PRELIMINARY HAZARD RANKING SYSTEM EVALUATION
FOR THE
BATTLEFIELD GOLF CLUB SITE
CITY OF CHESAPEAKE, VA
EPA ID No. VAN000306614
April 21, 2010

A preliminary Hazard Ranking System (HRS) score was calculated for the Battlefield Golf Club site as specified in the final rule of the HRS. The preliminary HRS score calculated for the site is documented on the attached HRS scoresheets.

Overall Score

The score calculated for this site is 16.27. This score is based on an observed release to the groundwater migration pathway and the potential to release to the surface water migration pathway. The soil exposure migration pathway (S_{se}) and the air migration pathway (S_{air}) were not scored because they would not significantly affect the overall score. The soil exposure pathway does not contribute significantly to the site score because no release to surface soil has been documented. The air migration pathway does not significantly affect the site score because a release to air has not been documented from the site.

Pathway Scores

S_{gw} = 32.47
S_{sw} = 1.67
S_{se} = Not Scored
S_{air} = Not Scored

OVERALL SCORE = 16.27

Source and Waste Characteristics

The source used to calculate the hazardous waste quantity was the approximately 1.5 million cubic yards of fly ash placed on the site. Comparison of background soil sample concentrations with fly ash sample results indicate that arsenic, barium, beryllium, boron, cadmium, chromium,

cobalt, copper, iron, magnesium, manganese, mercury, nickel, selenium and vanadium concentrations were detected in fly ash samples significantly above the average background soil concentrations.

Groundwater Migration Pathway

A review of the 2008 Tetra Tech groundwater data documents levels of arsenic (up to 21.5 µg/L), boron (up to 146 µg/L, estimated high), chromium (up to 2.7 µg/L), copper (up to 18.5 µg/L), lead (up to1.6 µg/L) and vanadium (up to 17.3 µg/L) in samples collected from shallow monitoring wells significantly above the levels detected in the background well. The sample from the background well was not collected by Tetra Tech, nor was it collected during the same sampling event as the release wells. It was not analyzed under EPA's Contract Laboratory Program; and consequently, comparison between this background well and the release wells is not considered to be adequate documentation for an observed release to groundwater. Although background groundwater levels of these metals have not been satisfactorily documented, in order to calculate a conservative score, an observed release to groundwater value of 550 was used and entered on line 1 of the groundwater scoresheet. To document this observed release score, additional background samples should be collected to satisfactorily determine background levels of these compounds in groundwater.

The waste characteristics factor value for the groundwater migration pathway is calculated using the product of the hazardous waste quantity (HWQ) factor value (10,000) and the highest toxicity/mobility value for the hazardous substances detected in the fly ash (10,000). This would result in a waste characteristics product of 1×10^8 and an overall waste characteristics value of 100 from Table 2-7 of the HRS Final Rule.

As discussed in detail in Section 4.7, Groundwater Conclusions of the SI report for the Battlefield Golf Club site, a release of fly ash constituents to nearby residential wells is not documented; therefore, no Level I or II residential wells are assigned. The nearest drinking water well is located less than 0.25 mile from the source. The nearest well value of 20 is obtained from Table 3-11 of the HRS Final Rule. That value is entered on line 7 of the groundwater pathway migration scoresheet. The population within the 4-mile target distance

limit (TDL) is assigned a potential contamination value based on the distance-weighted population values assigned for "other than karst aquifer" and summarized in the table 1 below.

TABLE 1
DRINKING WATER WELLS WITHIN 4 MILES OF SITE
SURFICIAL-YORKTOWN AQUIFER

Radial Distance from Site (miles)	Number of Residential Wells	Population Served by Residential Wells*	Number of Public Supply Wells	Population Served by Public Supply Wells	Total Population Served by Groundwater Sources	Dilution-Weighted Population (HRS Final Rule, Table 3-12)
0.00 to 0.25	52	145	0	0	145	164
0.25 to 0.50	14	39	0	0	39	33
0.50 to 1.0	22	61	0	0	61	17
1.0 to 2.0	20	56	0	0	56	10
2.0 to 3.0	21	59	1	50	109	21
3.0 to 4.0	115	321	2	75	396	42
TOTAL						**287**

Notes: * = Based on average population per household for Chesapeake County, VA of 2.79 persons.

