ADVANCED GeoServices
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August 19, 2010 2009-2484-1B

East Goshen Township
1580 Paoli Pike
West Chester, PA 19380

Attention: Mr. Rick Smith, Township Manager

Reference: Opinion of Costs
Hershey Mill Dam

Dear Mr. Smith:

Enclosed are Opinion of Costs for both restoring and breaching the Hershey Mill Dam in East Goshen Township, Chester County, Pennsylvania. The Opinion of Costs were prepared by Advanced GeoServices as requested by the Board of Supervisors at the July 20, 2010 East Goshen Township public meeting.

During the public meeting, Advanced GeoServices presented options to the restore the Hershey Mill Dam (Dam) as well as a discussion on breaching the Dam. The options presented to restore the Dam included enlarging the spillway and installing culverts. At the close of our presentation, the Board of Supervisors requested that Advanced GeoServices provide an opinion for both capital and operation/maintenance costs for enlarging the spillway as well as for breaching the Dam.

The Opinion of Costs presented herein are being provided to East Goshen Township for planning and budgeting purposes only. They reflect a level of precision based solely on the preliminary development of the options presented on the enclosed figures and by Advanced GeoServices at the public meeting, and on the preliminary nature of the assumptions made to develop the costs. The actual costs may change or be different based on further discovery/development of the chosen option during the design and construction phases of the project.

In addition, Advanced GeoServices makes no guarantee or representation that the costs presented will accurately predict actual bids from prospective contractors. Actual bids submitted may be lower or higher as a result of market conditions, the competitive bidding process, and variations in construction methods as well as material, equipment and labor costs.

A brief description of the concept of each option as well as a discussion of the Opinion of Costs is provided below.

DESCRIPTION OF OPTIONS

Restoring the Dam (Enlarging the Spillway)

The existing spillway is 22 feet wide and passes about 189 cubic feet per second (cfs) of flow before the Dam is overtopped. In order to pass the required design flood (100-year storm) of 1,089 cfs, Advanced GeoServices is proposing to enlarge the spillway to a minimum 74-feet width and to raise/level the top of the Dam to elevation 450.5.

- The existing Dam embankment will be raised to elevation 450.5 by placing soil fill within the existing reservoir as well as on the Dam crest. Portions of the face of the inside slope of the new embankment fill (facing the reservoir) will be covered with rip rap to provide long-term erosion protection.

- The new spillway slab and associated sidewalls on top of the Dam will be constructed of cast-in-place concrete. The existing spillway slab and adjacent sidewalls on top of the Dam will be demolished to construct the new spillway slab/sidewalls. In addition, sections of the earthen embankment and the existing stone/masonry face of the Dam will be lowered to accommodate the elevation of new spillway slab.

- As required by the PADEP Division of Dam Safety, the restoration of the Dam will require removal of the trees on the Dam embankment. The removal of trees and associated roots and stumps may damage the existing stone/masonry face of the Dam. In addition, due to its current condition/construction, portions of the existing stone/masonry face will not accommodate/withstand flow from the new spillway slab. Lastly, the existing stone/masonry face has deteriorated and portions may have been undermined by scour. Therefore, in conjunction with the expansion of the spillway, Advanced GeoServices believes that the existing face of the Dam should be encapsulated or replaced with a new concrete wall to reinforce the existing structure and extend the life of the Dam.

At this time, we believe that the most practical, efficient, and least disruptive method of constructing the new concrete wall for the face of the Dam is to use reinforced shotcrete (i.e., spray-applied concrete). The shotcrete wall will be supported on a new concrete foundation constructed at the base of the Dam. The construction of the new concrete foundation will include filling the existing scour hole at the base of the Dam and providing a concrete splash apron to prevent future scour.

Construction of a conventional gravity retaining wall where the foundation resists the overturning forces would require the foundation of the new wall to extend within (into) the existing embankment (i.e., requiring demolition of the existing structure to rebuild it). In order to avoid the demolition required to build this type of conventional foundation system, a new shotcrete wall can be applied to the existing Dam face and be restrained with soil anchors and/or deadmen constructed within/beneath the existing soil embankment. The necessary extent and magnitude of this type of restraining system can only be determined during the design phase of the project.

