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March 9, 2012

Ms. Emily Baker
Department of Transportation and Environmental Services\
City of Alexandria
301 King Street, Room 3200
Alexandria, VA 22314

Attention: Mr. Rashad Friday

Subject: **Windmill Hill Park**
Bulkhead Inspection Report

Dear Ms. Baker:

Please find enclosed one (1) copy of the condition inspection report for the existing bulkhead structure at Windmill Hill Park. Our inspection was performed on February 24, 2012 and the results and recommendations from our inspection are presented within the enclosed report.

If you have any questions or require additional information, please do not hesitate to contact me at 410-462-9247 or John Farley at 410-462-9366.

Sincerely,
Rummel, Klepper & Kahl, LLP

Richard J. Adams, Jr., PE
Associate

Enlosure
RJA:jjf

cc: DWW/106-044-23
RJA
BLH/JJF

WINDMILL HILL PARK

BULKHEAD INSPECTION REPORT

Prepared By: RK&K

Prepared For: City of Alexandria
Department of Transportation and
Environmental Services

Submitted: March 9, 2012

COMMONWEALTH OF VIRGINIA
BRIAN L HEPTING
Lic. No. 048627
3/9/12
PROFESSIONAL ENGINEER

RK&K

CITY OF ALEXANDRIA VIRGINIA

ABOVE WATER INSPECTION OF EXISTING CONCRETE BULKHEAD ALONG THE WINDMILL HILL PARK

DATE OF INSPECTION: February 24, 2012

LOCATION: Windmill Hill Park Waterfront
Alexandria, VA

INSPECTION TEAM: Karl Stegmann, P.E. (RK&K)
Allan McBride (RK&K)

WEATHER CONDITIONS: Overcast, 55 °F

LOCATION MAP:

In 2009, Rummel, Klepper & Kahl, LLP (RK&K) was asked by The City of Alexandria to conduct an above water inspection on the existing concrete bulkhead located at the Windmill Hill Park in the City of Alexandria, Virginia (Photo 1). On February 24, 2012, RK&K performed a follow-up inspection to the initial inspection, which occurred on January 23, 2009, to evaluate the change in condition of the bulkhead. Findings and recommendations resulting from this inspection are based only on data collected at the time of this inspection.

DESCRIPTION

The bulkhead is situated around the perimeter of a cove located on the western bank of the Potomac River approximately half (0.5) mile upstream of the Woodrow Wilson Bridge. The north and south quadrants in the vicinity of the bulkhead are residential townhouses: Harborside and Ford's Landing, respectively. To the immediate west of the bulkhead is an open park area. The bulkhead is open to the public.

The bulkhead consists of two distinct structure types. The north bulkhead wall is approximately 285' long and consists of concrete walkway slabs supported by timber sheeting (Photo 24). The concrete walkway is located approximately 3' above the mean low water elevation. A concrete retaining wall with brick facing supports the remaining excavation. The second portion of the bulkhead is a full height concrete retaining wall with timber sheeting below the waterline (Photo 11). Concrete walkway slabs are located 2' to 5' inshore of the top of the concrete bulkhead in this portion of the bulkhead.

FINDINGS

The bulkhead is divided into four different segments:

1. West River Wall
2. South Cove Wall
3. West Cove Wall
4. North Cove Wall

A summary of findings for each segment is presented in this section. For the full defect report, see Appendix B. In addition, the tilt of the walkway slabs were measured using a level and folding rule. These results are produced in Appendix C.

<u>WEST RIVER WALL:</u>

The west river wall (Photo 2) portion of the bulkhead measured approximately 95' in length and supports seven 5'-10" wide concrete walkway slabs. The majority of concrete bulkhead in this section is severely deteriorated and provides minimal structural support.

Four transverse, up to 1/16" wide and up to 26" long cracks were observed in the first concrete slab. A full width, 1/2" wide crack was located in Slab 6 (Photo 3). Two spalls up to 1" deep without exposed rebar were present in Slab 3.

Differential movement between walkway slabs was observed at various locations along the west river wall. Between Slabs 1 and 2, there was a 2 1/4" horizontal gap with a vertical displacement of 5 1/2" (Photo 4). In addition, Slab 2 was offset 5 1/2" to the east of Slab 1. A tree stump and a 1" gap were observed between Slabs 3 and 4. Slabs 4 and 5 are separated by a 3" horizontal gap with a vertical differential of 5" (Photo 5). The gap between Slabs 5 and 6 was measured at 1" horizontally with no measureable vertical displacement.

