TECHNICAL REPLY

To The Response by the Ramble Community Development Committee to the Draft Environmental Impact Assessment of the Proposed Cemetery at Burnt Ground, Hanover.

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Preamble

This report was prepared by Environmental Impact Assessment (EIA) consultants the further to an in-depth review of written response to the Draft EIA, which was submitted to the National Environment and Planning Agency on May 2nd 2007. As far as possible all concerns that have been raised by the Ramble Community Development Committee in their response to the Draft EIA have been addressed. All figures have been placed at the back for ease of reference.

Issue 1. Over 50% of the Total Property Unsuitable for Burial

Bullets 1-2 (p6): In the original permit ~12,400 m^2 were designated for burials in Lot 48. **None of this permitted area falls inside of the exclusion zone demarcated in the EIA**. The EIA actually recommends that an additional 4175 m^2 of Lot 48 can be used for burial, including an area to the west of the proposed burial area, which was originally proposed for parking. No application had been made for Lot 47, and so none approved. However, the EIA actually recommended that a further 6000 m^2 (not previously included in the permit) was most suitable for burial. This includes a paved area on the top of the central hill (separating the burial area from the pond in the front) that is now being used as a parking lot. A simplified drawing is given as Figure 1, showing the area that has been excluded in blue. More than 22,400 m^2 is considered suitable for interment at the site when both lots are considered as a whole.

Bullets 3-4 (p6) Surface ponding of flood water is inconsistent with a hypothesis of well developed internal drainage.

Bullets 5-6 (p6). The pond on property and perched water on the western side of the property are likely to be impacted by surface run-off from the pig farm, and any monitoring of this area will reflect this run-off component. The recommendation to construct the bund was therefore mainly to be able to more effectively monitor the effect of the cemetery on the pond on the property by restricting the pig farm as a factor. The bund is NOT for containment as stated by the Community. It is quite improper to suppose that this relates to any concern about any pollutants leaving the site.

The EIA did not suggest a bund along three boundaries, only one parallel to the main western boundary, within the buffer zone and for the express purpose of preventing adjacent i.e. off-site and above material moving onto the cemetery site. The footprint of the bund can be accommodated on the western side of the property. The cost is of no concern to the RCDC.

In practical terms Lots 47 and 48 should be regarded as one development lot. There is enough space in Lot 48 available to accommodate the cemetery's needs if it was desired not to allow any development on Lot 47. Later in the response there is a question of whether the area to the east of

the pond is suitable for burials. All areas immediately around the front pond have been excluded (see Figure 1).

Bullet 7 (p6): *"Calculations concerning the lateral movement of the pollutant are presented in the report, but none for the vertical movement downwards which would take the pollutant in the groundwater"*. The 8 m 100-day travel time is along the hydraulic gradient. In the case of the unsaturated zone there is no hydraulic gradient, so the pathway can be taken as a combination vector (horizontal and vertical, or better horizontal flow pulled downward by gravity) with a significant horizontal component in view of the fine soils and other site factors. The modeled percolation rate of 8.1m per 100 days represents a **worst case** scenario, and suggests that it will be less than this.

The 100-day travel time has been found to be a useful measure for the time taken to allow for the decay of relevant bacterial populations, and/or the dispersion or de-naturing of viruses.

Based on the available data from the boreholes, the soils on the site are 10 m thickness on average, thus after an interment 2.5 m depth, there will be ~7.5 m of soil above the bedrock (Figure 2). If an interflow on a 5% gradient (2.86º) was applied to this, water would reach the soil-bedrock interface in about 150 m laterally, taking more than 5 years (based on the evaluated hydraulic conductivity). The model was developed for a presumed worst case scenario. In reality groundwater movement in the soil is likely to be more retarded than the model used.

The Community's borehole opposite the site indicated that groundwater was present in the bedrock at 16.2 m below ground level. The ground at this site is below the average topography of the proposed cemetery and it seems likely that the regional groundwater, if and where present, would be even lower than the 16 m. Even conservatively, this suggests that the vertical distance between the grave base and any possible groundwater table would be more than 13 m (Figure 2).

