SOUTHEASTERN REALIGNMENT

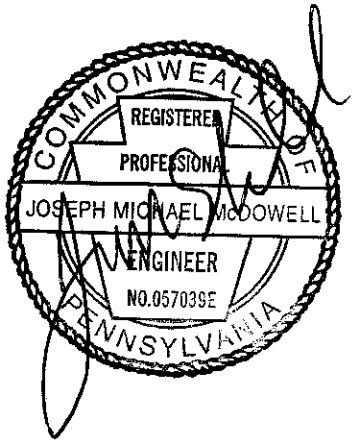
IESI PA BETHLEHEM LANDFILL

"Post Construction Stormwater Management Report"

Lower Saucon Township

Northampton County

Pennsylvania



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SOUTHEASTERN REALIGNMENT

IESI PA BETHLEHEM LANDFILL

"Post Construction Stormwater Management Report"

Lower Saucon Township Northampton County

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1.0 Introduction

This Stormwater Management Plan is submitted on behalf of IESI PA Bethlehem Landfill Corporation for the development of the Southeastern Realignment at the IESI PA Bethlehem Landfill. The project is proposed to be constructed within the existing landfill permit boundary on the +/-224 acre property in Lower Saucon Township, Northampton County. The area of development contains +/-67 acres of which only 3.75 acres will impact upon current undeveloped lands. All other areas of the proposed Southeastern Realignment are located within previously approved development areas for landfill or landfill support operations.

Stormwater runoff from the project site will be managed during and following construction through the implementation of various controls and Best Management Practices (BMPs), which are illustrated and described on the Land Development and Post Construction Stormwater Plans.

Pursuant to Map 8 of the Watershed Management Plan titled "Release Rates – Saucon Creek Watershed" the Bethlehem Landfill appears to be located within Sub-Areas 188, 189 and 196. Basin 2 being the subject of this report and is located within Sub-Area 188. The dual release rate for Area 188 is 30/50 indicating a release rate of 30% for the 2-year event and 50% for all other events. As outlined throughout this report in order to document compliance with said release rates current approved discharge rates from Basin 2 were maintained and thus compliance is achieved.

2.0 Stormwater Management Design Objectives

The objectives of this Stormwater Management Plan are as follows:

- To comply with the Lower Saucon Township standards for stormwater management contained within Chapter 137 of the Lower Saucon Township Code.
- To comply with the Lower Saucon Township Subdivision and Land Development Ordinance Chapter 145 of the Lower Saucon Township Code, as applicable.
- To comply with the whole of 25 Pa. Code Chapter 102.

3.0 Site Description

The subject +/-224 acre property is an active landfill and as such grades within the site change on a daily basis. Additionally, since the 1980's various Stormwater and Erosion and Sediment Control Plans have been prepared for the site as the landfill operations have expanded. Therefore, for the purposes of pre-development or existing conditions the latest Stormwater Management Plan approved by the Township in 2011 is utilized. This plan was filed associated with the development of the Cell 4-F Modification. The Cell 4-F final grades as approved have been depicted on all plans as existing contours including the pre-development drainage area mapping.

This current approved plan proposes management of stormwater runoff by utilization of several detention basins throughout the site, five (5) in total. All stormwater basins are designed to collect runoff from the landfill development via a series of channels and culverts for management. Upon detention within the approved basins the runoff is released at rates previously approved to be in compliance with Township requirements. Thus if post development discharge rates resulting from development of the Southeastern Realignment from basins are less than the approved basin release rates compliance with the Ordinance is achieved regarding rate control.

A NPDES Permit for Stormwater Discharges Associated with Industrial Activities is maintained as part of the landfill operation. The permit includes as discharges from the site each basin outfall. The discharges are tributary to unnamed tributaries of the East Branch of Saucon Creek which is classified as TSF in Chapter 93. As a result of extending the landfill disposal area to the southeast, an offsite area which currently is excluded from analysis must be considered as part of the project. Thus, the pre-development drainage area analysis is consistent with the Cell 4-F Stormwater Plan except for the addition of offsite Area "A".

According to Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map Number 42095C0335E Panel 0335E, no portion of the property is located in a mapped floodplain. Appendix A contains a USGS 7.5-minute series location map and a FEMA National Flood Insurance Program Flood Insurance Rate Map of the project area.

No changes to existing points of discharge as defined within the NPDES Permit are proposed as part of the Southeastern Realignment. Except one new point of discharge is proposed onsite at a level spreader at the southeast corner to manage the offsite run-on.

The subject site is located within Several Stormwater Management Districts. However, each district requires a dual release rate requirement. The dual requirement is 30% for the 2-year event and 100% for the 10-year through 100-year events. As stated previously regarding rate control, if upon development of the Southeastern Realignment discharge rates from each basin are less than approved pre-development rates the required release rate is met.

4.0 Soils Classifications

Soils classifications were obtained from the Natural Resource Conservation Service National Cooperative Soil Survey (Web Soil Survey) Website. No hydrologic group is exclusive to the site. Developed landfill areas are considered Group "B" while those undeveloped areas are considered "A". Hydric soils are not present within the project area. The following table is a listing of the soil types occurring at the site. NRCS Soil Classification Maps and Soils reports are attached in Appendix B.

Table 4.0 - Soils

Map Symbol	Name	Hydrologic Soil Group
CaB	Califon Loam, 3 to 8 percent slopes	D
GIB	Gladstone Gravelly Loam, 3 to 8 percent slopes	A
GIC	Gladstone Gravelly Loam, 8 to 15 percent slopes	A
GmF	Gladstone Gravelly Loam, 25 to 55 percent slopes	A
GnD	Gladstone-Parker Gravelly Loam, 15 to 25 percent slopes	A
UfB	Udorthents, Sanitary Landfill	B
UupB	Urban Land – Udorthents, 0 to 8 percent slopes	C

*As outlined in the table above the existing landfill areas are defined by NRCS as being of the Hydrologic Soil Group B. Thus, for analysis of rate control all areas which have been approved for landfill or landfill support activities have been considered as part of the Hydrologic Soil Group B and those areas which lie outside the area of landfill approval utilize that Hydraulic Soil group described within the table above.

