time (min)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	Comment CO
0.00	9.7	0.0	0.1	21.4	5	10
0.50	9.9	0.0	0.2	21.2	5	7
1.00	10.0	0.0	0.3	21.1	5	5
1.50	10.1	0.0	0.4	21.1	5	6
2.00	10.2	0.0	0.4	21.1	5	8
2.50	10.3	0.0	0.4	20.9	5	8
3.00	10.6	0.0	0.5	20.9	5	8
3.50	10.8	0.0	0.5	20.8	5	8
4.00	11.0	0.0	0.5	20.7	5	9
4.50	11.1	0.0	0.6	20.6	5	11
5.00	11.3	0.0	0.6	20.5	5	11
5.50	11.4	0.0	0.7	20.5	5	11
6.00	11.5	0.0 (0.1)	0.7	20.5	5	11
6.50	11.6	0.0	0.8	20.4	5	11
7.00	11.8	0.0	0.8	20.3	5	11
7.50	11.9	0.0	0.8	20.2	5	11
8.00	12.0	0.0	0.9	20.1	5	11
8.50	12.2	0.0	0.9	20.1	5	12
9.00	12.3	0.0	0.9	20.2	5	11
9.50	12.4	0.0	0.9	20.1	5	12
10.00	12.5	0.0	1.0	20.1	5	13
10.50						
11.00						
11.50						
12.00						
12.50						
13.00						
13.50						
14.00	13.9	0.0	1.3	19.8	5	12
14.50	14.0	0.0	1.3	19.7	5	11
15.00	14.1	0.0	1.2	19.6	4	13

Flicker to 0.1 CH4

Notes:

Flux Testing

Client: V2019
Site: Woodlawn
Date: 22/5/07 – 3:15pm
Location / test: 9B – repeat at ⑨ – quality / repeatability check

Climatic conditions:	Min.	Avg.	Max	3:30pm
Temperature (oC)	8.2	8.5	9.2	8.7
Humidity (%)	54.9	64.7	68.4	63.7
Atm. Pressure (hPa)	936.1	936.3	936.6	936.4
Wind speed (m/s)		1.4	3.4	–

Time (min)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	Comment CO
0.00	8.7	0.0	0.1	21.5	4	1
0.50	8.7	0.0	0.1	21.4	5	6
1.00	8.7	0.0	0.1	21.4	5	3
1.50	8.7	0.0	0.1	21.4	5	4
2.00	8.8	0.0	0.1/0.2	21.3	5	3
2.50	8.9	0.0	0.2	21.3	5	3
3.00	9.0	0.0	0.2	21.3	5	2
3.50	9.1	0.0	0.2	21.3	5	3
4.00	9.2	0.0	0.2	21.2	5	3
4.50	9.3	0.0	0.2	21.2	5	5
5.00	9.4	0.0	0.2	21.2	4	3
5.50	9.5	0.0	0.2	21.3	5	4
6.00	9.6	0.0	0.2	21.2	5	4
6.50	9.6	0.0	0.3	21.2	5	4
7.00	9.7	0.0	0.3	21.2	5	4
7.50	9.9	0.0	0.3	21.1	4	3
8.00	10.0	0.0	0.3	21.1	4	5
8.50	10.1	0.0	0.3	21.1	4	3
9.00	10.2	0.0	0.3	21.0	4	5
9.50	10.3	0.0	0.3	21.0	4	7
10.00	10.4	0.0	0.3	21.1	4	3
10.50						
11.00						
11.50						
12.00						
12.50						
13.00						
13.50						
14.00	11.1	0.0	0.4	20.9	4	3
14.50	11.1	0.0	0.4	20.9	4	3
15.00	11.2	0.0	0.4	20.9	4	3

Notes:

Check calibration of GA2000 – 3:35pm
Calgas ③ $CH_4 = 0.5$ (0.5) $CO_2 = 0.0$, $O_2 = 21.3$, $H_2S = 3$, $CO = 4$
Calgas ② $CH_4 = 0.0$ (0.0) $CO_2 = 10.1$ (10.0) $H_2S = 3$, $CO = 3$
$O_2 = 12.6$ (12.0) Little high

Final Atmospheric Rdg: $CH_4 = 0.0$, $CO_2 = 0.2$, $O_2 = 21.2$, $H_2S = 3$, $CO = 3$

Gas Profile Testing

Client: Veolia
Site: Woodlawn
Date: 22/5/07

Undertaken by: S. Dever / A. Roberts

Weather:
9.45am: Cold (8°C). Scattered cloud. Rain overnight.

Climatic conditions:	Min.	Avg.	Max
Temperature (oC)			
Humidity (%)			
Atm. Pressure (hPa)			
Wind speed (m/s)			

Not measured.
See climate conditions during flux testing.

Location / test: (1)

Depth (mm)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO
0 — Atmospheric		0.0	0.2	20.6	0	.
100		—	—	—	—	
200		1.1 / 1.4	23.0/16.0	2.6/9.7	2/>100	360/307
300		2.3/	21.9/	1.7/	>100	549
~~400~~ 350		6.2	22.4	4.6	>100	705
500		~~Terminated. Could not drive in further.~~				
600						
700						
800						
900						
1000						

Had to relocate after 200. — Terminated

Location / test: (2)

Sensor out of whack after first test. Exceeded gauge of sensor.

Depth (mm)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO
0 — Atmospheric		0.1	0.2	20.6	0 —	44
100		—	—	—	—	—
200		1.8	14.0	9.0	—	97
300		0.9/1.2	26.3	1.5	—	770
400		~~Terminated — could not drive in further~~				
500						
600						
700						
800						
900						
1000						

Gas Profile Testing

Client: Veolia
Site: Woodlawn
Date: 22/5/07

Location / test: (3)

sensor out of whack from first test. Exceeded range.

Depth (mm)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO
0 — Atmosphere		0.1	0.2	20.4	—	Atmosphere Rdg
100		—	—	—	—	—
200		5.3	37.0	1.0/0.1	—	794
300		10.0	48.5	0.6/1.1	—	>1000
400		terminated — cannot drive in any further.				
500		Probe broke ~~off~~ above ss tip — just as before.				
600						
700		Retrieved probe by digging. → waste very well compacted/ dense v hard to excavate.				
800						
900						
1000						

Location / test:

Depth (mm)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	
0						
100						
200						
300						
400						
500						
600						
700						
800						
900						
1000						

Location / test:

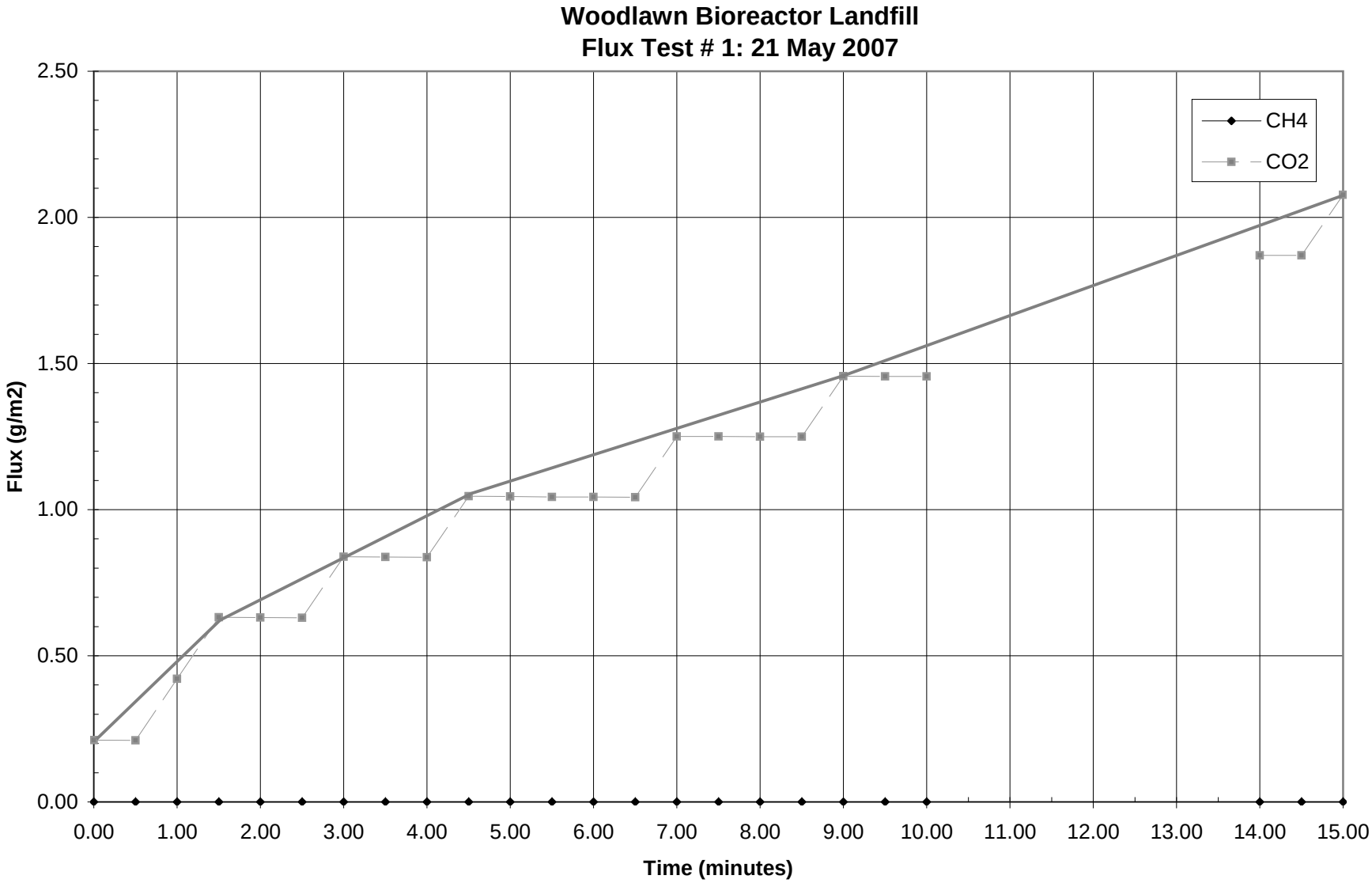
Depth (mm)	Temp (oC)	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	
0						
100						
200						
300						
400						
500						
600						
700						
800						
900						
1000						

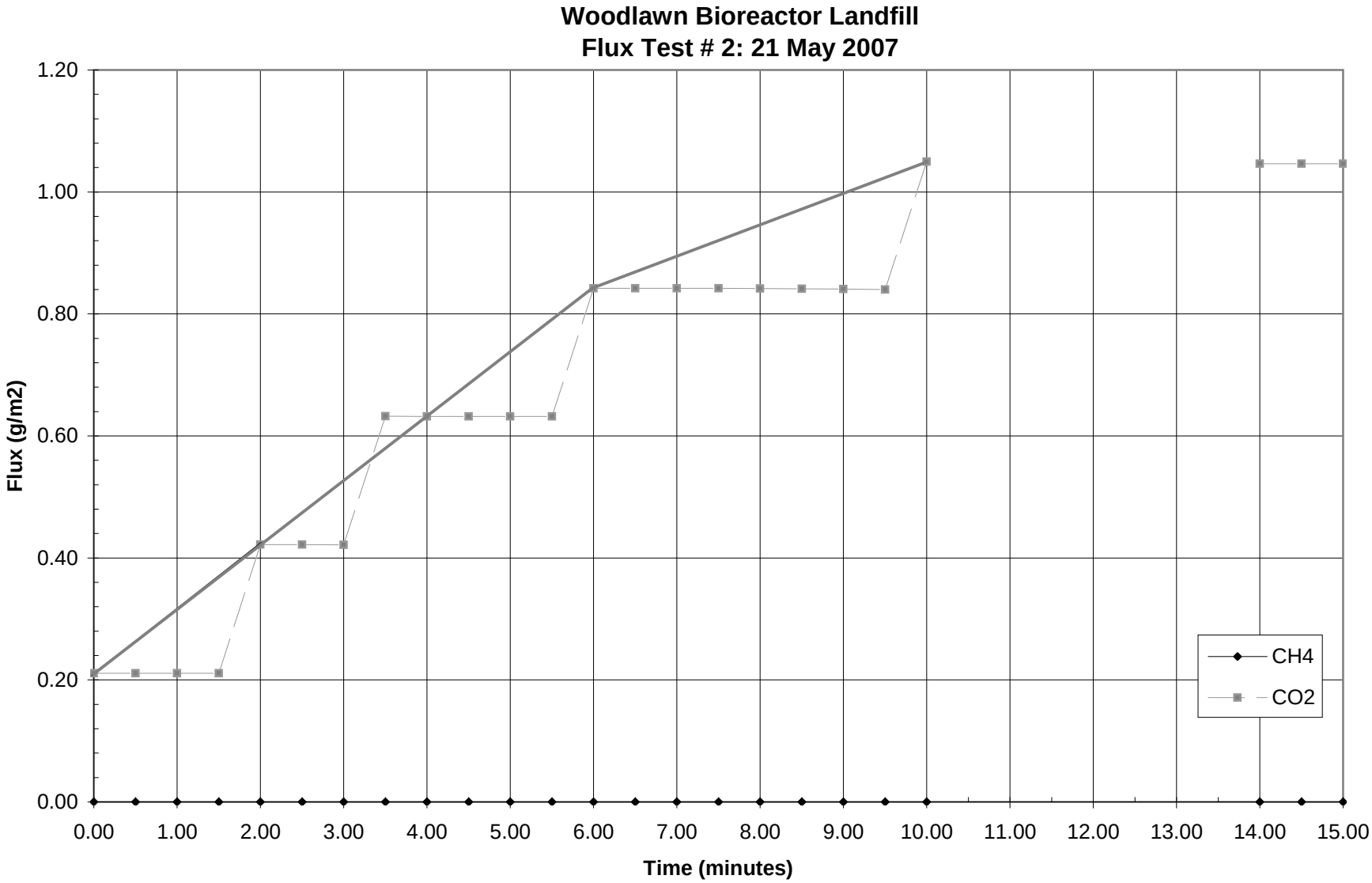
Notes:

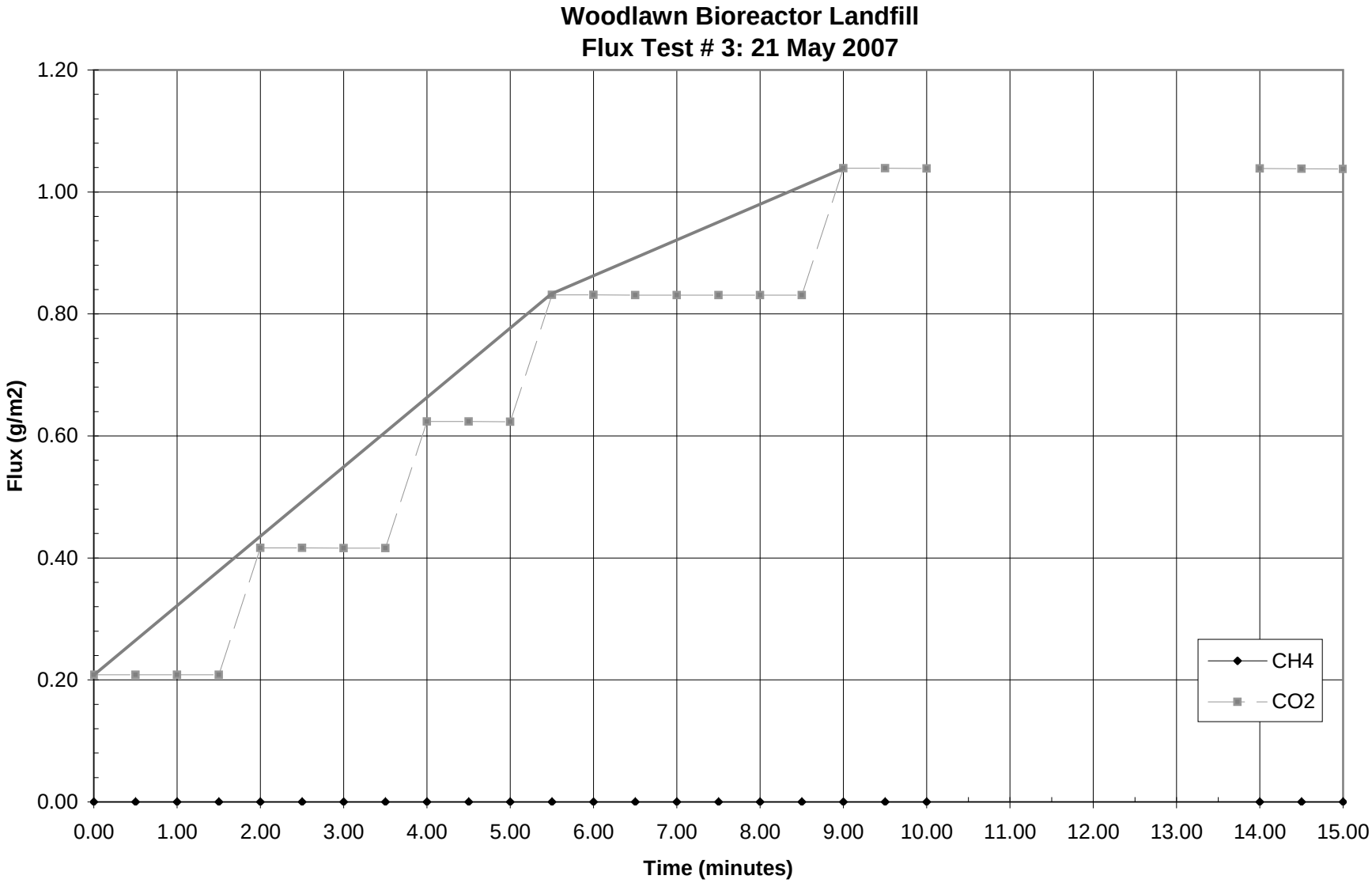
1. Relatively low methane levels (subsurface (1-10%)), compared to CO_2 (14-48%), suggests ?? primarily aerobic degradation or methane oxidation — Consistent with flux results.
2. Low levels of subsurface oxygen — (1-9%) but variable
3. v. high H_2S levels — not consistent with flux results? — no significant flux
4. v. high CO levels — " " " " " on Monday.

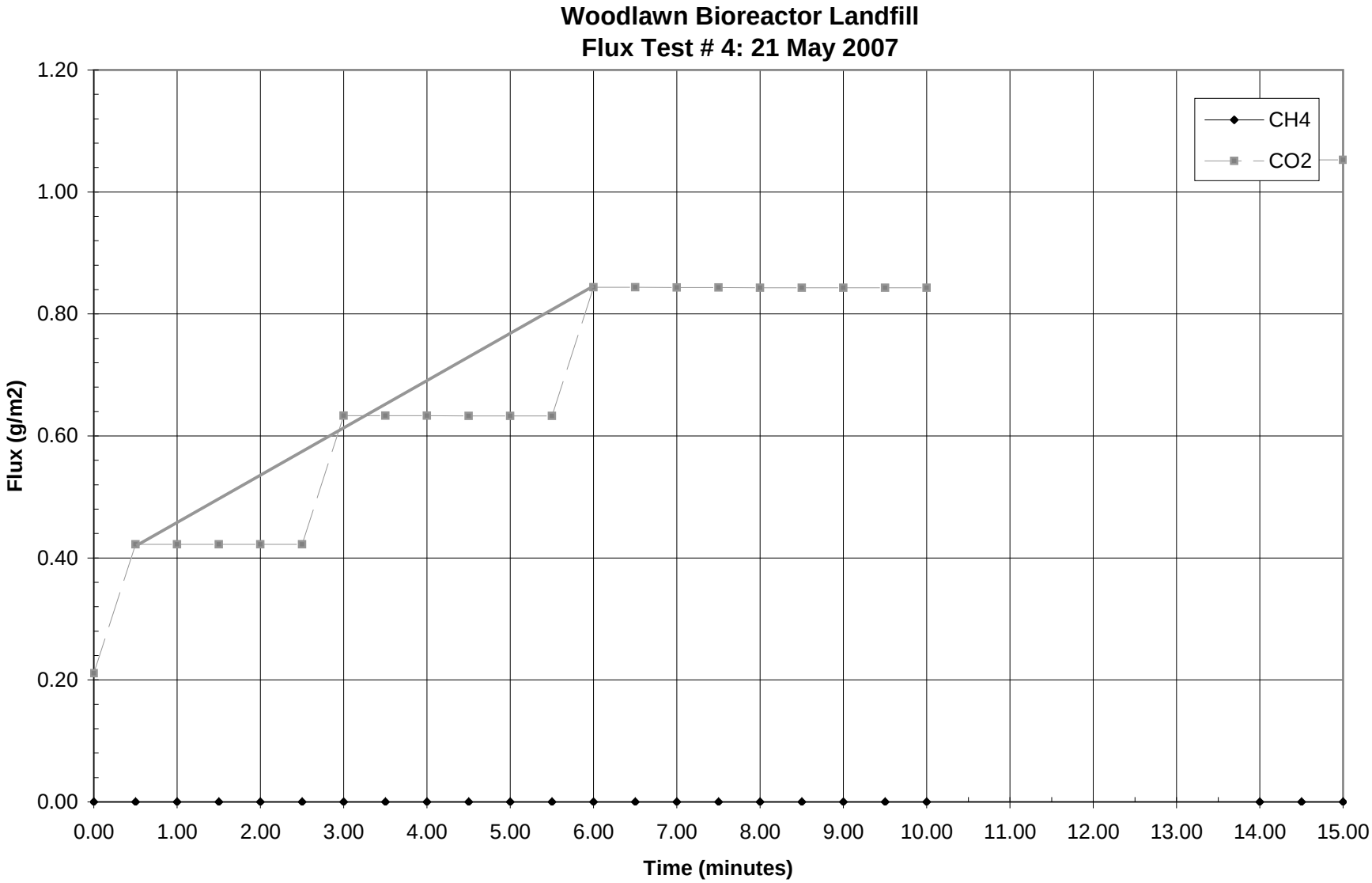
Appendix C

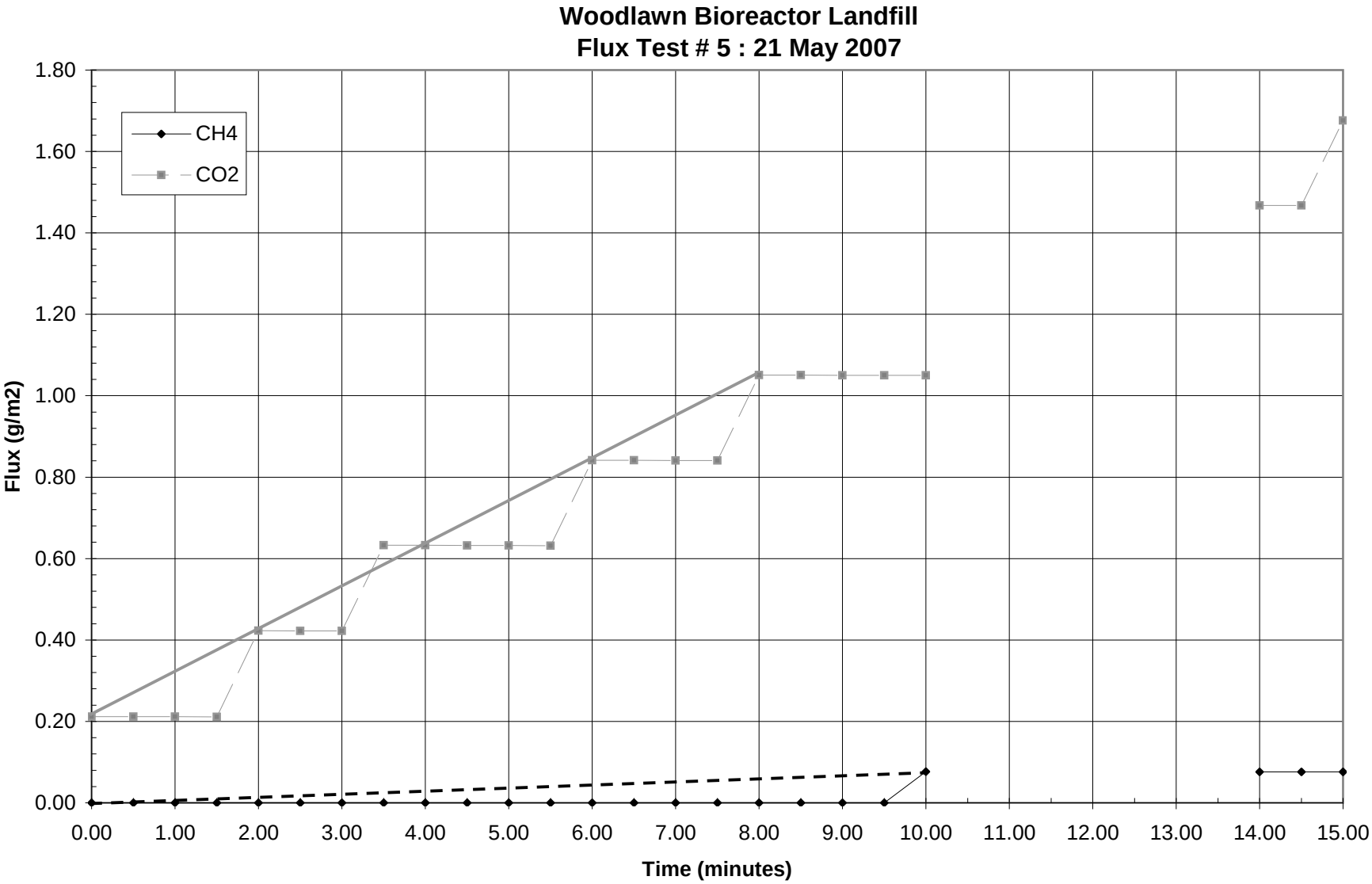
Flux Curves

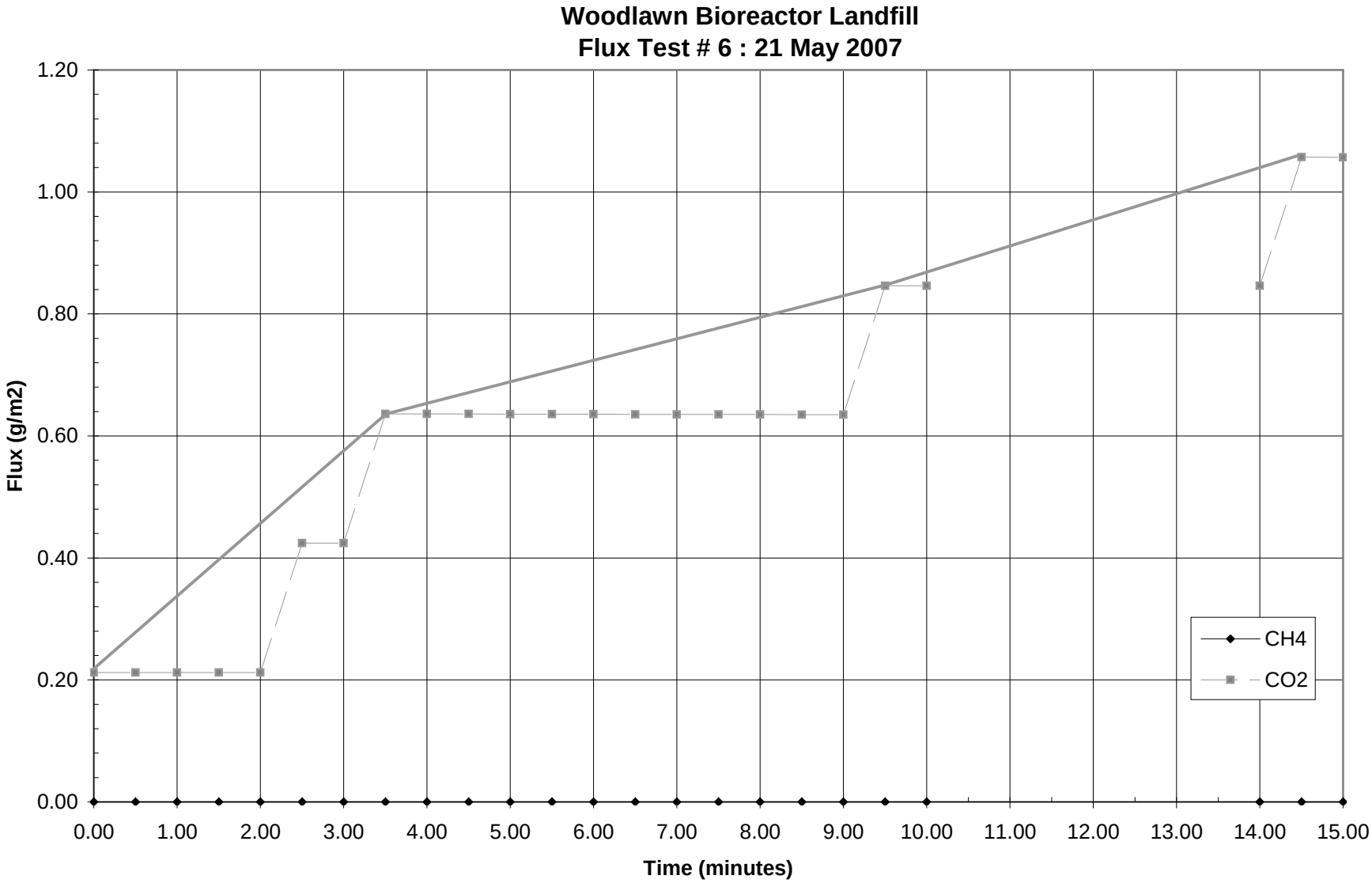

Woodlawn Bioreactor Landfill
Flux Test # 1: 21 May 2007
Flux (g/m2)
2.50
2.00
1.50
1.00
0.50
0.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
11.00
12.00
13.00
14.00
15.00
Time (minutes)
CH4
CO2

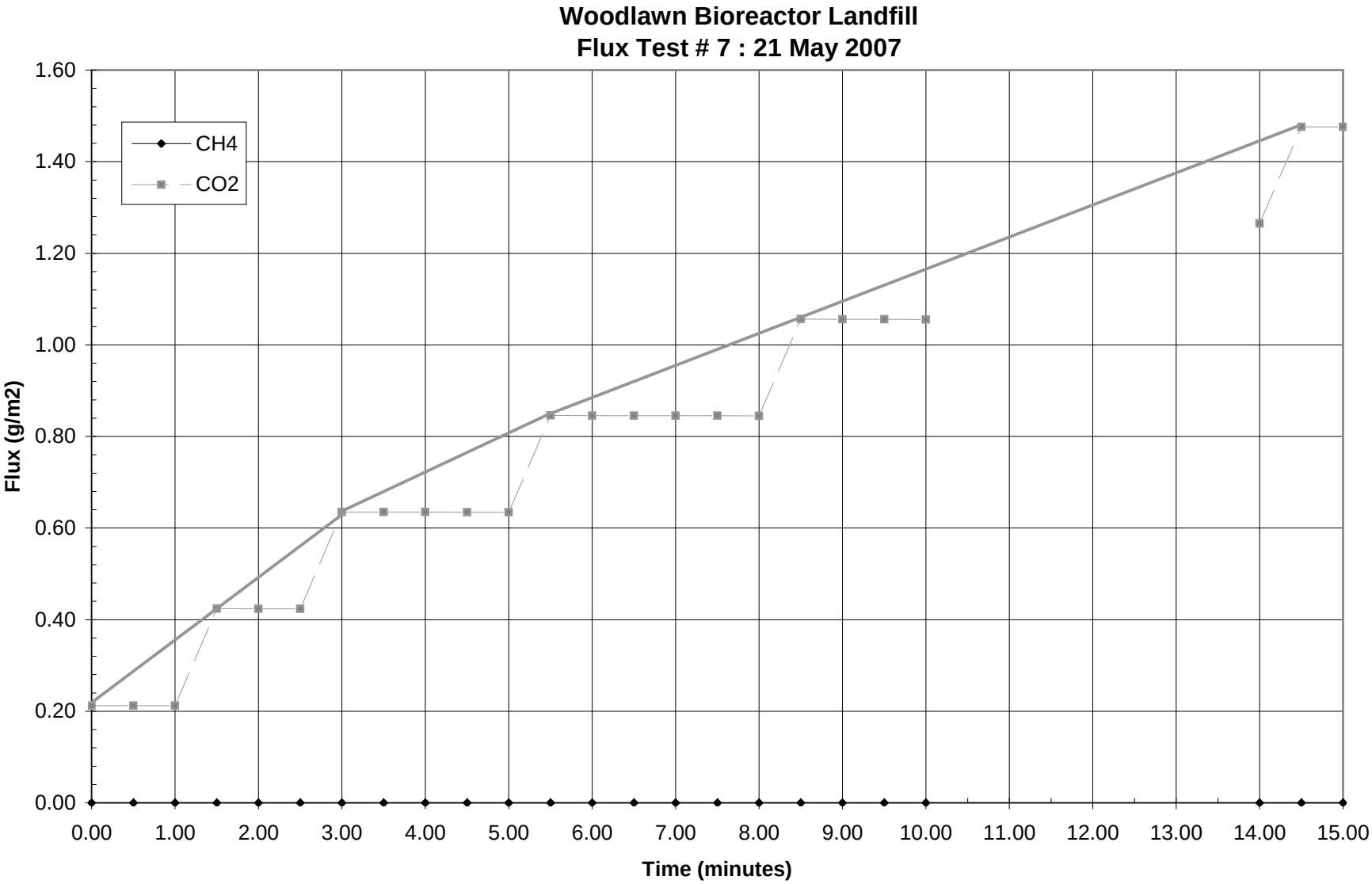

Woodlawn Bioreactor Landfill
Flux Test # 2: 21 May 2007
Flux (g/m2)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
11.00
12.00
13.00
14.00
15.00
Time (minutes)
CH4
CO2

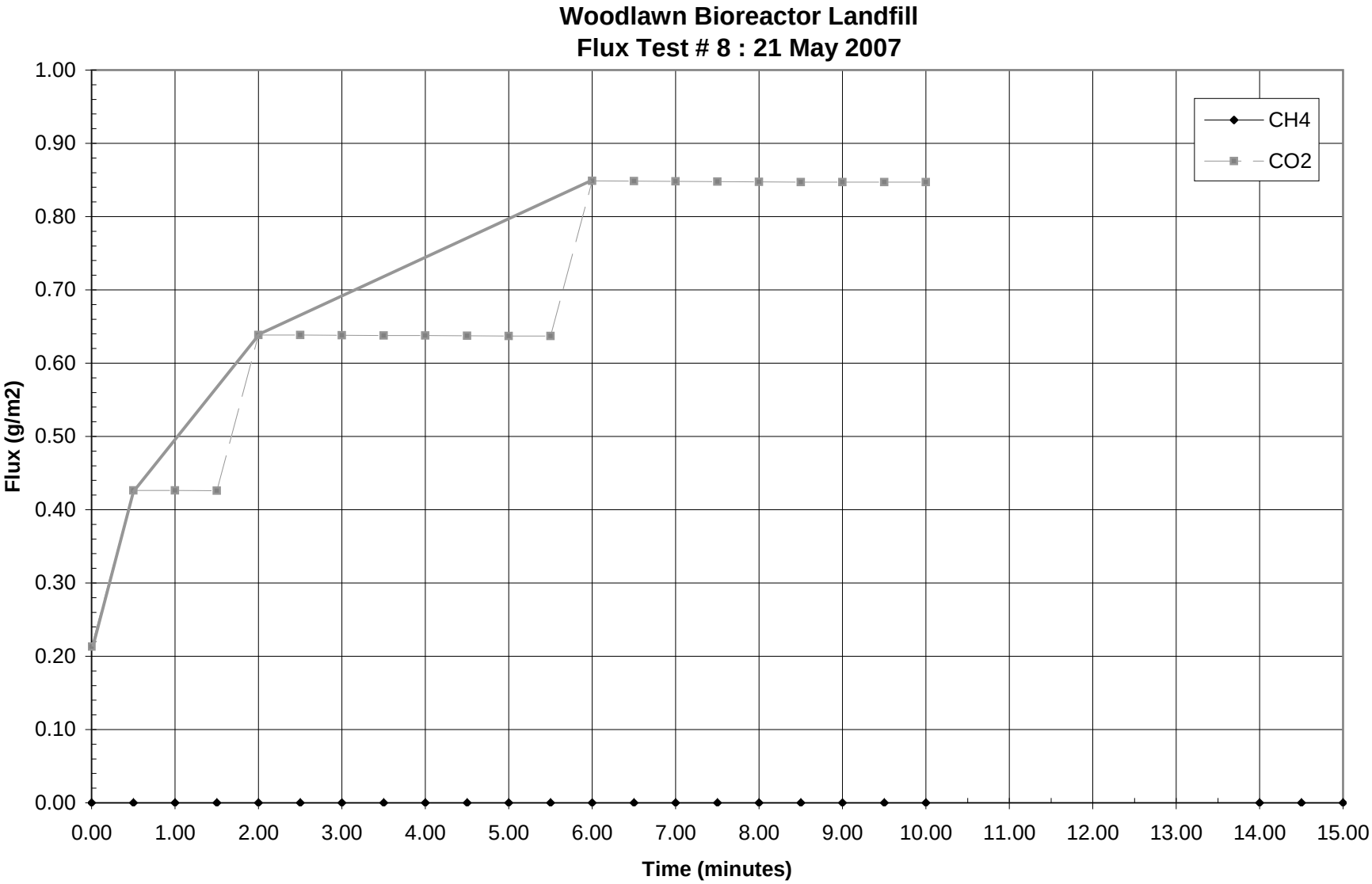

Woodlawn Bioreactor Landfill
Flux Test # 3: 21 May 2007
Flux (g/m2)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
11.00
12.00
13.00
14.00
15.00
Time (minutes)
CH4
CO2

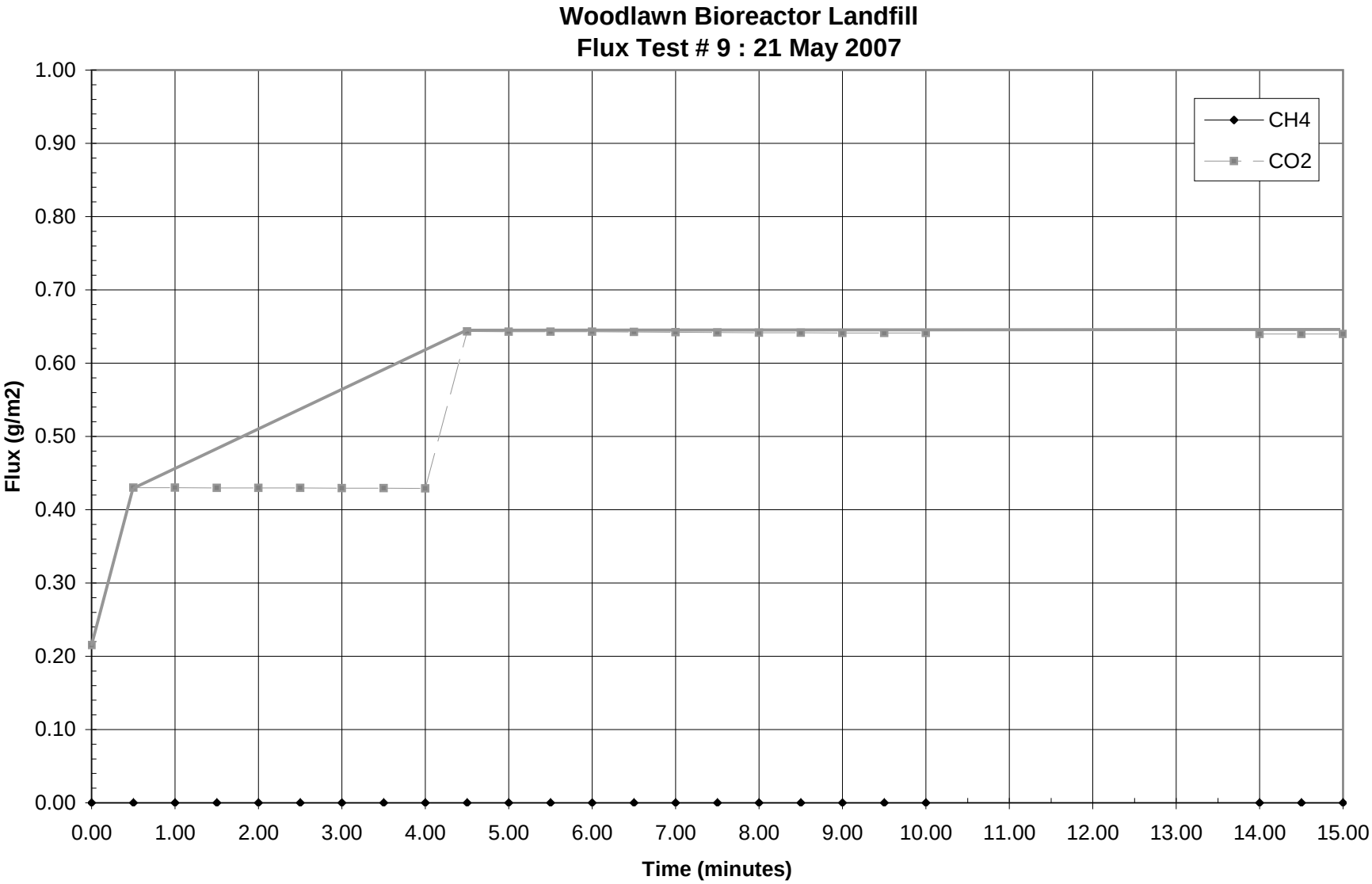

Woodlawn Bioreactor Landfill
Flux Test # 4: 21 May 2007
Flux (g/m2)
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1.00
0.80
0.60
0.40
0.20
0.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
11.00
12.00
13.00
14.00
15.00
Time (minutes)
CH4
CO2

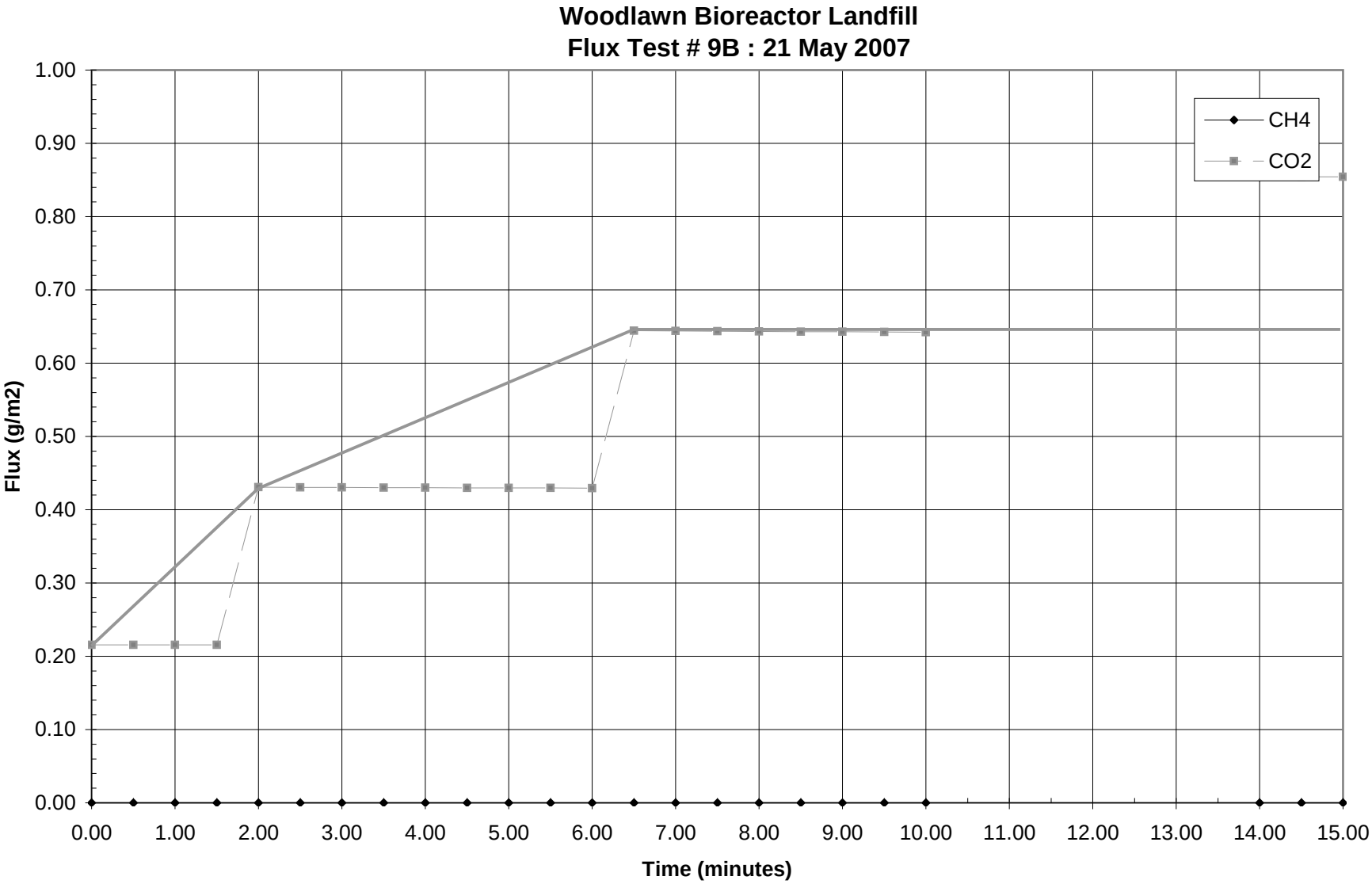

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Flux Test # 5 : 21 May 2007
CH4
CO2
Flux (g/m2)
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1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
1.00
2.00
3.00
4.00
5.00
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10.00
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12.00
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15.00
Time (minutes)

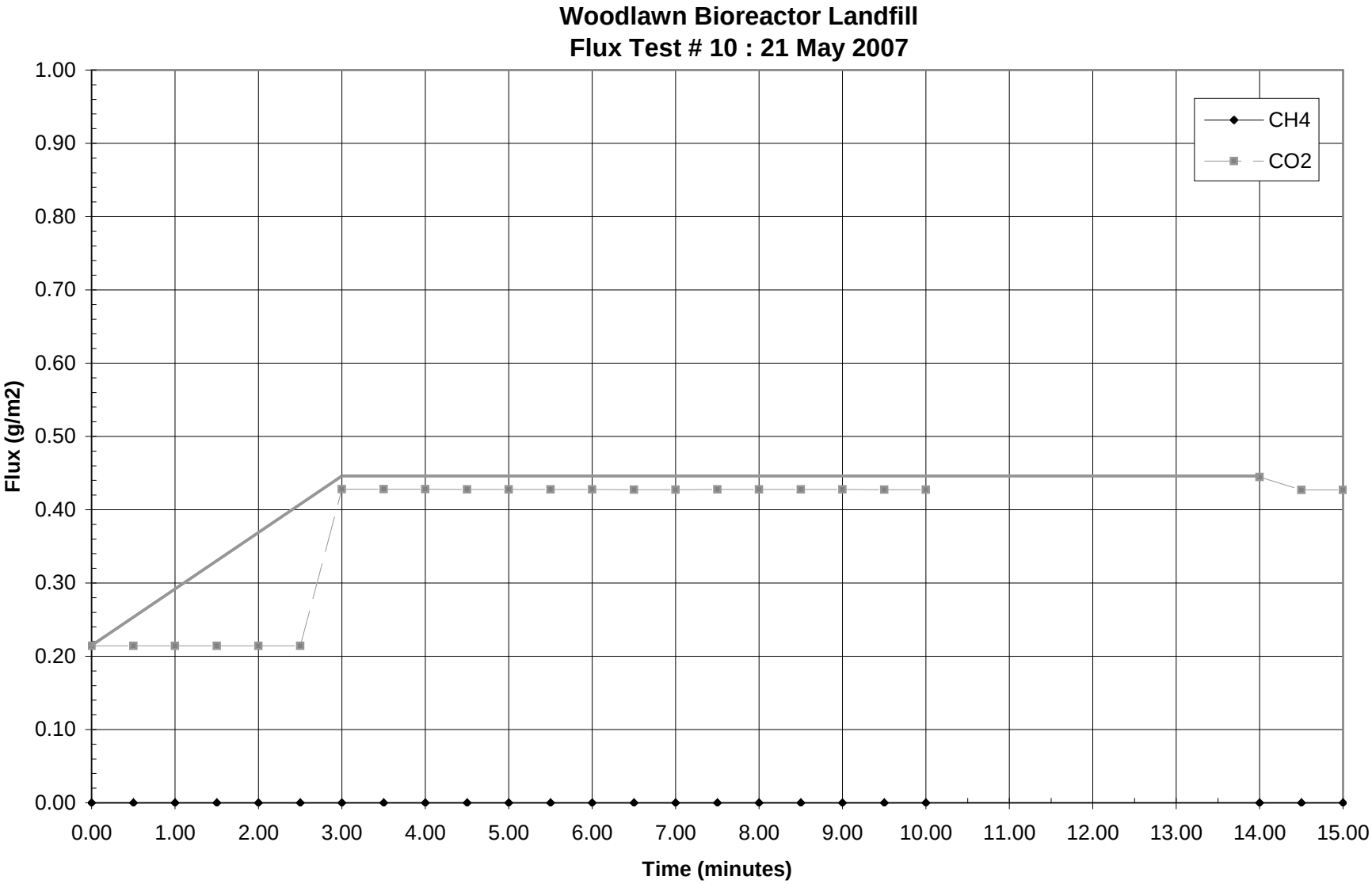

Woodlawn Bioreactor Landfill
Flux Test # 6 : 21 May 2007
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0.80
0.60
0.40
0.20
0.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
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8.00
9.00
10.00
11.00
12.00
13.00
14.00
15.00
Time (minutes)
CH4
CO2

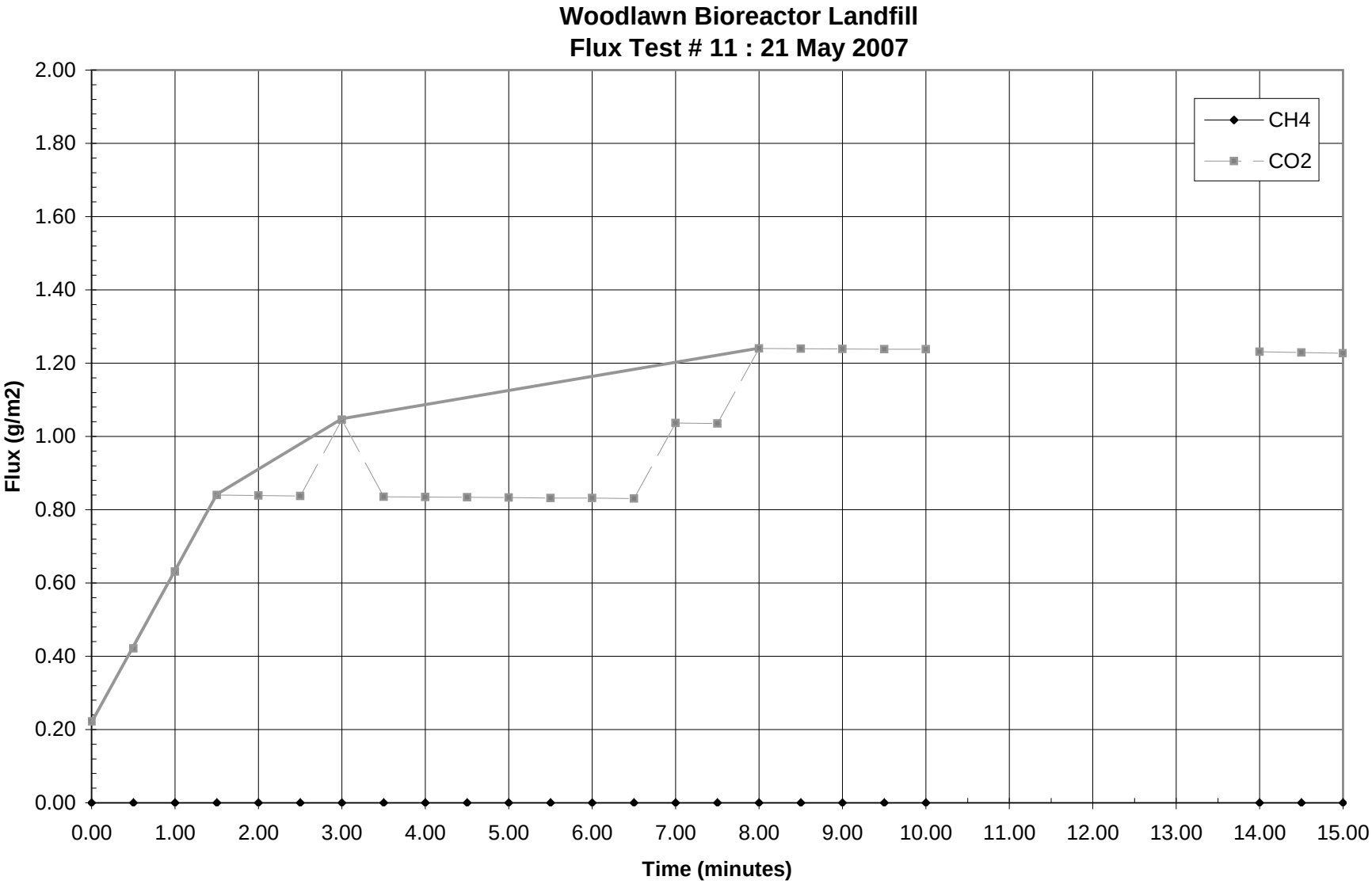

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Flux Test # 7 : 21 May 2007
CH4
CO2
Flux (g/m2)
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1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
1.00
2.00
3.00
4.00
5.00
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14.00
15.00
Time (minutes)

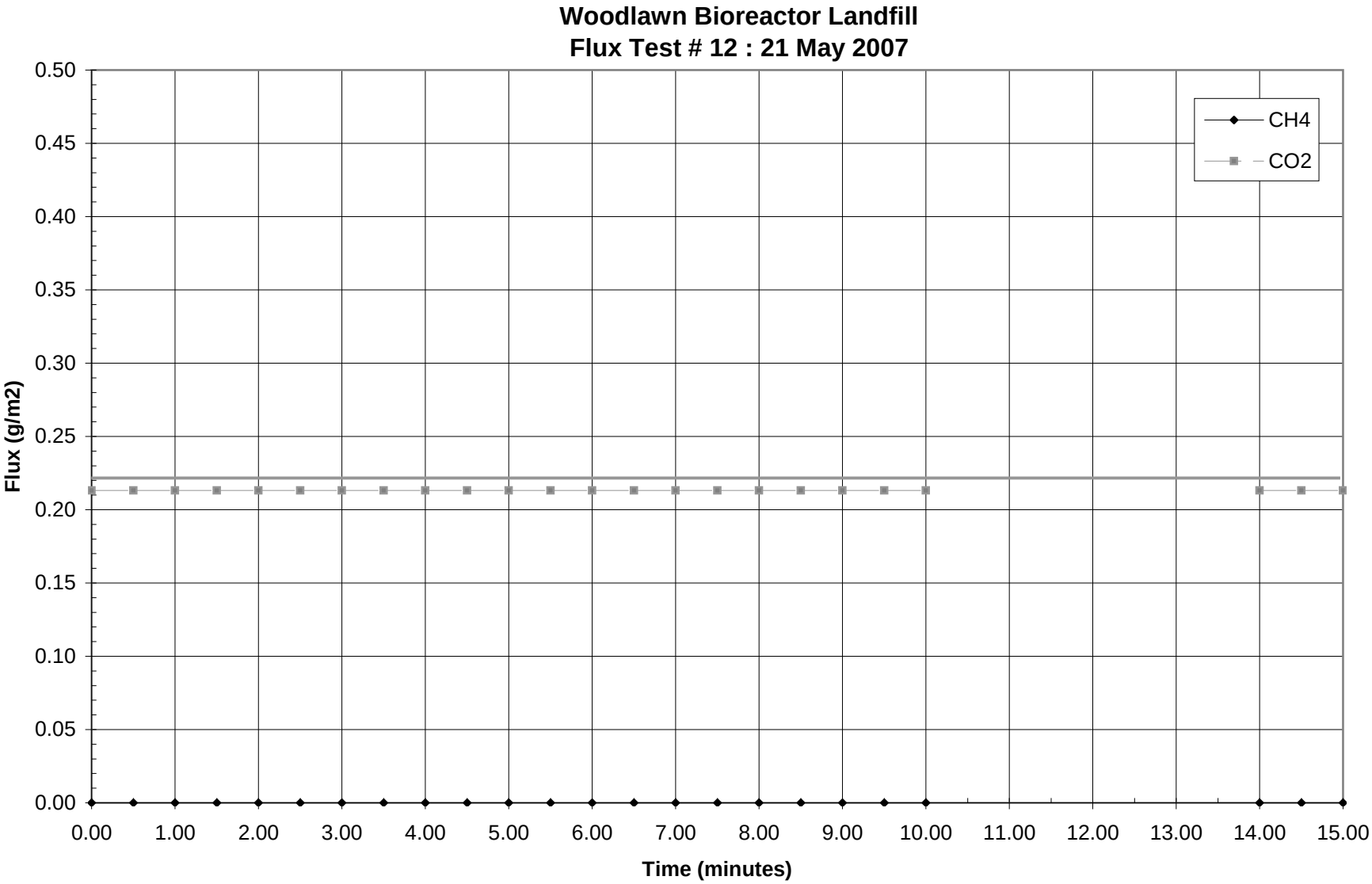

Woodlawn Bioreactor Landfill
Flux Test # 8 : 21 May 2007
Flux (g/m2)
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0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
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Time (minutes)
CH4
CO2

