Bushkill Creek Survey Report
3rd Street to the PA Route 22 Overpass

CE 421 Hydrology Class
Prof. David Brandes
Dept of Civil & Environmental Engineering
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Author:
William Thomas Barlow, EIT
License Number: ET013832
Certification Date: 06/18/2010

barloww@lafayette.edu
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1. Background

The purpose of this report is to provide the necessary base mapping for the continued analysis of the Bushkill Creek low-head dam on Lafayette College owned property near 3rd Street in the city of Easton. The feasibility of this structure to provide hydro-power to the existing buildings in the immediate area was previously evaluated in the spring of 2009 and a report of those findings is available through the Department of Civil and Environmental Engineering. It appears, based on the aforementioned report, that a project utilizing hydropower at this location is neither economically or technically feasible based on currently available technologies.

Therefore focus has shifted from utilizing and rehabilitating the existing dam to the removal of the structure. This could be accomplished through the cooperation of private industry with various local and state regulatory agencies including the Pennsylvania Fish and Boat Commission which provides funding for projects similar to this one in both size and scope. This base mapping is being prepared in conjunction with separate reports that will analyze the potential environmental impacts of the removal of this dam, the flood protection which the current dam may or may not provide, and the potential hydraulic impacts to the channel if the dam were removed.
2. Site Description

The Bushkill Creek dam is located approximately three hundred feet (300’), west of the bridge at north Third Street in the City of Easton. There are existing structures built over the channel by using concrete piers. The survey of the channel began at the face of the first row of piers and continued to the west. The western limit of the survey is the Pennsylvania Department of Transportation (PennDOT) bridge for Route 22 over the Bushkill Creek and Bushkill Drive / Pearl Street. The total length of surveyed channel is approximately nine hundred feet (900’). Figure 1 below shows a topographic map of the general project area from a USGS 7.5 minute, 1:24000, Easton PA-NJ quadrangle.

![Figure 1: Topographic Map of Bushkill Creek](image)

The survey located the edges of existing pavement for Bushkill Drive / Pearl Street. The northern edge of pavement is also the bottom of the embankment at the base of the college campus. This also represents the northern limit of the survey. The southern limit of the survey is the top of the stream embankment adjacent to a recently demolished industrial facility, an existing warehouse, and a recently refurbished parking area. An aerial photograph, from Google Maps, is shown in Figure 2 below and better depicts the limits of the survey.
3. Methods & Objectives

In order to provide adequate base mapping to support the analyses mentioned in the Background section of this report two types of surveys were conducted. First, a horizontal and vertical traverse was established which encompassed the project area. According to the *Land Surveyor Reference Manual*, “a traverse is a series of lines connecting successive instrument stations of a survey. The relative position of the stations is determined by the direction and length of the lines (Harbin 1989).” The traverse is sometimes referred to as the “control” for a survey. In this case, a particular type of traverse was employed, which is called a closed traverse or loop traverse. Again using the definition from the *Land Surveyor Reference Manual*, “The closed traverse, also called the loop traverse, starts and ends at the same point. Because it is a closed polygon, the interior angles and lengths of the sides may be checked for accuracy and
mathematically adjusted (Harbin 1989).” By using this type of survey the accuracy and precision of the survey can be measured and reported.

The second type of survey conducted at this location if a topographic survey. This is done to create a topographic map or contour map of the area. Referring to the *Land Surveyor Reference Manual*, “Topographic Surveys are made to determine the relative positions of points and objects so that a map maker can accurately represent their positions on the map (Harbin 1989).” Each contour line shown on a topographic map is an imaginary line at the ground surface representing an equal vertical elevation. The contour interval is the vertical distance separating two adjacent contour lines. The most common intervals used for detailed mapping are one and two foot spacing and the one used here is the one foot spacing. This means that each contour line shown on the finished topographic map represents one foot of vertical elevation change. The spacing of the contour lines between one another also gives an indication of how steep the ground slopes. For example the closer these lines are spaced the more steep the elevation change of the ground. The farther apart contour lines are spaced the flatter or more gradual the ground slope.