The potential population is the sum of the distance weighted population divided by 10 or 28.7. This value is entered in line 8c of the groundwater scoresheet. The target population score is the potential population score of 28.7 plus the nearest well score of 20 for a total of 48.7 and is entered into line 11(b) of the groundwater scoresheet.

The overall ground water score is calculated by multiplying the observed release value (550), the waste characteristics value (100) and the target population value (48.7). This number is then divided by 82,500 for a groundwater migration pathway score of 32.5 (line 13 of the groundwater migration pathway scoresheet and HRS Final Rule).

Surface Water Migration Pathway

Surface water runoff from the Battlefield Golf Club site flows to one of the on-site ponds or to a perennial unnamed tributary to Pocaty River. The ponds do not have an outfall. The unnamed tributary flows along the southern boundary of the site in an easterly direction, continues to the northeast, eventually discharging into the Pocaty River 3 miles from the site. The Pocaty River flows east approximately 7.1 miles until discharging into the North Landing River. The 15-mile HRS downstream target distance limit (TDL) is completed within North Landing River. The 15-mile TDL is shown in Appendix A, Figure 11 of the 2009 Site Inspection report for the site. The surface water migration pathway includes three components: drinking water, human food chain, and sensitive environments.

The potential to release to the unnamed tributary by overland flow is evaluated. The 2008 and 2009 samples collected by Tetra Tech were used to determine if an observed release has occurred to the unnamed perennial tributary (see Tables 8 through 11 in Appendix A of SI Report). An observed release to the surface water migration pathway cannot be documented; and therefore, the potential to release to surface water is evaluated. There is no maintained engineered cover or surface water run-on or runoff control system over the area where the fly ash was placed; therefore, a containment value of 10 is assigned from Table 4-2 of the HRS Final Rule and is entered in line 2a of the scoresheet. The drainage area for the fly ash is estimated to be between 50 and 250 acres. The drainage area value of 2 is obtained from Table 4-3 of the HRS Final Rule using a drainage area of 50 to 250 acres. The soil type at the site is coarse-textured soils with high infiltration rates. The 2-year 24-hours rainfall for the site is 3.5 inches.

Using soils with high infiltration rates and the 2-year 24-hour rainfall value of 3.5 inches, a rainfall/runoff value of 3 is assigned using Table 4-5 of the HRS Final Rule. Using the drainage area value of 2 and rainfall/runoff value of 3, a runoff factor value of 1 is obtained from Table 4-6 of the HRS Final Rule and is entered on line 2b of the scoresheet. The distance to surface water from the fly ash is less than 100 feet. Using Table 4-7 of the HRS Final Rule, an assigned value of 25 is obtained for the distance to surface water factor value and is entered in line 2c of the scoresheet. The potential to release by overland flow value is obtained from the sum of the runoff factor value (1) and distance to surface water value (25) multiplied by the containment value (10) giving a product of 260 (HRS Final Rule).

Drinking Water Threat

There is no threat to any drinking water intakes. No drinking water intakes are located along the 15-mile downstream TDL. The waste characteristics value for the drinking water threat is obtained by determining the HWQ value for the fly ash from the HRS Final Rule Table 2-5. The fly ash includes 1.5 million cubic yards of waste. This quantity is divided by 2.5 (source type - other) yielding a value of 600,000 for the HWQ value (EPA 1990). The HWQ value of 600,000 is used to assign a HWQ factor value from Table 2-6 of the HRS Final Rule. The HWQ factor value is 10,000, which is entered on line 7. The HWQ value (10,000) is multiplied by the highest toxicity/persistence value for the hazardous substances associated with the fly ash, which is 10,000. This product (5×10^8) is used to obtain a waste characteristics factor value of 100 from HRS Final Rule Table 2-7. This value is entered on line 8 of the scoresheet.