5.0 Geotechnical Investigation and Infiltration Analysis

An extensive geotechnical study and investigation has been performed for the site as part of the PaDEP Municipal Solid Waste Application which has been provided to the Township. The geotechnical study is provided as a separate document to this report. In general the conclusions of the geotechnical study concludes the landfill nor the Southeastern Realignment is underlain with carbonate geology.

Section 137-15 L prohibits the use of infiltration BMPs on "hot spot" land use areas. Section 137-15 K provides a listing of "hot spot" land uses which includes certain industrial uses regulated under the NPDES Stormwater Program. The IESI PA Bethlehem Landfill is regulated under the NPDES Stormwater Program. A NPDES Permit is maintained onsite which monitors all offsite discharge points. Therefore, based upon Chapter 137 of the Lower Saucon Code the subject property is considered a "hot spot" land use and infiltration BMPs are prohibited. We concur with this approach in that discharges/infiltration of runoff from the landfill industrial use has the potential to result in groundwater contamination. Based upon the above no infiltration testing nor geologic assessment was performed onsite to determine the suitability of the site for infiltration given its prohibition. Further no recharge volume, loading ratio or other calculations or evaluations were performed as prescribed in Section 135-16 since this section is not applicable to the project.

6.0 Methods of Analysis and Design

6.1 Watershed Analyses

Contained within the IESI Pa Bethlehem Landfill there currently exists six (6) watersheds. Watersheds are as follows:

1. Basin 1
2. Basin 2
3. Basin 3
4. Basin 4
5. Basin 6
6. Lehigh River

These drainage sheds have been analyzed numerous times as the landfill has expanded over time. Historical mapping with each drainage shed can be found within Appendix C. The Southeastern Realignment proposes development within the watersheds of Basin 1, Basin 2, Basin 4 and Basin 6. The proposed development either maintains or reduces the existing drainage area of each watershed except Basin 2 where an increase in drainage area is proposed. Assuming the water sheds as previously approved met release rate criteria, then the watersheds as impacted by the Southeastern Realignment by decreasing or maintaining the watershed area continue to meet release rate criteria. Further, the area of development within these watersheds is consistent with previous development regarding land cover and slope. Thus no further analyses of these watersheds (Basin1, Basin 4 and Basin 6) is required.

Basin 2 however has an increased drainage area as a result of development and thus requires further analysis. Peak Runoff Analyses were performed using the soil cover complex method within the SEDCAD 4 computer program. Drainage Area Mapping specific to Basin 2 is contained within Appendix D. Comprehensive Watershed Analyses are provided in Appendix G and H.

6.2 Rainfall Depths

Rainfall depths (24-hr) were obtained from Appendix "C", Chapter 137 of the Lower Saucon Township Code as follows:

1 year	=	2.40"
2 year	=	3.00"
5 year	=	3.60"
10 year	=	4.56"
25 year	=	5.52"
50 year	=	6.48"

100 year = 7.44"

6.3 Runoff Curve Numbers

Runoff curve numbers were obtained from Chapter 137 Appendix C of the Lower Saucon Township Code. A copy of the runoff curve numbers can be found within Appendix F as well as weighted runoff curve number calculations.

6.4 Times of Concentration (T_c)

Times of concentration were calculated using a segmental approach based on flow characteristics approximated through interpretation of existing and proposed topography and ground surface coverage. Time of concentration calculations is located in Appendix E. T_c paths are depicted on the drainage area maps are provided in Appendix D.

6.5 Stormwater Detention Basin

One stormwater management basin was designed as peak rate and water quality BMP. The basin receives the vast majority of runoff from the Southeastern Realignment development area. Peak runoff from the onsite contributory drainage areas was routed through the detention basin under post construction conditions to confirm adequate discharge attenuation from the site. The design of this facility accounts for all of the site conditions, constraints and design considerations as outlined within the Pa Stormwater BMP Manual.

Calculations in Appendix I include water quality treatment and dewatering times. Construction details are provided on the Post Construction Stormwater Management Plans.

6.6 Stormwater Channels

Stormwater channels were designed to convey peak runoff generated during a 100-year design storm as derived using the Soil Cover Complex Method within SEDCAD 4 for calculating stormwater runoff. Channel linings were selected based on the governing condition of flow velocity or shear stress occurring when conveying the design peak flow. All calculations pertaining to channel design are located in Appendix J. Stormwater facility drainage area maps are located in Appendix D for reference.

6.7 Stormwater Culverts

Stormwater culverts were designed to convey peak runoff generated during a 100-year design storm as derived using the Soil Cover Complex Method within SEDCAD 4 for calculating stormwater runoff. Manning's Equation within SedCAD 4 programe was used to model the hydraulics of the stormsewer system. All calculations for culvert design are located in Appendix K.

7.0 Pre Construction Peak Runoff Analysis

Pre-construction peak runoff volumes and peak discharges were analyzed at two points of interest (POI). POI-1 is located at the outfall of existing Basin 2. As stated previously Basin 2 was most recently redesigned as part of the Cell 4-F expansion. This analysis was used as pre-development conditions for peak rate of discharge. POI-2 is a non-descriptive area which contains some offsite tributary area that discharges to the south from the Southeastern corner of the property. Peak runoff rates were calculated at the points of interest for the two (2), five (5), ten (10), twenty-five (25), fifty (50) and one-hundred (100) year storm events. Pre-construction hydrograph summaries and detailed hydrographs are provided in Appendix G of this report. A pre-construction drainage area map is included within Appendix D. The following table is a summary of existing peak discharges from the project site.

Table 7.0 – Pre-construction Peak Discharge Summary

In Cubic Feet per Second

Design Storm Event	POI-1 (Basin 2)	POI-2 (Area "A")
2-year	0.43	0.23
5-year	0.49	0.79
10-year	1.00	2.14
25-year	1.30	3.89
50-year	2.41	5.93
100-year	6.5*	8.22

*Allowable discharge rate for 100-year event from Table I-3 of Cell 4-F Modification.