The slope of the concrete walkway slabs were typically tilting down toward the river (east). The values generally ranged from 5° to 8°; however, Slab 2 had the greatest slope at 15.4°.

Overall, the west river wall was in similar condition to that which was noted in 2009. A few additional cracks were noted in Slab 1 and an additional spall was noted in Slab 7. The horizontal gaps and vertical displacements between the slabs had no measurable change. The change in the tilt of the slabs in the north/south and east/west directions was generally minor (approximately 2° max).

SOUTH COVE WALL:

The south cove wall (Photo 6) portion of the bulkhead measured approximately 157' in length, and eleven 5'-6" wide concrete walkway slabs are supported behind the wall. The majority of the concrete bulkhead in this section is severely deteriorated and provides minimal structural support.

The corner where the south cove wall and the west river wall intersect was undermined (Photo 7). There was a 7" x 3" x 1'-4" deep void under Slab 7 and a 1'-6" x 6" x full width void under Slab 8. In addition, the full width of Slab 9 was undermined for a 5'-0" x 1'-0" area.

Many of the concrete slabs of the south cove wall exhibited medium to wide, full width cracks. In particular, Slab 9 had a full width by up to 1 1/2" crack, which was significantly wider than was observed during the previous inspection (Photo 8). At the end of a full width crack in Slab 10, there was a 1'-2" x 1'-0" x 7 1/2" deep spall (Photo 9). Spalls were also observed in Slabs 8, 11, and 12. At the northwest corner of Slab 18, there was a 3'-0" x 4'-7" fractured area at the utility pole (Photo 10). The fractured sections had up to 4" vertical displacement as compared to the remaining slab.

At the east end of the south cove wall, there was a 4" horizontal gap between Slabs 7 and 8; otherwise, horizontal gaps between the slabs were minimal. The slabs, however, had titled at varying degrees with the general slope being down toward the cove (north).

In general, the condition of the south cove wall had worsened since the 2009 inspection. The previously noted cracks in the slabs had widened, and additional cracks were noted in a few of the slabs. Most of slabs exhibited minor changes in slope; however, Slabs 9 and 10 had settled approximately 5° back toward the west.

WEST COVE WALL:

The west cove wall portion of the bulkhead (Photo 11) measured approximately 263' long. This portion of the wall consisted of the concrete bulkhead supporting walkway slabs with two ramps. The ramps sloped from the existing groundline to the top of the existing concrete bulkhead. The majority of concrete bulkhead in this section is severely deteriorated and provides minimal structural support.

Wide cracks with deep voids were typical along the west cove wall in the area of the bulkhead to the east of the walkway slabs. Along Slabs 21 and 22, there was a 23'-0" long by 3" to 4" wide crack with a 3'-6" deep void (Photo 12). The void had caused the bulkhead to collapse inward and created a 1 1/2" vertical displacement between Slabs 21 and 22. In front of Slabs 30 and 31, there was a 15'-0" long by 3" wide crack with a 1'-4" deep void with a 1 1/2" vertical displacement (Photo 13). Finally, there was 20'-0" long by 3" wide crack with a 2'-0" deep void along Slab 33.

Deep voids and undermining also exist at a few other sections along the west cove wall. Slab 30 had a 2'-6" x 7" void that extends through the concrete bulkhead (Photo 14). A 15'-0" x 6'-0" deep void was found in front of Slab 33 (Photo 15). The largest void observed was 10'-0" x 15'-0" x 3'-0" deep underneath the corner slab at the northwest corner of the cove. This void had caused the top slap to slide and tilt toward the water (Photo 16). Gaps ranged from 4" to 5" between the slabs above the void.

At various locations, portions of the concrete bulkhead were missing along the water's edge. The missing portions of concrete bulkhead measured 1'-6" x 2'-1" x 6" deep at Slab 23, 2'-4" x 1'-1" x 1'-0" deep (Photo 17) and 2'-8" x 1'-6" x 1'-0" deep at Slab 30, and 2'-1" x 1'-8" x 1'-0" deep at Slab 31 (Photo 18). There was also a 1'-8" x 5'-0" x 3" deep spall at water's edge at Slab 27 (Photo 19). There were two

additional spalls in the bulkhead to the east of the walkway slabs – a 9” x 7” x 4” deep spall at Slab 26 and a 5’-0” x 3’-0” x 2” deep spall at Slab 33 (Photo 20).