The North Landing River is a designated recreational area, a resource identified in Section 4.1.2.3.3 of the HRS Final Rule. A value of 5 is assigned to the resource and is entered on line 11 of the surface water migration pathway, drinking water threat scoresheet.

Human Food Chain Threat

The human food chain component includes fisheries within Pocaty and North Landing River. The on-site ponds are not used for fishing. The waste characteristics value for the human food chain is obtained by determined the HWQ value for the fly ash from the HRS Final Rule Table

2-5. The fly ash includes 1.5 million cubic yards of waste. This quantity is divided by 2.5 (source type other) yielding a value of 600,000 for the HWQ value (EPA 1990). The HWQ value of 600,000 is used to assign a HWQ factor value from Table 2-6 of the HRS Final Rule. The HWQ factor value is 10,000, which is entered on line 16. The HWQ value (10,000) is multiplied by the highest toxicity/persistence/bioaccumulation value for the hazardous substances associated with the fly ash, which is 5,000,000. This product (5×10^{10}) is used to obtain a waste characteristics factor value of 320 from HRS Final Rule Table 2-7. This value is entered on line 17 of the scoresheet.

A fishery is located within the TDL. An observed release to the fishery cannot be documented. A food chain individual value of 0.02 is assigned using Section 4.1.3.3.1 of the HRS Final Rule which indicates that if no observed release is documented to fishery, the value of 20 is multiplied by the dilution weight of 0.001 for the Pocaty River (HRS Final Rule, Table 4-13). (The lowest dilution weight for fisheries within the TDL is used to assign the dilution weight). This value (0.02) is entered in line 18 of the scoresheet. The human food chain production value is obtained from Table 4-18 of the HRS Final Rule. The human food chain production for surface water within the TDL is not documented. Therefore, the value selected from Table 4-18 is 0.03, using a human food chain production value of greater than zero pounds. That value, 0.03, is divided by 10 in accordance with Section 4.1.3.3.2.3 of the HRS Final Rule, giving a value of 0.003 which is entered on line 19c of the scoresheet.

Environmental Threat

The waste characteristics value for sensitive environments is obtained by multiplying the HWQ factor value (10,000) by the highest ecosystem toxicity/persistence/bioaccumulation value for the hazardous substances associated with the fly ash, which is 5,000,000. This product (5×10^{10}) is used to obtain a waste characteristics factor value of 320 from Table 2-7 of the HRS Final Rule. This value is entered on line 25 of the scoresheet.

Sensitive environments within the TDL include approximately 23 miles of wetland frontage (sensitive environment value of 500) and habitat likely to be used by the State Threatened species *Falco peregrinus* (Peregrine Falcon) (sensitive environment value of 50) and Federally

Threatened *Haliaeetus leucocephalus* (Bald Eagle) (sensitive environment value of 75). The total sensitive environment value is 675. That value is multiplied by the dilution weighted value of 0.001 for a large river (Pocaty River) giving a value of 0.675 (HRS Final Rule, Table 4-13). That product (0.675) is then divided by 10 giving a value of 0.0675, which is entered on line 26c (HRS Final Rule, Section 4.1.4.3.1.3).

The overall surface water score is calculated by summing the scores for each surface water component – drinking water (1.58), human food chain (0.023), and environmental (0.071) for a total of 1.67.

Overall HRS Score

The overall HRS score is calculated by summing the squares of the individual pathway scores, dividing the result by 4 and then taking the square root of that number for the final score. In this case, the groundwater pathway $(32.5)^2$ plus the surface water pathway $(1.67)^2$ divided by 4 equals 264.76. The square root of that number is 16.27, which is the final score for the site.

