Upper Moreland Township
Stormwater Management Improvement Implementation Plan

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February 2013

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I. Executive Summary

Upper Moreland Township has significant existing stormwater and flooding issues throughout all areas of the Township that threaten the health, safety and welfare of the residents, business community and the general public that commutes through the Township each day. This report identifies and describes existing problem locations and develops a rating system to prioritize implementation of improvements to alleviate those problems. The report further identifies ways to address those specific problems, ways to reduce the overall effect of flooding in the municipality and downstream, ways to improve water quality and ways to educate and involve the public. Lastly, the report discusses how to execute stormwater management improvement projects by identifying potential funding sources and partnering opportunities.

II. Background

Upper Moreland is a relatively old community in comparison to the surrounding municipalities in the Delaware Valley. Much of the Township was developed prior to the inception of stormwater management ordinance requirements and prior to the innovative stormwater management techniques applied in newer communities. As such, the Township's stormwater infrastructure is undersized, deteriorating and all together non-existent in many places. Further, where stormwater infrastructure does exist it only serves to convey stormwater with little to no consideration for reduction in peak flows, runoff volume or water quality enhancement.

The resulting effect of a highly developed Township with limited stormwater infrastructure is a community that has significant stormwater and flooding problems when it rains. In many cases, these flooding events occur with minimal amounts of rain and occur numerous times per year. In turn, the Township's residents are negatively affected by road closures, yard damage, building damage, decreased property values and even delayed emergency service response times in some cases. All of these negative effects threaten the health, safety and welfare of the community. In addition to the Township residents, the business community is affected as patrons can not access their stores and some businesses incur water damage. Lastly, as the Township contains several main traffic routes (Easton Road, York Road, Welsh Road, Moreland Road, Davisville Road and County Line Road) as well as a major SEPTA transit line and the Pennsylvania Turnpike, the commuters that traverse the township each day are affected by increased travel times.

The daily operations of the Township are also affected by the flooding problems. Public Works must expend resources to clean up after flood events, must proactively close roads in anticipation of rain events to protect motorists, and clean and maintain the Township's stormwater infrastructure to prevent additional drainage issues. The Township's Emergency Service Personnel (the Police Department, Fire Marshal's office, etc.) are often involved in water rescues of motorists and residents who become trapped in their cars and homes by flood water. These rescues threaten the safety of the emergency service responders and cause a burden to the tax base when residents need to be provided with

temporary housing. The flood waters have caused fires, building collapses, road failures and loss of life, among other hazards.

In addition to the health, safety and welfare concerns described above, the Department of Environmental Protection (DEP), in recent years, has increased the requirements that municipalities must meet to reduce stormwater runoff rates, stormwater runoff volume and the water quality of stormwater runoff reaching natural watercourses. These requirements include educating the public, getting the public involved, mapping the entire stormsewer system, monitoring stormsewer outfalls for illicit discharges, enacting ordinances to require new development and redevelopment projects to meet enhanced stormwater quality standards, training of municipal employees, good housekeeping techniques for Township staff and improvement to stormwater runoff quality through implementation of stormwater best management practices (BMPs).

III. Purpose

The goals of this report seek to improve the health, safety and welfare of the residents, business community and commuters of Upper Moreland Township by improving water quality, reducing flooding and reducing the negative effects caused by flooding. A goal of this report is not to identify stormwater problems associated with the need for more proactive maintenance activities. To that end, specific goals of this report are:

- Goal 1: To identify existing stormwater problems in the Township.
- Goal 2: Develop a rating system for the existing problems in order to prioritize implementation of solutions.
- Goal 3: Identify potential ways to address stormwater management, both for specific stormwater problems as well as improving stormwater quality and quantity throughout the Township.
- Goal 4: Identify potential partnering options to address stormwater management.
- Goal 5: Identify potential funding sources to address stormwater management.
- Goal 6: Identify potential BMP implementation locations throughout the Township and develop a rating system to prioritize implementation.
- Goal 7: Keep major thoroughfares open so all points of the Township can be accessed by emergency service personnel.
- Goal 8: Taking into account the information compiled in Goals 1 through 7, compile a list of recommendation steps the Township should take to implement improvements as funding becomes available.

IV. Data Gathering Process

The information contained in this report was obtained from multiple sources which include: previous reports, interviews with elected officials, public input and institutional knowledge from Township employees. Specifically, information was obtained from:

A. Interviews with the 7 Commissioners in Office during 2012

B. Public Input at Various Community Development Committee meetings, complaints received by the Township and other informal requests

C. Institutional knowledge from current and former Township employees; John Primus, Jack Snyder, Paul Purtell, Robert Drennen, Pat Stasio and David Dodies

D. Township-Wide Stormwater Study for Upper Moreland Township prepared by Chambers & Associates, Inc., dated February 2009, updated September 2009

E. Norwyn Road Drainage Study prepared by Chambers & Associates, Inc., dated January 26, 1983

F. Norwyn Road Drainage Problem Letter Report prepared by Chambers & Associates, Inc., dated May 18, 1995

G. Pennsylvania Environmental Council PennVEST Grant Application with supporting materials submitted to DEP on May 5, 2009

H. Pennsylvania Environmental Council PennVEST Grant Application with supporting materials submitted to PennVEST on February 16, 2009

I. Pennypack Creek Watershed Letter Report prepared by Jacques Whitford (now Stantec) outlining potential regional basin locations within Hatboro Borough, Horsham Township and Upper Moreland Township submitted to the Pennsylvania Environmental Council on February 19, 2009

J. Temple University's Center for Sustainable Communities draft Pennypack Creek Act 167 Study

V. Stormwater Accomplishments to Date

Upper Moreland has implemented various projects and initiatives designed to reduce the frequency and severity of flooding within the Township. Many of the constructed stormwater facilities also function to improve the quality of runoff that reaches the waterways. The following is a list of accomplishments that have been completed in recent years:

A. Through the land development approval process the Township was able to have the developer of the Student Housing (a.k.a College Station) project on

York Road install a stormwater pipe at the intersection of York Road and Lincoln Avenue to alleviate localized flooding due to insufficient pipe and inlet capacity. The estimated value of this improvement is $41,500.

B. Through a Transportation Enhancement (TE) Grant obtained through Congresswoman Schwartz' office the Township stabilized roughly 700 feet of streambank within Memorial Park between York Road and Mineral Avenue. The streambank stabilization improves water quality and through the use of vegetative stabilization techniques also slows down water within the stream to further reduce erosion downstream.

C. Through funding obtain through Montgomery County, the Township installed a small parking lot expansion in Memorial Park. Associated with the parking lot is an over-sized rain garden to reduce stormwater runoff from the area and improve water quality.

D. As of January 1, 2013 the Township has accumulated a Stormwater Management fund supported solely by private development contributions in the amount of $72,500. The donations have been provided by the PA Turnpike, Giant Fueling Facility and Miller's Ale House and date back to 2010. In addition to the $72,500 an additional $27,000 is committed when the Rosen Automobile Storage Land Development approval is finalized.

E. Associated with the Transit Management Overlay District Zoning Amendment; the developer for the Wawa offered as a Declaration of Covenant running with the development of the property to improve roughly 365 feet of Phase II of the Memorial Park Streambank Project. The improvement is valued at $127,000.

F. Through the land development approval of the residential conversion at 718 Fitzwatertown Road the Applicant is stabilizing the streambank on the property to improve water quality.

G. With assistance from PEMA and FEMA the Township bought out several properties along Bonnett Lane that were subject to frequent and severe flooding.

H. Through the Sabia land development approval of townhouses on Blair Mill Road, the Township was able to have the developer install stormwater drainage improvements to reduce localized drainage issues for the adjacent residential properties located along Linden Avenue.

I. At the request of the Township, the Upper Moreland-Hatboro Joint Sewage Authority stabilized the streambank along 2306 Terwood Road to improve water quality downstream.

J. Through the Progressive Insurance land development approval, the Township was able to reduce the amount of impervious which previously existed on the property while also having the Applicant oversize the stormwater management basin to further reduce stormwater runoff.

K. The Township partnered with the Huntingdon Valley Golf Course to install several infiltration trenches on the property to reduce stormwater runoff into the watershed.

L. The Township partnered with the Borough of Hatboro to remove and replace the bridge on Monument Avenue whose opening was undersized and causing flooding on upstream properties.

M. The Township upgraded a stormsewer culvert on Greyhorse Road to reduce localized flooding.

N. The Township participated in a committee which planted hundred of trees within Horsham Township. The trees reduce stormwater flow to downstream municipalities such as Upper Moreland Township.

O. In 2011 the Township adopted numerous amendments to the Township's Zoning and Subdivision and Land Development Ordinances that promote best management practices with regards to stormwater management.

P. The Township participated in the Act 167 Plan prepared by Temple University and anticipates adopting a model ordinance consistent with the plan in the near future.

Q. The Township performs public education, outreach and participation through numerous outlets such as the website, cable channel, email alerts, Township newsletter, ongoing agenda item on the Community Development Committee monthly meeting, etc.

VI. Rating System For Existing Problems

In an effort to create a way to prioritize potential stormwater management and flood mitigation projects, a rating system was developed to act as a non-partial guideline to determine the order in which existing flooding problems will be remedied. The rating system utilizes the data gathered by the sub-committee for each of the existing drainage problems that were identified throughout the Township.

The first step of the rating system is to break down the existing drainage problems into the following three categories based on the type of damage that is caused by flooding events. For the basis of this system no project from a lower priority "category" can take precedence over a project from a higher priority "category". For example, no project from Category 2 will be implemented until solutions to all problems within Category 1 have been considered. Once all feasible solutions are achieved in the higher priority category, solutions will begin to be implemented in the lower priority category.

Category 1 – Flooding that result in damage to the homes of Township residents. The frequent flooding in these areas results in property damage directly to houses and therefore represents the highest priority

to try and reduce and / or eliminate the frequency that flood waters damage houses within the community.

Category 2 – Flooding that result in damage within the right-of-way of Township owned streets or in some cases PennDOT highways. The flood waters result in road closures that affect the travel patterns of township residents and commuters as well as create delays in the response time of emergency services personnel. Costs are incurred by the township during and after flood events for items such as; setting up barricades on closed roads, directing traffic around closures, cleanup of debris from floodwaters, etc.

Category 3 – Flooding is mainly contained within the yards of private property, both residential and non-residential. The flooding is generally outside of the public right-of-way and damage to buildings is not incurred. Since the flooding does not occur within public streets or right-of-way, traffic and emergency response time are generally not impacted.

After the potential projects were broken down into the three categories discussed above, a more in-depth rating system was developed in order to differentiate between projects within the same category and ultimately determine the order in which solutions will be explored. The following five criteria were utilized to rank projects within each category; Frequency of Flooding, Depth of Flooding, Duration of Flooding, Emergency Response Delay Time and Average Daily Traffic (ADT) affected.

Frequency of Flooding: (1) Flooding typically occurs more than 3 times per year
(2) Flooding typically occurs between 1-3 times per year
(3) Flooding typically occurs less than 1 time per year

Depth of Flooding: (1) Typically flood depths are in excess of 1 foot
(2) Typically between 6 to 12 inches is observed
(3) Typically less than 6 inches of flooding is observed

Duration of Flooding: (1) Flooding generally lasts in excess of 4 hours
(2) Flooding generally lasts between 2 and 4 hours
(3) Flooding generally lasts less than 2 hours

ADT Affected: (1) Greater than 10,000 ADT impacted
(2) Between 1,000 and 10,000 ADT impacted
(3) Less than 1,000 ADT impacted

Emergency Response Delay: (1) Major delay and road closures
(2) Slight delay and no road closures
(3) No delay

A comprehensive list of the projects within each category along with their rating for each of the five specific criteria is attached as an appendix to this report. Please note that some minor prioritization changes were made when previous

attempts to solve a problem weren't accepted by a resident (by-out). Individual descriptions of each project along with potential remedies can be found in the *Existing Stormwater & Flooding Problems* section of this report.

VII. Existing Stormwater & Flooding Problems

The rating system outlined in the previous section was utilized to put all of the existing stormwater and flooding problems, identified during the data gathering process, into one of three distinct categories. Projects are then assigned priority within the categories based on the five criteria discussed in the previous section.

A. Existing Problems – Category 1

Project Location	Report Exhibit #	Priority
Davisville Between Terwood & Carson-Simpson	6.1a	1
2603 Broadway	2.4	2
Robert Bruce Apartments	2.2	3
Mill & York Road	5.1a	4
Warminster Road near Lori & Surrey Lane	5.2a	5

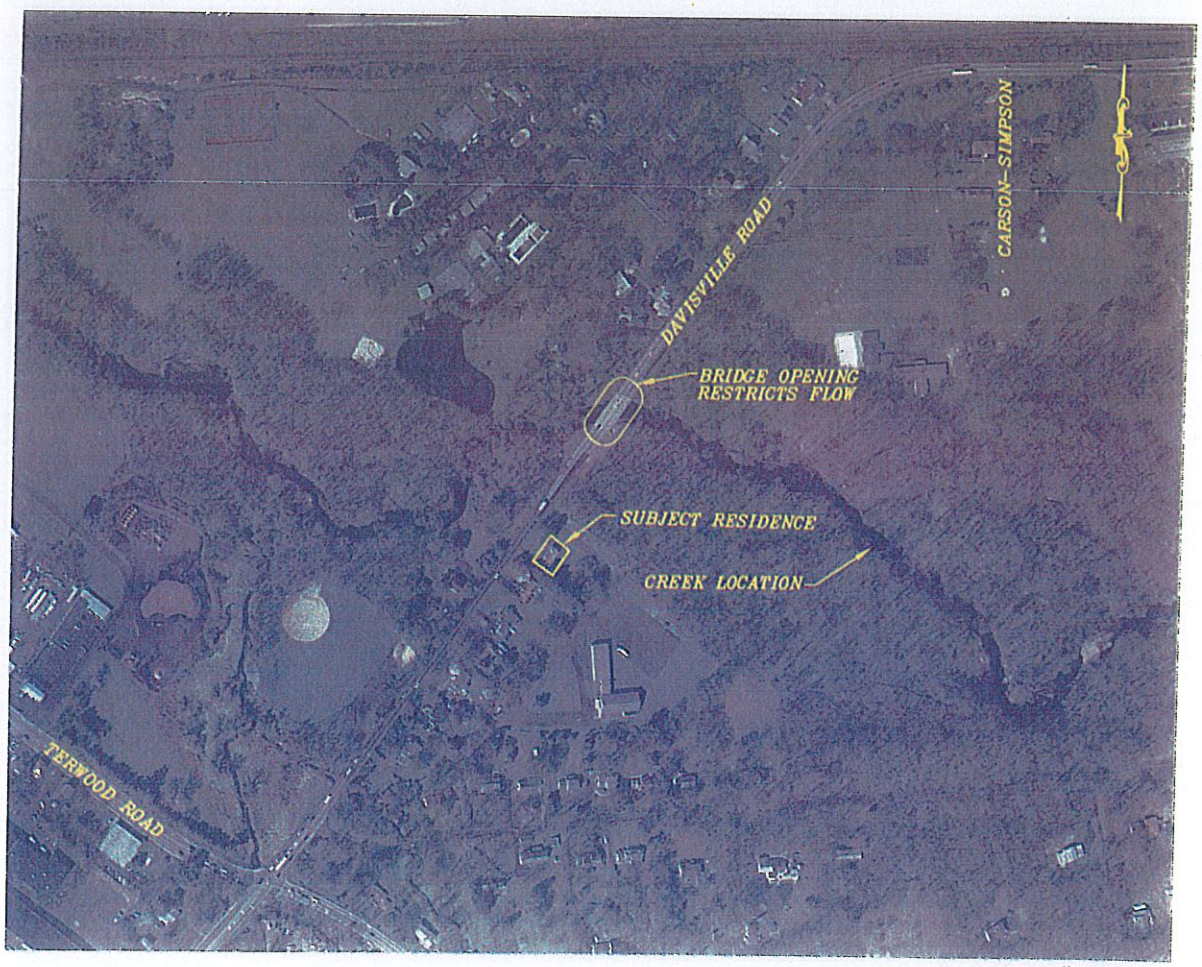
EXHIBIT 6.1a

Project Location:
Ward 6 – Davisville Road from Terwood Road to Carson-Simpson

Description of Problem:
Road & private property flooding is caused by flooding within the Pennypack Creek. The property highlighted below is known to experience building damage as a result of the severe creek flooding.

Potential Remedy:
Stream flooding is caused by regional drainage issues that are created by uncontrolled runoff from upstream areas within multiple adjacent municipalities. The only solution to try and correct the flooding in this area is to implement stormwater projects in upstream areas to reduce the volume of water within the Pennypack Creek, during rain events. A solution should first be explored to try and alleviate the flooding damage to the highlighted residence. Possible solutions could include a diversion / protective berm or to raise the elevation of the house above the flood line. It is quite possible that further investigation will conclude that the only viable option to alleviate the frequent building damage would be a buyout of the property.

Estimated Project Cost: $5,000



SCALE: 1"=500'

Project Location:
Ward 2 – 2603 Broadway Avenue

Description of Problem:
The rear yard of the highlighted property is the lowest point in the immediate area and does not have anywhere to drain. The backyard receives stormwater from the surrounding private properties as well as runoff during larger storm events from Broadway and Sycamore Avenues. A small inlet and trench were installed in the rear yard during the last 5-10 years in an attempt to infiltrate some of the water; however, the inlet is not connected to anything and does not function to reduce the flooding.

Potential Remedy:
The inlet on Broadway should be cleaned out to ensure that it is functioning as well as possible. Additionally, existing storm sewer in the area should be examined to determine if it is possible to install an inlet in the rear yard that could be tied into the existing system.

Estimated Project Cost: $10,000



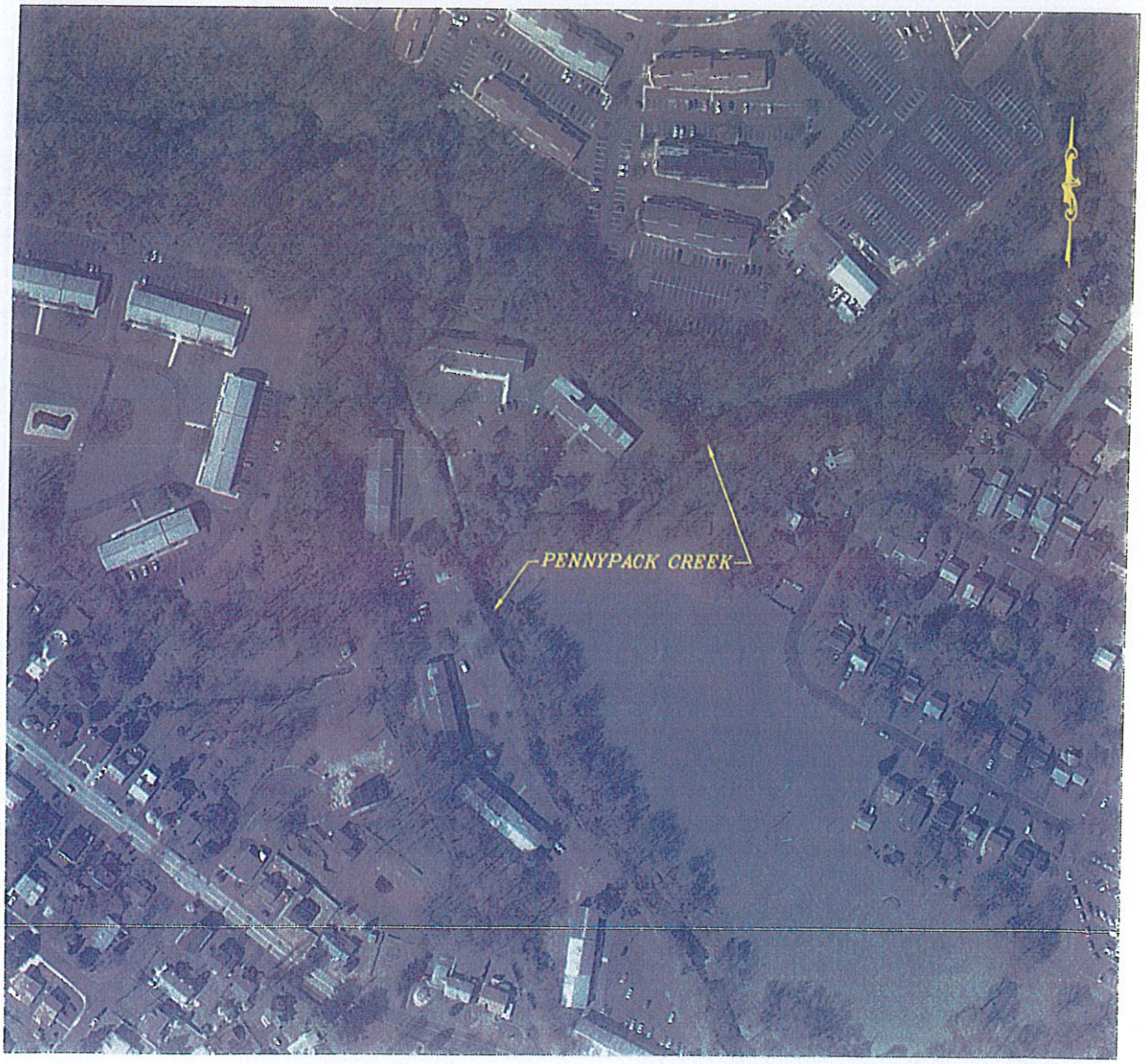
SCALE: 1"=200'

Project Location:
Ward 2 – Robert Bruce Apartments

Description of Problem:
Flooding within the Pennypack Creek causes damage to buildings within the apartment complex.

Potential Remedy:
The problem of flooding within the stream cannot be fixed on site. Basins need to be installed upstream in order to reduce the volume of water within the Pennypack Creek.

Estimated Project Cost: NA



SCALE: 1"=300'

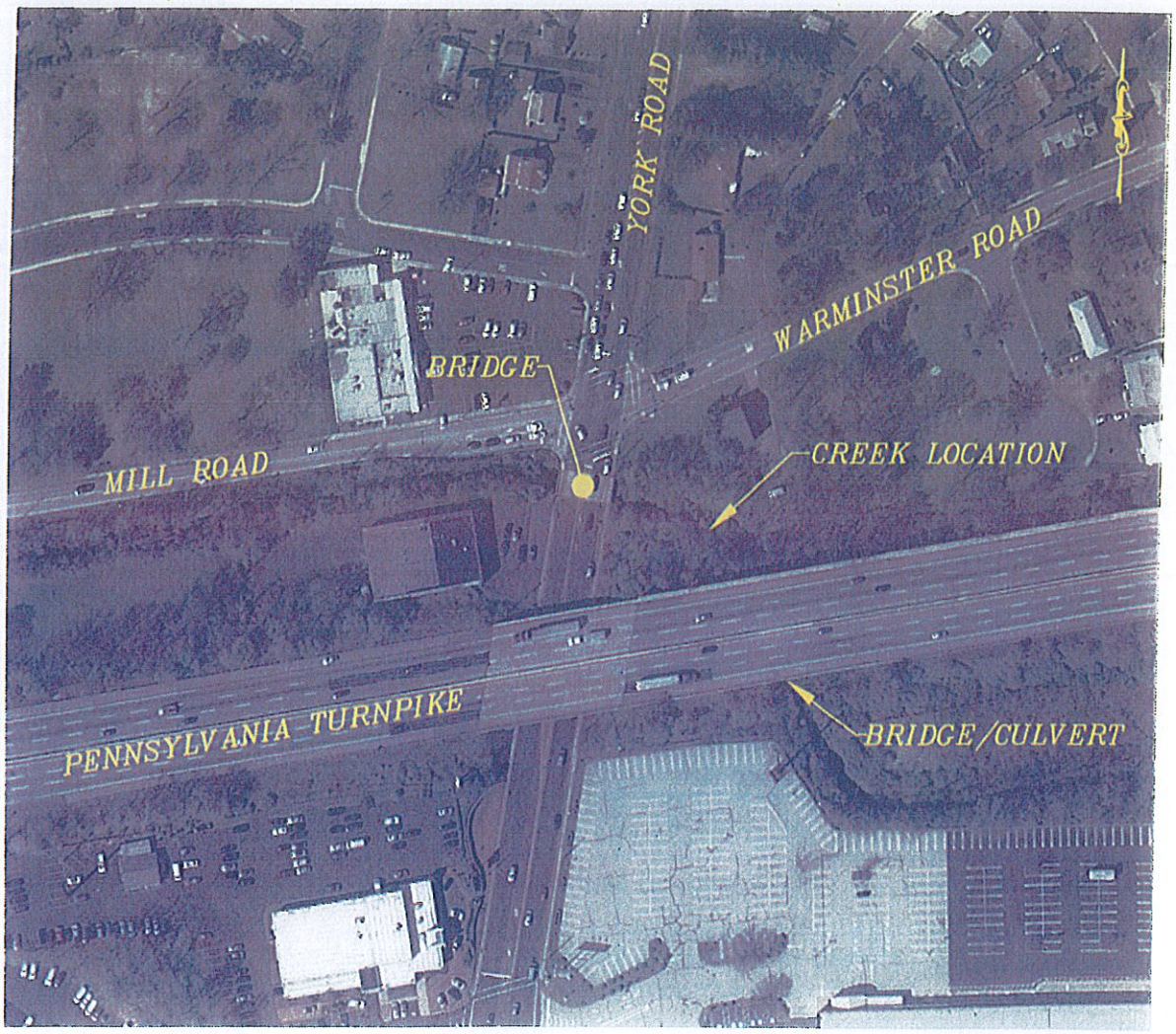
EXHIBIT 5.1a

Project Location:
Ward 5 – Mill Road & York Road

Description of Problem:
Intersection & private property flooding occurs due to flooding in the adjacent Pennypack Creek.

Potential Remedy:
The only viable solution to the problem is to implement stormwater basin projects in the areas upstream of this location to reduce the flooding in the creek. The other option would be to increase the stream opening under the Turnpike, but that would negatively affect downstream areas. It is our understanding that the property owners within this area that experience frequent flooding were offered buyout options. Some owners decided to take the buyout option and those houses have since been demolished, others decided to stay, essentially at their own risk. As such, this problem with regards to Category 1 can be eliminated for future consideration.

Estimated Project Cost: NA



SCALE: 1"=200'

EXHIBIT 5.2a

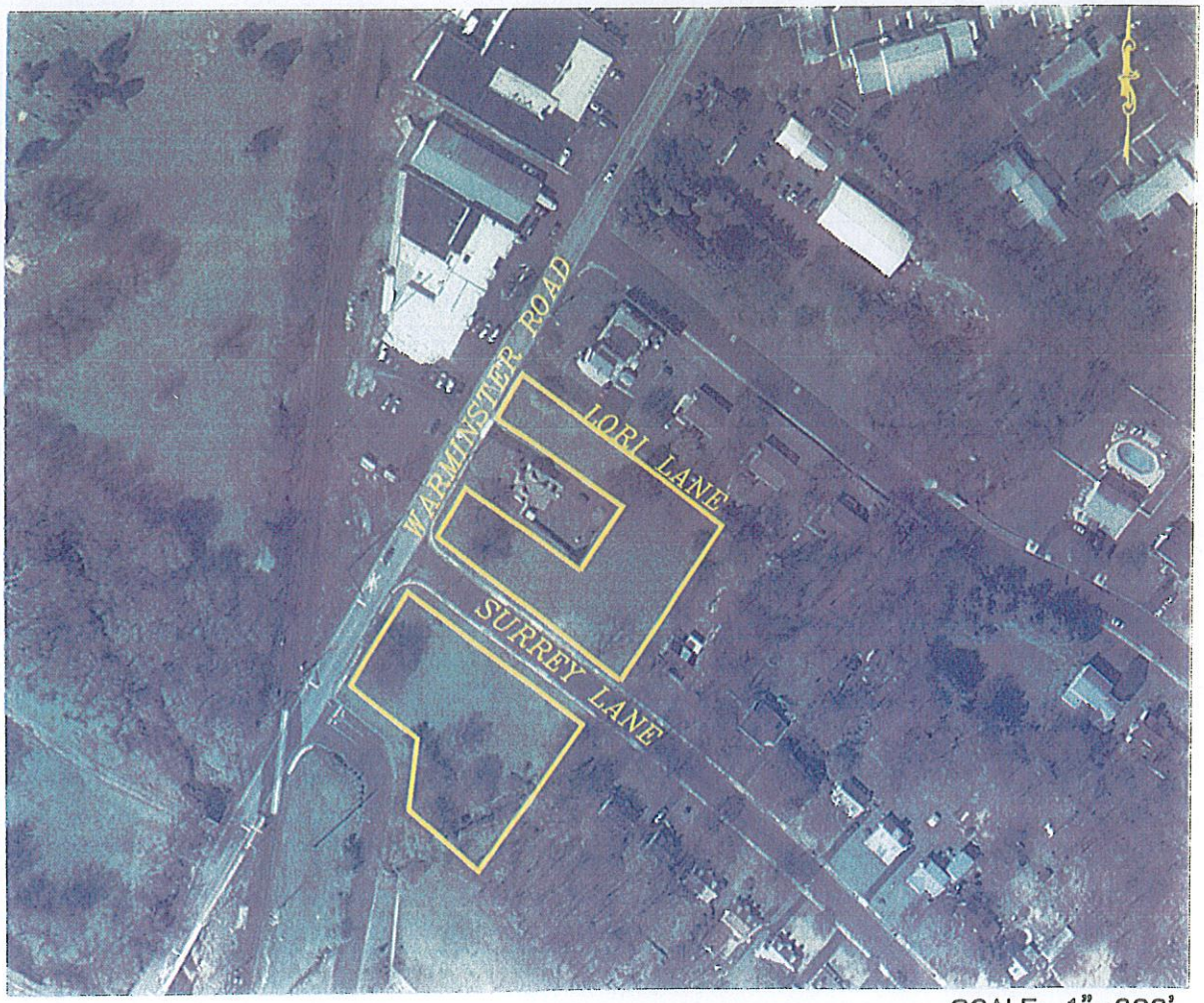
Project Location:
Ward 5 – Warminster Road near Lori Lane & Surrey Lane

Description of Problem:
There are no existing inlets or storm sewer system in this area. Roadway flooding occurs due to the lack of a proper drainage system.

Potential Remedy:
The Township owns property on both the north and south side of the intersection of Surrey Lane and Warminster Road (highlighted below). It is our understanding that the sole property on the north side of Surrey Lane that the Township does not own elected to decline buyout and to stay, essentially at their own risk.

This area has been identified as a potential location for the construction of a stormwater basin. If a basin were to be constructed in this area, the project would also need to incorporate a drainage system necessary to convey water to the basin.

Estimated Project Cost: NA



SCALE: 1"=200'

B. *Existing Problems – Category 2*

Project Location	Report Exhibit #	Priority
Davisville Between Terwood & Carson-Simpson	6.1b	1
Byberry Road Bridge near Pioneer	6.4	1
Mill & York Road	5.1b	1
Route 611 & Maryland Road	4.1	4
Mason's Mill Road Bridge	6.5	4
Blair Mill near County Line	2.8	6
Exton & Orangeman's Intersection	5.5	7
Terwood Road Tributary	6.2	7
Norwyn & Shirley Road	2.1	7
Whitehall Drive near Hideaway	4.2	10
Warminster Road near Lori & Surrey Lane	5.2b	10
Frazier & Evans Circle	1.4	10
Bonnett Lane at St. Dunstans Road	5.3	10
Church & Cherry Streets	1.8	14
Monument Avenue	2.3	15
Cameron & Sheldon Road	4.4	15
239 Cowbell Road	1.6	17
523 Grant Street	3.2	17
Duffield Street (natural spring)	3.3	19
Sheldon Road between Ellis & Fitzwatertown	4.5	19
1400 Terwood Road (PennDOT to fix)	6.3	21
Fern Village Park at Exton Road	7.1	22
Division & Krewson Street	1.7	22
Quigley Road	1.2	22

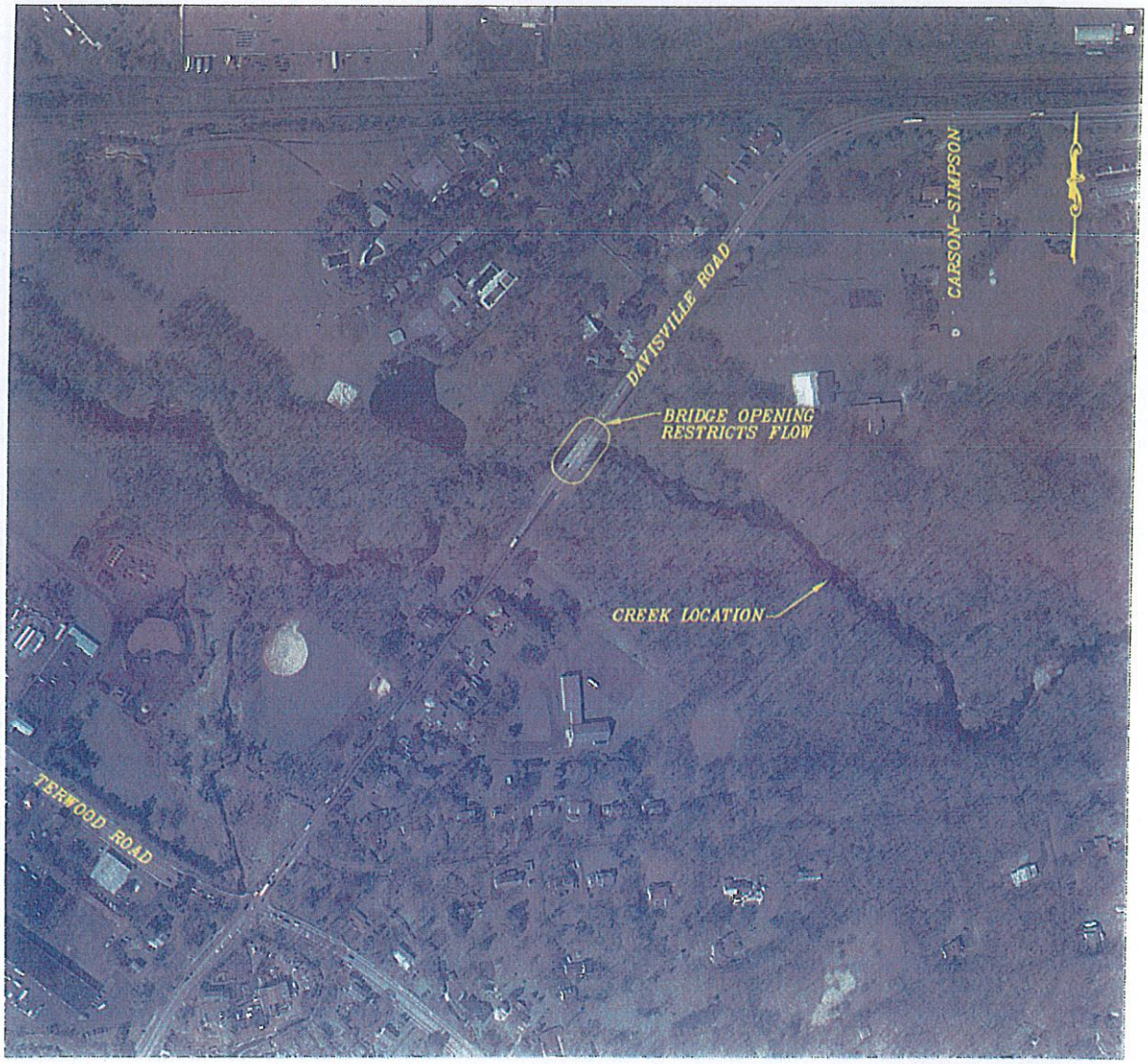
EXHIBIT 6.1b

Project Location:
Ward 6 – Davisville Road from Terwood Road to Carson-Simpson

Description of Problem:
Road flooding is caused by flooding within the Pennypack Creek.

Potential Remedy:
Stream flooding is caused by regional drainage issues that are created by uncontrolled runoff from upstream areas within multiple adjacent municipalities. The only solution to try and correct the flooding in this area is to implement stormwater projects in upstream areas to reduce the volume of water within the Pennypack Creek, during rain events.

Estimated Project Cost: NA



SCALE: 1"=500'

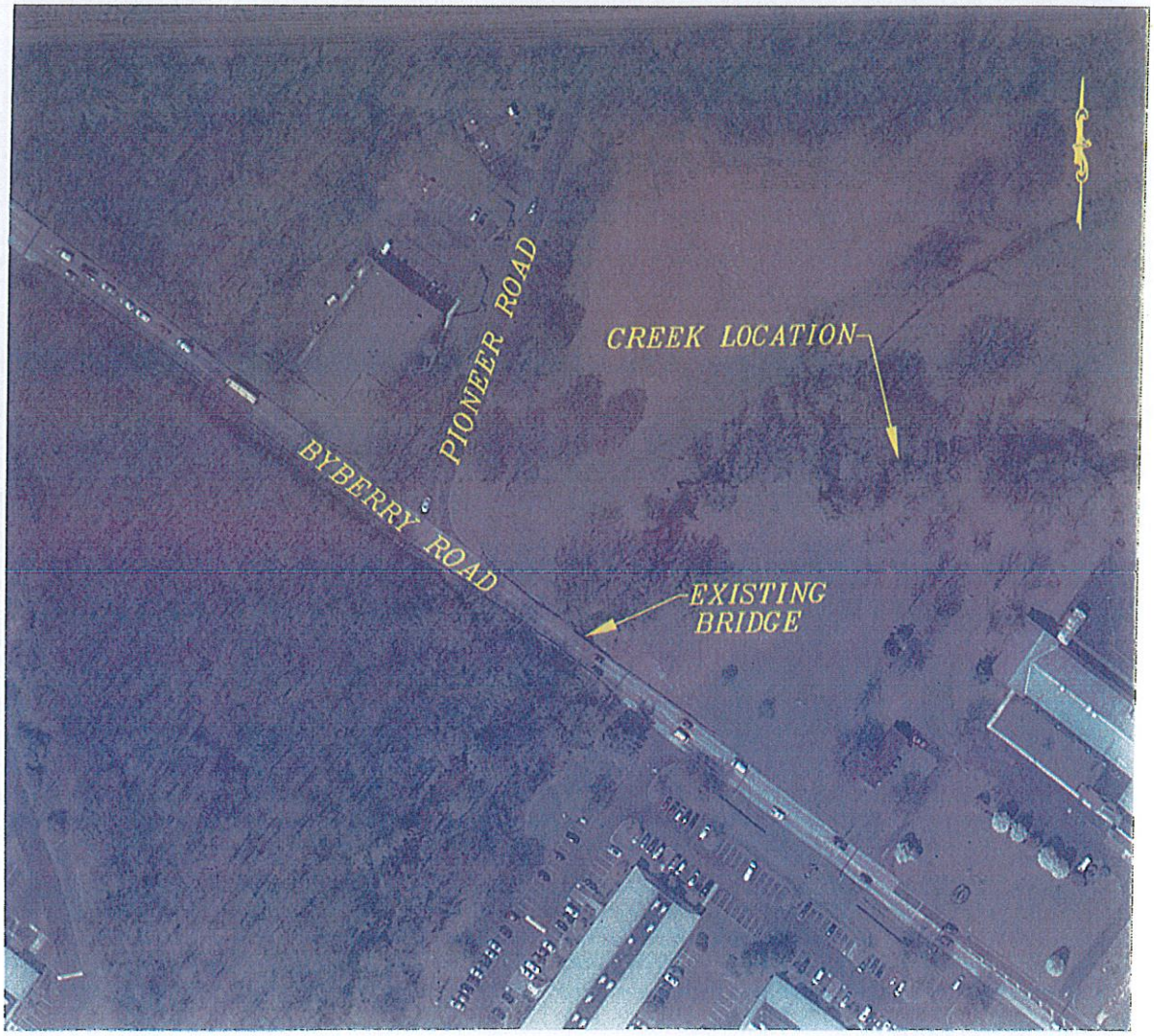
EXHIBIT 6.4

Project Location:
Ward 6 – Byberry Road near Pioneer Road

Description of Problem:
Road and bridge flooding occurs due to flooding within the adjacent Southampton Creek.

Potential Remedy:
The Township owns property upstream of this area at Pelleggi Park. If a stormwater basin were implemented upstream it could help to reduce flooding in this area. A study would need to be done in order to determine what, if any, measurable impacts the basin project would have on this and other areas of the Township. Another option would be to raise the road and bridge above the flood elevation height. Further solutions would require partnership with Warminster and Upper Southampton Townships.

