DECLARATION OF PAUL M. WOODWORTH

I, Paul M. Woodworth, of full age, having been duly sworn and upon my oath, do hereby declare:

Qualifications

1. My name is Paul M. Woodworth.
2. I am a currently employed as a Staff Scientist / Fluvial Geomorphologist by Princeton Hydro, LLC, a private consulting firm.
3. A true and correct copy of my curriculum vitae is attached as Attachment F.
4. As fluvial geomorphologist with Princeton Hydro since 2008, I have conducted numerous geomorphic assessments of streams and rivers for a range of restoration projects. Fluvial geomorphology is the study of the processes that form river channels. In over 20 projects focused on removal of barriers including dams, weirs and culverts, my role was to collect field data, write technical reports, design restoration plans, write state and federal permit applications, and over-see construction.
5. In the projects that I work on, components relate to channel form and stability, sediment contamination and transport, aquatic habitat restoration, and fish passage, among others.
6. Prior to joining Princeton Hydro, LLC, I studied fluvial geomorphology at the University of Connecticut from 2006 - 2008 and earned a M.A. in Geography focused in fluvial geomorphology. I studied the processes that form and influence stream and river channels. For my Master's thesis, I used computer modeling to depict changes

in stream channel habitat following a dam removal. Prior to graduate school, I worked for a Conservation District in Connecticut monitoring stream water quality and coordinating watershed protection and restoration projects. Combined, I have 10 years of experience in water resource assessment, protection and restoration.

7. I have been employed as a professional in stream restoration with particular respect to stream crossings, for example, recently, I helped design a replacement of a culvert road crossing known to obstruct fish movement following Massachusetts Stream Crossing guidelines and the Stream Simulation approach of the US Forest Service, and I have also trained members of a Pennsylvania chapter of Trout Unlimited to assess stream crossings (bridges and culverts) for fish passage and geomorphic compatibility.

8. Currently, I co-chair the Stream Restoration Committee of the New Jersey Chapter of the American Water Resources Association – a professional organization working to promote stream restoration throughout the Mid-Atlantic region.

9. In my capacity as a fluvial geomorphologist, I reviewed the engineering design plans entitled "Drawings for Construction of State Route 1012 Section 61M" (Approved 4/8/10) and visited both sites, Tettemer Road – Headquarters Road (at an unnamed tributary to Little Tinicum Creek) and Cafferty Road – Headquarters Road (at Little Tinicum Creek) on June 2, 2011 (hereafter Headquarters Road Replacement Bridge Project).

10. I have also reviewed correspondence and related files obtained by the Delaware Riverkeeper Network through a Freedom of Information Act Request dated May 23, 2011 (CENAP-OP-R-2011-0280 and CENAP-OP-R-2011-0281) from the US Army

Corps of Engineers. This material includes applications and supporting materials for the Pennsylvania State Programmatic General Permit (SPGP-3) submitted to Pennsylvania Department of Environmental Protection (PADEP, referred to as a "Water Obstruction and Encroachment Permit") and US Army Corps of Engineers (USACE) for the Headquarters Road Replacement Bridge Project. In addition, I have reviewed the erosion and sediment pollution control plan approval letters from the Bucks County Conservation District dated December 12, 2008 and December 3, 2009.

PennDOT Manual and Standards

11. Tinicum Creek and Little Tinicum Creek (aka Sundale Creek) are Exceptional Value (EV) streams (PA Code Section 93.9e Drainage List E) with antidegradation status and therefore warrant additional environmental design criteria in proposed development / construction projects to protect existing water quality, and eliminate additional water quality impacts under proposed conditions (PA Code Section 93.4c Implementation of antidegradation requirements).

11. 1. However, it appears that the Antidegradation standards and Post Construction Stormwater Management measures outlined in Section 13.7 of the PennDOT Design Manual 2 (Exhibit A) were <u>not</u> considered in the bridge and roadway designs referenced above for the Headquarters Road Replacement Bridge Project.

11.2 According to PennDOT Design Manual 2 Section 13.7 (Exhibit A), due to the EV status, this project warrants the highest (Level 4) Post Construction Stormwater Management measures to prevent or minimize any increase in the quantity (rate and volume) of runoff while also minimizing the factors affecting water quality.