It would be extremely unlikely that water movement at the site would be vertical as there because of the clay content of the soil, and the likelihood that clay lenses will encourage lateral diffusion. The model assumed a curvilinear direction artificial interflow as this is most likely to represent the greatest possibility of water movement towards bedrock. Conservatively, a steep gradient was assumed for this interflow. The borehole data suggested that the soils were not getting wetter or looser with depth. Since water content for the samples of the top 3.6 m of the site are highly consistent (~ 27 – 31%), it was thought that contained soil water would not be any benefit to 'vertical' percolation. The site's soils show a considerable uniformity. Any water percolating through the unsaturated zone is predicted to encounter a chemically weathered soil-bedrock interface, from where it might ultimately enter a regional groundwater system (Figure 2). At the site, the regional system here is a confined system due to the overlying load of silty-clayey soils.

Issue 2. Benefit – Cost Analysis of Alternative Uses of the Land

The RCDC claims that the cemetery cannot increase the value of the land and "*would be akin to locating the Municipal garbage dump here"*. The consultant disagrees with the comparison of a dump to a development of a landscaped well-maintained cemetery with a church and condolence hall, where people choose to bury their loved ones, and visit their graves. The cemetery will generate income, and therefore can be reasonably expected to raise the value of the land. Cemeteries located elsewhere in Jamaica do not appear to negatively impact land values. Text Box 1 further explains the issue of land value.

Text Box 1 Cemetery Land Values

"Economic" factors in cemetery planning should indicate not only the issues related to the economic conditions of cemeteries, but also characters that may affect preference to buyers because of "economical" superiority. Attractions brought by them will have impact on the competition of cemeteries and again react the profit of the cemetery owner as a feedback.

1. Land value

Cemeteries can generate a high net return imputable to the land. If the supply and demand for cemetery land is favorable, we can expect an established cemetery to generate a higher net return than surrounding land.

Cemeteries are located in most types of use zones. Since they fulfill a social need, local governments find various means of bringing them within their zoning structures. These means include the issuance of conditional-use permits, the granting of variances, and special cemetery zoning. For this reason the value of a cemetery site may differ substantially from that of surrounding parcels (BOE, 1997).

Assessing cemetery land is a complex work for it may include appraisal work of land value, improvement value and depreciation etc. The improvements are relatively scarce and represent only a segment of an operation business. The three causes of depreciation--physical deterioration, functional obsolescence, and economic obsolescence are all applicable to cemetery property, but cemeteries generally suffer less from obsolescence than most other types of properties. Nevertheless, not like the value for residential, commercial or industrial land, the land value for burial purpose is always ignored by government and appraiser. Generally speaking, discriminative work should be done to profit-seeking cemeteries and non-profit cemeteries, and all three of the traditionally accepted appraisal approaches—the cost approach, the sales comparison approach and the income approach may be applied (BOE, 1997).

Excerpted from **Land for the Dead: Locating Urban Cemeteries, Case Study, Guilin, China. Zhang, Dian, 2004.** p14.

Page 9 of the response suggests that the "*earning opportunities*" was wrongly classified as 2nd after Residential Land use because of the low number of jobs. However, the criterion was not specifically dealing with the creation of jobs. Page 72 of the EIA indicates that there would be few jobs, but that there might be some patronage of local businesses by the increased traffic from Montego Bay, as well as a demand for goods or services associated with the functions that might be held at the condolence hall.

These opportunities are expected to be greater than those that may be created by agricultural expansion. The system used in the cost benefit analysis is a ranking rather than a scoring system. Both the no action and orange farm alternative ranked above the cemetery, and the animal farm option was ranked on par with the cemetery option.

The RCDC's request (page 9 para 4) for the developer to present audited accounts for the government to purchase the land are in appropriate, as it is the developer who is the legal land owner, and can develop the property as he chooses, within the laws of the land.

