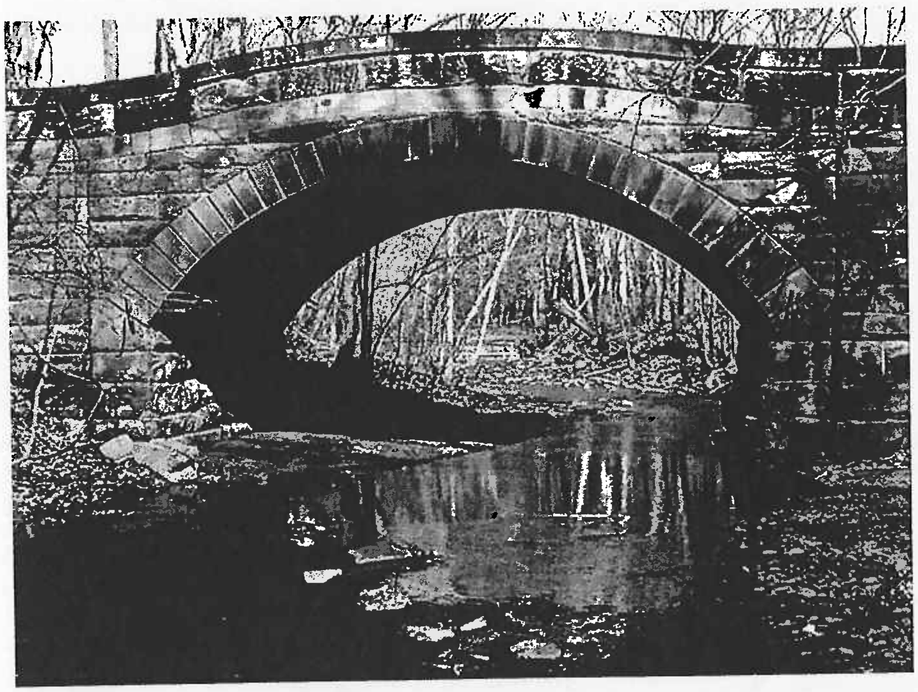
LITTLE SEWICKLEY CREEK WATERSHED ACT 167 STORMWATER MANAGEMENT PLAN



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Allegheny County Department of Planning

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Preface

This Plan has been prepared pursuant to the Pennsylvania Stormwater Management Act (Act of October 4, 1978, P.L. 864, No. 167) and in accordance with adopted guidelines of the Pennsylvania Department of Environmental Protection (PADEP). The preparation of this Plan was financed in part by a grant from PADEP.

Acknowledgements

The Allegheny County Department of Planning and the consultants wish to acknowledge the contributions of the following persons and agencies, whose cooperation and assistance facilitated the preparation and completion of the Little Sewickley Creek Watershed Stormwater Management Plan.

Members of the Watershed Plan Advisory Committee
Allegheny County Department of Elections
Allegheny County Department of Engineering
Allegheny County Department of Special Services and Maintenance Operations
Little Sewickley Creek Watershed Association
PADEP Bureau of Dams and Waterway Management / Southwest District Office
Mr. Edward Schroth and the "Up the Creek Gang" at Quaker Valley High School

VOLUME II

LITTLE SEWICKLEY CREEK WATERSHED STORMWATER MANAGEMENT PLAN

1.0 INTRODUCTION

1.1 Background

This Stormwater Management Plan for the Little Sewickley Creek Watershed has been prepared in accordance with the requirements of the Pennsylvania Stormwater Management Act (Act of October 4, 1978, P.L. 864, No. 167). Commonly referred to as Act 167, the law requires that Pennsylvania counties prepare and adopt stormwater management plans for each designated watershed as identified by the Pennsylvania Department of Environmental Protection (PADEP). The law mandates a comprehensive approach to developing and controlling stormwater runoff to prevent and reduce the occurrence of stream flooding, which threatens public health and safety. This report is the culmination of the efforts to prepare the Plan.

This Stormwater Management Plan includes ordinance provisions designed to implement technical standards. The ordinances can be used as **a guide** for municipalities within the watershed to adopt or amend current stormwater management ordinances. The Plan can assist municipalities in addressing administration and management issues so that Plan adoption, implementation, and updates can be completed in a consistent and efficient manner.

1.2 Plan Summary

The scope of the Little Sewickley Creek Watershed Stormwater Management Plan was developed utilizing the required tasks delineated in Act 167 as a basis. The actual tasks used to guide the Plan preparation are as follows:

* Task 1 - Project Initiation/Administration

  This task involved the administrative work required to initiate contracts and to plan coordination activities with the Allegheny County Management Committee, the Watershed Plan Advisory Committee, and the municipalities.

* Task 2 - Project Coordination/Public Participation

  This task involved creation and convening of the Watershed Plan Advisory Committee (WPAC). The purpose of the WPAC meetings were to review project progress, provide guidance, elicit support, and generate feedback from the WPAC members, the public, and the municipalities.

*   Task 3 - Data Collection/Review/Analysis

This task involved the efforts to gather, review, and analyze the necessary data to complete the technical and institutional planning steps for the Plan. Particular attention was paid to land use changes, existing problem areas, and significant obstructions.

*   Task 4 - Institutional Data Preparation

This task involved the detailed evaluation of the municipal ordinances gathered during Task 3 and prepares a municipal ordinance comparison matrix. The matrix displayed the existing stormwater management provisions contained in the municipal ordinances for all watershed municipalities.

*   Task 5 - Data Preparation for Technical Analysis

This task involved the engineering work necessary to transform the raw data collected as part of Task 3 into a format that could be used directly in the technical tasks.

*   Task 6 - Model Selection and Setup

This task involved selecting and preparing a hydrologic model appropriate for the analysis of the watershed.

*   Task 7 - Model Runs

This task involved running the selected model and developing watershed-level storm runoff characteristics for the 2, 10, 25, and 100-year frequency storms.

*   Task 8 - Develop Technical Standards and Criteria

This task involved performing a detailed evaluation of the modeling results and their impacts on the existing design criteria and standards for runoff control.

*   Task 9 - Institutional Analysis

This task involved reviewing the Municipal Ordinance Matrix and identifying the provisions for each municipality that will be required in order to effectively comply with the standards and criteria recommended in the Plan.

*   Task 10 - Plan Report Preparation

This task involved the preparation of this final report.

* Task 11 - Priorities for Plan Adoption, Implementation, and Updates

This task involved addressing and prioritizing issues for adopting and implementing the Plan and planning for future updates.

Detailed descriptions of how the tasks listed above were addressed for the Plan can be found in Sections 2 through 7 of this report.

A separate Executive Summary Report for the Little Sewickley Creek Watershed Stormwater Management Plan has also been prepared. This reports goes over the main technical points and recommendations of the watershed study. It also highlights the model ordinances and provisions for implementation, reviewing and updating of the plan.

1.3 Public Information and Watershed Plan Advisory Committee Activities

Activities conducted to disseminate information concerning the Little Sewickley Creek Stormwater Management Plan to citizens and municipal officials were primarily associated with the Watershed Plan Advisory Committee (WPAC). The WPAC was formed in accordance with Act 167, with each community and affected agency within the watershed requested to designate at least one representative to the committee. The purpose of the WPAC was to provide a forum for presenting and discussing the project progress, results, and recommendations and obtaining feedback from the committee members and other interested persons. The WPAC and other public information tasks conducted during the project are described in the following paragraphs.

1.4 Watershed Plan Advisory Committee

Section 6 of Act 167 stipulates establishing a WPAC in any watershed for which a Plan is being prepared. For the Little Sewickley Creek Watershed, the following municipalities and agencies were requested to designate at least one representative to serve on the committee:

- Sewickley Heights
- Sewickley Hills
- Leet Township
- Leetsdale
- Edgeworth
- Bell Acres
- Franklin Park
- U.S. Army Corps of Engineers - Pittsburgh District
- Allegheny County Conservation District

Three WPAC meetings were held form July 1991 to November 1992 to discuss the plan and invite public comment. The current report, dated November 2002 updated the previous version of the plan. Because the scope and intent of the plan has not changed form the 1991 plan, additional public meetings involving the WPAC are not warranted. When the draft plan is reviewed and approved by PADEP, the Municipalities within the Little Sewickley Creek Watershed will then review, comment and adopt the plan. Additional WPAC meeting will be held if needed or requested.

2.0 LITTLE SEWICKLEY CREEK WATERSHED DESCRIPTION

General

This section describes the work involved in compiling, reviewing, and analyzing the data necessary to prepare the Plan. The information included technical data such as land use and stream flow and institutional data such as municipal ordinances. A field survey was performed to verify the information contained in this section. The primary purpose of this effort was to evaluate the stormwater management facilities, planning, and administrative measures in place throughout the watershed.

In September 2000, the Allegheny County Department of Economical Development sent out questionnaires to all municipalities and affected agencies in the watershed. The questionnaire was a primary tool in the data collection effort and requested information on both the technical and administrative aspects of stormwater control under each recipient's jurisdiction. A sample copy and summaries of the municipal questionnaires are included in Appendix D.

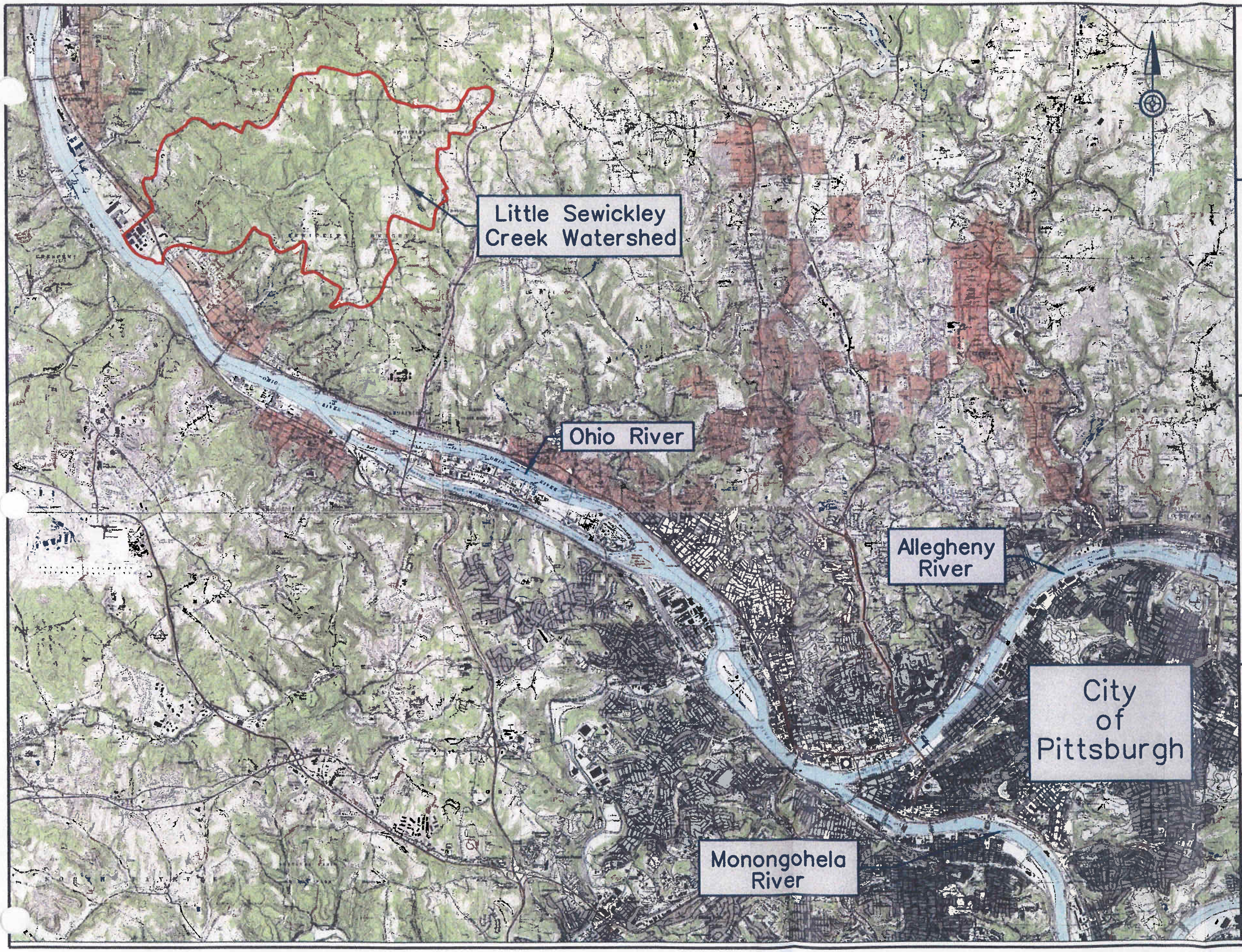
2.1 Location

The Little Sewickley Creek is a tributary to the Ohio River, and is therefore located within the Ohio River Basin. The delineation of the watershed is shown on Figure 2-1. The watershed is located in the western portion of Allegheny County and is approximately 10 square miles in size. The main branch of Little Sewickley Creek is about 6.8 miles long and flows in a west/southwesterly direction. The headwater of Little Sewickley Creek is located in the Borough of Franklin Park. The creek empties into the Ohio River about 13.5 miles downstream from the confluence of the Allegheny and Monongahela Rivers in downtown Pittsburgh.

There are seven municipalities located within the Little Sewickley Creek Watershed. See Figure 2-2. A summary of the land areas associated with each municipality is presented in Table 2-1.

Table 2-1
Summary of Municipal Areas in Little Sewickley Creek Watershed

Borough / Township	Area (Square miles)
Sewickley Heights Borough	4.65
Sewickley Hills Borough	1.00
Sewickley Borough	0.05
Leetsdale Borough	0.33
Franklin Park Borough	0.40
Bell Acres Borough	2.12
Edgeworth Borough	0.65
Leet Township	0.86
Total	**10.06**



Allegheny County
Little Sewickley Creek
Act 167 Plan

Watershed Location Map

Source: USGS Quadrangles, Ambridge, Pa., Emsworth, Pa., Glenshaw, Pa., Pittsburgh East, Pa. Pittsburgh West, Pa. Oakdale, Pa.

8000 0 8000 16000
SCALE IN FEET

FIGURE 2-1

URS
671 Moore Rd.
King of Prussia, Pa 19406
Tel. 610-337-3666
Fax. 610-337-2149

2.2 Land Use

The watershed is comprised largely of residential and open areas, with regions of commercial and industrial activity concentrated mostly near the Ohio River. At the headwaters of Little Sewickley Creek located in Franklin Park and Sewickley Hills, the watershed is mostly wooded area with scattered 1 to 2-acre residential developments. Sewickley Heights and Bell Acres are similar in nature with some recreational areas such as parks and golf courses. At the confluence of the Ohio River, the density of development dramatically increases with a mixture of Commercial, Industrial and 1/2 to 1/3-acre residential developments. This area, which includes Leetsdale Borough, Edgemont Borough and Leet Township, contains most of the impervious cover, by percentage, in the watershed.

Table 2-2 and the Land Use Map, Figure 2-3 present a summary of the current land use of the watershed.

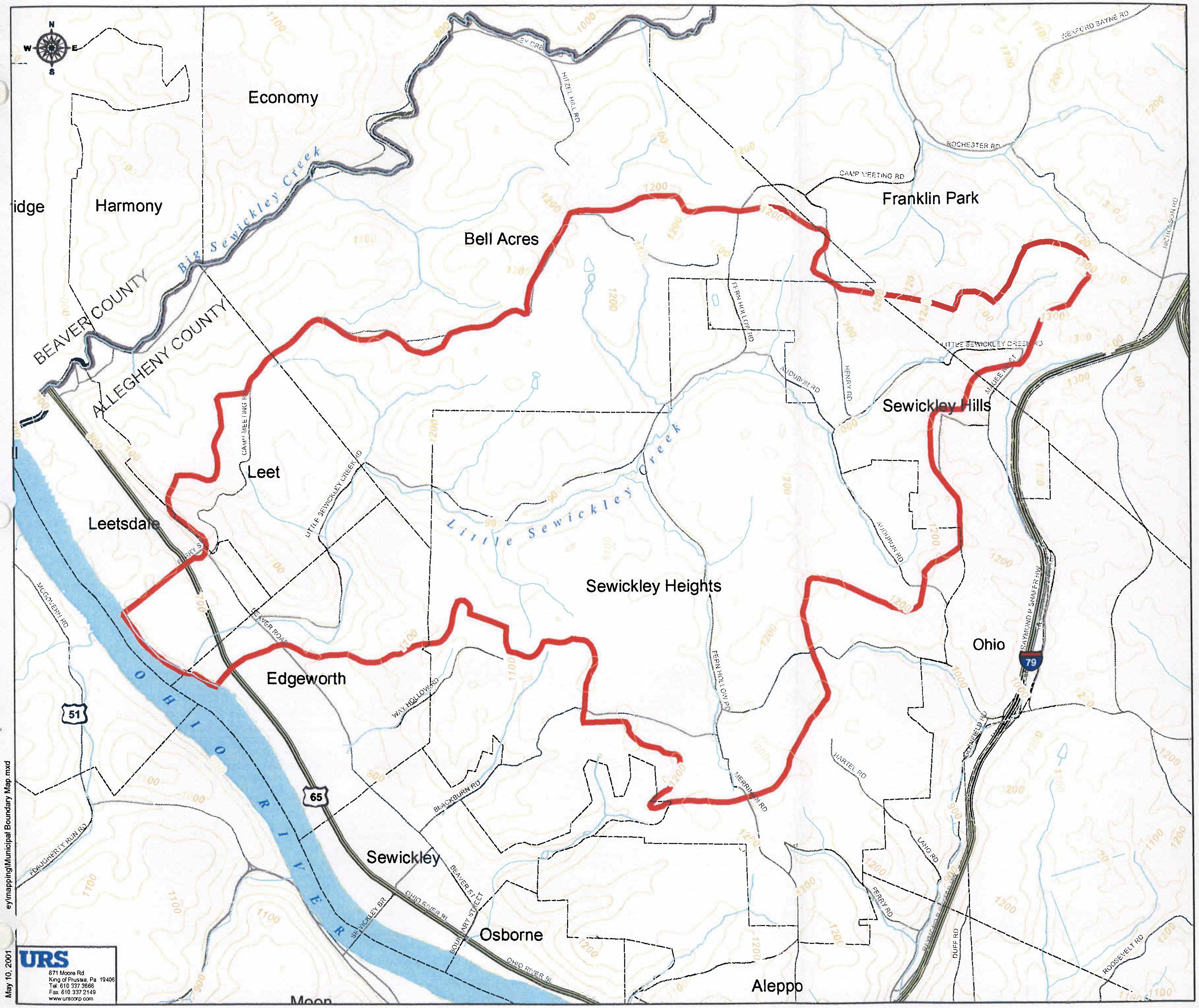
Table 2-2
Summary of Land Use by Area

Type of Land Use	Percent of Watershed	Acres
Woods / Forest	71.4	4602
Open Space/Recreational	5.4	349
Low Density Residential 2-acres	9.0	579
Medium Density Residential 1-acres	8.2	525
High Density Residential 1/2 -1/3-acres	3.3	210
Commercial	0.6	39
Industrial	2.1	138
Total	100.0	6442

2.3 Topography

The topography of the watershed consists of steeply sloped regions divided by the stream valleys of Little Sewickley Creek and its tributaries. The valleys are generally narrow with depths of up to 300 feet. The relative steepness of the watershed is indicated by the overall average slope of almost 14 percent. Consequently, developable land is restricted to the valleys and ridges within the watershed. A slope map, See Figure 2-4, is included and is based on U.S.G.S. maps, the Allegheny County Soil Survey, and GIS information obtained from the Allegheny County Department of Economic Development and the Southwestern Pennsylvania Commission. (Reference 5)

Allegheny County Little Sewickley Act 167 Plan



Legend

- Municipal Boundary
- State Road
- Highway
- 100' Contour Interval
- Streams
- Water
- Little Sewickley Watershed
- County Boundary

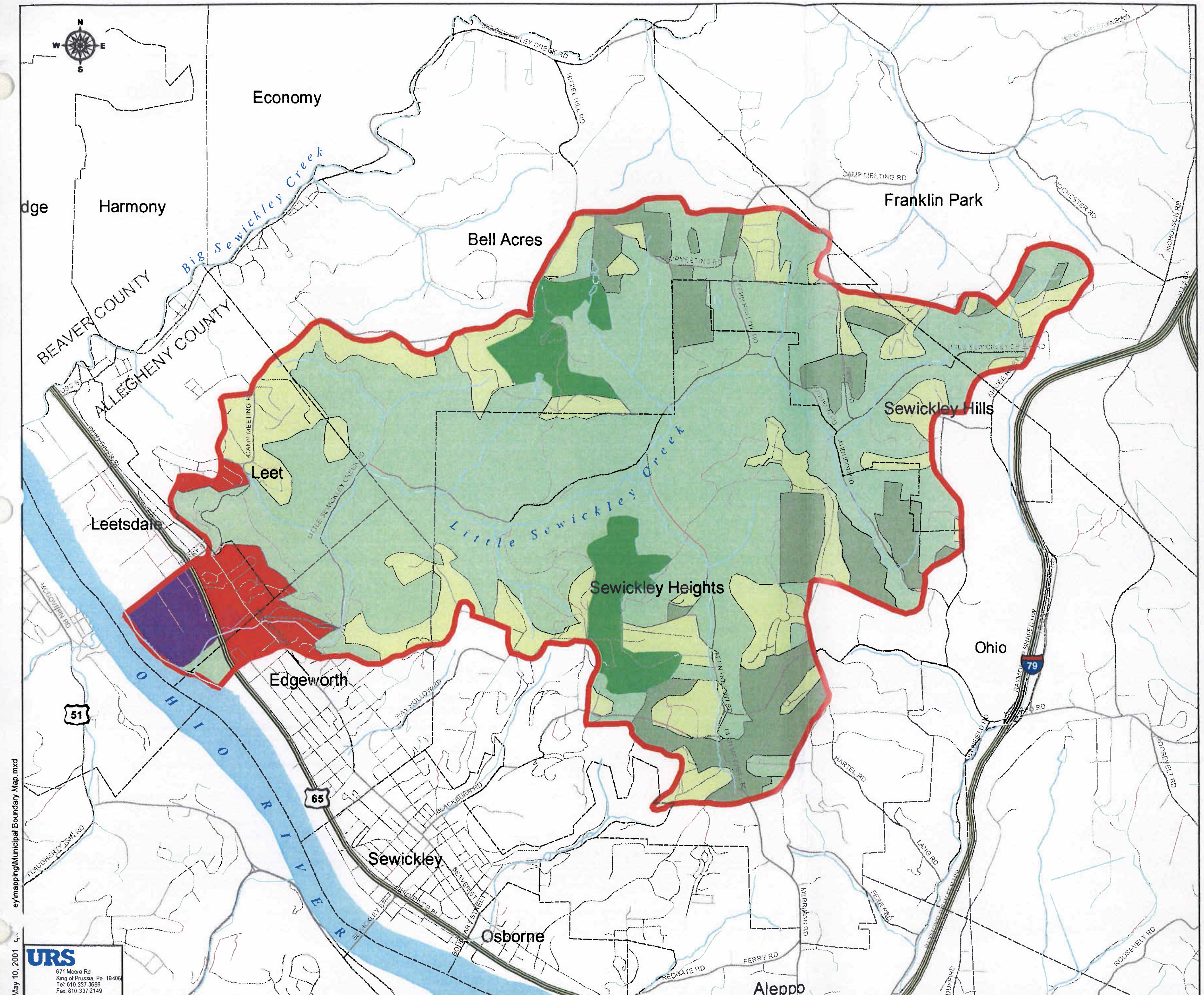
3,000 0 3,000 Feet

1 inch equals 3,000 feet

Municipal Boundaries Map

Figure 2-2

Sources:
County Boundary, Municipal Boundary, Roads, and Streams: PennDOT 2001 GIS Data.
Contours: Derived from USGS 1:24,000 Quadrangles- Ambridge, PA. Emsworth, PA.
Watershed Delineation conducted by URS.



Allegheny County Little Sewickley Act 167 Plan

Legend

- Municipal Boundary
- Local Roads
- State Road
- Highway
- Streams
- Water
- Little Sewickley Watershed

LULC

- Agricultural/Pasture
- Commercial
- Forest
- High Density Residential
- Industrial
- Low Density Residential
- Recreational

3,000 0 3,000 Feet

1 inch equals 3,000 feet

Land Use Map

Figure 2-3

Sources:
County Boundary, Municipal Boundary, Roads, and Streams: PennDOT 2001 GIS Data.
Contours: Derived from USGS 1:24,000 Quadrangles-Ambridge, PA. Emsworth, PA.
Watershed Delineation conducted by URS.

2.4 Soils

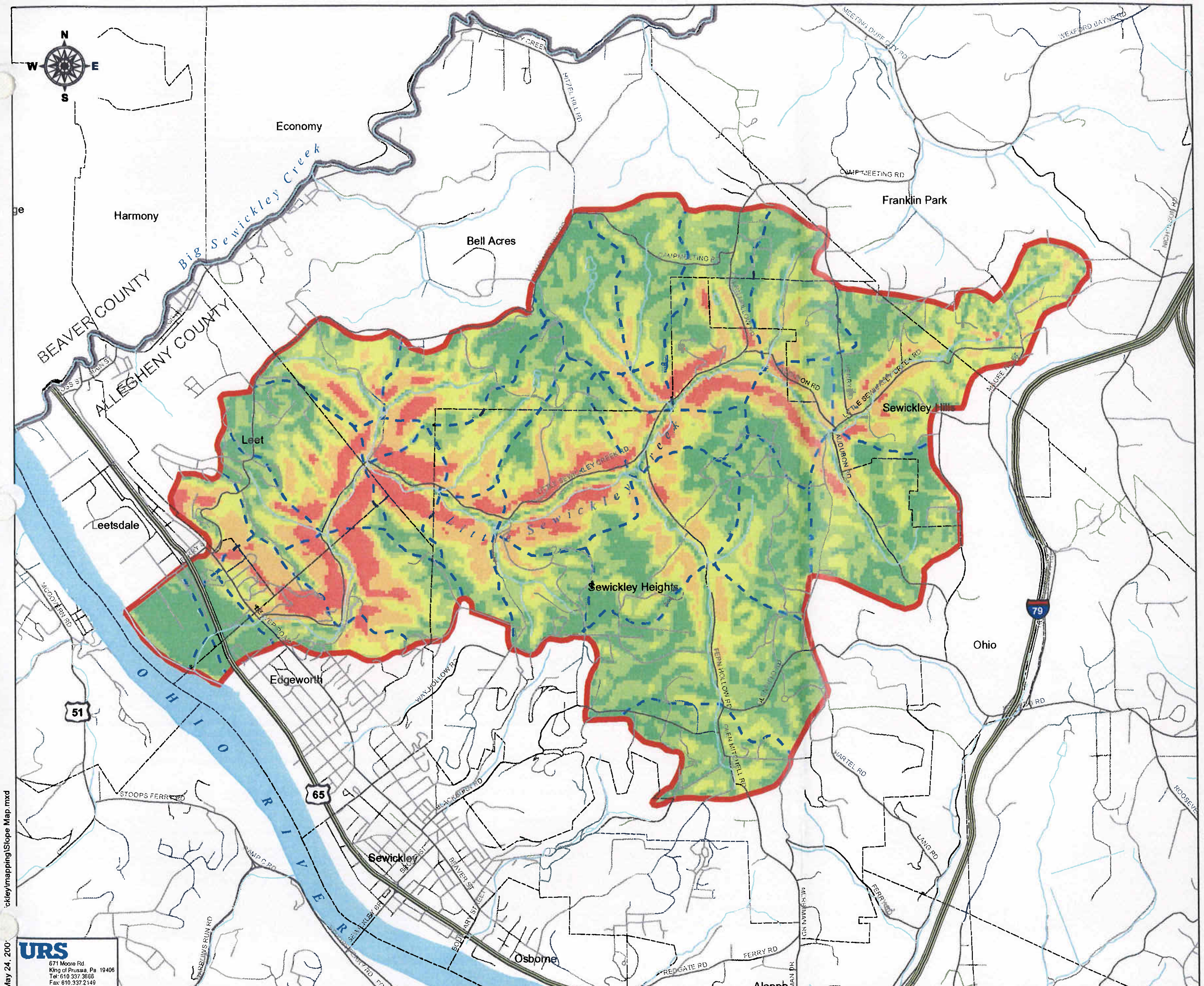
The watershed contains the soils of Gilphin-Upshur-Atkins, Gilpin-Wharton-Upshur, and Urban Land-Philo-Rainsboro. These soils are moderately deep and moderately well drained underlain by red and gray shale on upland areas. The soils in the watershed are mostly silty clay loams with moderate to high runoff potential. The overall average Soil Conservation Service (SCS) hydrologic soil group designation of the watershed is "C". Soils with a C rating have low infiltration rates when thoroughly wetted. They consist mostly of soils with a layer that impedes the downward movement of water and that have a moderately fine to fine texture. They have a low rate of water transmission. These soils, combined with the relatively shallow bedrock that exists in the area, provide conditions that are conducive to rapid runoff, especially during intense storms. Figure 2-5 shows the soil map and classifications according to the Soil Survey of Allegheny County (Reference 5)

2.5 Geology

The majority of the geological makeup of Allegheny County consists of sandstone, shale, clay, limestone and coal. Rock strata within the Little Sewickley Creek Watershed consist mostly of shale and red shale bedrock. They are located mostly along the side of the steep valley that makes up the watershed. Fine-grained sandstone bedrock exists at the top of the hills and normally within the Clymer soils. (Reference 5)

2.6 Climate

The Climate for Southwestern Pennsylvania is a humid continental type, marked by extreme seasonal temperature changes. Annual precipitation is about 38 inches. The rainfall is rather uniform during April through September, averaging about 20 to 23 inches. Flooding problems typically occur during intense thunderstorm events that can happen in the summer months. Mean Annual temperature is about 50 ^{o}F. (Reference 5). Table 2-3 shows the average monthly temperature and precipitation for Southwestern Pennsylvania.



Allegheny County
Little Sewickley
Act 167 Plan

Legend

- Municipal Boundary
- Streams
- Local Roads
- State Road
- Highway
- Sub-Watersheds
- Little Sewickley Watershed
- County Boundary
- Water

Percent Slope

- 0 - 3
- 3 - 8
- 8 - 15
- 15 - 25
- 25+

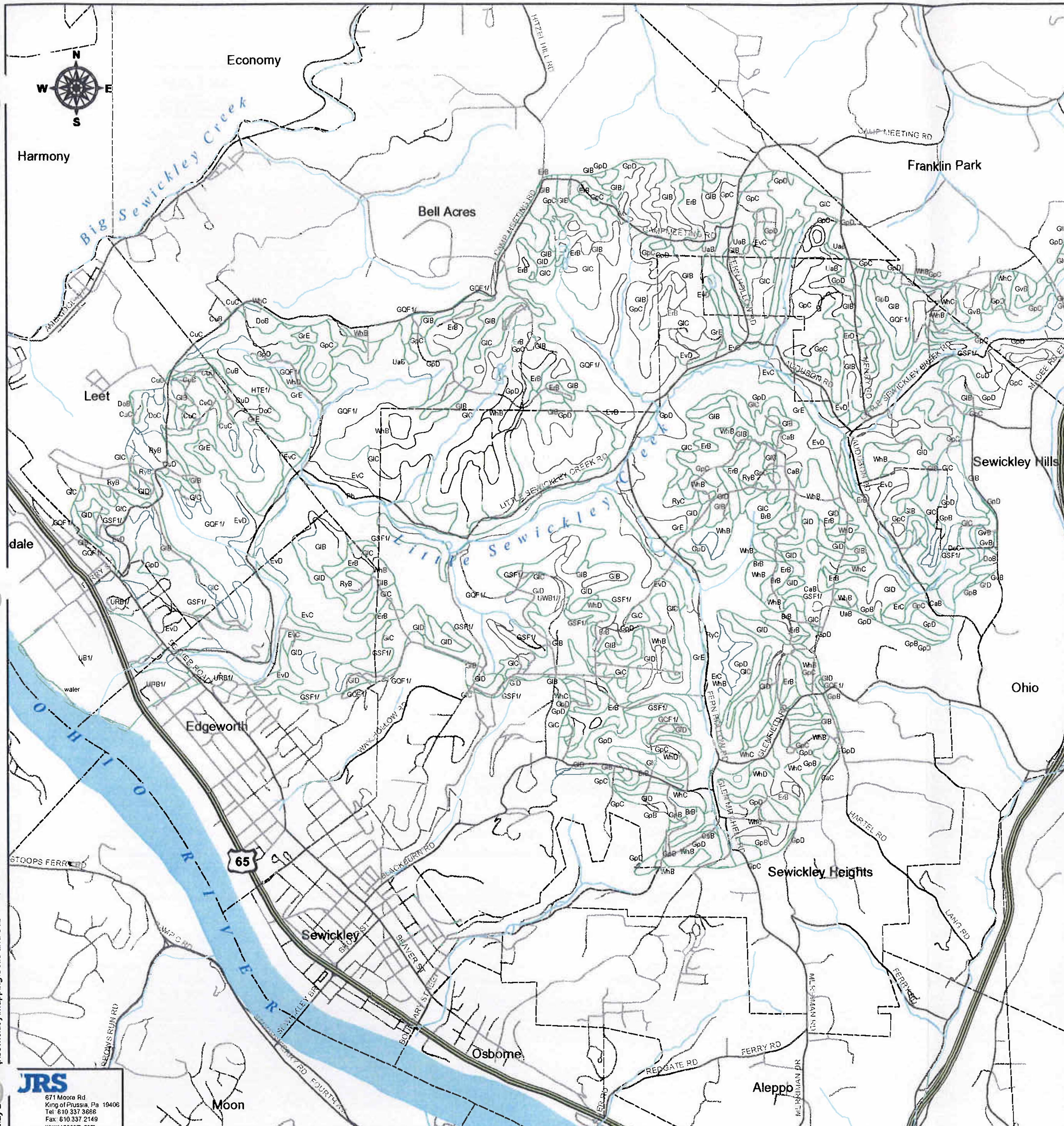
3,000 1,500 0 3,000 Feet

1 inch equals 3,000 feet

Slope Map

Figure 2-4

Sources:
County Boundary, Municipal Boundary, Roads, and Streams: PennDOT 2001 GIS Data.
Slope: Derived from USGS 1:24,000 Quadrangles-Ambridge, PA. Emsworth, PA.
Watershed Delineation conducted by URS.



Soil	Soil Name	Hydrologic Group	Hydric Soil
At	Atkins	D	Yes
BrB	Brinkerto	D	Yes
CaB	Cavode	C	No
CaC	Cavode	C	No
CuB	Culleoka	B	No
CuC	Culleoka	B	No
CuD	Culleoka	B	No
DoB	Dormont	C	No
DoC	Dormont	C	No
ErB	Ernest	C	No
ErC	Ernest	C	No
ErD	Ernest	C	No
EvB	Ernest	C	No
EvC	Ernest	C	No
EvD	Ernest	C	No
GIB	Gilpin	C	No
GIC	Gilpin	C	No
GID	Gilpin	C	No
GpB	Gilpin	C	No
GpC	Gilpin	C	No
GpD	Gilpin	C	No
GQF1/	Gilpin	C	No
GrE	Gilpin	C	No
GSF1/	Gilpin	C	No
GvB	Guernsey	C	No
GvC	Guernsey	C	No
HTE1/	Hazleton	B	No
Ph	Philo	B	No
RaB	Rainsboro	C	No
RyB	Rayne	B	No
RyC	Rayne	B	No
UaB	Upshur	D	No
UB1/	Urban Land	-	Yes
UCB1/	Urban Land	-	Yes
URB1/	Urban Land	-	Yes
UWB1/	Urban Land	-	Yes
WhB	Wharton	C	No
WhC	Wharton	C	No
WhD	Wharton	C	No

Allegheny County
Little Sewickley 167 Plan

Legend
- Municipal Boundary
- Streams
- State Road
- Highway
- Local Roads
- Water
- Soils

3,000 1,500 0 3,000 Feet

1 inch equals 3,000 feet

Soils

Figure 2-5

Sources:
County Boundary, Municipal Boundary, Roads, and Streams: PennDOT 2001 GIS Data.
Soils: Soil Conservation Service Soil Surveys for Allegheny and Beaver Counties.
Watershed Delineation conducted by URS.

Table 2-3
Summary of Climatic Data

Months	Average Monthly Temperature (^{o}F)	Average Monthly Precipitation (in)	Average Monthly Snow (in)
January	26.1	2.54	12.6
February	28.7	2.39	10.1
March	39.4	3.41	7.7
April	49.6	3.15	1.7
May	59.5	3.59	0.2
June	67.9	3.71	--
July	72.1	3.75	--
August	70.5	3.21	--
September	63.9	2.97	--
October	52.4	2.36	0.2
November	42.3	2.85	3.2
December	31.5	2.92	8.1

Source: "National Weather Service – Pittsburgh Historical Snowfall, Temperature Average and Precipitation Totals from 1836 to current"

2.7 Aerial Photography

Aerial photography and geographical information systems (GIS) techniques were used to facilitate the land use and drainage characteristic investigations. Aerial photos of 1:14400 scale were obtained from the Allegheny County Department of Economic Development and the Southwestern Pennsylvania Commission. The photos were taken in April 2000. These photos were combined with digitized soil and topography data and entered into PC/ARCINFO GIS data files by URS Corporation.

2.8 Significant Obstructions

Significant obstructions include bridges, culverts, dams, and sediment and debris accumulation that limit flows within the channels of the Little Sewickley Creek. In May 2002, field investigations were performed throughout the watershed to identify these obstructions. The majority of the obstructions in the Little Sewickley Watershed are bridges, concrete box culverts, and pipe culverts. A map of these obstructions is shown in Figure 2-6. A complete listing of the obstructions with their hydraulic capacities is located in Appendix C. Obstructions that have significant flow reduction due to sediment debris and are in serious conditions of disrepair are noted.

The potential for flooding exists at any obstruction that significantly reduces the cross sectional area of the creek. Because of this potential for flooding, assessing existing and proposed obstructions should be an intricate part of any stormwater planning. A state permitting process exists for the construction and maintenance of culverts, dams, and bridges for Pennsylvania streams.

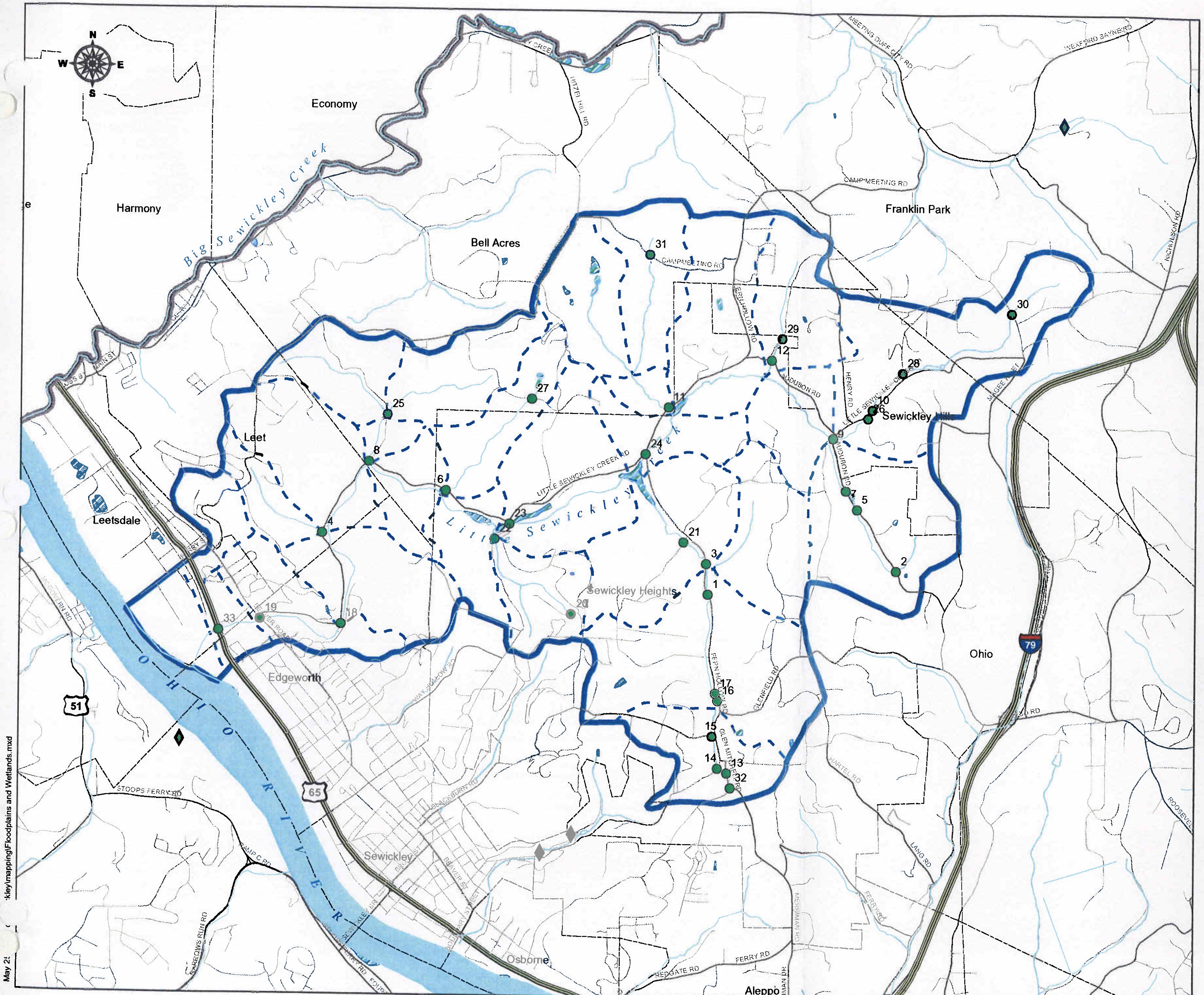
2.9 Floodplain and Wetlands Data

The Federal Emergency Management Agency (FEMA) Flood Insurance Study maps are the official source of the 100-year floodplain locations for the watershed. Flood Insurance Studies for the watershed municipalities were prepared in the 1970's. The Flood Plain Maps for the Little Sewickley Creek Watershed area have been updated in October 1995.

Wetland areas were located through the U.S. Fish and Wildlife, National Wetland Inventory Quadrangles. Both the Wetland and 100-year flood plain boundaries are shown in Figure 2-7

2.10 Existing Problem Areas

As part of the September 2000 questionnaire (see section 2.0), the municipalities were asked to identify any existing stormwater problems. Three of the seven municipalities indicated no stormwater problems exist. The remaining four indicated that all problems were minor and were in the nature of gutter capacity, local storm sewer clogging, and piled snow plowed melting. Copies of the municipal questionnaires are included in Appendix D, with summaries shown in Table 2-3 below.



Allegheny County Little Sewickley Act 167 Plan

Legend

- Dams
- Stream Crossing
- Municipal Boundary
- Streams
- Local Roads
- State Road
- Highway
- County Boundary
- Sub-Watersheds
- Water
- Little Sewickley Watershed

3,000 1,500 0 3,000 Feet

1 inch equals 3,000 feet

Significant Obstructions Map

Figure 2-6

Sources:
County Boundary, Municipal Boundary, Roads, and Streams: PennDOT 2001 GIS Data.
Floodplain: FEMA.
Watershed Delineation conducted by URS.
Wetlands: NRCS NWI Quadrangles - Ambridge, PA. Emsworth, PA.

May 2… …ckley\mapping\Floodplains and Wetlands.mxd

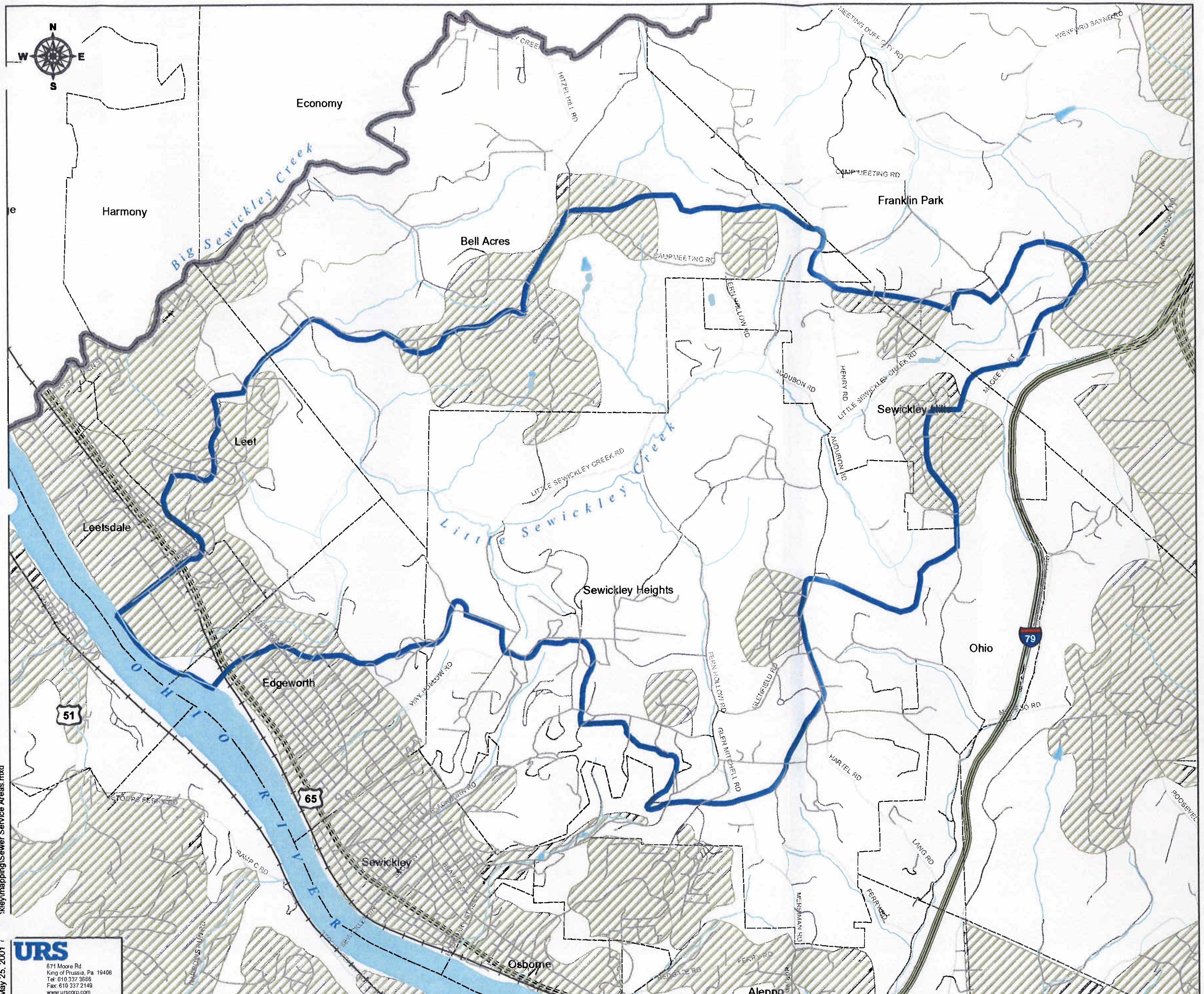
Table 2-3
Summary of Problem Areas in Little Sewickley Creek Watershed

Borough / Township	Response to Questionnaire
Sewickley Heights Borough	No Reported Problems
Sewickley Hills Borough	No Reported Problems
Sewickley Borough	One Area Only
Leetsdale Borough	Clogged Storm Sewers
Franklin Park Borough	No Reported Problems
Bell Acres Borough	No Reported Problems
Edgeworth Borough	No Reported Problems
Leet Township	Minor Problems, snow melt gutter capacity

2.11 Existing and Proposed Collection Systems

Local storm drainage collection systems are constructed primarily as part of new development and to correct flooding problem areas. The Little Sewickley Creek Watershed consists mostly of wooded and open space area (75%). The remaining areas are low to high-density residential areas and commercial and industrial developments along the Ohio River. The majority of the storm sewers area exists within these developed areas. Existing Stormwater Collection System are shown in Figure 2-8. These systems are designed to the requirements of the agency or municipality with jurisdiction over the system location. Where relevant, these existing systems were considered in the model.

A summary of the Municipal Storm Sewer and Stormwater management ordinance is located in Section 5 Table 5-1



Allegheny County Little Sewickley Act 167 Plan

Legend

- Local Roads
- State Roads
- Highway
- Railroad
- Rivers
- Municipal Boundary
- Little Sewickley Watershed
- County Boundary
- Sewer District

3,000 1,500 0 3,000 Feet

1 inch equals 3,000 feet

Sanitary/Storm Sewer Service Areas

Figure 2-8

Sources:

County Boundary, Municipal Boundary, Roads, and Streams: PennDOT 2001 GIS Data.
Sewer District: SPC.
Watershed Delineation conducted by URS.

The primary results of the watershed characteristics review are as follows:

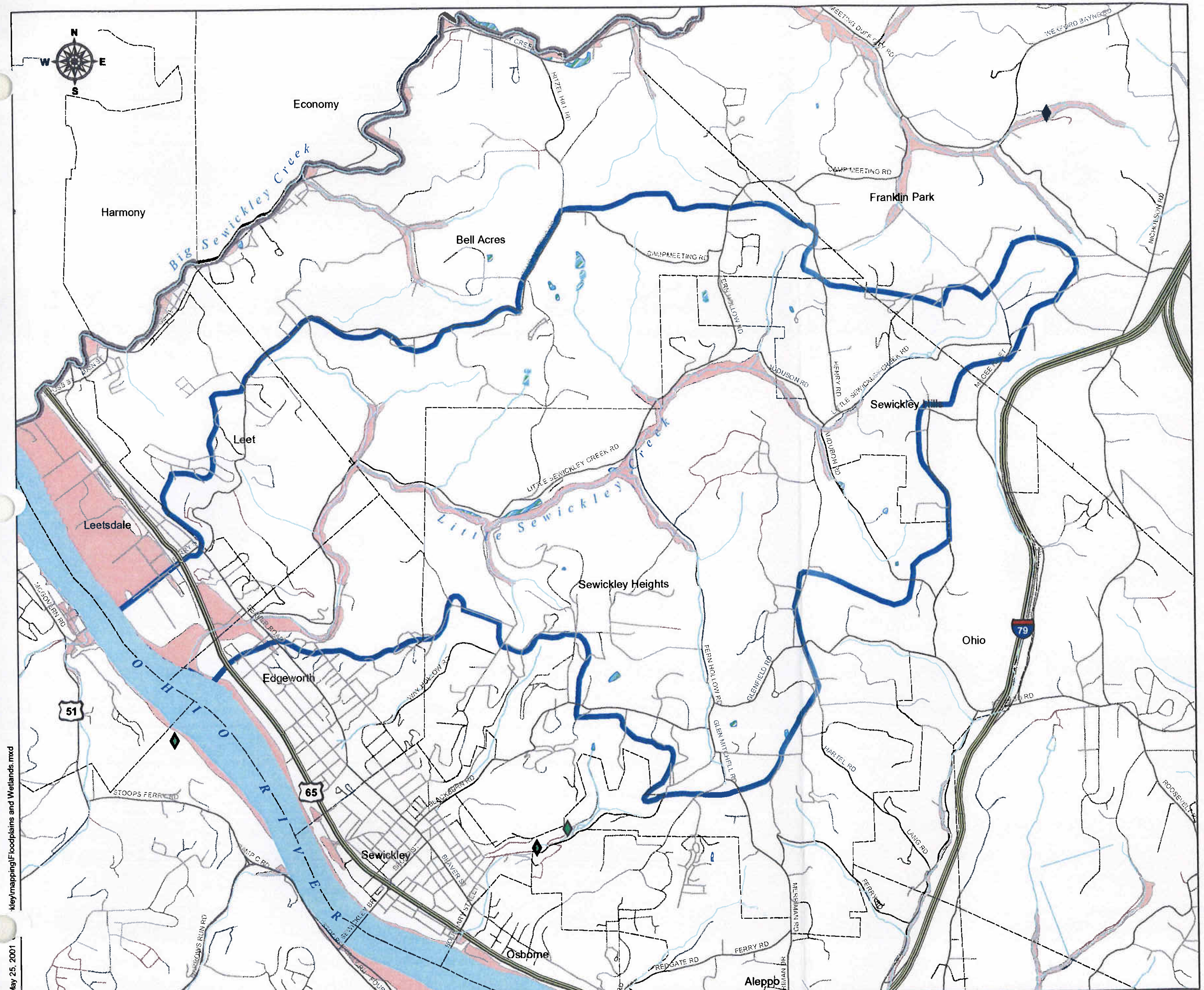
a. Assessment of existing land use was determined as well as potential of future development.

b. Based upon the modeling input data, the overall impervious area of the watershed is approximately 6 percent.

c. Capacity of existing watercourse channels were determined.

d. The watershed was divided into 40 subareas to define the watershed for modeling purposes. Some of the subareas are "dummy", or junction, subareas required for the watershed model input. These subareas do not contain any actual land area; they are strictly a function of the model. A more detailed description of the modeling aspects of the watershed data can be found in Sections 3.

e. It is estimated that some development will take place in the watershed. The majority of the development will likely occur in the middle regions of the watershed. A large percentage of the developable area in the watershed has already been developed. Because of the steep slope and valley of the watershed, an significant amount of the watershed is considered un-developable and will remain preserved in its natural state. Although there are areas available for development, much of the new development may involve a transition from one developed state to another (i.e. expansion of existing buildings, new buildings on former parking lots, etc.).



Allegheny County
Little Sewickley
Act 167 Plan

Legend

- Dams
- Municipal Boundary
- Streams
- Local Roads
- State Road
- Highway
- Little Sewickley Watershed
- Floodplain
- Water
- County Boundary
- Wetlands

3,000 1,500 0 3,000 Feet

1 inch equals 3,000 feet

Floodplains & Wetlands Map

Figure 2-7

Sources:
County Boundary, Municipal Boundary, Roads, and Streams: PennDOT 2001 GIS Data.
Floodplain: FEMA.
Watershed Delineation conducted by URS.
Wetlands: NRCS NWI Quadrangles - Ambridge, PA. Emsworth, PA.

3.0 WATERSHED MODELING

3.1 General

The purpose of hydrologic modeling is to predict the amount of flows and volume of waters from particular rainfall events within a specified watershed. The results of this modeling process are used to analyze the existing storm runoff and determine the possible impacts that future development within the watershed may have. The process involves obtaining available data concerning the land use, soils, topography, and physical facilities existing in the watershed and making the most appropriate assumptions of how these parameters will affect the runoff patterns. Data for this process was obtaining through many sources as explained in Section 2.0

The purpose of the watershed modeling tasks for the Little Sewickley Creek Watershed Stormwater Management Plan was to select and prepare a hydrologic computer model to estimate the quantity and timing of runoff generated by various rainfall events. The resulting model would then be used to:

- Estimate the runoff rates and stream flows for the required design storms;
- Calculate release rate percentages for each subarea;
- Identify areas of potential surcharge or flooding; and
- Determine performance standards for stormwater control for the watershed.

3.2 Model Selection

The Penn State Runoff Method (PSRM) was selected as the model for use in the Little Sewickley Creek Watershed. There are several reasons for this, including:

- It is capable of estimating the effect of runoff from upstream subareas on downstream points of interest, facilitating the development of subarea technical performance standards.

- It is easy to work with. Data entry and results are straightforward. It is similar to the Soil Conservation Service (SCS) methods, which are commonly used in the engineering profession for stormwater management design.

- PSRM has been used in Act 167 stormwater management plans in Allegheny County including Flaughtery Run and Turtle Creek. The Allegheny County Department of Planning and most municipal engineering staffs are familiar with its concepts.

The 1992 version of PSRM was used for the Little Sewickley Creek model.

The following sections describe the watershed modeling efforts performed for the Little Sewickley Creek Watershed.

3.3 Subarea Delineation

Stormwater drainage subareas are areas within a watershed that are tributary to a particular point of interest or portion of a stream. The Little Sewickley Creek Watershed was divided into 40 subareas for modeling purposes. The subareas are shown on Figure 3-1. Dividing a watershed into subareas allows for:

- o better definition of the watershed characteristics;
- o selection of locations where the model will provide flow figures; and
- o delineation of areas for the application of performance standards.

The 1992 version of PSRM, utilized for this project, requires the formation of "dummy", or junction, subareas at any confluence of two or more streams. Thus, subareas 3, 6, 10, 12, 17, 19, 22, 25, 29, 31, 34, and 39 were added to the model. These subareas, although assigned an area of 0.1 acre in the model, do not actually incorporate any land area and are not "developable". No release rate percentages or other performance standards are applicable to these subareas. The inclusion of these "dummy" subareas in the model did not affect the modeled results for the actual subareas.

3.4 PSRM Input Data Development

The PSRM software program requires parameters or data that describe the hydrologic characteristics of the watershed as well as hydraulic characters of the stream or watercourse. Hydrologic information includes rainfall parameters, drainage areas, land use, soils, and slopes. Hydraulic data includes channel capacities, obstruction capacities, and flood plain information where required.

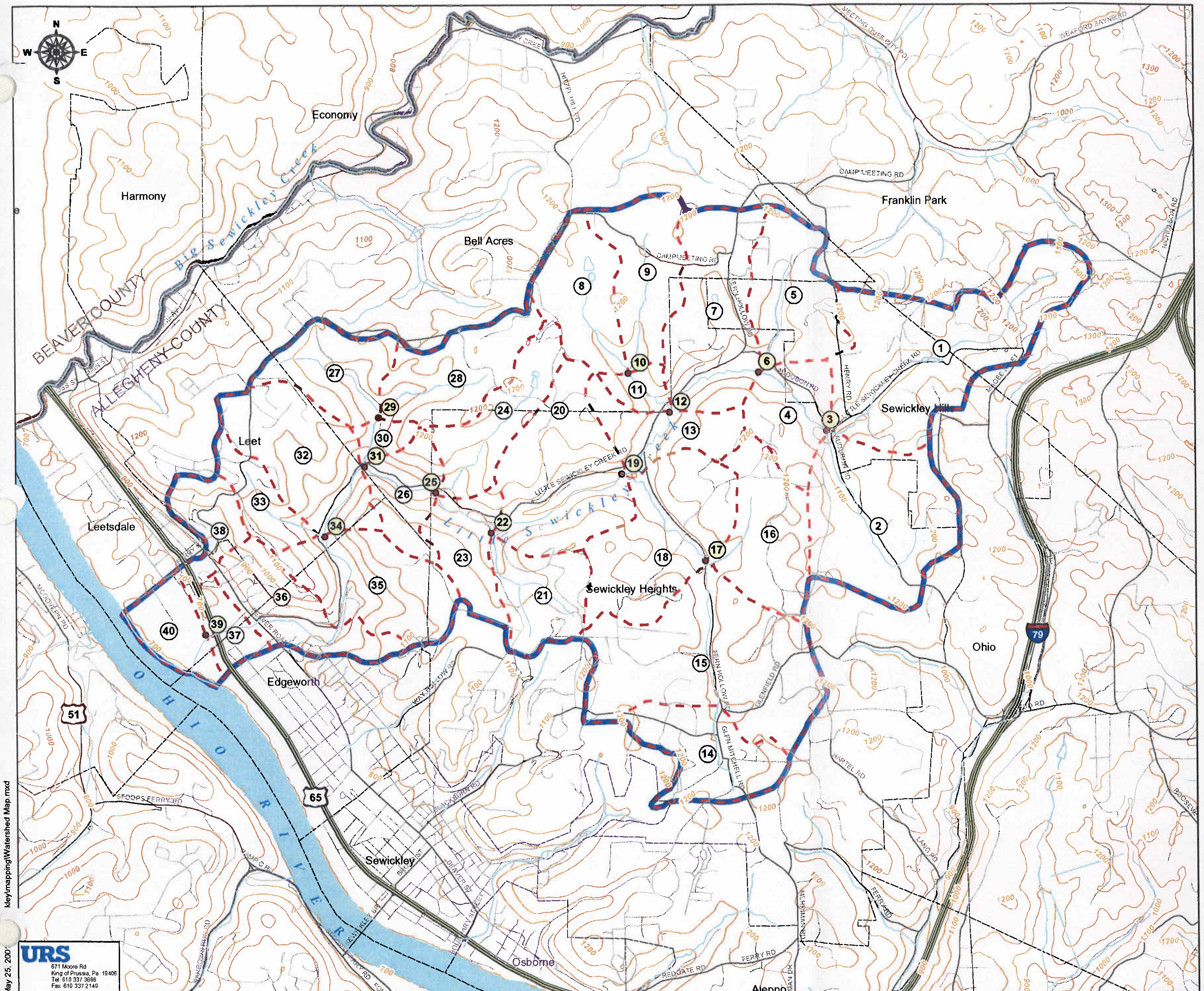
The PSRM model input data was developed using the techniques and sources described in Section 2. The data required for model input is shown in Table 3-1:

Table 3-1
Input Data for PSRM version 1992

o	Area	subarea area in acres
o	Length	representative overland flow length, in feet, which is the average length a particle of water has to travel to reach the stream
o	Slope	representative overland flow slope, in feet per foot, of the overland flow length
o	Manning's "n" Factors	indication of relative roughness of overland flow surface, both impervious and pervious; larger numbers mean a rougher surface and, therefore, slower overland flow

o	Impervious Fract.	the fraction or percentage of the subarea area that is impervious
o	SCS Curve Numbers	curve numbers (CN) indicate the relative imperviousness, or runoff potential, of an area; higher numbers mean greater runoff; the CN is also used within the infiltration and storage calculations of the model
o	IA	"initial abstraction", in inches, is that volume of rainfall occurring at the beginning of the storm that will be intercepted, infiltrated, or stored and will not appear as runoff
o	Coordinates	the relative "x" and "y" coordinates of the centroid of each subarea, based upon a grid system used for only this project; the coordinates indicate the subareas' relative positions within the watershed to the model
o	Depression Storage	the amount of rain, expressed in inches, that collects in natural depressions on the ground surface; values are input for both pervious and impervious conditions
o	Drainage Elements	PSRM terms the streams, pipes, or whatever stormwater conveyance facilities exist in the watershed as drainage elements; the numbered drainage elements in the model input represent the conveyance system just downstream of the corresponding numbered subarea, i.e., Drainage Element No. 1 flows from Subarea 1 and actually flows through Subarea 2. The capacities and full-flow travel times of each drainage element are input so that the model can route flows through the drainage system.
o	CTS	The ratio of overbank to channel flow travel times through the length of the drainage element; the model uses this factor to increase the flow travel times whenever the drainage element capacity is exceeded and surcharge conditions exist

Allegheny County Little Sewickley Act 167 Plan



Legend

- 100' Contour Interval
- Streams
- Municipal Boundary
- State Road
- Highway
- Local Roads
- Stream Junction
- Sub-Watersheds
- Little Sewickley Watershed
- County Boundary
- Water

3,000 1,500 0 3,000 Feet

1 inch equals 3,000 feet

Sub-Watershed Map

Figure 3-1

Sources:
County Boundary, Municipal Boundary, Roads, and Streams: PennDOT 2001 GIS Data.
Contours: Derived from USGS 1:24,000 Quadrangles- Ambridge, PA. Emsworth, PA.
Watershed Delineation conducted by URS.

3.5 Model Methodologies

The Little Sewickley Creek Watershed was modeled, using the PSRM software program, to create two hydrologic models. Flows were calculated for each subarea within the watershed. Subareas flows were applied to the next downstream subarea and resulted in a total flow to the subarea. An "Existing Conditions" model was used to determine the current hydrologic condition of the watershed. In addition, a "Future Conditions" model was used to predict the runoff effect of potential development within the watershed.

Existing Conditions

In order to create a technical baseline for which the watershed stormwater plan can be developed, the existing conditions were modeled. Flows to each sub basin were computed and used to evaluate individual stormwater management policies. Existing conditions parameters, soils, obstructions, channel capacities, etc., were obtained through the various agencies as detailed in Section 2.0. Some of the parameters were verified by site investigations. Existing storm sewer facilities were incorporated where appropriate. Results of existing peak flows for all storms (2, 10, 25, and 100-year) are shown in Table 3-2a. There are two sets of Data for each storm event. The first number shows the total flow contribution to the overall watershed. The second number shows the accumulated flow in the stream banks of the Little Sewickley Creek and its tributary. The last flow number in the subarea 40 shows the total Peak Flow of the watershed for that particular storm event. As noted all junctions points (i.e., Subareas 3, 6, 10, 12, …) contribute no flow to the watershed.