Estimated Project Cost: $2M



SCALE: 1"=200'

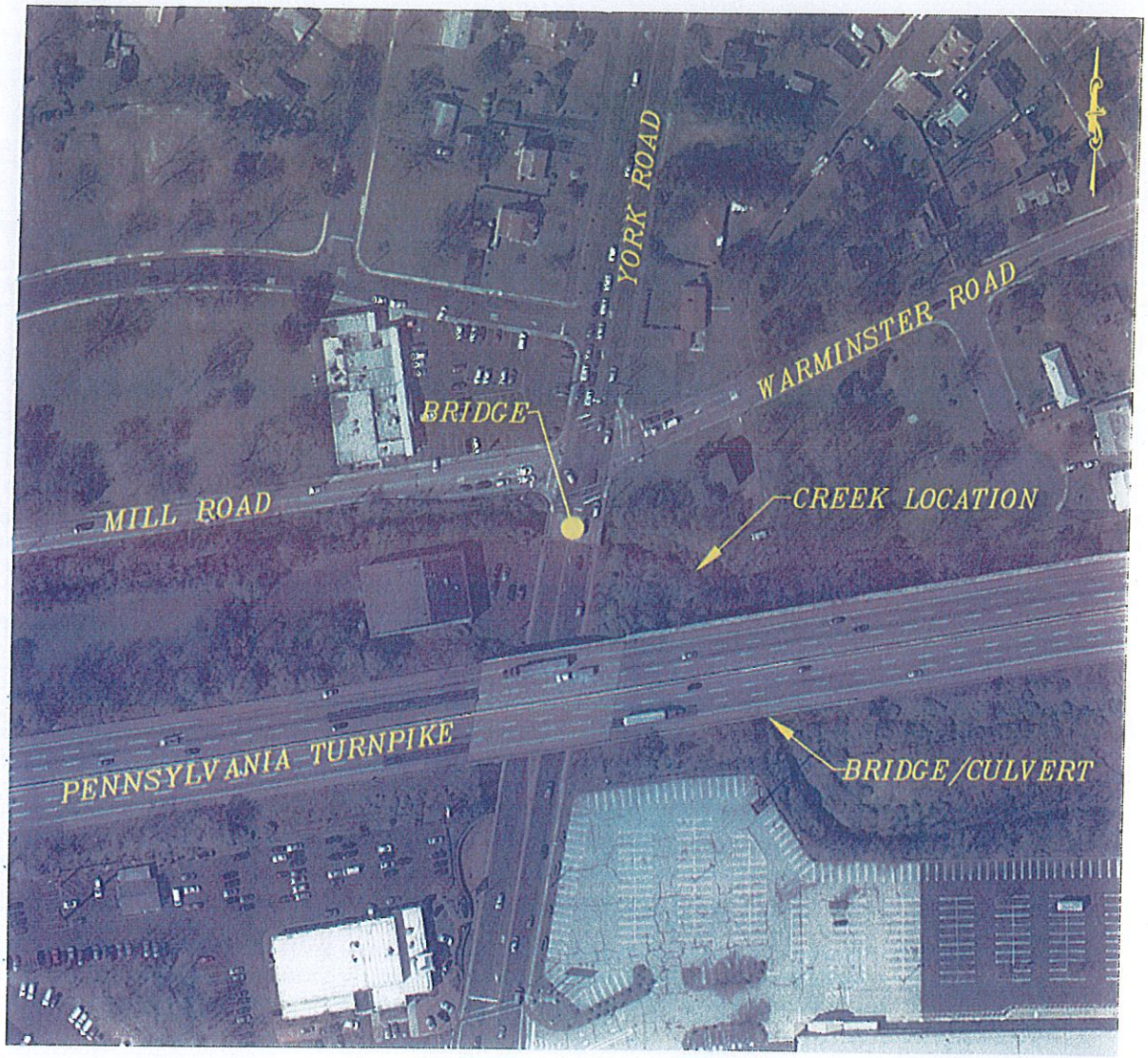
EXHIBIT 5.1b

Project Location:
Ward 5 – Mill Road & York Road

Description of Problem:
Intersection flooding occurs due to flooding in the adjacent Pennypack Creek.

Potential Remedy:
The only viable solution to the problem is to implement stormwater basin projects in the areas upstream of this location to reduce the flooding in the creek. The other option would be to increase the stream opening under the Turnpike, but that would negatively affect downstream areas.

Estimated Project Cost: NA



SCALE: 1"=200'

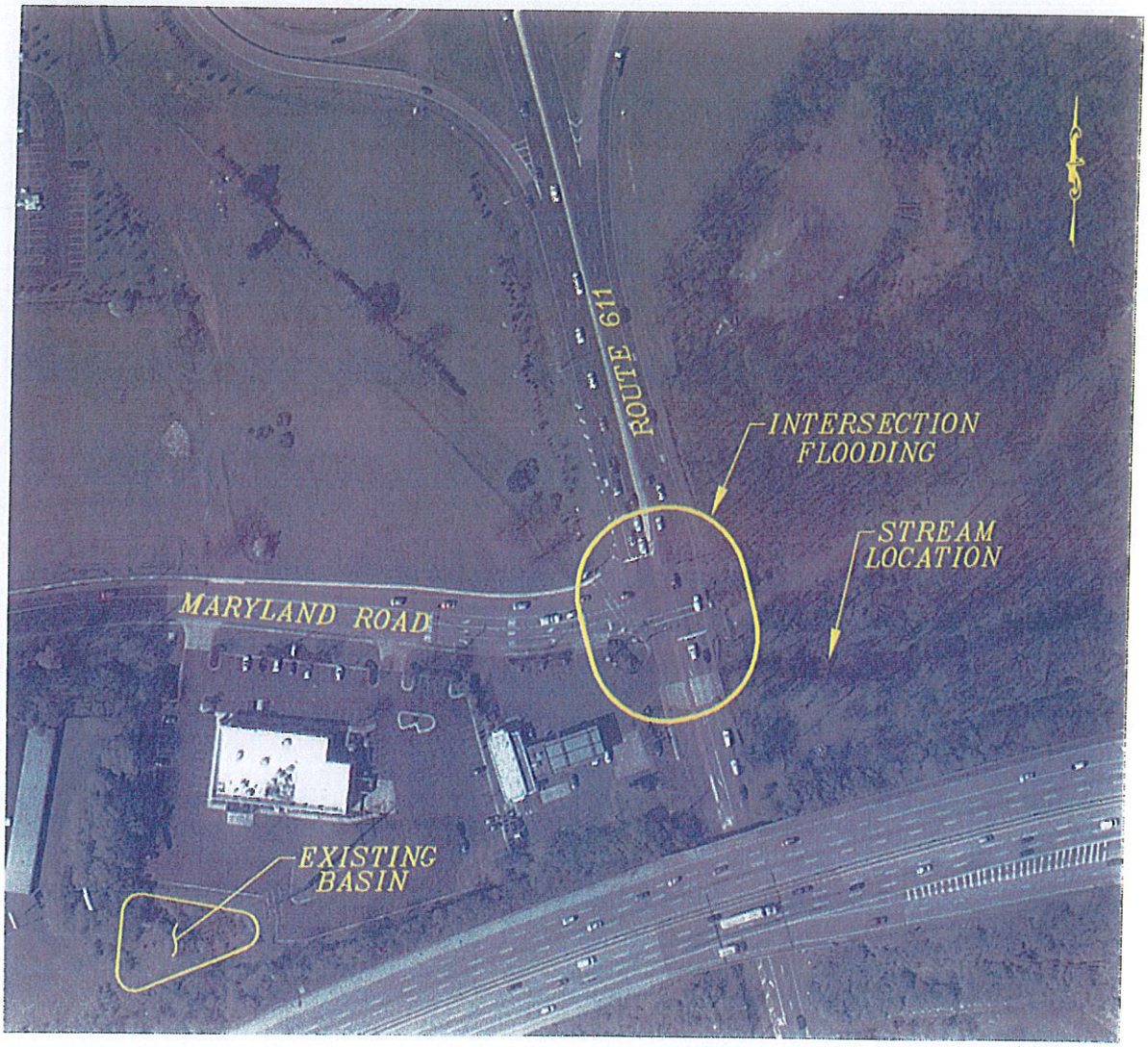
EXHIBIT 4.1

Project Location:
Ward 4 – Route 611 & Maryland Road

Description of Problem:
Intersection floods due to high water level in the adjacent stream.

Potential Remedy:
Stormwater basins and other improvements must be implemented upstream in order to reduce the volume of water within the stream. No improvement in the vicinity of this problem would have a measurable impact on the volume of water within the stream; however, the existing basin on the Carrabba's property, highlighted below, could be retrofitted to provide additional storage and also serve to increase water quality. It is worth noting that since UPS, Willow Point, and Horsham Gate were developed upstream the flooding has been significantly reduced at this location.

Estimated Project Cost: NA



SCALE: 1"=200'

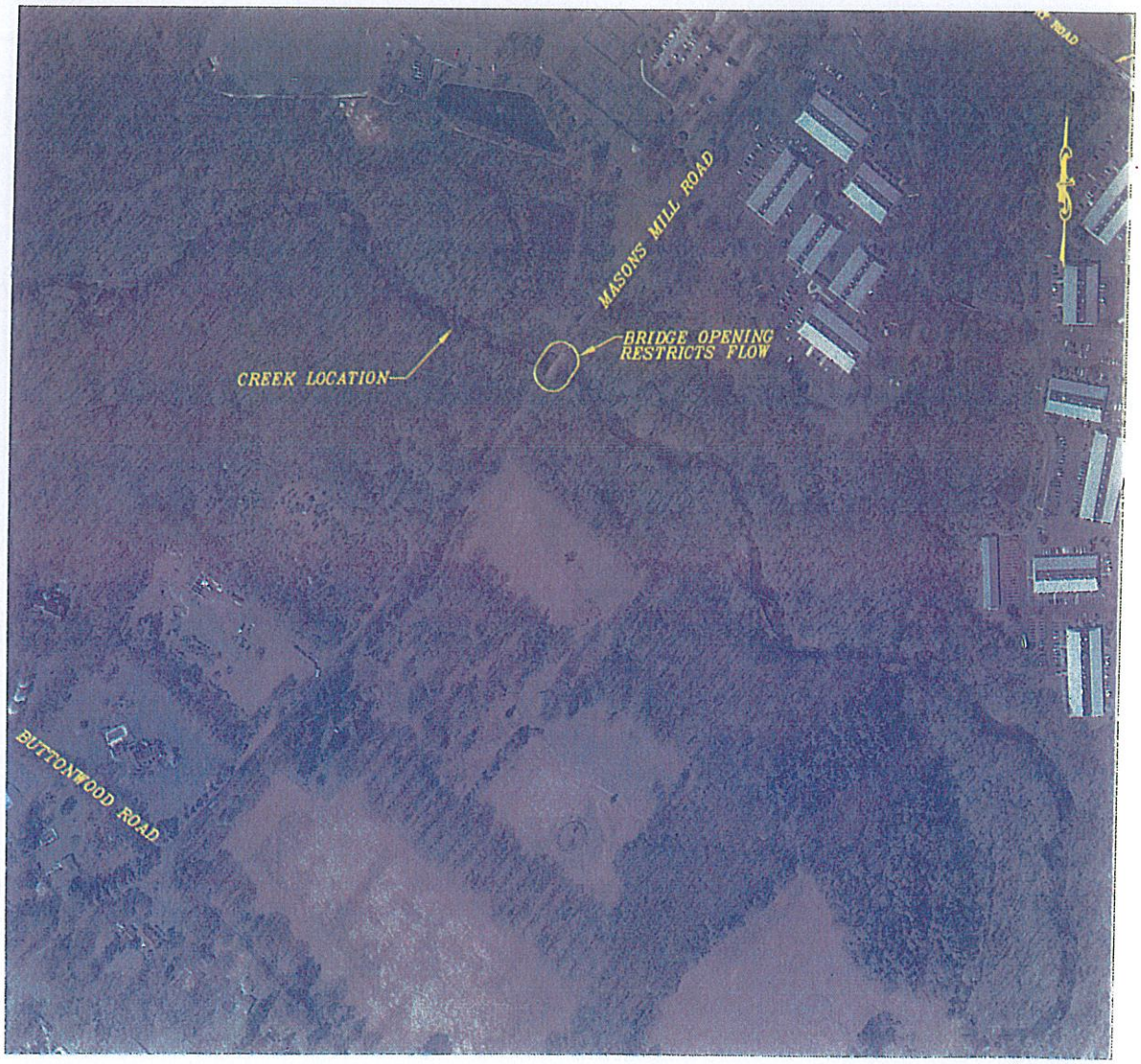
EXHIBIT 6.5

Project Location:
Ward 6 – Masons Mill Road between Buttonwood Road & Byberry Road

Description of Problem:
Road and bridge flooding occurs due to flooding in the adjacent creek.

Potential Remedy:
Stormwater projects need to be implemented upstream to reduce the water levels within the stream, during rain events. Another option would be to raise the road and bridge at this location.

Estimated Project Cost: $2M



SCALE: 1"=500'

EXHIBIT 2.8

Project Location:
Ward 2 – Blair Mill Road near County Line Road

Description of Problem:
Drainage system that originates in Horsham and Warminster Townships crosses under County Line Road and discharges to a swale / ditch along the west side of Blair Mill Road. Heavy flow from this system causes flooding at the intersection of Blair Mill and County Line Road.

Potential Remedy:
Blair Mill and County Line are both PennDOT roads and the adjacent Blair Mill Park is owned by Horsham Township and Hatboro Borough. The remedy to this problem is to install stormwater basins upstream in either Horsham or Warminster Township in order to reduce the volume of flow that discharges to the swale / ditch along Blair Mill Road. Alternatively, a storm sewer system could be installed in Upper Moreland on Blair Mill Road, but would need to be associated with a new basin at downstream end to mitigate negative effects of storm sewer system.

Estimated Project Cost: $1M – $1.5M



SCALE: 1"=200'

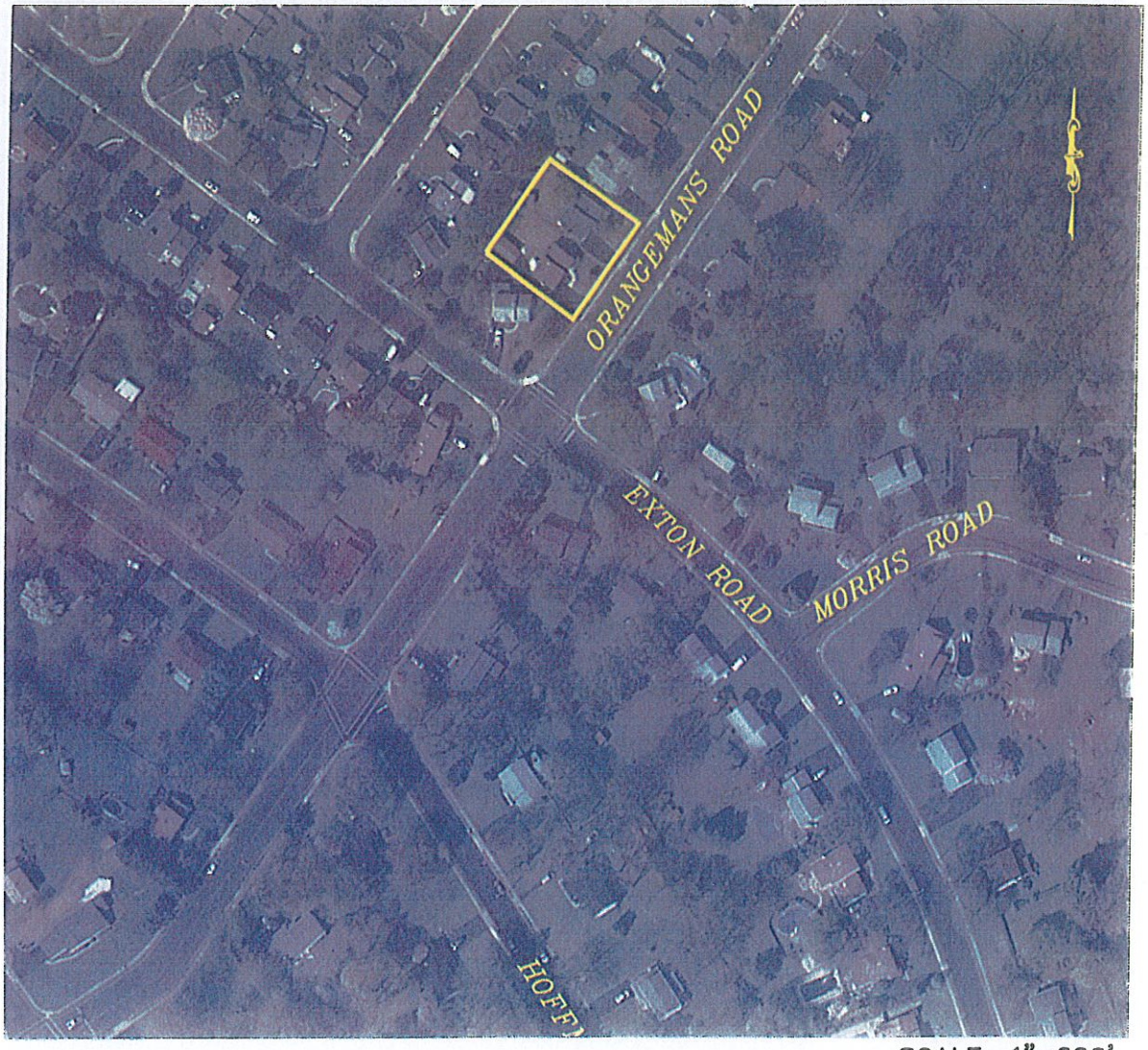
EXHIBIT 5.5

Project Location:
Ward 5 – Exton Road & Orangemans Road

Description of Problem:
Inlets on Orangemans Road to not provide proper drainage and as a result during heavy rains the ponding water encroaches on the highlighted properties.

Potential Remedy:
The storm sewer system and inlets in the area should be inspected to make sure that no inlets or pipes are clogged. The system would need to be analyzed, but the pipes are likely undersized to safely convey runoff from their contributing drainage areas. Increasing pipe size and adding additional inlets could reduce the depth and frequency of flooding in this area. Any increase in pipe conveyance capacity would need to be accompanied with a basin downstream.

Estimated Project Cost: $100K - $500K



SCALE: 1"=200'

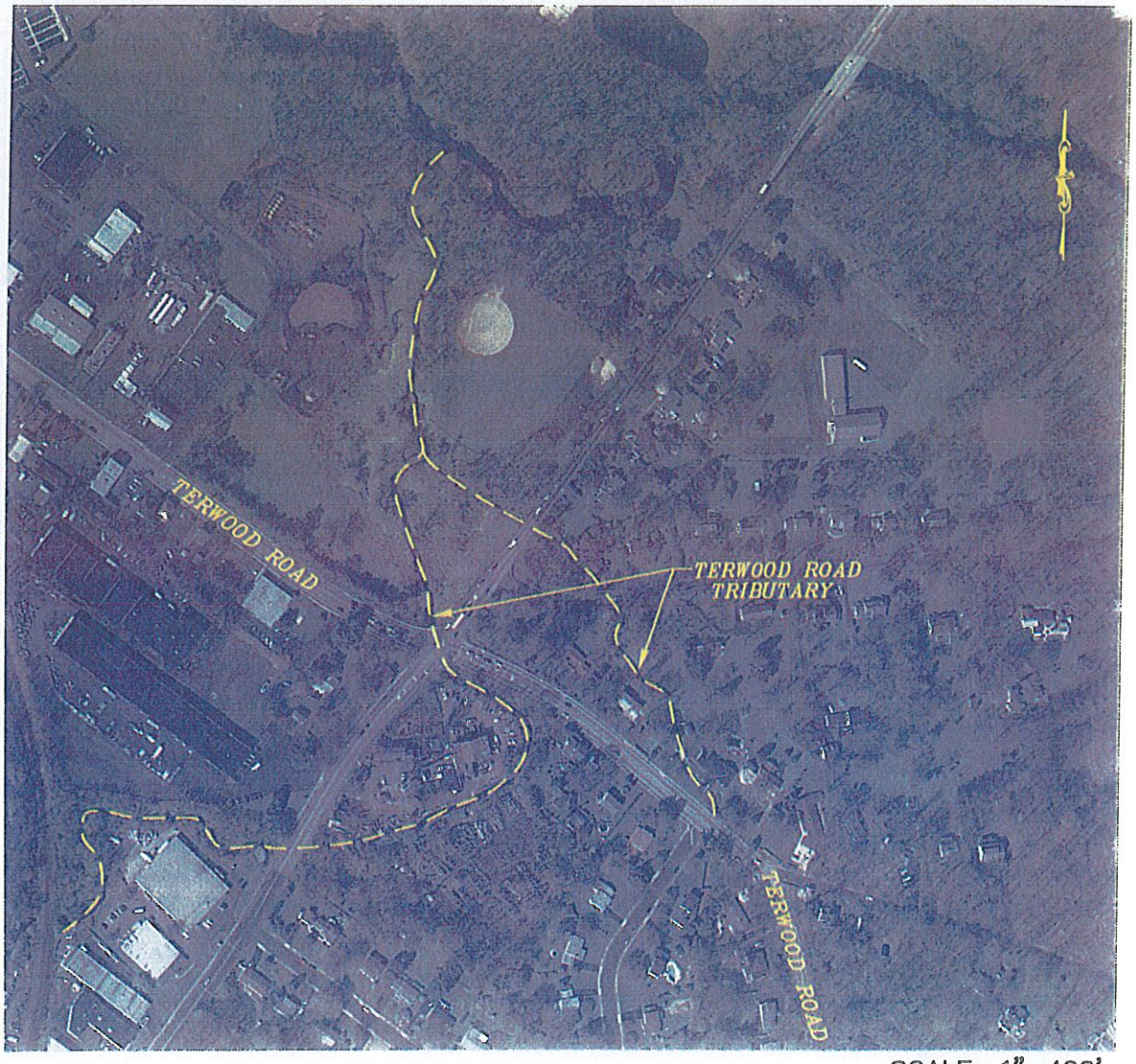
EXHIBIT 6.2

Project Location:
Ward 6 – Terwood Road Tributary

Description of Problem:
Flooding on private properties and state highways is caused by flooding within the adjacent creek.

Potential Remedy:
Flooding within the Pennypack Creek is caused by uncontrolled runoff from upstream areas. Basins and other stormwater facilities need to be installed upstream in order to reduce the flow within the creek.

Estimated Project Cost: NA



SCALE: 1"=400'

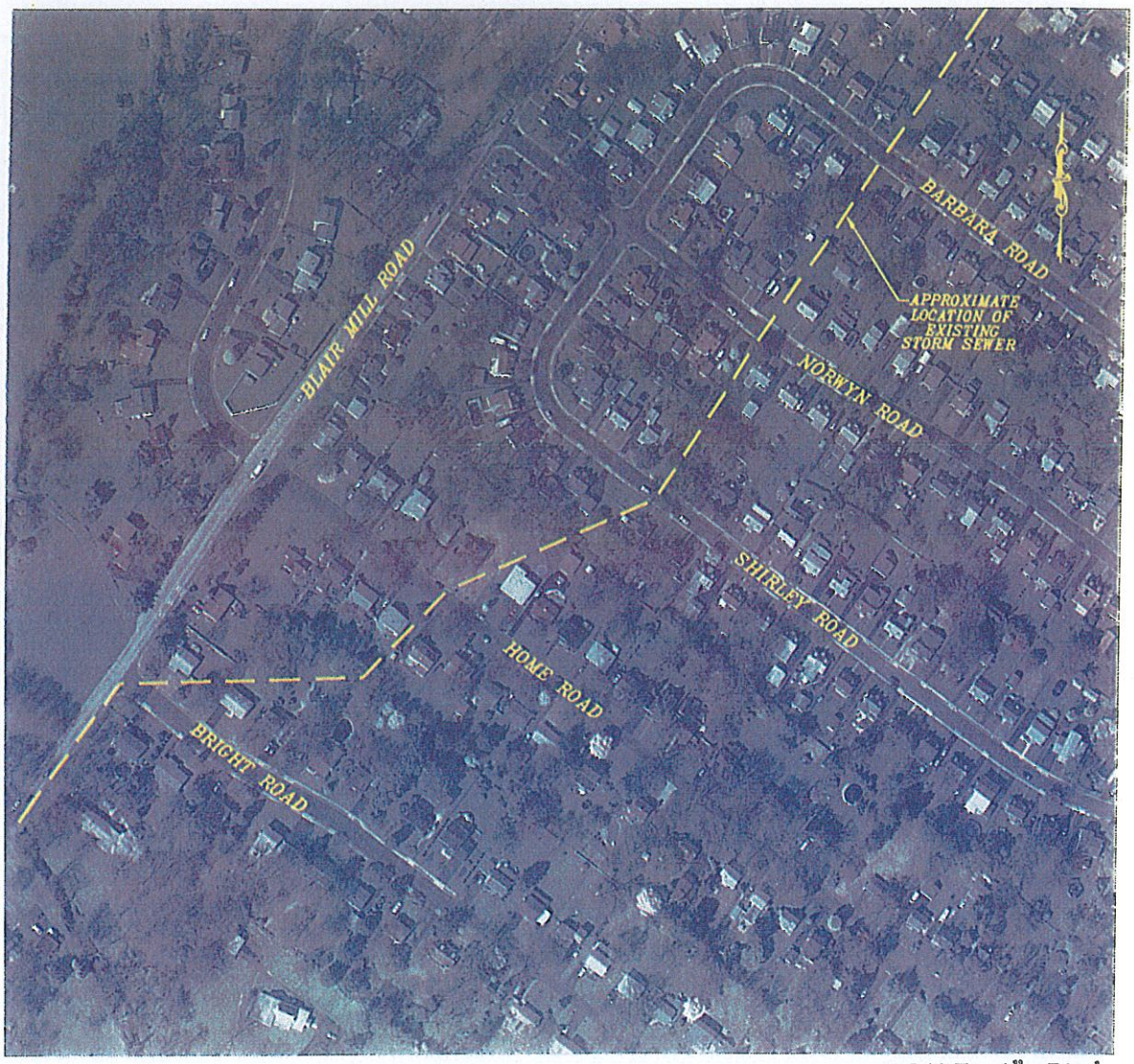
EXHIBIT 2.1

Project Location:
Ward 2 – Norwyn Road

Description of Problem:
Existing storm sewer system collects runoff from all streets from Bright up to County Line Road. The system runs south and eventually dumps into the Pennypack Creek in the vicinity of Bright Road. Flooding in the creek does not allow for the free outfall of flow from this system. As the creek rises the backup occurs and does not let any additional flow enter the system.

Potential Remedy:
Any solution to this problem would have to be done upstream, in neighboring municipalities, in order to reduce the volume of water within the creek and allow the system to function correctly. Further, any additional inlet or pipe capacity would need to be offset with basin construction.

Estimated Project Cost: $500K - $1M



SCALE: 1"=300'

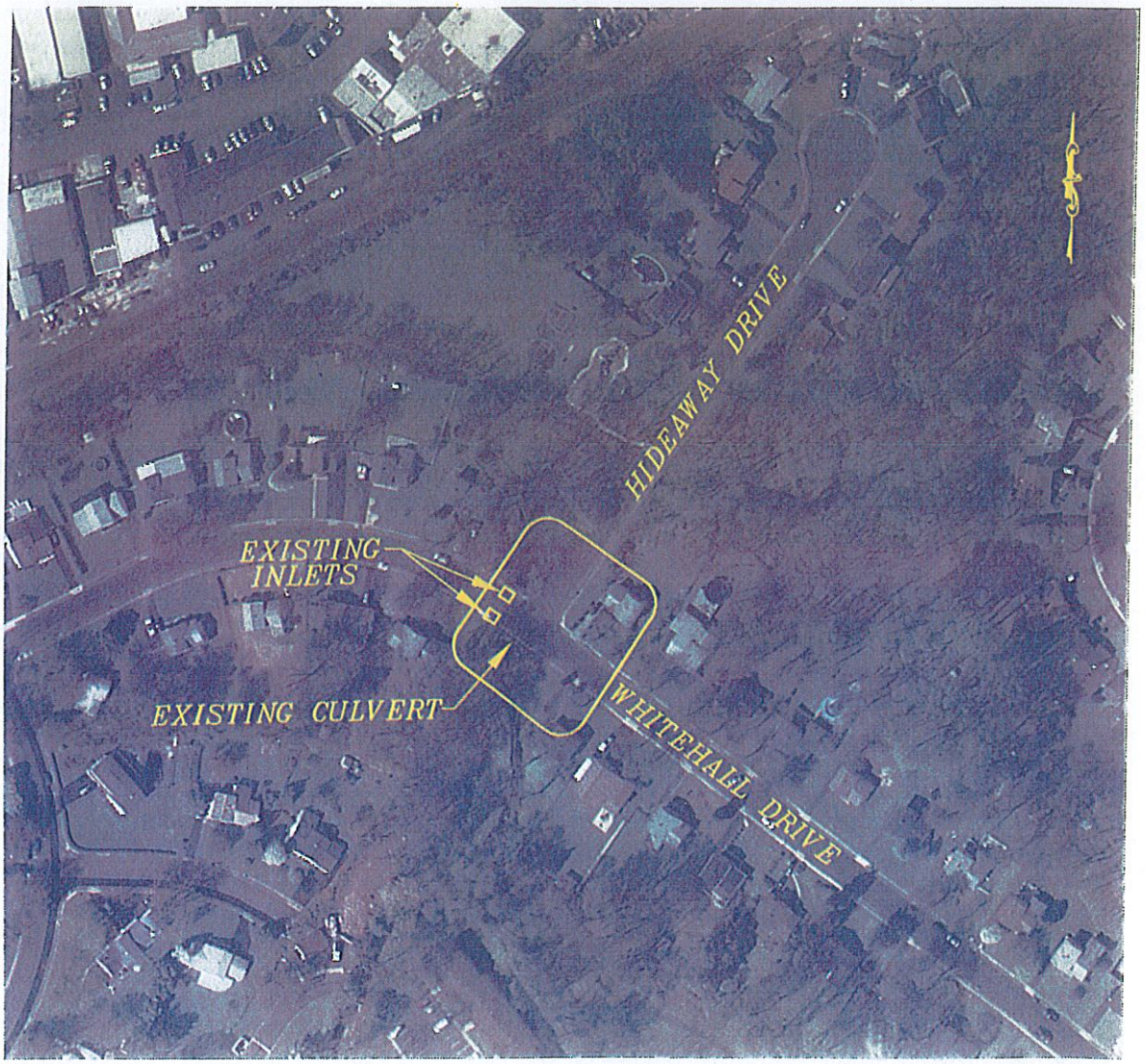
EXHIBIT 4.2

Project Location:
Ward 4 – Whitehall Drive near Hideaway Drive

Description of Problem:
Intersection of Whitehall and Hideaway Drive floods because it is located at low point and the two inlets discharge directly to the adjacent stream. As the water level in the stream rises the inlets cannot function properly, causing water to pond within the intersection.

Potential Remedy:
The high water level within the stream that is causing the problem can only be remedied by implementing stormwater basins upstream in order to reduce the volume of water within the stream.

Estimated Project Cost: NA



SCALE: 1"=200'

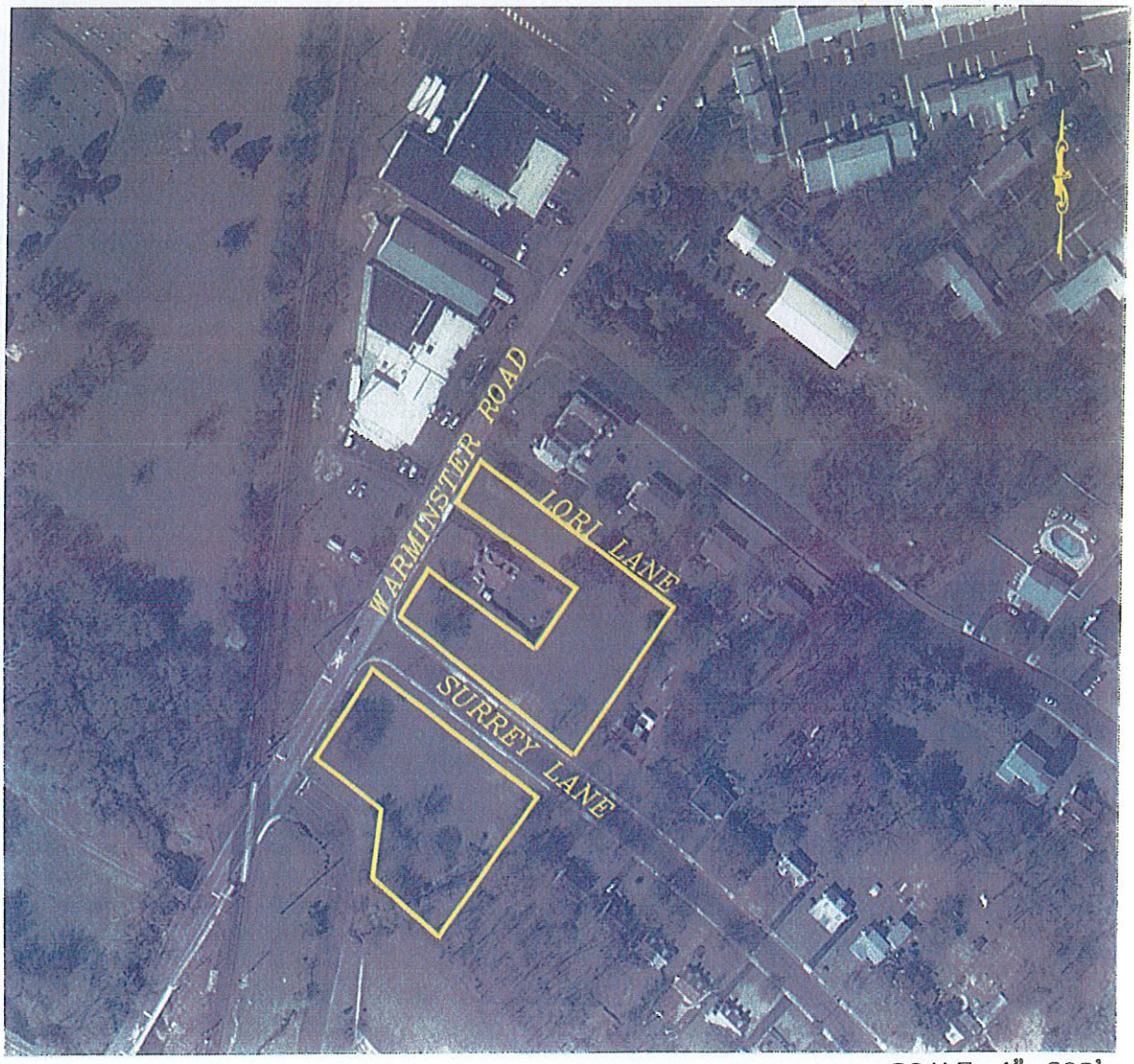
EXHIBIT 5.2b

Project Location:
Ward 5 – Warminster Road near Lori Lane & Surrey Lane

Description of Problem:
There are no existing inlets or storm sewer system in this area. Roadway flooding occurs due to the lack of a proper drainage system.

Potential Remedy:
The Township owns property on both the north and south side of the intersection of Surrey Lane and Warminster Road (highlighted below). This area has been identified as a potential location for the construction of a stormwater basin. If a basin were to be constructed in this area, the project would also need to incorporate a drainage system necessary to convey water to the basin.

Estimated Project Cost: NA



SCALE: 1"=200'

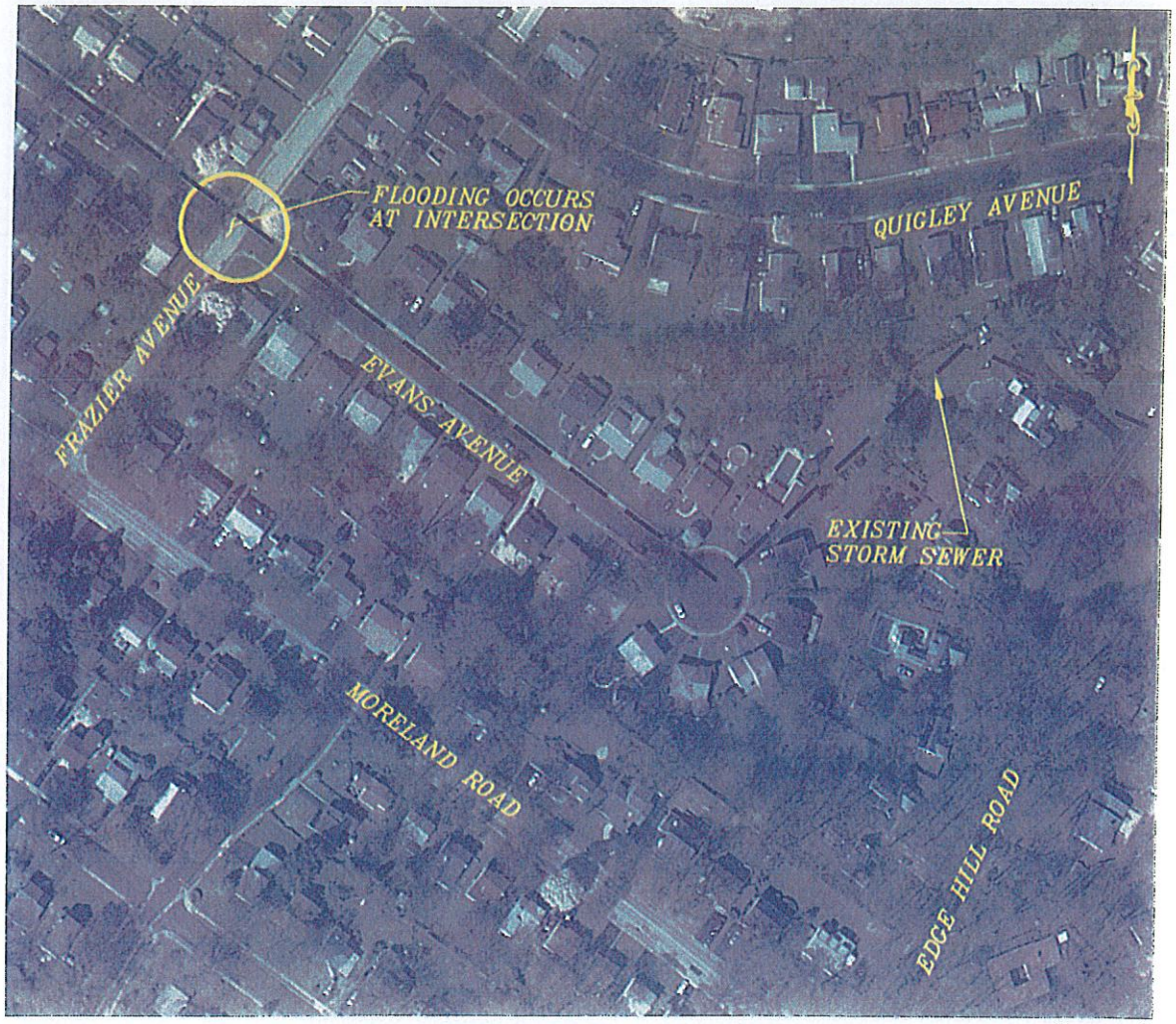
EXHIBIT 1.4

Project Location:
Ward 1 – Frazier Avenue & Evans Circle Intersection

Description of Problem:
Intersection flooding occurs generally during thunderstorms and other "flash" type events, which generate heavy downpours.

Potential Remedy:
Installing additional inlets within the intersection and / or increasing the capacity of the existing storm sewer system within the area are the only viable solutions. Unfortunately, by increasing the flow within the existing system, there is a high probability that downstream residents will experience an increase in flooding depth and frequency. No obvious location downstream exists to install a basin.