Multiple concrete slabs behind the concrete bulkhead wall displayed signs of distress with medium to wide cracks and random large spalls. Slabs 20, 21, 23, 27 and 30 exhibited full width transverse cracks from 1/4” to 1” wide. There were six spalls throughout the walkway slabs of the west cove wall. Slab 19 had a 1’-5” x 1’-3” x 1” deep spall in the southwest corner of the panel. Two spalls, 2’-2” x 1’-0” x 1 1/2” deep and 1’-2” x 1’-2” x 2” deep, were located in Slab 21. There was a 10” x 6” x 2 1/2” deep spall in Slab 23 at the end of a wide transverse crack (Photo 21). Finally, Slab 34 had two edge spalls, 3’-8” x 1’-6” x 2” deep and 6’-0” x 1’-0” x 1 1/2” deep, along the south end. In addition to the spalling, Slabs 24, 25, 32, and 36 had large areas of scaling up to 1 1/2” deep (Photo 22).

Differential movement between walkway slabs was observed at various locations along the west cove wall. Between Slabs 21 and 22, there was a vertical differential of 1 1/2”. Between Slabs 25 and 26, a 1” horizontal gap with a 1” vertical displacement was observed. A 1 1/2” horizontal gap with a 1 1/2” vertical displacement existed between Slabs 27 and 28, and a 1/4” horizontal gap with a 3/4” vertical displacement was found between Slabs 27 and 28.

The tilt of the concrete walkway slabs was measured, and the slabs generally were observed to be sloping down toward the cove (east). The maximum tilt occurred at Slab 20, with the slab sloping 11.5° down towards the cove (east). The slabs were not level in the north-south direction either, but the direction of sloping varied.

In the 2009 inspection, a concrete slab located near the northwest corner of the cove was found to have a large concrete spall with protruding rebar that created a safety hazard. Since that inspection, the protruding rebar had been removed (Photo 23).

The west cove wall panels were generally in similar condition to that which was noted in 2009 with a few notable exceptions. A 30’ long by 1 1/2” wide crack was noted along Slabs 23 and 24, and the bulkhead had a few new areas of scaling noted. The most significant changes occurred at the northwest corner of the cove. New defects observed include multiple 8’-0” long by up to 0.030” wide cracks in Slabs 34 and 35. In addition, the gaps between the corner slab and the bulkhead increased by 1/2”, and an 8’-0” long by 1/2” crack was noted in the corner slab. The change in slope of the slabs was generally minor with the exceptions of Slab 20, which is approximately 3° more east, and Slab 28, which is approximately 4° more north.

NORTH COVE WALL:

The north cove wall (Photo 24) differs in construction compared to the other sections of the bulkhead. Along the north cove wall, the walkway slabs are located along the water’s edge at approximately 3’ feet above low tide. The slabs are supported on soil behind timber sheeting. In general, the slabs had failed (Photo 25), and the walkway is hazardous to the public. Most of the slabs were severely cracked, uneven, and/or spalled with large voids below the slabs (Photo 26). Multiple full grown trees or tree stumps were present on the slabs causing further failure. Since the walkway was in such poor condition, specific defect notes were not taken; however, the walkway appeared to be in worse condition than in 2009 by observation.

There is a concrete retaining wall with brick facing behind the concrete walkway slabs which supports the remaining fill behind the bulkhead. The wall was in fair condition with a few random medium to wide cracks. A majority of the brick facing was missing throughout the wall. The wall was measured for degree of overturning at 20’ intervals. These measurements can be found in Appendix D. In general, the overturning angle of the retaining wall had increased by 1° since the previous inspection. No voids or subsidence in the existing ground was observed behind the wall. There are two staircases in the wall leading from the sidewalk along the top of the bulkhead to the walkway in front of the wall. The staircases were in poor condition as they were spalled, uneven, and contained loose bricks. The larger staircase had a large tree stump located near the top that caused the landings to vertically separate (Photo 27).

