Pennoni
PENNONI ASSOCIATES INC.
CONSULTING ENGINEERS

December 9, 2014

EGOS 0611

Rick Smith, Township Manager
East Goshen Township
1580 Paoli Pike
West Chester, PA 19380

RE: Milltown Reservoir Dam (DEP Permit No. D15-146)
Construction Cost Estimates/Alternatives Analysis

Dear Rick:

In accordance with the Construction Cost Estimate/Alternatives Analysis phase of our September 11, 2014 letter regarding the referenced dam, we have investigated: 1) reinforcing the dam; and 2) breaching the dam. This analysis is based on the assumption that the DEP's calculations are reasonably accurate (see July 18, 2014 correspondence by Ronald Mease, PE of DEP's Division of Dam Safety, attached).

In brief, the informal analysis completed by the DEP indicates that during the ½ peak maximum flood (PMF) event, the spillway overtopping depth exceeds four (4) feet. Per current regulations, this depth is unacceptable and must be addressed by either reinforcing or breaching the dam.

All probable project costs include engineering and design, but are exclusive of construction administration costs.

REINFORCEMENT

The earthen dam face measures approximately 220 feet wide by fifteen (15) feet high. The dam has a 70-foot wide concrete spillway. The earthen dam face is at a slope of approximately 1:1.5 (H:V) and 35 feet long. Therefore, the area requiring reinforcement is approximately 7,700 square feet.

Several alternatives are available to reinforce the earthen dam, outside of the spillway area. Each employs similar construction methods regarding installation, including the removal of the existing rock face down to the compacted earthen material and the installation of the selected reinforcement.

Typical reinforcement alternatives that we analyzed include:

1. Geomembrane liners/geocells

2. Gabions
3. Conventional or mass concrete
4. Precast concrete blocks/articulated concrete
5. Roller-compacted concrete (RCC)

Note we have excluded rip-rap reinforcement from our analysis, as the DEP had indicated the use of rip-rap for providing overtopping protection on this dam is no longer an acceptable practice.

All reinforcing options include $100,000 to re-bid and complete the sluice gate replacement project, as this will still be required by the DEP.

Geomembrane liners/geocells

This alternative includes the installation of a geotextile fabric, a geocell (plastic box), topsoil and seeding. The geocell is a three-dimensional honeycomb-shaped plastic grid. The geocell contains the soil and grass and holds it in a small space to minimize erosion from an overtopping event. The existing slope of the dam face is steeper than what is normally acceptable for this alternative. This alternative may require the face of the dam to be re-contoured. It will also require the installation of concrete termination walls at the top and bottom of the slope to reduce the susceptibility to undermining. It has been our experience that once a geocell is undermined, its susceptibility to failure is increased. Further engineering design would dictate the viability of this alternative.

Probable Project Costs: $350,000 to $400,000

Gabions

Gabions can be installed as a basket or a blanket. Both options permit stone that is smaller in diameter (i.e., four to eight-inches). The baskets are more expensive, as they require added excavation and construction time to install in a stepped manner. Blankets can be installed on the re-contoured surface of the embankment and attached with anchors. Baskets withstand higher erosive forces than blankets, therefore blankets will require additional anchoring than the baskets. We anticipate a combination of baskets and blankets would be utilized.

Probable Project Costs: $375,000 to $425,000

Conventional or mass concrete

This alternative involves covering the entire dam face with a layer of reinforced concrete. We anticipate the thickness of the concrete will be approximately 8 to 12 inches. The velocity of the water in an overtopping event will be higher than with the other alternatives. Therefore, additional protection would be required at the bottom of the dam face to prevent erosion.

Probable Project Costs: $400,000 to $450,000

Precast concrete/articulated concrete

There are a variety of prefabricated concrete products available for dam reinforcement. Concrete blocks require the removal of the existing ground cover to create a relatively smooth subgrade. Articulated concrete blocks arrive on-site in mats with the individual blocks tied together with a cable to create a pre-determined size. This alternative will require the installation of concrete termination walls at the top and bottom of the slope to reduce the susceptibility to undermining.

Probable Project Costs: $400,000 to $450,000

Roller-compacted concrete (RCC)

Roller compacted concrete (RCC) involves installing a slightly damp mix of concrete, spreading the material with a front end loader (or similar) and rolling the material with a vibratory roller. The concrete is typically placed in one foot, level lifts. Since the height of the dam is approximately fifteen (15) feet, approximately fifteen (15) lifts will be required. The final product would have a stepped appearance. Typically this alternative is applicable to larger scale dams.

Probable Project Costs: $500,000 to $550,000

Engineering, Design and Permitting

Engineering and design would include preparation of bid documents and permitting coordination with the DEP. Since the reinforcement would disturb less than one (1) acre, no permits will be required from the Conservation District. However, per discussion with DEP the Division of Dam Safety will review any reinforcement project.