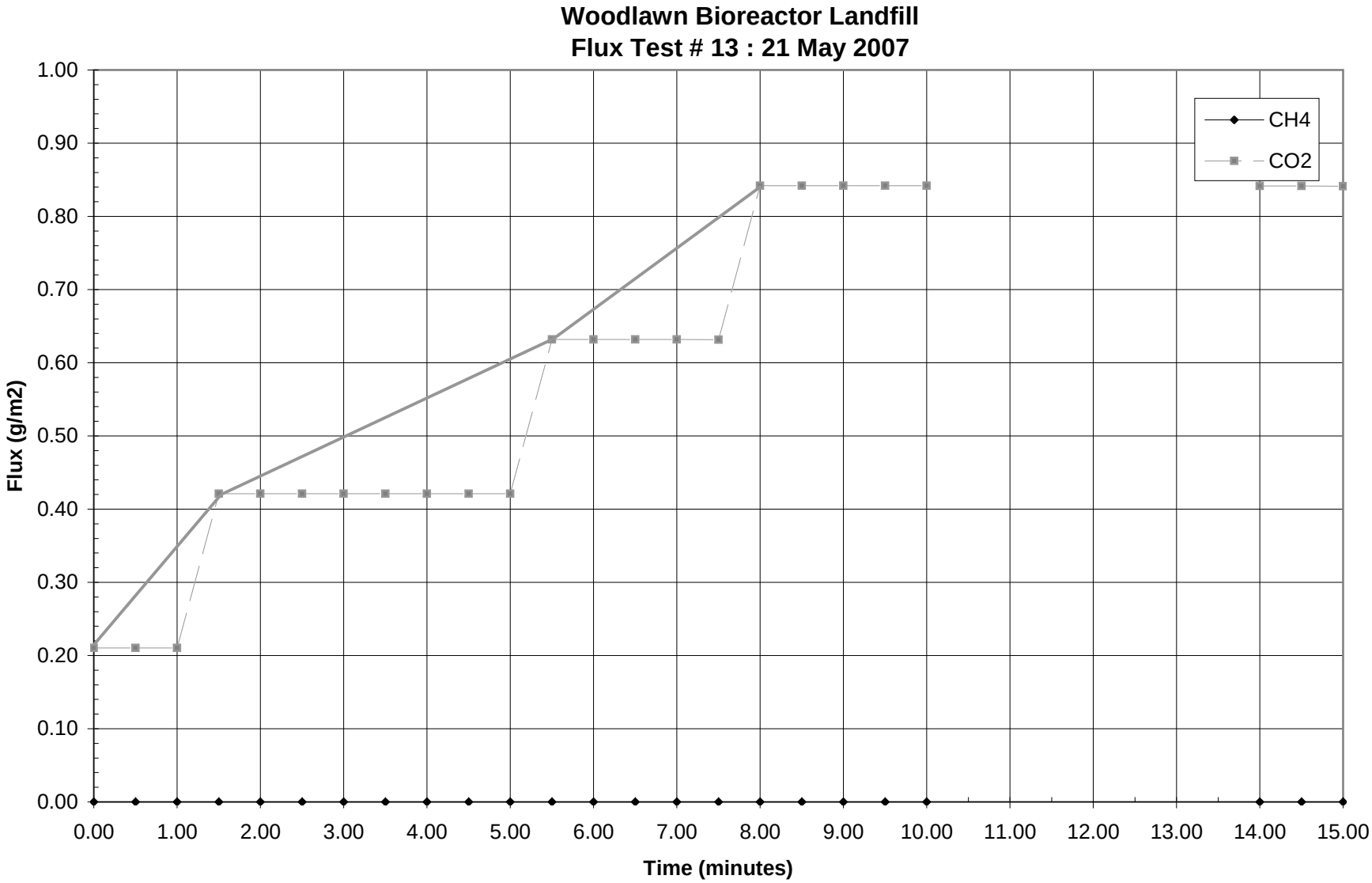

Woodlawn Bioreactor Landfill
Flux Test # 9 : 21 May 2007
Flux (g/m2)
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0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
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Time (minutes)
CH4
CO2

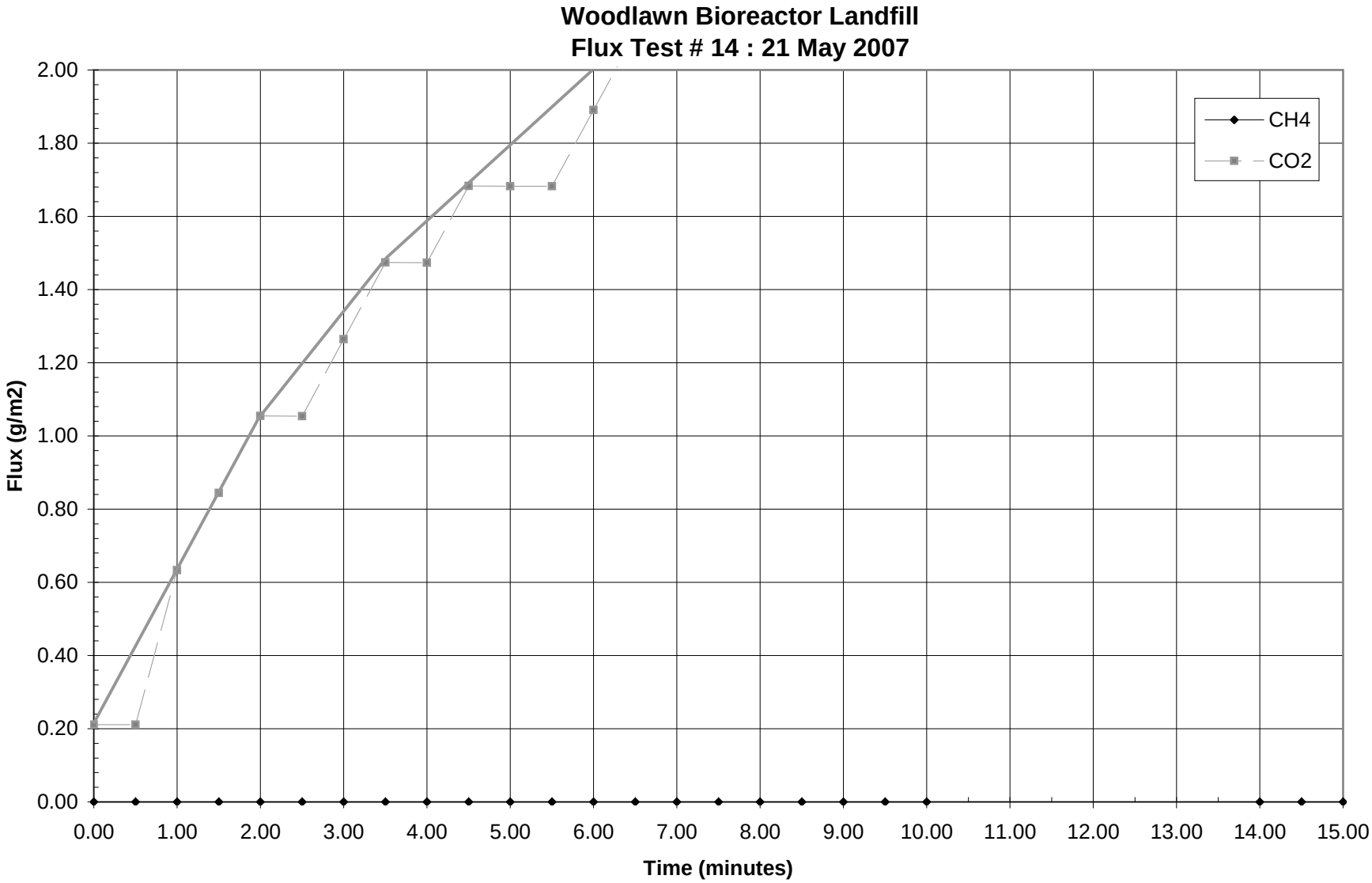

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Flux Test # 9B : 21 May 2007
Flux (g/m2)
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0.80
0.70
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0.50
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0.20
0.10
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Time (minutes)
CH4
CO2

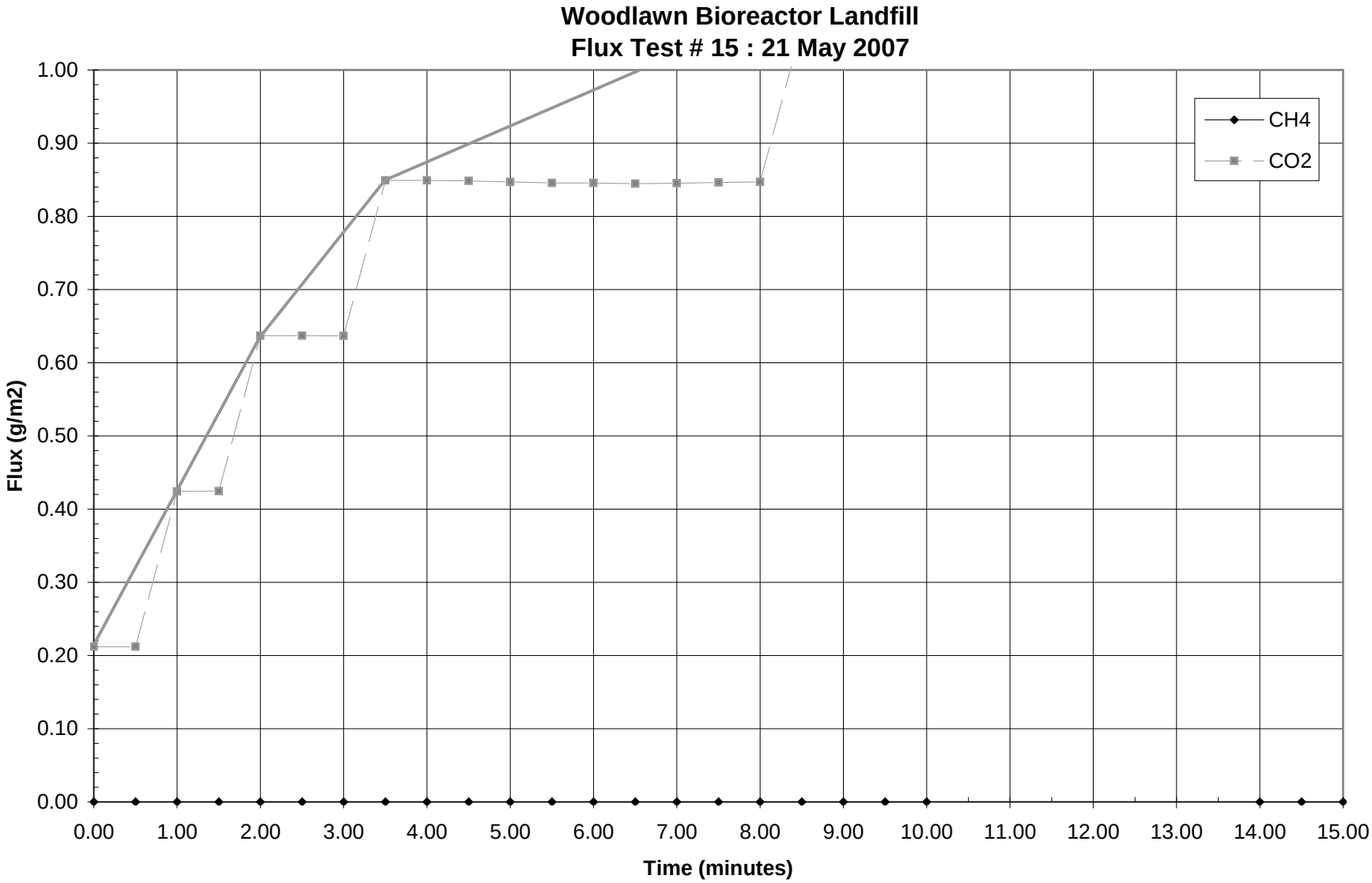

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Flux Test # 10 : 21 May 2007
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0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00
1.00
2.00
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Time (minutes)
CH4
CO2

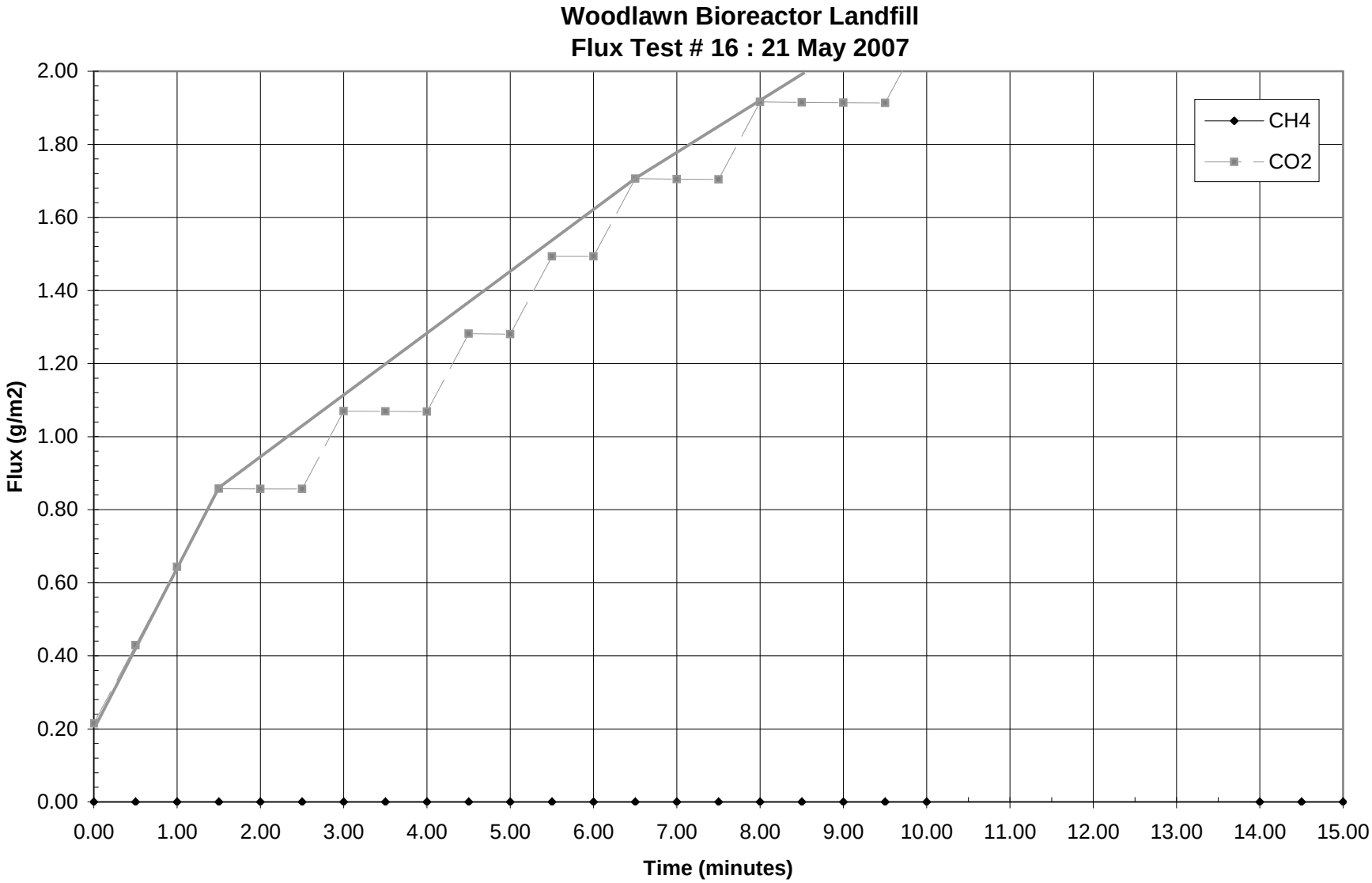

Woodlawn Bioreactor Landfill
Flux Test # 11 : 21 May 2007
Flux (g/m2)
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1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
1.00
2.00
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10.00
11.00
12.00
13.00
14.00
15.00
Time (minutes)
CH4
CO2


Woodlawn Bioreactor Landfill
Flux Test # 12 : 21 May 2007
Flux (g/m2)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.00
1.00
2.00
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8.00
9.00
10.00
11.00
12.00
13.00
14.00
15.00
Time (minutes)
CH4
CO2


Woodlawn Bioreactor Landfill
Flux Test # 13 : 21 May 2007
Flux (g/m2)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00
1.00
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10.00
11.00
12.00
13.00
14.00
15.00
Time (minutes)
CH4
CO2


Woodlawn Bioreactor Landfill
Flux Test # 14 : 21 May 2007
Flux (g/m2)
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
1.00
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10.00
11.00
12.00
13.00
14.00
15.00
Time (minutes)
CH4
CO2


Woodlawn Bioreactor Landfill
Flux Test # 15 : 21 May 2007
Flux (g/m2)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
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0.00
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10.00
11.00
12.00
13.00
14.00
15.00
Time (minutes)
CH4
CO2


Woodlawn Bioreactor Landfill
Flux Test # 16 : 21 May 2007
Flux (g/m2)
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1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
1.00
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12.00
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14.00
15.00
Time (minutes)
CH4
CO2

Appendix D

Results of GC Analysis

Woodlawn Bioreactor

Summary of GC Analysis

Sample	Methane		Carbon Dioxide	
	Field Reading (% v/v)	GC Results (% v/v)	Field Reading (% v/v)	GC Results (% v/v)
2	0.0%	0.046%	0.5%	0.56%
3	0.0%	0.056%	0.5%	0.56%
5	0.1%	0.134%	1.0%	0.81%
14	0.0%	0.086%	1.7%	1.11%

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10 Bond Street Sydney NSW 2000

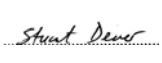
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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	S Dever	D Gamble		S Dever		21.6.07

Noise Assessment | Appendix G

HEGGIES

REPORT 30-2464-R1

Revision 3

Noise Impact Assessment

Woodlawn Expansion Project

PREPARED FOR

Veolia Environmental Services (Australia) Pty Ltd
Cnr. Unwin & Shirley Streets
Rosehill NSW 2142

14 JULY 2010

HEGGIES PTY LTD
ABN 29 001 584 612

Incorporating New Environment Graeme E. Harding & Associates Eric Taylor Acoustics

Noise Impact Assessment

Woodlawn Expansion Project

PREPARED BY:

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THIS DOCUMENT HAS BEEN PREPARED IN ACCORDANCE WITH THE REQUIREMENTS OF THAT SYSTEM.

DOCUMENT CONTROL

Reference	Status	Date	Prepared	Checked	Authorised
30-2464-R1	Revision 3	14 July 2010	John Cotterill	Robert Hall	John Cotterill
30-2464-R1	Revision 2	21 June 2010	John Cotterill	Nathan Archer	John Cotterill
30-2464-R1	Revision 1	27 April 2010	John Cotterill	Katie Teyhan	John Cotterill
30-2464-R1	Revision 0	22 April 2010	John Cotterill	Katie Teyhan	John Cotterill

EXECUTIVE SUMMARY

Heggies Pty Ltd (Heggies) has been engaged by Veolia Environmental Services (Australia) Pty Limited (Veolia) to undertake an assessment of noise impacts associated with the proposed Woodlawn Expansion Project.

Existing Environment

Ambient noise surveys were conducted to characterise and quantify the acoustical environment in the area surrounding the project site.

These measurements were then used to develop noise goals for operation of the development in accordance with Department of Environment Climate Change and Water (DECCW) *NSW Industrial Noise Policy* (INP) and *NSW Environmental Noise Control Manual* (ENCM). Traffic generated by the operation was assessed with reference to the *Environmental Criteria for Road Traffic Noise* (ECRTN).

A background monitoring survey, which included unattended continuous monitoring and operator attended monitoring, was undertaken at three (3) residential locations as part of a previous assessment conducted for the approved Alternative Waste Treatment facility (AWT). The background assessment conducted for the AWT was considered appropriate for use in this assessment as the background levels recorded were conservative (low). The background levels recorded for the AWT were predominantly below the minimum levels set in the INP and therefore further monitoring could only have resulted in higher ambient levels and hence less stringent project specific criteria. Existing background noise was typical of a rural environment.

Weather data from an on-site weather station was used to determine prevailing weather conditions for the site. Weather data was analysed in accordance with procedures outlined in the INP. Seasonal wind records indicate that wind from 0.5 m/s to 3 m/s exceeds the 30% threshold during summer nights and is therefore considered a feature of the area for the night-time period.

Meteorological data was analysed from the weather station to allow the determination of the percentage occurrence of temperature inversions during winter nights. Temperature inversion during the night-time period was identified to exceed the 30% criterion and has therefore been considered as part of this noise assessment.

The assessment of noise impacts during the occurrence of temperature inversions is confined to the night-time period (between 10.00 pm and 7.00 am) in accordance with the INP.

Potential Impacts

The noise assessment has considered the following potential environmental noise impacts:

- Noise impact of the Woodlawn Bioreactor and Crisps Creek Intermodal Facility as a result of the Woodlawn Expansion Project and extended hour of operation.
- Cumulative impact of noise from the existing Woodlawn Bioreactor, approved Woodlawn Wind Farm, and approved AWT.
- Traffic noise impact of the proposed additional transportation of waste from the Crisps Creek Intermodal Facility, the local area (50,000 tpa Section 75W modification), the proposed additional 80,000 tpa of regional waste and by the approved AWT facility.

EXECUTIVE SUMMARY

Noise Assessment

A computer model was used to predict noise emissions from operation of the proposed Woodlawn Expansion Project.

The operational noise modelling was undertaken using SoundPLAN v6.4 software, developed by Braunstein and Berndt Gmbh in Germany. A three-dimensional digital terrain map giving all relevant topographic information was used in the modelling process. The model used this map, together with noise source data, ground cover, shielding by barriers and/or adjacent buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers.

Conclusion

Operational noise emission levels from Woodlawn Bioreactor and the Crisps Creek Intermodal facility due to the proposed Woodlawn Expansion Project are predicted to meet the relevant project specific noise goals over the extended hours at all existing non-project related residential dwellings surrounding the site.

The cumulative impact of noise from the existing Woodlawn Bioreactor, approved Woodlawn Wind Farm, and approved AWT are predicted to comply with the relevant criteria set in accordance with the INP at residential receivers surrounding the site.

The contribution to traffic noise from heavy vehicles associated with the Woodlawn site, including the additional traffic generated from the Crisps Creek Intermodal Facility (IMF) and the regional waste component is predicted to comply with the ECRTN criteria.

TABLE OF CONTENTS

1	INTRODUCTION		1
2	PROJECT DESCRIPTION		2
	2.1	Nearest Residences	2
	2.2	Local Traffic	3
3	IMPACT ASSESSMENT PROCEDURES		4
	3.1	General Objectives	4
	3.2	Assessing Intrusiveness	4
	3.3	Assessing Amenity	4
	3.4	Assessing Sleep Disturbance	6
	3.5	Road Traffic Noise	6
4	EXISTING ACOUSTICAL AND METEOROLOGICAL ENVIRONMENT		7
	4.1	Ambient Background Noise Monitoring	7
	4.2	Unattended Continuous Noise Monitoring	10
	4.3	Operator Attended Noise Monitoring	11
	4.4	Effects of Meteorology on Noise Levels	12
	4.5	Temperature Inversion	13
5	PROJECT SPECIFIC NOISE CRITERIA		14
	5.1	Operational Noise Design Criteria	14
	5.2	Existing Licence Conditions IMF	14
	5.3	Sleep Disturbance Noise Goals	16
	5.4	Road Traffic Noise Design Criteria	16
6	NOISE MODELLING		17
	6.1	Noise Modelling Parameters	17
	6.2	Operational Scenario - Noise Model Summary	18
	6.3	Bioreactor Operational Noise Modelling Results and Discussion	19
	6.4	Bioreactor Sleep Disturbance Analysis	20
	6.5	IMF Operational Noise Modelling Results and Discussion	20
	6.6	IMF Sleep Disturbance Analysis	20
	6.7	Cumulative Noise Assessment	21
	6.8	Cumulative Intrusive Noise Assessment	23
7	ROAD TRAFFIC NOISE ASSESSMENT		26
8	CONCLUSION		28

TABLE OF CONTENTS

Table 1	Hours of Operation	2
Table 2	Potentially Affected Residences	2
Table 3	Amenity Criteria - Recommended LAeq Noise Levels from Industrial Noise Sources	5
Table 4	Modification to Acceptable Noise Level (ANL)* to Account for Existing Levels of Industrial Noise	6
Table 5	Background Noise Monitoring Locations	7
Table 6	Summary of Existing Ambient Background Noise Levels	10
Table 7	Operator Attended Noise Measurements	11
Table 8	Seasonal Frequency of Occurrence of Wind Speed Intervals - Daytime	12
Table 9	Seasonal Frequency of Occurrence of Wind Speed Intervals - Evening	12
Table 10	Seasonal Frequency of Occurrence of Wind Speed Intervals - Night	12
Table 11	Operational Project Specific Noise Criteria	14
Table 12	Sleep Disturbance Criteria	16
Table 13	Road Traffic Noise Criteria	16
Table 14	Meteorological Parameters for Noise Predictions	17
Table 15	Operational Scenario Considered in Noise Model	18
Table 16	Predicted Woodlawn Bioreactor Noise Levels – Woodlawn Expansion Project	19
Table 17	Predicted Intermodal Noise Levels - Chinnery	20
Table 18	Predicted Cumulative Impact	22
Table 19	Operational Scenario Considered in Noise Model	24
Table 20	Predicted Cumulative Woodlawn Bioreactor and AWT Noise Levels	25
Table 21	Proposed Heavy Vehicle Traffic Movements	26
Table 22	Predicted Road Traffic Noise Levels – Collector Road	27
Table 23	Predicted Road Traffic Noise Levels – Tarago and Bungendore Towns	27
Figure 1	Location of Nearest Residences	8
Figure 2	Location Nearest Affected Residence* – Crisps Creek IMF	9
Appendix A	Equipment Sound Power Levels	
Appendix B	Statistical Ambient Noise Monitoring Results	

1 INTRODUCTION

Heggies Pty Ltd (Heggies) has been engaged by Veolia Environmental Services (Australia) Pty Limited (Veolia) to undertake an assessment of noise impacts associated with the proposed Woodlawn Expansion Project (the Project).

Broadly, the objective of the assessment was to identify the potential impacts of noise from the proposed Project. The noise impacts include that from transport and processing of up to 1.13 million tonnes per annum (tpa) of putrescible waste at the Woodlawn Bioreactor and up to 1.18 million tonnes per annum at the Crisps Creek Intermodal Facility (IMF).

The noise assessment has been prepared with reference to Australian Standard AS 1055:1997 *Description and Measurement of Environmental Noise* Parts 1, 2 and 3 and in accordance with the Department of Environment, Climate Change and Water (DECCW) *NSW Industrial Noise Policy* (INP). Where issues relating to noise are not addressed in the INP, such as sleep disturbance, reference has been made to the *NSW Environmental Noise Control Manual* (ENCM). Traffic generated by the operation has been assessed with reference to the *Environmental Criteria for Road Traffic Noise* (ECRTN).

Reference has also been made to the following previous reports for the site:

- Woodward-Clyde *Woodlawn Waste Management Facility Environmental Impact Statement* dated 1999.
- Wilkinson Murray Report No. 04098 Version B *Woodlawn Wind Farm Noise Assessment* dated 2004.
- Heggies report 30-1392R1R3 *Woodlawn Alternative Waste Technology (AWT) Facility Noise Impact Assessment* dated January 2006.
- Heggies report 30-2474R1 *Noise Impact Assessment Woodlawn Regional Waste Modification* dated January 2010.

2 PROJECT DESCRIPTION

The purpose of the application is to assess the receival of up to 1.13 million tpa of general solid waste (putrescible) per annum at the Woodlawn Bioreactor and up to 1.18 million tpa through the IMF. The additional tonnage would enable waste to be received either by road or rail from the local region, as well as increasing the volume of waste received by rail from the greater Sydney region through the Crisps Creek Intermodal Facility (IMF).

To facilitate the additional tonnage and provide for adequate contingency in the operations, an extension to the hours of operation is being sought at both Crisps Creek and the Woodlawn Bioreactor. The proposed hours of operation are contained in **Table 1**.

Table 1 Hours of Operation

Description	Current	Proposed
Train operations at Crisps Creek Intermodal	6:00 am to 6:00 pm	6:00 am to 10:00 pm
Train unloading at Crisps Creek Intermodal	7:00 am to 6:00 pm	7:00 am to 10:00 pm
Woodlawn Bioreactor operations	6:00 am to 7:00 pm	6:00 am to 10:00 pm

This proposal would require an increase in equipment and personnel at both facilities. It is estimated that an additional 11 employees would be required between these two facilities and the additional equipment would include an extra forklift, bulldozer, landfill compactor and a container tipper. It should be noted that the additional equipment will be used for contingencies and not in normal operating purposes.

There would be no major construction work required for the proposed project, with the exception of additional lighting in Crisps Creek IMF, along the access road and in working areas within the void and the installation of additional gas collection and extraction infrastructure within the void.

While this application proposes to increase the annual input rate to the Bioreactor, the size of the void and therefore the total volume of waste that could be received at the facility throughout the life of the site would remain unchanged.

2.1 Nearest Residences

The nearest most potentially affected residences are summarised in **Table 2**.

Table 2 Potentially Affected Residences

Property ID	Property Name	Approximate Distance to Woodlawn Bioreactor (m)
A	“Cowley Hills”(owned by Veolia)	2,000
B	“Woodlawn Farm” (owned by Veolia)	1,600
C	“Pylara” (owned by Veolia)	4,000
D	“Torkina”	3,700
E	“Willeroo”	5,900
F	“Bernallah”	4,500
G*	“Chinnery”	680 (from IMF)

* Location G is the closest affected residence to the IMF. A residence on Lime St is closer but due to topographic shielding is less affected than Location G

2.2 Local Traffic

It is expected that the Project will generate a maximum of 15 heavy vehicle movements per hour between the Crisps Creek Intermodal facility and the Woodlawn Bioreactor site. The current traffic generation between the Intermodal and Woodlawn is approximately 10 heavy vehicle movements per hour.

It is also envisaged that there will be addition waste transported by road from regional areas, further to that proposed for the Section 75 W Regional Waste Modification (50,000 tpa total from Goulbourn Mulwaree, Palerang, Queanbeyan and Bega Valley Councils). This application include waste from Upper Lachlan & Yass Valley (3,000 tpa - for each Council), Eurobodalla (21,000 tpa) and the ACT (53,000 tpa – 50 percent of the total "Commercial & Industrial" and "Private" waste streams). Proposed traffic movement are discussed further in **Section 7** of this report.

3 IMPACT ASSESSMENT PROCEDURES

3.1 General Objectives

Responsibility for the control of noise emission in New South Wales is vested in Local Government and the DECCW. The INP was released in January 2000 and provides a framework and process for deriving noise criteria for consents and licences that will enable the DECCW to regulate premises that are scheduled under the Protection of the Environment Operations Act, 1997.

The specific policy objectives are:

- To establish noise criteria that would protect the community from excessive intrusive noise and preserve amenity for specific land uses.
- To use the criteria as the basis for deriving project specific noise levels.
- To promote uniform methods to estimate and measure noise impacts, including a procedure for evaluating meteorological effects.
- To outline a range of mitigation measures that could be used to minimise noise impacts.
- To provide a formal process to guide the determination of feasible and reasonable noise limits for consents or licences that reconcile noise impacts with the economic, social and environmental considerations of industrial development.
- To carry out functions relating to the prevention, minimisation and control of noise from premises scheduled under the Act.

The INP provides two forms of noise criteria with the aim of achieving environmental noise objectives; one to account for intrusive noise which involves setting a noise goal relative to the existing acoustic environment and the other to protect the amenity of particular land uses.

3.2 Assessing Intrusiveness

For assessing intrusiveness, the background noise level must be measured. The intrusiveness criterion essentially means that the equivalent continuous noise level (L_{Aeq}) of the source should not be more than five decibels above the measured background level (L_{A90}).

3.3 Assessing Amenity

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise and do not include road, rail or community noise. The existing noise level from industry is measured. If it approaches the criterion value, then noise levels from new industries need to be designed so that the cumulative effect does not produce noise levels that would significantly exceed the criterion.

An extract from the INP that relates to the amenity criteria is given in **Table 3** and **Table 4**.

Table 3 Amenity Criteria - Recommended L_{Aeq} Noise Levels from Industrial Noise Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended $L_{Aeq(Period)}$ Noise Level (dBA)	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
	Urban	Day	60	65
		Evening	50	55
		Night	45	50
School classrooms - internal	All	Noisiest 1 hour period when in use	35	40
Hospital wards - internal	All	Noisiest 1 hour period	35	40
Hospital wards - external	All	Noisiest 1 hour period	50	55
Place of worship - internal	All	When in use	40	45
Area specifically reserved for passive recreation (eg National Park)	All	When in use	50	55
Active recreation area (eg school playground, golf course)	All	When in use	55	60
Commercial premises	All	When in use	65	70
Industrial premises	All	When in use	70	75

Note: Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am, On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.
The L_{Aeq} index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

Table 4 Modification to Acceptable Noise Level (ANL)* to Account for Existing Levels of Industrial Noise

Total Existing L_{Aeq} noise level from Industrial Noise Sources	Maximum L_{Aeq} Noise Level for Noise from New Sources Alone, dBA
≥ Acceptable noise level plus 2 dBA	If existing noise level is *likely to decrease* in future acceptable noise level minus 10 dBA If existing noise level is *unlikely to decrease* in future existing noise level minus 10 dBA
Acceptable noise level plus 1 dBA	Acceptable noise level minus 8 dBA
Acceptable noise level	Acceptable noise level minus 8 dBA
Acceptable noise level minus 1 dBA	Acceptable noise level minus 6 dBA
Acceptable noise level minus 2 dBA	Acceptable noise level minus 4 dBA
Acceptable noise level minus 3 dBA	Acceptable noise level minus 3 dBA
Acceptable noise level minus 4 dBA	Acceptable noise level minus 2 dBA
Acceptable noise level minus 5 dBA	Acceptable noise level minus 2 dBA
Acceptable noise level minus 6 dBA	Acceptable noise level minus 1 dBA
< Acceptable noise level minus 6 dBA	Acceptable noise level

* ANL = recommended acceptable L_{Aeq} noise level for the specific receiver, area and time of day from **Table 3**

3.4 Assessing Sleep Disturbance

The DECCW has acknowledged that the relationship between maximum noise levels and sleep disturbance is not currently well defined. Criteria for assessing sleep disturbance has not been identified under the INP and hence, sleep arousal has been assessed using the guidelines set out in the ENCM Chapter 19-3.

To avoid the likelihood of sleep disturbance the ENCM recommends that the $L_{A1(1minute)}$ noise level of the source under consideration should not exceed the background noise level (L_{A90}) by more than 15 dBA when measured outside the bedroom window of the receiver during the night-time hours (10.00 pm to 7.00 am).

3.5 Road Traffic Noise

The Environment Protection Authority released the "*Environmental Criteria for Road Traffic Noise*" in May 1999. The policy sets out noise criteria applicable to different road classifications for the purpose of defining traffic noise impacts.

4 EXISTING ACOUSTICAL AND METEOROLOGICAL ENVIRONMENT

4.1 Ambient Background Noise Monitoring

Ambient noise levels were measured during a previous assessment conducted by Heggies for the AWT refer Heggies report 30-1392R1R3 *Woodlawn Alternative Waste Technology Facility Noise Impact Assessment* dated January 2006). A background monitoring survey was undertaken at the nearest residential locations given in **Table 5**. The noise monitoring locations are identified in the location maps contained in **Figure 1** and **Figure 2**. **Figure 1** includes associated residences that are owned by Veolia, as well as the nearest affected residences

Table 5 Background Noise Monitoring Locations

Noise Monitoring Location	Description
Location A	Cowley Hills (owned by Veolia)
Location B	Woodlawn Farm (owned by Veolia)
Location G	Chinnery

The background noise monitoring consisted of continuous, unattended noise logging and operator attended noise surveys. The operator attended noise surveys help to define noise sources and the character of noise in the area and are, therefore, used to qualify unattended noise logging results.

The background assessment conducted for the AWT was considered appropriate for use in this assessment as the background levels recorded were conservative (low). The background levels recorded for the AWT were predominantly below the minimum levels set in the INP and therefore further monitoring could only have resulted in higher ambient levels and hence less stringent project specific criteria.

Figure 1 Location of Nearest Residences (Source: Umwelt 2006 AWT Report)

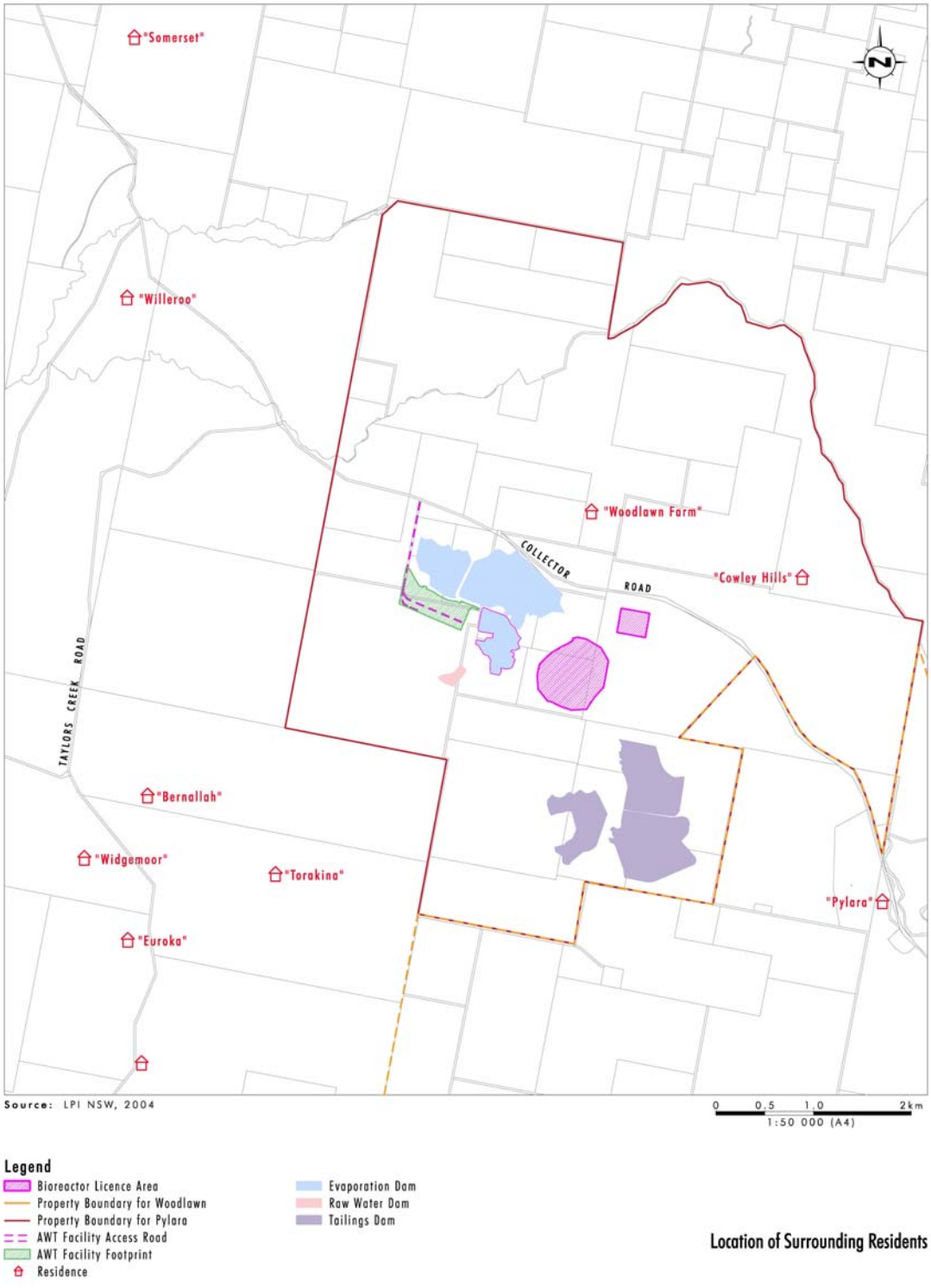
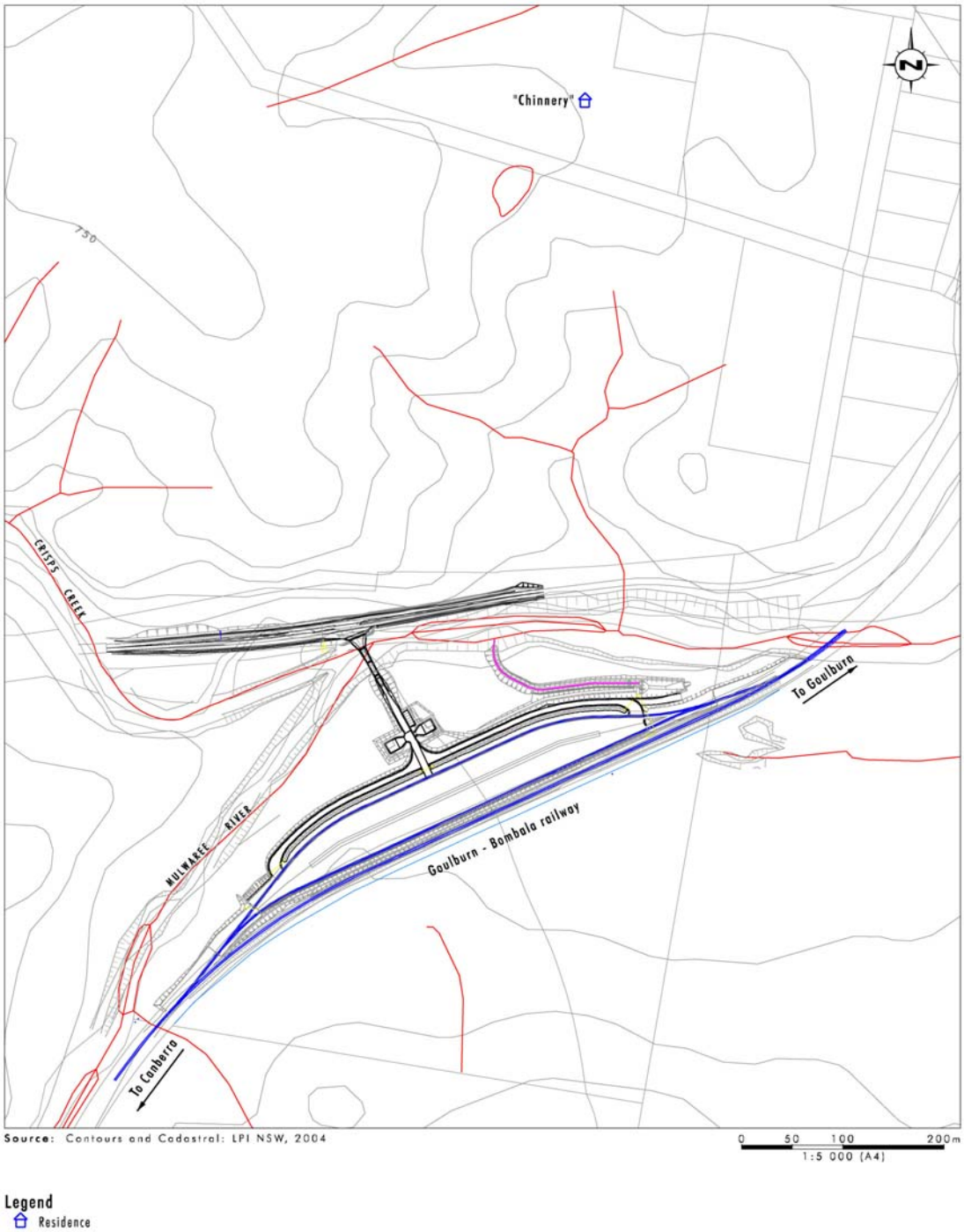


Figure 2 Location Nearest Affected Residence* – Crisps Creek IMF (Source: Umwelt 2006 AWT Report)



* Chinnery is the closest affected residence to the IMF. A residence on Lime St is closer but due to topographic shielding is less affected than Chinnery.

4.2 Unattended Continuous Noise Monitoring

The objective of the background monitoring survey was to measure $L_{A90(15minute)}$ and $L_{Aeq(15\ minute)}$ noise levels at the nearest potentially affected receptors during proposed operational periods to determine the intrusiveness and amenity criteria for the development.

Background noise levels were monitored by Heggies using ARL Type EL316 and Type EL215 environmental noise loggers at Locations A, B and G from Wednesday 4 May 2005 to Saturday 21 May 2005.

Noise data during periods of any rainfall and/or wind speeds in excess of 5 m/s (approximately 9 knots) were discarded in accordance with INP weather affected data exclusion methodology.

A summary of the results of the unattended continuous noise monitoring are given in **Table 6**. The ambient noise levels from each monitoring location are presented in graphical format in **Appendix B**.

Table 6 Summary of Existing Ambient Background Noise Levels

Location	Description	Background Noise Level (L_{A90} dBA)	Existing industrial noise contribution L_{Aeq} (dBA)
		Rating Background Level	
Location A Cowley Hills (owned by Veolia)	Daytime	30 dBA	<44 dBA
	Evening	30 dBA	<39 dBA
Logger serial number 16-203-506	Night	30 dBA	<34 dBA
Location B Woodlawn Farm (owned by Veolia)	Daytime	31 dBA	<44 dBA
	Evening	30 dBA	<39 dBA
Logger serial number 16-203-509	Night	30 dBA	<34 dBA
Location G Chinerry	Daytime	30 dBA	<34 dBA
	Evening	30 dBA	<34 dBA
Logger serial number 16-203-506	Night	30 dBA	<34 dBA

Notes: Monday to Saturday, Daytime 7.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 7.00 am.
Sundays & Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am
The L_{A90} represents the level exceeded for 90% of the interval period and is referred to as the average minimum or background noise level
The L_{Aeq} descriptor corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

Existing industrial noise contributions were determined from attended measurements at each of the monitoring locations. The existing industrial noise contribution was not discernable at the monitored locations.

4.3 Operator Attended Noise Monitoring

Operator-attended surveys were conducted at each of the noise monitoring locations to verify the unattended logging results and to determine the character and contribution of noise sources to the total ambient noise level.

Operator attended noise surveys were conducted during logger deployment on Wednesday 4 May 2005 at Locations A and B and Friday 13 May 2005 at Location G. Results of these surveys are shown in **Table 7**. Ambient noise levels given in the tables include all noise sources such as traffic, insects, birds, and local activities. The table provides the following information:

- Monitoring location
- Date /Start time/ Weather Conditions
- Typical maximum (L_{Amax}) and contributed noise levels

Table 7 Operator Attended Noise Measurements

Location	Date/ Start time/ Weather	Primary Noise Descriptor (dBA re 20 μPa)					Description of Noise Emission Typical Maximum Levels L_{Amax} (dBA)
		L_{Amax}	LA1	LA10	LA90	LAeq	
Location A Cowley Hills (owned by Veolia)	4/5/05 10:15 Day W=1 m/s NW Temp=17°C	77	72	46	35	56	Truck passby 74, 75, 76 Birds Insects 34 -38 Wind in trees 35-36
Location B Woodlawn Farm (owned by Veolia)	4/5/05 11:15 Day W=1 m/s NW Temp=16°C	66	57	50	44	49	Birds Insects 45-46 Wind in trees 45-50
Location G Chinnery	13/5/05 14:50 Day W=0.5 m/s NW Temp=17°C	61	46	36	26	35	Truck on Highway 40 Car on Highway 35 Farm activity (farm car) 49 Birds 50

It should be noted that the typical maximum noise levels recorded during the operator attended surveys do not reflect the L_{Aeq} contribution of these sources.

4.4 Effects of Meteorology on Noise Levels

Wind

Wind has the potential to increase noise at a receiver when it is light and stable and blows from the direction of the source of the noise. As the strength of the wind increases the noise produced by the wind will obscure noise from most industrial and transport sources.

Wind effects need to be considered when wind is a feature of the area under consideration. Where wind blows from the source to the receiver at speeds up to 3 m/s for more than 30% of the time in any season, then wind is considered to be a feature of the area and noise level predictions must be made under these conditions.

Weather data was obtained, for a period of 12 months - December 2008 to December 2009, from a weather station located on the Woodlawn site. The weather data was analysed to determine the frequency of occurrence of winds up to speeds of 3 m/s for daytime, evening and night in each season. A summary of the most frequently occurring winds is contained within **Table 8**, **Table 9** and **Table 10**. The percentage occurrence figures provided in bold are those that exceed the 30% threshold.

Table 8 Seasonal Frequency of Occurrence of Wind Speed Intervals - Daytime

Period	Calm	Wind Direction	0.5 - 2 m/s	2 - 3 m/s	0.5 - 3 m/s
Summer	0.2%	ENE±45°	3.8%	9.3%	13.1%
Autumn	3.5%	W±45°	11.4%	9.8%	21.2%
Winter	100.0%	NNW±45°	0.0%	0.0%	0.0%
Spring	0.5%	NE±45°	4.6%	6.4%	11.0%

Table 9 Seasonal Frequency of Occurrence of Wind Speed Intervals - Evening

Period	Calm	Wind Direction	0.5 - 2 m/s	2 - 3 m/s	0.5 - 3 m/s
Summer	2.3%	ENE±45°	6.8%	11.6%	18.3%
Autumn	8.0%	E±45°	13.2%	13.9%	27.1%
Winter	8.3%	WSW±45°	10.2%	13.3%	23.5%
Spring	2.7%	ENE±45°	7.0%	11.4%	18.4%

Table 10 Seasonal Frequency of Occurrence of Wind Speed Intervals - Night

Period	Calm	Wind Direction	0.5 - 2 m/s	2 - 3 m/s	0.5 - 3 m/s
Summer	10.9%	ENE±45	17.4%	13.7%	**31.0%**
Autumn	26.3%	E±45	17.1%	9.5%	26.6%
Winter	10.7%	WSW±45	12.9%	11.9%	24.8%
Spring	11.8%	ENE±45	11.7%	10.6%	22.3%

Seasonal wind records indicate that winds from 0.5 m/s to 3 m/s exceed the 30% threshold during the night from the east-north-east and are therefore a feature of the area during this period. Consequently, prevailing wind has been considered as part of this assessment.

4.5 Temperature Inversion

Temperature inversions, when they occur, have the ability to increase noise levels by focusing sound waves. Temperature inversions occur predominantly at night during the winter months. For a temperature inversion to be a significant characteristic of the area it needs to occur for approximately 30% of the total night-time during winter, or about two nights per week.

Weather data from an on-site weather station was used to determine prevailing weather conditions for the site. Weather data was analysed in accordance with procedures outlined in the INP. Seasonal wind records indicate that wind from 0.5 m/s to 3 m/s exceeds the 30% threshold during summer nights and is therefore considered a feature of the area for the night-time period.

Meteorological data was analysed from the weather station to allow the determination of the percentage occurrence of temperature inversions during winter nights. Temperature inversion during the night-time period was identified to exceed the 30% criterion and has therefore been considered as part of this noise assessment.

5 PROJECT SPECIFIC NOISE CRITERIA

5.1 Operational Noise Design Criteria

The noise emission design criteria for the Woodlawn Bioreactor have been established with reference to the INP as outlined in **Section 3** of this report.

The amenity criteria have been set from **Table 3**, with adjustments to account for existing industrial noise contributions, from **Table 4** as necessary.

The acoustical environment typifies that of a rural environment. The residences in the general area have been assessed under the relevant receiver type as shown in **Table 11**.

The intrusive and amenity noise assessment criteria for the assessment localities, with reference to the INP, are presented in **Table 11**.

Table 11 Operational Project Specific Noise Criteria

Location	Locality (Noise Amenity Area)	Period	Intrusiveness Criteria $L_{Aeq(15minute)}$ (dBA)	Amenity Criteria $L_{Aeq(Period)}$ (dBA)
A	Cowley Hills (owned by Veolia) (Rural)	Day	35	50
		Evening	35	45
		Night	35	40
B	Woodlawn Farm (owned by Veolia) (Rural)	Day	36	50
		Evening	35	45
		Night	35	40
G	Chinnery (Rural)	Day	35	50
		Evening	35	45
		Night	35	40

For Monday to Saturday, Daytime 7.00 am - 6.00pm; Evening 6.00pm - 10.00pm; Night-time 10.00pm - 7.00am.
On Sundays and Public Holidays, Daytime 8.00am - 6.00pm; Evening 6.00pm - 10.0 pm; Night-time 10.0 pm - 8.00am.

The intrusive criteria will be the limiting criteria at all areas during all periods.

The INP states that these criteria have been selected to protect at least 90% of the population, living in the vicinity of industrial noise sources, from the adverse effects of noise for at least 90% of the time. Provided the criteria in the INP are achieved, it is unlikely that most people would consider the resultant noise levels excessive.

5.2 Existing Licence Conditions IMF

The current Crisps Creek IMF Environmental Protection Licence (EPL) noise limits are outlined as follows:

L6 Noise Limits

L6.1 Except as provided in condition L6.2, noise from the premises must not exceed an $L_{Aeq\ (15\ minute)}$ noise emission criterion of 35 dB(A) at the most affected residential receiver.

L6.2 Noise emissions from freight trains entering and leaving the premises must not exceed the noise limit of 45 dB(A) $L_{Aeq\ (15\ minutes)}$ prior to 7:00 am and 50 dB(A) $L_{Aeq\ (15\ minutes)}$ after 7:00 am. These limits apply only where there are no more than two freight trains entering and leaving the premises per day, otherwise the limit in condition L6.1 applies.

L6.3 For the purpose of Conditions L6.1 and L6.2

The L_{Aeq} noise level must be measured or computed at the most affected residential receiver over a period of 15 minutes using "FAST" response on the sound level meter. In the case of condition L6.2, the period is the duration of a train entering and/or leaving the premises if this is less than 15 minutes.

5dB(A) must be added to the measured level if the noise is substantially tonal or impulsive in character.

Measurement locations are:

for night time (10 pm to 7 am) assessment – 1 metre from the façade of the residence; and

for day time (7 am to 10 pm) assessment – at the residential boundary or 30 metres from the residence where the boundary is more than 30 metres from the residence.

The noise emission limits apply for prevailing meteorological conditions and winds up to 3 metres per second, except under conditions of temperature inversions.

Currently, the Intermodal does not operate during the evening period. It would be expected that a noise limit of 35 dBA $L_{Aeq(15minute)}$ would be applied to the evening period for normal operations and a noise limit of 45 dB(A) $L_{Aeq(15minute)}$ for freight trains entering and leaving the premises during the evening period.

5.3 Sleep Disturbance Noise Goals

The relevant sleep disturbance noise goals for each residential area are provided in **Table 12**.

Table 12 Sleep Disturbance Criteria

Location	Locality (Noise Amenity Area)	Period	Sleep Disturbance Criteria $L_{A1(1minute)}$ dBA
A	Cowley Hills (owned by Veolia) (Rural)	Night	45
B	Woodlawn Farm (owned by Veolia) (Rural)	Night	45
G	Chinnery (Rural)	Night	45

5.4 Road Traffic Noise Design Criteria

Road traffic noise criteria are set out in the ECRTN. The criteria recommended in the policy document are based on the functional categories of the subject roads, as applied by the RTA. Bungendore Road would be classified as a sub-arterial road and Collector Road would be classified as a collector road. The relevant road traffic noise criteria for the subject development are provided in **Table 13**.

Table 13 Road Traffic Noise Criteria

Type of Development	Criteria		
	Day 7 am - 10 pm	Night 10 pm - 7 am	Where Criteria are Already Exceeded
Land use developments with potential to create additional traffic on existing freeways/ arterials	60 dBA $L_{Aeq(15hour)}$	55 dBA $L_{Aeq(9hour)}$	Where feasible, existing noise levels should be mitigated to meet the noise criteria. Examples of applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using 'quiet' vehicles; and using barriers and acoustic treatments. In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB.
Land use developments with potential to create additional traffic on existing collector roads	60 dBA $L_{Aeq(1hour)}$	55 dBA $L_{Aeq(1hour)}$	

6 NOISE MODELLING

6.1 Noise Modelling Parameters

A computer model was used to predict noise emissions from operation of the proposed Project. The operational noise modelling was undertaken using SoundPLAN v6.4 software, developed by Braunstein and Berndt Gmbh in Germany. A three-dimensional digital terrain map giving all relevant topographic information was used in the modelling process. The model used this map, together with noise source data, ground cover, shielding by barriers and/or adjacent buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers.