The pre-development release rates for Basin 2 outlined above are considerably less, in our view, than what would be expected from a "True" pre-existing landfill and Basin 2 condition. A search through volumes of analysis did not reveal any analysis performed prior to the landfill existing including Basin 2. Thus, this report and past reports have relied upon the basin discharge rates from previous reports as the required release rate. These are the values reflected within Table 7.0. The 100-year event while analyzed herein resulted in a peak pre-development rate of 5.35 cfs, we note the allowable release rate established is 6.5 cfs taken from the referenced Cell 4-F Modification document for compliance.

8.0 Post Construction Peak Rate Management

Post construction peak runoff was calculated for the same points of interest examined in the pre-construction analysis, thus a direct comparison is made. A post construction drainage area map is included within Appendix D . Peak runoff rates were calculated for the two (2), five (5), ten (10), twenty-five (25), fifty (50) and one-hundred (100) year storm events. Post construction peak discharge rates will be managed through the construction of a stormwater detention basin to minimize the rate of surface runoff discharged from the project area.

The following table is a summary of proposed post construction peak discharges with stormwater management controls compared to pre-construction discharges at the points of interest. Post construction hydrograph summaries, detailed rational hydrographs and routing hydrographs are provided in Appendix H.

Table 8.0 – Post Construction Peak Discharge Summary

In Cubic Feet per Second – with Stormwater Controls

Design Storm Event	POI-1 (Basin 2)		POI-2 (Area "A")	
	Pre Peak Q	Post Peak Q	Pre Peak Q	Post Peak Q
2-year	0.43	0.26	0.23	0.20
5-year	0.49	0.32	0.79	0.67
10-year	1.00	0.60	2.14	1.82
25-year	1.30	1.25	3.89	3.31
50-year	2.41	2.31	5.93	5.05
100-year	6.5*	6.5	8.22	7.01

*Allowable discharge rate for 100-year event form Table I-3 of Cell 4-F Modification.

As evidenced by the results presented above, post construction peak discharge rates are anticipated to be less than pre-construction peak discharge rates for all storm events analyzed. Thus, since the pre-development approved rates are assumed to account for required release rates the proposed development meets or exceeds the requirement as it relates to rate control.

9.0 Post Construction Water Quality Analysis

As shown on the land cover plans provided in Appendix L for Pre and Post Development, The area of development associated with the Southeastern Realignment is +/-67 acres. Current conditions yield this area of development to include Woodlands, Grass Cover and Impervious Area. The vast majority of this development area consists of previously developed landfill and support activities. Upon development of the Southeastern Realignment the area of impact to land cover not currently approved as landfill or landfill support activities change is limited to 3.75 acres. The proposed land cover within this area will be grass and impervious surface. Based upon this change in natural land cover the Water Quality Volume can be calculated in accordance with Ordinance requirements as follows:

Where: c = Rational Method Post Development Coeff - 2yr Storm

$$c = \frac{(0.30)(2.68\ Ac.) + (0.97)(1.07\ Ac.)}{3.75}$$

Where: 1.07 Ac. is impervious (0.97) and 2.68 Ac. is grass (0.30)

c = 0.49

P = 1.25 inches

A = Area of Prop. New Activity or Land Cover Change (3.75 ac.)

1.) $$WQv = \frac{(c)(P)(A)}{12}$$

$$WQv = \frac{(0.49)(1.25\ in.)\ (3.75\ Ac.)}{12}$$

WQv = 0.19 ac-ft of 8,388 cf

Thus as shown above utilizing calculation methodology #1 the Water Quality Volume is calculated as 0.19 ac-ft or 8,338 cf.

As per the Ordinance a second calculation is required to determine which method results is the higher water quality volume. As shown below the land cover change from pre to post within the +/-67 acres of development area the water quality volume is calculated as 0.094 ac-ft of 4,104 cf.

2-year/24 hour rain event = 3.0 inches

EXISTING CONDITIONS

COVER TYPE/CONDITION	SOIL TYPE	AREA (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q (runoff) (in)	Runoff Vol. (ft^3)	Runoff Vol. (ac-ft)
Woodlands	B	129,373	2.97	55	8.2	1.64	0.19	2,100	0.048
Grass (Good Condition)	B	2,627,539	60.32	61	6.4	1.28	0.37	79,949	1.835
Impervious		104,980	2.41	98	0.2	0.04	2.77	24,218	0.556
TOTAL		**2,861,892**	**67.00**				**3.33**	**106,267**	**2.440**

DEVELOPED CONDITIONS

COVER TYPE/CONDITION	SOIL TYPE	AREA (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q (runoff) (in)	Runoff Vol. (ft^3)	Runoff Vol. (ac-ft)
Grass (Good Condition)	B	2,745,587	63.03	61	6.4	1.28	0.37	83,541	1.918
Impervious	B	116,305	2.67	98	0.2	0.04	2.77	26,830	0.616
TOTAL		**2,861,892**	**67.00**				**3.13**	**110,371**	**2.534**

INITIAL CHANGE IN RUNOFF VOLUME (POST-PRE)		
CONDITION	Runoff Volume (ft^3)	Runoff Volume (ac-ft)
EXISTING CONDITIONS	106,267	2.440
DEVELOPED CONDITIONS	110,371	2.534
INITIAL CHANGE IN RUNOFF VOLUME	**4,104**	**0.094**

Based upon the calculations above, the larger of the two volumes calculated utilized calculation #1 which resulted in a water quality volume of 8,388 cf.

The water quality volume is accounted for under post development conditions by utilizing the following BMP's in series.