BREACHING THE DAM

Process

The removal of the dam and spillway requires a plan be submitted to the DEP's Division of Dam Safety. The DEP has outlined the process on the attached Fact Sheet, *Breaching of Dams in Pennsylvania.*

Although the DEP has streamlined the process to remove dams in Pennsylvania, they require several other agencies to be included in the permitting process. In order to obtain approval, DEP will require the input of the Fish and Boat Commission and the U.S. Army Corp of Engineers.

DEP's policy states if major environmental impacts are identified, the Township may be required to comply with a more comprehensive review process. This added review would be expected if an endangered plant or animal is impacted by this work. In such a situation the U.S. Fish and Wildlife Service would also be involved.

Once the plan is approved by the DEP (via a waiver process), a drawdown permit will be required from the Fish and Boat Commission and an Erosion and Sedimentation Control permit will be required from the Conservation District.

Per the current permit requirements, the entire dam does not need to be removed. DEP requires that the new stream channel be adequate for the 100-year storm event. Removing an adequate portion of the dam and spillway to "match" the upstream and downstream channels will minimize the volume of materials to remove. We anticipate: removing the entire spillway; removing the westernmost abutment and gate house; and removing a sufficient area of the earthen dam west of the gate house to permit appropriate grading of the area. The easternmost abutment would remain (see attached sketch, EX-1). In addition, the stream would need to be re-established upstream of the dam. We've estimated 750 feet of upstream stream restoration and have assumed that all silt would be able to remain on-site and distribute throughout the impoundment area.

Environmental concerns

The result of an initial Pennsylvania Natural Diversity Index (PNDI) request was non-specific, but the Fish and Boat Commission believes there are threatened "*sensitive species*" in the area. Depending on the nature of this issue, additional environmental coordination may be required. Environmental issues include:

1. Wetland evaluation
2. Threatened/endangered plants or animals evaluation (i.e. bog turtle, etc.)
3. Sediment evaluation (to identify any contamination)
4. Identification/methodology of sediment disposal locations
5. Stream bank restoration

We would also recommend that several samples of the silt behind the dam be tested early in the permitting process to determine any possible complications with relocating this material, whether on-site or off-site.

Costs

The engineering/permitting involves applying for a drawdown permit, preparing a plan that indicates compliance with DEP's Division of Dam Safety requirements, designing adequate E&S controls in order to obtain a permit from the Conservation District, addressing restoration, addressing the prevention of sediment entering Chester Creek, and creating construction documents for bidding purposes. It will also include coordination with DEP and various other agencies.

Construction costs involve the mobilization of the required equipment, installation of E & S controls, bypass pumping and drawdown, removal of gates, structures, earth and concrete, and the disposal of the same. If DEP permits materials to remain on site, this would reduce costs.

Probable Project Costs - $700,000 to $850,000

The range of the above project costs for the breaching alternative are due to the following factors, some of which would be further clarified by a pre-application meeting with DEP and preliminary engineering:

1. Access to work area, including bottom of dam
2. Construction challenges on the 1:1.5 slope
3. Unknown extent of stream restoration, silt conditions and silt quantities
4. Bypass pumping and dewatering issues
5. Limited construction staging area
6. Risk associated with significant storm events during construction

GRANTS

There are a number of grants available at the local, state, federal and private levels for the removal of dams, however, we are not aware of any grants that would be applicable to reinforcing the dam. Dam removal and stream restoration currently have significant support from various environmental groups. Some possible funding options include:

1. Growing Greener Watershed Protection (DEP)
2. H2O PA - High Hazard Unsafe Dam Projects (PA DCED)
3. Various fish-related programs (NOAA Restoration Center, U.S. Fish and Wildlife Service, National Fish Habitat Partnership, National Fish and Wildlife Foundation, etc.) if we can identify fish habitat restoration/benefits
4. Natural Resource Conservation Service (NRCS) – Watershed and Flood Prevention Operations Program
5. Rivers Conservation Development Grants (PA DCNR)
6. Water Resources Education Network (WREN) Grants (League of Women Voters of PA)
7. William Penn Foundation

Once the Township determines the preferred alternative, additional research would be completed to further identify those grants which currently have funding, are most applicable to the project and the most viable opportunity for the Township to pursue.

SUMMARY

The costs to reinforce the embankment will vary significantly depending on the alternative chosen. In some of the alternatives, such as gabions, there is minimal maintenance or repairs required for many years. In others, the upfront cost may be lower, but the annual maintenance

and inspection costs will be the ongoing operating cost of the dam. Reinforcing the dam will not address other ongoing issues, such as repairing the sluice gate valves, repairing and maintaining the spillway coating, annual inspections, graffiti control, and general liability/insurance requirements of owning a dam and reservoir. Future modifications to dam operation and maintenance standards by the DEP are unknown at this time.

Long term, the removal of the dam may be less costly than some reinforcement alternatives. Removal permanently eliminates future inspection and maintenance issues. The engineering costs involved in the removal will be higher than those anticipated for reinforcement alternatives. Environmental unknowns could further increase costs; therefore we have included a higher range of costs for this alternative.