At the public meeting, we presented the concept of placing a stone veneer over the new concrete wall to restore the existing aesthetics. However, based on discussions with our Structural Engineer and contractors experienced in dam reconstruction/repair, placing stone on the face of the spillway is not recommended and is very uncommon in spillway repair/reconstruction due to the potential ongoing maintenance from the long-term affects of continual exposure to water flow and temperature changes (freeze/thaw, etc.) on the masonry. In addition, forming the outside face of the concrete (i.e., cast-in-place concrete) and providing anchors for the stone veneer would be required to provide a stable/uniform surface. As an alternative to a stone veneer, we are proposing in these Opinion of Costs that the shotcrete be stained and finished to provide a stone-like appearance. The visible portions of the cast-in-place concrete sidewalls of the spillway on top of the Dam will also be finished with shotcrete in a similar manner.

A conceptual picture of the proposed spillway enlargement is attached as Figure 1. Please keep in mind that the stone/masonry face shown on Figure 1 depicts the existing stone veneer conditions. The actual finish of the shotcrete face will be different. Pictures of stained and textured shotcrete walls are provided as Attachment 1.

Breaching the Dam

Breaching will include removing about 100 feet of the existing Dam embankment and establishing channels and overbank areas (for the two creeks that currently feed the Dam) via sediment removal/disposal and grading within the existing reservoir area. In order to maintain aesthetics, portions of the existing stone/masonry Dam face adjacent to the breach location will be left in place. The two creeks that currently feed the reservoir will be combined into one channel immediately upstream of the breach location.

The reservoir behind the Dam is almost completely filled with sediment. We estimate that the average level of the top of sediment is at about elevation 445.5 (about 13 inches below the level of the existing spillway). A conceptual grading plan for breaching the Dam and for establishing channels and overbank areas for the two creeks is shown on the attached Figure 2. Based on the grading presented, we estimate that the removal of approximately 6,500 cubic yards of sediment from the existing reservoir area will be required.

We believe that the presence of the Dam has also resulted in the deposition of sediment within the two creeks/floodplain areas upstream of the reservoir. In order to prevent disturbance (i.e., sediment removal to re-establish the original creek beds) of the heavily-vegetated floodplain areas upstream of the reservoir limits, the grading plan shows the construction of a check dam within each creek at the upstream edge of the reservoir as well as additional check dams further downstream toward the breach location. The purpose of the check dams is to lower the elevation of each creek channel in a stepwise fashion in order to provide a minimal channel slope through the former reservoir area. The check dams will also create pool areas in the main channels.

The restoration requirements (wetlands, vegetation, trees, rip rap, etc.) within the former reservoir area will be dependant upon the stability of the remaining sediments and preferences of the adjacent residents, East Goshen Township, and other interested parties that will influence the selection of the future use and aesthetics of the former reservoir area. All of these elements are not known at this time.

OPINION OF COSTS: (Enlarging the Spillway)

Opinions for Capital and Operation & Maintenance Costs for enlarging the spillway are discussed below. These costs do **not** include engineering design, permitting, or construction oversight.

Capital Cost

A Capital Cost of $450,997 is estimated to enlarge the spillway through the use of shotcrete and deadman/soil anchors as described in the previous section. A breakdown of this cost is provided on the attached Table 1.

The above cost does not include replacing/refurbishing the drawdown valve and its associated mechanisms. The valve is over 30 years old; we recommend that East Goshen Township investigate the condition of the valve and the associated mechanisms, and consider replacement/refurbishment, as required, if the option of restoring the Dam is chosen.

Annualized Operation & Maintenance Cost

An Annualized Operation & Maintenance Cost of $3,300 is estimated for the Dam. This cost includes landscaping (lawn care, etc.) for the Dam embankment, a yearly inspection of the Dam by a Registered Professional Engineer, operation of the drawdown valve by East Goshen Township personnel twice a year, and updating the Emergency Action Plan every five years. A breakdown of this cost is provided on the attached Table 2.

Sediment Removal

At the public meeting, the Board of Supervisors also requested that Advanced GeoServices provide an Opinion of Cost for dredging (removing) the sediment within the reservoir if the Dam is restored. An Opinion of Cost for this activity is provided below.

Mobilization/Demobilization per Event	$15,000[(1)]
Removal/Disposal of Sediment	$92,000/per ft. of reservoir area[(2)]

[(1)] Cost includes erosion and sedimentation control, water management, and site restoration for each removal event. The removal of sediment will be performed in the "dry" by draining the reservoir through the drawdown pipe.

[(2)] Cost is to remove and dispose one foot of sediment over entire 2.2+/- acre reservoir area (about $26 per cubic yard of sediment). Cost assumes that the sediment can be disposed as clean fill material.

Based on discussions with Richard A. Reisinger, P.E. (Chief of the Delaware Watershed Section of the PADEP Division of Dam Safety), we understand that the PADEP does not have any regulation requiring the removal of sediment that is associated with dam maintenance.