RATING:

The findings discussed above indicate that the concrete bulkhead remains in “Critical” condition. There is major deterioration in the critical structural components along with obvious vertical and horizontal movement affecting the structural stability of the system and indicating a lack of soil support behind the wall. Total or partial imminent failure of the structure is possible due to a variety of potential loadings including but not limited to tidal action from a heavy storm surge, collision with flotsam or vessel, or heavy ice buildup. The walkway along the north cove wall should be considered in “Failed” condition. The panels that remain in place have little structural stability and cannot function as intended.

RECOMMENDATIONS

Rummel Klepper & Kahl recommends that the bulkhead be removed and replaced in the near future. The bulkhead is not safe for individuals to utilize due to the numerous tripping and safety hazards, and the severe deterioration of the existing wall could cause the structure to become unstable. The amount of the damage to the structure is so extensive that it is beyond repair.

We reiterate the suggestion from the 2009 report that the City immediately barricade the bulkhead to prevent public access. Since the park in the surrounding vicinity of the bulkhead is frequently utilized, it is our recommendation that a fence and “Keep Off” signs should be placed around the perimeter of the structure until a new structure is constructed. Until access is restricted, we recommend providing safety measures such as life rings that can be used in the event a person falls into the cove.

APPENDIX A

PHOTOS

Photo No. 1: Windmill Hill Bulkhead General View

Photo No. 2: West River Wall

Photo No. 3: Full Width x 1/2” Wide Crack in Slab 6

Photo No. 4: 5 1/2” Vertical Displacement between Slabs 1 & 2

Photo No. 5: 3” Horizontal Gap between Slabs 4 & 5

Photo No. 6: South Cove Wall

Photo No. 7: Undermining of Slab 8 – 1’-6” x 6” x Full Width

Photo No. 8: Full Width x 1 1/2” Wide Crack in Slab 9

Photo No. 9: 1’-2” x 1’-0” x 7 1/2” Deep Spall at the End of a Full Width x 1 1/2” Crack in Slab 10

Photo No. 10: 3’-0” x 4’-7” Fractured Corner of Slab 18 at Utility Pole

Photo No. 11: West Cove Wall

Photo No. 12: 23’-0” x 3”-4” Wide Crack along Slabs 21 & 22 with 3’-6” Deep Void

Photo No. 13: 15’-0” x 3” Wide Crack along Slab 31

Photo No. 14: Undermining of Slab 30 – 2’-6” x 7” x Full Width

Photo No. 15: 15’-0” x 6’-0” Deep Void under Slab 33

Photo No. 16: 10’-0” x 15’-0” x 3’-0” Deep Void under the Corner Slab

Photo No. 17: 2’-4” x 1’-1” x 1’-0” Deep Area of Missing Concrete at Water’s Edge at Slab 30

Photo No. 18: 2’-1” x 1’-8” x 1’-0” Deep Area of Missing Concrete at Water’s Edge at Slab 31

Photo No. 19: 1’-8” x 5’-0” x 3” Deep Spall at Water’s Edge at Slab 27

Photo No. 20: 5’-0” x 3’-0” x 2” Deep Spall at Slab 33 and 6’-0” x 1’-0” x 1 1/2” Deep Edge Spall of Slab 34

Photo No. 21: 10” x 6” x 2 1/2” Deep Spall at the end of a 3’-0” x 3/4” Crack in Slab 23