Table 3-2a
Peak Flow Existing Conditions

OUTFLOW SUMMARY TABLE								
	2 year		10 year		25 year		100 year	
Subarea No.	Basin cfs	Total cfs	Basin cfs	Total cfs	Basin cfs	Total cfs	Basin cfs	Total cfs
1	129	129	317	317	447	447	602	602
2	62	62	169	169	248	248	343	343
3	0	178	0	398	0	575	0	779
4	25	196	69	447	101	641	140	866
5	33	33	97	97	144	144	202	202
6	0	199	0	524	0	737	0	984
7	39	224	105	602	153	850	212	1135
8	61	61	161	161	230	230	310	310
9	43	43	127	127	188	188	260	260
10	0	91	0	257	0	372	0	506
11	20	106	56	291	80	415	107	559
12	0	291	0	747	0	1055	0	1397
13	26	306	72	785	106	1108	146	1466
14	41	41	103	103	147	147	199	199
15	99	122	245	301	349	429	474	573
16	32	32	94	94	139	139	195	195
17	0	150	0	388	0	558	0	731
18	58	194	137	495	192	709	258	933
19	0	460	0	1182	0	1673	0	2243
20	51	490	132	1271	190	1801	260	2414
21	27	27	69	69	99	99	136	136
22	0	497	0	1313	0	1854	0	2474
23	33	510	84	1349	119	1902	162	2535
24	42	42	117	117	171	171	235	235
25	0	529	0	1384	0	1954	0	2597
26	13	536	37	1409	55	1989	77	2644
27	51	51	119	119	165	165	219	219
28	89	89	194	194	265	265	346	346
29	0	121	0	292	0	405	0	537
30	7	127	22	308	33	429	46	568
31	0	582	0	1527	0	2137	0	2820
32	79	607	170	1587	230	2221	301	2927
33	49	49	110	110	150	150	196	196
34	0	604	0	1577	0	2221	0	2933
35	80	629	193	1629	271	2287	362	3016
36	133	640	267	1661	351	2299	446	3036
37	52	640	92	1666	114	2312	138	3024
38	51	51	97	97	125	125	156	156
39	0	644	0	1657	0	2323	0	3056
40	30	652	55	1665	68	2332	82	3065

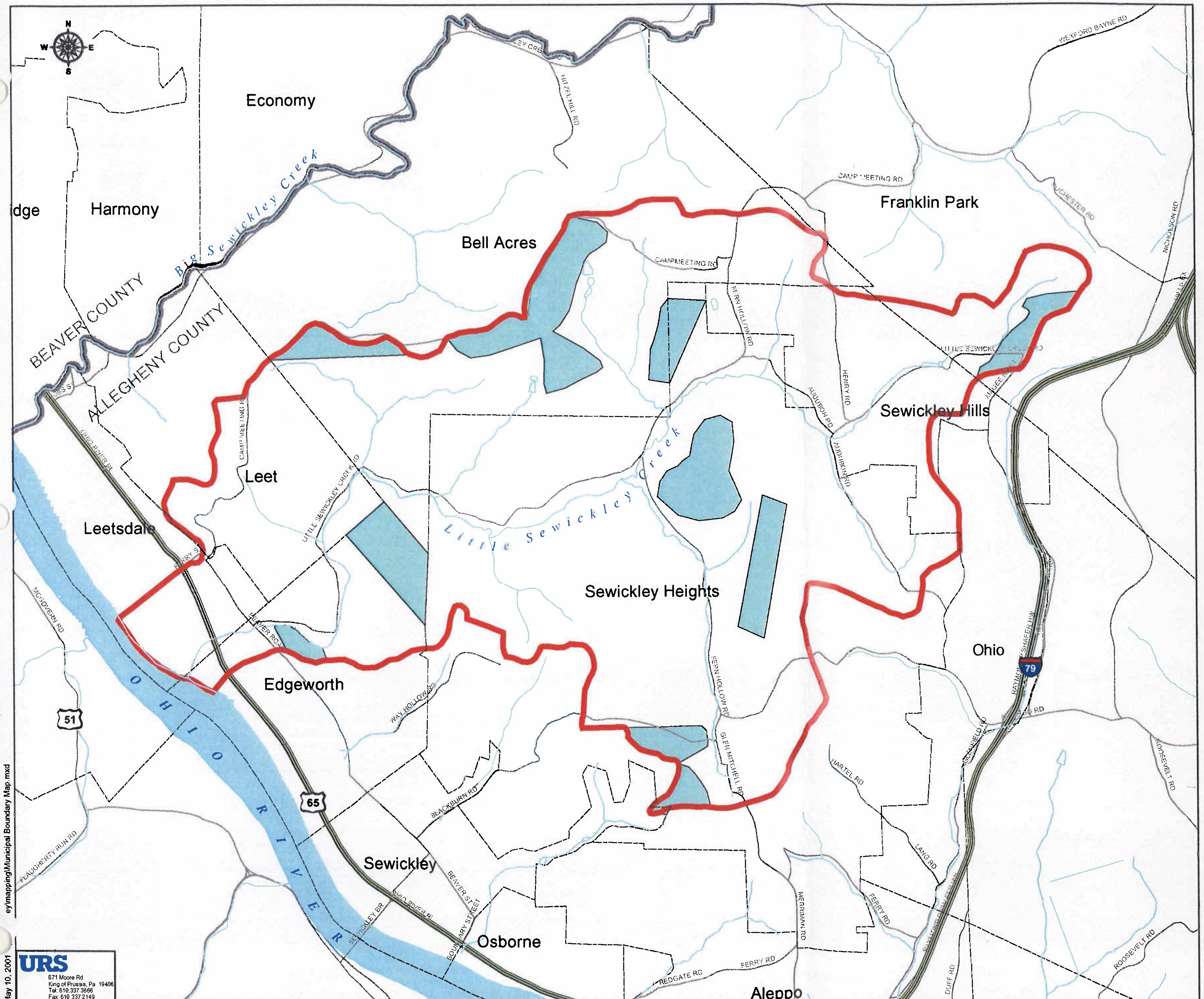
Future Conditions

In order to analyze the impact of future development within the Little Sewickley Creek Watershed, the input parameters for the model are projected to simulate future growth. Future development within the watershed was estimated by using information from county and municipal sources. The information includes data from questionnaires, zoning ordinances, water and sewerage projections, planning documents, and population projections from the United States Census Bureau and the Pennsylvania State Data Center, Penn State, Harrisburg. (Reference 8 and 9) The project growth areas are shown in Figure 3-2. These growth areas were projected based on county and municipal estimates, as well as growth limitations based on physical characteristic of the watershed. As noted in Section 2.3 topography, the step slopes and valleys of the watershed will restrict normal development.

The model developed for the future conditions is not a worst-case scenario. It is based on a reasonably expected development condition. The results of the future condition model were compared to the existing condition to help estimate the impacts of increase runoff from new development. Results of existing peak flows for all storms (2, 10, 25, and 100-year) are shown in Table 3-2b.

Table 3-2b
Peak Flow Future Conditions

OUTFLOW SUMMARY TABLE								
	2 year		10 year		25 year		100 year	
Subarea No.	Basin cfs	Total cfs	Basin cfs	Total cfs	Basin cfs	Total cfs	Basin cfs	Total cfs
1	163	163	367	367	505	505	666	666
2	62	62	169	169	248	248	343	343
3	0	211	0	432	0	608	0	816
4	25	228	69	482	101	675	140	903
5	33	33	97	97	144	144	202	202
6	0	224	0	556	0	775	0	1027
7	51	252	123	636	175	889	237	1179
8	94	94	206	206	280	280	365	365
9	47	47	133	133	195	195	268	268
10	0	116	0	292	0	411	0	548
11	20	130	56	326	80	454	107	601
12	0	319	0	779	0	1091	0	1437
13	32	335	81	818	116	1144	157	1505
14	75	75	154	154	206	206	265	265
15	99	145	245	337	349	461	474	614
16	51	51	122	122	172	172	232	232
17	0	187	0	445	0	612	0	791
18	82	243	176	569	237	780	309	1012
19	0	520	0	1266	0	1770	0	2348
20	58	556	142	1357	202	1900	273	2520
21	27	27	69	69	99	99	136	136
22	0	571	0	1399	0	1953	0	2584
23	33	585	84	1435	119	2002	162	2645
24	58	58	140	140	197	197	263	263
25	0	593	0	1468	0	2033	0	2683
26	22	602	52	1493	72	2069	97	2730
27	51	51	119	119	165	165	219	219
28	130	130	255	255	334	334	422	422
29	0	157	0	345	0	466	0	604
30	7	163	22	361	33	489	46	634
31	0	659	0	1614	0	2234	0	2926
32	79	684	170	1675	230	2319	301	3034
33	49	49	110	110	150	150	196	196
34	0	686	0	1668	0	2305	0	3025
35	98	712	219	1726	300	2372	394	3108
36	152	717	294	1754	381	2399	478	3123
37	52	725	92	1754	114	2411	138	3131
38	51	51	97	97	125	125	156	156
39	0	725	0	1749	0	2409	0	3151
40	30	734	55	1757	68	2419	82	3160



Allegheny County Little Sewickley Act 167 Plan

Legend

- Municipal Boundary
- State Road
- Highway
- Streams
- Water
- Little Sewickley Watershed
- County Boundary
- Area of Potential Growth 2001-2011

3,000 0 3,000 Feet

1 inch equals 3,000 feet

Future Condition Potential Growth Location

Figure 3-2

Sources:
County Boundary, Municipal Boundary, Roads, and Streams: PennDOT 2001 GIS Data.
Contours: Derived from USGS 1:24,000 Quadrangles-Ambridge, PA. Emsworth, PA.
Watershed Delineation conducted by URS.

3.6 Design Storm Selection

Rainfall data used in the Plan were established by the Natural Resources Conservation Service (formerly the Soil Conservation Service). The SCS method is commonly used throughout the engineering professional to estimate peak flow and for analysis of stormwater analysis and design. The Little Sewickley Creek Watershed Study will utilize the SCS Type II, 24-hour storm for storm water volumes. The United States Department of Agriculture Technical Release 5 (TR-55) "Urban Hydrology for Small Watersheds" publishes Synthetic Rainfall Distribution and Rainfall Maps for the Continental USA (Reference 10). Interpolating these maps determines the 24 hour rainfall intensity for the Little Sewickley Watershed.

The plan will evaluate four design storms – the 2-year storm, 10-year storm, 25-year storm, and 100-year storm. These storms represent a wide range of stormwater parameters from a 2-year storm, which typical represents a flowing full channel or stream, to the 100-year flow, which is typically used in flood plain management. The design storm rainfall intensity for each event is listed in Table 3-3 below.

Table 3-3
Design Storm /Rainfall Data

Storm event	24-Hr Rainfall Intensity (Inches)
2-Year	2.6
10-Year	3.8
25-Year	4.4
100-Year	5.0

3.7 Model Calibration and Validation.

In order to verify the peak flows calculated by the PSRM model, additional hydrologic data is needed. A search of the USGS web site indicates that there are no gauging stations located within the Little Sewickley Watershed. One nearby gauge is located in Sewickley Borough, but measures the flow in the Ohio River.

With no USGS gauges nearby, additional hydrologic methodologies were computed for the watershed and compared with the peak flows. Flows for the watershed were generated by the PSU-IV Hydrologic Model. PSU-IV is a regional model that is based on the Log Pearson III equation. Additionally, comparison of the PRSM peak flow can be made to stream gauges from nearby watershed with similar characteristics. Peak Flows from the nearby Turtle Creek Watershed were determined from the USGS publication "Techniques for Estimating Magnitude and Frequency of Peak Flows for Pennsylvania Streams". (Reference 12) The peak flows were divided by the total drainage area for a flow/acres unit. This number was compared to the Little Sewickley Creek Watershed's

PSRM peak flow/area. Although there were some differences between the comparison flows, the differences were acceptable, considering the different type of hydrologic methodologies and the PSRM Peak Flow were validated. Results of these comparisons are shown in Appendix E.

4.0 TECHNICAL STANDARDS AND CRITERIA

The purpose of this task was to evaluate technical standards and criteria for the control of increased runoff in the Little Sewickley Creek Watershed. This involved a detailed evaluation of the modeling results, problem area analyses, and developing technical data to be made part of the recommended ordinance.

The following paragraphs summarize the findings and conclusions of the standards and criteria review. In order to properly implement the provisions of the Little Sewickley Creek Watershed Stormwater Management Plan, the watershed communities must adopt these Standards and Criteria as minimum requirements for the proper control of stormwater runoff. The appropriate ordinances in each community must include the following criteria either directly or through reference.

4.1 Stormwater Management Philosophy

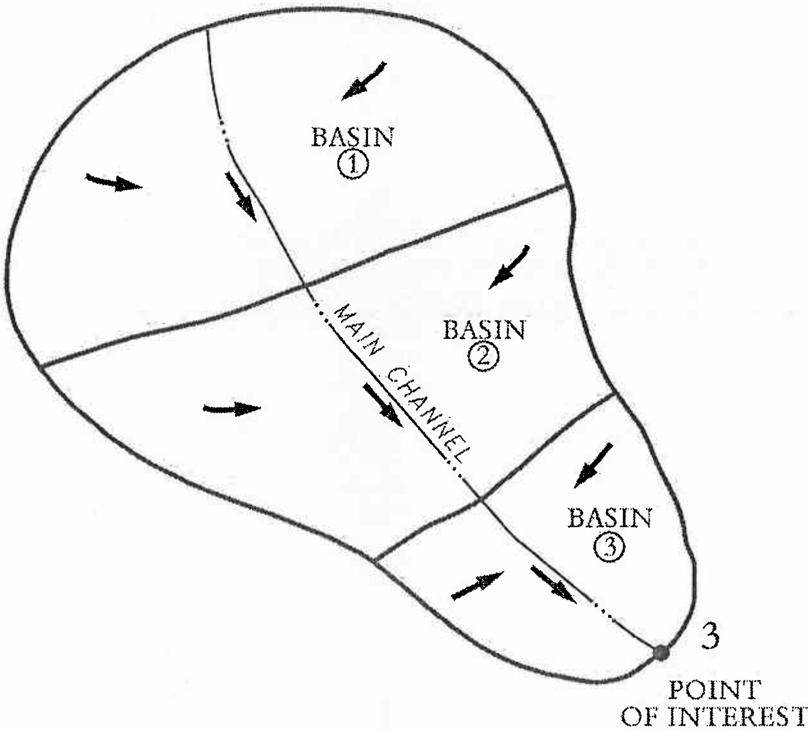
In order to sustain a level of growth and prosperity within a community, a certain amount of land development is anticipated and encouraged. Whether it is new commercial or industrial facilities, residential development, or rehabilitation of existing land, this development usually brings an increase in impervious surfaces such as parking areas, buildings and roads. This increase in impervious surfaces results in increased stormwater runoff and increased chance of flooding. The purpose of stormwater management is to control this increase in runoff and reduce flooding potential.

There are two types of stormwater management philosophy: "at-site" and release rate (watershed level) methodology. These philosophies are explained in the following sections.

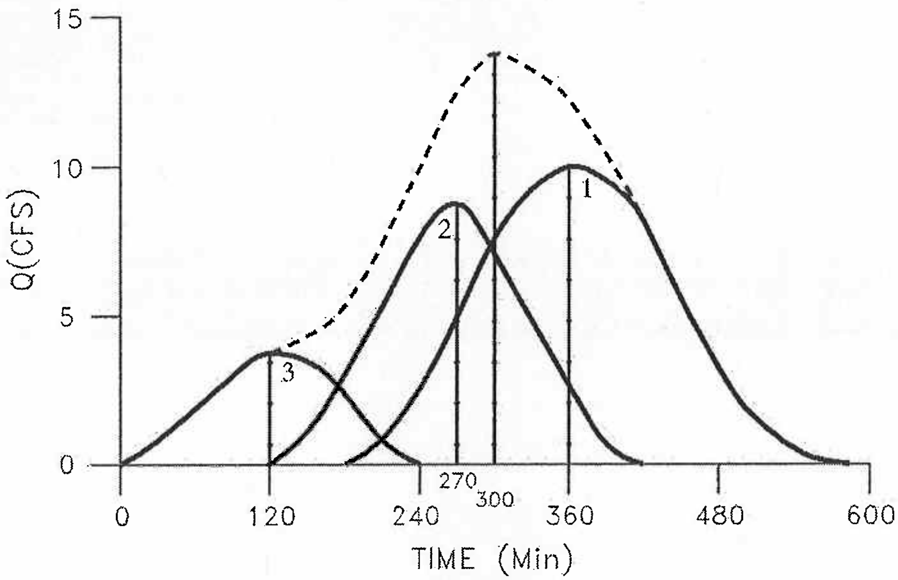
4.2 "At Site" Philosophy

Before adoption of Pennsylvania's Stormwater Management Act 167, stormwater management criteria were established, usually by municipal ordinance, based on an "at-site" criterion. That is, the intent to reduce after-development runoff to pre-development flows applied only to the boundaries of the developed site. Impacts of the development to downstream communities were not considered. Although the "at-site" criterion reduced the peak flow from a site, it also extended the time during which a reduced peak flow left the site. The cumulative effect of this "at-site" design at a downstream location of the watershed resulted in an increase in the peak flow and a corresponding increase in flooding potential.

Figure 4-1 represents a typical watershed divided into 3 subbasins. For the purposes of this example, we will focus on the peak flows at the bottom of the watershed at point of interest (POI) #3. Figure 4-2 shows the peak flow hydrographs, (peak flow defined as maximum flow at certain time) from the individual subbasin areas and the combined peak flow hydrograph that occurs at POI #3. To determine the combined hydrograph at POI #3, simply add the flows from each individual basin at any time, and plot along the graph. As show in Figure 4-2 the total peak flow at the downstream point of interest, subarea #3 is 14 cubic feet per second (CFS) at 300 minutes. Figure 4-3 shows the post development peak flow hydrographs from the individual subbasin areas and the combined peak flow hydrograph that occurs at POI #3. Assuming development with stormwater management facilities in all subareas and using the "at-site" stormwater management method, you can see an overall increase in the peak flow at POI #3 (19 CFS vs. 15 CFS). When the peak flows of the sub basins are controlled, the result is a lengthening of the time at which the peak rate runoff leaves the site. These extended periods of peak flow discharges often overlap in the main channel of the watershed causing an increase in peak flow and cause flooding in downstream areas.

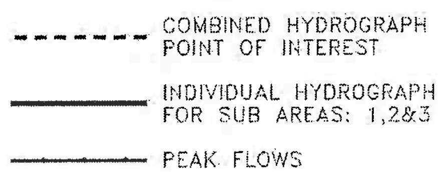


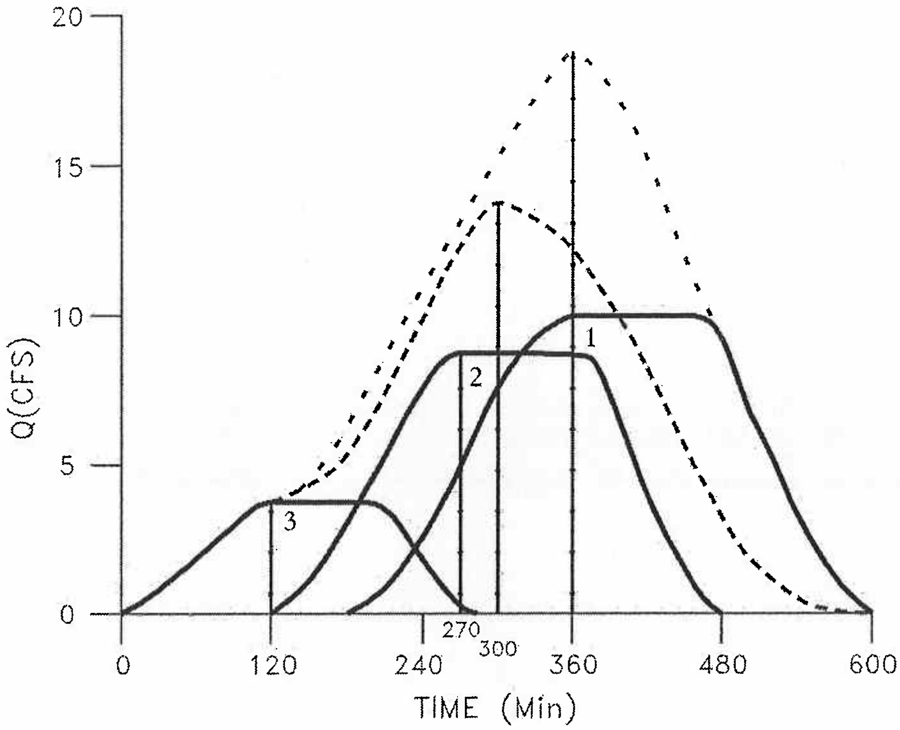
WATERSHED SUBBASINS
FIGURE 4-1



<u>HYDROGRAPH AT POINT OF INTEREST #3</u>

<u>FIGURE 4-2</u>





HYDROGRAPH AT POINT OF INTEREST #3
POST DEVELOPEMENT "AT SITE" SWM CONCEPT
FIGURE 4-3

PRE-DEVELOPEMENT POINT OF INTRERSTS PEAK FLOW HYDROGRAPHS

POST DEVELOPEMENT INDIVIDUAL PEAK FLOW HYDROGRAPHS "AT SITE" CONCEPT

POST DEVELOPEMENT POINT OF INTEREST PEAK FLOW HYDROGRAPHS "AT SITE" CONCEPT

PEAK FLOWS

4.3 Release Rate Philosophy

The Act 167 stormwater management philosophy was to control the peak runoff from a site in relation to the timing of peak flows of the entire watershed. The goal of stormwater management was revised from trying to reduce peak flow from the developed site, to "managing " flows from a developed site to reduce peak flows throughout the watershed. This is the basis of the "Release Rate Concept"

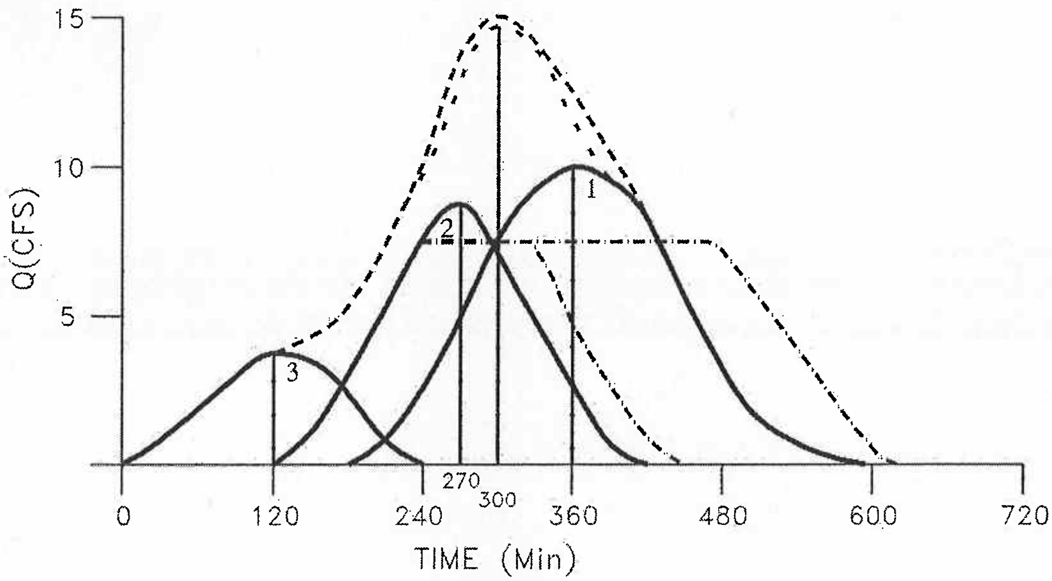
The release rate sets levels to which post development storm runoff must be controlled. The release rate is expressed as a percentage. The release rate percentage is intended to identify subareas of the watershed and their contribution to downstream flooding. For example if a subarea has a designated release rate of 80%, any on-site stormwater management facilities in that subarea must reduce the post development stormwater flows to 80% of the pre-development levels. These percentages represent the amount of post-development flows that can be discharge from a site to avoid increasing peak flows downstream.

Figure 4-4 shows the hydrograph at POI #3 when the "Release Rate" concept is utilized in stormwater management. The portion of the upstream peak flow that contributes to the downstream peak flow is determined. This is done by dividing each basin's flow contribution to a downstream location (the POI) by that's basin peak flow runoff. The resulting proportion is considered the Release Rate Percentage. It is express by the following formula.

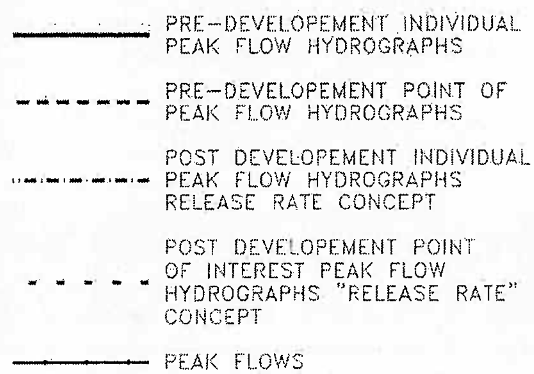
Release Rate = Q1 / Q2 x 100%
Q1 = Runoff from upstream basin at a downstream POI peak flow time (CFS)
Q2 = Peak flow runoff from upstream basin (CFS)

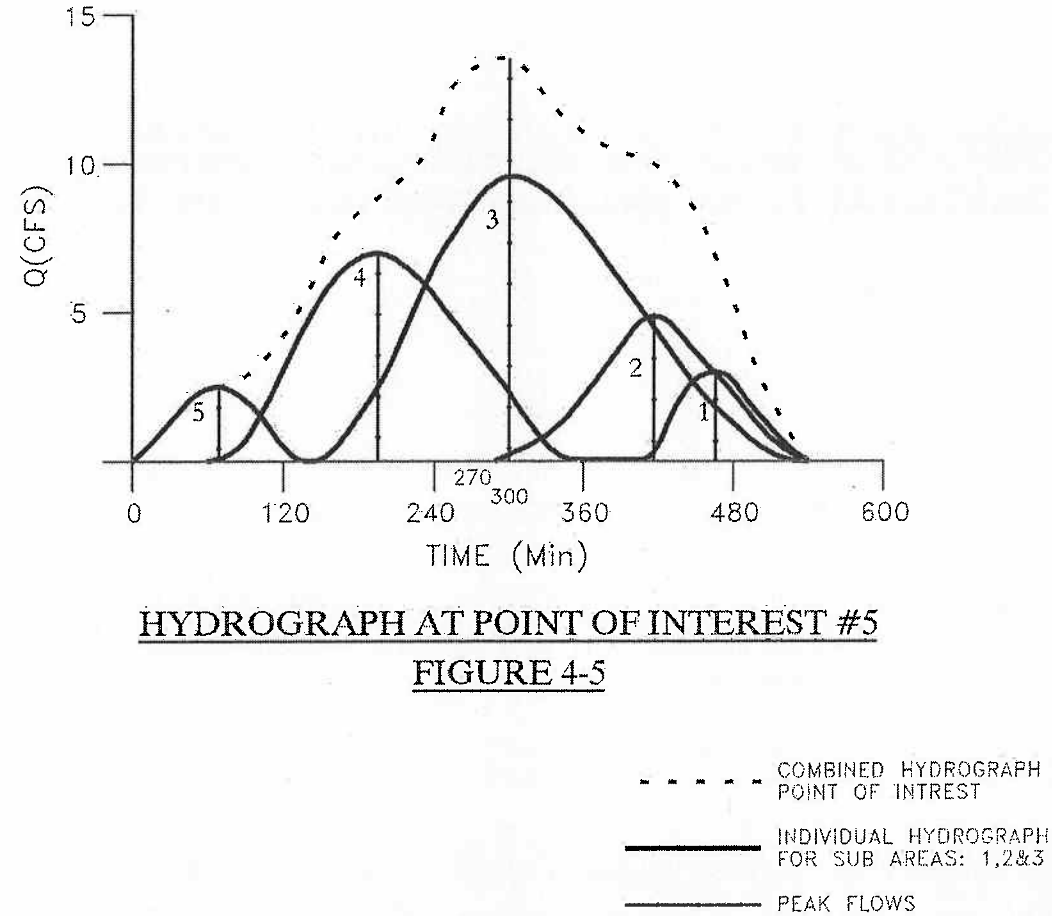
For the example in Figure 4-4, dividing Basin 1's contribution of 7.5 CFS to POI #3 peak flow (at 300 min) by Basin 1 peak flow of 10 CFS (at 360 min) results in a Release Rate of 0.75 or 75%. All stormwater management facilities in Basin 1 would be designed to reduce the post-development flow to 75% of the pre-development levels. The same calculation could be used to determine Basin 2's Release Rate. Dividing Basin 2's contribution of 7.5 CFS to POI #3 peak flow (at 300 min) by Basin 2 peak flow of 9.0 CFS (at 270 min) results in a Release Rate of 0.83 or 83%.

As shown in Figure 4-5, there are cases when the flows from both upstream and downstream basins contribute little to the peak flow at a downstream POI. This can occur when the peak flow from an individual basin occurs at a time well before or well after the peak flow of the combined basins at a downstream POI. Looking at Figure 4-5, Basin 1 and Basin 5 contribute no flow to the peak flow of POI #5. If the basins will have no effect on the peak flow rate at the POI, applying a release rate is not warranted. Therefore, a Release Rate of 100% for Basin 1 and 5 is justified.



POST DEVELOPEMENT "RELEASE RATE" SWM CONCEPT
FIGURE 4-4





HYDROGRAPH AT POINT OF INTEREST #5

FIGURE 4-5

4.4 Little Sewickley Creek Release Rate Determination

The Release Rates for Little Sewickley Creek were determined in several steps. The first step was to run the PSRM program and determine the release rates for the 100 and 10-year storms for each of the 40-sub basins. The 10-year storm was selected because it is standard in storm runoff calculations and is commonly a stream flowing full rainfall event. The 100-year storm was chosen because it is a standard flood plain management storm event.

Some restrictions on release rates were established.

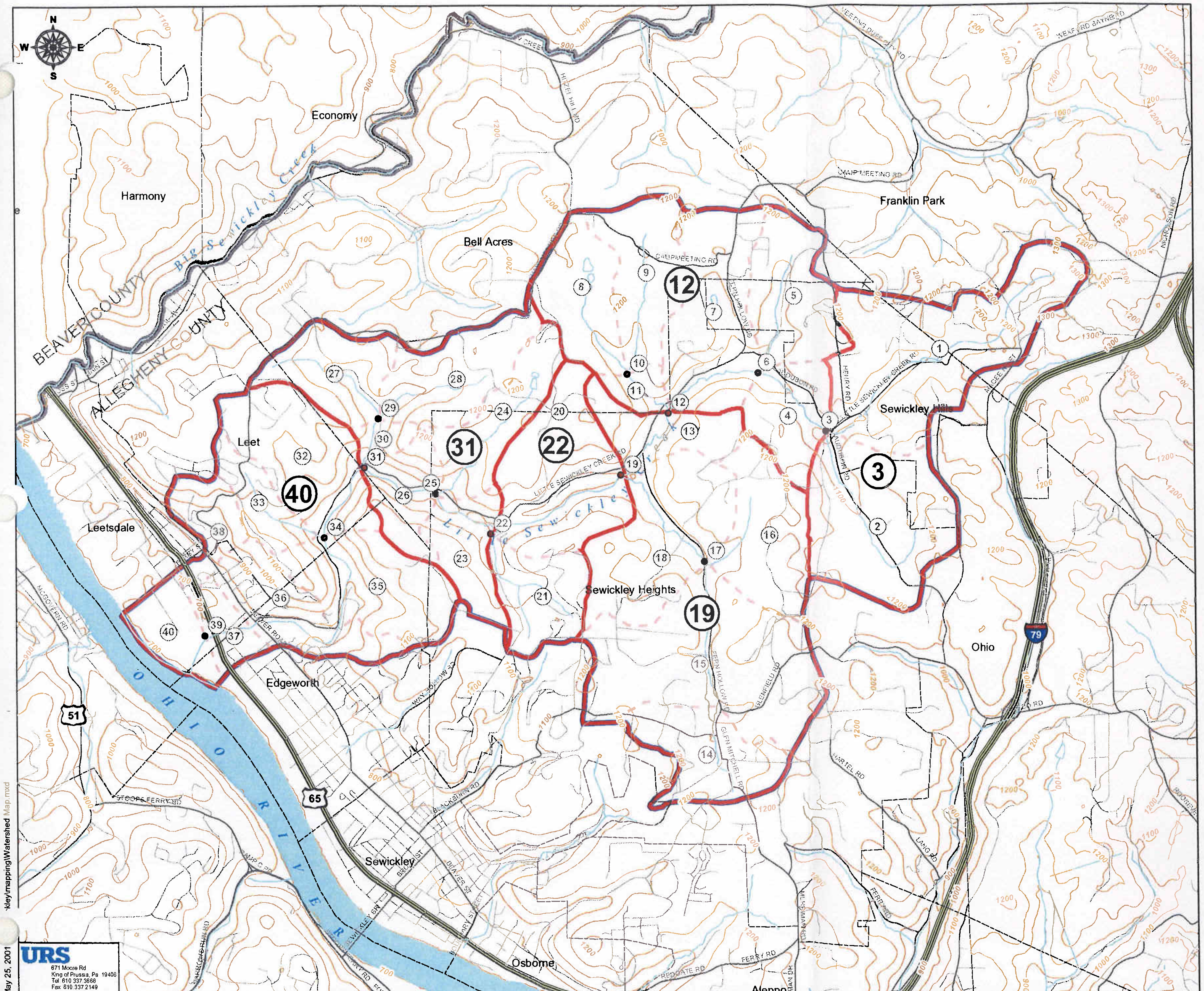
1. A 10 percent flow contribution to downstream peak flows was established as a minimum percentage where Release Rates were required. Any basin that contributed less than 10 percent to the downstream basin was given a 100% Release Rate.
2. A 50% percent Release Rate was established as a lower limit. This is common in most established ACT 167 Watershed Plans.
3. The lower of the two Release Rates, 10 year and 100-year storms, was used.

Each basin was analyzed and a Release Rate was calculated for each basin by the PSRM program. This resulted in 40 separate release rates for both the 10 and 100-year storms. The results yielded a wide variety of rates. The 40 subareas are shown on Figure 3-1 .

The second step was to attempt to moderate the disparities in the calculated release rates. In order to do this a regional approach to the subbasins was taken. For the Little Sewickley Creek, regional basins were set up at confluences of tributaries to the main stream body. Six regional basins were established and located at the following confluences/ junctions: 3, 12, 19, 22, 31, and 40. (See Figure 4-6) Using the PSRM program, the peak flow rates were analyzed at these six locations. The flows of the regional areas were compared with the downstream peak flows and new release rates were calculated based on the Release Rate equation stated previously. The final subarea release rate percentages for the Little Sewickley Creek Watershed are listed in Table 4-1.

Table 4-1
Regional Release Rates

Region	10-Year Release Rate (%)	100-Year Release Rate (%)	Actual Region Release rate (%)
3	79.6	79.3	80
12	97.8	95.0	95
19	97.4	96.8	95
22	96.7	97.1	95
31	86.5	89.8	85
40	100	100	100



Allegheny County Little Sewickley Act 167 Plan

Region	Release Rate
3	80%
12	95%
19	95%
22	95%
31	85%
40	100%

Legend

- Stream Junction
- Sub-Watersheds
- Regional Boundary

3,000 1,500 0 3,000 Feet

1 inch equals 3,000 feet

Regional Release Rate Map

Figure 4-6

Sources:
County Boundary, Municipal Boundary, Roads, and Streams: PennDOT 2001 GIS Data.
Contours: Derived from USGS 1:24,000 Quadrangles- Ambridge, PA. Emsworth, PA.
Watershed Delineation conducted by URS.

4.5 Application of Release Rates

In calculating the release runoff rates for the Little Sewickley Creek Stormwater Management Plan, the 10 and 100 years storms were utilized. The remaining storm events should be incorporated into the Release Rate stormwater Management Application. The 2-year storm should be incorporated because of its flooding potential for smaller stream and tributaries. The 25-year storm should be incorporated because it would reduce the disparities that might occur by designing for the 10 and 100-year storm only. It is recommended, at a minimum, the release rate should be applied to the 2-year, 10-year, 25-year, and 100-year storm events. The 5- and 50-year events are of lesser importance. Not because these events are less significant than the others, but by designing for the 2-year, 10-year, 25-year, and 100-year storm events, the 5-year and 50-year events are usually reduced by default. Performing the extra calculations for the 5-year and 50-year events would be redundant. It should be left to the municipalities whether to apply release rates to the 5-year and 50-year events.

4.6 Exemptions

The following project and development types and land uses shall be exempt from certain detailed requirements as described. No project, development or land use shall be exempt, however, from the application of proper runoff, erosion, and sediment controls so that downstream properties and watercourses are not harmed.

4.6.1 Small Developments

Any development resulting in the creation of less than 5,000 square feet of new impervious surface area shall be exempt from the application of release rate controls and from submitting a detailed stormwater management plan. Provisions for stormwater management on small development sites must be approved by the municipal engineer prior to issuance of a building permit.

4.6.2 Farming

Farming operations shall be exempt from stormwater management plan submission requirements under municipal stormwater ordinance provisions as long as there is an approved erosion and sedimentation control plan for the site. The erosion and sedimentation control plan must be submitted for approval concurrently with the application for farm operations zoning approval.

4.6.3 Mining

Mining activities are regulated by state and federal law. The Pennsylvania law for surface mining preempts any local regulation except those adopted pursuant to the Municipalities Planning Code. The municipal ordinance shall state that zoning approval for mining is contingent upon receipt of all state and federal permits. This includes approval of the drainage and erosion and sedimentation control plans required under state regulations. According to Act No. 167, DER and the county must assure that any erosion and stormwater control facilities are consistent with the approved watershed plan.

4.7 Project Site Stormwater Management Plan Requirements

Stormwater management plans for projects proposed in the Little Sewickley Creek watershed must be prepared in accordance with the requirements of this section. Plans shall be prepared and submitted in "preliminary" and "final" formats. The following paragraphs contain detailed descriptions of the required plan components. In general, however, the minimum requirements for stormwater management plan submission include:

- The plan must be prepared by or under the direction of a licensed Pennsylvania professional engineer experienced in similar work.
- A brief written description of the proposed development and the proposed stormwater management controls shall be included.
- Calculations shall be indexed and all charts, figures, tables, etc. obtained from texts or other materials shall be referenced.
- Detailed plans, sections, and specifications shall clearly indicate the proposed construction methods for any stormwater management facilities.
- The supervising engineer shall seal the plan prior to submission.

The omission of any of these general items shall cause the plan to be immediately returned to the engineer for corrections.

4.7.1 Preliminary Plan Contents

The required components for a preliminary project site stormwater management plan are described below. Each of these components must be addressed in order for the plan to be approved.

A. Project Location - Provide a key map showing the project site location within the Little Sewickley Creek watershed and subarea(s). Show watershed and/or subarea boundaries as required on all site drawings. Identify the watershed and/or subarea by name or number, respectively.

B. Floodplain Boundaries - Identify the 100-year floodplain limit(s) as necessary on all site drawings. Floodplain boundaries shall be based on available FEMA Flood Insurance Maps.

C. Natural Features - Show the location of all bodies of water (natural and artificial), watercourses (permanent and intermittent), swales, wetlands, and other natural drainage courses both on-site and off-site if they will be affected by the development's runoff.

D. Soils - Indicate the soils, types, and boundaries existing within the project site.

E. Contours - Show the existing and final contours at two-foot intervals. Five-foot intervals may be used in areas with slopes greater than 15 percent.

F. Existing Stormwater Management Controls - Show any existing stormwater management or drainage control facilities such as sewers, swales, culverts, etc., located on the project site. Show any off-site facilities which will be affected by runoff from the development.

G. Runoff Calculations - Calculations for determining pre- and post-development discharge rates and for designing proposed stormwater control facilities must be included. All calculations shall be performed in accordance with Sections 4.2, 4.3, 4.4, and 4.5 of this report.

H. Proposed Stormwater Management Controls - All proposed runoff control measures must be shown on the plan. This includes methods of collecting, conveying, and storing stormwater runoff during and after construction. Erosion and sedimentation controls approved by the Allegheny County Conservation District shall also be shown. The plan must provide information on the general type, location, sizing, etc., of all proposed facilities and their relationship to the existing watershed drainage system. If the development is to constructed in stages, the plan must illustrate how the control facilities will be installed to safely manage stormwater and erosion during each development stage.

I. Easements, Rights-of-Way, Deed Restrictions - Show all existing and proposed easements and rights-of-way for drainage and/or access to stormwater control facilities and identify the current property owner. Show any areas subject to special deed restrictions relative to or affecting stormwater management on the development site.

J. Other Permits/Approvals - Include a list of any approvals or permits relative to stormwater management that will be required from other governmental agencies and anticipated dates of submission and receipt. This includes, for example, an obstruction permit from PADEP.

K. Maintenance Program - The plan must contain a proposed maintenance plan for all stormwater control facilities constructed as part of the development and affected by the development's runoff. The proposed ownership entities (initial, interim, and final) must be identified, along with the time period for which each is responsible. The maintenance program must be described, including the type of maintenance activities required, probable frequencies, personnel and equipment requirements, and estimated annual costs.

A method of financing the continuing operation and maintenance of the facility must be identified if it is to be owned by an entity other than the municipality.

4.7.2 Final Plan Contents

The final project site stormwater management plan must be comprised of the following items:

A. All information pertaining to stormwater management of the site from the preliminary plan along with any changes or additions.

B. Final plan maps showing the exact nature and location of all temporary and permanent stormwater management control facilities along with design and construction specifications.

C. A schedule for the installation of all temporary and permanent stormwater control facilities.

D. An accurate survey showing all current and proposed easements and rights-of-way, along with copies of all proposed deed restrictions.

E. The maintenance program establishing ownership and maintenance responsibilities for all stormwater control facilities, as well as any legal agreements required to implement the maintenance program and copies of the maintenance agreement.

F. Financial guarantees to ensure that all stormwater control facilities will be installed properly and function satisfactorily.

4.7.3 Plan Review Procedures

All preliminary and final project site stormwater management plans must be submitted to the appropriate municipality for review in conjunction with the subdivision/land development plans for the site. Each municipality in the Little Sewickley Creek Watershed shall, by the time of adoption of this Plan, have executed a formal agreement with the Allegheny County Planning Department (ACPD) to review the stormwater management provisions of the subdivision and land development submittals. A copy of the stormwater plan including all runoff calculations shall, therefore, be forwarded to the ACPD by the municipality or, if requested, submitted directly to the ACPD by the developer.

The ACPD review will assure that the stormwater plan conforms to the requirements of this Plan and that downstream impacts have been adequately addressed. The ACPD shall report the results of the review to the municipality within 30 days of plan submission. If any deficiencies are noted, the developer will be advised so that the necessary modifications can be made to the plan. The municipal engineer cannot approve the stormwater plan until it receives a positive review from the ACPD.

The developer must also receive all of the other required approvals and permits prior to issuance of a building permit.

4.8 No-Harm Evaluations

The "No-Harm Evaluation" shall remain an alternative method for analyzing proposed developments in the Little Sewickley Creek Watershed. The procedure for performing these evaluations shall be as follows:

- Determine from the modeling results the discharge control values at all control points indicated in Table ___ between the proposed development site and the base of the watershed.

- Using an approved hydrograph method, the existing land use and soils input data available from the Allegheny County Planning Department, and the travel times contained in the model input data, compute the 2-, 5-, 10-, 25-, 50-, and 100-year storm predevelopment discharge values at the point of discharge from the site and at all control points.

- Compare the predevelopment discharge values to the post-development discharge values. If the values are within 20 percent of the comparison values, the computed values are acceptable and may be used for all further analysis.

- Using the same approved hydrograph method, compute the post-development discharges for the same storms for the same locations used above. The calculations of the post-development discharges should include the proposed on- and off-site stormwater management control facilities.

- The computed post-development discharges for the required storms cannot exceed the computed pre-development discharges at any of the control points.

Although it is apparent that this option requires considerable effort on the part of the developer and the reviewing engineer, it does provide the flexibility for creative stormwater management practices. There may be cases where this option proves advantageous to a particular site and allows a cost-effective approach that adequately satisfies the requirements of the Stormwater Management Act. It is recommended that anyone proposing to perform a no-harm evaluation contact the Allegheny County Planning Department so that the current watershed model and land use data can be utilized.

5.0 EXISTING INSTITUTIONAL CONTROLS

Existing stormwater controls throughout the Little Sewickley Creek Watershed occur through compliance with municipal ordinances for the various boroughs and townships. Most of the Municipalities within the watershed have some type of Stormwater Management and Storm Sewer ordinance. The types of stormwater ordinances were obtained from questionnaires submitted to the municipalities. The results of these questionnaires are shown in Appendix D. Table 5-1 below is a summary table outline the existing stormwater control for each municipality.

Table 5-1
Municipal Stormwater Ordinance Summary

Municipality	Comprehensive Plan	Erosion Control Ordinance	Storm Sewer Ordinance	Stormwater Management Ordinance
Sewickley Heights Borough	Y	Y DEP Standards	Y	Y No Post Development Increase
Sewickley Hills Borough	N	Y No Standards	Y No Standards	Y No Post Development Increase
Leet Township	N	Y DEP Standards	Y No Standards	Y No Post Development Increase
Edgeworth Borough	N	Y DEP Standards	Y No Standards	Y No Post Development Increase
Bell Acres Borough	N	Y DEP Standards	Y TR-55	Y No Post Development Increase
Franklin Park Borough	Y	Y DEP Standards	Y TR-55	Y No Standards
Sewickley Borough	Y	Y DEP Standards	Y No Standards	Y No Standards
Leetsdale Borough	N	Y DEP Standards	Y No Standards	None

Table 5-1 indicates the current stormwater management methodologies recommended for development within the respective municipalities. The "No Standards" items indicate where the ordinances specify that the type of compliance is at the discretion of the Municipal Engineer. For Stormwater Management the municipalities require "at-site" control design. As discussed in the previous sections a watershed approach to stormwater management would minimize the adverse impact of development on downstream locations.

It is the intent of the plan to introduce to the municipalities within the Little Sewickley Creek Watershed a watershed based methodology to stormwater management. A model ordinance has been created which may be used in part or whole by the municipalities to implement this "Watershed Approach" to Stormwater Management. The model ordinance is located in Appendix F.

6.0 Alternative Runoff Control Measures

Many techniques can be utilized to reduce peak flow from a site. These techniques range from infiltration of runoff into the ground to constructing retention / detention basins regionally or on-site.

The developer is responsible for selecting the appropriate alternative based on the type of project and characteristics of the site. Ideally, the chosen method should be the control system that is the most efficient with the least cost.

6.1 Best Management Practices (BMPs)

In this section, the term "Best Management Practice" or BMP is introduced. A BMP or Best Management Practice is a method for controlling runoff from a site, either regional or localized, with the intent of reducing storm runoff to a criteria level established in Stormwater Management Computations

A few BMPs suited for reduction of storm runoff will be discussed in this section. The developer is encouraged to reference the "Pennsylvania Handbook of Best Management Practices for Developing Areas" prepared by CH2MHILL and published in 1998 for additional BMP options.

It should be noted that this handbook also suggests Alternative BMPs for controlling accelerated soil erosion and sedimentation as well as suggested BMPs for Water Quality.

To determine the most appropriate BMPs for each site, several conditions should be evaluated.

- Soil permeability and erodibility
- Subsurface condition
- Topography
- Costs and maintenance

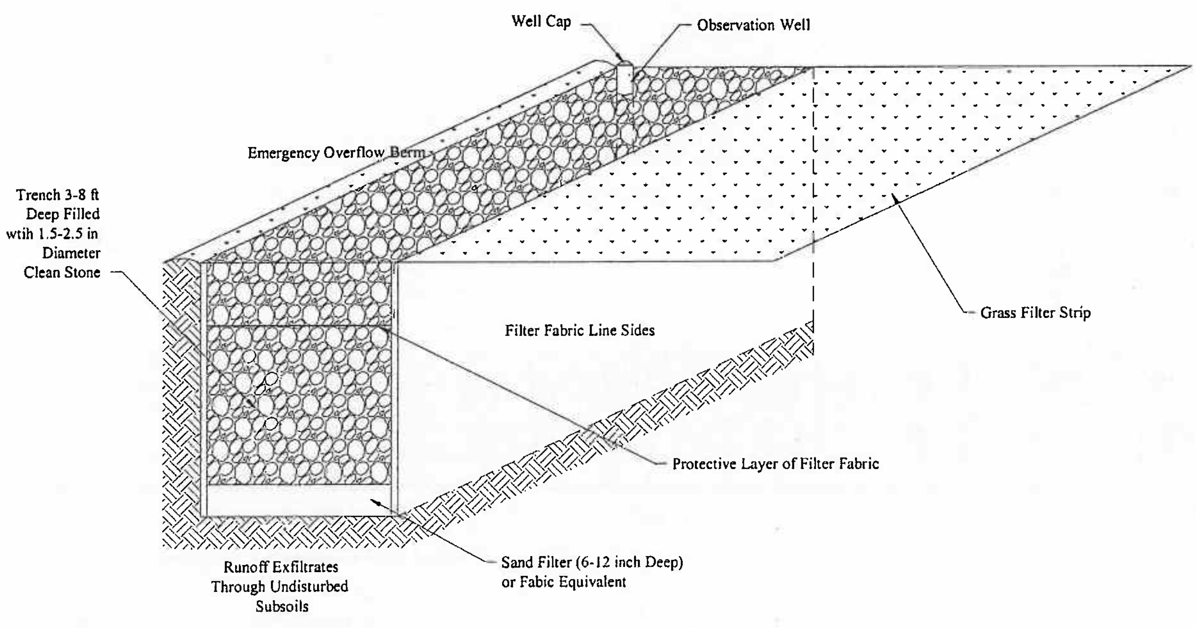
6.2 Types of Best Management Practices (BMPs)

Infiltration Trenches

Infiltration trenches are excaved trenches filled with stone in which stormwater runoff is collected and drained into the nearby soil. They reduce the runoff volume and then recharge the groundwater through infiltration.

Infiltration trenches are used in small drainage areas, such as individual single-family housing developments. The soils must be well drained, such as soils with a hydrologic soil group classification of "A" or "B". Clogging will occur if the soil is not well drained. Because most of the soils in Little Sewickley Creek Watershed are group "C", caution should be used when installing an infiltration trench on-site. Soil percolation tests could be performed to determine the permeability of the area. Infiltration trenches should not be used in steep slope areas. These devices are frequently used in parking lots. A grass filter strip should be installed between the paving and the trench so that sediment and litter will be trapped before entering the trench and clogging the device.

Figure 6-1: Infiltration Trench

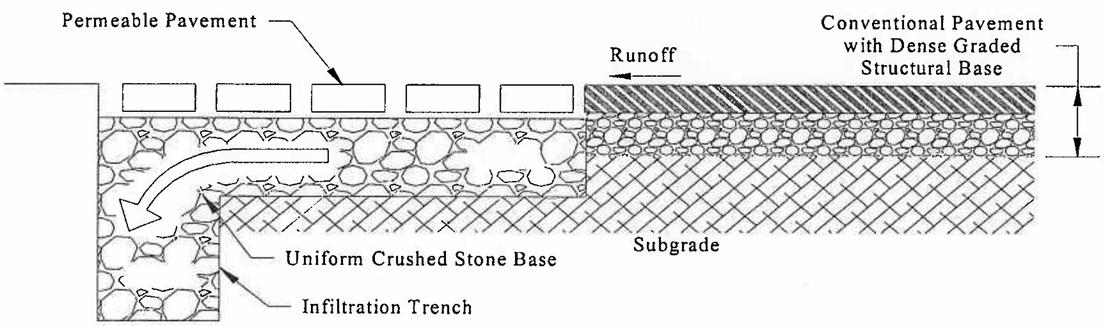


Permeable Paving System

A Permeable Paving System is used to reduce the imperviousness of trafficked surfaces for reducing surface runoff and increasing infiltration. The permeable paving system can be effective to reduce the peak surface runoff rate.

This system requires moderately permeable soil and a depth to the seasonal high water table or bedrock of not less than 3 feet below grade. It will prevent groundwater mounding or concentrated discharging to the groundwater. Permeable paving is best installed with impervious paving in the same site. The impervious paving is for the heavier traffic and the permeable paving is for parking lot or sidewalk. This device should not be used in an area with concerns for the contamination of surface runoff from dissolved pollutants.

Figure 6-2: Interconnected Infiltration Trench under Permeable Pavement

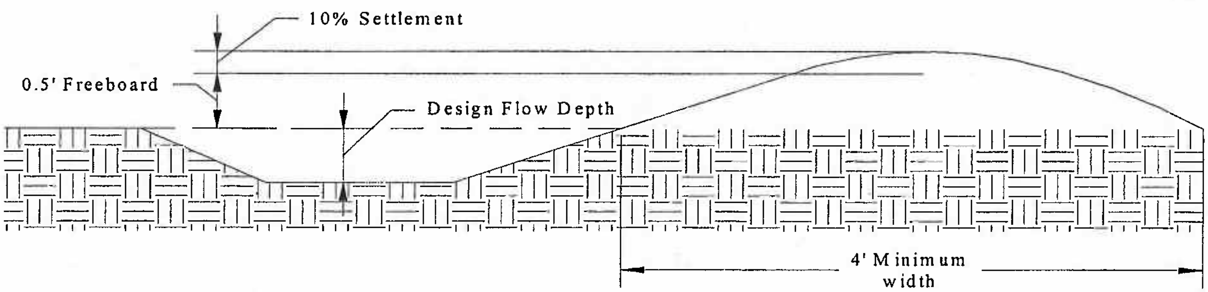


Diversion Channel

A diversion channel is a channel constructed across a slope with a supporting berm located on the down-slope side. The channel is used to divert excess or up-slope runoff from the developed area. It is also useful to reduce flow velocity by conveying runoff across a slope. It can prevent damage to the down slope areas caused by surface flow and high-velocity runoff.

Diversion of runoff from upland areas can be used to reduce the size or cost of the other BMPs by reducing the amount of water that must be controlled. The excessive runoff from up-slope areas will interfere with the efficient operation of stormwater controls.

Figure 6-3: Typical Diversion Channel

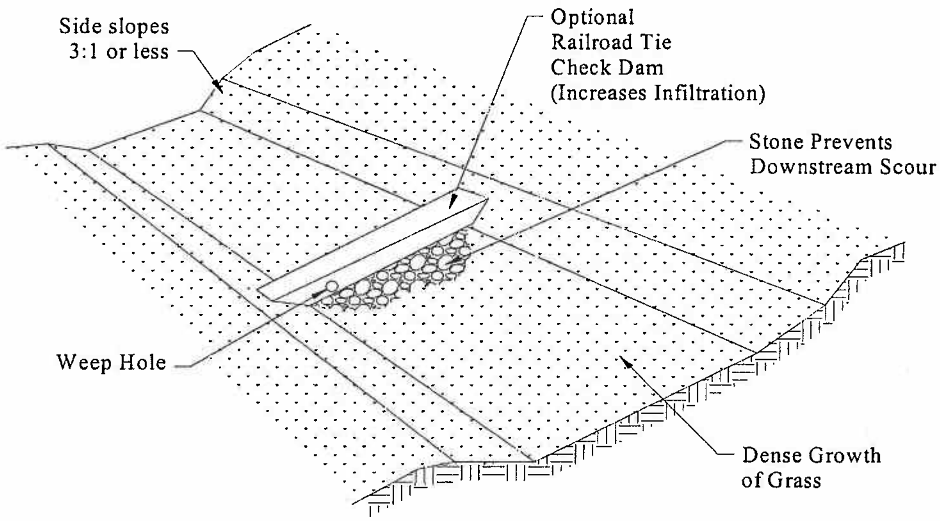


Grass Swale

A grass swale is a combination of an open channel and a conventional storm sewer. It is vegetated with grass or suitable vegetation. A grass swale is an excellent water quality BMP, as the vegetation is a good pollutant-filtering device.

Grass swales can reduce the runoff peak rate and increase the amount of infiltration. Guidelines for installing and sizing grass swales should be included in municipal ordinances. The longitudinal slope for the swale should be flat to minimize the velocity and maximize the time for infiltration. However, if the slope is less than 1 percent, ponding may occur. It works best in conjunction with the other best management practices devices.

Figure 6-4: Typical Grass Swale



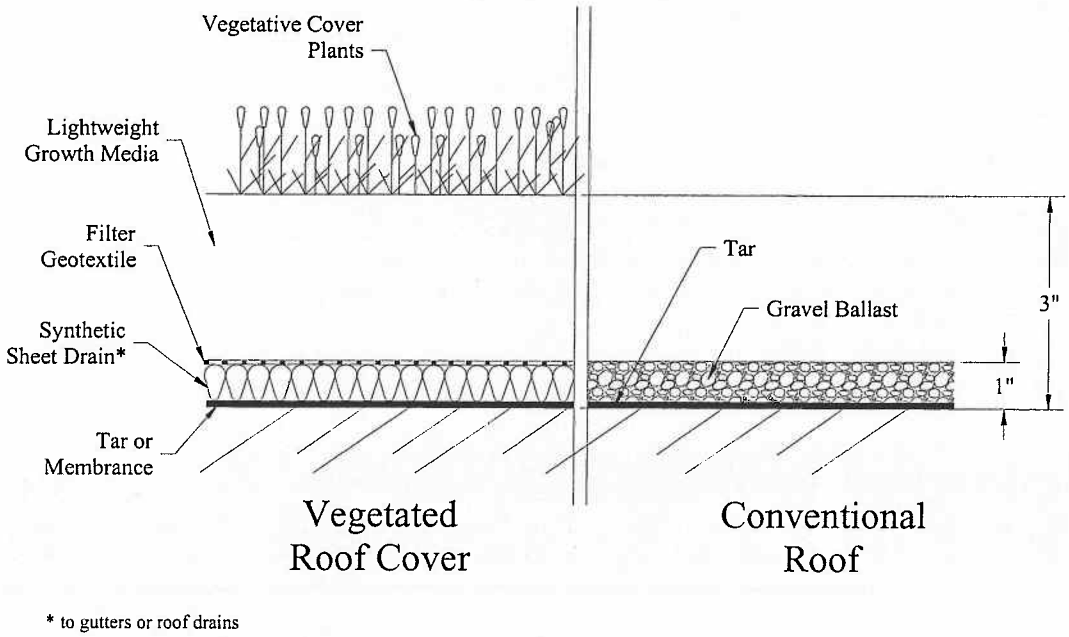
*Swale Slopes as close to zero as Drainage will Permit; <2%

Rooftop Runoff Management

Rooftop Runoff Management is a modification to conventional building design that retards runoff originating from roofs. It includes vegetated roof covers, roof gardens, vegetated building facades, and roof ponding areas. For developed sites, roofs are one of the important sources of concentrated runoff. The concentrated runoff is a big issue in sizing BMPs. If the concentrated runoff can be reduced, the BMP throughout the site can also be reduced. It may also increase the time of concentration of the runoff derived from roofs, delay runoff peak, and lower runoff discharge rates.

The rooftop runoff management is suitable for flat or gently sloping roofs. Also, it can be retrofitted to most conventionally constructed buildings. Vegetated roof covers are effective for extensive roofs. The filtering effect of vegetated roof covers results in a roof discharge that is free of leaves and roof litter.

Figure 6-5: Comparison Between Vegetative Roof Cover and Conventional Roof System



Basins (Wet and Dry)

A wet basin is a permanent stormwater management facility with a permanent pool of water for enhancing water quality and with additional capacity for detaining stormwater runoff. Storm runoff is diverted to the basin, either through storm sewer or diversion channels. The runoff is then released at controlled levels through a discharge structure, which consists of any combination of orifices or weirs. The orifices or weirs will be placed above a certain water elevation to maintain the basin at its normal depth. Wet basins improve water quality by reducing the highest concentrations of the pollutants released downstream in the early phase of the storm. The methodologies of removing the pollutants include settling of suspended particulate and biological uptake, and consumption of pollutants by plants, algae, and bacteria in the water.

A dry basin is essentially the same as a wet basin, only the discharge structure will be constructed to drain the entire basin. A dry basin can also be used to improve water quality by restricting the 1-year storm event and discharging it over a period of no less than 24 hours. This will allow pollutants to settle to the bottom of the basin.

Release Rates can best be applied to Basins. Orifices and weirs in discharge structures can be designed in many different sizes, elevations, and combinations to achieve the required percentage reduction in flow with ease. Given these various discharge structure options, basin volume requirements then become the more critical wet or dry basin design criteria.

Figure 6-4: Cross Section of the Wet Basin

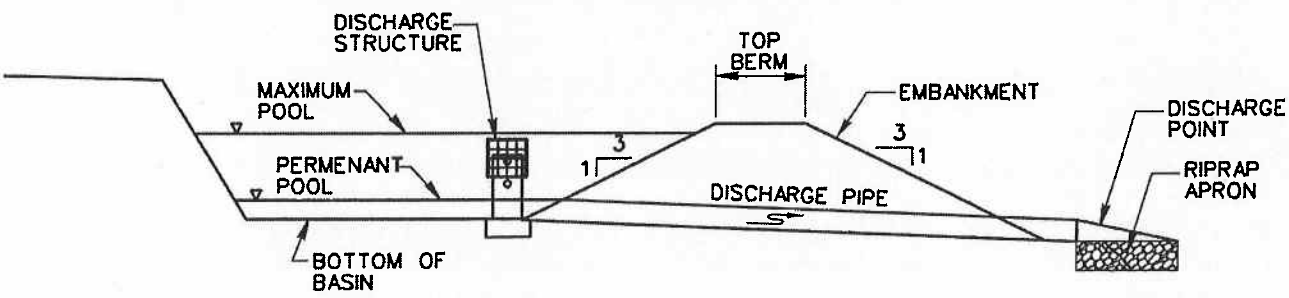
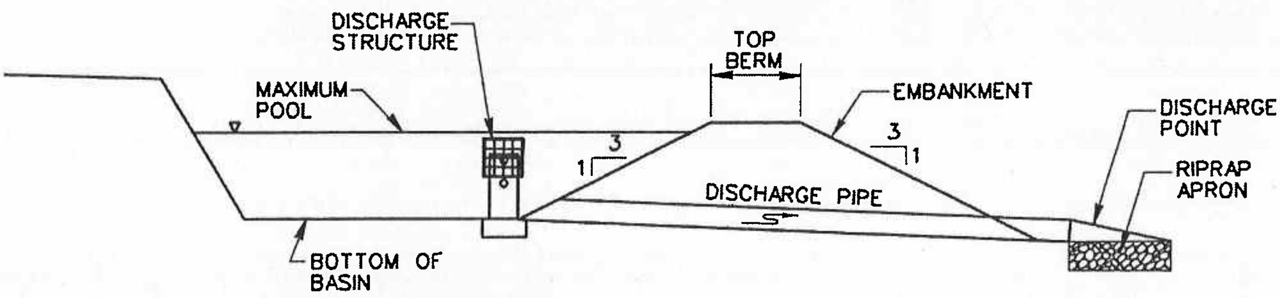


Figure 6-5: Cross Section of the Dry Basin



6.3 Advantages and Disadvantages of BMPs

Table 6-1 Advantages and Disadvantages of the Stormwater Management Devices

Device	Advantages	Disadvantages
Infiltration Trenches	Reduce runoff peak discharge. Reduce runoff volume. Recharge the groundwater. Reduce the size of downstream stormwater management system.	Use only in well-drained soils that are Hydrologic groups A and B. Easy to clog by sediment. Cannot be used on or adjacent to steep slope. Cannot be used with contaminated surface.
Permeable Paving Systems	Reduce surface runoff. Increase infiltration in order to recharge the groundwater. Reduce peak surface runoff rate. Lower cost than conventional pavements. Reduce the size of downstream stormwater management system.	Easy to clog by sediment. Cannot be used with contaminated surface. Water freezing within the pores takes longer to thaw and limits infiltration in the winter.
Diversions	Divert excess water away from disturbed area. Reduce flow velocity Reduce the size of other stormwater management system. Reduce total runoff volume	Easy to clog by sediment. Cannot be used with contaminated surface. Easy to have erosion in the channel. Result in concentration of runoff.
Grass Swales	Pollutants filtering devices. Reduce runoff peak rates. Increase infiltration. Reduce runoff peaks. Large-capture storage capacities. Reduce runoff velocity.	Easy to clog by sediment. Cannot be used around with a contaminated area. Easy to have erosion in the channel. Low slope swales can create wetland areas.
Rooftop Runoff Management	Reduces concentrated runoff. Reduces the size of other stormwater management system.	Effective only with 2-yr or less design storms. Cannot recharge the groundwater.