4. **Horizontal & Vertical Control Survey**

The control loop was started at a nail set along the southern edge of pavement of Bushkill Drive / Pearl Street. This point was also located just north of the existing dam. The first back-sight was established at the intersection of Bushkill Drive with North Third Street. A radial control point was established in a concrete structure on the north side of the existing dam and overlooking the area. The next control point was established travelling west and set near the northern edge of pavement of Bushkill Drive / Pearl Street and to the east of an existing two-story residential dwelling. A radial control point was established in a concrete structure along the north side of Bushkill Creek with a view of the island below the Route 22 overpass. The next control point, travelling south and west was established at the intersection of Bushkill Street with Pearl Street and sighting under the Route 22 overpass structure. This point was set in the Bushkill Street Bridge over the creek. The next control point was established travelling east along Bushkill Street on the northeast corner of the Route 22 off-ramp. The next control point was established travelling east along Bushkill Street at the northwest corner of the intersection with North Third Street. The next control point which was observed was also the first back-sight point located on the northwest corner of the intersection of North Third Street and Bushkill Drive. The last observations were made by occupying this control point and closing the traverse to the point of beginning at the first control point.

The Horizontal and Vertical Control data were recorded in a field book and the corresponding notes are included as *Attachment A* at the end of this report.
control station, observations were made direct and inverse to help reduce error. This data was entered into an Excel spreadsheet to determine the average observed angles in both the horizontal and vertical direction. The average horizontal angle was then used as the interior angle of the traverse loop, sometimes referred to as the angle turned. The reduction of this data is shown in the attached spreadsheet as Attachment B. A sketch of the raw or unadjusted traverse loop was prepared and is shown as Attachment C. The sum of the interior angles for any closed figure with \((n)\) number of sides is as follows:

\[
\text{Sum of Interior Angles} = (n-2) \times 180^\circ
\]

Using the above equation the total horizontal angular error can be determined. The total error for this traverse was calculated to be thirty-six seconds (36”). There are a total of six interior angles for this traverse and the error per control observation is six seconds (6”). The precision of the Topcon total station used for this survey was five seconds (5”). The angular precision for this control survey is within acceptable tolerances. The linear errors of closure were as follows:

<table>
<thead>
<tr>
<th></th>
<th>Hz.</th>
<th>Vt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1’</td>
<td>0.037’</td>
<td>0.004’</td>
</tr>
<tr>
<td>2-2’</td>
<td>0.027’</td>
<td>0.008’</td>
</tr>
</tbody>
</table>

The total perimeter of the traverse is approximately 2782.664’. According to the Land Surveyor Reference Manual, “The ratio of the error, or precision, of a traverse is the ratio of the error of closure to the perimeter. It is expressed with the numerator as one (1) and the denominator in round numbers. It is a measure of the precision of a traverse (Harbin 1989).” In this case the error of closure or ratio of error is as follows:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1’</td>
<td>1 / 75,207’</td>
</tr>
<tr>
<td>2-2’</td>
<td>1 / 103,676’</td>
</tr>
</tbody>
</table>

This indicates an error of one foot per 75,207 feet in distance. Although these errors indicate a survey with acceptable precision for the sake of completeness the traverse was balanced using the compass rule, sometimes called the Bowditch rule. This method of adjustment is most commonly used and applies when the angular and linear accuracies are approximately the same (Harbin 1989). According to the Land Surveyor Reference Manual, “Using the compass rule, the difference in the sums of the north and south latitudes is distributed over the latitudes of the traverse. A correction is made in the latitude of each side to bring the north and south latitudes into balance. The difference in the sums of the east and west departures is distributed in the same way (Harbin 1989).”
The equation is shown as follows:

\[
\text{correction for } AB = \frac{\text{dif in lat}}{\text{perimeter}} \times \text{length } AB
\]

The traverse loop was adjusted based on the above equation in both the north-south (latitudes) and east-west (departures) directions. The Excel Spreadsheet showing these calculations and corresponding corrections is shown as Attachment D at the end of this report. These control points were then inserted into an AutoCAD drawing file, specifically Land Development Desktop 2009 edition.

Once inserted it should be noted that the original survey was conducted based on an arbitrary, assumed datum with starting point located at the first established control point with the following coordinate information:

<table>
<thead>
<tr>
<th>Point #</th>
<th>Northing</th>
<th>Easting</th>
<th>Elevation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5,000.00</td>
<td>5,000.00</td>
<td>100.00</td>
<td>PK Nail</td>
</tr>
</tbody>
</table>

This information was then compared with two National Geodetic Survey (NGS) control points KV1684 and KV1464. The NGS data sheets for these two control benchmarks are shown in Attachment E at the end of this report. The Northampton County GIS department aerial photograph was then imported into the drawing. This mapping is based on the Pennsylvania State Plane – South Zone Coordinate system. Once inserted the positions of the two control points were located based on the arbitrary survey and the desired coordinate system mentioned above. The survey was then translated and rotated to the aerial photograph as accurately as possible.