Issue 3. Site Stratigraphy (Soil Profile)

Borehole 1 was located at the highest elevation of the site. The unit described by Hill Betty as "*cream brown sandy gravel*" mentioned in the bottom of the borehole (at 9 m) appears to be a marly limestone. Borehole 2 is located on the middle area of the proposed burial area, and seemed to be dominated by colluvial deposits to a depth of ~10. 5 m, which were underlain by a marly limestone (*"very dense cream brown sandy gravel"*). Borehole 3 encountered perched water at 6 m (no sample taken) and generally consisted of thick colluvial deposits underlain at a depth of 12 m by *"very dense light brown gravel with some sand and silt"* which is interpreted to be a marly impure limestone.

Due to the differences in the descriptive terminologies, these boreholes cannot be directly compared to those of Ramble CDC. Based on samples taken, the consultants support the WRA view that this area is underlain by thick clayey (colluvial) deposits, referred to as the Chudleigh Clay Loam.

The perched water in Pit 7 had a low pH (4.2), as did the soils in general. The acidity of the soil was double-checked by the laboratory conducting the analysis and confirmed as accurate. The Chudleigh Clay Loam is reported to be very acid. Vinegar has an acidity of 2.4. Strongly acid soil conditions are regarded as a factor that promotes decomposition and biodegradation processes, and therefore add to the suitability of the site as a burial ground.

The WRA did not have the benefit of the intensive site investigation done for the EIA. They estimated the soil regolith to be clayey and 41 ft (12.5 m) thick. This estimate was very close to the actual field results (9 – 12 m of soils). The soils are clayey and very acidic and most likely to be correctly classified as the Chudleigh Clay Loam. Due to the thickness and other characteristics of the soil overburden in the unsaturated zone, the scientific investigation placed greater emphasis on the soil than the bedrock.

The rate of transmissivity in the phreatic zone (in bedrock) is simply not relevant because leachate from the base of the grave would take such a long time to reach the phreatic zone that it would be innocuous by the time it got there (see Figure 2). Deep, clayey and acid soils are ideal for retarding, and permitting reaction with, any deleterious solutes (organic, salt or metal), and permitting the decay and burn-out and de-naturing of bacterial populations or viruses.

Issue 4. The Missing Link

"*The cemetery is immediately above the gravitational system which is the Shettlewood Spring, and is therefore linked to it by virtue of the certainty that the aquifer exist at a depth of fifty (50) feet below the surface and will be polluted by chemicals and other water borne diseases arising from the decomposition of human remains, if this development is allowed to take place."*

There is no scientific evidence to support a direct flow pathway either surface or sub-surface between the cemetery site and the spring.

Figure 3 is a schematic cross section between the cemetery site and the spring, showing a possible hypothetical scenario for the underlying geological succession. The bedding is shown as horizontal because available structural information (published geological map) shows the strike of the beds to be parallel to the section between the site and the spring. If the northeast strike is correct, the beds are dipping gently (12 degrees) to the northwest (back into the page). Figure 4 shows line of section use. Although the cemetery site is located a higher elevation than the spring, the following must be considered in evaluating the validity of a straight line connection between the two:

- The area is subject to localized block faulting. These faults have possibly juxtaposed a less permeable lithology (lower Montpelier) against a low grade aquifer (Bonny Gate), resulting in the spring. The uplifted on the western side of the spring is likely to have been further dissected and subjected to later block faulting. The low relief area associated with the orange fields and the cemetery appears to be an uplifted block, where much the aquifer has been weathered away. Colluvial material from the surrounding younger limestone hills have contributed to the thick soil profile blanketing this basin.
- The straight line distance between the cemetery site and the spring is more than 2000 m.
- The surface drainage patterns support drainage toward the south and southeast from the site along the main road toward the Great River.
- The physiographic catchment to the northwest of the spring is the most logical recharge area for the spring.

- Grave leachate is predicted to become innocuous after a distance of ~8 m. Assuming a worst case scenario (that this distance is only the vertical plane, which it is not), the leachate would be innocuous before leaving the overlying soil burden which is more than 9 m thick. The depth to groundwater is therefore not a primary concern.