Topographic contours and operational plans were supplied by Veolia for the purpose of modelling noise from the proposed development.

Prediction of noise emission levels was carried out under calm and prevailing atmospheric conditions. Atmospheric parameters under which noise predictions were made are given in **Table 14**.

Table 14 Meteorological Parameters for Noise Predictions

	Temperature	**Humidity**	**Wind Speed**	**Wind Direction** (degrees from north)	**Temperature Inversion**
Calm (All periods)	20°C	65%	n/a	n/a	n/a
Wind (Night only)	20°C	65%	3 m/s	67	n/a
Inversion (Night only)	10°C	90%	n/a	n/a	3°C/100m

Sound power levels of relevant equipment have been obtained from measurements on the Woodlawn site or have been sourced from a Heggies database of similar equipment. Relevant noise source data is contained within **Appendix A**.

6.2 Operational Scenario - Noise Model Summary

The operational scenario modelled during each period is summarised in **Table 15**. A tick (✓) indicates that the equipment is in operation during the relevant period. A cross (×) indicates that the equipment is not in operation during the relevant period. Where there is a number in brackets following a tick, this represents the number of items of equipment that have been considered in the noise model during the relevant period.

Table 15 Operational Scenario Considered in Noise Model

Plant and Equipment	Moring Shoulder (night) 6.00 am - 7.00 am	Day 7.00 am - 6.00 pm	Evening 6.00 pm – 10.00 pm
Woodlawn Bioreactor			
Trucks	×	✓ (10)	✓ (10)
Container tipper	×	✓ (2)	✓ (2)
Dump trucks	×	✓(2)	✓(2)
Dozer	×	✓(2)	✓(2)
Compactor	×	✓(2)	✓(2)
Compressor	✓	✓	✓
FEL	×	✓	✓
Aerators	✓(2)	✓(2)	✓(2)
Generators	✓(24)	✓(24)	✓(24)
Crisps Creek IMF			
Forklifts	×	✓(2)	✓(2)
Train	✓(1)	✓(1)	✓(1)
Trucks	×	✓ (6)	✓ (6)

Note: Additional tipper, dump truck, dozer and compactor and forklift have been included in the model, however they are only expected to be used for contingency, not under operating conditions

6.3 Bioreactor Operational Noise Modelling Results and Discussion

Noise emission levels were predicted from the proposed Project for a typical operational scenario described in **Table 15**. Noise levels predicted at the nearest residential receiver locations are provided in **Table 16**.

Table 16 Predicted Woodlawn Bioreactor Noise Levels – Woodlawn Expansion Project

Location	Assessment Period	Predicted Noise Level $L_{Aeq(15minute)}$ (dBA)		Project Specific Noise Criteria
		Calm Conditions	Adverse Conditions	dBA $L_{Aeq(15minute)}$
Location A Cowley Hills (owned by Veolia)	Morning Shoulder	33	37	35
	Daytime	34	N/A	
	Evening	34	N/A	
Location B Woodlawn Farm (owned by Veolia)	Morning Shoulder	34	37	35
	Daytime	35	N/A	36
	Evening	35	N/A	35
Location C Pylara (owned by Veolia)	Morning Shoulder	< 30	< 30	35
	Daytime	< 30	N/A	
	Evening	< 30	N/A	
Location D Torkina	Morning Shoulder	< 30	< 30	35
	Daytime	< 30	N/A	
	Evening	< 30	N/A	
Location E Willeroo	Morning Shoulder	< 30	< 30	35
	Daytime	< 30	N/A	
	Evening	< 30	N/A	
Location F Bernallah	Morning Shoulder	< 30	< 30	35
	Daytime	< 30	N/A	
	Evening	< 30	N/A	

The noise impact of the proposed Project has minimal impact on noise generated by the current bioreactor operation. Operational noise levels of the bioreactor operation with the proposed Project are predicted to meet the project specific noise criteria at all residential locations under calm weather conditions. Operational noise levels of the bioreactor operation with the proposed Project are predicted to meet the project specific noise criteria at all but two (2) residential locations where exceedances of up to 2 dBA are predicted under prevailing weather conditions. These properties - Cowley Hills and Woodlawn Farm - are both owned by Veolia and as such are considered “project related” for this assessment.

6.4 Bioreactor Sleep Disturbance Analysis

The proposed expansion will not impact noise levels in the morning shoulder period between 6:00 am and 7:00 am (night) as no additional activities will occur during this period as a result of the proposal. Given the relative constant nature of existing approved noise sources that operate in the morning shoulder period it is not likely that sleep disturbance will occur as a result of the operation.

6.5 IMF Operational Noise Modelling Results and Discussion

Noise emission levels were predicted from the IMF for a typical operational scenario detailed in **Table 15**. The assessment included the arrival of trains, the unloading using of forklifts and truck movements on site. The noise emission from the site will be similar in character to that of the existing operation but will include an additional forklift. The hours of operation will also extend to the evening period between 6.00 pm and 10.00 pm. There is no increase in the approved number of trains to proposed for the IMF.

Noise levels predicted at Location G, which was deemed to be representative of the nearest affected residential receivers, are provided in **Table 17**. There is a residence on Lime Street that is closer to the IMF but this residence is afforded shielding by topographic features that reduce the predicted noise levels below those provided for Location G.

Table 17 Predicted Intermodal Noise Levels - Chinnery

Location/Activity	Assessment Period	Predicted Noise Level $L_{Aeq(15minute)}$ (dBA)		Project Specific Noise Criteria dBA $L_{Aeq(15minute)}$
		Calm Conditions	Adverse Conditions	
Location G Chinnery Train arrival	Morning Shoulder 6:00 am to 7:00 am	<30 dBA	<30 dBA	45 dBA
	Daytime 7.00 am to 6:00 pm	<30 dBA	N/A	50 dBA
	Evening 6:00 pm to 10:00 pm	<30 dBA	N/A	45 dBA
Location G Chinnery Loading/ unloading operations	Daytime 7.00 am to 6:00 pm	33 dBA	N/A	35 dBA
	Evening 6:00 pm to 10:00 pm	33 dBA	N/A	

Operational noise levels from the IMF are predicted to meet the project specific noise criteria at all residential locations during the morning shoulder, daytime and evening periods.

6.6 IMF Sleep Disturbance Analysis

The proposed expansion will not impact noise levels in the morning shoulder period between 6:00 am and 7:00 am (night) as no additional activities will occur during this period as a result of the proposal. Train arrival during the morning shoulder period (6:00 am to 7:00 am) has the potential to cause sleep disturbance. L_{Amax} levels measured during a train arrival were used as input to the noise model in order to assess sleep disturbance. The maximum noise level is predicted to be below 40 dBA during a train arrival and will therefore meet the sleep disturbance criteria set for residential Location G.

6.7 Cumulative Noise Assessment

The INP prescribes detailed calculation routines for establishing "project specific" $L_{Aeq(15minute)}$ intrusive criteria and $L_{Aeq(Period)}$ amenity criteria at potentially affected receivers for a development (in isolation).

Potential cumulative noise impacts from existing and successive developments are embraced by the INP procedures by ensuring that the appropriate noise emission criteria (and consent limits) are established with a view of maintaining acceptable noise *amenity* levels for residences.

In order to assess potential cumulative noise impacts it is important to appreciate and distinguish the INP's first and second environmental noise control objectives as follows:

Intrusive Noise Criteria $L_{Aeq(15minute)}$

The INP's first objective, that the intrusive noise emission from any single source does not exceed the background level by more than 5 dBA relates to each individual development and the intrusive noise limit is generally specified in the Development Consent and/or Licences and Approvals.

There is not an established procedure (or regulatory requirement) to determine the cumulative intrusive $L_{Aeq(15minute)}$ noise criterion in relation to the simultaneous operation of existing operations.

Cumulative Noise Amenity Criteria $L_{Aeq(period)}$

The INP's second objective is that the $L_{Aeq(period)}$ amenity level does not exceed the specified "acceptable" level appropriate for the particular locality and land use and is aimed at restricting the potential cumulative increase in noise *amenity* levels (otherwise known as "background creep").

Based on the INP, the acceptable $L_{Aeq(period)}$ noise *amenity* level in relation to the simultaneous operation of the Woodlawn Bioreactor, approved Wind Farm and AWT are daytime 50 dBA $L_{Aeq(11hour)}$, evening 45 dBA $L_{Aeq(4hour)}$ and night-time 40 dBA $L_{Aeq(9hour)}$.

The potential for the simultaneous operation of the Woodlawn Bioreactor, Wind Farm and AWT to exceed the acceptable and maximum noise amenity criteria can be assessed on a worst case scenario basis by adding the predicted intrusive noise levels from each individual site together for each period. The cumulative intrusive level is then adjusted (by -3 dBA) to the equivalent amenity level for comparison with the relevant amenity criteria for each location. The cumulative noise amenity levels during calm and adverse weather conditions for the areas of greatest potential cumulative impact are presented in **Table 18**. Predicted intrusive noise levels for the Woodlawn Wind Farm were sourced from Wilkinson Murray Report No. 04098 Version B "Woodlawn Wind Farm Noise Assessment" dated 2004. AWT predicted noise emission levels have been sourced from Heggies report 30-1392R1R3 *Woodlawn Alternative Waste Technology Facility Noise Impact Assessment.* Woodlawn Bioreactor existing and proposed modification predicted intrusive noise levels were taken from the data presented in **Table 16**.

Table 18 Predicted Cumulative Impact

Location	Period	Intrusive Predicted Noise Level LAeq(15minute) (dBA)						Cumulative Amenity Level LAeq(period)		Amenity Criteria (LAeq)
		Wind Farm		Bioreactor		AWT				
		Calm	Adverse	Calm	Adverse	Calm	Adverse	Calm	Adverse	
Location A Cowley Hills (owned by Veolia)	Day	< 30 dBA	30 dBA	34 dBA	N/A	< 30 dBA	N/A	34 dBA	<30 dBA	50 dBA
	Evening	< 30 dBA	30 dBA	34 dBA	N/A	< 30 dBA	N/A	34 dBA	<30 dBA	45 dBA
	Night	< 30 dBA	30 dBA	33 dBA	37 dBA	< 30 dBA	32 dBA	34 dBA	36 dBA	40 dBA
Location B Woodlawn Farm (owned by Veolia)	Day	< 30 dBA	34 dBA	35 dBA	N/A	34 dBA	N/A	36 dBA	31 dBA	50 dBA
	Evening	< 30 dBA	34 dBA	35 dBA	N/A	35 dBA	N/A	36 dBA	31 dBA	45 dBA
	Night	< 30 dBA	34 dBA	34 dBA	37 dBA	35 dBA	38 dBA	36 dBA	39 dBA	40 dBA
Location C Pylara (owned by Veolia)	Day	< 30 dBA	35 dBA	< 30 dBA	N/A	< 30 dBA	N/A	32 dBA	32 dBA	50 dBA
	Evening	< 30 dBA	35 dBA	< 30 dBA	N/A	< 30 dBA	N/A	32 dBA	32 dBA	45 dBA
	Night	< 30 dBA	35 dBA	< 30 dBA	< 30 dBA	< 30 dBA	< 30 dBA	32 dBA	34 dBA	40 dBA
Location D Torkina	Day	< 30 dBA	35 dBA	< 30 dBA	N/A	< 30 dBA	N/A	32 dBA	32 dBA	50 dBA
	Evening	< 30 dBA	35 dBA	< 30 dBA	N/A	30 dBA	N/A	32 dBA	32 dBA	45 dBA
	Night	< 30 dBA	35 dBA	< 30 dBA	< 30 dBA	30 dBA	35 dBA	32 dBA	36 dBA	40 dBA
Location E Willeroo	Day	< 30 dBA	< 30 dBA	< 30 dBA	N/A	< 30 dBA	N/A	32 dBA	32 dBA	50 dBA
	Evening	< 30 dBA	< 30 dBA	< 30 dBA	N/A	< 30 dBA	N/A	32 dBA	<30 dBA	45 dBA
	Night	< 30 dBA	< 30 dBA	< 30 dBA	< 30 dBA	< 30 dBA	< 30 dBA	32 dBA	32 dBA	40 dBA
Location F Bernallah	Day	< 30 dBA	< 30 dBA	< 30 dBA	N/A	< 30 dBA	N/A	32 dBA	<30 dBA	50 dBA
	Evening	< 30 dBA	< 30 dBA	< 30 dBA	N/A	31 dBA	N/A	32 dBA	<30 dBA	45 dBA
	Night	< 30 dBA	< 30 dBA	< 30 dBA	< 30 dBA	31 dBA	35 dBA	32 dBA	34 dBA	40 dBA

N/A: the meteorological condition is not relevant during this period

The results contained in **Table 18** show that the cumulative impact of the Project, Wind Farm, and AWT will comply with the relevant amenity criteria set in accordance with the INP at residential receivers surrounding the site.

6.8 Cumulative Intrusive Noise Assessment

Noise emissions from the Woodlawn Bioreactor and AWT have been assessed separately. Consents for each development were also issued as follows:

- Woodlawn Bioreactor – DA No. 31-02-99
- AWT – Application no 06_0239 Granted 6 November 2007

It should be noted that the EPL for the Woodlawn Bioreactor does not contain noise limits for the approved AWT facility.

Although the Woodlawn Bioreactor and AWT facilities are two distinct operations with separate development consents, as part of this noise assessment DECCW wish to examine the cumulative noise impact against the intrusive criteria for the Bioreactor and the AWT operations.

Notwithstanding this, the noise emission levels of the combined Bioreactor and AWT operations were modelled.

The operational scenario modelled during each period is summarised in **Table 19**. A tick (✓) indicates that the equipment is in operation during the relevant period. A cross (×) indicates that the equipment is not in operation during the relevant period. Where there is a number in brackets following a tick, this represents the number of items of equipment that have been considered in the noise model during the relevant period.

Table 19 Operational Scenario Considered in Noise Model

Plant and Equipment	Morning Shoulder (night) 6.00 am - 7.00 am	Day 7.00 am - 6.00 pm	Evening 6.00 pm – 10.00 pm
Woodlawn Bioreactor			
Trucks	×	✓ (10)	✓ (10)
Container tipper	×	✓ (2)	✓ (2)
Dump trucks	×	✓(2)	✓(2)
Dozer	×	✓(2)	✓(2)
Compactor	×	✓(2)	✓(2)
Compressor	✓	✓	✓
FEL	×	✓	✓
Aerators	✓(2)	✓(2)	✓(2)
Generators	✓(24)	✓(24)	✓(24)
Woodlawn AWT			
WASP Plant	✓	✓	✓
WASP FEL (Komatsu 320 or similar)	✓ (2)	✓(2)	✓(2)
WASP Truck Delivery	✓(2)	✓(2)	✓(2)
Alternative Fuel	✓(2)	✓(2)	✓(2)
Alternative Fuel Compactor	✓(2)	✓(2)	✓(2)
Resource Recovery Bins	✓	✓	✓
Organic Raw Material Bins	✓	✓	✓
Reject Bins - East	✓(2)	✓(2)	✓(2)
WOCOG Plant	✓	✓	✓
WOCOG Truck Delivery	✓(2)	✓(2)	✓(2)
WOCOG FEL	✓(2)	✓(2)	✓(2)
Windrow Turner (SCAT or similar)	×	✓	×
Sifter - de-stoner	×	✓	×
Final Screen/ trommel	×	✓	×

Note: Additional tipper, dump truck, dozer and compactor and forklift have been included in the model, however they are only expected to be used for contingency, not under operating conditions

As discussed in **Section 6.7** the INP does not establish a procedure to determine a cumulative intrusive criteria. To take into account the project specific noise levels for the proposed Bioreactor and the existing consent of the approved AWT a cumulative intrusive criteria was developed by logarithmically adding the two criteria. The predicted cumulative intrusive levels from the proposed Bioreactor and approved AWT against the relevant criteria are contained in **Table 20**.

Table 20 Predicted Cumulative Woodlawn Bioreactor and AWT Noise Levels

Location	Assessment Period	Predicted Noise Level $L_{Aeq(15minute)}$ (dBA)		Noise Criteria dBA $L_{Aeq(15minute)}$		
		Calm Conditions	Adverse Conditions	Bioreactor Project Specific	AWT Consent	Cumulative Intrusive
Location A Cowley Hills (owned by Veolia)	Morning Shoulder	33	38	35	35	38
	Daytime	34	N/A			
	Evening	34	N/A			
Location B Woodlawn Farm (owned by Veolia)	Morning Shoulder	38	41	35	35	38
	Daytime	38	N/A	36	35	38
	Evening	38	N/A	35	35	38
Location C Pylara (owned by Veolia)	Morning Shoulder	< 30	< 30	35	35	38
	Daytime	< 30	N/A			
	Evening	< 30	N/A			
Location D Torkina	Morning Shoulder	30	35	35	35	38
	Daytime	< 30	N/A			
	Evening	30	N/A			
Location E Willeroo	Morning Shoulder	< 30	< 30	35	35	38
	Daytime	< 30	N/A			
	Evening	< 30	N/A			
Location F Bernallah	Morning Shoulder	31	35	35	35	38
	Daytime	< 30	N/A			
	Evening	31	N/A			

The cumulative noise impact of the proposed Bioreactor operation and the approved AWT complies with the cumulative intrusive criteria for the developments at all residential locations except Location B Woodlawn farm. At this location, an exceedance of up to 3 dB during the morning shoulder period under prevailing weather conditions is predicted. The cumulative operational noise levels are at or below 35 dBA at all residential locations with the exception of Location A Cowley Hills and Location B Woodlawn Farm. These properties - Cowley Hills and Woodlawn Farm - are both owned by Veolia and as such are considered “project related” for this assessment.

7 ROAD TRAFFIC NOISE ASSESSMENT

7.1.1 Road Traffic Noise Modelling Parameters

Traffic noise modelling has considered the additional traffic that is proposed between the Intermodal and the Woodlawn Bioreactor as well as traffic from other local areas. This traffic was considered in addition to that proposed for the Section 75 W Regional Waste Modification and approved AWT facility. Proposed heavy vehicle movements used for traffic noise predictions are provided in **Table 21**.

Table 21 Proposed Heavy Vehicle Traffic Movements

Type of Delivery/Vehicle	Average Daily Movements	Average Hourly Movements
Woodlawn Bioreactor (total proposed)		
Transport to/from Crisps Creek Intermodal (total proposed)	240[1]	15
AWT Facility (approved)		
Transport to/from Crisps Creek Intermodal	64[2]	6
Product Despatch from AWT	16	3
Other Heavy Vehicles	10	2
Regional Waste Modification (proposed in separate modification),		
Goulburn Mulwaree Council	8[3]	0.8
Palerang Council	4[3]	0.4
Queanbeyan Council and Bega Valley Council	8[3]	0.8
Additional Regional Waste (proposed in this application)		
Yass Valley	2[3]	0.2
Upper Lachlan	2[3]	0.2
Eurobodalla	8[3]	0.8
ACT	18[3]	1.6

Note 1 These movements occur between 6:00 am and 10:00 pm
2 These movements occur between 6:00 am and 10:00 pm
3 These movements occur between 7:00 am and 6.00 pm however not expected to arrive until after 9:00 am

There is one (1) residential receiver along the transport route from the IMF along Bungendore Road (Chinnery approximately 530 metres from trucks exiting the IMF). There are two (2) residential receivers along Collector Road at Pylara and Cowley Hills, at which the closest residences are 40 metres and 140 metres respectively from the roadside. These residences on Collector Road are owned by Veolia. There no planned traffic movements along Collector Road west of the Woodlawn Bioreactor towards the Federal Highway.

7.1.2 Road Traffic Noise Modelling Results

Collector Road/Bungendore Road

Additional traffic along Collector Road and Bungendore Road has been considered during the daytime period as waste will arrive at the site between 7:00 am and 10:00 pm. Five (5) additional heavy vehicle movements per hour from Crisps Creek IMF will occur on Bungendore Road (North of Collector Road). Trucks travelling through Tarago and Bungendore are programmed to arrive at the Woodlawn Bioreactor site during daytime hours of 7:00 am to 6:00 pm, however, are expected not to arrive at the site until 9:00 am. This traffic has therefore not been assessed at Tarago and Bungendore before 7:00 am.

Road traffic noise contributions from the proposed Project have been predicted (at 40 metres from the roadside for Collector Road and 530 metres for Bungendore Road) and are presented in **Table 22**.

Table 22 Predicted Road Traffic Noise Levels – Collector Road

	Predicted Traffic Noise Level	**Criteria**
	Day	**Day**
	7 am - 10 pm	**7 am - 10 pm**
Bungendore Road	36 dBA $L_{Aeq(15hour)}$	60 dBA $L_{Aeq(15hour)}$
Collector Road	55 dBA $L_{Aeq(1hour)}$	60 dBA $L_{Aeq(1hour)}$

The road traffic noise level contribution from the Project is predicted to be below the relevant noise goal specified in the ECRTN for both Bungendore and Collector Roads.

Tarago and Bungendore Towns

An additional assessment of noise impacts associated with traffic movements for the transport through Tarago and Bungendore has been conducted using the following assumptions:

- Trucks are travelling at 50 km/hr (speed limit through Tarago and Bungendore).
- 42 truck movements occur during the daytime period through Bungendore.
- 8 truck movements occur during the daytime period through Tarago.
- The road is classified as Arterial or Sub-arterial.
- Sound pressure level from trucks of 75 dBA at 20 metres or 110 dBA SWL (flat terrain low speed environment).
- The nearest residence is 8 metres from the travel path of the truck.

As stated in **Table 21**, the proposed transportation of waste due to the Project will potentially generate an additional 30 truck movements per day from Upper Lachlan, Yass Valley, Eurobodalla and ACT (C&I and Private) through Bungendore. Only eight (8) heavy vehicle movements from the Goulburn Mulwaree Region would travel through Tarago (assessed for the regional waste modification). The traffic noise contribution from heavy vehicles has been predicted at 8 metres from the roadside for Tarago and Bungendore and is presented in **Table 23**.

Table 23 Predicted Road Traffic Noise Levels – Tarago and Bungendore Towns

	Predicted Traffic Noise Level	**Criteria**
	Day 7 am - 10 pm	**Day 7 am - 10 pm**
Tarago	46 dBA $L_{Aeq(15hour)}$	60 dBA $L_{Aeq(15hour)}$
Bungendore	53 dBA $L_{Aeq(15hour)}$	60 dBA $L_{Aeq(15hour)}$

The contribution to traffic noise from heavy vehicles associated with the Project, including the previously considered traffic generated by the regional waste modification, will comply with the daytime ECRTN criteria.

8 CONCLUSION

Operational noise emission levels from Woodlawn Bioreactor and the Crisps Creek IMF due to the proposed Project are predicted to meet the relevant project specific noise goals over the extended hours at all existing residential dwellings surrounding the site with the exception of Location A Cowley Hills and Location B Woodlawn Farm for which various marginal exceedances are predicted. These properties - Cowley Hills and Woodlawn Farm - are both owned by Veolia and as such are considered "project related" for this assessment.

The cumulative impact of noise from the existing Woodlawn Bioreactor, approved Wind Farm, and approved AWT are predicted to comply with the relevant criteria set in accordance with the INP at residential receivers surrounding the site.

The contribution to traffic noise from heavy vehicles associated with the Woodlawn site, including the additional traffic generated from the Crisps Creek Intermodal and additional local waste transportation, is predicted to comply with the ECRTN criteria.

Appendix A

Report 30-2464

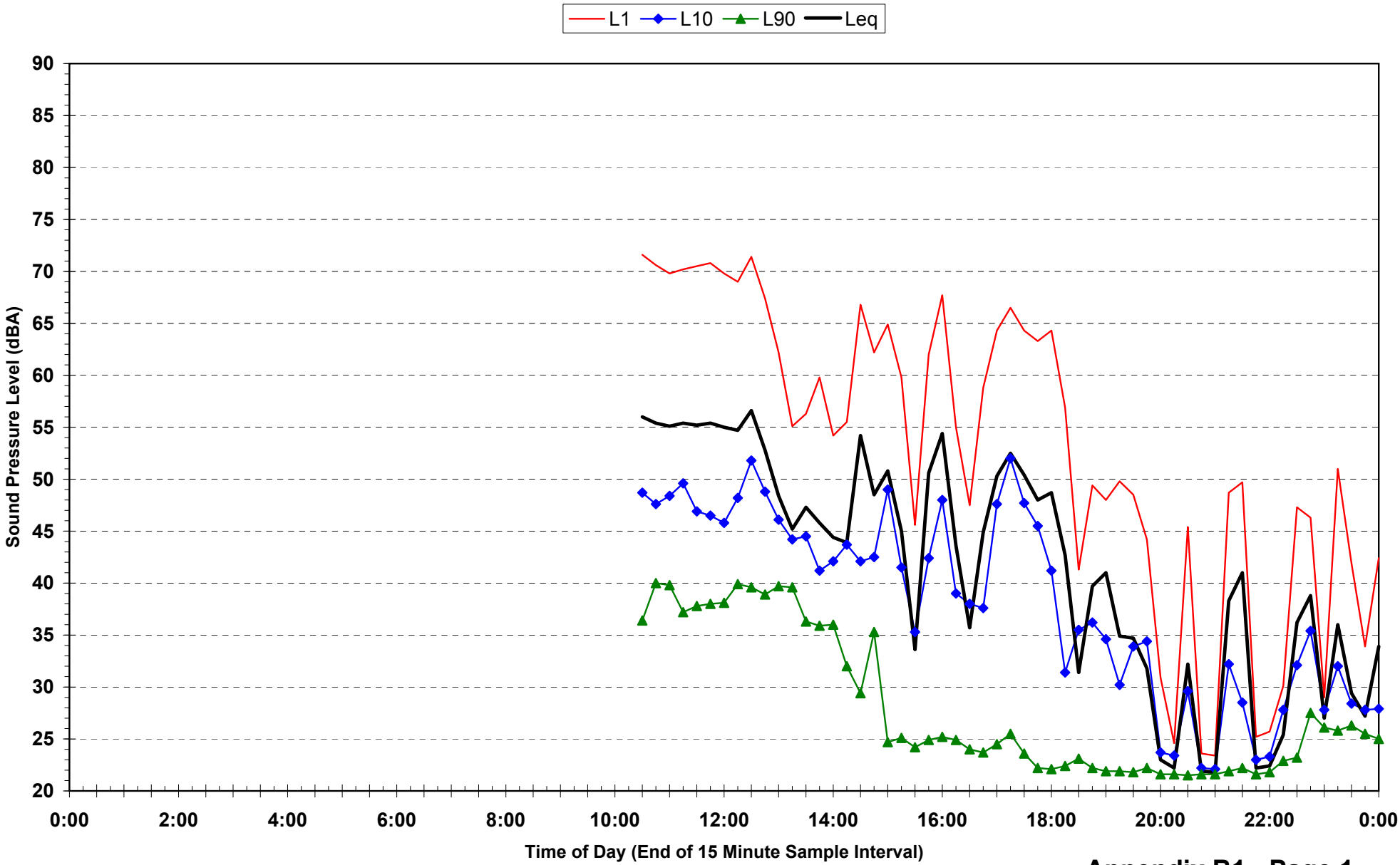
Equipment Sound Power Levels

Equipment	One Third Octave Band Frequency (Hz) - dB																																Overall Sound	
	12.50	**16**	**20**	**25**	**31.5**	**40**	**50**	**63**	**80**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1.6k**	**2K**	**2.5K**	**3.15K**	**4K**	**5K**	**6.3K**	**8K**	**10K**	**12.5K**	**16K**	**20K**	**A**	**L**
Waste Truck	96	95	97	95	95	99	96	99	112	109	103	103	106	102	106	108	104	104	102	103	102	100	99	98	97	96	95	93	93	95	89	88	84	112	**118**
Dump Truck	85	89	88	93	94	105	101	106	121	106	105	110	103	105	103	106	105	101	99	97	98	96	104	100	90	88	85	83	84	80	78	83	68	111	**122**
Compactor	93	88	88	93	102	101	100	97	97	109	95	98	98	96	102	103	100	102	101	100	99	98	98	94	93	90	88	87	87	84	81	80	73	109	**114**
Dozer	88	88	92	95	96	107	103	101	103	106	98	101	104	95	103	108	102	100	102	102	100	98	98	94	91	89	88	85	81	79	75	71	66	110	**116**
Front end Loader	86	85	82	87	92	102	101	102	101	100	97	100	103	96	104	101	96	94	94	95	105	95	94	94	90	89	86	83	83	81	77	73	71	109	**113**
Container Tipper	90	90	88	90	103	103	96	97	101	97	95	97	94	90	91	98	98	97	98	99	96	98	98	100	102	97	99	100	99	97	94	93	88	111	**113**
Air Compressor	69	75	72	75	76	77	77	78	76	77	78	80	80	78	73	75	77	76	74	72	71	71	69	71	69	65	61	58	54	51	48	50	-	83	**90**
Water Cart	93	94	90	91	87	91	100	100	102	104	100	98	99	95	100	101	97	98	98	98	97	95	95	94	89	87	87	89	84	83	82	81	77	107	**112**
Aerator	85	82	79	79	80	85	84	85	86	93	90	89	88	82	87	91	90	86	87	88	88	88	89	89	88	88	87	86	85	84	82	80	76	99	**103**
Generators	96	93	94	95	95	97	106	99	105	107	109	104	107	103	101	103	100	96	95	94	92	89	87	87	84	82	84	81	79	73	68	-	-	106	**116**
Grader	91	91	91	91	90	99	98	100	111	102	100	100	98	97	95	101	97	98	99	98	97	95	94	92	89	90	89	90	87	85	83	81	78	73	**114**
Excavator	-	63	58	61	67	72	67	70	70	78	71	75	68	64	70	69	71	68	69	68	66	64	63	62	60	56	55	52	49	46	45	-	-	77	**84**

Equipment Sound Power Levels IMF

Equipment	One Third Octave Band Frequency (Hz) - dB																															Overall SWL	
	12.50	16	20	25	31.50	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1.6K	2K	2.5K	3.15K	4K	5K	6.3K	8K	10K	12.5K	16K	20K	A	L
Train Arrival	113	111	111	108	107	107	110	105	103	103	98	97	97	101	99	96	96	94	91	89	88	88	87	86	85	82	84	79	73	72	68	64	55	102	119
Forklift	103	106	101	97	106	101	92	99	96	92	92	93	90	87	90	94	93	93	98	97	96	95	92	88	89	82	80	78	74	71	69	67	64	104	113

Statistical Ambient Noise Levels
30-2464 Cowley Hills - Wednesday 4 May 2005

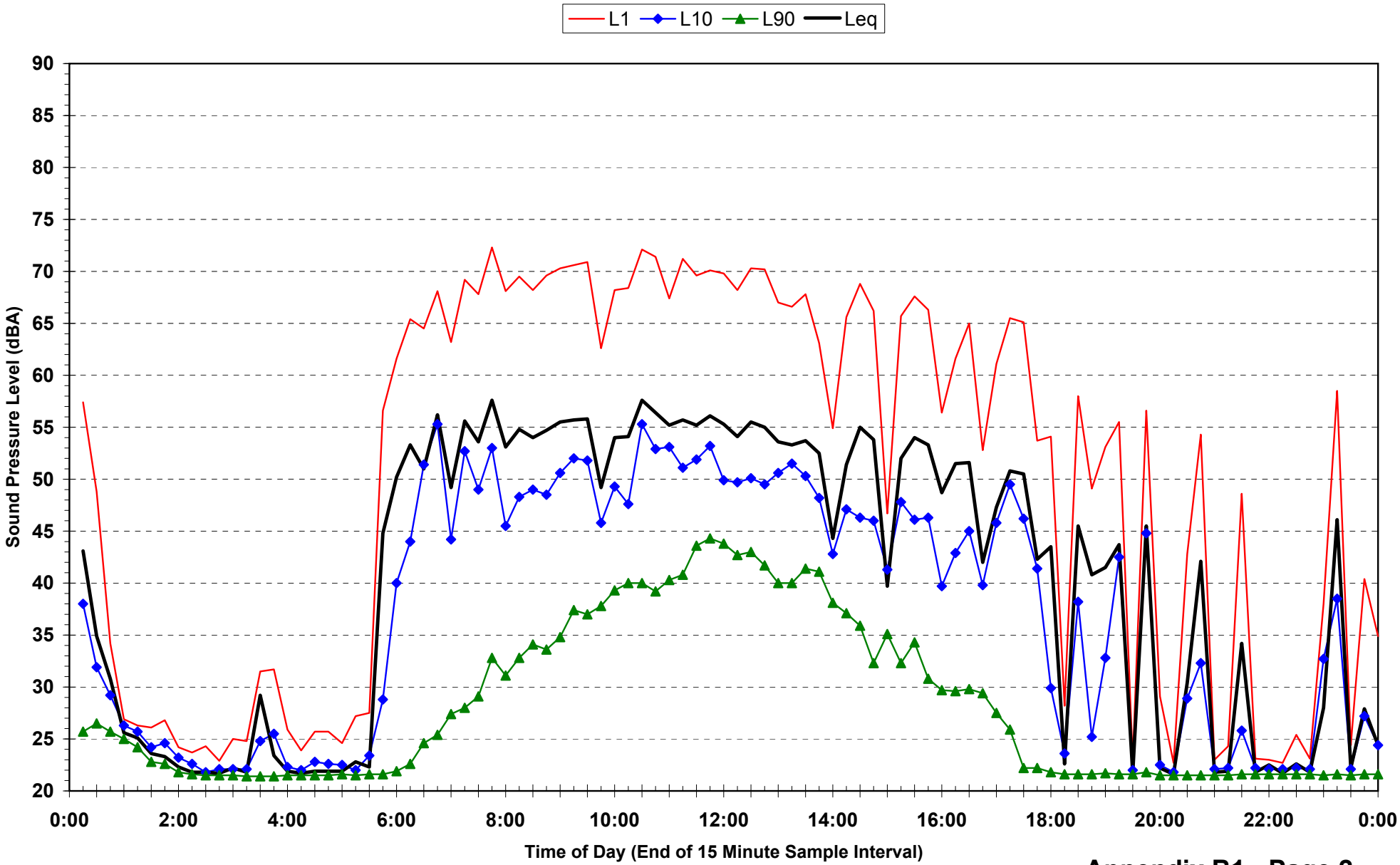


Appendix B1 - Page 1

Statistical Noise Levels

Heggies Report 30-2464

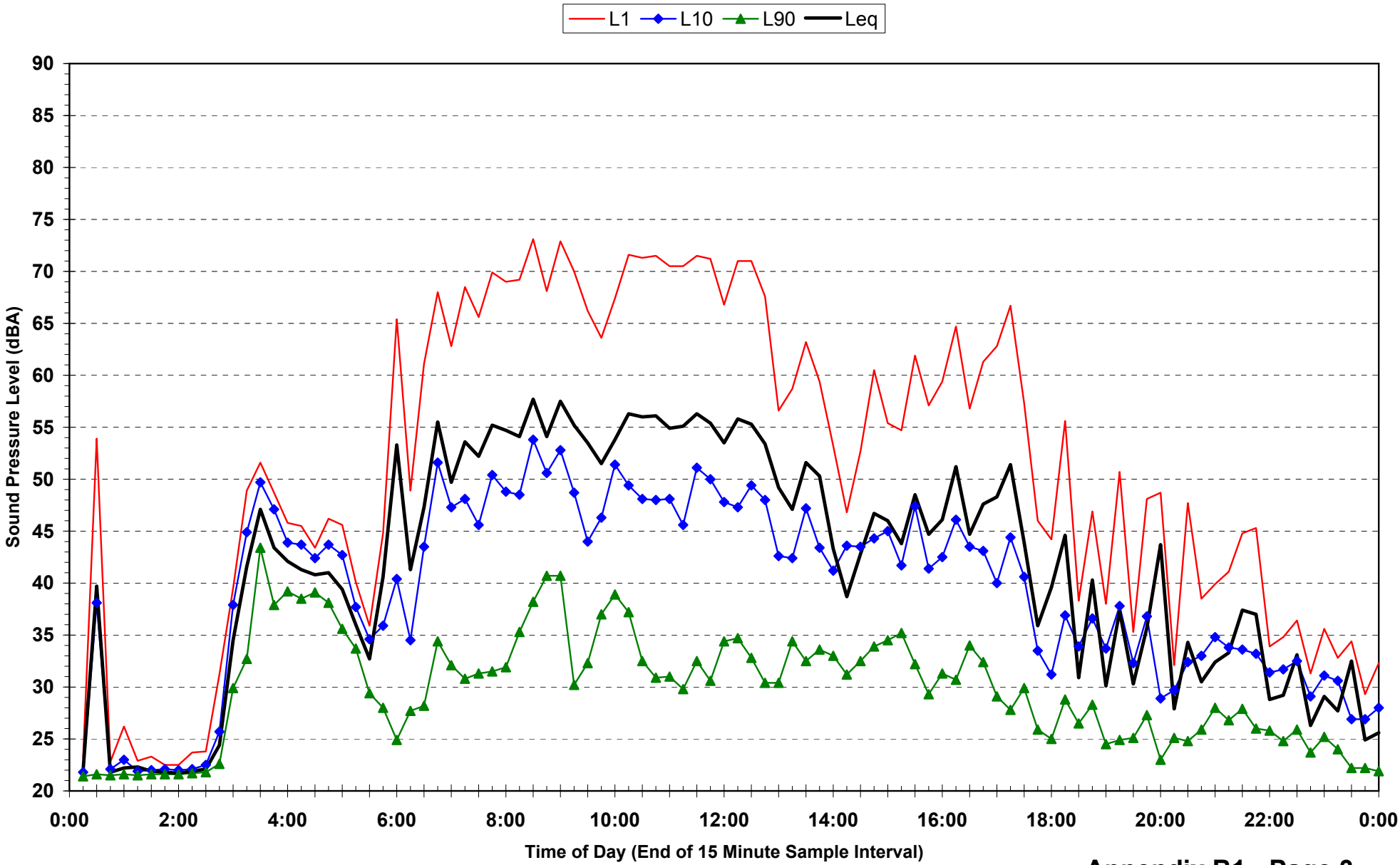
Statistical Ambient Noise Levels
30-2464 Cowley Hills - Thursday 5 May 2005



Appendix B1 - Page 2
Statistical Noise Levels
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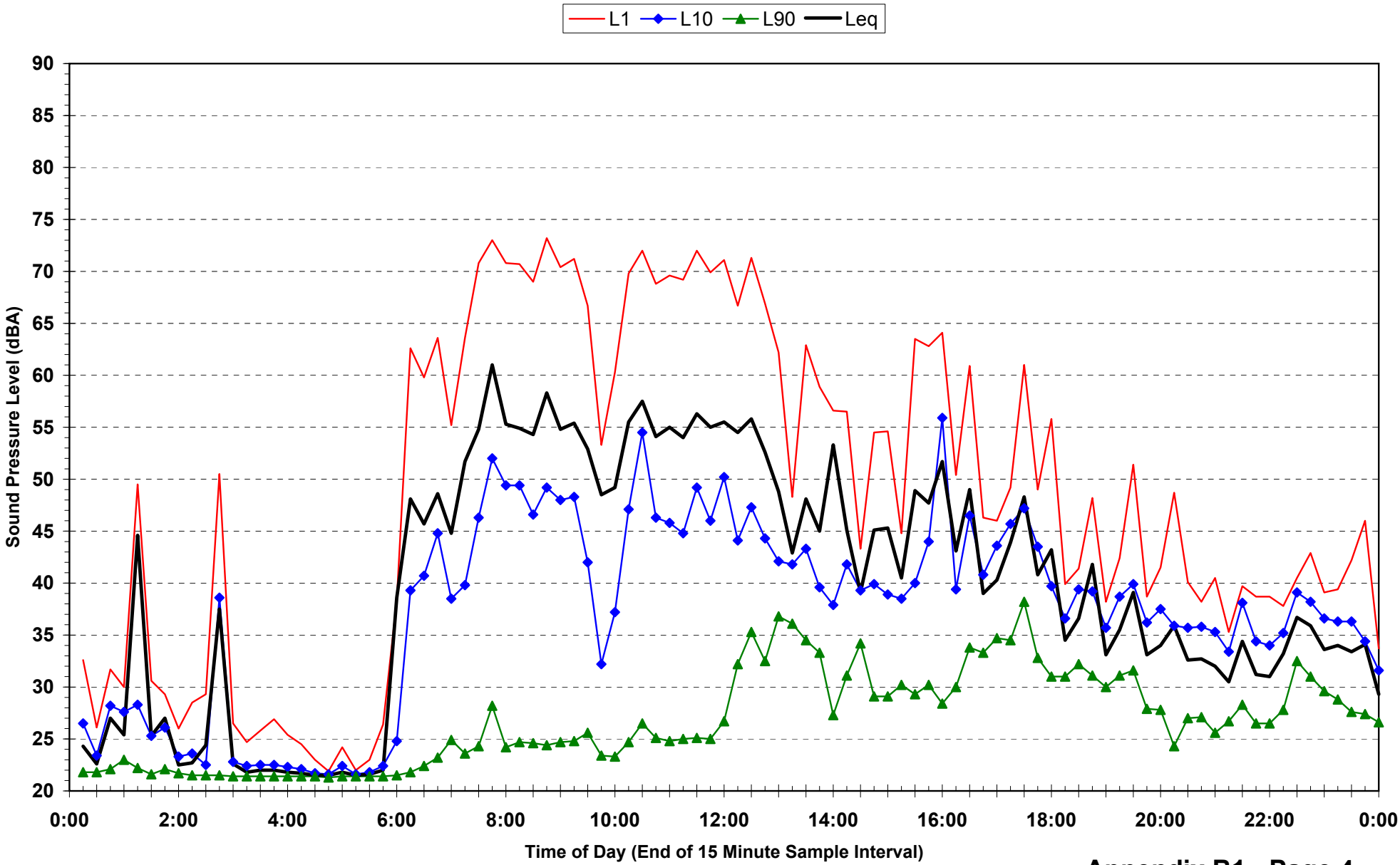
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Statistical Ambient Noise Levels
30-2464 Cowley Hills - Friday 6 May 2005



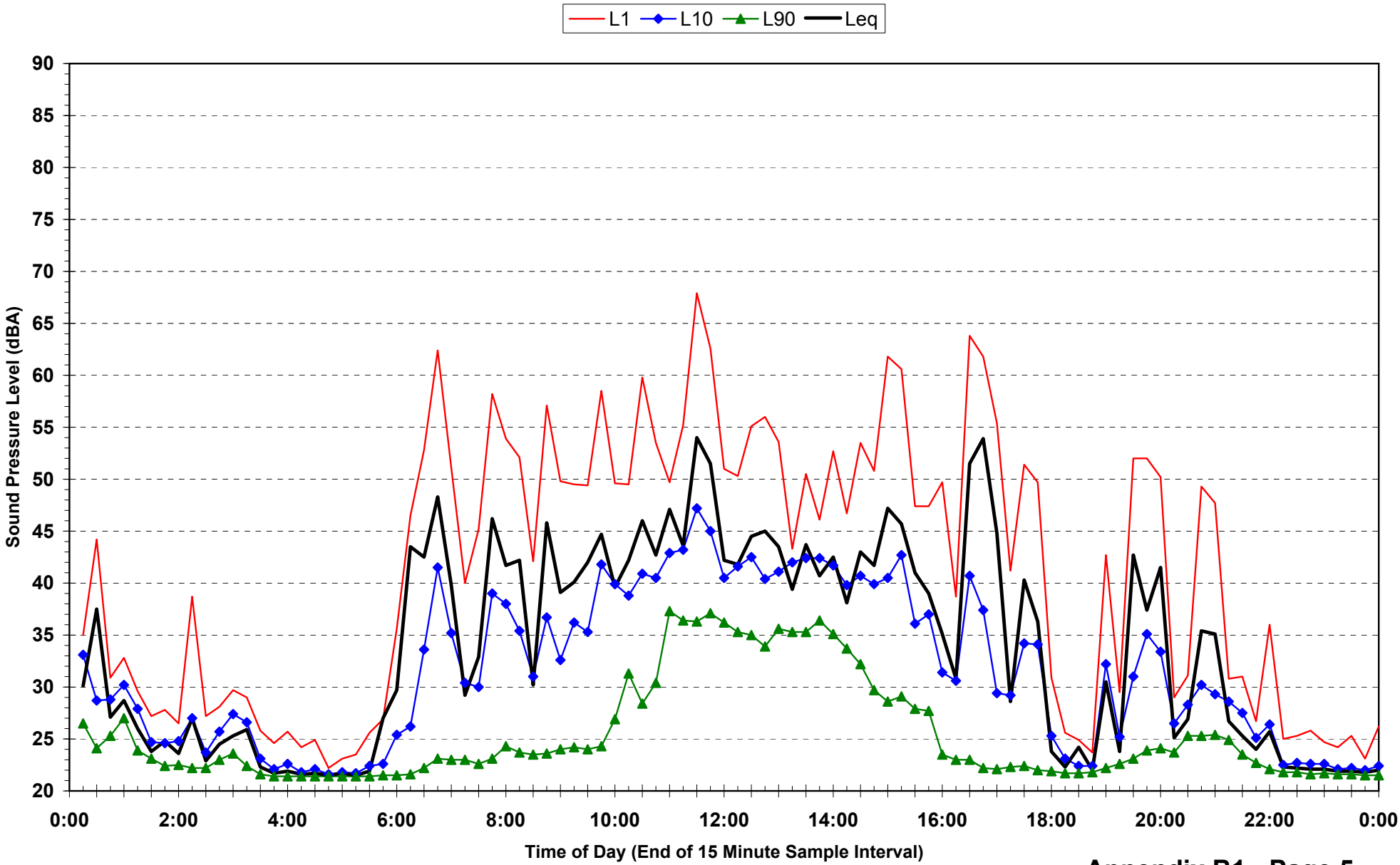
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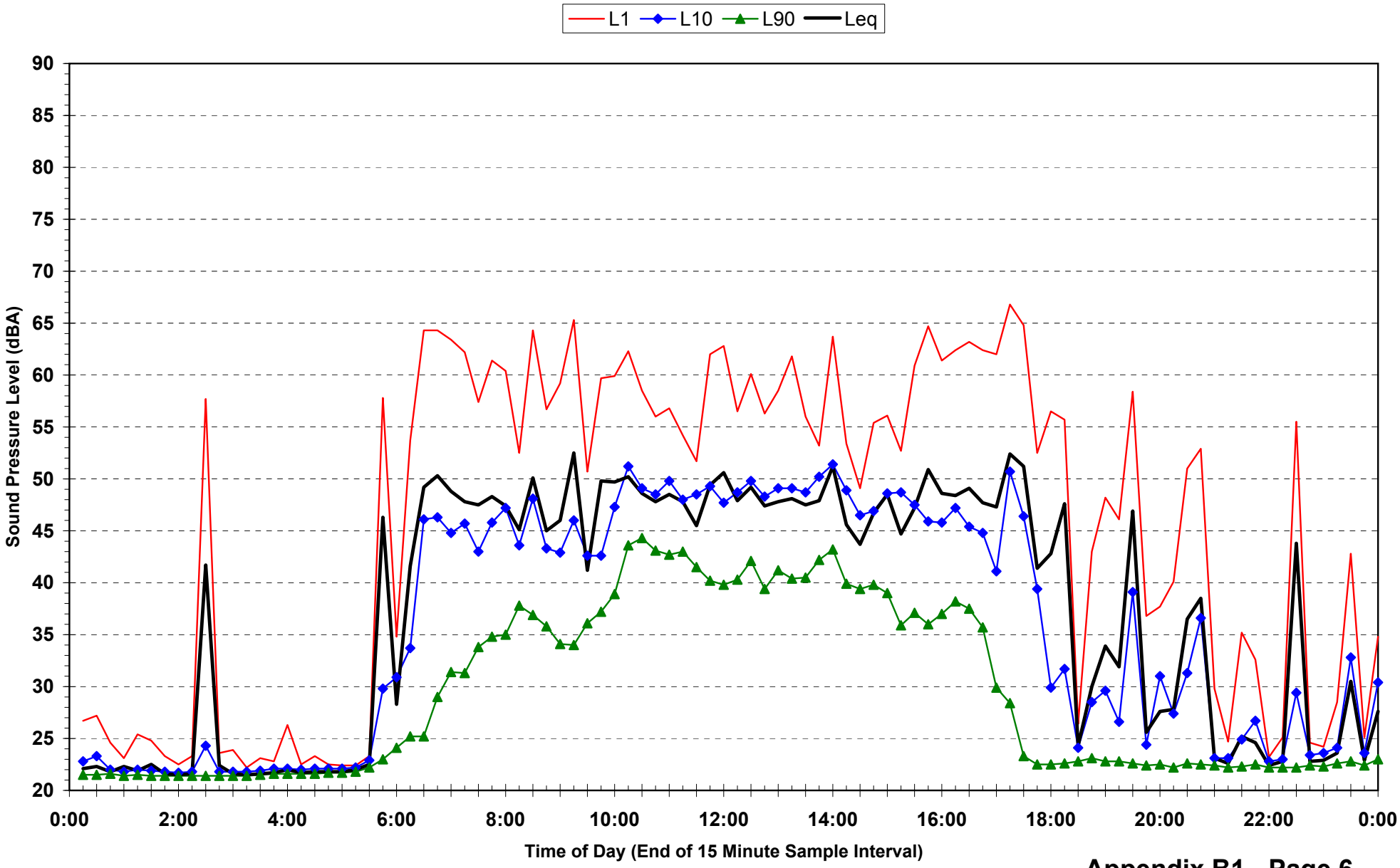
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Statistical Ambient Noise Levels
30-2464 Cowley Hills - Sunday 8 May 2005



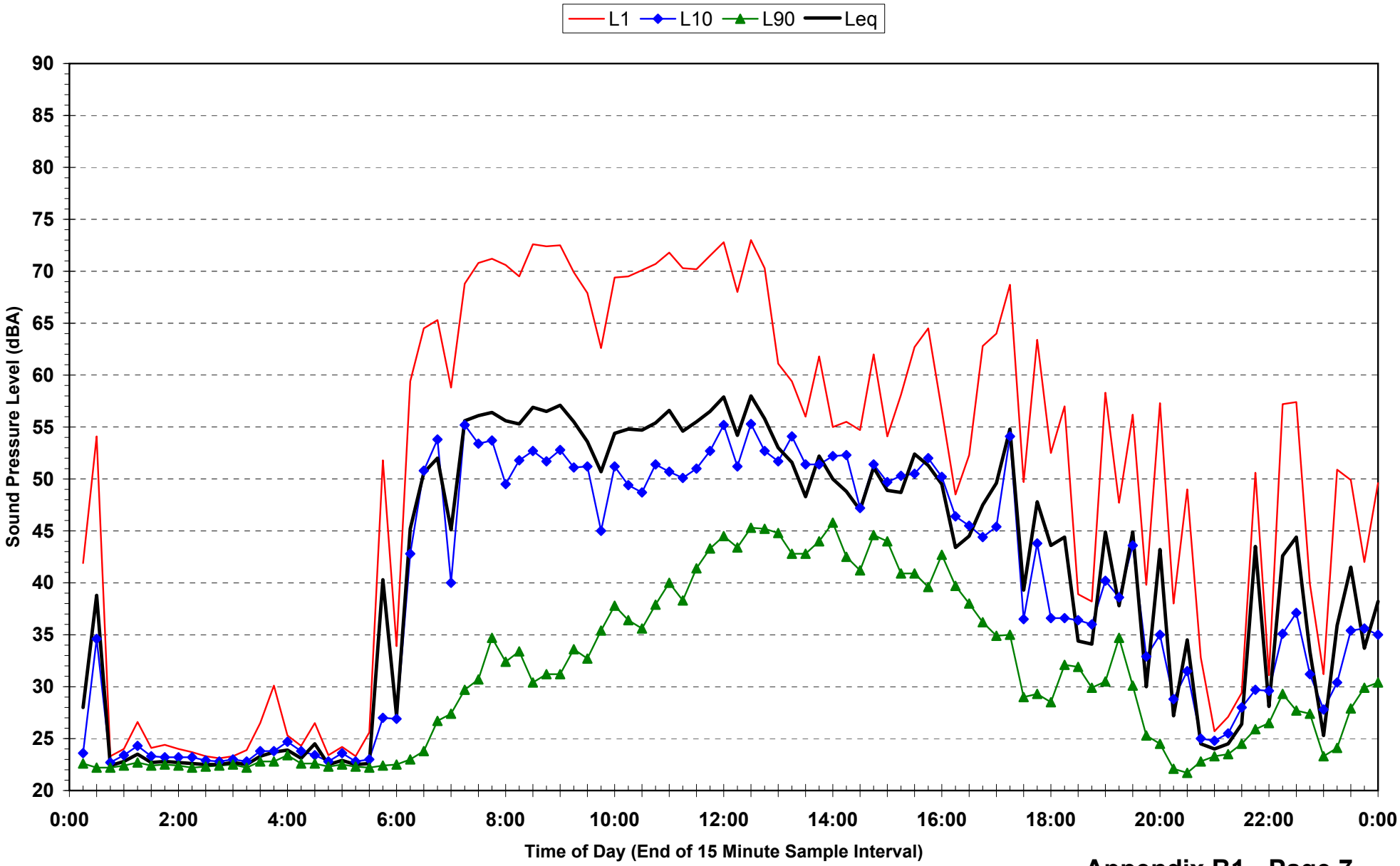
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Statistical Ambient Noise Levels
30-2464 Cowley Hills - Monday 9 May 2005



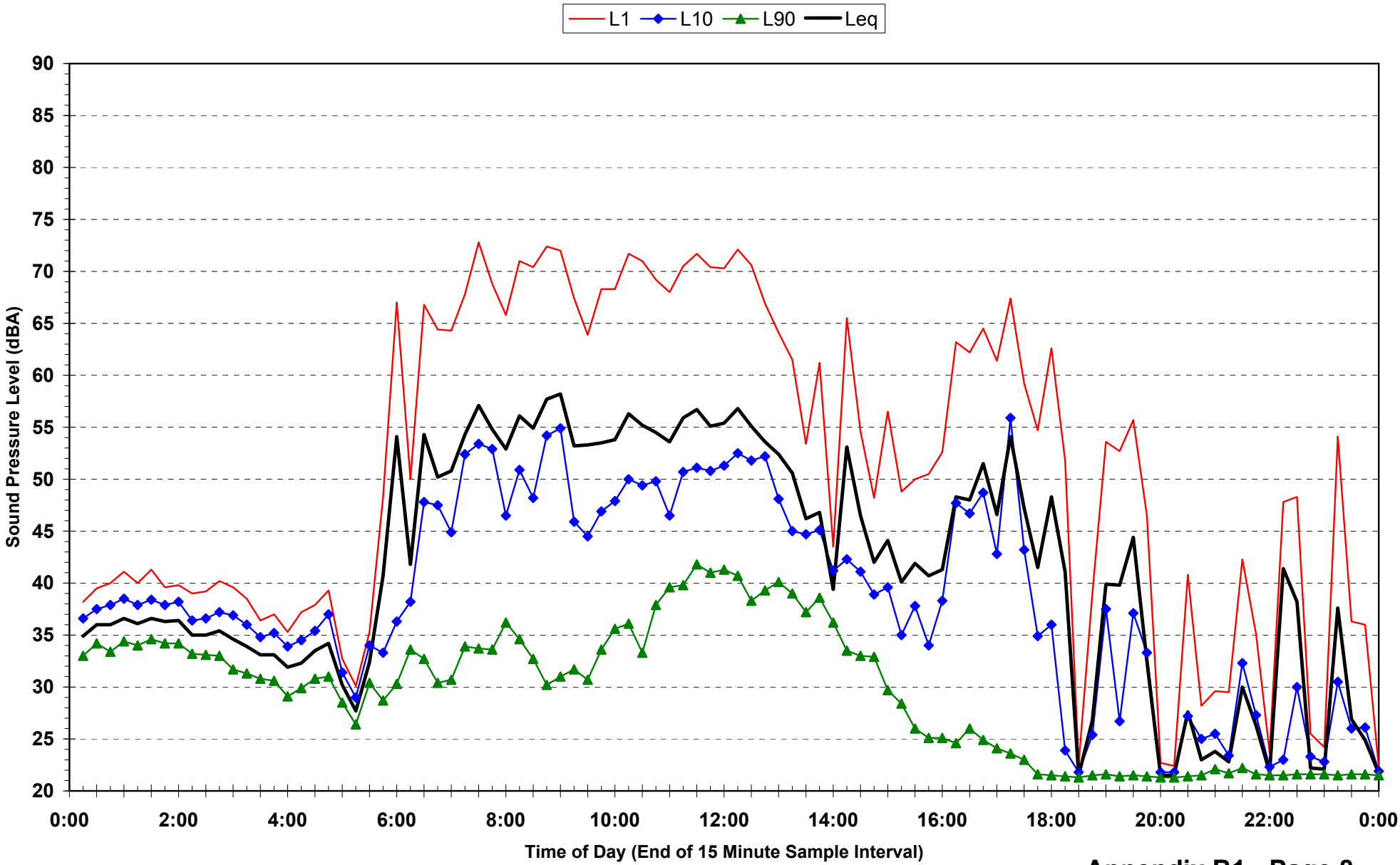
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Statistical Ambient Noise Levels
30-2464 Cowley Hills - Tuesday 10 May 2005