	Delays runoff peaks. Reduces runoff discharge rates. Relieves pressure on the roof. Requires less space to construct. Suitable in most of the roofs. Reduces energy consumption for heating and cooling.	Leaks may cause damage to the building and contents. Increases the load imposed on the structure.
Wet Ponds	Improve water quality. Reduce the concentration of pollutants in runoff release to downstream. Provide wildlife habitat and recreation areas.	Not reliable for recharging groundwater. Significant operation and maintenance program. Cost a lot more than the other kinds of BMP. Contribute to thermal pollution and cause downstream warming.
Dry Ponds	Delay stormwater runoff peaks. Reduce potential for flooding. Prevents erosion around the stream bank in downstream areas. Control runoff from multiple development sites or entire drainage area.	Not suitable for infiltration and groundwater recharge. Large land use to construct. Can be very expensive.

6.4 Maintenance of BMP's

Table 6-2 Maintenance and Operation

Devices	Maintenance
Infiltration Trenches	Control the accumulation of the sediment. Inspection. Replace the filter cloth annually.
Permeable Paving Systems	Should not use sand or cinders in snow removal operations. Clean and remove the sediment to avoid slowing down the infiltration process.
Diversions	Keep the inlet clean in the storm sewer and remove the sediment. Maintain the sod and control the trees and brushes. Avoid overturning equipment.
Grass Swales	Maintaining the vegetation and remove the trash. Periodic watering and fertilizing and routine mowing. Remove the sediment periodically.
Rooftop Runoff Management	Inspect and maintenance periodically. Attend to plant nutritional needs. Fertilizing the plants. Inspect the roof drainage system.
Wet Ponds	Grass maintenance. Control of noxious weeds and invasive plants. Maintenance of wetland vegetation, pond, and mechanical component. Removal and disposal of trash, debris, and sediment. Inspection. Elimination of mosquito-breeding habitats.
Dry Ponds	Prevent clogging the outlet. Prevent standing water. Prevent growth of weeds and noxious plants. Maintain turf grass on the tops of berms and exterior slopes. Inspect quarterly and after major storms.

6.5 Water Quality BMPs

In 1987, the Clean Water Act was amended to mandate the Environmental Protection Agency to develop the National Pollutant Discharge Elimination System (NPDES). NPDES Phase I permits addressed storm water runoff from Municipal Separate Storm Sewer Systems (MS4s) with populations of 100,000 or greater. The purpose of NPDES Phase I was to reduce the pollutant discharges into the nation's water resources (lakes, river, streams, etc.) from large communities, construction sites, and industrial activities.

In March of 2003, The NPDES Phase II regulations will take effect. Phase II intends to further reduce adverse impacts to water quality and aquatic habitat by instituting the use of controls on the unregulated sources of stormwater discharges from smaller MS4s, population of 10,000 or more. Additionally any watershed with an approved ACT 167 Watershed Study will be required to comply with NPDES Phase II regulations. This in effect will require most municipalities within the State of Pennsylvania to comply with these regulations.

How Water Quality Affects Storm Water Management

During storm events, runoff from the road washes pollutants such as oils, salt, fertilizers, and sediment into roadside storm sewer and stormwater management basins. These drainage facilities eventually discharge the pollutant runoff directly into the river and streams. These discharges help destroy aquatic life habitat and contaminate drinking water supplies and recreational waterways. NPDES Phase II permits will require modifications to the standard designs of storm sewer and stormwater management facilities to help reduce the level of pollutants. There are several measures that can be incorporated into storm sewer design to help reduce the impact of storm runoff. They range from municipal street cleaning and public awareness programs to more structural elements such as monitoring construction sites and treating storm runoff at inlets, outfalls, and stormwater management basins.

For stormwater management facilities, there are two basic types of methodologies for water quality treatment - Volume Based Solutions and Filter Type Solutions.

Stormwater Management Basin – Water Quality - Volume Based Solutions

Volume based solutions involve retaining storm runoff in a basin or pond for a long enough period to allow the pollutants and sediment to settle to the bottom of the basin. Most roadway pollutants are washed from roadways and fields during the smaller, short-term storm events, 1-year Storm or less. 1-year storms have a 100% chance of occurring each year. Stormwater Management Basins are normally not designed to retain events of such small intensity. The runoff from a 1-year storm event would leave a SWM basin at almost the same rate it enters. Without retaining the runoff, settlement would not occur, and pollutants would flush through the basin into the watercourse.

To comply with NPDES Phase II water quality requirements, stormwater management basins may be designed to hold runoff from 1-year storm events and release it over a 24-hour period. This would provide enough retention time for the pollutants to settle to the bottom of the basin. The volume to retain the 1-year storm runoff would be over and above the volume required to comply with the Act 167 Stormwater Management Requirements for reduced runoff.

This additional volume would increase the area required for a stormwater management basin. Additionally, allowing the 1-year storm to be release in no more than 24 hours requires smaller discharge orifices. These orifices, typically 2 to 4 inch in diameter, have a tendency to clog easily. Additional maintenance may be required.

The volume-based solutions can be incorporated in either Wet or Dry Basins, (see section 6.0). The vegetation typically found in wet basins can also act to promote biological activities, which may further reduce some pollutants.

Stormwater Management Basin – Water Quality - Filter Based Solutions

Filter based solutions to water quality involve the movement of pollutants through vegetation. Water quality is increased as storm runoff passes through plants and vegetation, trapping pollutants and sediment. The planting of a landscape buffer around a stormwater management basin or the planting of wildflowers and grassy meadow type plants in the bottom and side slopes of the basin will filter or trap many pollutants and sediments found in storm runoff. Concrete low-flow channels can be eliminated and explained with a "natural channel".

This "naturalization" of the stormwater basins still maintains the overall design standard of the basins, while increasing the water quality and aesthetics. Increased basin sizes are not required, as the planting of plants and grasses does not require additional volume. It can also reduce maintenance costs. Naturalized basins tend to have vegetation that require only annual mowing as opposed to grass lined basin which can require monthly or weekly mowing.

Naturalization of stormwater basins will become more common as municipalities begin to comply with NPDES Phase II Regulations in March or 2003.

Stormwater Management Basin – Water Quality - Other Solutions

Improving water quality is not limited to stormwater basin design. Other water quality Best Management Practices (BMPs) include filtering measures that are inserted into storm sewer systems, stream bank protection, and roadway maintenance. Contractors are encouraged to adopt water quality BMPs that are the best fitted to their particular land development project.

7.0 PRIORITIES FOR PLAN ADOPTION, IMPLEMENTATION, AND FUTURE UPDATES

7.1 General

The previously described efforts to develop the Little Sewickley Creek Stormwater Management Plan culminate in what are perhaps the three most important issues of the program - Plan Adoption, Implementation, and Planning for Future Updates. The following paragraphs describe the tasks necessary to appropriately administer the Plan.

7.2 Plan Recommendations

The primary recommendations resulting from the Little Sewickley Creek Watershed Stormwater Management Plan are as follows:

- The Allegheny County Board of Commissioners should adopt the Plan by resolution.
- Each municipality within the watershed should adopt the provisions of the Plan into the appropriate ordinances, and aggressively monitor and enforce them.
- Each municipality within the watershed should execute an agreement with the Allegheny County Department of Planning to review the stormwater management provisions of all development submittals. This includes residential subdivisions, commercial areas, and industrial facilities.
- Allegheny County should work in conjunction with the Pennsylvania Department of Environmental Protection to identify and correlate data on obstruction, encroachment, and other appropriate permit holders and the associated facilities.

7.3 Plan Adoption

The specific procedures required to adopt the Plan are delineated in Act 167. The primary steps are listed below in the order of expected completion:

- Complete draft plan and submit to the Pennsylvania Department of Environmental Protection for review and comment.
- Each municipality within the watershed must review the Plan and provide any comments to Allegheny County.
- A public hearing must be held to present the findings of the Plan and receive further public comment.
- The Board of Allegheny County Commissioners must approve the Plan and adopt it by resolution.

- The Pennsylvania Department of Environmental Resources must review and approve the final version of the Plan.

- Each municipality must adopt the provisions of the Plan into their appropriate ordinances within six months after Pennsylvania Department of Environmental Protection approval.

Each municipality and affected agency should receive ample time to review and offer comments on the Plan prior to the public hearing.

7.4 Plan Implementation

The steps required to implement the Plan are primarily the responsibility of the watershed municipalities and Allegheny County. The municipalities should enforce the provisions of their updated ordinances so that development is accomplished in accordance with the performance standards outlined in the Plan. Allegheny County, through its subdivision and land development plan review function, should continue to identify deficiencies in proposed plans and assist the municipalities in ensuring their correction.

Additionally, to facilitate the implementation and ongoing performance of the Plan provisions, Allegheny County should maintain and make the updated watershed model available for use by municipalities, developers, and engineers. This will provide improved estimates of the impact of any development or other land use change on the downstream environment and infrastructure. This will also aid in the review of any no-harm evaluations submitted with development plans.

7.5 Future Plans

Section 5 of Act 167 requires that stormwater management plans must be updated at least every 5 years, or when development conditions make an update project desirable. Given the expected pace of continued development in the Little Sewickley Creek Watershed, it is recommended that Allegheny County plan to complete the next Plan in 2007. Many of the products and procedures resulting from the 2002 effort should facilitate the future work. These include the updated watershed model and the computer-based watershed land use data.

APPENDIX A

REFERENCES

REFERENCES

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11. Field Manual of Procedure PSU-IV for Estimating Design Flood Peaks on Unguaged Pennsylvania Watersheds., Pennsylvania State University , Department of Civil Engineering, Pennsylvania Department of Transportation, April 1981.

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APPENDIX B

DEFINITIONS

DEFINITIONS

ACT: The Storm Water Management Act (Act of October 4, 1978, P.L. 864 No. 167; 32 P.S. 680.1-680.17, as amended by Act of May 24, 1984, No. 63).

CHANNEL: A natural stream that conveys water; a ditch or open channel excavated for the flow of water.

CONDUIT: Any channel intended for the conveyance of water, whether open or closed.

CONFLUENCE: Points where watercourses join together.

CONSERVATION DISTRICT (ACCD): The Allegheny County Conservation District.

COUNTY: The County of Allegheny, Pennsylvania.

CULVERT: A pipe, conduit or similar structure including appurtenant works which carries a stream under or through an embankment or fill.

DAM: Any artificial barrier, together with its appurtenant works, constructed for the purpose of impounding or storing water, or a structure for highway, railroad or other purposes that may impound water.

DESIGN STORM: The amount of precipitation from a storm event measured in probability of frequency of occurrence (e.g., 50-year storm) and duration (e.g., 24-hour), and used in computing stormwater management control systems.

DETENTION: Slowing, dampening, or attenuating runoff flows entering the storm drainage system by temporarily holding water in areas such as detention basins, reservoirs, on roof tops, in streets, parking lots, or within the drainage system itself, and releasing the water at a desired rate of discharge.

DETENTION BASIN: A basin designed to retard stormwater runoff by temporarily storing the runoff and releasing it at a predetermined rate.

DEVELOPER: Any landowner, agent of such landowner or tenant with the permission of such landowner, who makes or causes to be made a subdivision or land development.

DEVELOPMENT: Any activity, construction, alteration, change in land use or similar action that affects storm water runoff characteristics.

DISCHARGE: Rate of flow, specifically fluid flow. A volume of fluid flowing from a conduit or channel, or being released from detention storage, per unit of time. Commonly expressed as cubic feet per second (cfs), million gallons per day (mgd), gallons per minute (gpm), or cubic meters per second (cms).

DISCHARGE CONTROL POINT: A point of hydraulic concern, such as a bridge, culvert, or channel section, for which the rate of runoff is computed or measured in the watershed plan.

DISCHARGE STRUCTURE: A structure design to meter storm runoff through a Stormwater Management Basin. Structure may contain different sizes of circular orifices, weirs and other discharge appurtenances. The structure may be a circular pipe or stand pipe or a box type structure such as a roadway inlet

DRAINAGE: Interception and removal of excess surface water or groundwater from land by artificial or natural means.

DRAINAGE AREA: The contributing area to a single drainage basin, expressed in acres, square miles, or other units of area; also called a catchment area, watershed, or river basin, the area served by a drainage system or by a watercourse receiving storm and surface water.

ENCROACHMENT: Any structure or activity which in any manner changes, expands or diminishes the course, current or cross section of any watercourse, floodway or body of water.

EROSION: The wearing away of the land surface by running water, wind, ice, or other geological agents.

FLOOD CONTROL PROJECT: Any device or structure designed and constructed to protect a designated area from flood flows of a specified magnitude and probability (frequency) of occurrence.

FLOOD HAZARD AREA: A normally dry land area that has been and is susceptible to being inundated by surface or subsurface flow in addition to stream overflow.

FLOODPLAIN: A normally dry land area adjacent to stream channels that is susceptible to being inundated by overbank stream flows. For regulatory purposes, the Flood Plain Management Act (Act of October 4, 1978, P.L. 851, No. 166) and regulations pursuant to the Act define the floodplain as the area inundated by a 100-year flood and delineated on a map by FEMA (Federal Emergency Management Agency).

FLOODWAY: A channel, natural, excavated, or bounded by dikes and levees used to carry excessive flood flows to reduce flooding. Sometimes considered the transitional area between the active channel and the floodplain.

GROUNDWATER: That part of the subsurface water that is below the zone of saturation.

HYDRAULIC CHARACTERISTICS: The features of a watercourse which determine its water conveyance capacity. These include size and configuration of the cross section of the watercourse, alignment of watercourse, gradient of the watercourse, texture of materials along the watercourse, amount and type of vegetation within the watercourse, and size, configuration and other characteristics of structures within the watercourse.

HYDROLOGY: The science dealing with the waters of the earth and their distribution and circulation through the atmosphere. Engineering hydrology deals with the application of hydrologic concepts to the design of projects for use and control of water.

IMPERVIOUS MATERIAL OR SURFACE: Material that resists the entrance or passing through of water or other liquids.

INFILTRATION: The penetration and movement of water through the earth's surface.

LAND DEVELOPMENT: As defined by the Municipalities Planning Code [Section 107 (11)]: "(i) the improvement of one lot or two or more contiguous lots, tracts or parcels of land for any purpose involving (a) a group of two or more buildings, or (b) a division or allocation of land or space between or among two or more buildings, or (c) a division or allocation of land or space between or among two or more existing or prospective occupants by means of, or for the purpose of, streets, common areas, leaseholds, and condominiums, building groups, or other features; (ii) a division of land."

LAND DISTURBANCE: Any activity involving grading, tilling, digging, filling, or stripping of vegetation; or any other activity which causes land to be exposed to the danger of erosion.

OBSTRUCTION: Any surface structure, or fill above or below the surface of land or water, any activity that might impede, retard, or change flood flows.

OUTFALL: Points or areas at which storm water runoff leaves a site, which may include streams, storm sewers, swales or other well defined natural or artificial drainage features, as well as areas of dispersed overland flows.

OUTLET STRUCTURE: A structure designed to control the volume of storm water runoff that passes through it during a specific length of time.

PEAK RATE OF RUNOFF (OR DISCHARGE): The maximum rate of flow of water at a given point and time resulting from a predetermined storm.

PERFORMANCE STANDARD: A standard which establishes a result or outcome which is to be achieved but does not prescribe specific means for achieving it.

PERMEABILITY: The rate at which water will move through a saturated soil.

PERVIOUS MATERIAL: Material which permits the passage or entrance of water or other liquid.

POINT OF INTEREST: A point of hydrological and hydraulic importance used for computing a release rate percentage. These may include points of stream confluences, an existing obstruction or problem area, or other similar points.

RATE OF RUNOFF: Instantaneous measurement of water flow expressed in a unit of volume per unit of time, also referred to as DISCHARGE. Usually stated in cubic feet per second (cfs) or gallons per minute (gpm).

RELEASE RATE PERCENTAGE: The percentage of predevelopment peak rate of runoff from a watershed subarea (as delineated in the watershed plan), which defines the allowable post-development peak discharge from any development site in that subarea. The release rate percentage is determined by computing the following:

$$\frac{\text{Subarea predevelopment rate of runoff contributing to peak at downstream point of interest}}{\text{Subarea pre-development peak rate of runoff}} \times 100 = \text{Release Rate Percentage}$$

RESERVOIR: Any basin, either natural or artificial, which contains or will contain the water impounded by a dam.

RUNOFF CHARACTERISTICS: The surface components of any watershed that affect the rate, amount, and direction of storm water runoff. These may include but are not limited to: vegetation, soils, slopes, and man-made landscape alterations.

SCS: Soil Conservation Service, U.S. Department of Agriculture.

SEDIMENT: Solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site or origin by air, water, gravity, or ice and has come to rest on the earth's surface.

SEDIMENTATION: The process by which mineral or organic matter is accumulated or deposited by moving wind, water, or gravity.

SOIL-COVER COMPLEX METHOD: A method of runoff computation developed by the U.S. Soil Conservation Service and found in its publication "Urban Hydrology for Small Watersheds," Technical Release No. 55, SCS, January 1975 (or most current edition).

STORM SEWER: A sewer that carries intercepted surface runoff, street water, and other wash waters, or drainage, but excludes sewage and industrial wastes.

STORM SEWER DISCHARGE: Flow from a storm sewer that is discharged into a receiving stream.

STORM WATER COLLECTION SYSTEM: Natural or engineered structures which collect and transport storm water through or from a drainage area to the point of final outlet, including but not limited to, any of the following: conduits and appurtenant features, canals, channels, ditches, streams, culverts, streets and pumping stations.

STORM WATER MANAGEMENT PLAN: The plan for managing storm water runoff from a specific development site.

STORM WATER RUNOFF: Waters resulting from snow melt or precipitation within a drainage basin, flowing over the surface of the ground, collected in channels and conduits, and carried by receiving streams.

SUBAREA: A portion of the watershed that has similar hydrological characteristics and drains to a common point.

TIME OF CONCENTRATION: The time necessary for surface runoff to reach the outlet of a subarea from the hydraulically most remote point in the tributary drainage area.

VOLUME OF STORM WATER RUNOFF: Quantity of water normally measured in inches, cubic feet, or acre-feet, measured or determined analytically from (1) runoff coefficients; (2) rainfall/runoff ratios; and (3) areas underneath hydrographs.

WATERCOURSE (WATERWAY): Any channel of conveyance of surface water having a defined bed and banks, whether natural or artificial, with perennial or intermittent flow.

WATERSHED: The entire region or area drained by a river or other body of water whether natural or artificial.

WATERSHED STORM WATER MANAGEMENT PLAN (OR WATERSHED PLAN): The plan for management of storm water runoff throughout a designated watershed as required by the Pennsylvania Storm Water Management Act.

APPENDIX C

SIGNIFICANT OBSTRUCTION AND ANALYSIS.

[illegible] Watershed Study
[illegible] 100.81
Field Visit 6/5/02

CROSSING NO.	Sub Area	DISK/PHOTO	COMMENTS	Capacity CFS (see calcs)			
1	1	n/a	24" RCP, 75% buried	22.2			
2	1	3-04	60" RCP	230			
3	1	3-02	60" RCP with wingwalls	195			
4	1	3-03	30" CMP	41			
5	2	3-01	30" CMP. Wingwalls on upstream side.	41			
6	2	1-15	RC box culvert - 8' wide, 4' high	240			
7	2	1-14	RC box culvert - 8' wide, 6' high	400	A sft	V fps	Q cfs =V*A
8	2	1-13	Concrete deck bridge - 14' wide, 6' high. Audubon and Little Sewickley Rds.	672	84	8	672
9	5	1-11	42" RCP. Burt Rd.	85			
10	5	1-12	27" RCP under Audubon Rd.	40			
33	9	n/a	27" CMP. Recently reconstructed, fresh riprap and SF	28.5			
11	11	1-10	Concrete deck bridge - 15' wide, 2-1/2' high - Backbone Rd.				
12	13	n/a	RC box culvert - 25' wide, 8' high "Bridge #3' on plaque. Old Picture No. 9? Intersection of Fern Hollow and Little Sewickley Rds.	2125	A sft	V fps	Q cfs =V*A
13	14	n/a	Concrete deck bridge - 12' wide, 4' high, Blackburn Road tee	n/a	48	8	384
14	14	3-09	Concrete deck bridge - 15' wide, 6-1/2' deep	780	97.5	8	780
16	14	3-08	Concrete deck bridge - 12' wide, 8-1/2' high, Pony Hollow & Fern Hollow Rds.	816	102	8	816
19	15	3-10	Concrete deck bridge w/ upstream conc. Wall - 15' wide, 5' high	600	75	8	600
20	18	3-07	RC box culvert - 15' wide, 7' high	1050	A sft	V fps	Q cfs =V*A
21	18	3-06	Steel deck bridge - 30' wide, 3-1/2' high, Pink House & Fern Hollow Rds.	840	105	8	840
22	20	1-08	Concrete deck bridge - 30' wide, 15' high - Backbone Rd.	3600	450	8	3600
24	21	1-09	36" dia. RCP	88			
25	24	n/a	No structure - stone filled channel covered by earth	0			
26	24	1-07	Wooden bridge on steel beams - 4' wide, 30' high	960	120	8	960
27	28	12	48" HDPE - 'homemade'	113			
28	30	n/a	Twin 24" RCPs. Sevins & Little Sewick. Rds.	50			
29	33	3-11	Headwater end - 48" wide RCP half circle with headwall Tailwater end - RC box culvert	45			
30	36	1-05,06	30' wide concrete arch	5200			
31	36	1-04	30' wide concrete half circle	5200			
32	37	1-01,02,03	2 - 30' wide concrete half circles - combination road and RR	5200			
15	n/a	n/a	Could not locate				
23	n/a	n/a	No access - road closed				
n/a		3-05	24" RCP with headwall				

Little Sewickley Watershed Study
99-00010100.81
Field Visit 6/5/02

CROSSING NO.	DISK/PHOTO	COMMENTS
1	n/a	24" RCP, 75% buried
2	3-04	60" RCP
3	3-02	60" RCP with wingwalls
4	3-03	30" CMP
5	3-01	30" CMP. Wingwalls on upstream side.
6	1-15	RC box culvert - 8' wide, 4' high
7	1-14	RC box culvert - 8' wide, 6' high
8	1-13	Concrete deck bridge - 14' wide, 6' high. Audubon and Little Sewickley Rds.
9	1-11	42" RCP. Burt Rd.
10	1-12	27" RCP under Audubon Rd.
11	1-10	Concrete deck bridge - 15' wide, 2-1/2' high - Backbone Rd.
12	n/a	RC box culvert - 25' wide, 8' high 'Bridge #3' on plaque. Old Picture No. 9? Intersection of Fern Hollow and Little Sewickley Rds.
13	n/a	Concrete deck bridge - 12' wide, 4' high Blackburn Road tee
14	3-09	Concrete deck bridge - 15' wide, 6-1/2' deep
15	n/a	Could not locate
16	3-08	Concrete deck bridge - 12' wide, 8-1/2' high Pony Hollow & Fern Hollow Rds.
19	3-10	Concrete deck bridge w/ upstream conc. Wall - 15' wide, 5' high
20	3-07	RC box culvert - 15' wide, 7' high
21	3-06	Steel deck bridge - 30' wide, 3-1/2' high Pink House & Fern Hollow Rds.
22	1-08	Concrete deck bridge - 30' wide, 15' high - Backbone Rd.
23	n/a	No access - road closed
24	1-09	36" dia. RCP
25	n/a	No structure - stone filled channel covered by earth
26	1-07	Wooden bridge on steel beams - 4' wide, 30' high
27	12	48" HDPE - 'homemade'
28	n/a	Twin 24" RCPs. Sevins & Little Sewick. Rds.
29	3-11	Headwater end - 48" wide RCP half circle with headwall Tailwater end - RC box culvert
30	1-05,06	30' wide concrete arch
31	1-04	30' wide concrete half circle
32	1-01,02,03	2 - 30' wide concrete half circles - combination road and RR
33	n/a	27" CMP. Recently reconstructed, fresh riprap and SF
n/a	3-05	24" RCP with headwall

URS

Page ____ of ____

Job LITTLE SEWICKLEY CREEK | Project No. 99-00010100.8 | Sheet 1 of ____

Description ASSUMPTIONS. | Computed by [illegible] | Date 7-3[illegible]

Checked by ____ | Date ____

Reference

OB 1 : CROWN → Assume Inv in = 100'
(24" RCP)
S = 0.0021 (base on Sub area 1)
Length = 30' (assume two lanes w/ shoulder)
⇒ Inv out = 100 - 30 (0.0021)
= 99.94'
→ Assume HW Elevation = 100' + 2' (pipe dia)
= 102'
∴ HW/D = 2'/2' = 1

ROADWAY → Assume HW Elevation = 100' + 2' (pipe dia) + 1' (pavement depth)
= 103'
∴ HW/D = 3'/2' = 1.5

* Assume Entrance Type = Groove End projecting.
* Assume TW = 0.1' Elev. ⇒ 99.94' + 0.1 = 100.04'

OB2 : CROWN → Assume Inv in = 100'
(60" RCP)
S = 0.0021 (base on Sub area 1)
Length = 40' (assume two lanes w/ Shoulder).
⇒ Inv out = 100 - (0.0021)(40)
= 99.92'
→ Assume HW Elevation = 100' + (60/12) (pipe dia) = 105'
∴ HW/D = 5'/5' = 1

ROADWAY → Assume HW Elevation = 100' + 5' (Pipe dia.) + 3' (pavement depth) ↳ base on photo.
= 108'
∴ HW/D = 8'/5' = 1.6.

* Assume Entrance Type = Groove End projecting

* Assume TW = 0.3' (base on the photo)
= 99.92 + 0.3'
Elev = 100.22'

URS

Job LITTLE SEWICKLEY CREEK | Project No. 99-00010100.81 | Page ___ of ___ | Sheet 2 of ___
Description ASSUMPTIONS | Computed by YLEL | Date 7/31/02
Checked by ___ | Date ___

Reference

OB 3: (60" RCP) w/ wingwall

CROWN → Assume. Inv in = 100'
S = 0.0021 (base on Subarea 1)
Length = 35' (assume)
Inv out = 100' − 35'(0.0021)
= 99.93'

→ Assume HW Elevation = 100' + (60/12) = 105' (Pipe dia)
HW/D = 1

ROADWAY → Assume HW Elevation = 100' + 5' + 2.5' (Pavement depth → base on photo.)
= 107.5'
HW/D = 7.5/5 = 1.5

* Entrance Type = Square edge w/ headwall
* Assume TW = 0.5'
Elev. = 99.93' + 0.5' = 100.43'

OB 4: (30" CMP)

CROWN → Assume Inv in = 100'
S = 0.0021 (base on Subarea 1)
Length = 45' (assume)
Inv out = 100 − 45(0.0021) = 99.91'

→ Assume HW Elevation = 100' + 30/12 = 102.5' (↓ pipe dia)
HW/D = 1

Roadway → Assume HW Elevation = 100' + 2.5' + 3' (pavement depth, base on photo)
= 105.5'
HW/D = 5.5/2.5 = 2.2

* Assume Entrance Type = Projecting.
* Assume TW = 0.5'
Elev. = 99.91 + 0.5' = 100.41

Page ____ of ____

Job: LITTLE SEWICKLEY CREEK | Project No. 99-00010100.81 | Sheet 3 of ____
Description: ASSUMPTION | Computed by: YLEL | Date: 7/31/02
Checked by: ____ | Date: ____

Reference

OB5:
(30" CMP w/ Wingwall)

CROWN → Assume inv in = 100'
S = 0.0022 (base on Sub area 2)
Length = 35' (assume)
inv out = 100 − 0.0022(35)
= 99.92'

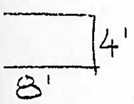
→ Assume HW Elevation = 100 + 30/12 = 102.5'
(30/12 ↓ pipe dia)
HW/D = 1

ROADWAY → Assume HW Elevation = 100' + 2.5' + 2'
= 104.5'
(↳ pavement to base of culvert)

HW/D = 4.5 / 2.5 = 1.8

* Assume Entrance type = wingwall
* Assume TW ≃ 0.1
Elev. = 99.92' + 0.1' = 100.02'

OB6:
(RC Box Culvert)
8'W x 4'H



CROWN → Assume inv in = 100'
S = 0.0022 (base on Subarea 2)
Length = 40' (assume)
inv out = 100 − 40(0.0022)
= 99.91'

→ Assume HW Elevation = 100 + 4 = 104'
HW/D = 4/4 = 1

ROADWAY → Assume HW Elevation = 100' + 4' + 1' (pavement to base of culvert)
= 105'

HW/D = 5/4 = 1.25

* Assume Entrance type = wingwall flare w/ 30° to 75°
* Assume TW = 0.25
Elev = 99.91' + 0.25' = 100.16'

URS

Job LITTLE SEWICKLEY CREEK.	Project No. 99-00010100.81	Page ____ of ____
		Sheet 4 of ____
Description ASSUMPTIONS.	Computed by YLEL	Date 3-1-02
	Checked by ____	Date ____

Reference

OB 7:
(RC Box CULVERT)
8'W x 6'H.

CROWN → Assume Inv in = 100'

S = 0.0022 (base on [illegible])

Length = 40' (assume)

→ Inv out = 100 − 40 (0.0022)

= 99.91'

→ Assume HW Elevation = 100' + 6' = 106'

HW/D = 6/6 = 1

(6' ↓ pipe dia)

ROADWAY → Assume HW Elevation = 100' + 6' + 1'

(6' ↑ pipe dia; 1' pavement depth (base on [illegible]))

= 107'

HW/D = 7/6 = 1.17'

* Assume Entrance type = Skewed Headwall. 15°

* Assume TW = 0.5'

Elev = 99.91' + 0.5' = 100.41'

URS

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Job LITTLE SEWICKLEY CREEK.

Project No. 99-00010100.81

Sheet 5 of ____

Description ASSUMPTION

Computed by YLEL

Date 8-1-02

Checked by ____

Date ____

Reference

OB 9 (42" RCP)

CROWN → Assume Inv in = 100'
S = 0.0021' (base on Sub ...)
L = 16'. (assume by photo)
→ Inv out = 100 − 16(0.0021)
= 99.97'

→ Assume HW Elevation = 100' + 42/12 = 103.5' (42/12 ↓ pipe dia.)
∴ HW/D = 3.5/3.5 = 1

ROADWAY → Assume HW Elevation = 100' + 3.5' + 1.5' (paveme...)
= 105'
∴ HW/D = 5/3.5 = 1.43

∴ Assume Entrance Type = Groove End projecting.
Assume TW = 0.5'   Elev = 99.97' + 0.5' = 100.47'

OB 10. (27" RCP)

CROWN →. Assume Inv in = 100'
S = 0.0021 (base on Subarea ...)
L = 35' (assume)
→ Inv out = 100 − 35(0.0021)
= 99.93'

→ Assume HW Elevation = 100' + 27/12 = 102.25' (27/12 ↓ pipe dia)
HW/D = 2.25/2.25 = 1

ROADWAY → Assume HW Elevation = 100' + 2.25' + 3.5'
= 105.75'

∴ HW/D = 5.75/2.25 = 2.56

∴ Entrance Type = Square edge with Headwall

Assume TW = 0.2'
Elev. = 99.93' + 0.2' = 100.13'

URS

Job Little Sewickley Creek	Project No. 99-00010100.81	Page ___ of ___	
Description Assumptions	Computed by JEA	Sheet ___ of ___	Date 8/2/02
	Checked by YLEL	Date 8/6/02	

Reference

O.B. # 12
(25'W x 8'H RC Box)

Crown

ASSUME INV IN = 100.00'
S = 0.0026 (Subarea 13)
L = 33' (2 lanes w/ shoulder)
INV OUT = 100 - (33)(0.0026) = 99.914

HW ELEV = 100.00' + 8.0' = 108.00'
HW/D = 8/8 = 1.0
TW ≈ 6' + 99.914 = 105.914 (Assumed)

Roadway

HW ELEV = 100.00' + 8.0' + 2.0' (pavement)
= 110.00'
HW/D = 1.25
TW ≈ 6.5' + 99.914 = 106.414 (Assumed)

Entrance Condition wingwall @ 45° (Assumed)

O.B. # 20
(15'W x 7'H RC Box)

Crown

ASSUME INV IN = 100.00
S = 0.0020 (Subarea 15)
L = 33' (2 lanes w/ shoulders)
INV OUT = 100.00 - (33)(0.002) = 99.934

HW ELEV = 100.00 + 7.0' = 107.00'
HW/D = 7'/7' = 1.0
TW ≈ = 5' + 99.934 = 104.934

Roadway

HW ELEV = 100.00 + 7.0' + 2.0' (pavement)
= 109.00'
HW/D = 9'/7' = 1.286
TW ≈ 5.5 + 99.934' = 105.434

Entrance condition wingwall @ 45° assumed

URS

Job: LITTLE SEWICKLEY CREEK	Project No. 99-00010100.81	Page ___ of ___	Sheet ___ of ___
Description: ASSUMPTIONS	Computed by: JEA	Date: 8/2/02	
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OB 27
(48" HDPE)

CROWN ASSUME INV IN = 100.00'
S = 0.0017 (SUBAREA 28)
Length = 40' (ASSUME 2 LANES w/ shoulder)
INV OUT = 100.00 − (40)(0.0017) =
= 99.93'

HW ELEV. = 100.00 + 4.0' (Pipe DIAM)
= 104.00

HW/D = 4'/4' = 1.0

TW ≈ d_c = 2.6' + 99.93 = 102.55 (based on HDS 5 Chart 4 & HW/D = 1.0)

Roadway ASSUME 100.00 + 4.0 (pipe ϕ) + 2.0 (Top of wall)
= 106.00
HW/D = 6'/4' = 1.5

Entrance = SEH based on Photo
TW ≈ d_c = 3.2' + 99.93 = 103.13 (based on HDS 5 chart 4 and HW/D ...)

OB 28
(Twin 24" RCP)

Crown ASSUME INV IN = 100.00'
S = 0.0018 (Subarea 27)
Length = 40' (ASSUME 2 Lanes w/ shoulder)
INV OUT = 100 − (40)(0.0018) = 99.93'
HW ELEV = 100.00 + 2.0' (pipe ϕ) = 102.00'
TW ELEV = 1.3' + 99.93 = 101.23' (based d_c)

Roadway ASSUME 100.00 + 2.0' pipe ϕ + 2.0' (pavement)
= 104.00'
HW/D = 4/2 = 2
TW ELEV = 1.75 + 99.93 = 101.68' (based on d_c)

Entrance condition, ASSUME SEH

O.B. # 29
(Half circle 48" Ref Ø)

CROWN

ASSUME INV IN = 100.00'
S = 0.0017 (subarea 33)
Length = 33' (2 Lanes w/in R/W)
INV OUT = 100.00' − (33)(0.0017) = 99.9

HW Elev = 100.00 + 2.0' (½ full Ø)
= 102.00
HW/D = 2/2 = 1
TW ≈ d_c = 1.6' + 99.94 = 101.54

Roadway
ASSUME 100.00' + 2.0' (½ full Ø) + 2.0' pav...
HW ELEV = 104.00
HW/D = 4/2 = 2
TW ELEV ≈ d_c = 2.6' + 99.94 = 102.54

Entrance Condition SEH = based on photo # 334

O.B. # 30
(30' wide Stone Arch)

CROWN

ASSUME INV IN = 100.00
S = 0.0020 (Subarea 35)
Length = 32' (2 Lanes w/ sidewalk)
inv out = 100 − (32)(0.002) = 99.936
(assumed height)
HW ELEV = 100 + 18.83 = 118.83
TW ≈ Embankment depth ≈ 10' = 99.936 + 10.0 = 109.94
HW/D = 1.0

Roadway
ASSUME Top of wall ≈ 6.0 + Height of arch
= 100.0' + 18.83 + 6.0 = 124.83
TW ELEV ≈ Embankment depth = 10'
= 109.94

Entrance SEH based on photo

URS

Job: Little Sewickley Creek	Project No. 99-00010100.81	Page ___ of ___	Sheet ___ of ___
Description: Assumptions	Computed by: JEA	Date: 8/6/02	
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		Reference	

O.B. # 31
(30' wide concrete 1/2 ϕ)

Crown

ASSUME INV IN = 100.00
S = 0.0017 (Subarea 36)
LENGTH = 40' (2 Lanes w/ shoulder)
INV OUT = 100.0 − (40)(0.0017) = 99.932
HW ELEV = 100 + 18.83 = 118.83
TW = 10' (assumed)
= 99.932 + 10 = 109.932

Roadway

ASSUME Parapet wall 6.0'
HW = 100.0 + 18.83 + 6.0 = 124.83
TW = 10' assumed
= 109.932

Entrance SEH

O.B. # 32
((2) 30' wide conc. 1/2 ϕ)

Crown

ASSUME INV. IN = 100.00
S = 0.0005 (Subarea 37)
Length = 140' (2 Lanes w/ shoulder & Service ...)
INV OUT = 100.0 − (140)(0.0005) = 99.93
HW ELEV = 100 + 18.83 = 118.83'
HW/D = 1.0
TW = 10' assumed + 99.93 = 109.93

Roadway

Assume Pave Depth 3.0'
HW ELEV = 100.00 + 18.83 + 3.0 = 121.83'
TW = 10' assumed + 99.93 = 109.93'

Entrance Condition Wingwall Flare w/ 30°−75°

URS

Page ____ of ____
Sheet ____ of ____

Job: Little Sewickley Creek
Project No. 99-00010160.81
Description: Assumptions
Computed by: JEA
Date: 8/2/02
Checked by: YLEL
Date: 8/6/02

Reference

O.B. #33
(27" CMP)

Crown

ASSUME INV IN ELEV. = 100.00'
S = 0.0027 (Subarea 9)
Length = 33 ft (2 Lanes w/ shoulder)
INV OUT = 100.00' − (33)(0.0027) = 99.91

HW ELEV = 100.00 + 2.25' = 102.25'
HW/D = 1.0
TW ≈ dc = 1.35' + 99.91 = 101.26 (Assume dc

Roadway

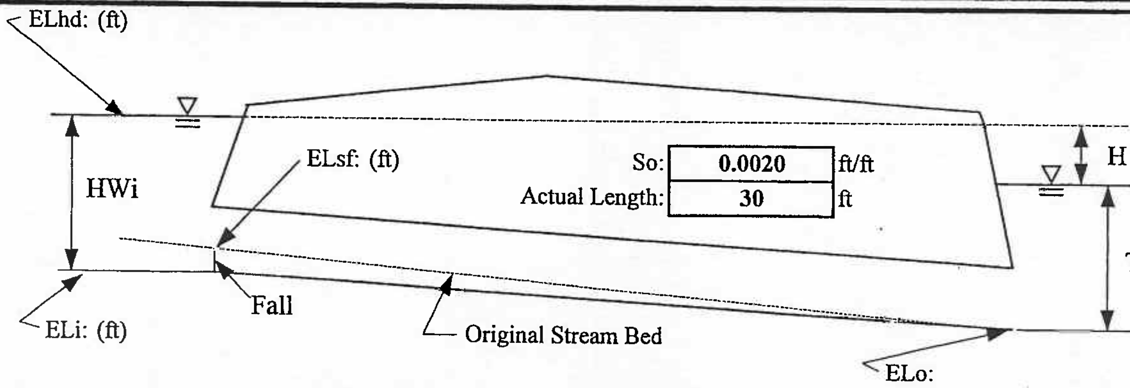
HW ELEV = 100.00 + 2.25' + 2.0' (pavement)
= 104.25'
HW/D = 4.25/2.25 = 1.89'
TW ≈ dc = 1.70 + 99.91 = 101.61 (Assume dc

Entrance Condition projecting (assumed)

PRO	STATION:	CULVERT DESIGN FORM
Little Sewickley Creek	Obstruction 1 (OB1)	DESIGNER / DATE: YLEL 7/31/02
		REVIEWER / DATE:

HYDROLOGICAL DATA

	ELi	ELo
a	100	99.94



CULVERT DESCRIPTION:

	Pipe Run #	Pipe Length (ft)	Pipe Dia. (Inch)	Total Flow Q (cfs)	HEADWATER CALCULATIONS: INLET CONTROL HWi/D (2)	HWi	FALL (3)	ELhi (4)	OUTLET CONTROL TW (5)	dc	(dc+D)/2	ho (6)	ke	H (7)	ELho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	Comments
a	OB1	30	24	**13.8**	1.00	2.00		102.00								102.00		at the Crown
a.	OB1	30	24	**22.2**	1.50	3.00		103.00								103.00		at the Roadway

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS
(2) HWi/D = HW/D OR HWt/D FROM DESIGN CHARTS
(3) FALL = HWi - (ELhd - ELsf) ; FALL IS ZERO FOR CULVERTS ON GRADE
(4) EL hi = HWi + ELi (INVERT OF INLET CONROL SECTION)
(5) TW BASED ON DOWNSTREAM CONTROL OR FLOW DEPTH IN CHANNEL
(6) ho = TW or (dc +D)/2 WHICHEVER IS GREATER
(7) H =[1 + ke +(29n^2L)/R^1.33] V^2 / 2g
(8) ELho = ELo + H + ho

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION

COMMENTS / DISCUSSION:

Note:

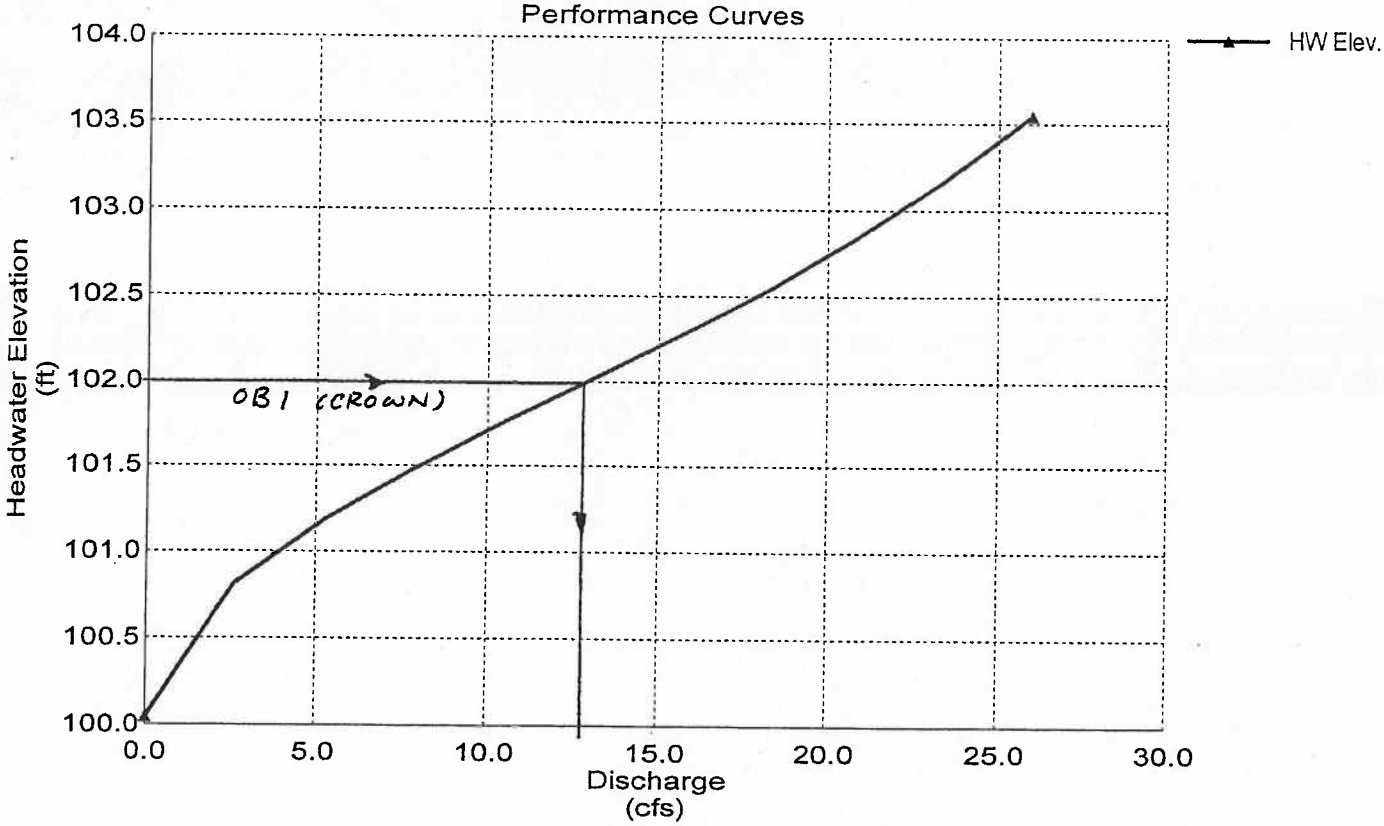
1. **Assume Inv. In at 100'**
2. **75% of pipe is buried so the actual flow should be 75% of the pipe flow.**
3. **Used HDS 5 Chart 1**

CULVERT BARREL SELECTED:

Size: 24"
Shape: Circular
Material / n: RCP / 0.012
Entrance: Groove end projection

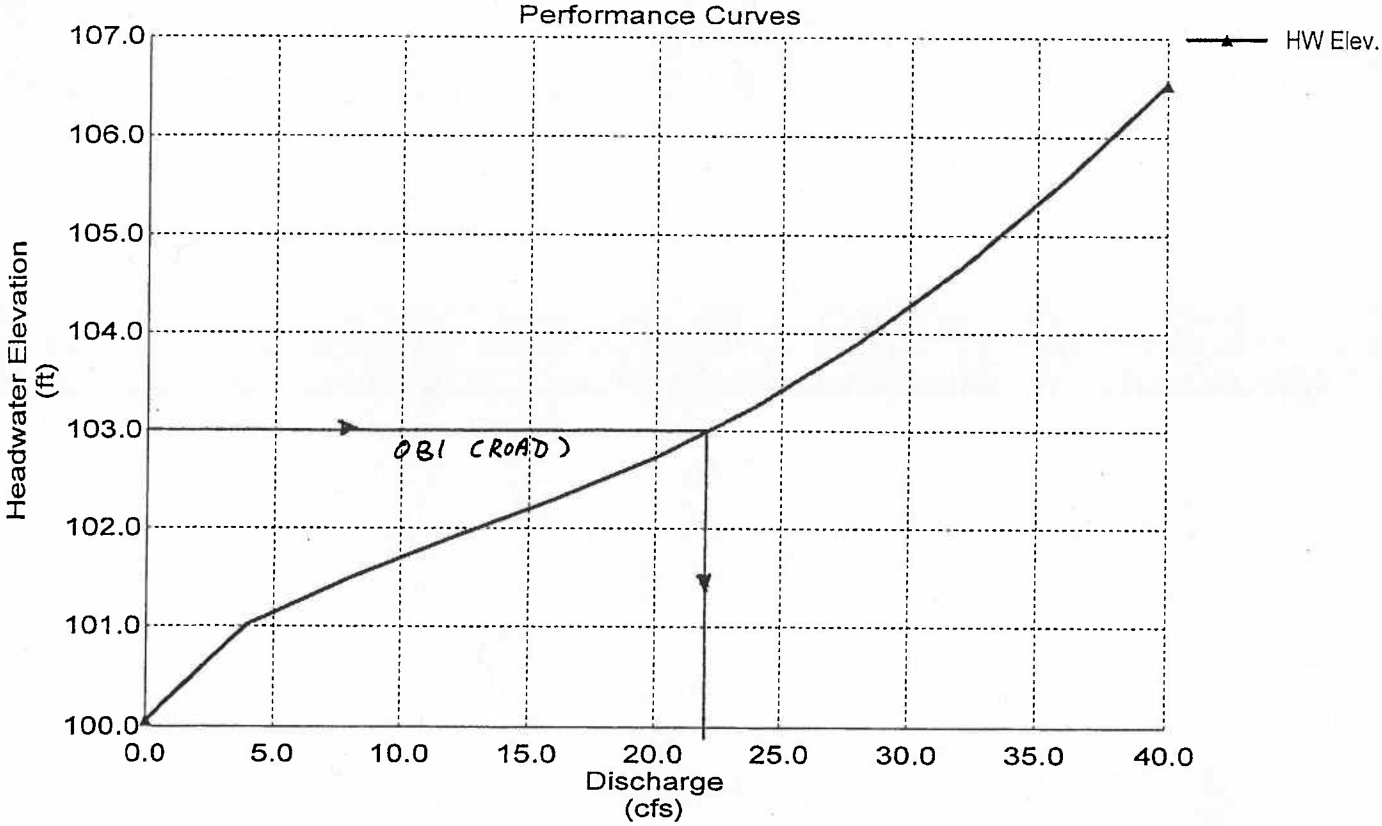
Performance Curves Report
OB-1-Crown

Range Data:				
	Minimum	Maximum	Increment	
Discharge	0.00	26.00	2.60	cfs



Performance Curves Report
OB-1-Road

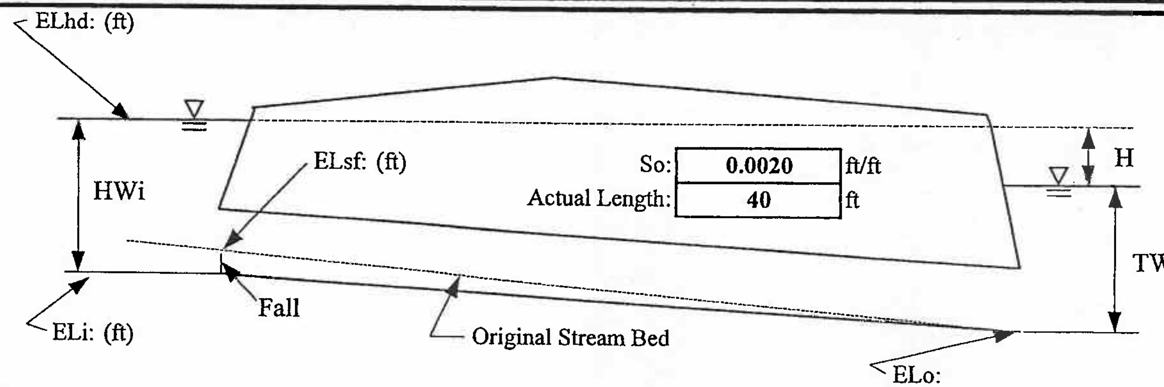
Range Data:				
	Minimum	Maximum	Increment	
Discharge	0.00	40.00	4.00	cfs



PRO	STATION:	CULVERT DESIGN FORM
Little Sewickley Creek	Obstruction 2 (OB2)	DESIGNER / DATE: YLEL. 7/31/02
		REVIEWER / DATE:

HYDROLOGICAL DATA

	ELi	ELo
a	100	99.92



CULVERT DESCRIPTION: / **HEADWATER CALCULATIONS**

	Pipe Run #	Pipe Length (ft)	Pipe Dia. (Inch)	Total Flow Q (cfs)	INLET CONTROL HWi/D (2)	HWi	FALL (3)	ELhi (4)	OUTLET CONTROL TW (5)	dc	(dc+D)/2	ho (6)	ke	H (7)	ELho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	Comments
a	OB2	40	60	130.0	1.00	5.00		105.00								105.00		at the Crown
a.	OB2	40	60	230.0	1.60	8.00		108.00								108.00		at the Roadway

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS
(2) HWi/D = HW/D OR HWt/D FROM DESIGN CHARTS
(3) FALL = HWi - (ELhd - ELsf) ; FALL IS ZERO FOR CULVERTS ON GRADE
(4) EL hi = HWi + ELi (INVERT OF INLET CONROL SECTION)
(5) TW BASED ON DOWNSTREAM CONTROL OR FLOW DEPTH IN CHANNEL
(6) ho = TW or (dc +D)/2 WHICHEVER IS GREATER
(7) H =[1 + ke +(29n^2L)/R^1.33] V^2 / 2g
(8) ELho = ELo + H + ho

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION

COMMENTS / DISCUSSION:

Note:

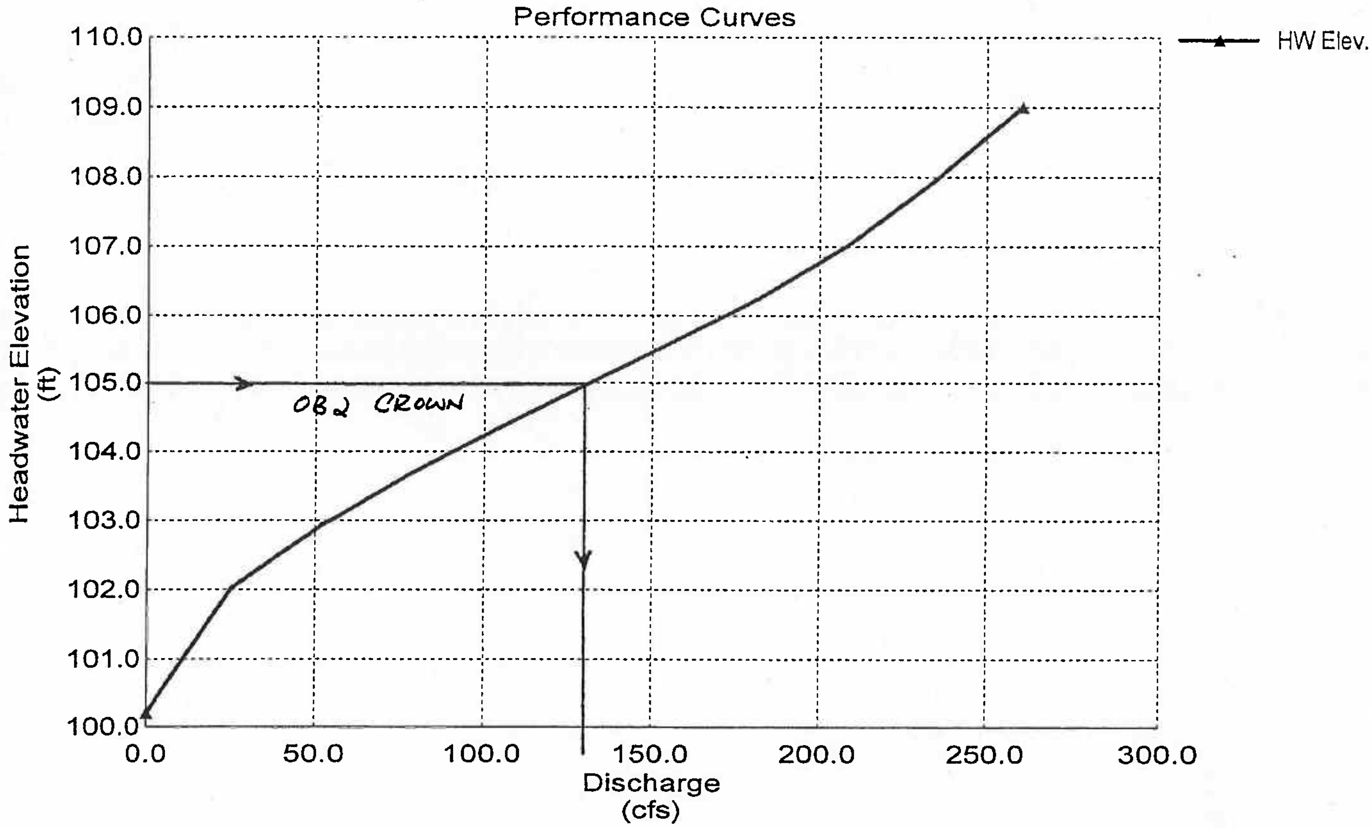
1. Assume Inv. In at 100'
2. Used HDS 5 Chart 1

CULVERT BARREL SELECTED:

Size: 60"
Shape: Circular
Material / n: RCP / 0.012
Entrance: Groove end projection

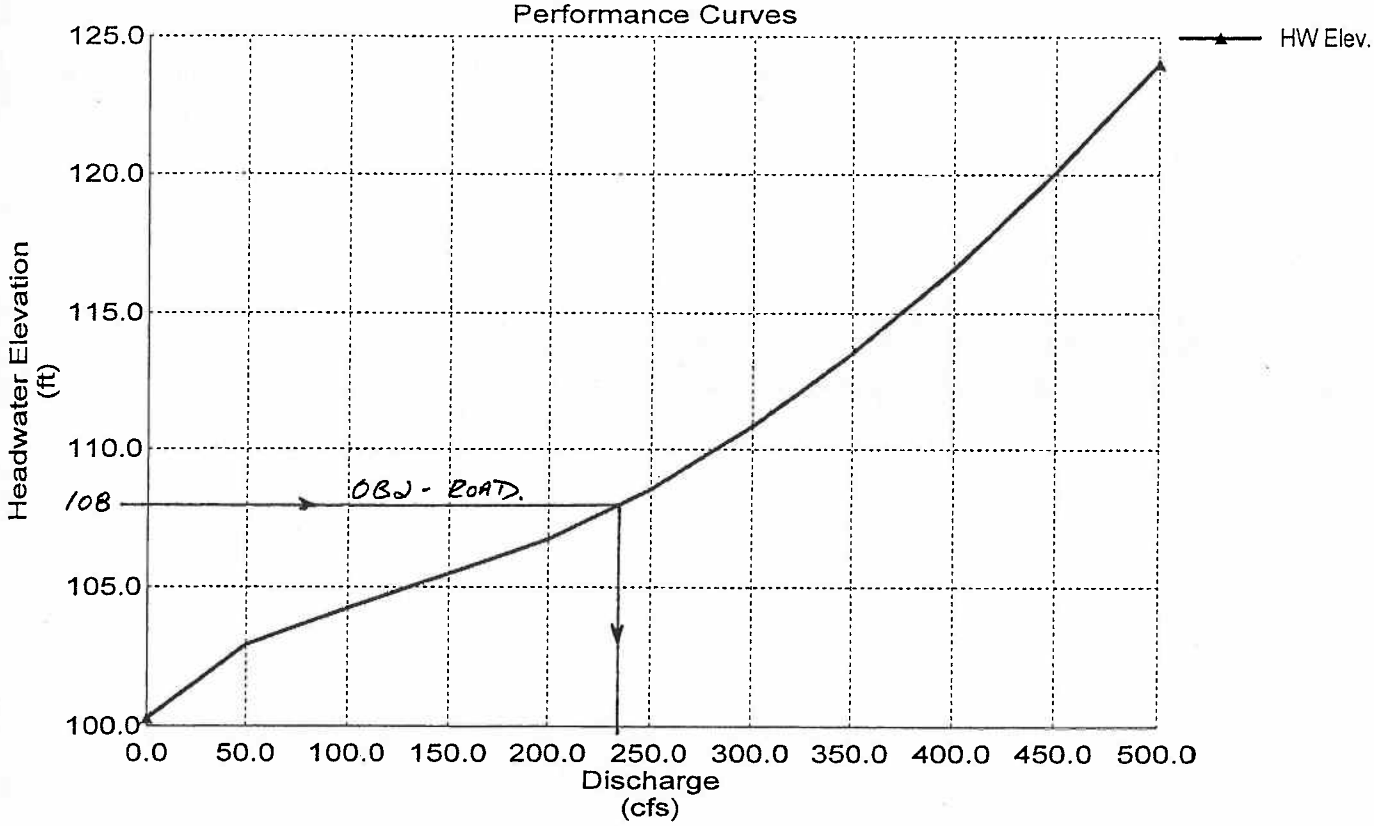
Performance Curves Report
OB2-Crown

Range Data:				
	Minimum	Maximum	Increment	
Discharge	0.00	260.00	26.00	cfs



Performance Curves Report
OB2-Road

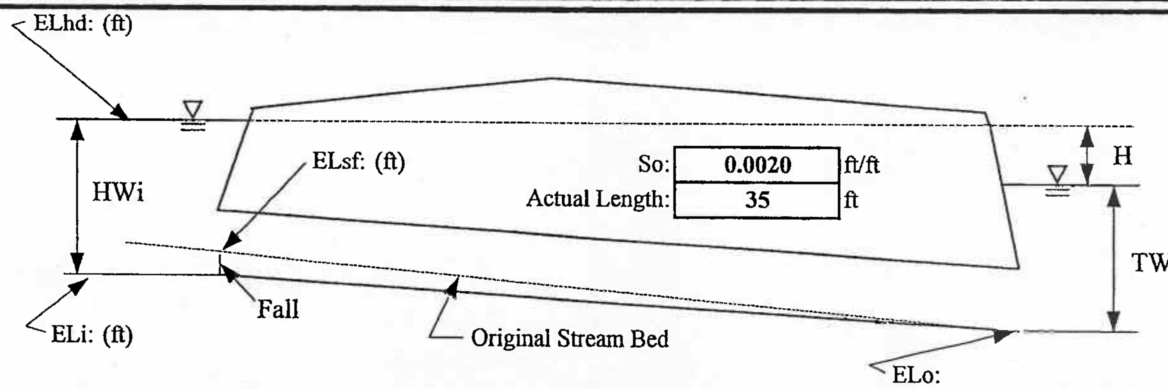
Range Data:			
	Minimum	Maximum	Increment
Discharge	0.00	500.00	50.00 cfs



PROJECT: Little Sewickley Creek	STATION: Obstruction 3 (OB3)	CULVERT DESIGN FORM
		DESIGNER / DATE: YLEL 7/31/02
		REVIEWER / DATE:

HYDROLOGICAL DATA

	ELi	ELo
a	100	99.93



CULVERT DESCRIPTION:

	Pipe Run #	Pipe Length (ft)	Pipe Dia. (Inch)	Total Flow Q (cfs)	INLET CONTROL HWi/D (2)	HWi	FALL (3)	ELhi (4)	OUTLET CONTROL TW (5)	dc	(dc+D)/2	ho (6)	ke	H (7)	ELho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	Comments
a	OB2	35	60	**120.0**	1.00	5.00		105.00								105.00		at the Crown
a.	OB2	35	60	**195.0**	1.50	7.50		107.50								107.50		at the Roadway

(HEADWATER CALCULATIONS)

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS
(2) HWi/D = HW/D OR HWt/D FROM DESIGN CHARTS
(3) FALL = HWi - (ELhd - ELsf) ; FALL IS ZERO FOR CULVERTS ON GRADE
(4) EL hi = HWi + ELi (INVERT OF INLET CONROL SECTION)
(5) TW BASED ON DOWNSTREAM CONTROL OR FLOW DEPTH IN CHANNEL
(6) ho = TW or (dc +D)/2 WHICHEVER IS GREATER
(7) H =[1 + ke +(29n^2L)/R^1.33] V^2 / 2g
(8) ELho = ELo + H + ho

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION

COMMENTS / DISCUSSION:

Note:
1. **Assume Inv. In at 100'**
2. **Used HDS 5 Chart 1**

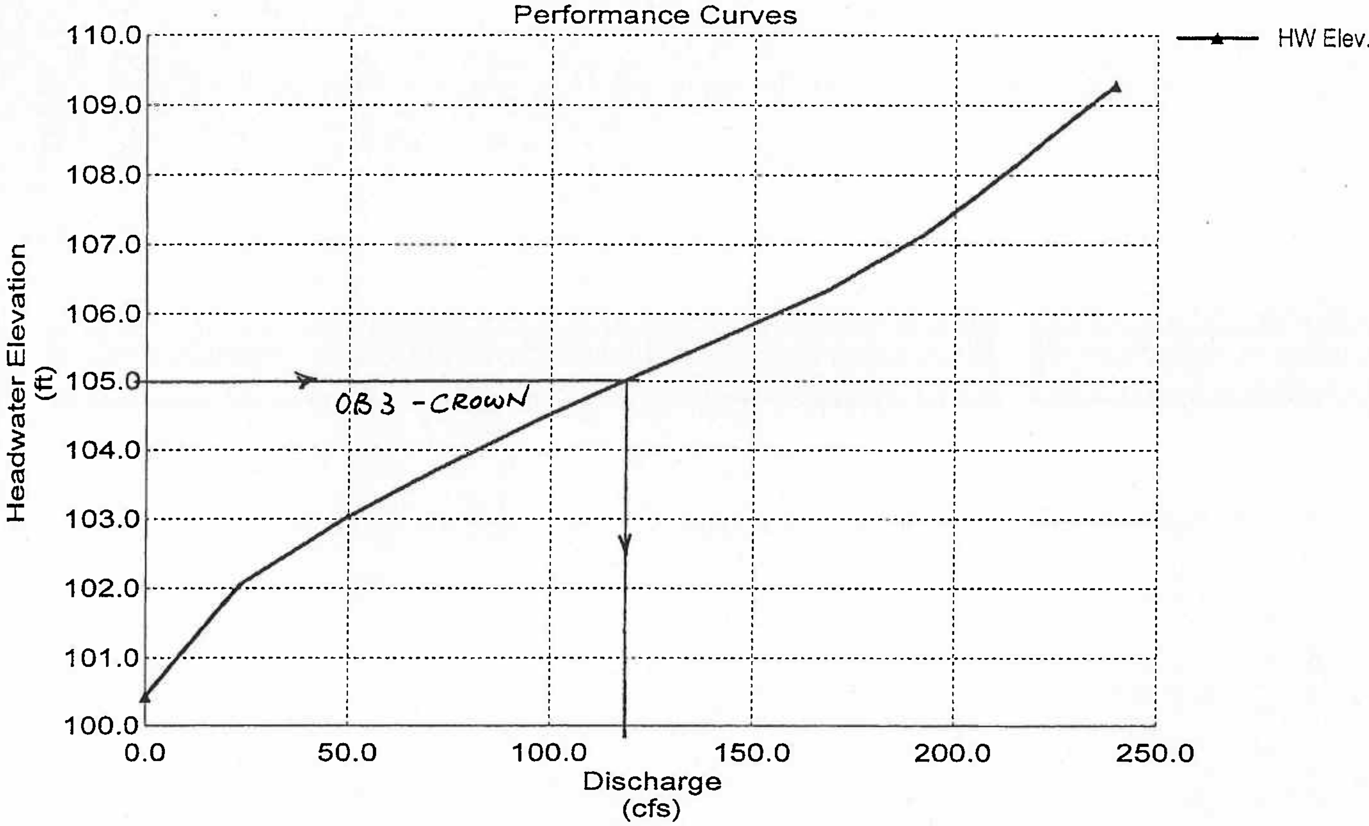
CULVERT BARREL SELECTED:

Size: 60"
Shape: Circular
Material / n: RCP / 0.012
Entrance: Endwall

Performance Curves Report
OB3-Crown

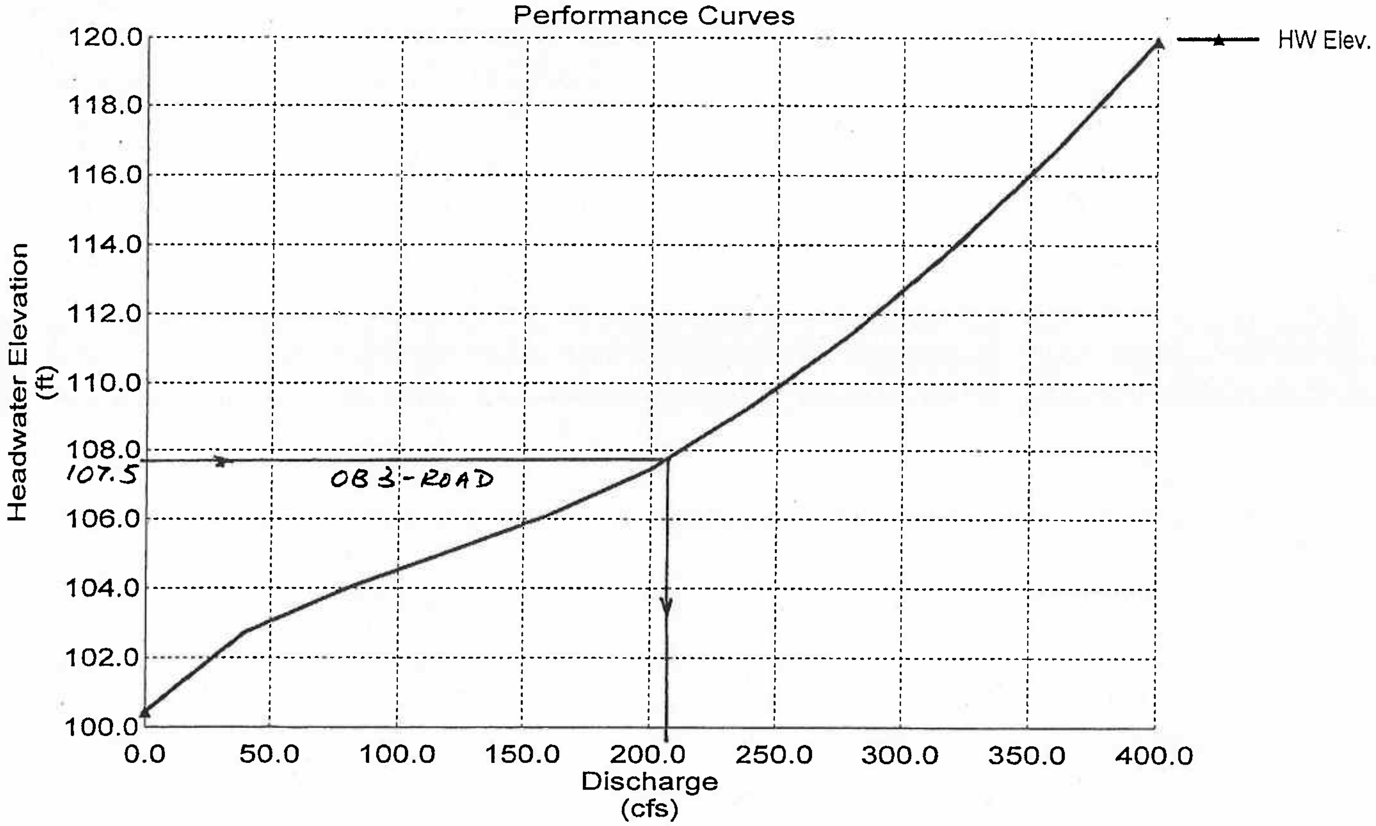
Range Data:

	Minimum	Maximum	Increment
Discharge	0.00	240.00	24.00 cfs



Performance Curves Report
OB3-Road

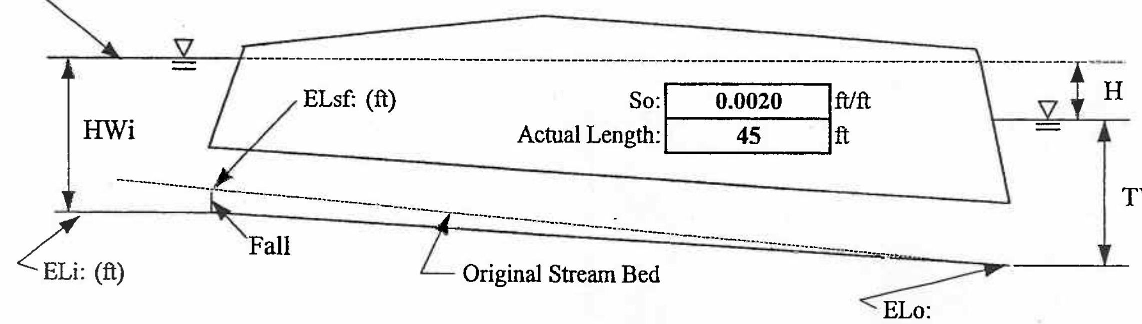
Range Data:			
	Minimum	Maximum	Increment
Discharge	0.00	400.00	40.00 cfs



PROJECT:	STATION:	CULVERT DESIGN FORM
Little Sewickley Creek	Obstruction 4 (OB4)	DESIGNER / DATE: YLEL 7/31/02
		REVIEWER / DATE:

HYDROLOGICAL DATA

	ELi	ELo
a	100	99.91



	CULVERT DESCRIPTION: Pipe Run #	Pipe Length (ft)	Pipe Dia. (Inch)	Total Flow Q (cfs)	INLET CONTROL HWi/D (2)	HWi	FALL (3)	ELhi (4)	OUTLET CONTROL TW (5)	dc	(dc+D)/2	ho (6)	ke	H (7)	ELho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	Comments
a	OB4	45	30	**20.0**	1.00	2.50		102.50								102.50		at the Crown
a.	OB4	45	30	**41.0**	2.20	5.50		105.50								105.50		at the Roadway

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS
(2) HWi/D = HW/D OR HWt/D FROM DESIGN CHARTS
(3) FALL = HWi - (ELhd - ELsf) ; FALL IS ZERO FOR CULVERTS ON GRADE
(4) EL hi = HWi + ELi (INVERT OF INLET CONROL SECTION)
(5) TW BASED ON DOWNSTREAM CONTROL OR FLOW DEPTH IN CHANNEL
(6) ho = TW or (dc +D)/2 WHICHEVER IS GREATER
(7) H =[1 + ke +(29n^2L)/R^1.33] V^2 / 2g
(8) ELho = ELo + H + ho

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION

COMMENTS / DISCUSSION:

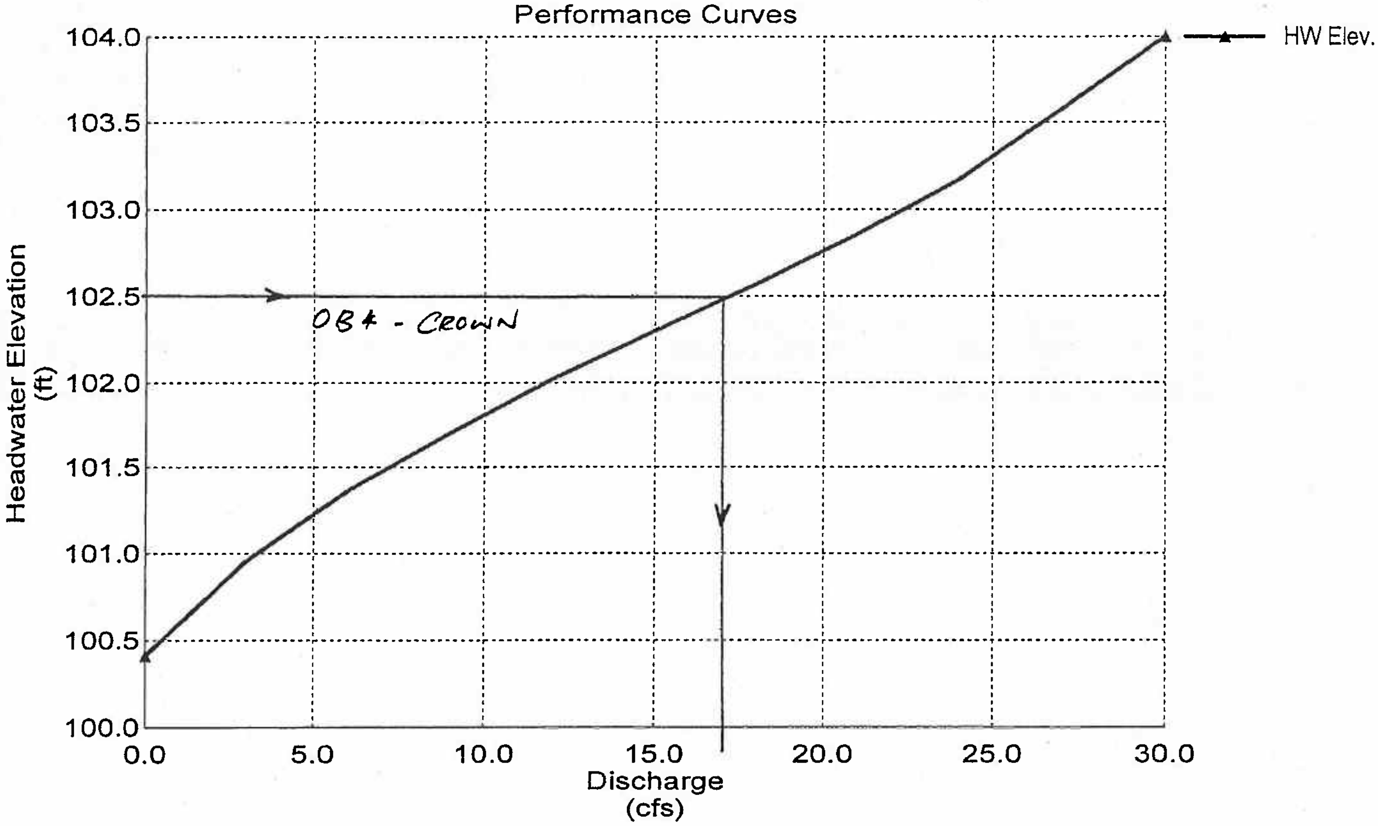
Note:
1. Assume Inv. In at 100'
2. Used HDS 5 Chart 2

CULVERT BARREL SELECTED:

Size: 30"
Shape: Circular
Material / n: CMP / 0.017
Entrance: Projection

Performance Curves Report
OB4-Crown

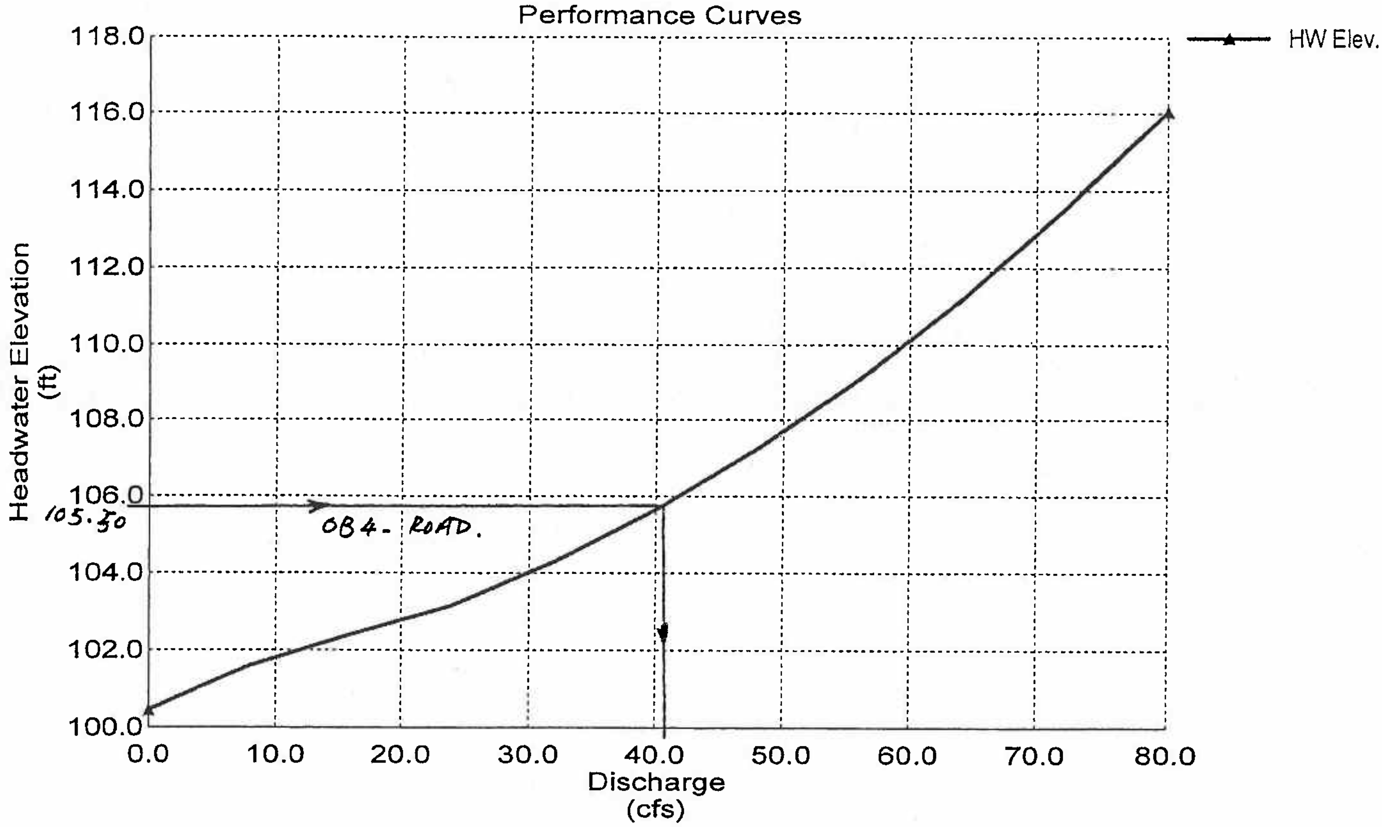
Range Data:			
	Minimum	Maximum	Increment
Discharge	0.00	30.00	3.00 cfs



Performance Curves Report
OB4-Road

Range Data:

	Minimum	Maximum	Increment	
Discharge	0.00	80.00	8.00	cfs



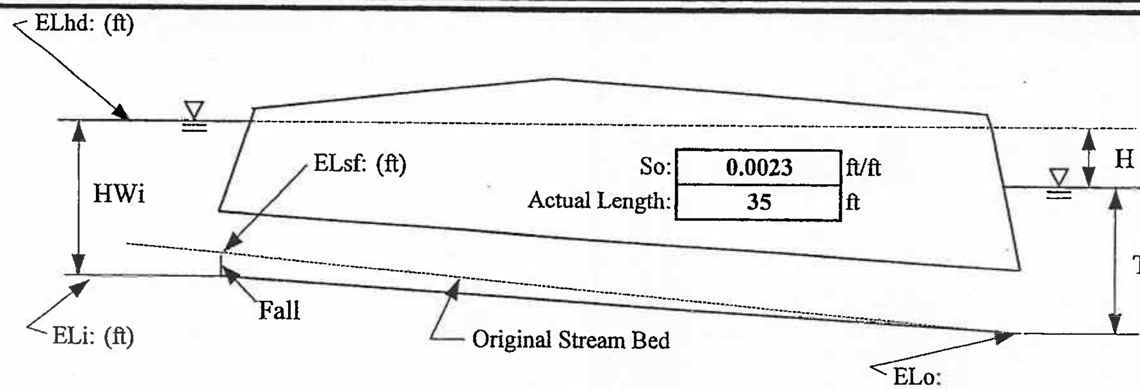
PRO..
Little Sewickley Creek

STATION: Obstruction 5 (OB5)

CULVERT DESIGN FORM
DESIGNER / DATE: YLEL 7/31/02
REVIEWER / DATE:

HYDROLOGICAL DATA

	ELi	ELo
a	100	99.92



CULVERT DESCRIPTION: / **HEADWATER CALCULATIONS**

	Pipe Run #	Pipe Length (ft)	Pipe Dia. (Inch)	Total Flow Q (cfs)	INLET CONTROL HWi/D (2)	HWi	FALL (3)	ELhi (4)	OUTLET CONTROL TW (5)	dc	(dc+D)/2	ho (6)	ke	H (7)	ELho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	Comments
a	OB5	35	30	22.0	1.00	2.50		102.50								102.50		at the Crown
a.	OB5	35	30	41.0	1.80	4.50		104.50								104.50		at the Roadway

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS
(2) HWi/D = HW/D OR HWt/D FROM DESIGN CHARTS
(3) FALL = HWi - (ELhd - ELsf) ; FALL IS ZERO FOR CULVERTS ON GRADE
(4) EL hi = HWi + ELi (INVERT OF INLET CONROL SECTION)
(5) TW BASED ON DOWNSTREAM CONTROL OR FLOW DEPTH IN CHANNEL
(6) ho = TW or (dc +D)/2 WHICHEVER IS GREATER
(7) H =[1 + ke +(29n^2L)/R^1.33] V^2 / 2g
(8) ELho = ELo + H + ho

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION

COMMENTS / DISCUSSION:

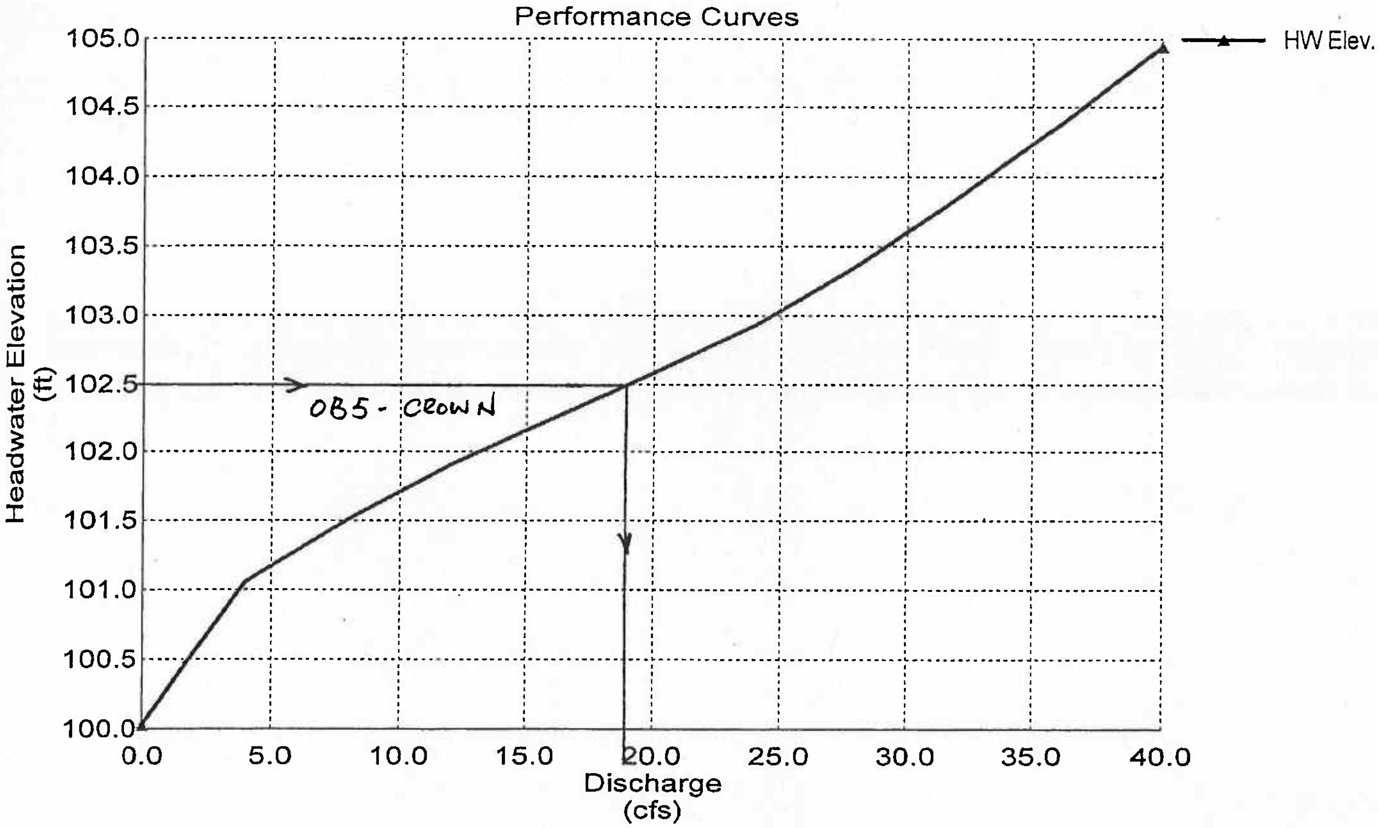
Note:
1. **Assume Inv. In at 100'**
2. **Used HDS 5 Chart 2**

CULVERT BARREL SELECTED:

Size: 30"
Shape: Circular
Material / n: CMP / 0.017
Entrance: Projection

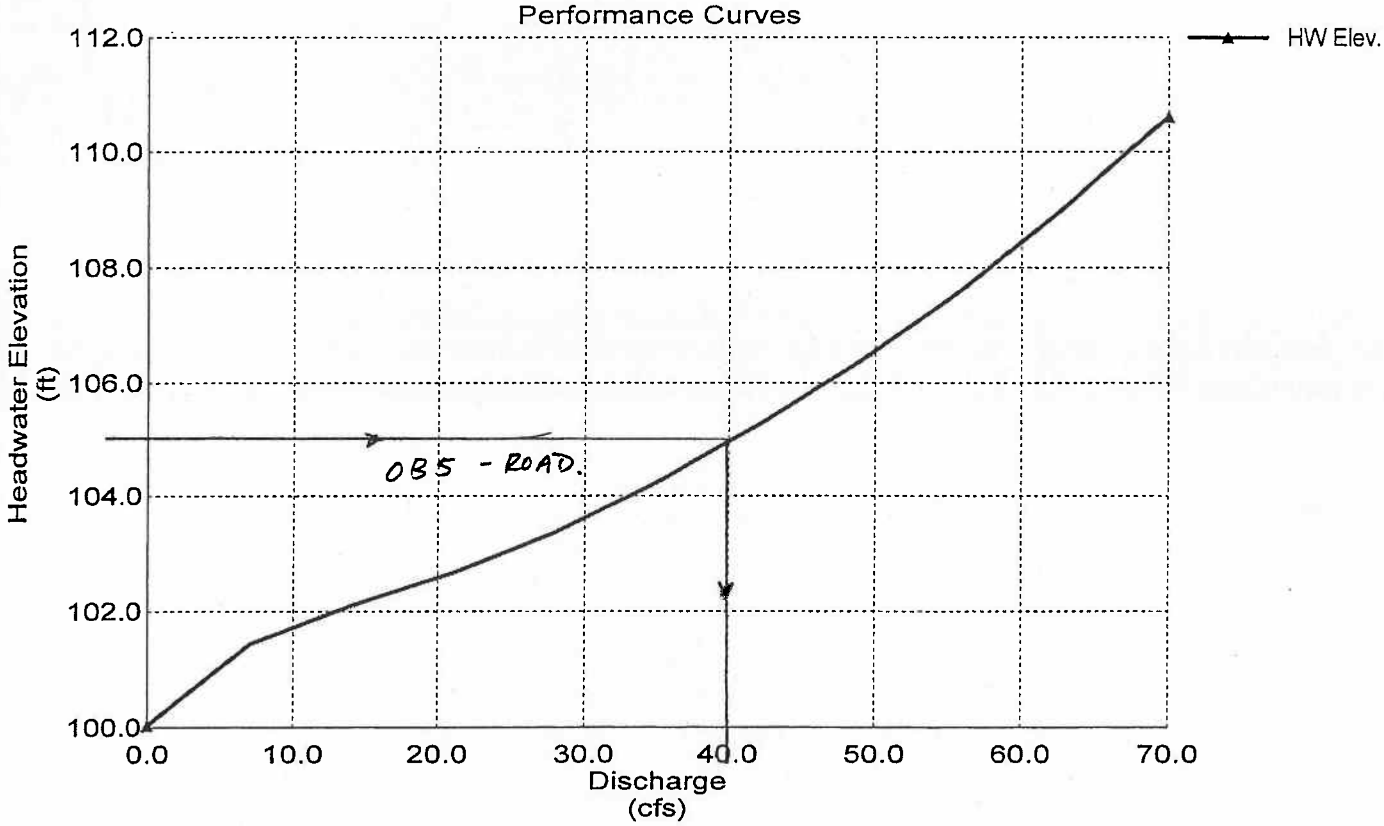
Performance Curves Report
OB5-Crown

Range Data:				
	Minimum	Maximum	Increment	
Discharge	0.00	40.00	4.00	cfs



Performance Curves Report
OB5-Road

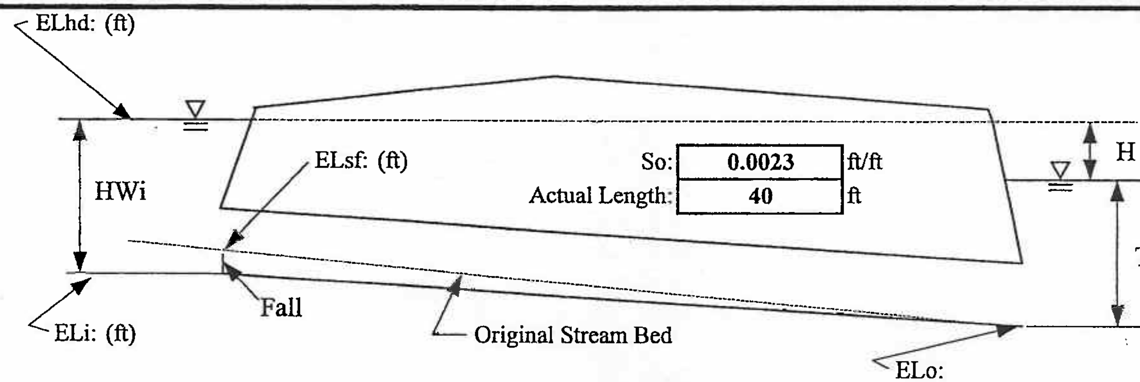
Range Data:				
	Minimum	Maximum	Increment	
Discharge	0.00	70.00	7.00	cfs



PROJECT: Little Sewickley Creek	STATION: Obstruction 6 (OB6)	CULVERT DESIGN FORM DESIGNER / DATE: YLEL 7/31/02 REVIEWER / DATE:

HYDROLOGICAL DATA

	ELi	ELo
a	100	99.91



CULVERT DESCRIPTION:		Pipe Length (ft)	Pipe Dia. (Inch)	Total Flow Q (cfs)	HEADWATER CALCULATIONS											CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	Comments
					INLET CONTROL				OUTLET CONTROL									
	Pipe Run #				HWi/D (2)	HWi	FALL (3)	ELhi (4)	TW (5)	dc	(dc+D)/2	ho (6)	ke	H (7)	ELho (8)			
a	OB6	40	48	184.0	1.00	4.00		104.00								104.00		at the Crown
a.	OB6	40	48	240.0	1.25	5.00		105.00								105.00		at the Roadway
	* 8'w x 4'h - 4'=pipe dia																	

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS
(2) HWi/D = HW/D OR HWt/D FROM DESIGN CHARTS
(3) FALL = HWi - (ELhd - ELsf) ; FALL IS ZERO FOR CULVERTS ON GRADE
(4) EL hi = HWi + ELi (INVERT OF INLET CONROL SECTION)
(5) TW BASED ON DOWNSTREAM CONTROL OR FLOW DEPTH IN CHANNEL
(6) ho = TW or (dc +D)/2 WHICHEVER IS GREATER
(7) H =[1 + ke +(29n^2L)/R^1.33] V^2 / 2g
(8) ELho = ELo + H + ho

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION

COMMENTS / DISCUSSION:

Note:

1. Assume Inv. In at 100'
2. Used HDS 5 Chart 8

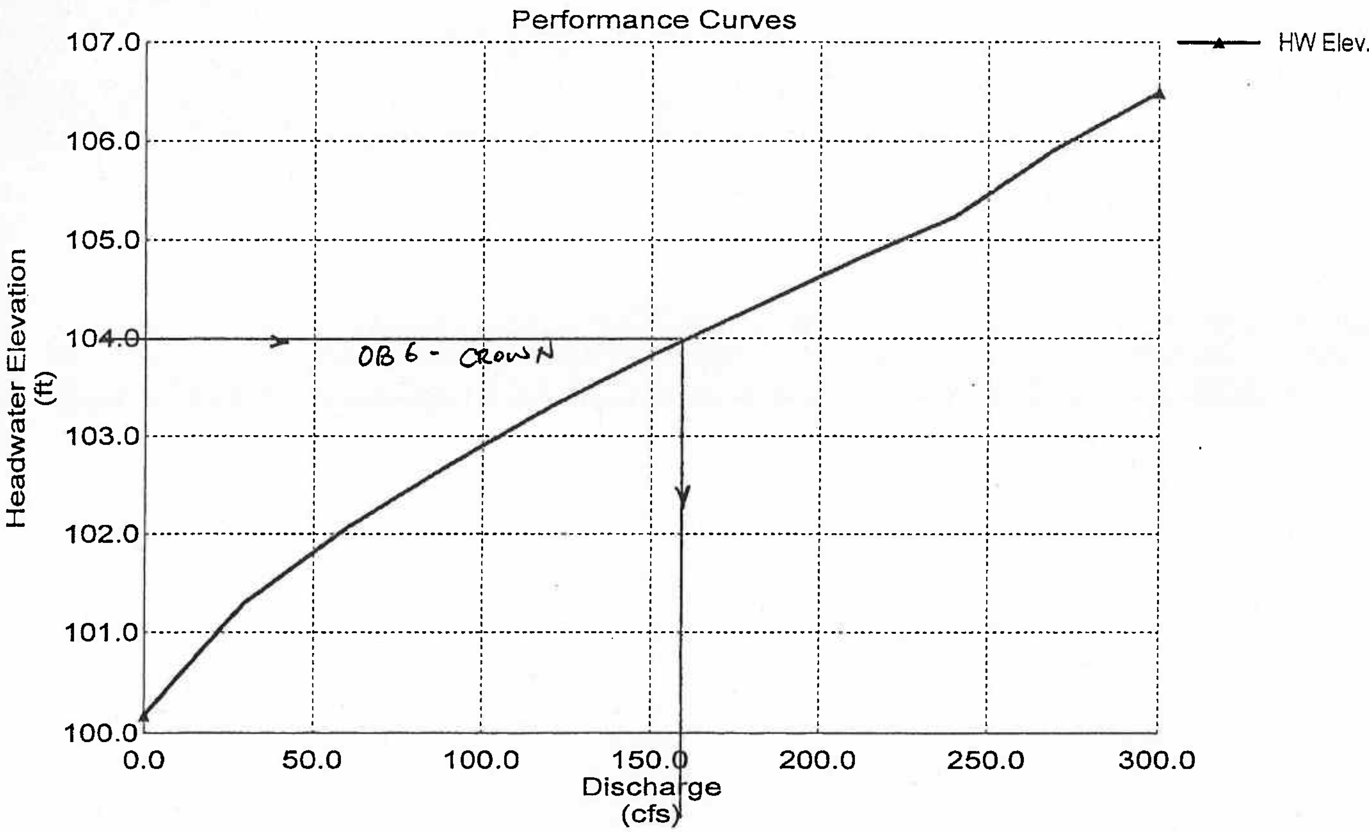
CULVERT BARREL SELECTED:

Size: 8'w x 4'h
Shape: Rectangular
Material / n: RC / 0.014
Entrance: Wingwall Flare w/ 30° to 75°

Performance Curves Report
OB6-Crown

Range Data:

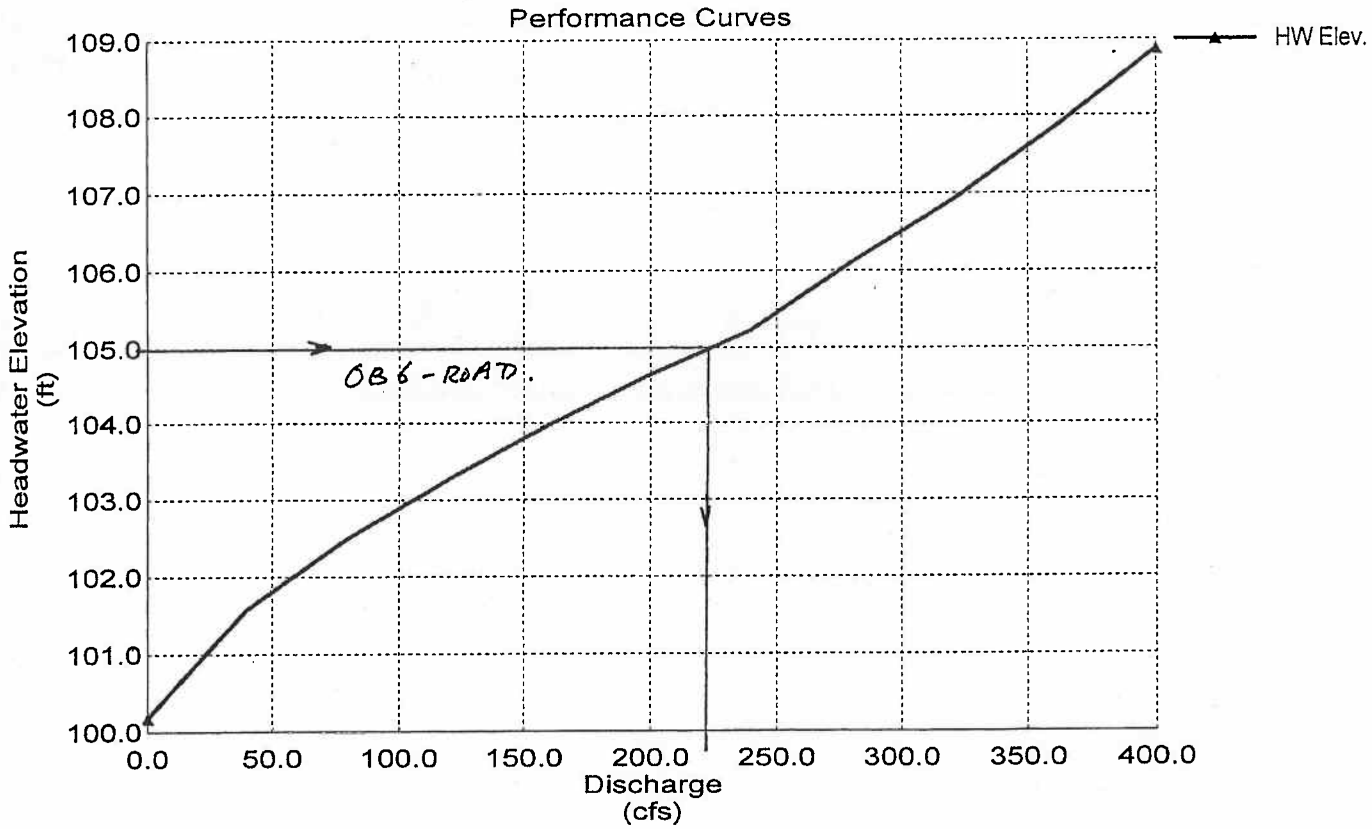
	Minimum	Maximum	Increment
Discharge	0.00	300.00	30.00 cfs



Performance Curves Report
OB6-Road

Range Data:

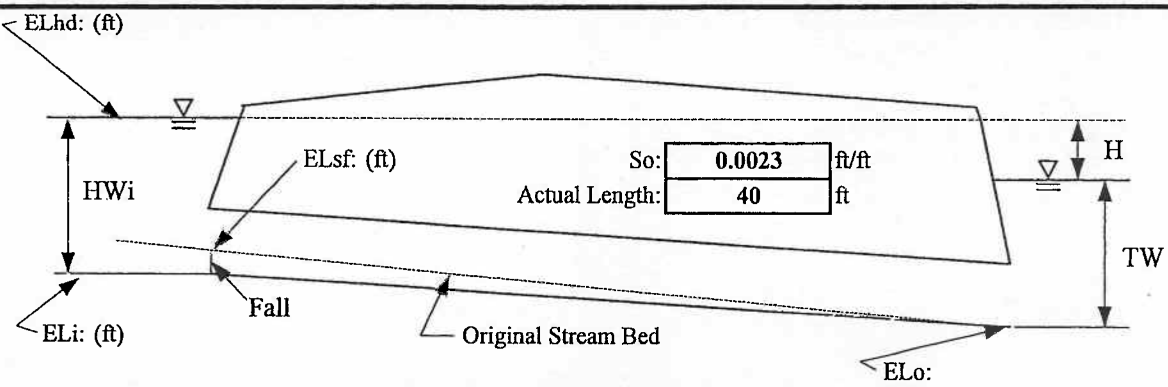
	Minimum	Maximum	Increment	
Discharge	0.00	400.00	40.00	cfs



PRO	STATION: Obstruction 7 (OB7)	CULVERT DESIGN FORM
Little Sewickley Creek		DESIGNER / DATE: YLEL 8/1/02
		REVIEWER / DATE:

HYDROLOGICAL DATA

	ELi	ELo
a	100	99.91



CULVERT DESCRIPTION:

	Pipe Run #	Pipe Length (ft)	Pipe Dia. (Inch)	Total Flow Q (cfs)	INLET CONTROL HWi/D (2)	HWi	FALL (3)	ELhi (4)	OUTLET CONTROL TW (5)	dc	(dc+D)/2	ho (6)	ke	H (7)	ELho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	Comments
a	OB7	40	72	**320.0**	1.00	6.00		106.00								106.00		at the Crown
a.	OB7	40	72	**400.0**	1.17	7.02		107.02								107.02		at the Roadway
	* 8'w x 6'h - 6'=pipe dia																	

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS
(2) HWi/D = HW/D OR HWt/D FROM DESIGN CHARTS
(3) FALL = HWi - (ELhd - ELsf) ; FALL IS ZERO FOR CULVERTS ON GRADE
(4) EL hi = HWi + ELi (INVERT OF INLET CONROL SECTION)
(5) TW BASED ON DOWNSTREAM CONTROL OR FLOW DEPTH IN CHANNEL
(6) ho = TW or (dc +D)/2 WHICHEVER IS GREATER
(7) H =[1 + ke +(29n^2L)/R^1.33] V^2 / 2g
(8) ELho = ELo + H + ho

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION

COMMENTS / DISCUSSION:

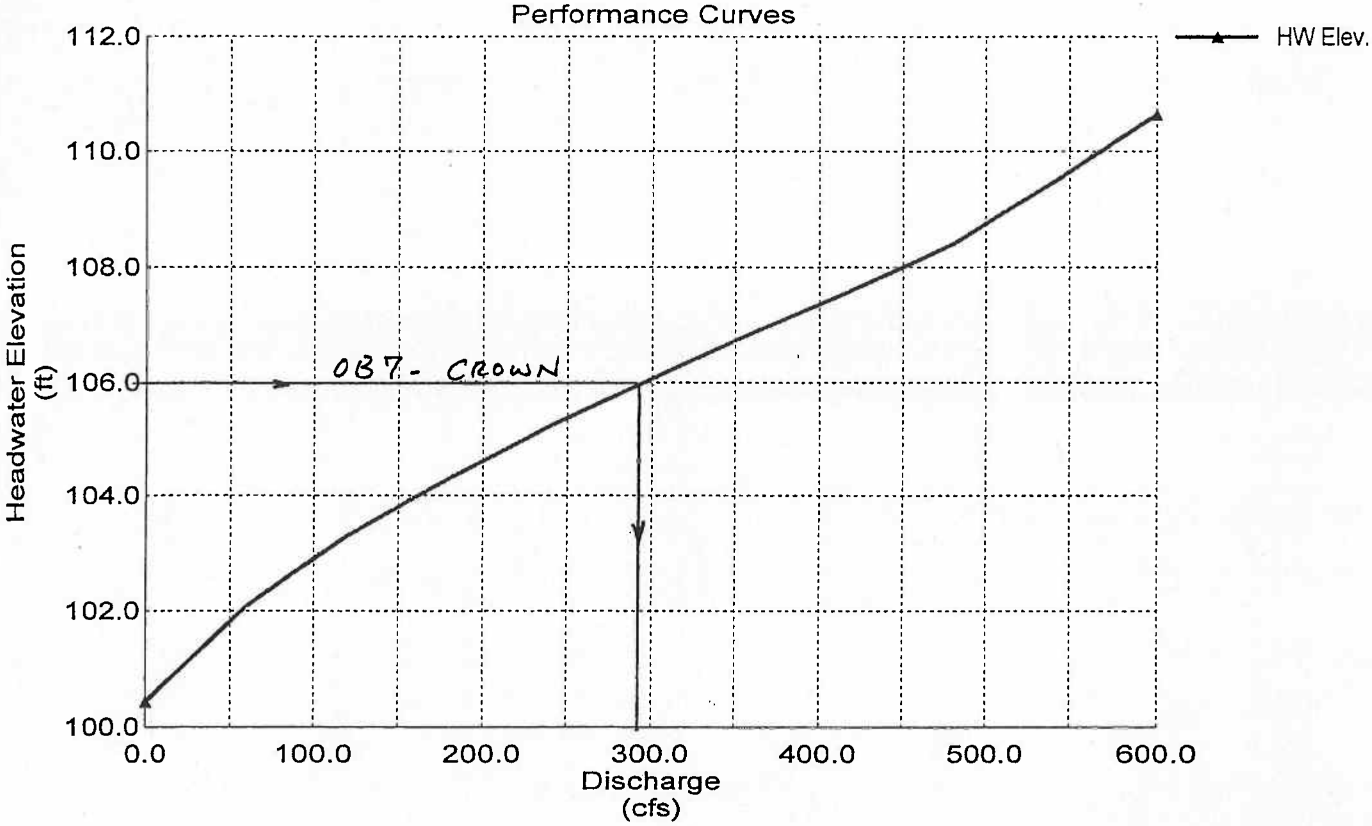
Note:
1. **Assume Inv. In at 100'**
2. **Used HDS 5 Chart 11**

CULVERT BARREL SELECTED:

Size: 8'w x 6'h
Shape: Rectangular
Material / n: RC / 0.014
Entrance: Skew Headwall 15°

Performance Curves Report
OB7-Crown

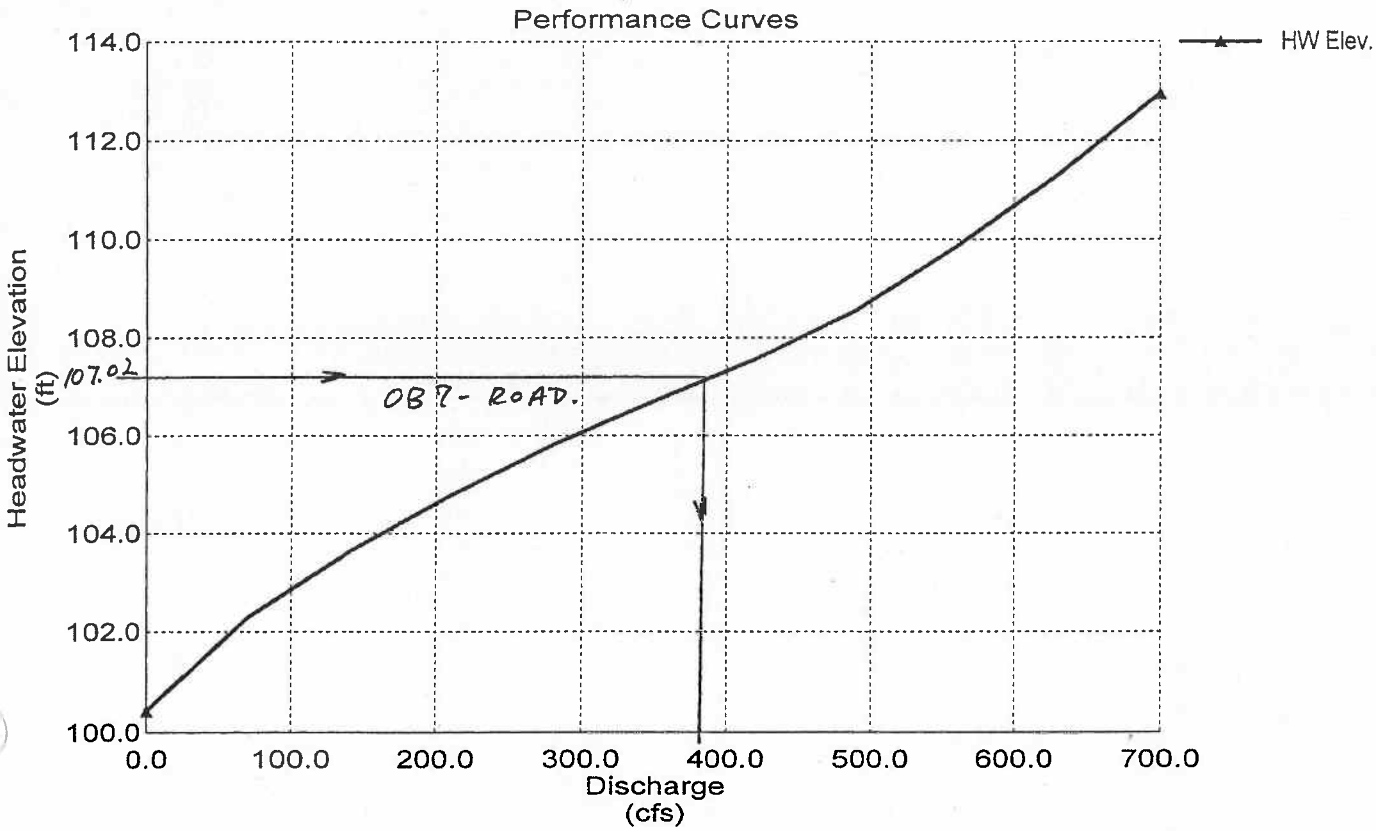
Range Data:				
	Minimum	Maximum	Increment	
Discharge	0.00	600.00	60.00	cfs



Performance Curves Report
OB7-Road

Range Data:

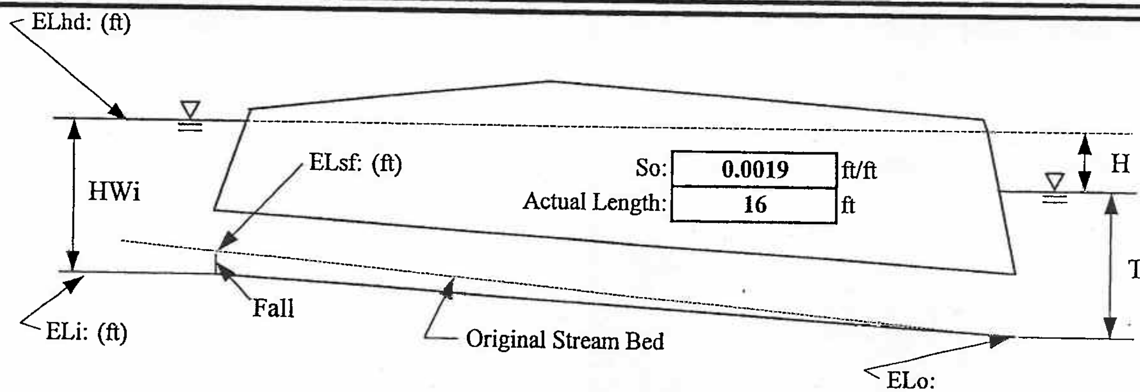
	Minimum	Maximum	Increment
Discharge	0.00	700.00	70.00 cfs



PRO	STATION:	CULVERT DESIGN FORM
Little Sewickley Creek	Obstruction 9 (OB9)	DESIGNER / DATE: YLEL 8/1/02
		REVIEWER / DATE:

HYDROLOGICAL DATA

	ELi	ELo
a	100	99.97



CULVERT DESCRIPTION:

	Pipe Run #	Pipe Length (ft)	Pipe Dia. (Inch)	Total Flow Q (cfs)	INLET CONTROL HWi/D (2)	HWi	FALL (3)	ELhi (4)	OUTLET CONTROL TW (5)	dc	(dc+D)/2	ho (6)	ke	H (7)	ELho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	Comments
a	OB9	16	42	**55.0**	1.00	3.50		103.50								103.50		at the Crown
a.	OB9	16	42	**85.0**	1.43	5.01		105.01								105.01		at the Roadway

HEADWATER CALCULATIONS

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS
(2) HWi/D = HW/D OR HWt/D FROM DESIGN CHARTS
(3) FALL = HWi - (ELhd - ELsf) ; FALL IS ZERO FOR CULVERTS ON GRADE
(4) EL hi = HWi + ELi (INVERT OF INLET CONROL SECTION)
(5) TW BASED ON DOWNSTREAM CONTROL OR FLOW DEPTH IN CHANNEL
(6) ho = TW or (dc +D)/2 WHICHEVER IS GREATER
(7) H =[1 + ke +(29n^2L)/R^1.33] V^2 / 2g
(8) ELho = ELo + H + ho

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION

COMMENTS / DISCUSSION:

Note:

1. Assume Inv. In at 100'

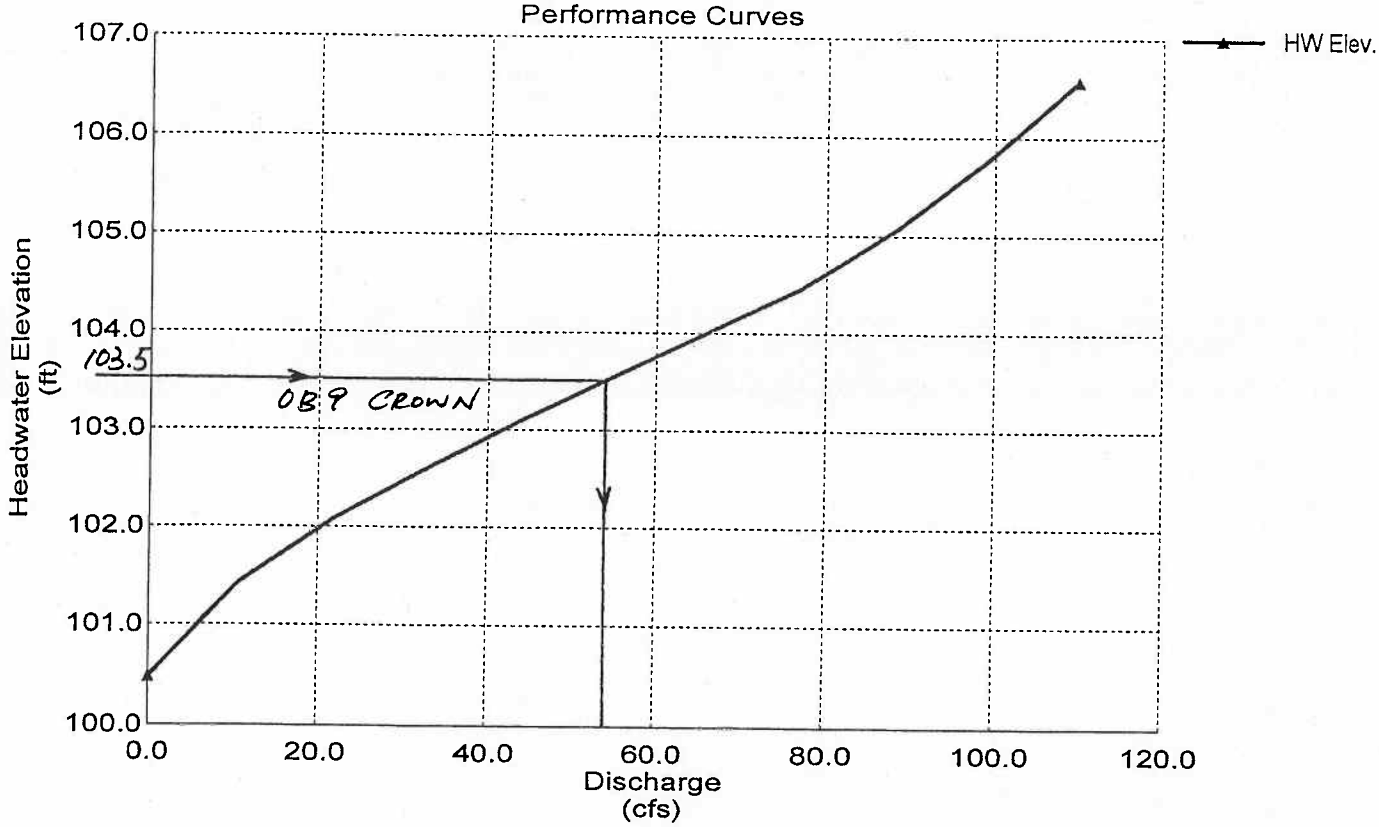
2. Used HDS 5 Chart 1

CULVERT BARREL SELECTED:

Size: 42"
Shape: Circular
Material / n: RCP / 0.012
Entrance: Groove end projection

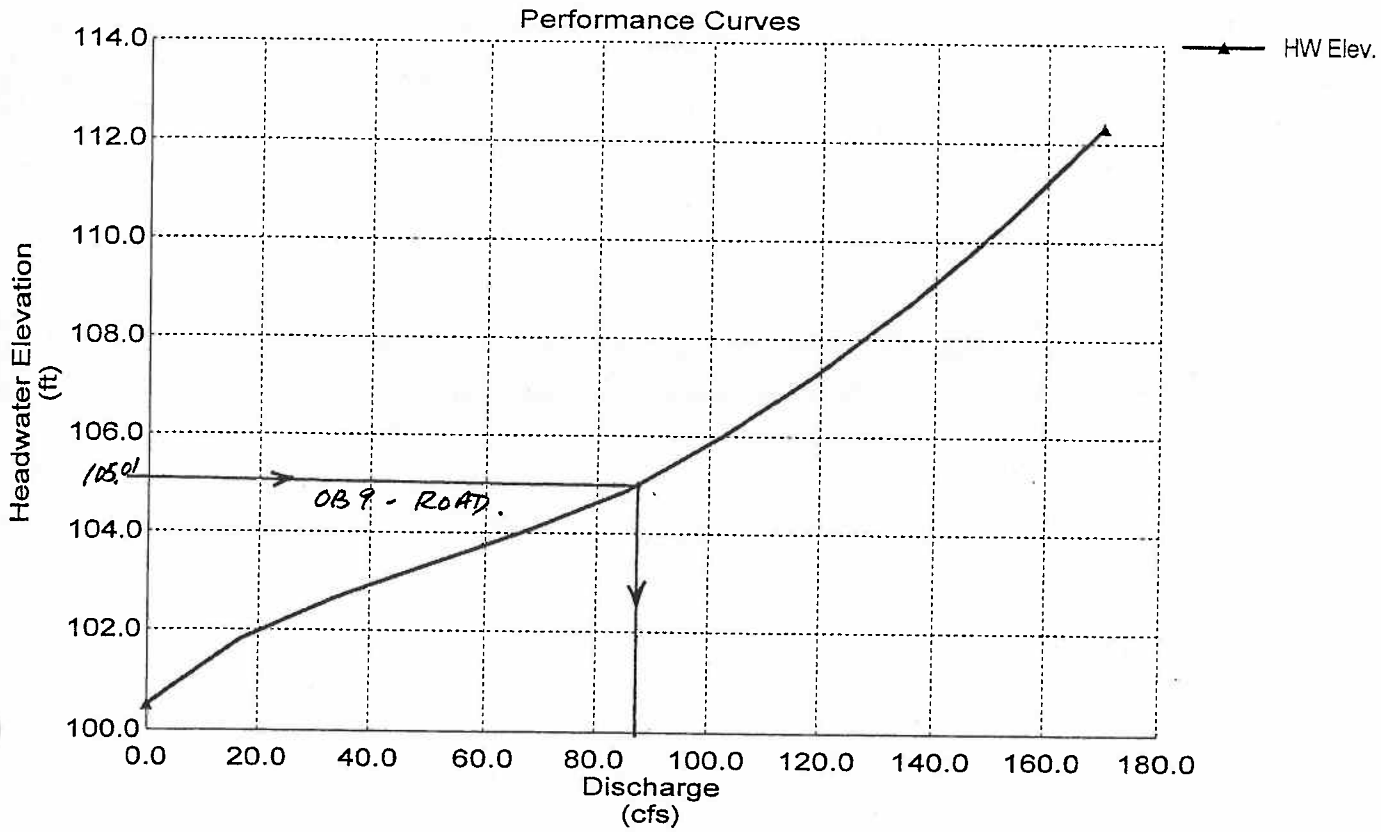
Performance Curves Report
OB9-Crown

Range Data:				
	Minimum	Maximum	Increment	
Discharge	0.00	110.00	11.00	cfs



Performance Curves Report
OB9-Road

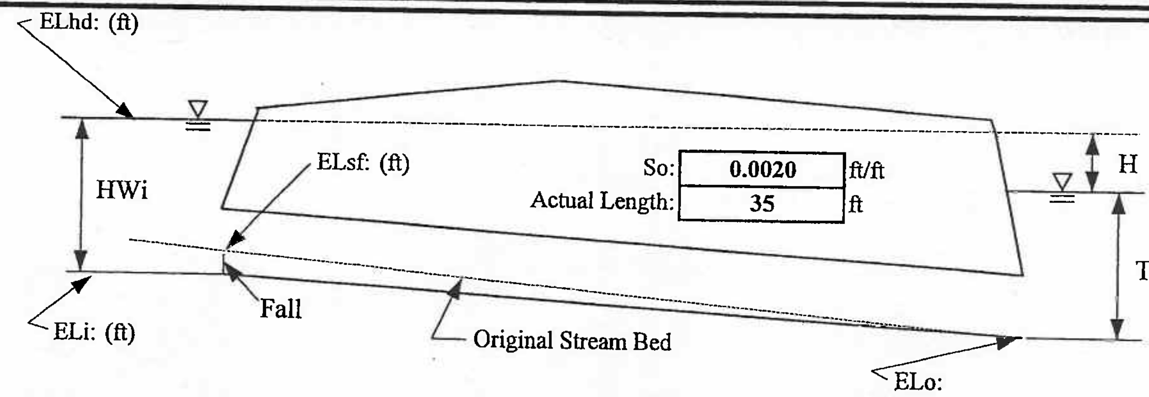
Range Data:				
	Minimum	Maximum	Increment	
Discharge	0.00	170.00	17.00	cfs



PRC Little Sewickley Creek	STATION: Obstruction 10 (OB10)	CULVERT DESIGN FORM
		DESIGNER / DATE: YLEL 8/1/02
		REVIEWER / DATE:

HYDROLOGICAL DATA

	ELi	ELo
a	100	99.93



CULVERT DESCRIPTION:

	Pipe Run #	Pipe Length (ft)	Pipe Dia. (Inch)	Total Flow Q (cfs)	INLET CONTROL HWi/D (2)	HWi	FALL (3)	ELhi (4)	OUTLET CONTROL TW (5)	dc	(dc+D)/2	ho (6)	ke	H (7)	ELho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	Comments
a	OB10	35	27	**17.0**	1.00	2.25		102.25								102.25		at the Crown
a.	OB10	35	27	**40.0**	2.56	5.76		105.76								105.76		at the Roadway

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS
(2) HWi/D = HW/D OR HWt/D FROM DESIGN CHARTS
(3) FALL = HWi - (ELhd - ELsf) ; FALL IS ZERO FOR CULVERTS ON GRADE
(4) EL hi = HWi + ELi (INVERT OF INLET CONROL SECTION)
(5) TW BASED ON DOWNSTREAM CONTROL OR FLOW DEPTH IN CHANNEL
(6) ho = TW or (dc +D)/2 WHICHEVER IS GREATER
(7) H =[1 + ke +(29n^2L)/R^1.33] V^2 / 2g
(8) ELho = ELo + H + ho

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION

COMMENTS / DISCUSSION:

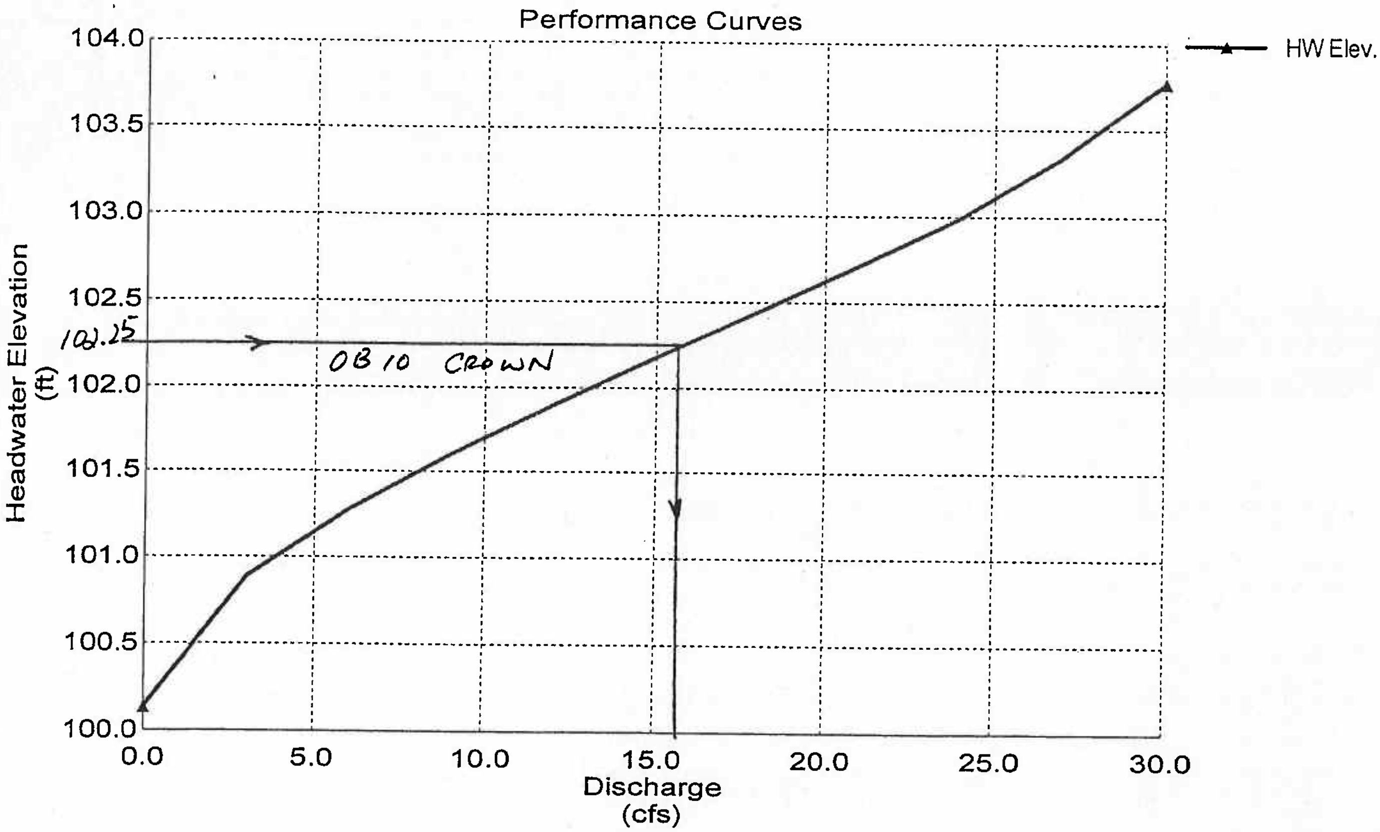
Note:
1. **Assume Inv. In at 100'**
2. **Used HDS 5 Chart 1**