Conventional Gravity Retaining Wall

For comparison purposes, we estimate that the total cost of constructing a conventional cast-in-place gravity retaining wall (i.e., demolishing and rebuilding the Dam, as discussed in the previous section) will be at least $30,000 more than using shotcrete to reconstruct the spillway. Under this option, the cast-in-place concrete can be finished with stained shotcrete to provide a stone-like appearance.

Unlike the shotcrete option, a conventional cast-in-place gravity retaining wall does not have the potential complications associated with damaging/undermining the existing stone/masonry Dam face as discussed at the public meeting. However, the existing Dam face and a portion of the soil embankment will have to be removed making the logistics of this construction more complicated. As a result, the conventional cast-in-place gravity retaining wall option will have a longer and more complicated construction schedule; greater exposure to the risks associated with potential adverse weather and flooding conditions; greater potential to disturb the adjacent stone/masonry walls (particularly on the DeRiemer property); and greater disturbance to the existing soil embankment and downstream floodplain area.

OPINION OF COSTS: (Breaching the Dam)

A range of Opinion of Capital Costs to breach the Dam is listed below. A breakdown of these costs is provided on the attached Table 3. These costs do **not** include engineering design, permitting, or construction oversight.

Range in Capital Cost : $289,012 - $439,012

The range in the Capital Costs is provided to account for the unknowns associated with the restoration requirements (wetlands, vegetation, trees, rip rap, etc.) of the former reservoir and the ongoing maintenance needed to maintain the planted vegetation until it is adequately established. As stated previously, these requirements will be dependant upon the stability of the remaining sediments and preferences of the adjacent residents, East Goshen Township, and other interested parties that will influence the selection of the future use and aesthetics of the former reservoir area; all of these elements are not known at this time.

Based on discussions with PADEP personnel, we understand that they have no defined requirement for restoration following a dam breach other than that the channel and overbank areas must be vegetated to resist erosion and designed to be hydraulically stable. It is our understanding that on some breach projects the PADEP has hydroseeded the former reservoir area and allowed the area to re-vegetate with the native seeds contained with the remaining sediments.

We understand that it has been reported by others that stream restoration efforts in Pennsylvania have cost as much as $1 million per stream mile to re-establish the natural stream, wetlands, overbank wetlands, and riparian buffers. This criterion was adopted to establish the upper limit for the range of the Opinion of Capital Costs. We believe that this upper limit should be adequate to account for restoration and any required maintenance until the vegetation is adequately established.

Lastly, the range in the Opinion of Capital Costs for breaching the Dam assume that the sediments can be disposed as clean fill material and that the remaining sediments within the former reservoir area will be stable and capable of accommodating grading/earthwork/restoration activities.

We appreciate this opportunity to be of service to you. If you have any questions concerning these matters, please contact us.