Estimated Project Cost: $100K - $500K



SCALE: 1"=200'

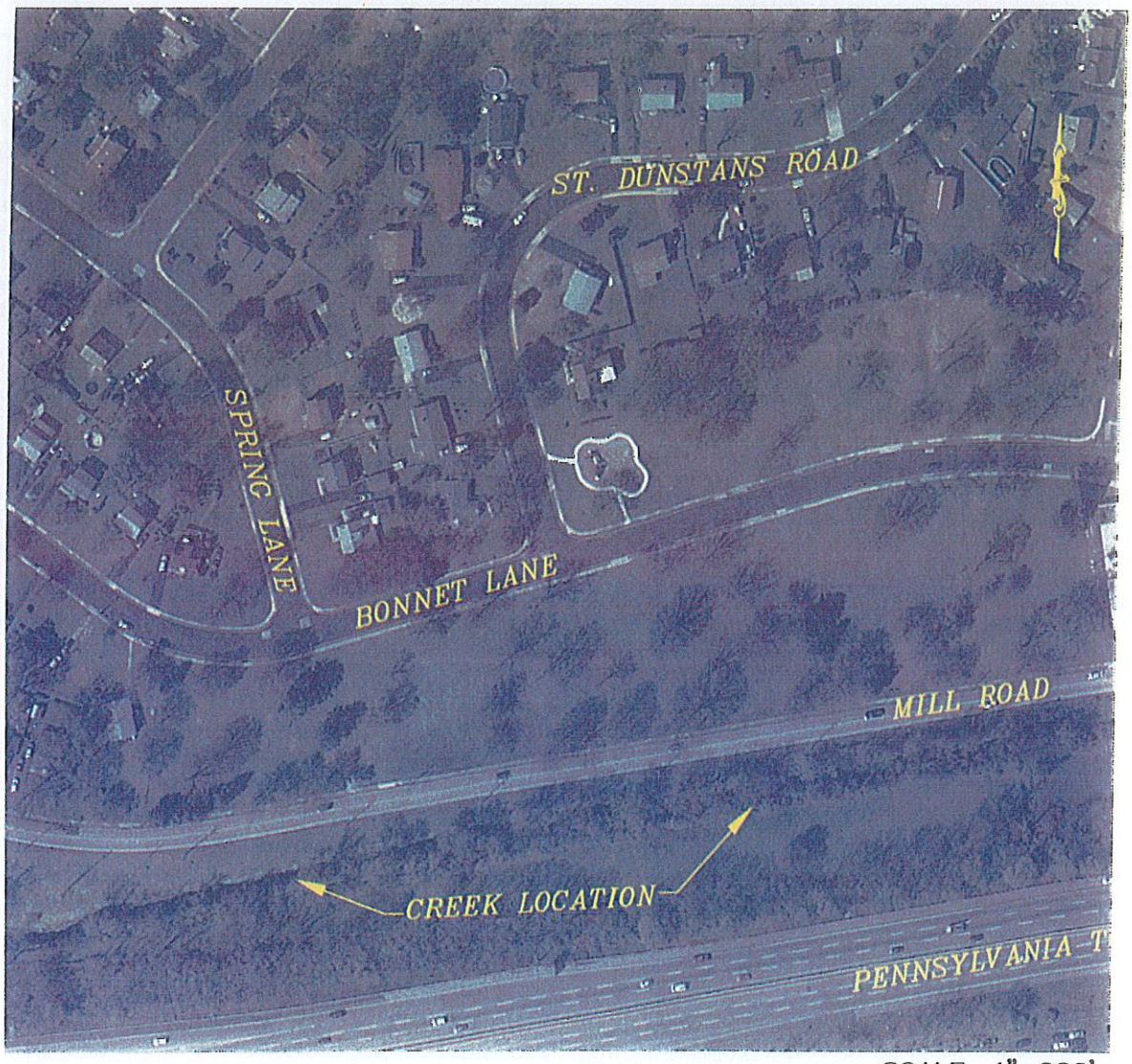
EXHIBIT 5.3

Project Location:
Ward 5 – Bonnet Lane & St. Dunstans Road

Description of Problem:
Roadway flooding occurs in this area due to flooding in the nearby creek.

Potential Remedy:
The Township owns property between Bonnet Lane and Mill Road that has been identified as a potential location for a stormwater basin in the 2009 Pennvest application. Due to the close proximity to the 100-year floodplain in this area, any basin design would need to include measures to allow for flood water from the creek to enter the basin (the increase in storage within the basin could offset flooding in other areas). The area between Bonnet Lane and Mill Road, depicted below, used to be the site of single family homes that were bought out using funding from PEMA / FEMA.

Estimated Project Cost: NA



SCALE: 1"=200'

Project Location:
Ward 1 – Church Street & Cherry Street between S.R. 611 and S.R. 63

Description of Problem:
Road flooding occurs in this area but only during extreme rain events. The existing storm sewer system in the area cuts through residential properties from Church Street to Cherry Street and then runs along Davisville Road before ultimately discharging to Veteran's Memorial Park.

Potential Remedy:
Storm sewer capacity would need to be increased. This would be a major undertaking because the pipe size would need to be increased all the way to the discharge at Veteran's Memorial Park. Increasing the discharge to the creek could also cause downstream flooding issues as well as stream bank erosion within the park. A basin in the park would need to be installed to offset the additional stormwater.

Estimated Project Cost: $500K - $1M



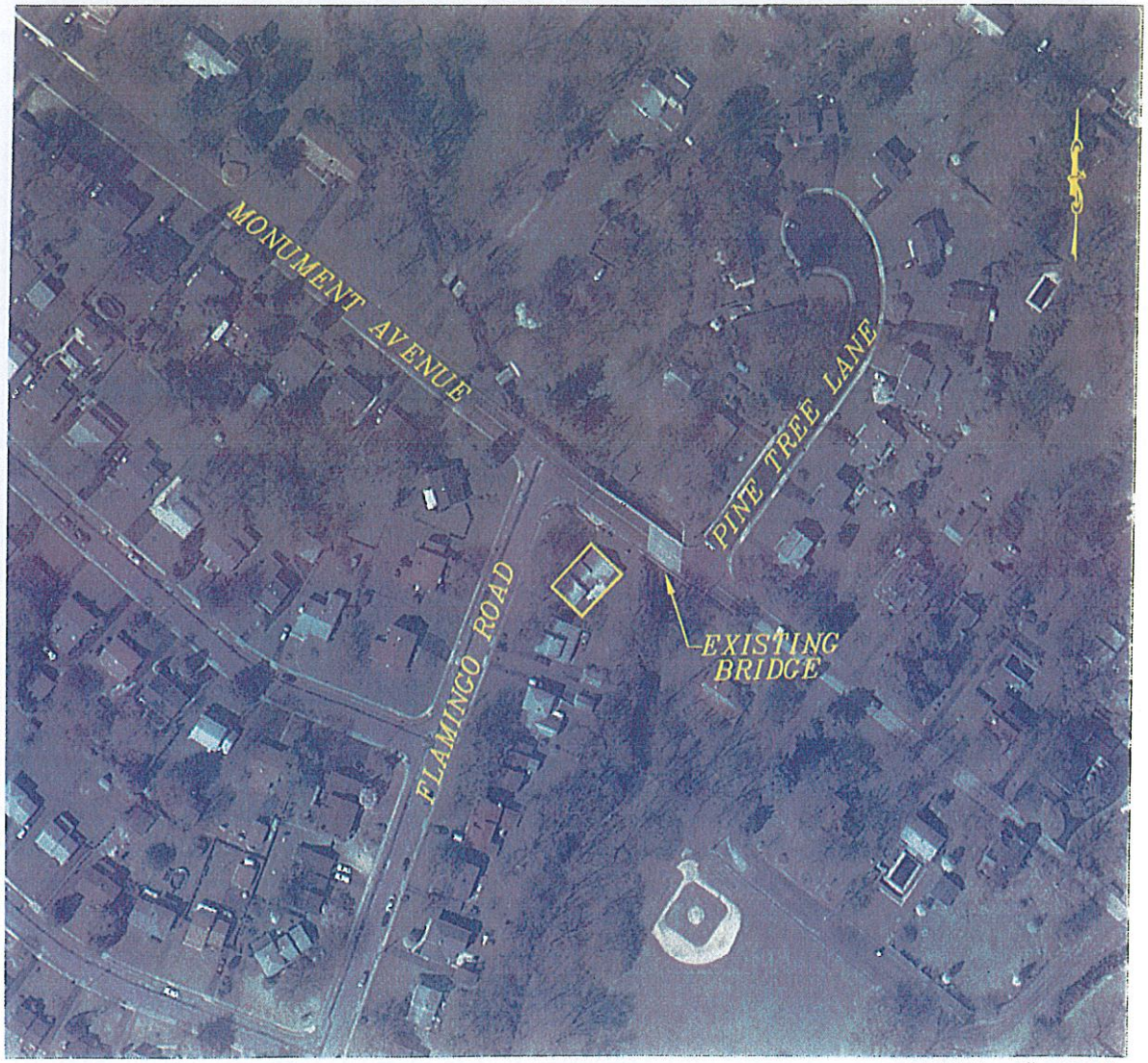
SCALE: 1"=200'

Project Location:
Ward 2 – Monument Avenue near Pine Tree Lane

Description of Problem:
Flooding occurs when water backs up in the area of the existing bridge. The creek takes a 90 degree turn just prior to going under the bridge, causing an in efficient hydraulic situation. Flooding occurs on the highlighted property and on some properties north of Monument Avenue (Hatboro).

Potential Remedy:
Bridge opening should be increased in order to allow for a smoother transition under Monument Avenue. However, this bridge has been replaced within the last 10 years, so the cost of mitigating the flooding issue would be very high, considering that the bridge does not need to be replaced for structural reasons. Also, increasing the opening will "push" the problem downstream.

Estimated Project Cost: $1M - $1.5M



SCALE: 1"=200'

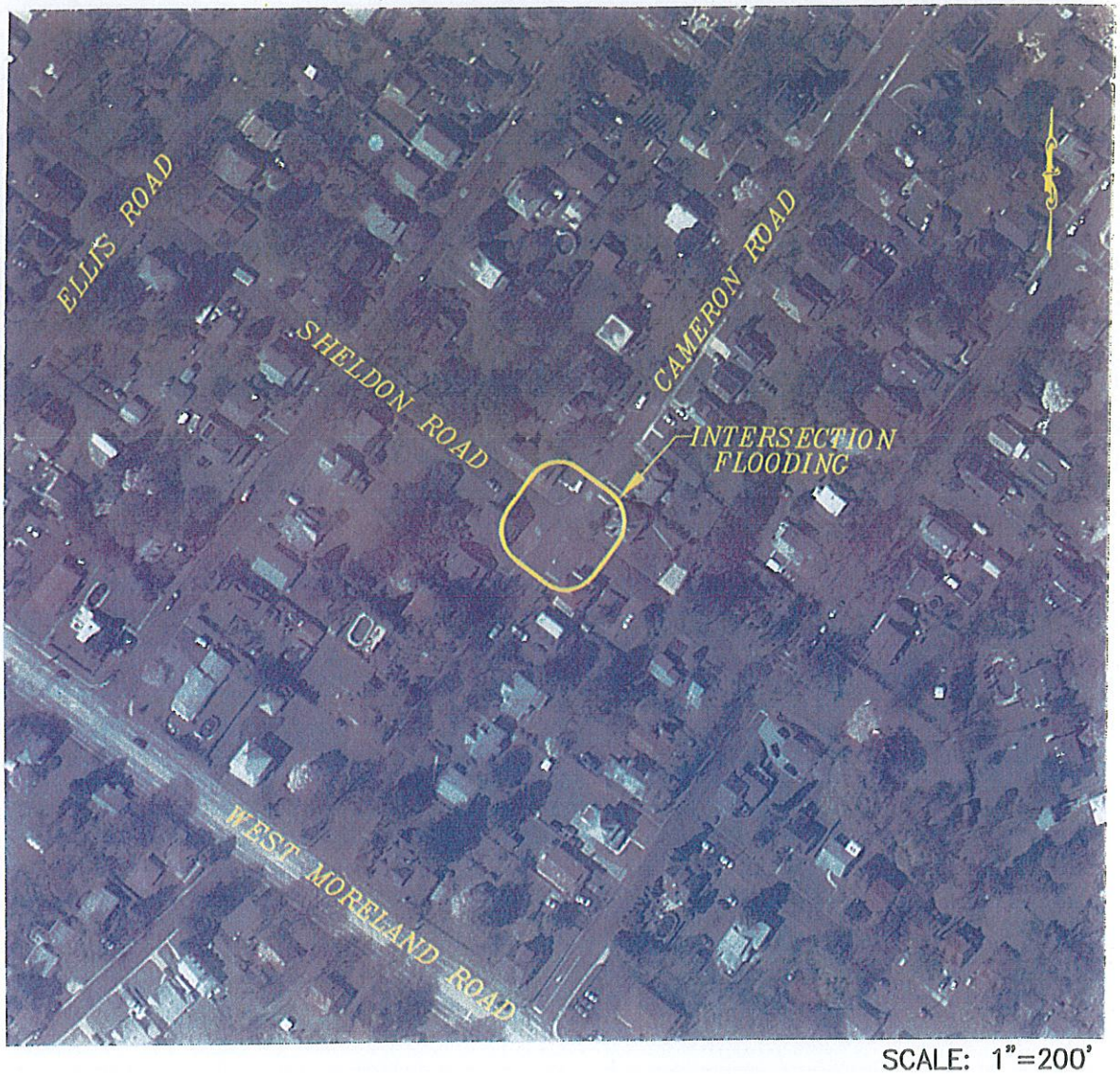
EXHIBIT 4.4

Project Location:
Ward 4 – Cameron Road & Sheldon Road

Description of Problem:
Intersection and road flooding occurs during heavy rains due to the lack of storm sewer and inlets within the area.

Potential Remedy:
Storm sewer needs to be installed within the development to reduce the amount of gutter flow and convey the runoff underground to the nearest stream. The problem with installing storm sewer throughout the area is that the water, currently ponding in yards and intersections, would be conveyed fast to the stream and likely have a negative impact on the downstream areas.

Estimated Project Cost: $100K - $500K



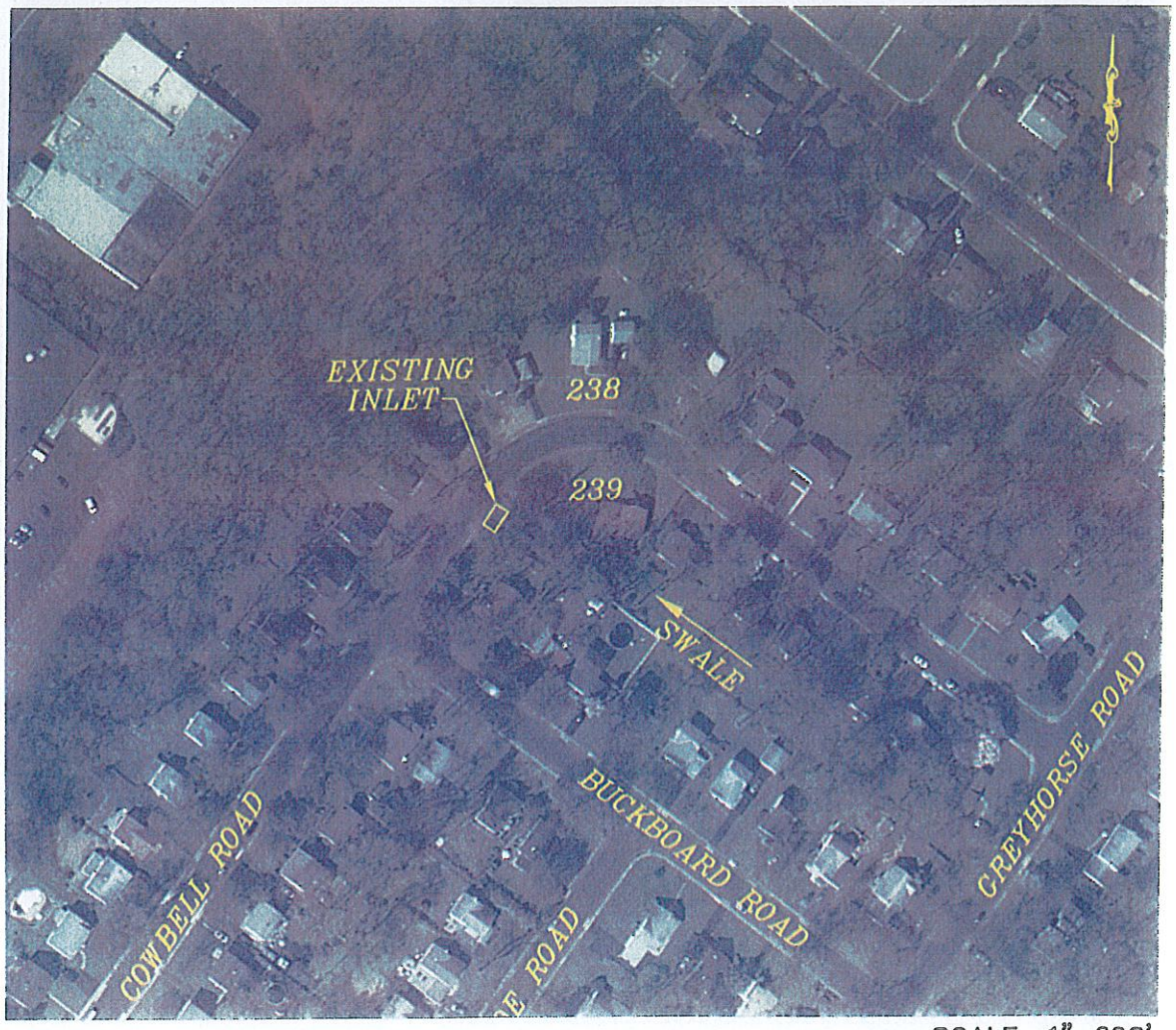
SCALE: 1"=200'

Project Location:
Ward 1 – 239 Cowbell Road

Description of Problem:
Swale in rear yards is not graded properly and does not allow water to reach the existing inlet as intended. Flooding occurs in the street as a result of overflow from the highlighted inlet. Further investigation is needed to determine if the pipe leaving the highlighted inlet is undersized.

Potential Remedy:
Remedial grading needs to be performed on private properties in order to ensure positive drainage towards the existing inlet. Additionally, any obstructions within the swale (i.e. fences, sheds, fallen trees, etc.) that are inhibiting the flow of water should be removed. If the pipe leaving the inlet is undersized and causing the overflow the pipe size may need to be increased. The downstream system would need to be analyzed to ensure that the increased flow will not negatively impact downstream areas.

Estimated Project Cost: $100K - $500K



SCALE: 1"=200'

EXHIBIT 3.2

Project Location:
Ward 3 – 523 Grant Avenue

Description of Problem:
Overflow from inlet near 523 Grant Avenue was designed to utilize a swale between the residences on Grant Avenue and enter into the storm sewer system along Lincoln Avenue. When the lot was subdivided and the house was built at 523 Grant, the grading did not keep a defined swale towards Lincoln Avenue.

Potential Remedy:
The proposed development at 501 York Road (Student Housing) should help drainage issues along Lincoln Drive by increasing the pipe size along Lincoln Drive at the York Road crossing. Grading could be performed between 523 and 528 Grant Avenue in order to create a defined swale for overflow from the existing inlet.

Estimated Project Cost: Less than $100K



SCALE: 1"=200'

EXHIBIT 3.3

Project Location:
Ward 3 – Duffield Street

Description of Problem:
An underground spring from the highlighted property used to be piped towards the street and would constantly cause wet and sometimes icy conditions on Duffield Street. The homeowner paid a contractor to direct the flow towards the rear of the property and this has caused wet conditions in the rear yards to the east of the subject property.

Potential Remedy:
Spring should be piped into an under drain or small pipe within the ROW to the nearest inlet as part of the next Township paving program of this street. As such, we recommend this street be placed on the paving program in 2014.

Estimated Project Cost: Less than $10,000



SCALE: 1"=200'

EXHIBIT 4.5

Project Location:
Ward 4 – Sheldon Road between Ellis Road & Fitzwatertown Road

Description of Problem:
Intersection and road flooding occurs during heavy rains due to the lack of storm sewer and inlets within the area.

Potential Remedy:
Storm sewer needs to be installed within the development to reduce the amount of gutter flow and convey the runoff underground to the nearest stream. The problem with installing storm sewer throughout the area is that the water, currently ponding in yards and intersections, would be conveyed faster the stream and likely have a negative impact on the downstream areas.

Estimated Project Cost: Less than $100K



SCALE: 1"=200'

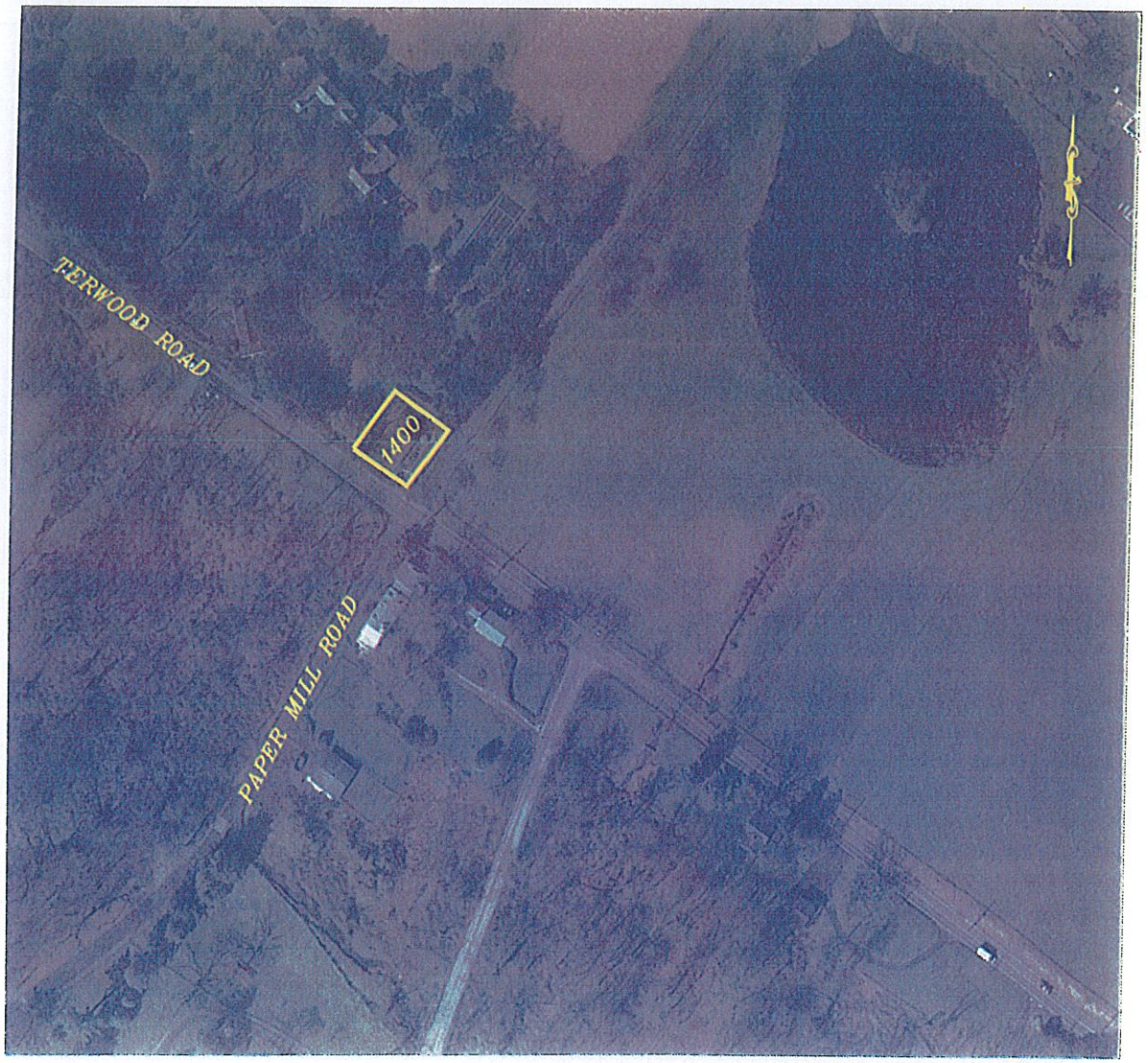
EXHIBIT 6.3

Project Location:
Ward 6 – 1400 Terwood Road

Description of Problem:
Flooding occurs on the property highlighted below as a result of poor drainage along Terwood Road.

Potential Remedy:
PennDOT installed an 18" cross-over pipe under Terwood Road to remedy the drainage issue. The Township public works should monitor the property during rain events to see if PennDOT work solved the problem.

Estimated Project Cost: Less than $10,000



SCALE: 1"=200'

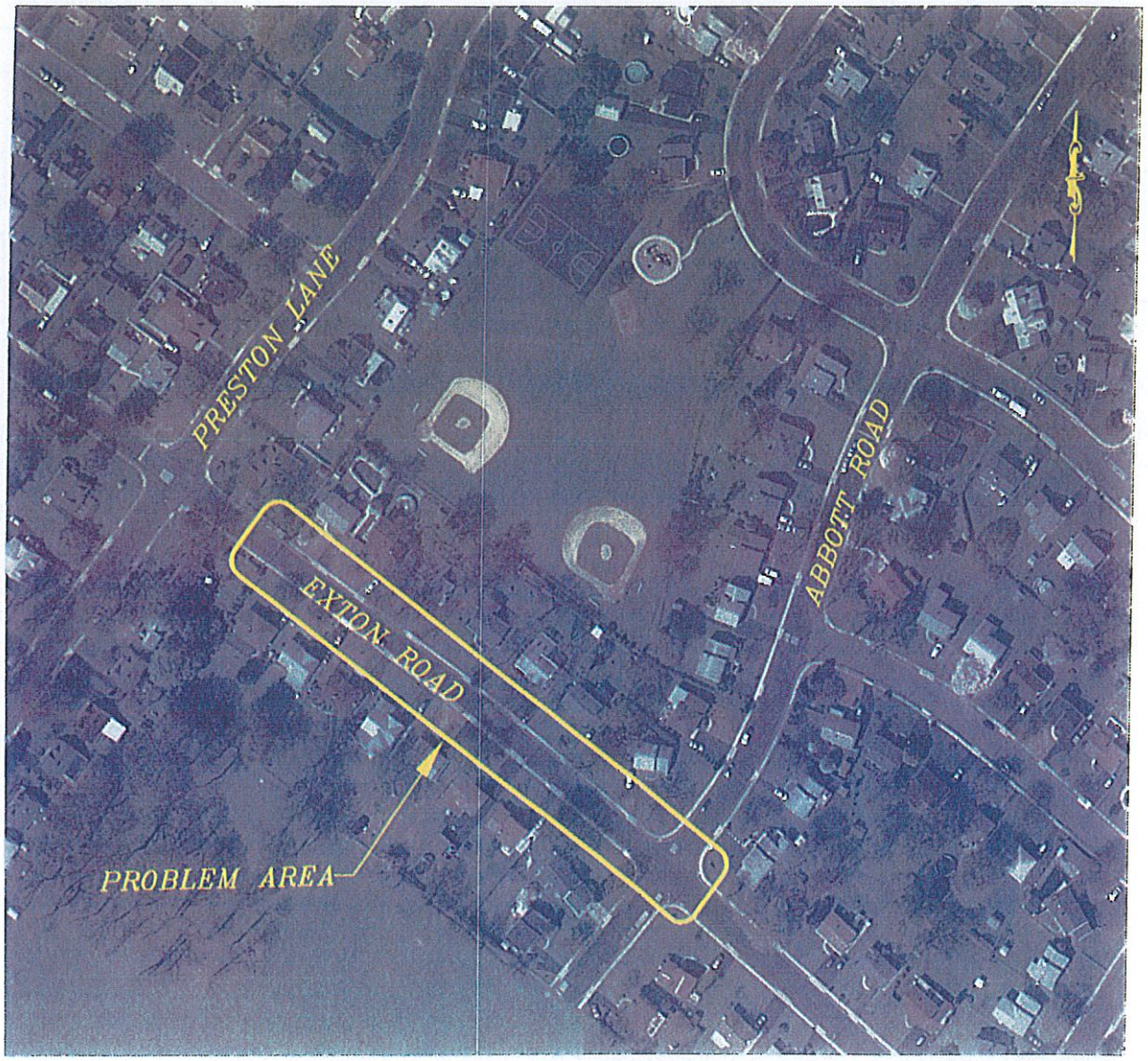
EXHIBIT 7.1

Project Location:
Ward 7 – Fern Village Park @ Exton Road

Description of Problem:
Road flooding on Exton in the area of Fern Village Park.

Potential Remedy:
The stormwater system along Exton Road flows towards Orangmans Road. The Township should investigate to determine if any corrective grading within the park could help prevent the flooding along Exton.

Estimated Project Cost: Less than $100K



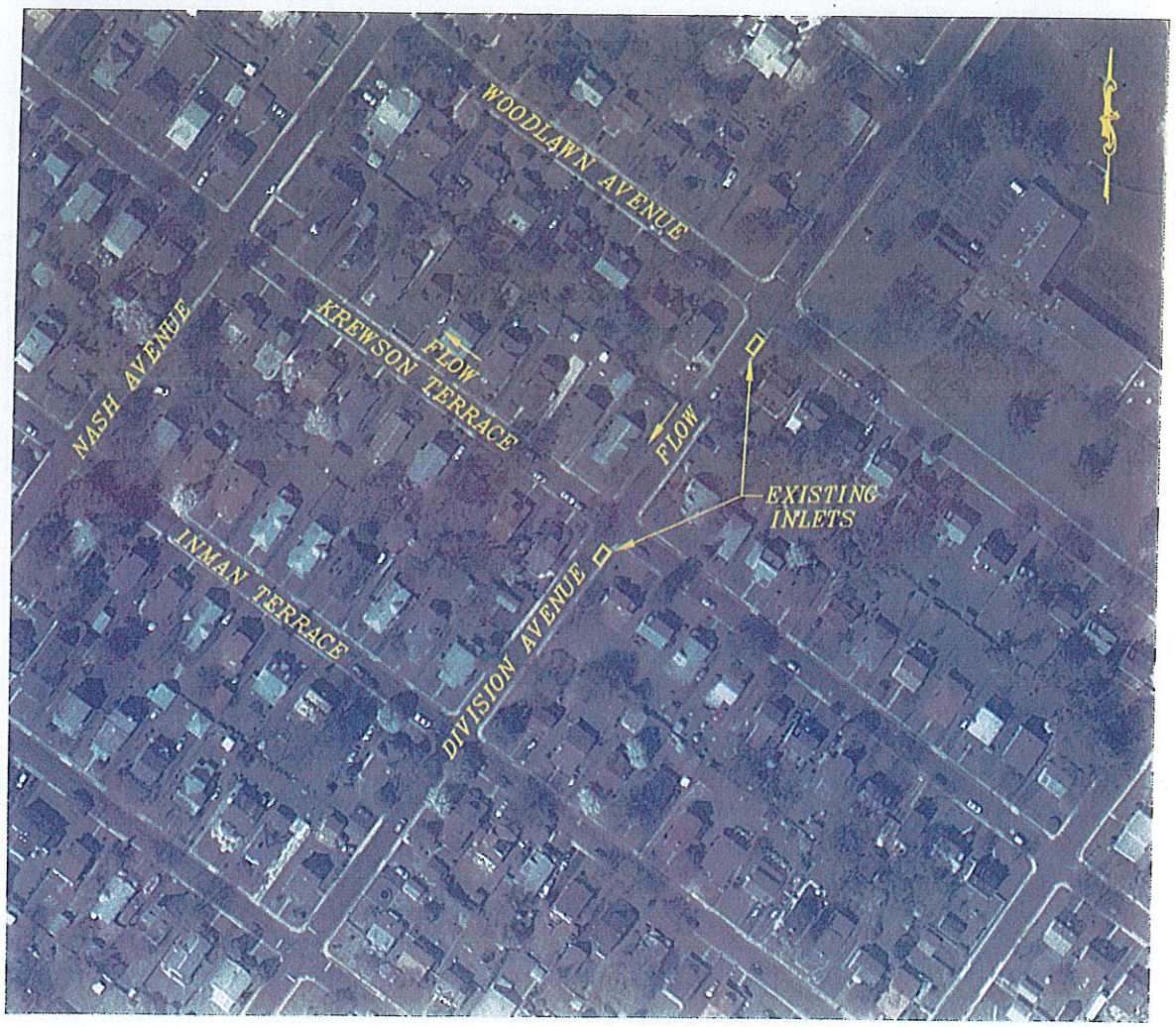
SCALE: 1"=200'

Project Location:
Ward 1 – Division Avenue & Krewson Terrace

Description of Problem:
Lack of inlets within the area causes deep gutter flow and road flooding along Krewson Terrace in the vicinity of Nash and Division Avenues. Only two inlets exist between Woodlawn and Krewson and they are located along the east curb line. Gutter flow down the west side of Division Avenue turns the corner and runs down Krewson. No inlets exist along Krewson, and deep gutter flow often encroaches into the travel lanes.

Potential Remedy:
Additional inlets need to be installed along the west curb line of Division Avenue as well as along Krewson Terrace. These inlets would allow for the excessive gutter flow to be captured and conveyed underground. The existing system along the east side of Division Avenue is more than likely undersized and an analysis would need to be performed to determine if additional flow could be accommodated.

Estimated Project Cost: $25,000



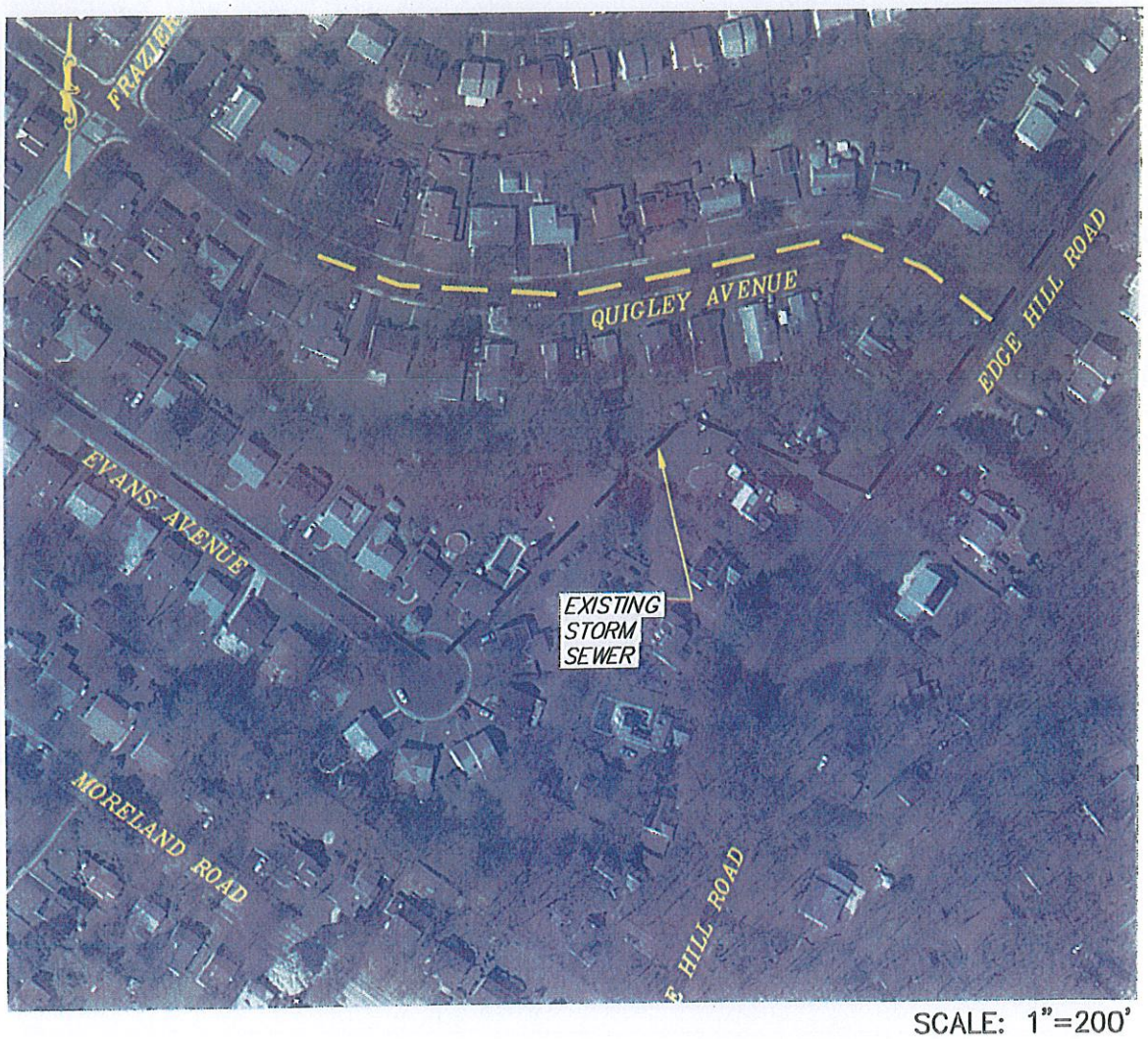
SCALE: 1"=200'

Project Location:
Ward 1 – Quigley Road

Description of Problem:
Road drainage along Quigley Road is inadequate due to lack of storm sewer. Issue does not result in flooding and the main problem is deep gutter flow along the road that encroaches into the travel lanes.

Potential Remedy:
Installation of inlets and storm sewer along Quigley Road would reduce depth of gutter flow; however, the new storm sewer system would have to connect to the existing system along a portion of Quigley and Evans Circle. The addition of flow into the system would have the potential to cause increase flooding downstream along Willow Brook Drive, where stormwater is currently conveyed through roadside ditches.

Estimated Project Cost: $100K - $500K



SCALE: 1"=200'

C. Existing Problems – Category 3

Project Location	Report Exhibit #	Priority
Green Willow Run Apartments	3.5	1
Edge Hill & Moreland Road	1.1	2
Fitzwatertown Road	3.7	2
4115 Hoffman Road	5.4	4
3800 Meyer Lane	5.6	4
2105 Huntingdon Road	6.7	4
Evans Circle & Quigley Road	1.3	7
Inman Road near Frazier	1.5	7
Parkside at Sycamore	2.6	7
Costello Avenue near Lynn	2.7	7
Blair Mill between Broadway & Parkside	2.9	7
Commerce Avenue Apartments	3.1	7
401 & 403 Crown Street	3.8	7
Huntingdon Road at Mason's Mill	6.6	7
Dogwood Lane Cul-de-sac	4.3	15
Maryland Road (stream erosion)	4.6	16

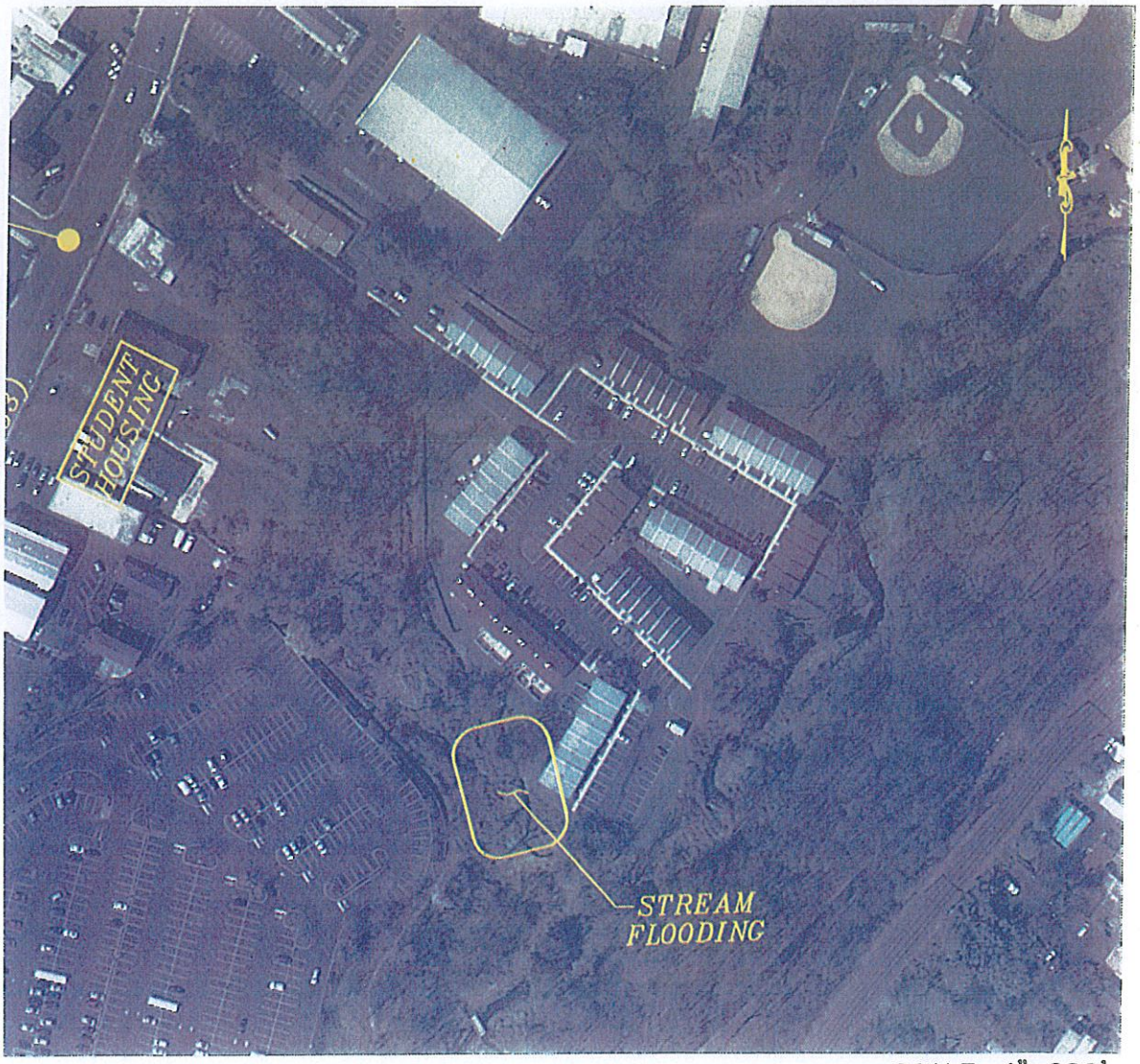
EXHIBIT 3.5

Project Location:
Ward 3 – Green Willow run Apartments

Description of Problem:
Stream flooding occurs in the apartment complex located adjacent to the Student Housing land development.

Potential Remedy:
The stream channel could be cleaned of debris and maintained within the area highlighted below. More than likely this minor maintenance will not fix the problem, stormwater basins must be installed upstream in order to reduce the volume of water within the stream. The Student Housing project may help this situation as they are installing a large underground basin and rain gardens.