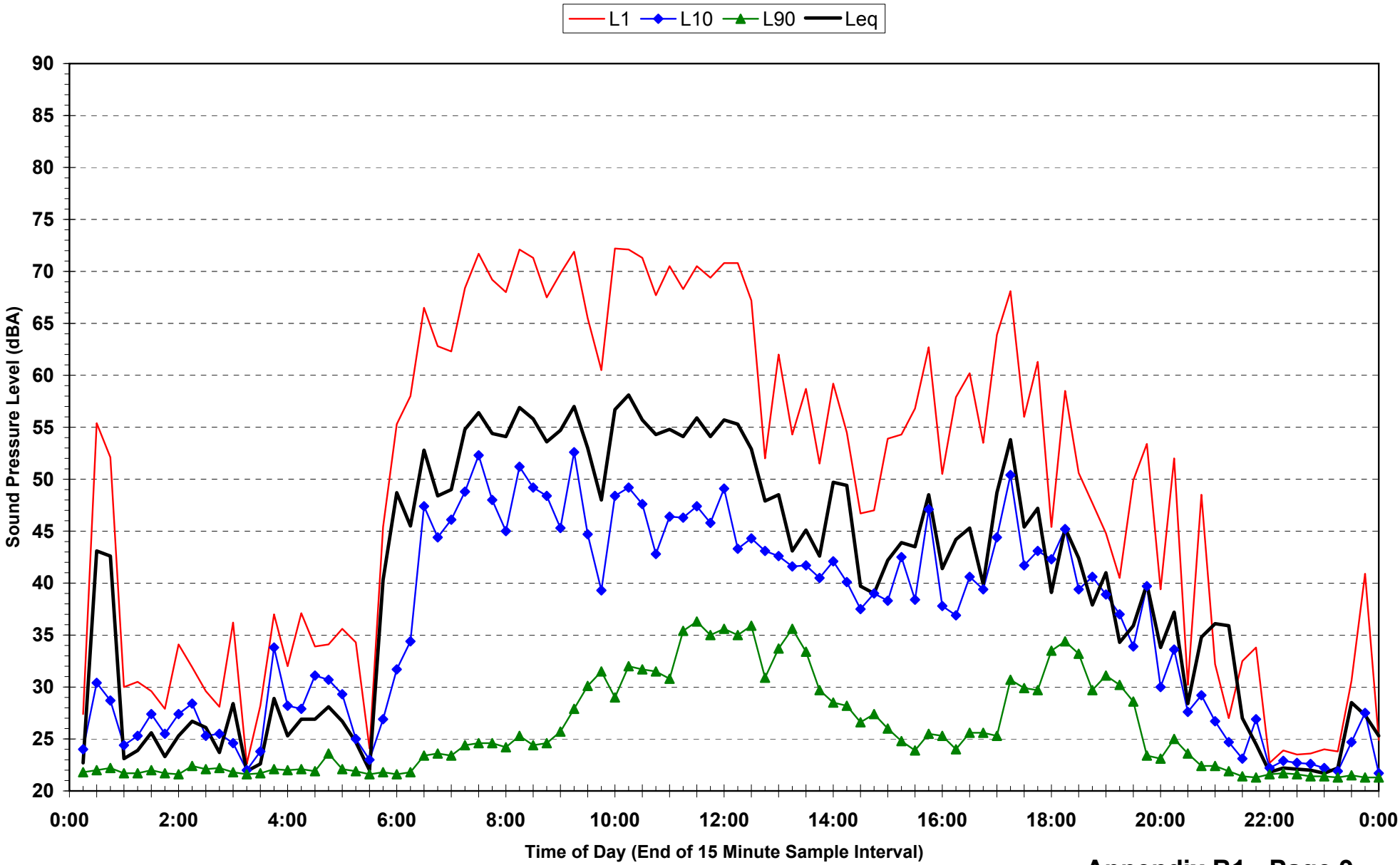
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Statistical Ambient Noise Levels
30-2464 Cowley Hills - Wednesday 11 May 2005



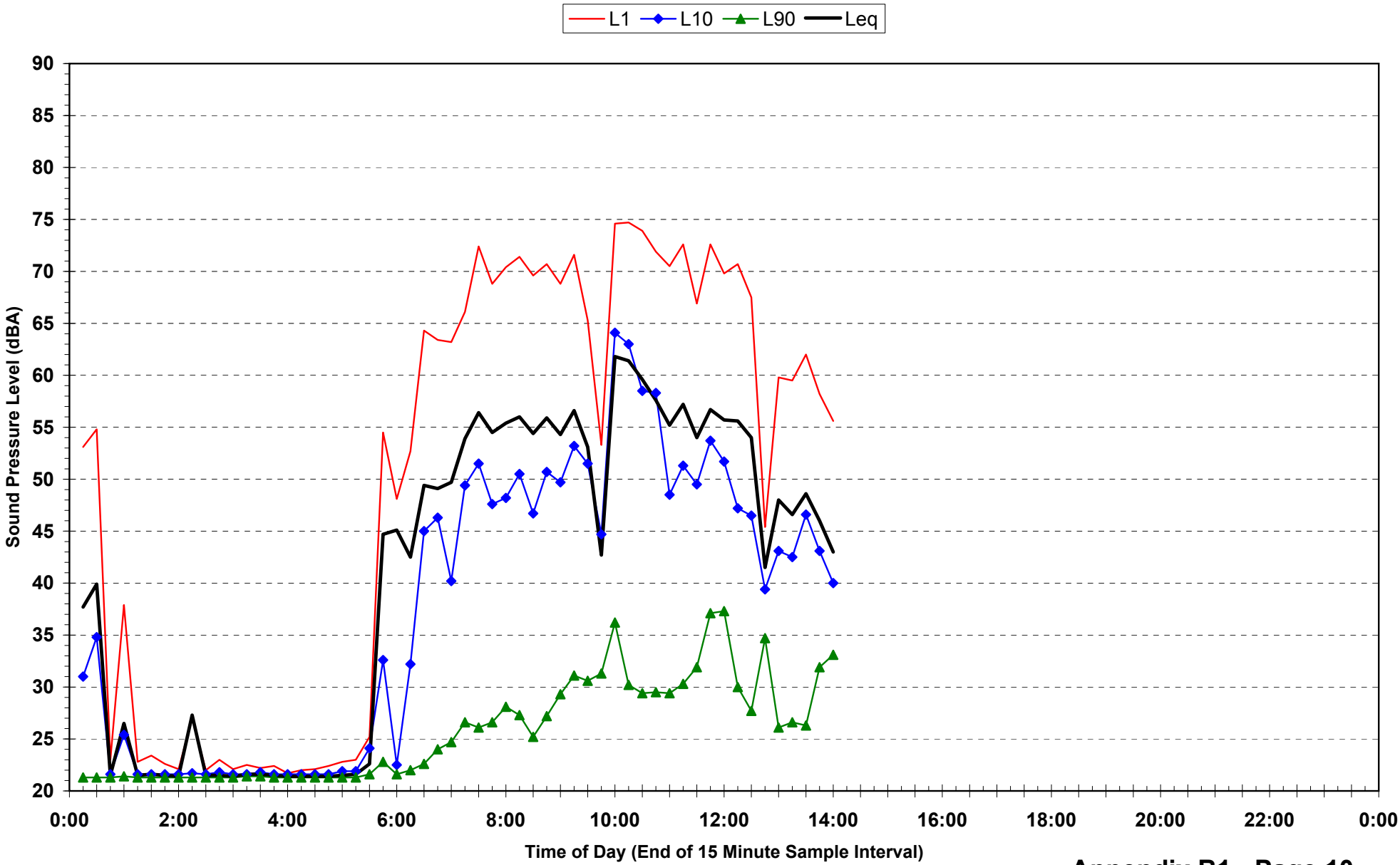
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Statistical Ambient Noise Levels
30-2464 Cowley Hills - Thursday 12 May 2005



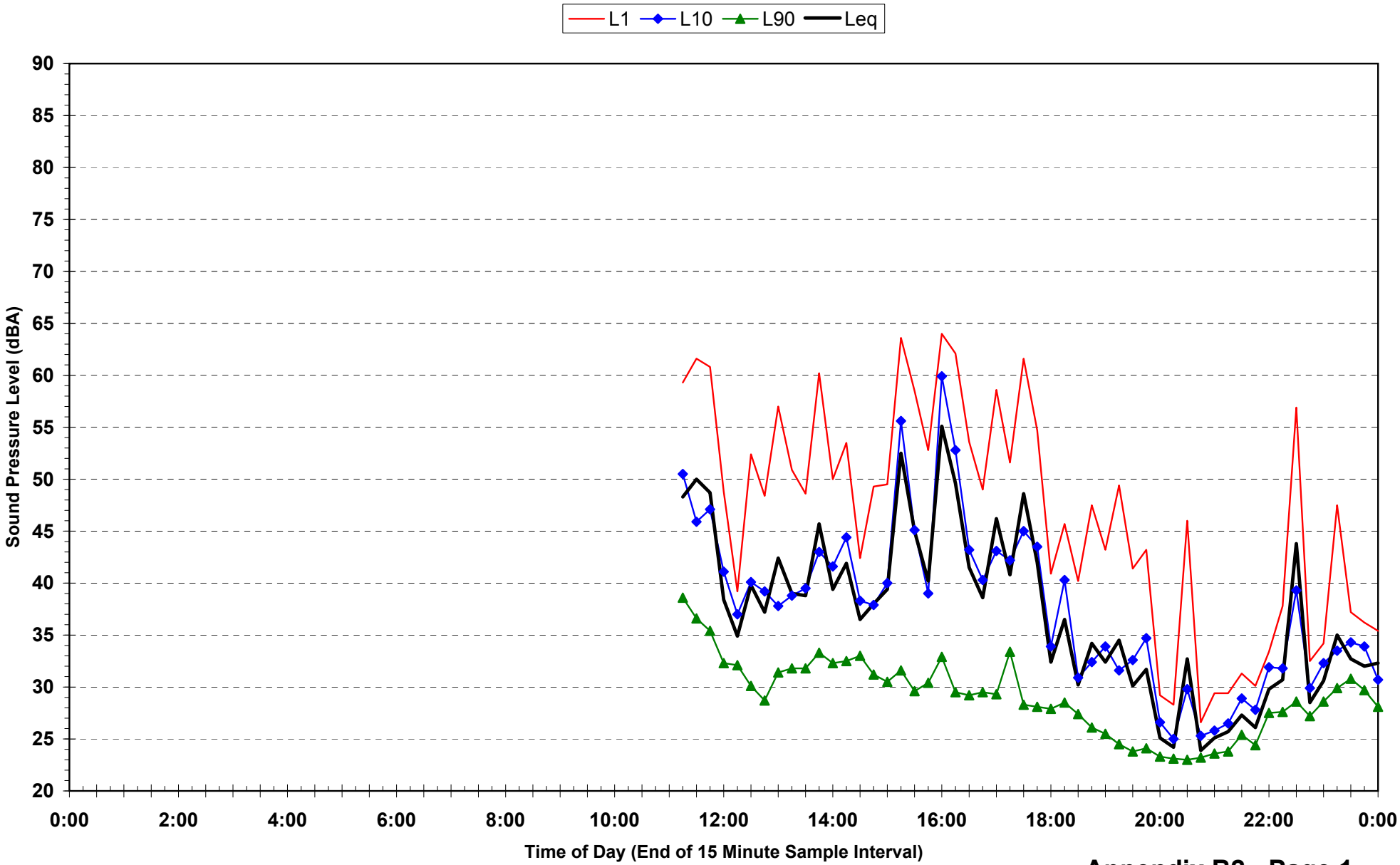
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Statistical Ambient Noise Levels
30-2464 Cowley Hills - Friday 13 May 2005



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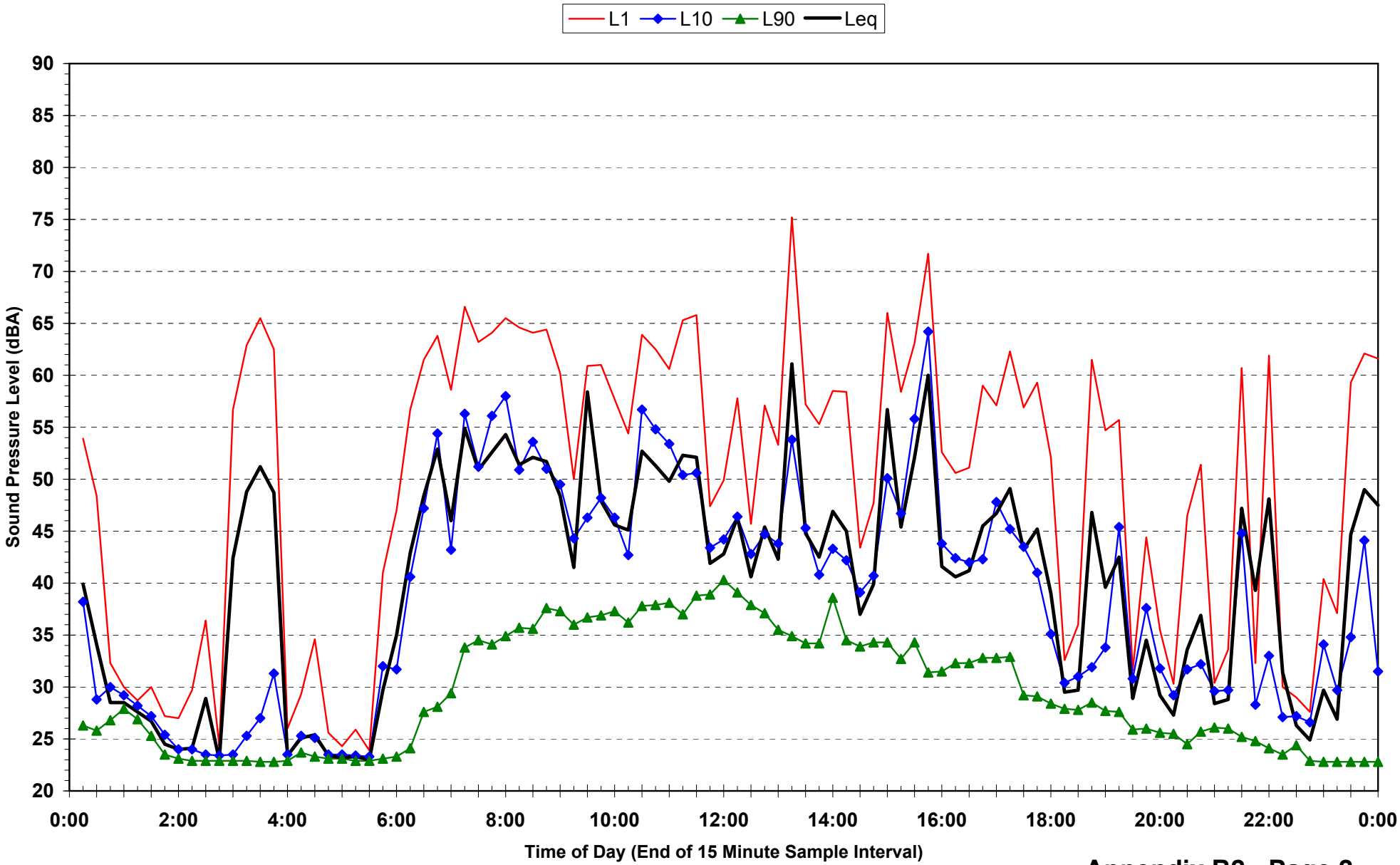


Appendix B2 - Page 1

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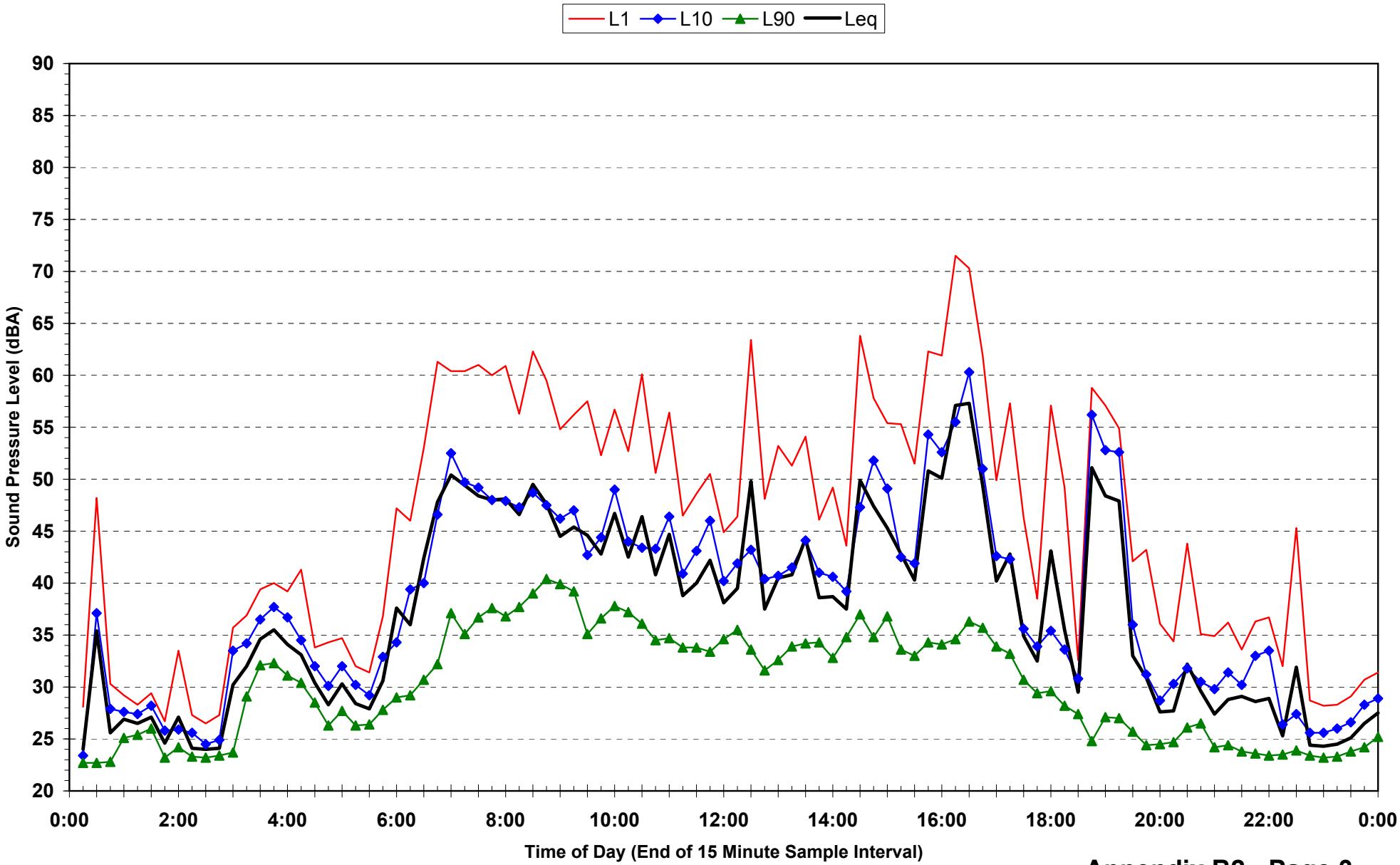
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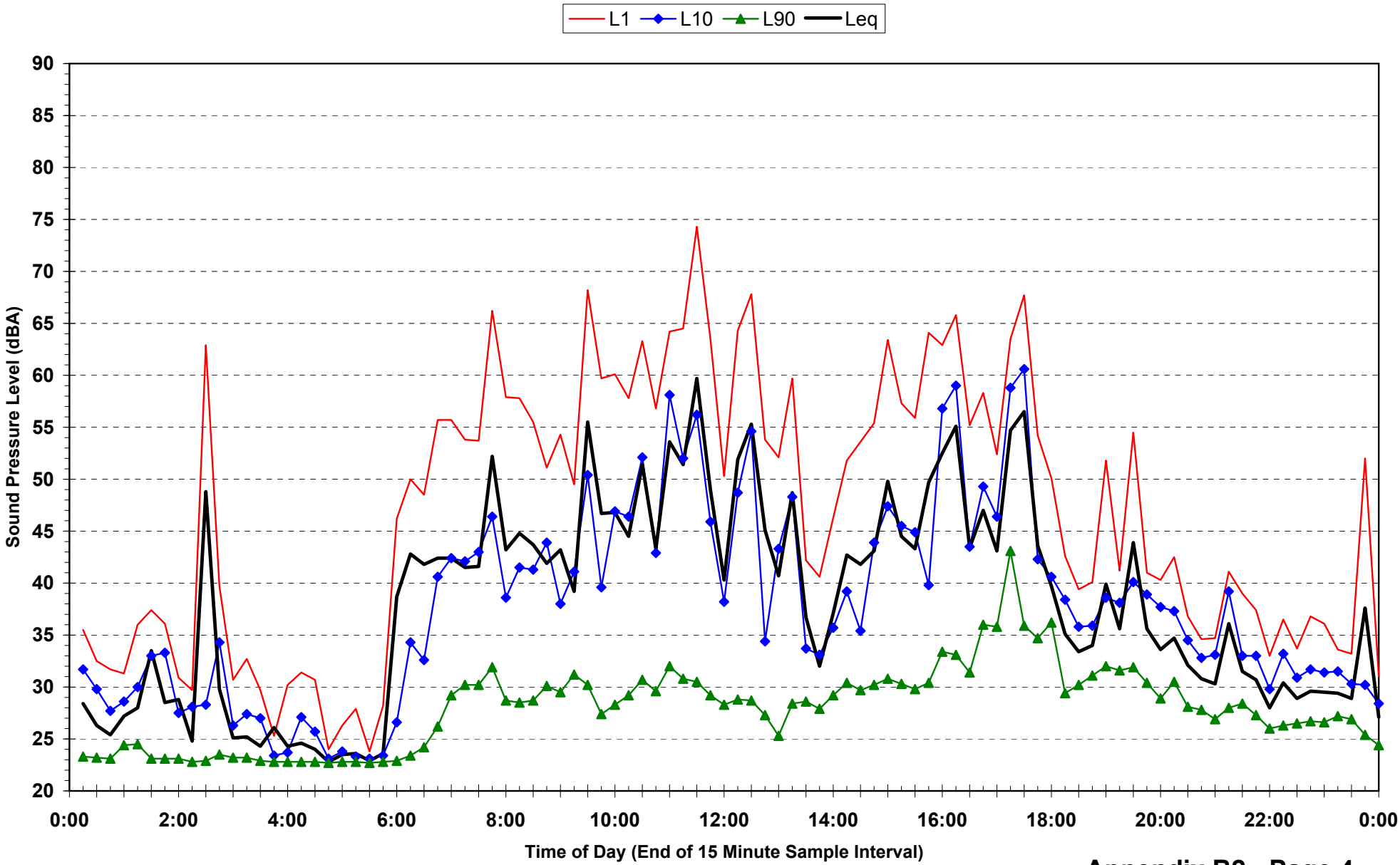


Appendix B2 - Page 3

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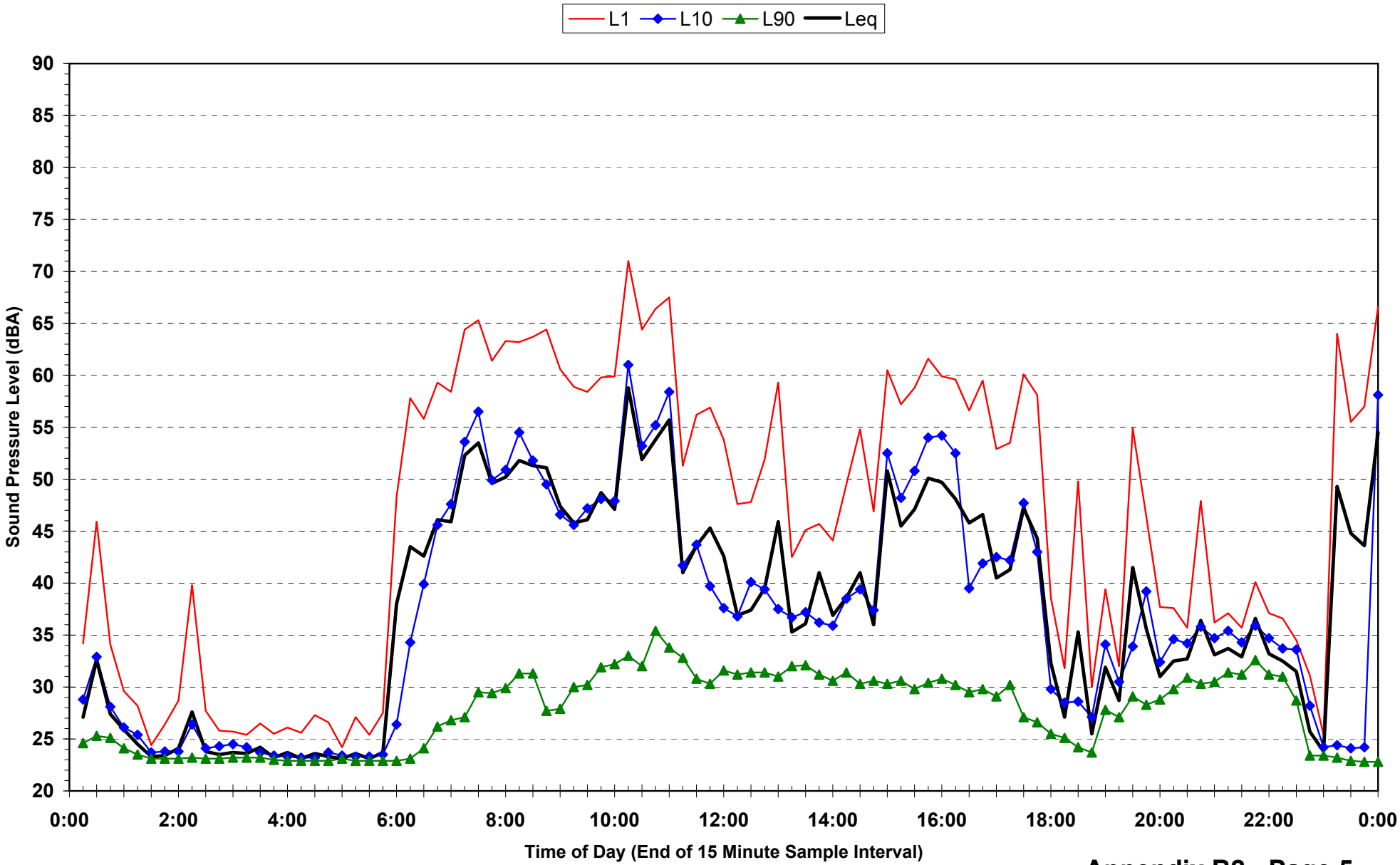
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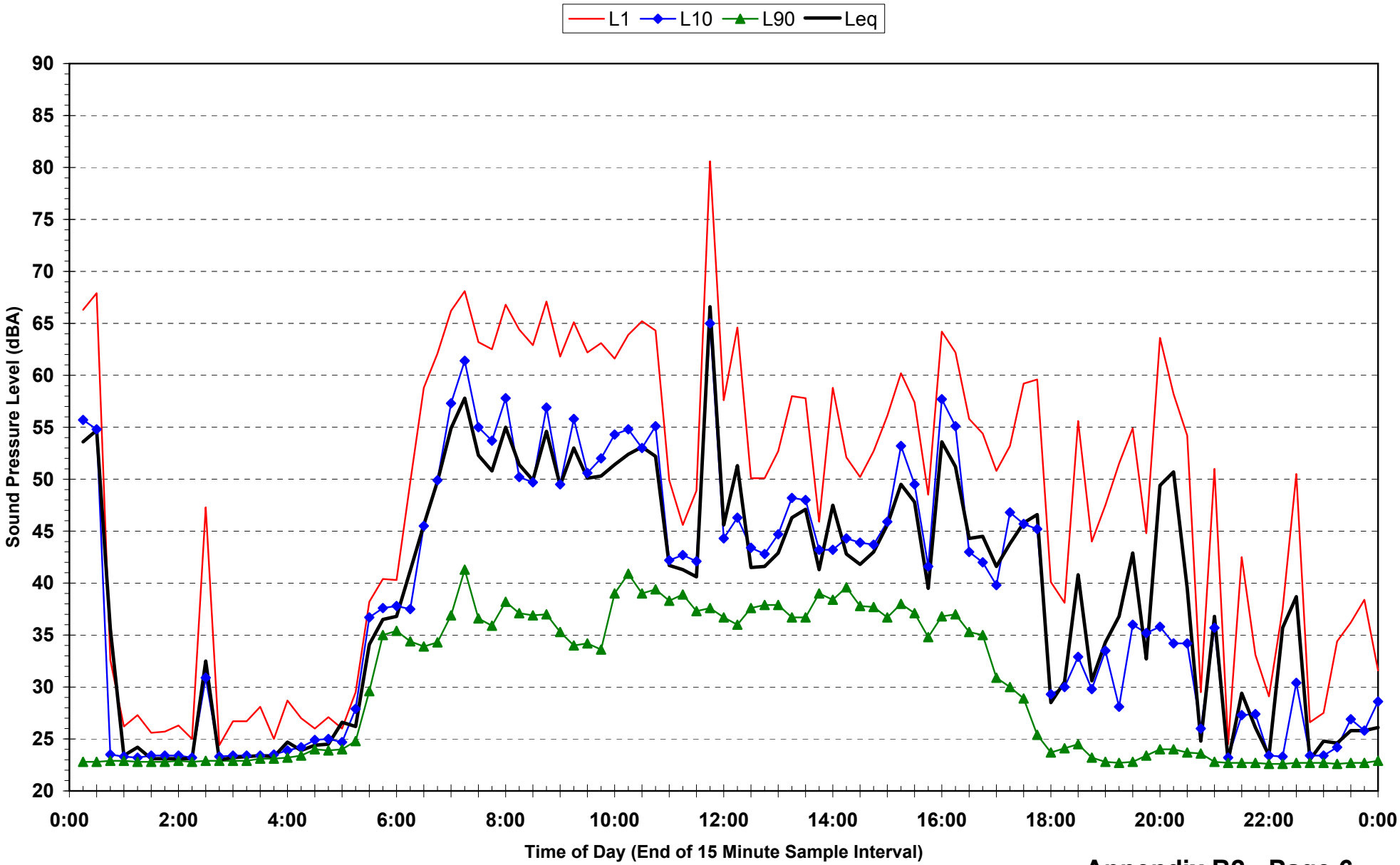
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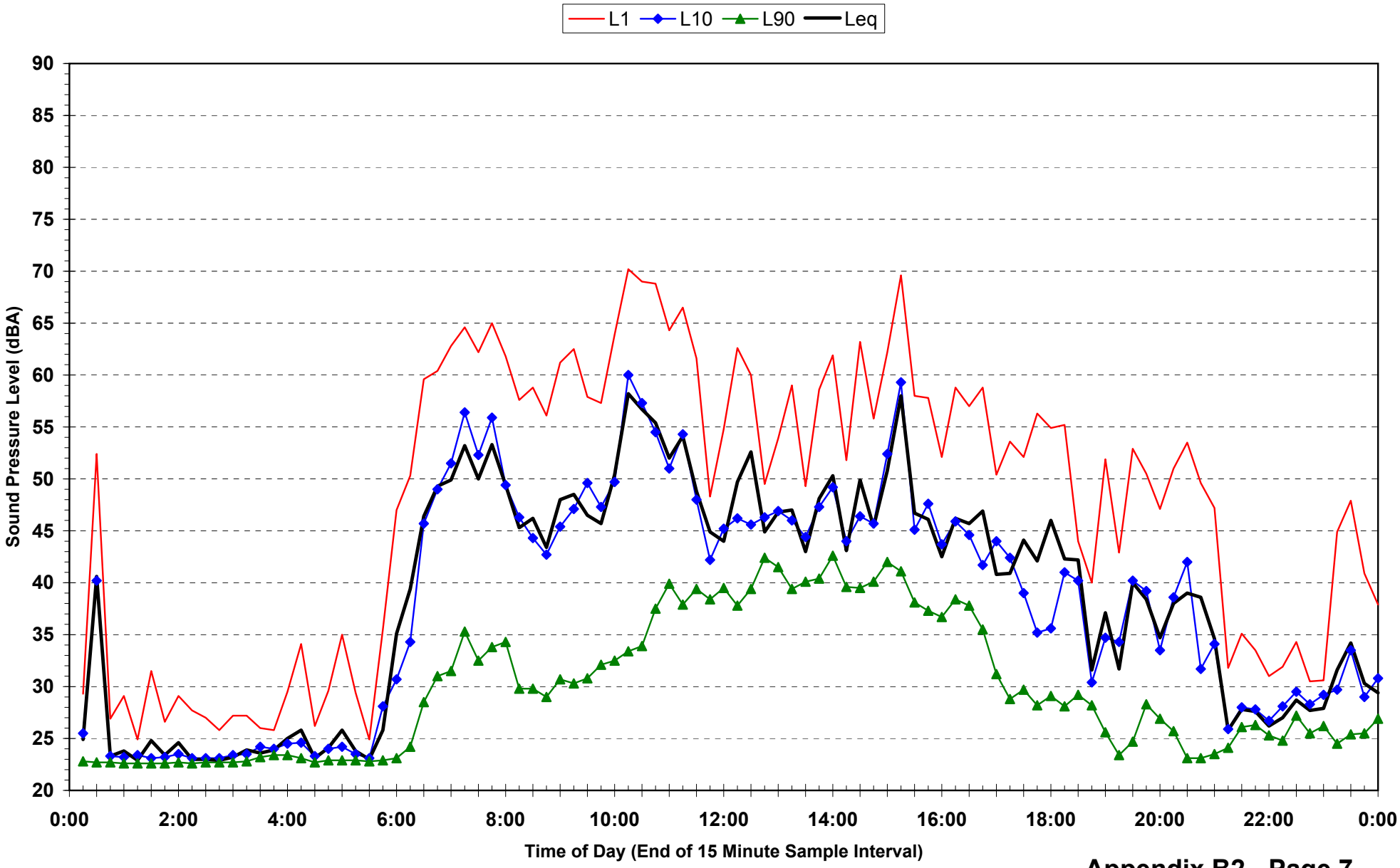
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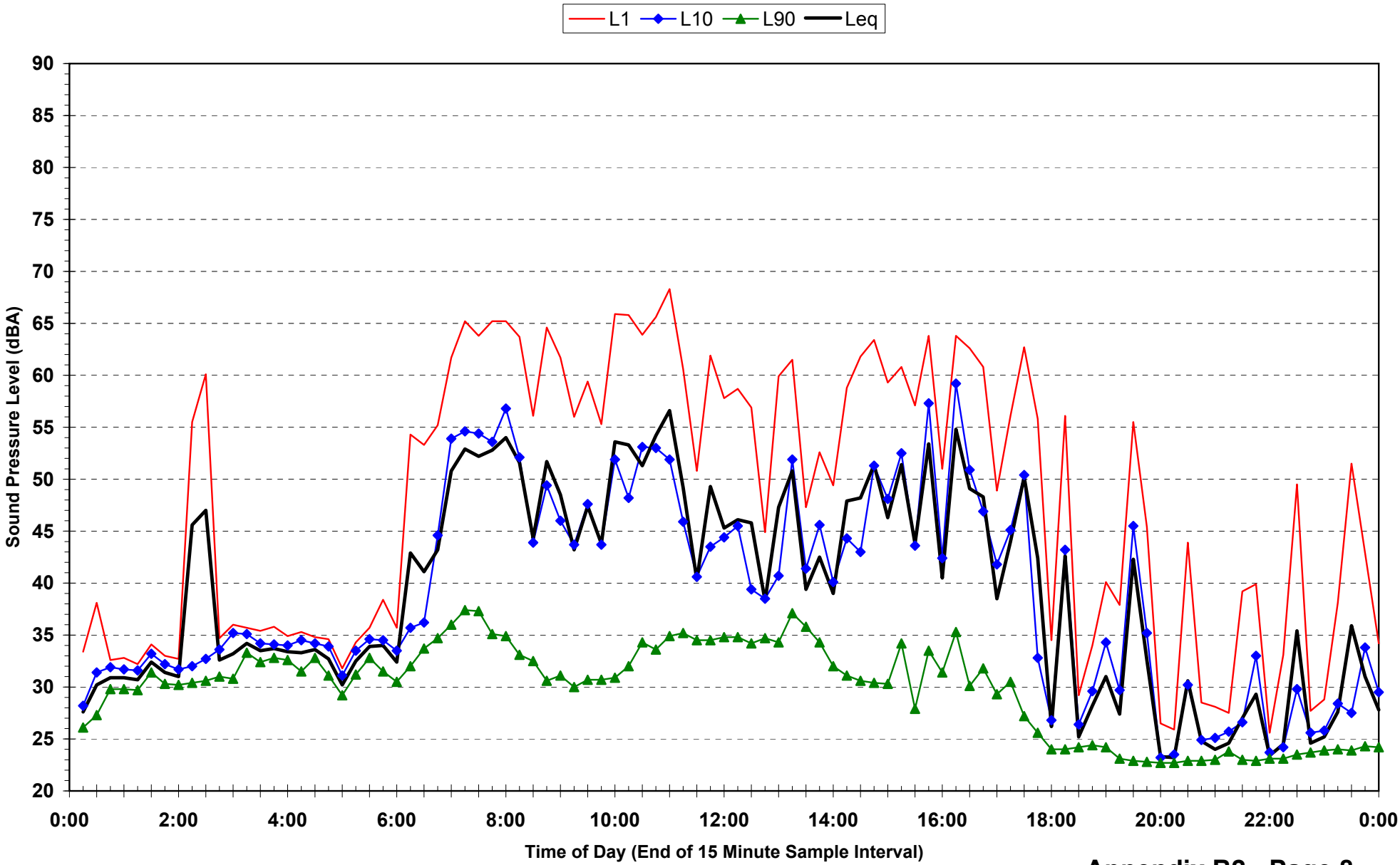
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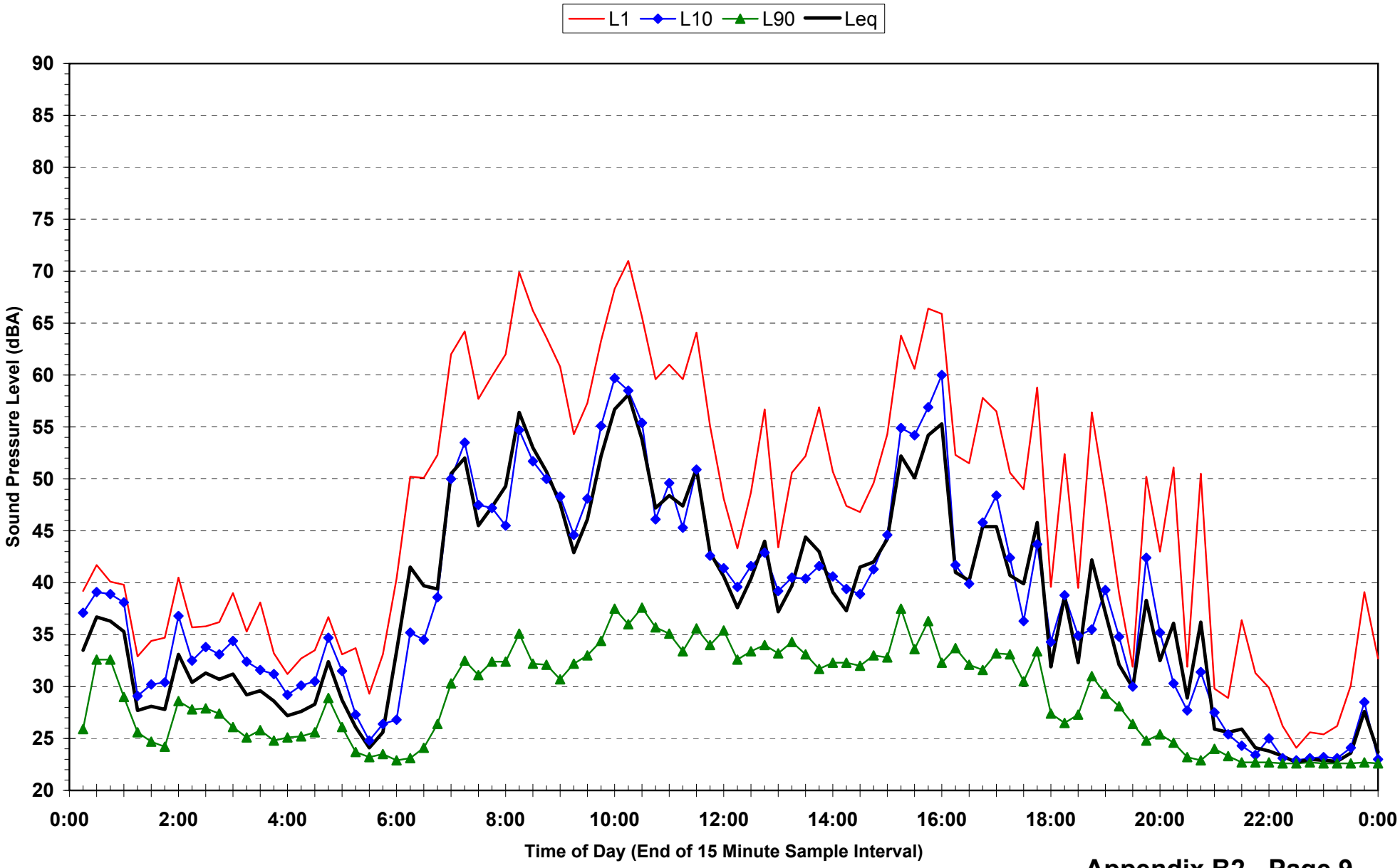
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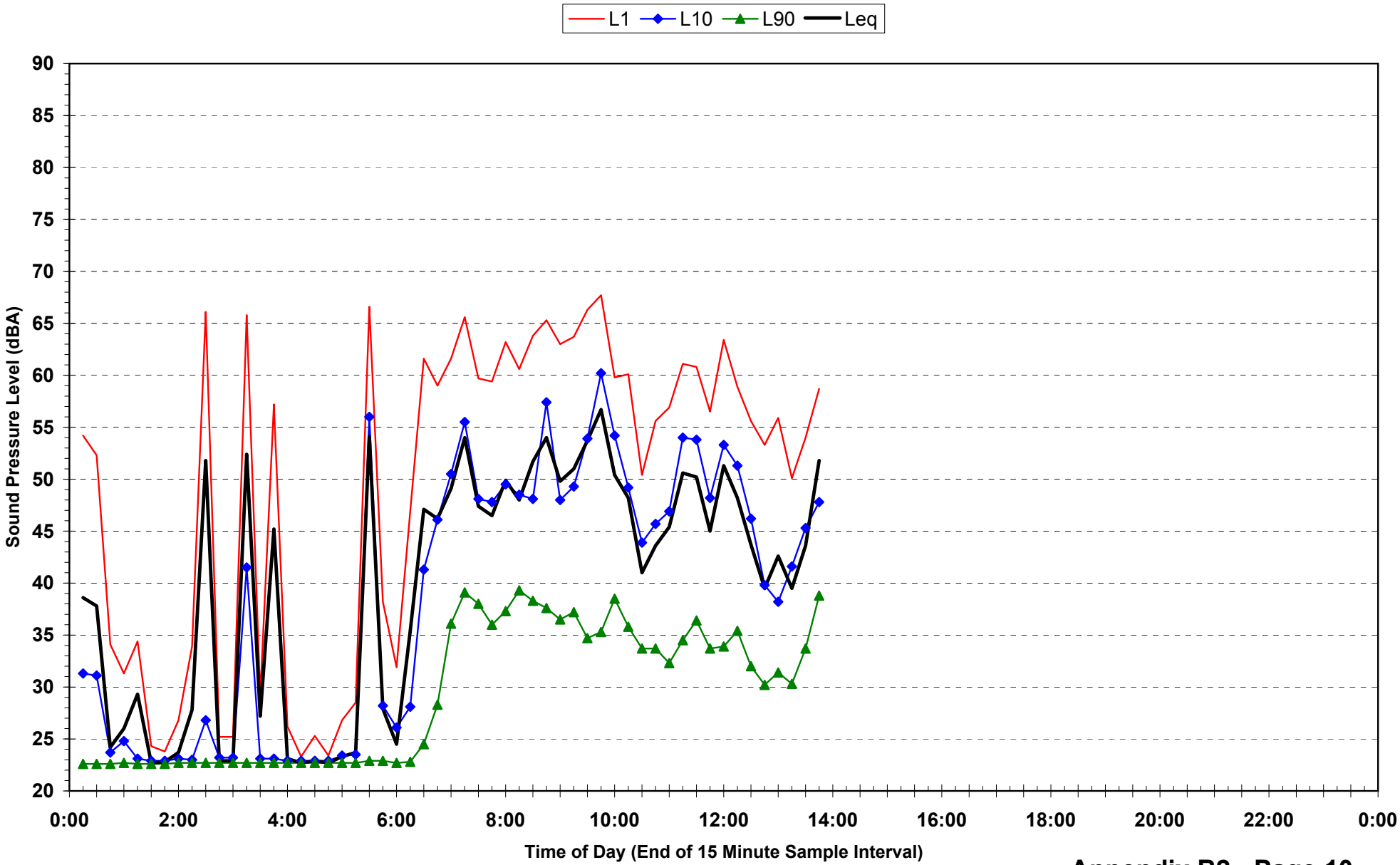
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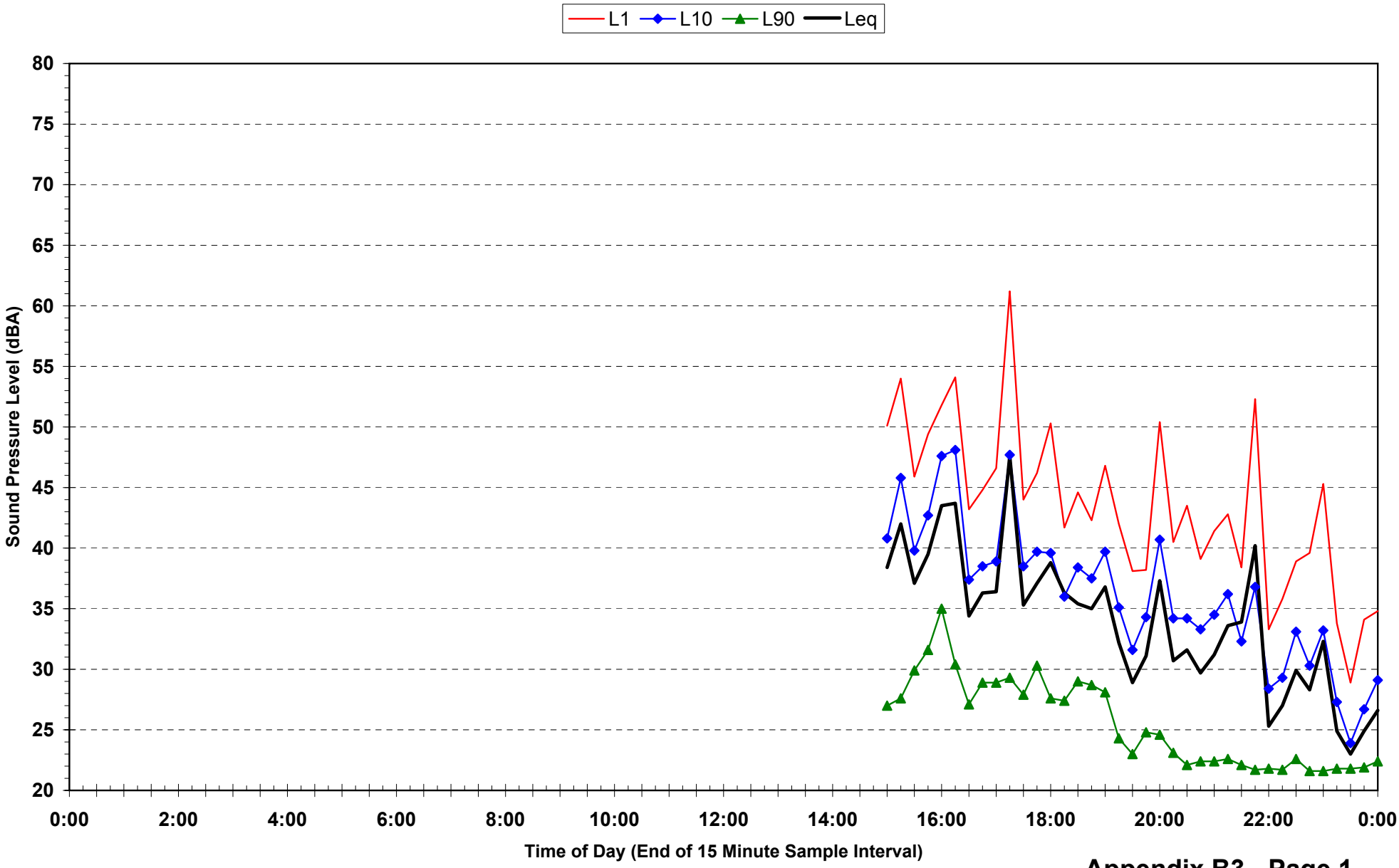
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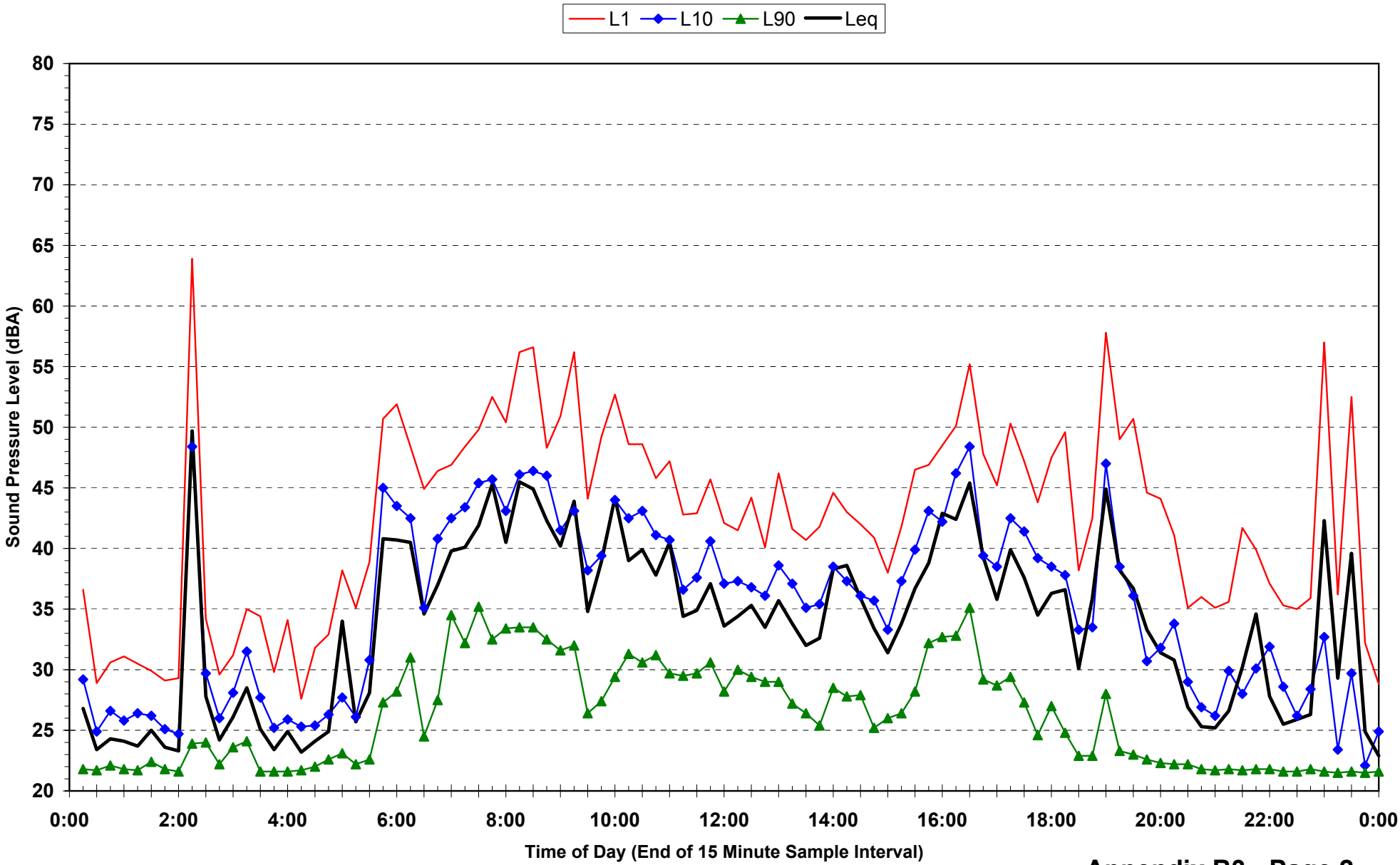
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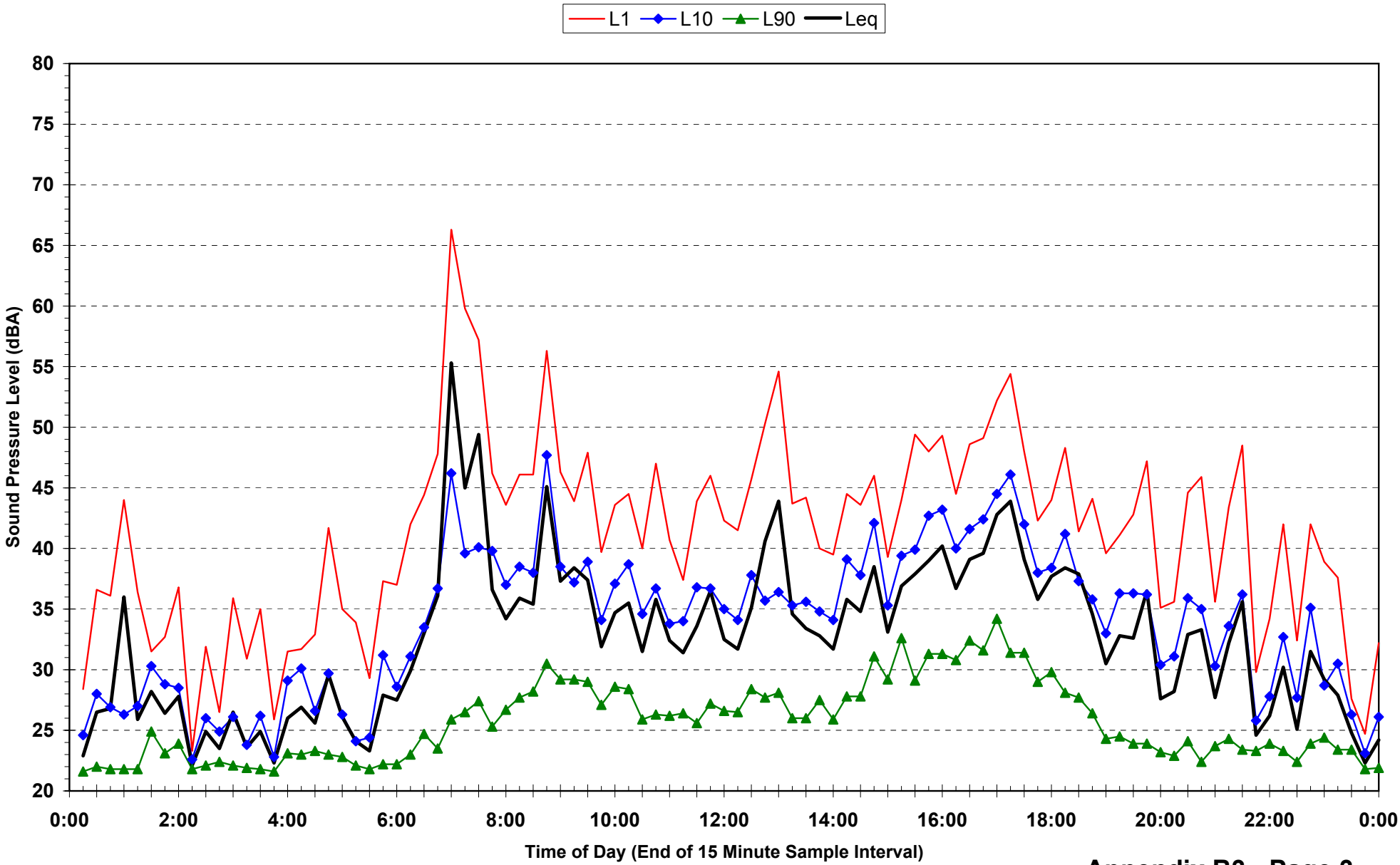
Appendix B3 - Page 1
Statistical Noise Levels
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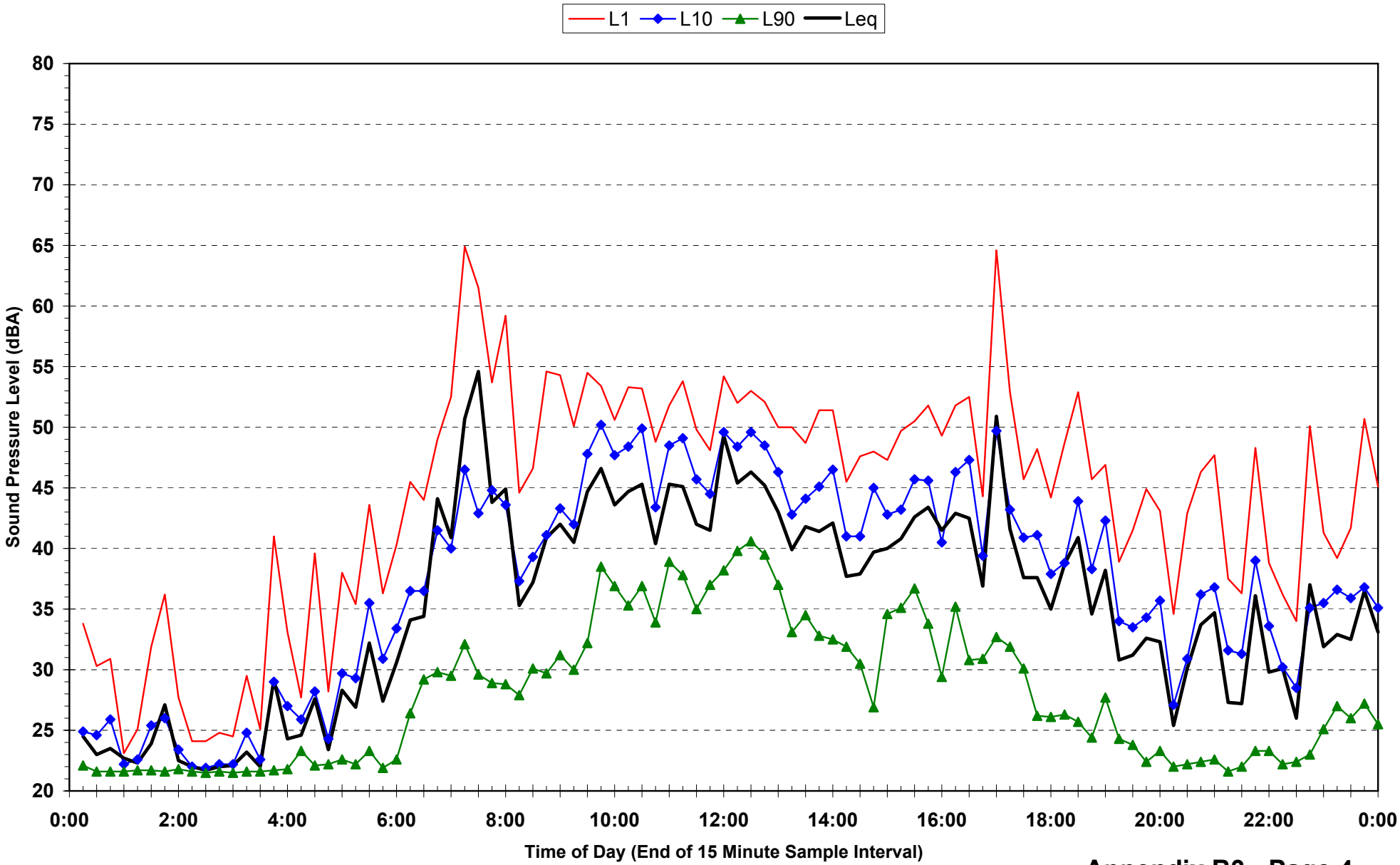