Photo No. 22: 20’-0” x 5’-0” x 1 1/2” Deep Scaling at Slab 32

Photo No. 23: Protruding Rebar Removed from Slab near Northwest Corner of Cove

Photo No. 24: North Cove Wall

Photo No. 25: Slabs Have Failed along the North Cove Wall

Photo No. 26: Typical Walkway Slab of the North Cove Wall

Photo No. 27: Tree Stump Causing Damage to Stairway in North Cove Wall

APPENDIX B

SCHEMATIC OF BULKHEAD

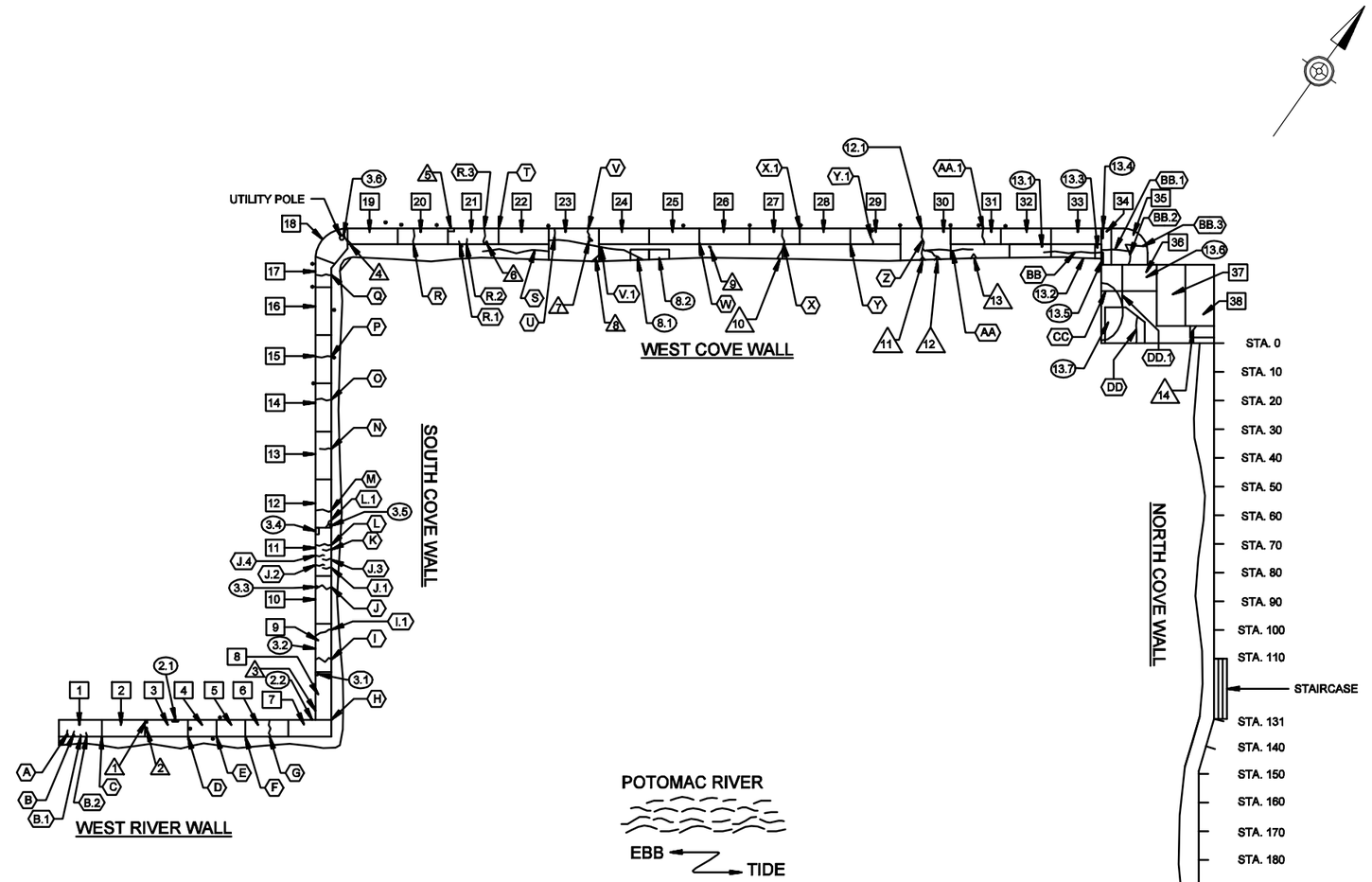
CRACK/SLAB GAPS SIZE CHART

ID	TYPE	SIZE	REMARKS	YEAR
A	CRACK	26" x 1/16"	SLAB 1 EAST SIDE	2009
B	CRACK	22" x 1/16"	SLAB 1 EAST SIDE	2009
B.1	CRACK	6" x 0.040"	SLAB 1 EAST SIDE	2012
B.2	CRACK	16" x 0.035"	SLAB 1 EAST SIDE	2012
C	GAP	2 1/4"	HORIZONTAL GAP B/W SLABS 1 & 2, SLAB 2: 5 1/2" EAST	2009
D	GAP	1"	HORIZONTAL GAP B/W SLABS 3 & 4	2009
E	GAP	3"	HORIZONTAL GAP B/W SLABS 4 & 5	2009
F	GAP	1"	HORIZONTAL GAP B/W SLABS 5 & 6	2009
G	CRACK	FW x 1/2"	SLAB 6	2009
H	GAP	4"	HORIZONTAL GAP B/W SLABS 7 & 8	2009
I	CRACK	FW x 1 1/2"	SLAB 9	2009
I.1	CRACK	FW x 0.035"	SLAB 9, DIAGONAL CRACK	2012
J	CRACK	FW x 0.030"	SLAB 10 ADJACENT TO SPALL 3.3	2009
J.1	CRACK	27" x 0.025"	SLAB 11 NORTH SIDE	2012
J.2	CRACK	24" x 0.040"	SLAB 11 SOUTH SIDE	2012
J.3	CRACK	27" x 0.020"	SLAB 11 NORTH SIDE	2012
J.4	CRACK	25" x 0.020"	SLAB 11 SOUTH SIDE	2012
K	CRACK	48" x 0.040"	SLAB 11 NORTH SIDE	2009
L	CRACK	FW x 1/4"	SLAB 11	2009
L.1	CRACK	30" x 24" x 0.035"	SLAB 12, NORTHEAST CORNER "D" CRACK	2012