CULVERT BARREL SELECTED:

Size: 27"
Shape: Circular
Material / n: RCP / 0.012
Entrance: Headwall

Performance Curves Report
OB10-Crown

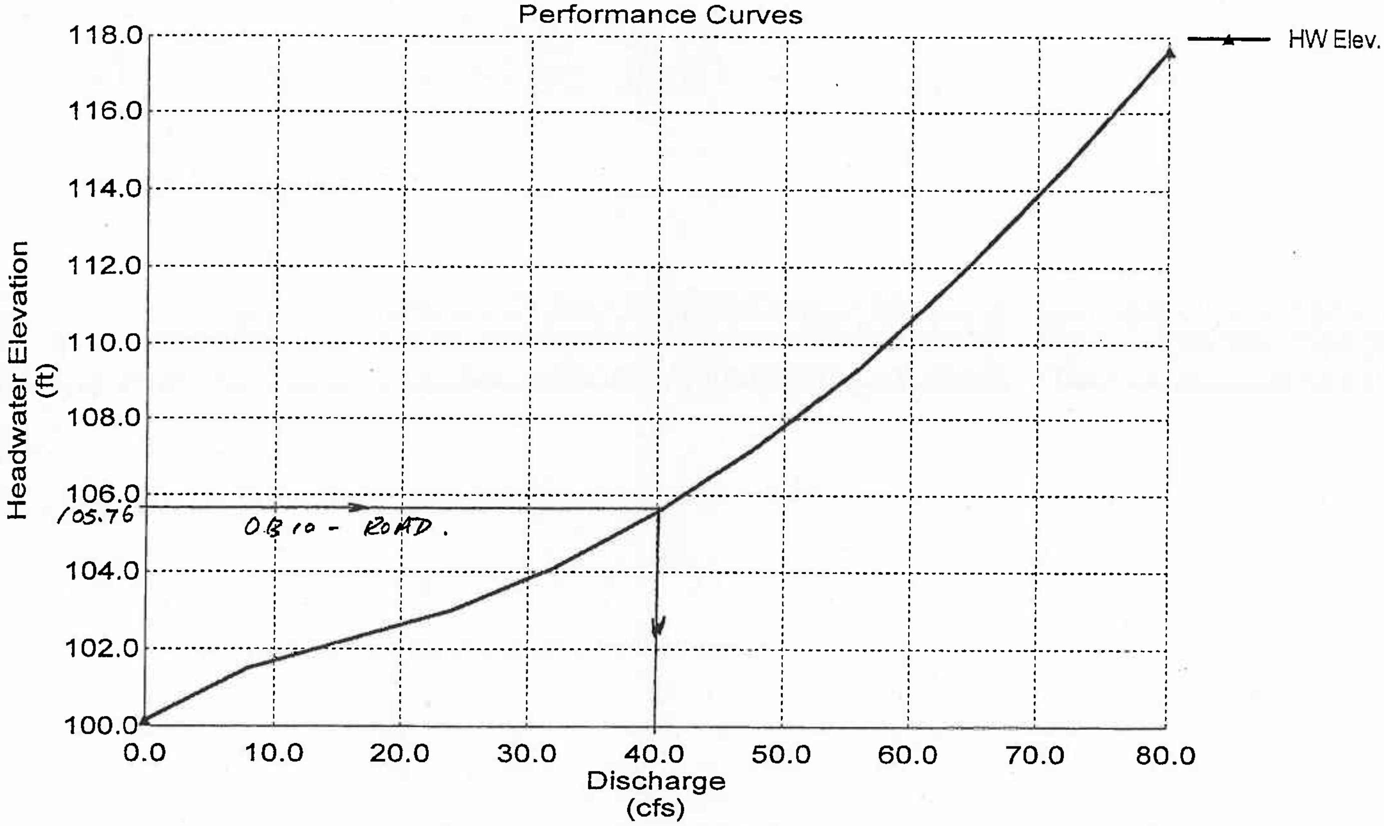
Range Data:				
	Minimum	Maximum	Increment	
Discharge	0.00	30.00	3.00	cfs



Performance Curves Report
OB10-Road

Range Data:

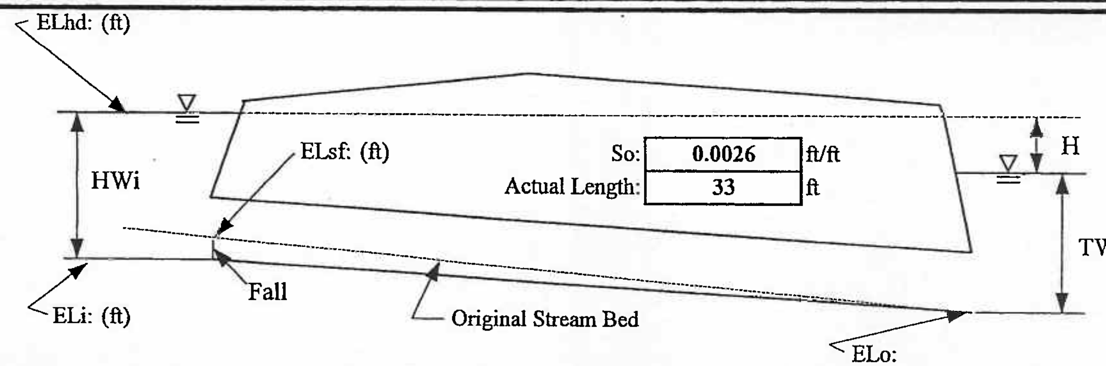
	Minimum	Maximum	Increment
Discharge	0.00	80.00	8.00 cfs



[illegible]	STATION: Obstruction 12 (OB12)	CULVERT DESIGN FORM
Little Sewickley Creek		DESIGNER / DATE: JEA 8/2/02
		REVIEWER / DATE: ylEL 8/6/02

HYDROLOGICAL DATA

	ELi	ELo
a.	100	99.91



CULVERT DESCRIPTION: / HEADWATER CALCULATIONS

	Pipe Run #	Pipe Length (ft)	Pipe Dia. (Inch)	Total Flow Q (cfs)	INLET CONTROL HWi/D (2)	HWi	FALL (3)	ELhi (4)	OUTLET CONTROL TW (5)	dc	(dc+D)/2	ho (6)	ke	H (7)	ELho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	Comments
a.	OB12	33	96	1675.0	1.00	8.00		108.00								108.00		at the Crown
a.	OB12	33	96	2125.0	1.25	10.00		110.00								110.00		at the Roadway

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS
(2) HWi/D = HW/D OR HWt/D FROM DESIGN CHARTS
(3) FALL = HWi - (ELhd - ELsf) ; FALL IS ZERO FOR CULVERTS ON GRADE
(4) EL hi = HWi + ELi (INVERT OF INLET CONROL SECTION)
(5) TW BASED ON DOWNSTREAM CONTROL OR FLOW DEPTH IN CHANNEL
(6) ho = TW or (dc +D)/2 WHICHEVER IS GREATER
(7) H =[1 + ke +(29n^2L)/R^1.33] V^2 / 2g
(8) ELho = ELo + H + ho

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION

COMMENTS / DISCUSSION:

Note:
1. **Assume Inv. In at 100'**
2. **Used HDS 5 Chart 8**

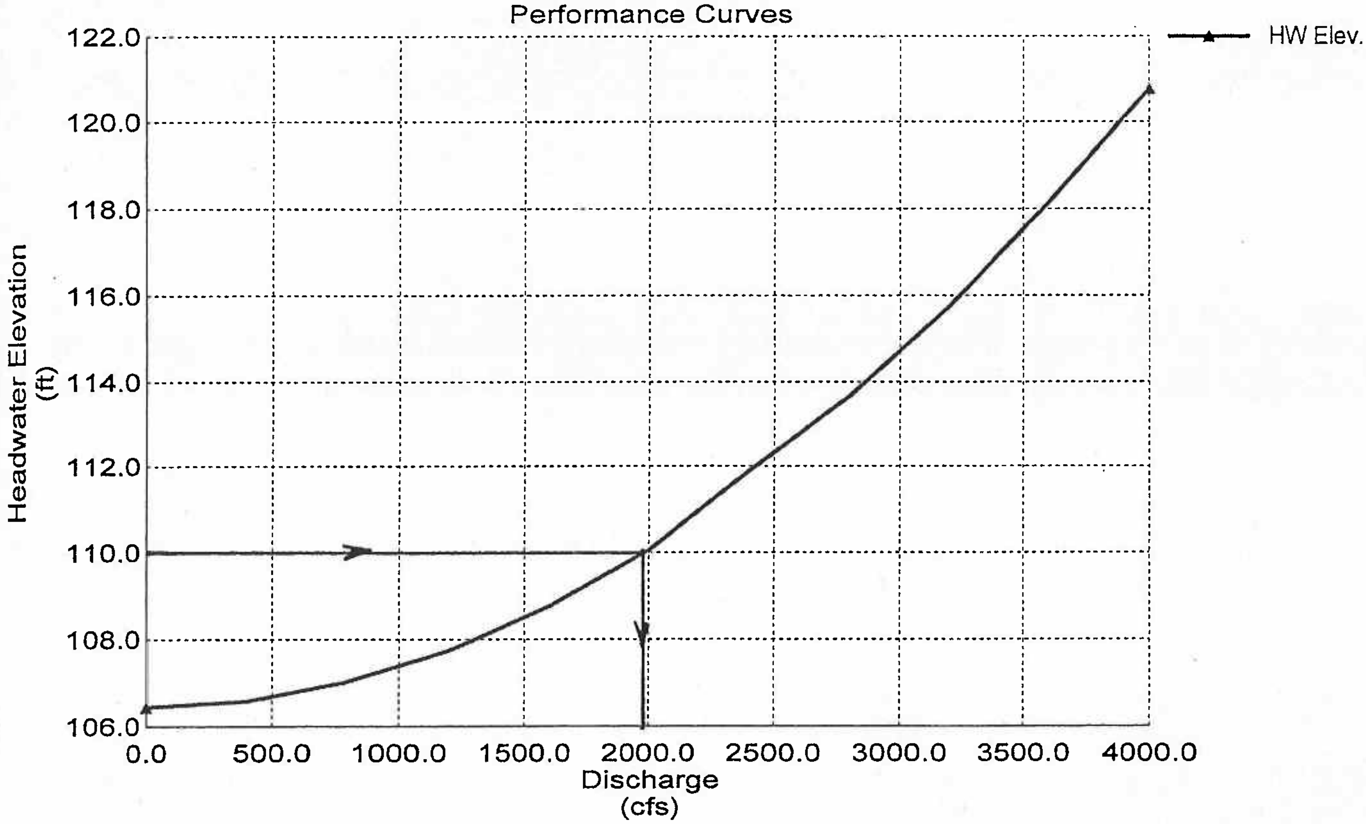
CULVERT BARREL SELECTED:

Size: 25'w x 8'h
Shape: Rectangular
Material / n: RC / 0.014
Entrance: Wingwall Flare w/ 30° to 75°

Performance Curves Report
OB-12-Road

Range Data:

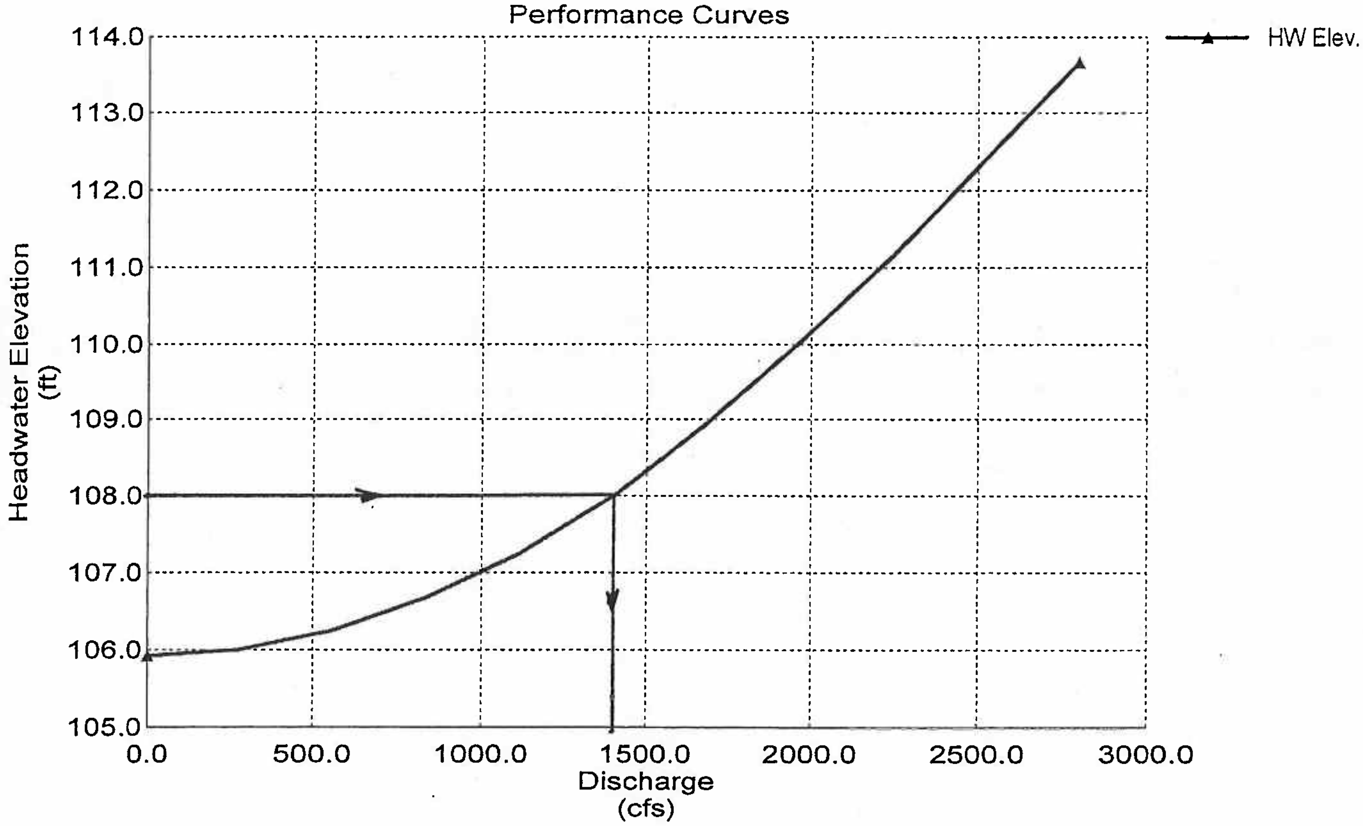
	Minimum	Maximum	Increment	
Discharge	0.00	4,000.00	400.00	cfs



Performance Curves Report
OB-12-Crown

Range Data:

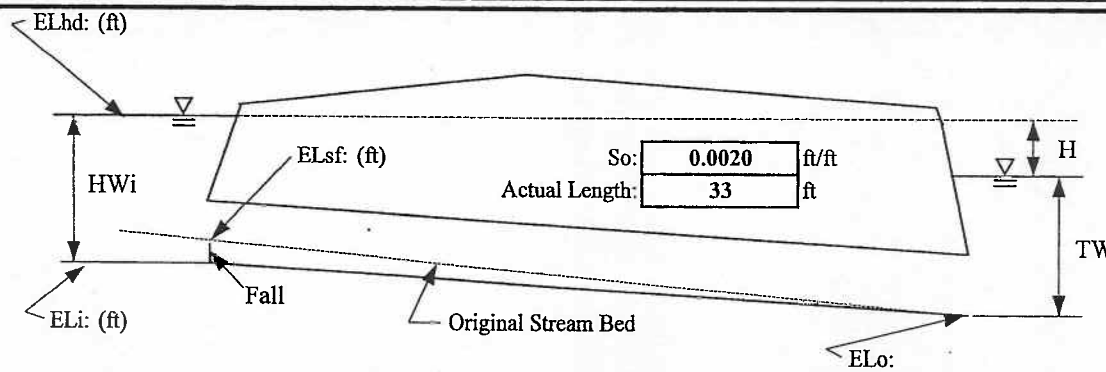
	Minimum	Maximum	Increment	
Discharge	0.00	2,800.00	280.00	cfs



P :	STATION:	CULVERT DESIGN FORM
Little Sewickley Creek	Obstruction 20 (OB20)	DESIGNER / DATE: JEA 8/2/02
		REVIEWER / DATE: YLEL 8/6/02

HYDROLOGICAL DATA

	ELi	ELo
a.	100	99.93



CULVERT DESCRIPTION: / HEADWATER CALCULATIONS

	Pipe Run #	Pipe Length (ft)	Pipe Dia. (Inch)	Total Flow Q (cfs)	INLET CONTROL HWi/D (2)	HWi	FALL (3)	ELhi (4)	OUTLET CONTROL TW (5)	dc	(dc+D)/2	ho (6)	ke	H (7)	ELho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	Comments
a.	OB20	33	84	**750.0**	1.00	7.00		107.00								107.00		at the Crown
a.	OB20	33	84	**1050.0**	1.29	9.00		109.00								109.00		at the Roadway

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS
(2) HWi/D = HW/D OR HWt/D FROM DESIGN CHARTS
(3) FALL = HWi - (ELhd - ELsf) ; FALL IS ZERO FOR CULVERTS ON GRADE
(4) EL hi = HWi + ELi (INVERT OF INLET CONROL SECTION)
(5) TW BASED ON DOWNSTREAM CONTROL OR FLOW DEPTH IN CHANNEL
(6) ho = TW or (dc +D)/2 WHICHEVER IS GREATER
(7) H =[1 + ke +(29n^2L)/R^1.33] V^2 / 2g
(8) ELho = ELo + H + ho

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION

COMMENTS / DISCUSSION:

Note:
1. **Assume Inv. In at 100'**
2. **Used HDS 5 Chart 8**

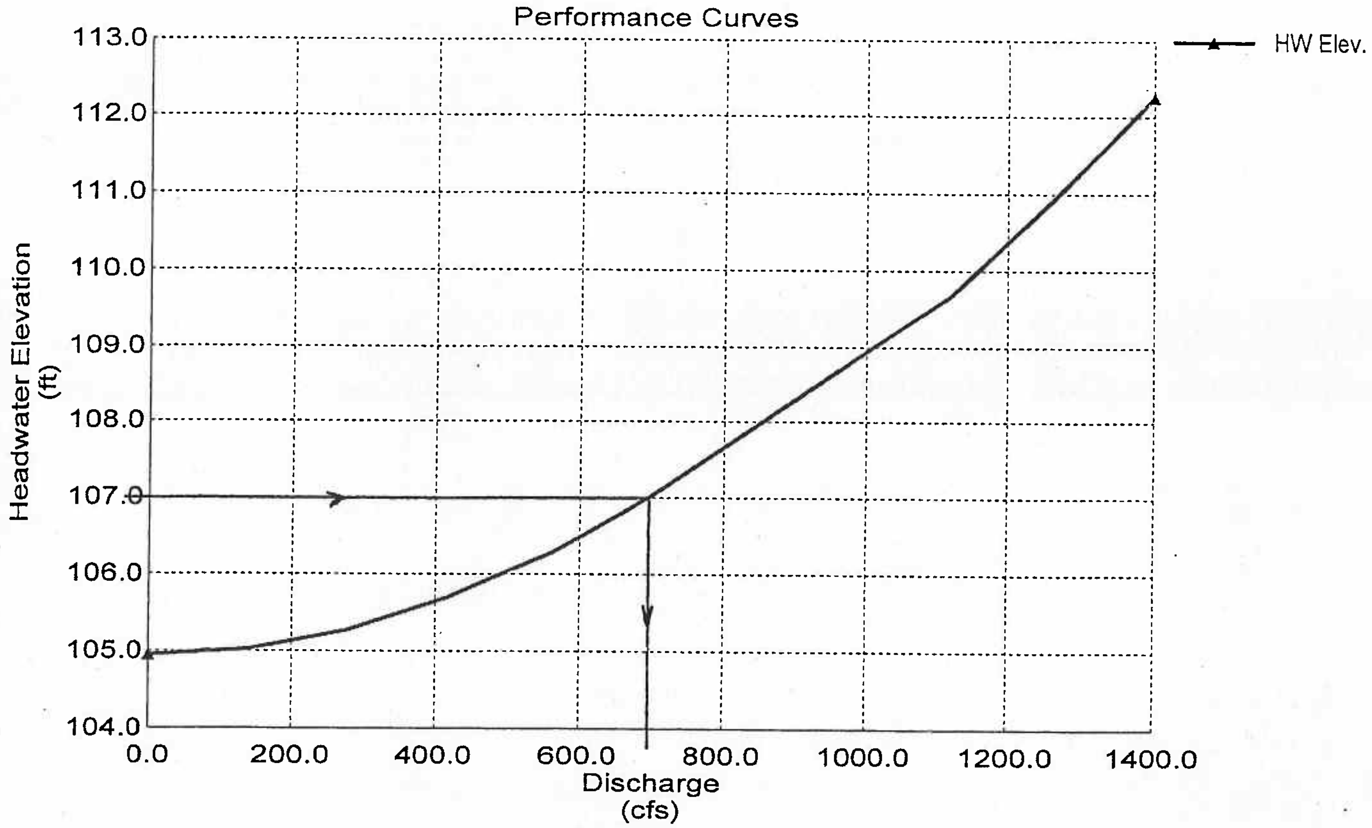
CULVERT BARREL SELECTED:

Size: 15'w x 7'h
Shape: Rectangular
Material / n: RC / 0.014
Entrance: Wingwall Flare w/ 30° to 75°

Performance Curves Report
OB-20-Crown

Range Data:

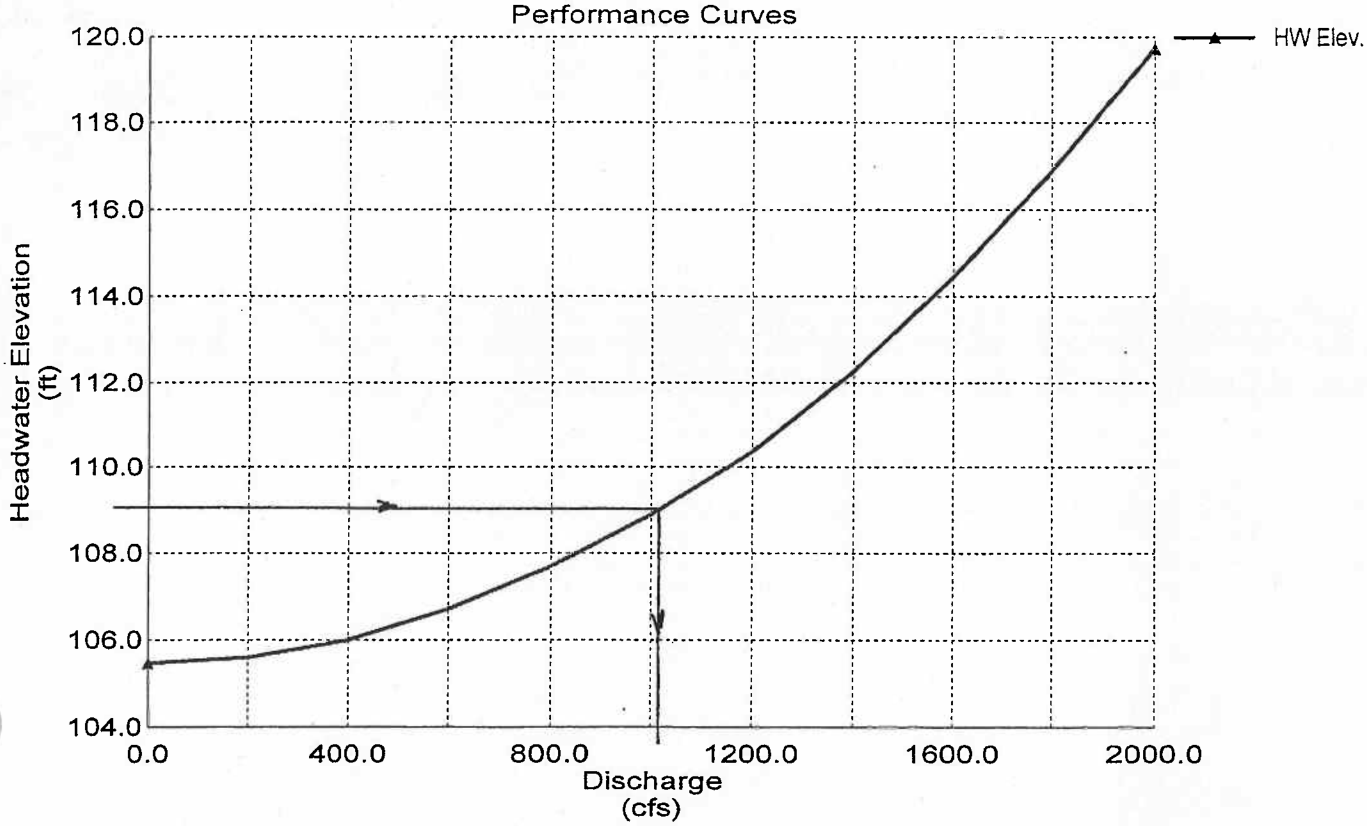
	Minimum	Maximum	Increment	
Discharge	0.00	1,400.00	140.00	cfs



Performance Curves Report
OB-20-Road

Range Data:

	Minimum	Maximum	Increment	
Discharge	0.00	2,000.00	200.00	cfs



…T: Little Sewickley Creek

STATION: Obstruction 27 (OB27)

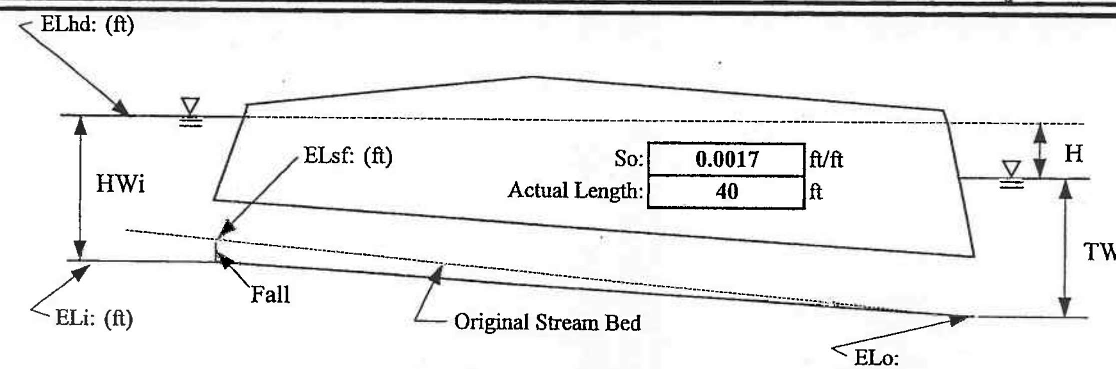
CULVERT DESIGN FORM

DESIGNER / DATE: JEA 8/2/02

REVIEWER / DATE: YLEL 8/6/02

HYDROLOGICAL DATA

	ELi	ELo
a	100	99.93



CULVERT DESCRIPTION: / **HEADWATER CALCULATIONS**

Pipe Run #	Pipe Length (ft)	Pipe Dia. (Inch)	Total Flow Q (cfs)	INLET CONTROL HWi/D (2)	HWi	FALL (3)	ELhi (4)	OUTLET CONTROL TW (5)	dc	(dc+D)/2	ho (6)	ke	H (7)	ELho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	Comments
a OB27	40	48	72.0	1.00	4.00		104.00								104.00		at the Crown
a. OB27	40	48	113.0	1.50	6.00		106.00								106.00		at the Roadway

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS
(2) HWi/D = HW/D OR HWt/D FROM DESIGN CHARTS
(3) FALL = HWi - (ELhd - ELsf) ; FALL IS ZERO FOR CULVERTS ON GRADE
(4) EL hi = HWi + ELi (INVERT OF INLET CONROL SECTION)
(5) TW BASED ON DOWNSTREAM CONTROL OR FLOW DEPTH IN CHANNEL
(6) ho = TW or (dc +D)/2 WHICHEVER IS GREATER
(7) H =[1 + ke +(29n^2L)/R^1.33] V^2 / 2g
(8) ELho = ELo + H + ho

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION

COMMENTS / DISCUSSION:

Note:
1. Assume Inv. In at 100'
2. Assume Corrugated HDPE
3. Used HDS 5 Chart 2

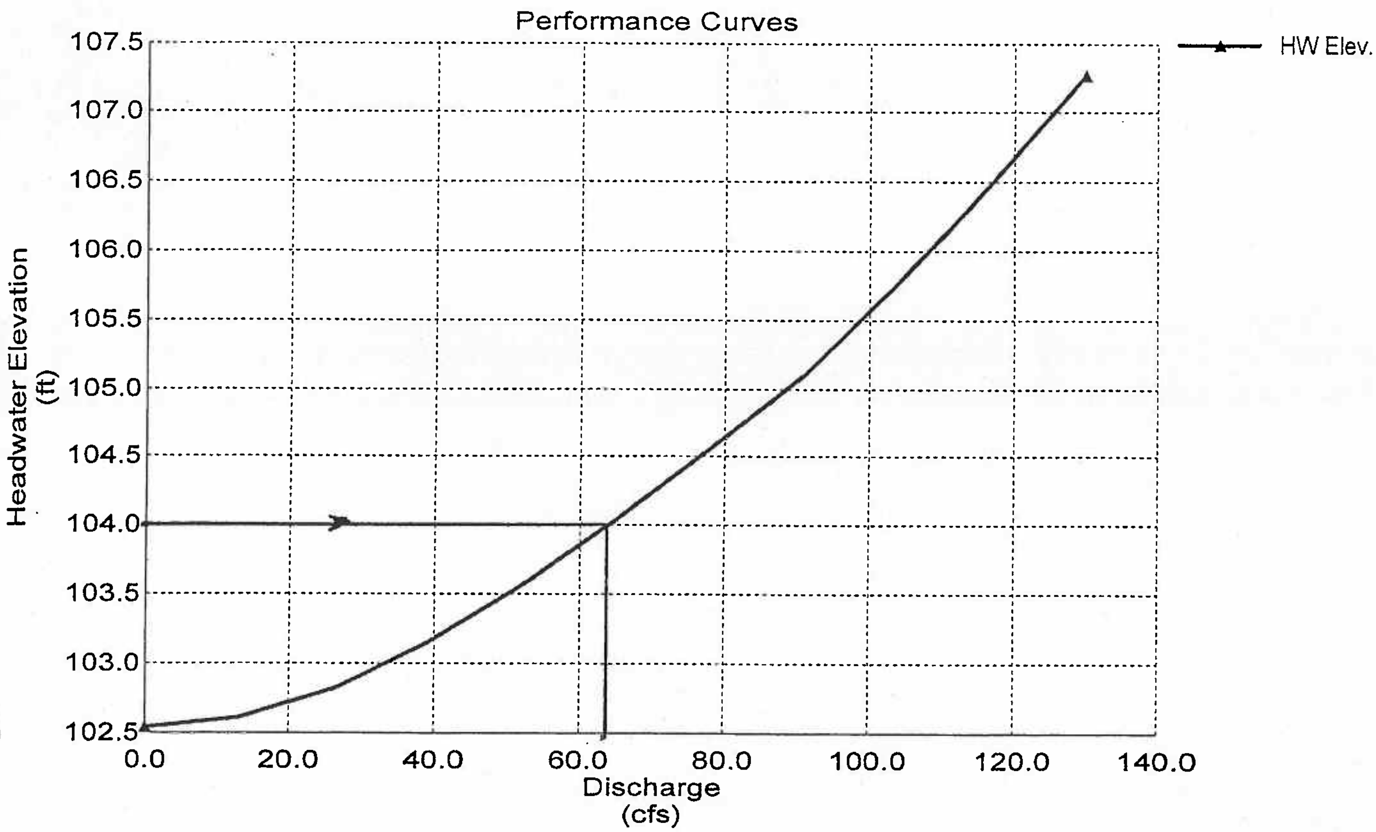
CULVERT BARREL SELECTED:

Size: 48"
Shape: Circular
Material / n: HDPE / 0.024
Entrance: SEH

Performance Curves Report
OB-27-Crown

Range Data:

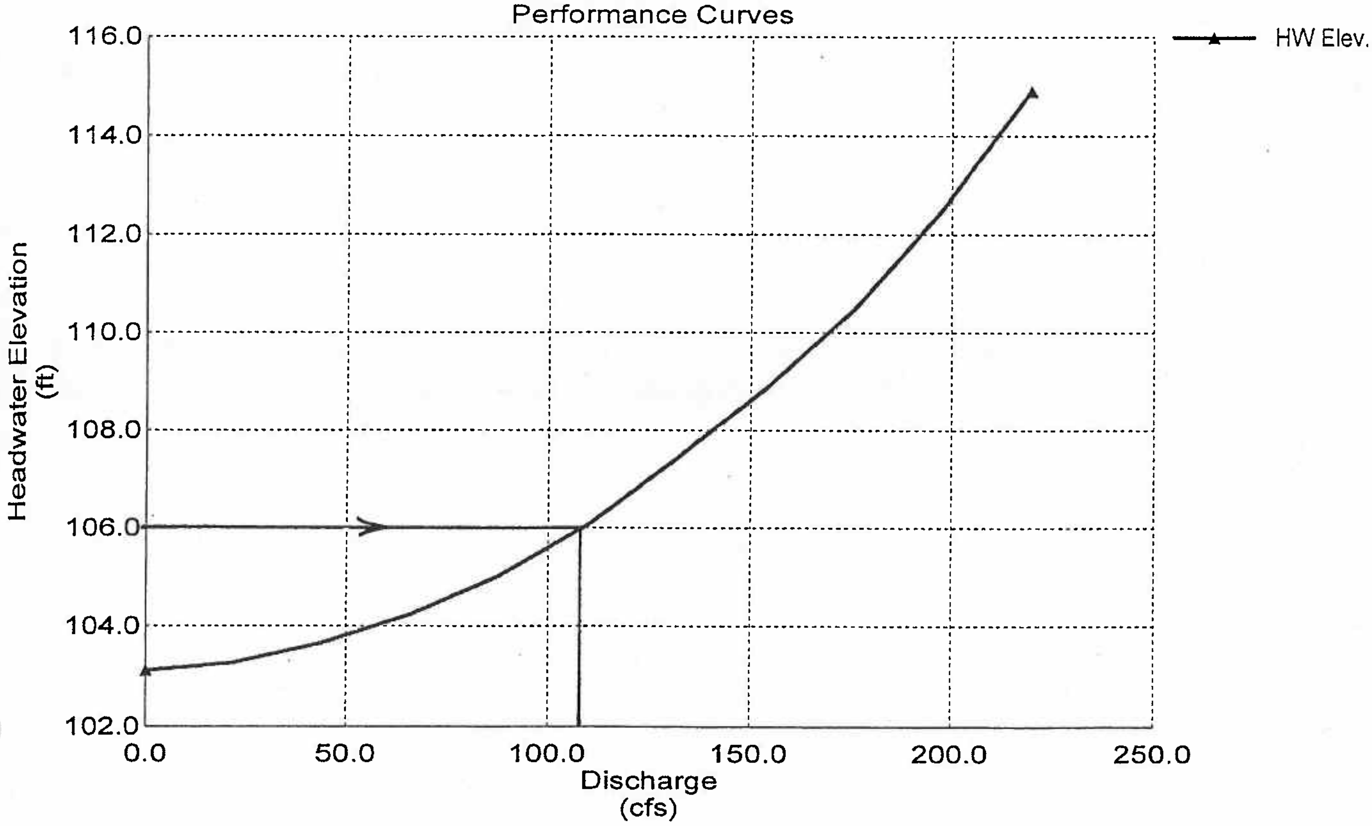
	Minimum	Maximum	Increment
Discharge	0.00	130.00	13.00 cfs



Performance Curves Report
OB-27-Road

Range Data:

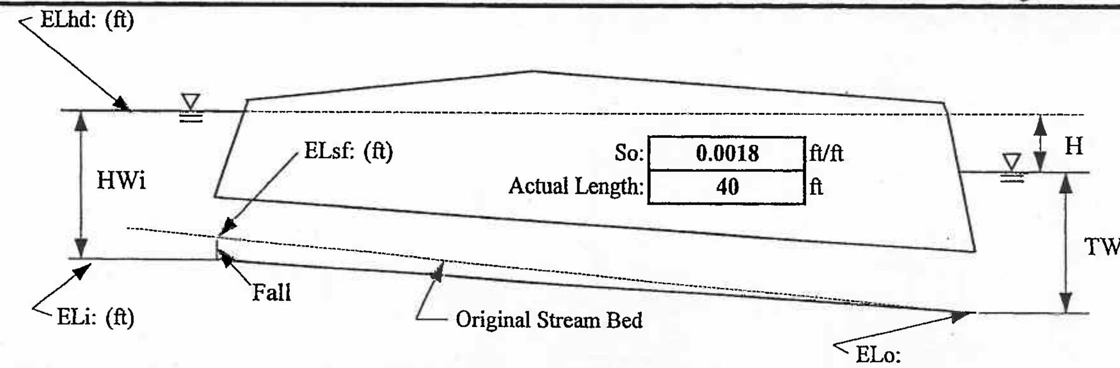
	Minimum	Maximum	Increment	
Discharge	0.00	220.00	22.00	cfs



PROJECT:	STATION:	CULVERT DESIGN FORM
Little Sewickley Creek	Obstruction 28 (OB28)	DESIGNER / DATE: JEA 8/2/02
		REVIEWER / DATE: YLGL 8/6/02

HYDROLOGICAL DATA

	ELi	ELo
a	100	99.93



CULVERT DESCRIPTION:

	Pipe Run #	Pipe Length (ft)	Pipe Dia. (Inch)	Total Flow Q (cfs)	INLET CONTROL HWi/D (2)	HWi	FALL (3)	ELhi (4)	OUTLET CONTROL TW (5)	dc	(dc+D)/2	ho (6)	ke	H (7)	ELho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	Comments
a	OB28	40	24	**25.4**	1.00	2.00		102.00								102.00		at the Crown
a.	OB28	40	24	**50.0**	2.00	4.00		104.00								104.00		at the Roadway

(HEADWATER CALCULATIONS)

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS
(2) HWi/D = HW/D OR HWt/D FROM DESIGN CHARTS
(3) FALL = HWi - (ELhd - ELsf) ; FALL IS ZERO FOR CULVERTS ON GRADE
(4) EL hi = HWi + ELi (INVERT OF INLET CONROL SECTION)
(5) TW BASED ON DOWNSTREAM CONTROL OR FLOW DEPTH IN CHANNEL
(6) ho = TW or (dc +D)/2 WHICHEVER IS GREATER
(7) H =[1 + ke +(29n^2L)/R^1.33] V^2 / 2g
(8) ELho = ELo + H + ho

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION

COMMENTS / DISCUSSION:

Note:
1. Assume Inv. In at 100'
2. Assume SEH
3. Used HDS 5 Chart 1
4.Total flow is (2) x (Q) due to twin culverts

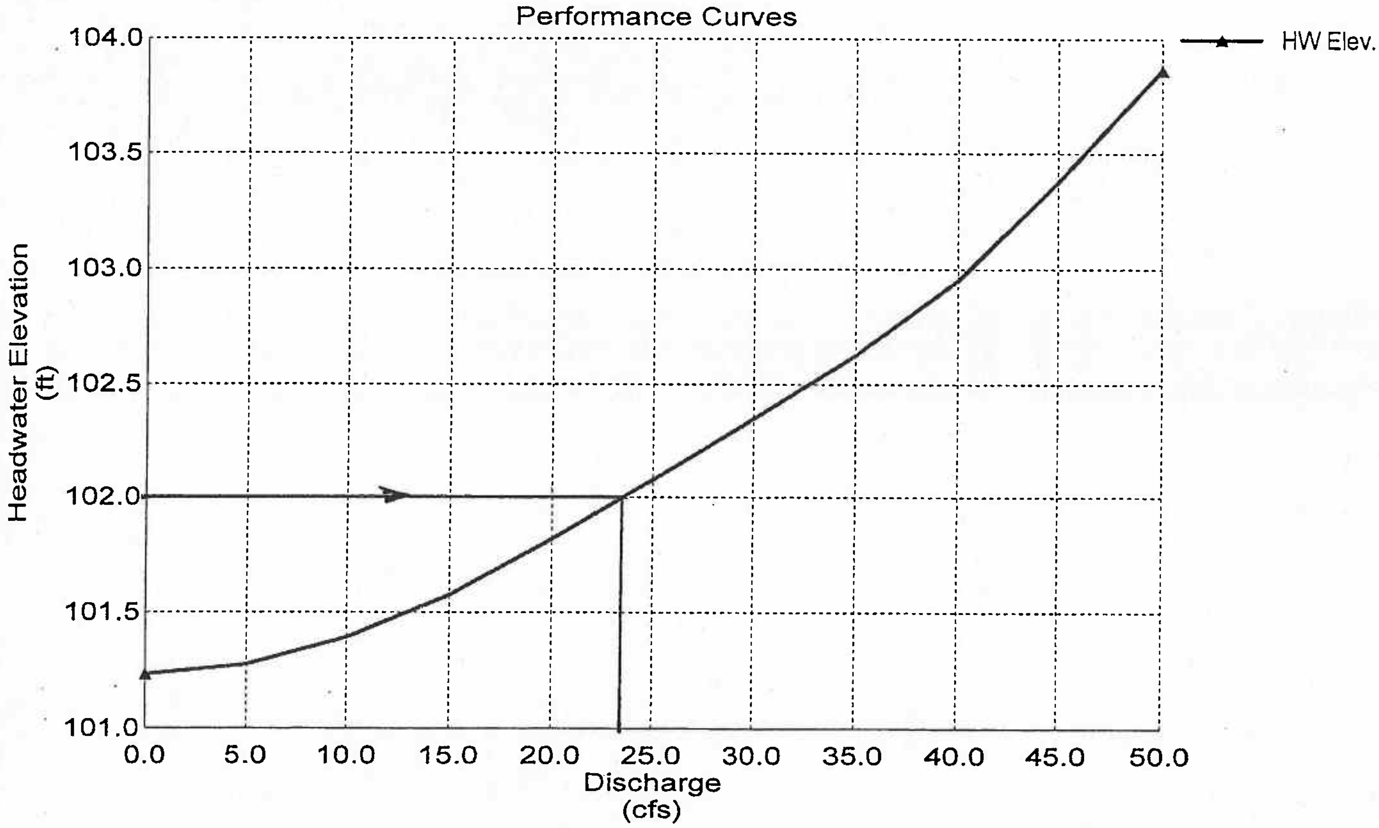
CULVERT BARREL SELECTED:

Size: Twin 24"
Shape: Circular
Material / n: RCP / 0.012
Entrance: SEH

Performance Curves Report
OB-28-Crown

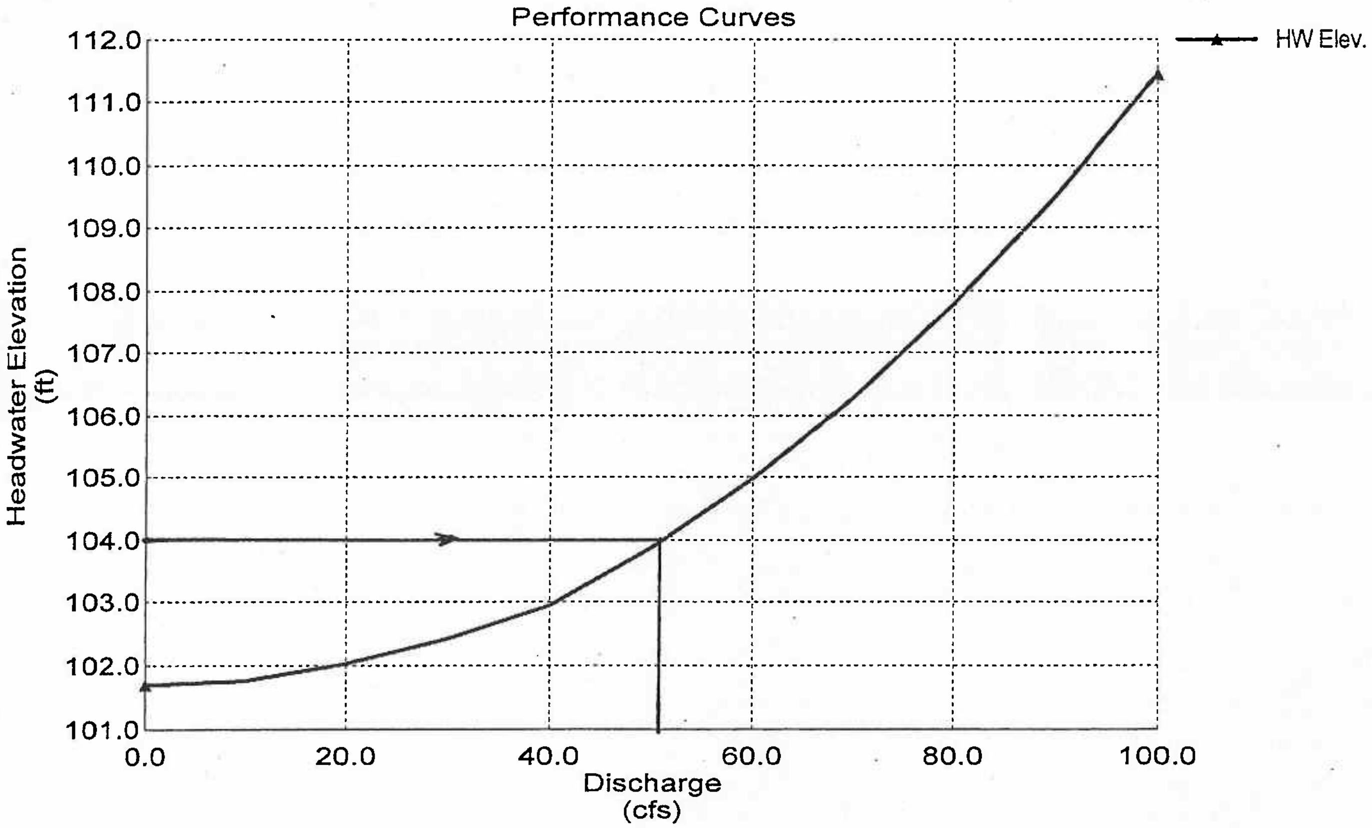
Range Data:

	Minimum	Maximum	Increment
Discharge	0.00	50.00	5.00 cfs



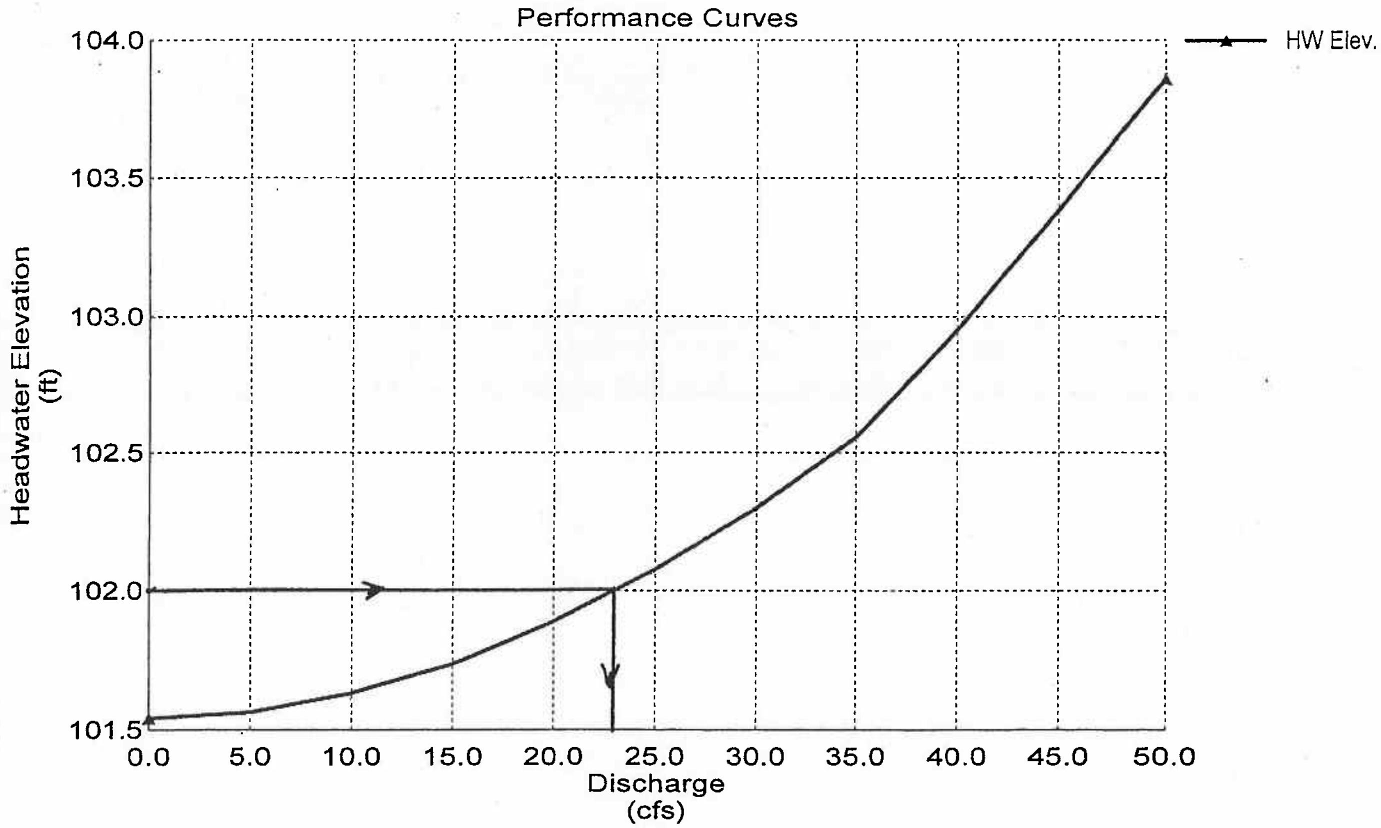
Performance Curves Report
OB-28-Road

Range Data:			
	Minimum	Maximum	Increment
Discharge	0.00	100.00	10.00 cfs



Performance Curves Report
OB-29-Crown

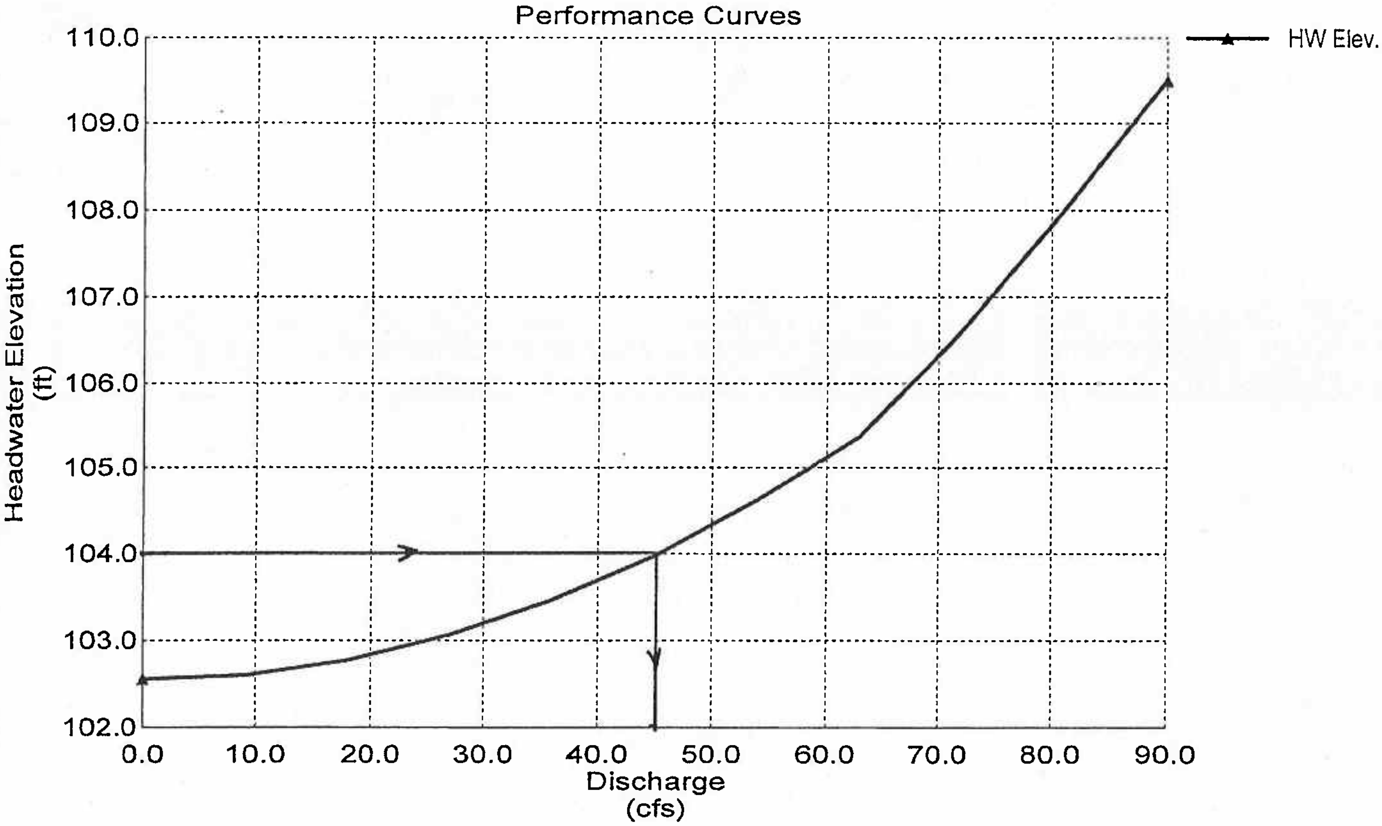
Range Data:				
	Minimum	Maximum	Increment	
Discharge	0.00	50.00	5.00	cfs



Performance Curves Report
OB-29-Road

Range Data:

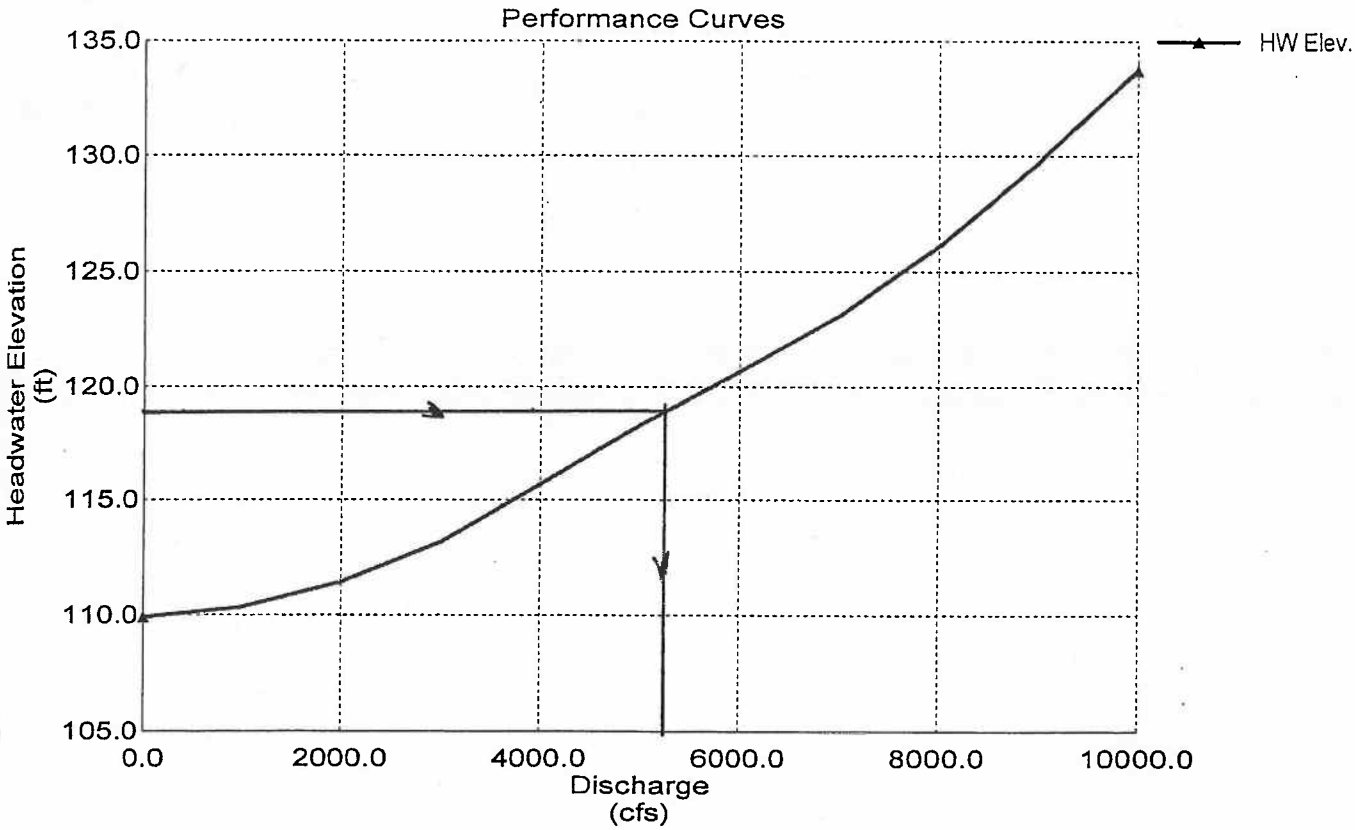
	Minimum	Maximum	Increment	
Discharge	0.00	90.00	9.00	cfs



Performance Curves Report
OB-30-Crown

Range Data:

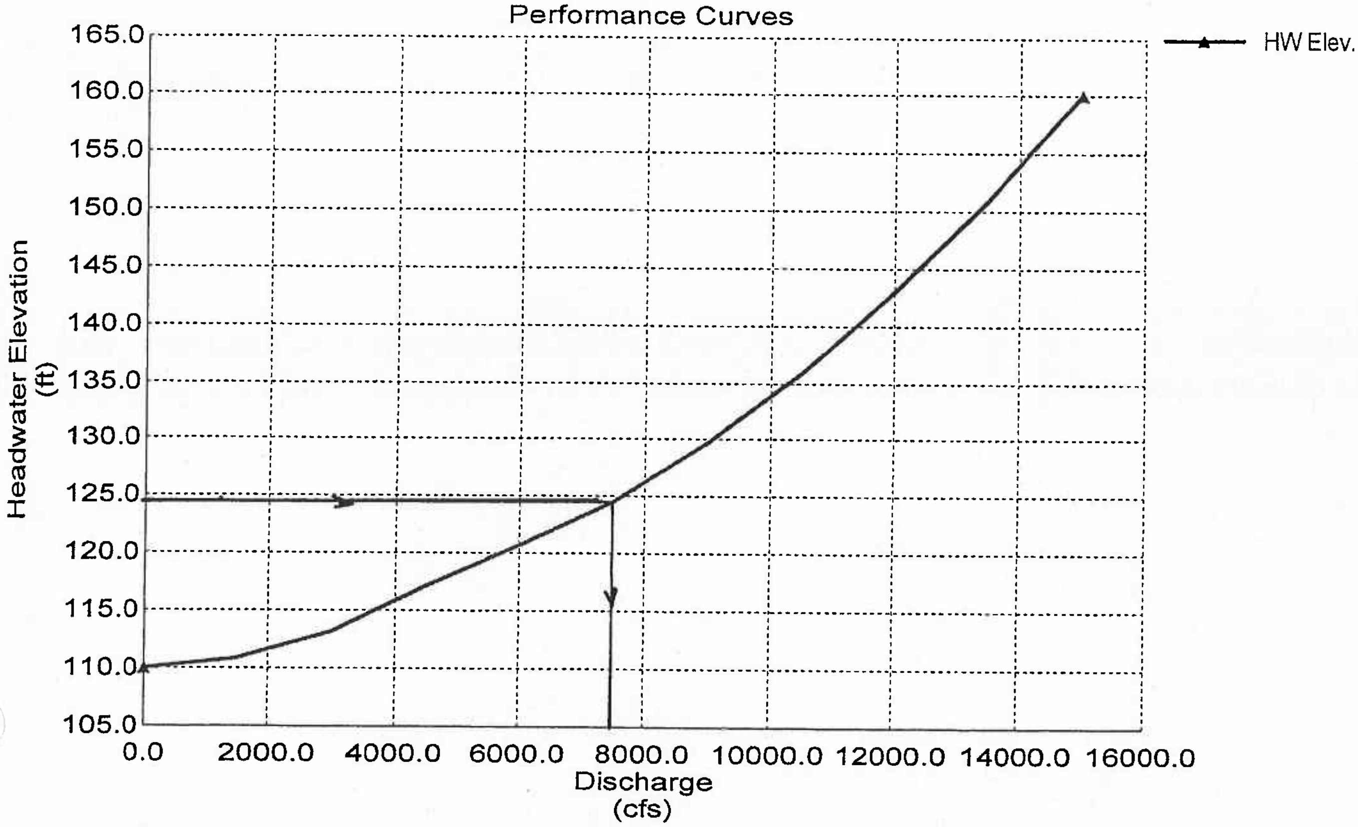
	Minimum	Maximum	Increment	
Discharge	0.00	10,000.00	1,000.00	cfs



Performance Curves Report
OB-30-Road

Range Data:

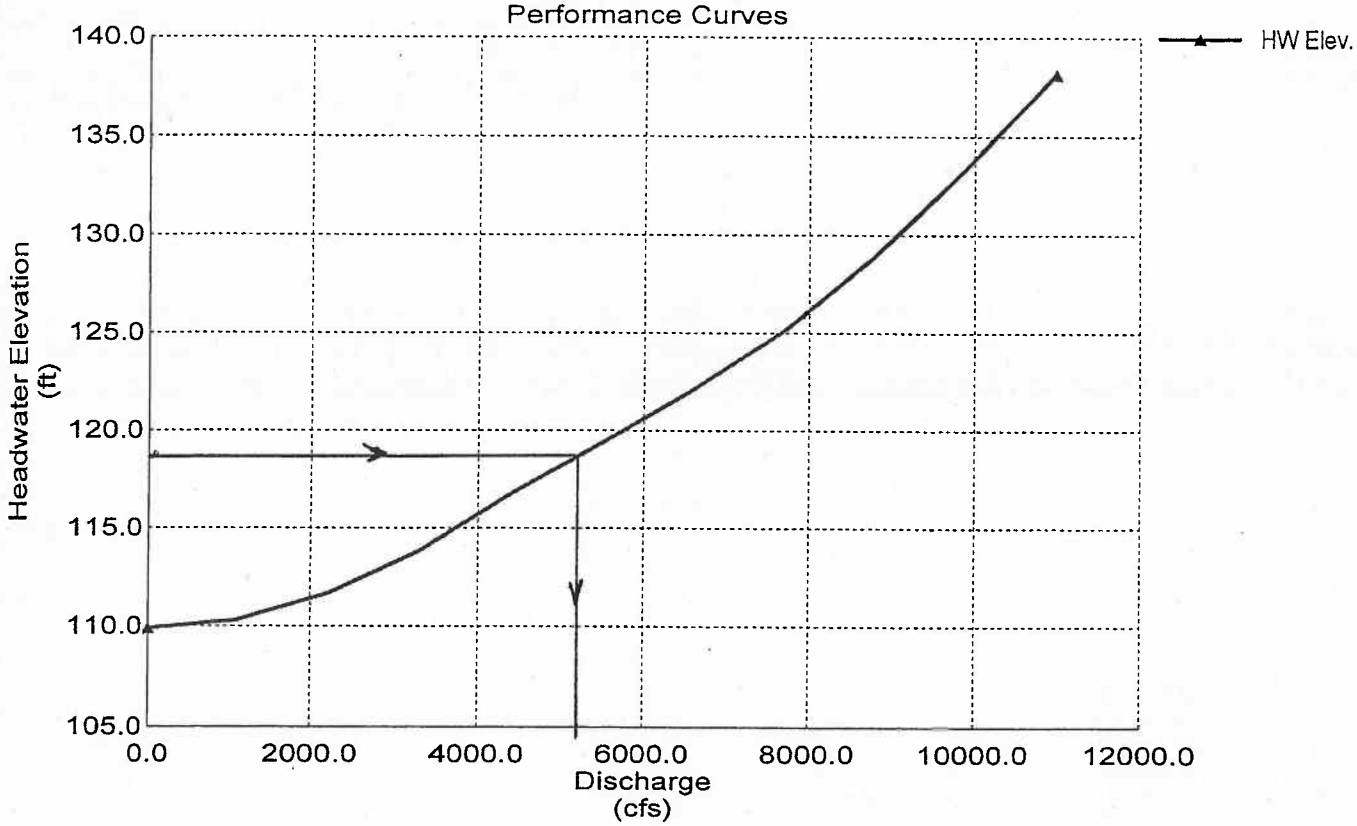
	Minimum	Maximum	Increment	
Discharge	0.00	15,000.00	1,500.00	cfs