1.) Vegetated Swales

2.) Extended Detention Basins

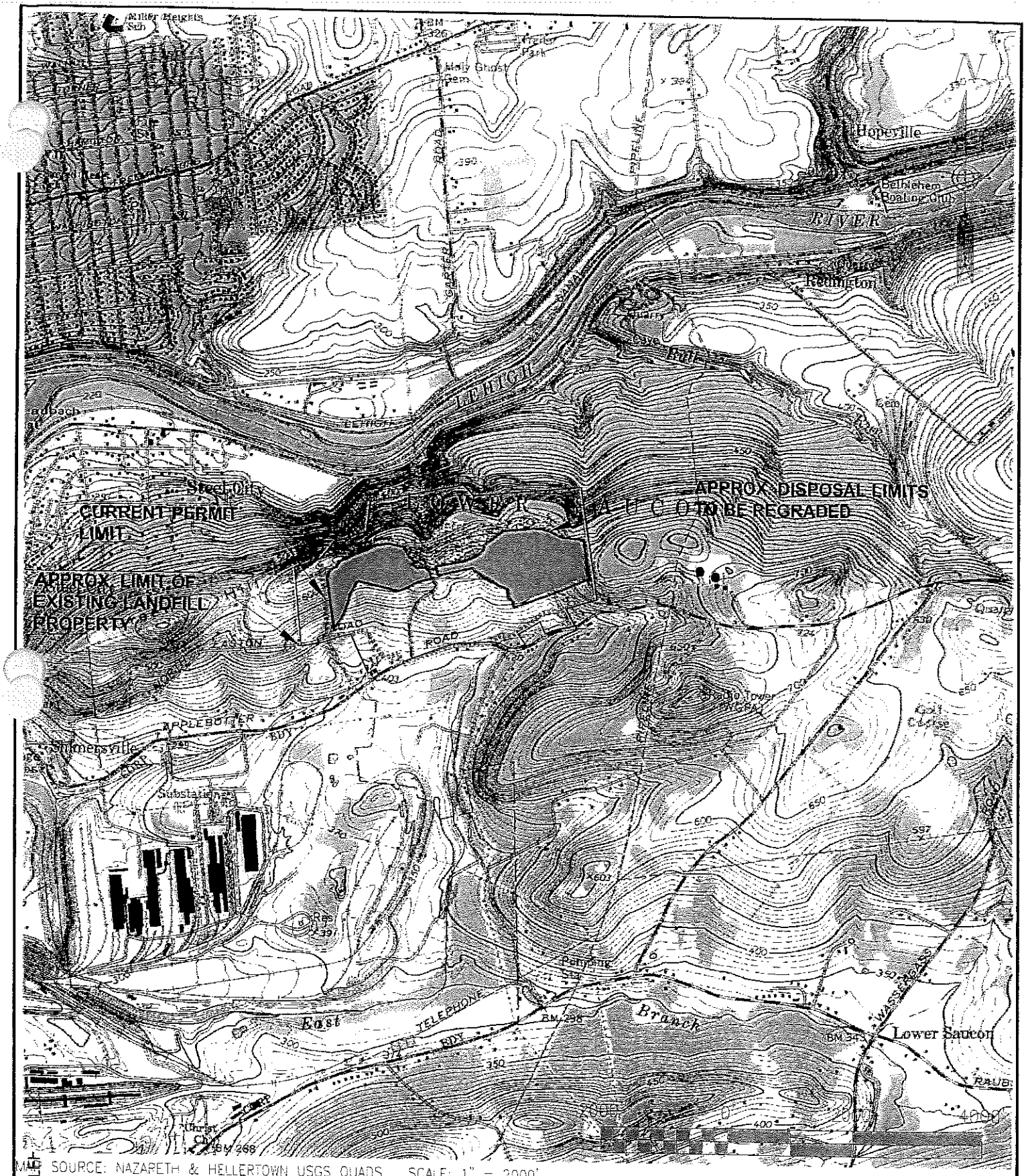
Refer to Appendix N for more details regarding the Water Quality Volume Analysis.

10. Conclusion

We certify that this Stormwater Management Report has been prepared according to accepted professional engineering means, methods and standards. The plan is designed in compliance with Lower Saucon Township Stormwater Management Ordinance. The calculations demonstrate that the objectives stated in Section 2 have been met.

Appendix A

USGS 7.5-Minute Series Location Map
Federal Emergency Management Agency NFIP Map



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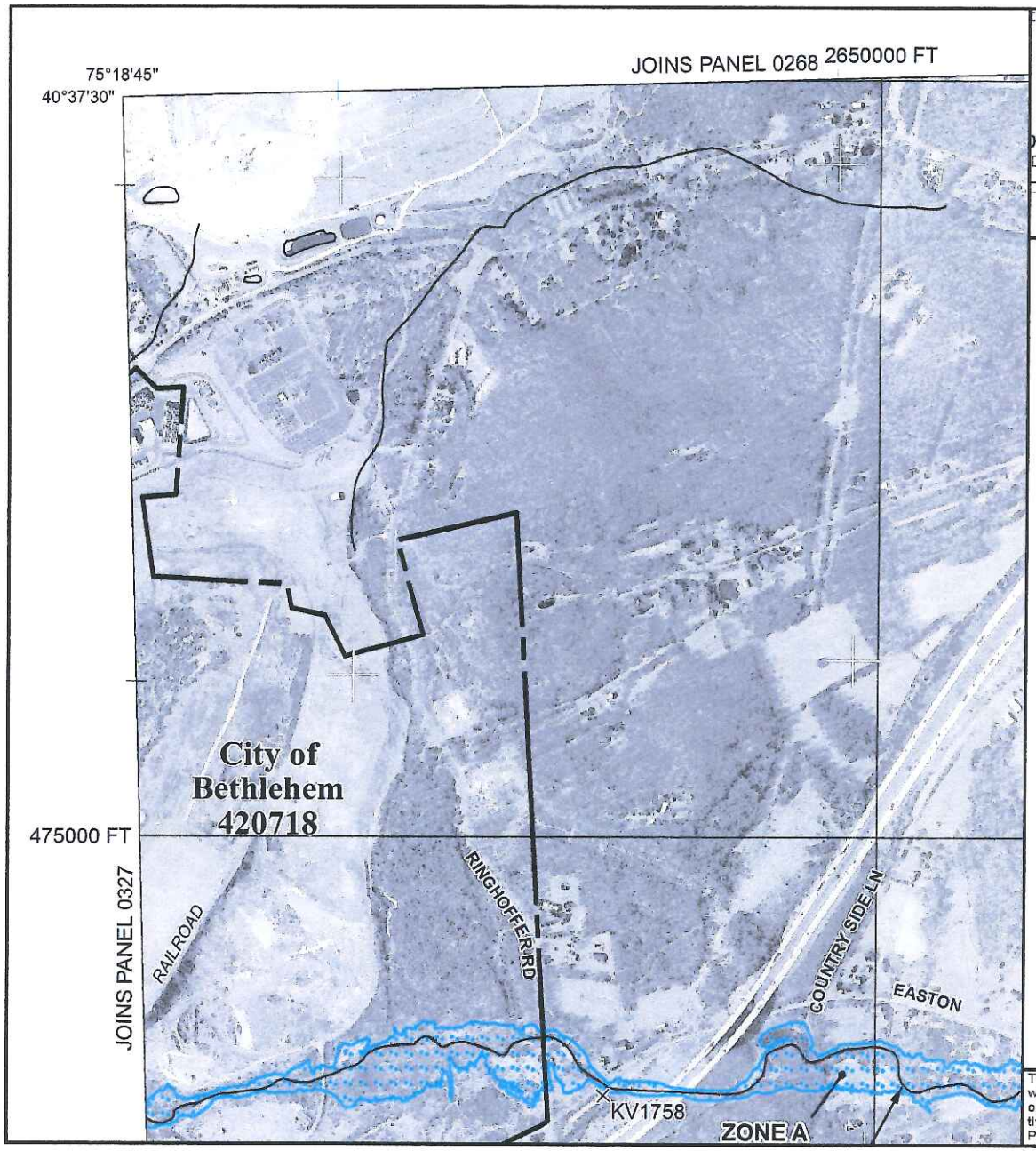
SOUTHEAST REALIGNMENT