M	CRACK	FW x 1/4"	SLAB 12	2009
N	CRACK	48" x 1/8"	SLAB 13 NORTH SIDE	2009
O	CRACK	FW x 1/8"	SLAB 14	2009
P	CRACK	FW x 1/2"	SLAB 15	2009
Q	CRACK	FW x 1/4"	SLAB 17, 1/2" VERTICAL DISPLACEMENT	2009
R	CRACK	FW x 1/4"	SLAB 20, 1 1/2" VERTICAL DISPLACEMENT	2009
R.1	CRACK	25" x 0.040"	SLAB 21 EAST SIDE	2012
R.2	CRACK	12" x 0.040"	SLAB 21 EAST SIDE	2012
R.3	CRACK	FW x 0.010"	SLAB 21	2012
S	CRACK	276" x 3"-4"	SLABS 21 & 22, 42" DEEP VOID	2009
T	GAP	1 1/2"	VERTICAL DISPLACEMENT B/W SLABS 21 & 22	2009
U	CRACK	36" x 1"	SLAB 23 WEST SIDE	2009
V	CRACK	36" x 3/4"	SLAB 23 WEST SIDE	2009
V.1	CRACK	360" x 1 1/2"	SLABS 23 & 24, EAST PORTION SHIFTED 1 1/2" EAST	2012
W	GAP	1/2"	HORIZ. GAP B/W SLABS 25 & 26 W/ 1" VERT. DISP.	2009
X	CRACK	FW x 1/2"	SLAB 27	2009
X.1	GAP	1 1/2"	HORIZ. GAP B/W SLABS 27 & 28 W/ 1 1/2" VERT. DISP.	2012
Y	GAP	1/4"	HORIZ. GAP B/W SLABS 28 & 29 W/ 3/4" VERT. DISP.	2009
Y.1	CRACK	FW x 0.030"	SLAB 29 AT TREE STUMP	2012
Z	CRACK	FW x 3"	SLAB 30, 3" VERTICAL DISPLACEMENT	2009
AA	CRACK	180" x 3"	SLABS 30 & 31, 16" VOID AND 1 1/2" VERT. DISP.	2009
AA.1	CRACK	FW x 0.020"	SLAB 31 AT TREE STUMP	2012
BB	CRACK	240" x 3"	SLAB 33, 24" DEEP VOID	2009
BB.1	CRACK	96" x 0.030"	SLABS 34 & 35	2012
BB.2	CRACK	96" x 0.030"	SLAB 35	2012
BB.3	CRACK	96" x 0.010"	SLAB 35	2012
CC	GAP	4 1/2"	HORIZ. GAP B/W CORNER SLAB W/ 4" VERT. DISP.	2009
DD	GAP	5 1/2"	HORIZ. GAP B/W CORNER SLAB W/ 1" VERT. DISP.	2009
DD.1	CRACK	96" x 1/2"	CORNER SLAB	2012

