Orica Independent Monitoring Committee

Report for Botany Groundwater Community Liaison Committee on Task 3 from the combined IMC/CLC meeting of 8 May 2006

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Task 3
Prof Brian Priestly & Dr Mark Hibberd are to provide a paper for the CLC presenting their joint independent advice on the ground level concentrations of dioxins which would result from the concentrations detected at the GTP stack and the resulting human health risk. This advice is to include comment on how ground level concentrations and health risks would vary at distances from the GTP site.

Report
This issue has been addressed in large part by URS in a report to Steve Cornish at Orica dated 14 June 2006. In this report, URS provided an assessment of the impact of increased dioxin emissions on the conclusions from the original human health risk assessment (*Review of Groundwater Treatment Plant EIS HHRA – Increased Dioxin Emissions*, WCIE4298).

The IMC members Prof Brian Priestly and Dr Mark Hibberd agree with this assessment and provide the following response in relation to Task 3.

Ground-level concentrations
Ground-level concentrations of dioxin were modelled in the original Environmental Impact Statement for the Groundwater Treatment Plant (November 2004) prepared by URS. The ground-level concentrations of pollutants released from a stack depend on several factors:

i) The rate at which a pollutant is emitted from the stack (usually expressed in grams per second). All else remaining the same, a doubling of the rate at which a pollutant is emitted will double the ground-level concentration.
ii) The concentration of the pollutant in the stack gas (usually expressed as grams per cubic metre). All else being equal, halving the concentration of the pollutant in the stack gas will halve the ground level concentration.
iii) The height of the stack releasing the pollutant. All else being equal, an increase in stack height will reduce the maximum ground-level concentration.
iv) The temperature of the gas being released from the stack. All else being equal, the higher the temperature of the pollutant gas being released from the stack, the higher the plume will rise and the lower the maximum ground-level concentration will be.

Table 1 compares the stack operating conditions modelled in the original EIS with those of the stack as built. It lists the dioxin emission rates (in nanograms per hour) used in the EIS – both the normal emission rate of 2,500 ng/hr and the emission rate in upset conditions of 12,500 ng/hr.

Table 1 Stack operating conditions and dioxin emission rates

Parameter	Stack modelled in EIS	Stack as built
Stack height	20 m	34 m
Stack diameter	1.36 m	1.8 m
Gas temperature	67ºC	114ºC
Gas flow rate	12.8 Nm^3/s	33 Nm^3/s
Efflux velocity	15 m/s	18 m/s
Dioxin emission rate – normal operations	2,500 ng/hr	
Dioxin emission rate – measured March & April 2006		6,300 – 6,600 ng/hr
Dioxin emission rate – upset operating conditions	12,500 ng/hr	

Table 1 also lists the results from the stack testing in March and April 2006. In these tests, the concentrations at the EPA point 9 were measured and found to exceed the allowable concentration of 0.1 ng/m^3 (at 11% O_2). The dioxin emission rates corresponding to these measurements were computed from the dioxin concentrations and the volume flows measured in these test; they were 6,300 and 6,600 ng/hr. The table shows that these release rates are approximately 2.6 times higher than "normal operations" modelled in the EIS and approximately half those modelled as "upset operating conditions" in the EIS.

Referring to the points numbered (i) to (iv) above describing the effect of the changes to the stack operating conditions and/or the dioxin emission rates, we can make the following observations about their impact on ground-level concentrations.

i) *The rate at which a pollutant is emitted from the stack (usually expressed in grams per second).* All else being equal, the 2.6-fold increase in the dioxin emission rate to 6,300 – 6,600 ng/hr will increase the estimated ground-level concentrations by a factor of 2.6 compared to those predicted for a dioxin emission rate of 2,500 hg/hr.

ii) *The concentration of the pollutant in the stack gas (usually expressed as grams per cubic metre).* Compared to the stack emissions modelled for the EIS, the actual stack has a hot, fast air stream added to the exhaust gas (referred to as plume suppression air). This reduces the concentration of dioxin in the gas released from the stack by a factor of at least 2 (and possibly up to a factor of 3). All else being equal, this halving of the dioxin concentration will halve the estimated ground level concentration.

iii) *The height of the stack releasing the pollutant.* Compared to the stack height of 20 m modelled in the EIS, the actual height of the stack as built is 34 m. All else being equal, this increase in stack height will reduce the maximum ground-level concentration.

iv) *The temperature of the gas being released from the stack.* Compared to the stack gas temperature of 67ºC considered in the EIS, the actual stack gas temperature is 114ºC. This higher temperature increases plume rise and will reduce the predicted maximum ground-level concentration.