The vertical benchmark for this survey is the NGS disk located in the east pillar of the entrance gate near the intersection of Bushkill Drive and North Third Street. The datum used is the stamped elevation of 196.217 as established in 1932. It should be noted that according to NGS this survey mark is of questionable or unknown stability because repeated measurements indicate possible vertical movement. The amount of vertical movement described is acceptable for the analyses being conducted on the dam, particularly the hydrologic / hydraulic analyses for which accurate relative elevations, (i.e. elevation difference), are required rather than absolute elevations. Therefore the elevation as marked on the stamped brass disk is being used and held as the vertical control benchmark for the survey.

The method employed here does not guarantee the accuracy of the control points or survey to within survey grade precision of the State Plane Coordinate system; however the values of the observed survey positions and their relative location based on the aerial photograph were extremely close to one another. The control points listed in the
coordinate index and shown as Attachment F at the end of this report are within a reasonable tolerance for the analyses being conducted on the existing dam.

5. Topographic Survey

The topographic survey was conducted on July 16, 22, and 23, 2010. Additional data was collected on November 6, 2010. Cross sections of the channel were located at approximately fifty-foot (50’) intervals. All defining features of the channel were located including edges of pavement along Bushkill Drive and Pearl Streets, top and bottom of embankment, several shots along the bottom of the stream bed, the island was located to the north and east of the Route 22 overpass, and the piers and parapet walls of the existing bridge were located. Measurements were taken to define the geometry of the dam, spillway, and concrete apron downstream of the structure. The piers of the existing buildings at North Third Street were also measured.

This information was collected using a TDS data collector / data logger. The raw data was imported into the control survey. The points were then used to create a topographic map with one foot contour intervals. The complete point file of all the data points is shown as Appendix G of this report. The complete topographic map showing the locations of the cross section generated for the data analysis of the existing dam structure is shown as Appendix H of this report. Vertical centerline profiles were generated from the base topographic mapping and are shown in the following Appendices:

- **Appendix I:** Centerline Profile of Bushkill Creek through Center of Island
- **Appendix J:** Centerline Profile of Bushkill Creek Main Channel around the North Side of the Island
- **Appendix K:** Centerline Profile of Bushkill Creek Secondary Channel around the South Side of the Island

Finally, the above mapping was combined into one sheet consisting of two plan views, one with an aerial photograph overlay and one without, and all three profile views. An exhibit size, not to scale, version of this drawing is shown in Appendix L at the end of this report. A full size, 24”x36” scaled copy of the same sheet is included in a separate folder at the back of this report.
6. References

7. Appendix A: Field Book Notes
TRIGONOMETRIC FORMULAE

Solution of Right Triangles
For Angle A. sin A = a/c, cos A = b/c, tan A = a/b, sec A = c/b, csc A = c/a, cot A = b/a

<table>
<thead>
<tr>
<th>Given</th>
<th>Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>a, b</td>
<td>c, A, B</td>
</tr>
<tr>
<td>a, c</td>
<td>B, A, C</td>
</tr>
<tr>
<td>A, a</td>
<td>B, C</td>
</tr>
<tr>
<td>A, b</td>
<td>B, C</td>
</tr>
<tr>
<td>A, c</td>
<td>B, C</td>
</tr>
</tbody>
</table>

Solution of Oblique Triangles
Given Required
A, B, a b = A sin A, C = 180° - (A + B), C = 180° - (A + B)
A, b, c b = A sin c, C = 180° - (A + B), C = 180° - (A + B)
A, c, C A = 180° - (A + B), C = 180° - (A + B), C = 180° - (A + B)
A, a, c b = A sin A, C = 180° - (A + B), C = 180° - (A + B)
A, b, c b = A sin c, C = 180° - (A + B), C = 180° - (A + B)
A, c, a b = A sin A, C = 180° - (A + B), C = 180° - (A + B)

Description:
- Control Loop Survey for Bushkill Creek Dam area geographical mapping
- Start Loop at Dam on North Side of Creek
- Looped Counter-Clockwise
- Traveled West along Bushkill Drive & Pearl St under PA Route 22 overpass
- Proceeded east along Bushkill Street to N. 3rd Street
- Proceeded north on N. 3rd Street to Bushkill Drive near B.M. at stone archway
- Proceeded west along Bushkill Dr. & Pearl St. to close traverse loop at R.O.B.