Estimated Project Cost: NA



SCALE: 1"=200'

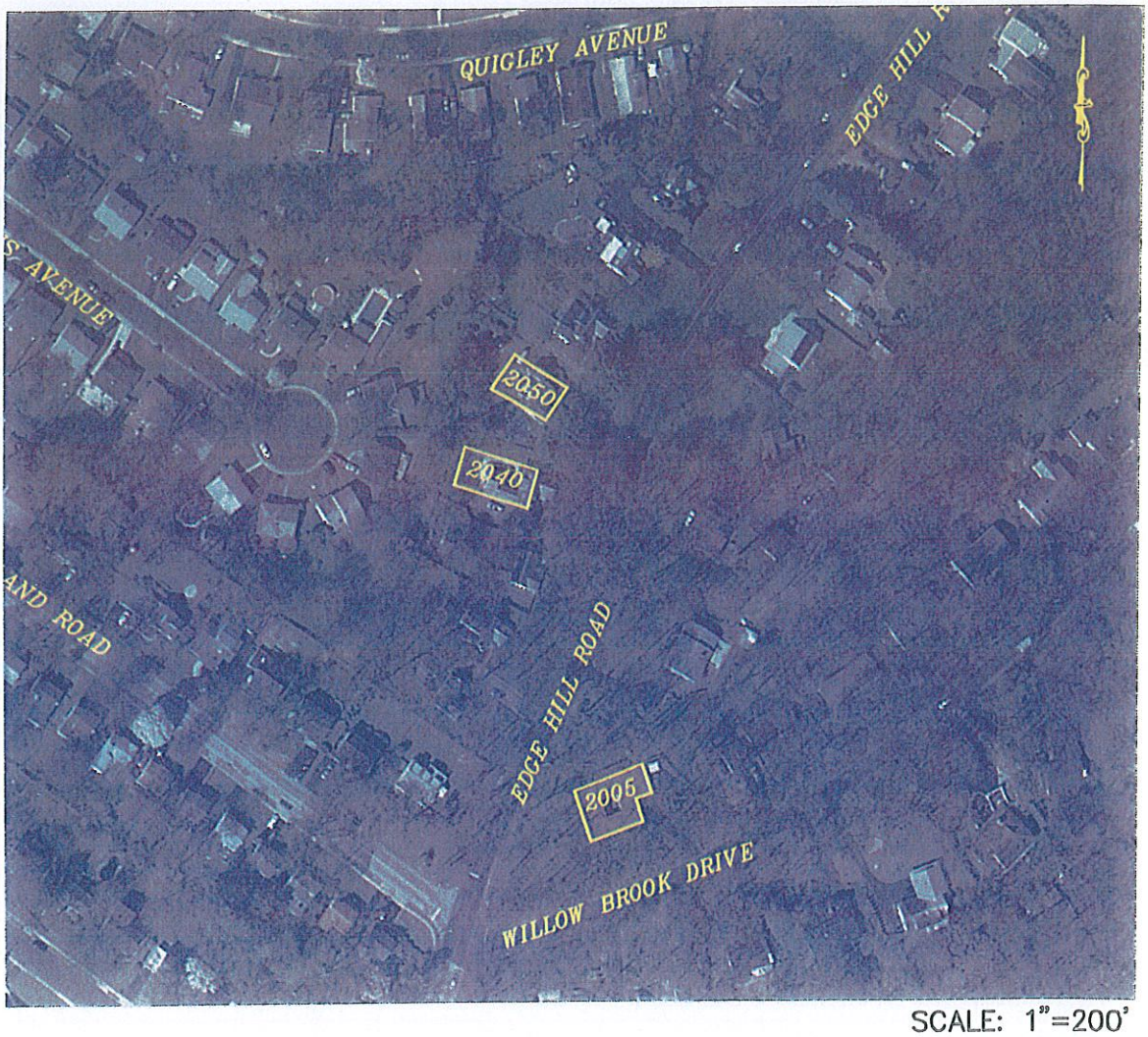
EXHIBIT 1.1

Project Location:
Ward 1 – Edge Hill Road & E. Moreland Road

Description of Problem:
Low areas on private properties that are highlighted below (2005, 2040 & 2050 Edge Hill Road)

Potential Remedy:
Minor grading on private properties could help eliminate ponding water. If yard drains were installed they could be connected to the existing storm sewer system along Quigley Road.

Estimated Project Cost: $10,000



SCALE: 1"=200'

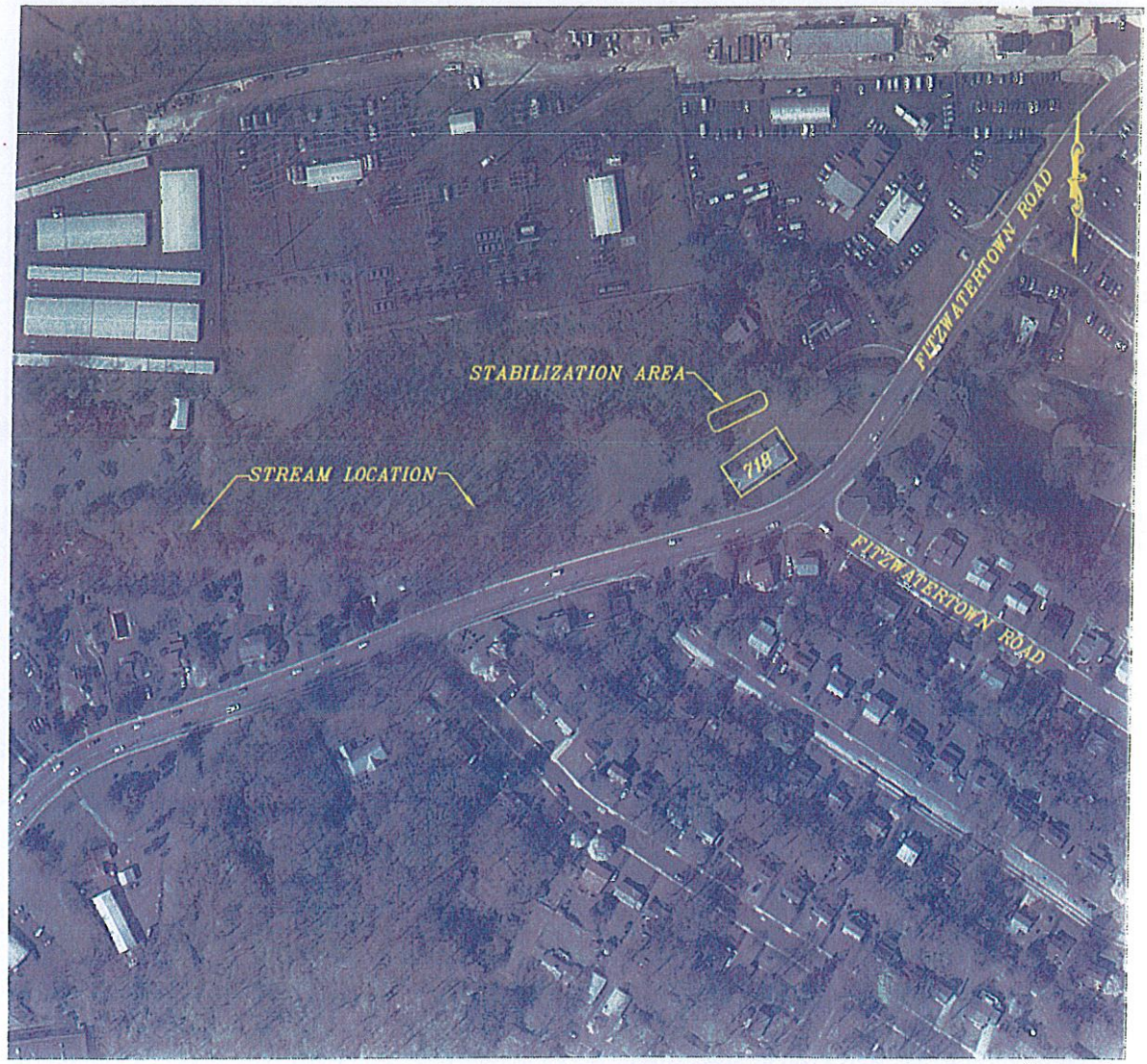
EXHIBIT 3.7

Project Location:
Ward 3 – Fitzwatertown Road

Description of Problem:
The rear yards of properties on the north side of Fitzwatertown Road have flooding due to flooding in the adjacent stream.

Potential Remedy:
Volume of water in the stream must be reduced by implementing stormwater basins upstream to control the flow of water before it reaches the stream. There is an approved land development plan for 718 Fitzwatertown Road and stream bank stabilization will be completed as part of that project. Stabilizing the stream bank will help to reduce the amount of sediment in the stream bed, but will not serve to alleviate the flooding issue.

Estimated Project Cost: NA



SCALE: 1"=200'

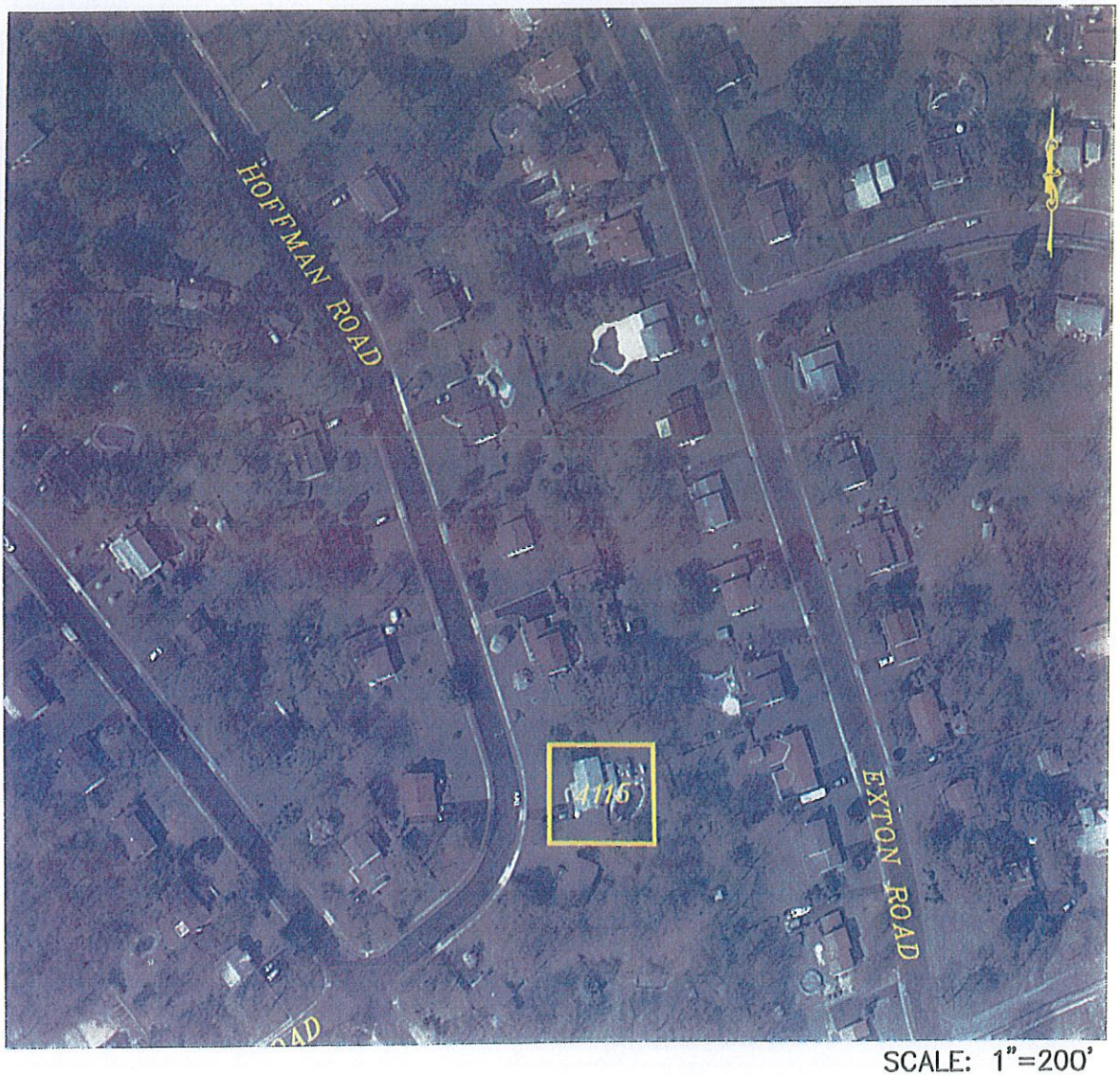
EXHIBIT 5.4

Project Location:
Ward 5 – 4115 Hoffman Road

Description of Problem:
Yard flooding occurs due to lack of positive drainage on the highlighted property.

Potential Remedy:
This issue is a dispute between neighbors involving private property. The residents must first determine what is causing the issue and then hire a contractor to perform the work necessary to correct the problem.

Estimated Project Cost: $10,000



SCALE: 1"=200'

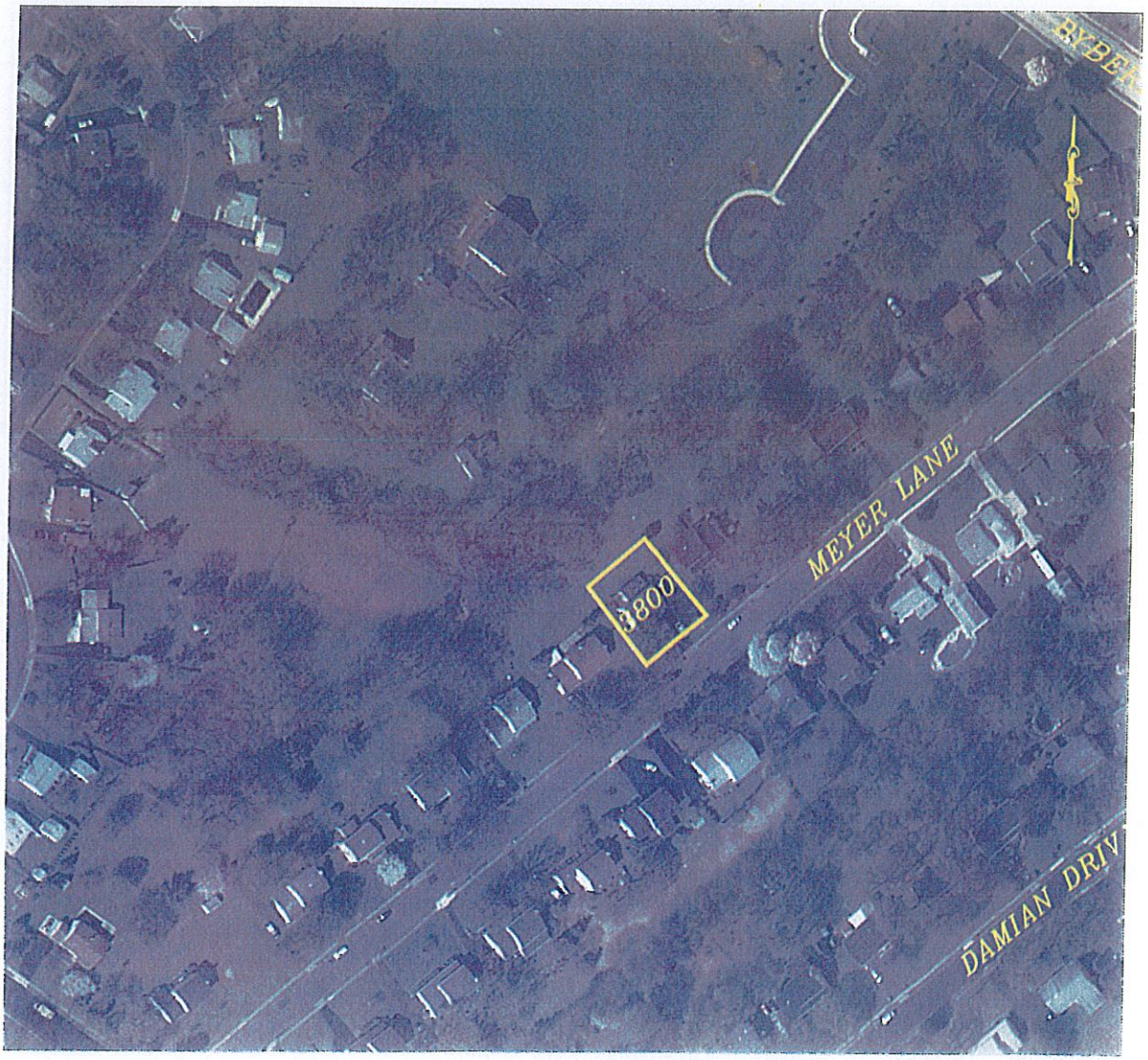
EXHIBIT 5.6

Project Location:
Ward 5 –3800 Meyer Lane

Description of Problem:
Water ponds in rear yards adjacent to Boileau Park.

Potential Remedy:
The adjacent creek should be inspected to ensure that no obstructions exist that are inhibiting the flow of water within the stream channel. The Township could investigate and see if any corrective grading could be done on the park property to divert water away from the private residences.

Estimated Project Cost: $10,000



SCALE: 1"=200'

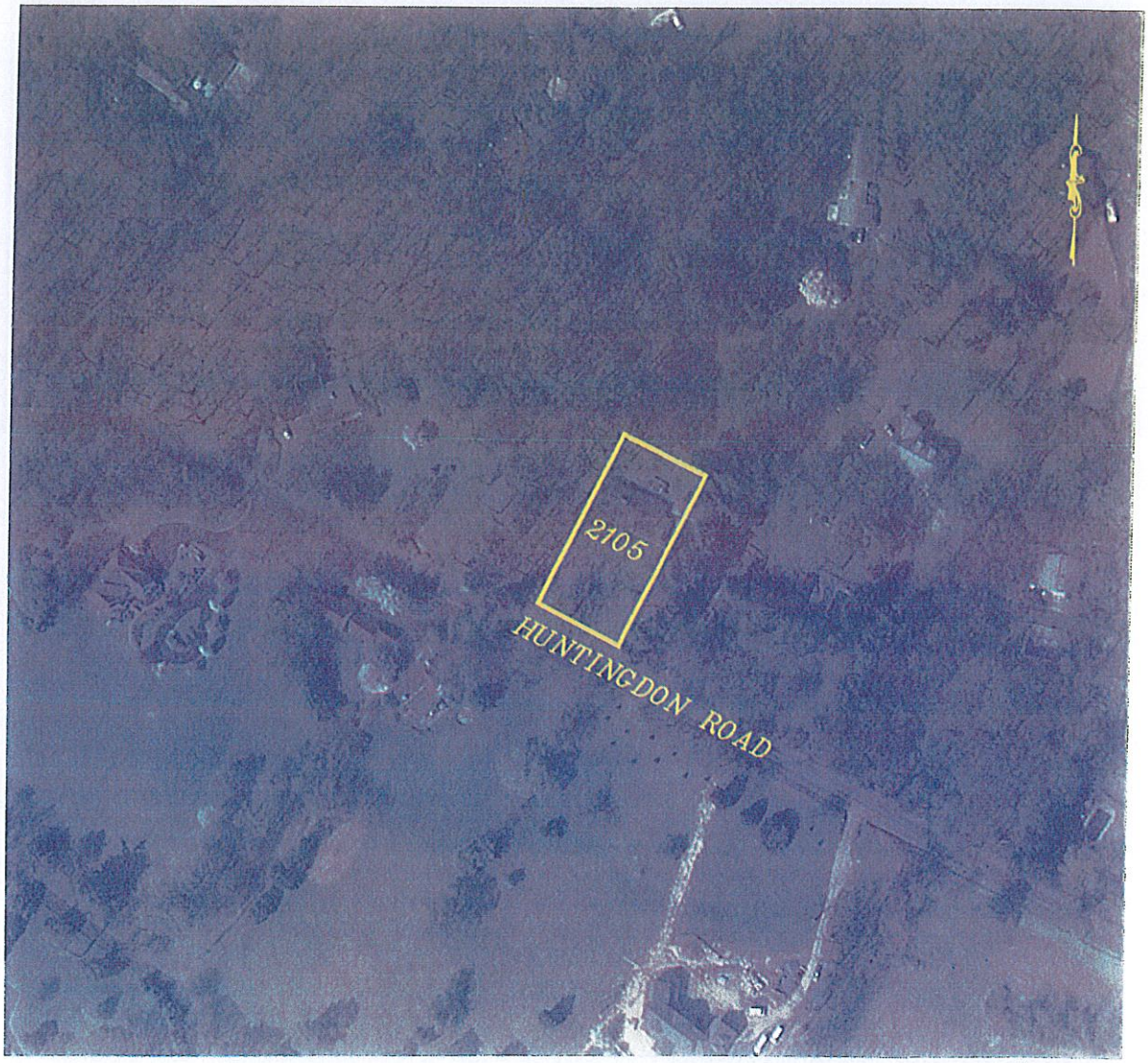
EXHIBIT 6.7

Project Location:
Ward 6 – 2105 Huntingdon Road

Description of Problem:
Private Road flooding occurs and as a result there is a dispute between neighbors as to what is causing the issue.

Potential Remedy:
The flooding is occurring on private property and the neighbors need to come to an agreement on what is causing the issue and then take the steps necessary to correct the problem.

Estimated Project Cost: NA



SCALE: 1"=200'

EXHIBIT 1.3

Project Location:
Ward 1 – Evans Circle & Quigley Road

Description of Problem:
Grading issue in rear yards of private residences along Evans Circle and Quigley Road causes poor drainage / standing water.

Potential Remedy:
Minor grading in rear yards to promote positive drainage as was initially intended when the houses were built. Additionally, yard drains could be installed within the rear yards and tied into the existing storm sewer system that runs from Evans Circle to Edge Hill Road.

Estimated Project Cost: $10,000



SCALE: 1"=200'

EXHIBIT 1.5

Project Location:
Ward 1 – Inman Terrace near Frazier Avenue

Description of Problem:
Flooding occurs in the rear yard of the highlighted property on Inman Terrace. Property is down slope of the apartment complex and receives flow from the adjacent site. Property owner believes that recent grading performed on his neighbor's property is the cause of the problem, which has began within the past year or two.

Potential Remedy:
Problem exists on private property. Residents would need to agree on a solution and hire a contractor to perform remedial grading in order to correct the problem.

Estimated Project Cost: $10,000



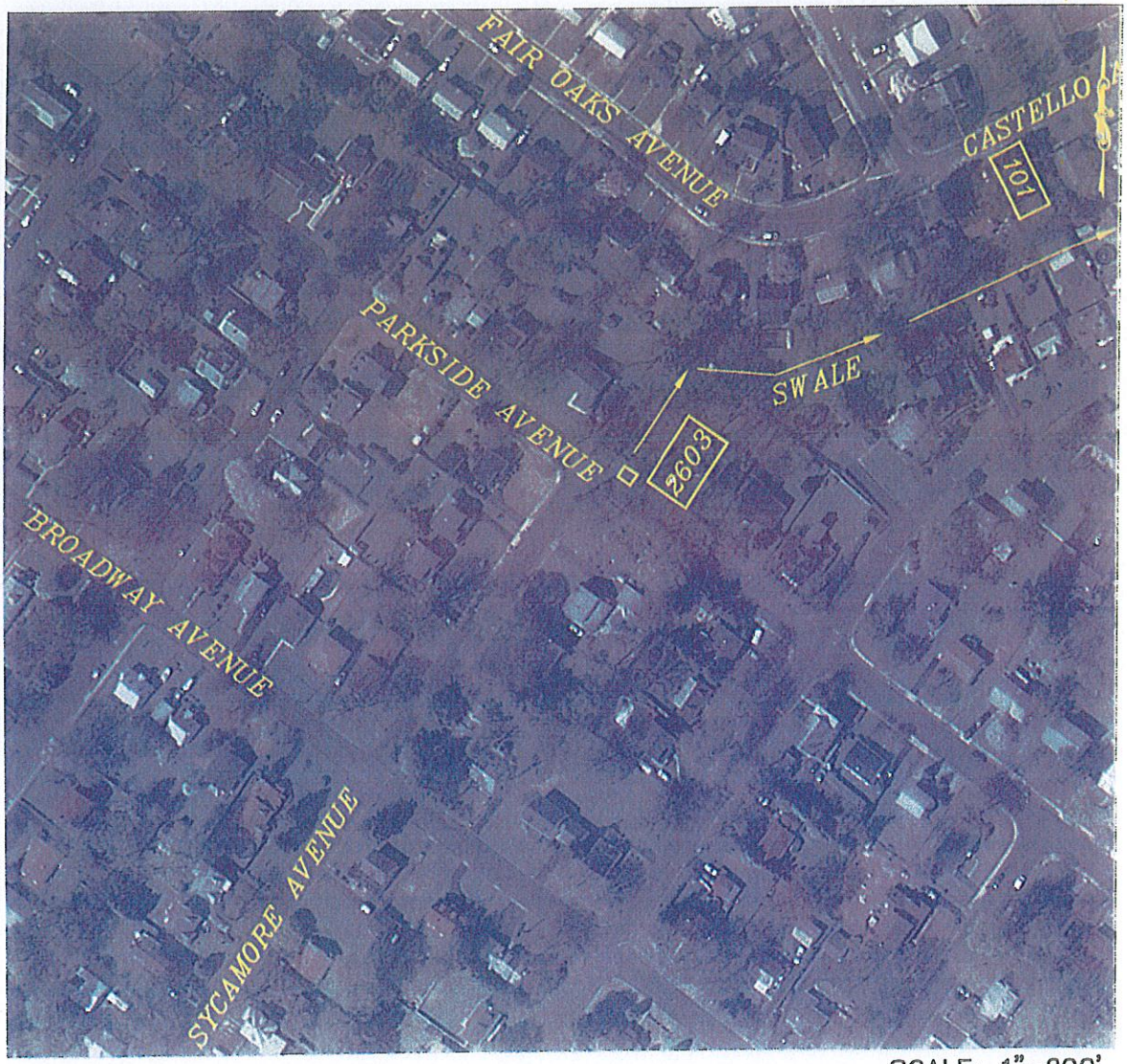
SCALE: 1"=200'

Project Location:
Ward 2 – Parkside & Sycamore Avenue

Description of Problem:
The existing inlet located along Parkside Avenue (2603) discharges to a swale that runs along common back yards of the properties on Parkside Avenue, Fair Oaks Avenue, and Continental Road. The swale eventually runs into Hatboro and its discharge location is unknown.

Potential Remedy:
Grading needs to be performed within this area to create a better defined swale. Additionally, the residents in the area must be vigilant in keeping the swale clear of all debris or other obstructions that may hinder the flow of water.

Estimated Project Cost: $10,000



SCALE: 1"=200'

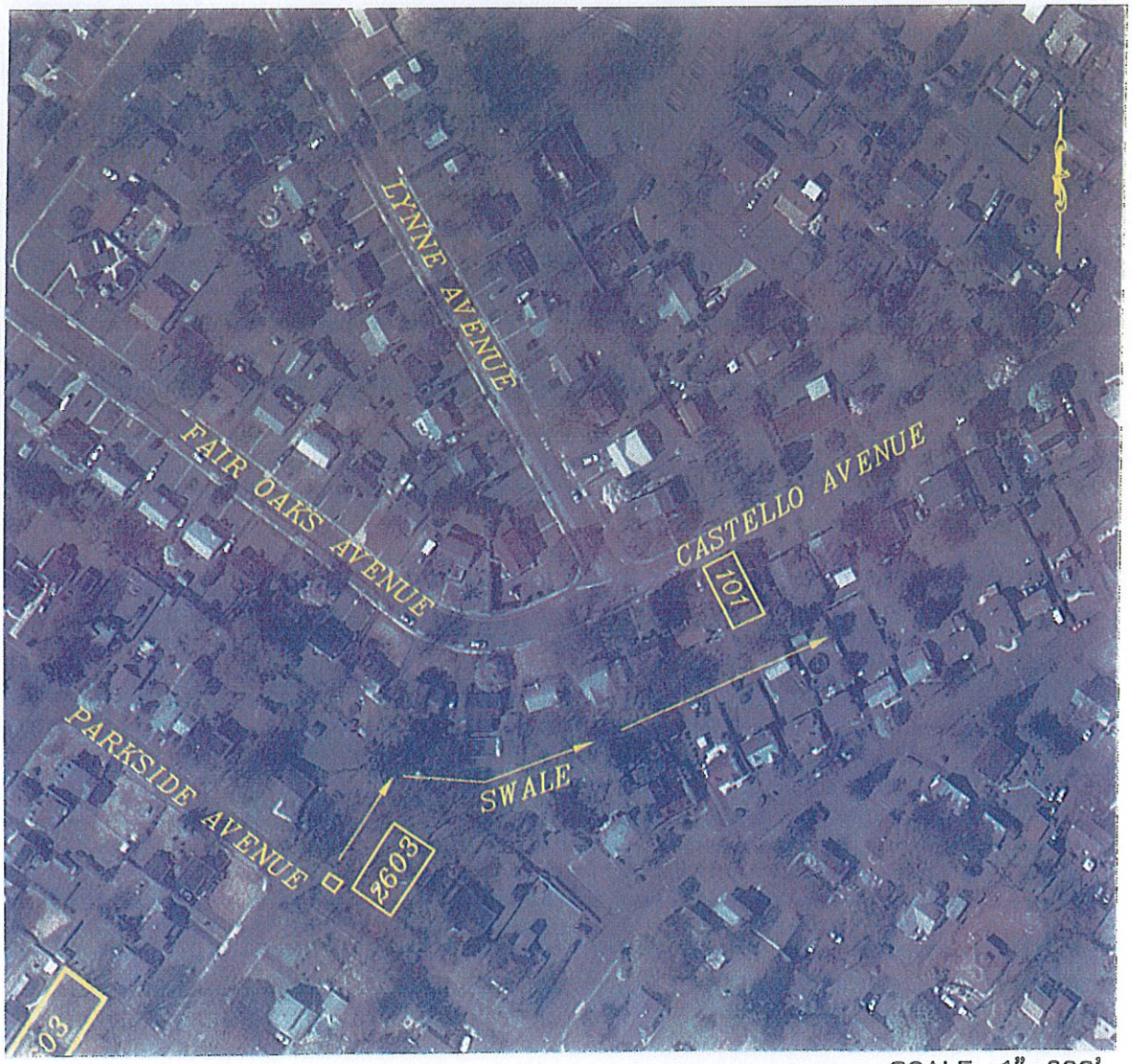
EXHIBIT 2.7

Project Location:
Ward 2 – Castello Avenue near Lynne Avenue

Description of Problem:
Inlet located in the vicinity of 101 Castello Avenue discharges to a swale located along the common rear yards of the residences along Castello Avenue and Continental Road. This is the same swale that is causing the issue at 2603 Parkside Avenue.

Potential Remedy:
Grading should be performed in this area to create a more defined swale. Additionally, residents need to ensure that the swale is properly maintained by removing all debris and other obstructions on a regular basis.

Estimated Project Cost: $10,000



SCALE: 1"=200'

EXHIBIT 2.9

Project Location:
Ward 2 – Blair Mill Road between Broadway & Parkside

Description of Problem:
Rear yard flooding occurs in swale that runs from Broadway Avenue to Parkside Avenue.

Potential Remedy:
Swale is on private property, minor grading could be done to ensure that swale is as defined as possible through this area. Residents should ensure that all debris and obstructions are removed from the swale on a regular basis.

Estimated Project Cost: $10,000



SCALE: 1"=200'

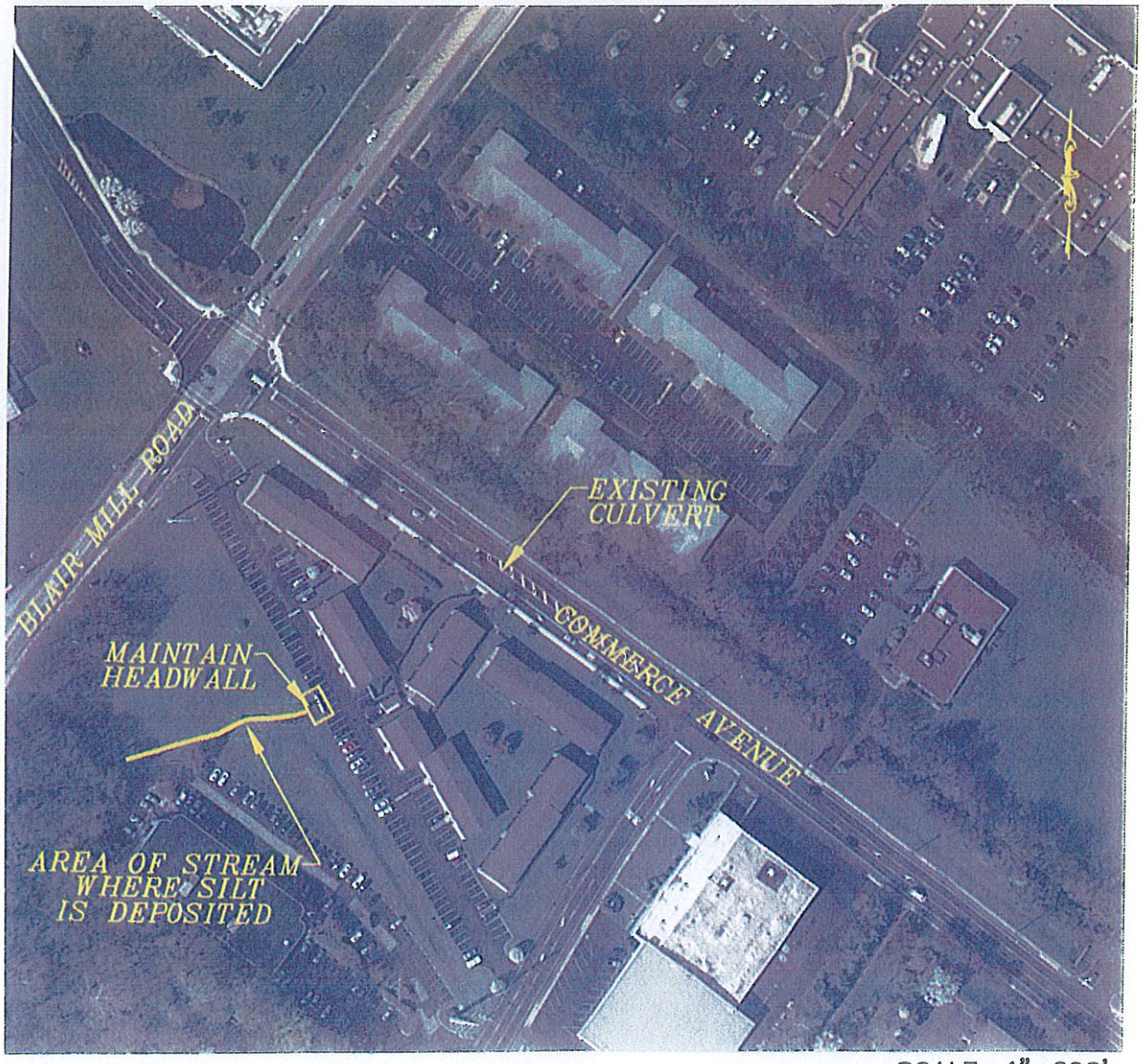
EXHIBIT 3.1

Project Location:
Ward 3 – Commerce Avenue Apartments

Description of Problem:
Stream erosion and flooding occurs on the site in the area of the existing headwall.

Potential Remedy:
Stream and headwall are on private property and need to be maintained by the owner. The area just upstream of the headwall should be cleared of all debris and obstructions, accumulated silt may need to be removed. The Township has replaced the culvert under Commerce Avenue within the last 10-15 years.

Estimated Project Cost: $25,000



SCALE: 1"=200'

EXHIBIT 3.8

Project Location:
Ward 3 – 401 & 403 Crown Street

Description of Problem:
Yard flooding occurs at 401 & 403 Crown Street due to offsite drainage and poorly defined and maintained swales.

Potential Remedy:
The swale on the east side of 401 Crown Street needs to be maintained properly and all debris and obstructions should be removed on a regular basis. Additionally, minor grading could be performed on both properties to ensure that runoff reaches the swale and is safely conveyed around the residences.

Estimated Project Cost: $10,000



SCALE: 1"=200'

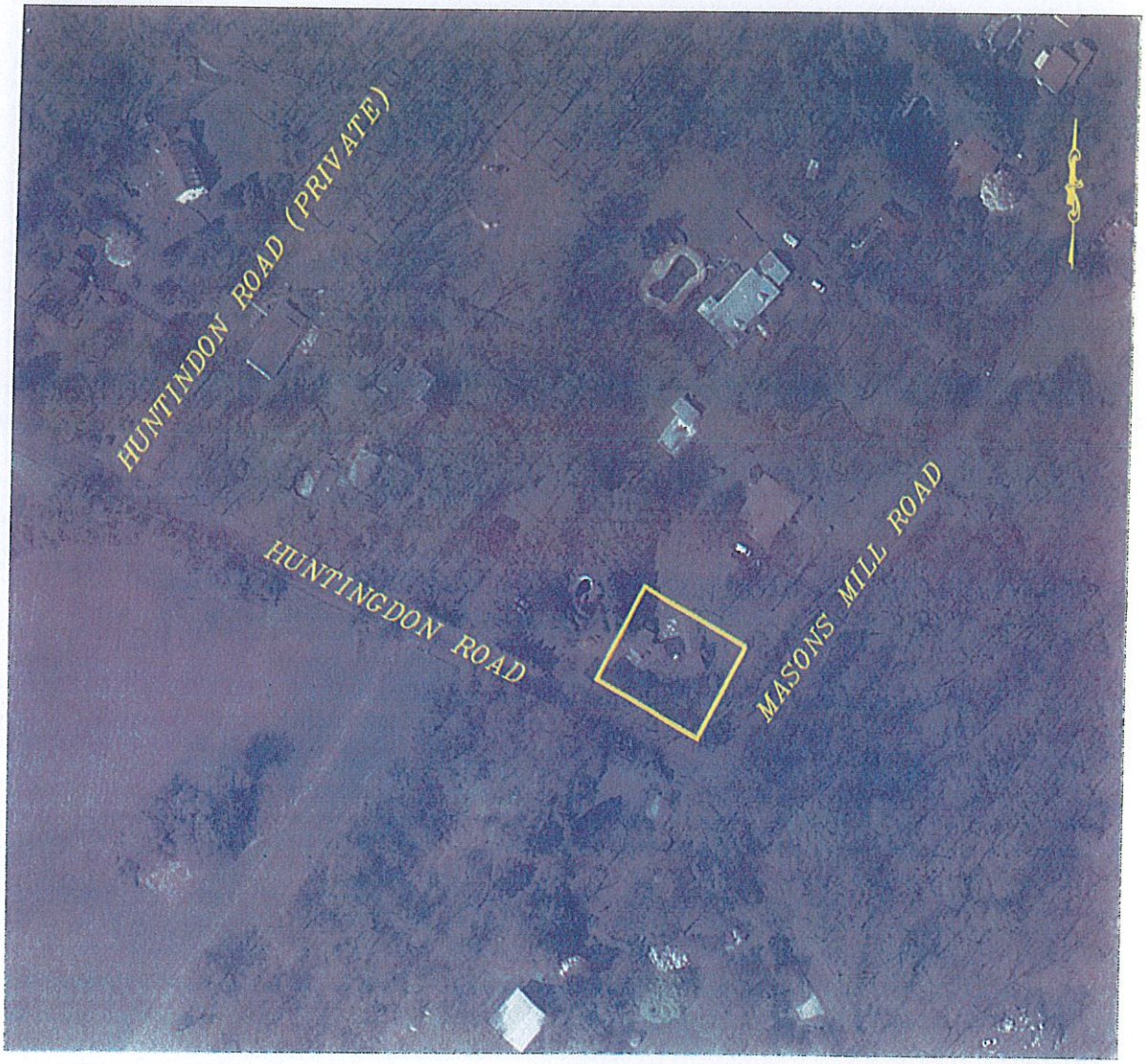
EXHIBIT 6.6

Project Location:
Ward 6 – Huntingdon Road & Masons Mill Road

Description of Problem:
Flooding occurs on the private property highlighted below. There is a small culvert in the rear of the property that could be removed to increase flow capacity of the adjacent channel. The larger problem is that the property is down hill of large open area (June-Feit) that has no stormwater controls.

Potential Remedy:
A stormwater basin could be implemented on the June-Feit property to reduce the peak flow within the adjacent channel. Additionally, if curbing were installed along Huntingdon Road, it could help to direct water away from the private property.

Estimated Project Cost: $25,000



SCALE: 1"=200'

EXHIBIT 4.3

Project Location:
Ward 4 – Dogwood Lane

Description of Problem:
Rear yards of residences along Bartram Road and Dogwood Lane experience flooding issues.

Potential Remedy:
Grading could be performed on the private properties to try and achieve positive drainage towards Bartram Road. Additionally, yard drains could be installed in natural low areas within the rear yards and tied into the existing storm sewer system.