A sensitivity assessment carried out by Dr Mark Hibberd using TAPM (The Air Pollution Model) showed that the combined effect of points (ii), (iii), and (iv) is to reduce the maximum annual average ground-level concentration by a factor of 7. This is the same factor as reported in the URS report of 14 June 2006.

The maximum annual average ground-level concentration which would results from continuous dioxin emissions at a rate of 6,600 ng/m^3 (the maximum measured in the March and April 2006 stack testing) has been estimated to be 0.6 x 10^{-6} ng/m^3. This is based on the value of 1.54 x 10^{-6} ng/m^3 reported in the EIS for a normal dioxin emission rate with the original stack design, multiplied by 2.6 to account for the increased dioxin emission rate, and divided by 7 to account for the improved dispersion described in points (ii)–(iv) above.

Accurate prediction of the how the ground-level concentration reduces with distance from the GTP stack would require a detailed model study, which is beyond the scope of this note. However, based on the results reported in the EIS and a sensitivity assessment undertaken by Dr Mark Hibberd, the annual average ground-level concentrations would be expected to be less than 0.3 x 10^{-6} ng/m^3 at a distance of 1 km from the GTP stack, and generally less than 0.1 x 10^{-6} ng/m^3 at a distance of 2 km from the GTP stack.

Human Health Risk Assessment

The EIS human health risk assessment (HHRA) has been revised by URS (report of 14 June 2006) using the March-April 2006 dioxin emission rate as representative of normal operations. The risks have been calculated on the basis of a conservative assessment of potential exposure where it was assumed that all receptors (i.e. off-site residents and workers) are exposed to the maximum predicted concentrations and deposition rates.

Table 2. Summary of risk, as calculated by URS. The right-hand columns indicate the risk associated with the increased dioxin emissions measured in March-April 2006.

Receptors	Calculated Dioxin Risk (Threshold HI) Presented in HHRA from EIS – Normal Operations (Table 6.1)			Calculated Dioxin Risk (Threshold HI) Associated with Increased Dioxin Emissions – Normal Operations		
	Adults	**Children**	**Infants**	**Adults**	**Children**	**Infants**
Residents	0.001	0.003	0.09	0.003	0.008	0.2
Recreational	0.00008	0.0001	na	0.0002	0.0003	na
Workers (onsite)	0.0002	na	Na	0.0005	na	na
Target Risk	**1**	**1**	**1**	**1**	**1**	**1**

na – not assessed – refer to HHRA within the EIS for discussion

Table 2 lists the risks calculated by URS. The right-hand columns were calculated assuming that the increased dioxin emissions reported in March and April 2006 occurred continuously for the life of the project. The calculated risks are higher than those on the left-hand side (as presented in the EIS), but remain lower than the target threshold Hazard Index of 1.

The calculated risks associated with the increased dioxin emissions of March-April 2006 are also lower than the risks calculated in the EIS for the upset conditions with dioxin emissions of 12,500 ng/hr (five times higher than normal operation) for a period of 12 months. These risks were presented in Table 6.2 of the HHRA in the EIS. The relevant figures have been extracted from this table and are shown in Table 3 below.

Table 3. Extract from Table 6.2of the HHRA in the EIS.

	Increased Dioxin Emission (12,500 ng/hr) over 12 months as presented in EIS		
	Adults	**Children**	**Infants**
Calculated dioxin risk (Threshold HI) for residents	0.003	0.01	0.5
Target Risk Levels	**1**	**1**	**1**

Prof Brian Priestly and Dr Mark Hibberd agree with the URS assessment that "On the basis of these results, exposures by residents, recreational users of areas surrounding the BIP and workers (on and off site) are considered negligible and representative of acceptable risks to human health. This is consistent with the conclusions presented within the EIS."