Appendix B3 - Page 2
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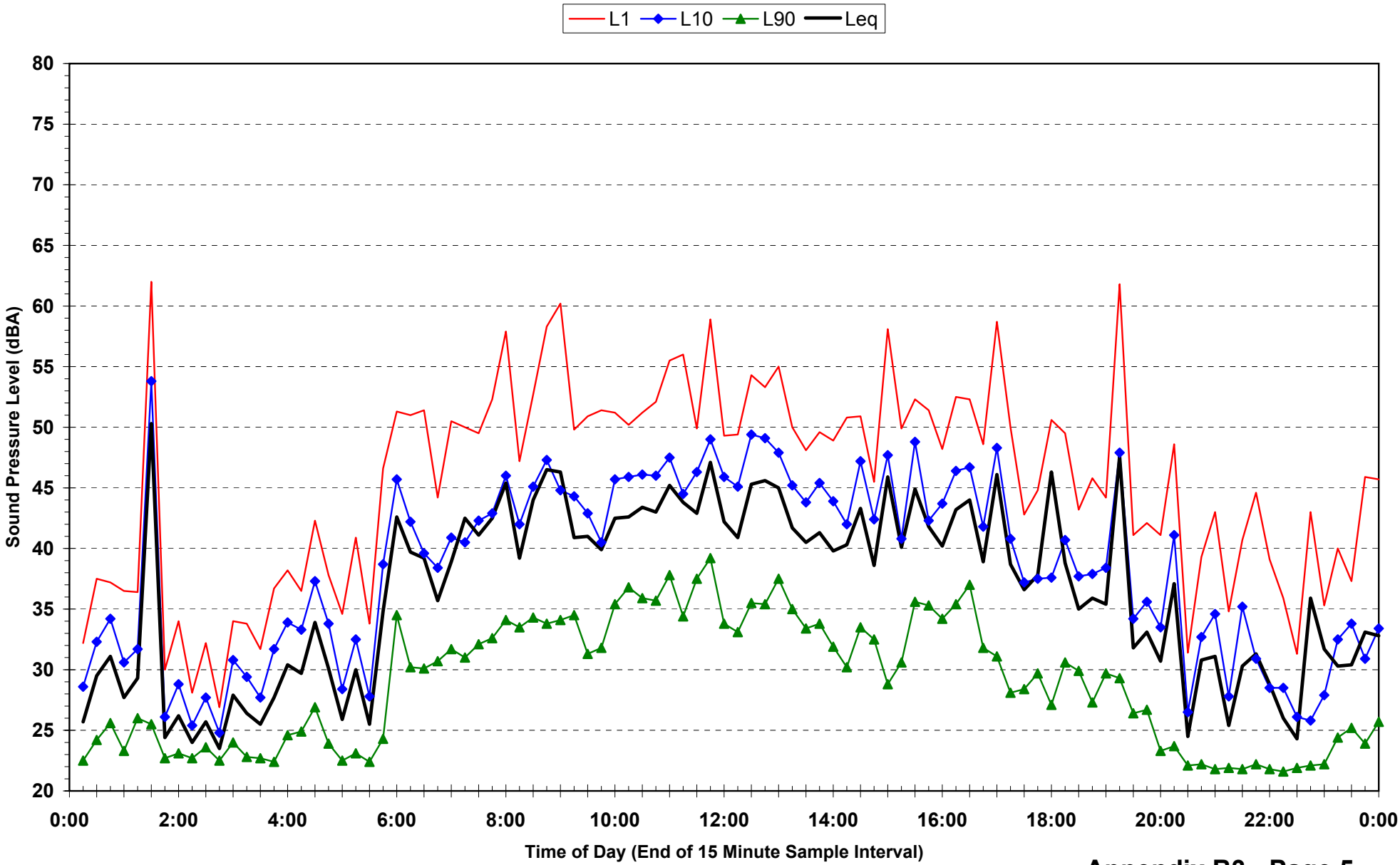
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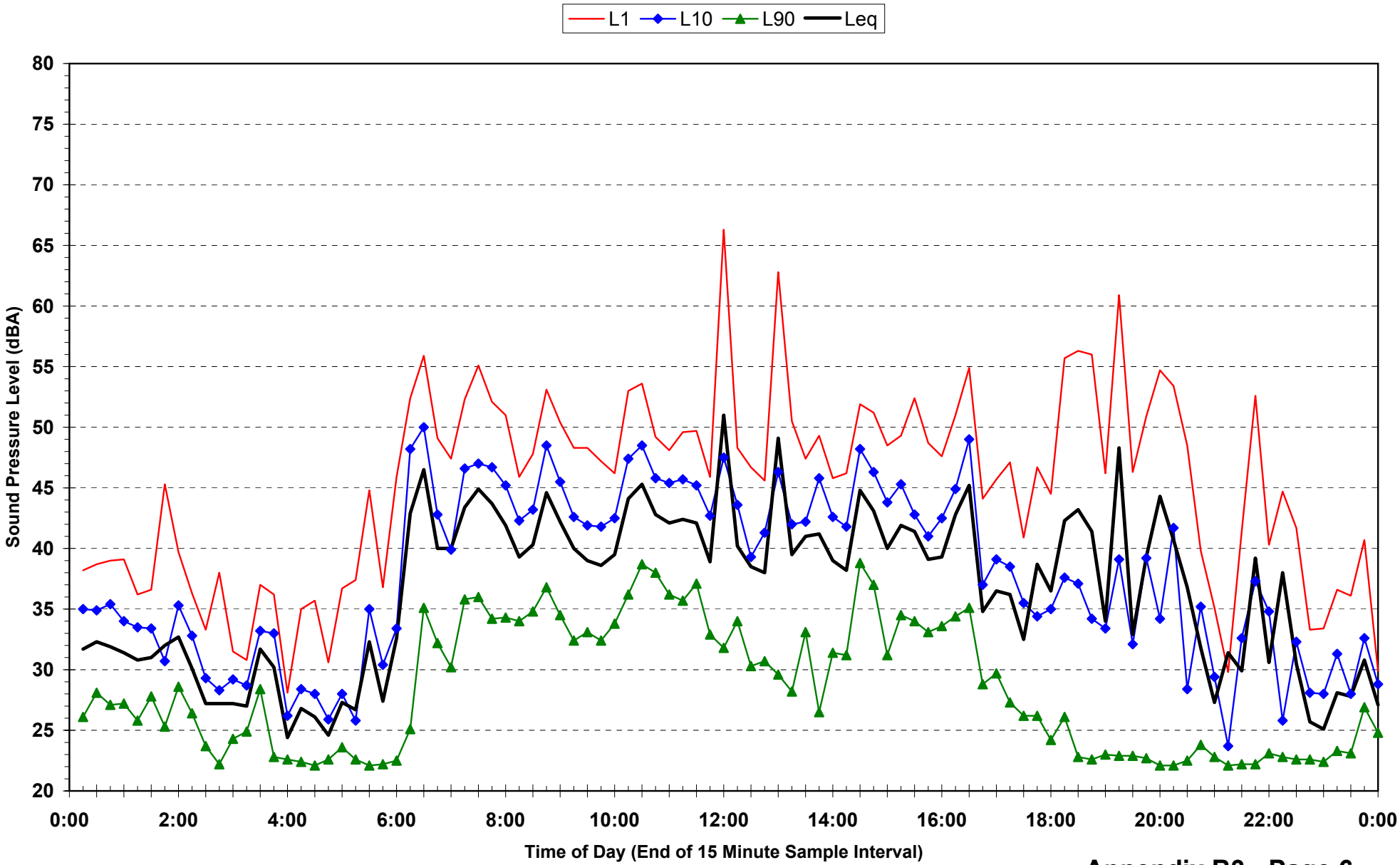
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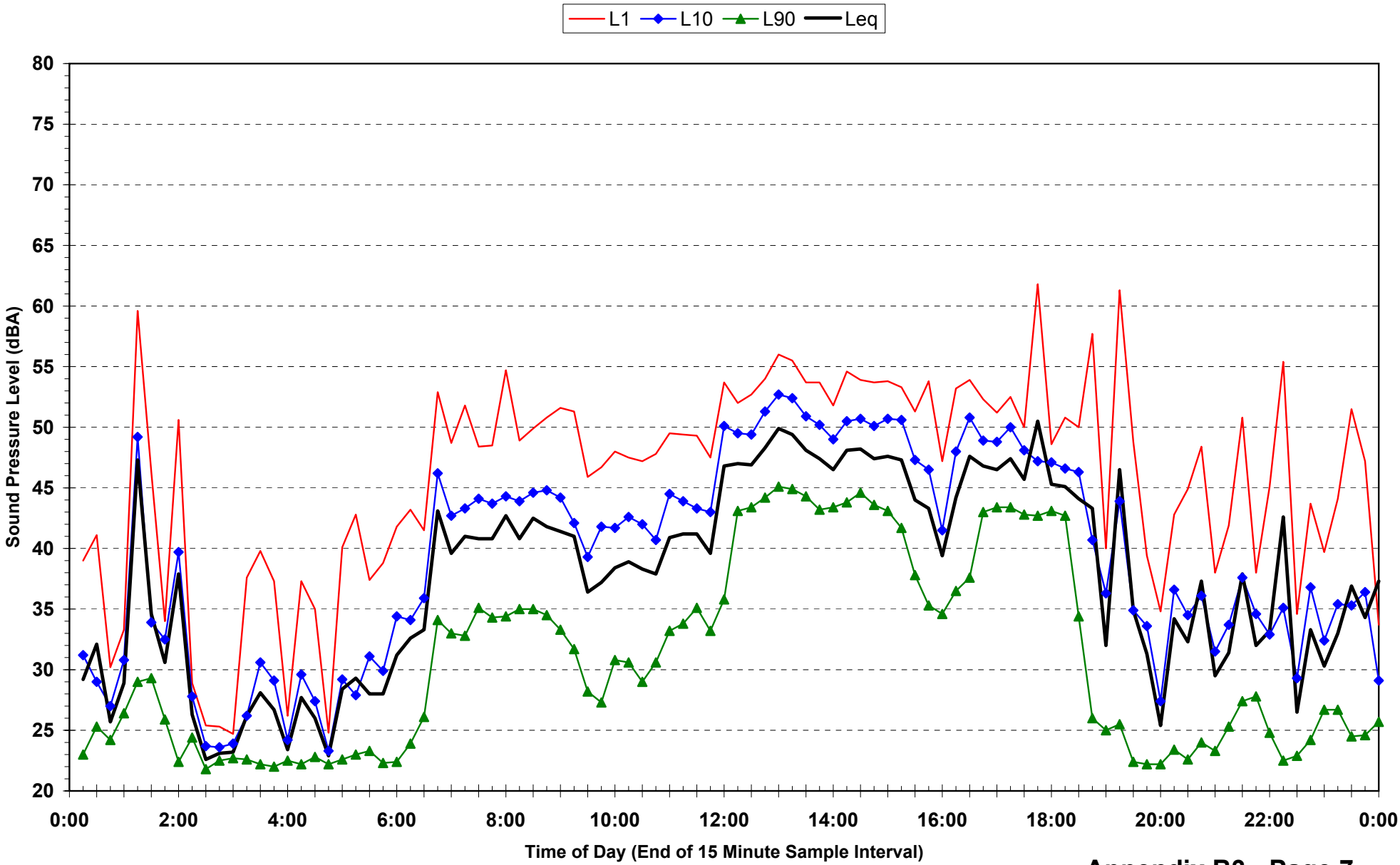
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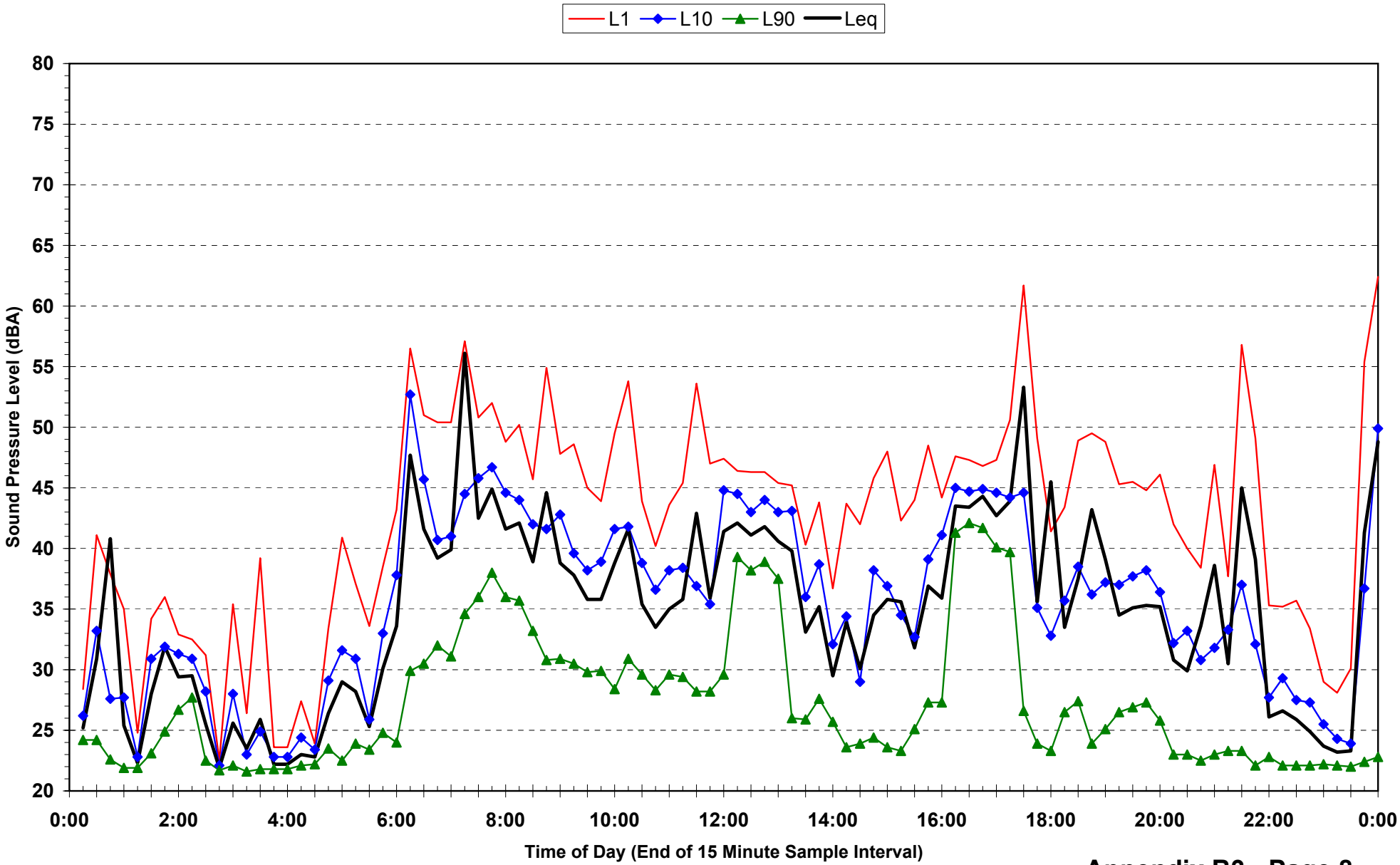
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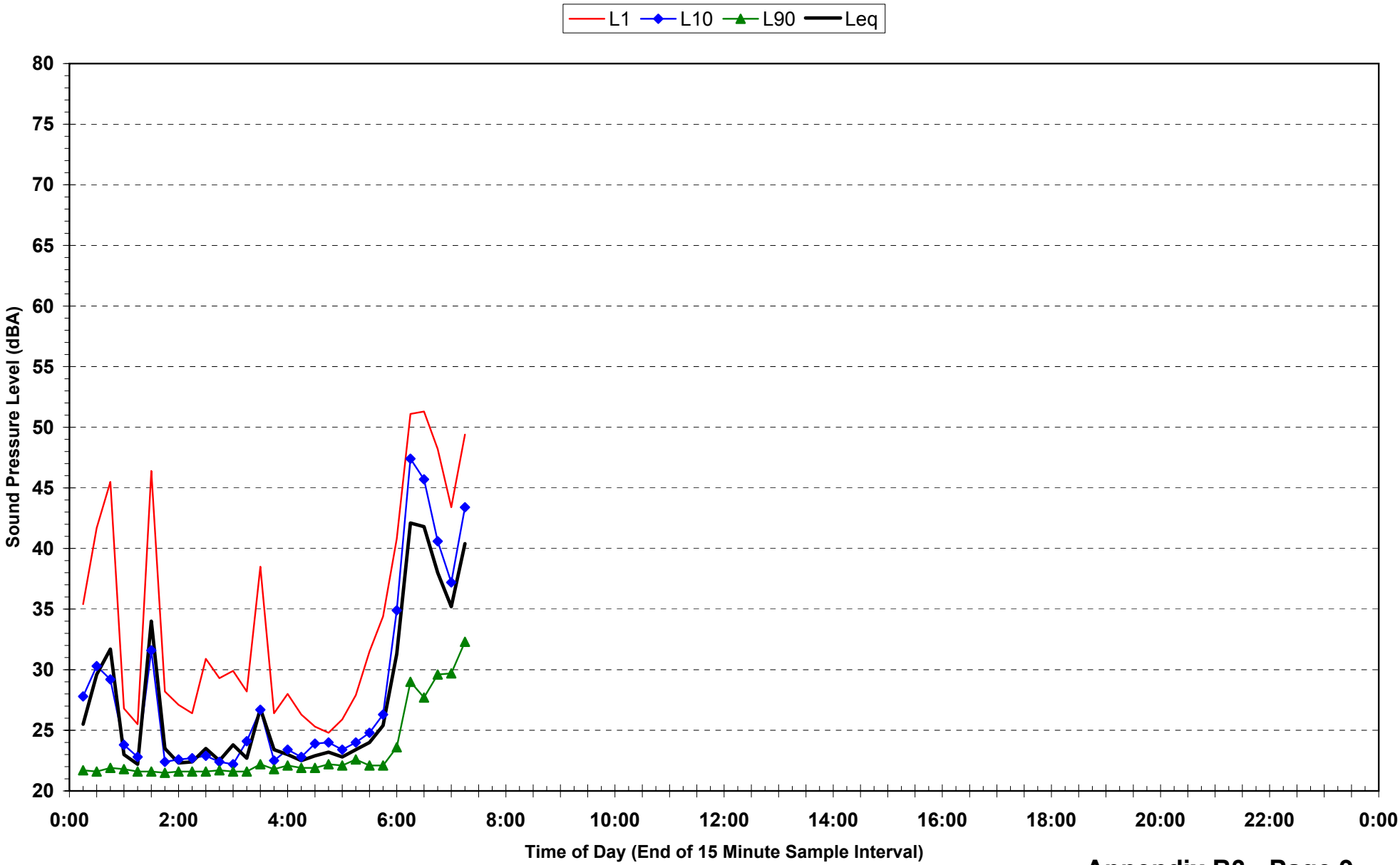
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Statistical Ambient Noise Levels
30-2464 Chinnery - Friday 20 May 2005



Statistical Ambient Noise Levels
30-2464 Chinnery - Saturday 21 May 2005



Woodlawn Bioreactor Environmental Assessment, Transport Impact Assessment

Appendix H



Report

Woodlawn Bioreactor Environmental Assessment, Transport Impact Assessment

26 JULY 2010

Prepared for

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Date: **26 July 2010**
Reference: 43177703/43177703/0
Status: Final

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Table of Contents

Executive Summary v

1 Introduction 1

1.1 Background 1

1.2 Site Location 1

2 Existing Transport Conditions 3

2.1 Levels of Service 3

2.2 Road Network 3

2.3 Existing Traffic 5

2.4 Other State and Regional Roads 7

2.5 Existing Operational Traffic 8

2.5.1 Approved Operational Traffic 8

2.6 Access Arrangements 8

2.6.1 Crisps Creek IMF 8

2.6.2 Woodlawn Bioreactor 8

2.7 Parking 9

2.8 Public Transport, Pedestrians and Cyclists 9

2.9 Existing Rail Operations 9

3 Description of Proposal 10

3.1 Proposed Operations 10

3.2 Traffic Generation Estimates 10

3.2.1 Construction Traffic Generation 10

3.2.2 Operational Traffic Generation 10

3.3 Other Developments in Area 12

4 Impact of Traffic Generation 15

4.1 Impact on Midblocks 15

4.2 Impact at Intersections 16

4.2.1 SIDRA Analysis 17

4.2.2 Assumptions 17

4.3 Vehicle Size 21

4.4 Access Arrangements 21

4.5 Parking Provision 21

4.6 Rail Based Operational Impacts 21
4.6.1 Proposed Rail Scheduling 22
4.6.2 Crisps Creek Operations 23
4.6.3 Rail / Road Interactions 23
4.6.4 Contingency Planning 23
5 Mitigation and Management Measures 25
6 Conclusion 27
7 Limitations 29

Tables

Table 2-1 Levels of Service, Rural Two-Lane Two-Way Roads 3
Table 2-2 Summary of Historical AADT for Surrounding Road Network 6
Table 3-1 Average Hourly Heavy Vehicle Movements from Crisps Creek IMF, Waste Haulage 11
Table 3-2 Regional Vehicle Movement Impact Considerations 11
Table 4-1 Impact Assessment of AM Peak Hour Vehicle Movements (two-way) for the Project 15
Table 4-2 SIDRA Analysis Results 17
Table 4-3 Crisps Creek Siding Capacity 22
Table 4-4 Expected Future Rail Scheduling - Crisps Creek IMF 22
Table 6-1 Statement of Commitments 27

Figures

Figure 1-1 Regional Site Location 2
Figure 2-1 Route between Crisps Creek IMF and Woodlawn Bioreactor 4
Figure 2-2 RTA Traffic Count Stations 7
Figure 3-1 Other Developments in the Eco-Precinct 13
Figure 4-1 Haulage Routes for regional areas 19
Figure 4-2 Vehicle Routes of Developments in Eco-Precinct 20

Plates

Plate 2-1 Collector Road, Towards East, East of Woodlawn Bioreactor Access 5
Plate 2-2 Collector Road, Towards East, East of Woodlawn Bioreactor Access 5

Plate 2-3 Woodlawn Bioreactor Access, Towards West 9
Plate 2-4 Woodlawn Bioreactor Access, Towards East 9

Appendices

Appendix A Rail Capacity Assessment
Appendix B Train Order Working Project

Executive Summary

URS Australia Pty Ltd has been commissioned by Veolia Environmental Services (Australia) Pty Ltd (Veolia) to conduct a Transport Impact Assessment (TIA) to support a Major Project Application to increase the tonnage of waste received at the Woodlawn Bioreactor.

Specifically, Veolia is seeking approval to expand the Woodlawn Bioreactor from its existing assessed maximum input rate of 500,000 tonnes per annum to 1.13 million tonnes per annum (tpa). This total includes additional waste by rail from Sydney as well as 130,000 tpa of waste sourced from regional areas by road of which 50,000 tpa is now approved under DA 31-12-09.

Simultaneously, Veolia is also seeking to increase the maximum throughput rate at the Crisps Creek Intermodal Facility (IMF) to 1.18 million tpa. The Crisps Creek IMF has previously been assessed to accept up to 500,000 tpa of waste to service the Bioreactor, and to also accept up to 280,000 tpa of waste to service the approved Woodlawn Alternative Waste Technology (AWT) Facility.

The application also seeks to extend the operating hours of the Bioreactor and Crisps Creek IMF to between 0600 and 2200 hours to facilitate an additional train at the Crisps Creek IMF.

The Bioreactor is a key facility within Veolia's 6,000ha Eco-Precinct which is located approximately 250km south west of Sydney. The Eco-Precinct also includes a number of approved waste management and renewable energy facilities (including the approved Alternative Waste Technology (AWT) facility and the Woodlawn Wind Farm) which have been factored into the assessment so as to determine overall cumulative impacts.

Based on existing Annual Average Daily Traffic volumes and estimates for existing local traffic volumes, the additional traffic volumes resulting from the proposal are not expected to significantly alter the Level of Service from the existing acceptable Level of Service along the transportation route between the Crisps Creek IMF and the Bioreactor, and along roads that will be used to transport regional waste.

The existing access arrangements for the Woodlawn Bioreactor and Crisps Creek Intermodal Facility are adequate to support this proposal. Existing parking provisions at both sites have sufficient capacity to accommodate the additional vehicles.

1

Introduction

1.1 Background

URS Australia Pty Ltd (URS) has been commissioned by Veolia Environmental Services (Australia) Pty Ltd (Veolia) to undertake a Transport Impact Assessment to support the Environmental Assessment for the proposed Woodlawn Expansion Project. The Woodlawn Bioreactor is a major facility within Veolia's Woodlawn Eco-Precinct. The Eco-Precinct consists of approximately 6,000ha of land located approximately 250km south west of Sydney, and includes a variety of approved waste management and renewable energy facilities including, the approved Alternative Waste Technology (AWT) facility and the Woodlawn Wind Farm.

The Woodlawn Bioreactor and Crisps Creek Intermodal Facility (IMF) are owned and operated by Veolia. The Woodlawn Bioreactor was assessed to receive up to 500,000 tonnes per annum (tpa) of general solid waste (putrescible) by rail from the Sydney region via the Crisps Creek IMF. However, the Conditions of Development Consent issued by the Department of Planning in November 2000 limited the input rate at Woodlawn to 400,000 tpa, which would then reduce by ten percent every five years.

Veolia is now seeking approval to expand the Woodlawn Bioreactor from its existing approved maximum input rate to 1.13 million tpa. This total includes additional waste by rail from Sydney as well as 130,000 tpa of waste sourced from regional areas by road, of which 50,000 tpa is now approved under DA 31-12-09.

Simultaneously, Veolia is also seeking to obtain consent to increase the maximum throughput rate at the Crisps Creek IMF to a total of 1.18 million tpa. The Crisps Creek IMF has been assessed to accept up to 500,000 tpa of waste delivered by train from Sydney to service the Bioreactor, and to also accept up to 280,000 tpa of waste to service the approved Woodlawn Alternative Waste Technology Facility (AWT), resulting in a total throughput at the IMF of 780,000 tpa.

1.2 Site Location

The Woodlawn Bioreactor and the Crisps Creek IMF (referred to herein as the 'Major Project Application') are located approximately 250 kilometres south-west of Sydney, approximately 40 kilometres south of Goulburn. The Bioreactor and the IMF are located approximately 10 kilometres and 3km south-west of Tarago respectively.

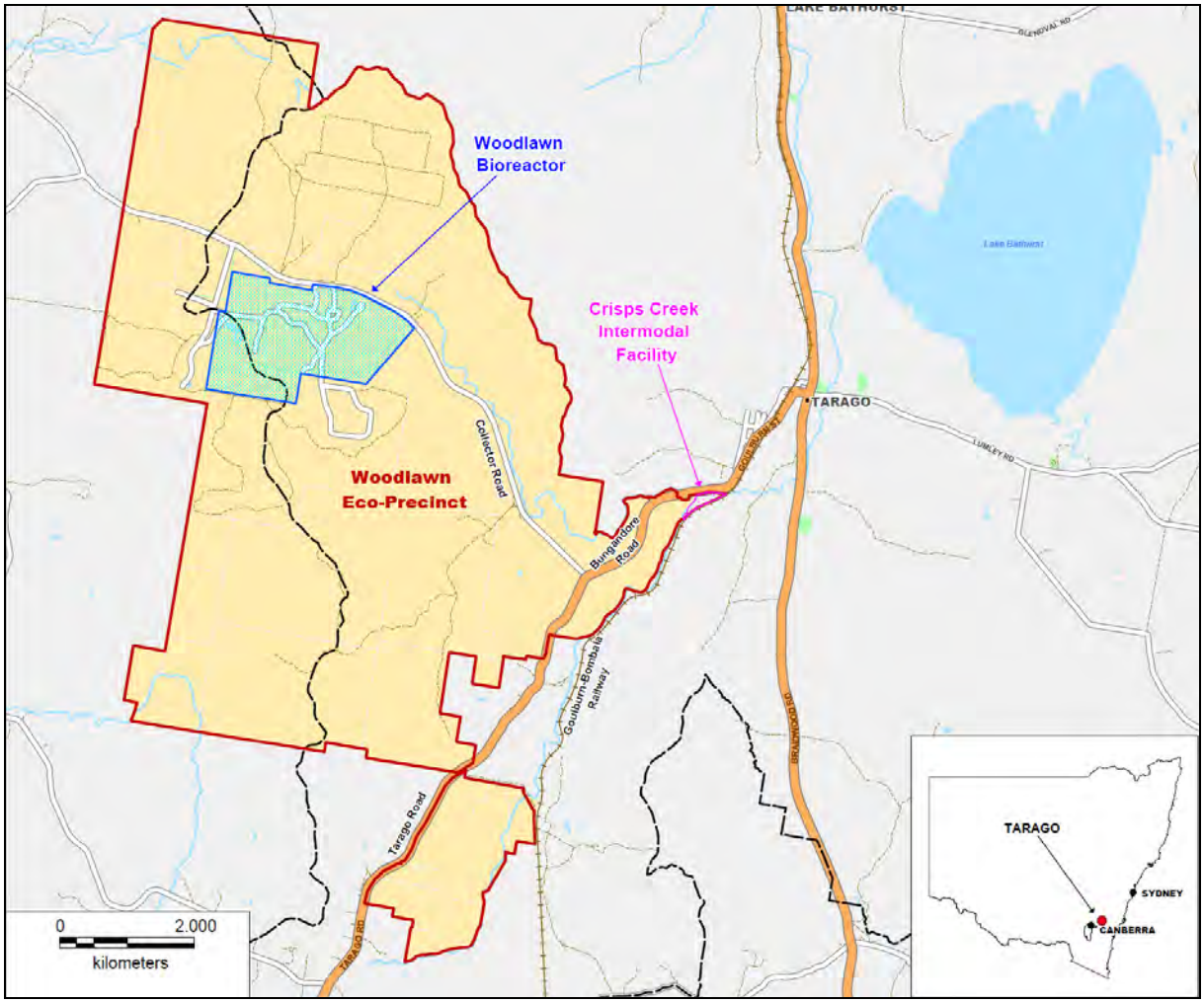
Access to the Woodlawn Bioreactor is via Collector Road, which runs in an east-west direction from its intersections with Bungendore Road to the east and Federal Highway to the west. The Woodlawn Bioreactor is located approximately 500 metres south of Collector Road.

Crisps Creek IMF is located on Bungendore Road, approximately 3 km south-west of Tarago. The intersection of Bungendore Road and Collector Road is a further 1.5 km south-west of the IMF.

Figure 1-1 illustrates the location of the site.

1 Introduction

Figure 1-1 Regional Site Location



2

Existing Transport Conditions

2.1 Levels of Service

In accordance with the *Guide to Traffic Generating Developments*, version 2.2 (RTA, October 2002), the Levels of Service relevant to rural local roads are summarised in Table 2-1. The threshold volumes for the peak hour flow (veh/h) on two-lane rural roads associated with each Level of Service are based on the combined counts for both directions. These traffic volumes account for total vehicle movements. For the purposes of this study, the proportion of heavy vehicles has an assumed conservative estimate of 10 percent.

Table 2-1 Levels of Service, Rural Two-Lane Two-Way Roads

Level of Service	Traffic Volume Threshold (Level Terrain)	Traffic Volume Threshold (Rolling Terrain)	Definition
A	N/A	N/A	Free-flow conditions with a high degree of freedom for motorists to select speed and manoeuvre within traffic flow
B	610 veh/h	470 veh/h	Stable flow conditions, reasonable freedom to select speed and manoeuvre within traffic flow
C	960 veh/h	750 veh/h	Stable flow conditions, restricted freedom to select speed and manoeuvre within traffic flow
D	1,450 veh/h	1,110 veh/h	Approaching unstable flow conditions, severely restricted to select speed and manoeuvre within traffic flow
E	2,270 veh/h	1,730 veh/h	Close to capacity, virtually no freedom to select speed and manoeuvre within traffic flow. Small increases in traffic volume would generally cause operational problems.

Notes:

1. Volumes rounded up to nearest 10 vehicles.
2. Source: Guide to Traffic Generating Developments, Version 2.2, 2002.

Roads operating at a Level of Service of C or better are generally considered to have acceptable flow conditions.

2.2 Road Network

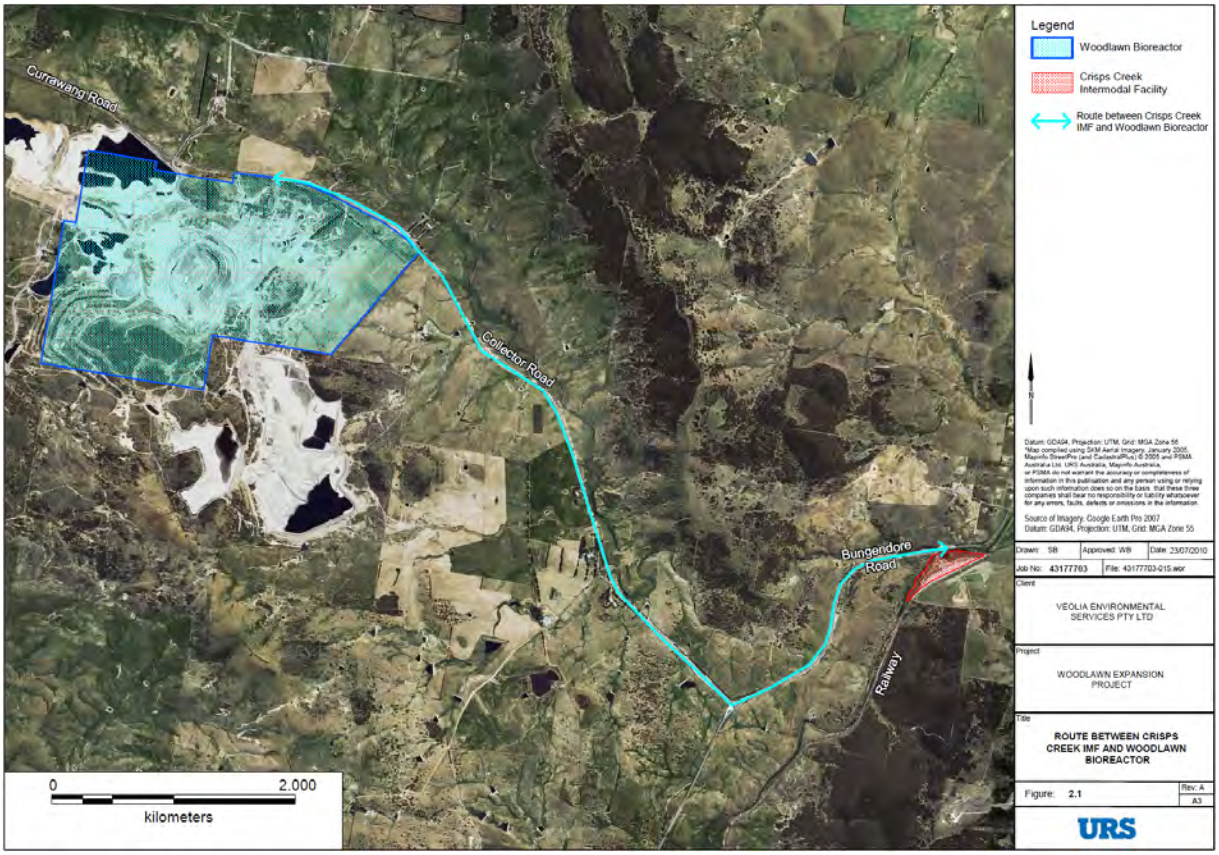
The Woodlawn Bioreactor is accessed via Collector Road from Bungendore Road. The Crisps Creek IMF is located on Bungendore Road approximately three kilometres from the township of Tarago.

Containerised waste is transported from the Crisps Creek IMF to the Bioreactor along Bungendore and Collector Roads.

Figure 2-1 illustrates the route between the Crisps Creek IMF and Woodlawn Bioreactor.

2 Existing Transport Conditions

Figure 2-1 Route between Crisps Creek IMF and Woodlawn Bioreactor



Braidwood Road (MR79)

Braidwood Road is a classified road comprising a two-lane, two-way configuration. There is a shoulder on both sides of the road generally with a width of approximately one metre. Braidwood Road has a posted speed limit of 100 kilometres per hour for the majority of its length with 50 or 60 kilometres per hour through towns.

The nearest RTA count station (94.142) is in Bungendore, east of Bungendore Road.

Bungendore Road (MR268)

Bungendore Road is a classified road and comprises a two-lane two-way configuration for the majority of its length, with a shoulder of approximately one metre on each side. The posted speed limit is 100 kilometres per hour with a 60-kilometre per hour speed limit through the town of Tarago. The existing pavement along Bungendore Road appears to be in good condition.

At the Crisps Creek Intermodal Facility, Bungendore Road has a right-turn bay for a length of approximately 100 metres to provide access to the facility for eastbound vehicles. Additionally, there is an acceleration lane for vehicles turning left out of the facility, for a length of approximately 100 metres. The existing intersection configuration is a Give-Way controlled t-intersection.

The nearest RTA count station (94.143) is in Bungendore, north of Braidwood Road.

2 Existing Transport Conditions

Collector Road

Collector Road comprises a two-lane, two-way configuration for the majority of its length, with a shoulder of approximately one metre on each side. The posted speed limit is 100 kilometres per hour. The existing pavement along Collector Road appears to be in good condition for the length between Bungendore Road and the Bioreactor access. Plate 2-1 illustrates the general configuration and condition of Collector Road.

Plate 2-1 **Collector Road, Towards East, East of Woodlawn Bioreactor Access**



Plate 2-2 **Collector Road, Towards East, East of Woodlawn Bioreactor Access**



Source: URS, 4 February 2010.

2.3 Existing Traffic

Traffic count data for relevant locations along the classified roads was obtained from the RTA database. The Annual Average Daily Traffic (AADT) for these roads has been summarised in Table 2-2.

2 Existing Transport Conditions

Table 2-2 Summary of Historical AADT for Surrounding Road Network

Station	Location	2000 AADT	2003 AADT	Average Annual Growth	2010 AADT Estimate[1]	Peak Hour Volume Estimate[2]
94.143	**MR268 Bungendore Road**, north of MR51 Braidwood Road, Bungendore	2,085	2,577	+8%	4,420	440
94.142	**MR79 Braidwood Road**, east of MR268 Bungendore Road, Bungendore	4,444	4,536	<+1%	4,540	450
94.470	**MR268 Bungendore Road,** at Yarralumla Shire Boundary	684	663	-1%	618	54
94.804	**MR79 Braidwood Road.** 1.5 km south of Currawong Road, Goulburn	1,309	1,458	+3%	1,794	311

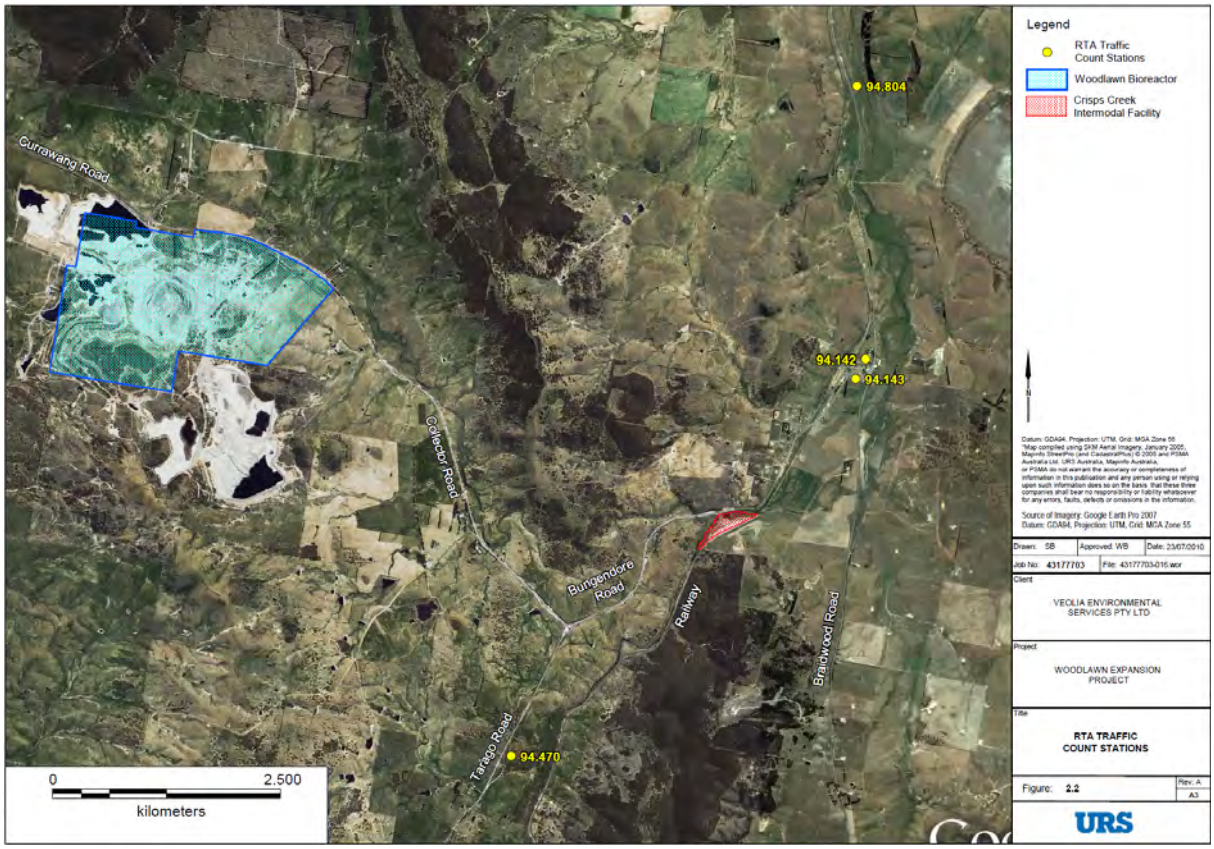
Source: RTA Traffic Volume Data Southern Region 2006.

Notes:
1. Based on linear average annual growth between 2000 and 2003 AADT data.
2. Based on the assumption that approximately ten percent of the AADT represents the peak traffic volume.

The Levels of Service thresholds in Table 2-1 indicate that Bungendore Road and Braidwood Road currently operate at Level of Service A.

2 Existing Transport Conditions

Figure 2-2 RTA Traffic Count Stations



Site observations on Collector Road suggest that the average daily traffic volume is less than 1,500 vehicles per day, which equates to up to 150 vehicles in the peak hour, assuming the peak hour volume represents ten percent of the average daily volume. Based on the Levels of Service specified in Table 2-1, Collector Road is currently operating at Level of Service A.

2.4 Other State and Regional Roads

As discussed in Section 1.1, part of this Major Project Application includes the receipt of up to 130,000 tpa of waste from regional areas by road, of which 50,000 tpa was assessed separately and is now approved under the existing consent. (AECOM, 22 January 2010). Therefore, while taking account the previous assessment of 50,000 tpa, this TIA also addresses the impacts of the transportation of the remaining 80,000 tpa of regional waste.

Since the exact sources and volumes of waste arriving from each regional area is unknown at this stage, it is assumed that waste would be transported via the three key highways before travelling along Bungendore Road and Collector Road to access the Bioreactor site. The key highways (including a sample RTA AADT) are:

- Hume Highway – 21,071 (2003 AADT, Yarra, 1.5 km east of SH3);
- Federal Highway – 11,240 (2003 AADT, Yarra, 1.5 km south of SH2); and
- Kings Highway – 3,705 (2006 AADT, approximately 30km east of Bungendore).

2.5 Existing Operational Traffic

The road haulage between the Crisps Creek IMF and Woodlawn takes approximately seven hours. This time accounts for a 56-container train set to arrive and be unloaded, transported to the Bioreactor, the unloading of containerised waste into the void and to make the return trip to the Crisps Creek IMF, equating to an average of 10 trips per hours or 20 vehicle movements (accounting for return trip). The original Bioreactor EIS considered traffic impacts for an average of 11 vehicles per hour, which equates to 22 movements per hour (accounting for a return trip).

2.5.1 Approved Operational Traffic

The Bioreactor facility is not the only development generating traffic within the Eco-Precinct. There are three approved facilities within the Eco-Precinct that will generate traffic concurrent with the proposed increases in vehicle activity at the Bioreactor site. The traffic generated by these facilities has been taken into account in this TIA to obtain an understanding of overall cumulative traffic impacts.

A summary of these other approved, but not operational activities, in the Eco-Precinct include:

- The AWT facility is approved to accept up to 280,000 tpa of waste from the Crisps Creek IMF;
- The Woodlawn windfarm development is an approved wind energy facility on Collector Road (east of the Bioreactor site) consent was given for approximately 200 vehicle trips generated per day during its construction phase only; and
- 50,000 tpa of regional waste to be received at the Bioreactor from the regional municipalities of Goulburn-Mulwaree, Queanbeyan, Bega Valley and Palerang Council's.

2.6 Access Arrangements

2.6.1 Crisps Creek IMF

The Crisps Creek Intermodal Facility access is located on Bungendore Road, approximately eight kilometres from the Woodlawn Bioreactor site. The access comprises a right-turn bay for eastbound movements on Bungendore Road, which is approximately 100 metres long and an acceleration lane for vehicles turning out of the Crisps Creek Intermodal Facility travelling southwest towards the Bioreactor site. The sealed access road consists of a single lane of approximately seven metres width. The left and right turns into the Crisps Creek Intermodal Facility access have large radii, which allow for heavy vehicle turning movements. The existing pavement adjacent to the access and along the access road is in good condition. The access location provides good sight distance in both directions.

2.6.2 Woodlawn Bioreactor

The Woodlawn Bioreactor access is on Collector Road and is a t-intersection incorporating a stop control. The access is approximately 30 metres wide with sufficient site distance to oncoming traffic in both directions. Plates 2-3 and 2-4 illustrate the width and stop-control of the access to the Woodlawn Bioreactor. The access road is sealed with a width of approximately eight metres. The existing pavement on Collector Road adjacent to the access and the access road itself is in good condition. The left turn into the Bioreactor access has a large radius, which allows for heavy vehicle turning movements.

2 Existing Transport Conditions

Plate 2-3 Woodlawn Bioreactor Access, Towards West



Plate 2-4 Woodlawn Bioreactor Access, Towards East



Source: URS, 4 February 2010.

2.7 Parking

There is visitor and employee parking located on the Bioreactor site. The occupancy rate of the visitor car park during the site visit was observed to be approximately ten percent. Car parking for at least 50 vehicles is provided on site.

There are an additional five parking spaces available for light vehicles at the entrance to the IMF site.

2.8 Public Transport, Pedestrians and Cyclists

During the site visit there were no public transport, pedestrian or cyclist facilities identified along key road corridors surrounding the Crisps Creek Intermodal Facility and the Bioreactor site.

2.9 Existing Rail Operations

Current operations involve one train set comprising of 56 containers, being transported from the Clyde Transfer Terminal to the Crisps Creek IMF on a daily basis.

The rail operations are summarised below:

- The train departs Clyde at approximately 1.30am with a laden set of containers
- Arrive at Crisps Creek IMF at 6.30am.
- Unloading operations using a container handler commence at approximately 7 am.
- Containers are placed on prime movers to be transported to the Bioreactor.
- Prime movers return empty containers to the IMF and are reloaded onto the train.
- Train departs the IMF at approximately 4.30pm.

3

Description of Proposal

3.1 Proposed Operations

The Major Project Application seeks to increase the maximum input rate at the Woodlawn Bioreactor to 1.13 million tpa. This total includes additional waste by rail from Sydney as well as 130,000 tpa of waste sourced from regional areas by road of which 50,000 tpa is already approved.

Simultaneously, Veolia is also seeking to obtain consent to increase the maximum throughput rate at the Crisps Creek IMF to a total of 1.18 million tpa. Additionally, the Major Project Application seeks to extend the hours of operation at the Crisps Creek IMF and Woodlawn Bioreactor to facilitate an additional train each day.

To facilitate the increased input rates, some additional equipment and personnel may be required at both the Crisps Creek IMF and Woodlawn Bioreactor. The following additions would cover the proposed operating conditions as well as any additional contingency requirements:

- 11 employees between the two facilities;
- One container handler;
- One bulldozer;
- One landfill compactor; and
- One container tripper.

3.2 Traffic Generation Estimates

3.2.1 Construction Traffic Generation

There is limited construction work associated with the Project as Veolia is not proposing to increase the project footprint of either the Bioreactor of the IMF. If required, any construction traffic would consist of short-term deliveries to install additional mobile and permanent lighting infrastructure at the Woodlawn Bioreactor to facilitate evening operations. Given the one off nature of these operations, any delivery and installation traffic is considered to have a negligible impact on the transportation network.

3.2.2 Operational Traffic Generation

The proposed increase in tonnage would require an increase to the hours of operation to unload and transport the additional containers received at Crisps Creek.

Table 3-1 summarises the average hourly vehicles required for the proposal in comparison to the original Bioreactor proposal.

3 Description of Proposal

Table 3-1 Average Hourly Heavy Vehicle Movements from Crisps Creek IMF, Waste Haulage

	Existing Operations	Proposed Operations	Change
Truck operation hours	0700 to 1800 (11 hours)	0600 to 2200 (16 hours)	+5 hours
Number of Vehicles to Bioreactor	10	15	+5 Vehicles
Number of Vehicles to AWT	0	6	+6 Vehicles
Total Number of Vehicles[1]	10	21	+11 Vehicles
Total Number of Vehicle Movements[2]	**20**	**42**	**+22 Vehicle Movements**

Source: Veolia, January 2010.

Notes:
1. Considers one-way vehicle movements (to/from Crisps Creek IMF)
2. Considers two-way vehicle movements (to/from Crisps Creek IMF)

.

The Major Project Application would require an increase in equipment and personnel at the Woodlawn Bioreactor and the Crisps Creek IMF. This includes an additional 11 employees, one forklift, one bulldozer, one landfill compactor and one container tipper. The delivery of the additional equipment is a one-off impact and is considered to have an insignificant impact on the surrounding transport network. For the purpose of this proposal it is assumed that the additional 11 employees would travel to the Bioreactor site in separate cars during the AM peak hour and leave the site in the PM peak hour.

The proposal also includes the receipt of up to 130,000 tpa of waste from regional areas, of which 50,000 tpa is already approved to be received from the regional municipalities of Goulburn-Mulwaree, Queanbeyan, Bega Valley and Palerang. Appendix H of the *Environmental Assessment – Modification to DA 31-02-99 to Receive Regional Council Waste at the Woodlawn Bioreactor* (AECOM/Veolia, February 2010) outlines the estimated traffic volumes and haulage routes between these Councils and the Bioreactor site and are summarised in Table 3-2.

Although the exact sources and volumes of the additional 80,000 tpa of regional waste have not been confirmed, estimates of the traffic generated by the additional regional waste are outlined in Table 3-2.

Table 3-2 Regional Vehicle Movement Impact Considerations

Council	Waste (tpa)	Annual Trucks	Daily Trucks One Way (Two-Way)
Approved Regional Waste (50,000 tpa) [1]			
Goulburn Mulwaree	20,000	1,053	4 (8)
Palerang	10,000	526	4 (8)
Queanbeyan	8,000	421	2 (4)
Bega Valley	12,000	632	2 (4)
Total	50,000	2,632	10 (20)
Additional 80,000 tpa proposed under this Environmental Assessment			
Upper Lachlan	3,000	158	1 (2)
Yass Valley	3,000	158	1 (2)
Eurobodalla	21,000	1,105	4 (8)
ACT[2]	53,000	2,789	9 (18)
Total	80,000	4.210	15 (30)

1. *Environmental Assessment – Modification to DA 31-02-99 to Receive Regional Council Waste at the Woodlawn Bioreactor (Aecom/Veolia, February 2010) – Appendix H*
2. *ACT figures based on 50% of total Commercial, Industrial and Private Waste Volumes, (ACT SoE Report, 2006/7)*

Based on a conservative approach, it is assumed that all the truck trips associated with the transportation of the 130,000 tpa of waste from regional areas would take the route via Bungendore Road and Collector Road only. A conservative truck capacity figure was used i.e. 19 tonnes. In addition, it was assumed that all daily truck movements outlined in Table 3-2 (i.e from surrounding areas) will occur during the peak periods. Although this may not actually occur during the operational phase, this will produce the conservative approach for the traffic impact analysis conducted in section 4 of this document.

Based on the figures contained in Table 3-2, the following regional traffic is expected to be generated

- 130,000 tpa of regional waste equates to approximately 6,842 vehicle trips to the Woodlawn Bioreactor per year, assuming each truck transports 19 tonnes of waste;
- Although waste can be transported six days per week for 52 weeks of the year, totalling 312 days per year; all has been assumed to occur during the modelled period and will produce the 'worst-case' scenario.

3.3 Other Developments in Area

The Woodlawn Bioreactor is located on Collector Road which is subject to two more additional developments that may be in their construction and/or operational phase at the same time of the increased traffic generation rates described in section 3.2. The first of these developments is the Woodlawn Windfarm Project and is a proposed wind energy facility incorporating twenty wind turbines. The site access to this windfarm for construction vehicles will be on Collector Road at the entrance to Pylara Farm and is located east of the Bioreactor access road. Over-dimensional and construction vehicles accessing the windfarm site will be originating in Port Kembla and/or Goulburn and travel along Bungendore Road via Tarago.

The second development along Collector Road is the Woodlawn Alternate Waste Technology Facility which is located west of the Bioreactor access road. Additional vehicles generated by this Project will be travelling between the AWT facility and the Crisps Creek IMF.

Details of the vehicle generation assumed for each site is provided in Table 4-1 and have been adopted in the traffic impact analysis in section 4.