Estimated Project Cost: $25,000



SCALE: 1"=200'

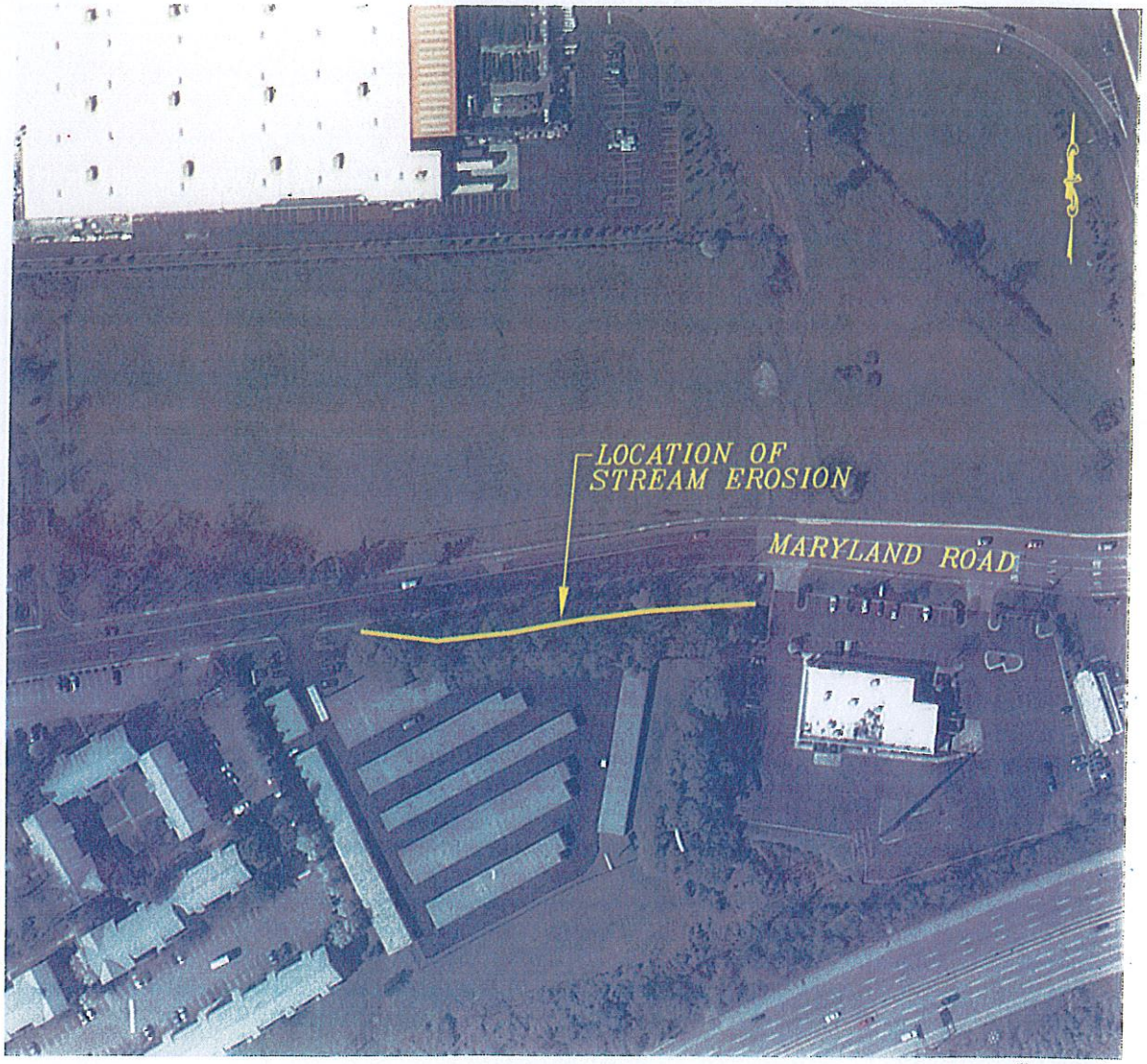
EXHIBIT 4.6

Project Location:
Ward 4 – Maryland Road

Description of Problem:
Stream erosion has occurred between Route 611 and storage units.

Potential Remedy:
The length of stream where the erosion has occurred is highlighted below. A project could be implemented to stabilize the banks and correct the existing issue, however; the stabilization project will not help any of the existing flooding problems in the area.

Estimated Project Cost: $100K - $500K



SCALE: 1"=200'

VIII. Potential Ways to Address Stormwater Management Improvements

In addition to identifying existing stormwater problems and how to attempt to alleviate them, the Township can explore other ways to implement stormwater management improvements from a larger watershed wide perspective:

1. *Ground Level Incentive Program* – The Township could provide incentives to individual residents who chose to willingly implement BMPs on their property. Incentives could be waiver of all permit or review fees or could include a small percentage contribution towards the BMP installation.

2. *Rain Barrel Program* – Some local municipalities provide their resident's rain barrels at a reduced cost. The municipality pre-buys the barrels in bulk at a discounted price and then resells them to residents. One drawback of this program is the Township doesn't have significant storage space at this time.

3. *Developer Incentive Program* – The Township could implement an incentive program for developers that provides the developer with reduced building permit fees or increased density if the developer exceeds the requirements of the Township Stormwater Management Ordinance. Careful consideration, in conjunction with the Solicitor's office, would be required to implement such a program that would still protect the Township from development that doesn't meet the community's goals.

4. *Construct or retrofit BMPs on Township Lands* – See Section X of this report for a listing of the potential sites that BMPs could be installed on Township lands as well as a priority rating system to determine the order in which BMPs should be implemented when funding becomes available.

5. *Construct or retrofit BMPs on Private Property* – See Section X of this report for a listing of all the potential sites that BMPs could be installed on private property as well as a priority rating system to determine the order in which BMPs should be implemented when funding becomes available. The priority rating system for Private Property BMPs is more complicated since the land owner needs to be involved in implementation.

6. *Implement Green Infrastructure within Township ROWs* – As outlined in a presentation to the Community Development Committee back in February 2011, there are numerous ways to implement stormwater improvements within the confines of the existing street network. Although no one improvement will make an immediate difference to overall flooding in the Township, the cumulative effect of many projects will be beneficial. Many of these improvements could be incorporated into other initiatives that are funded by grants that don't historically pay for stormwater improvements. Green Infrastructure improvements to the streetscape include: porous pavement, rain gardens, street trees, disconnected roof drains, porous concrete, etc.

7. *No-mow Low-mow Areas* – The Township could identify areas within the existing park system to reseed with natural seed mix that doesn't require frequent mowing. Often these areas are located adjacent to streams as part of the riparian buffer. The buffer serves to reduce volume and improve water quality. Further, the reduced mowing results in less operation & maintenance costs for the Township.

8. *Tree Replacement Fund* – Money from the Township's existing Tree Replacement Fund (as of January 2013 the fund contained roughly $94,000) can be utilized in stormwater management projects specifically where plantings are needed in BMPs such as rain gardens, basin retrofits, riparian buffer restoration, stream bank stabilization, etc.

9. *Public Education* – Continue to educate the public on stormwater management by keeping stormwater as an agenda item on the Community Development Committee meeting, information on the website, information on the cable channel, email alerts, education signage when new BMPs are installed, the Township newsletter, etc.

10. *Stormwater Committee* – The Township could amend their by-laws to create a new committee focused solely on stormwater management issues.

11. *Innovative Funding & Partnering Sources* – As described in the next section, there are numerous potential funding and partnering sources available to Upper Moreland. Some have been previously explored, while others have not. Although some partners and funding sources are more obvious, all potential options should be exhausted since the task of reducing flooding and implementing stormwater management improvements is a large undertaking over many years across many geographic, municipal and political boundaries.

IX. Potential Funding Sources & Partnering Opportunities

In order to achieve the goals set forth in the *Stormwater Management Improvement Implementation Plan*, Upper Moreland will need to grow partnerships with various entities that share the burden of flooding caused by the insufficient stormwater management infrastructure within the Township and other adjacent municipalities. The cost of designing and implementing stormwater management projects is often very high and although Upper Moreland is committed to taking the steps needed to help alleviate the frequency and severity of flooding within the township and surrounding communities, partnerships and grant opportunities must be explored to generate the funding necessary to make a measurable impact on the specific goals identified within this report. The following is a list of funding and/or partnership opportunities that have been identified as potential sources to help implement stormwater management facilities and programs:

A. Available Grants

1. *PennVest* – Grant funding and low interest loans are available through PennVest, which has been empowered by the Pennsylvania Infrastructure Investment Authority Act 16 of 1988 to administer and finance the Clean Water State Revolving Fund (CWSRF) and the Drinking Water State Revolving Fund (DWSRF). The average project size is 1.5 million, but can be up to 11 million for one municipality or 20 million for multiple municipalities.

2. *Pennsylvania Redevelopment Assistance Capital Program (RACP)* – RACP is a Commonwealth grant program administered by the Office of Budget for the acquisition and construction of economic, cultural, or civic improvement projects. RACP projects must have a total cost of at least $1 million and the Township must provide a 50% match (doesn't allow for in-kind contributions) and the project must occur in an industrial or commercial area. Additionally, engineering, legal, and administration costs are not eligible for reimbursement under the terms of the RACP grant program. Under the current RACP program standalone stormwater projects aren't viewed as favorably as other projects.

3. *H2O PA (Water Supply, Sanitary Sewer and Storm Water Projects)* – Grant funding is available for storm water projects with a total cost of $500,000 or more with a 50% match from the Township. Unlike the RACP grant, the Township match for the H2O PA grant may come from another funding source, including PennVest. Additionally, design and administrative costs are reimbursable under the terms of the H2O PA grant. However, "shovel ready" projects are more desirable and historically have been the only projects selected to receive funding.

4. *Local Municipal Resources and Development Program (LMRDP)* – Local municipalities are eligible to receive funding through the LMRDP for projects that will improve the quality of life within the community.

5. *Floodplain Land Use Assistance Programs* – Funding is available to local governments to encourage the proper use of land and the management of floodplain land within the municipality. Grants through this program typically require the municipality to match 50% of the grant amount.

6. *Growing Greener Grant* – Funding is available from the Department of Environmental Protection through the Growing Greener program for infrastructure improvements such as drinking water, wastewater, or stormwater. Grants through this program will require the municipality to match a portion of the grant amount (minimum 15%).

7. *DCNR Conservation & Recreation Grant* – Funding is available through DCNR. Eligible projects must include development of parks and recreation, but can also include stormwater improvements. The grant requires a 50% match which can be comprised of "in-kind" contributions such as design costs, Township labor, donations, etc.

8. *County Conservation & Recreation* - Funds are distributed by the County. Funds may be used to acquire lands for recreational or conservation purposes and land damaged or prone to drainage by storms or flooding.

9. *Community Development Block Grant (CDBG)* – This program is only eligible in certain census tracts. The program identifies "Flood Drain Improvements" as a medium priority project. CDBG will pay for 100% of the construction costs of a project and a municipality must pay all the design and soft costs.

10. *Municipal Challenge Grant* – Grants will help support municipal tree inventories, tree planting, and tree care. Grant amount can range from $1,000 – $5,000 and require the municipality to match the amount with in-kind services. Planting trees can help reduce the volume of stormwater runoff through evapotranspiration and planting deciduous trees to shade impervious surfaces can help to reduce thermal impacts to the streams throughout the Township.

11. *TreeVitalize* – Funding is available to municipalities for assistance with tree planting programs in public open space, streetscapes, parks, and riparian buffer areas. Planting trees will help reduce stormwater volume and peak rate as well as function to increase stormwater quality.

12. *PA Act 13 Conservation & Recreation Funding* – This newly established program is funded by the Marcellus Shale Impact fees. The fees generated by Act 13 are dispersed to numerous agencies and funds including; Conservation District, Public Utility Commission (PUC), Fish & Boat Commission, PennDOT, DEP, PEMA and the Marcellus Legacy Fund. The Legacy Fund allocates money to; The Commonwealth Financing Authority, Highway Bridge Improvement, Growing Greener, County Conservation & Recreation, PennVEST and DCED.

13. *William Penn Foundation* – The Foundation has a Watershed Protection division whose goal is to protect the supply of clean drinking water within the Delaware watershed. The Foundation contributed significant funding to Temple's Center for Sustainable Communities efforts to develop an ACT 167 plan for the Pennypack Creek.

14. *Transportation Enhancement (TE) Program* – This grant program provides funding for transportation enhancement projects. Typically the grant is used for traffic improvements and pedestrian and streetscape improvements, but funds can be used to the improve roadway drainage system too. The Township took advantage of this grant program to construct Phase I of the streambank stabilization improvements in Veteran's Memorial Park. The funding for this grant comes from the federal level and is administered by PennDOT and DVRPC.

15. *Infrastructure Development Program (IDP)* – This program provides grants and low-interest funding for public and private infrastructure improvements. Funding is capped at $1.25 million per project. The grant requires that new jobs be created based on the level of funding received. Thus, if the Township received funds for a drainage improvement project using this program the Township would need to hire additional staff as part of the program.

B. Township Funds

1. *Stormwater Fund* – The Township has a stormwater fund program that was instituted in 2010. Various developers have made contributions to the fund since its inception and as of the date of this report the fund has approximately $72,000 available to be utilized for stormwater management projects throughout the Township. Another $27,000 is committed pending the project moving forward and there are several large projects in the sketch plan phase which will likely make contributions to the fund.

2. *Tree Replacement Fund* – As mentioned in a previous section, money from the Township's existing Tree Replacement Fund can be utilized in stormwater management projects specifically where plantings are needed in BMPs such as rain gardens, basin retrofits, riparian buffer restoration, stream bank stabilization, etc. Also, as the need for stormwater funds grows and the amount of available land to use the tree fund diminishes, the Sub-Committee proposes that moving forward the Township should consider asking developers to contribute money to the stormwater fund in-lieu of the required tree fund contribution. The contributed amount could be a portion of the total that would be required to be contributed to the tree replacement fund (85%). The "discount" would provide incentive for the developer to contribute the money to the stormwater fund.

3. *Public Works Drainage Fund* – Money from the existing Public Works Drainage Fund which is funded in each year's budget can be utilized as a "match" for a grant application or combined with money from the Stormwater Fund to help pay for a smaller project.

4. *Tax Generated Money* – The Township may elect to introduce a slight tax increase as a result of the need to improve the quality of life of Township residents through the rehabilitation of existing stormwater infrastructure and creation of new stormwater management facilities in order to reduce flooding and increase the quality of water within the nearby streams. A tax increase of 1% would have the ability to generate roughly $50,000 per year that could be utilized for much needed stormwater management upgrades within the Township. A voter referendum could be used to determine if the residents of the Township are in favor of a large capital investment program to generate revenue for stormwater projects. The total cost of all improvements identified in this report totals roughly 28 million dollars.

5. *Liquid Fuels* – The Pennsylvania Liquid Fuels Tax program allows municipalities to utilize the funds for the construction, reconstruction, maintenance, and repair of public roads or streets including culverts and drainage structures within the township owned right-of-way of a public street.

6. *Stormwater Permit Fees* – Upper Moreland Township could implement a stormwater fee program for all building permits similar to Whitpain Township. Whitpain Township implemented a permit fee for all building permits. The program placed a charge for every new square foot of impervious surface proposed. Whitpain's charge was $2.50 per square foot. The money generated by the program funded a basin retrofit.

   As mentioned above, for Upper Moreland Township the total cost of all the stormwater improvements identified in this report totals roughly 28 million dollars. The Township contains 7.5 square miles of surface area. That corresponds to 15 cents per square foot of land area (Not the cost per square foot of impervious area).

7. *Loans* – Some of the agencies which provide the grant programs mentioned above (AMEC, PEC, DCED, etc.) also have low-interest loan programs available too. Loans require the entire amount borrowed to be repaid by the Township.

8. *Bonds* – As the Township has done in the past for other large-scale improvements, the Township could borrow money to raise funding for stormwater management improvements. Like a low-interest loan the money associated with the bond would need to eventually be repaid. Since taxpayer funds would likely be the source of money to repay the bond a voter referendum could be used to determine if the residents of the Township are in favor of a large capital investment program to generate revenue for stormwater projects.

C. Partnerships with Large Land Owners

In order to implement stormwater management projects the Township will need to develop and maintain strong relationships with the largest land owners throughout the municipality. Not only does runoff from large expansive tracts of land contribute to the flooding and drainage issues experienced in the Township, but this land is also large enough to implement considerable BMP improvements on it. In many instances we may find that the installation of a stormwater basin or other BMP on the privately owned property can serve to alleviate flooding on surrounding properties and streams. In some cases a large land owner such as the Pennypack Ecological Restoration Trust (PERT) may have a vested interest in improving the quality of water within the Pennypack Creek through the implementation of stormwater management projects. The following is a list of large land owners that have been identified by the Sub-Committee as possible partners in stormwater projects:

1. *Pennypack Ecological Restoration Trust (PERT)* – As mentioned above PERT is a large land owner within the Township that has a vested interest in preserving the natural resources within the Township. A partnership with PERT could include utilizing their land to install BMPs that would help to reduce flooding within the Pennypack Creek. Also, PERT may be willing to contribute money for the installation of BMPs or riparian buffer restoration on township owned property that will have a positive impact on the Pennypack Creek.

2. *Huntingdon Valley Golf Course* – The golf course provides a unique opportunity for partnership because vegetated BMPs such as rain gardens, constructed wetlands, and wet ponds can be incorporated into the course as natural hazards. The BMPs would function to enhance the golf course as well as provide stormwater volume and rate control to help reduce the frequency and severity of flooding within the surrounding areas.

3. *Upper Moreland School District* – The school district may be interested in teaming up with the Township in an effort to reduce flooding on its various properties by installing BMPs and other stormwater infrastructure. The school district could also use an installed BMP such as a rain garden or porous pavement as a teaching tool to get children interested and aware of the effects of stormwater runoff.

4. *Hatboro-Horsham School District* – For all the reasons stated above regarding the Upper Moreland School District, Hatboro-Horsham may also be interested in participating in projects with the Township.

5. *Upper Moreland Little League* – The little league association owns land throughout the Township that contains athletic fields and associated parking lots. The little league association may be interested in having BMPs installed on their property to help reduce flooding in the community. In many cases playfields can be used as stormwater BMPs during rain events when the athletic activities wouldn't typically be occurring.

6. *Carson-Simpson Farm* – The property is very large and contains acres of undeveloped land located adjacent to the Pennypack Creek and adjacent to Davisville Road which is a major transportation route to get from one side of the Township to another by emergency responders.

7. *Willow Grove Day Camp* - The property is very large and contains acres of undeveloped land located adjacent to the Pennypack Creek and adjacent to Davisville Road which is a major transportation route to get from one side of the Township to another by emergency responders.

8. *June Fete* – The property is very large and contains aces of undeveloped land only used on seldom occasions. The property is located adjacent to the PERT owned land identified previously in the report.

9. *Private Developers* – The Township has a number of private developers that own a large number of parcels within the township. Many of these developers have existing stormwater basins on their properties that are subject to maintenance agreements with the township. The Township could partner with the developer to retrofit the existing basins to provide greater volume and/or naturalize the basins to provide a water quality function. Large private land owners could also be approached to see if there are any opportunities to place additional BMPs on a parcel of land that they may own. This land could be dedicated open space or other land with little to no value to the owner.

D. Authorities, Agencies & Elected Officials

In addition to the various entities that own large portions of land within the Township, there are also many agencies, authorities, and commissions that work throughout the Township and surrounding watersheds that may have interest in creating a partnership to help implement stormwater management facilities. The following is a list of outside agencies, authorities, etc. that the Sub-Committee has identified as possible partners in implementing stormwater management projects:

1. *Upper Moreland-Hatboro Joint Sewer Authority (UMHJSA)* – UMHJSA provides collection, conveyance, and treatment of waste water for all customers within Upper Moreland Township. A major issue for UMHJSA is inflow and infiltration of stormwater into their conveyance systems. The unwanted stormwater flow creates a strain on treatment plants and increases the cost of operation for the facilities. Road flooding during heavy rain events is a major producer of unwanted stormwater inflow into the sanitary sewer system. The authority may be willing to partner with the Township in order to implement stormwater projects that will limit the frequency and severity of the inflow of stormwater into the Authority's system. The Authority also has land at the treatment plant that is currently unused that could be the site of a stormwater management basin.

2. *Philadelphia Water Department (PWD)* – The PWD has a mission to provide safe drinking water to the greater Philadelphia area while also protecting the rivers and streams of the region. The Pennypack Creek is tributary to the Delaware River and connects with the Delaware within Philadelphia city limits. Controlling flow in the Pennypack Creek will have a favorable impact on reducing flooding within the Delaware River and ultimately the City of Philadelphia. For this reason the PWD may be interested in exploring partnership options with Upper Moreland to implement stormwater projects that can reduce the flow within the Pennypack Creek and ultimately the Delaware River. Further, with EPA's mandate to the City of Philadelphia and the millions of dollars to be invested in the coming years to comply with the mandate the PWD should be a very willing partner with available funds to make improvements.

3. *Pennsylvania Department of Transportation (PennDOT)* – Many state owned and maintained highways traverse Upper Moreland Township. These roads contribute a significant amount of uncontrolled stormwater runoff into the Township's storm sewers and streams. A partnership opportunity with PennDOT may be available to install BMPs that could reduce flooding on state highways and in turn increase the quality of travel on the state highways.

4. *Pennsylvania Turnpike Commission* - A portion of the Pennsylvania Turnpike runs through the Township and the Willow Grove Interchange is located in the Township. The Turnpike Commission may be willing to partner with the Township in order to implement stormwater management facilities that will reduce flooding on the roads that lead to the interchange.

5. *Pennsylvania Environmental Council (PEC)* – PEC has a mission to protect and restore the natural and built environments within the state through innovation, collaboration, education, and advocacy. PEC has been involved in implementing stormwater programs in nearby watersheds such as the Wissahickon Creek and partnership opportunities with the Council to develop programs such as rain barrel workshops and stream bank projects within Upper Moreland Township may be possible.

6. *Delaware Valley Insurance Trust (DVIT)* – DVIT provides liability insurance to many municipalities throughout the Delaware Valley including Upper Moreland Township. A partnership with DVIT would be keyed on the idea that reducing the frequency of flooding within the Township would result in a decreased risk of the Township needing to utilize their liability coverage in the event of an accident or death due to flooding caused by insufficient stormwater management infrastructure.

7. *Southeastern Pennsylvania Transportation Authority (SEPTA)* – SEPTA operates a regional rail line and also provides bus service within Upper Moreland Township. A partnership with SEPTA would be based on the idea that reducing flooding on their bus and train routes would serve to increase the level of service and decrease the risk of an accident caused by flood waters. The Township could reach out to SEPTA to determine if there are any specific spots on their bus or train routes within the township that are subject to frequent flooding issues.

8. *Municipal or Regional Stormwater Authority* – Creating a municipal or regional stormwater authority as described in the proposed PA House Bill 1390 would allow funds to be raised through fees paid to the authority based on the amount of runoff that each property owner contributes to the watershed similar to what the City of Philadelphia implemented in recent years. (As mentioned above, a 15 cent per square foot of property owned would generate 28 million dollars.) This approach would force the properties that contribute a large majority of the runoff to bare the burden of installing BMPs to control what is discharging from their properties by paying the largest usage fees. The authority could be only Upper Moreland Township or a partnership with some surrounding municipalities

to form a regional stormwater authority. Funds generated from the stormwater fees paid by land owners would be used to fund stormwater improvement projects and flood mitigation project throughout the township and/or region. The Township should beware that this option has many negative effects (both real and perceived) that would need to be carefully considered before moving forward with this option.

9. *Pennsylvania Department of Environmental Protection (DEP)* – DEP has a vested interest in protecting the streams and other natural environments within the Township. Occasionally grants are administered through DEP's office and may become available to install stormwater BMPs that will increase water quality in the surrounding streams and wetlands.

10. *Montgomery County Conservation District* – The District receives thousands of dollars each year from the State. The funds are generated through permit fees associated with E&S and NPDES applications. The District is supposed to use these funds for stormwater education, outreach and improving the environment. Also, the District can serve as the sponsor for grant funding as they have a long track record of implementing successful projects in the eyes of DEP.

11. *Federal / Pennsylvania Emergency Management Agency (FEMA / PEMA)* Grant funding or a partnership with FEMA or PEMA may be possible in order to alter properties that are frequently flooded in order decrease the risk of flood damage to the property. Since 2004 FEMA has been assisting property owners to raise their houses above the base flood elevation as part of the Severe Repetitive Loss Program. Additionally, property "buy outs" have been utilized in the past in Upper Moreland to remove property from areas subject to frequent and severe flooding.

12. *Regional Utility Owners (Aqua, PECO, Verizon, etc.)* – Flood waters often affect the service that regional utility owners provide to their customers. Each year floods cause utility poles to fall and PECO transformers to fail causing wide spread power outages and the high cost of repairing the transmission lines. Also, a utility owner such as Aqua PA has a vested interest in the quality of water that reaches their reservoirs and supply wells. Aqua may be interested in partnering with the Township on projects that will improve the quality of runoff from areas of the Township that are tributary to public water supplies.

13. *Elected Officials* – Local and State elected officials have a duty to serve the best interests of their constituents. Since flooding and water quality issues are serious problems to the health, safety and welfare of the residents of Upper Moreland Township, these elected officials have a vested interest in helping the Township secure funding to implement improvements.

14. *Township Residents* – The Township could host workshops and provide assistance to residents who would like to install small BMPs such as rain gardens, rain barrels, seepage pits, etc. on their properties in order to help

control stormwater runoff. A few small projects would have a limited effect on the overall flooding issue in the Township. However, if enough small BMPs were installed across the Township they could have a measurable impact on decreasing the frequency of flooding.

E. Neighboring Municipalities

Major causes of the flooding issues within the Pennypack Creek in Upper Moreland Township are a result of where the Township is located geographically compared to the entire Pennypack Creek Watershed. Surrounding municipalities contribute approximately 10,300 acres of drainage area to the portion of the Pennypack Creek that runs through the Township. On the downstream side, Lower Moreland Township will receive the same 10,300 acres from adjacent municipalities plus an additional 4,800 acres from Upper Moreland Township. Partnership opportunities with adjacent municipalities could have a positive impact for the residents of multiple communities. Installation of a large scale stormwater detention facility in a municipality that is upstream of Upper Moreland would serve to reduce the severity and frequency of flooding from the Pennypack Creek within the limits of Upper Moreland. It is important now more than ever in the current economic climate to utilize what little funds are available in a way that will have the greatest impact to the residents of the Township. The following is a list of the adjacent municipalities that could serve as potential partners in large scale stormwater management projects:

- Abington Township (Contributes 940 Acres)
- Borough of Bryn Athyn (Contributes 302 Acres)
- Hatboro (Contributes 895 Acres)
- Horsham Township (Contributes 3,700 Acres)
- Upper Dublin Township (Contributes 265 Acres)
- Upper Southampton Township (Contributes 1,090 Acres)
- Warminster Township (Contributes 3,100 Acres)
- Lower Moreland Township (Receives 15,360 Acres)

X. Potential Best Management Practice (BMP) Locations

Per a 2009 PennVest Grant application, thirteen (13) locations where identified throughout the Township as potential sites for construction of stormwater management basins aimed at controlling flooding and improving stormwater quality. In addition to the thirteen locations outlined in the PennVEST application, the Sub-Committee has identified additional areas throughout the Township that could serve as potential sites for stormwater basins.

To select the basin projects that the Township should concentrate on implementing first, a priority table was created to rank the potential basin projects. The priority table takes into account how easily the land needed to construct the basin could be obtained. Land already owned by the Township receives the highest rating and land that could be reasonably obtained receives the next highest score. Private property that does not appear easily obtainable

would receive the lowest score. The second criteria for the basin rating system considers how many "points of confluence" or downstream areas within the Township will be positively impacted by the basin. A basin project located on upstream side of the Township will have the ability to positively impact the entire Township; where as, a project on the downstream end would have an impact on only a small portion of the Township.

A. Potential Basin Projects

Potential Stormwater Basin - Construction Priority Table							
Potential Location	Report Exhibit	Volume (ac-ft)	Estimated Cost*	Weighted Cost ($ / Ac-ft)	Land Owner	Points Affected***	Total Score**
Blair Mill Elementary School	A	1.8	$106,500	$48,409	2	6	8
Fair Oaks Park	E	9	$416,500	$46,278	3	5	8
Hatboro Little League Fields	G	2.4	$130,500	$48,333	2	6	8
Hatboro Memorial Park	H	5.7	$344,000	$44,103	2	6	8
North Willow Grove Park	Q	2.7	$125,550	$46,500	3	5	8
Surrey Lane	D	2.8	$195,000	$48,750	3	4	7
J.T. Eaton Memorial Park	I	10	$371,500	$44,226	2	5	7
Pennypack Elementary School	K	20.7	$1,039,000	$43,840	2	5	7
Between Mill & Bonnet Lane	V	9.6	$446,400	$46,500	3	4	7
Blair Mill Village Apartments	AA	3	$139,500	$46,500	2	5	7
Dawson Manor Park	EE	1.8	$83,700	$46,500	3	4	7
Turnpike Drive	L	23	$1,568,500	$44,814	2	4	6
Upper Moreland Middle School	M	9	$459,500	$95,730	2	4	6
Carrabbas Basin Retrofit	T	0.6	$27,900	$46,500	2	4	6
La Rosa Basin Retrofit	U	3	$139,500	$46,500	3	3	6
Basin Retrofit at Betz & Byberry	W	0.9	$41,850	$46,500	2	4	6
Pilleggi Park	X	17.1	$795,150	$46,500	3	3	6
Fulmer Heights	DD	9.3	$432,450	$46,500	2	4	6
Turnpike Interchange	FF	18.6	$864,900	$46,500	2	4	6
Boileau Park	B	3.6	$280,000	$49,123	3	2	5
Butternut Drive	C	4.2	$199,000	$47,381	2	3	5
Former Sam's Club Parking Lot	F	11.7	$485,000	$47,549	1	4	5
Woodlawn Park	N	1.5	$69,750	$46,500	3	2	5
Mason's Mill Park	P	2.4	$111,600	$46,500	3	2	5
Former Cold Springs Elementary	R	5.1	$237,150	$46,500	2	3	5
Open Space (North of Veterans)	S	9.9	$460,350	$46,500	3	2	5
Terwood Park	J	6.9	$344,000	$44,103	2	2	4
UMHJSA Property	CC	12.9	$599,850	$46,500	2	2	4
Little League Park	BB	10.5	$488,250	$46,500	1	2	3
Carson-Simpson	Y	4.5	$209,250	$46,500	1	1	2
Willow Grove Day Camp	Z	12.3	$571,950	$46,500	1	1	2
Beuhler Park	O	NA	NA	NA	NA	NA	NA

Total Volume = 236.5 ac-ft

Total Cost = $11,784,050

* Estimated construction cost and storage volume are taken from 2009 PennVest Grant application for basin projects A through M. For projects N through DD, which were not identified in the PennVEST application, an average of $46,500 per ac-ft of storage was assumed based on the cost estimates for basins A through M.

** Total score is the sum of the "Land Owner" and "Points Affected" categories. Projects with the highest "Total Score" should be implemented before projects with lower scores.

***Points Affected: Denotes the number of confluence points that would be positively impacted by basin construction.

Land Owner: (3) Township owned property
(2) Not Township owned, but reasonably obtainable
(1) Not Township owned & not easily obtainable

BASIN EXHIBIT A

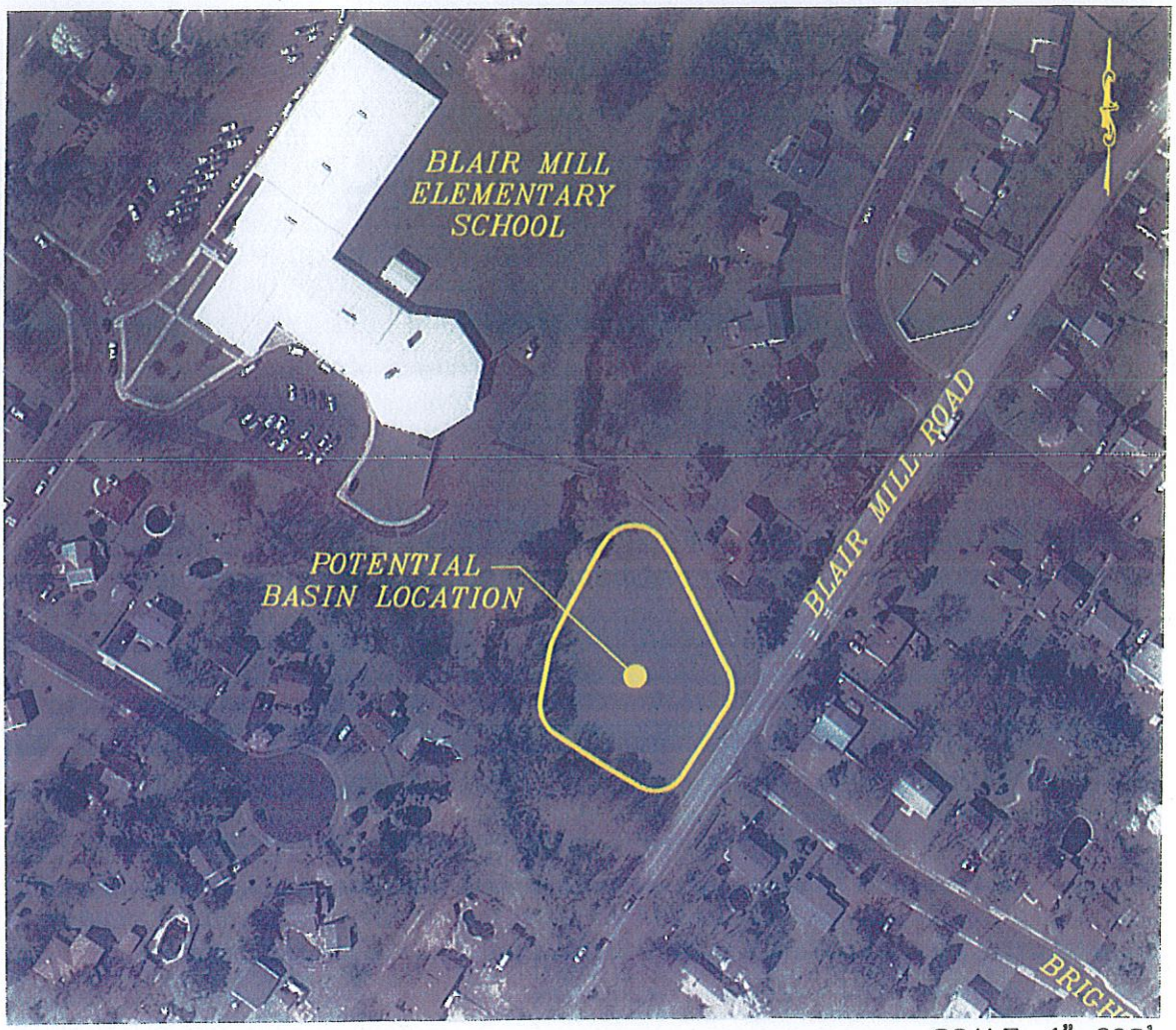
Basin Location: Blair Mill Elementary School

Area: Approximately 0.9 acres

Depth: Approximately 2 feet

Storage: Approximately 1.8 acre-feet

Notes: Basin location is identified in 2009 PennVEST grant application. A basin in this location may help to reduce the frequency of flooding on Norwyn, Shirley, and Barbara Roads, identified in Exhibit 2.1 of this report.



SCALE: 1"=200'

BASIN EXHIBIT E

Basin Location: Fair Oaks Park

Area: Approximately 3 acres

Depth: Approximately 3 feet

Storage: Approximately 9 acre-feet

Note: This location is identified in the 2009 PennVEST grant application. There is existing storm sewer in the area that runs down Lynn Avenue and collects runoff from the park. A basin project could be implemented in this area without losing the existing baseball field in the park.



SCALE: 1"=300'

BASIN EXHIBIT G

Basin Location: Hatboro Little League Fields

Area: Approximately 0.8 acres

Depth: Approximately 3 feet

Storage: Approximately 2.4 acre-feet

Note: This location is identified in the 2009 PennVEST grant application. Basin could be implemented in this area without losing any of the existing baseball fields on the site. Property is owned by Hatboro Borough in Horsham Township.



SCALE: 1"=300'

BASIN EXHIBIT H

Basin Location: Hatboro Memorial Park

Area: Approximately 1.9 acres

Depth: Approximately 3 feet

Storage: Approximately 5.7 acre-feet

Notes: This location is identified in the 2009 PennVEST grant application. The park is located within Hatboro and would require a joint effort between municipalities. Additionally, implementation of the basin project to the extent outlined in the grant application would require either the removal of the existing baseball field or a groundwater study to determine if the baseball field could function at a lower elevation.



SCALE: 1"=300'

BASIN EXHIBIT Q

Basin Location: North Willow Grove Park

Area: Approximately 0.9 acres

Depth: Approximately 3 feet

Storage: Approximately 2.7 acre-feet

Notes: A basin project could be implemented in this Township owned park without the need to remove the existing baseball field.



SCALE: 1"=300'

BASIN EXHIBIT D

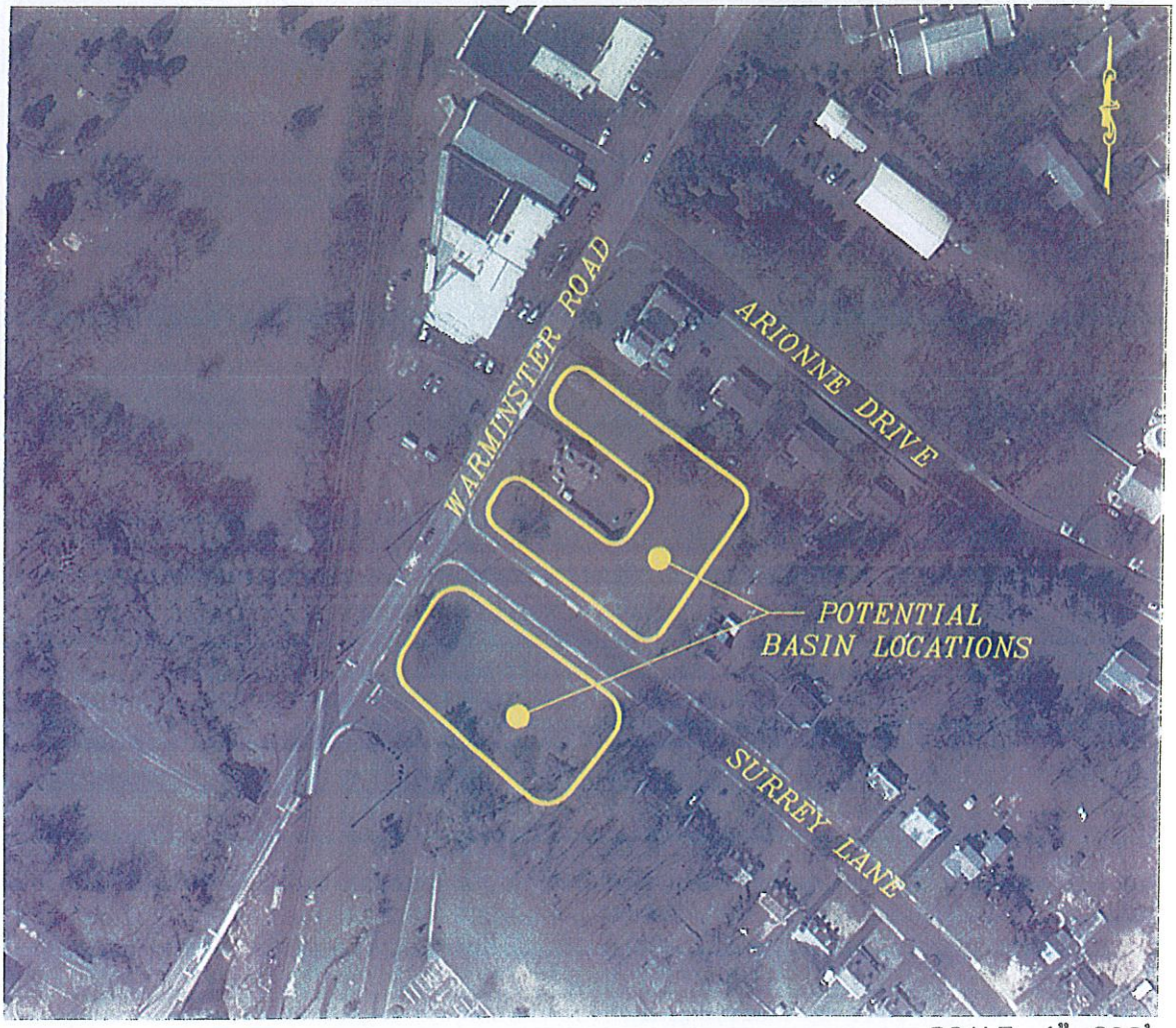
Basin Location: Surrey Lane

Area: Approximately 1.4 acres

Depth: Approximately 2 feet

Storage: Approximately 2.8 acre-feet

Notes: This location is identified in the 2009 PennVEST grant application. The highlighted areas are Township owned properties. There is no existing storm sewer system along Warminster Road or Surrey Lane in this vicinity, so any potential basin project would also need to include the construction of a stormwater conveyance system to get runoff into the basin.