Therefore, we maintain the basic conclusion that: "*the pathway of any infiltrated water molecule at the site to the spring – even if it occurs - would be extremely tortuous and long. It will be longer than the 141 years above because it must move through the deep soils to the water table. The dilution which would occur when factoring in concomitant infiltration and percolation over the 2100 m distance would be extremely large so as to render the likelihood of tracing such a molecule pathway nonsensical*".

The RCDC indicated that "*majority know that the site for the Shettlewood cemetery (which is across from the proposed cemetery) is not being used because of the proximity to the water table).* The EIA consultants were not previously advised during their consultations with the RCDC that this was a proposed cemetery site, although another site was shown to them in Ramble. That site had been abandoned because it was in a clay lined depression and prone to ponding. No proposal for a cemetery at the site mentioned has been received by NEPA.

Issue 5. Socio-Economic Impact Survey

The socio-economic consultant denies that children were interviewed, asserts that all respondents were above the age of 18.

In respect of the comment that "*Dr Burrowes was disrespectful*" (page 17) reviewers are reminded that the entire meeting was tape-recorded, and both this and the verbatim report are still available for review.

A meeting was held subsequently to the February 2nd Meeting (March 19th), and all community stakeholders were given the opportunity to make presentations and to have their concerns documented. The purpose of a town meeting held before the EIA is completed would be to give an opportunity for community issues to be brought to the attention of the EIA consultant, for due consideration in the EIA process. The EIA consultant is satisfied that this objective was adequately satisfied. In addition, the community members could have contacted the consultant at any time during the process to share additional insights. All concerns submitted to the EIA consultant were thoroughly addressed in the EIA.

Issue 6. Proximity of Cemeteries

Page 19, indicates that Dr. Burrowes states that the "*Shettlewood Spring is closer in proximity to at least five other cemeteries in the area"*.

The Executive Summary indicates that "*there are at least five other cemeteries and family plots in similar or closer proximity to the Shettlewood Spring*". The consultants wish to clarify this statement. As indicated on page 77 of the EIA "*There a number of cemeteries operating within very similar conditions to this site in this area including Parish Council Cemetery in Chester Castle which is 2.6 km from the spring, the All Saints Cemetery in Chester Castle (3.7 km from the spring) and St. Mary's Cemetery (3.2 km from the spring), Parish Council Cemetery at Haughton Grove (4.5 km from the spring) and Mt Ward Grave Yard (4.9 km from the spring)*". Some of the cemeteries that are further away from the spring, actually have a more direct link to the Great River, as is the case of the All Saints Cemetery at Chester Castle, and the St. Mary's Cemetery in Montpelier.

Family plots are not uncommon in this area and are likely to occur in the recharge area of the spring. Burial practices in respect of body preparation for family plots are identical to those observed in communal burial places, as reported by Delapenha, who has undertaken family-plot burials in the Copse area and other sites nearer to the spring.

Issue 7. Ignored Water Sample

Page 20 "*Dr. Burrowes has totally ignored the water sample provided by a member of the RCDC at the February* (sic March) *18th 2007 meeting"*.

The source of the sample could not be independently verified. Also, the sample had not been kept at a suitable temperature to restrict microbial growth, and therefore could not be expected to yield reliable results.

Issue 8. Field Percolation Testing

The study did not use the percolation rate provided by Hill Betty Engineers, as there was reason to believe that data was not valid. Further, the soil percolation rates measured by Dr. Dent are more relevant to the calculations because of the thickness of the overlying soil burden. Hill Betty Engineers Ltd. and the Mines and Geology Laboratory undertook ***dry*** sieving of the soil samples submitted for grain size analysis and erroneously reported dry aggregated soil peds (clay clumps) as sands and gravels. These samples are available for inspection.