Bushkill Creek Control Survey
Dates: 7/12/2010 7/13/2010
Party: W.T. Balto
A. Bernstein
D. Brandt, Ph.D.
D. Germanoski, Ph.D.
T. Germanoski
M. Conlan
M. Thompson

~ 5:30 - 7:30 PM
~ 85° Sunny / Warm
~ Humid ~ 7/12/2010
~ 85° Humid / Overcast Rain at end of setup ~ 7/13/2010
### LAFAYETTE COLLEGE; DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING

<table>
<thead>
<tr>
<th>STA:</th>
<th>Hs</th>
<th>Ve</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>00-00</td>
<td>00</td>
</tr>
<tr>
<td>90</td>
<td>90-43</td>
<td>00</td>
</tr>
<tr>
<td>180</td>
<td>180-40</td>
<td>00</td>
</tr>
<tr>
<td>270</td>
<td>249-16-30</td>
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<tr>
<td>STA:</td>
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<td>2</td>
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<td>3</td>
<td>25-35</td>
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<tr>
<td>4</td>
<td>48-40-35</td>
<td>10</td>
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<tr>
<td>5</td>
<td>57-57-20</td>
<td>00</td>
</tr>
<tr>
<td>6</td>
<td>65-41-40</td>
<td>00</td>
</tr>
<tr>
<td>7</td>
<td>180-00</td>
<td>00</td>
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<td>8</td>
<td>249-41-50</td>
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</tr>
<tr>
<td>9</td>
<td>31-20-10</td>
<td>00</td>
</tr>
<tr>
<td>10</td>
<td>252-24-15</td>
<td>00</td>
</tr>
</tbody>
</table>

**Note:** last shot to BM - plus (2½ ft from G disk) ~ +0.177

**Rod Height Calibration:**
- when checked rod heights

<table>
<thead>
<tr>
<th>Green Rod</th>
<th>Yellow Rod</th>
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<tbody>
<tr>
<td>Act</td>
<td>4.5375</td>
</tr>
<tr>
<td>High</td>
<td>+0.177</td>
</tr>
<tr>
<td>Low</td>
<td>-0.0675</td>
</tr>
</tbody>
</table>

**Day 1:**
- B.S. = green rod
- F.S. = yellow rod

**Day 2:**
- B.S. = yellow rod
- F.S. = green rod

---

**KV1664 - NGS Data Sheet**
- target to face of brass
- to measured distance
- did not measure as reading

<table>
<thead>
<tr>
<th>Green</th>
<th>Yellow</th>
</tr>
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<tbody>
<tr>
<td>5.00 = 59 ¾”</td>
<td>5.00 = 61 ¼”</td>
</tr>
</tbody>
</table>

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**P.T. S = shot with green rod**
- KV1664 = shot with yellow rod
- PF 1 = shot with green rod
- PF 1 = shot with yellow rod
Cross Section Survey

Bushkill Creek

Dates: 11/04/2010

Notes:
- Cross Sections measured at 50' intervals along length of Bushkill Creek from up inside of dam.
- Rods checked & calibrated prior to collection.
- Rods checked & calibrated prior to collection.
- TDS, DO, pH, and temperature recorded.
- Runoff measured.
- Flow measured.
- Water quality samples collected.
- Water temperature measured.
- Water depth measured.
- Water velocity measured.
- Water clarity measured.
- Water color measured.
- Water odor measured.
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- Water color measured.
- Water odor measured.
- Water taste measured.
- Water temperature measured.
- Water depth measured.
- Water velocity measured.
- Water clarity measured.
- Water color measured.
- Water odor measured.
**Vertical Control**

<table>
<thead>
<tr>
<th>No.</th>
<th>HT (ft)</th>
<th>AV (ft)</th>
<th>TG (ft)</th>
<th>Elev. (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.150</td>
<td>0</td>
<td>0</td>
<td>100.030</td>
</tr>
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- **Average HZ:** 19.03
9. Appendix C: Raw Traverse Sketch

Angle Closure:
\[
\text{Sum of Interior Angles} = (n-2) \times 180°
\]
\[
(6-2) \times 180° = 720°
\]
Survey:
- 199.50 60
- 48.42 18
- 180.14 12
- 90.31 08
- 46.41 38
\[
\Sigma = 720° - 00' - 36''
\]
\[
\text{Error} = 36''
\]

Error per setup = 00' 00' 06"
5" instrument

Linear Error Closure:
\[
0.02684 \times (2 - 2)
\]
Total Perimeter of Traverse:
- 303.947
- 429.806
- 581.971
- 541.290
- 497.819
- 508.657
\[
\Sigma = 2782.464
\]

Ratio of Error / Hz Precision:
\[
\frac{0.02684}{2782.464} = 0.00304
\]

1 ft per 103.674 ft
Roughly
1 ft error per 19.6 miles
## Appendix D: Compass Rule Adjustment

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<th>Distance</th>
<th>Lat</th>
<th>Dep</th>
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<th>N</th>
<th>E</th>
<th>Elev</th>
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### PERIMETER

| 2782.664 |

### ADJUSTMENT

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11. Appendix E: NGS Data Sheets

The NGS Data Sheet

See file _dssdata.txt_ for more information about the datasheet.