SCALE: 1"=200'

BASIN EXHIBIT I

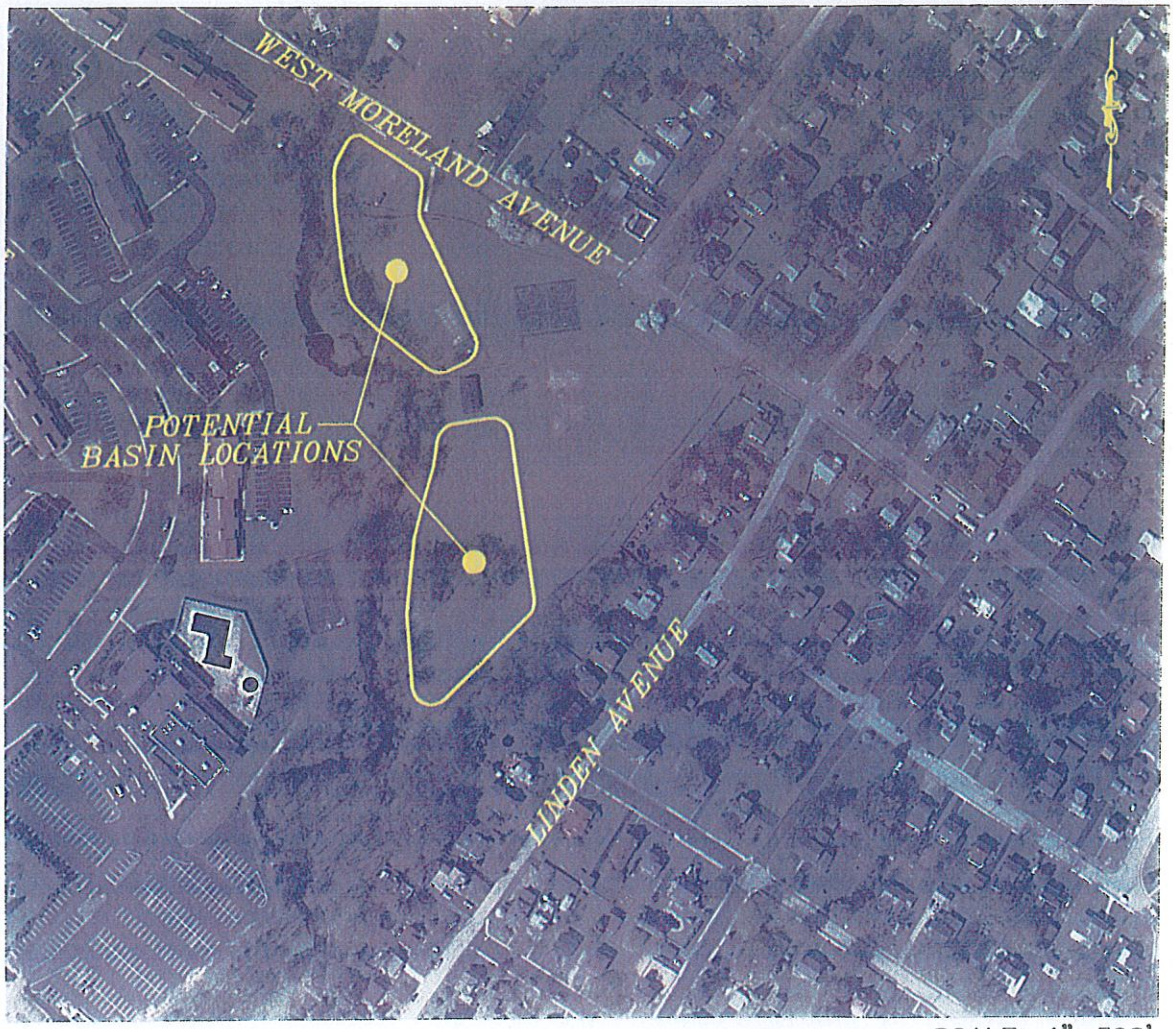
Basin Location: J.T. Eaton Memorial Park

Area: Approximately 2.5 acres

Depth: Approximately 4 feet

Storage: Approximately 10 acre-feet

Notes: This location is identified in the 2009 PennVEST grant application. Implementation of basins in the areas identified below could help to provide more storage for floodwaters and decrease the severity of flooding downstream.



SCALE: 1"=300'

BASIN EXHIBIT K

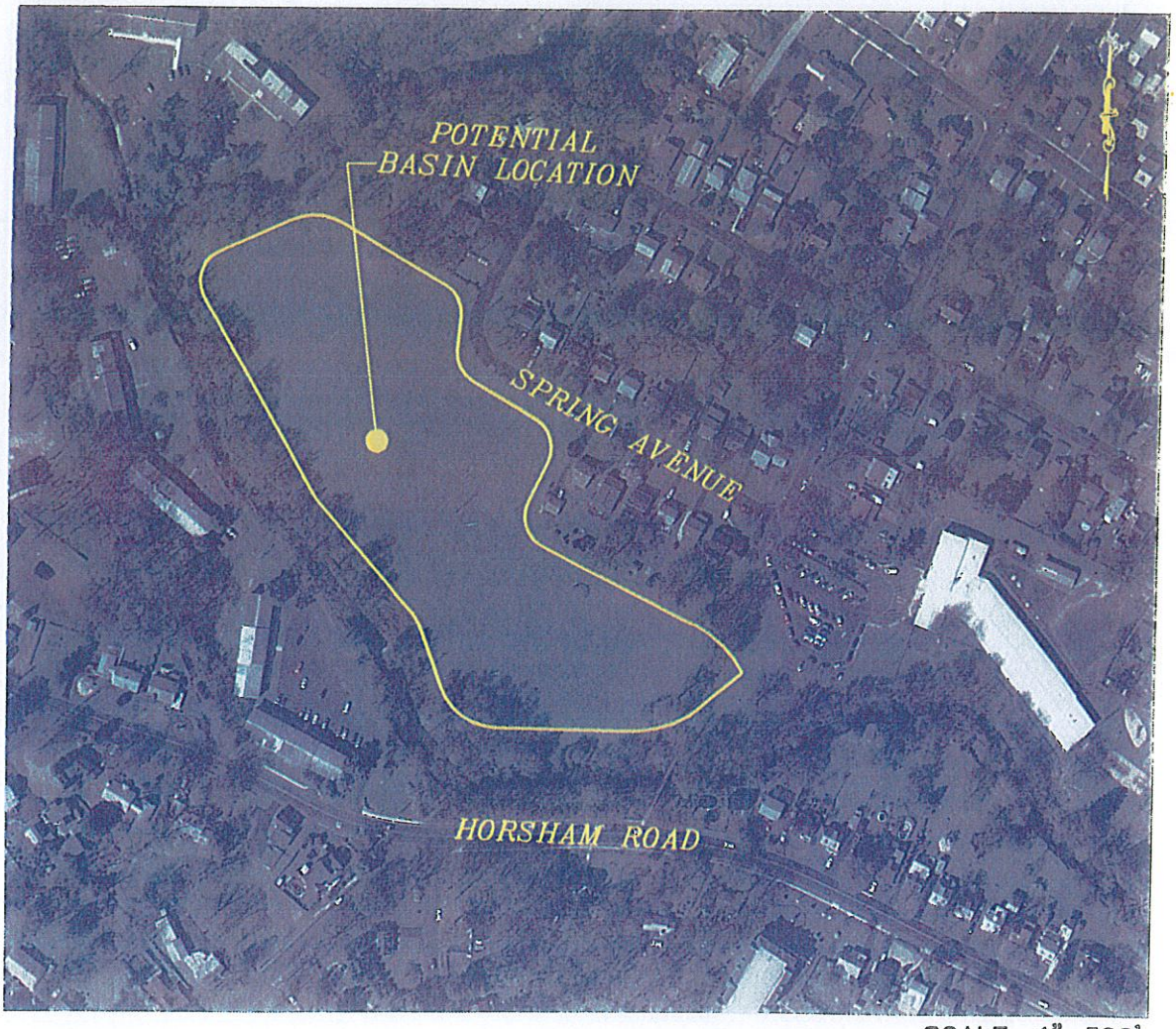
Basin Location: Pennypack Elementary School

Area: Approximately 6.9 acres

Depth: Approximately 3 feet

Storage: Approximately 20.7 acre-feet

Notes: This location is identified in the 2009 PennVEST grant application. A basin project in this location could serve to provide additional storage in the area directly adjacent to the creek and may reduce the severity of flooding in downstream areas and help the Robert Bruce Apartment flooding problem.



SCALE: 1"=300'

BASIN EXHIBIT V

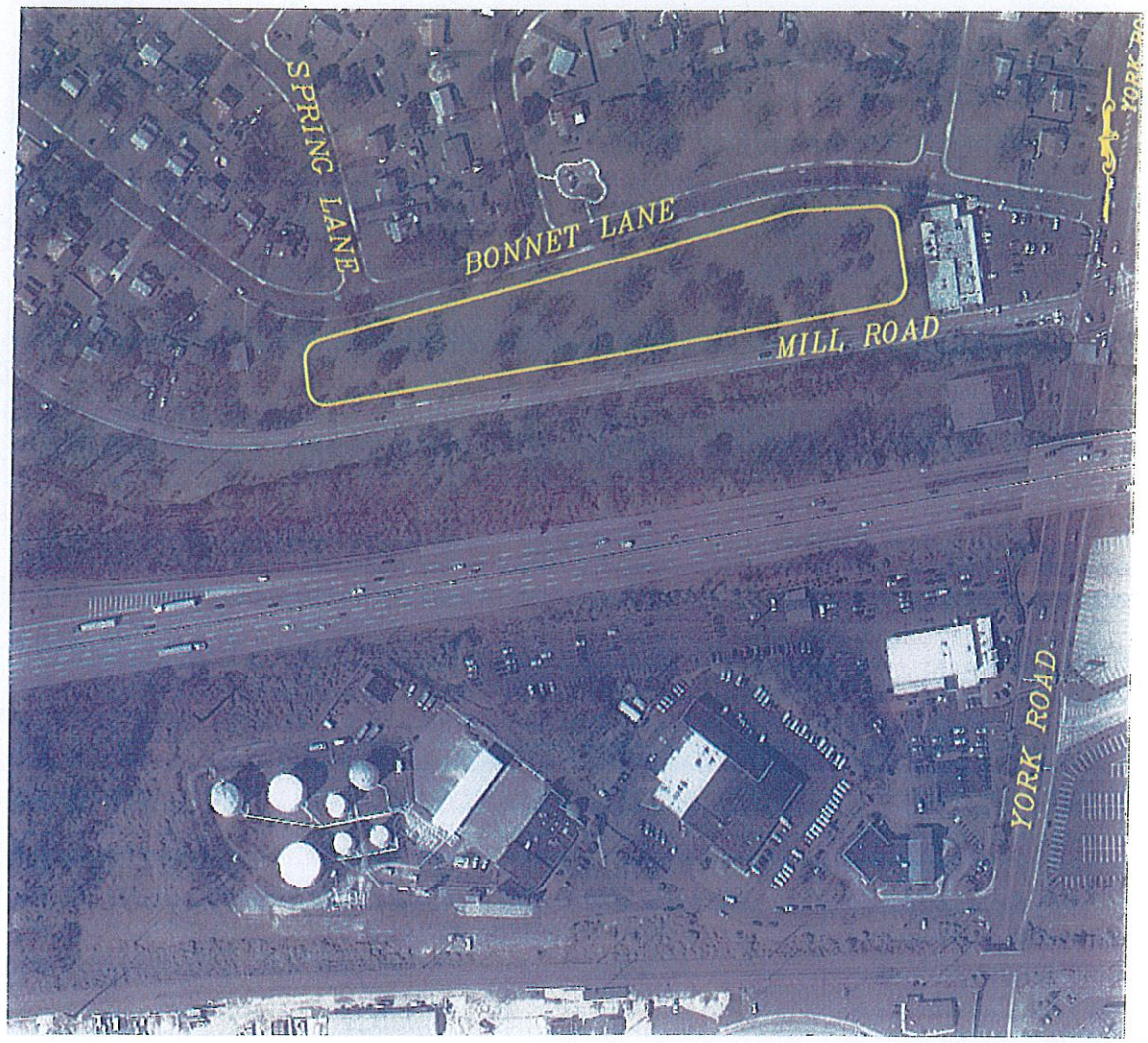
Basin Location: Between Mill Road & Bonnet Lane

Area: Approximately 3.2 acres

Depth: Approximately 3 feet

Storage: Approximately 9.6 acre-feet

Notes: A basin could be implemented in the highlighted area on land that was acquired as part of a FEMA funded buyout of frequently flooded residences. The area is adjacent to the creek and within the 100-year floodplain. A basin could be constructed on this property that could serve as additional storage for the creek during flood events and potentially reduce the severity of flooding in downstream areas.



SCALE: 1"=300'

BASIN EXHIBIT AA

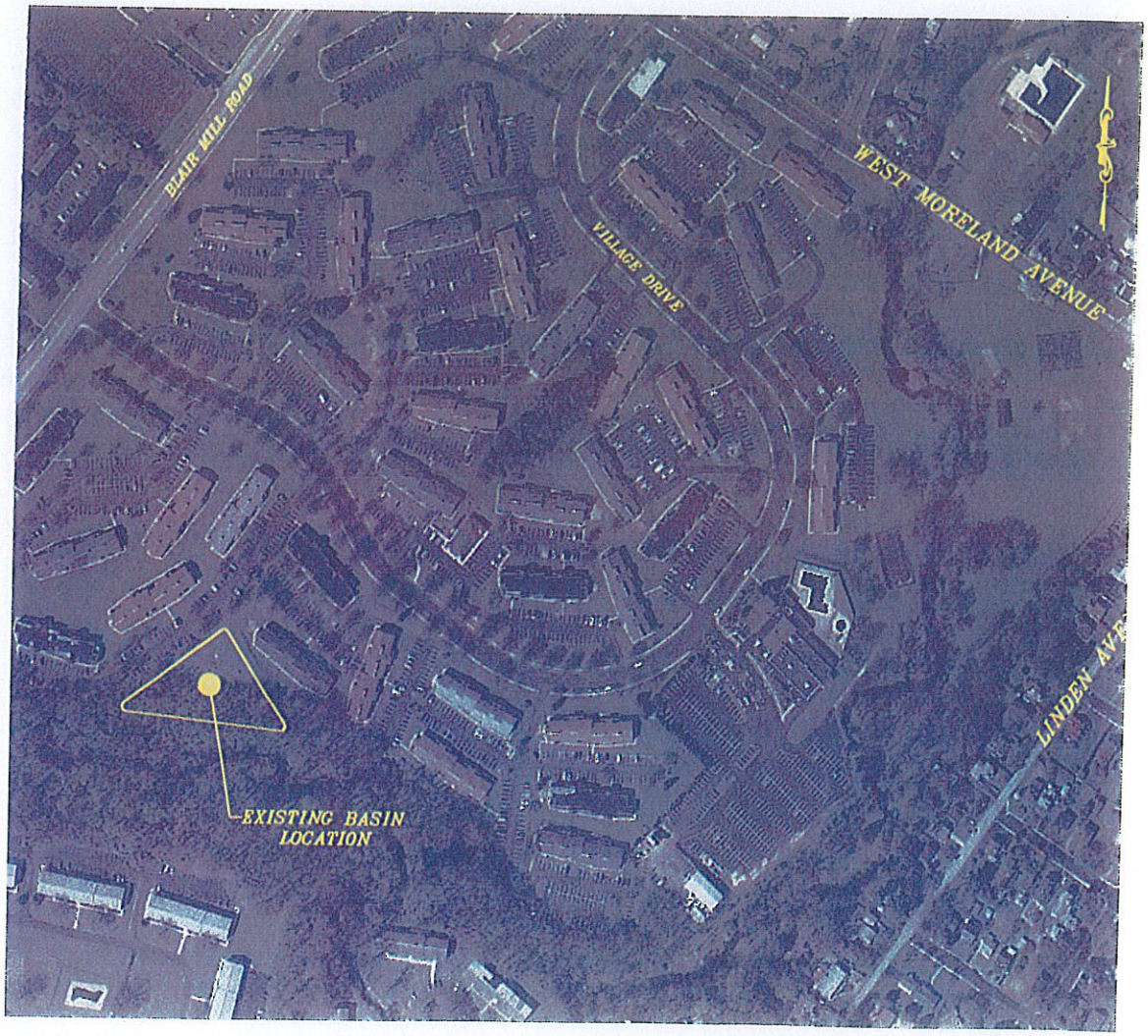
Basin Location: Blair Mill Village Apartments

Area: Approximately 1 Acre

Depth: Approximately 3 feet

Storage: Approximately 3 acre-feet

Notes: The existing basin for the Blair Mill Village Apartments complex needs to be properly maintained. The Township should approach the owner of the property and ask them to clean out the basin and any inlets on the property so that the existing basin and stormwater infrastructure can function as intended. Additionally, the existing basin could be retrofitted to provide more volume by raising the berm and / or modifying the existing outlet structure.



SCALE: 1"=400'

BASIN EXHIBIT EE

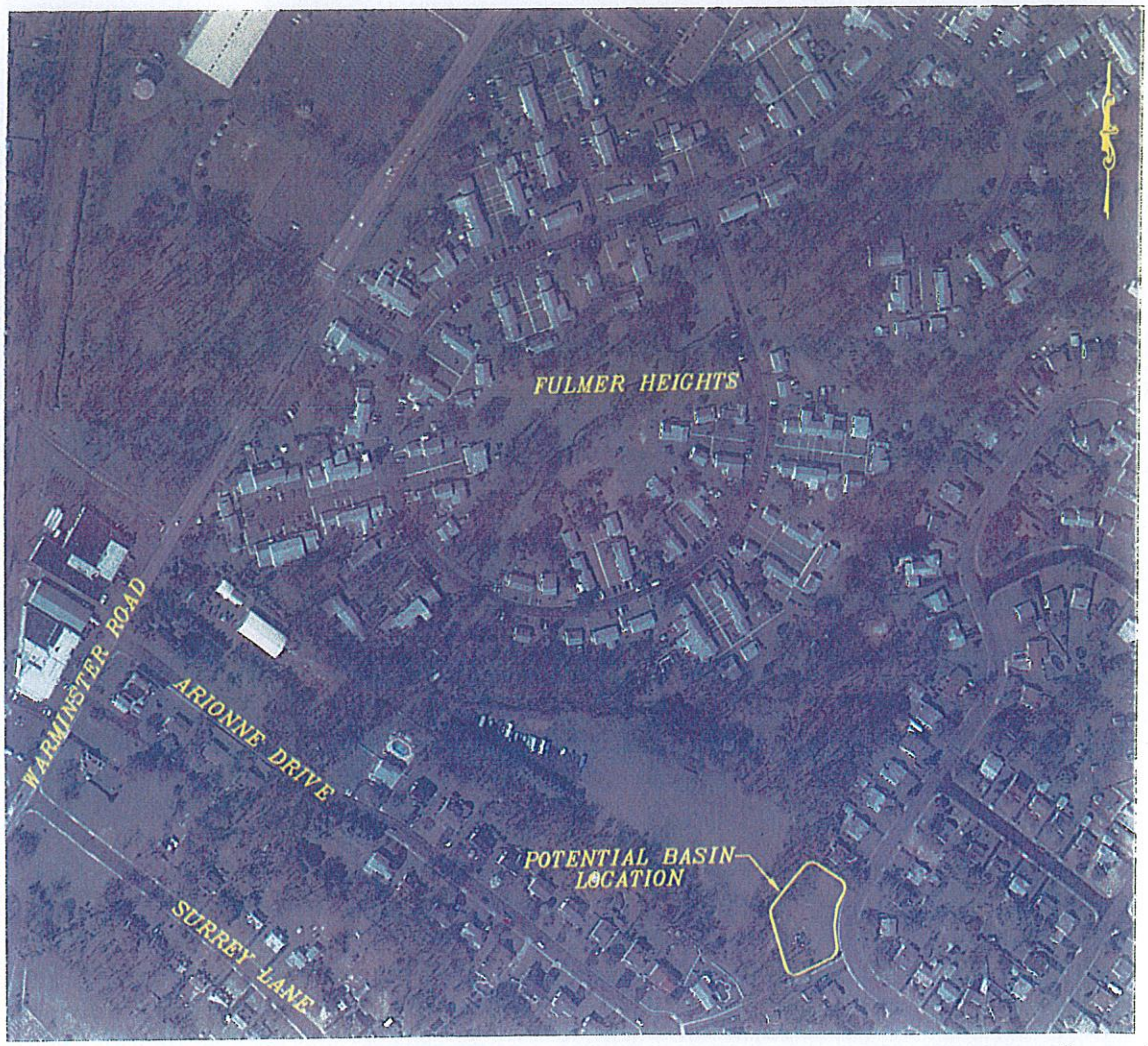
Basin Location: Dawson Manor Park

Area: Approximately 0.6 Acres

Depth: Approximately 3 feet

Storage: Approximately 1.8 acre-feet

Notes: Dawson Manor Park is a Township owned park that could be a viable spot to install a stormwater basin. The park is located adjacent to the Fulmer Heights development that is discussed in Basin Exhibit DD as a potential basin location. If the Township were able to obtain development rights to place a basin on the Fulmer Heights property, then Dawson Manor Park could be used as either an extension of the Fulmer Heights basin or a sediment forebay to the larger basin.



SCALE: 1"=400'

BASIN EXHIBIT L

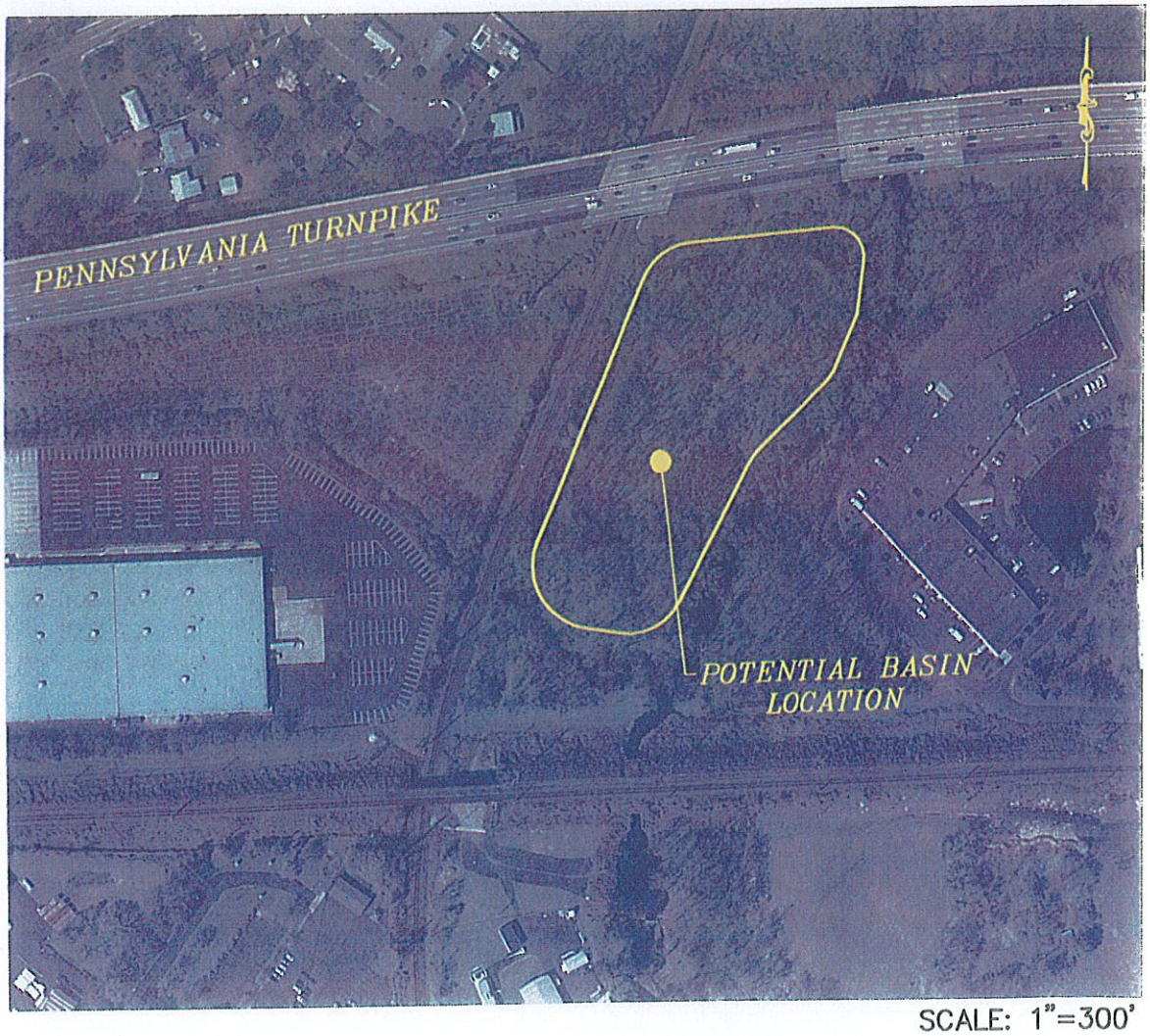
Basin Location: Turnpike Drive

Area: Approximately 4.6 acres

Depth: Approximately 5 feet

Storage: Approximately 23 acre-feet

Notes: This location is identified in the 2009 PennVEST grant application. The area is dedicated open space associated with the adjacent industrial development and although the Township does not currently own the property, it may be possible to acquire from the Hankin Building Group. Lastly, this basin was submitted for funding as part of the 2012-2013 RACP grant program.



SCALE: 1"=300'

BASIN EXHIBIT M

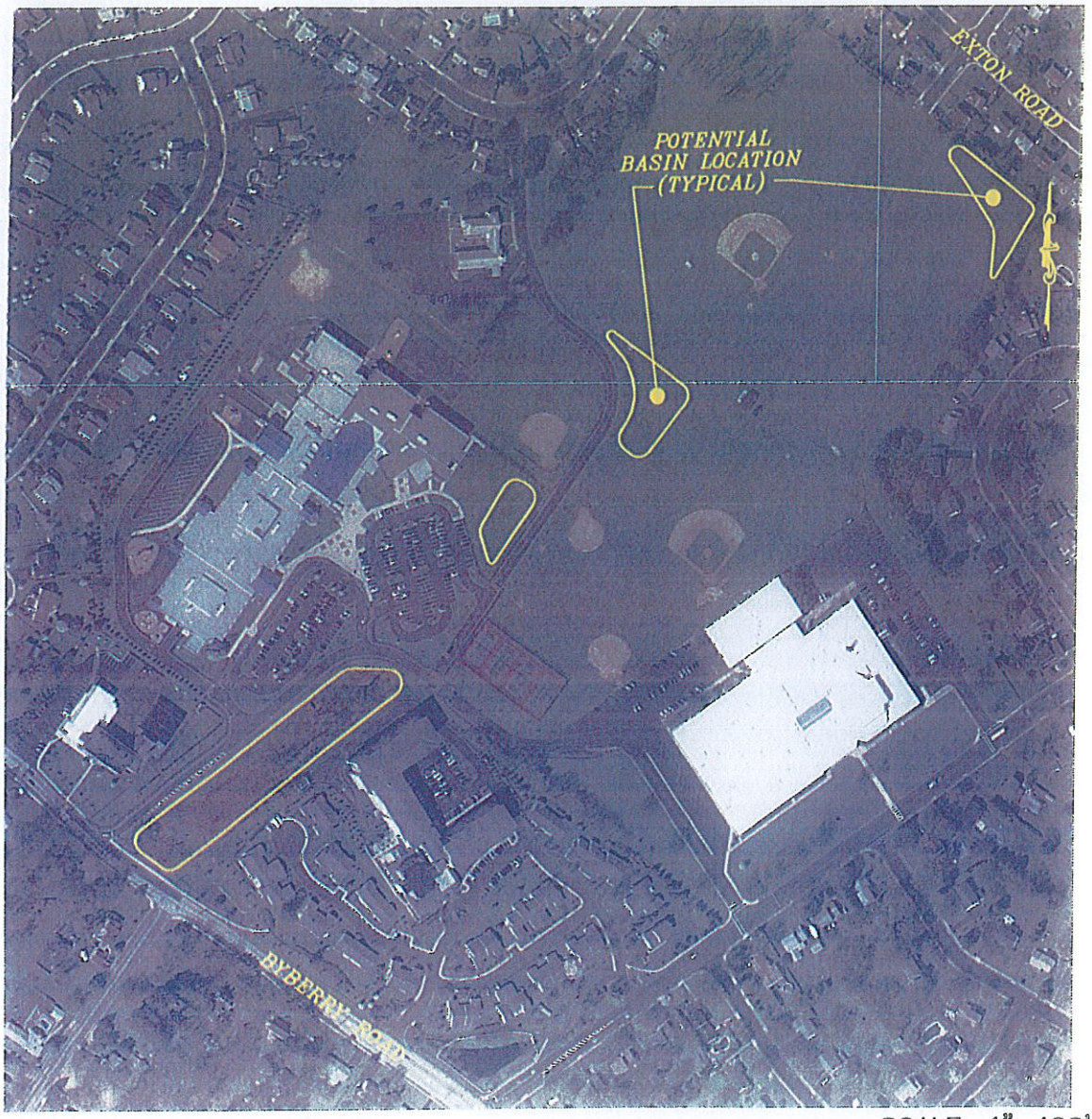
Basin Location: Upper Moreland Middle School

Area: Approximately 3 acres*

Depth: Approximately 3 feet

Storage: Approximately 9 acre-feet*
*Area and Storage values represent a sum of all four potential locations

Notes: These locations were identified in the 2009 PennVEST grant application. A detailed analysis would need to be done in order to determine which, if any, of the potential locations highlighted below are in fact viable for a basin project. If it is determined that a basin can be implemented on the school district property, it could be used as a teaching aid to educate students of the importance of stormwater runoff control.



SCALE: 1"=400'

BASIN EXHIBIT T

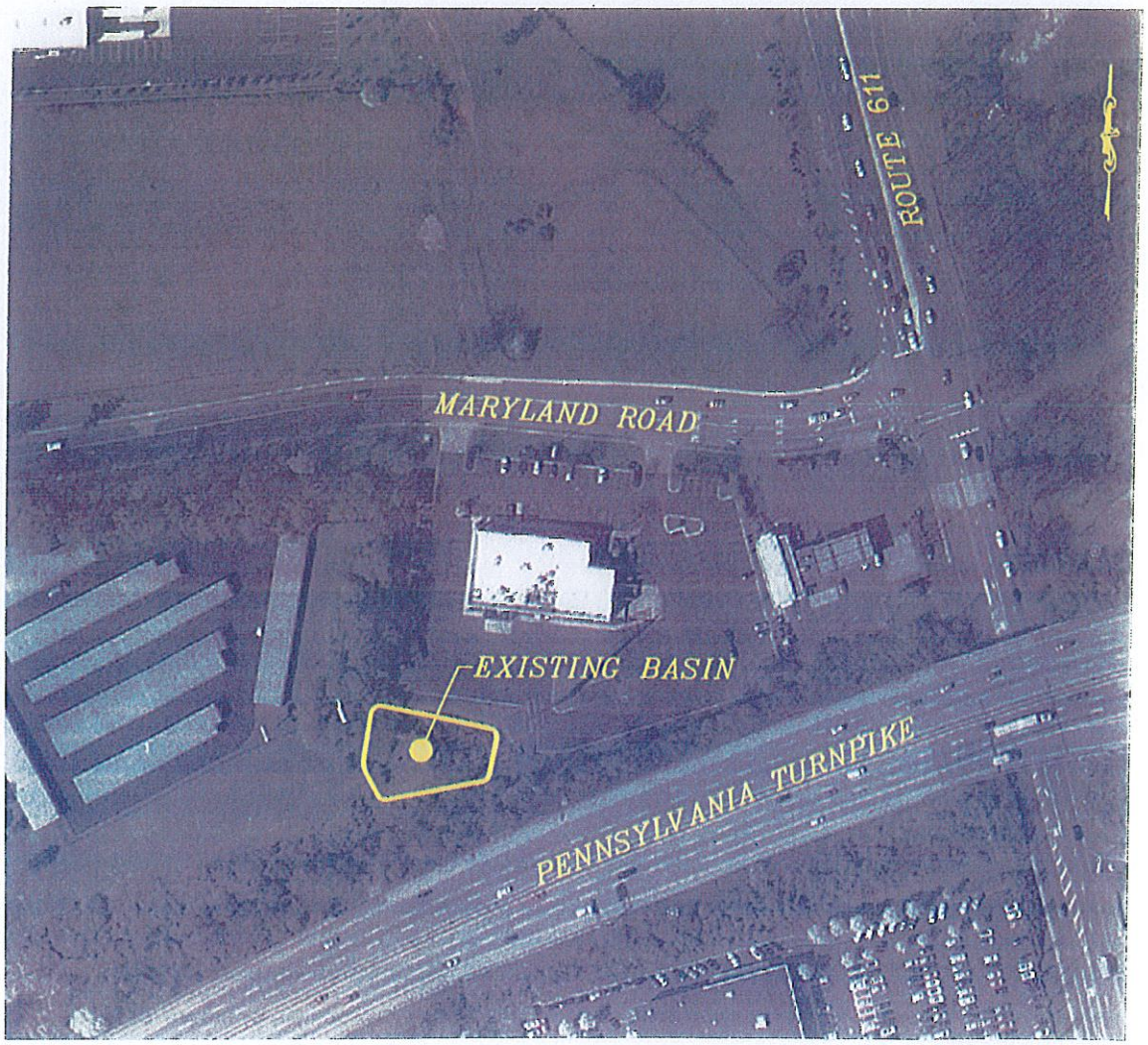
Basin Location: Carrabbas Basin Retrofit

Area: Approximately 0.2 Acres

Depth: Approximately 3 feet

Storage: Approximately 0.6 acre-feet

Notes: The existing stormwater basin could be retrofitted to provide increased water quality by naturalizing the basin bottom with wet tolerant plantings. Additionally, the storage volume may be increased in the basin by a combination of raising the basin berm and modifying the existing outlet structure.



SCALE: 1"=200'

BASIN EXHIBIT U

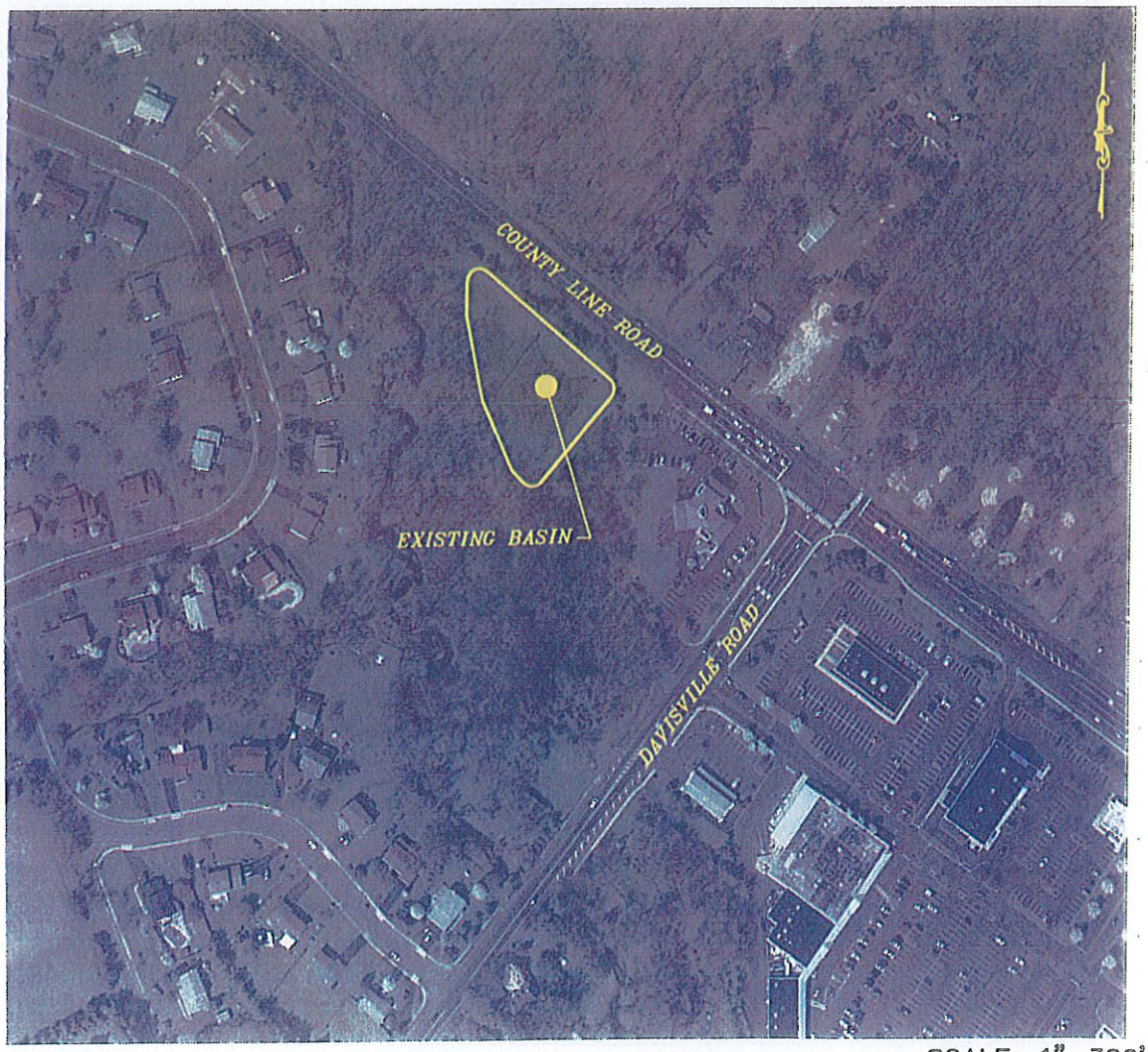
Basin Location: La Rossa Basin Retrofit

Area: Approximately 1 Acre

Depth: Approximately 3 feet

Storage: Approximately 3 acre-feet

Notes: The existing stormwater basin is in the process of being donated to the Township, this basin could be retrofitted to provide increased water quality by naturalizing the basin bottom with wet tolerant plantings. Additionally, the storage volume may be increased in the basin by a combination of raising the basin berm and modifying the existing outlet structure.



SCALE: 1"=300'

BASIN EXHIBIT W

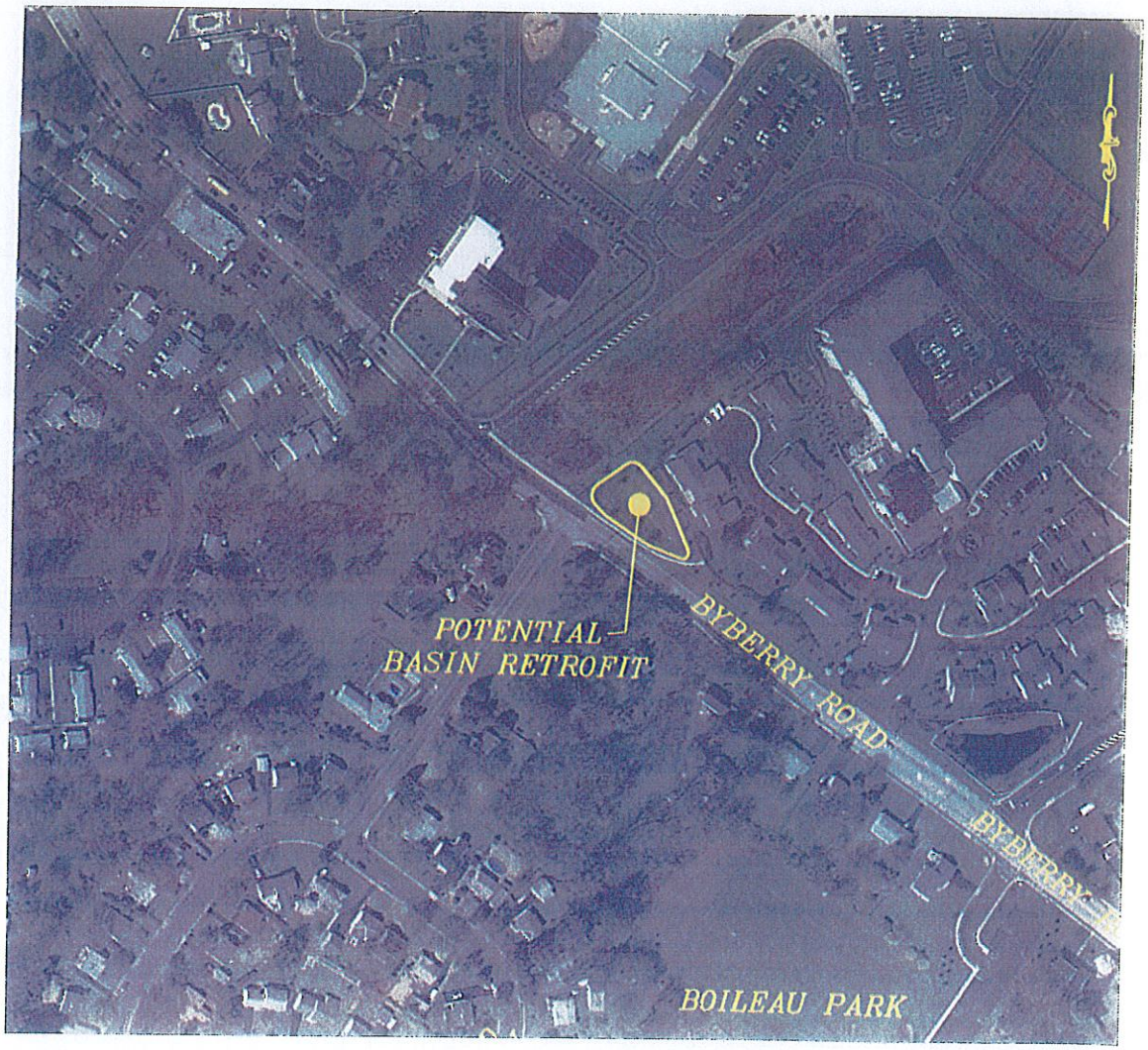
Basin Location: Betz & Byberry – Basin Retrofit

Area: Approximately 0.3 acres

Depth: Approximately 3 feet

Storage: Approximately 0.9 acre-feet

Notes: The existing stormwater basin could be retrofitted to provide increased water quality by naturalizing the basin bottom with wet tolerant plantings. Additionally, the storage volume may be increased in the basin by a combination of raising the basin berm and modifying the existing outlet structure.