Issue 9. The Need for Burial Vaults

It could be expected that under the extreme seismic shaking possible in the district that any vault structures may crack to some extent; when this happens they will no longer contain any body decomposition fluids. However, using vaults or concrete lined bases in the first instance is a questionable activity. There is no compulsion from any aspect of cemetery management to require this. The site soils will in most instances accommodate open hole excavation as they seem to be quite competent. Enclosing remains in vaults can be unsatisfactory as it delays interaction of the decomposition fluids with the soil, thus permitting storage and concentration of deleterious compounds and providing food for bacterial nourishment and possibly resources for virus survival. Likewise, plastic coffins/caskets and plastic liners should not be allowed.

The consultants therefore maintain their recommendation that direct earth contact is most suitable for burial in this environment due to the thickness and clay content of the soil. Filling the base with gravel and charcoal may be considered. This is expected to aid in the infiltration process at the grave base by facilitating an even distribution of fluids into the soil and also possibly retarding bacteria by creation of bio-films.

The acceleration due to gravity (gal) is not reported in “gallons”.

Issue 10. The level of Risk and the Use of Formaldehyde

(pages 24-26)

There is the suggestion on page 25 that each of 2040 interments will require 10 gallons of “pollutant” and that this will produce a “*concentration of a viscous liquid akin to oil but chemically reactive with human flesh and internal organs”*. This is a false statement as it will take 10 – 20 years to inter 2040 bodies assuming a rate of interment of 100 and 200 burials per year. There is no expectation that discrete and temporally-distributed loadings of formaldehyde would remain for that time. The figure of 10 gallons is highly unsatisfactory for examining any pollutant load of an individual body. Since bodies are interred at different times and decay differentially across the cemetery it is extremely unlikely that there will be 20000 gallons of decay fluids on site at any time.

Delapenha uses a maximum of 0.7 liters of embalming fluid (for a 91 kg corpse) with 36% formaldehyde in it. The embalming fluid is diluted in 7.7 liters of water before it is injected, displacing the blood. The quantity actually taken in by the body would be the actual blood volume, which is ~1/11th the weight (5 liters and not the 37.8 liter equivalent of 10 gallons). This gives a 4% final concentration at most. The grave fluids are likely to consist mainly of water and organic compounds with a relatively minor amount of formaldehyde (methanal).

Open gut embalming (visceral) is only done when is there has been an autopsy which has disrupted the arterial circuit. In which case, the organs are soaked in a bucket of the diluted fluid for 30 minutes, then replaced in the cavity with the least possible fluid as excess will cause a leakage problem in the casket. It is reported that sometimes a visceral embalming may be needed if the body is required to go overseas, in which case it would not be buried at the cemetery. Soaking a body in fluid is actually not even preferred because this could produce leakage from the coffin during the service.

Issue 11. Monitoring Programme

(page 27)

An extensive baseline water quality monitoring programme was implemented for this project. The programme was designed to characterize the water quality profiles in the spring, Great River (nearest point to the cemetery) and water bodies in proximity to the site. Formaldehyde was not included in the baseline monitoring as interment at the site had not commenced. Section 7.4.2. (page 83) of the EIA presents a (post-implementation) monitoring plan for the permanent pond located on the property:

Monitoring Regime	**Stipulation**
Location	One station at a minimum depth of 1 m.
Frequency	Quarterly
Replicates per events	Three
Parameters	• pH, conductivity and TDS • BOD, sulphate, total organic nitrogen, calcium phosphorus, potassium, sodium, chlorine and **formaldehyde**. • Screening* (presence/absence) for E. *faecalis, Pseudomonas, Clostridium,* and *Salmonella* spp

*The consultants wish to modify these microbial parameters to *E. Coli*, *Pseudomonas aeruginosa*, *Clostridium perfringens,* and *Salmonella* spp.