Conclusions

The site score of 16.27 reflects the large waste quantity (1.5 million cubic yards) placed on the site resulting in a very high waste characteristics value assigned for the groundwater and surface water migration pathways. Although not satisfactorily documented with existing data, to calculate a conservative score, an observed release value of 550 was used for the groundwater pathway. As discussed earlier, in order to satisfactorily document this score additional background analytical data would need to be acquired. The purpose of this preliminary HRS score was to calculate a very conservative HRS score to determine if, in the presence of better background data, the site would score above the necessary 28.5 to warrant possible inclusion on the National Priorities List (NPL). The results of the preliminary HRS show that the site would not achieve this score even if better background data could be obtained to adequately document the observed release.

It should be further noted that lead levels above the EPA action level of 15µg/L were detected in several home wells sampled in 2008 and 2009. The presence of lead in these wells is not

attributable to the fly ash placed on the site. Lead has been detected at very low levels above the detection limit of 1.0µg/L in three monitoring wells surrounding the site (in MW-2 at 1.3µg/L, MW-6A at 1.1µg/L, and MW-14 at 1.6µg/L). None of the other on-site monitoring well samples had lead levels reported above 1.0µg/L. Further evidence that the lead issue detected in these wells is not due to migration from the fly ash is based on a review of the residential well analytical data collected by Stokes in 2001. This data indicated the presence of lead in 20 of the 40 residential well samples collected in 2001. These samples were collected prior to the placement of the fly ash at the site. The lead concentrations reported in these residential wells in 2001 ranged from 1 to 10µg/L. In addition, lead was not detected significantly above background soil samples in fly ash samples collected from the site. EPA's removal section continues to offer to collect samples of these wells on a quarterly basis. It should be further noted that the City of Chesapeake is moving forward with providing all residents in the vicinity of the site with public drinking water; thereby eliminating any future human health risk that may be posed by the site.

ATTACHMENT 1

HRS SCORESHEETS

****** SUMMARY SCORESHEET ******
****** FOR COMPUTING PROJECTED HRS SCORE ******

Site Name: Battlefield Golf Club — Region: 3

City, County, State: City of Chesapeake, VA — Evaluator: Donna Davies, Tetra Tech

EPA ID#: VAN000306614 — Date: April 21, 2010

Lat/Long: 36.68982; 76.17790

	S pathway	S^2 pathway
Ground Water Migration Pathway Score (S_{gw})	32.5	1056.25
Surface Water Migration Pathway Score (S_{sw})	1.67	2.79
Soil Exposure Pathway Score (S_s)		
Air Migration Score (S_a)		
$S^2_{gw} + S^2_{sw} + S^2_s + S^2_a$		1059.04
$(S^2_{gw} + S^2_{sw} + S^2_s + S^2_a)/4$		264.76
$\sqrt{(S^2_{gw} + S^2_{sw} + S^2_s + S^2_a)/4}$		16.27

✳ Pathways not assigned a score (explain):

Since the air and soil exposure pathways would provide negligible scores, these pathways were not evaluated.

TABLE 3-1 --GROUND WATER MIGRATION PATHWAY SCORESHEET

Factor categories and factors	Maximum Value	Value Assigned	
Aquifer Evaluated: Surficial - Yorktown			
Likelihood of Release to an Aquifer:			
1. Observed Release	550	550	
2. Potential to Release:			
2a. Containment	10		
2b. Net Precipitation	10		
2c. Depth to Aquifer	5		
2d. Travel Time	35		
2e. Potential to Release [lines 2a(2b + 2c + 2d)]	500		
3. Likelihood of Release (higher of lines 1 and 2e)	550		550
Waste Characteristics:			
4. Toxicity/Mobility	(a)	10000	
5. Hazardous Waste Quantity	(a)	10000	
6. Waste Characteristics	100		100
Targets:			
7. Nearest Well	50	20	
8. Population:			
8a. Level I Concentrations	(b)		
8b. Level II Concentrations	(b)	0	
8c. Potential Contamination	(b)	28.7	
8d. Population (lines 8a + 8b + 8c)	(b)		28.7
9. Resources	5	0	
10. Wellhead Protection Area	20	0	
11. Targets (lines 7 + 8d + 9 + 10)	(b)		48.7
Ground Water Migration Score for an Aquifer:			
12. Aquifer Score [(lines 3 x 6 x 11)/82,500][c]	100		32.5
Ground Water Migration Pathway Score:			
13. Pathway Score (S_{gw}), (highest value from line 12 for all aquifers evaluated)[c]	100		32.5