SCALE: 1"=300'

BASIN EXHIBIT X

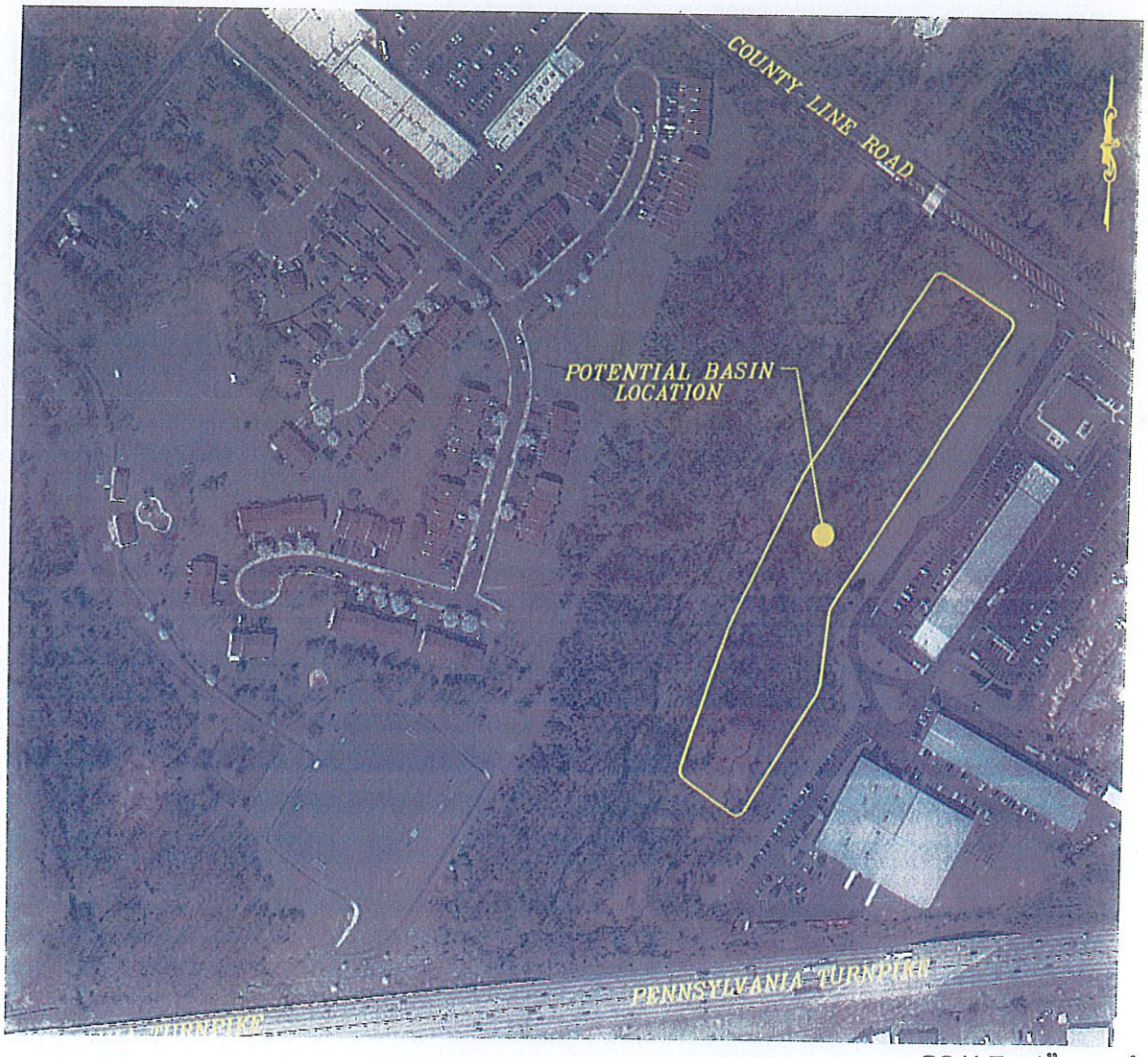
Basin Location: Pilleggi Park

Area: Approximately 5.7 Acres

Depth: Approximately 3 feet

Storage: Approximately 17.1 acre-feet

Notes: A basin project could be implemented within the Township owned park. The creek runs through the center of the park and a basin could be constructed in this area to provide additional storage volume during flood events and may help to reduce the severity of downstream flooding.



SCALE: 1"=400'

BASIN EXHIBIT DD

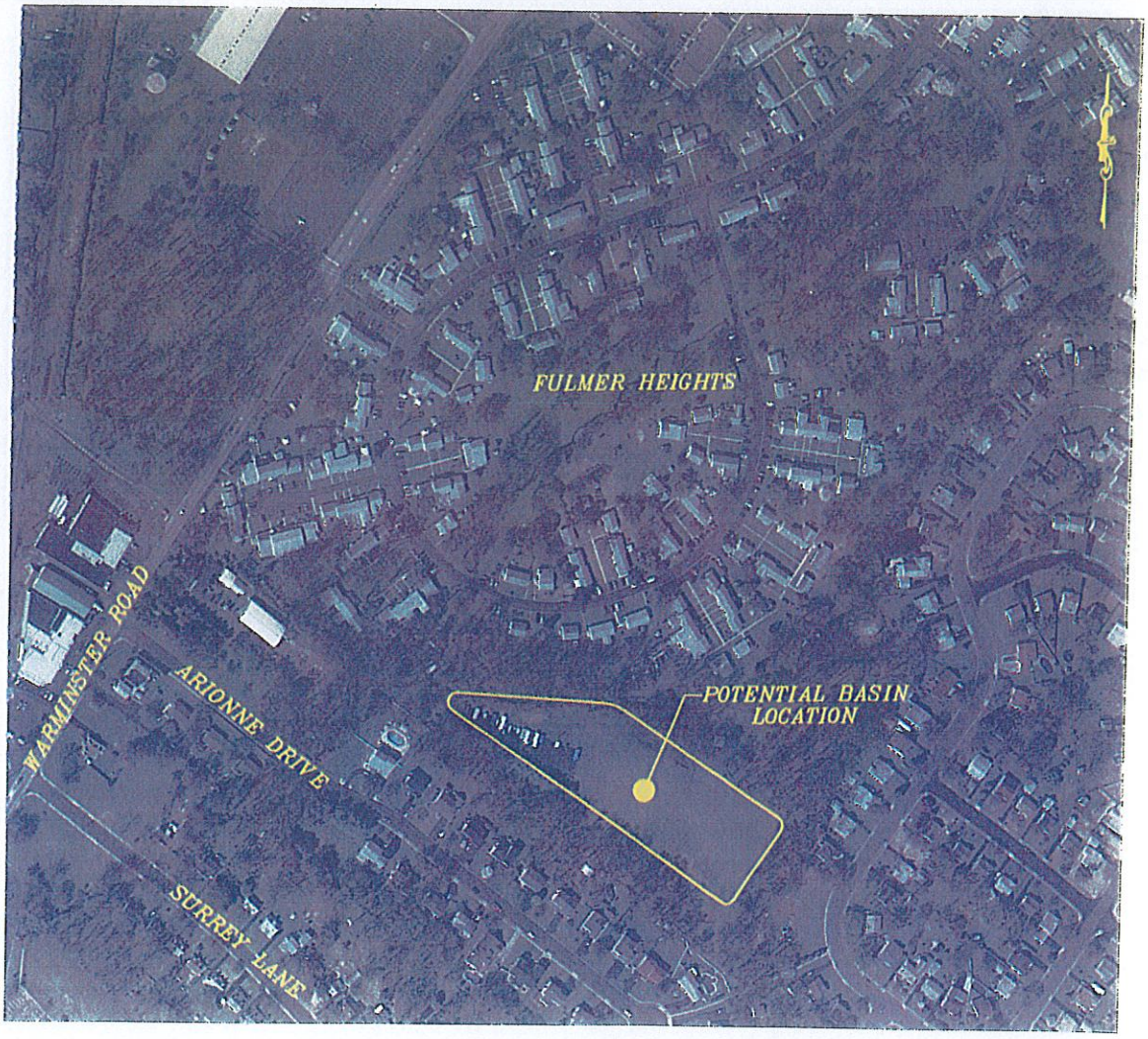
Basin Location: Fulmer Heights

Area: Approximately 3.1Acres

Depth: Approximately 3 feet

Storage: Approximately 9.3 acre-feet

Notes: The Fulmer Heights housing development does not have an existing basin on site. A basin located in the area highlighted below could provide peak rate control for the development. A detailed stormwater analysis of the property would need to be conducted in order to determine if this is a viable location to construct a stormwater basin.



SCALE: 1"=400'

BASIN EXHIBIT FF

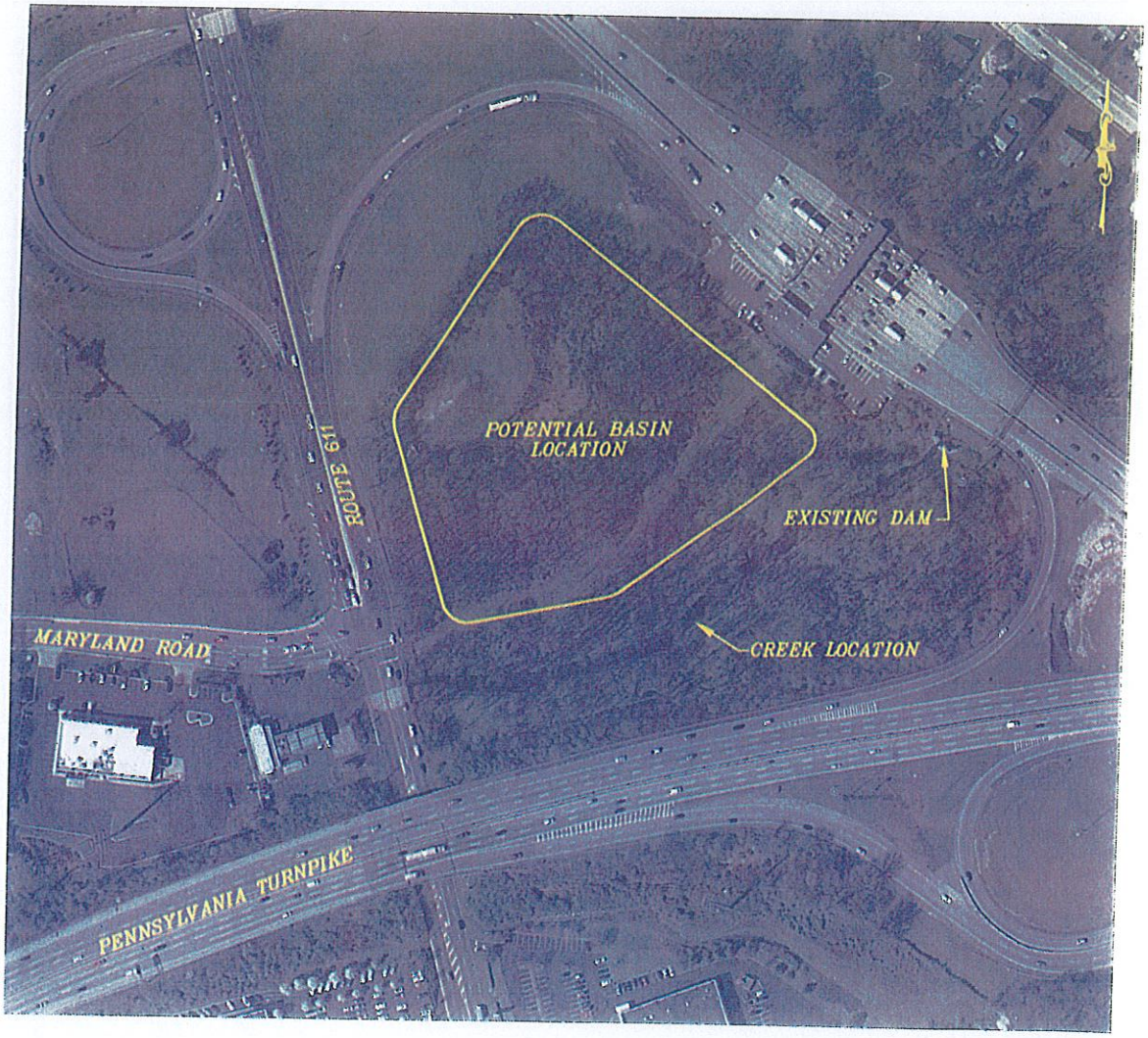
Basin Location: Turnpike Interchange

Area: Approximately 6.2 Acres

Depth: Approximately 3 feet

Storage: Approximately 18.6 acre-feet

Notes: The potential basin area is on property owned by the Turnpike Commission. A basin in this location would provide additional storage volume behind the existing high hazard dam. Downstream areas would benefit from more water being held back by the dam during flood events.



SCALE: 1"=400'

BASIN EXHIBIT B

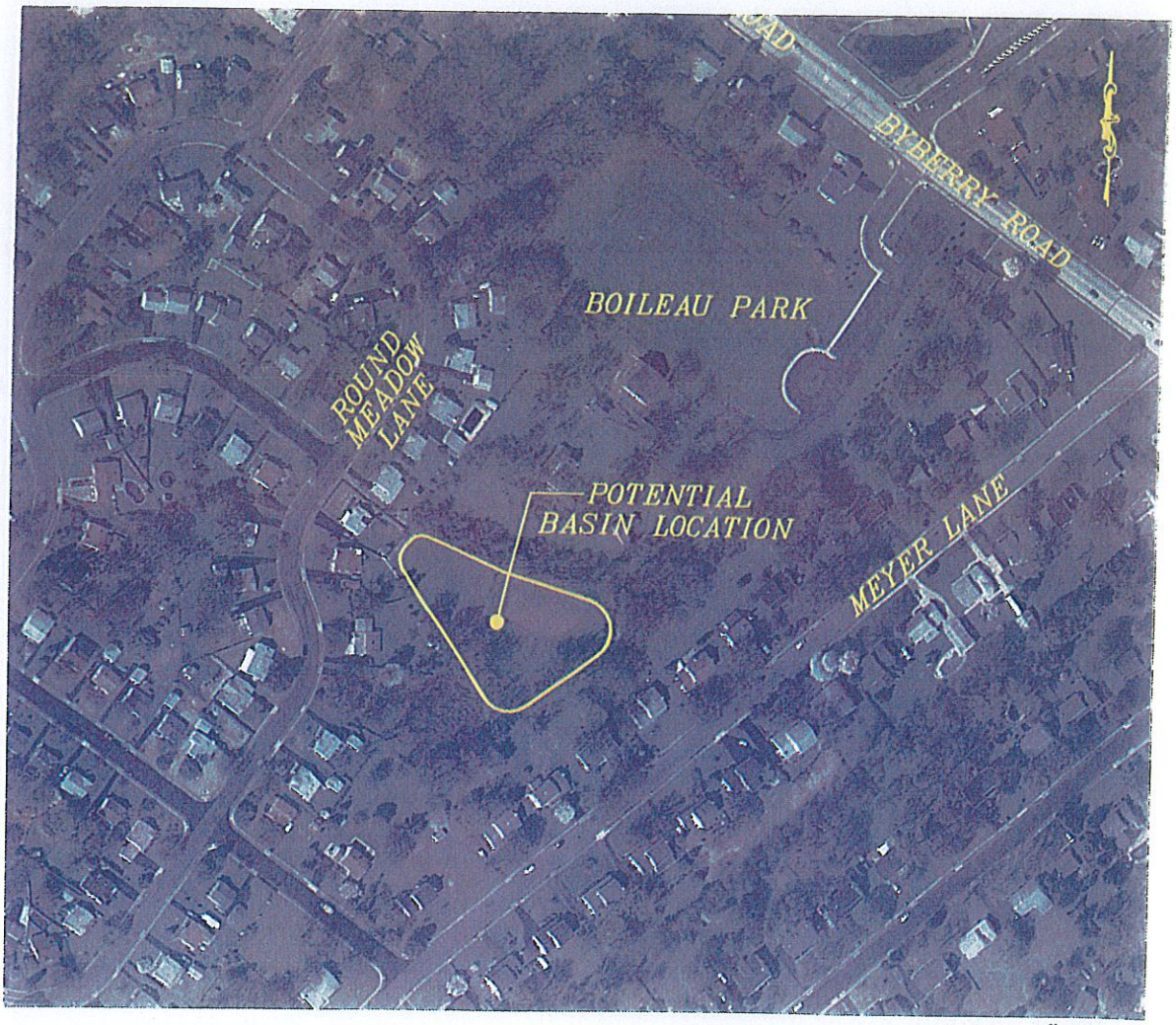
Basin Location: Boileau Park

Area: Approximately 1.2 acres

Depth: Approximately 3 feet

Storage: Approximately 3.6 acre-feet

Notes: Basin location is identified in 2009 PennVEST grant application. The area is within a Township owned park and could potentially help solve the problem identified in Exhibit 5.6.



SCALE: 1"=300'

BASIN EXHIBIT C

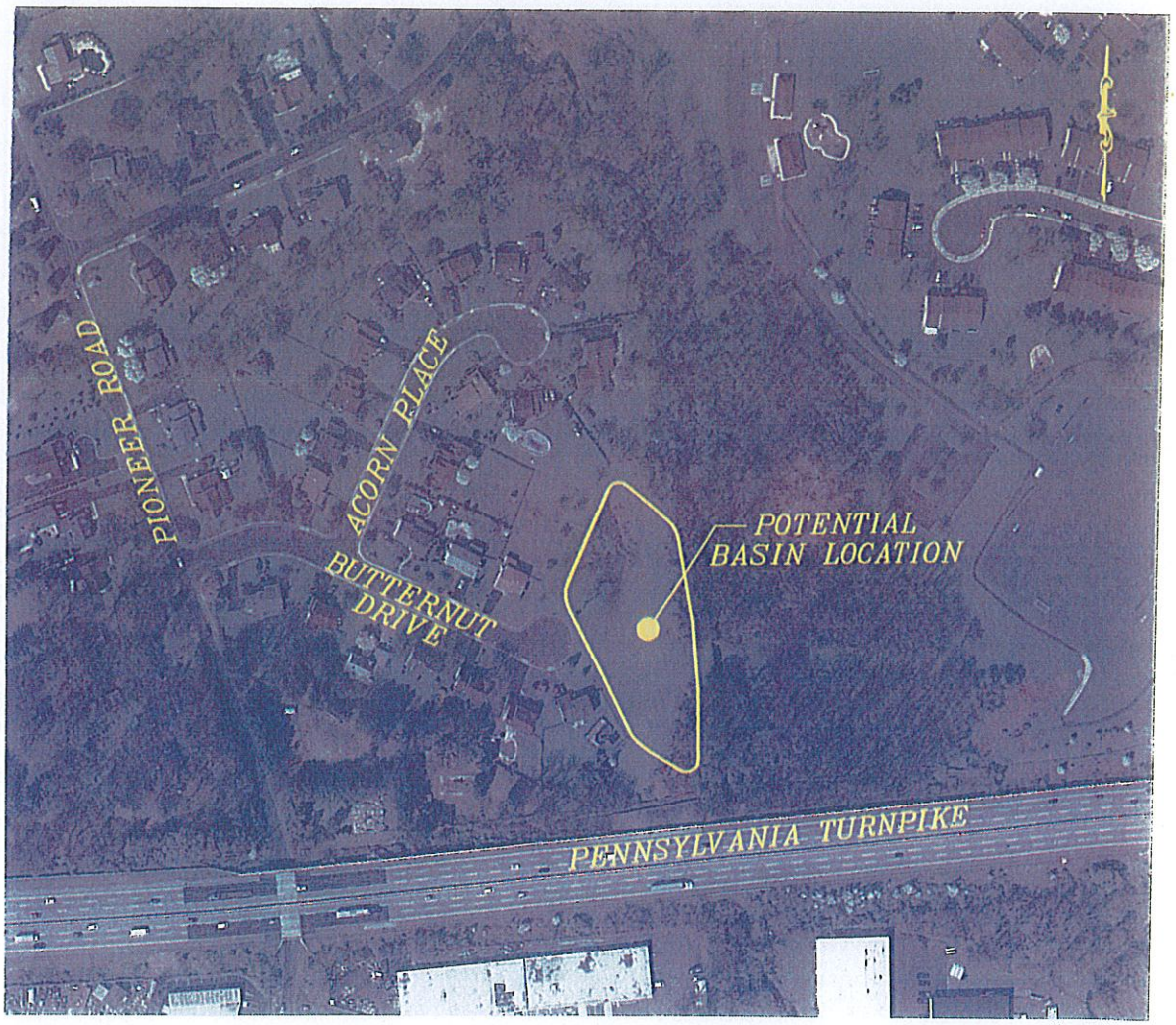
Basin Location: Butternut Drive

Area: Approximately 1.4 acres

Depth: Approximately 3 feet

Storage: Approximately 4.2 acre-feet

Notes: Basin location is identified in 2009 PennVEST grant application. There is an existing basin at the end of Butternut Drive that could be made larger to hold back more water.



SCALE: 1"=300'

BASIN EXHIBIT F

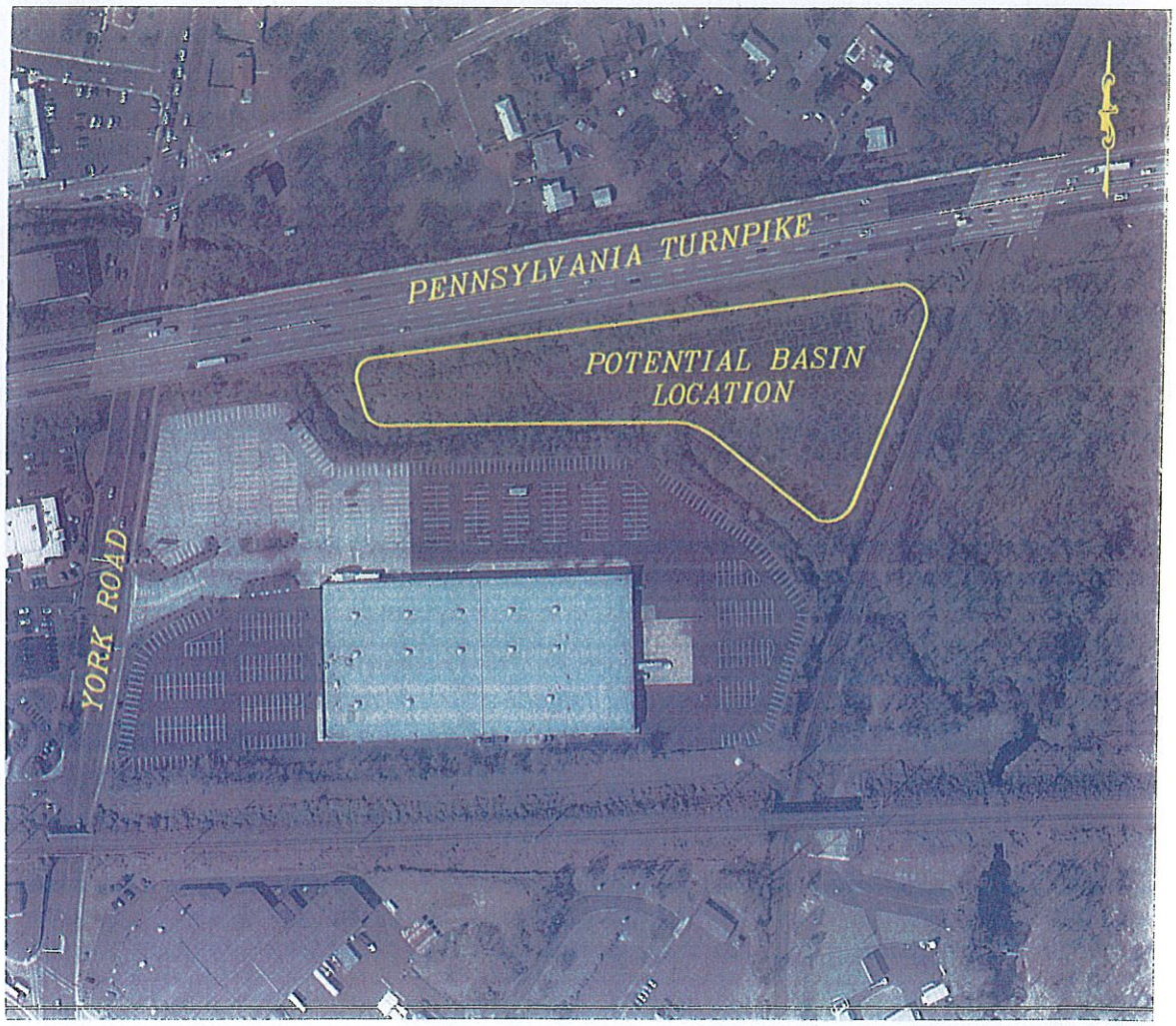
Basin Location: Former Sam's Club Parking Lot

Area: Approximately 3.9 acres

Depth: Approximately 3 feet

Storage: Approximately 11.7 acre-feet

Note: This location is identified in the 2009 PennVEST grant application. The parcel is not currently owned by the Township and it is unknown how easily the land could be obtained.



SCALE: 1"=300'

BASIN EXHIBIT N

Basin Location: Woodlawn Park

Area: Approximately 0.5 acres*

Depth: Approximately 3 feet

Storage: Approximately 1.5 acre-feet*

*Area and Storage represent the sum of both locations.

Note: A basin could be implemented within this Township owned park without the need to remove the existing baseball field.



SCALE: 1"=200'

BASIN EXHIBIT P

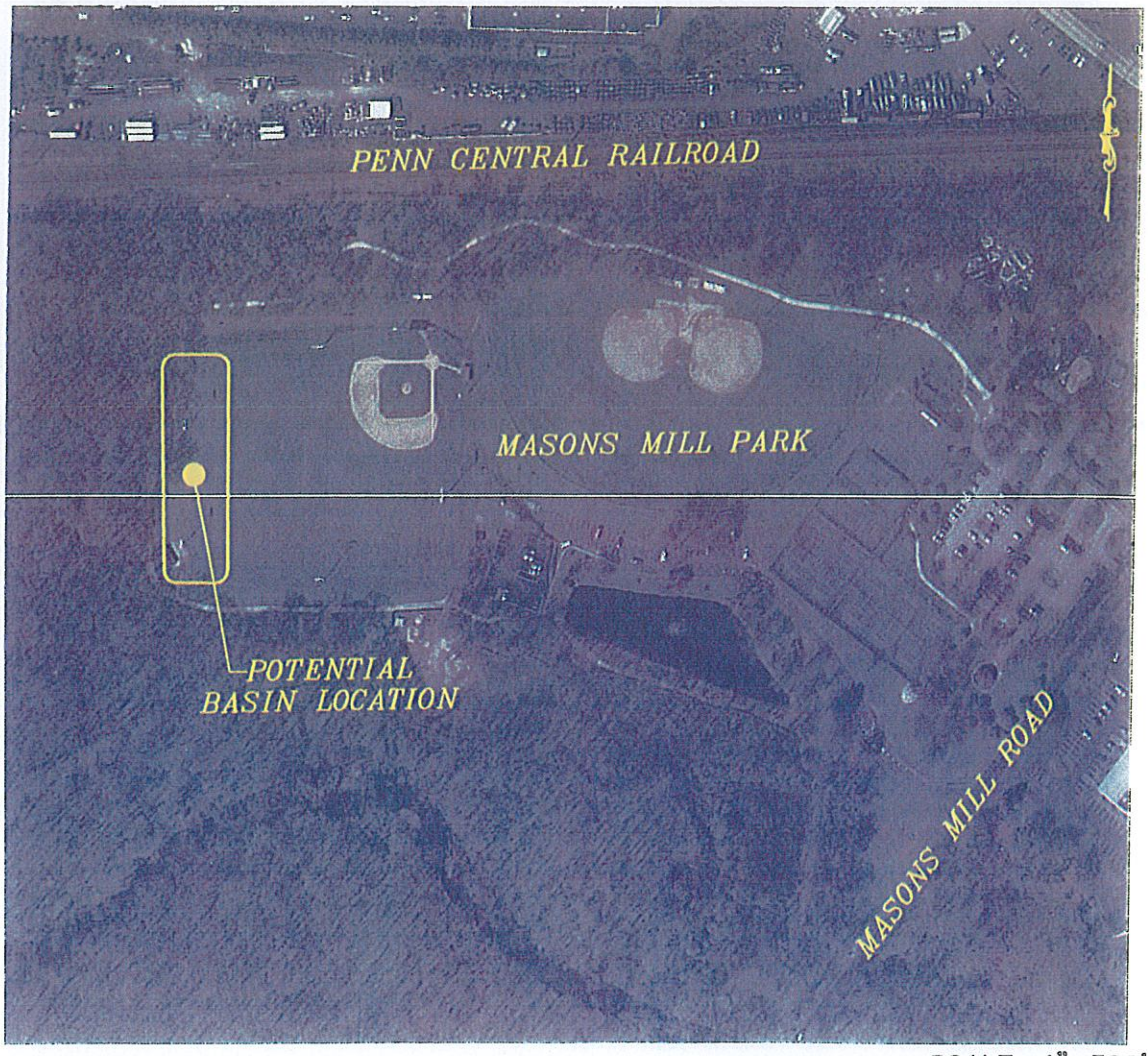
Basin Location: Masons Mill Park

Area: Approximately 0.8 acres

Depth: Approximately 3 feet

Storage: Approximately 2.4 acre-feet

Notes: A basin project could be implemented at this location without the need to remove any of the existing athletic fields.



SCALE: 1"=300'

BASIN EXHIBIT R

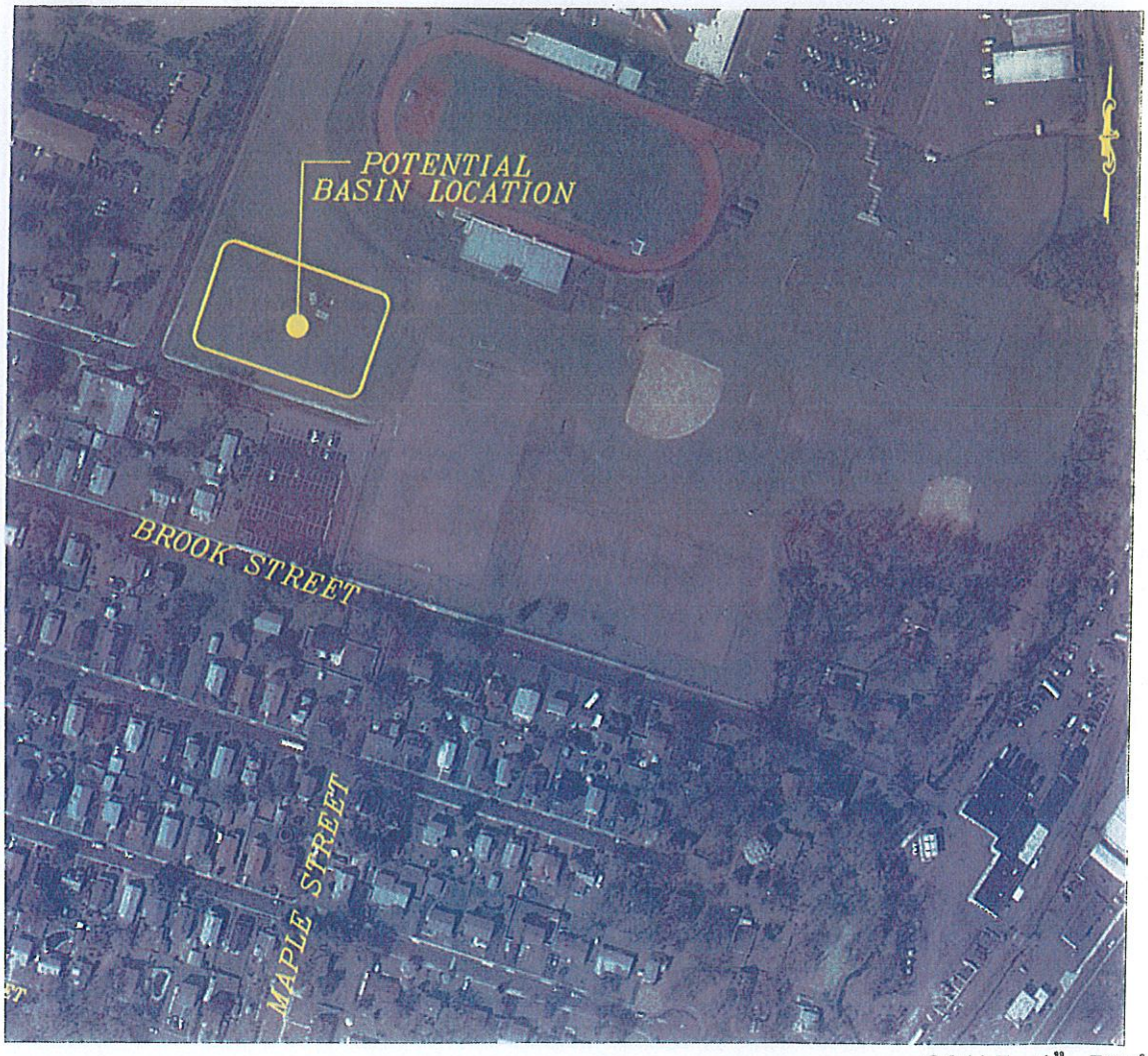
Basin Location: Former Cold Springs Elementary

Area: Approximately 1.7acres

Depth: Approximately 3 feet

Storage: Approximately 5.1 acre-feet

Notes: The existing soccer fields located on the south side of the property in the location of the former Cold Springs Elementary school have irrigation systems that were recently installed. The potential basin location depicted below is in the vicinity of the shot putt / discus track and field equipment. If the school district agreed to move the equipment to another area on site, this may be a viable basin location; however, a detailed analysis of the contributing drainage area and topography of the site would need to be conducted to determine if this location is suitable for the construction of a stormwater basin.



SCALE: 1"=300'

BASIN EXHIBIT S

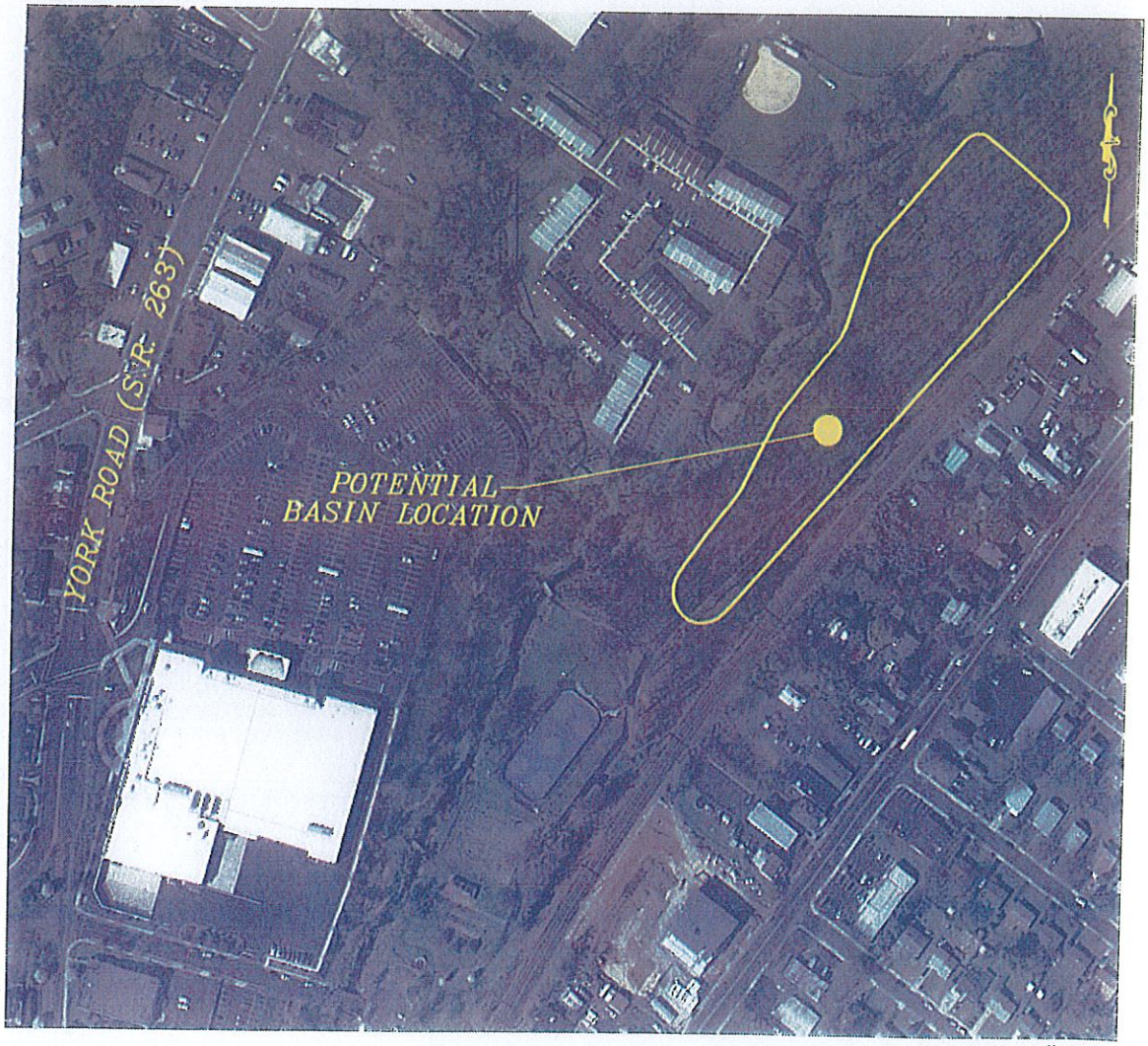
Basin Location: Township Open Space adjacent to Veteran's Memorial Park

Area: Approximately 3.3 acres

Depth: Approximately 3 feet

Storage: Approximately 9.9 acre-feet

Notes: Giant Super Market was identified by the sub-committee as a potential basin location; however, the super market has an existing underground basin on site that would be very costly to increase in size. Additionally, there is a steep grade change in the area between the development and the creek, which would not be a viable place to put a basin. The location highlighted below is on Township owned property that is adjacent to Veteran's Memorial Park, although the area is 100% wooded, it may be a viable spot for a small basin or several small basins around existing trees within the highlighted area.