Figure 1 Burial Space at Burnt Ground Cemetery Site

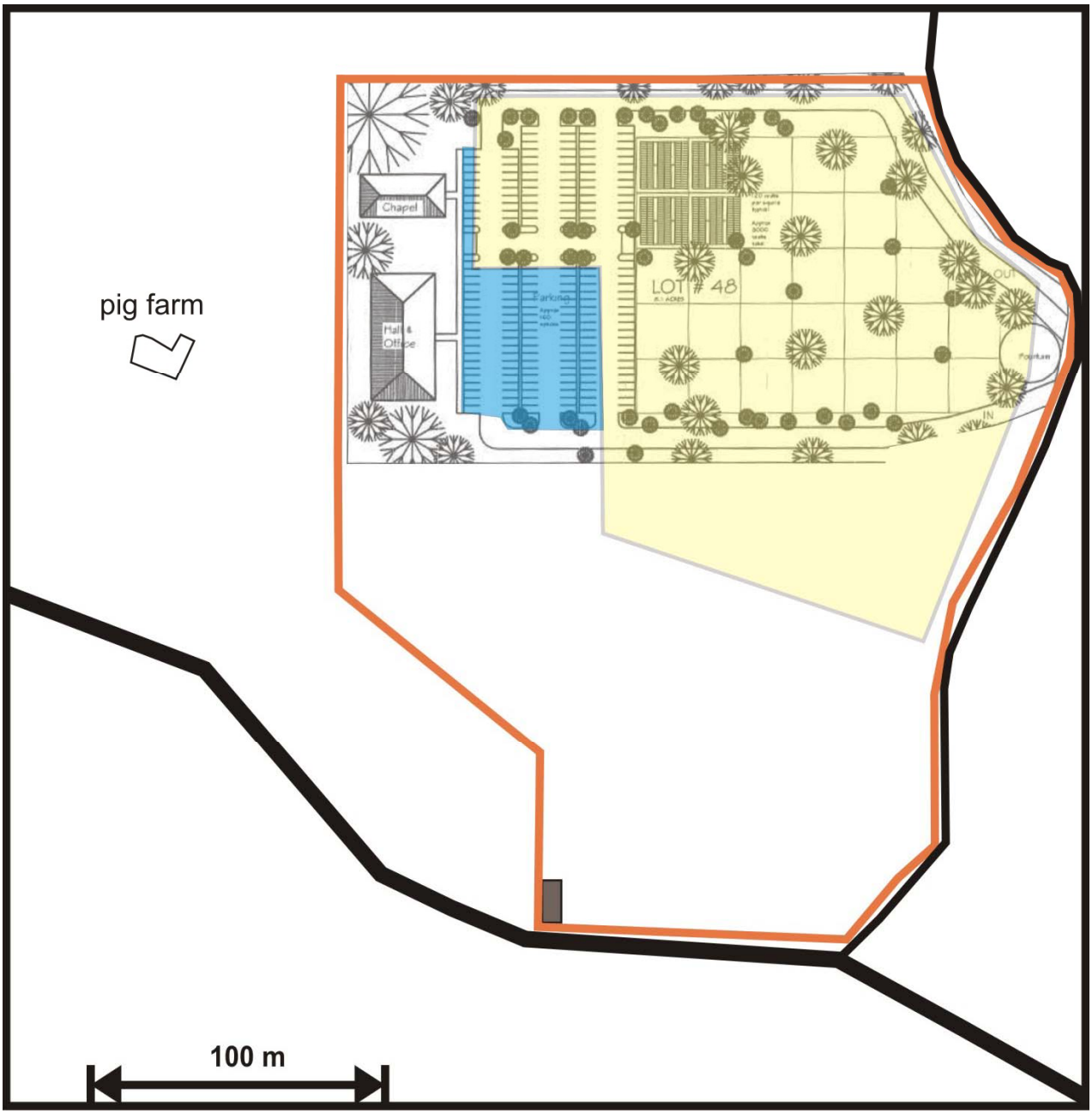
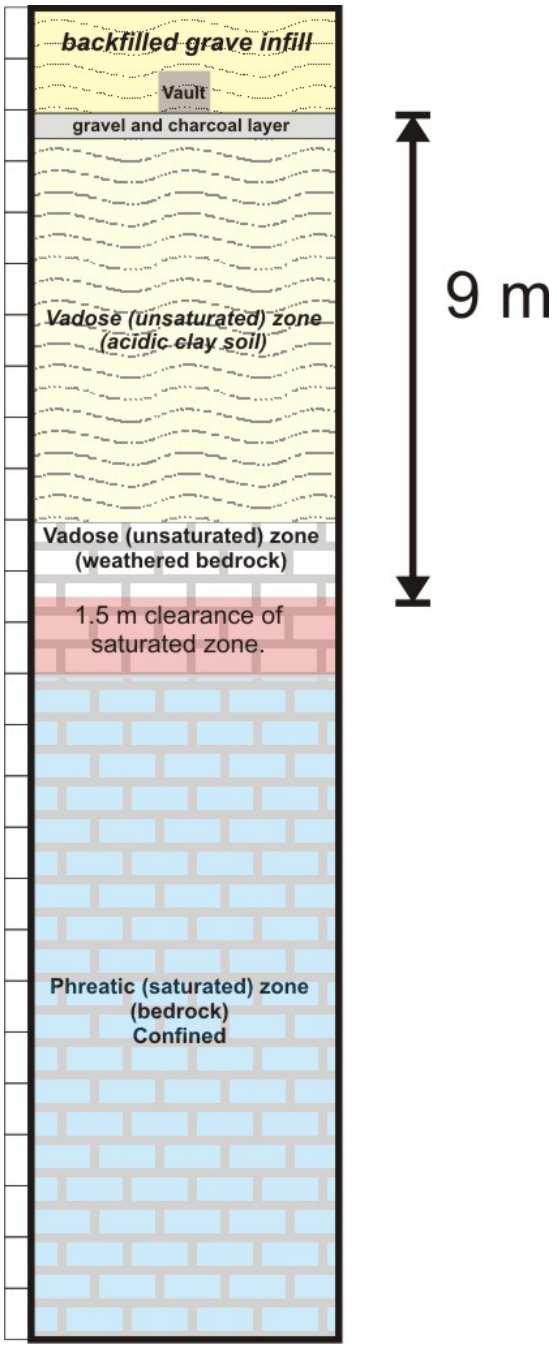