Specifically, the target for Level 4 projects is to (1) reduce the post-construction runoff peak rate to the pre-construction peak rate for the 1-year through 100-year storm events and (2) reduce the post-construction runoff volume to the pre-construction runoff volume for the 2-year 24-hour storm event and smaller (Exhibit A, p. 13-29).

11.3 According to the engineering plans (referenced in Section 9 above) that involve widening the roads/bridges, no Post Construction Stormwater Management measures have been proposed by PennDOT or included in the projects to prevent or minimize any increase in the rate and volume of runoff or to minimize factors affecting water quality.

11.4 If Best Management Practices cannot prevent an increase in stormwater rate, volume and quality, then Antidegradation Best Available Combination of Technologies (ABACT) BMPs (Best Management Practices) must be incorporated into the Project. These include according Table 13.11 (Exhibit A, p. 13-30):

Treatment BMPs	**Land Disposal**	**Pollution Prevention**
Vegetated swale	Bioslope	Street sweeping
Bioretention	Bioretention	Impervious disconnection
Constructed wetland	Vegetated filter strip	Slope roughening
Wet pond	Impervious disconnection	Pavement width reduction
Infiltration trench		Riparian buffers
Infiltration basin		Landscaping and planting
Infiltration berm		Soil amendments
Permeable pavement		

11.5 Vegetated swales are commonly used Best Management Practices (BMPs) because they can fit within narrow right-of-way spaces while providing drainage and post construction storm water (PCSM) functions (Exhibit A, p. 13-36). Vegetated swales are shallow depressions that receive runoff from adjacent impervious surfaces

and are designed to slow flow, promote infiltration, and filter pollutants and sediments while conveying runoff (Exhibit A, p. 13-36).

11.6 An infiltration trench is an excavated trench lined with filter fabric and backfilled with stone to encourage stormwater infiltration (Exhibit A, p. 13-39). Infiltration trenches also work well in narrow right-of-way spaces and can receive stormwater via sheet flow or channelized flow (Exhibit A, p. 13-39).

11.7 Pavement width reduction means not widening roadways, or other paved areas, but narrowing paved areas, such as narrower lanes. Pavement width reduction serves to reduce the area of impervious surface cover and thereby reduce the volume of stormwater runoff. Proposed designs in this category may consider lane widths that are less than design standards (Exhibit A, p. 13-35).

11.8 A riparian buffer is a vegetated area along a stream or river that protects the water resource from adjacent land use. Riparian buffers are recommended in the PennDOT Design Manual Section 13.7 (Exhibit A) because they "protect...water resources from pollution, prevent bank erosion, provide wildlife food and cover, and shade the adjacent water, moderating water temperatures for aquatic species," (Exhibit A, p. 13-36). "PennDOT projects that are adjacent to bodies of water with depleted riparian buffers may consider restoration as a structural BMP. ... Restoration design should be coordinated with PA DEP early in project development[.]" (Exhibit A, p.13-36).

11.9 According to PennDOT Design Manual 2 Section 13.7 (Exhibit A, p. 13-29), Level 4 projects require a water quality analysis, even if the targets for rate and volume have been met. In addition, the PennDOT Design Manual states that Level 4

Best Management Practices should be considered only after Level 1 – 3 Best Management Practices are applied (p. 13-45). The Design Manual also specifies that additional water quality calculations are required to demonstrate reductions in pollutants and directs the designer to Chapter 8 of the Pennsylvania DEP Best Management Practice Manual for the appropriate worksheets to document consistency with pollutant removal guidelines (Exhibit A, p. 13-45).

11.10 After examining the engineering design plans entitled "Drawings for Construction of State Route 1012 Section 61M" (Approved 4/8/10), it appears none of the water quality calculations above were performed for this Headquarters Road Replacement Bridge Project.

NPDES Permits

12. A NPDES Permit for stormwater discharges associated with construction activities is required for "earth disturbance activities that disturb equal to or greater than one (1) acre of earth disturbance, or an earth disturbance on any portion, part, or during any stage of, a larger common plan of development or sale that involves equal to or greater than one (1) acre of earth disturbance." (Exhibit G, Permit Summary Sheet for General or Individual NPDES Permits for Stormwater Discharges Associated with Construction Activities).