Performance Curves Report
OB-31-Crown

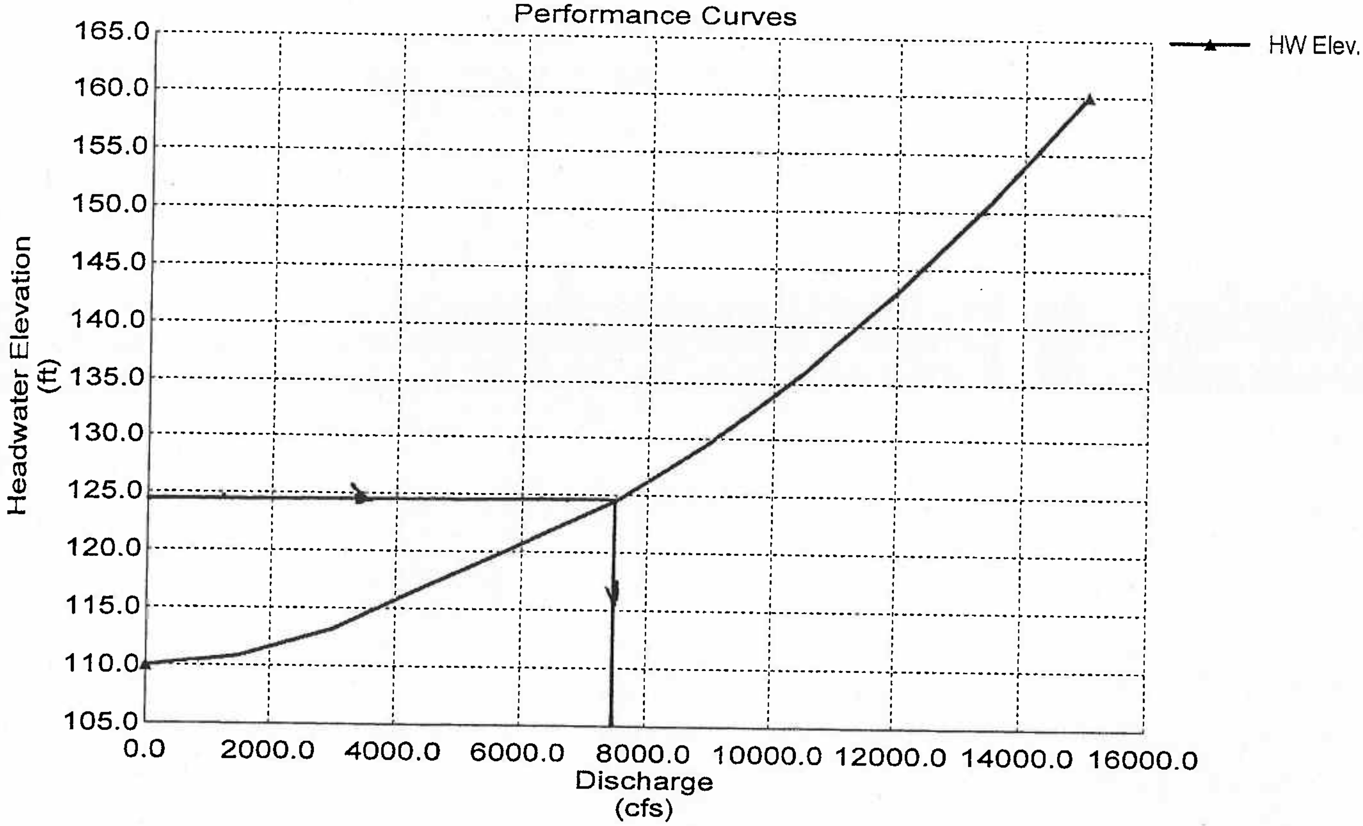
Range Data:

	Minimum	Maximum	Increment	
Discharge	0.00	11,000.00	1,100.00	cfs



Performance Curves Report
OB-31-Road

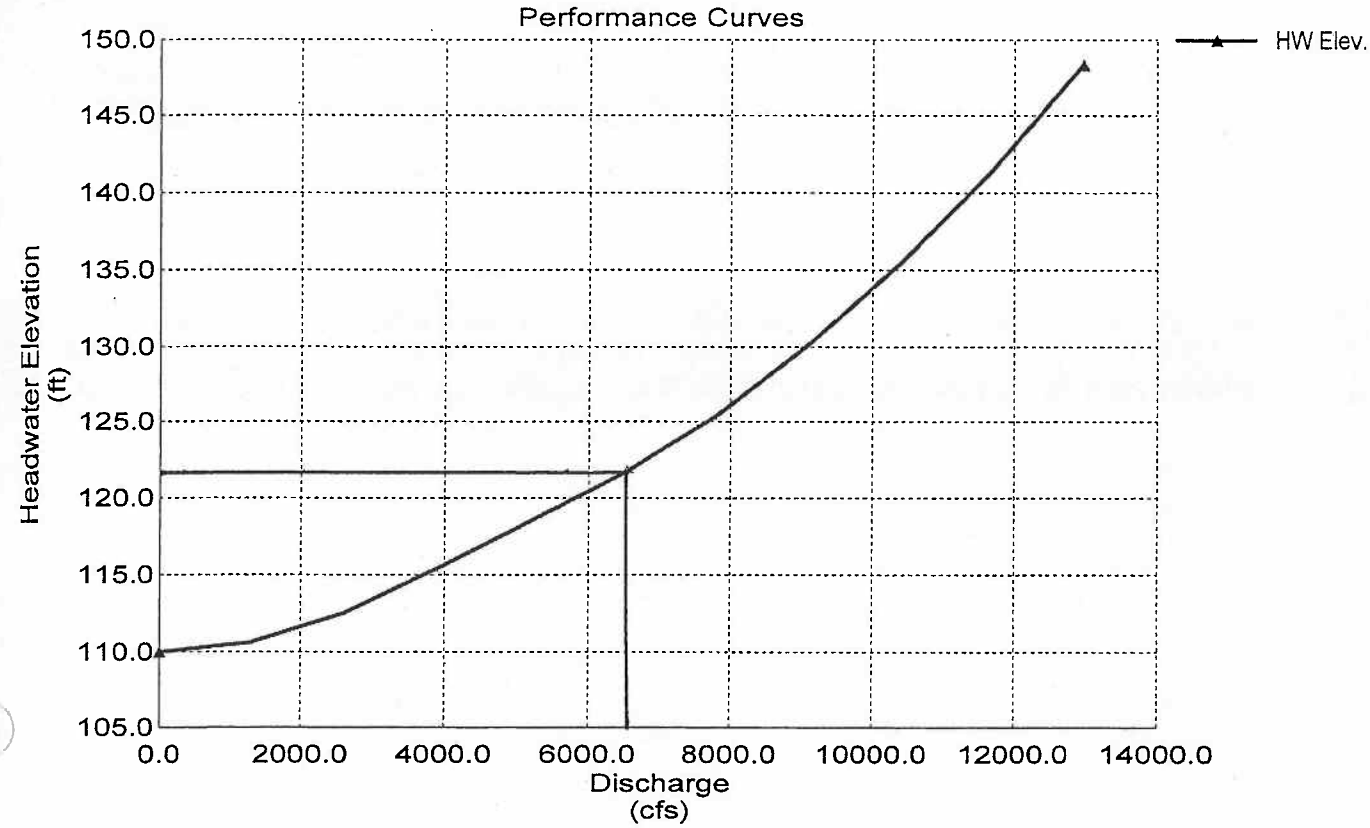
Range Data:				
	Minimum	Maximum	Increment	
Discharge	0.00	15,000.00	1,500.00	cfs



Performance Curves Report
OB-32-Road

Range Data:

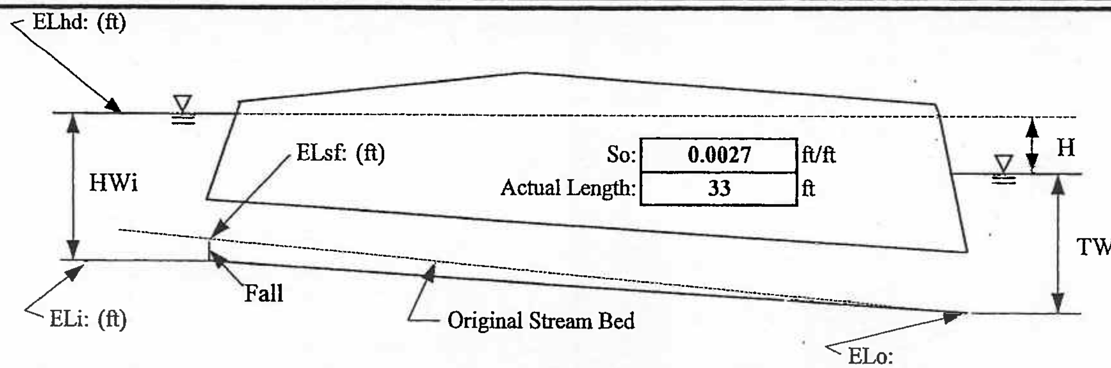
	Minimum	Maximum	Increment	
Discharge	0.00	13,000.00	1,300.00	cfs



[illegible]: Little Sewickley Creek	STATION: Obstruction 33 (OB33)	CULVERT DESIGN FORM
		DESIGNER / DATE: JEA 8/2/02
		REVIEWER / DATE: 7LEI 8/6/02

HYDROLOGICAL DATA

	ELi	ELo
a.	100	99.91



CULVERT DESCRIPTION: / **HEADWATER CALCULATIONS**

	Pipe Run #	Pipe Length (ft)	Pipe Dia. (Inch)	Total Flow Q (cfs)	INLET CONTROL HWi/D (2)	HWi	FALL (3)	ELhi (4)	OUTLET CONTROL TW (5)	dc	(dc+D)/2	ho (6)	ke	H (7)	ELho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	Comments
a.	OB33	33	27	**15.7**	1.00	2.25		102.25								102.25		at the Crown
a.	OB33	33	27	**28.5**	1.89	4.25		104.25								104.25		at the Roadway

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS
(2) HWi/D = HW/D OR HWt/D FROM DESIGN CHARTS
(3) FALL = HWi - (ELhd - ELsf) ; FALL IS ZERO FOR CULVERTS ON GRADE
(4) EL hi = HWi + ELi (INVERT OF INLET CONROL SECTION)
(5) TW BASED ON DOWNSTREAM CONTROL OR FLOW DEPTH IN CHANNEL
(6) ho = TW or (dc +D)/2 WHICHEVER IS GREATER
(7) H =[1 + ke +(29n^2L)/R^1.33] V^2 / 2g
(8) ELho = ELo + H + ho

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION

COMMENTS / DISCUSSION:

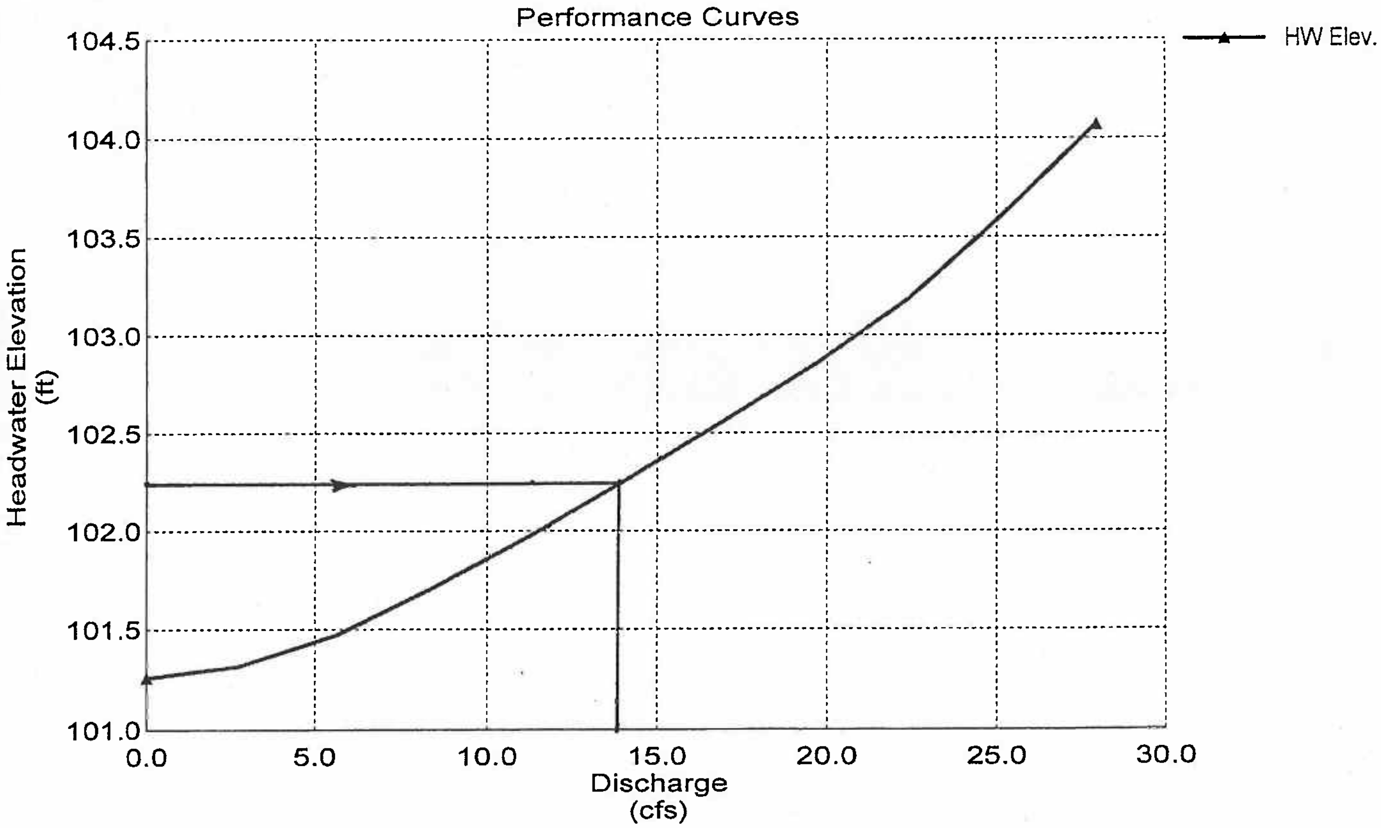
Note:
1. Assume Inv. In at 100'
2. Used HDS 5 Chart 2
3. Assume Entrance condition

CULVERT BARREL SELECTED:

Size: 27"
Shape: Circular
Material / n: CMP / 0.020
Entrance: Projecting

Performance Curves Report
OB-33-Crown

Range Data:			
	Minimum	Maximum	Increment
Discharge	0.00	28.00	2.80 cfs

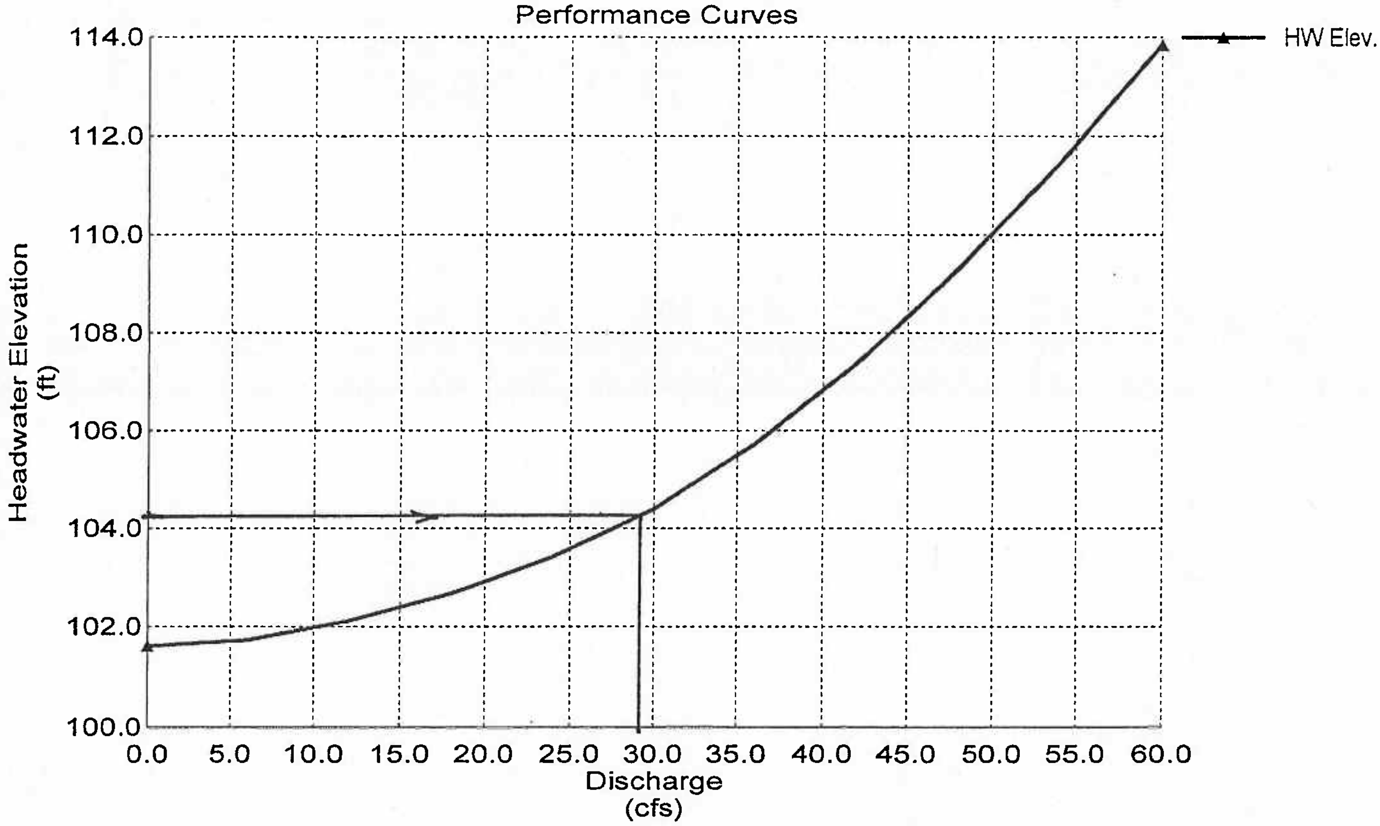


  URS Greiner Woodard Clyde
37 Brookside Road Waterbury, CT 06708 USA +1-203-755-1666

Performance Curves Report
OB-33-Road

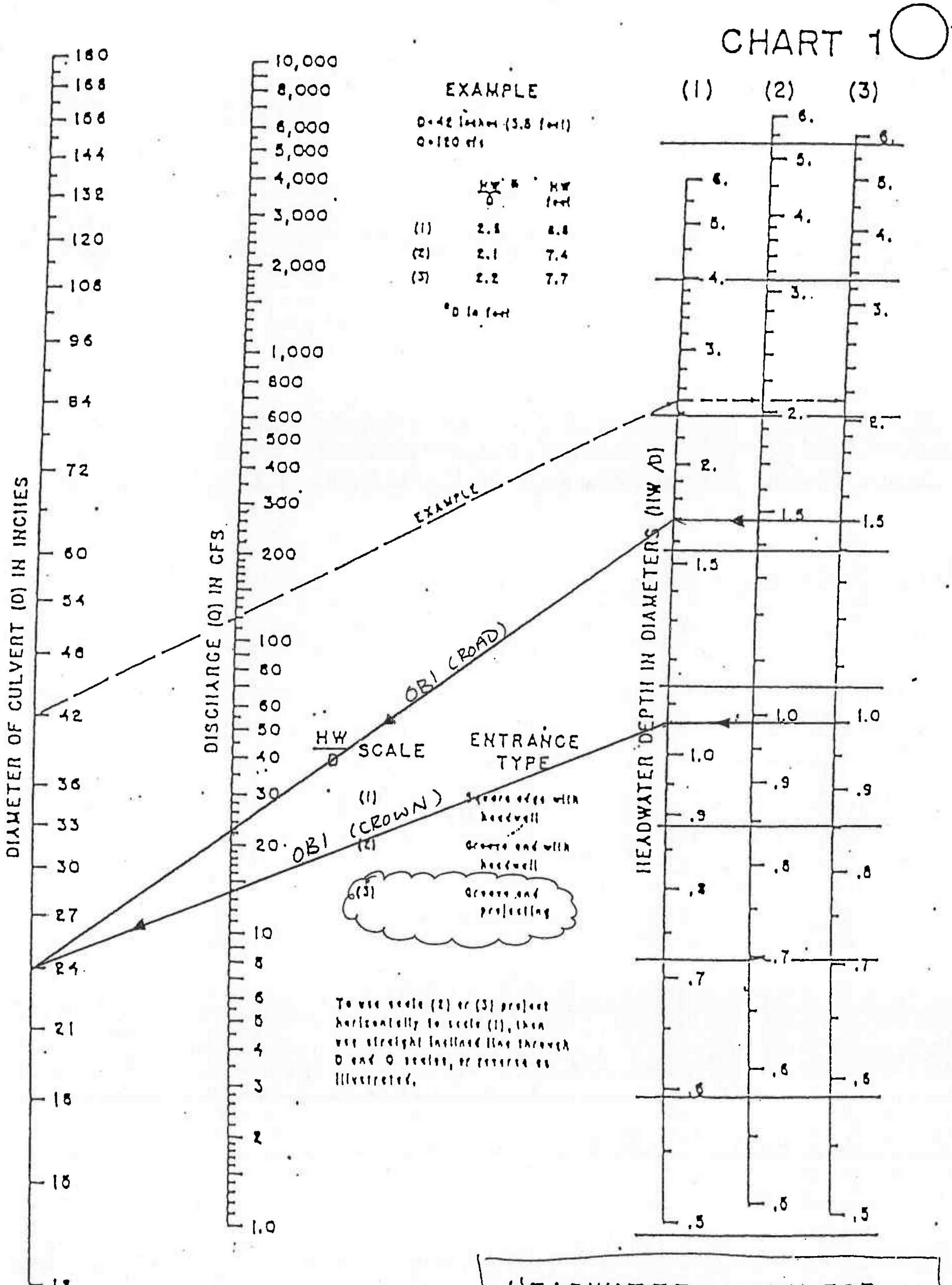
Range Data:

	Minimum	Maximum	Increment	
Discharge	0.00	60.00	6.00	cfs



OBSTRUCTION # 1

YCEL 7/31/02



Q = VA.

HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

Culvert Calculator Report
OB-1-Crown

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	102.00 ft	Headwater Depth/Height	1.00
Computed Headwater Eleva	102.00 ft	Discharge	12.90 cfs
Inlet Control HW Elev.	101.93 ft	Tailwater Elevation	100.04 ft
Outlet Control HW Elev.	102.00 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.94 ft
Length	30.00 ft	Constructed Slope	0.002000 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	1.29 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.29 ft
Velocity Downstream	6.01 ft/s	Critical Slope	0.005780 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	102.00 ft	Upstream Velocity Head	0.38 ft
Ke	0.20	Entrance Loss	0.08 ft

Inlet Control Properties

Inlet Control HW Elev.	101.93 ft	Flow Control	Unsubmerged
Inlet Type	Groove end projecting	Area Full	3.1 ft²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

Culvert Calculator Report
OB-1-Road

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	103.00 ft	Headwater Depth/Height	1.50
Computed Headwater Eleva	103.00 ft	Discharge	22.12 cfs
Inlet Control HW Elev.	102.95 ft	Tailwater Elevation	100.04 ft
Outlet Control HW Elev.	103.00 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.94 ft
Length	30.00 ft	Constructed Slope	0.002000 ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile	Depth, Downstream	1.68 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.68 ft
Velocity Downstream	7.86 ft/s	Critical Slope	0.009179 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	1		

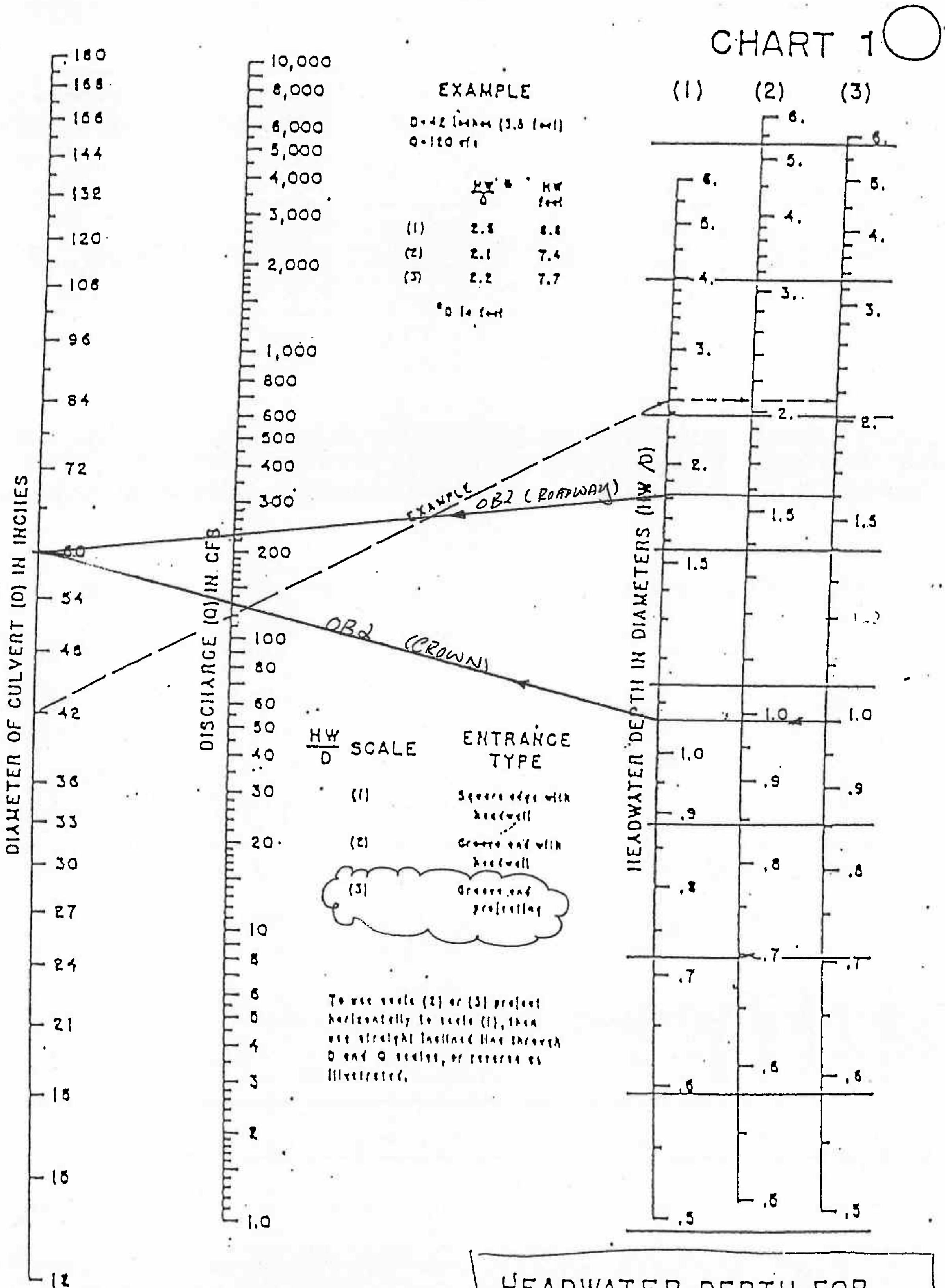
Outlet Control Properties

Outlet Control HW Elev.	103.00 ft	Upstream Velocity Head	0.77 ft
Ke	0.20	Entrance Loss	0.15 ft

Inlet Control Properties

Inlet Control HW Elev.	102.95 ft	Flow Control	Submerged
Inlet Type	Groove end projecting	Area Full	3.1 ft²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

OBSTRUCTION #2.



Q = VA.

HEADWATER SCALES 2&3 REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

Culvert Calculator Report
OB2-Crown

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	105.00 ft	Headwater Depth/Height	1.00
Computed Headwater Eleva	105.00 ft	Discharge	130.74 cfs
Inlet Control HW Elev.	104.90 ft	Tailwater Elevation	100.22 ft
Outlet Control HW Elev.	105.00 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.92 ft
Length	40.00 ft	Constructed Slope	0.002000 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	3.27 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	3.27 ft
Velocity Downstream	9.60 ft/s	Critical Slope	0.004318 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	5.00 ft
Section Size	60 inch	Rise	5.00 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	105.00 ft	Upstream Velocity Head	1.13 ft
Ke	0.20	Entrance Loss	0.23 ft

Inlet Control Properties

Inlet Control HW Elev.	104.90 ft	Flow Control	Unsubmerged
Inlet Type	Groove end projecting	Area Full	19.6 ft²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

Culvert Calculator Report
OB2-Road

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	108.00 ft	Headwater Depth/Height	1.60
Computed Headwater Eleva	108.00 ft	Discharge	235.37 cfs
Inlet Control HW Elev.	108.00 ft	Tailwater Elevation	100.22 ft
Outlet Control HW Elev.	107.62 ft	Control Type	Inlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.92 ft
Length	40.00 ft	Constructed Slope	0.002000 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	4.33 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	4.33 ft
Velocity Downstream	13.04 ft/s	Critical Slope	0.007505 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	5.00 ft
Section Size	60 inch	Rise	5.00 ft
Number Sections	1		

Outlet Control Properties

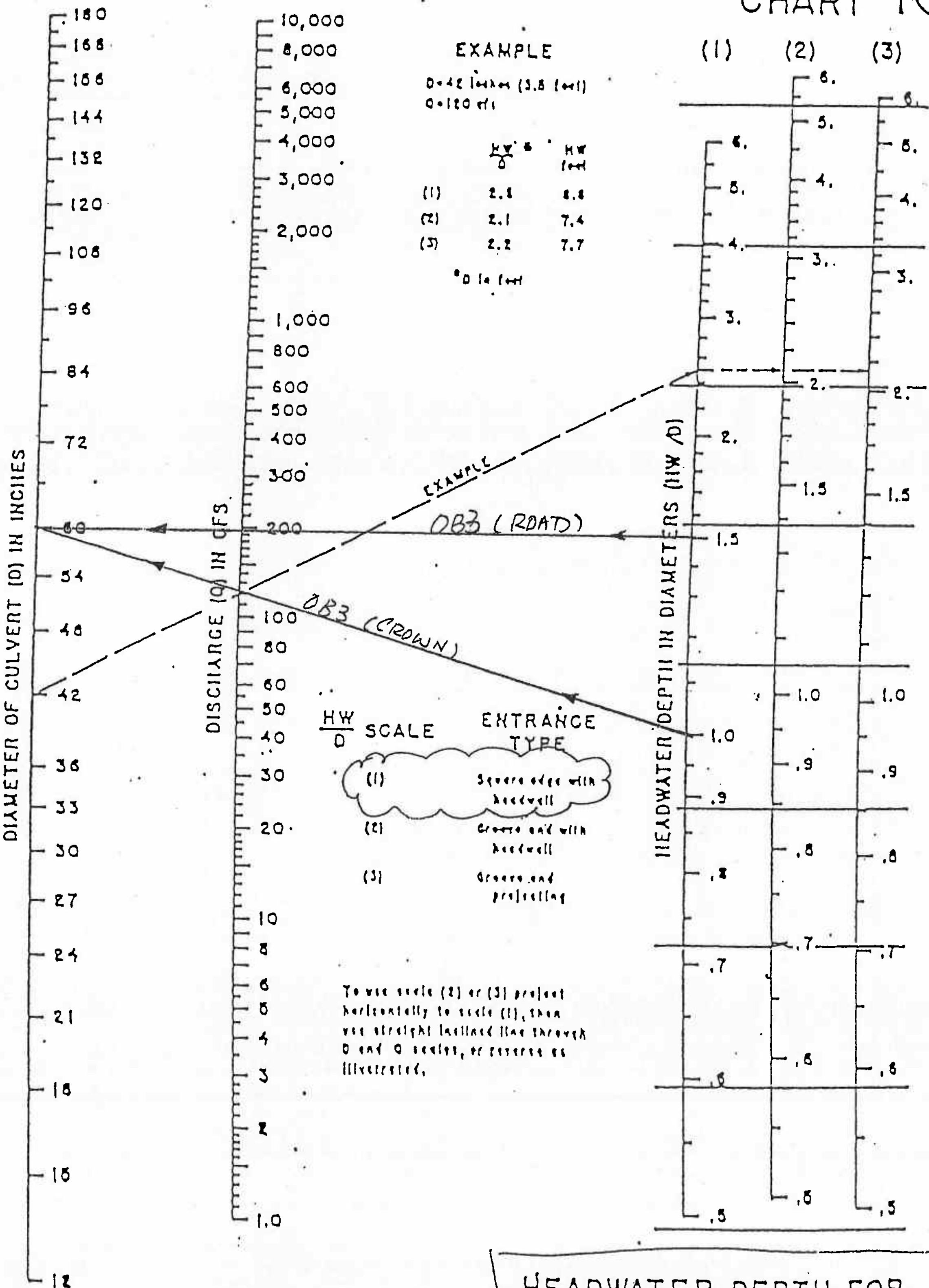
Outlet Control HW Elev.	107.62 ft	Upstream Velocity Head	2.25 ft
Ke	0.20	Entrance Loss	0.45 ft

Inlet Control Properties

Inlet Control HW Elev.	108.00 ft	Flow Control	Submerged
Inlet Type	Groove end projecting	Area Full	19.6 ft²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

OBSTRUCTION # 3. BIEL 7/31/02

CHART 1



Q = VA.

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER SCALES 2&3 REVISED MAY 1964

Culvert Calculator Report
OB3-Crown

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	105.00 ft	Headwater Depth/Height	1.00
Computed Headwater Eleva	105.00 ft	Discharge	117.81 cfs
Inlet Control HW Elev.	104.77 ft	Tailwater Elevation	100.43 ft
Outlet Control HW Elev.	105.00 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.93 ft
Length	35.00 ft	Constructed Slope	0.002000 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	3.10 ft
Slope Type	Mild	Normal Depth	4.15 ft
Flow Regime	Subcritical	Critical Depth	3.10 ft
Velocity Downstream	9.21 ft/s	Critical Slope	0.004102 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	5.00 ft
Section Size	60 inch	Rise	5.00 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	105.00 ft	Upstream Velocity Head	1.06 ft
Ke	0.50	Entrance Loss	0.53 ft

Inlet Control Properties

Inlet Control HW Elev.	104.77 ft	Flow Control	Unsubmerged
Inlet Type	Square edge w/headwall	Area Full	19.6 ft²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

Culvert Calculator Report
OB3-Road

olve For: Discharge

Culvert Summary

Allowable HW Elevation	107.50 ft	Headwater Depth/Height	1.50
Computed Headwater Eleva	107.50 ft	Discharge	200.62 cfs
Inlet Control HW Elev.	107.50 ft	Tailwater Elevation	100.43 ft
Outlet Control HW Elev.	107.21 ft	Control Type	Inlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.93 ft
Length	35.00 ft	Constructed Slope	0.002000 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	4.04 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	4.04 ft
Velocity Downstream	11.79 ft/s	Critical Slope	0.006084 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	5.00 ft
Section Size	60 inch	Rise	5.00 ft
Number Sections	1		

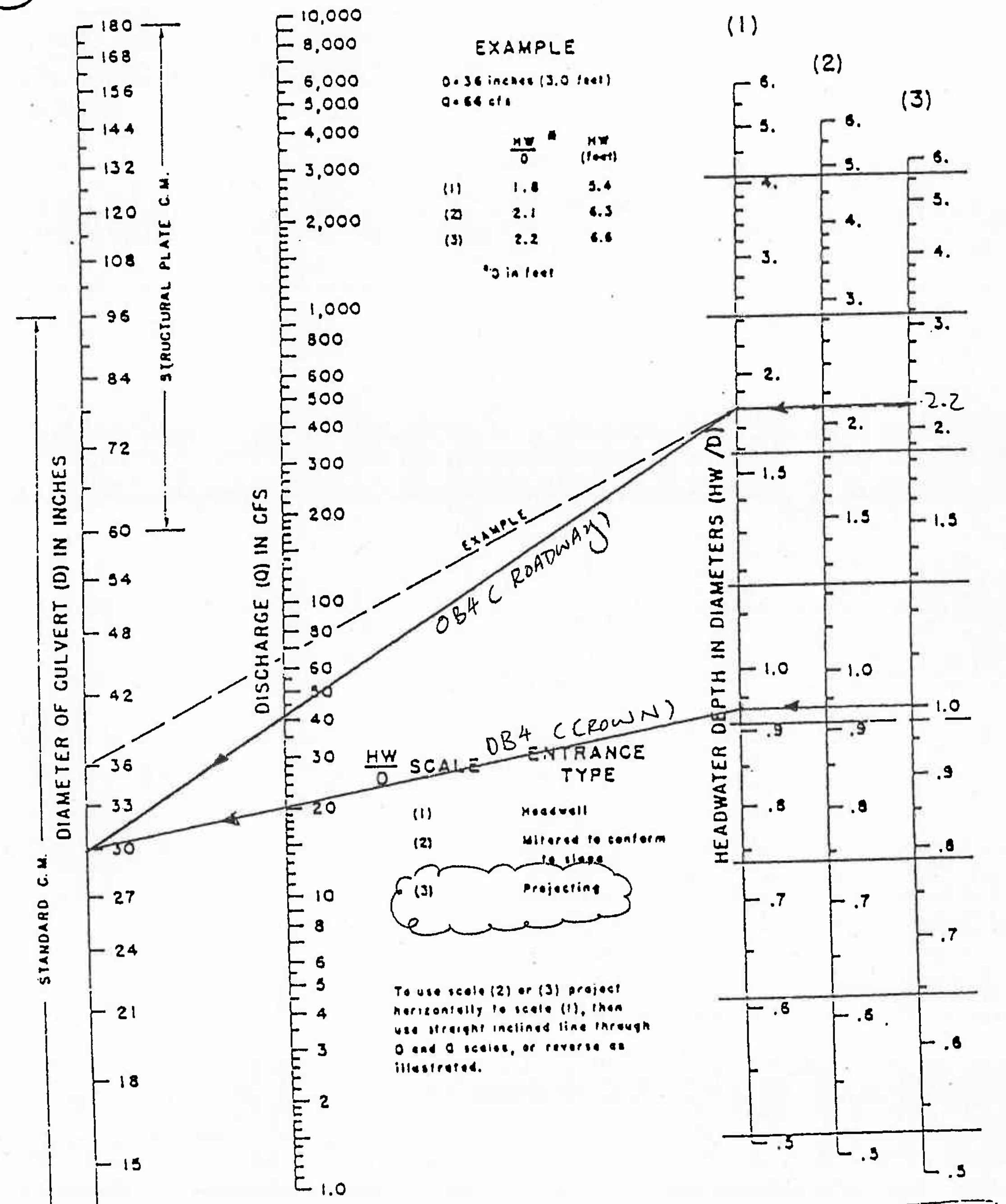
Outlet Control Properties

Outlet Control HW Elev.	107.21 ft	Upstream Velocity Head	1.78 ft
Ke	0.50	Entrance Loss	0.89 ft

Inlet Control Properties

Inlet Control HW Elev.	107.50 ft	Flow Control	Submerged
Inlet Type	Square edge w/headwall	Area Full	19.6 ft²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

CHART 2



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

Culvert Calculator Report
OB4-Crown

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	102.50 ft	Headwater Depth/Height	1.00
Computed Headwater Eleva	102.50 ft	Discharge	17.26 cfs
Inlet Control HW Elev.	102.26 ft	Tailwater Elevation	100.41 ft
Outlet Control HW Elev.	102.50 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.91 ft
Length	45.00 ft	Constructed Slope	0.002000 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	1.41 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.41 ft
Velocity Downstream	6.07 ft/s	Critical Slope	0.016395 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	2.50 ft
Section Size	30 inch	Rise	2.50 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	102.50 ft	Upstream Velocity Head	0.26 ft
Ke	0.90	Entrance Loss	0.23 ft

Inlet Control Properties

Inlet Control HW Elev.	102.26 ft	Flow Control	Unsubmerged
Inlet Type	Projecting	Area Full	4.9 ft²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Calculator Report
OB4-Road

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	105.50 ft	Headwater Depth/Height	2.20
Computed Headwater Eleva	105.50 ft	Discharge	39.11 cfs
Inlet Control HW Elev.	104.86 ft	Tailwater Elevation	100.41 ft
Outlet Control HW Elev.	105.50 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.91 ft
Length	45.00 ft	Constructed Slope	0.002000 ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile	Depth, Downstream	2.11 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	2.11 ft
Velocity Downstream	8.85 ft/s	Critical Slope	0.029513 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	2.50 ft
Section Size	30 inch	Rise	2.50 ft
Number Sections	1		

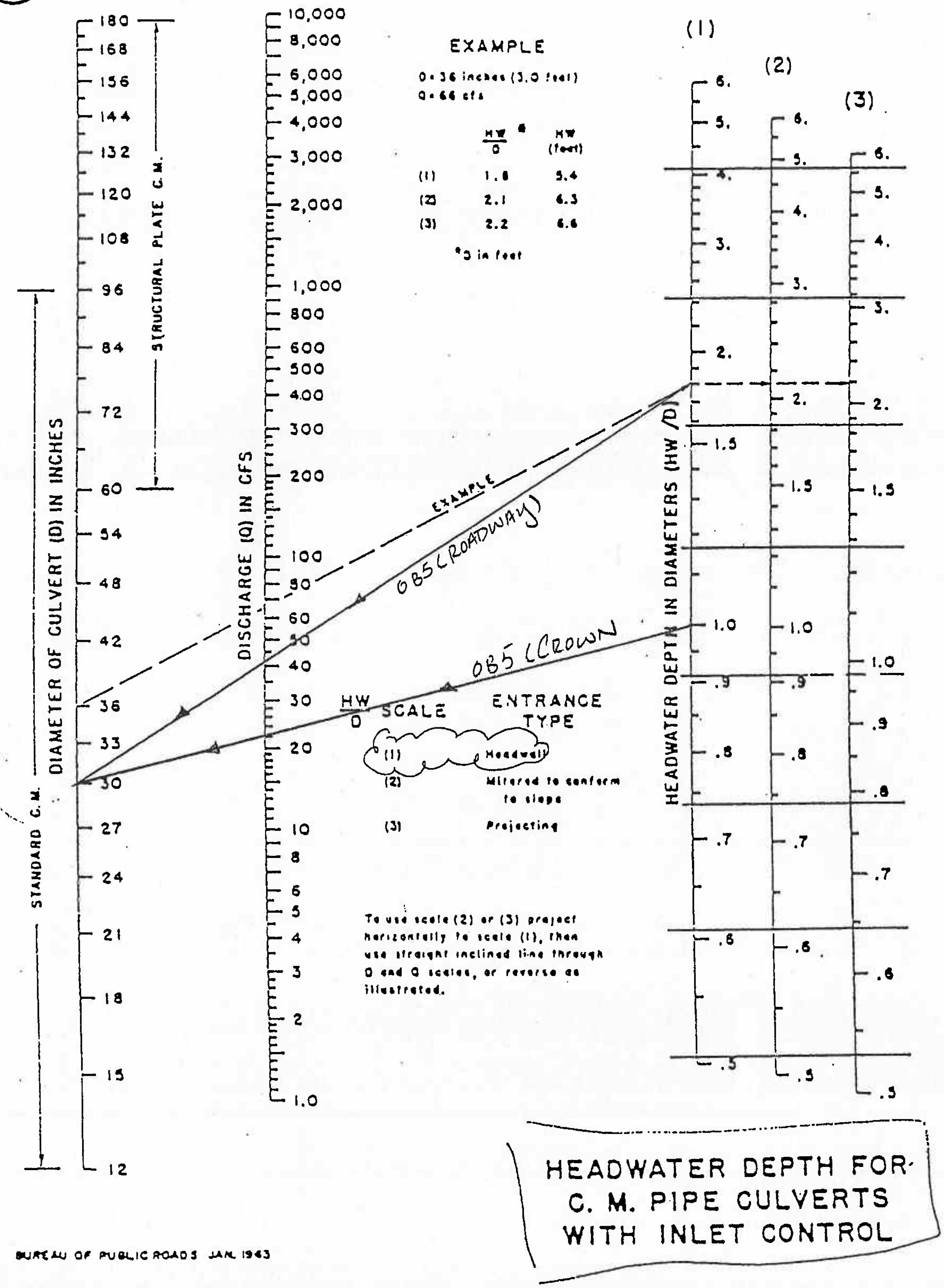
Outlet Control Properties

Outlet Control HW Elev.	105.50 ft	Upstream Velocity Head	0.99 ft
Ke	0.90	Entrance Loss	0.89 ft

Inlet Control Properties

Inlet Control HW Elev.	104.86 ft	Flow Control	Submerged
Inlet Type	Projecting	Area Full	4.9 ft²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

CHART 2



DIAMETER OF CULVERT (D) IN INCHES
180
168
156
144
132
120
108
96
84
72
60
54
48
42
36
33
30
27
24
21
18
15
12
STRUCTURAL PLATE C.M.
STANDARD C.M.
DISCHARGE (Q) IN CFS
10,000
8,000
6,000
5,000
4,000
3,000
2,000
1,000
800
600
500
400
300
200
100
80
60
50
40
30
20
10
8
6
5
4
3
2
1.0
EXAMPLE
D = 36 inches (3.0 feet)
Q = 66 cfs
HW/D * HW (feet)
(1) 1.8 5.4
(2) 2.1 6.3
(3) 2.2 6.6
*D in feet
HEADWATER DEPTH IN DIAMETERS (HW/D)
(1)
(2)
(3)
HW/D SCALE ENTRANCE TYPE
(1) Headwall
(2) Mitered to conform to slope
(3) Projecting
To use scale (2) or (3) project horizontally to scale (1), then use straight inclined line through D and Q scales, or reverse as illustrated.
EXAMPLE
OB5 (ROADWAY)
OB5 (CROWN
BUREAU OF PUBLIC ROADS JAN. 1963
HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

Culvert Calculator Report
OB5-Road

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	104.50	ft	Headwater Depth/Height	1.80	
Computed Headwater Eleva	104.50	ft	Discharge	36.95	cfs
Inlet Control HW Elev.	103.87	ft	Tailwater Elevation	100.02	ft
Outlet Control HW Elev.	104.50	ft	Control Type	Outlet Control	

Grades

Upstream Invert	100.00	ft	Downstream Invert	99.92	ft
Length	35.00	ft	Constructed Slope	0.002286	ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile		Depth, Downstream	2.06	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	2.06	ft
Velocity Downstream	8.54	ft/s	Critical Slope	0.027432	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	2.50	ft
Section Size	30 inch		Rise	2.50	ft
Number Sections	1				

Outlet Control Properties

Outlet Control HW Elev.	104.50	ft	Upstream Velocity Head	0.88	ft
Ke	0.50		Entrance Loss	0.44	ft

Inlet Control Properties

Inlet Control HW Elev.	103.87	ft	Flow Control	Submerged	
Inlet Type	Headwall		Area Full	4.9	ft²
K	0.00780		HDS 5 Chart	2	
M	2.00000		HDS 5 Scale	1	
C	0.03790		Equation Form	1	
Y	0.69000				

Culvert Calculator Report
OB5-Crown

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	102.50 ft	Headwater Depth/Height	1.00
Computed Headwater Eleva	102.50 ft	Discharge	19.03 cfs
Inlet Control HW Elev.	102.21 ft	Tailwater Elevation	100.02 ft
Outlet Control HW Elev.	102.50 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.92 ft
Length	35.00 ft	Constructed Slope	0.002286 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	1.48 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.48 ft
Velocity Downstream	6.29 ft/s	Critical Slope	0.016959 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	2.50 ft
Section Size	30 inch	Rise	2.50 ft
Number Sections	1		

Outlet Control Properties

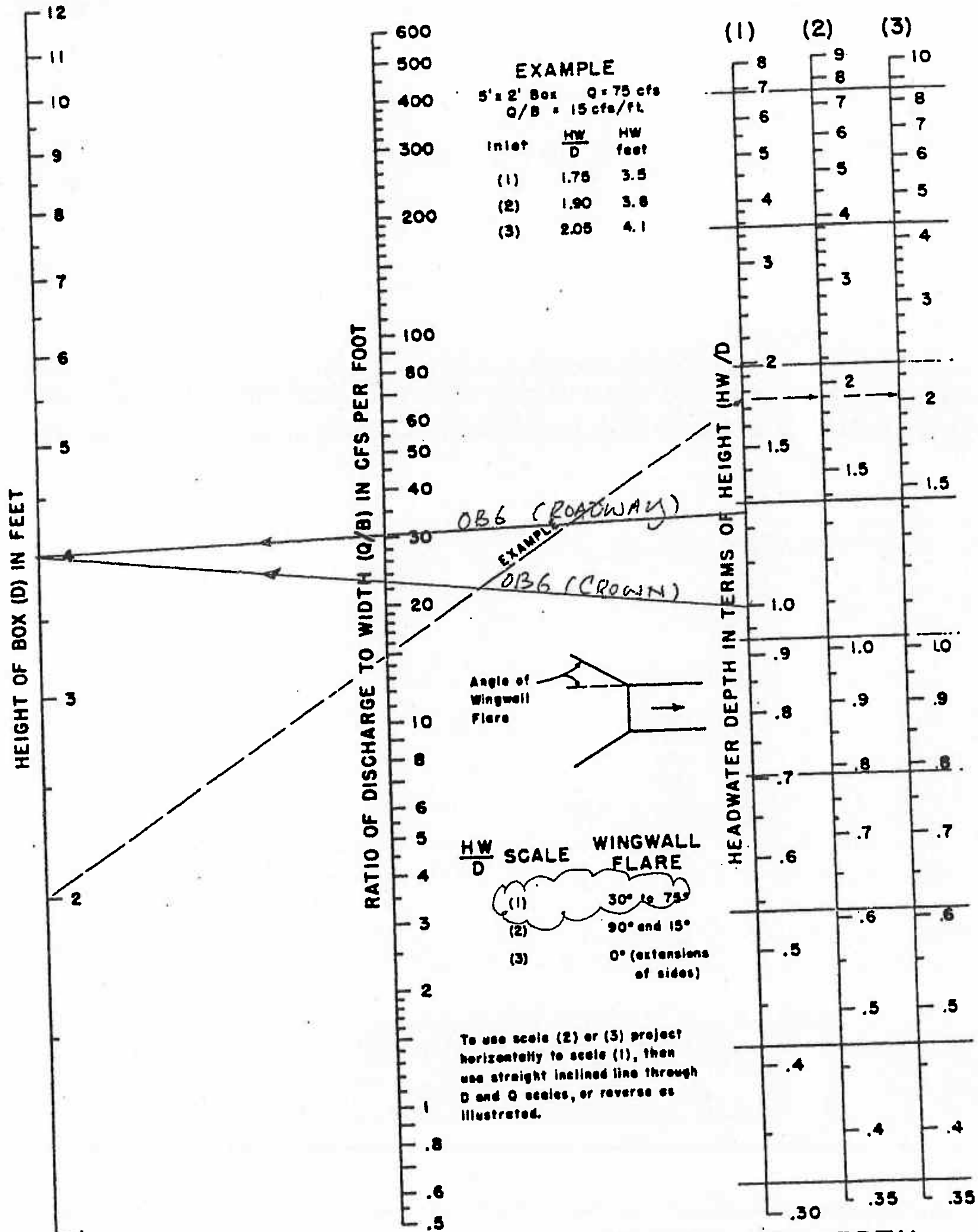
Outlet Control HW Elev.	102.50 ft	Upstream Velocity Head	0.31 ft
Ke	0.50	Entrance Loss	0.15 ft

Inlet Control Properties

Inlet Control HW Elev.	102.21 ft	Flow Control	Unsubmerged
Inlet Type	Headwall	Area Full	4.9 ft²
K	0.00780	HDS 5 Chart	2
M	2.00000	HDS 5 Scale	1
C	0.03790	Equation Form	1
Y	0.69000		

OBSTRUCTION # 6.
(8' W x 4' H)

CHART 8



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

OB6 (CROWN) Q/B = 23 cfs/ft = 23 x 8' = 184 cfs

OB6 (ROADWAY) Q/B = 30 cfs/ft = 30 x 8' = 240 cfs

Culvert Calculator Report
OB6-Crown

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	104.00 ft	Headwater Depth/Height	1.00
Computed Headwater Eleva	104.00 ft	Discharge	160.77 cfs
Inlet Control HW Elev.	103.74 ft	Tailwater Elevation	100.16 ft
Outlet Control HW Elev.	104.00 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.91 ft
Length	40.00 ft	Constructed Slope	0.002250 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	2.32 ft
Slope Type	Mild	Normal Depth	2.70 ft
Flow Regime	Subcritical	Critical Depth	2.32 ft
Velocity Downstream	8.65 ft/s	Critical Slope	0.003424 ft/ft

Section

Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	8.00 ft
Section Size	8 x 4 ft	Rise	4.00 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	104.00 ft	Upstream Velocity Head	0.98 ft
Ke	0.50	Entrance Loss	0.49 ft

Inlet Control Properties

Inlet Control HW Elev.	103.74 ft	Flow Control	Unsubmerged
Inlet Type	30 to 75° wingwall flares	Area Full	32.0 ft²
K	0.02600	HDS 5 Chart	8
M	1.00000	HDS 5 Scale	1
C	0.03470	Equation Form	1
Y	0.86000		

Culvert Calculator Report
OB6-Road

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	105.00 ft	Headwater Depth/Height	1.25
Computed Headwater Eleva	105.00 ft	Discharge	224.74 cfs
Inlet Control HW Elev.	104.73 ft	Tailwater Elevation	100.16 ft
Outlet Control HW Elev.	105.00 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.91 ft
Length	40.00 ft	Constructed Slope	0.002250 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	2.91 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	2.91 ft
Velocity Downstream	9.67 ft/s	Critical Slope	0.003574 ft/ft

Section

Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	8.00 ft
Section Size	8 x 4 ft	Rise	4.00 ft
Number Sections	1		

Outlet Control Properties

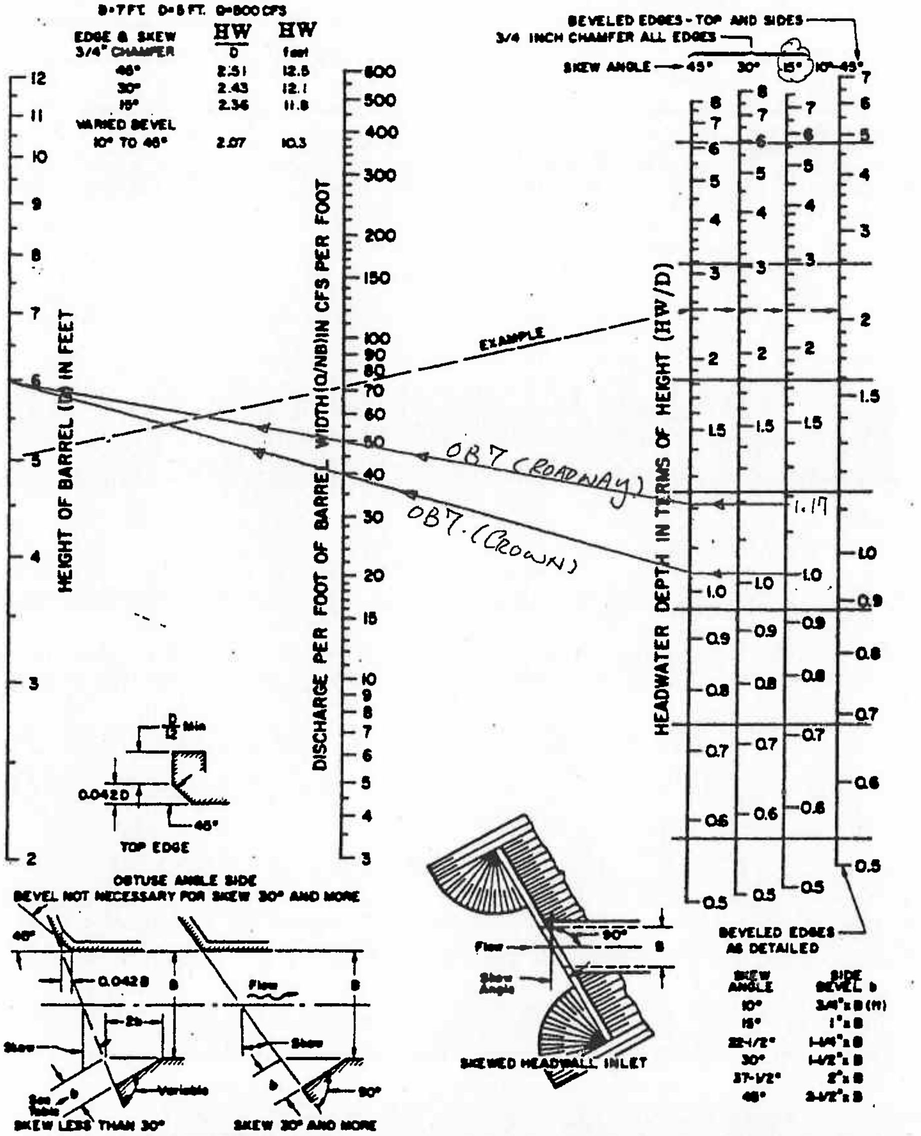
Outlet Control HW Elev.	105.00 ft	Upstream Velocity Head	1.22 ft
Ke	0.50	Entrance Loss	0.61 ft

Inlet Control Properties

Inlet Control HW Elev.	104.73 ft	Flow Control	Transition
Inlet Type	30 to 75° wingwall flares	Area Full	32.0 ft²
K	0.02600	HDS 5 Chart	8
M	1.00000	HDS 5 Scale	1
C	0.03470	Equation Form	1
Y	0.86000		

8'W x 6'H

CHART 11



BEVELED INLET EDGES
DESIGNED FOR SAME CAPACITY AT ANY SKEW

FEDERAL HIGHWAY ADMINISTRATION
MAY 1973

HEADWATER DEPTH FOR INLET CONTROL
SINGLE BARREL BOX CULVERTS
SKEWED HEADWALLS
CHAMFERED OR BEVELED INLET EDGES

OB7 (CROWN) Q/B = 40 cfs/ft = 40 x 8 = 320 cfs

OB7 (ROADWAY) Q/B = 50 cfs/ft = 50 x 8 = 400 cfs.

Culvert Calculator Report
OB7-Crown

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	106.00 ft	Headwater Depth/Height	1.00
Computed Headwater Eleva	106.00 ft	Discharge	295.35 cfs
Inlet Control HW Elev.	105.79 ft	Tailwater Elevation	100.41 ft
Outlet Control HW Elev.	106.00 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.91 ft
Length	40.00 ft	Constructed Slope	0.002250 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	3.49 ft
Slope Type	Mild	Normal Depth	4.22 ft
Flow Regime	Subcritical	Critical Depth	3.49 ft
Velocity Downstream	10.59 ft/s	Critical Slope	0.003746 ft/ft

Section

Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	8.00 ft
Section Size	8 x 6 ft	Rise	6.00 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	106.00 ft	Upstream Velocity Head	1.47 ft
Ke	0.50	Entrance Loss	0.73 ft

Inlet Control Properties

Inlet Control HW Elev.	105.79 ft	Flow Control	Unsubmerged
Inlet Type 3/4 in chamfers; 15° skewed headwall		Area Full	48.0 ft²
K	0.52200	HDS 5 Chart	11
M	0.66700	HDS 5 Scale	3
C	0.04020	Equation Form	2
Y	0.73000		

Culvert Calculator Report
OB7-Road

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	107.00 ft	Headwater Depth/Height	1.17
Computed Headwater Eleva	107.00 ft	Discharge	372.23 cfs
Inlet Control HW Elev.	106.76 ft	Tailwater Elevation	100.41 ft
Outlet Control HW Elev.	107.00 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.91 ft
Length	40.00 ft	Constructed Slope	0.002250 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	4.07 ft
Slope Type	Mild	Normal Depth	5.03 ft
Flow Regime	Subcritical	Critical Depth	4.07 ft
Velocity Downstream	11.44 ft/s	Critical Slope	0.003931 ft/ft

Section

Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	8.00 ft
Section Size	8 x 6 ft	Rise	6.00 ft
Number Sections	1		

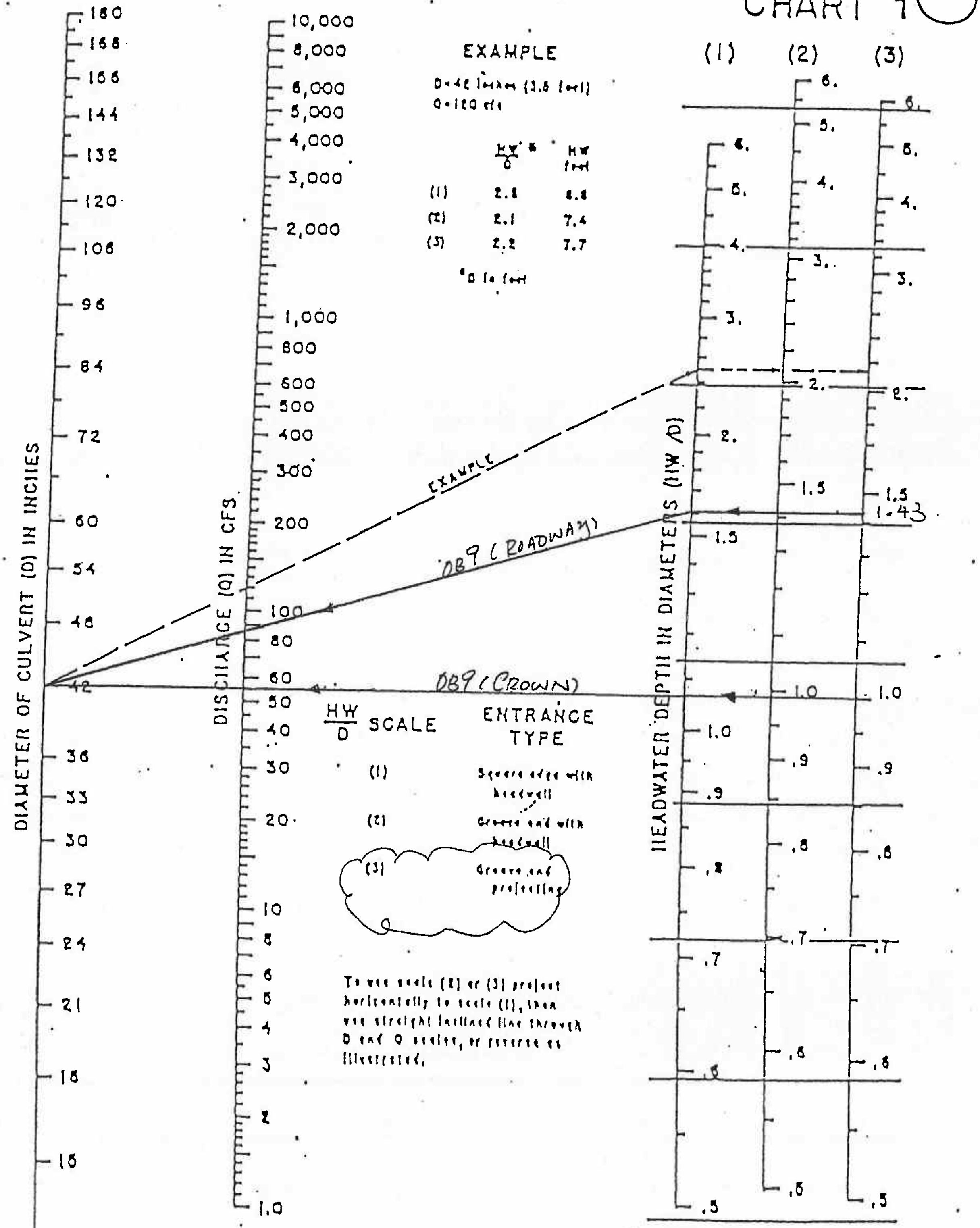
Outlet Control Properties

Outlet Control HW Elev.	107.00 ft	Upstream Velocity Head	1.71 ft
Ke	0.50	Entrance Loss	0.85 ft

Inlet Control Properties

Inlet Control HW Elev.	106.76 ft	Flow Control	Unsubmerged
Inlet Type	3/4 inch chamfers; 15° skewed headwall	Area Full	48.0 ft²
K	0.52200	HDS 5 Chart	11
M	0.66700	HDS 5 Scale	3
C	0.04020	Equation Form	2
Y	0.73000		

CHART 1



Q = VA.