DATABASE = , PROGRAM = datasheet, VERSION = 7.85

l

National Geodetic Survey, Retrieval Date = JUNE 30, 2010

KV1684

DESIGNATION - J 269 PAYH

KV1684

STATE/COUNTY - PA/NORTHAMPTON

KV1684

USGS QUAD - EASTON (1994)

KV1684

*CURRENT SURVEY CONTROL

KV1684

NAD 83 (1986) - 40 41 39. (N) 075 12 49. (W) SCALED

KV1684

NAVD 88 - 64.745 (meters) 212.42 (feet) ADJUSTED

KV1684

GEOID HEIGHT - -34.07 (meters)

KV1684

DYNAMIC HT - 64.715 (meters) 212.32 (feet) COMP

KV1684

MODELED GRAV - 980,157.4 (mgal)

KV1684

NAVD 88

KV1684

VERT ORDER - SECOND CLASS 0

KV1684

The horizontal coordinates were scaled from a topographic map and have an estimated accuracy of +/- 6 seconds.

KV1684

The orthometric height was determined by differential leveling and adjusted in June 1991.

KV1684

The geoid height was determined by GEOID09.

KV1684

The dynamic height is computed by dividing the NAVD 88 geopotential number by the normal gravity value computed on the Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45 degrees latitude (g = 980.6199 gals.).

KV1684

The modeled gravity was interpolated from observed gravity values.

KV1684

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<td>+/- 180 meters Scaled</td>
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<table>
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KV1684

NGVD 29 (??/??/??) 64.958 (m) 213.12 (f) ADJUSTED 2 0

KV1684

Superseded values are not recommended for survey control. NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

KV1684

See file _dssdata.txt_ to determine how the superseded data were derived.

KV1684

U.S. NATIONAL GRID SPATIAL ADDRESS: 18TVL819048 (NAD 83)

KV1684

MARKER: DD = SURVEY DISK

KV1684

SETTING: 36 = SET IN A MASSIVE STRUCTURE

KV1684

SP SET: BRIDGE

KV1684

STAMPING: J 269 1960

KV1684

STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL

KV1684

HISTORY - Date Condition Report By
KV1684  HISTORY       - 1960    MONUMENTED     PADH
KV1684  HISTORY       - 1961    GOOD         CGS
KV1684  HISTORY       - 20021117 GOOD      USPSQRD

KV1684

STATION DESCRIPTION
KV1684

DESCRIBED BY COAST AND GEODETIC SURVEY 1961
KV1684 '0.5 MI NW FROM EASTON.
KV1684 '0.5 MILE NORTH W EST FROM WHERE U.S. HY. 22 GOES OVER 3RD ST.
KV1684 'IN EASTON, LOCATED ON TOP OF THE SOUTH WEST WINGWALL OF A 200
KV1684 'FOOT CONCRETE BRIDGE OVER BUSHKILL CREEK AND BLACKTOP ROAD, 19.5
KV1684 'FEET SOUTH OF THE CENTERLINE OF EAST BOUND LANE, 33 FEET SOUTH
KV1684 'EAST OF THE CENTERLINE OF HY. 22, 56 FEET SOUTH WEST OF METAL
KV1684 'LIGHT POLE, ABOUT 1 FOOT ABOVE THE LEVEL OF THE HIGHWAY.
KV1684 'PENNSYLVANIA DEPARTMENT OF HIGHWAYS DISK DRILLED IN HORIZONTAL.
KV1684 'STAMPED J 269 1960.

KV1684

STATION RECOVERY (2002)
KV1684

RECOVERY NOTE BY US POWER SQUADRON 2002 (ML)
KV1684 'RECOVERED IN GOOD CONDITION.

*** retrieval complete.
Elapsed Time = 00:00:00
The NGS Data Sheet

See file dsdata.txt for more information about the datasheet.