12.1. Exhibit G also specifies when an Individual Permit applies: "Construction activities which are not eligible for coverage under the General Permit as referenced in 25 Pa. Code Chapter 92, must utilize the Individual NPDES Permit Application for Stormwater Discharges Associated with Construction Activities. These activities include, but are not limited to, earth disturbance activities that

are located in "special protection" watersheds (high quality, exceptional value, and exceptional value wetlands)..." (Exhibit G, p. 1).

12.2. According to the engineering plans referenced in Section 9 above, the Limit of Disturbance at the Tettemer Road bridge site is 0.97 acres (Erosion and Sediment Control Plan, Sheet 5 of 5).

12.3. I imported a digital format (PDF) of this sheet (Erosion and Sediment Control Plan, Sheet 5 of 5) into a Computer Aided Drafting program (AutoCAD 2010) and retraced this Limit of Disturbance and found that the earth disturbance acreage at the tettemer Road bridge site is at least 1.53 acres. (It appears that the Limit of Disturbance actually extends outside the bounds of the sheet and therefore, is actually greater than 1.53 acres.)

12.4. This Tettemer Road bridge project exceeds the 1 acre threshold and therefore requires a PADEP NPDES Permit. Exhibit H shows this delineation over the Erosion and Sediment Control Plan, Sheet 5 of 5.

12.5. According to the engineering plans referenced in Section 9 above, the Limit of Disturbance at the Cafferty Road bridge site is reported as 0.84 acres (Erosion and Sediment Control Plan, Sheet 6 of 6).

12.6. I imported a digital format (PDF) of this sheet (Erosion and Sediment Control Plan, Sheet 6 of 6) into a Computer Aided Drafting program (AutoCAD 2010) and retraced this Limit of Disturbance and found that the acreage is in fact 1.117 acres. This Cafferty Road bridge project site exceeds the 1 acre earth disturbance threshold and therefore requires a PADEP NPDES Permit. Exhibit I shows this delineation over the Erosion and Sediment Control Plan, Sheet 6 of 6.

12.7. Regardless of the actual acreage of the Limit of the Disturbance, each of which requires a NPDES permit, the PADEP chose to consider the sites as one single project and issued one single Water Obstruction and Encroachment Permit for the proposed work at both bridge sites, Tettemer Road and Cafferty Road, as stated in the permit issuance letter addressed to PennDOT dated March 17, 2010, signed by James Newbold, Regional Manager of Watershed Management, PADEP (Exhibit J).

12.8. In addition, the USACE issued one single SPGP-3 permit for the proposed work at both sites, Tettemer Road and Cafferty Road as stated in the permit issuance letter addressed to PennDOT dated April 30, 2010 signed by Frank J. Cianfrani, Chief, Regulatory Branch, USACE (Exhibit K).

12.9. With the reported areas of Limits of Disturbance exceeding 1 acre (taken individually or combined), a PADEP NPDES Permit should have been applied for for the Headquarters Road replacement Bridge Project (consisting of both bridges), and was required to be issued prior to any construction.

12.10. The PADEP NPDES Permit Summary Sheet (Exhibit G) states that the three major components of the PADEP NPDES Permit are:

12.10.1. Post Construction Stormwater Management Plan

12.10.2. Thermal Impact Analysis

12.10.3. Antidegradation Analysis

12.11. A Post Construction Stormwater Management Plan must include a Stormwater Analysis that demonstrates, among other features, no increase in the

post-development total runoff volume for all storms equal to or less than the 2-yr / 24-hour event (Exhibit G, p. 2).

12.12. A Thermal Impacts analysis is required to evaluate potential impacts from increased impervious areas and the removal of riparian vegetation (Exhibit G, p. 2). "Applicants must evaluate such potential impacts ... and avoid, minimize, and / or mitigate such changes in temperature through ... BMPs that address temperature such as reductions in the impervious footprint of the project ... and the preservation / installation of riparian buffers" (Exhibit G, p. 2).

12.13. It appears no such total runoff volume or temperature analyses were completed for this Headquarters Road Bridge Replacement Project since PennDOT did not apply for a PADEP NPDES Permit.

