

**APPENDIX D—ESTIMATE OF AMMONIA CONCENTRATION IN  
WORTHINGTON BRANCH DUE TO LAND DISPOSAL OF  
AMMONIATED ASH**

## Appendix D (continued)

### Calculation Input Parameters

Hydrologic Parameters:

Historical average precipitation, P =	52.9 in/yr =	4.41 ft/yr	<u>Source</u>
Dry stack runoff as % of P =	5%		Julian and Danzig (1996)
Leachate infiltration as % of P, $I_{net}$ =	5%		Young (1989), Young and Beard (1989)
Coal yard area runoff as % of P =	20%		Young (1989), Young and Beard (1989)
Groundwater seepage from CYDB, G1	44,824 L/day		Based on hydrologic characteristics of coal yd
Volume of water in CYDB, $V_o$ =	6.20E+06 gals =	2.35E+07 L	From 2D areal groundwater flow simulation
7 day, 10 year low flow (7Q10) in Worthington Branch estimated from nearby continuous gaging stations:			
<u>Stream</u>	<u>USGS Gage</u>	<u>Period</u>	<u>7Q10 cfs/mi<sup>2</sup></u>
Bullrun Ck	3535000	1958-86	0.07723
White's Ck	3528400	1935-70	0.22388
		Mean =	0.150555

Worthington Branch drainage area just downstream of CYDB = 1.78 mi<sup>2</sup>  
 Estimated 7Q10 for WB = 0.268 cfs = 655,633 L/day

Average ammonia concentration in dry ash:

<u>From</u>	<u>To</u>	mg NH3 per kg ash
0	4,999 hours	4.5
5,000	14,999 hours	41.5
15,000	17,499 hours	89.5
17,500	20,000 hours	134.5

Time-wtd avg concentration NH3 in dry ash = 49.9 mg/kg

Estimated average aqueous ammonia concentration in ash:

Porosity of ash =	0.423	<u>Source</u>
Ash bulk density =	1.22 kg/L	Young et al., 1993
Time-wtd avg concentration NH3 in dry ash =	49.9 mg-NH3/kg-ash	Young et al., 1993
Aqueous concentration NH3 in contact water, C1 =	144 mg/L	

Assumes complete leaching of NH3 from ash and saturation of ash by contact water.

Runoff from Phase II dry stack to CYDB:

Area of phase II stack (exposed) =	435,600 ft <sup>2</sup>	
Runoff, Q1 = area*P*%RO =	7,449 L/day	
NH3 concentration of runoff, C1 =	144 mg/L	

Runoff from unaffected areas draining to CYDB to sedimentation pond:

<u>Region</u>	<u>Area (ft<sup>2</sup>)</u>	<u>RO%</u>	<u>Runoff (L/day)</u>
Coal yard	1,175,000	20%	80,368
Phase I stack	827,640	20%	56,609
Phase II stack (unexposed)	479,160	20%	32,774
Total runoff from unaffected areas, Q2 =			169,750 L/day
NH3 concentration of runoff, C2 =			0.0 mg/L

Net infiltration from Phase II dry stack to Worthington Branch:

Exposed stack area =	435,600 ft <sup>2</sup>	
Net infiltration leachate, G2 = area*P*% $I_{net}$ =	7,449 L/day	
NH3 concentration of leachate, C1 =	144 mg/L	

Other constants related to eq. 3:

K1 = -(Q1+Q2)/V <sub>o</sub> =	-0.00755
K2 = Q1*C1+Q2*C2 =	1.071E+06
c = K2/K1 =	-1.419E+08

### Predicted Ammonia Concentration in Worthington Branch During Stacking Period

Time (yr)	Ammonia	Ammonia	Mass Flux	Mass Flux	Ammonia	Ammonia	Ammonia
	Mass in CYDB (mg)	Concentration in CYDB (mg/L)	Ammonia to WB from CYDB Seepage (mg/d)	Ammonia to WB from Dry Stack Leachate (mg/d)	Concentration in WB from CYDB (mg/L)	Concentration in WB from Dry Stack Leachate Only (mg/L)	Ammonia Concentration in WB from All Sources (mg/L)
0.0	0.00E+00	0.0	0.00E+00	0.00E+00	0.00	0.00	0.00
0.5	1.06E+08	4.5	2.03E+05	1.07E+06	0.31	1.63	1.94
1.0	1.33E+08	5.7	2.54E+05	1.07E+06	0.39	1.63	2.02
1.5	1.40E+08	5.9	2.67E+05	1.07E+06	0.41	1.63	2.04
2.0	1.41E+08	6.0	2.70E+05	1.07E+06	0.41	1.63	2.05
2.5	1.42E+08	6.0	2.71E+05	1.07E+06	0.41	1.63	2.05
3.0	1.42E+08	6.0	2.71E+05	1.07E+06	0.41	1.63	2.05
3.5	1.42E+08	6.0	2.71E+05	1.07E+06	0.41	1.63	2.05
4.0	1.42E+08	6.0	2.71E+05	1.07E+06	0.41	1.63	2.05
4.5	1.42E+08	6.0	2.71E+05	1.07E+06	0.41	1.63	2.05
5.0	1.42E+08	6.0	2.71E+05	1.07E+06	0.41	1.63	2.05
5.5	1.42E+08	6.0	2.71E+05	1.07E+06	0.41	1.63	2.05
6.0	1.42E+08	6.0	2.71E+05	1.07E+06	0.41	1.63	2.05