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2&3 REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

Culvert Calculator Report
OB9-Crown

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	103.50 ft	Headwater Depth/Height	1.00
Computed Headwater Eleva	103.50 ft	Discharge	53.77 cfs
Inlet Control HW Elev.	103.44 ft	Tailwater Elevation	100.47 ft
Outlet Control HW Elev.	103.50 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.97 ft
Length	16.00 ft	Constructed Slope	0.001875 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	2.29 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	2.29 ft
Velocity Downstream	8.04 ft/s	Critical Slope	0.004871 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	3.50 ft
Section Size	42 inch	Rise	3.50 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	103.50 ft	Upstream Velocity Head	0.82 ft
Ke	0.20	Entrance Loss	0.16 ft

Inlet Control Properties

Inlet Control HW Elev.	103.44 ft	Flow Control	Unsubmerged
Inlet Type	Groove end projecting	Area Full	9.6 ft²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

Culvert Calculator Report
OB9-Road

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	105.00 ft	Headwater Depth/Height	1.43
Computed Headwater Eleva	105.00 ft	Discharge	86.94 cfs
Inlet Control HW Elev.	105.00 ft	Tailwater Elevation	100.47 ft
Outlet Control HW Elev.	104.87 ft	Control Type	Inlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.97 ft
Length	16.00 ft	Constructed Slope	0.001875 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	2.90 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	2.90 ft
Velocity Downstream	10.20 ft/s	Critical Slope	0.007324 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	3.50 ft
Section Size	42 inch	Rise	3.50 ft
Number Sections	1		

Outlet Control Properties

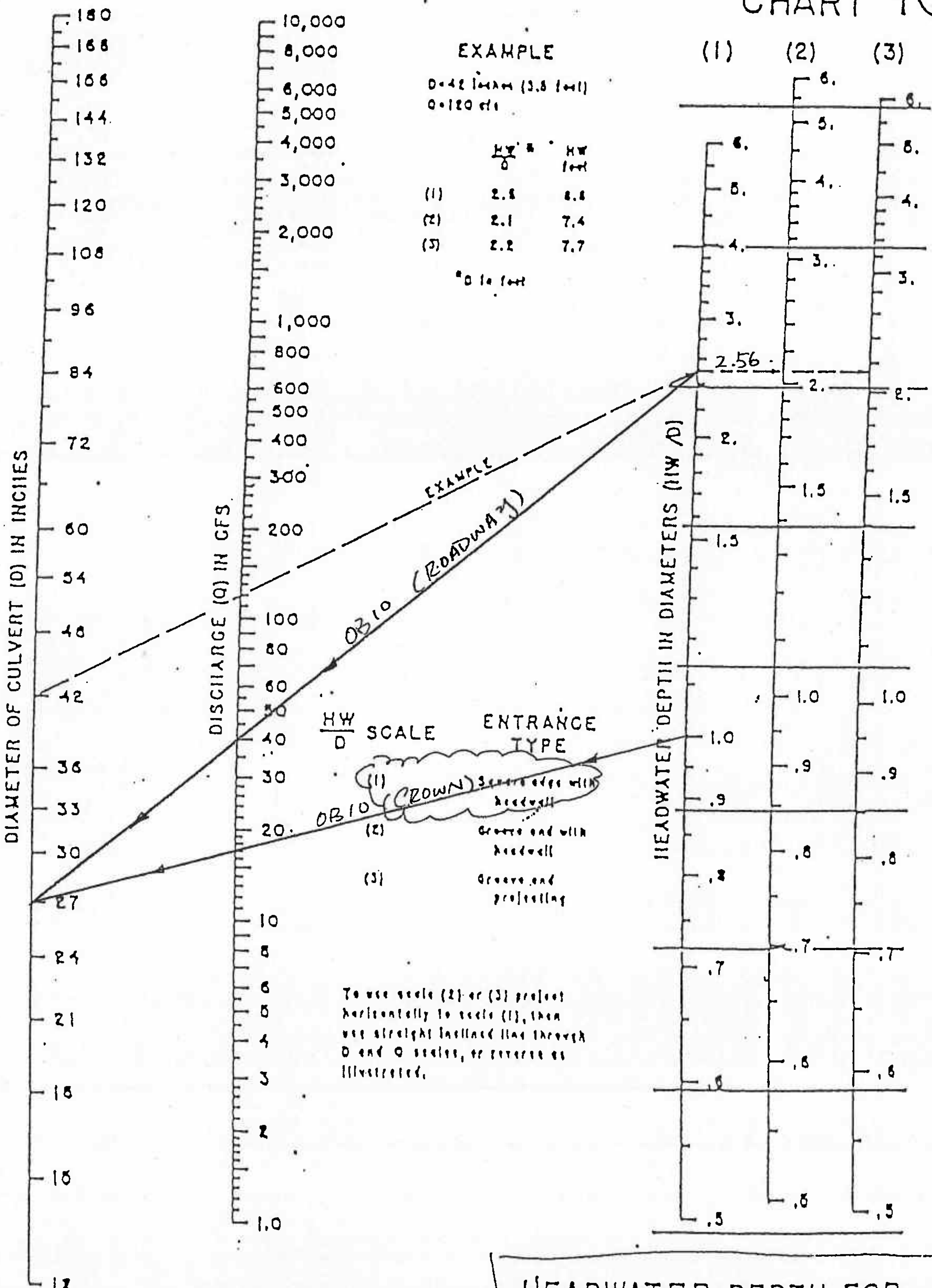
Outlet Control HW Elev.	104.87 ft	Upstream Velocity Head	1.36 ft
Ke	0.20	Entrance Loss	0.27 ft

Inlet Control Properties

Inlet Control HW Elev.	105.00 ft	Flow Control	Submerged
Inlet Type	Groove end projecting	Area Full	9.6 ft²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

OBSTRUCTION. #10. ZLEL 8/1/02

CHART 10



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

Q = VA.

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER SCALES 2&3 REVISED MAY 1964

Culvert Calculator Report
OB10-Crown

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	102.25	ft	Headwater Depth/Height	1.00	
Computed Headwater Eleva	102.25	ft	Discharge	15.87	cfs
Inlet Control HW Elev.	102.13	ft	Tailwater Elevation	100.13	ft
Outlet Control HW Elev.	102.25	ft	Control Type	Outlet Control	

Grades

Upstream Invert	100.00	ft	Downstream Invert	99.93	ft
Length	35.00	ft	Constructed Slope	0.002000	ft/ft

Hydraulic Profile

Profile	M2		Depth, Downstream	1.39	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.39	ft
Velocity Downstream	6.16	ft/s	Critical Slope	0.005331	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.25	ft
Section Size	27 inch		Rise	2.25	ft
Number Sections	1				

Outlet Control Properties

Outlet Control HW Elev.	102.25	ft	Upstream Velocity Head	0.40	ft
Ke	0.50		Entrance Loss	0.20	ft

Inlet Control Properties

Inlet Control HW Elev.	102.13	ft	Flow Control	Unsubmerged	
Inlet Type	Square edge w/headwall		Area Full	4.0	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Calculator Report
OB10-Road

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	105.75 ft	Headwater Depth/Height	2.56
Computed Headwater Eleva	105.75 ft	Discharge	41.06 cfs
Inlet Control HW Elev.	105.75 ft	Tailwater Elevation	100.13 ft
Outlet Control HW Elev.	105.22 ft	Control Type	Inlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.93 ft
Length	35.00 ft	Constructed Slope	0.002000 ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile	Depth, Downstream	2.11 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	2.11 ft
Velocity Downstream	10.62 ft/s	Critical Slope	0.015195 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.25 ft
Section Size	27 inch	Rise	2.25 ft
Number Sections	1		

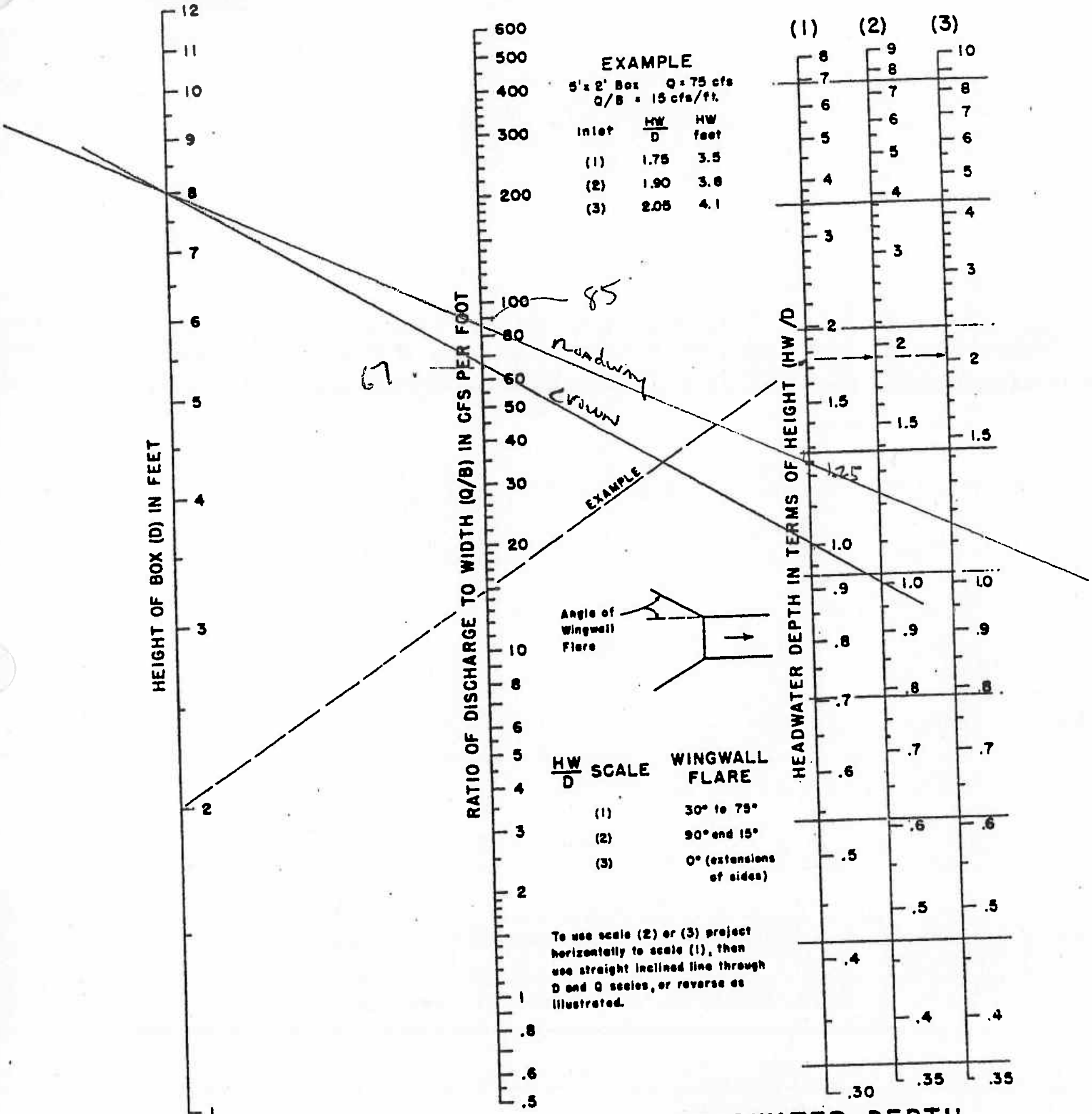
Outlet Control Properties

Outlet Control HW Elev.	105.22 ft	Upstream Velocity Head	1.66 ft
Ke	0.50	Entrance Loss	0.83 ft

Inlet Control Properties

Inlet Control HW Elev.	105.75 ft	Flow Control	Submerged
Inlet Type	Square edge w/headwall	Area Full	4.0 ft²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

CHART 8



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

CROWN: $Q/B = 67$ cfs/ft $\qquad Q = 67$ cfs/ft $\times 25'$
$= 1675$ cfs

ROADWAY: $Q/B = 85$ cfs/ft $\qquad Q = 85$ cfs/ft $\times 25'$
$= 2125$ cfs

Culvert Calculator Report
OB-12-Crown

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	108.00 ft	Headwater Depth/Height	1.00
Computed Headwater Eleva	108.00 ft	Discharge	1,398.51 cfs
Inlet Control HW Elev.	107.40 ft	Tailwater Elevation	105.91 ft
Outlet Control HW Elev.	108.00 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.91 ft
Length	33.00 ft	Constructed Slope	0.002606 ft/ft

Hydraulic Profile

Profile	M1	Depth, Downstream	6.00 ft
Slope Type	Mild	Normal Depth	4.60 ft
Flow Regime	Subcritical	Critical Depth	4.60 ft
Velocity Downstream	9.32 ft/s	Critical Slope	0.002608 ft/ft

Section

Section Shape	Box	Mannings Coefficient	0.014
Section Material	Concrete	Span	25.00 ft
Section Size	25 x 8 ft	Rise	8.00 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	108.00 ft	Upstream Velocity Head	1.39 ft
Ke	0.50	Entrance Loss	0.69 ft

Inlet Control Properties

Inlet Control HW Elev.	107.40 ft	Flow Control	Unsubmerged
Inlet Type	30 to 75° wingwall flares	Area Full	200.0 ft²
K	0.02600	HDS 5 Chart	8
M	1.00000	HDS 5 Scale	1
C	0.03470	Equation Form	1
Y	0.86000		

Culvert Calculator Report
OB-12-Road

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	110.00 ft	Headwater Depth/Height	1.25
Computed Headwater Eleva	110.00 ft	Discharge	1,988.89 cfs
Inlet Control HW Elev.	109.48 ft	Tailwater Elevation	106.41 ft
Outlet Control HW Elev.	110.00 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.91 ft
Length	33.00 ft	Constructed Slope	0.002606 ft/ft

Hydraulic Profile

Profile	M1	Depth, Downstream	6.50 ft
Slope Type	Mild	Normal Depth	5.84 ft
Flow Regime	Subcritical	Critical Depth	5.82 ft
Velocity Downstream	12.25 ft/s	Critical Slope	0.002643 ft/ft

Section

Section Shape	Box	Mannings Coefficient	0.014
Section Material	Concrete	Span	25.00 ft
Section Size	25 x 8 ft	Rise	8.00 ft
Number Sections	1		

Outlet Control Properties

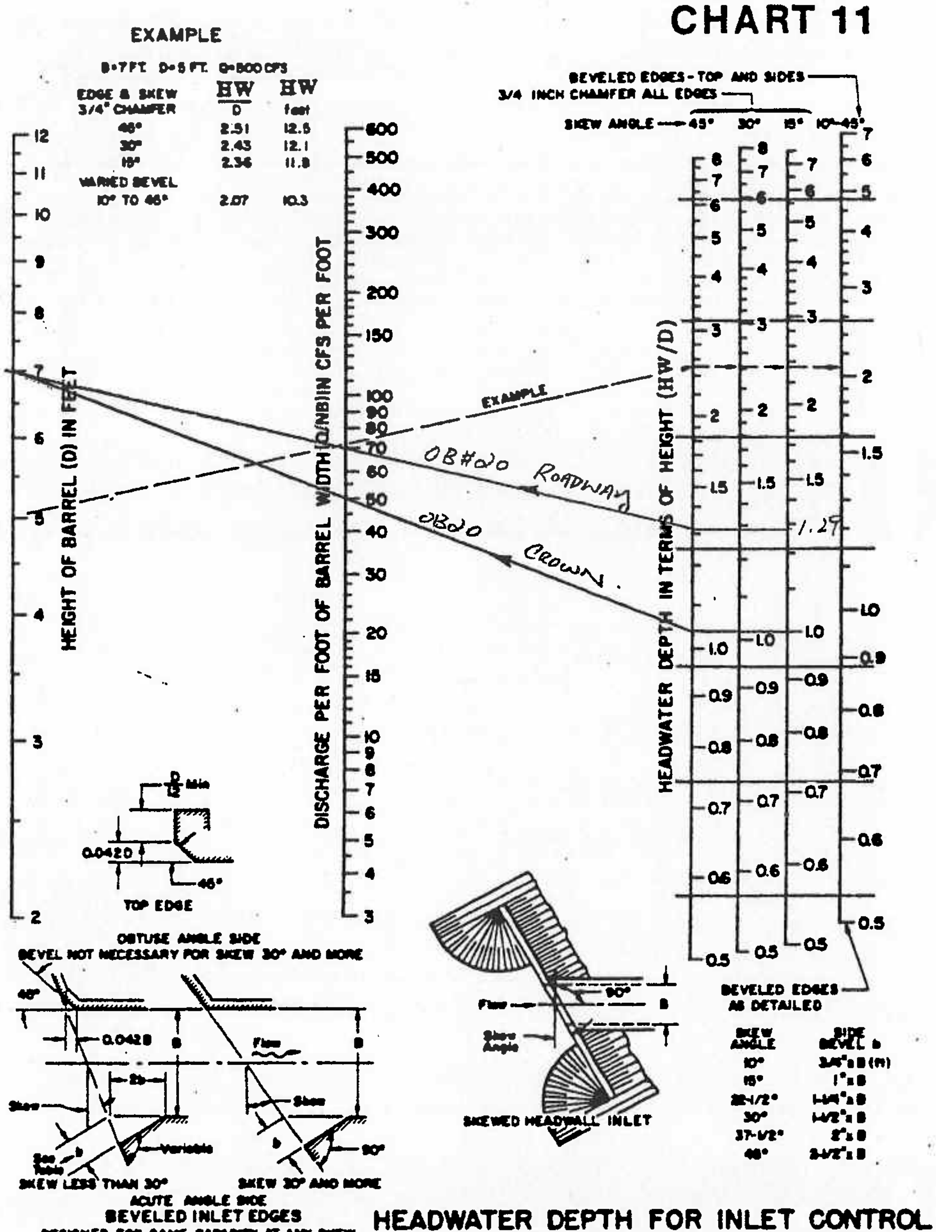
Outlet Control HW Elev.	110.00 ft	Upstream Velocity Head	2.39 ft
Ke	0.50	Entrance Loss	1.19 ft

Inlet Control Properties

Inlet Control HW Elev.	109.48 ft	Flow Control	Transition
Inlet Type	30 to 75° wingwall flares	Area Full	200.0 ft²
K	0.02600	HDS 5 Chart	8
M	1.00000	HDS 5 Scale	1
C	0.03470	Equation Form	1
Y	0.86000		

OBSTRUCTION # 020. JGL 8/6/02

CHART 11



FEDERAL HIGHWAY ADMINISTRATION
MAY 1973

HEADWATER DEPTH FOR INLET CONTROL
SINGLE BARREL BOX CULVERTS
SKEWED HEADWALLS
CHAMFERED OR BEVELED INLET EDGES

CROWN : $Q/B = 50$ cfs/ft $Q = 50 \frac{cfs}{ft} \times 15\ ft = 750$ cfs.

ROADWAY : $Q/B = 70$ cfs/ft $Q = 70 \frac{cfs}{ft} \times 15 ft = 1050$ cfs

Culvert Calculator Report
OB-20-Crown

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	107.00 ft	Headwater Depth/Height	1.00
Computed Headwater Eleva	107.00 ft	Discharge	695.25 cfs
Inlet Control HW Elev.	106.74 ft	Tailwater Elevation	104.93 ft
Outlet Control HW Elev.	107.00 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.93 ft
Length	33.00 ft	Constructed Slope	0.002000 ft/ft

Hydraulic Profile

Profile	M1	Depth, Downstream	5.00 ft
Slope Type	Mild	Normal Depth	4.78 ft
Flow Regime	Subcritical	Critical Depth	4.06 ft
Velocity Downstream	9.27 ft/s	Critical Slope	0.003187 ft/ft

Section

Section Shape	Box	Mannings Coefficient	0.014
Section Material	Concrete	Span	15.00 ft
Section Size	15 x 7 ft	Rise	7.00 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	107.00 ft	Upstream Velocity Head	1.34 ft
Ke	0.50	Entrance Loss	0.67 ft

Inlet Control Properties

Inlet Control HW Elev.	106.74 ft	Flow Control	Unsubmerged
Inlet Type	3/4 inch chamfers; 15° skewed headwall	Area Full	105.0 ft²
K	0.52200	HDS 5 Chart	11
M	0.66700	HDS 5 Scale	3
C	0.04020	Equation Form	2
Y	0.73000		

Culvert Calculator Report
OB-20-Road

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	109.00	ft	Headwater Depth/Height	1.29	
Computed Headwater Eleva	109.00	ft	Discharge	1,014.68	cfs
Inlet Control HW Elev.	108.79	ft	Tailwater Elevation	105.43	ft
Outlet Control HW Elev.	109.00	ft	Control Type	Outlet Control	

Grades

Upstream Invert	100.00	ft	Downstream Invert	99.93	ft
Length	30.00	ft	Constructed Slope	0.002200	ft/ft

Hydraulic Profile

Profile	M2		Depth, Downstream	5.50	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	5.22	ft
Velocity Downstream	12.30	ft/s	Critical Slope	0.003330	ft/ft

Section

Section Shape	Box		Mannings Coefficient	0.014	
Section Material	Concrete		Span	15.00	ft
Section Size	15 x 7 ft		Rise	7.00	ft
Number Sections	1				

Outlet Control Properties

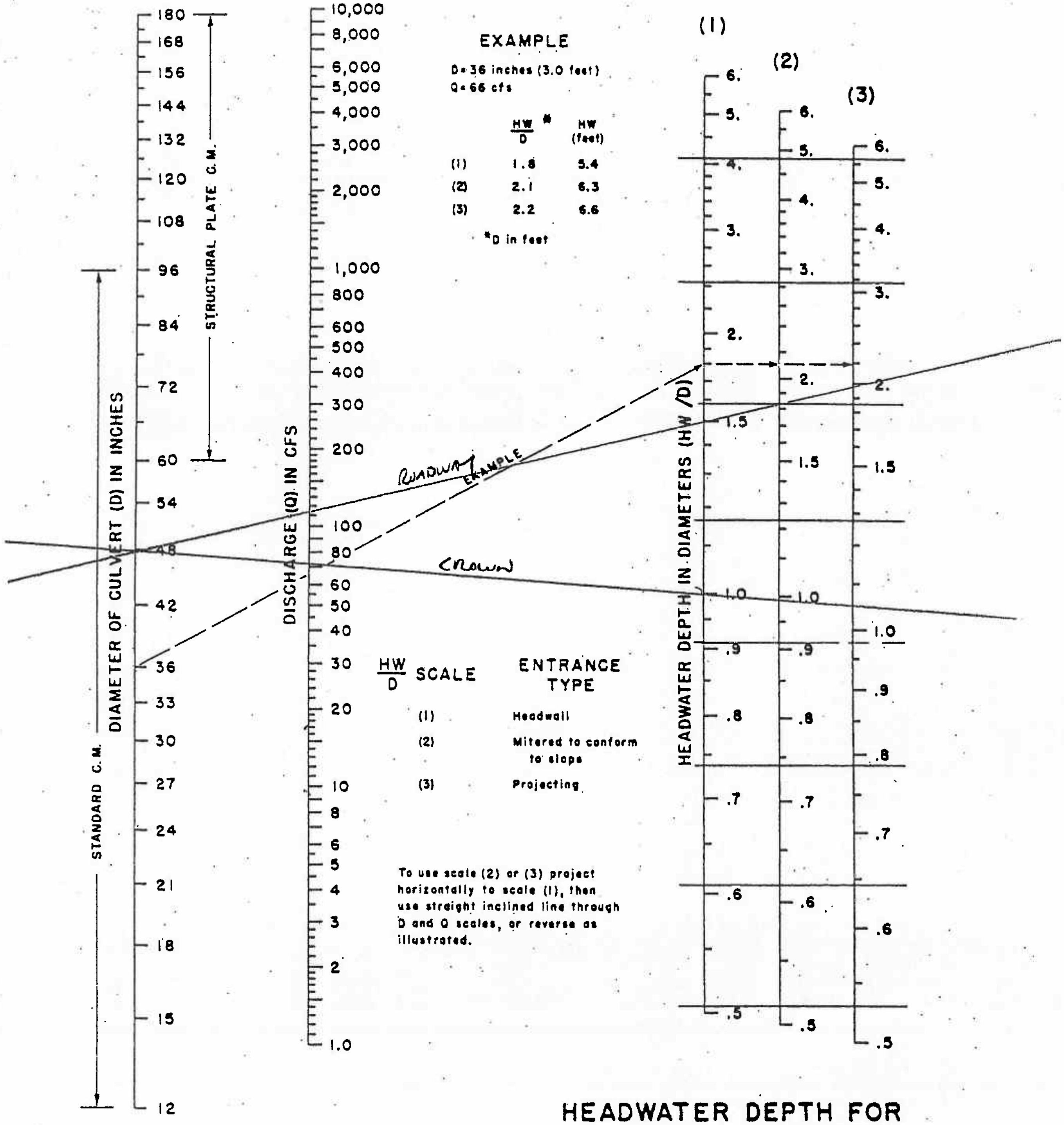
Outlet Control HW Elev.	109.00	ft	Upstream Velocity Head	2.26	ft
Ke	0.50		Entrance Loss	1.13	ft

Inlet Control Properties

Inlet Control HW Elev.	108.79	ft	Flow Control	Transition	
Inlet Type	3/4 inch chamfers; 15° skewed headwall		Area Full	105.0	ft²
K	0.52200		HDS 5 Chart	11	
M	0.66700		HDS 5 Scale	3	
C	0.04020		Equation Form	2	
Y	0.73000				

JA
99-00010100-81

CHART 2



HEADWATER DEPTH FOR
C. M. PIPE CULVERTS
WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

Culvert Calculator Report
OB-27-Crown

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	104.00	ft	Headwater Depth/Height	1.00	
Computed Headwater Eleva	104.00	ft	Discharge	63.72	cfs
Inlet Control HW Elev.	103.67	ft	Tailwater Elevation	102.53	ft
Outlet Control HW Elev.	104.00	ft	Control Type	Outlet Control	

Grades

Upstream Invert	100.00	ft	Downstream Invert	99.93	ft
Length	40.00	ft	Constructed Slope	0.001750	ft/ft

Hydraulic Profile

Profile	M2		Depth, Downstream	2.60	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	2.41	ft
Velocity Downstream	7.37	ft/s	Critical Slope	0.014699	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	Corrugated HDPE 48 inch (Corrugated Interior)		Span	4.00	ft
Section Size	48 inch		Rise	4.00	ft
Number Sections	1				

Outlet Control Properties

Outlet Control HW Elev.	104.00	ft	Upstream Velocity Head	0.55	ft
Ke	0.50		Entrance Loss	0.28	ft

Inlet Control Properties

Inlet Control HW Elev.	103.67	ft	Flow Control	Unsubmerged	
Inlet Type	Square edge w/headwall		Area Full	12.6	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Calculator Report
OB-27-Road

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	106.00 ft	Headwater Depth/Height	1.50
Computed Headwater Eleva	106.00 ft	Discharge	108.13 cfs
Inlet Control HW Elev.	105.62 ft	Tailwater Elevation	103.13 ft
Outlet Control HW Elev.	106.00 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.93 ft
Length	40.00 ft	Constructed Slope	0.001750 ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile	Depth, Downstream	3.20 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	3.15 ft
Velocity Downstream	10.03 ft/s	Critical Slope	0.020925 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.024
Section Material	Corrugated HDPE 48 inch (Corrugated Interior)	Span	4.00 ft
Section Size	48 inch	Rise	4.00 ft
Number Sections	1		

Outlet Control Properties

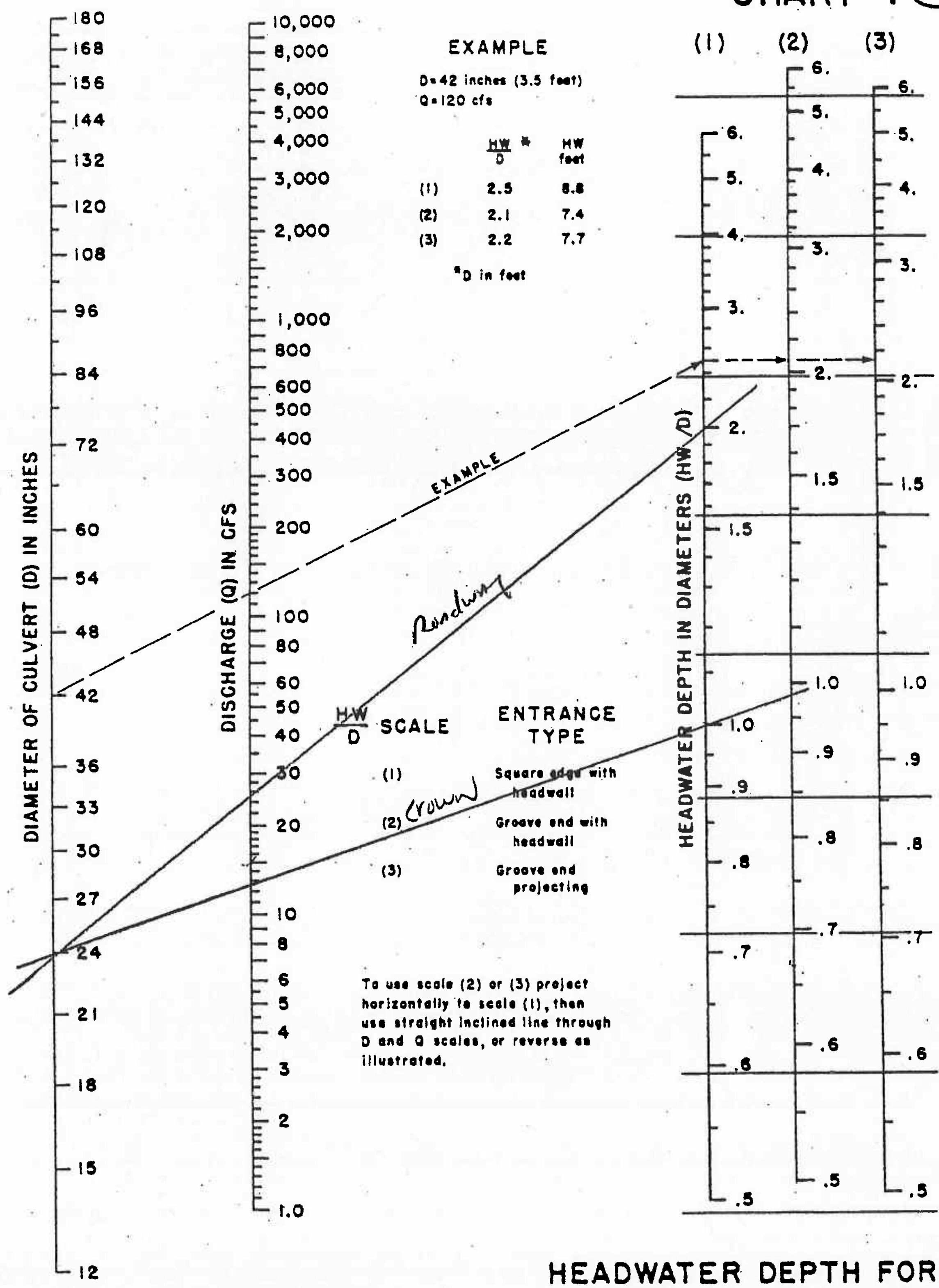
Outlet Control HW Elev.	106.00 ft	Upstream Velocity Head	1.15 ft
Ke	0.50	Entrance Loss	0.58 ft

Inlet Control Properties

Inlet Control HW Elev.	105.62 ft	Flow Control	Submerged
Inlet Type	Square edge w/headwall	Area Full	12.6 ft²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

JA
99-00010100.81

CHART 10



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

CROWN Q = 12.7 cfs for one pipe ⇒ Q for 2 pipes = 12.7 cfs × 2
= 25.4 cfs

ROADWAY Q = 25 cfs for one pipe ⇒ Q for 2 pipes = 25 cfs × 2
= 50 cfs

Culvert Calculator Report
OB-28-Crown

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	102.00 ft	Headwater Depth/Height	1.00
Computed Headwater Eleva	102.00 ft	Discharge	23.58 cfs
Inlet Control HW Elev.	101.89 ft	Tailwater Elevation	101.23 ft
Outlet Control HW Elev.	102.00 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.93 ft
Length	40.00 ft	Constructed Slope	0.001800 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	1.30 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.23 ft
Velocity Downstream	5.44 ft/s	Critical Slope	0.004719 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.012
Section Material	Concrete	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	2		

Outlet Control Properties

Outlet Control HW Elev.	102.00 ft	Upstream Velocity Head	0.35 ft
Ke	0.50	Entrance Loss	0.18 ft

Inlet Control Properties

Inlet Control HW Elev.	101.89 ft	Flow Control	Unsubmerged
Inlet Type	Square edge w/headwall	Area Full	6.3 ft²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

Culvert Calculator Report
OB-28-Road

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	104.00 ft	Headwater Depth/Height	2.00
Computed Headwater Eleva	104.00 ft	Discharge	51.38 cfs
Inlet Control HW Elev.	104.00 ft	Tailwater Elevation	101.68 ft
Outlet Control HW Elev.	103.83 ft	Control Type	Inlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.93 ft
Length	40.00 ft	Constructed Slope	0.001800 ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile	Depth, Downstream	1.78 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.78 ft
Velocity Downstream	8.70 ft/s	Critical Slope	0.009779 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.012
Section Material	Concrete	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	2		

Outlet Control Properties

Outlet Control HW Elev.	103.83 ft	Upstream Velocity Head	1.04 ft
Ke	0.50	Entrance Loss	0.52 ft

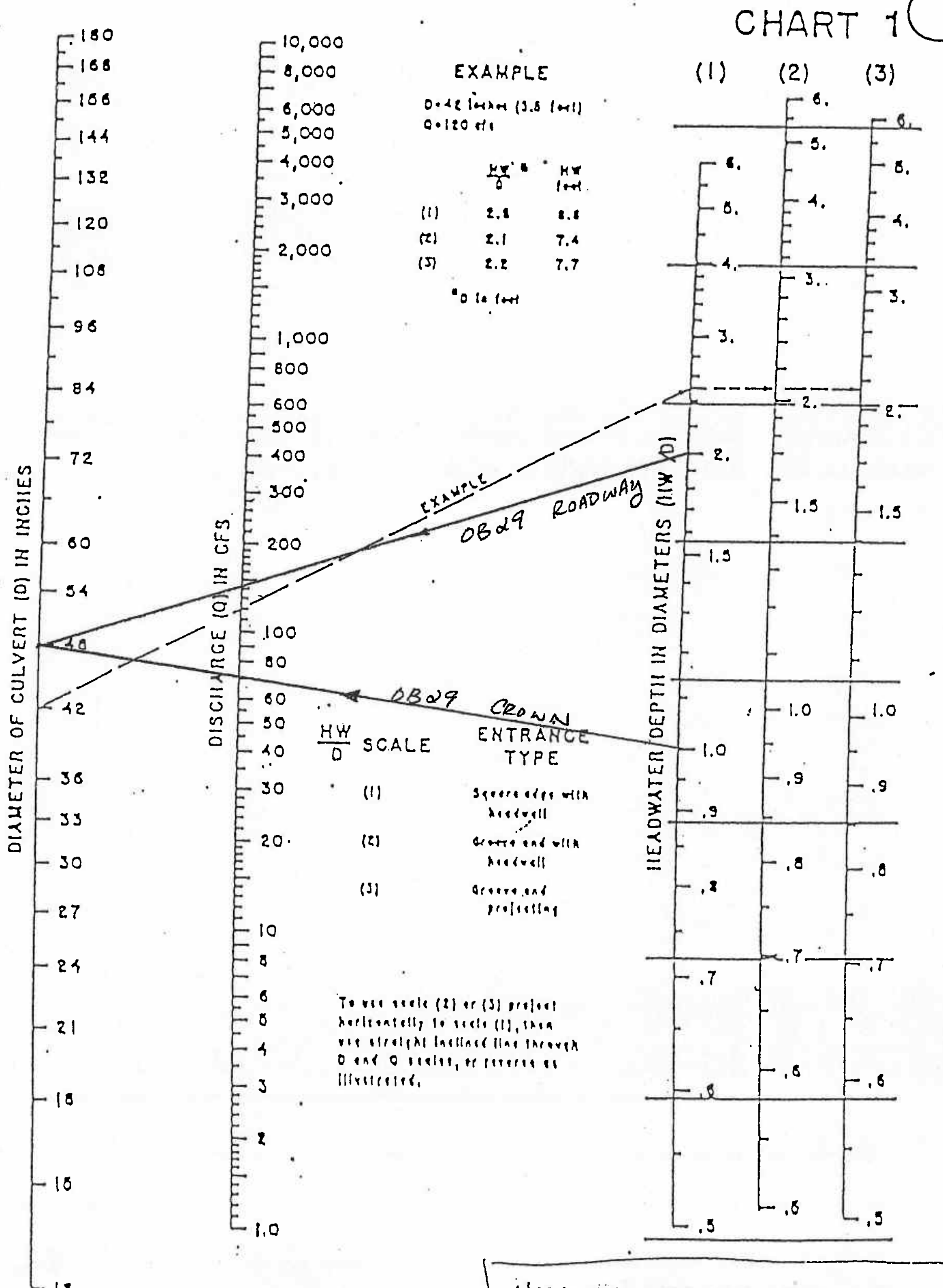
Inlet Control Properties

Inlet Control HW Elev.	104.00 ft	Flow Control	Submerged
Inlet Type	Square edge w/headwall	Area Full	6.3 ft²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

OBSTRUCTION # 24.

3 LEL 8/6/02

CHART 1



Q = VA.

HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR
CONCRETE PIPE CULVERTS
WITH INLET CONTROL

CROWN = Q = 71 cfs for 48" pipe ⇒ ½ 48" pipe ∴ Q = 71cfs/2 = 35.5cfs

ROADWAY Q = 140 cfs for 48" pipe ⇒ ½ 48" pipe Q = 140cfs/2 = 70cfs.

Culvert Calculator Report
OB-29-Crown

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	102.00 ft	Headwater Depth/Height	1.00
Computed Headwater Eleva	102.00 ft	Discharge	23.17 cfs
Inlet Control HW Elev.	101.70 ft	Tailwater Elevation	101.54 ft
Outlet Control HW Elev.	102.00 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.94 ft
Length	33.00 ft	Constructed Slope	0.001697 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	1.60 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.01 ft
Velocity Downstream	4.13 ft/s	Critical Slope	0.004980 ft/ft

Section

Section Shape	Arch	Mannings Coefficient	0.013
Section Material	Concrete	Span	4.00 ft
Section Size	48.0 x 24.0 inch	Rise	2.00 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	102.00 ft	Upstream Velocity Head	0.26 ft
Ke	0.50	Entrance Loss	0.13 ft

Inlet Control Properties

Inlet Control HW Elev.	101.70 ft	Flow Control	Unsubmerged
Inlet TypSquare edge w/headwall (arch)		Area Full	6.3 ft²
K	0.00980	HDS 5 Chart	0
M	2.00000	HDS 5 Scale	0
C	0.03980	Equation Form	1
Y	0.67000		

Culvert Calculator Report
OB-29-Road

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	104.00 ft	Headwater Depth/Height	2.00
Computed Headwater Eleva	104.00 ft	Discharge	45.27 cfs
Inlet Control HW Elev.	103.40 ft	Tailwater Elevation	102.54 ft
Outlet Control HW Elev.	104.00 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.94 ft
Length	33.00 ft	Constructed Slope	0.001697 ft/ft

Hydraulic Profile

Profile	PressureProfile	Depth, Downstream	2.60 ft
Slope Type	N/A	Normal Depth	N/A ft
Flow Regime	N/A	Critical Depth	1.54 ft
Velocity Downstream	7.21 ft/s	Critical Slope	0.007869 ft/ft

Section

Section Shape	Arch	Mannings Coefficient	0.013
Section Material	Concrete	Span	4.00 ft
Section Size	48.0 x 24.0 inch	Rise	2.00 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	104.00 ft	Upstream Velocity Head	0.81 ft
Ke	0.50	Entrance Loss	0.40 ft

Inlet Control Properties

Inlet Control HW Elev.	103.40 ft	Flow Control	Submerged
Inlet TypSquare edge w/headwall (arch)		Area Full	6.3 ft²
K	0.00980	HDS 5 Chart	0
M	2.00000	HDS 5 Scale	0
C	0.03980	Equation Form	1
Y	0.67000		

Culvert Calculator Report
OB-30-Crown

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	118.83 ft	Headwater Depth/Height	1.00
Computed Headwater Eleva	118.83 ft	Discharge	5,228.29 cfs
Inlet Control HW Elev.	117.69 ft	Tailwater Elevation	109.94 ft
Outlet Control HW Elev.	118.83 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.94 ft
Length	32.00 ft	Constructed Slope	0.002000 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	11.04 ft
Slope Type	Mild	Normal Depth	11.46 ft
Flow Regime	Subcritical	Critical Depth	11.04 ft
Velocity Downstream	18.38 ft/s	Critical Slope	0.002215 ft/ft

Section

Section Shape	Arch	Mannings Coefficient	0.013
Section Material	Concrete	Span	30.33 ft
Section Size	364 x 226 inch	Rise	18.83 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	118.83 ft	Upstream Velocity Head	5.08 ft
Ke	0.50	Entrance Loss	2.54 ft

Inlet Control Properties

Inlet Control HW Elev.	117.69 ft	Flow Control	Unsubmerged
Inlet TypSquare edge w/headwall (arch)		Area Full	434.3 ft²
K	0.00980	HDS 5 Chart	0
M	2.00000	HDS 5 Scale	0
C	0.03980	Equation Form	1
Y	0.67000		

Culvert Calculator Report
OB-30-Road

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	124.83 ft	Headwater Depth/Height	1.32
Computed Headwater Eleva	124.83 ft	Discharge	7,613.43 cfs
Inlet Control HW Elev.	124.83 ft	Tailwater Elevation	109.94 ft
Outlet Control HW Elev.	124.51 ft	Control Type	Inlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.94 ft
Length	32.00 ft	Constructed Slope	0.002000 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	13.55 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	13.55 ft
Velocity Downstream	21.85 ft/s	Critical Slope	0.002840 ft/ft

Section

Section Shape	Arch	Mannings Coefficient	0.013
Section Material	Concrete	Span	30.33 ft
Section Size	364 x 226 inch	Rise	18.83 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	124.51 ft	Upstream Velocity Head	7.02 ft
Ke	0.50	Entrance Loss	3.51 ft

Inlet Control Properties

Inlet Control HW Elev.	124.83 ft	Flow Control	Submerged
Inlet TypSquare edge w/headwall (arch)		Area Full	434.3 ft²
K	0.00980	HDS 5 Chart	0
M	2.00000	HDS 5 Scale	0
C	0.03980	Equation Form	1
Y	0.67000		

Culvert Calculator Report
OB-31-Crown

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	118.83 ft	Headwater Depth/Height	1.00
Computed Headwater Eleva	118.83 ft	Discharge	5,252.01 cfs
Inlet Control HW Elev.	117.75 ft	Tailwater Elevation	109.93 ft
Outlet Control HW Elev.	118.83 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.93 ft
Length	40.00 ft	Constructed Slope	0.001700 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	11.07 ft
Slope Type	Mild	Normal Depth	12.26 ft
Flow Regime	Subcritical	Critical Depth	11.07 ft
Velocity Downstream	18.41 ft/s	Critical Slope	0.002219 ft/ft

Section

Section Shape	Arch	Mannings Coefficient	0.013
Section Material	Concrete	Span	30.33 ft
Section Size	364 x 226 inch	Rise	18.83 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	118.83 ft	Upstream Velocity Head	4.96 ft
Ke	0.50	Entrance Loss	2.48 ft

Inlet Control Properties

Inlet Control HW Elev.	117.75 ft	Flow Control	Unsubmerged
Inlet TypeSquare edge w/headwall (arch)		Area Full	434.3 ft²
K	0.00980	HDS 5 Chart	0
M	2.00000	HDS 5 Scale	0
C	0.03980	Equation Form	1
Y	0.67000		

Culvert Calculator Report
OB-31-Road

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	124.83 ft	Headwater Depth/Height	1.32
Computed Headwater Eleva	124.83 ft	Discharge	7,612.55 cfs
Inlet Control HW Elev.	124.83 ft	Tailwater Elevation	109.93 ft
Outlet Control HW Elev.	124.46 ft	Control Type	Inlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.93 ft
Length	40.00 ft	Constructed Slope	0.001700 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	13.55 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	13.55 ft
Velocity Downstream	21.85 ft/s	Critical Slope	0.002840 ft/ft

Section

Section Shape	Arch	Mannings Coefficient	0.013
Section Material	Concrete	Span	30.33 ft
Section Size	364 x 226 inch	Rise	18.83 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	124.46 ft	Upstream Velocity Head	6.91 ft
Ke	0.50	Entrance Loss	3.45 ft

Inlet Control Properties

Inlet Control HW Elev.	124.83 ft	Flow Control	Submerged
Inlet TypSquare edge w/headwall (arch)		Area Full	434.3 ft²
K	0.00980	HDS 5 Chart	0
M	2.00000	HDS 5 Scale	0
C	0.03980	Equation Form	1
Y	0.67000		

Culvert Calculator Report
OB-32-Crown

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	118.83 ft	Headwater Depth/Height	1.00
Computed Headwater Eleva	118.83 ft	Discharge	5,318.10 cfs
Inlet Control HW Elev.	117.93 ft	Tailwater Elevation	109.93 ft
Outlet Control HW Elev.	118.83 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.93 ft
Length	140.00 ft	Constructed Slope	0.000500 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	11.14 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	11.14 ft
Velocity Downstream	18.51 ft/s	Critical Slope	0.002233 ft/ft

Section

Section Shape	Arch	Mannings Coefficient	0.013
Section Material	Concrete	Span	30.33 ft
Section Size	364 x 226 inch	Rise	18.83 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	118.83 ft	Upstream Velocity Head	4.34 ft
Ke	0.50	Entrance Loss	2.17 ft

Inlet Control Properties

Inlet Control HW Elev.	117.93 ft	Flow Control	Unsubmerged
Inlet TypSquare edge w/headwall (arch)		Area Full	434.3 ft²
K	0.00980	HDS 5 Chart	0
M	2.00000	HDS 5 Scale	0
C	0.03980	Equation Form	1
Y	0.67000		

Culvert Calculator Report
OB-32-Road

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	121.83 ft	Headwater Depth/Height	1.16
Computed Headwater Eleva	121.83 ft	Discharge	6,574.76 cfs
Inlet Control HW Elev.	121.19 ft	Tailwater Elevation	109.93 ft
Outlet Control HW Elev.	121.83 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.93 ft
Length	140.00 ft	Constructed Slope	0.000500 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	12.52 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	12.52 ft
Velocity Downstream	20.34 ft/s	Critical Slope	0.002531 ft/ft

Section

Section Shape	Arch	Mannings Coefficient	0.013
Section Material	Concrete	Span	30.33 ft
Section Size	364 x 226 inch	Rise	18.83 ft
Number Sections	1		

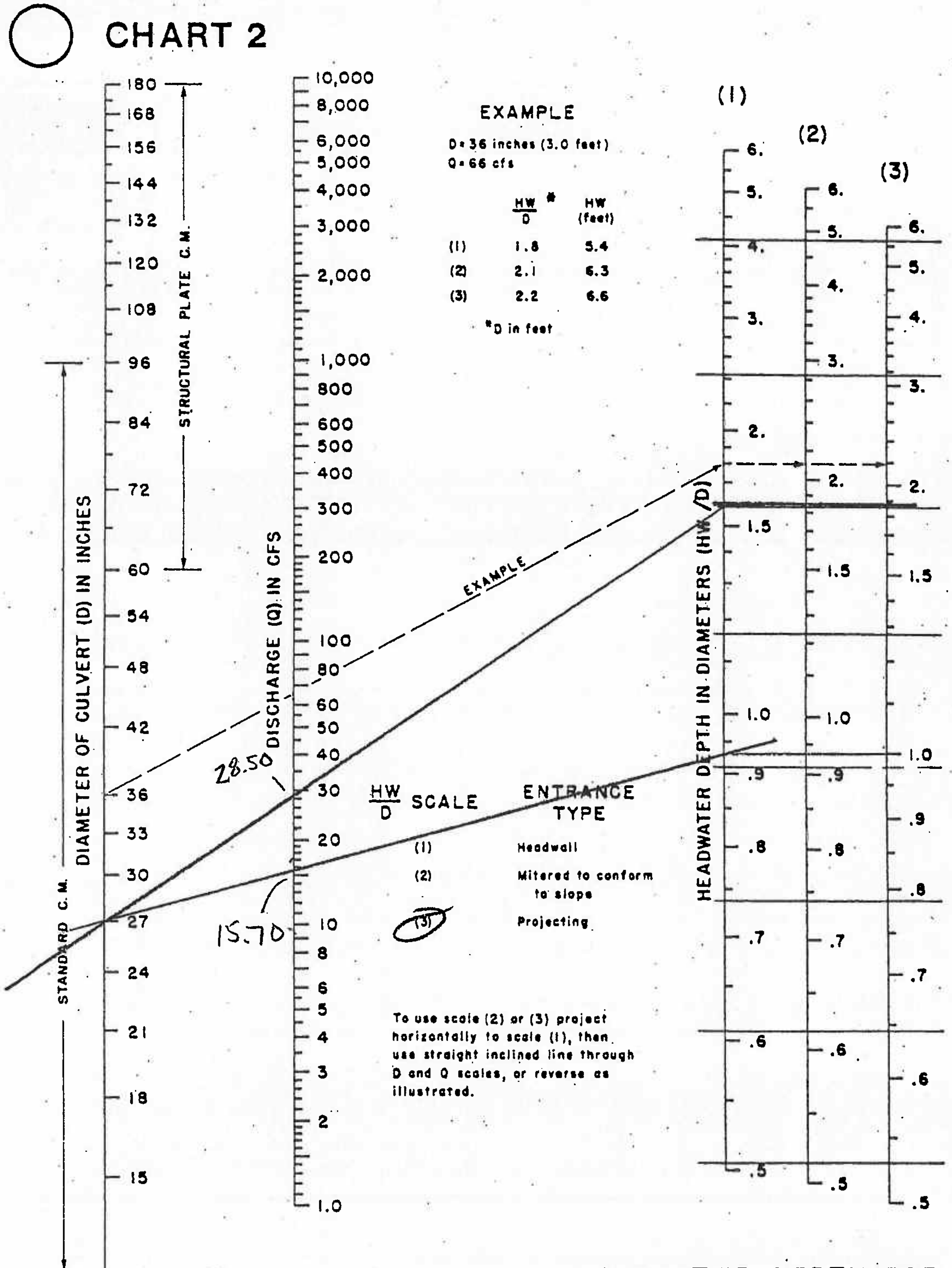
Outlet Control Properties

Outlet Control HW Elev.	121.83 ft	Upstream Velocity Head	5.28 ft
Ke	0.50	Entrance Loss	2.64 ft

Inlet Control Properties

Inlet Control HW Elev.	121.19 ft	Flow Control	Unsubmerged
Inlet Type	Square edge w/headwall (arch)	Area Full	434.3 ft²
K	0.00980	HDS 5 Chart	0
M	2.00000	HDS 5 Scale	0
C	0.03980	Equation Form	1
Y	0.67000		

JEA
99-00010100.81



HEADWATER DEPTH FOR
C. M. PIPE CULVERTS
WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

Culvert Calculator Report
OB-33-Crown

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	102.25 ft	Headwater Depth/Height	1.00
Computed Headwater Eleva	102.25 ft	Discharge	13.94 cfs
Inlet Control HW Elev.	102.10 ft	Tailwater Elevation	101.26 ft
Outlet Control HW Elev.	102.25 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.91 ft
Length	33.00 ft	Constructed Slope	0.002697 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	1.35 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.30 ft
Velocity Downstream	5.60 ft/s	Critical Slope	0.011994 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.020
Section Material	CMP	Span	2.25 ft
Section Size	27 inch	Rise	2.25 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	102.25 ft	Upstream Velocity Head	0.29 ft
Ke	0.90	Entrance Loss	0.26 ft

Inlet Control Properties

Inlet Control HW Elev.	102.10 ft	Flow Control	Unsubmerged
Inlet Type	Projecting	Area Full	4.0 ft²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Calculator Report
OB-33-Road

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	104.25 ft	Headwater Depth/Height	1.89
Computed Headwater Eleva	104.25 ft	Discharge	29.07 cfs
Inlet Control HW Elev.	104.17 ft	Tailwater Elevation	101.61 ft
Outlet Control HW Elev.	104.25 ft	Control Type	Outlet Control

Grades

Upstream Invert	100.00 ft	Downstream Invert	99.91 ft
Length	33.00 ft	Constructed Slope	0.002697 ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile	Depth, Downstream	1.87 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.87 ft
Velocity Downstream	8.22 ft/s	Critical Slope	0.020323 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.020
Section Material	CMP	Span	2.25 ft
Section Size	27 inch	Rise	2.25 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	104.25 ft	Upstream Velocity Head	0.83 ft
Ke	0.90	Entrance Loss	0.75 ft

Inlet Control Properties

Inlet Control HW Elev.	104.17 ft	Flow Control	Submerged
Inlet Type	Projecting	Area Full	4.0 ft²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

APPENDIX D

MUNICIPAL QUESTIONNAIRE

NICHOLS & SLAGLE ENGINEERING, INC.
PROFESSIONAL ENGINEERS

980 Beaver Grade Road, Suite 101, Westmark Building, Moon Township, PA 15108 - 412-269-9440 - 1-800-432-NSEI - FAX 412-269-0533

January 17, 2000

Township of Leet
198 Ambridge Avenue
Fair Oaks, PA 15003

Subject: Hill Street Haz. Mat. Site
Site Plan/Grading Permit
NSE No. P15-9999

Gentlemen:

On January 11, 2000, the road superintendent and I met to review the proposed site remediation project. A site plan or grading permit will be required based on the quantity and/or area disturbed. A grading/roadway bond will be required prior to any grading on this site.

We trust this evaluation meets with your approval. Should you have any questions regarding this recommendation, please do not hesitate to contact us.

Very truly yours,

Daniel B. Slagle, P.E.
Principal Engineer

DBS/ss

NICHOLS & SLAGLE ENGINEERING, INC.
PROFESSIONAL ENGINEERS

980 Beaver Grade Road, Suite 101, Westmark Building, Moon Township, PA 15108 - 412-269-9440 - 1-800-432-NSEI - FAX 412-269-0533

January 17, 2000

Township of Leet
198 Ambridge Avenue
Fair Oaks, PA 15003

Subject: Olde Sewickley Highlands
Detention Basin Rehabilitation
Site Inspection
NSE No. P15-9999

Gentlemen:

On January 11, 2000, the road superintendent and I met to inspect and comment on the condition of the Detention Basin 1 & 2A and 2B serving the Olde Sewickley Highlands plan. Based on our cursory review of the site, we suggest the following:

Detention Basin No. 1

- Remove sediment & stabilize.
- Expose 18" CMP and install endwall.
- Fill in dam erosion.
- Place rip-rap face on dam.
- Install rip-rap channels.

Detention Basin No. 2A

- Remove sediment and stabilize.
- Reinstall outlet structure and set in concrete.
- Pour concrete footer on endwall.

Detention Basin No. 2B

- Remove sediment and stabilize.
- Expose outlet structure and set in concrete if necessary.

In addition, we recommend that the Township research and acquire, if necessary, the following information:

- Obtain recorded plans for Old Sewickley Highlands.
- Check for the existence of R/W's for the sanitary and storm sewer lines across the lots.

- Check for a Homeowner's Association agreement with the Township.

- Research Township Minutes to determine when and what the Township accepted.

Once the ownership and conditions for ownership have been established, the Township should obtain quotes, if necessary, to rehabilitate these detention basins. In addition, it appears from the unrecorded subdivision plan that the area between Spencer Road's inlet and outlet is owned by the Township. This will be verified after reviewing the executed recorded plan.

We trust this evaluation meets with your approval. Should you have any questions regarding this recommendation, pleas do not hesitate to contact us.

Very truly yours,

Daniel B. Slagle, P.E.
Principal Engineer

DBS/ss

NICHOLS & SLAGLE ENGINEERING, INC.
PROFESSIONAL ENGINEERS

980 Beaver Grade Road, Suite 101, Westmark Building, Moon Township, PA 15108 - 412-269-9440 - 1-800-432-NSEI - FAX 412-269-0533

July 27, 1999

Township of Leet
198 Ambridge Avenue
Fair Oaks, PA 15003

Subject: William Penn Circle Catch Basin
Site Inspection
NSE No. P15-9999

Gentlemen:

On July 12, 1999, the road superintendent and I met in response to a complaint regarding the placement of a catch basin at the end of William Penn Circle in the Olde Sewickley Highlands Plan. The catch basin is installed at the end of the cul-de-sac less than 300-feet from the crest of the hill in keeping with standard design practices. The cul-de-sac is sloped toward this catch basin. We understand that the complaint occurs from water seepage during the winter months as a result of piled snow at the edge of the cul-de-sac. Please remember that the Township owns a 50-foot right-of-way around the center of this cul-de-sac or approximately 10-feet into each yard surrounding the cul-de-sac. The construction of an additional catch basin beneath were the snow is typically piled will help but may not fully remedy the problem.

We trust this evaluation meets with your approval. Should you have any questions regarding this recommendation, please do not hesitate to contact us.

Very truly yours,

Daniel B. Slagle, P.E.
Principal Engineer

DBS/ss

NICHOLS & SLAGLE ENGINEERING, INC.
PROFESSIONAL ENGINEERS

930 Beaver Grade Road, Suite 101, Westmark Building, Moon Township, PA 15108 - 412-269-9440 - 1-800-432-NSEI - FAX 412-269-0533

September 7, 1999

Township of Leet
198 Ambridge Avenue
Fair Oaks, PA 15003

Subject: Hill Street Driveway
Site Inspection
NSE No. P15-9999

Gentlemen:

On September 7, 1999, the Manager, Road Superintendent and I met with the homeowner of 178 Hill Street to discuss her driveway access concerns. Hill Street with its' existing concrete gutter was constructed according to the road superintendent over 40 years ago. The concrete gutter was installed to capture and control the water coming down the steep grade of Hill Street. This concrete gutter provides for a rough ride in order for the homeowners to gain access to their existing driveway. The homeowner purchased the house as is approximately 15 years ago. The existing driveway is accessible across the concrete gutter as documented by 2 passes with my car without dragging.

Our recommendations are as follows:

- No Action - The existing concrete gutter although rough is passable. Estimated Cost $0.
- New Catch Basin - Install one new catch basin and 50-feet of storm sewer across Hill Street. Estimated Cost $4,000.
- Cross Drain/Plates - Remove a section of concrete gutter and install 12-feet of 15-inch N-12 pipe or steel plates bridging the concrete gutter. Both options may present a safety hazard if a car's tire gets trapped in the gutter and hits these obstructions. Estimated Cost $2,000.

We trust this evaluation meets with your approval. Should you have any questions regarding this recommendation, please do not hesitate to contact us.

Very truly yours,

Daniel B. Slagle, P.E.
Principal Engineer

DBS/ss

NICHOLS & SLAGLE ENGINEERING, INC.
PROFESSIONAL ENGINEERS

980 Beaver Grade Road, Suite 101, Westmark Building, Moon Township, PA 15108 - 412-269-9440 - 1-800-432-NSEI

February 9, 1999

Mr. Ron Beadnell
Leet Township
198 Ambridge Avenue
Fair Oaks, PA 15003

Subject: Roadside Water Problem
Site Inspection
NSE No. P15-9999

Dear Mr. Beadnell:

On February 8, 1999, we met with the property owner at 108 Main Street to inspect and evaluate a reoccurring drainage problem infront of their house. Based on this cursory inspection, we observed a wet area and small puddle along Main Street. This condition reportedly occurs only during the wet weather season and is known to create an ice build-up during the winter months. The owner indicates that the Edgeworth Water Authority also inspected the site, listened for a leak (which proved negative) and sampled the water for chlorine (which tested positive). This wet area is about 3 feet from an existing curb stop. In addition, the house is constructed on a rather steep hillside conducive to springs. The uphill fold in the topography could concentrate these springs or at or near this location. No basement seepage is reported.

Based on the foregoing, a secondary possible cause for the wet area could be from the house's french drain or from the nearby roof drain discharge. The sewer system did not seem to be a candidate for the wet area based on a brief review of the sewer maps. We therefore recommend that the Township contact Edgeworth Water Authority and request that they reevaluate the integrity of their service connection at 108 Main Street. Further, we recommend that the Township notify PADOT of the hazard caused by the icing condition and request that they construct a stormsewer to remedy the problem.

Should you have any questions regarding these recommendations, please do not hesitate to contact us.

Very truly yours,

Daniel B. Slagle, P.E.
Principal Engineer

DBS/lb

cc: Roger Foley, Esq.

June 8, 1998

Township of Leet
198 Ambridge Avenue
Fair Oaks, PA 15003

Subject: Beech Street Hillside
Site Inspection
NSE No. P15-9999

Gentlemen:

On May 7, 1998, the road superintendent and I met to inspect the stream bank along Big Sewickley Creek in the vicinity of Beech Street. We understand that this area was defoliated by the Township to create clear site visibility around the bend and eliminate the overgrowth of poison ivy. The earthen bank had no visible signs of erosion. Because of the concrete curb, steep bank and small surface area, we do not anticipate excessive erosion problems in this area. However, we recommend that low profile vegetation (crown vetch) be planted to aid in stabilizing the stream bank.

Should you have any questions regarding this recommendation, please do not hesitate to contact us.

Very truly yours,

Daniel B. Slagle, P.E.
Principal Engineer

DBS/ss

// NICHOLS & SLAGLE ENGINEERING, INC.
PROFESSIONAL ENGINEERS

980 Beaver Grade Road, Suite 101, Westmark Building, Moon Township, PA 15108 - 412-269-9440 - 1-800-432-NSEI

July 9, 1998

Leet Township
198 Ambridge Avenue
Fair Oaks, PA 15003

Subject: Drainage Problem
Site Inspection
NSE No. P15-9999

Gentlemen:

On July 6, 1998, the Road Superintendent and myself met to inspect a drainage problem resulting from the recent rainfall events. An existing 48-inch diameter reinforced concrete pipe (RCP) was reportedly installed to drain a 127 acre watershed as shown on the enclosed USGS map. This watershed, based on the rational method of calculating peak discharges and a rainfall intensity for a 10 and 100 year storms, can generate peak flows of 170 cfs and 230 cfs respectively. Currently, this watershed is virtually undeveloped. Increased peak runoff flows will be experienced as a result of the construction of upstream development.

The existing RCP pipe periodically blinds from heavy debris and limbs during strong rainfalls. Excess stormwater is subsequently diverted down the water course causing minor flooding. An earthern dike was constructed in an attempt to reduce the downstream damage. This dike currently retains or ponds water. During heavy rainfalls we understand that this dike breaches causing more damage.

Based on the foregoing and our cursory evaluation, we suggest the following:

- The watershed should be routinely inspected and the stormsewer cleaned after every rainfall event.

- A headwall and emergency overflow on the existing pipe should be installed.

- Investigate the ownership of the property and/or gain permission to recontour the valley to form a functional detention basin.

These suggestions should be implemented as fund become available. Should you have any questions concerning this evaluation, please do not hesitate to contact us.

Very truly yours,

Daniel B. Slagle, P.E.
Principal Engineer

DBS/lb

Enclosure

NICHOLS & SLAGLE ENGINEERING, INC.
PROFESSIONAL ENGINEERS

980 Beaver Grade Road, Suite 101, Westmark Building, Moon Township, PA 15108 - 412-269-9440 - 1-800-432-NSEI - FAX 412-269-0533

July 11, 2000

Mr. Lou Hopkins
Camp Meeting Excavating Company
835 Camp Meeting Road
Sewickley, PA 15143

Subject: Leet Township
Lightener Drainage Project
NSE No. P15-9999

Dear Mr. Hopkins:

We are pleased to inform you that the Commissioners accepted your enclosed proposal in the amount of $9,592.00 at their regular meeting on July 10, 2000. Please make the necessary arrangements to perform this work at your earliest convenience. In addition, you are reminded to confine your work to the existing easement unless written permission is obtained from the adjoining land owners.

We look forward to working with you on this project. Should you have any questions regarding this authorization, please do not hesitate to contact us.

Very truly yours,

Daniel B. Slagle, P.E.
Principal Engineer

DBS/ss

Enclosure

cc: Township (w/enc.)