Deficiencies and Impacts of Engineering Plans and Reports

13. PADEP Water Pollution Biologist, Christian M. Vlot, authored a letter (Exhibit D) requesting (i) mitigation at both sites for impacts to the EV watershed and (ii) an alternative analysis that includes the environmental considerations that were taken into account (hereafter "Vlot Letter"). (Note: the letter was obtained in digital form and was encoded to refresh the date upon opening; therefore, the date printed at the top of the page is inaccurate is not the date of authorship and should be disregarded.)

13.1. In written correspondence dated January 15, 2010 (Exhibit B), KCI Technologies (the engineering firm contracted by PennDOT to design and permit this project) responded to the PADEP technical deficiency comments, in the Vlot Letter. In this letter (Exhibit B), KCI proposed the removal of the bridge and roadway approach and a planting plan to satisfy the request for mitigation.

13.2. In addition, KCI provided a 1-page alternatives analysis (undated, Exhibit C) that briefly compares the structures of the design alternatives (bridge/culvert) and briefly identifies the environmental impacts that were reduced by the final chosen design.

13.3. For the Cafferty Road bridge project, the alternatives analysis (Exhibit C, p. 1) identifies two culvert designs that were considered. The first alternative was eliminated because it "was not constructable" (p. 1). The second alternative was recommended because of a "larger hydraulic opening, lower roadway profile and lower construction cost" (p. 1). A single paragraph explains briefly that three environmental impacts were reduced by the proposed design including skewed bridge alignment, decreased bridge width and stream encroachment with use of retaining walls (p. 1). However, no information was provided for a second, "constructable" alternative.

13.4. This alternatives analysis fails to analyze more than one viable option. A non-constructable option is not a viable alternative to analyze.

13.5. None of the alternatives consider the environmental impacts beyond the crossing structure itself, such as the width of the approach roadway and resulting encroachment into the stream, the type of bank construction, or floodplain re-creation.

13.6. Thus, this alternatives analysis not only did not arrive at the optimal design for upholding antidegradation standards and mitigating impacts to this EV watershed, but did not actually consider constructable alternatives or compare their impacts.

13.7. For the Tettemer Road bridge project, three alternatives were compared for costs (Exhibit C, p. 1). The least expensive option was recommended (Exhibit C, p.2). An additional paragraph cites the skewed alignment and decreased bridge width as factors that reduced stream impacts (Exhibit C, p. 2). No information about alignment or bridge width is provided for the other two alternatives.

13.8. None of the alternatives consider the environmental impacts beyond the crossing structure itself, such as restoration of the stream channel, or the planting / stabilization of the stream banks. This alternatives analysis (Exhibit C) fails to analyze all the important considerations for the potential alternatives and shows a lack of faith in the planning and design phase.

13.9. Thus, this alternatives analysis did not support a design that conforms to antidegradation standards and mitigation of impacts to this Exceptional Value watershed.

14. The landscaping detail included in the engineering plans (referenced in Section 9) is confined to the former cart-way of Headquarters Road at the Headquarters Road-Tettemer Road site.

14.1. No planting is proposed along the stream banks downstream of the crossing within the limit of disturbance which would help stabilize banks, shade the stream channel, moderate water temperatures and sustain dissolved oxygen concentrations.

14.2. Water temperature and dissolved oxygen are explicit components of the Exceptional Value antidegradation standards as defined in the Pa Code (Section 93.7 Specific water quality criteria, Chapter 93 Water Quality Standards).

14.3. Riparian buffers are recommended Best Management Practices for protecting streams from polluted runoff specified in the PennDOT Design Manual 2 (Exhibit A, p. 13-30).

14.4. A Memorandum of Meeting, dated May 26, 2009 (Exhibit E, written by KCI to attendees from USACE, PADEP, Tinicum Township and PennDOT) memorializes requests that were made for streambank stabilization and mitigation of riparian impacts and tree clearing.

14.5. According to the memo, a KCI representative stated that trees would be replanted on the former roadbed as mitigation (Exhibit E). No planting is proposed for the riparian area downstream of the road crossing therefore, these areas will likely be impacted by lack of shading, lack of native plants, diminished riparian habitat and increased potential for bank erosion as explained in Section 25 above.