The 130,000 tpa of waste received by the Bioreactor facility from regional LGAs (detailed in section 3.2) also needs to be taken into consideration when assessing the traffic impacts of the proposed increases in activities of the Bioreactor facility, of which 50,000 tpa is already approved.

Figure 3-1 illustrates the Bioreactor site with the nearby developments in the area.

Woodlawn Bioreactor and AWT Site

Woodlawn Windfarm

Collector Road

Crisps Creek IMF

Bungendore Road

Railway

Braidwood Road

0 2.000

kilometers

N

Legend

- Site Boundaries
- Rail
- Road
- Access to Sites

*Map compiled using Mapinfo StreetPro 2010
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Datum: GDA94, Projection: UTM, Grid: MGA Zone 55

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Client

VEOLIA ENVIRONMENTAL SERVICES PTY LTD

Project

WOODLAWN EXPANSION PROJECT

Title

VEHICLE ROUTES OF DEVELOPMENTS IN ECO-PRECINCT

Figure: **3-1**	Rev: A
	A3

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4

Impact of Traffic Generation

This section provides the degree of traffic impact created by the increase in the proposed vehicle movements and extended operational hours of the Bioreactor site. The AM Peak Hour is the chosen period to be assessed as this will produce the 'worst-case' scenario. The assumptions used in determining the traffic impact is outlined in section 4.2.2.

4.1 Impact on Midblocks

The impact on key roads surrounding the Crisps Creek Intermodal Facility and the Bioreactor Site with respect to increased traffic volumes is presented in Table 4-1.

Table 4-1 Impact Assessment of AM Peak Hour Vehicle Movements (two-way) for the Project

Activity	Collector Road	Bungendore Road	Braidwood Road
No Development			
Traffic Flow	150	440	450
Existing Operational Traffic, Woodlawn Bioreactor	10	10	0
Total Traffic Flow – Existing	160	450	450
Level of Service	A	A	A
With Proposal			
Proposed Operational Traffic (additional IMF deliveries)[1]	30	30	0
Proposed Operational Traffic, Regional waste deliveries)[2]	50	50	8
Estimated Operational Traffic, Woodlawn AWT[3]	12	12	0
Additional Staff Required at IMF and AWT facilities[4]	11	10	9
Estimated Construction Traffic, Woodlawn Windfarm[5]	70	65	58
Total Traffic Flow – with Proposal	333	617	525
Percentage Change (from No Development)	108%	37%	17%
Midblock Level of Service	A	B	A / B[7]

Source: URS, February 2010.

Notes:

1. Represents two-way movements between Bioreactor and IMF.
2. Refer Table 3-2 for values – assumed all two-way movements occur during AM Peak Hour for 'worst-case scenario'.
3. Represents a total of twelve two-way truck movements between AWT site and IMF.
4. Represents one-way movements to site during AM Peak Hour. Assume employee distribution of 75% from Goulburn/Tarago, 15% from Bungendore and 10% from Collector.
5. Total construction volumes have been based on the *Woodlawn Wind Farm Modifications – Statement of Environmental Effects* (Aurecon, Jan 2010). Total of 50 one-way personnel movements and 20 return truck trips during AM Peak Hour. Assume employee distribution of 75% from Goulburn/Tarago, 15% from Bungendore and 10% from Collector for turning movement split for site access.
6. A level of service 'B' is still considered to have reasonable freedom of congestion and is not of any concern.
7. A level of service 'A' applies to Braidwood Road if the majority of its length is considered level terrain or is otherwise 'B' if considered rolling terrain. The site inspection indicated that the road typography is somewhere in between and therefore both levels of service have been provided. Nonetheless, a level of service 'B' is still considered to have reasonable freedom and is not of any concern.

Analysis of Table 4-1 for the Major Project Application indicates the following key elements:

- AM Peak Hour traffic on Collector Road would be approximately 108 percent higher than the existing traffic volumes. Despite this significant increase in peak hour traffic volumes, the Level of Service for Collector Road remains unchanged at Level of Service A.

- AM Peak Hour traffic on Bungendore Road and Braidwood Road would increase by 37 and 17 percent respectively and would have negligible impact on the operation of the roads.

As outlined earlier, it is expected that up to 130,000 tpa of waste may be transported from regional areas to the Bioreactor site for disposal. An assessment of the proposed delivery of waste to the Bioreactor from these areas, including sources, transportation arrangements, haulage routes and associated impacts has been incorporated into Table 4-1 and turning movements are outlined under the assumptions in section 4.2.2. As addressed in Section 2 of this report, it is assumed that the route taken by road is likely to be via the state highway network then Bungendore Road and Collector Road to access the Bioreactor site. Based on the existing high traffic volumes on the state highway network and the likelihood that these vehicular movements would be spread over a wide transport network, it is anticipated that traffic generated by this proposal on other road midblocks would be negligible and would be dissipated within normal traffic growth.

The cumulative effect of nearby developments proposed to be developed or operating simultaneously has also been considered in Table 4-1.

4.2 Impact at Intersections

The SIDRA modelling package was used to analyse the performance of the existing road network to identify the current traffic characteristics (in 2010 estimates) at three key intersections between the Crisps Creek IMF and Woodlawn Bioreactor sites:

- Crisps Creek IMF site access / Bungendore Road intersection;
- Bungendore Road / Collector Road intersection; and
- Woodlawn Bioreactor site access / Collector Road intersection.

There are a number of other intersections in the surrounding area (such as in Goulburn, Collector and Bungendore), however the impact of operational vehicles at these intersections will be negligible (i.e the only vehicles during the operational phase of the development will be from regional areas and will amount to only a handful of vehicles per hour).

The ‘degree of saturation’ and ‘95% queue length’ are used to compare the affect that operational vehicles will have on the operation of the intersections.

The Degree of Saturation refers to the ratio of an intersection between the traffic demand at the intersection compared to its total capacity. An intersection with a Degree of Saturation approaching 0.90 to 0.95 is considered to be at capacity.

The 95% queue length value is used as an indication of the length whereby the probability of exceeding it is only 5% - often referred to as the design queue length.

4 Impact of Traffic Generation

4.2.1 SIDRA Analysis

Table 4-2 provides the SIDRA analysis outputs for the three nominated intersections.

Table 4-2 SIDRA Analysis Results

Intersection		2010 Existing Conditions	2010 Estimated Values[1]	Critical Movement
Crisps Creek IMF site access / Bungendore Road intersection	Degree of Saturation	0.13	0.19	Eastbound Bungendore Road right turn into IMF site
	95% Queue Length	Less than one vehicle[2]	12m	
Bungendore Road / Collector Road intersection	Degree of Saturation	0.18	0.55	Eastbound Collector Road left and right turn movements into Bungendore Road
	95% Queue Length	7m	42m	
Woodlawn Bioreactor site access / Collector Road intersection	Degree of Saturation	0.05	0.23	Northbound Bioreactor site access right turn into Collector Road
	95% Queue Length	6m	15m	

Notes:
1. Includes impacts of proposed increase in Bioreactor volumes and cumulative effects of adjacent developments and regional LGA deliveries.
2. Queue Lengths of 'less than one vehicle' refer to a distance less than 6m.

The analysis summary provided in Table 4-2 during the AM Peak Hour indicates that there will no significant traffic impacts of the additional truck movements associated with the proposed increase in activities at the Woodlawn Bioreactor site. The Degree of Saturation outputs for all three intersections are well below the 0.90-0.95 threshold and the longest queue length is expected to be 42m (i.e approx 7 cars). As such, there is no indication that intersection improvements will be required even after taking into account the additional cumulative impact of the adjacent developments on the existing traffic.

4.2.2 Assumptions

Turning movements and heavy vehicle volumes must be known or estimated in order for intersections performance to be analysed in SIDRA. Midblock volumes, supplied by RTA counts, are the only known data and as such a number of assumptions have been made for the purposes of SIDRA modelling, and includes:

- Existing Traffic Conditions
  - Existing traffic directional split along Bungendore Road and Collector Road is assumed to be 50/50 (eg. 50% northbound, 50% southbound);
  - A conservative estimate of existing heavy vehicle proportion of 10% has been applied to all road sections;
  - The AM Peak Hour has been modelled and is estimated to represent 10% of total daily volumes; and
  - Collector Road attracts 10% of northbound traffic and 10% of southbound traffic on Bungendore Road.

4 Impact of Traffic Generation

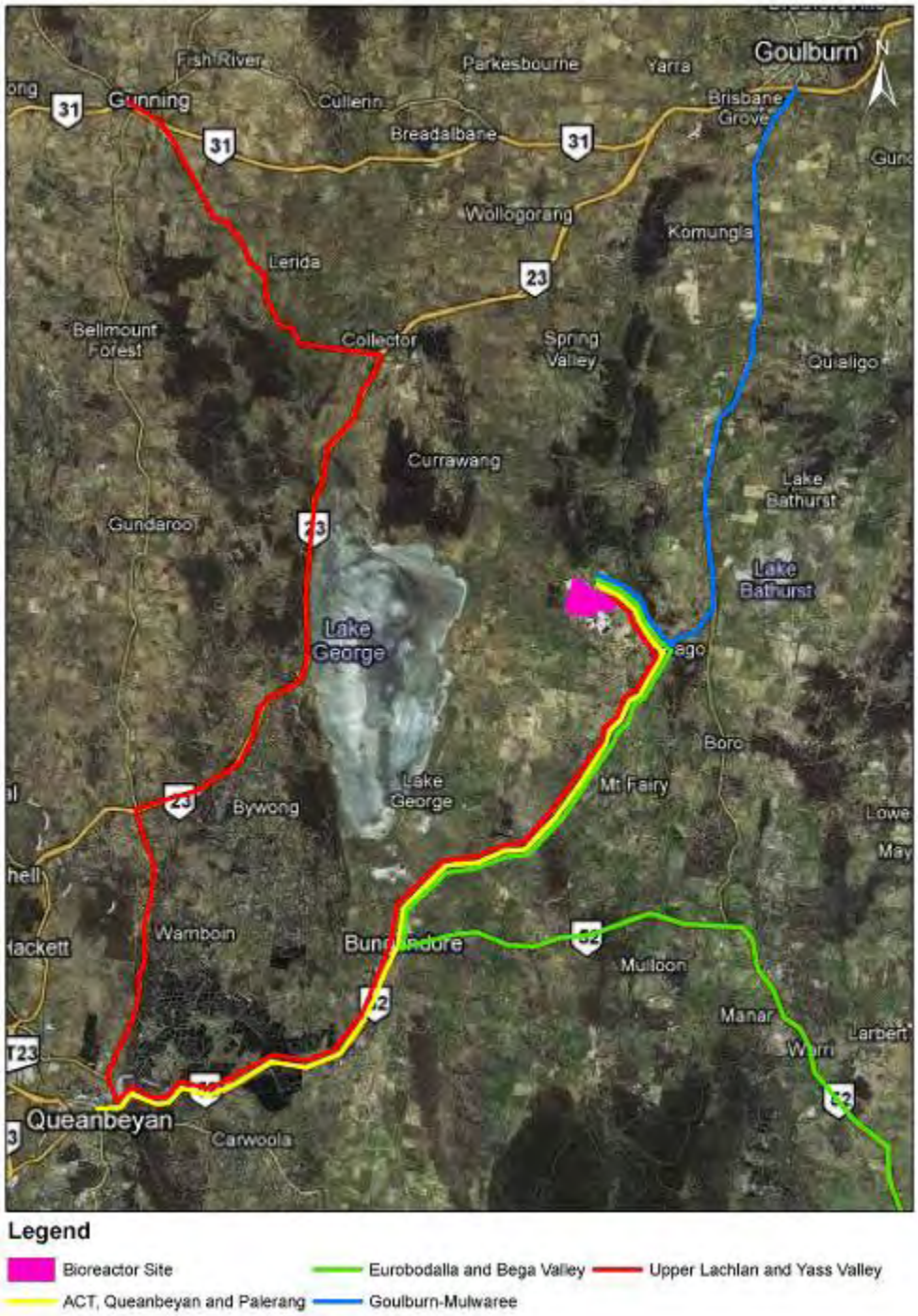
- Additional Bioreactor Vehicles
  - The public road network is assumed to have 100km/h posted speed limits while the Bioreactor and IMF site accesses will apply a 50km/h speed limit;
  - All additional truck movements from regional areas will occur in the AM Peak Hour;
  - All truck movements from regional areas will arrive to the site on Collector Road from the east with all deliveries following the route defined in Figure 4-1;
  - All personnel vehicle movements will occur during the AM Peak Hour and will be inbound to the site; and
  - Daily truck vehicle volumes are assumed to occur evenly over the proposed 16-hour working day.

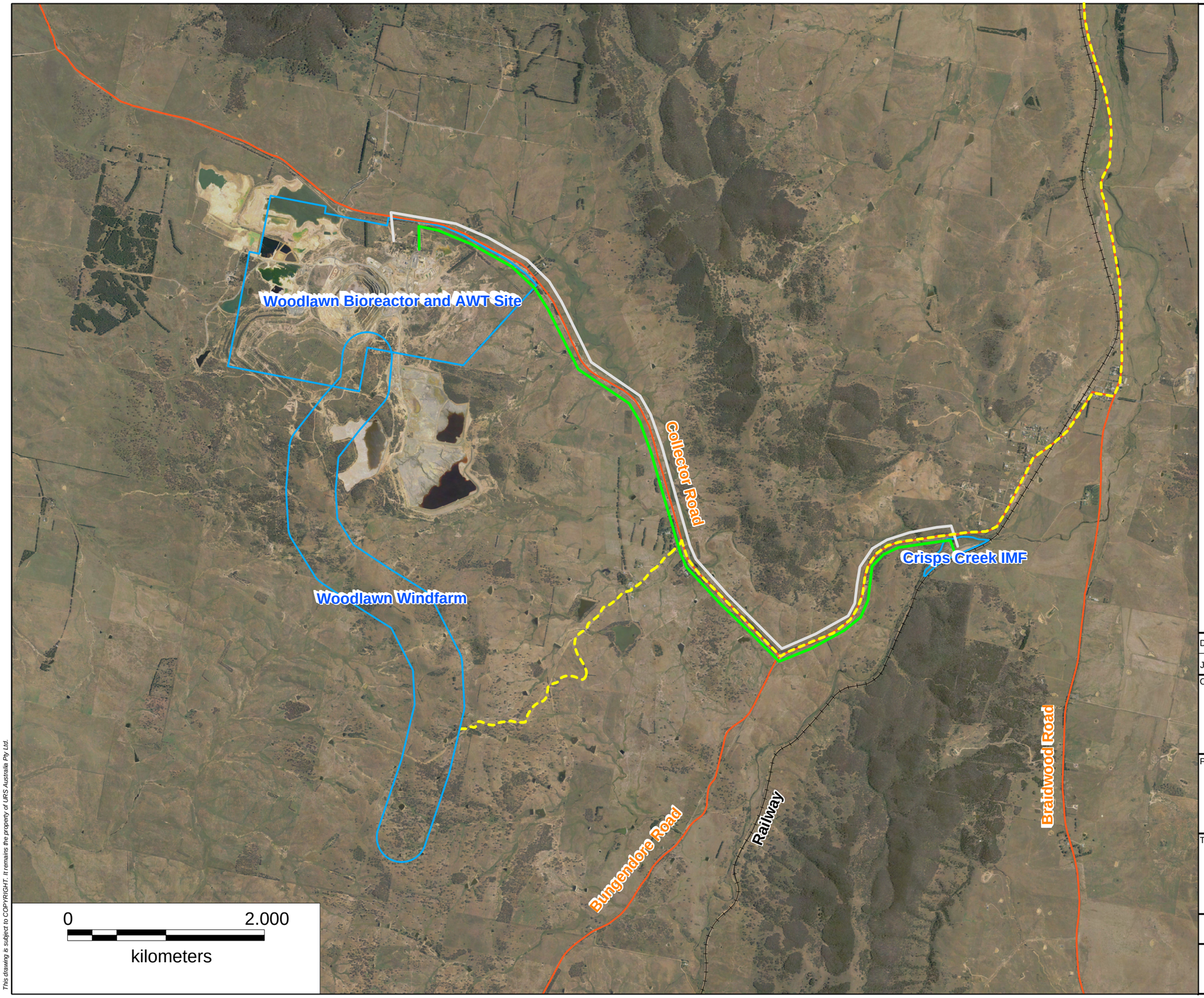
These assumptions may be conservative when being applied to the AM Peak Hour however will provide a 'worst-case scenario' of the traffic impacts of the increased operations of the Woodlawn Bioreactor as well as taking into account the cumulative impacts of surrounding developments.

A diagram of the delivery routes used for the various developments along Collector Road, and assumed in developing the cumulative impact of the construction and/or operation of these sites, is provided in Figure 4-2.

4 Impact of Traffic Generation

Figure 4-1 Haulage Routes for regional areas





Legend

- Site Boundaries
- Rail
- Road
- Woodlawn Windfarm Construction Traffic
- Woodlawn Bioreactor (IMF - Bioreactor)
- Woodlawn AWT (IMF - AWT)

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*Map compiled using Mapinfo StreetPro 2010
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VEHICLE ROUTES OF DEVELOPMENTS IN ECO-PRECINCT

Figure: **4-2**	Rev: A
	A3

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4.3 Vehicle Size

The conservative capacity of vehicle proposed for transportation between the Crisps Creek IMF and the Woodlawn Bioreactor site is to be a 19-tonne truck. This vehicle size and mass is below that of the B-Double which has a defined road network capable of accommodating these size limits. Map 30 of the RTA's *Travel Restrictions Vehicle Routes* indicates that Collector Road (between the Bioreactor site and Bungendore Road) and Bungendore Road (between Collector Road and Braidwood Road) are declared to be suitable for B-Double vehicle movements. These road sections incorporate the full route between the IMF and Bioreactor sites and as such there are no limitations in the existing infrastructure for vehicle sizes up to and including the B-Double (which includes 19-tonne trucks). Consequently, road and intersection upgrades due to physical dimensions, weight and swept path of vehicles associated with the proposed increased activity of the Bioreactor site is not required as this is already accommodated along the required lengths of Collector Road and Bungendore Road.

Section 7.2.2 of the *Goulburn Mulwaree Development Control Plan 2009* identifies a Haulage Route Standard. This standard outlines typical requirements expected by Council for road sections that are being upgraded due to being utilised as a haulage route for a particular development. However, no road or intersection upgrades along any haulage routes are required as Collector Road and Bungendore Road (between the IMF and Bioreactor facilities) have already been constructed to permit the use of vehicles up to a B-Double. As a result, the Haulage Route Standards do not apply to the proposed increase in vehicle movements outlined in this traffic assessment.

4.4 Access Arrangements

The existing accesses at the Crisps Creek Intermodal Facility and the Bioreactor site are adequate for the additional vehicles expected to be generated by the proposal and allow for the heavy vehicle turning movements associated with the haulage of waste, including B-double access. The impact on the existing accesses is anticipated to be insignificant and the safety of the accesses would not be compromised with the additional traffic.

4.5 Parking Provision

There is currently parking provision for over 50 vehicles at the Bioreactor site with an observed utilisation of 10% during current operations. The additional employees generated by the proposed increase in activity at the site (total of 6) will be easily catered by the current spare capacity of the parking area.

Existing truck parking areas within the Crisps Creek Intermodal Facility and the Bioreactor site are adequate for the additional vehicles required for the haulage of waste.

4.6 Rail Based Operational Impacts

In November 2009, Veolia requested Pacific National, the rail operator, to undertake an assessment of existing rail capacity to enable the proposed increase in tonnage to be transported from the Clyde marshalling yards to the Crisps Creek IMF. This assessment was updated in June 2010 by the rail operator and a copy contained in Appendix A.

4 Impact of Traffic Generation

The findings of this assessment concluded that 1.18 million tpa rail capacity at the Crisps Creek IMF would be achievable. This is based on the Crisps Creek IMF receiving two train sets per day, six days a week, with 60 containers on each train and a payload of 32 net tonnes per container. It is important to note that under the existing EPL conditions, and under the conditions of the existing development consent for the operations of the Crisps Creek IMF, the facility is approved to receive and unload up to two trains per day 6 days a week.

4.6.1 Proposed Rail Scheduling

The transportation of 1.18 million tpa of containerised waste can be accommodated by the current rail system by running two train sets per day with 60 containers on each. Each train will fit within the Crisps Creek IMF as shown in table 4-3 below**.**

Table 4-3 Crisps Creek Siding Capacity

No. of Wagons	Total Length of Wagons (m)	Total length of train set incl. locomotive (m)	Length of Crisps Creek Siding 1 (m)	Length of Crisps Creek Siding 2 (m)	Total length of Crisps Creek Siding (m)	Variance (m)
60	876	940	557	580	1137	197

The proposed train would only be 29.2m longer than the one currently deployed by the rail operator and as such the proposed trains would still be within current rail specifications both in terms of infrastructure and operating / service conditions.

Train scheduling would be expected to work with the two trains arriving at two separate times during the day. Based on the current rail network constraints, the first train would be expected to remain on its current approved plan whereby it leaves Clyde at 01:42 and arrives at Crisps Creek at 06:30 and shunted into position. As is currently the case, the containers would be unloaded onto trucks and transported to Woodlawn. In order to accommodate a second train, the first train would leave Crisps Creek at approximately 13:15.arriving at Clyde by 19:30. Based on current operating conditions, the second train would be expected to leave Clyde at 09:30 after the morning commuter peak period, and arrive at Crisps Creek at 14:45. As with the first train it would then be unloaded and containers transported to Woodlawn on trucks. The second train would be scheduled to leave Crisps Creek at 20:00 and arrive at Clyde by 03:30. Table 4-4 shows the expected operating plan to support the increased capacity based on existing freight operating curfews, crossings loops and rail network scheduling.

Table 4-4 Expected Future Rail Scheduling - Crisps Creek IMF

Future Operations Train Schedule				
	Train 1		Train 2	
	Clyde	Crisps Creek	Clyde	Crisps Creek
Depart	01:42		09:30	
Arrive		06:30		14:45
Depart		13:15		20:00
Arrive	19:30		03:30	

4 Impact of Traffic Generation

4.6.2 Crisps Creek Operations

The current infrastructure and equipment at both Crisps Creek and Woodlawn would enable the two trains to be safely and effectively unloaded at Crisps Creek, transported to Woodlawn, emptied and returned to Crisps Creek within the windows provided by Pacific National (Table 4-4 or Appendix A). This is based on the current average turn around time for the road haulage of 40 minutes.

With a continuous flow of truck movements each train could be unloaded using a single container handler and a single container tipper within a 6 hour period. If a train is required to be unloaded and reloaded within a shorter period of time, a second container handler and container tipper could be utilised. This would effectively half the period of time needed to unload and load a train. Two container handlers and container tippers are already a part of the current operation and are only used in the event of any unforseen issues arising due to maintenance, delays or emergency. This contingency measure would remain unchanged for the two train schedule.

4.6.3 Rail / Road Interactions

At present, the train is required to temporarily park across Bungendore Road level crossing after leaving the Crisps Creek Intermodal Facility. This is to enable the train driver to activate the manual switching device to allow for travel through to Goulburn. The obstruction of the level crossing has the potential to impact on motorist travelling on this part of Bungendore Road.

Veolia has received correspondence from Australian Rail Track Corporation (ARTC) advising that work has commenced to alter the method of train operation on the Canberra line to an electronic switching system known as ‘Train Working Order’. Under this working, trains will no longer be required to stop at the Tarago platform and block the Bungendore Roads level crossing. ARTC expects to finalise this work in 2011. A copy of this letters is included as Appendix B.

4.6.4 Contingency Planning

Existing contingency plans for Crisps Creek for late trains or truck transport issues include the ability to unload trains quickly by using the second container handler and tipper. This effectively allows for the train to be unloaded twice as quick as normally scheduled. Additional contingency measures include the ability to remove the last 6 to 8 containers from the train and place them on the IMF’s hard stand then replacing them with spare empty containers thus allowing the train to leave earlier. The remaining containers can then be transported to Woodlawn for emptying without affecting the train schedule. These contingency measures would also apply in the case of two train sets.

Further to these operational contingency measures, the proposed scenario of two 60 container trains per day provides for a contingency of one container per train per day.

5

Mitigation and Management Measures

The existing Traffic Management Plan for the IMF and Bioreactor operations would be updated to account for increased hours of operation and increased haulage of waste between Crisps Creek IMF and the Bioreactor site including the receipt of regional waste by road. As outlined in Table 3-2 and section 4, an assessment of the delivery of waste to the Woodlawn Bioreactor from regional areas has been included.

The pavement condition of the route between the Crisps Creek IMF and the Bioreactor site is to be monitored to assess damage caused by haulage vehicles. Financial contributions for repairs would be made as per existing arrangements under Goulburn Mulwaree Council's Section 94 Contributions Plan.

6

Conclusion

Traffic generated by this proposal is not considered to have a significant impact on the existing transport network, with current operation anticipated to remain at an acceptable Level of Service for key roads. The Mitigation and Management measures recommended by the Traffic Impact Assessment are provided in Table 6-1.

Table 6-1 Statement of Commitments

Mitigation Measure	Implementation		
	Design	Construction	Operation
Update the Traffic Management Plan for the existing operation activities to include the increased hours of operation and increased haulage activities			✓
Assess pavement condition and provide financial contributions to Council for repair of haulage routes			✓

7

Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Veolia Environmental Services (Australia) Pty Ltd and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 4 December 2009.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between 1 February and 26 July 2010 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

A

Appendix A Rail Capacity Assessment

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25 June 2010

Mr Justin Houghton
Site Manager
Woodlawn Bio-Reactor
Veolia Environmental Services
c\- email justin.houghton@veolia.com.au

Dear Justin

CRISPS CREEK TASK GROWTH – REVIEW OF SERVICE PLAN

I refer to our recent review of the Veolia task growth projections aganst a service plan with a capability to support the transport of 1.18mtpa of product from the Clyde Marshalling Yards to the Crisps Creek Intermodal Terminal.

The following review has been conducted with current service information and operating conditions. The information and conditions may change in future therefore validation will be required as part of the detailed planning and implementation.

1 Task Understanding

The current task of 400ktpa has a future growth forecast at 1.18mtpa. The capacity required will be based on a 52 week / 6 day week. Service planning to increase capacity will be supported through train marshalling changes within the terminal operations at the Clyde Transfer Facility and Crisps Creek Intermodal Facility.

2 Containers

Veolia containers are specialised ISO forty foot equivalent units (FEU) for the loading of waste. A fleet of FEU containers are deployed to enable efficient loading, transit and unloading activities to occur.
FEU (existing) specifications are:

Tare:	4.8
Net:	27.5
Gross:	32.3

Replacement of the fleet of FEU containers is in progress. New FEU's have an increased payload capacity.
FEU (new) specifications are:

Tare:	4.8
Net:	32.0
Gross:	36.8

3 Container Wagons

Pacific National container wagons currently deployed are capable of carrying a 56 tonne payload. The existing and new FEU's will be loaded one per wagon which is within the wagon limits.

Future opportunities may exist with acquisition of new two-deck container wagons. These would have a gross limit of 114 tonnes providing a capability of carrying two FEU's.

4 Service Plan

The service plan to provide a rail capacity to meet the 1.18mtpa task is based on a weekly demand of 22,692 tonnes, equivalent to 720 FEU's per week. A 6 day / week operation would require the capacity to transport ~ 120 FEU's / day.

To meet this demand Pacific National would deploy two train sets with capacity for 60 FEU's each operating 1 cycle per day.

The operating plan to support the capacity would be based on the following schedule*:

	Train 1	Train 2	Comments
Clyde – depart	01:42	09:30	
Crisps Creek –arrive	06:30	14:45	
Crisps Creek – depart	13:15	20:00	Train 1 crosses Train 2 at Goulburn and stages for return to Clyde
Clyde – arrive	19:30	03:30	

* Note: the schedules are based on a conceptual operating plan derived from current operating information.

The operation has considered the current operating conditions:

- RailCorp freight operating curfews.
- Goulburn – yard sidings to stage and cross trains.
- Goulburn to Tarago section of the Canberra line – Tarago crossing loop ~ 520m.
- Tarago to Crisps Creek (intermediate section) to Bundgendore section of the Canberra line – no suitable crossing loops.

The conceptual schedule has taking into consideration the Countylink (passenger) services operating to and from Canberra. At present there is a total of six passenger (forward & return) services each day. The 4 Veolia (forward & return) services operating on the Canberra line are scheduled around the passenger services.

Configuration of the electric staff instrument (ESI) safe working system permits one train between Goulburn to Tarago and Tarago to Bungendore sections. The Veolia service plan is permits the crossing of the passenger services at Goulburn and Crisps Creek.

Australian Rail Track Corporation (ARTC) manage the rail infrastructure and control the rail movements between Macarthur and Canberra. ARTC has indicated the intention to convert the ESI to a Train Order Working (TOW) safe working system as part of their upgrading. The TOW would permit the re-configuration of the line sections to improve the efficiency of rail movements on the Canberra line. This would remove the majority of constraints on the Canberra line and provide greater capacity to schedule windows for the Veolia Service arrival and departures.

5 Service Implementation

Pacific National would implement alterations to the service plan via its change management process which incorporates stakeholder consultation and risk assessments to manage the operation and interface between the Pacific National train crew and Veolia terminal operators.

I trust this proposal meets your requirements and I look forward to working with you to finalise the details. Please contact me if you require any additional information or if you would like to accept this proposal.

Yours sincerely

Peter Lew
Contract Manager, Bulk Rail

B

Appendix B Train Order Working Project

AUSTRALIAN RAIL TRACK CORPORATION LTD

ARTC Reference: Train Order Working Project Canberra Branch line

24th June 2010

Mr Henry Gundry
Environmental and Operations Manager - Woodlawn
Veolia Environmental Services Pty Ltd
619 Collector Road
Tarago
NSW 2580

Dear Henry,

The Australian Rail Track Corporation as the contractor to the Rail Infrastructure Corporation intend to alter the method of train operations on the Canberra branch line from the current dated token working system which involves trains stopping at a "staff location" to collect a token and receive authority from the Network Controller to enable the train to move into the section ahead.

At some locations depending upon train length and the location of the equipment within the location, nearby level crossings are sometimes blocked whilst this takes place. The system that will replace the current token working is known as Train Order Working and involves the issue of an electronic authority by voice communication to a train crew to enable trains to progress through the network.

This will mean that trains coming from the Crisps Creek Siding towards Goulburn will receive an authority whilst still in the siding to traverse the section Tarago (which will include the Crisps Creek Siding) and Goulburn. Under this working these trains will no longer stop at the Tarago platform and obstruct the Bungendore Road level crossing.

Train Order Working is proposed to be introduced throughout many sections of the New South Wales country rail network including Tarago during 2011. This project includes some major technology innovations and accordingly we can only provide this indicative time frame.

We hope this assist Veolia and advise that if you have any further enquiries please continue to liaise with our CRN Operations Manager Mick Sanders.

Regards

Tony Frazer
General Manager
CRN\Services

AUSTRALIAN RAIL TRACK CORPORATION LTD ACN: 081 455 754 / ABN: 75 081 455 754
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Woodlawn Socio-Economic Impact Assessment

Appendix I



Report

Woodlawn Socio-Economic Impact Assessment

JULY 2010

Prepared for

Veolia Environmental Services (Australia) Pty Ltd

Level 4, 65 Pirrama Rd
Pyrmont
NSW 2009

43177703

URS

Project Manager:

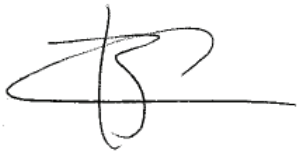


.....
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Date:	**July 2010**
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Table of Contents

1 Introduction 1
2 Methodology 2
2.1 Identification of area of analysis 2
2.2 Data collection 2
3 Baseline information 3
3.1 Population characteristics 3
3.2 Employment and income 3
3.3 Impacts of the current Woodlawn facility 4
3.3.1 Local impacts 4
3.3.2 Broader impacts 5
3.3.3 Local community funding 5
4 Impact Assessment 8
4.1 Overview 8
4.2 Employment and infrastructure 8
4.3 Local expenditure 8
4.4 Odour 8
4.5 Noise 9
4.6 Attainment of waste management objectives 10
4.7 Summary and Conclusions 10
5 References 12
6 Limitations 13

Tables

Table 3-1 Population change 1996-06 3
Table 3-2 Labour force participation and employment, 1996 - 2006 3

Charts

Chart 3-1 Percentage employment by industry, 2006 4

1

Introduction

URS Economics was engaged by Veolia Environmental Services (Australia) Pty Ltd (Veolia) to undertake an assessment of the socio-economic impacts of a proposed change in putrescible waste quantities received at the Woodlawn Bioreactor and the Crisps Creek Intermodal. These two facilities form part of the Woodlawn Eco-Precinct which includes the proposed Alternative Waste Technology Facility comprising Woodlawn Alternate Sorting and Processing (WASP) Facility, and Composted Organics and Greenwaste (WOCOG) facility, together with the Woodlawn Windfarm (approved, not yet built).

The Bioreactor is located in a former open-cut mine site near the township of Tarago, 50km north-east of Canberra, and currently receives 400,000 tonnes of putrescible waste per year by rail from the Sydney region. Veolia is seeking approval to increase the maximum input rate of the Bioreactor from 500,000 tonnes per annum (tpa) to 1.13 million tpa and to increase the maximum throughput rate at the Crisps Creek IMF to 1.18 million tpa.

This report presents the findings of the socio-economic assessment. Chapter 2 describes the methodology used for the assessment, while Chapter 3 discusses the characteristics of the area at present and current impacts of the Woodlawn site. Chapter 4 identifies the possible impacts of a change in waste quantities received, and assesses the overall benefit of the proposal.

2

Methodology

2.1 Identification of area of analysis

As described in the Preliminary Environmental Assessment, the Woodlawn Bioreactor is located on a 6,000 hectare Eco-Precinct, which is approximately 250km south-west of Sydney, 50km north-east of Canberra, and 40km south of Goulburn. The Bioreactor receives waste delivered by rail to Crisps Creek Intermodal Facility, which is 8km away and near the township of Tarago (Veolia 2010).

The Bioreactor facility falls within the local government area (LGA) of Goulburn Mulwaree Council and is on the boundary of Palerang Council. As any impact of the facility is highly localised, the area of analysis was restricted to those two LGAs.

2.2 Data collection

All information collected from the Australian Bureau of Statistics (ABS) Census of Population and Housing (1996, 2001 and 2006) refers to the following geographic areas as specified by the ABS:

- Goulburn Mulwaree (A) (LGA 13310)
- Palerang (A) (LGA 16180)
- New South Wales (STE 1)

The 2006 Census is the most recent census conducted, with the next scheduled to take place in 2011. All 'not stated' responses have been removed from data presented and subsequent analysis.

3

Baseline information

3.1 Population characteristics

In 2006, the project area had a resident population of just under 40,000 people, of which over half (20,127) lived in the City of Goulburn. The township of Tarago, nearest the Woodlawn site (in the LGA of Goulburn Mulwaree) is not recognised as an urban locality in the 2006 Census, which indicates that it most likely has a population of less than 200 people[1]. Within the project area, 1.7 percent of the population are of Indigenous descent (682 people).

Table 3-1 Population change 1996-06

LGA	Population (no. people)		Average annual growth rate
	1996	2006	
Goulburn Mulwaree	25,779	26,962	0.5%
Palerang	9,450	12,386	3.1%

Source: ABS 2007

As indicated by Table 3-1, both LGAs have experienced ongoing population growth since 2006. This is consistent with (and, in the case of Palerang, significantly higher than) the rate of population growth for New South Wales as a whole during the period, which was 0.9 percent per year.

3.2 Employment and income

In Palerang, the labour force was 6,567 people in 2006, whilst in Goulburn-Mulwaree the labour force was 11,923 people. In Table 3-2, the participation rate refers to the percentage of persons of working age either working or looking for work. This, and the unemployment rate data shown, indicates that Palerang has a higher proportion of people participating in the labour force, and a better fit between the supply and demand for labour, than either Goulburn-Mulwaree or New South Wales. The participation rate and unemployment rate in Goulburn-Mulwaree have shifted between 1996 and 2006 – it now sits below the state average participation rate, and above the average unemployment rate.

Table 3-2 Labour force participation and employment, 1996 - 2006

LGA/state	Participation rate		Unemployment rate	
	1996	2006	1996	2006
Palerang	71.1%	72.4%	6.2%	2.8%
Goulburn-Mulwaree	62.9%	57.9%	7.4%	6.2%
New South Wales	61.1%	63.2%	8.8%	5.9%

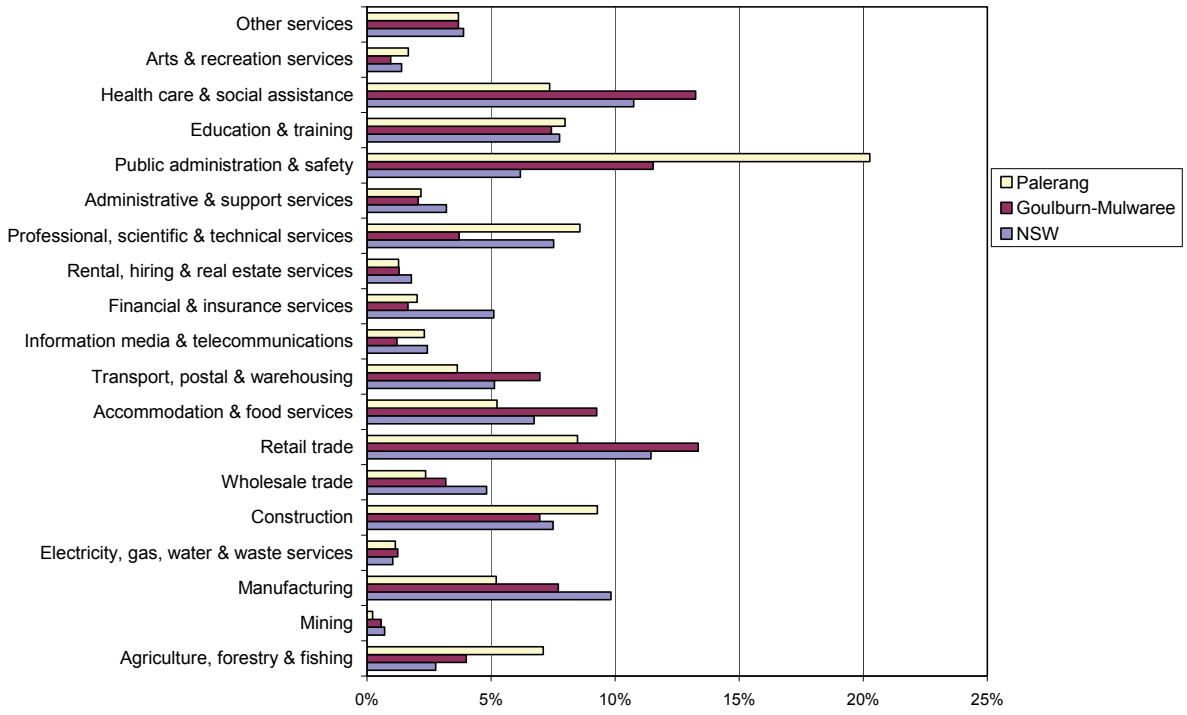
Source: ABS 2007

In both Palerang and Goulburn-Mulwaree, employment is spread across a range of industries. In Palerang, public administration and safety (1,264 employees), construction (579 employees), and professional, scientific and technical services (535 employees) are the top three industries by number employed. This is likely to reflect the area's proximity to Canberra and Queanbeyan, with many of those employed commuting to these cities on a regular basis (Palerang Council 2008). In Goulburn-Mulwaree, on the other hand, retail trade (1,467 employees), health care and social assistance (1,455

[1] To be classified as an 'urban locality', a geographic area must contain between 200 and 999 people (ABS 2005)

employees), and public administration and safety (1,267 employees) are the top three industries – this is likely to be a reflection of the city of Goulburn as a regional centre.

Chart 3-1 Percentage employment by industry, 2006



Source: ABS 2007

Household incomes across the project area vary substantially. The median weekly household income in Palerang in 2006 was reported as $1,285 – over $200 per week higher than the NSW average of $1,034. In Goulburn-Mulwaree, by contrast, the median weekly household income was $842 (ABS 2007).

3.3 Impacts of the current Woodlawn facility

3.3.1 Local impacts

The current Woodlawn Bioreactor has been operational and receiving waste through the Crisps Creek Intermodal Facility since September 2004. The site has been widely promoted and publicised within the local community and Veolia has been engaging on a regular basis with community members.

The site employs 26 staff (including 6 subcontractors), predominantly from Tarago and Goulburn, with major occupations being truck/forklift drivers and heavy machinery operators. Veolia's employees include 11 operators, 4 support staff, and 5 personnel in management and office administration. In 2009, Veolia spent approximately $3.8 million on purchases of goods and services through the local community (pers. comm., 18/2/10). It is assumed that this level of expenditure in the local community would be ongoing for the life of the site (excluding site closure and remediation costs). This is in

addition to the contributions made through the Veolia Mulwaree Trust, which are discussed in Section 3.3.3 and Appendix A.

Both during the initial community consultation programme and since operations began at the facility, Veolia have engaged directly with the community at a local level. Any issues raised by the community can be tabled at the Community Consultative Committee of which Veolia are a member, and which meets regularly to discuss the development. During commissioning of the Bioreactor facility a number of odour complaints were reported to Veolia by residents along Taylors Creek Road and Tarago Village. These complaints were identified in the most recent compliance report (Veolia 2009a), and, where attributable to Veolia, operations have been changed, improved or amended in order to reduce any offsite odour impacts. Veolia continues to monitor offsite impacts from the facility, as required by the Consent and Envrionmental Protection Licence, and in accordance with the principles of continuous improvement required by Veolia's ISO 14001 accreditation. Veolia will continue to work with the local community as part of the Woodlawn Community Liaison Committee in all facets of the site operation.

Impacts associated with train movements through the level crossing in Tarago have also been raised through the community liaison committee. Issues raised include noise arising as a result of trains starting and stopping as well as the delays in road traffic while the train is occupying the level crossing. As these impacts relate to rail activities on the main rail corridor, Veolia have raised these issues with the rail operator, Pacific National, and the track owner, Australian Rail Track Corporation (ARTC) (Veolia 2009b). Correspondence in relation to these rail operations is included in the Transport Impact Assessment, which is provided as **Appendix H** to this Environmental Assessment.

3.3.2 Broader impacts

Currently the site receives approximately 400,000 tonnes of putrescible waste per year from the greater Sydney region by rail (Veolia 2010). The facility provides a valuable alternative to assist in managing a current capacity shortage for putrescible waste disposal in the Sydney region.

Methane is a greenhouse gas which is released as waste decomposes. It has a global warming potential of 21 times that of carbon dioxide (UNFCCC 1995). Traditional landfills capture methane only when the landfill is filled and capped – the Woodlawn Bioreactor, in contrast, captures methane as the void is being filled, through a system of pipes. This means that it has the ability to capture a greater proportion of the total methane produced.

Since commencement of the Woodlawn Bioreactor until the end of 2009, the site has abated 119,490 tonnes of CO_2e through flaring and electricity production. The site has also generated 19,726 Renewable Electricity Certificates (REC's) and 74,167 New South Wales Greenhouse Abatement Certificates (NGAC's) (pers.comm, 18/3/2010) since the site was opened This rate of production is equivalent to the electricity required to power approximately 1800 houses during the 2009/2010 financial year alone. This level of methane capture enabled by the operation of the Bioreactor results in significant environmental benefits when compared to traditional landfills.

3.3.3 Local community funding

Veolia contributes to local community projects and infrastructure in several ways. The Veolia Mulwaree Trust was established in 2003, which provides funding to charitable projects within the Goulburn-Mulwaree area throughout the year and is administered through the Goulburn Mulwaree

3 Baseline information

Council. Since its inception, it has committed over $3.2 million in funding. Grant recipients are listed in Appendix A. Major grants included $100,000 to assist in fitting out the childrens ward at Bowral Hospital, $70,000 for a new skate park, $50,000 to assist in building a new early learning centre at Gunning and District Preschool, and $50,000 to help refurbish Legacy Lodge for the benefit of war widows. Other funding recipients included local schools, fire brigades, cancer/disease support groups, landcare groups, ambulance services and sports clubs (Veolia Mulwaree Trust 2010).

In accordance with section 94 of the Environmental Planning and Assessment Act 1979 (NSW), Veolia also makes development contributions to the relevant local councils. These primarily assist with the ongoing maintenance of local roads and to date Veolia have contributed over $700,000 to cover these and other infrastructure costs.

4

Impact Assessment

4.1 Overview

This section presents the results of the impact assessment conducted by URS Economics. It should be noted that this analysis was undertaken predominantly from the perspective of the local region. If there is no increase in waste received at the Woodlawn facility, and waste quantities remain the same, the waste would need to be disposed of in a different landfill site, and the impacts (both positive and negative) would be felt in a different region. The degree to which communities are impacted depends on a number of factors such as location and population density around the site. The alternative to the Woodlawn facility (i.e. where the waste would be taken if the increase is not approved for Woodlawn) is not known. Furthermore, the proposed increase in the rate of waste volume received would cause the void to fill sooner than otherwise, therefore the actual duration of identified impacts (positive and negative) would be reduced.

4.2 Employment and infrastructure

The project is anticipated to result in an additional 11 employees being hired at the Woodlawn site (Veolia 2010) and up to a further 25 for the proposed WASP. These are expected to be local hires and therefore lead to increased employment in the region for the life of the site. The additional staff are likely to be required to possess a similar skill mix as current staff (i.e. heavy machinery operators and drivers), and therefore benefit those who possess the required operational skills to fill the new positions. With the exception of additional lighting, no additional infrastructure would be required as a part of the project.

4.3 Local expenditure

The estimated cost of the proposal is $2.4 million, to be spent on new equipment (Veolia 2010). It is expected that this expenditure would be incurred outside the local area, predominantly on heavy machinery. It is assumed that Veolia would continue to spend in the order of $3.8 million per year (as per 2009) on purchased goods and services for the remainder of the landfill life. However, this figure would most likely increase to maintain operations as input rates increase and is in addition to the contributions made to the Veolia Mulwaree Trust which would continue to be used to fund local community projects. To date Veolia have contributed over $3.2million to community projects and will continue to support local initiatives through the Trust.

4.4 Odour

Atmospheric dispersion modelling of odour has been undertaken and is presented in **Chapter 9** and **Appendix D** of this EA. The modelling indicates that at all surrounding residences, odour is predicted to be at concentrations less than 4.1 OU as a 99th percentile, 1 second average. The Project specific odour performance goal was assumed to be 6 OU. Comparison with a 'base case' scenario designed to reflect current operating conditions at the site showed no increase in odour impact at surrounding receptors resulting from the increase in surface area of waste.

A worst case scenario was modelled, with all liquid storage areas modelled at capacity and with an active waste tipping area of 2 ha. In reality, leachate (treated and untreated) storage areas are unlikely to be at levels approaching capacity as leachate is used on the waste to encourage degradation of fresh waste. Excessive storage is unlikely and an active waste tipping face of the modelled size should not be required in reality.

Based upon the results of the modelling assessment, it is not considered that the proposed Woodlawn Expansion Project will lead to an exceedance of the odour performance goal.

Current management practices employed at the site to ensure project air quality goals are achieved will be maintained, including:

- traffic would be restricted to designated sealed access roads within and around the site;
- waste within the bioreactor would continue to be covered at days end;
- water carts for dust suppression continue to be utilised as required; and
- air quality monitoring in accordance with the existing AAQMP would continue.

4.5 Noise

As described in Section 3.3.1, impacts associated with train movements through the level crossing in Tarago have been communicated to the rail operator, Pacific National, and the track owner, Australian Rail Track Corporation (ARTC) (Veolia 2009b). Correspondence in relation to these rail operations is included in the Transport Impact Assessment, which is provided as **Appendix H** to this Environmental Assessment. Veolia are committed to minimising impacts due to noise on local residents and have complied with all Development Consent and Environmental Protection Licence conditions since opening the facility and during construction.

The noise assessment for the increase in tonnage provided as **Appendix G** within this EA considered the following potential environmental noise impacts:

- Noise impact of the Woodlawn Bioreactor and Crisps Creek Intermodal Facility as a result of the Woodlawn Expansion Project and extended hour of operation;
- Cumulative impact of noise from the existing Woodlawn Bioreactor, approved Woodlawn Wind Farm, and approved AWT; and
- Traffic noise impact of the total proposed transportation of waste from the Crisps Creek Intermodal Facility, and regional waste to the Bioreactor as well transport associated with the approved AWT facility.

Operational noise emission levels from Woodlawn Bioreactor and the Crisps Creek Intermodal facility due to the proposed Woodlawn Expansion Project were predicted to meet the relevant project specific noise goals over the extended hours at all existing non-project related residential dwellings surrounding the site.

The cumulative impact of noise from the existing Woodlawn Bioreactor, approved Woodlawn Wind Farm, and approved AWT were predicted to comply with the relevant criteria set in accordance with the INP at residential receivers surrounding the site.

The contribution to traffic noise from heavy vehicles associated with the Woodlawn site, including the additional traffic generated from the Crisps Creek Intermodal Facility (IMF) and the regional waste component was predicted to comply with the ECRTN criteria.

4.6 Attainment of waste management objectives

The *Waste Avoidance and Resource Recovery Act 2001 (NSW)* and the *Protection of the Environment Operations Act 1997 (NSW)* (the POEO Act) set out the waste management objectives of the NSW government. These Acts stress the need for environmental protection and ecologically sustainable development. Of particular interest to the Woodlawn Bioreactor are some of the objectives of the POEO Act, namely 'the reduction to harmless levels of the discharge of substances likely to cause harm to the environment' and 'the reduction in the use of materials and the re-use, recovery or recycling of materials' (NSW Government, nd).

The proposal to increase the amount of waste received at the Woodlawn Bioreactor would assist in meeting these objectives because it would assist in reducing the amount of harmful methane released into the atmosphere from decomposing waste. This then can be used as an alternative energy source and assist in reducing the amount of energy required to be produced from unsustainable sources such as coal. Further detail regarding resource recovery initiatives, and alternative waste management measures are detailed in **Chapter 3 Project Need, Justification and Alternatives**.

Limited putrescible landfill capacity has been identified as an immediate concern by the NSW government. In 2008 it commissioned the Wright Review (Wright 2009) to assess landfill capacity and demand in the Sydney region. The Wright Review identified an ongoing need for increased landfill capacity to address increases in waste received from the Sydney region

Sydney currently produces around 2 million tonnes of waste each year. This is sent to Eastern Creek landfill (3.3 million tonnes capacity remaining), Lucas Heights (5.5 million tonnes capacity remaining), Belrose (0.2 million tonnes capacity remaining) or Woodlawn (32 million tonnes capacity remaining) (Wright 2009). All current sites other than Woodlawn will soon be at capacity (within 4 to 6 years in the case of Eastern Creek and Lucas Heights). There are significant barriers to the development of new landfill sites, and alternative waste technologies are also not expected to reduce the amount of waste going to landfill in the short to medium term. Increasing the amount of waste received at the Woodlawn site would therefore provide a solution to address immediate waste capacity constraints. The Woodlawn site is an existing landfill with capacity to receive significant amounts of waste - the social and environmental impacts associated with using this site are minimal compared with other alternatives for waste disposal.

4.7 Summary and Conclusions

Overall, the proposal to increase the maximum input rate of the Bioreactor from 500,000 tpa to 1.13 million tpa and to increase the maximum throughput rate at the Crisps Creek IMF to 1.18 million tpa is identified as bringing forward impacts and/or benefits that would have otherwise occurred, in effect condensing them into a shorter timeframe.

Identified impacts, and benefits will be reduced in duration as a result of the increased input rates. Based on continued implementation of environmental management at the site, the community is likely to benefit overall in the long term. Veolia's contributions towards community facilities, through such groups as the Veolia Mulwaree Trust, and through section 94 development contributions, will continue. Veolia has well established mechanisms in place for addressing community concerns for engaging with the community to assist in the management of issues raised.