SCALE: 1"=300'

BASIN EXHIBIT J

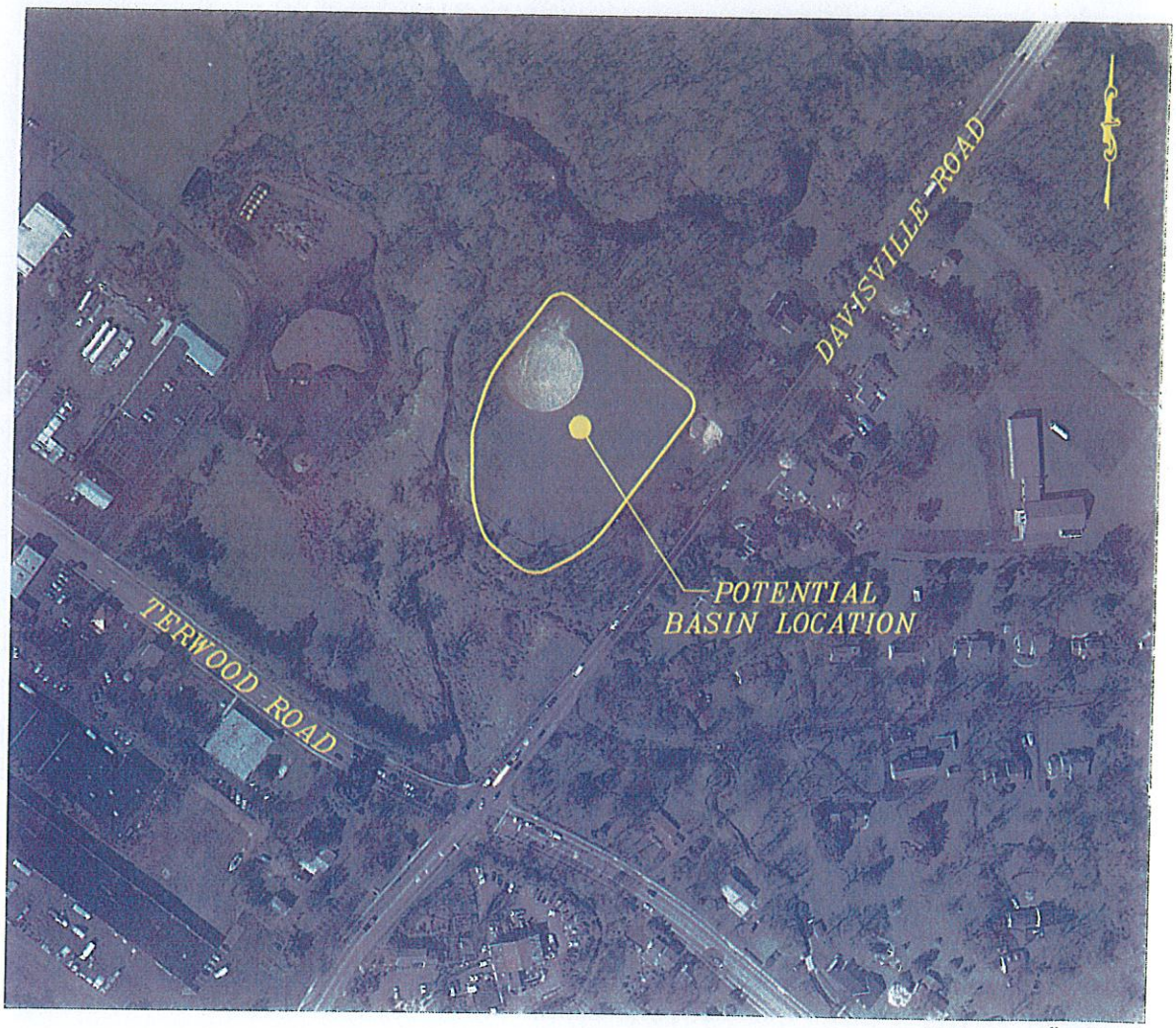
Basin Location: Terwood Park

Area: Approximately 2.3 acres

Depth: Approximately 3 feet

Storage: Approximately 6.9 acre-feet

Notes: This location is identified in the 2009 PennVEST grant application. Implementation of the basin project to the extent highlighted below and in the grant application would require either the removal of the existing baseball field or a groundwater study to determine if the baseball field could function at a lower elevation. Additionally, the property is owned by the Upper Moreland Hatboro Joint Sewer Authority and leased to the Township, so any proposed development on the parcel would require UMHJSA approval.



SCALE: 1"=300'

BASIN EXHIBIT CC

Basin Location: Upper Moreland – Hatboro Joint Sewer Authority

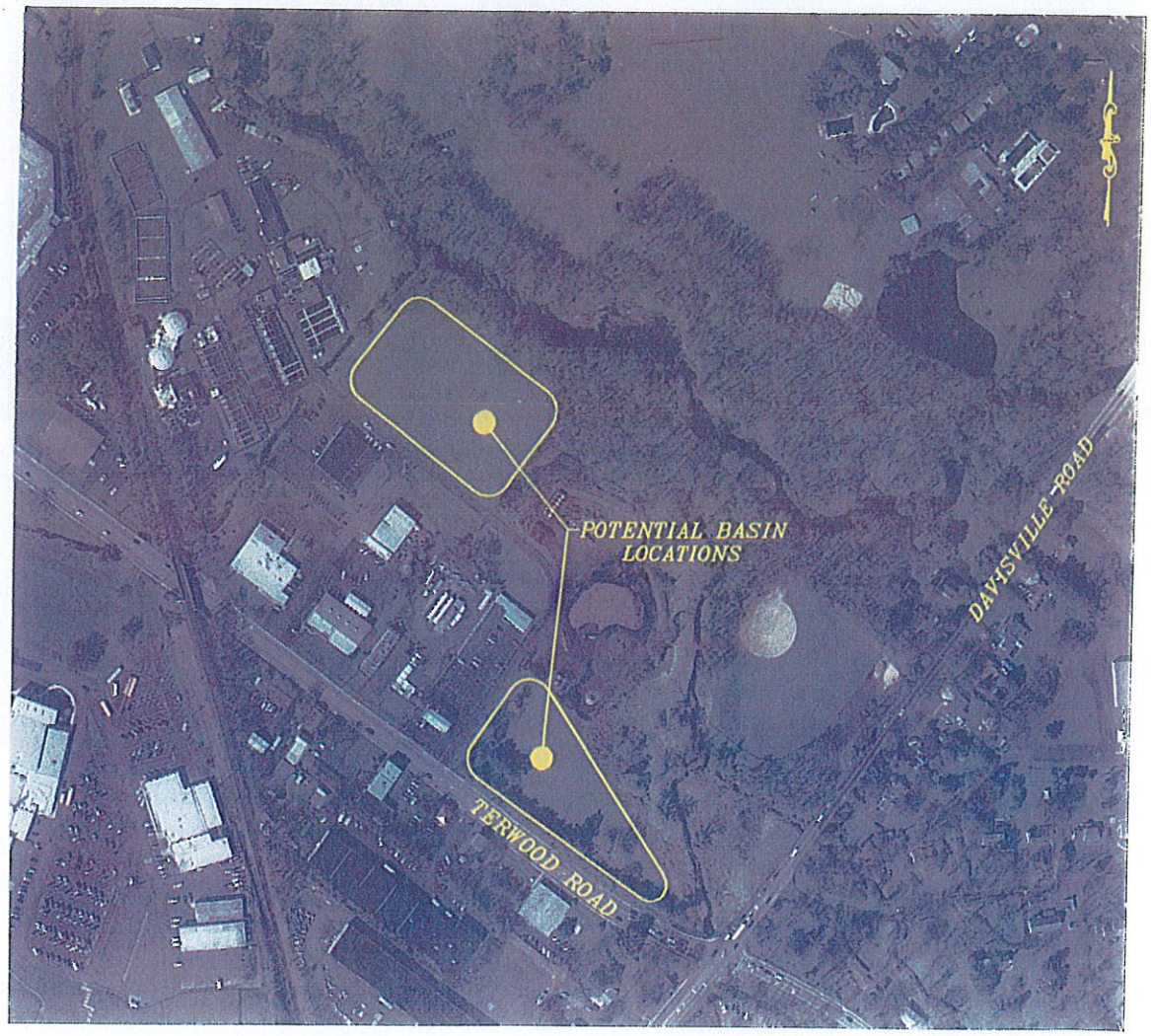
Area: Approximately 4.3 Acres*

Depth: Approximately 3 feet

Storage: Approximately 12.9 acre-feet*

* Area and Storage represent sum of both potential locations.

Notes: The property is owned by the UMHJSA and any basin project would require coordination and an agreement with the authority. The northern location highlighted below is adjacent to the creek and could provide additional storage during flood events and reduce the severity of flooding downstream. A detailed analysis of the topography of the site, contributing drainage area, and existing stormwater infrastructure in the area would be necessary to determine if a basin project could be implemented on this site.



SCALE: 1"=400'

BASIN EXHIBIT BB

Basin Location: Little League Park

Area: Approximately 3.5 Acres

Depth: Approximately 3 feet

Storage: Approximately 10.5 acre-feet

Notes: Implementing a stormwater project on the property would require coordination and an agreement with the little league association. In order to construct a basin on this property either one or more baseball fields would need to be removed or a groundwater study done to determine if the baseball fields could function at a lower elevation.



SCALE: 1"=300'

BASIN EXHIBIT Y

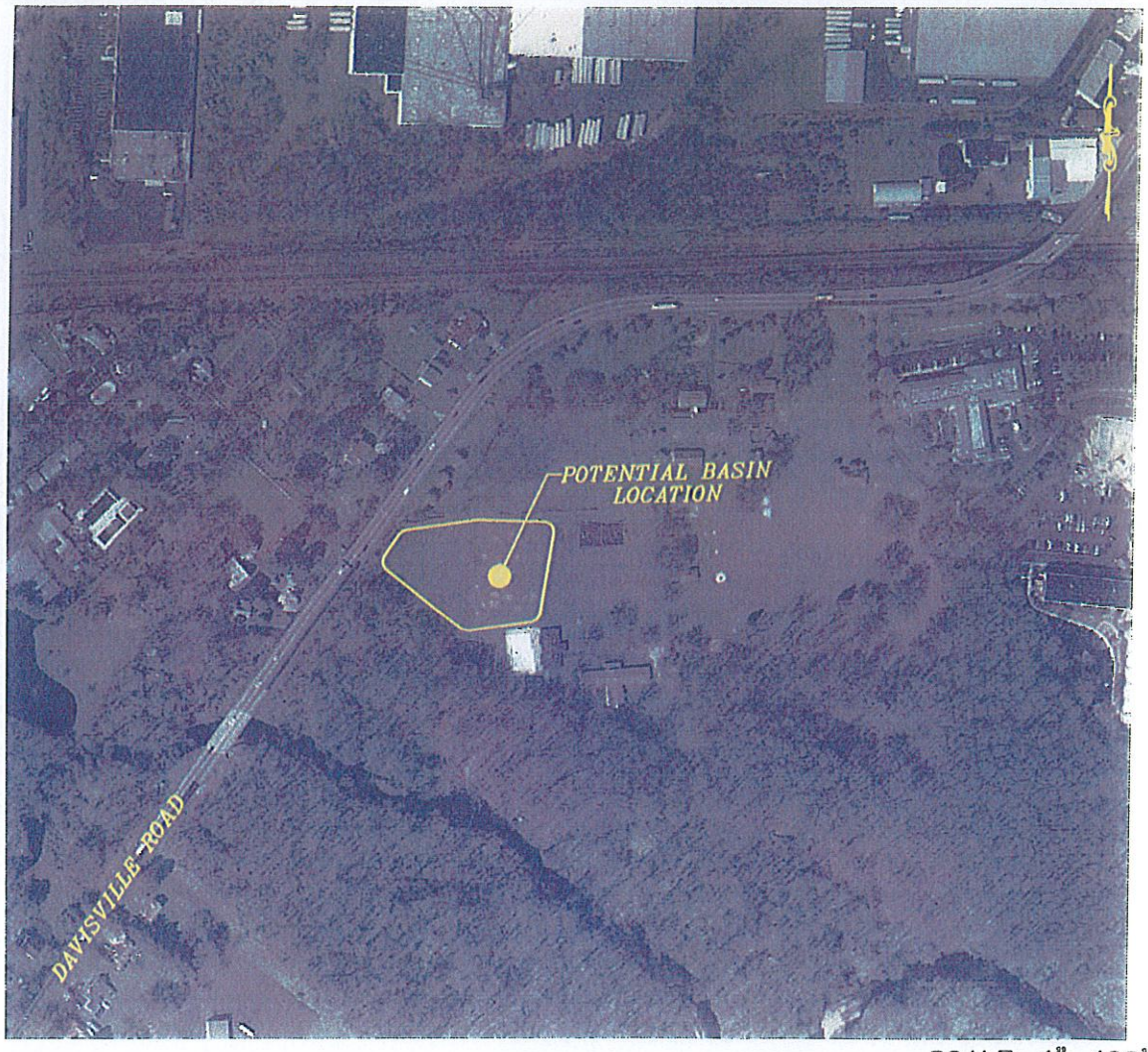
Basin Location: Carson-Simpson Farm Christian Center

Area: Approximately 1.5 Acres

Depth: Approximately 3 feet

Storage: Approximately 4.5 acre-feet

Notes: A basin could be implemented on the Carson-Simpson Farm property. This location is on private property and it is unknown whether the owner would be interested in letting the Township install a basin on the property.



SCALE: 1"=400'

BASIN EXHIBIT Z

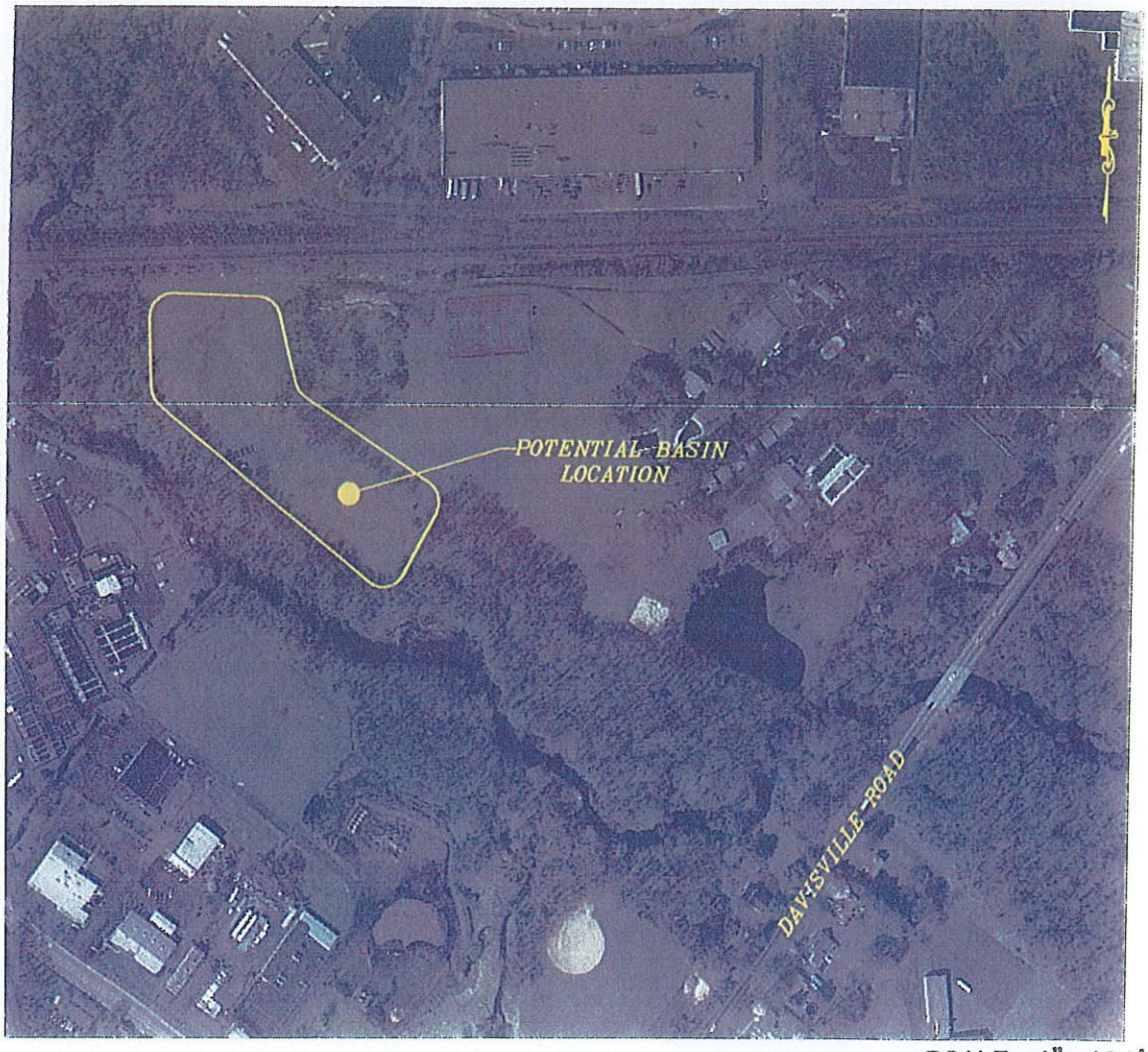
Basin Location: Willow Grove Day Camp

Area: Approximately 4.1 Acres

Depth: Approximately 3 feet

Storage: Approximately 12.3 acre-feet

Notes: A basin could be implemented on the Willow Grove Day Camp property. This location is on private property and it is unknown whether the owner would be interested in letting the Township install a basin on the property.



SCALE: 1"=400'

BASIN EXHIBIT O

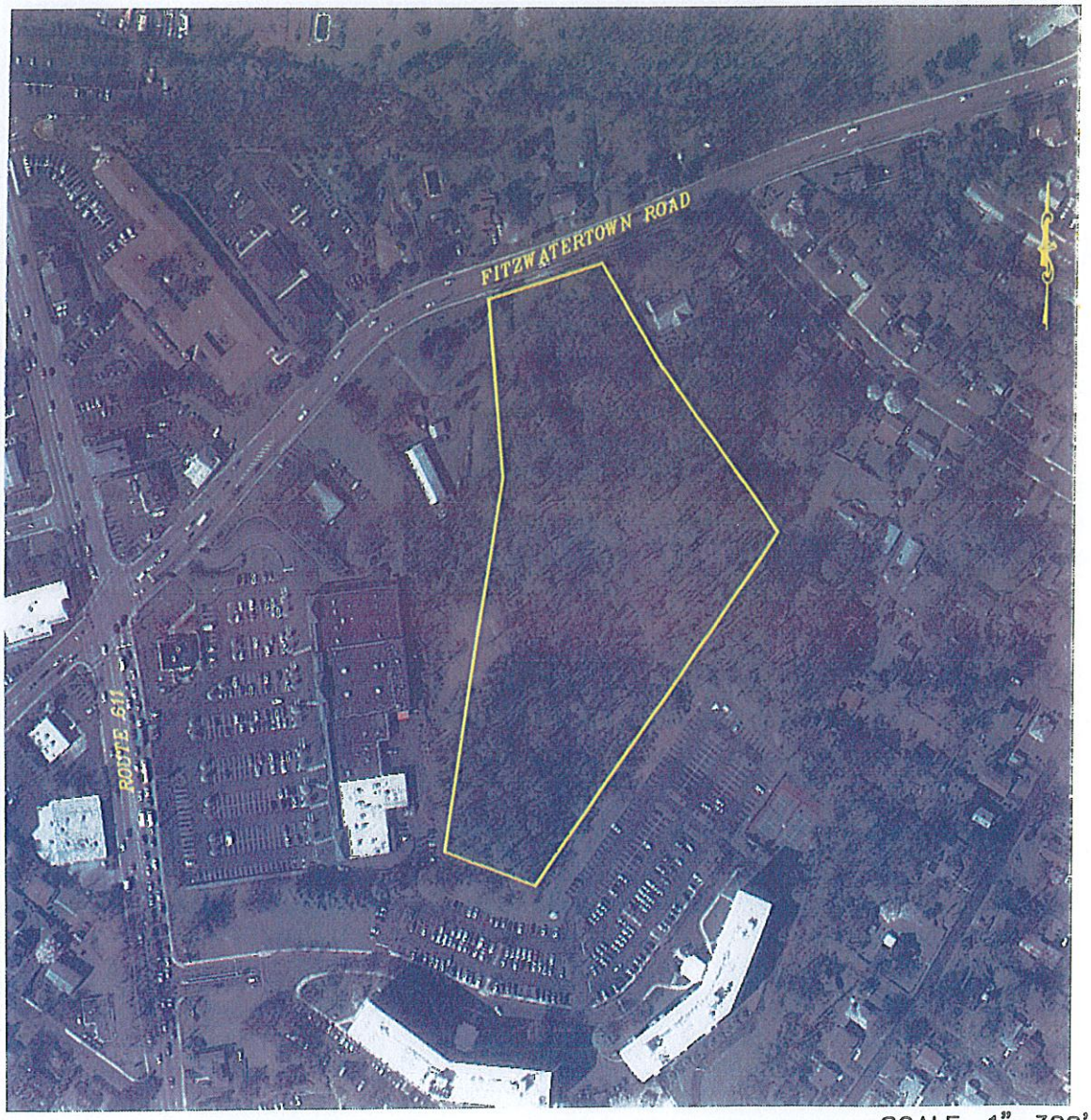
Basin Location: Beuhler Park

Area: NA

Depth: NA

Storage: NA

Notes: The existing park is 90-95% wooded and therefore does not represent a viable option for basin placement.



SCALE: 1"=300'

XI. Recommendations

Based on the information contained in the report, the stormwater sub-committee recommends the Township take the following actions to implement improvements to meet the goals outlined earlier in the report:

A. Once all input is received from the public, commissioners, township staff and other stakeholders, the Township should adopt, via resolution, this report as the official stormwater management improvement implementation plan to guide the Township in making improvements, applying for grants, fixing problem areas, etc.

B. This report recommends that all Category 1 problems be explored and fixed (where possible) before moving onto Category 2 problems. Since solutions to Mill & York Road and Warminster Road near Surrey Lane have been previously explored and the remaining residents declined to be "bought out" of their properties, these two issues should be considered "closed" by the Township. Further, since the Robert Bruce Apartments have been previously analyzed and determined that no localized solution exists, this issue should also be considered "closed" by the Township. As such, the remaining two issues: 2603 Broadway and the single-family home on Davisville Road are the highest priority issues to address. The Township should authorize further investigation of these two issues prior to moving onto Category 2 problems.

C. A large majority of the existing stormwater problems identified in the Township are due to creek flooding and backwater conditions. The problems are not localized drainage issues. As such, besides the two issues identified in Item B above, the Township should concentrate all available resources and funding to implement the BMPs identified in Section X of this report.

D. Unless a specific grant requirement or partnering source affects the BMP project chosen to be implemented, the Township should follow the priority listing of potential basins identified in Section X as the analysis is based on the basin that provides the maximum benefit for the entire Township.

E. There are numerous locations on Township owned land where small BMPs, like rain gardens, could be implemented. Since these smaller BMPs will not have the same regional benefit as large basins the Township should not expend resources to implement these types of BMPs until significant progress has been made with regards to the BMPs outlined in Section X of this report. *This approach was supported by the majority of the commissioners during the interview process.*

F. This report identifies numerous grant programs available to help implement stormwater improvements. The Township should assign a staff member in charge of tracking grant opportunities in conjunction with the Township Engineer and Redevelopment Coordinator.

G. The Township should contact all of the potential partners identified in this report. We suggest the primary contact be via the Township Manager's office

in the form of a letter which could even attach a copy of this report along with a follow-up phone call. The secondary contact should be at the elected official level based on personal and/or political relationships.

H. Place one of the following or both proposals on an upcoming election ballot as referendum questions:

   i. Support of a tax increase dedicated to stormwater management improvements to address flooding and drainage concerns in Upper Moreland Township. *Based on the commissioner interviews, 5 of the 7 commissioners believed their residents could support a 2% increase.*

   ii. Support of the Township borrowing a large sum of money (ex: 10 million dollars) towards the implementation of stormwater management improvements in accordance with the findings of this report. *This large sum would likely be used to make several projects "shovel ready" and as the required matching funds for a grant program.*

I. A stormwater permit fee for building permits is worth adopting in the event a tax increase dedicated to stormwater management improvements is not implemented.

J. Money from the Township's existing Tree Replacement Fund should be utilized in stormwater management projects specifically where plantings are needed in BMPs such as rain gardens, basin retrofits, riparian buffer restoration, stream bank stabilization, etc.

K. Authorize the professional staff to negotiate with developers regarding tree replacement fund money being applied to the stormwater management fund. The contributed amount could be a portion of the total that would be required to be contributed to the tree replacement fund (85%). The "discount" would provide incentive for the developer to contribute the money to the stormwater fund.

L. The Township should authorize the professional staff to work with in-house staff to develop an ordinance amendment that provides an incentive for developers to exceed the requirements of the Township Stormwater Management Ordinance in exchange for an increase in density or impervious coverage or building coverage, but not height. The incentive would allow for a 25% incentive when the stormwater requirements are exceeded by more than 25% for all design storms as determined by the Township Engineer.

M. The Parks & Recreation Director should identify areas within the Township park system that could be converted from lawn to low-mow/no-mow areas for approval by the Board of Commissioners.

N. There are three major routes to get from one side of the Township to the other; Easton Road (SR 0611), York Road (SR 0263) and Davisville Road (SR 2042). At current time, Easton Road represents the best route for emergency service purposes during storm events since it's higher in the

watershed and recent improvements to the UPS facility and Horsham Gate in Horsham Township and Willow Pointe in Upper Moreland Township have significantly reduced flooding at the intersection with Maryland Road. Davisville Road represents the next best route as the area that experiences flooding has fewer constraints to implement future road and drainage improvements when compared to York Road. York Road closes at Mill Road, but due to the Turnpike overpass and SEPTA regional rail line it is very constrained with regard to potential improvements.

O. At present time its unclear if the creation of a stormwater authority is allowed by law. However, the sub-committee does not recommend the creation of a new Stormwater Authority unless it's multi-municipal. If the Township wishes to explore the possibility of a multi-municipal authority, we recommend the Township Manager reach out to gauge interest with the neighboring municipalities who contribute flow to the Pennypack Creek as identified in this report.

P. Amending the Township By-Laws for the creation of a Stormwater Committee is not recommended since stormwater management is a standing agenda item on the existing Community Development Committee meeting agenda. Also, the stormwater sub-committee that helped prepare this report can meet as necessary when stormwater management issues arise.

Q. This report and its recommendations should be considered a constantly evolving document that is always being updated as new information becomes available. As such, a semi-annual review of its contents should be performed to determine if the policy set forth herein is still applicable and the most-effective approach to guarantee the health, safety and welfare of the residents, business community and the general public that commutes through the Township each day.

Appendix A

Existing Stormwater Problem Master List

Upper Moreland Township - Stormwater Project Priority Rating System									
Project Location	Report Exhibit #	Category	Frequency of Flooding	Depth of Flooding	Duration of Flooding	Emergency Response Delay	ADT Affected	Estimated Project Cost*	Average Score
Edge Hill & Moreland Road	1.1	3	1	3	1	3	3	$10,000	2.20
Quigley Road	1.2	2	3	3	3	3	3	$100K - $500K	3.00
Evans Circle & Quigley Road	1.3	3	2	3	2	3	3	$10,000	2.60
Frazier & Evans Circle	1.4	2	1	1	2	2	3	$100K - $500K	1.80
Inman Road near Frazier	1.5	3	2	3	2	3	3	$10,000	2.60
239 Cowbell Road	1.6	2	2	2	3	2	3	$100K - $500K	2.40
Division & Krewson Street	1.7	2	3	3	3	3	3	$25,000	3.00
Church & Cherry Streets	1.8	2	1	2	2	2	3	$500K - $1M	2.00
Norwyn & Shirley Road	2.1	2	1	1	2	1	3	$500K - $1M	1.60
Robert Bruce Apartments	2.2	1	1	1	1	1	3	NA	1.40
Monument Avenue	2.3	2	2	2	3	2	2	$1M - $1.5M	2.20
2603 Broadway	2.4	1	1	1	1	1	3	$10,000	1.40
Parkside at Sycamore	2.6	3	1	3	3	3	3	$10,000	2.60
Costello Avenue near Lynn	2.7	3	1	3	3	3	3	$10,000	2.60
Blair Mill near County Line	2.8	2	1	1	2	2	1	$1M - $1.5M	1.40
Blair Mill between Broadway & Parkside	2.9	3	2	2	3	3	3	$10,000	2.60
Commerce Avenue Apartments	3.1	3	2	3	2	3	3	$25,000	2.60
523 Grant Street	3.2	2	1	3	3	2	3	< $100K	2.40
Duffield Street (natural spring)	3.3	2	1	3	3	3	3	< $10,000	2.60
Lincoln Avenue & York Road	3.4	2	1	2	2	1	3	NA	1.80
Green Willow Run Apartments	3.5	3	1	1	2	3	3	NA	2.00
Fitzwatertown Road	3.7	3	2	1	2	3	3	NA	2.20
401 & 403 Crown Street	3.8	3	2	3	2	3	3	$10,000	2.60
Route 611 & Maryland Road	4.1	2	1	1	2	1	1	NA	1.20
Whitehall Drive near Hideaway	4.2	2	1	1	3	2	2	NA	1.80
Dogwood Lane Cul-de-sac	4.3	3	2	3	3	3	3	$25,000	2.80
Cameron & Sheldon Road	4.4	2	1	2	2	3	3	$100K - $500K	2.20
Sheldon Road between Ellis & Fitzwatertown	4.5	2	1	3	3	3	3	< $100K	2.60
Maryland Road (stream erosion)	4.6	3	3	3	3	3	3	$100K - $500K	3.00
Mill & York Road	5.1a	1	1	1	1	1	1	NA	1.00
Mill & York Road	5.1b	2	1	1	1	1	1	NA	1.00
Warminster Road near Lori & Surrey Lane	5.2a	1	1	2	1	2	3	NA	1.80
Warminster Road near Lori & Surrey Lane	5.2b	2	1	2	1	2	3	NA	1.80
Bonnett Lane at St. Dunstans Road	5.3	2	1	1	1	3	3	NA	1.80
4115 Hoffman Road	5.4	3	2	2	2	3	3	$10,000	2.40
Exton & Orangeman's Intersection	5.5	2	1	1	3	1	2	$100K - $500K	1.60
3800 Meyer Lane	5.6	3	2	2	2	3	3	$10,000	2.40
Davisville Between Terwood & Carson-Simpson	6.1a	1	1	1	1	1	1	$5,000	1.00
Davisville Between Terwood & Carson-Simpson	6.1b	2	1	1	1	1	1	NA	1.00
Terwood Road Tributary	6.2	2	1	2	2	1	2	NA	1.60
1400 Terwood Road (PennDOT to fix)	6.3	2	3	3	3	3	2	< $10K	2.80
Byberry Road Bridge near Pioneer	6.4	2	1	1	1	1	1	$2M	1.00
Mason's Mill Road Bridge	6.5	2	1	1	1	1	2	$2M	1.20
Huntingdon Road at Mason's Mill	6.6	3	2	2	3	3	3	$25,000	2.60
2105 Huntingdon Road	6.7	3	2	2	2	3	3	NA	2.40
Fern Village Park at Exton Road	7.1	2	3	3	3	3	3	< $100K	3.00
							Total Cost:**	**$12,525,000**	

Average score is the average score obtained for each project when taking into account the 5 criteria's numeric amount assigned. The lower the average, the higher the priority.

*** Estimated Project Costs with "NA" represents project that do not have a localized solution. Only regional basins will help alleviate flooding in these areas.***

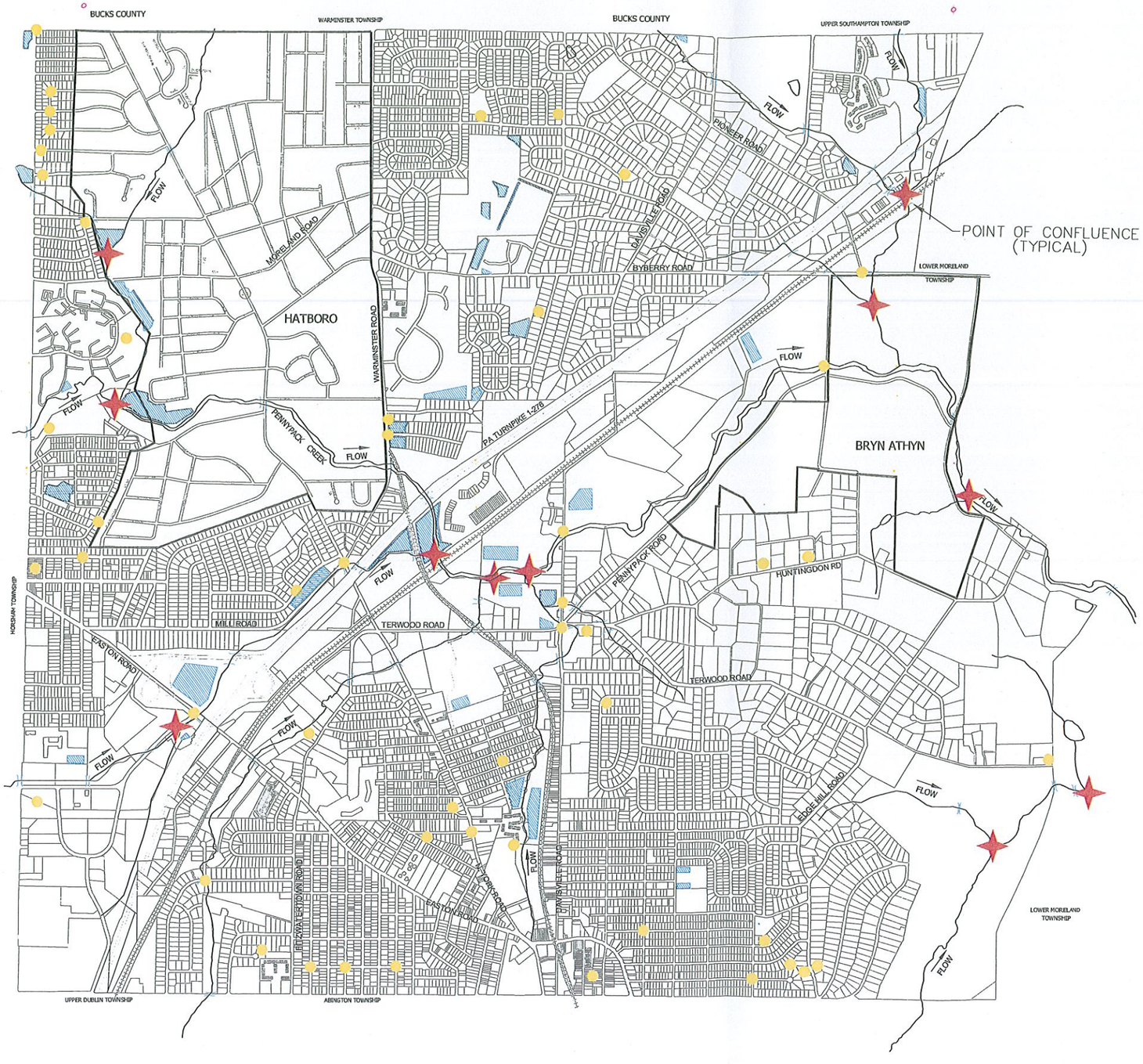
**** Total Cost is based on higher value for projects where estimated cost is given as a range.***

Appendix B

Potential Basin Location Map

POTENTIAL BASIN LOCATION MAP

UPPER MORELAND TOWNSHIP, MONTGOMERY COUNTY



LEGEND

- EXISTING STORMWATER PROBLEM
- POINT OF CONFLUENCE
- POTENTIAL BASIN LOCATION

REV.	DESCRIPTION	DATE	BY

POTENTIAL BASIN LOCATION MAP

UPPER MORELAND TOWNSHIP

UPPER MORELAND TOWNSHIP, MONTGOMERY COUNTY, PENNSYLVANIA

SCALE: NOT TO SCALE

DATE: 2-4-13

GILMORE & ASSOCIATES, INC.

ENGINEERING & CONSULTING SERVICES

65 EAST BUTLER AVENUE, SUITE 100 • NEW BRITAIN, PA 18901-5008 • (215) 345-4330 • www.gilmore-assoc.com

NTS 0 NTS NTS

SCALE IN FEET

JOB NO.: 12-01004

SHEET NO.: 1 OF 1

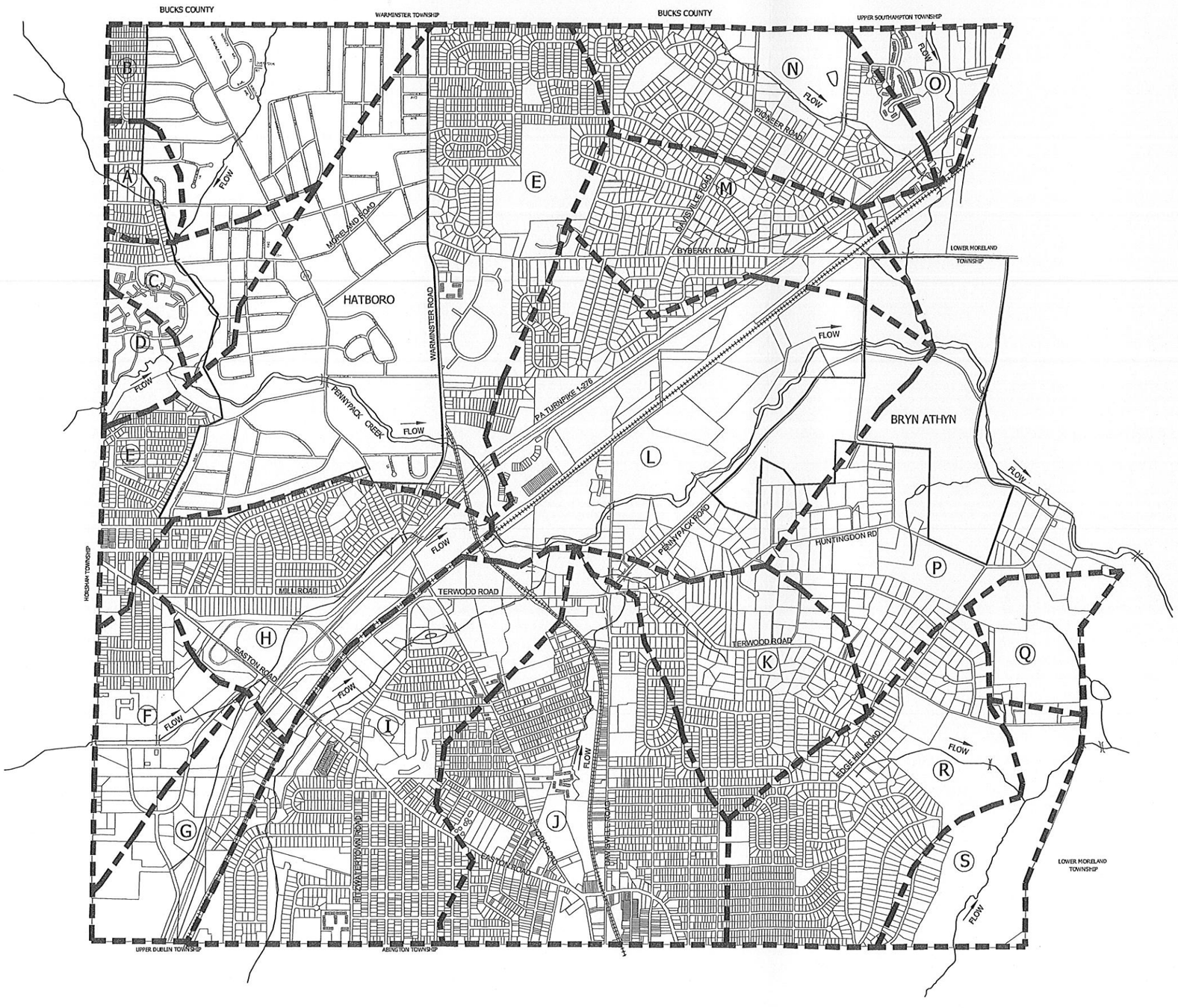
DESIGNED BY: JCG | DRAWN BY: JSH | CHECKED BY: JCG

Appendix C

Pennypack Creek Sub-Watershed Map

PENNYPACK CREEK SUB WATERSHED MAP

UPPER MORELAND TOWNSHIP, MONTGOMERY COUNTY



PENNYPACK CREEK SUB WATERSHED AREA	
SUB-WATERSHED	DRAINAGE AREA WITHIN UMT
A	40.5 AC.
B	28.6 AC.
C	58.8 AC.
D	58.6 AC.
E	531.0 AC.
F	175.1 AC.
G	168.2 AC.
H	352.4 AC.
I	549.2 AC.
J	575.0 AC.
K	284.8 AC.
L	631.1 AC.
M	262.3 AC.
N	320.7 AC.
O	94.7 AC.
P	266.6 AC.
Q	102.2 AC.
R	395.7 AC.
S	170.4 AC.
TOTAL	5,065.9 AC.

AREA FROM ADJACENT MUNICIPALITIES CONTRIBUTING FLOW TO THE PENNYPACK IN UMT	
ABINGTON TOWNSHIP	940 ACRES
BRYN ATHYN BOROUGH	302 ACRES
BOROUGH OF HATBORO	895 ACRES
HORSHAM TOWNSHIP	3,700 ACRES
UPPER DUBLIN TOWNSHIP	265 ACRES
UPPER SOUTHAMPTON TWP.	1,090 ACRES
WARMINSTER TOWNSHIP	3,100 ACRES
TOTAL	10,292 ACRES

NOTE: CONTRIBUTING AREAS TAKEN FROM THE PENNYPACK CREEK ACT 167 PLAN PREPARED BY THE TEMPLE UNIVERSITY CENTER FOR SUSTAINABLE COMMUNITIES.

REV.	DESCRIPTION	DATE	BY
SCALE: NOT TO SCALE	PENNYPACK CREEK SUB WATERSHED MAP		
DATE: 2-4-13	*UPPER MORELAND TOWNSHIP*		
	UPPER MORELAND TOWNSHIP, MONTGOMERY COUNTY, PENNSYLVANIA		
	GILMORE & ASSOCIATES, INC. ENGINEERING & CONSULTING SERVICES		
	JOB NO.: 12-01004		
	SHEET NO.: 1 OF 1		
DESIGNED BY: JEC	DRAWN BY: JJH	CHECKED BY: JEC	