14.6. Secondly, a USACE representative noted severe bank erosion downstream of the crossing and requested that bank stabilization be added to the project (Exhibit E). The USACE representative provided some preliminary design suggestions such as regrading, plantings and erosion control matting to reduce erosion of the downstream bank (Exhibit E). A PennDOT representative responded that "he would consult further with the Environmental Unit staff at District 6-0" (Exhibit E).

14.7. During my site visit on June 2, 2011, I confirmed the eroding condition of this bank.

14.8. The engineering plans do not include any design or specifications for any such bank stabilization or bank planting and as a result, this bank will continue to erode, contributing sediment to Little Tinicum Creek.

14.9. Thirdly, according to the above referenced Memorandum of Meeting (Exhibit E), attendees noted that the perched culvert in the adjacent private driveway is a barrier to fish movement migration; attendees recognized the bridge as a potential site for mitigation for other projects in the watershed. Instead, mitigation was proposed as described in Section 14.5 above.

15. The engineering plans (referenced in Section 9, Sheet 17 of 20) depict encroachment into the channel to accommodate the widening of the approach roadway at the Cafferty Road crossing.

15.1. This encroachment constitutes, in my professional opinion, the greatest impact to Little Tinicum Creek resulting from this project. During my visit to the site, I measured the existing channel width at 23 feet.

15.2. The areal extent of impact appears minimal on the engineering plans but amounts to narrowing the 23-foot wide channel by approximately 2-3 feet, or approximately 8.6-13.0% over a 100-foot length of the stream, upstream of the crossing as depicted in the above referenced engineering plans (referenced in Section 9, Sheet 17 of 20).

15.3. During my June 2, 2011 site visit, I noted that the opposing bank in this reach is composed of native soils and lacks bedrock, boulders or other erosion resistant materials.

15.3.1. Narrowing the channel will increase flow velocities and deflect the physical energy of stream flow from the retaining wall to the opposing natural, unarmored bank. It is very likely, based on my knowledge of geomorphic processes and my professional experience in stream assessments, the channel narrowing will cause accelerated erosion of the opposing bank. Accelerated erosion results in increased suspended sediment and turbidity in the water column and constitutes a violation of the antidegradation standards as defined in the Pa Code (Section 93.4a Antidegradation Requirements, Chapter 93 Water Quality Standards).

15.4. The Final Hydrologic and Hydraulic Report (Exhibit L, "Final Hydrologic and Hydraulic Report, S.R. 1012, Section 61M Headquarters Road Bridge Over Sundale Creek") required for the PADEP Water Obstruction and Encroachment Permit that contains manipulations of the channel cross-section under proposed conditions that render the model results invalid.

15.5. Close comparison of the channel cross-sections (Exhibit L, Appendices B and C) utilized in the hydraulic model reveals that dimensions of the channel were altered in ways inconsistent with the work proposed in the above referenced engineering plans (Section 9), thereby misrepresenting water surface elevations and velocities under proposed conditions.

15.6. For example, comparison of the dimensions at cross-section 6 under existing conditions (Exhibit L, Appendix B, Section 6) and proposed conditions (Exhibit L, Appendix C, Section 6) indicates that the top left bank, has been widened by approximately 5 feet (approximately to Station 62) from the existing conditions position (approximate Station 67). This expansion of the modeled cross-section alters the hydraulic conditions, reducing water surface elevations and velocities computed by the model.

15.7. No work is proposed for this stream bank in the above referenced engineering plans (Section 9); therefore, this is a misrepresentation of proposed conditions and raises serious doubts about the integrity and accuracy of the Final Hydrologic and Hydraulic Report (Exhibit L).

15.8. A second example of flaws in the Final Hydrologic and Hydraulic Report (Exhibit L) may be found at cross-section 4.1 (downstream of the Headquarters Road crossing). Comparison of cross-section 4.1 under existing conditions (Appendix B, Section 4.1) and proposed conditions (Appendix C, Section 4.1) indicates that the bottom of the channel is leveled off at elevation 225.

15.9. This expansion of the modeled cross-section alters the hydraulic conditions and reduces water surface elevations and velocities computed by the model.