MISCELLANEOUS CHART

ID	TYPE	SIZE	REMARKS	YEAR
1	SPALL	28" x 9" x 1" DEEP	SLAB 3 SOUTH END	2009
2	SPALL	-	GROUPED WITH 1	2009
2.1	SPALL	12" x 5" x 1" DEEP	SLAB 3 WEST SIDE	2012
2.2	UNDERMINING	7" x 3" x 16" DEEP	SLAB 7 UNDERMINED AT SLAB 8	2012
3	UNDERMINING	18" x 6" x FW	SLAB 8 UNDERMINED FULL WIDTH AT EAST END	2009
3.1	SPALL	10" x 4" x 4"	SLAB 8 SOUTHWEST CORNER	2012
3.2	UNDERMINING	60" x 12" x FW	SLAB 9 UNDERMINED FULL WIDTH	2012
3.3	SPALL	14" x 12" x 7 1/2" DEEP	SLAB 10 SOUTH SIDE	2012
3.4	SPALL	36" x 6" x 1" DEEP	SLAB 11 SOUTHWEST CORNER	2012
3.5	SPALL	16" x 6" x 3" DEEP	SLAB 12 NORTH FACE AT EAST END	2012
3.6	FRACTURE	36" x 55"	SLAB 18 AT UTILITY POLE W/ 4" VERT. DISP.	2012
4	SPALL	17" x 15" x 1" DEEP	SLAB 19 SOUTHEAST CORNER	2009
5	SPALL	26" x 12" x 1 1/2" DEEP	SLAB 21 SOUTHWEST CORNER	2009
6	SPALL	14" x 14" x 2" DEEP	SLAB 21 EAST SIDE WALKWAY SLAB	2009
7	SPALL	10" x 6" x 2 1/2" DEEP	SLAB 23 IN BULKHEAD	2009
8	MISSING CONCRETE	18" x 25" x 6" DEEP	SLAB 23 AT WATER'S EDGE	2009
8.1	SCALING	60" x 36" x 1" DEEP	SLAB 24 IN BULKHEAD	2012
8.2	SCALING	84" x 22" x 1" DEEP	SLAB 25 IN BULKHEAD	2012
9	SPALL	9" x 7" x 4" DEEP	SLAB 26 IN BULKHEAD	2009
10	SPALL	20" x 60" x 3" DEEP	SLAB 27 IN BULKHEAD	2009
11	MISSING CONCRETE	28" x 13" x 12" DEEP	SLAB 30 AT WATER'S EDGE	2009
12	MISSING CONCRETE	32" x 18" x 12" DEEP	SLAB 30 AT WATER'S EDGE	2009
12.1	UNDERMINING	30" x 7" x FW	SLAB 30 UNDERMINED FULL WIDTH	2009
13	MISSING CONCRETE	25" x 20" x 12" DEEP	SLAB 31 AT WATER'S EDGE	2009
13.1	SCALING	240" x 60" x 1 1/2" DEEP	SLAB 32 IN BULKHEAD	2012
13.2	UNDERMINING	180" x 72" DEEP	SLAB 33	2012
13.3	SPALL	60" x 36" x 2" DEEP	SLAB 33 IN BULKHEAD	2012
13.4	SPALL	44" x 18" x 2" DEEP	SLAB 34 SOUTHWEST CORNER	2012
13.5	SPALL	72" x 12" x 1 1/2" DEEP	SLAB 34 SOUTHEAST CORNER	2012
13.6	SCALING	75% OF AREA x 1" DEEP	SLAB 36	2012
13.7	UNDERMINING	120" x 180" x 36"	CORNER SLAB	2009
14	EXPOSED REBAR	-	REBAR REMOVED	2009

NOTE: YEAR INDICATES YEAR DEFECT WAS FIRST RECORDED.



LEGEND AND ABBREVIATIONS

1	SLAB NUMBER
A AA	CRACKING/SLAB GAPS
1 1.1	MISCELLANEOUS
FW	FULL WIDTH
•	TREE STUB

RK&K
CONSULTING ENGINEERS
BALTIMORE, MARYLAND

Project Name:
WINDMILL HILL
BULKHEAD INSPECTION
SCHEMATIC

DATE: FEBRUARY 24, 2012

DES: ADM	DWG: ADM	CHK: KPS	JOB: 06044-23.1	DATE: FEBRUARY 24, 2012	FILE: FV_REPORT.DGN

OPERATOR: MLH
FILE NAME: \\rkm\v2006\20060608044_coal\Task 23 _ WMH BH\CADD\FV_Report.dgn
PLOTTED: 3/6/2012

