APPENDIX G

Calculation of Distance for Concentration of COCs to Reach Acceptable Levels

The travel distance beyond which the concentration of each COC in groundwater beneath each of the areas is estimated to return to acceptable levels (i.e. screening levels) has been calculated. The calculation was carried out using the Domenico equation given below:

$$C_{ED} = C_o \exp\left\{\frac{x}{2a_x}\left[1 - \sqrt{1 + \frac{4\lambda a_x}{u}}\right]\right\} erf\left(\frac{S_y}{4\sqrt{a_y x}}\right) erf\left(\frac{S_z}{4\sqrt{a_z x}}\right)$$

where:

Rate of contaminant movement due to retardation $u = \dfrac{ki}{nR_c} = \dfrac{ki}{n + K_d\rho}$

Retardation factor $R_c = \left(1 + \dfrac{K_d\rho}{n}\right)$

and

C_{ED}	= concentration of contaminant at distance x (mg/l)
C_0	= initial contaminant concentration in groundwater (mg/l)
λ	= decay constant = 0.693/half life for degradation of contaminant (d)
a_x, a_y, a_z	= dispersion coefficient in three dimensions (m)
S_z, S_y	= width and mixing zone thickness of plume at source (saturated zone) (m)
K_d	= partition coefficient (l/kg)
ρ	= bulk density (g/cm^3)
n	= effective porosity
i	= hydraulic gradient
k	= hydraulic conductivity (m/d)
x	= distance to compliance point
erf	= error function
exp	= exponential

In each case the Solver function was used within excel to iteratively find the best solution, which was the distance at which the concentration reached acceptable levels. This distance was double checked by comparing the solution to the graph of concentration against distance presented within the Tier 3 groundwater worksheet of the P20 spreadsheet.

It should be noted that the distance is approximate as the solution incorporates the dispersivity in the x, y and z directions, which in turn is dependent on the travel distance to the receptor. In addition the equation does not include some of the processes important for reducing the mass of non degrading COC such as precipitation and sorption to iron, and therefore the distance at which concentration reduce to reach acceptable levels are usually overestimated.

The spreadsheets used to calculate distance are included in Appendix F

Calculation of Time for COC to Reach Blessington at Unacceptable Concentrations

At the time of production of this report the location of existing groundwater abstraction boreholes in Blessington were unknown. Therefore it was estimated that the distance from the up gradient boundary of Areas 1, 4 and 6 to existing groundwater abstraction boreholes in Blessington were 1800m, 1500m and 900m respectively.

The time taken for COC to reach Blessington were calculated iteratively using the time variant Domenico equation within the P20 Tier 3 groundwater spreadsheet. The existing P20 spreadsheets for each COC in each area were modified so that the distance to the receptor was the distance to Blessington. The time for the COC to reach Blessington at the concentrations at acceptable concentrations and above was found by manually varying the time within the spreadsheet until the concentration at the receptor reached the upper bound of acceptable levels.

This process was only completed for those COC which reached Blessington before their concentration returned to an acceptable level.

The spreadsheets used to calculate time are included in Appendix F