Very truly yours,

ADVANCED GEOSERVICES

Todd D. Trotman, P.E., LEED®AP
Project Consultant

Paul F. Marano, P.E.
Senior Project Consultant

PFM:TDT:kk

Enclosures

TABLES

OPINION OF COST

TABLE 1
OPINION OF CAPITAL COSTS
ENLARGING SPILLWAY OF HERSHEY MILL DAM
SHOTCRETE REPAIR OPTION

Work Item	Unit	Quantity	Unit Price or %	Source	Cost
General					
Mobilization/Demobilization	Project	1	5.00%	AGC Sources	$18,156.09
Erosion and Sediment Control	Project	1	0.50%	AGC Sources	$1,815.61
Water Management	Project	1	1.00%	AGC Sources	$3,631.22
Site Restoration	Project	1	1.50%	AGC Sources	$5,446.83
Site Preparation					
Construction Entrance at Hershey Mill Road	Lump Sum	1	$1,500.00	AGC Sources	$1,500
Construction Entrance at Greenhill Road	Lump Sum	1	$1,500.00	AGC Sources	$1,500
Downstream Rock Filter	Each	1	$1,000.00	AGC Sources	$1,000
Remove Trees (26" to 36" diameter)	Each	6	$520.00	Means 31 13 13.20 3200	$3,120
Remove Trees (14" to 24" diameter)	Each	4	$415.00	Means 31 13 13.20 3150	$1,660
Remove Trees (8" to 12" diameter)	Each	5	$229.00	Means 31 13 13.20 3050	$1,145
Remove Stumps	Each	6	$245.00	Means 31 13 13.20 2150	$1,470
Remove Stumps	Each	4	$157.00	Means 31 13 13.20 2100	$628
Remove Stumps	Each	5	$42.00	Means 31 13 13.20 2040	$210
Remove Topsoil/Vegetation/Roots from Top of Dam	S.Y.	787	$1.53	Means 31 14 13.23 1460	$1,204
Remove/Dispose Sediment/Soft Soils from Inside Face of Dam	B.C.Y.	800	$20.00	AGC Sources	$16,000
Remove/Dispose Sediment/Soft Soils from Plunge Pool	B.C.Y.	67	$20.00	AGC Sources	$1,340
Extend Drawdown Pipe through Downstream Work Area	L.F.	40	$50.00	AGC Sources	$2,000
Remove/Demolish Existing Spillway Slab	S.F.	440	$6.85	Means 02 41 16.17 0420	$3,014
Remove/Demolish Existing Spillway Sidewalls	C.F.	804	$5.05	Means 02 41 13.33 1400	$4,060
Lower Existing Masonry Wall for New Spillway	C.F.	250	$5.05	Means 02 41 13.33 1400	$1,263
Dispose Demolition Debris, Vegetation, Stumps, etc.	C.Y.	100	$21.00	Means 02 41 19.18 0500	$2,100
Earthworks					
Excavate for New Spillway Slab (Top of Dam)	B.C.Y.	152	$16.85	Means 31 23 16.16 6040	$2,561
Excavate for New Spillway Side Walls (Top of Dam)	B.C.Y.	63	$16.85	Means 31 23 16.16 6040	$1,062
Excavate for Turn-Down Portion of Spillway Slab (Top of Dam)	B.C.Y.	28	$16.85	Means 31 23 16.16 6040	$472
Fill Top of Dam to Elevation 450	B.C.Y.	751	$13.75	Means 31 23 23.15 4000	$10,326
Compaction of Fill on Top of Dam	E.C.Y.	751	$0.81	Means 31 23 23.23 5720	$608
Place 18-in Layer of Rip Rap along Upstream Face of Dam	C.Y.	285	$67.00	AGC Sources	$19,095
Geotextile Fabric Beneath Rip Rap	S.Y.	570	$2.43	Means 31 32 19.16 1510	$1,385

TABLE 1
OPINION OF CAPITAL COSTS
ENLARGING SPILLWAY OF HERSHEY MILL DAM
SHOTCRETE REPAIR OPTION

Work Item	Unit	Quantity	Unit Price or %	Source	Cost
Excavate for New Spillway Foundation and Splash Apron	B.C.Y.	120	$25.00	Means 31 23 16.16 6030	$3,000
Six (6) Inches of Topsoil on Eastern Top of Dam	S.Y.	350	$6.65	Means 32 91 19.13 0800	$2,328
Turf Reinforcement Mat on Eastern Slope of Dam	S.Y.	600	$7.55	Means 31 25 13.10 0060	$4,530
Fill in Front of Plunge Pool	B.C.Y.	70	$13.75	Means 31 23 23.15 4000	$963
Compact Fill in Front of Plunge Pool	E.C.Y.	70	$0.81	Means 31 23 23.23 5720	$57
Place 18-in Layer of Rip Rap in Front of Plunge Pool	C.Y.	23	$67.00	AGC Sources	$1,541
New Spillway					
Fill Existing Plunge Pool with Lean Concrete/Flowable Fill	C.Y.	168	$130.00	Means 03 31 05.70 1950	$21,840
Construct Foundation and Splash Apron for Spillway	C.Y.	63	$299.00	Means 03 30 53.40 4050	$18,837
Finish Splash Apron with Stained and Textured Shotcrete	S.F.	1100	$21.00	AGC Sources	$23,100
Anchors to Deadman	Each	15	$2,700.00	AGC Sources	$40,500
Anchors to Soil	Each	7	$1,685.00	AGC Sources	$11,795
Construct Turn-Down Portion of Spillway Slab (Top of Dam)	C.Y.	34	$299.00	Means 03 30 53.40 4000	$10,166
Construct Shotcrete Spillway Face	C.Y.	53	$1,100.00	AGC Sources	$58,300
Finish Spillway Face with Stained and Textured Shotcrete	S.F.	1078	$21.00	AGC Sources	$22,638
Reinforcement for Shotcrete Spillway Face	Tons	5.8	$1,450.00	Means 03 21 10.60 0750	$8,410
Construct Foundation for Spillway Side Walls (Top of Dam)	C.Y.	17	$250.00	Means 03 30 53.40 3950	$4,250
Construct Spillway Side Walls (Top of Dam)	C.Y.	27	$380.00	Means 03 30 53.40 4260	$10,260
Finish Spillway Sidewalls with Stained and Textured Shotcrete	S.F.	606	$21.00	AGC Sources	$12,726
Construct Spillway Slab (Top of Dam)	C.Y.	71	$299.00	Means 03 30 53.40 4050	$21,229
Aggregate Base Course for Spillway Slab	S.Y.	212	$8.75	Means 32 11 23.23 0100	$1,855
Pressure Point DeRiemer Retaining Wall	S.F.	135	$45.00	AGC Sources	$6,075