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c] Do not round to nearest integer

TABLE 4-1 --SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET

Factor categories and factors	Maximum Value	Value Assigned	
Watershed Evaluated: Pocaty River/North Landing River			
Drinking Water Threat			
Likelihood of Release:			
1. Observed Release	550	0	
2. Potential to Release by Overland Flow:			
2a. Containment	10	10	
2b. Runoff	25	1	
2c. Distance to Surface Water	25	25	
2d. Potential to Release by Overland Flow [lines 2a(2b + 2c)]	500	260	
3.Potential to Release by Flood:			
3a. Containment (Flood)	10	0	
3b. Flood Frequency	50		
3c. Potential to Release by Flood (lines 3a x 3b)	500	0	
4. Potential to Release (lines 2d + 3c, subject to a maximum of 500)	500	260	
5. Likelihood of Release (higher of lines 1 and 4)	550		260
Waste Characteristics:			
6. Toxicity/Persistence	(a)	10000	
7. Hazardous Waste Quantity	(a)	10000	
8. Waste Characteristics	100		100
Targets:			
9. Nearest Intake	50	0	
10. Population:			
10a. Level I Concentrations	(b)	0	
10b. Level II Concentrations	(b)	0	
10c. Potential Contamination	(b)	0	
10d. Population (lines 10a + 10b + 10c)	(b)	0	
11. Resources	5	5	
12. Targets (lines 9 + 10d + 11)	(b)		5
Drinking Water Threat Score:			
13. Drinking Water Threat Score [(lines 5x8x12)/82,500, subject to a max of 100]	100		1.58
Human Food Chain Threat			
Likelihood of Release:			
14. Likelihood of Release (same value as line 5)	550		260
Waste Characteristics:			
15. Toxicity/Persistence/Bioaccumulation	(a)	5000000	
16. Hazardous Waste Quantity	(a)	10000	
17. Waste Characteristics	1000		320
Targets:			
18. Food Chain Individual	50	0.02	
19. Population			
19a. Level I Concentration	(b)		
19b. Level II Concentration	(b)		
19c. Potential Human Food Chain Contamination	(b)	0.003	
19d. Population (lines 19a + 19b + 19c)	(b)	0.003	
20. Targets (lines 18 + 19d)	(b)		0.023
Human Food Chain Threat Score:			
21. Human Food Chain Threat Score [(lines 14x17x20)/82500, subject to max of 100]	100		0.023

Environmental Threat			
Likelihood of Release:			
22. Likelihood of Release (same value as line 5)	550		260
Waste Characteristics:			
23. Ecosystem Toxicity/Persistence/Bioaccumulation	(a)	5000000	
24. Hazardous Waste Quantity	(a)	10000	
25. Waste Characteristics	1000		320
Targets:			
26. Sensitive Environments			
26a. Level I Concentrations	(b)		
26b. Level II Concentrations	(b)		
26c. Potential Contamination	(b)	0.0675	
26d. Sensitive Environments (lines 26a + 26b + 26c)	(b)	0.070	
27. Targets (value from line 26d)	(b)		0.070
Environmental Threat Score:			
28. Environmental Threat Score [(lines 22x25x27)/82,500 subject to a max of 60]	60		0.071
Surface Water Overland/Flood Migration Component Score for a Watershed			
29. Watershed Score[c] (lines 13+21+28, subject to a max of 100}	100		1.674
Surface Water Overland/Flood Migration Component Score			
30. Component Score (S_{sw})[c] (highest score from line 29 for all watersheds evaluated)	100		1.674

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c] Do not round to nearest integer