DATABASE =  , PROGRAM = datasheet, VERSION = 7.85
1 National Geodetic Survey,  Retrieval Date = JUNE 30, 2010
KV1464

**CURRENT SURVEY CONTROL**

KV1464

KV1464 NAD 83 (1986) - 40 41 44. (N) 075 12 35. (W) 195.47 (feet) SCALED

KV1464 NAVD 88 - 59.580 (meters) 195.38 (feet) COMP

KV1464 GEOD HEIGHT - -34.06 (meters) GEOID09

KV1464 DYNAMIC HT - 59.552 (meters) NAVD 88

KV1464 MODELED GRAV - 980,159.1 (mgal)

KV1464 VERT ORDER - FIRST CLASS II

KV1464 The horizontal coordinates were scaled from a topographic map and have

KV1464 an estimated accuracy of +/- 6 seconds.

KV1464 The orthometric height was determined by differential leveling and

KV1464 adjusted in June 1991.

KV1464 WARNING-Repeat measurements at this control monument indicate possible

KV1464 vertical movement.

KV1464 Photographs are available for this station.

KV1464 The geoid height was determined by GEOID09.

KV1464 The dynamic height is computed by dividing the NAVD 88

KV1464 geopotential number by the normal gravity value computed on the

KV1464 Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45

KV1464 degrees latitude (g = 980.6199 gals.).

KV1464 The modeled gravity was interpolated from observed gravity values.

KV1464; North  East  Units  Estimated Accuracy

KV1464 SPC PA S - 154,340.  814,670.  MT (+/- 180 meters Scaled)

KV1464 SUPERSEDED SURVEY CONTROL

KV1464 NGVD 29 (??/??/??) 59.794 (m) 196.17 (f) ADJUSTED 1 2

KV1464 Superseded values are not recommended for survey control.

KV1464 NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

KV1464 See file dsdata.txt to determine how the superseded data were derived.

KV1464 U.S. NATIONAL GRID SPATIAL ADDRESS: 18T9L022049(NAD 83)

KV1464 MARKER: DB = BENCH MARK DISK

KV1464 SETTING: 50 = SET IN A LIGHT STRUCTURE

KV1464 SP_SET: PILLAR
KV1464 STAMPS: 196.217 GATE 1932
KV1464 STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY
KV1464 SATELLITE: THE SITE LOCATION WAS REPORTED AS NOT SUITABLE FOR
KV1464 SATELLITE OBSERVATIONS - October 04, 2009
KV1464
KV1464 HISTORY - Date Condition Report By
KV1464 HISTORY - 1932 MONUMENTED CGS
KV1464 HISTORY - 1961 GOOD CGS
KV1464 HISTORY - 1978 GOOD NGS
KV1464 HISTORY - 1984 GOOD USGSQU
KV1464 HISTORY - 20020105 GOOD USGSQU
KV1464 HISTORY - 20091004 GOOD GEOCAC
KV1464
KV1464 STATION DESCRIPTION
KV1464
KV1464 'DESCRIBED BY COAST AND GEODETIC SURVEY 1932
KV1464 'AT EASTON.
KV1464 'AT EASTON, NORTHAMPTON COUNTY, AT THE NORTH END OF NORTH THIRD
KV1464 'STREET AT ITS JUNCTION WITH COLLEGE AVENUE, AT THE MEMORIAL
KV1464 'ENTRANCE GATE TO LAFAYETTE COLLEGE, AND IN THE WEST FACE OF THE
KV1464 'EAST STONE PILlar. A STANDARD DISK, STAMPED 196.217 GATE 1932
KV1464 'AND SET VERTICALLY.
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KV1464 STATION RECOVERY (1961)
KV1464
KV1464 'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1961
KV1464 'RECOVERED IN GOOD CONDITION.
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KV1464 STATION RECOVERY (1978)
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KV1464 STATION RECOVERY (2002)
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KV1464 'RECOVERY NOTE BY US POWER SQUADRON 2002 (RCN)
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KV1464 'RECOVERY NOTE BY GEOCACHING 2009 (PR)
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12. Appendix F: Control Survey Points

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13. Appendix G: Complete List of Topographic Points

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14. Appendix H: Topographic Map
15. Appendix I: Centerline Profile of Bushkill Creek through the Center of the Island
16. Appendix J: Profile of Bushkill Creek Main Channel (North Side of the Island)
17. Appendix K: Profile of Bushkill Creek Secondary Channel (South Side of the Island)
18. Appendix L: Composite Plan View and Centerline Profiles of Bushkill Creek