Figure 2 Schematic Profile



The diagram on the left shows is a scaled schematic showing the relative distance of the base of the grave, and thicknesses of the expected underlying material. The scale on the left of the column is in meters. There is a 9 m clearance between the base of the vault and the saturated zone (assumed to be at 16 m below ground level).

However, the diagram below shows the curvilinear pathway between the base of a grave and the estimated phreatic zone (using the 16 m suggested by the RCDC). The 100-day extent is also show on the diagram above.

Assuming an unlikely direct path between the cemetery and the spring, the 150-m point of interception with the surface of the phreatic zone (which will take ~5 years to reach) is still at least 1,750 m away from the spring. Thus there would be even further dilution and breakdown (or assimilation) of leachate compounds within a confined aquifer system.

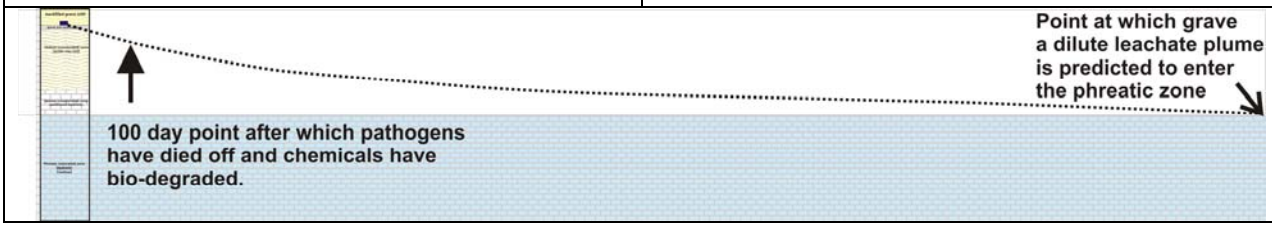
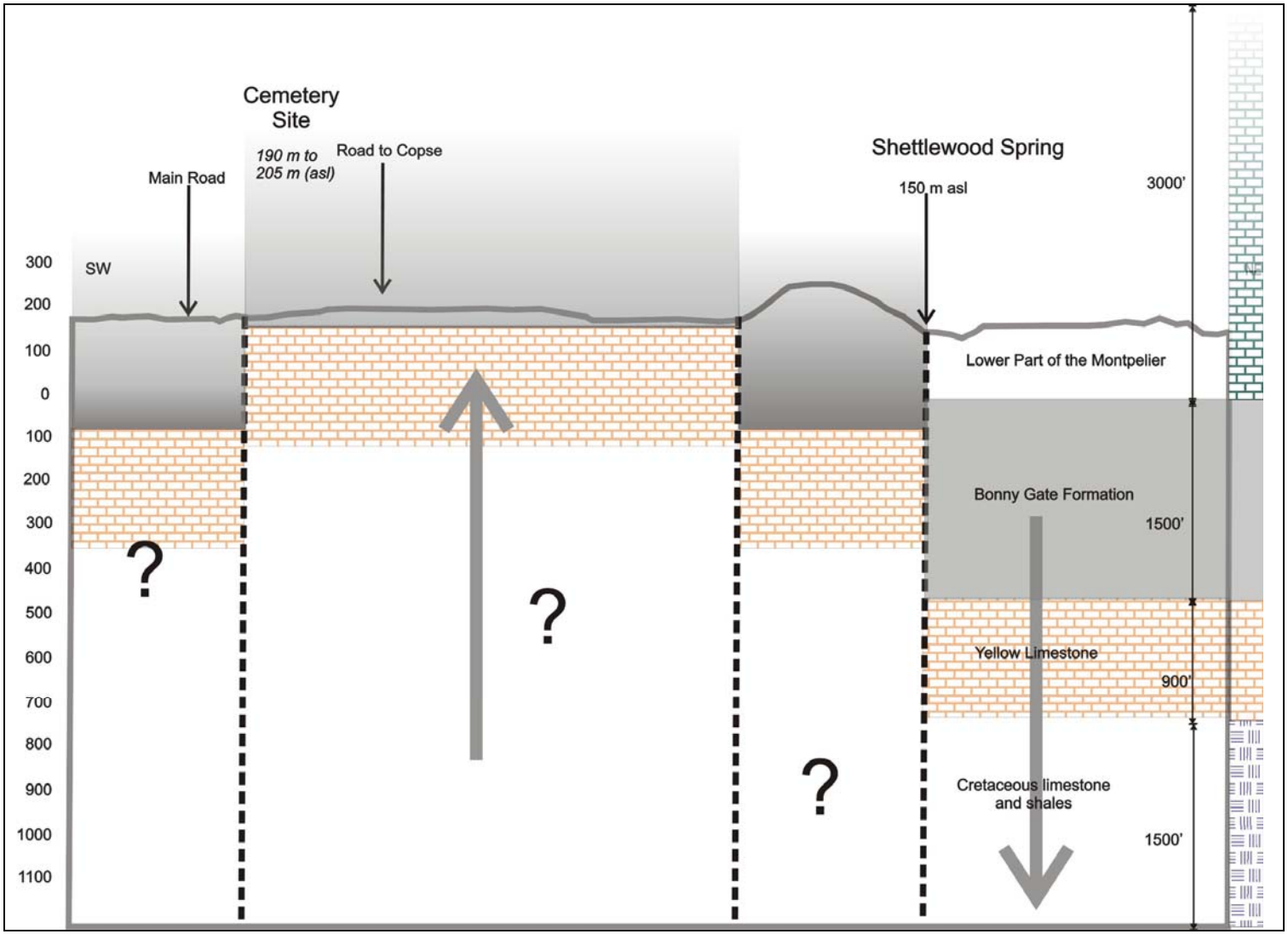


Figure 3 Schematic Cross Section between the Cemetery Site and the Spring



(see Figure 4 for the map showing section line)

It must be cautioned that this visual interpretation is only intended to represent a possible scenario, and is not being submitted as the actual geology of the area. It is included at this time as a means of representing an alternative scenario to the "*gravitational system*" being posited by the Ramble CDC.

Figure 4 Geological Map (Site to Spring)