15.10. No modification of the bedrock stream bed is proposed in the engineering plans (referenced Section 9); therefore, this is a misrepresentation of proposed conditions and raises doubts about the integrity and accuracy of the Final Hydrologic and Hydraulic Report (Exhibit L).

16. At the Cafferty Road bridge project site, the engineering plans (referenced in Section 9) propose the use of retaining walls for over 500-linear feet of stream.

16.1. The use of retaining walls precludes the establishment of native bank vegetation such as herbs, shrubs and trees which help moderate water temperatures and maintain optimal dissolved oxygen concentrations.

16.2. Precluding a riparian buffer prevents stream shading, exposing surface water to direct sunlight and subjecting the water to increased temperatures during warm months and causing a parallel reduction in dissolved oxygen concentrations. In addition, exclusion of bank vegetation eliminates cover for fish and other aquatic organisms.

16.3. Water temperature and dissolved oxygen are explicit components of the Exceptional Value antidegradation standards as defined in the Pa Code (Section 93.7 Specific water quality criteria, Chapter 93 Water Quality Standards).

16.4. Changes in existing water quality constitute a violation of the antidegradation standards as defined in the Pa Code (Section 93.4a Antidegradation Requirements, Chapter 93 Water Quality Standards).

17. I observed during my site visit that the streambed in the reach at the Headquarters Road – Cafferty Road is dominated by bedrock with only sparse deposits of sand, gravel and plate-shaped, cobbles (a product of the watershed's shale bedrock).

17.1. The engineering plans (referenced in Section 9) describe bank material as being "choked with streambed material" (Sheet 17 of 20; Sheet 19 of 20; Erosion and Sediment Control Plan S-26292, Sheet 5 of 5; and Erosion and Sediment Control Plan S-26291, Sheet 6 of 6).

17.2. The Environmental Assessment (Exhibit M) submitted to PADEP and USACE includes a description of the macroinvertebrate community and demonstrates that the project reach supports a diverse assemblage of pollution tolerant taxa (Exhibit M, Enclosure C, p. 2-3).

17.3. The macroinvertebrates identified in the above Environmental Assessment (Exhibit M) inhabit the crevices and interstitial spaces within these isolated sediment deposits for foraging, finding refuge from current and predators, and living out most of their life cycles (Allan, J. D. and Castillo, M.M. 2007. Stream Ecology: Structure and function of running waters. Second edition. p. 88.).

17.4. Any removal of this limited substrate for re-use as bank armoring would deplete the project reach with essential habitat and negatively impact the aquatic community.

17.5. Furthermore, it is uncertain if the project reach contains enough sediment (without excavating banks and the bedrock stream bottom) to serve as a useful source for mixing with stream bank armoring.

18. For the reasons stated above, it is my professional opinion that the engineering plans (referenced in Section 9) for the Headquarters Road replacement Bridge Project (for both bridges and associated structures):

18.1. Do not comply with the antidegradation standards incorporated in the PennDOT Design Manual 2,

18.2. Do not adequately mitigate impacts to the stream channel and water quality and,

18.3. Constitute a violation of the antidegradation standards as defined in the Pa Code (Section 93.4a Antidegradation Requirements, Chapter 93 Water Quality Standards).

19. Per the PennDOT's Manual, Part 2, relating to stormwater, the water quality of Tinicum Creek and Little Tinicum Creek will be degraded if the Headquarters Road Replacement Bridge Project is constructed as designed, without the benefit of the analyses and calculations described above that are required by NPDES permit applications, and without the incorporation of Post Construction Stormwater Management measures and practices and Antidegradation Best Available Combination of Technologies (ABACT), all of which would be impractical if not impossible to incorporate into the Project after the fact of construction.

20. The degradation of the water quality of Tinicum Creek and Little Tinicum Creek from an increase in volume and rate of runoff, and an increase in temperature and turbidity is highly likely beginning with the anticipated start of construction of the Headquarters Road Replacement Bridge Project this week.

Sworn to and subscribed before me

this 12th day of July, 2011

Paul M. Woodworth

Paul M. Woodworth

Sworn to and subscribed before me this 12 day of July, 2011

Gail A. Skupien

GAIL A. SKUPIEN
NOTARY PUBLIC OF NEW JERSEY
My Commission Expires July 25, 2014