APPENDIX C

DEGREE OF TILT OF CONCRETE WALKWAY SLABS

Degree of Tilt of Concrete Walkway Slabs

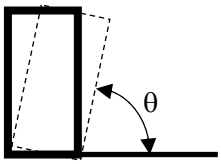
	Slab No.	N/S Degree of Tilt (deg) (+North)			E/W Degree of Tilt (deg) (+East)		
		2012	2009	Difference	2012	2009	Difference
West River Wall	1	+0.3	+0.5	-0.2	+4.8	+5.7	-0.9
	2	+2.1	+2.3	-0.2	+15.4	+15.1	+0.3
	3	-1.8	-1.6	-0.2	+8.0	+10.1	-2.1
	4	-2.4	-2.1	-0.3	+4.8	+4.9	-0.1
	5	+2.1	+1.2	+0.9	+6.5	+6.5	+0.0
	6	+2.4	+0.8	+1.6	+7.1	+5.7	+1.4
	7	+0.0	+1.5	-1.5	+6.8	+7.2	-0.4
South Cove Wall	8	+3.0	+3.1	-0.1	+2.1	+1.2	+0.9
	9	+5.4	+3.2	+2.2	-1.8	+2.7	-4.5
	10	+10.0	+8.6	+1.4	+1.2	+6.0	-4.8
	11	+8.3	+8.3	-0.0	+1.5	+0.6	+0.9
	12	+6.2	+6.5	-0.3	+0.0	+2.1	-2.1
	13	+7.4	+6.4	+1.0	+2.4	+2.3	+0.1
	14	+9.8	+9.3	+0.5	+0.0	+0.9	-0.9
	15	+8.6	+7.4	+1.2	+0.0	+0.7	-0.7
	16	+6.2	+6.5	-0.3	+1.8	+0.5	+1.3
	17	+5.4	-	-	+2.7	-	-
	18	+4.8	-	-	+1.2	-	-
West Cove Wall	19	+2.4	+3.4	-1.0	+8.0	+8.0	+0.0
	20	+0.9	+1.1	-0.2	+11.5	+8.7	+2.8
	21	+1.2	+0.2	+1.0	+10.9	+10.1	+0.8
	22	-1.5	+0.7	-2.2	+9.5	+8.6	+0.9
	24	+0.0	+0.6	-0.6	+5.4	+4.9	+0.5
	25	-1.8	-2.0	+0.2	+6.2	+6.0	+0.2
	26	-1.8	-2.0	+0.2	+7.4	+7.1	+0.3
	27	-0.9	-1.2	+0.3	+8.9	+8.3	+0.6
	28	+1.8	-2.4	+4.2	+7.1	+7.8	-0.7
	29	+0.9	-0.1	+1.0	+5.9	+6.1	-0.2
	31	+0.6	+0.8	-0.2	+6.5	+5.8	+0.7
	32	-0.6	-0.5	-0.1	+3.9	+3.4	+0.5
	33	-0.6	-0.2	-0.4	+0.0	+0.2	-0.2

Notes:
1) 0.0 degress is completely level.
2) A positive degree of tilt indicates the slab is tilting downward to the north or east.
3) Slab 9 was fractured in 2 places. The middle section was measured.
4) The tilt of Slabs 17 and 18 was not measured in 2009.

APPENDIX D

NORTH COVE WALL DEGREE OF OVERTURNING

North Cove Wall Degree of Overturning

Station	Degree of Overturning (deg)			Sketch
	2012	2009	Difference	
0	85.1	86.3	-1.2	
20	86.4	86.9	-0.5	
40	86.4	87.3	-0.9	
60	83.5	84.9	-1.4	
80	85.2	87.5	-2.3	
100	87.7	88.9	-1.2	
120	STAIRWAY			
140	86.8	87.7	-0.9	
160	87.6	87.5	0.1	
180	86.0	87.5	-1.5	
200	86.8	84.4	2.4	
220	84.3	84.6	-0.3	
240	81.2	82.1	-0.9	
260	83.7	84.5	-0.8	

Notes:
1) See schematic in Appendix B for station locations.
2) 90 degrees is completely vertical wall.