5

References

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6

Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Veolia Environmental Services (Australia) Pty Ltd and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 4/12/2009.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between 18/1/2010 and 28/6/2010 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

A

Appendix A Mulwaree Trust Grant Recipients

A.1 2009-10 grant recipients (preliminary)

Grant recipient (2009-10)	Amount
Majors Creek Recreation Reserve Trust	$12,000
St Bede's Primary School	$5,000
Bungendore Quilters Inc	$2,500
RSPCA Goulburn and Southern Highlands Branch	$500
Diabetes Australia - Goulburn Support Group	$1,000
Make A Wish Foundation - Goulburn Branch	$1,000
All Saints Anglican Church, Collector	$6,800
Goulburn Liedertafel Inc	$22,190
Australian National University	$7,000
Jennifer Lamb Veolia Art Scholarship Program	$20,000
Gunning PA and I Society	$26,856
Tallong Community Focus Group	$3,900
Goulburn Relay for Life 2009	$5,000
Braidwood FM Inc	$6,578
Wingecarribee Community Health Nursing	$10,000
Crookwell Public School	$14,849
Tallong Public School	$5,700
Marulan and District Preschool (Anglicare)	$4,450
Goulburn Cycle Club	$19,400
St Saviour's Patchwork Group	$500
Anglican Parish of Crookwell	$2,970
Goulburn and District Community Palliative Care	$10,000
Goulburn Regional Art Gallery	$9,320
Penrose Public School	$1,402
South East Regional Academy of Sport (SERAS)	$10,000
Bungendore Community Landcare Group Inc	$6,588
Oberon Men's Shed	$6,378
Nowra Youth Services Inc	$10,080
Collector Community Association	$40,000
Goulburn AP and H Society	$6,208
Wollondilly Public School	$25,438
Boro/Mt Fairy Rural Fire Brigade	$16,000
Crookwell High School	$18,992
Queanbeyan Enterprise Centre	$3,709
Braidwood and District Education Foundation	$6,000
Oberon Hospital Exercise Group Auxiliary	$2,964
Goulburn and District Education Foundation	$6,000
St Laurence O'Toole Catholic Church (Mary Queen of Apostles Catholic Church)	$4,331
Palerang Council (in conjunction with Mick Sherd Oval Canteen and Amenities Committee)	$89,000

Appendix A

Grant recipient (2009-10)	Amount
Bungendore Public School	$12,137
Penrose Rural Fire Brigade	$16,000
Marulan & District Lions Club	$1,940
Pejar Local Aboriginal Land Council	$6,500
Oberon Uniting Church	$5,200
The Smith Family	$3,000
Tuena Hall & Recreation Area Committee	$8,000
Shoalhaven Women's Health Centre	$9,500
Bomaderry Community Preschool/Nowra Anglican College/Sydney	$15,000
Goulburn Scout Group	$11,781
Snowy Hydro South Care	$50,000
Camp Quality	$3,000
National Breast Cancer Foundation	$2,000
Guide Dogs NSW	$3,000
Royal Institute for Deaf & Blind Children	$2,000
Red Cross	$2,000
Heart Foundation	$3,000
The Smith Family	$3,000
The Starlight Children's Foundation	$2,000
Patient Transport Services Goulburn	$3,000
Captains Flat Public School	$1,000
Bigga Public School	$1,000
St Vincent de Paul	$4,000
Abbeyfield Australia Goulburn Society Inc	$1,000
University of Wollongong	$6,000
University of Canberra	$6,000
Charles Sturt Foundation	$6,600
Illawarra Institute of TAFE	$2,000
Total	$640,261

A.2 2008-09 grant recipients

Grant recipients (2008-09)	Amount
Multiple Sclerosis Society	$ 3,000

Grant recipients (2008-09)	Amount
Taralga Rugby Club	$ 1,000
Wingecarribee Community Services Centre Inc	$ 18,660
Salvation Army Goulburn	$ 3,000
Anglicare Canberra	$ 8,324
Goulburn Base Hospital	$ 11,162
Tallong Memorial Hall	$ 9,779
Royal Institute for Deaf and Blind Children	$ 5,500
Psychiatric Rehab Association	$ 5,838
Crescent School Goulburn	$ 50,000
Wamboin Pony Club	$ 8,871
Goulburn PCYC	$ 7,825
Warrigal Care Goulburn	$ 31,200
Crookwell Branch CWA	$ 6,742
Mulwaree Bushfire Headquarters Group	$ 2,000
Marulan Pony Club	$ 3,327
Goulburn Roundhouse Preservation Society	$ 11,364
Gill Warninda Aged Care Facility	$ 8,264
Marulan and District Cricket Club	$ 14,941
Towrang Recreation Reserve Trust	$ 16,000
Goulburn Multiple Sclerosis Branch	$ 6,000
Goulburn Public School	$ 3,000
Wingecarribee Rural Fire Service	$ 10,307
Goulburn West Primary School	$ 23,340
Quota Club of Goulburn Inc	$ 1,000
Juvenile Diabetes Research Foundation	$ 3,000
Cancer Council of NSW	$ 5,000
Braidwood Central School	$ 35,000
Goulburn Rainbow Club	$ 1,000
Middle Arm/Mt Wayo Bushfire Brigade	$ 10,148
Marulan Cricket Club	$ 14,941
Taralga Pony Club	$ 9,509
Goulburn Mulwaree Little Athletics	$ 8,154
Braidwood Hospital Auxiliary	$ 23,000
Southern Tablelands Autism Support Group	$ 4,000
Marulan Bushfire Brigade	$ 16,000
Crookwell Activity Centre	$ 11,910
Windellama Progress Association Hall Inc	$ 3,429
Goulburn Riding for the Disabled	$ 12,327
Parkesbourne/Yarra Landcare Group	$ 9,632
Spastic Centre of ACT and Southern Districts	$ 20,000
Tarago Branch of the CWA	$ 7,000
Gunning District Tennis Association	$ 19,250

Appendix A

Grant recipients (2008-09)	Amount
Lifeline Macarthur	$ 5,000
Windellama Public School	$ 6,543
Marulan Public School	$ 10,000
Lynton International Horse Trials	$ 3,350
Bungendore Showground Trust	$ 11,500
Crookwell and District Historical Society	$ 2,546
Total	$ 522,683

A.3 2007-08 grant recipients

Grant recipients (2007-08)	Amount
Anglicare Canberra Goulburn - Goulburn Emergency Accommodation	$ 21,863
BDCU Children's Foundation	$ 100,000
Bourke St Health Service	$ 13,992
Bradfordville Public School	$ 11,751
Bradley van Heythusen Memorial Trust for Youth Inc (Palerang Council)	$ 70,000
Cancer Council - Relay for Life	$ 5,000
Convoy for Kids Goulburn Inc	$ 5,000
Country Women's Association Goulburn	$ 7,000
Friends of the Goulburn War Memorial Museum	$ 7,568
Goulburn Mulwaree District Bushfire Groups	$ 19,189
Goulburn and District Education Foundation Inc	$ 10,000
Goulburn and District Multiple Sclerosis Branch	$ 3,000
Goulburn and District Show Jumping Club	$ 15,922
Goulburn AP and H Society	$ 2,000
Goulburn Base Hospital - Greater Southern Area Health Service	$ 95,341
Goulburn Challenge Foundation Inc	$ 7,000
Goulburn High School	$ 45,704
Goulburn High School	$ 2,000
Goulburn Lantern Club - Royal Institute for Deaf and Blind Children	$ 3,000
Goulburn Mulwaree Multicultural Advisory Group	$ 3,450
Goulburn North Public School	$ 21,576
Goulburn Parkinson's Support Group	$ 5,000
Goulburn PCYC	$ 2,000
Goulburn Pipes and Drums Band	$ 5,150
Goulburn Pony Club	$ 3,000
Goulburn Preschool Association	$ 9,300
Goulburn Prostate Cancer Support Group	$ 5,000
Goulburn Rotary Club	$ 5,000

Grant recipients (2007-08)	Amount
Goulburn Rugby Union Club	$ 40,000
Goulburn SPACExpo	$ 3,000
Gunning and District Preschool	$ 50,000
Hannah McKellar Trust	$ 3,000
Jennifer Lamb Veolia Creative Arts Scholarship Program	$ 10,000
Juvenile Diabetes Research Foundation	$ 5,000
Legacy Club of Goulburn	$ 50,000
Lieder Theatre	$ 7,500
North Goulburn Primary School	$ 3,000
Parkesbourne Yarra Landcare Group	$ 9,632
Red Cross Blood Service (Goulburn Branch)	$ 34,200
Roslyn Progress and Memorial Hall Association Inc	$ 25,000
Southern Region Community College	$ 31,634
Southern Tablelands Regional Library	$ 13,000
Ss Peter and Paul's Old Cathedral Restoration Fund	$ 40,000
St John Ambulance Australia - Goulburn Division	$ 11,000
St Josephs Primary School	$ 45,639
St Saviours Cathedral	$ 16,790
Tallong Rural Fire Brigade	$ 16,729
Tarago Preschool	$ 20,430
Taralga and District Showground Coop Ltd	$ 18,200
Taralga Golf Club	$ 12,602
Taralga Historical Society Inc	$ 2,975
The Spastic Centre of ACT and Southern Districts	$ 20,000
Wingello Rural Fire Brigade	$ 15,000
Total	**$ 1,009,137**

A.4 2006-07 grant recipients

Grant recipients (2006-07)	Amount
Anglican Church, Taralga Parish	$ 13,569
Argyle Society Inc	$ 15,440
Big Hill Rural Fire Brigade	$ 4,127
Billyrambija Landcare Group	$ 7,500
Brooke Chapman	$ 2,000
Bungonia Progress Association	$ 6,286
Cancer Council of NSW	$ 5,000
Challenge Foundation Goulburn Incorporated	$ 10,000
Country Women's Association Southern Tablelands	$ 50,000
Crescent School Goulburn	$ 10,000
Early Childhood Intervention Coordination Program of Goulburn	$ 1,000

Appendix A

Grant recipients (2006-07)	Amount
Father Riley's Youth off the Streets Program	$ 9,000
Goulburn and District Breast Cancer Support Group	$ 5,000
Goulburn and District Multiple Sclerosis Branch	$ 2,000
Goulburn Base Hospital	$ 30,005
Goulburn and District Community Palliative Care Support Group	$ 1,000
Goulburn High School - Red Cross Youth Challenge	$ 12,000
Goulburn PCYC	$ 4,075
Goulburn PCYC	$ 4,525
Goulburn Railway Bowling Club Guinness World Record Attempt	$ 5,000
Goulburn Railway Tennis Club	$ 14,509
Goulburn Regional Art Gallery	$ 5,000
Goulburn Schools as Community Centres	$ 6,000
Goulburn Scouts and Girl Guides	$ 4,380
Goulburn SES Unit	$ 10,000
Goulburn Soldiers Club Pipes and Drums Band	$ 12,960
Gundary Rural Bush Fire Brigade	$ 16,000
Lady McKell Preschool	$ 10,000
Legacy Club of Goulburn	$ 40,000
Leukemia Foundation	$ 5,000
Majors Creek Progress Association	$ 15,000
Marulan Public School	$ 3,000
Mulwaree High School	$ 45,000
Australian National University Medical School - Rural Clinical School	$ 50,000
Australian National University Medical School - Rural Clinical School	$ 30,000
Salvation Army Gill Waminda Aged Care Facility	$ 25,000
Salvation Army Goulburn	$ 10,000
Southern Region Community College	$ 16,800
Southern Tablelands Education Centre	$ 53,120
Southern Tablelands Football Association - Dana Cup Team	$ 40,000
Southern Tablelands Regional Library	$ 10,300
St Mathias Anglican Parish, Currawang	$ 2,850
St Vincent de Paul Society Goulburn	$ 10,000
Sydney Children's Hospital Gold Week Fundraising Campaign	$ 10,000
Tallong Community Hall Trust	$ 8,250
Tallong Public School	$ 3,000
Tarago and Distric Show Society	$ 24,360
Tarago Preschool	$ 20,972
Tarago Public School	$ 4,707
Tarago Public School	$ 3,000
Tarago Public School	$ 62,204
Taralga Christ the King Parish	$ 24,000
Taralga Medical Association Inc	$ 2,850

Grant recipients (2006-07)	Amount
Taralga Public School	$ 3,000
Tirranna Public School	$ 3,000
Uniting Church Parkesbourne Fellowship	$ 5,686
Windellama Public School	$ 3,000
Total	$ 810,475

A.5 Prior to 2006-07 grant recipients

Grant recipients (before 2006-07)	Amount
Taralga skatepark	$ 75,000
Marulan skatepark	$ 75,000
Tarago hall	$ 85,000
Total	$ 235,000



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PHA of Woodlawn Project | Appendix J

PRELIMINARY HAZARD ANALYSIS OF

THE WOODLAWN EXPANSION PROJECT

Prepared for: URS Australia Limited

Document Number: URS\18-B233

Revision C

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27 April 2010

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Preliminary Hazard Analysis

Woodlawn Expansion Project

Acknowledgment

The author would like to thank Luke O'Dwyer (URS Australia) and Evelyn Melinis (Veolia) for their assistance in preparing this report.

Disclaimer

This report was prepared by Planager Pty Ltd (Planager) as an account of work for URS Australia Limited. The material in it reflects Planager's best judgement in the light of the information available to it at the time of preparation. However, as Planager cannot control the conditions under which this report may be used, Planager and its related corporations will not be responsible for damages of any nature resulting from use of or reliance upon this report. Planager's responsibility for advice given is subject to the terms of engagement with URS Australia Limited.

Rev	Date	Description	Prepared By	Reviewed By	Authorised By
A	27/02/2010	Draft for Comment	Karin Nilsson	Maarten Tentij	Luke O'Dwyer
B	16/04/2010	Draft II for Comment	Karin Nilsson	Maarten Tentij	Evelyn Melinis
C	27/04/2010	Final	Karin Nilsson	Maarten Tentij	Evelyn Melinis

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CONTENTS

EXECUTIVE SUMMARY I

GLOSSARY II

1 INTRODUCTION 3

1.1 Background 3

1.2 Scope and Aim of Study 4

2 SITE DESCRIPTION 5

2.1 Location 5

2.2 Site Infrastructure 5

3 STUDY METHODOLOGY 10

3.1 Introduction 10

3.2 Hazard and Risk Screening 10

4 HAZARD IDENTIFICATION 12

4.1 Hazardous Materials 12

4.2 Potential Hazardous Incidents and their control 12

5 HAZARD AND RISK ANALYSIS 24

5.1 Hazards and Risks to Off-Site Populations 24

5.1.1 Fires and Explosion On-Site 24

5.1.2 Fire and Explosion Hazard During Transport 24

5.1.3 Explosion Due to Migration of Landfill Gas Off-Site 25

5.1.4 Diseases 25

5.2 Hazards and Risks to On-Site Populations 26

5.2.1 Fire and Explosion Hazards 26

5.2.2 Exposure to Toxic and Harmful Gases 26

5.2.3 Biological Hazards 27

5.2.4 Electrical Hazards 27

5.2.5 Safety Hazards 27
5.2.6 Noise 28
5.2.7 Heat Stress 28
5.3 Hazards and Risks to the Environment 28
6 CONCLUSION AND RECOMMENDATIONS 30
6.1 Risks to On-Site Population 30
6.2 Risks to Off-Site Population 30
7 REFERENCES 31

LIST OF FIGURES

Figure 1 – Aerial Photograph 6
Figure 2 – Project Application Area 7
Figure 3 - Bioreactor and Intermodal Facility Process Map 8
Figure 4 – LFG Flowchart 9

LIST OF TABLES

Table 1 - Typical Chemicals / Products Stored Onsite 12
Table 2 – Hazard Identification Word Diagram 14

EXECUTIVE SUMMARY

Veolia Environmental Services (Veolia) is proposing to increase the annual waste tonnages received at the Woodlawn Bioreactor to up to 1.13 million tonnes per annum to provide for the current and future disposal capacity of the greater Sydney region as well as the local and regional areas surrounding Woodlawn. The proposal would enable additional waste to be received by rail from the Sydney region and by road from the local region.

A Preliminary Hazard Analysis (PHA) is required as part of the Director General's Requirements for this Proposal. The PHA has been prepared to assess the potential for on and off site risks, including fire risk and management, risks associated with gases produced at the facility and risks relating to the storage of hazardous material. The PHA also analyses the procedures and measures available for risk mitigation. The PHA has been conducted in accordance with the NSW Department of Planning's requirements for hazard and risk assessment as detailed in their Hazardous Industry Planning Advisory Paper number 6: *Guidelines for Hazard Analysis.*

The risk screening of the proposal shows that the site is not considered to be *potentially hazardous*. With the low levels of risk associated with the Facility, this PHA has been kept qualitative only and no quantification of any risks has been conducted.

The hazard and risk assessment found that the waste expansion project does not introduce any new hazards to the Facility and that the hazards are all well known and understood by the Woodlawn Bioreactor management and staff. Further, the assessment found that the expansion project is not likely to increase the severity of the hazards associated with the operation of the landfill site. The risks to the environment are also unlikely to increase due to the proposed expansion project.

It is not expected that the risk to off-site population from an incident on-site would increase due to the expansion project. The risk to off-site population is expected to remain negligible with the large buffer between any operations on-site and the site boundaries remaining intact.

Recommendation 1: It is recommended that Veolia assesses the impact of the increase in methane capture rate on the existing plant. Hazard and Operability (HAZOP) study technique or other similar methodology is required to assess the impact of the change on plant systems to ensure that the risks associated with the methane handling is reduced to As Low As Reasonably Practicable levels.

Recommendation 2: It is recommended that Veolia reviews the safety-implications of the increased waste transfer on on-site populations and determine whether any further safety measures are required to maintain a low level of safety risk to on-site population.

GLOSSARY

C1	Combustible liquids (according to classification in AS1940)
DECCW	Department of Environment Climate Change and Water
ED3	Evaporation Dam 3
EIS	Environmental Impact Statement
EMP	Environment Management Plan
EP&A Act	Environmental Planning and Assessment Act
EPL	Environment Protection Licence
H_2S	Hydrogen sulphide
HIPAP	Hazardous Industry Planning Advisory Paper
LEMP	Landfill Environment Management Plan
LFG	Landfill Gas
PHA	Preliminary Hazard Analysis
PPE	Personal Protective Equipment
SEPP 33	State Environmental Planning Policy No. 33 — *Hazardous and Offensive Development*

REPORT

1 INTRODUCTION

1.1 BACKGROUND

The Woodlawn Bioreactor has been operational since September 2004. The Facility receives containerised waste by rail from the Clyde Transfer Terminal located in Sydney, via the Crisps Creek Intermodal Facility, which is located approximately 8km from the Woodlawn Bioreactor site near the township of Tarago.

Prior to becoming a waste management facility, Woodlawn operated as a base metals mine site between the 1970s and 1990s. The Bioreactor is now located within a 25 million cubic metre open cut void, which was created during the mining operations. The Woodlawn Bioreactor operations utilises the evaporation dams known as ED3, it also utilises part of the existing office buildings, and part of the plant area for power generation infrastructure.

The original application for development at both Woodlawn and Clyde assessed the environmental impacts associated with receival of up to 500,000 tonnes of putrescible waste by rail from the Sydney region per year however, the Conditions of Development Consent limited the input to 400,000 tonnes per annum, reducing by 10% every five years, unless the need for additional capacity can be shown.

The Woodlawn Expansion Project (the 'Project'), relates to a proposal under Part 3A of the Environmental Planning and Assessment (EP&A) Act 1979, to increase the annual waste tonnages received at the Woodlawn Bioreactor from 500,000 tonnes to 1.13 million tonnes.

The purpose of the Project is to provide for the current and future disposal capacity of the greater Sydney region as well as the local and regional areas surrounding Woodlawn. The additional tonnage would enable waste to be received either by road or rail from the local region, as well as increasing the volume of waste received by rail from the greater Sydney region through the Crisps Creek Intermodal Facility.

While this application proposes to increase the annual input rate to the Bioreactor, the size of the void and therefore the total volume of waste that could be received at the facility throughout the life of the site would remain unchanged.

The Project would require an increase in personnel and equipment at both facilities. It is estimated that an additional eleven staff members would be

required and the additional equipment would consist of an extra dozer, landfill compactor, container tipper and forklift.

This application also includes a proposal to extend the hours of operation at the Bioreactor site, consistent with the proposed extended hours at Crisps Creek Intermodal Facility to ensure adequate turn-around times for loading and unloading containers.

1.2 SCOPE AND AIM OF STUDY

A Preliminary Hazard Analysis (PHA) is required as part of the Director General's Requirements for this Project. The PHA is to assess the potential for on and off site risks, including fire risk and management, risks associated with gases produced at the facility and risks relating to the storage of hazardous material. The PHA is also to analyse the procedures and measures available for risk mitigation.

Planager Pty Ltd has been commissioned by URS Australia Limited to prepare the PHA. The PHA has been conducted in accordance with the NSW Department of Planning's requirements for hazard and risk assessment as detailed in their Hazardous Industry Planning Advisory Paper number 6: *Guidelines for Hazard Analysis* (Ref 1). This document forms an appendix to the Environmental Assessment and provides details of the PHA undertaken for the proposed Woodlawn Expansion Project.

The scope of this report includes the following;

- Systematic identification and documentation of the major hazards, based on the information supplied and relevant experience with similar processes;

- Establishment of the consequence of each identified hazard and determination as to their offsite effects;

- Where offsite effects are identified, the frequency of occurrence is estimated based on historical data. If such data is unavailable, assumptions and qualitative discussions are presented;

- Determination of the acceptability (or otherwise) risk; and

- Identification of risk reduction measures as deemed necessary.

2 SITE DESCRIPTION

2.1 LOCATION

The Woodlawn Bioreactor is located approximately 250 kilometres south west of Sydney, approximately 40 kilometres south of Goulburn and approximately 50 kilometres north-east of Canberra within a 6,000 hectare Eco-Precinct owned by Veolia Environmental Services Pty Ltd. An aerial photograph of the Bioreactor is provided in Figure 1 below.

2.2 SITE INFRASTRUCTURE

The land relevant to this project application at the Woodlawn Management Facility is outlined in red in Figure 2, and includes the following areas:

1. Access road
2. Mine void
3. Evaporation dam
4. Offices and workshop,
5. Power station and associated infrastructure (gas collection system)

Bioreactor Operations

The Woodlawn Bioreactor is designed to encourage the biodegradation of waste through controlled leachate recirculation.

Containerised waste is received at the bioreactor on trucks travelling from the IMF. All trucks are weighed at a weighbridge building and will then proceed to the active tipping face of the bioreactor. Once deposited, the waste is spread and covered with an approved alternate daily cover material and soil.

Landfill gas (LFG) is produced as a by product of the decomposition of organic matter in the waste. To maximise the capture of LFG, an active gas extraction system has been progressively installed and operated at the site. LFG generally contains methane, carbon dioxide, nitrogen and trace elements of hydrogen sulphide and oxygen.

The gas is collected in a system of pipes and transferred to the generators driven by reciprocating engines designed to work on a mixture of methane and air. The electricity generated from the landfill gas is exported to the Network Service Provider (NSP). A flare is also in operation at the site.

Figure 3 shows the process map for the Woodlawn Bioreactor and Figure 4 shows the LFG flowchart.

Figure 1 – Aerial Photograph

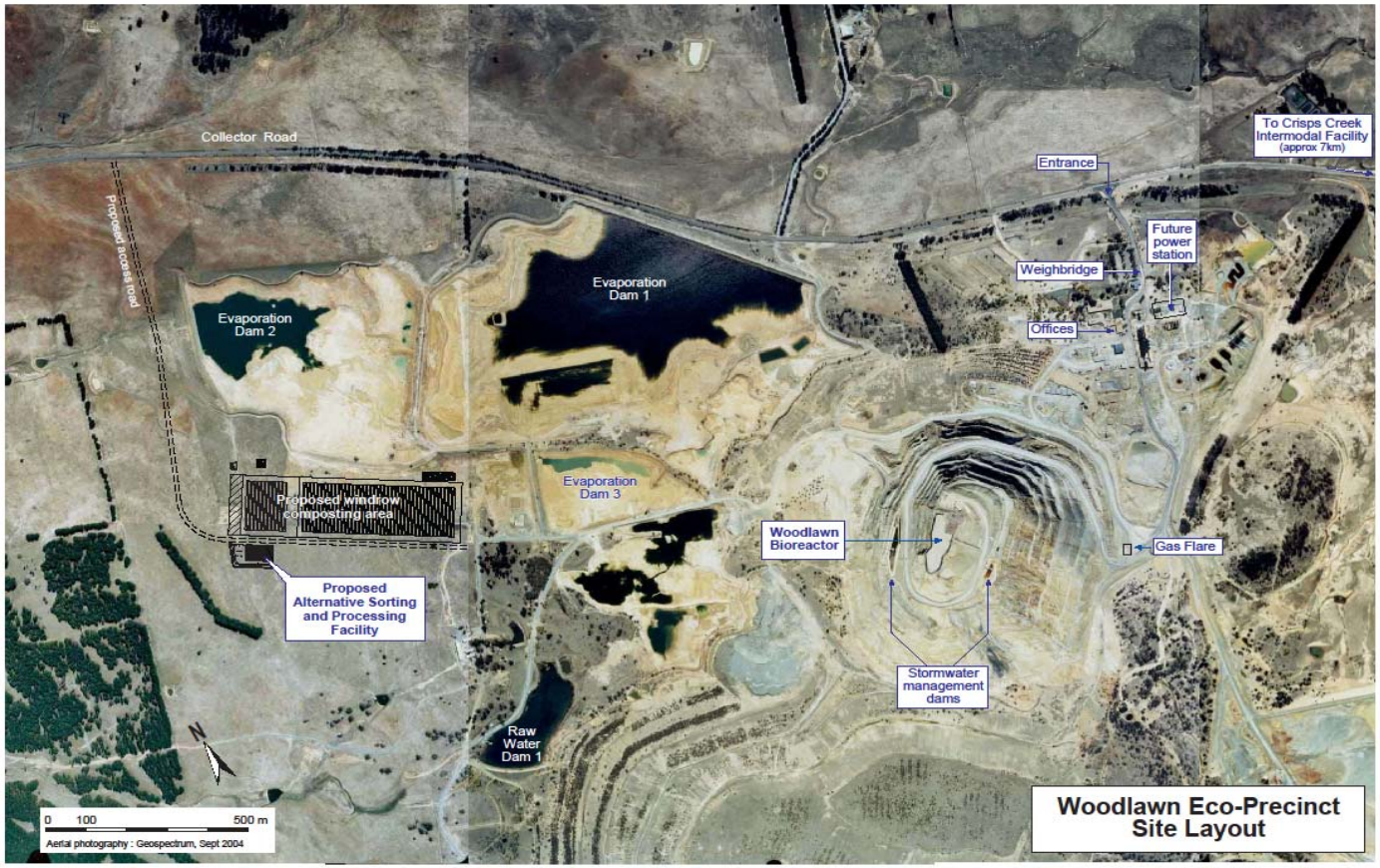


Figure 2 – Project Application Area

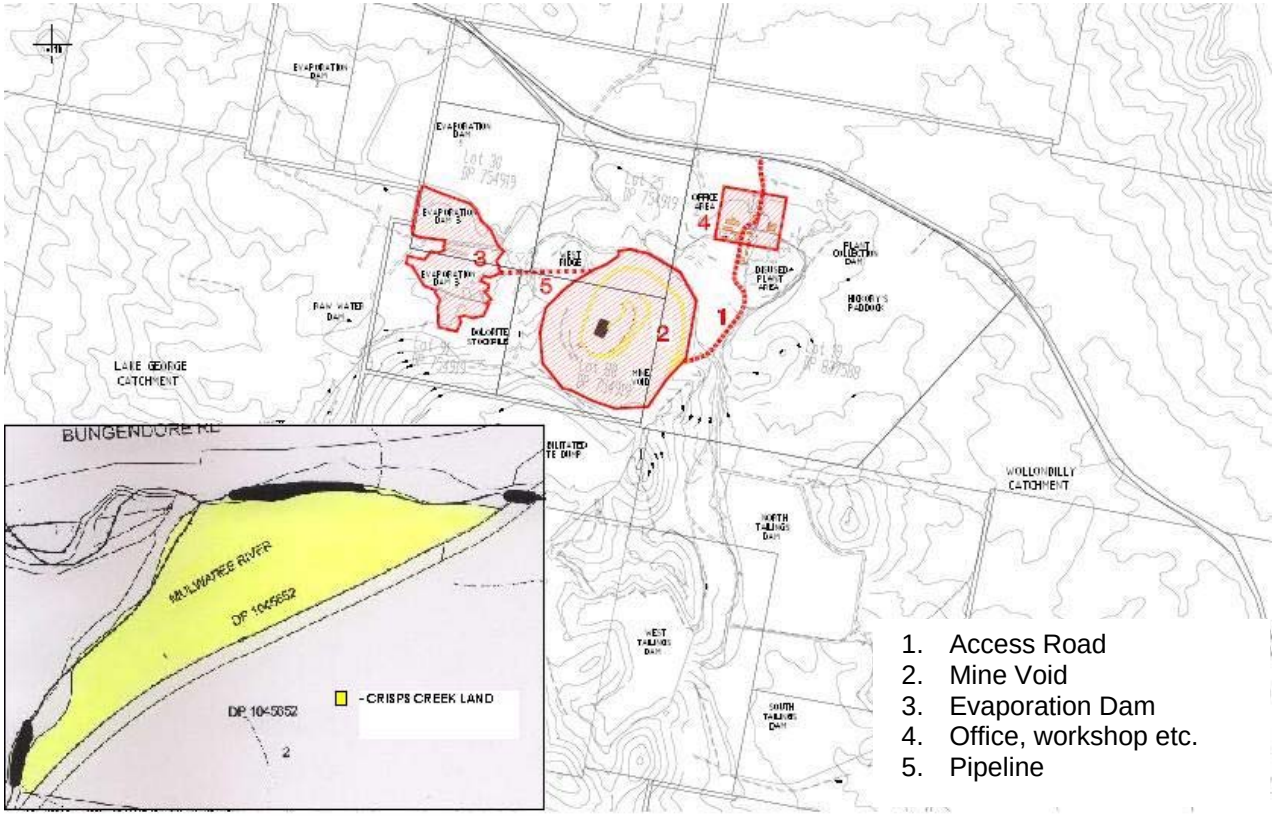


Figure 3 - Bioreactor and Intermodal Facility Process Map

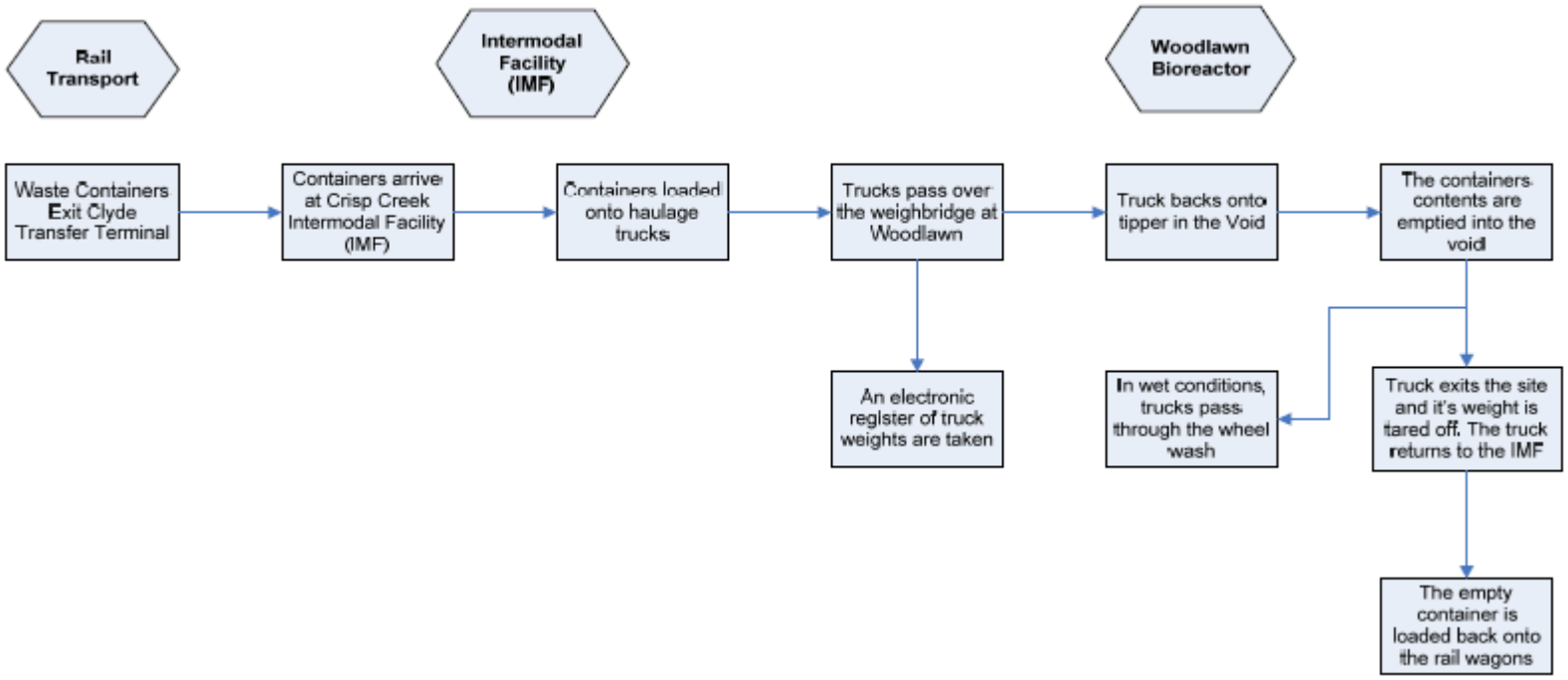
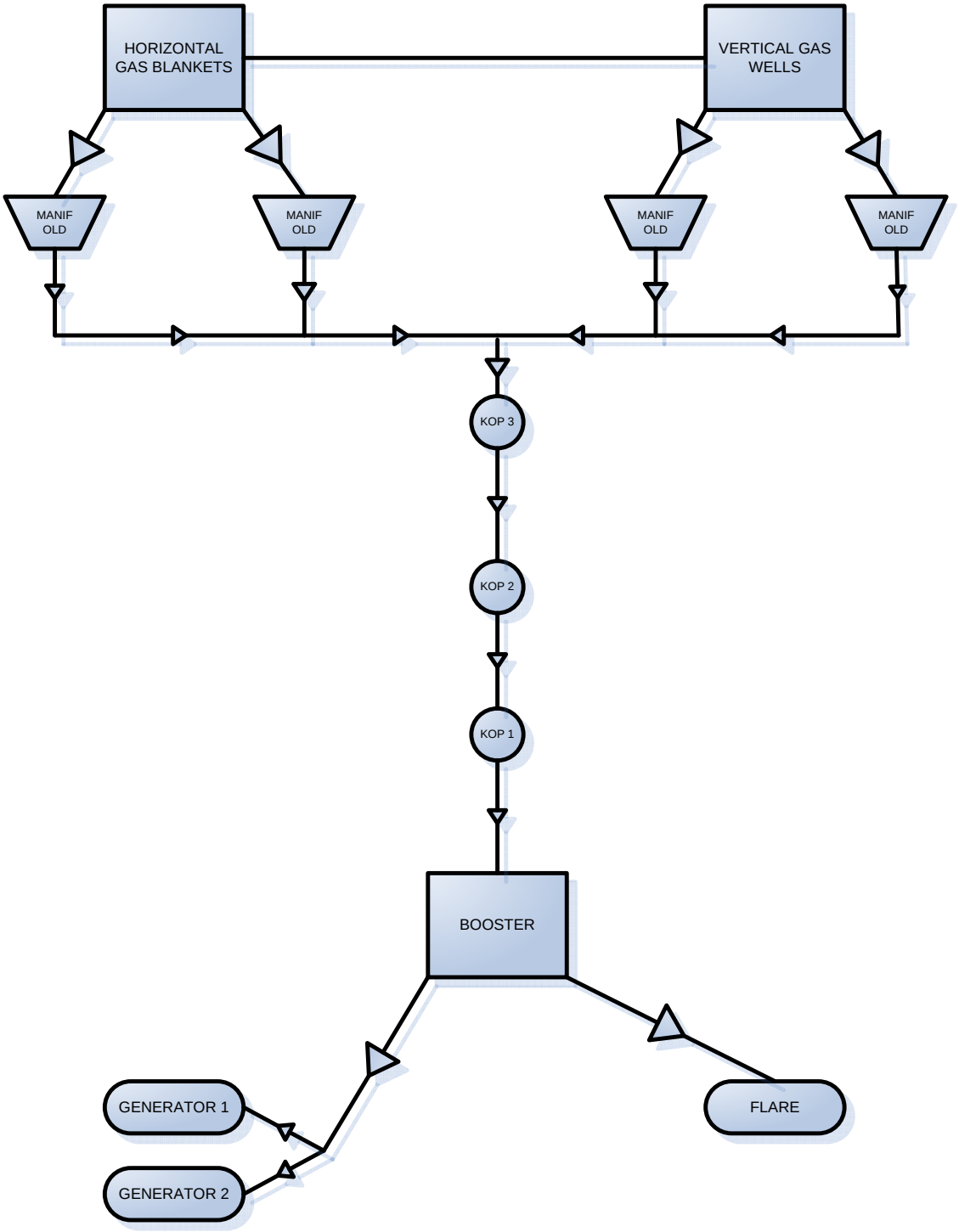


Figure 4 – LFG Flowchart



3 STUDY METHODOLOGY

3.1 INTRODUCTION

The assessment has been carried out in accordance with the Department of Planning's HIPAP No 6 (*Guidelines for Hazard Analysis*, Ref 1). This document describes the methodology and the criteria to be used in PHAs, as required by the NSW Department of Planning for major "potentially hazardous" development.

3.2 HAZARD AND RISK SCREENING

A hazard and risk screening has been conducted in accordance with the State Environmental Planning Policy No. 33 — *Hazardous and Offensive Development* (SEPP 33), as described in the guideline document entitled *Applying SEPP 33* (Ref 2).

SEPP 33 represents the approach used in NSW for planning and assessing proposals for industrial development. Through the policy, the permissibility of an industrial proposal is linked to its safety and pollution control performance.

SEPP 33 ensures that only those industrial proposals which are suitably located, and able to demonstrate that they can be built and operated with an adequate level of safety, can proceed.

SEPP 33 applies to any proposals which fall under the policy's definition of 'potentially hazardous industry' or 'potentially offensive industry'. For development proposals classified as 'potentially hazardous industry' the policy establishes a comprehensive test by way of a PHA to determine the risk to people, property and the environment at the proposed location and in the presence of controls.

The screening procedure is primarily based on the quantity of potentially hazardous materials[1] involved in the proposal and, in some cases, the distance of these materials from the site boundary. The potential for a proposal, in the absence of safeguards, to emit a polluting discharge is assessed as part of the screening process. Further, the quantities of materials (potentially hazardous and/or dangerous goods) transported to and from the facilities are also assessed.

The Woodlawn Bioreactor facility does not involve the storage or use of substances which are classified as Dangerous Goods under the *Australian*

[1] Hazardous Materials is defined in SEPP 33 as: ...*substances falling within the classification of the Australian Code for Transportation of Dangerous Goods by Road and Rail (Dangerous Goods Code).*

Dangerous Goods Code. Diesel, which is stored at the facility is a Class C1 combustible liquid and as such is not defined as Dangerous Goods. The same applies to the various oils used in the generators. In accordance with *Applying SEPP 33* (Ref 2), if class C1 combustible liquids are present on the site and are stored in separate bunded area or within a storage area where they are the only combustible liquid present, they are not considered to be *potentially hazardous*.

With the low levels of risk associated with the Facility, this PHA has been kept qualitative only and no quantification of any risks has been conducted.

The Facility will require licences under the NSW Protection of Environment and Operations Act 1997. The Crisps Creek IMF & Woodlawn Bioreactor have been issued with EPLs by the DECCW.

In accordance with *Applying SEPP 33* the proposal has the potential to be offensive. *Applying SEPP 33* indicates that the level of offense would not be considered to be significant if relevant licences can be obtained.

4 HAZARD IDENTIFICATION

4.1 HAZARDOUS MATERIALS

A list of the types and storage quantities of materials that are likely to be found at the proposed site is included in the following table. Quantities are indicative only.

Table 1 - Typical Chemicals / Products Stored Onsite

Plant Area / Use	Chemical/Product	Anticipated Storage Qty
Fuel for vehicles	Distillate (Diesel)	70,000L capacity aboveground tank - maximum of 35,000L stored at any one time) and 10,000L capacity underground tank - maximum of 4,000L stored at any one time)
Transformers, pumps, air compressor, lubrication, fire pump	Insulating oil (non PCB)	Maximum of 4,500L stored at any one time in IBCs or drums
Chemicals for maintenance / repair work and clean-up	Chemicals typically used in workshops.	Various minor quantities of chemicals, managed through standard processes. Not discussed further in this PHA.

4.2 POTENTIAL HAZARDOUS INCIDENTS AND THEIR CONTROL

The following potential incidents have been identified for the Facility. None of these incidents are new to the site and have been managed since the commencement of the operation in September 2004 using formal procedures and systems.

1. Loss of containment of fuel or oil leading to environmental pollution if not properly contained. Possible fire if an ignition source is present and sufficiently powerful.
2. Fire in the bioreactor (waste, gas).
3. Fire in Waste Haulage Vehicle.
4. Fire in Offices / Workshops / Laboratory
5. Fire Involving Site Plant And Equipment
6. Bush fire at site boundary

7. Loss of containment of stored waters including leachate
8. Exposure to hydrogen sulphide (H_2S)
9. Biological Hazards
10. Geotechnical instability / dam failure or overflow
11. Fire / explosion at the power generation.
12. Extraction of gas risks
13. Power station risks (High voltage area, low voltage area, generators)
14. Flare operation risks
15. Flooding results in process upsets and damage to plant and equipment.
16. Land subsidence, earthquake or mining activity results in plant damage.

The risk mitigation strategy for each one of the above hazards is provided in the Hazard Identification Word Diagram in Table 2 below. Further discussions are provided in Section 5 below.

Table 2 – Hazard Identification Word Diagram

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
1. Loss of containment of fuel or oil leading to environmental pollution if not properly contained. Possible fire scenario if ignition source present and sufficiently powerful (combustible liquids only held onsite – no flammable liquids).	1. Loss of containment during unloading from truck to the diesel tank. 2. Mechanical failure, damage to tank etc. 3. Overfilling of tank. 4. Loss of containment of hydraulic oil from equipment. Potential ignition sources: - Hot work - Lightning - Sabotage	Environmental damage if spill is not contained on site. Risk of fire. Personnel hazard and damage to property.	- Areas around tanks kept clean. Waste is removed on a regular basis. Regular workplace inspections carried out issues corrected and recorded in HIPPO (Veolia's integrated management system). - Regular inspections and maintenance. - Fuel tank located on a hardstand area away from general traffic. Impact protection in the form of several fixed posts around tank. Tank is double skinned and meets AS1940 requirements. No other potentially flammable materials or incompatible substances stored near to the tanks. - Any spills of fuel will be cleared up immediately. Spill kits on site all personnel trained in spill kit deployment. - All tanks will be clearly labelled and stored with the appropriate placards. - Spill containment as per AS1940. - Site emergency response plan that is reviewed annually. - Emergency services call-out as required. - Fire protection (fire extinguishers, separation distances etc.) provided and inspected every 6 months. Distances in accordance with AS 1940. - The valves and piping are contained within the tank frame and are in accordance with AS 1940. - No smoking signs in place. Diesel is combustible only. - Diesel tank has a 70,000 litre capacity. Diesel is purchased in 33,000 litre amounts. Low limit, triggers the purchase of a top up load of diesel. - Operator present during tanker unloading operations. Provided AS1940 requirements are followed the risk of this scenario is negligible. The scenario will not be discussed further.

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
2. Fire in the bioreactor (waste, gas)	Decomposition of solid waste in anaerobic conditions (without oxygen) generates heat and methane and other gases – possible ignition of combustible materials.	Fire at the void. Generation of heat and harmful combustion products. Personnel hazard and damage to property. May spread to large areas at the void. Flammable gas may explode if accumulated.	- Waste is covered with Alternate Daily Cover (ADC) materials and soil. - Smoking is not permitted in landfill areas. - Operators checks in the area they are working in throughout the day, to ensure any potential fire situation is recognised quickly, allowing prompt action to extinguish it. - Equipment fire suppression systems is serviced and inspected as required. - Gas alarms available onsite as well as personal gas monitoring alarms. - An Infra Red Camera is used to detect heat thresholds on the surface of the waste mass. An alarming device is installed to notify personnel once a heat threshold has been reached. - No combustion engines allowed at the void. - Flare available if methane concentration exceeds 25%. Procedures and training requirements for operation of flare. - Waste fires are tackled by attempting to excavate out any waste on fire and/or smother the fire with inert soil or similar material. Water cart is available onsite in the event that a fire does occur at the site. - Breathing apparatus available onsite. The scenario could lead to a hazardous situation and will be discussed further in Section 5 below.

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
3. Fire In Waste Haulage Vehicle	Overheating of combustible material at vehicle causes fire.	Damage to vehicle. Personnel hazard. Fire may spread to other areas.	- Operators are trained to recognise such events and quickly respond. - Fire extinguishers on vehicles. - Maintenance and cleaning of vehicles. The scenario could lead to a hazardous situation and will be discussed further in Section 5 below.
4. Fire In Offices / Workshops / Laboratory	Ignition of flammable or combustible material in office, workshop or laboratory.	Damage to office / workshop / laboratory. Personnel hazard.	- Housekeeping. - Labelling and placarding of any chemicals. - Dedicated disused chemicals store. - No smoking permitted outside of dedicated areas. - Hot work permit system. - Hot work (eg. oxy-acetylene cutting and welding) only in areas away from potentially flammable materials. - Fire extinguishers (serviced and inspected on a 6 monthly basis). - Any spillage of flammable liquid or material will be cleared up immediately. - Procedures and training. Provided general safety precautions are followed the risk of this scenario is negligible. The scenario will not be discussed further.

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
5. Fire Involving Site Plant And Equipment	Build-up of material heats up and causes fire.	Damage to plant and/or equipment. Personnel hazard. Fire may spread to other areas.	- All plant are cleaned and maintained regularly to avoid the build-up of waste or other material. - All belly plates and other more difficult areas are checked regularly and cleaned out at each service or more frequently if required. - Plant and equipment are moved away from potential fire areas when not in use and out of hours. - Operators checks equipment throughout the shift to ensure that no fires or hazards are imminent. The management of this scenario appear rigorous and the scenario will not be discussed further.
6. Bush fire at site boundary	External cause	Threat to people working on-site.	- The Environmental Management Representative checks the site boundary regularly during times of high fire danger. - Site personnel fully cooperates with members of the fire service in the event of a bushfire. - The effectiveness of on and off-site firebreaks will be reviewed by the Environmental Management Representative. The management of this scenario appear rigorous and the scenario will not be discussed further.
7. Loss of containment of stored waters including leachate	Leak in containment.	Environmental pollution if not contained appropriately.	- ED3-South & North levels are monitored on a monthly basis and reported to DECCW annually. Ponds must be maintained below 55% of their total capacity. - Leachate is recirculated through the landfill. This scenario is discussed in detail in the relevant section of the original EIS and will not be assessed further in this PHA.

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
8. Exposure to hydrogen sulphide (H_2S) and other potentially harmful or toxic gases (nitrogen, methane, carbon dioxide)	- Geologic materials with high sulfate content. - Acid water and existing spoils with high acid potential and high sulphur. - Zones of sulfate reduction characterised by high H_2S production. - Biological degradation of waste materials in landfills under anaerobic conditions. - Methane (CH_4) forms explosive mixtures in air, The flammable range of CH_4 is approximately 5% to 15% (by volume) in the air. The lower limit of 5% is referred to as the Lower Explosive Limit (LEL); the upper limit of 15% is referred to as the Upper Explosive Limit (UEL). The auto-ignition temperature of CH_4 is 540 degrees C.	H_2S is a toxic and harmful gas. Oleofactory senses may become numbed if prolonged exposure to H_2S, thus removing the hazard warning usually afforded by this gas. Carbon dioxide and methane gas mainly present hazards from displacing oxygen and possibly rendering the atmosphere oxygen deficient. There would hence be a risk of workers entering an oxygen deficient area without appreciating the risk.	- Personal monitoring for H2S - Gas detectors fitted. - Training of staff. - Breathing apparatus in place. - Monitoring of leachate, groundwater and surface water (including sulfate concentration, pH levels, conductivity) - Water management measures to intercept and minimise volume of infiltrated mine run-off into the void. - Operational use of crushed hematite on the waste to reduce the release of H2S at the surface. The scenario could lead to a hazardous situation and will be discussed further in Section 5 below.

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
9. Biological hazards	Risk of infection such as tetanus from cuts and abrasions. Pathogen containing putrescibles waste.	Diseases to on-site personnel.	- Not allowing the public access to the tipping face. - Compacting waste and applying covering material at regular intervals. - Controlling waste entry. - Minimising off-site movement of litter. - Hygiene practices and PPE. - All employees must have Hep A, Hep B and tetanus inoculations This scenario will be discussed further in Section 5 below.
10. Geotechnical instability / dam failure or overflow	1. Land movement. 2. Local instability caused by failure to control loading of void. 3. Damage to dam wall.	Personnel injury potential. Damage to equipment and vehicles.	- Visual inspections of pit crest, beams and toe of slope (photographic record, as required) conducted on a weekly basis. - Slope monitoring surveys undertaken monthly. - Survey interpretation and geotechnical monitoring report prepared quarterly. - Management and monitoring procedures are provided in the following documents: Geotechnical Management Plan and Barrier System and Quality Assurance Plan. - Management and monitoring procedures for dam failure or overflow are provided in the following document: ED3 Management Plan. The management of the risk from this scenario appear rigorous and the scenario will not be discussed further in this PHA.

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
11. Fire / explosion at the power station For risks associated with electricity, refer to scenarios 12 and 14 below.	- Faulty connection or internal fault in generator. - Failure of the burner management system. - Leak of flammable gas which ignites.	Fire or explosion in the generator building. Material damage. Potential for propagation to other generators. Personnel injury potential.	- Isolation of electrical energy sources. - Fire protection system available on site to minimise damage from fire. - Emergency response plan and procedures. - Fire retardant engine rooms & flammable gas detectors. - Ventilation of generator building according to Code requirements. - UV & Infrared Sensors Located in Generator Rooms - Power station supervision on call 24h/7. - Engine Maintenance Agreement for routine and dedicated maintenance. - Fire protection (extinguishers etc.) provided and inspected every 6 months. - Intrinsically safe pumps. Earthing. - Permit to work procedures. All contractors are selected for the work that they do and are on the preferred contractor list. All work undertaken is in accordance with VES Permit to Work Procedure. - Hazards have been assessed and risks ranked with controls in place in accordance with VES procedure. The scenario could lead to a hazardous situation and will be discussed further in Section 5 below.

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
12. Extraction of gas risks	Leak of flammable gas which ignites.	Fire or explosion. Material damage. Potential for propagation to other areas. Personnel injury potential.	- Gas (installation) Construction Plan. Protection of gas pipes through use of adequate piping material (High Density plastic pipe) and constructed to minimise risk of damage through use of sand and then aggregated stone. - Monitoring of gas flow and quantity. - Fire protection system available on site to minimise damage from fire. - Emergency response plan and procedures. - Permit to work procedures. All contractors are selected for the work that they do and are on the preferred contractor list. All work undertaken is in accordance with VES Permit to Work Procedure. - Hazards have been assessed and risks ranked with controls in place in accordance with VES procedure. - PPE Requirements - Personal Gas Monitors, Safety Boots, Hi-Vis Wear, Spot Light. The scenario could lead to a hazardous situation and will be discussed further in Section 5 below.

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
13. Power station risks (High voltage area, low voltage area, generators) (For fire/explosion risks at the power station, refer to Scenario number 10 above).	Electrocution hazard. Sparks, arcs. Voltage between phases and earth and across open switch contacts.	Personnel injury or death	- Induction/Access Rights. - Visitors are supervised at all times. - Personnel working on HV equipment have HV training. - Engine Maintenance Agreement for routine and dedicated maintenance. Internal maintenance/sub-contracted maintenance. - Access requirements for various electrical situations, such as access permits or safety clearances from exposed energised conductors. - Switching instructions are required. - Use of insulated tools, barriers and gloves. - Signage DANGER HIGH VOLTAGE - HV room under lock and key. - Lone Worker Procedure - battery powered, portable duress transmitter unit for lone worker use. - PPE Requirements. - Generator room design (including double glazed glass). - No Entry for Visitors in Generator Room. - Isolation and tagging/locking out procedures. - Emergency plan includes electric shock management. The management of the risk from this scenario appear rigorous and the scenario will not be discussed further in this PHA.

Event	Cause/Comments	Possible Consequences	Prevention/ Protection
14. Flare operation risks	Operator error during operation of flare.	Gaseous emissions, explosion, fire .	- Procedure and training for flare operation. - Flare is locked at all times. - Flare Operation Log Sheet – Note volumes and Methane Gas Concentrations. Historical graph online - Fire Extinguisher(s). - Site Traffic Management Plan Requirements. - PPE – Hi Visible Wear, Hard Hats, Appropriate Footwear, Personal Gas Monitors. The management of the risk from this scenario appear rigorous and the scenario will not be discussed further in this PHA.
15. Flooding results in process upsets and damage to plant and equipment.	Uncontrolled flooding of site	Potential for damage to process / storage facilities resulting in release of potentially hazardous material	- Site elevation and surface run-off design to ensure potential for flooding is minimised. The management of the risk from this scenario appear rigorous and the scenario will not be discussed further in this PHA.
16. Land subsidence, earthquake or mining activity results in plant damage.	Land subsiding in area creates failure resulting in potential for loss of containment of leachate	Release of leachate leading to environmental harm.	- Geotechnical study has been performed and the outcomes of this study have been integrated into the design of the facility. The management of the risk from this scenario appear rigorous and the scenario will not be discussed further in this PHA.

5 HAZARD AND RISK ANALYSIS

5.1 HAZARDS AND RISKS TO OFF-SITE POPULATIONS

5.1.1 Fires and Explosion On-Site

Hazard: Landfill gas is generated through decomposition of the waste mass in the void under anaerobic (without oxygen) conditions. Landfill gas contains methane gas. The gas is transferred through pipes to the power station or to the flare. Methane gas can ignite in the presence of oxygen and an ignition source. If ignited, methane gas can either burn as a fire or explode generating overpressure effects. There is also a risk of fire occurring at the landfill site though spontaneous combustion of waste material where there is sufficient oxygen available. Fires not only pose the obvious hazard of intense heat, open flame and smoke inhalation, but may also cause the release of toxic chemicals into the environment. Fires may also cause damage to equipment and site facilities.

Safeguards: Fire and explosion hazards associated with LFG at the Facility are controlled through the removal of air (waste is compacted to minimise air voids and covered by suitable material; purging of oxygen in pipes and the control of ignition sources (Permit To Work, no smoking, no combustion engines allowed in the void, heavy vehicle drivers have access to a fire extinguisher at all times). Construction of fire tracks suitable for fire trucks to allow clear access to the fire water cart at all times. Further, gas build-up is monitored through on-site gas detectors with associated alarms and personal gas monitoring. Infra Red cameras are used to detect any small fire, allowing it to be controlled before escalation is possible (waste fires are tackled by attempting to excavate out any waste on fire and/or smother the fire with inert soil or similar material; water cart[2] is available onsite in the event that a fire does occur at the site).

Risk: Even though the rate of generation of methane gas on site most likely increases with the expansion of the waste treatment at the Facility, the buffer zone between any location at the void or at the power station where flammable gas may be present and the site boundaries is so great that the consequences of a fire or an explosion to off-site populations are negligible.

5.1.2 Fire and Explosion Hazard During Transport

Hazard: Methane gas can be generated in the containers during transport to the Woodlawn facility. Methane gas may be ignited though static electricity charges generated through the movement in the containers during transit.

[2] 50,000 Litres

Safeguards: To reduce the risk of a fire or an explosion in the containers during transport to the Facility the containers are fitted with vents to minimise the amount of methane that can build up (methane gas is lighter than air and would readily escape from the vents). In addition, the transition from aerobic (with oxygen) to anaerobic (without oxygen) conditions in waste, required for the formation of methane gas, has been observed to take a minimum of 100 days in confined situations such as in the containers. Further, because railcars are grounded, static electricity is unlikely to occur.

Risk: Given that the timeframe between the waste being placed in the containers and unloaded at the landfill would normally be a maximum of 24 hours, the potential risk of an explosion occurring during transport of the waste to the Facility would be minimal, also with the increase in quantities of waste being transferred to the Facility.

5.1.3 Explosion Due to Migration of Landfill Gas Off-Site

Hazard: There is a risk of flammable gas migrating off site through underground cracks and fissures. Explosions have been known to occur in underground or confined spaces in areas near landfills as the result of build-up of methane.

Safeguard: The geology of the mine void is such that migration of flammable gases to any off-site location is extremely unlikely to occur. A gas collection system is installed at the landfill. Further, sub-surface and surface (including accumulation) gas monitoring of methane gas is carried out in accordance with the facility's EPL and Gas Management Plan (part of the Landfill Environmental Management Plan) to ensure no migration offsite.

Risk: The increase in waste being transported to the site is not likely to lead to an increase in the risk of migration off-site of landfill gas. Further, given the safeguards discussed above, the risk of methane gas migrating off site through underground cracks and fissures is extremely small.

5.1.4 Diseases

Hazard: An effective and efficient waste disposal system significantly reduces the risk of diseases spreading throughout the population. Proper waste disposal is an important component of the public health infrastructure.

Safeguards: Control of pests which can transmit diseases, control of diseases relating to the health and the public and on-site personnel, and control of agricultural pests are described in detail in Section 21 in the EIS.

Risk: Pest and disease control are an integral part of landfill operation. With the implementation of correct operating and control procedures, the potential public health risks related to landfills are minimised.

5.2 HAZARDS AND RISKS TO ON-SITE POPULATIONS

On-site population which may be exposed to on-site hazards comprise site personnel, contractors and visitors. The types of hazards which relate to on-site populations are fire and explosion hazards, exposure to harmful and toxic gases, biological hazards, electrical hazards, safety hazards, noise and heat stress.

5.2.1 Fire and Explosion Hazards

Hazard: As discussed above, there is a risk of fire at the landfill site due to the heat generated during decomposition reactions (leading to spontaneous ignition) and due to the flammable methane gas being generated in anaerobic condition. There is also a risk of methane gas leaking from transfer pipes, e.g. in the generator building. Ignition of methane gas may cause a fire or an explosion.

Safeguards: Refer Section 5.1.1 above. The generator (engine) room is constructed in fire retardant material and fitted with flammable gas detectors. The generator building is also automatically ventilated. Further, there is a fire protection system available on site and an emergency procedure available to minimise damage from fire. Gas pipes are constructed in adequate material (e.g. high density plastic) and laid in sand and then aggregate stone to prevent damage. Gas flow is monitored. Gas flow is monitored.

Risk: With proper management of change systems, operating procedures and training the risk to on-site populations from fire or explosion can be reduced to acceptable levels.

Recommendation 1: It is recommended that Veolia assesses the impact of the increase in methane capture rate on the existing plant. Where required, Hazard and Operability (HAZOP) study techniques or other similar methodology is to be applied to plant systems to ensure that the risks associated with the methane handling is reduced to As Low As Reasonably Practicable levels.

5.2.2 Exposure to Toxic and Harmful Gases

Hazard: Decomposition of solid waste generates a number of gases which are harmful to human health (hydrogen sulphide, nitrogen, methane, carbon dioxide). Carbon dioxide and methane gas mainly present hazards from displacing oxygen and possibly rendering the atmosphere oxygen deficient. There would hence be a risk of workers entering an oxygen deficient area without appreciating the risk. Other gases such as hydrogen sulphide, are toxic and extremely harmful to human health in high concentrations.

Safeguards: A gas collection system is installed to minimise build-up of gases. Personnel carry gas monitoring devices and gas detectors are fitted. Confined space permit system is heavily controlled in enclosed areas or below ground

level where a build-up of gases may occur. Further, operational use of crushed hematite on the waste to reduce the release of H2S at the surface.

.**Risk:** The management of the above mentioned safeguard is imperative to control the risk of exposure to toxic and/or harmful gases by on-site population.

5.2.3 Biological Hazards

Hazard: The main biological risk associated with the landfill site is likely to be the risk of infection such as tetanus from cuts and abrasions in areas where waste is handled. Solid, putrescible waste can also contain varying degrees of other pathogen which have the potential to cause illness.

Safeguards: Not allowing the public access to the tipping face; compacting waste and applying covering material at regular intervals; controlling waste entry; minimising off-site movement of litter. Further, good hygiene practices and wearing PPE when waste is directly handled. All employees must have Hep A, Hep B and tetanus inoculations.

Risk: Careful maintenance of the above safeguards will ensue that the risk is kept low. Refer recommendation number 2 below.

5.2.4 Electrical Hazards

Hazard: Power station – High Voltage (HV) room, Low Voltage (LV) room, generators and main corridor areas. Voltages between phases and earth, voltages across open switch contacts.

Safeguards: Access requirements for various electrical situations e.g. access permits or safety clearances. Only suitably trained personnel and contractors are allowed to work on electrical equipment. Permit To Work (including HV permit) and isolation and tagging procedures apply. No work allowed during heavy electrical storms.

Risk: Provided the safeguards above are maintained the risk associated with electrical incidents can be maintained.

5.2.5 Safety Hazards

Hazard: The site contains a number of safety hazards such as uneven terrain (e.g. holes, ditches), heavy vehicles movements.

Safeguards: General safety precautions such as PPE, high visibility vests worn, speed limits, training and procedures apply.

Risk: The increase in waste transfer rate is likely to increase the risk of general safety hazards to on-site populations.

Recommendation 2: Veolia needs to review the risk-implications of the increased waste transfer on on-site populations and determine whether any

further safety measures are required to maintain a low level of safety risk to on-site population.