Subtotal Items	**$392,171**
Project Overhead and Profit at 10%	$39,217
Contingency at 5%	$19,609
Opinion of Cost	**$450,997**

TABLE 2
OPINION OF OPERATION & MAINTENANCE COSTS
ENLARGING SPILLWAY OF HERSHEY MILL DAM
SHOTCRETE REPAIR OPTION

Work Item	Unit	Quantity Per Year	Unit Price	Annualized Cost
Landscaping (mowing grass)	Bi-Weekly	15	$60.00	$900
Inspection by Professional Engineer	Once a Year	1	$1,000.00	$1,000
Operation of Drawdown Valve	Twice a Year	2	$500.00	$1,000
Updating Emergency Action Plan	Every 5 Years	0.2	$2,000.00	$400
		Total Annualized Cost		**$3,300**

TABLE 3
OPINION OF CAPITAL COSTS
BREACHING HERSHEY MILL DAM

Work Item	Unit	Quantity	Unit Price or %	Source	Cost
Mobilization/Demobilization	Project	1	2.5%	AGC Sources	$6,041
Erosion and Sediment Control	Project	1	0.5%	AGC Sources	$1,208
Water Management	Project	1	1%	AGC Sources	$2,416
Construction Entrance at Hershey Mill Road	Lump Sum	1	$1,500.00	AGC Sources	$1,500
Construction Entrance at Greenhill Road	Lump Sum	1	$1,500.00	AGC Sources	$1,500
Downstream Rock Filter	Each	2	$1,000.00	AGC Sources	$2,000
Excavation and Disposal of Sediment	C.Y.	6500	$20.00	AGC Sources	$130,000
Floodplain Grading	Acres	2.21	$8,000.00	AGC Sources	$17,680
18-in Layer of Rip Rap at Check Dams	C.Y.	134	$67.00	AGC Sources	$8,978
Gabion Check Dam Mats	S.Y.	292	$63.50	Means 31 36 13.10 0500	$18,542
Gabion Check Dam Walls	S.Y.	70	$153.00	Means 31 36 13.10 0800	$10,710
Geotextile Fabric Beneath Rip Rap at Check Dams	S.Y.	267	$2.43	Means 31 32 19.16 1510	$649
Turf Reinforcement Mat on Main Channels	S.Y.	1650	$7.55	Means 31 25 13.10 0060	$12,458
Turf Reinforcement Mat on Overbank Areas	S.Y.	9,046	$1.79	Means 31 25 13.10 0020	$16,192
Remove Trees (26" to 36" diameter) from Dam	Each	2	$520.00	Means 31 13 13.20 3200	$1,040
Remove Stumps from Dam	Each	2	$245.00	Means 31 13 13.20 2150	$490
Remove/Demolish Existing Spillway Slab	S.F.	440	$6.85	Means 02 41 16.17 0420	$3,014
Remove/Demolish Existing Spillway Sidewalls	C.F.	804	$5.05	Means 02 41 13.33 1400	$4,060
Remove/Demolish Masonry Wall at Breach	C.F.	1350	$5.05	Means 02 41 13.33 1400	$6,818
Hydroseeding	M.S.F.	96.3	$62.50	Means 32 92 19.14 4400	$6,019

Subtotal Items	**$251,315**
Project Overhead and Profit at 10%	$25,132
Contingency at 5%	$12,566
Total Cost	**$289,012**

Stream Restoration 0.15 miles x $1 million/mile = ***$150,000.00***

Range in Opinion of Cost **$289,012 - $439,012**

TABLE 3
OPINION OF CAPITAL COSTS
BREACHING HERSHEY MILL DAM

Notes:

1. Costs assume that masonry removed from existing dam will be used as rip rap for stream restoration.
2. Costs assume that the fill excavated from the dam embankment will be used to fill floodplain immediately downstream of dam.
3. Costs assume that the remaining sediments can accommodate grading, earthworks, and restoration activities.
4. Costs assume that the sediments can be disposed as clean fill material.