Regardless of the decision the Township makes, we anticipate the next step would be to request a pre-application meeting with DEP representatives to further identify and confirm the permit and construction process.

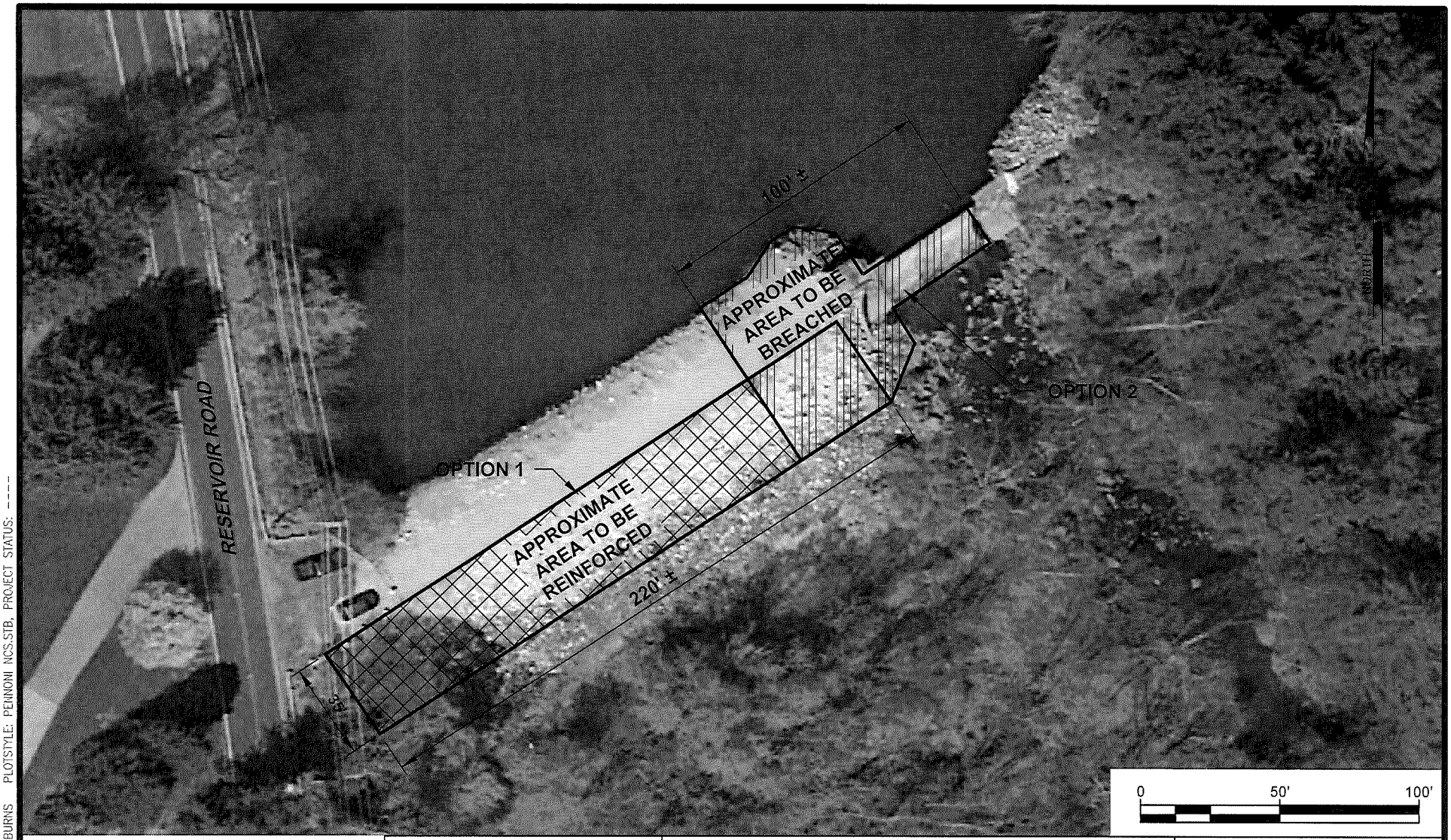
Should you have any further questions, please contact me.

Sincerely,

PENNONI ASSOCIATES INC.

Nathan M. Cline, PE
Township Engineer

cc: Mark Miller, Director of Public Works (via e-mail)



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PLOTTED: 10/3/2014 4:14:59 PM, BY: MATTHEW BURNS PLOTSTYLE: PENNONI NCS.STB, PROJECT STATUS: ----

Pennoni

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MILLTOWN DAM
RESERVOIR ROAD
WEST CHESTER, PA

APPROXIMATE WORK AREAS

EAST GOSHEN TOWNSHIP
1580 PAOLI PIKE
WEST CHESTER, PA 19380

PROJECT	EGOS 0611
DATE	2014-12-5
DRAWING SCALE	1"=50'
DRAWN BY	MJB
APPROVED BY	NC

EX-1

SHEET 1 OF 1