LOWER SAUCON TWP. NORTHAMPTON CO.

PA Bethlehem Landfill Corp.
2335 Applebutter Road Bethlehem, Pennsylvania 18015



tional Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

00 0 1000 2000 FEET

METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0335E

FIRM

FLOOD INSURANCE RATE MAP

NORTHAMPTON COUNTY, PENNSYLVANIA
(ALL JURISDICTIONS)

PANEL 335 OF 355

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BETHLEHEM, CITY OF	420718	0335	E
LOWER SAUCON, TOWNSHIP OF	420982	0335	E
WILLIAMS, TOWNSHIP OF	421036	0335	E

Notice to User: **The Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
42095C0335E

MAP REVISED
JULY 16, 2014

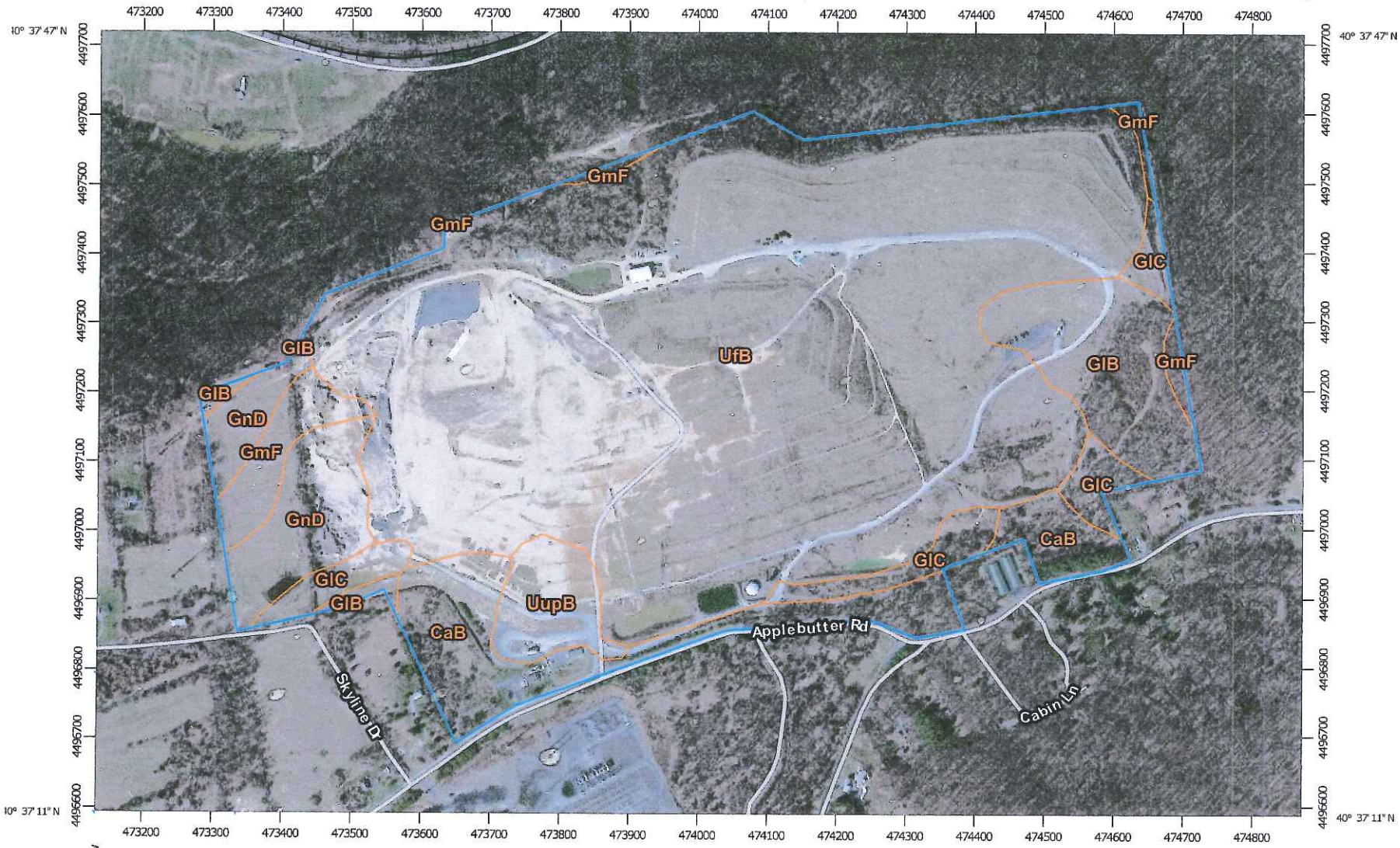
Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Appendix B

NRCS Soils Mapping and Reports

Soil Map—Northampton County, Pennsylvania
(IESI PA Bethlehem Landfill Soils Map)



Map Scale: 1:7,950 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 350 700 1400 2100