5.2.6 Noise

Hazard: The effect from noise from heavy equipment and vehicles could lead to the following hazards:

- Hearing damage,
- Communication interference leading to misunderstanding or confusion or to the inability to warn of a danger.
- Workers being startled, annoyed or distracted.

Safeguards: Hearing guards such as ear muffs worn or plugs in certain high-noise areas (such as at the generators). Visual demarcations are used in conjunction with audible information and alarms.

Risk: The increase in waste transfer rate would increase noise generation from heavy machinery and vehicles on-site. The risk of hearing loss is minimal due to the safeguards available and enforced to be used on-site. The risk of communication loss will be managed.

5.2.7 Heat Stress

Hazard: Heat is a major hazard especially for workers wearing PPE in hot conditions.

Safeguards: Sensible scheduling of work and rest periods, and frequent replacement of fluids. Control of lone worker.

Risk: The risk from heat stress can be reduced to as low as reasonably practicable. Adhere to lone worker procedure.

5.3 HAZARDS AND RISKS TO THE ENVIRONMENT

The following hazard is associated with the Woodlawn Bioreactor:

- The potential for large volumes of surface water from evaporation dam (ED3) to migrate off-site.

To decrease the risks associated with possible structural fault or failure of ED3 the following actions have been implemented: a comprehensive surveillance report prepared every 5 years in accordance with NSW Dams Safety Committee standards and an annual intermediate surveillance inspection and report.

The inspections for surveillance are undertaken by an experienced dams engineer.

Routine inspections are undertaken and include checking for seepage from bank toes and checking for erosion at pumped inflow point.

An emergency plan has been formulated in the event of:

- Structural fault or failure
- ED3 reaching full capacity and overflowing

In the event of a structural fault or failure, the water stored in ED3 would be pumped into the various surface storage ponds within the mine void. Alternatively, the other storage areas at Woodlawn could be utilised.

Repairs would be carried out in accordance with a “Specific Repair Plan” approved by the Dams Safety Committee.

At conclusion of the emergency, the quantity of water pumped to the storages is to be estimated and returned to ED3.

Once ED3 reaches maximum capacity, the emergency spillway connecting the north rim of ED3 to ED1 would allow additional flow to spill over into ED1. This has been considered a worst case scenario and based on previous studies is considered unlikely that this event would occur.

In the event of structural fault or failure, ED3 would require pump-out and temporary storage within the other storage areas available on site. Should structural fault or failure occur when ED3 is full, requiring the maximum volume of water to be relocated elsewhere, one option would include ED1 and ED2 being used as temporary storage. For this situation ED1 and ED2 have a combined capacity of 1215ML providing capacity for 415ML of water stored in ED3 (LEMP, 2007).

6 CONCLUSION AND RECOMMENDATIONS

The Woodlawn Expansion Project does not introduce any new hazards. The hazards associated with the Woodlawn Bioreactor operations are well known and understood.

The expansion project is not likely to increase the severity of the hazards associated with the operation of the landfill site.

6.1 RISKS TO ON-SITE POPULATION

The increase in methane capture rate is likely to impact on the rest of the plant and the implications of this would need to be assessed.

Recommendation 1: It is recommended that Veolia assesses the impact of the increase in methane capture rate on the existing plant. Hazard and Operability (HAZOP) study technique or other similar methodology may be required to assess the impact of the change on the plant to ensure that the risks associated with the methane handling is reduced to As Low As Reasonably Practicable levels.

Recommendation 2: It is recommended that Veolia reviews the safety-implications of the increased waste transfer on on-site populations and determine whether any further safety measures are required to maintain a low level of safety risk to on-site population

6.2 RISKS TO OFF-SITE POPULATION

It is not expected that the risk to off-site population from an incident on-site would increase due to the waste expansion project. The risk to off-site population is expected to remain negligible with the large buffer between any operations on-site and the site boundaries remaining intact.

7 REFERENCES

1 Hazardous Industry Planning Advisory Paper No. 6 (HIPAP No. 6): *Guidelines for Hazard Analysis*, NSW Department of Planning

2 *Applying SEPP 33, Hazardous and Offensive Development Application Guidelines*, Department of Urban Affairs and Planning, 1994

Post Closure Landfill Rehabilitation Management Plan

Appendix K

VEOLIA
ENVIRONMENTAL SERVICES

Veolia Environmental Services Pty Ltd

Woodlawn Bioreactor

Post Closure Landfill Rehabilitation Management Plan (incorporating Rehabilitation Management Plan)

MAY 2007

Woodlawn Bioreactor

Post Closure Landfill Rehabilitation Management Plan

Revision	Revision Date	Details
A	21/03/01	Draft LEMP Issue (Maunsell McIntyre)
B	23/04/01	Licence Application Issue (Maunsell McIntyre)
C	21/06/02	OEMP (Maunsell McIntyre)
D	August 2004	Collex review
E	May 2007	VES Review

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Table of Contents

Table of Contents 4

1 Introduction 5
- 1.1 Overview 6
- 1.2 Background 6
- 1.3 Objective 7
  - 1.3.1 Licence for Closure Management 8
- 1.4 Site Description 8

2 Post Closure Environmental Monitoring 10
- 2.1 Site Closure 11
  - 2.1.1 Revegetation 11
  - 2.1.2 Stormwater 11
  - 2.1.3 ED3 Management 11
  - 2.1.4 Leachate 11
  - 2.1.5 Groundwater 12
  - 2.1.6 Landfill Gas 12

3 Site Rehabilitation Plan – Post Closure Management 13
- 3.1 Introduction 14
- 3.2 Objectives 14
- 3.3 Monitoring And Maintenance 14
  - 3.3.1 Introduction 14
- 3.4 Records And Reporting 15
  - 3.4.1 Monitoring Results 15
  - 3.4.2 Records of Pollution Complaints 15
- 3.5 Staffing And Training Requirements 16
- 3.6 Environmental Review 16
- 3.7 Management System Audits 16

4 Financial Assurances 17
- 1.1 Bioreactor Rehabilitation 18
- 4.1 18
- 4.2 Whole of Mine Site Rehabilitation 18

5 Closure Strategies 19
- 5.1 Early Closure strategies 20
  - 5.1.1 Early Closure Strategies: Mine Void 20
  - 5.1.2 Early closure strategy: ED3 22
  - 5.1.3 Maintenance 22
- 5.2 Final Closure of Bioreactor 23
  - 5.2.1 Mine void 23
  - 5.2.2 ED3 23
  - 5.2.3 Rehabilitation of Plant/Office Area 23

6 Rehabilitation Standards and Schedule 25
- 6.1 Site Capping 26
- 6.2 Revegetation 26
- 6.3 ED3 28
- 6.4 Site Decommissioning 28
- 6.5 Rehabilitation Schedule 28

Table of Contents

7	**Integration of Rehabilitation Works**	**29**
8	**References**	**31**

List of Figures

Figure 10407001-560-A	**Map of Bioreactor Consent and Licence Area**
Figure 3.15	**Proposed Mine Void Surface Water Management Early Closure of Bioreactor – Option 1**
Figure 3.16	**Proposed Mine Void Surface Water Management Early Closure of Bioreactor – Option 2**
Figure 3.17	**Proposed Mine Void Surface Water Management Early Closure of Bioreactor – Option 3**
Figure 3.18	**Proposed Mine Void Surface Water Management Completed Rehabilitated Bioreactor**
Figure 3.20	**Proposed Surface Water Management at Woodlawn Mine Site at Completion of Rehabilitation of Mine Areas**

1 Introduction

1 Introduction

1.1 Overview

VES's Development Consent for the Woodlawn Bioreactor covers the mine void, ED3, an area surrounding the administration buildings for offices and landfill infrastructure such as landfill gas generators. This area is shown in Drawing 10407001-560-A.

VES's EPA Licence for the Woodlawn Bioreactor (Licence number 11436) covers the same area as the Development Consent.

This Post Closure Landfill Rehabilitation Management Plan (incorporating the required Rehabilitation Management Plan), covers the area regulated by the Development Consent and EPA Licence (as shown in Drawing 10407001-560-A).

VES has taken over ownership of the whole of the Woodlawn property, most of which is covered by Special Mining Lease 20 (SML20). VES now becomes responsible for the rehabilitation of the entire Woodlawn mine site, in addition to the post-closure rehabilitation of the Bioreactor licenced area.

The plan for rehabilitation of areas of the Woodlawn site which are outside of VES's Development Consent are not covered in this Management Plan. The rehabilitation of these other areas (including plant area, tailings dams, ED1 and ED2) is being undertaken in accordance with the Mine Operations Plan (MOP) for Woodlawn Mine, under the guidance of the Mine Rehabilitation Environmental Management Process. For information about rehabilitation of the wider mine site areas outside of VES's Woodlawn Bioreactor consent area, please refer to the Woodlawn Mine Operations Plan (2004).

1.2 Background

This Post Closure Landfill Rehabilitation Management Plan (PCLRMP) describes the proposed post closure management and rehabilitation activities to be undertaken to manage the site following either early or final closure of the site. The site will be managed and maintained in accordance with VES environmental policies and the requirements of regulatory authorities, principally the NSW Environment Protection Authority (EPA).

Note: Under the terms of the current Consent Conditions for the 20 year operation of the site, the mine void will not be filled to the level of the mine void rim. Refer to the Filling Schedule in this LEMP for details of approximate levels expected to be reached based on the maximum input rates in the current Consent Conditions.

The Plan has been developed to reflect the requirements of the "Environmental Guidelines: Solid Waste Landfills" (EPA, 1996) and contains references to the Environmental Goals and Benchmark Techniques described in the guidelines. It provides a basis for the EPA to assess the environmental performance of the

1 Introduction

bioreactor site and to review the management and monitoring activities that are carried out on site.

This PCLRMP is based on a continuation of progressive rehabilitation compatible with long term use of the site. The document will be updated periodically in light of new information and new standards for environmental performance.

Subsequent to the Development Consent granted for the Woodlawn Bioreactor, VES has taken over responsibility for whole-of-mine site rehabilitation. The involvement of VES in the planning and execution of both the Bioreactor post-closure rehabilitation and the whole-of-mine site rehabilitation will ensure that these rehabilitation efforts are integrated.

1.3 Objective

The Plan addresses the rehabilitation and after care management issues associated with stormwater, leachate, biogas, management of ED3 and revegetation for the site. The staging of the rehabilitation works is dependent on the proposed filling plan. The operational phases of these issues are fully described in the Woodlawn Bioreactor Environmental Management Plan (LEMP).

The primary objectives of this plan are to meet the requirements of Consent Conditions 15 and 22. These conditions call for the preparation of a PCLRMP and a Rehabilitation Management Plan (RMP) respectively. Due to the similarity between the two plans, they have been combined in one document, while still addressing all of the consent condition requirements.

Consent Condition 15 specifies that this PCLRMP will address the following:

a) Closure strategies in the event that landfilling activities conclude prior to filling of the mine void
b) Site capping and revegetation in accordance with benchmark technique 28 of the Environmental Guidelines: Solid Waste Landfills
c) Post closure environmental monitoring
d) Post closure management of surface water in the event that the void is not filled with waste
e) Post closure management of Evaporation Dam No3 (ED3)
f) Post closure leachate management, including the management of the bioreactor processes
g) Post closure maintenance
h) The estimated costing for these works must be provided and should be based on a nominal period of at least 50 years after the landfill ceases to accept waste. The actual duration of this period will be determined from actual monitoring data at the time.

1 Introduction

Consent Condition 22 requires the preparation and implementation of a Rehabilitation Management Plan (RMP). The RMP shall address, but not necessarily be limited to the following matters:

a) Clear identification of the proposed new rehabilitation works to be undertaken by the Applicant, details of the Woodlawn Mine site rehabilitation works being undertaken by the mine leaseholder, and a clear definition of the respective obligations of the parties;
b) An outline of financial arrangements for site rehabilitation works proposed in the plan;
c) The rehabilitation standards to be adopted;
d) A rehabilitation schedule (to be reviewed on a regular basis);
e) A post-establishment maintenance and monitoring program for rehabilitated areas;
f) Procedures for the removal of all derelict buildings and infrastructure;
g) Closure strategies in the event that landfilling activities conclude prior to the capacity of the mine void being filled; and
h) Integration of rehabilitation works with the rehabilitation of the Woodlawn mine site.

The Environmental Guidelines (EPA, 1996) adopt a performance based approach. The performance outcomes are defined as Environmental Goals and include Benchmark Techniques appendices. The Benchmark Techniques applicable to rehabilitation and after care have been addressed in this document.

1.3.1 Licence for Closure Management

Prior to closure, VES will need to obtain a licence under the Protection of the Environment Operations Act 1997 to cover closure and post closure management of the facility. The Application for the licence by VES will be based on the proposals set out in this PCLRMP to cover post closure management.

1.4 Site Description

Bioreactor Site

The Woodlawn mine site is located approximately 7km (10km by road) west of the township of Tarago in the Mulwaree LGA.

The mine void is located in a 3,000 ha property owned by Veolia Environmental Services Pty Ltd. In addition to the void, the property contains waste rock dumps, tailings dams, evaporation ponds, disused mine buildings and infrastructure and surrounding rural land and pine plantations. Areas of the site subject to the DA include the void, the access road into the site and an area to the northeast of the void where facilities such as a weighbridge and site office will be located, and Evaporation Dam 3 (ED3). These areas are shown on in Drawing 10407001-560-A.

Access to the mine site is off Collector Road, which runs in an east-west direction from its intersection with Bungendore Road. The mine void is located approximately

1 Introduction

500m south of Collector Road on top of a ridgeline that forms part of the Great Dividing Range at an elevation of 800m AHD. The mine void in which the landfilling is proposed has a depth of about 200m and a volume of approximately 25 million cubic metres.

At the end of 20 years (the period of operation for which the current consent has been granted), it is estimated that should the allowed tonnages of waste be placed (in accordance with that consent) approximately 6 million cubic metres of the available void space will have been filled.

The site is situated at the head of the Allianoyonyiga and Crisps Creeks catchments. The watershed of the Wollondilly River/Lake George catchment also traverses the site. Lake George is located approximately 7.5km to the west and Lake Bathurst approximately 8.5km to the northeast of the mine site.

Intermodal Facility

The Intermodal facility is located approximately 2km to the south of Tarago and approximately 6km to the southeast of the mine site. The site has an area of 10 ha and is bounded by the Mulwaree River to the north and west and the Goulburn-Bombala railway line to the east and south.

2 Post Closure Environmental Monitoring

2 Post Closure Environmental Monitoring

2.1 Site Closure

The EPA Environmental Guidelines : Solid Waste Landfills (EPA 1996) reflect good management practice for conventionally constructed landfills. In particular, the guidelines contain techniques that are appropriate to sites which accept sufficient mass of solid wastes, to permit the construction of slope angles sufficient to promote surface drainage. Because of differences in the bioreactor design, local topography and site geology, some "Benchmark Techniques" require adaptation to suit the unique conditions at Woodlawn.

In accordance with Benchmark Technique 29 (Landfill Closure and Post-Closure Monitoring and Maintenance) of the Landfill Guidelines (EPA 1996), the monitoring and maintenance activities will be provided until the bioreactor does not pose a threat to the environment. Additionally, as outlined below, all leachate collection, gas collection, stormwater sediment controls, monitoring and reporting practices will be maintained to a standard equivalent to that employed during the operational life of the bioreactor.

2.1.1 Revegetation

All necessary revegetation works will be completed in accordance with the final design contour plan to ensure erosion protection and stabilisation of eroded drains, ponds and dams. The final contour plan is shown in Figure 3.18.

Details of the revegetation and landscaping of the final landform are contained in *Section 5.2* of this plan.

2.1.2 Stormwater

At the completion of landfilling activities, the necessary environmental controls regarding stormwater collection and treatment will be installed in accordance with EPA Environmental Guidelines.

Details of the post closure stormwater and surface water management and monitoring are contained in *Section 8: Closure Strategies* in this plan.

2.1.3 ED3 Management

The post closure management of ED3 will be carried out in accordance with Consent Condition 70. Details of the management techniques proposed are contained in *Sections 5.4* and *Section 7* of this Plan.

2.1.4 Leachate

The leachate collection and treatment utilised during the operational phase of the site will continue following closure. The monitoring regime established during the operation of the site will initially be maintained and reviewed as appropriate.

2 Post Closure Environmental Monitoring

Details of the leachate monitoring program and leachate management practices are contained in the Leachate Management Plan and the Environmental Monitoring Schedule.

2.1.5 Groundwater

The groundwater monitoring regime established during the operation of the site will be maintained post closure.

Details of the monitoring regime and management are contained in the Groundwater Monitoring Program.

2.1.6 Landfill Gas

The gas management and control systems installed during the operation of the site will continue to operate during the post closure after care until the active gas generation phase is completed.

The gas monitoring program established during the operation of the site will also continue post closure. Details of this monitoring program are contained in the Gas Management Plan.

3 Site Rehabilitation Plan – Post Closure Management

3 Site Rehabilitation Plan – Post Closure Management

3.1 Introduction

Collex currently have approval to operate the bioreactor for a period of 20 years in accordance with Consent Condition 3. Extension of filling activities beyond 20 years would be subject to further approvals applicable at the time. It is estimated that complete filling of the void would take in the order of 50 to 60 years.

3.2 Objectives

The ultimate aim of the ongoing post closure management activities is to stabilise the bioreactor and ensure that it does not pollute the surrounding environment.

Once the Bioreactor has achieved stability, VES may seek to complete all obligations and seek return of financial assurance lodged with the EPA. VES will need to issue a certified statement of completion, stating that all necessary site remediation work has been completed (gas, leachate, stormwater and revegetation management) and no further environmental management of the site is necessary.

The certified statement will be required to show the following:

- Gas concentration levels in all perimeter gas wells have fallen to less than 1% methane (v/v) and less than 1.5% carbon dioxide for a period of 24 months;
- Waste stabilisation to be completed. The leachate and gas monitoring data documented indicate low level contamination, posing no hazard to the environment;
- Groundwater monitoring results indicate threat to groundwater quality;
- Bioreactor capping layer has been assessed over several years and found to be stable with acceptable surface water drainage;
- Necessary documentation to demonstrate that all requirements in the closure planning segment of the LEMP have been completed; and
- Site has been placed on the Unhealthy Building Land Register.

Following approval by the EPA of the certified statement of completion, the licensee can cease all maintenance and monitoring requirements for site, and all financial assurance requirements will lapse.

3.3 Monitoring And Maintenance

3.3.1 Introduction

Ongoing management of the site will be undertaken following closure of the site. This would consist primarily of monitoring of the site and undertaking of required

3 Site Rehabilitation Plan – Post Closure Management

maintenance. The aim of the ongoing monitoring and maintenance program is to demonstrate compliance with licence conditions and ensure management activities are working effectively.

VES will ensure that all leachate collection, gas collection, stormwater controls and reporting practices are maintained to the same level employed at the end of the operational life of the bioreactor. The environmental management measures will continue until VES can demonstrate that the bioreactor does not pose a threat to the environment.

VES will ensure that waste materials are not received for disposal at the site after the landfilling operations cease. Any waste materials that are intended for use in the rehabilitation will be documented and reported in the same method used during the operation of the bioreactor.

VES will undertake ongoing environmental management responsibilities related to the bioreactor site such as gas extraction, remedial work on areas of settlement and surface water management and leachate control in accordance with the LEMP.

Regular maintenance of the final landform and landscape will be undertaken in accordance with the LEMP. This will comprise:

- Monitoring of surface water and leachate dams and drains and undertaking repairs where necessary
- Filling of depressions created by settlement of the filled waste (to ensure shedding of surface water runoff)
- Replacement of vegetation, if necessary, to maintain the vegetation density
- Repairing erosion scours
- Clearing and maintenance of water courses and swales

The above activities would continue until the bioreactor has been stabilised.

3.4 Records And Reporting

3.4.1 Monitoring Results

Results for the post closure monitoring of surface water, groundwater, leachate, biogas and settlement, are to be maintained in accordance with the practices detailed in the operational monitoring plans for the site.

3.4.2 Records of Pollution Complaints

The records of all complaints received by VES will be kept on site these records will include:

- Date and time of the complaint;
- Details of the complaint;
- Nature of the complaint;
- The action taken by VES including any follow-up contact with the complainant.

3 Site Rehabilitation Plan – Post Closure Management

3.5 Staffing And Training Requirements

It is VES's responsibility to provide adequate staff/contractors to ensure that all requirements described in this PCLRMP are met. It is also VES's responsibility to provide adequate training to all personnel performing critical tasks such as site inspections and the operation and maintenance of environmental control equipment.

3.6 Environmental Review

VES intends to evaluate the success of its after care management approach on an annual basis.

The annual environmental review will have the following objectives:

- Quantitatively evaluate the significance of the environmental impacts associated with site activities;
- Formulate and periodically review environmental objectives, targets and programs for the site;
- Evaluate the effectiveness, completeness and need for the improvement of existing environmental management practices, to ensure compliance with current environmental legislation and guidelines;
- Assist in the continual improvement and optimisation of the site's existing environmental management practices;
- Provide confidence to the general public, community groups and regulatory agencies in regards to the impact of site activities on the environment and the effectiveness of the site's environmental management practices.

3.7 Management System Audits

Internal management system audits and supplier audits will be conducted on a regular basis to verify that the site's operations comply with the requirements of this PCLRMP. The results of the audits will be recorded and recommendations for improvement communicated to the relevant management personnel.

4 Financial Assurances

4 Financial Assurances

4.1 Bioreactor Rehabilitation

VES has provided to the EPA financial assurance commensurate with the ongoing environmental management and rehabilitation responsibilities for the bioreactor and associated activities. The financial assurance consists of:

a. A bank guarantee. The financial assurance is to be adjusted annually so that it keeps pace with inflation until agreed between VES and the EPA. The amount of the assurance has been determined by an independent review of the costings applicable to activities identified in the LEMP, and

b. An accumulating fund generated by monies set aside annually on deposit, or other form of financial assurance acceptable to the EPA, in respect of post closure works and responsibilities. The initial and ongoing annual deposit into this fund has been determined by an independent expert review of the costings applicable to activities identified in the Post Closure Landfill Rehabilitation Management Plan.

The financial assurance shall be maintained during the operation of the facility and thereafter until such time as the EPA notifies VES in writing that it is satisfied that the premises have been appropriately rehabilitated and are environmentally secure.

4.2 Whole of Mine Site Rehabilitation

VES has provided to the NSW Department of Mineral Resources (DMR) financial assurance pursuant to the rehabilitation responsibilities for the Woodlawn Mine (Special Mining Lease 20). The financial assurance consists of a bank guarantee.

The financial assurance shall be maintained during the life of the mining lease and thereafter until such time as the DMR notifies VES in writing that it is satisfied that the premises have been appropriately rehabilitated and are environmentally secure.

5 Closure Strategies

5 Closure Strategies

5.1 Early Closure strategies

Closure strategies in the event of filling operations ending prior to the complete filling of the mine void are outlined below.

Water management techniques are the primary activities that are affected by early closure of the filling operations. All other techniques including leachate collection, biogas collection, capping and revegetation will remain as outlined in this and other relevant documents.

Early closure of the bioreactor refers to the closure of the bioreactor prior to filling the mine void. The exposed walls of the mine void will produce acid mine drainage and pose a risk to the environment. As a result, the acidic surface water generated from the cliff face will be collected and managed separately to the runoff from the rehabilitated surface of the mine void.

Three options for managing early closure of the bioreactor are illustrated in Figure 3.15, Figure 3.16 and Figure 3.17. These figures indicate several options for storing and managing the surface water generated within the rehabilitated mine void.

5.1.1 Early Closure Strategies: Mine Void

Option 1

The proposed mine void surface water management during early closure of bioreactor Option 1 is shown in Figure 3.15, within 8 low-lying depressions, where the contaminated water is collected and kept separate to the clean surface water collected within the rehabilitated areas.

Unrehabilitated Area of the Mine Void

Within Figure 3.15, the 4 depressions indicated by the hatched contour lines collect the contaminated surface water generated from the cliff face of the mine void. Contaminated surface water is collected through a series of perimeter rock drains into the four depressions and pump to ED3 for storage through level activated pumps.

Rehabilitated Area within the Mine Void

The 4 depressions indicated by the solid contour lines (Figure 3.15) collect the surface water generated from within the rehabilitated areas. The surface water can be managed through the use of spray evaporation, surface water evaporation and pumping to the adjoining clean catchments as required.

The overall slope of the finished surface can be seen in cross section 1, Figure 3.15, showing a gentle peak in the middle and low points on either side, collecting the clean surface water. From here the slope peaks and falls again to provide storage for the contaminated surface water generated from the exposed mine wall areas.

5 Closure Strategies

Option 2

The proposed mine void surface water management during early closure of bioreactor Option 2 is shown in Figure 3.16, within 8 low-lying depressions, where the contaminated water is collected and kept separate to the clean surface water collected within the rehabilitated areas.

The difference between options 1 and 2 is in the location of the depressions rather than the number which indicates that a number of possible alternatives exist for the layout of the depressions.

Unrehabilitated Area of the Mine Void

The 4 depressions indicated by the hatched contour lines (Figure 3.16) collect the contaminated surface water generated from the cliff face of the mine void. Contaminated surface water is collected through a series of perimeter rock drains into the 4 depressions and is pumped to ED3 for storage through level activated pumps.

Rehabilitated Area within the Mine Void

The 4 depressions indicated by the solid contour lines, collect the surface water generated from within the rehabilitated areas where the surface water can be managed through the use of spray evaporation, surface water evaporation and pumping to the adjoining clean catchments on a as needs basis.

The overall slope of the finished surface can be seen in cross section 1, Figure 3.16, showing a gentle peak in the middle and low points on either side, collecting the clean surface water. From here the slope peaks and lowers again to provide storage for the contaminated surface water generated from the exposed mine wall areas.

Option 3

The proposed mine void surface water management during early closure of bioreactor Option 3 is shown in Figure 3.17, within 2 low-lying depressions, where the contaminated water is collected and kept separate to the clean surface water collected within the rehabilitated areas.

The difference between option 3 and options 1 and 2 is in the number and location of the depressions, further indicating that a number of possible alternatives exist for the layout of the depressions.

Unrehabilitated Area of the Mine Void

The depression indicated by the hatched contour lines, collects the contaminated surface water generated from the cliff face of the mine void. Contaminated surface water is collected through a series of perimeter rock drains into the depressions and pumped to ED3 for storage through level activated pumps.

5 Closure Strategies

Rehabilitated Area within the Mine Void

The depression indicated by the solid contour lines collects the surface water generated from within the rehabilitated areas. The surface water can be managed through the use of spray evaporation, surface water evaporation and pumping out to the adjoining clean catchments on a as needs basis.

The overall slope of the finished surface can be seen in cross section 1, Figure 3.17, showing a peak at one end of the rehabilitated layer that slopes down to the other end providing depression for the clean surface water and the contaminated surface water.

Management options 1 to 3 will be implemented through the use of level control pumps that automatically trigger during wet weather events and pump the contaminated surface water to ED3. The surface water generated from the rehabilitated areas will also be pumped out of the mine void through level activated pumps and will flow off-site to adjoining clean catchments.

5.1.2 Early closure strategy: ED3

If the bioreactor is closed before the void is filled the surface water generated from the mine void will be required to be pumped out and stored in ED3 due to acid mine drainage (attributed to the exposed walls of the mine void). The diversion and collection of surface water at the surface of the rehabilitated area will allow for:

- Contaminated surface water that has come into contact with the sides of the wall to be segregated away from the rest of the surface water
- Contaminated water to kept separate from the rehabilitated sections of the mine void through the use of perimeter drains
- Contaminated water collected within the perimeter drains will be collected to sump points and pumped out to ED3 on a level control system.

Storage will be provided for the clean surface water that can be pumped out as required by level activated pumps. The finished surface of the mine void and the surface water management have been detailed in Figures 3.15, 3.16 and 3.17 detailing the continued management of contaminated water through the use of ED3.

5.1.3 Maintenance

The pump system will require activation through level control. Pumps, pipelines and storage levels will need to be checked after a significant rainfall event. Due to the chemical characteristic of the exposed mine wall and the surrounding rehabilitated areas, pumps and pipelines must be well maintained. Inspection during and after a significant rainfall event ensures that the system is fully operational. In addition,

5 Closure Strategies

regular routine inspections are to be undertaken to ensure that the system will operate during storm events.

To assess the performance of the system during a storm event, systems can be set up to indicate to maintenance personnel once a pre-determined depth of rainfall has been reached. The pumping system could then be inspected.

5.2 Final Closure of Bioreactor

5.2.1 Mine void

The proposed mine void surface water management at the completed rehabilitated bioreactor is projected to be approximately 50 years. After which time, subject to extension to current consent conditions for operations at the site of 20 years, the bioreactor zones should have filled the mine void to ground level (RL 845.0). Once the exposed mine walls and bioreactor have been capped and rehabilitated, the surface water generated from this area is considered clean. The flow of water from this area will be similar to the flow of surface water on any of the Woodlawn rehabilitated areas, by the use of contour drains, surface water is diverted to adjoining clean catchments. The final surface contours and flow of surface water at the mine void is shown in Figure 3.18, where the rehabilitated area form the existing contours of land surrounding the mine void similar to the surface of the rehabilitated waste dump area.

The overall slope of the finished surface is indicated in cross section 1, Figure 3.18, forming a ridge where the surface water generated flows via constructed contour drains onto adjoining Wollondilly and Lake George Catchments. Integration of the final surface of the rehabilitated mine void into the surrounding rehabilitated areas at Woodlawn site is shown in Figure 3.20 where the flow generated from the rehabilitated areas flows onto the adjoining Wollondilly and Lake George catchments.

5.2.2 ED3

At final closure of the bioreactor, the surface of the rehabilitated bioreactor will be level with the existing adjoining ground surface. The mine void is considered to be fully rehabilitated and the surface water generated is considered to be clean. Surface water generated can be diverted through contour drains off site to the Lake George and Wollondilly catchments.

The function of ED3 will be to collect and store any rainfall collected from the surface area of the dam. The water stored in ED3 will be managed via evaporation. Average annual precipitation (0.7m) and evaporation (1.4m) levels indicate that evaporation alone is sufficient to manage the water level within ED3.

5.2.3 Rehabilitation of Plant/Office Area

5 Closure Strategies

At the completion of rehabilitation of the disused plant area, the surface water will be collected and diverted into a permanent sedimentation pond, formerly known as the plant collection dam.

Surface water flow within the rehabilitated mine/office area is shown in Figure 3.20 where the clean flow will be collected in the sedimentation dam.

6 Rehabilitation Standards and Schedule

6 Rehabilitation Standards and Schedule

6.1 Site Capping

Site capping and revegetation should ensure that the final surface of the bioreactor provides a barrier to the migration of water into the waste, controls emissions to water and atmosphere, promotes sound land management and conservation, prevents hazards and protects amenity. This would include the following:

- VES will commence capping completed filling areas within 30 days of completion of filling in that area, weather permitting
- The bioreactor should have a final capping comprising five parts:
  - The seal bearing surface
  - The gas drainage layer
  - The sealing surface
  - The infiltration drainage layer, and
  - The revegetation layer

In accordance with Benchmark Technique 28: Site Capping and Revegetation, of the NSW EPA Guidelines: Solid Waste Landfills, the capping will comprise the following:

- The seal bearing surface should consist of a properly designed and engineered layer of material
- The gas drainage layer will have a maximum thickness of 30cm. The calcium carbonate content of the gas drainage layer must not exceed 10% by weight to prevent encrustation
- A sealing layer will consist of a clay layer at least 50cm thick and having a permeability less than $K = 10^{-8}$ m/s^{-1}
- A drainage layer of permeability not less than $K = 10^{-5}$ m/s^{-1} will be placed over the sealing layer. The drainage layer will not be less than 30cm thick.
- A revegetation layer of depth not less than 100cm will be placed over the drainage layer. Plants selected for revegetation shall have root systems which will not penetrate beyond the revegetation layer or block the drainage layer. The final settlement of the seal bearing surface should leave a gradient of greater than 5% to defined drainage points
- If the sealing layer is left for a period exceeding seven days before being covered by the revegetation layer, it should be covered by a flexible membrane liner protection layer.

These procedures will be reviewed when capping of the bioreactor is required, and amended to reflect the best available technology at the time.

6.2 Revegetation

The rehabilitation of the Bioreactor site will involve the establishment of a stable vegetated landform over a compacted capping layer. Due to the limitations of topsoil depth, no trees or tall shrubs can be grown on the capped area of the Bioreactor. Therefore the predominant vegetation on the Bioreactor site will be native and

6 Rehabilitation Standards and Schedule

introduced grasses, with some potential for trees and taller shrubs beyond the capping layer on the margins of the site.

While preference is given to the use of native grass species on the site, consideration should be given to the proposed end-use of the site and therefore the suitability of the species for that use. For example if livestock grazing for production purposes is considered desirable, then the use of introduced species will be necessary.

The topsoil must be of a standard suitable for growing a consistent and healthy cover of vegetation. If the soil quality is poor, eg low nutrient and organic matter levels, then soil improver products such as the Nitro Humus™ and BioVerm™ are recommended.

Placement of Topsoil

- Obtain Nitro Humus™ or similar composted green waste from an approved supplier

- Remove site topsoil from stockpile and mix with Nitro Humus™ at a rate of 10% by volume. Install the improved topsoil to top of landfill to no less than 100cm depth

- Cultivate area to a depth of 100mm. Remove stones exceeding 100cm diameter, weeds, rubbish or other deleterious material, brought to the surface during cultivation

Planting

- Seeding to be undertaken by means of hydromulching immediately after topsoil has been placed and the surface prepared

- Hydromulching: a one-step process involving the application of seed, fertiliser, mulch, binder and soil conditioner in one operation. BioVerm™ soil conditioner, or similar, is to be incorporated with the hydromulch mix to improve seed emergence and plant establishment

- Thoroughly mix seed, fertiliser, wood-fibre mulch, binder and soil conditioner to provide a slurry and apply under pressure using a purpose-made machine according to manufacturer's instructions

- Seedmix composition should be confirmed with DEC prior to commencement of works and may include some of the species identified below:
  - Native Grass species such as Wallaby Grass, Spear Grass, Tussock Grass, Kangaroo Grass and Red Anthered Wallaby Grass
  - Introduced Grass species such as Perennial Rye Grass, Cocksfoot, Phalaris, Demeter Tall Fescue, Cereal Ryecorn, White Clover and Sub Clover
  - Native Shrub species such as Acacias, Melaleucas, Leptospermums and Kunzea

6 Rehabilitation Standards and Schedule

Maintenance

- A maintenance establishment period will be necessary to ensure the successful development of all planting areas including the following tasks:
  - Water seeded area so that mulch fibre is kept moist and until seedlings are established
  - Reseed areas where treatment has failed
  - Remove any extensive infestation of weeds, including all tree and tall shrub seedlings which could penetrate the capping layer

On-going maintenance will be less intensive than the establishment period and will be limited to occasional plant replacement, slashing the grassed areas to reduce fire hazard and weed proliferation

6.3 ED3

Post closure management of ED3 will primarily be through evaporation.

Options exist for further post-closure rehabilitation of ED3. A general scope of works could include:

- Progressively reducing catchment
- Dewatering pond
- Removing contaminated layer of sediment
- Utilising wall material for other rehabilitation efforts
- Sowing seed, liming, enriching soil using biosolids

6.4 Site Decommissioning

At the completion of operations, as part of the rehabilitation of the bioreactor site, there is a requirement for decommissioning and removal of all derelict buildings and infrastructure constructed specifically for the Bioreactor Facility. These activities would need to be tied in with any remaining rehabilitation activities being undertaken for the remainder of the mine site.

Additionally, there will still be a requirement for selected office buildings and laboratory to be maintained as part of the post closure maintenance and monitoring activities. Structures such as the gatehouse and weighbridge can be removed at the completion of filling activities.

Finalisation of the site decommissioning activities would be dependant upon the final end landuse proposed for the site.

6.5 Rehabilitation Schedule

The schedule for the rehabilitation of the bioreactor is reliant upon the final landform and proposed end land use of the site, and will, therefore, be determined closer to the time of final rehabilitation.

7 Integration of Rehabilitation Works

7 Integration of Rehabilitation Works

The filling of the Woodlawn mine void with waste and the final rehabilitation of the land subject to the DA shall be undertaken in a manner which is complementary with the rehabilitation of the Woodlawn mine site. The filling activities will not impede or limit the rehabilitation works on any part of the Woodlawn Mine site.

The rehabilitation of the mine void at the completion of filling is to be finalised on the basis of the final landform and the proposed after care land use.

At the completion of filling, ED3 will be managed primarily through evaporation.

The Department of Mineral Resources (DMR) requires a Mining Operations Plan (MOP) for the wider Woodlawn mine site. The MOP aims to delineate the progressive and integrated approach to whole-of-mine-site rehabilitation

An Annual Environmental Management Report (AEMR) supports the MOP by reporting rehabilitation progress each year as part of the Mining Rehabilitation and Environmental Management Process (MREMP).

The MOP outlines the strategy for whole-of-mine rehabilitation. The areas identified are:

- Evaporation Dams 1 & 2
- Plant Area
- Hickory Paddock
- Rehabilitated Waste Rock Dump
- Tailings impoundments
- Dolerite Stockpile
- Other disturbed areas

The information in this Management Plan relating to VES's licenced areas of operation is consistent with the above strategies for whole-of-mine remediation.

As VES is now both the licence holder for the Bioreactor as well as the owner of the wider Woodlawn mine site, VES will be responsible for undertaking Bioreactor post-closure rehabilitation works as well as whole-of-mine rehabilitation works. VES's involvement in the preparation of both this LEMP and the Woodlawn Mining Operations Plan will further ensure that the Bioreactor post-closure rehabilitation strategies are integrated with whole-of-mine rehabilitation activities.

8 References

8 References

(2007) VES, *Woodlawn Bioreactor: Environmental Management Plan*

(2007) VES, *Woodlawn Bioreactor: Leachate Management Plan*

(2007) VES, *Woodlawn Bioreactor: Filling Schedule*

(2007) VES, *Woodlawn Bioreactor: Environmental Monitoring Schedule*

(2007) VES, *Woodlawn Bioreactor: Gas Management Plan*

(2007) VES, *Woodlawn Bioreactor: Groundwater Monitoring Program*

(2000) DUAP, Woodlawn Waste Management Facility: Conditions of Development Consent

(2004) Collex: *Woodlawn Mine*: *Mine Operations Plan (Draft @ May 04)*

(1996) NSW EPA, *Environmental Guidelines: Solid Waste Landfills*

(2004) NSW EPA, *Woodlawn Bioreactor: Environment Protection Licence No. 11436*

North

EVAPORATION DAM 2

EVAPORATION DAM 1

Lot 30 DP 754919

Lot 25 DP 754919

EVAPORATION DAM 3

EVAPORATION DAM 3

3

WEST RIDGE

5

OFFICE AREA

4

PLANT COLLECTION DAM

DISUSED PLANT AREA

1

HICKORY'S PADDOCK

RAW WATER DAM

DOLORITE STOCKPILE

2

Lot 91 DP 754919

Lot 88 DP 754919

MINE VOID

Lot 19 DP 827588

LAKE GEORGE CATCHMENT

WASTE ROCK DAM

REHABILITATED WASTE DUMP

WOLLONDILLY CATCHMENT

NORTH TAILINGS DAM

WEST TAILINGS DAM

SOUTH TAILINGS DAM

LAKE GEORGE CATCHMENT

AREA SOURCE - WOODWARD-CLYDE DRAWING A8602362/0600

PROJECT AREAS

1 - ACCESS ROAD
2 - MINE VOID
3 - EVAPORATION DAM
4 - OFFICES, WORKSHOP, POWER GENERATING INFRASTRUCTURE
5 - PIPELINE

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Last modified: 23 Jun 04 - 15:00

REVISIONS				
No.	BY	DATE	DESCRIPTION	APPD
A	SGG	23.6.04		

Before commencing work, all controlling dimensions on the drawings must be verified on the site, particularly those relative to property allgnments, other structures, and services.

Figured dimensions take preference over scaled. If in doubt, ask.

SCALES

0 100 200 300 400m

1 : 1500 at A3

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	PREPARED	CHECKED	
DESIGN			PASSED
DRAFTING	PM		DATE

maunsell

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An AECOM company

WOODLAWN BIOREACTOR

WOODLAWN MINE SITE

LICENCED PREMISES

10407001-560 | A

EMERGENCY PUMPING TO CLEAN CATCHMENT

RL 845.00

PUMPING PIPELINE TO ED3

ACCESS ROAD

EXPOSED MINE WALL

PUMPING PIPELINE TO ED3

RL 845.00

EMERGENCY PUMPING TO CLEAN CATCHMENT

PROPOSED ACCESS ROAD

PUMPING PIPELINE TO ED3

RL 737.2

RL 845.00

ACCESS ROAD

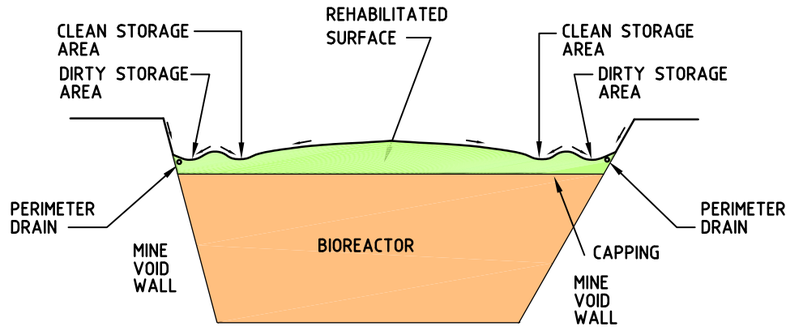
EXPOSED MINE WALL

PUMPING PIPELINE TO ED3

RL 845.00

830.0

820.0



SECTION 1

NOT TO SCALE

LEGEND

- CATCHMENT AREA
- EXISTING ROAD
- EXISTING ROAD TO BE TRIMMED & SEALED
- TABLE DRAIN/DIRECTION OF FLOW
- PERIMETER GRAVEL DRAIN ALONG WALL OF DISUSED MINE VOID
- FLOW LINE WITHIN MINE VOID
- PIPELINE & DIRECTION OF FLOW
- SUMP PUMP
- FINAL CONTOURS
- CONTAMINATED MINE VOID SURFACE WATER SUMP AREAS
- REHABILITATED SURFACE OF MINE VOID

NOT FOR CONSTRUCTION

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maunsell COLLEX ONYX WOODLAWN BIOREACTOR

50m 0 50 100 150m

SCALE AT A3

Woodlawn Bioreactor and Intermodal

Proposed Mine Void Surface Water Management
Early closure of Bioreactor - Option 1

Figure 3.15

PIPELINE TO ED3

RL 845.00

EMERGENCY PUMPING TO CLEAN CATCHMENT

ROAD

ACCESS

EXPOSED MINE WALL

RL 845.00

EMERGENCY PUMPING TO CLEAN CATCHMENT

PUMP/PIPELINE

RL 737.2

PIPELINE TO ED3

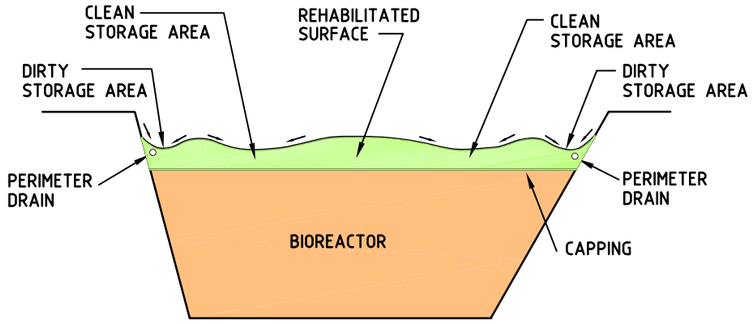
RL 845.00

ACCESS ROAD

EXPOSED MINE WALL

RL 845.00

830.0



SECTION 1

NOT TO SCALE

LEGEND

- CATCHMENT AREA
- EXISTING ROAD
- EXISTING ROAD TO BE TRIMMED & SEALED
- OPEN DRAIN/DIRECTION OF FLOW
- PERIMETER GRAVEL DRAIN WITHIN LAND FILLING AREA
- FLOW LINE WITHIN MINE VOID
- PIPELINE & DIRECTION OF FLOW
- SUMP PUMP
- FINAL CONTOURS
- CONTAMINATED MINE VOID SURFACE WATER SUMP AREAS
- REHABILITATED SURFACE OF MINE VOID

NOT FOR CONSTRUCTION

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COLLEX ONYX

WOODLAWN BIOREACTOR

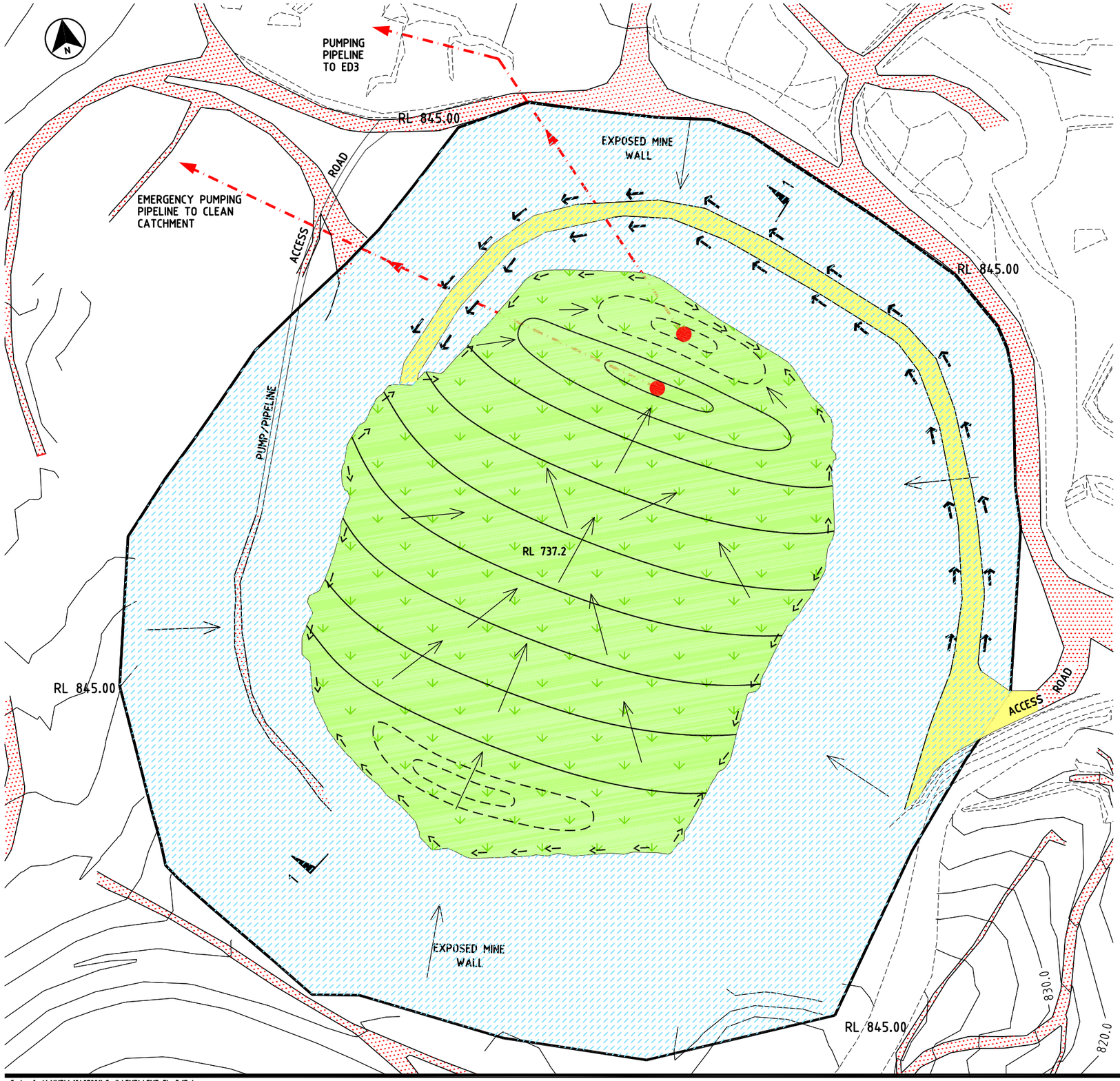
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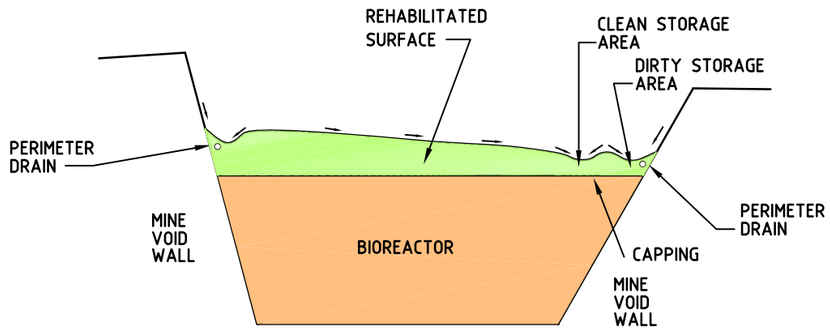
SCALE AT A3

Woodlawn Bioreactor and Intermodal

Proposed Mine Void Surface Water Management
Early closure of Bioreactor - Option 2

Figure 3.16





SECTION 1

NOT TO SCALE

LEGEND

- CATCHMENT AREA
- EXISTING ROAD
- EXISTING ROAD TO BE TRIMMED & SEALED
- TABLE DRAIN/DIRECTION OF FLOW
- PERIMETER GRAVEL DRAIN WITHIN LAND FILLING AREA
- FLOW LINE WITHIN MINE VOID
- PIPELINE & DIRECTION OF FLOW
- SUMP PUMP
- FINAL CONTOURS
- CONTAMINATED MINE VOID SURFACE WATER SUMP AREAS
- REHABILITATED SURFACE OF MINE VOID

NOT FOR CONSTRUCTION

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maunsell COLLEX ONYX WOODLAWN BIOREACTOR

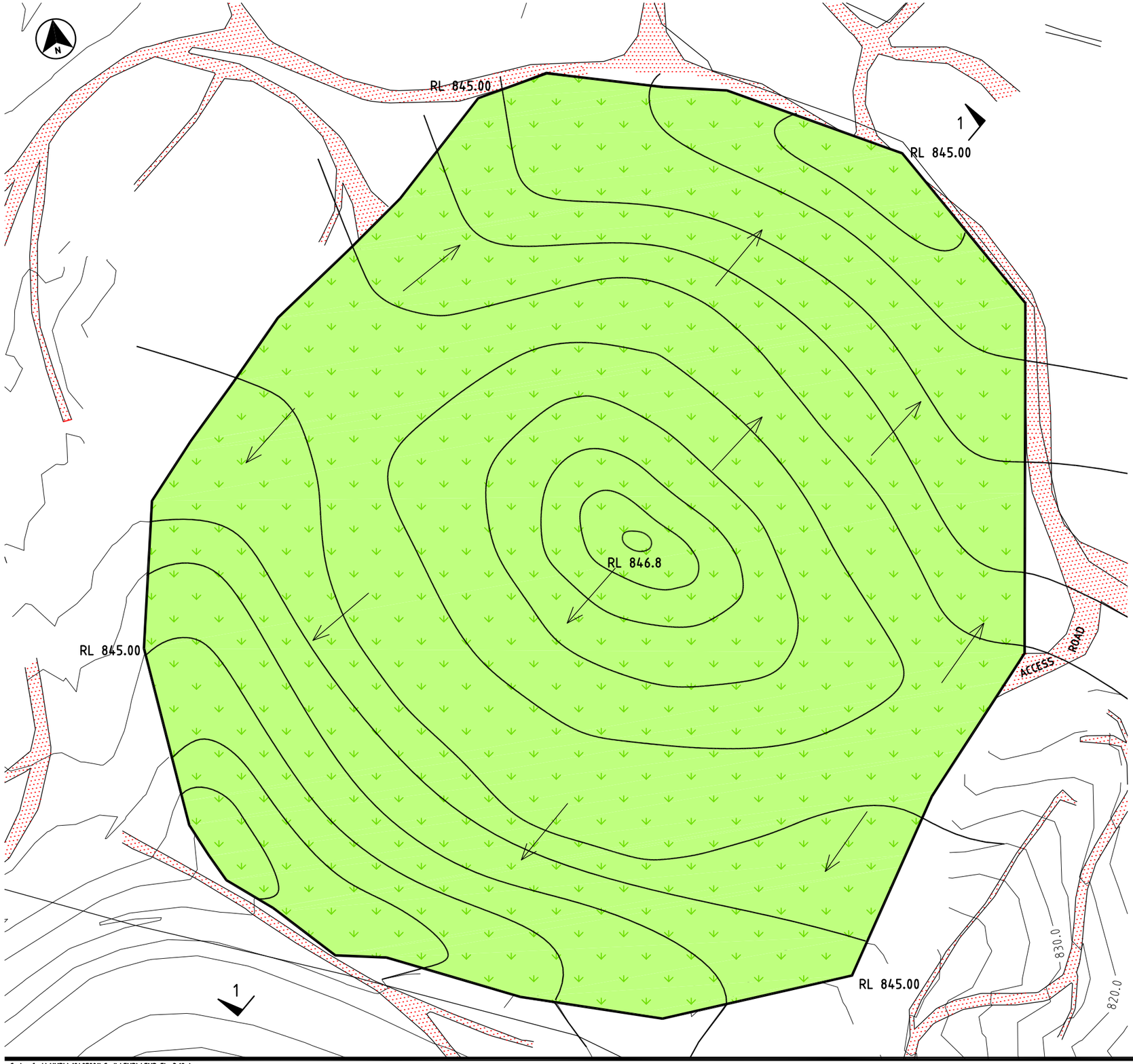
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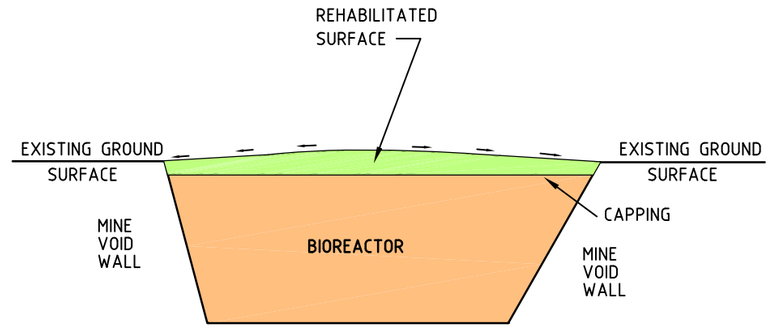
SCALE AT A3

Woodlawn Bioreactor and Intermodal

Proposed Mine Void Surface Water Management Early closure of Bioreactor - Option 3

Figure 3.17





SECTION 1
NOT TO SCALE

LEGEND

- EXISTING ROAD
- FLOW LINE ALONG SURFACE OF REHABILIATED AREA
- FINAL CONTOURS
- REHABILITATED SURFACE OF MINE VOID

NOT FOR CONSTRUCTION

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maunsell COLLEX ONYX WOODLAWN BIOREACTOR

50m 0 50 100 150m

SCALE AT A3

Woodlawn Bioreactor and Intermodal

Proposed Mine Void Surface Water Management
Completed Rehabilitated Bioreactor

Figure 3.18

WOLLONDILLY CATCHMENT

DRAINS TO CRISP'S CREEK

DRAIN TO CRISP'S CREEK

WASTE WATER TREATMENT SYSTEM

DRAINS TO CRISP'S CREEK

EVAPORATION DAM 2

EVAPORATION DAM 1

EVAPORATION DAM 3

EVAPORATION DAM 3

OFFICE AREA

DISUSED PLANT AREA

SEDIMENTATION DAM

DRAINS TO ALLIANOYANYIGA CREEK

REHABILITATED WEST RIDGE

MINE VOID

DRAINS TO CRISP'S CREEK

REHABILITATED DOLORITE STOCKPILE

RAW WATER DAM

WOLLONDILLY CATCHMENT

LAKE GEORGE CATCHMENT

REHABILITATED WASTE DUMP

WASTE ROCK DAM

DRAINS TO LAKE GEORGE

NORTH TAILINGS DAM

WEST TAILINGS DAM

SOUTH TAILINGS DAM

DRAINS TO LAKE GEORGE

GREAT DIVIDING RANGE

LAKE GEORGE CATCHMENT

DRAINS TO CRISP'S CREEK

LEGEND

- CLEAN WATER FLOW LINES
- CONTAMINATED WATER FLOW LINES
- PIPELINE
- HAUL ROAD
- REHABILITATED AREAS
- PROPOSED REHABILITED AREAS
- MINE WASTE WATER COLLECTION DAMS (NO OUTFLOW)
- CLEAN WATER COLLECTION DAMS
- PROPOSED WORKS

NOT FOR CONSTRUCTION

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Woodlawn Bioreactor and Intermodal

maunsell COLLEX ONYX WOODLAWN BIOREACTOR

75m 0 75 150 225 300 375m

SCALE 1:7500 AT A3

Proposed Surface Water Management at Woodlawn Mine Site
At Completion of Rehabilitation of Mine Areas

Figure 3.20