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Northampton County, Pennsylvania
Survey Area Data: Version 5, Sep 22, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 20, 2011—May 10, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Northampton County, Pennsylvania (PA095)				
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**	LISTED GROUP
CaB	Califon loam, 3 to 8 percent slopes	18.2	8.4%	D
GlB	Gladstone gravelly loam, 3 to 8 percent slopes	13.9	6.4%	A
GlC	Gladstone gravelly loam, 8 to 15 percent slopes	9.0	4.2%	A
GmF	Gladstone gravelly loam, 25 to 55 percent slopes, very bouldery	6.1	2.8%	A
GnD	Gladstone-Parker gravelly loams, 15 to 25 percent slopes	11.7	5.3%	A
UfB	Udorthents, sanitary landfill	153.4	70.3%	B
UupB	Urban land-Udorthents, schist and gneiss complex, 0 to 8 percent slopes	5.8	2.6%	C
Totals for Area of Interest		**218.0**	**100.0%**	

Appendix C

Historical Drainage Area Mapping

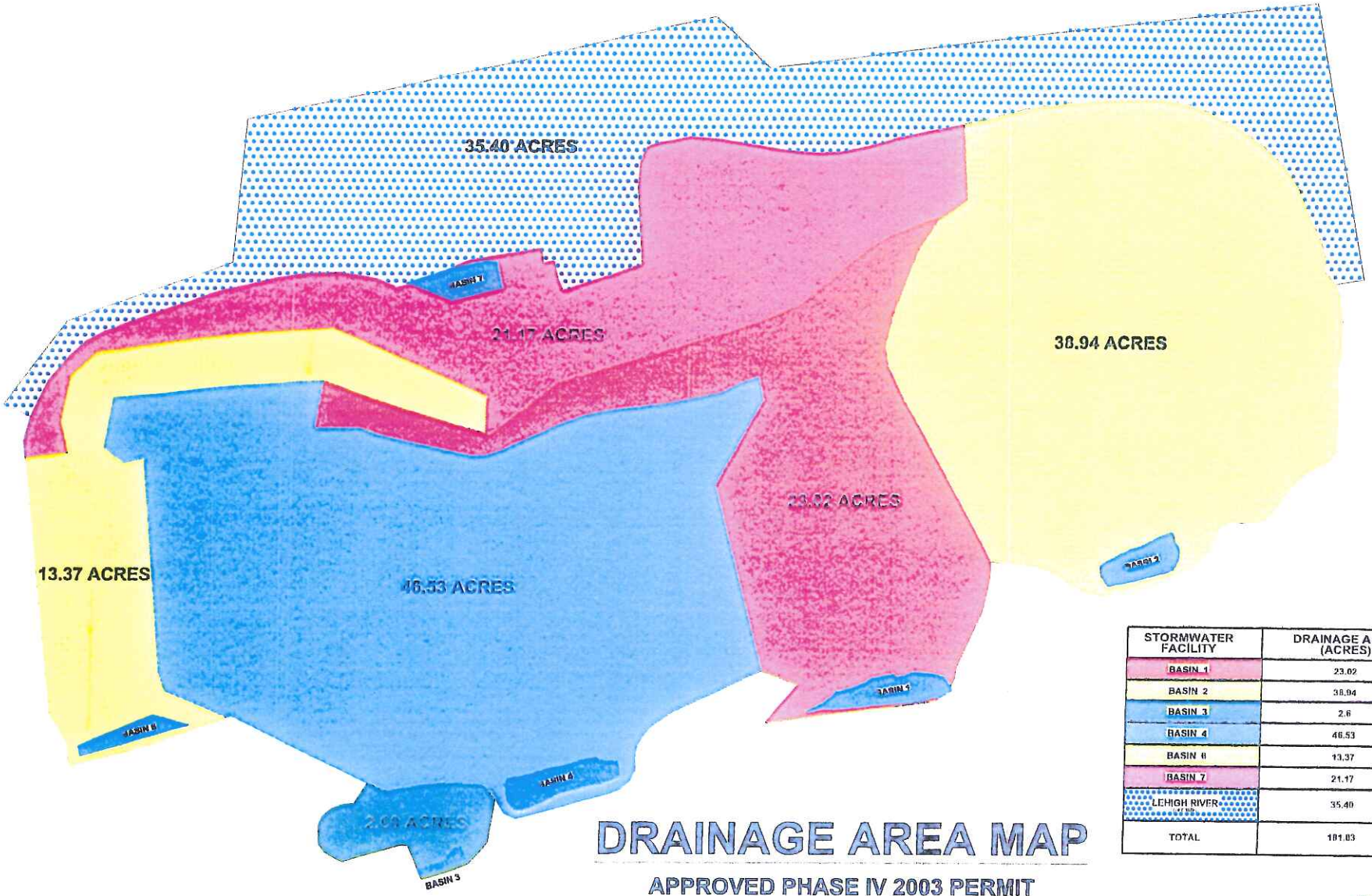
Summary of Drainage Areas

Exhibit 1 -Approved Phase IV

Exhibit 2 - Approved Phase IV – Cell 4F Minor Modification

Exhibit 3 - Approved Final Grade Adjustment - Cap Removal Minor Modification

Exhibit 4 - Proposed Southeastern Realignment – Major Modification

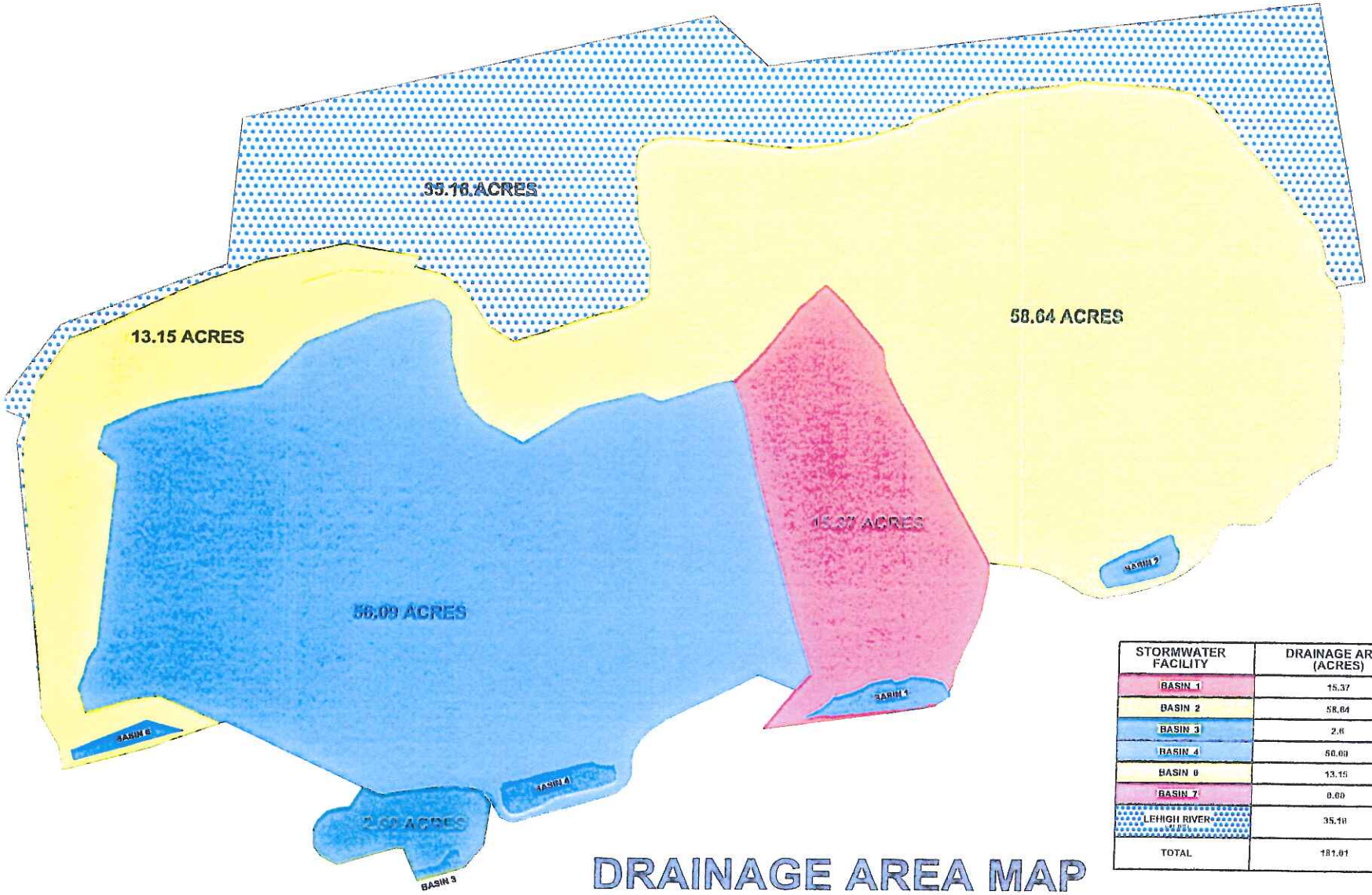


STORMWATER FACILITY	DRAINAGE AREA (ACRES)
BASIN 1	23.02
BASIN 2	38.94
BASIN 3	2.6
BASIN 4	46.53
BASIN 6	13.37
BASIN 7	21.17
LEHIGH RIVER	35.40
TOTAL	181.03

DRAINAGE AREA MAP

APPROVED PHASE IV 2003 PERMIT

EXHIBIT 1

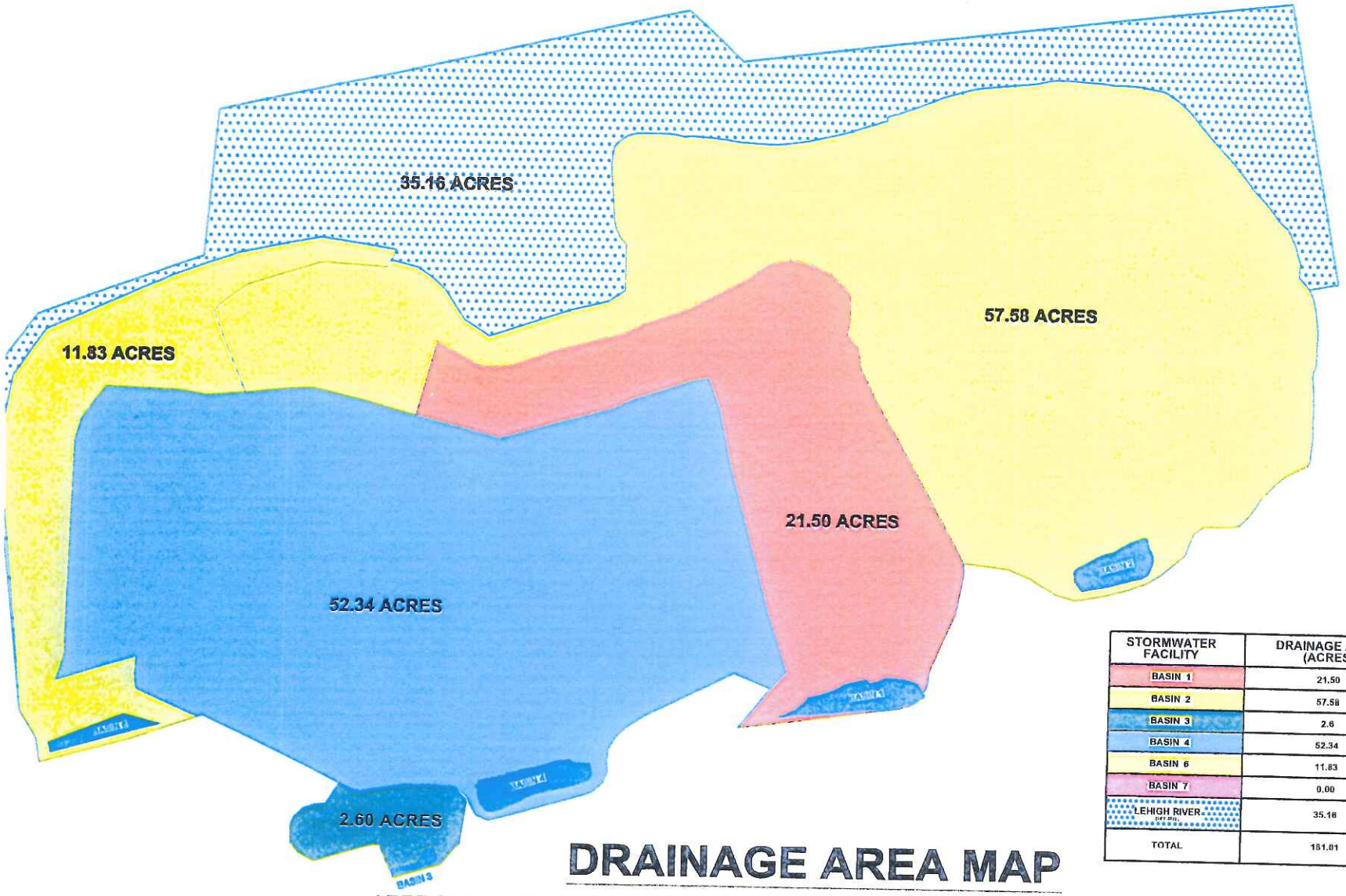


STORMWATER FACILITY	DRAINAGE AREA (ACRES)
BASIN 1	15.37
BASIN 2	58.64
BASIN 3	2.6
BASIN 4	56.09
BASIN 6	13.15
BASIN 7	0.00
LEHIGH RIVER	35.16
TOTAL	181.01

DRAINAGE AREA MAP

APPROVED CELL 4F MINOR MODIFICATION

EXHIBIT 2

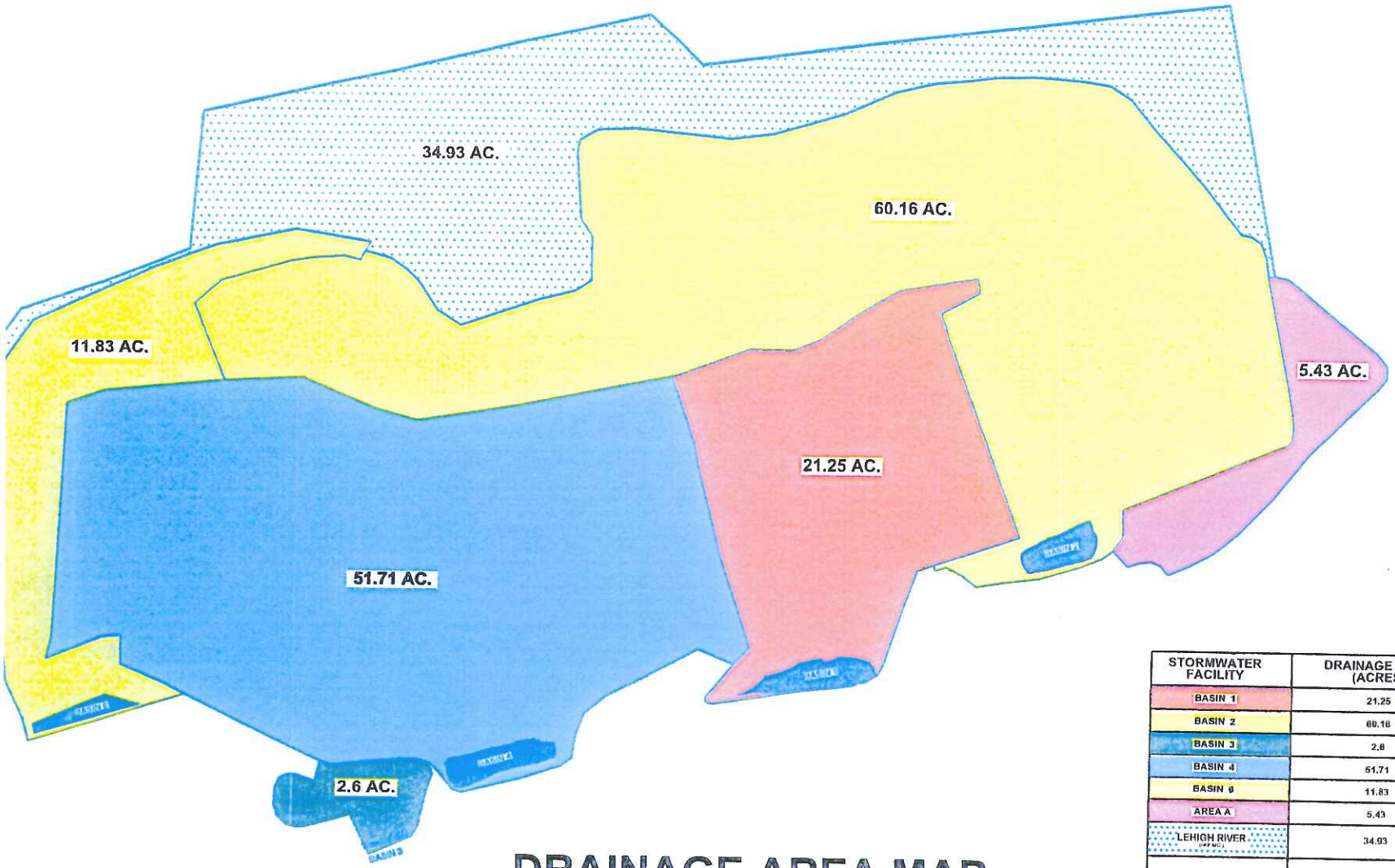


STORMWATER FACILITY	DRAINAGE AREA (ACRES)
BASIN 1	21.50
BASIN 2	57.58
BASIN 3	2.6
BASIN 4	52.34
BASIN 6	11.83
BASIN 7	0.00
LEHIGH RIVER	35.16
TOTAL	181.01

DRAINAGE AREA MAP

APPROVED FINAL GRADE ADJUSTMENT - CAP REMOVAL MINOR MODIFICATION

EXHIBIT 3



STORMWATER FACILITY	DRAINAGE AREA (ACRES)
BASIN 1	21.25
BASIN 2	60.16
BASIN 3	2.6
BASIN 4	51.71
BASIN 6	11.83
AREA A	5.43
LEHIGH RIVER	34.93
TOTAL	187.91

DRAINAGE AREA MAP

PROPOSED SOUTHEASTERN REALIGNMENT - MAJOR MODIFICATION

EXHIBIT 4

Appendix D

Drainage Area Mapping