NICHOLS & SLAGLE ENGINEERING, INC.
PROFESSIONAL ENGINEERS

980 Beaver Grade Road, Suite 101, Westmark Building, Moon Township, PA 15108 - 412-269-9440 - 1-800-432-NSEI - FAX 412-269-0533

October 18, 2000

Ms. Anna Lee Oswald
Leet Township
198 Ambridge Avenue
Fair Oaks, PA 15003

Subject: Leet Township
Lower Field Sewer Separation Project
NSE No. P015-9999(y)

Dear Ms. Oswald:

Pursuant to the Township's request, we have evaluated the storm sewer/sanitary interconnection near the proposed Fair Oaks VFD building. The existing concrete gutter system currently connects to an existing catch basin with a 24-inch concrete storm sewer. This existing catch basin connects to a sanitary manhole owned by the Leet Township Municipal Authority by an 8-inch sewer. This storm sewer could be disconnected by either constructing a new storm sewer straight to Big Sewickley Creek or by constructing a new storm sewer along Ambridge Avenue to an existing drainage ditch. The estimated cost for each option is presented in the enclosed Exhibits. The Big Sewickley Creek option, although more direct, will require rights-of-way between the two houses as well as an expensive roadway boring across Ambridge Avenue. The Ambridge Avenue option, although long, will require extensive work in PADOT's road right-of-way. Both options basically cost the same.

We trust this information is useful in making your decision. Should you have any questions regarding this cost estimate, please do not hesitate to contact our office.

Very truly yours,

Daniel B. Slagle, P.E.
Principal Engineer

DBS/ss

Enclosures

NICHOLS & SLAGLE ENGINEERING, INC.
PROFESSIONAL ENGINEERS

980 Beaver Grade Road, Suite 101, Westmark Building, Moon Township, PA 15108 - 412-269-9440 - 1-800-432-NSEI - FAX 412-269-0533

January 17, 2000

Township of Leet
198 Ambridge Avenue
Fair Oaks, PA 15003

Subject: Lightener Drainage Problem
Site Inspection
NSE No. P15-9999

Gentlemen:

On January 11, 2000, the road superintendent and I met in response to a complaint from Mr. Lightener regarding a drainage problem from the Quaker Heights Plan. Water appears to discharge from a storm sewer serving Kenny Drive onto the Lightener property and running overland to the storm sewer system on Camp Meeting Road. Prior to any action by the Township, we recommend obtaining a copy of the executed recorded plan, site and grading plan. We look forward to reviewing this information.

Should you have any questions regarding this recommendation, please do not hesitate to contact us.

Very truly yours,

Daniel B. Slagle, P.E.
Principal Engineer

DBS/ss

APPENDIX D

MUNICIPAL QUESTIONNAIRE

The Borough of Sewickley Heights

INCORPORATED AUGUST 3, 1935
Borough Hall
Country Club Road
Sewickley, PA 15143-9402

OFFICE OF THE
BOROUGH MANAGER

412/741-5119 • 412/741-5946
FAX 412/741-2215

December 13, 2000

Mr. Bud Schubel, Assistant Manager
Department of Economic Development
County of Allegheny
Suite 800
425 Sixth Avenue
Pittsburgh, PA 15219

Dear Mr. Schubel:

Enclosed is a copy of the Borough of Sewickley Heights Zoning Ordinance, Comprehensive Plan and Stormwater Management Ordinance. The Zoning Ordinance contains the latest Zoning District Map. This information is forward to you per your request and the discussion you had with the Borough Engineer today.

→ Flooding occurs in the Borough but not that often. And if so, it is usually from a sudden burst of rain, where the water from the creek spills onto the Little Sewickley Creek Road for a few hours. I have only witnessed this twice in the last eighteen years.

If you have any questions, please contact me.

Sincerely,

William P. Rohe
Borough Manager

C:\MyFiles\Land Development .wpd

Little Sewickley Creek Watershed Study

Existing Municipal Ordinance Matrix

Existing Regulatory Controls	Municipality: BOROUGH OF EDGEWORTH
Land Use Planning Standards	CHAPTER 130 - ZONING CHAPTER 113 - SUBDIVISION AND LAND DEVELOPMENT
Storm Water Control Provisions	CHAPTER 113-25 - STORMWATER DRAINAGE
Rate of Runoff Standards	DISCHARGE WATER WITHOUT ACCELERATION OF THE RATE OF RUNOFF
Specific Calculation Method	NOT DEFINED, CONTACT BOROUGH MANAGER OR BOROUGH ENGINEER
Design Standard for Stormwater Controls	DISCHARGE WATER WITHOUT ACCELERATION OF THE RATE OF RUNOFF
Erosion and Sediment Control	CHAPTER 113-30
Plan Review Process	CHAPTER 113-13, 113-14, AND 113-15
Fees	CHAPTER 113-12
Inspection Schedule	CHAPTER 113-44
Maintenance Provisions	NOT DEFINED

Little Sewickley Creek Watershed Study

Existing Municipal Flooding Problem

Municipality: BOROUGH OF EDGEWORTH

Problem Area and Location	Channel / Stream Flooding	Street / Intersection Flooding	Private Property Flooding	Soil Erosion	Groundwater Flooding	Other (use Comments)	Obstruction of Flow	Increased Runoff Due to Development	Lack of or Insufficent Storm Sewer	Other (Use Comments)	Once a Year	More than Once a Year	Less Than once a Year	Every Significant Rainfall Event	Comments
1															NO REPORTED AREAS OF CONCERN IN THE LITTLE SEWICKLEY CREEK WATERSHED.
2															
3															
4															
5															
6															
7															
8															
10															

Reference all sites to existing road stationing or distance to nearest intersection

Use additional sheets if necessary.

Little Sewickley Creek W...ershed Study

Existing Municipal Ordinance Matrix

Existing Regulatory Controls	Municipality: Franklin Park Borough
Land Use Planning Standards	Franklin Park Borough Code Chapters 184, 186 and 212
Storm Water Control Provisions	Appendix E
Rate of Runoff Standards	TR55 Standards
Specific Calculation Method	TR55 standards
Design Standard for Stormwater Controls	Appendix E
Erosion and Sediment Control	Alleg. Co. Conservation District Standards
Plan Review Process	As provided for in the Franklin Park Borough Code and the PA MPC
Fees	See Fee schedule
Inspection Schedule	N/A
Maintenance Provisions	N/A

Little Sewickley Creek Watershed Study

Existing Municipal Flooding Problem

Municipality: Franklin Park Borough

Problem Area and Location	Channel / Stream Flooding	Street / Intersection Flooding	Private Property Flooding	Soil Erosion	Groundwater Flooding	Other (use Comments)	Obstruction of Flow	Increased Runoff Due to Development	Lack of or Insufficent Storm Sewer	Other (Use Comments)	Once a Year	More than Once a Year	Less Than once a Year	Every Significant Rainfall Event	Comments
1 N/A															Little or no development
2															in this area of the
3															Borough
4															
5															
6															
7															
8															
9															
10															

Reference all sites to existing road stationing or distance to nearest intersection
Use additional sheets if necessary.

Little Sewickley Creek Watershed Study

Existing Municipal Ordinance Matrix

Existing Regulatory Controls	Municipality: Leetsdale Borough
Land Use Planning Standards	Subdivision and Land Development Ordinance 479; Zoning Ordinance 411
Storm Water Control Provisions	Ordinance 479 Section 502 - Stormwater Drainage
Rate of Runoff Standards	None
Specific Calculation Method	None
Design Standard for Stormwater Controls	Ordinance 479, Section 502 - Stormwater Drainage
Erosion and Sediment Control	Ordinance 479, Section 506 - Erosion and Sediment Control
Plan Review Process	Ordinance 479, Part 3 - Plan Applications and Review Procedures.
Fees	Ordinance 537
Inspection Schedule	None
Maintenance Provisions	None

Municipality: Leetsdale Borough

Little Sewickley Creek Watershed Study

Existing Municipal Flooding Problem

Problem Area and Location	Channel / Stream Flooding	Street / Intersection Flooding	Private Property Flooding	Soil Erosion	Groundwater Flooding	Other (use Comments)	Obstruction of Flow	Increased Runoff Due to Development	Lack of or Insufficent Storm Sewer	Other (Use Comments)	Once a Year	More than Once a Year	Less Than once a Year	Every Significant Rainfall Event	Comments
1 Low Lying Wooded Area West of Monroe Wat			X						X				X		Leetsdale Borough is currently in the process of replacing the existin plugged stormsewer which drains this area.
2															
3															
4															
5															
6															
7															
8															
9															
10															

Reference all sites to existing road stationing or distance to nearest intersection
Use additional sheets if necessary.

Little Sewickley Creek Wa[illegible]shed Study

Existing Municipal Ordinance Matrix

Existing Regulatory Controls	Municipality: BOROUGH OF SEWICKLEY
Land Use Planning Standards	YES
Storm Water Control Provisions	YES
Rate of Runoff Standards	—
Specific Calculation Method	—
Design Standard for Stormwater Controls	REVIEW BY ENGINEER
Erosion and Sediment Control	YES
Plan Review Process	YES
Fees	— ONLY AS IT WOULD PERTAIN TO BUILDING PERMIT
Inspection Schedule	YES
Maintenance Provisions	YES

Little Sewickley Creek Watershed Study

Municipality: Sewick... 7

Existing Municipal Flooding Problem

Problem Area and Location	Channel / Stream Flooding	Street / Intersection Flooding	Private Property Flooding	Soil Erosion	Groundwater Flooding	Other (use Comments)	Obstruction of Flow	Increased Runoff Due to Development	Lack of or Insufficent Storm Sewer	Other (Use Comments)	Once a Year	More than Once a Year	Less Than once a Year	Every Significant Rainfall Event	Comments
1 WAL MEMORIAL PARK	X										X				HOYE'S RUN INTO OHIO RIVER
2															
3															
4															
5															
6															
7															
8															
9															
10															

Reference all sites to existing road stationing or distance to nearest intersection
Use additional sheets if necessary.

Little Sewickley Creek Watershed Study

Existing Municipal Ordinance Matrix

Existing Regulatory Controls	**Municipality:** BELL ACRES BOROUGH
Land Use Planning Standards	ZONING ORDINANCE - BELL ACRES CODE - CHAPTER 165
Storm Water Control Provisions	SUBDIVISION AND LAND DEVELOPMENT ORDINANCE - BELL ACRES CODE - CHAPTER 149
Rate of Runoff Standards	100% PRE-DEVELOPMENT RATE - CODE CHAPTER 149 - APPENDIX E
Specific Calculation Method	TR-55 - CODE CHAPTER 149 - APPENDIX E
Design Standard for Stormwater Controls	CODE CHAPTER 149 - APPENDIX E
Erosion and Sediment Control	CODE CHAPTER 149 - APPENDIX E
Plan Review Process	CODE CHAPTER 149 - ARTICLE II, CODE CHAPTER 165 - ARTICLE XV
Fees	CODE CHAPTER 91 AUTHORIZING FEE RESOLUTIONS
Inspection Schedule - STORMWATER	NONE
Maintenance Provisions - STORMWATER	NONE

Little Sewickley Creek Watershed Study

Municipality: Bell Acres Borough

Existing Municipal Flooding Problem

Problem Area and Location	Channel / Stream Flooding	Street / Intersection Flooding	Private Property Flooding	Soil Erosion	Groundwater Flooding	Other (use Comments)	Obstruction of Flow	Increased Runoff Due to Development	Lack of or Insufficent Storm Sewer	Other (Use Comments)	Once a Year	More than Once a Year	Less Than once a Year	Every Significant Rainfall Event	Comments
1 None in Little Sewickley Creek Watershed															
2															
3															
4															
5															
6															
7															
8															
9															
10															

Reference all sites to existing road stationing or distance to nearest intersection
Use additional sheets if necessary.

Little Sewickley Creek W ... .ed Study

Existing Municipal Ordinance Matrix

Existing Regulatory Controls	Municipality: Leet Township
Land Use Planning Standards	Subdivision and Zoning Ordinances
Storm Water Control Provisions	Pre equals Post
Rate of Runoff Standards	Pre equals Post
Specific Calculation Method	N/A
Design Standard for Stormwater Controls	N/A
Erosion and Sediment Control	E&S Plan Required for all Earth moving Acitivities
Plan Review Process	Grading Site, Subdivision and PRD's reviewed by Township Engineers
Fees	As Required
Inspection Schedule	Required for Site, Subdivision and PRD's
Maintenance Provisions	Maintenance Bond

NSE

Little Sewickley Creek ... ned Study

Municipality: Leet Towns

Existing Municipal Flooding Problem

Problem Area and Location	Channel / Stream Flooding	Street / Intersection Flooding	Private Property Flooding	Soil Erosion	Groundwater Flooding	Other (use Comments)	Obstruction of Flow	Increased Runoff Due to Development	Lack of or Insufficent Storm Sewer	Other (Use Comments)	Once a Year	More than Once a Year	Less Than once a Year	Every Significant Rainfall Event	Comments
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															

Reference all sites to existing road stationing or distance to nearest intersection
Use additional sheets if necessary.

SEE Enclosed List of Letters

Leet Twp

APPENDIX E

PSRM RESULTS

RELEASE RATE CALCULATIONS

Future Conditions 2011								
OUTFLOW SUMMARY TABLE								
	2 year		10 year		25 year		100 year	
Subarea No.	Basin cfs	Total cfs	Basin cfs	Total cfs	Basin cfs	Total cfs	Basin cfs	Total cfs
1	163	163	367	367	505	505	666	666
2	62	62	169	169	248	248	343	343
3	0	211	0	432	0	608	0	816
4	25	228	69	482	101	675	140	903
5	33	33	97	97	144	144	202	202
6	0	224	0	556	0	775	0	1027
7	51	252	123	636	175	889	237	1179
8	94	94	206	206	280	280	365	365
9	47	47	133	133	195	195	268	268
10	0	116	0	292	0	411	0	548
11	20	130	56	326	80	454	107	601
12	0	319	0	779	0	1091	0	1437
13	32	335	81	818	116	1144	157	1505
14	75	75	154	154	206	206	265	265
15	99	145	245	337	349	461	474	614
16	51	51	122	122	172	172	232	232
17	0	187	0	445	0	612	0	791
18	82	243	176	569	237	780	309	1012
19	0	520	0	1266	0	1770	0	2348
20	58	556	142	1357	202	1900	273	2520
21	27	27	69	69	99	99	136	136
22	0	571	0	1399	0	1953	0	2584
23	33	585	84	1435	119	2002	162	2645
24	58	58	140	140	197	197	263	263
25	0	593	0	1468	0	2033	0	2683
26	22	602	52	1493	72	2069	97	2730
27	51	51	119	119	165	165	219	219
28	130	130	255	255	334	334	422	422
29	0	157	0	345	0	466	0	604
30	7	163	22	361	33	489	46	634
31	0	659	0	1614	0	2234	0	2926
32	79	684	170	1675	230	2319	301	3034
33	49	49	110	110	150	150	196	196
34	0	686	0	1668	0	2305	0	3025
35	98	712	219	1726	300	2372	394	3108
36	152	717	294	1754	381	2399	478	3123
37	52	725	92	1754	114	2411	138	3131
38	51	51	97	97	125	125	156	156
39	0	725	0	1749	0	2409	0	3151
40	30	734	55	1757	68	2419	82	3160

Existing Conditions 2001								
OUTFLOW SUMMARY TABLE								
	2 year		10 year		25 year		100 year	
Subarea No.	Basin cfs	Total cfs	Basin cfs	Total cfs	Basin cfs	Total cfs	Basin cfs	Total cfs
1	129	129	317	317	447	447	602	602
2	62	62	169	169	248	248	343	343
3	0	178	0	398	0	575	0	779
4	25	196	69	447	101	641	140	866
5	33	33	97	97	144	144	202	202
6	0	199	0	524	0	737	0	984
7	39	224	105	602	153	850	212	1135
8	61	61	161	161	230	230	310	310
9	43	43	127	127	188	188	260	260
10	0	91	0	257	0	372	0	506
11	20	106	56	291	80	415	107	559
12	0	291	0	747	0	1055	0	1397
13	26	306	72	785	106	1108	146	1466
14	41	41	103	103	147	147	199	199
15	99	122	245	301	349	429	474	573
16	32	32	94	94	139	139	195	195
17	0	150	0	388	0	558	0	731
18	58	194	137	495	192	709	258	933
19	0	460	0	1182	0	1673	0	2243
20	51	490	132	1271	190	1801	260	2414
21	27	27	69	69	99	99	136	136
22	0	497	0	1313	0	1854	0	2474
23	33	510	84	1349	119	1902	162	2535
24	42	42	117	117	171	171	235	235
25	0	529	0	1384	0	1954	0	2597
26	13	536	37	1409	55	1989	77	2644
27	51	51	119	119	165	165	219	219
28	89	89	194	194	265	265	346	346
29	0	121	0	292	0	405	0	537
30	7	127	22	308	33	429	46	568
31	0	582	0	1527	0	2137	0	2820
32	79	607	170	1587	230	2221	301	2927
33	49	49	110	110	150	150	196	196
34	0	604	0	1577	0	2221	0	2933
35	80	629	193	1629	271	2287	362	3016
36	133	640	267	1661	351	2299	446	3036
37	52	640	92	1666	114	2312	138	3024
38	51	51	97	97	125	125	156	156
39	0	644	0	1657	0	2323	0	3056
40	30	652	55	1665	68	2332	82	3065

Exist100

NHL	NA	NRES	NRG	NNRG	NPRT	NOBS	NPFP	NWG	EXW	IPCS
4	40	0	0	1	2	0	2	1	2.0	75

Little Sewickley Creek
Stormwater Managment Plan
Act 167
Exist 100 Year 24 Hr storm

TR	PRI	DT	DTR	TRI
1440.0	15.0	1.50	15.0	720.0

STDN1	STDN2	STCN1	STCN2	STDIA	STDS1	STDS2	STCTS	CBF
0.040	0.300	95.0	70.0	0.100	0.060	0.000	1.50	0.0010

SCS Hyetograph	NPT	PPT	Dummy Variables		
96		5.00	0	0	dummy

Subareas for Hydrograph Output
26 40
Subareas for Peak Flow Presentation
26 40

Subarea ID	Area	Length	Slope	Imp.Fr.	X-Coord	Y-Coord
1	573.00	1500.0	0.130	0.06	23.90	12.60
2	419.00	1750.0	0.120	0.03	22.70	8.90
3	0.10	50.0	0.120	0.01	21.30	11.60
4	171.00	1900.0	0.140	0.03	20.10	12.30
5	242.00	1800.0	0.150	0.02	20.10	15.70
6	0.10	50.0	0.140	0.01	19.20	13.40
7	346.00	2600.0	0.120	0.03	16.80	15.10
8	208.00	800.0	0.130	0.05	13.90	15.90
9	222.00	1000.0	0.120	0.02	15.70	16.30
10	0.10	50.0	0.130	0.01	15.20	13.40
11	50.00	600.0	0.380	0.00	15.50	12.70
12	0.10	50.0	0.200	0.01	16.50	12.30
13	154.00	1700.0	0.170	0.03	16.00	11.60
14	219.00	1300.0	0.070	0.05	17.90	1.80
15	564.00	2000.0	0.130	0.05	17.60	5.10
16	249.00	1750.0	0.120	0.02	19.30	8.50
17	0.10	50.0	0.120	0.01	17.70	7.40
18	359.00	2500.0	0.110	0.06	16.40	8.70
19	0.10	50.0	0.120	0.01	15.00	10.30
20	369.00	2500.0	0.140	0.04	13.20	10.60
21	174.00	2000.0	0.120	0.04	12.60	6.60
22	0.10	50.0	0.130	0.01	11.10	8.50
23	145.00	1600.0	0.200	0.05	10.30	8.30
24	196.00	1300.0	0.200	0.03	11.10	11.80
25	0.10	50.0	0.200	0.01	9.40	9.80
26	136.00	2850.0	0.140	0.02	8.50	9.90
27	187.00	1400.0	0.130	0.08	6.40	13.40
28	233.00	1250.0	0.180	0.11	10.00	13.20
29	0.10	50.0	0.170	0.01	7.60	12.10
30	41.00	1500.0	0.260	0.01	7.80	11.60
31	0.10	50.0	0.220	0.01	7.20	10.70

32	303.00	2350.0	0.160	0.10	5.50	10.90
33	106.00	950.0	0.250	0.11	4.00	9.60
34	0.10	50.0	0.200	0.01	5.80	8.50
35	282.00	1600.0	0.260	0.07	7.30	7.40
36	207.00	1050.0	0.300	0.19	4.50	6.60
37	67.00	1400.0	0.020	0.48	3.30	5.70
38	121.00	2600.0	0.130	0.21	2.70	8.60
39	0.10	50.0	0.030	0.01	2.40	5.60
40	38.00	2000.0	0.010	0.72	1.70	5.30

Parameters	n1	n2	CN1	CN2	IA	DEP1	DEP2	CTS
1	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
2	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
3	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
4	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
5	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
6	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
7	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
8	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
9	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
10	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
11	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
12	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
13	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
14	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
15	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
16	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
17	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
18	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
19	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
20	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
21	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
22	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
23	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
24	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
25	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
26	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
27	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
28	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
29	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
30	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
31	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
32	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
33	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
34	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
35	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
36	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
37	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
38	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00

39	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
40	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00

DRAINAGE ELEM. DATA	KP	CAP	PT	NAP(1)	NAP(2)	NAP(3)
1	0	90.0	25.0	0	0	0
2	0	90.0	15.0	0	0	0
3	2	175.0	0.2	1	2	0
4	1	200.0	7.0	3	0	0
5	0	35.0	10.0	0	0	0
6	2	230.0	0.2	4	5	0
7	1	275.0	8.0	6	0	0
8	0	55.0	6.0	0	0	0
9	0	50.0	8.0	0	0	0
10	2	90.0	0.2	8	9	0
11	1	100.0	5.0	10	0	0
12	2	350.0	0.2	7	11	0
13	1	355.0	8.0	12	0	0
14	0	150.0	7.0	0	0	0
15	1	215.0	12.0	14	0	0
16	0	80.0	7.0	0	0	0
17	2	285.0	0.2	15	16	0
18	1	325.0	11.0	17	0	0
19	2	615.0	0.2	13	18	0
20	1	630.0	12.0	19	0	0
21	0	50.0	6.0	0	0	0
22	2	6.0	0.2	20	21	0
23	1	635.0	5.0	22	0	0
24	0	150.0	8.0	0	0	0
25	2	650.0	0.2	23	24	0
26	1	655.0	6.0	25	0	0
27	0	60.0	10.0	0	0	0
28	0	80.0	9.0	0	0	0
29	2	135.0	0.2	27	28	0
30	1	130.0	5.0	29	0	0
31	2	695.0	0.2	26	30	0
32	1	700.0	6.0	31	0	0
33	0	50.0	5.0	0	0	0
34	2	705.0	0.2	32	33	0
35	1	720.0	9.0	34	0	0
36	1	730.0	9.0	35	0	0
37	1	725.0	5.0	36	0	0
38	0	75.0	8.0	0	0	0
39	2	730.0	0.2	37	38	0
40	1	9999.0	5.0	39	0	0

End of Input

Fut1001

NHL	NA	NRES	NRG	NNRG	NPRT	NOBS	NPFP	NWG	EXW	IPCS
4	40	0	0	1	2	0	2	1	2.0	75

Little Sewickley Creek
Stormwater Managment Plan
Act 167
Future 100 Year 24 Hr storm

TR	PRI	DT	DTR	TRI
1440.0	15.0	1.50	15.0	720.0

STDN1	STDN2	STCN1	STCN2	STDIA	STDS1	STDS2	STCTS	CBF
0.040	0.300	95.0	70.0	0.100	0.060	0.000	1.50	0.0010

SCS Hyetograph	NPT	PPT	Dummy Variables		
96		5.00	0	0	dummy

Subareas for Hydrograph Output
3 12
Subareas for Peak Flow Presentation
3 12

Subarea ID	Area	Length	Slope	Imp.Fr.	X-Coord	Y-Coord
1	573.00	1500.0	0.130	0.09	23.90	12.60
2	419.00	1750.0	0.120	0.03	22.70	8.90
3	0.10	50.0	0.120	0.01	21.30	11.60
4	171.00	1900.0	0.140	0.03	20.10	12.30
5	242.00	1800.0	0.150	0.02	20.10	15.70
6	0.10	50.0	0.140	0.01	19.20	13.40
7	346.00	2600.0	0.120	0.05	16.80	15.10
8	208.00	800.0	0.130	0.12	13.90	15.90
9	222.00	1000.0	0.120	0.03	15.70	16.30
10	0.10	50.0	0.130	0.01	15.20	13.40
11	50.00	600.0	0.380	0.00	15.50	12.70
12	0.10	50.0	0.200	0.01	16.50	12.30
13	154.00	1700.0	0.170	0.05	16.00	11.60
14	219.00	1300.0	0.070	0.13	17.90	1.80
15	564.00	2000.0	0.130	0.05	17.60	5.10
16	249.00	1750.0	0.120	0.06	19.30	8.50
17	0.10	50.0	0.120	0.01	17.70	7.40
18	359.00	2500.0	0.110	0.10	16.40	8.70
19	0.10	50.0	0.120	0.01	15.00	10.30
20	369.00	2500.0	0.140	0.05	13.20	10.60
21	174.00	2000.0	0.120	0.04	12.60	6.60
22	0.10	50.0	0.130	0.01	11.10	8.50
23	145.00	1600.0	0.200	0.05	10.30	8.30
24	196.00	1300.0	0.200	0.07	11.10	11.80
25	0.10	50.0	0.200	0.01	9.40	9.80
26	136.00	2850.0	0.140	0.06	8.50	9.90
27	187.00	1400.0	0.130	0.08	6.40	13.40
28	233.00	1250.0	0.180	0.19	10.00	13.20
29	0.10	50.0	0.170	0.01	7.60	12.10
30	41.00	1500.0	0.260	0.01	7.80	11.60
31	0.10	50.0	0.220	0.01	7.20	10.70

32	303.00	2350.0	0.160	0.10	5.50	10.90
33	106.00	950.0	0.250	0.11	4.00	9.60
34	0.10	50.0	0.200	0.01	5.80	8.50
35	282.00	1600.0	0.260	0.10	7.30	7.40
36	207.00	1050.0	0.300	0.23	4.50	6.60
37	67.00	1400.0	0.020	0.48	3.30	5.70
38	121.00	2600.0	0.130	0.21	2.70	8.60
39	0.10	50.0	0.030	0.01	2.40	5.60
40	38.00	2000.0	0.010	0.72	1.70	5.30

Parameters	n1	n2	CN1	CN2	IA	DEP1	DEP2	CTS
1	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
2	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
3	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
4	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
5	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
6	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
7	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
8	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
9	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
10	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
11	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
12	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
13	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
14	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
15	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
16	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
17	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
18	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
19	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
20	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
21	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
22	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
23	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
24	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
25	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
26	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
27	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
28	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
29	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
30	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
31	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
32	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
33	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
34	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
35	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
36	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
37	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
38	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00

39	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00
40	-1.000	-1.000	-1.0	-1.0	-1.0	-1.00	-1.00	-1.00

DRAINAGE ELEM. DATA	KP	CAP	PT	NAP(1)	NAP(2)	NAP(3)
1	0	90.0	25.0	0	0	0
2	0	90.0	15.0	0	0	0
3	2	175.0	0.2	1	2	0
4	1	200.0	7.0	3	0	0
5	0	35.0	10.0	0	0	0
6	2	230.0	0.2	4	5	0
7	1	275.0	8.0	6	0	0
8	0	55.0	6.0	0	0	0
9	0	50.0	8.0	0	0	0
10	2	90.0	0.2	8	9	0
11	1	100.0	5.0	10	0	0
12	2	350.0	0.2	7	11	0
13	1	355.0	8.0	12	0	0
14	0	150.0	7.0	0	0	0
15	1	215.0	12.0	14	0	0
16	0	80.0	7.0	0	0	0
17	2	285.0	0.2	15	16	0
18	1	325.0	11.0	17	0	0
19	2	615.0	0.2	13	18	0
20	1	630.0	12.0	19	0	0
21	0	50.0	6.0	0	0	0
22	2	6.0	0.2	20	21	0
23	1	635.0	5.0	22	0	0
24	0	150.0	8.0	0	0	0
25	2	650.0	0.2	23	24	0
26	1	655.0	6.0	25	0	0
27	0	60.0	10.0	0	0	0
28	0	80.0	9.0	0	0	0
29	2	135.0	0.2	27	28	0
30	1	130.0	5.0	29	0	0
31	2	695.0	0.2	26	30	0
32	1	700.0	6.0	31	0	0
33	0	50.0	5.0	0	0	0
34	2	705.0	0.2	32	33	0
35	1	720.0	9.0	34	0	0
36	1	730.0	9.0	35	0	0
37	1	725.0	5.0	36	0	0
38	0	75.0	8.0	0	0	0
39	2	730.0	0.2	37	38	0
40	1	9999.0	5.0	39	0	0

End of Input

RELEASE RATE CALCULATIONS

Little Sewickley Creek Watershed
Act 167 Watershed Study
Release Rate Calculations
Future Development 100 Year Storms

Formula

$$RR = \frac{Qi\ @t = Tp}{Qpi} \times 100\%$$

RR =	Release Rate
Qi =	Runoff from an upstream Basin "i"
Qi@t=TP=	Qi corresponding to the time at which the total peak flow occurs at a downstream location
Qpi =	Peak runoff flow from Basin"i"

Release Rate for Sub Area	
3	79.3%
12	95.1%
19	96.8%
22	97.1%
31	79.3%
40	100.0%

Sub area 3		cfs	Time (mins)
	Qi@t=TP=	647	795
	Qpi =	816	780
	RR =	79%	

Sub area 12		cfs	Time (mins)
	Qi@t=TP=	1366	780
	Qpi =	1437	795
	RR =	95%	

Sub area 19		cfs	Time (mins)
	Qi@t=TP=	2274	795
	Qpi =	2348	780
	RR =	97%	

Sub area 22		cfs	Time (mins)
	Qi@t=TP=	2509	810
	Qpi =	2584	795
	RR =	97%	

Sub area 31		cfs	Time (mins)
	Qi@t=TP=	2320	855
	Qpi =	2926	810
	RR =	79%	

Sub area 40		cfs	Time (mins)
	Qi@t=TP=	3160	855
	Qpi =	3160	855
	RR =	100%	

Little Sewickley Creek
Act 167 Stormwater Management Plan September 2002
Future Development Year 2011
100 Yr Storm Sub Areas 3 and 12

Peak Flow Presentation for Subarea 3

			Time, minutes										
Sub Areas	Travel Time (minutes)	Time, (minutes)	705	720	735	750	765	780	795	810	825	840	855
		Total Q (cfs)	21	31	72	329	767	816	647	535	446	375	317
3	0		0	0	0	0	0	0	0	0	0	0	0
2	20.5		6	11	41	230	308	269	231	197	168	143	123
1	35.8		15	20	31	99	460	547	416	338	278	231	194
Sub Area Total			21	31	72	329	768	816	647	535	446	374	317

Peak Flow Presentation for Subarea 12

Sub Areas	Travel Time (minutes)	Time, (minutes)	720	735	750	765	780	795	810	825	840	855	870
		Total Q (cfs)	106	417	963	1251	1366	1437	1272	1046	874	736	624
12	0		0	0	0	0	0	0	0	0	0	0	0
11	7.1		12	65	81	46	29	20	14	11	8	7	5
10	7.4		0	0	0	0	0	0	0	0	0	0	0
9	18.6		9	37	209	219	171	134	106	85	69	57	47
8	15.9		20	76	348	225	158	118	90	71	57	46	38
7	11.1		20	93	222	194	172	153	135	120	106	94	83
6	11.3		0	0	0	0	0	0	0	0	0	0	0
5	25.5		5	14	81	188	168	144	122	103	87	74	63
4	21.1		4	16	90	126	110	95	81	69	59	50	43
3	21.3		0	0	0	0	0	0	0	0	0	0	0
2	41.9		5	9	23	114	324	285	246	211	180	153	131
1	57.2		13	17	25	56	238	627	456	367	301	249	208
Sub Area Total			88	327	1079	1168	1370	1576	1250	1037	867	730	618

Little Sewickley Creek
Act 167 Stormwater Management Plan September 2002
Future Development Year 2011
100 Yr Storm Sub Areas 19 and 22

Peak Flow Presentation for Subarea 19

Sub Areas	Travel Time (minutes	Time, (minutes)	705	720	735	750	765	780	795	810	825	840	855
		Total Q (cfs)	78	128	380	1242	2159	2348	2274	2148	1860	1558	1317
19	0		0	0	0	0	0	0	0	0	0	0	0
18	14.7		13	21	71	304	230	193	167	146	128	113	100
17	15		0	0	0	0	0	0	0	0	0	0	0
16	24.3		6	9	24	114	210	171	144	122	104	88	76
15	30.9		9	13	22	83	439	391	335	288	248	213	183
14	39.4		7	9	13	33	137	232	163	131	109	91	77
13	11.1		5	13	62	146	117	97	80	66	56	47	40
12	11.3		0	0	0	0	0	0	0	0	0	0	0
11	18.4		1	3	16	87	69	40	26	18	13	10	8
10	18.7		0	0	0	0	0	0	0	0	0	0	0
9	30		3	5	10	46	261	205	160	126	100	80	65
8	27.2		9	14	31	132	338	204	147	110	85	67	54
7	22.4		6	10	28	138	214	188	167	148	131	116	103
6	22.7		0	0	0	0	0	0	0	0	0	0	0
5	36.8		2	3	5	21	120	184	162	139	117	99	84
4	32.4		2	3	5	20	117	122	106	91	78	66	57
3	32.7		0	0	0	0	0	0	0	0	0	0	0
2	53.2		3	4	6	10	33	181	314	276	237	203	173
1	68.5		10	12	14	19	29	81	366	581	433	350	288
Sub Area Total			**76**	**119**	**307**	**1153**	**2314**	**2289**	**2337**	**2242**	**1839**	**1543**	**1308**

Peak Flow Presentation for Subarea 22

Sub Areas	Travel Time (minutes	Time, (minutes) Total Q (cfs)	Time, minutes 720	735	750	765	780	795	810	825	840	855	870
			103	245	718	1480	2347	2584	2509	2360	2066	1744	1478
22	0		0	0	0	0	0	0	0	0	0	0	0
21	7.9		14	75	124	108	94	81	70	61	53	46	40
20	16.5		13	47	244	232	203	178	156	136	120	105	92
19	16.8		0	0	0	0	0	0	0	0	0	0	0
18	31.5		13	19	62	281	238	197	170	148	130	115	102
17	31.8		0	0	0	0	0	0	0	0	0	0	0
16	41.1		5	8	20	92	215	174	147	124	106	90	77
15	47.7		9	12	20	75	395	400	342	294	252	217	187
14	56.2		7	9	13	28	112	243	168	134	111	93	79
13	27.8		4	10	47	149	120	99	82	68	57	48	40
12	28.1		0	0	0	0	0	0	0	0	0	0	0
11	35.2		1	3	14	76	74	43	27	19	14	11	8
10	35.5		0	0	0	0	0	0	0	0	0	0	0
9	46.7		3	5	9	41	236	212	165	130	103	83	67
8	44		9	13	24	99	355	212	151	113	87	69	55
7	39.2		6	9	24	116	218	191	169	150	133	118	104
6	39.5		0	0	0	0	0	0	0	0	0	0	0
5	53.6		2	3	5	18	101	186	165	141	120	101	86
4	49.2		2	3	5	18	104	124	108	93	79	68	58
3	49.5		0	0	0	0	0	0	0	0	0	0	0
2	70		3	4	5	9	28	149	319	280	242	207	176
1	85.3		10	11	14	18	27	69	304	603	444	358	294
Sub Area Total			101	231	630	1360	2520	2558	2543	2494	2051	1729	1465

Little Sewickley Creek
Act 167 Stormwater Management Plan September 2002
Future Development Year 2011
100 Yr Storm Sub Areas 31 and 40

Peak Flow Presentation for Subarea 31

Sub Areas	Travel Time (minutes)	Time, (minutes) / Total Q (cfs)	735	750	765	780	795	810	825	840	855	870	885
		Total Q (cfs)	469	1150	1686	2147	2693	2926	2847	2627	2320	1982	1681
31	0		0	0	0	0	0	0	0	0	0	0	0
30	7		27	40	33	26	21	17	13	11	9	8	6
29	7.3		0	0	0	0	0	0	0	0	0	0	0
28	19.9		78	318	294	188	142	111	89	73	60	51	43
27	20.9		31	149	181	139	112	92	76	63	53	45	38
26	8.3		53	88	75	66	59	52	46	41	36	32	28
25	8.6		0	0	0	0	0	0	0	0	0	0	0
24	18.3		43	215	201	151	117	93	74	60	50	41	35
23	15.5		29	155	125	100	81	66	54	45	38	32	27
22	15.8		0	0	0	0	0	0	0	0	0	0	0
21	23.7		14	69	124	109	94	82	71	61	53	46	40
20	32.3		12	45	233	234	204	179	157	137	120	106	93
19	32.5		0	0	0	0	0	0	0	0	0	0	0
18	47.3		13	19	60	269	242	199	171	149	131	116	102
17	47.5		0	0	0	0	0	0	0	0	0	0	0
16	56.8		5	8	18	83	217	176	148	125	107	91	78
15	63.4		9	12	20	72	376	404	345	296	254	219	188
14	71.9		7	9	12	26	102	247	169	135	112	94	79
13	43.6		4	9	41	151	121	100	82	68	57	48	41
12	43.9		0	0	0	0	0	0	0	0	0	0	0
11	50.9		1	3	13	72	77	44	28	19	14	11	8
10	51.2		0	0	0	0	0	0	0	0	0	0	0
9	62.5		3	5	9	39	225	214	168	132	104	84	68
8	59.8		8	12	21	84	363	215	153	115	88	70	56
7	54.9		6	9	23	107	219	192	170	151	134	118	105
6	55.2		0	0	0	0	0	0	0	0	0	0	0
5	69.3		2	3	5	16	93	187	166	143	121	102	86
4	64.9		2	3	5	17	98	125	109	93	80	68	58
3	65.2		0	0	0	0	0	0	0	0	0	0	0
2	85.7		3	4	5	9	26	135	321	282	244	208	177
1	101		10	11	13	18	26	63	278	612	449	362	297
Sub Area Total			360	1186	1511	1976	3015	2993	2888	2811	2314	1952	1653
Peak Flow subarea as a % of total peak flow													

Peak Flow Presentation for Subarea 40

Sub Areas	Travel Time (minutes)	Time, (minutes) Total Q (cfs)	780	795	810	825	840	855	870	885	900	915	930
			1679	**2035**	**2401**	**2768**	**3064**	**3160**	**3033**	**2768**	**2437**	**2098**	**1793**
40	0		29	22	18	15	13	11	10	9	8	8	7
39	0.3		0	0	0	0	0	0	0	0	0	0	0
38	10.4		69	57	49	42	37	33	29	26	23	21	18
37	7.2		44	34	28	24	20	18	16	14	13	12	11
36	19.6		173	123	92	72	57	47	39	33	28	24	21
35	32.1		281	209	164	131	106	87	72	60	51	44	37
34	32.4		0	0	0	0	0	0	0	0	0	0	0
33	39.2		164	100	71	52	40	31	25	20	17	14	12
32	40.7		275	207	172	146	125	108	94	81	71	62	55
31	41		0	0	0	0	0	0	0	0	0	0	0
30	48		37	39	31	25	19	16	13	10	9	7	6
29	48.2		0	0	0	0	0	0	0	0	0	0	0
28	60.9		99	404	242	171	131	104	84	69	57	48	41
27	61.9		40	196	165	130	106	87	72	60	50	43	36
26	49.2		73	84	73	64	57	50	44	39	35	31	28
25	49.5		0	0	0	0	0	0	0	0	0	0	0
24	59.2		62	257	182	140	109	87	70	57	47	39	33
23	56.4		60	151	118	95	77	63	52	43	36	30	26
22	56.7		0	0	0	0	0	0	0	0	0	0	0
21	64.6		18	98	120	105	91	79	68	59	51	44	39
20	73.2		18	76	261	225	197	173	151	133	116	102	90
19	73.5		0	0	0	0	0	0	0	0	0	0	0
18	88.2		14	25	95	296	226	190	165	144	127	112	99
17	88.5		0	0	0	0	0	0	0	0	[illegible]	0	0
16	97.8		6	9	27	132	205	168	142	120	102	87	75
15	104.4		9	13	25	102	458	384	330	284	244	210	181
14	112.9		7	10	14	37	157	224	159	128	107	90	76
13	84.5		5	15	74	143	115	95	79	65	55	46	39
12	84.8		0	0	0	0	0	0	0	0	0	0	0
11	91.9		2	4	17	95	64	38	25	18	13	10	8
10	92.2		0	0	0	0	0	0	0	0	0	0	0
9	103.4		3	6	14	68	255	201	157	123	98	79	64
8	100.7		9	14	37	161	323	198	143	108	83	66	53
7	95.9		6	10	31	157	212	186	165	146	130	115	101
6	96.2		0	0	0	0	0	0	0	0	0	0	0
5	110.3		2	3	6	23	136	182	160	136	115	97	83
4	105.9		2	3	5	22	128	120	104	89	76	65	56
3	106.2		0	0	0	0	0	0	0	0	0	0	0
2	126.7		3	4	6	11	38	209	311	272	234	200	170
1	142		10	12	14	19	30	91	419	562	424	343	283
Sub Area Total			**1520**	**2185**	**2151**	**2703**	**3532**	**3280**	**3198**	**2908**	**2420**	**2049**	**1748**
Peak Flow subarea as a % of total peak flow													

Little Sewickley Creek
Act 167 Stormwater Management Plan September 2002
Future Development Year 2011
100 Yr Storm Sub Areas

Peak Flow Presentation for Subarea 40

Sub Areas	Travel Time (minutes)	Time, (minutes) Total Q (cfs)	780 1679	795 2035	810 2401	825 2768	840 3064	855 3160	870 3033	885 2768	900 2437	915 2098	930 1793	Release Rate
1	142		10	12	14	19	30	91	419	562	424	343	283	100
2	126.7		3	4	6	11	38	209	311	272	234	200	170	100
3	106.2		0	0	0	0	0	0	0	0	0	0	0	27
Sub Area Total			**13**	**16**	**20**	**30**	**68**	**300**	**730**	**834**	**658**	**543**	**453**	
Peak Flow subarea as a % of total peak flow								**9%**						
4	105.9		2	3	5	22	128	120	104	89	76	65	56	86
5	110.3		2	3	6	23	136	182	160	136	115	97	83	90
6	96.2		0	0	0	0	0	0	0	0	0	0	0	15
7	95.9		6	10	31	157	212	186	165	146	130	115	101	79
8	100.7		9	14	37	161	323	198	143	108	83	66	53	54
9	103.4		3	6	14	68	255	201	157	123	98	79	64	75
10	92.2		0	0	0	0	0	0	0	0	0	0	0	13
11	91.9		2	4	17	95	64	38	25	18	13	10	8	36
12	84.8		0	0	0	0	0	0	0	0	0	0	0	10
Sub Area Total			**24**	**40**	**110**	**526**	**1118**	**925**	**754**	**620**	**515**	**432**	**365**	
Peak Flow subarea as a % of total peak flow								**29%**						
13	84.5		5	15	74	143	115	95	79	65	55	46	39	60
14	112.9		7	10	14	37	157	224	159	128	107	90	76	84
15	104.4		9	13	25	102	458	384	330	284	244	210	181	81
16	97.8		6	9	27	132	205	168	142	120	102	87	75	73
17	88.5		0	0	0	0	0	0	0	0	0	0	0	11
18	88.2		14	25	95	296	226	190	165	144	127	112	99	61
19	73.5		0	0	0	0	0	0	0	0	0	0	0	8
Sub Area Total			**41**	**72**	**235**	**710**	**1161**	**1061**	**875**	**741**	**635**	**545**	**470**	
Peak Flow subarea as a % of total peak flow								**34%**						
20	73.2		18	76	261	225	197	173	151	133	116	102	90	63
21	64.6		18	98	120	105	91	79	68	59	51	44	39	58
22	56.7		0	0	0	0	0	0	0	0	0	0	0	5
Sub Area Total			**36**	**174**	**381**	**330**	**288**	**252**	**219**	**192**	**167**	**146**	**129**	
Peak Flow subarea as a % of total peak flow								**8%**						
23	56.4		60	151	118	95	77	63	52	43	36	30	26	39
24	59.2		62	257	182	140	109	87	70	57	47	39	33	33
25	49.5		0	0	0	0	0	0	0	0	0	0	0	4
26	49.2		73	84	73	64	57	50	44	39	35	31	28	52
27	61.9		40	196	165	130	106	87	72	60	50	43	36	40
28	60.9		99	404	242	171	131	104	84	69	57	48	41	25
29	48.2		0	0	0	0	0	0	0	0	0	0	0	4
30	48		37	39	31	25	19	16	13	10	9	7	6	34
31	41		0	0	0	0	0	0	0	0	0	0	0	4
Sub Area Total			**371**	**1131**	**811**	**625**	**499**	**407**	**335**	**278**	**234**	**198**	**170**	
Peak Flow subarea as a % of total peak flow								**13%**						
32	40.7		275	207	172	146	125	108	94	81	71	62	55	36
33	39.2		164	100	71	52	40	31	25	20	17	14	12	16
34	32.4		0	0	0	0	0	0	0	0	0	0	0	3
35	32.1		281	209	164	131	106	87	72	60	51	44	37	22
36	19.6		173	123	92	72	57	47	39	33	28	24	21	10
37	7.2		44	34	28	24	20	18	16	14	13	12	11	13
38	10.4		69	57	49	42	37	33	29	26	23	21	18	21
39	0.3		0	0	0	0	0	0	0	0	0	0	0	2
40	0		29	22	18	15	13	11	10	9	8	8	7	14
Sub Area Total			**1035**	**752**	**594**	**482**	**398**	**335**	**285**	**243**	**211**	**185**	**161**	
Peak Flow subarea as a % of total peak flow								**11%**						

Little Sewickley Creek Watershed
Act 167 Watershed Study
Release Rate Calculations
Future Development 10 Year Storms

Formula

$$RR = \frac{Qi\ @t = Tp}{Qpi} \times 100\%$$

RR = Release Rate
Qi = Runoff from an upstream Basin "i"
Qi@t=TP= Qi corresponding to the time at which the total peak flow occurs at a downstream location
Qpi = Peak runoff flow from Basin"i"

Release Rate for Sub Area	
3	79.6%
12	97.8%
19	97.4%
22	96.7%
31	86.5%
40	100.0%

Sub area 3		**cfs**	**Time (mins)**
	Qi@t=TP=	344	795
	Qpi =	432	765
	RR =	80%	

Sub area 22		**cfs**	**Time (mins)**
	Qi@t=TP=	1353	810
	Qpi =	1399	795
	RR =	97%	

Sub area 12		**cfs**	**Time (mins)**
	Qi@t=TP=	762	780
	Qpi =	779	795
	RR =	98%	

Sub area 31		**cfs**	**Time (mins)**
	Qi@t=TP=	1396	840
	Qpi =	1614	810
	RR =	86%	

Sub area 19		**cfs**	**Time (mins)**
	Qi@t=TP=	1233	795
	Qpi =	1266	780
	RR =	97%	

Sub area 40		**cfs**	**Time (mins)**
	Qi@t=TP=	1757	840
	Qpi =	1757	840
	RR =	100%	

Little Sewickley Creek
Act 167 Stormwater Management Plan September 2002
Future Development Year 2011
10 Yr Storm Sub Areas 3 and 12

Peak Flow Presentation for Subarea 3

			Time, minutes										
Sub Areas	Travel Time (minutes)	Time, (minutes)	690	705	720	735	750	765	780	795	810	825	840
		Total Q (cfs)	11	13	18	40	190	432	427	344	289	244	205
3	0		0	0	0	0	0	0	0	0	0	0	0
2	18.5		3	3	5	21	131	152	136	120	104	89	76
1	34.4		9	10	13	18	59	280	290	225	186	155	129
Sub Area Total			12	13	18	39	190	432	426	345	290	244	205

Peak Flow Presentation for Subarea 12

Sub Areas	Travel Time (minutes)	Time, (minutes)	720	735	750	765	780	795	810	825	840	855	870
		Total Q (cfs)	59	238	529	683	762	779	676	561	470	394	331
12	0		0	0	0	0	0	0	0	0	0	0	0
11	6.7		5	34	44	29	19	13	9	6	4	3	2
10	7		0	0	0	0	0	0	0	0	0	0	0
9	17.5		4	17	111	112	93	75	61	49	39	31	25
8	15.2		11	44	204	125	93	71	55	43	34	27	21
7	10.3		11	53	115	100	89	79	70	62	55	48	42
6	10.5		0	0	0	0	0	0	0	0	0	0	0
5	23.7		2	7	47	91	84	75	65	55	47	39	33
4	19.6		2	8	49	62	56	49	43	37	31	27	23
3	19.8		0	0	0	0	0	0	0	0	0	0	0
2	38.4		3	5	15	87	157	141	125	109	94	80	68
1	54.3		9	12	16	41	186	325	240	197	164	137	115
Sub Area Total			47	180	601	647	777	828	668	558	468	392	329

Little Sewickley Creek
Act 167 Stormwater Management Plan September 2002
Future Development Year 2011
10 Yr Storm Sub Areas 19 and 22

Peak Flow Presentation for Subarea 19

Sub Areas	Travel Time (minutes	Time, (minutes)	705	720	735	750	765	780	795	810	825	840	855
		Total Q (cfs)	51	80	250	749	1199	1266	1233	1146	985	828	700
19	0		0	0	0	0	0	0	0	0	0	0	0
18	13.4		9	15	53	169	126	104	89	78	68	60	53
17	13.6		0	0	0	0	0	0	0	0	0	0	0
16	21.8		4	5	15	76	107	88	76	65	55	47	40
15	27.8		6	8	16	73	233	197	171	149	129	112	96
14	34.9		5	7	9	27	116	118	86	70	58	49	42
13	10.3		3	7	35	75	61	52	44	37	31	26	21
12	10.5		0	0	0	0	0	0	0	0	0	0	0
11	17.3		0	1	7	48	38	25	16	11	8	6	4
10	17.5		0	0	0	0	0	0	0	0	0	0	0
9	28		2	2	6	34	127	106	87	71	57	46	37
8	25.7		6	8	20	90	183	115	86	66	51	40	32
7	20.8		4	6	16	82	110	96	86	76	68	60	53
6	21		0	0	0	0	0	0	0	0	0	0	0
5	34.2		1	1	2	10	70	89	82	72	62	52	44
4	30.1		1	1	2	11	66	61	54	47	41	35	30
3	30.4		0	0	0	0	0	0	0	0	0	0	0
2	48.9		2	3	3	5	21	128	152	137	120	104	89
1	64.8		7	8	10	13	18	58	273	293	226	186	156
Sub Area Total			**50**	**72**	**194**	**713**	**1276**	**1237**	**1302**	**1172**	**974**	**823**	**697**

Peak Flow Presentation for Subarea 22

Sub Areas	Travel Time (minutes	Time, (minutes)	Time, minutes: 720	735	750	765	780	795	810	825	840	855	870
		Total Q (cfs)	65	147	444	907	1337	1399	1353	1253	1079	911	771
22	0		0	0	0	0	0	0	0	0	0	0	0
21	6.8		8	42	62	55	49	43	37	32	28	24	20
20	15.2		7	25	137	118	104	92	81	71	62	54	47
19	15.5		0	0	0	0	0	0	0	0	0	0	0
18	28.8		9	14	49	170	127	104	90	78	69	60	53
17	29.1		0	0	0	0	0	0	0	0	0	0	0
16	37.3		3	5	15	73	107	89	76	65	56	47	40
15	43.2		6	8	15	67	234	197	172	150	130	112	96
14	50.3		5	7	9	26	112	120	86	70	59	50	42
13	25.7		2	6	33	75	62	52	44	37	31	26	22
12	26		0	0	0	0	0	0	0	0	0	0	0
11	32.7		0	1	7	47	39	25	17	11	8	6	4
10	33		0	0	0	0	0	0	0	0	0	0	0
9	43.5		2	2	6	31	127	107	88	71	57	46	37
8	41.2		6	8	19	85	186	116	87	67	52	40	32
7	36.3		4	5	16	79	110	97	86	76	68	60	53
6	36.5		0	0	0	0	0	0	0	0	0	0	0
5	49.7		1	1	2	10	68	90	82	72	62	53	45
4	45.6		1	1	2	10	64	61	54	47	41	35	30
3	45.8		0	0	0	0	0	0	0	0	0	0	0
2	64.3		2	3	3	5	20	124	153	137	121	105	90
1	80.3		7	8	10	12	18	56	264	296	227	188	156
Sub Area Total			**63**	**136**	**385**	**863**	**1427**	**1373**	**1417**	**1280**	**1071**	**906**	**767**

Little Sewickley Creek
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10 Yr Storm Sub Areas 31 and 40

Peak Flow Presentation for Subarea 31

Sub Areas	Travel Time (minutes)	Time, (minutes) / Total Q (cfs)	735	750	765	780	795	810	825	840	855	870	885
			Time, minutes										
		Total Q (cfs)	294	686	997	1284	1549	1614	1538	1396	1213	1028	868
31	0		0	0	0	0	0	0	0	0	0	0	0
30	6.6		13	20	18	15	12	10	8	6	5	4	3
29	6.9		0	0	0	0	0	0	0	0	0	0	0
28	18.9		50	205	168	110	84	67	54	43	36	29	24
27	19.3		18	91	95	74	61	51	42	35	29	24	20
26	7.7		30	46	39	35	31	27	24	21	18	16	14
25	7.9		0	0	0	0	0	0	0	0	0	0	0
24	15.9		25	132	103	82	65	53	42	34	27	22	18
23	14.3		17	81	65	54	45	37	31	25	21	17	14
22	14.6		0	0	0	0	0	0	0	0	0	0	0
21	21.5		8	43	62	55	49	43	37	32	28	24	20
20	29.8		7	27	138	118	104	92	81	71	62	54	47
19	30.1		0	0	0	0	0	0	0	0	0	0	0
18	43.5		9	15	52	169	126	104	89	78	68	60	53
17	43.7		0	0	0	0	0	0	0	0	0	0	0
16	51.9		4	5	15	75	107	88	76	65	55	47	40
15	57.9		6	8	16	71	233	197	172	150	130	112	96
14	65		5	7	9	27	115	118	86	70	58	49	42
13	40.4		3	7	34	75	61	52	44	37	31	26	21
12	40.6		0	0	0	0	0	0	0	0	0	0	0
11	47.3		0	1	7	48	39	25	16	11	8	6	4
10	47.6		0	0	0	0	0	0	0	0	0	0	0
9	58.1		2	2	6	34	127	106	88	71	57	46	37
8	55.8		6	8	20	89	184	115	86	66	51	40	32
7	50.9		4	6	16	82	110	96	86	76	68	60	53
6	51.1		0	0	0	0	0	0	0	0	0	0	0
5	64.3		1	1	2	10	70	89	82	72	62	53	44
4	60.2		1	1	2	10	66	61	54	47	41	35	30
3	60.5		0	0	0	0	0	0	0	0	0	0	0
2	79		2	3	3	5	21	127	152	137	120	104	89
1	94.9		7	8	10	12	18	57	271	294	226	187	156
Sub Area Total			218	717	880	1250	1728	1615	1621	1441	1201	1015	857

Peak Flow Presentation for Subarea 40

Sub Areas	Travel Time (minutes)	Time, (minutes)	765	780	795	810	825	840	855	870	885	900	915
		Total Q (cfs)	854	1045	1253	1464	1652	1757	1739	1618	1442	1247	1060
40	0		28	21	17	14	11	10	9	8	7	6	5
39	0.3		0	0	0	0	0	0	0	0	0	0	0
38	9.2		53	40	33	28	24	21	18	16	14	12	11
37	6.7		44	30	23	19	15	13	12	10	9	8	7
36	18.4		172	105	76	58	45	35	28	22	18	15	12
35	30		219	146	115	92	74	60	49	40	33	27	22
34	30.2		0	0	0	0	0	0	0	0	0	0	0
33	36.6		71	85	56	41	31	24	18	14	11	9	7
32	38		98	146	110	92	78	67	58	50	43	37	32
31	38.2		0	0	0	0	0	0	0	0	0	0	0
30	44.8		3	21	19	16	13	11	9	7	6	4	4
29	45.1		0	0	0	0	0	0	0	0	0	0	0
28	57.2		26	98	233	130	96	75	60	49	40	32	27
27	57.6		9	39	113	83	68	56	47	39	32	27	22
26	45.9		9	48	42	37	33	29	26	23	20	17	15
25	46.2		0	0	0	0	0	0	0	0	0	0	0
24	54.2		14	70	124	93	74	60	48	38	31	25	20
23	52.6		9	48	74	60	50	41	34	28	23	19	16
22	52.9		0	0	0	0	0	0	0	0	0	0	0
21	59.7		3	13	66	58	52	46	40	35	30	26	22
20	68.1		6	16	78	129	111	98	87	77	67	58	51
19	68.3		0	0	0	0	0	0	0	0	0	0	0
18	81.7		8	10	27	113	149	116	97	84	74	64	57
17	81.9		0	0	0	0	0	0	0	0	0	0	0
16	90.1		3	4	6	22	119	96	82	70	60	52	44
15	96.1		5	7	10	30	160	216	185	162	140	121	104
14	103.2		5	6	7	13	49	148	98	77	64	54	46
13	78.6		2	3	11	64	68	57	48	41	34	28	24
12	78.9		0	0	0	0	0	0	0	0	0	0	0
11	85.6		0	1	3	22	50	32	21	14	10	7	5
10	85.9		0	0	0	0	0	0	0	0	0	0	0
9	96.4		1	2	3	13	83	117	98	80	64	52	41
8	94.1		5	7	10	35	163	146	101	77	59	46	36
7	89.1		3	4	7	28	119	103	91	81	72	64	56
6	89.4		0	0	0	0	0	0	0	0	0	0	0
5	102.6		1	1	2	4	26	92	87	77	67	57	49
4	98.4		1	1	2	6	35	64	58	51	44	38	33
3	98.7		0	0	0	0	0	0	0	0	0	0	0
2	117.2		2	2	3	4	10	52	161	146	129	113	97
1	133.1		7	8	9	11	14	27	112	352	253	206	172
Sub Area Total			**807**	**982**	**1279**	**1315**	**1820**	**1912**	**1782**	**1768**	**1454**	**1224**	**1037**

Little Sewickley Creek
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Peak Flow Preseantation for Sub Area 40
Time, Minutes

Sub-Area	Travel Time	Time Minutes	765	780	795	810	825	840	855	870	885	900	915
		Total Q	854	1045	1253	1464	1652	1757	1739	1618	1442	1247	1060
1	133.1		7	8	9	11	14	27	112	352	253	206	172
2	117.2		2	2	3	4	10	52	161	146	129	113	97
3	98.7		0	0	0	0	0	0	0	0	0	0	0
Sub Area Total			**9**	**10**	**12**	**15**	**24**	**79**	**273**	**498**	**382**	**319**	**269**
Peak Flow subarea as a % of total peak flow								**4%**					
4	98.4		1	1	2	6	35	64	58	51	44	38	33
5	102.6		1	1	2	4	26	92	87	77	67	57	49
6	89.4		0	0	0	0	0	0	0	0	0	0	0
7	89.1		3	4	7	28	119	103	91	81	72	64	56
8	94.1		5	7	10	35	163	146	101	77	59	46	36
9	96.4		1	2	3	13	83	117	98	80	64	52	41
10	85.9		0	0	0	0	0	0	0	0	0	0	0
11	85.6		0	1	3	22	50	32	21	14	10	7	5
12	78.9		0	0	0	0	0	0	0	0	0	0	0
Sub Area Total			11	16	**27**	108	476	554	456	380	316	264	220
Peak Flow subarea as a % of total peak flow								32%					
13	78.6		2	3	11	64	68	57	48	41	34	28	24
14	103.2		5	6	7	13	49	148	98	77	64	54	46
15	96.1		5	7	10	30	160	216	185	162	140	121	104
16	90.1		3	4	6	22	119	96	82	70	60	52	44
17	81.9		0	0	0	0	0	0	0	0	0	0	0
18	81.7		8	10	27	113	149	116	97	84	74	64	57
19	68.3		0	0	0	0	0	0	0	0	0	0	0
20	68.1		6	16	78	129	111	98	87	77	67	58	51
21	59.7		3	13	66	58	52	46	40	35	30	26	22
22	52.9		0	0	0	0	0	0	0	0	0	0	0
Sub Area Total			**32**	**59**	**205**	**429**	**708**	**777**	**637**	**546**	**469**	**403**	**348**
Peak Flow subarea as a % of total peak flow								**44%**					
23	52.6		9	48	74	60	50	41	34	28	23	19	16
24	54.2		14	70	124	93	74	60	48	38	31	25	20
25	46.2		0	0	0	0	0	0	0	0	0	0	0
26	45.9		9	48	42	37	33	29	26	23	20	17	15
27	57.6		9	39	113	83	68	56	47	39	32	27	22
28	57.2		26	98	233	130	96	75	60	49	40	32	27
29	45.1		0	0	0	0	0	0	0	0	0	0	0
30	44.8		3	21	19	16	13	11	9	7	6	4	4
31	38.2		0	0	0	0	0	0	0	0	0	0	0
Sub Area Total			70	324	605	419	334	272	224	184	152	124	104
Peak Flow subare as a % of total peak flow								15%					
32	38		98	146	110	92	78	67	58	50	43	37	32
33	36.6		71	85	56	41	31	24	18	14	11	9	7
34	30.2		0	0	0	0	0	0	0	0	0	0	0
35	30		219	146	115	92	74	60	49	40	33	27	22
36	18.4		172	105	76	58	45	35	28	22	18	15	12
37	6.7		44	30	23	19	15	13	12	10	9	8	7
38	9.2		53	40	33	28	24	21	18	16	14	12	11
39	0.3		0	0	0	0	0	0	0	0	0	0	0
40	0		28	21	17	14	11	10	9	8	7	6	5
Sub Area Total			**685**	**573**	**430**	**344**	**278**	**230**	**192**	**160**	**135**	**114**	**96**
Peak Flow subare as a % of total peak flow								**13%**					

Little Sewickley Creek
Act 167 Stormwater Management Plan September 2002
Future Development Year 2011
10 Yr Storm

Peak Flow Preseantation for Sub Area 40
Time, Minutes

Sub-Area	Travel Time	Time Minutes	765	780	795	810	825	840	855	870	885	900	915
		Total Q	854	1045	1253	1464	1652	1757	1739	1618	1442	1247	1060
1	133.1		7	8	9	11	14	27	112	352	253	206	172
2	117.2		2	2	3	4	10	52	161	146	129	113	97
3	98.7		0	0	0	0	0	0	0	0	0	0	0
Sub Area Total			**9**	**10**	**12**	**15**	**24**	**79**	**273**	**498**	**382**	**319**	**269**
Peak Flow subarea as a % of total peak flow								**4%**					
4	98.4		1	1	2	6	35	64	58	51	44	38	33
5	102.6		1	1	2	4	26	92	87	77	67	57	49
6	89.4		0	0	0	0	0	0	0	0	0	0	0
7	89.1		3	4	7	28	119	103	91	81	72	64	56
8	94.1		5	7	10	35	163	146	101	77	59	46	36
9	96.4		1	2	3	13	83	117	98	80	64	52	41
10	85.9		0	0	0	0	0	0	0	0	0	0	0
11	85.6		0	1	3	22	50	32	21	14	10	7	5
12	78.9		0	0	0	0	0	0	0	0	0	0	0
Sub Area Total			**11**	**16**	**27**	**108**	**476**	**554**	**456**	**380**	**316**	**264**	**220**
Peak Flow subarea as a % of total peak flow								**32%**					
13	78.6		2	3	11	64	68	57	48	41	34	28	24
14	103.2		5	6	7	13	49	148	98	77	64	54	46
15	96.1		5	7	10	30	160	216	185	162	140	121	104
16	90.1		3	4	6	22	119	96	82	70	60	52	44
17	81.9		0	0	0	0	0	0	0	0	0	0	0
18	81.7		8	10	27	113	149	116	97	84	74	64	57
19	68.3		0	0	0	0	0	0	0	0	0	0	0
20	68.1		6	16	78	129	111	98	87	77	67	58	51
21	59.7		3	13	66	58	52	46	40	35	30	26	22
22	52.9		0	0	0	0	0	0	0	0	0	0	0
Sub Area Total			**32**	**59**	**205**	**429**	**708**	**777**	**637**	**546**	**469**	**403**	**348**
Peak Flow subarea as a % of total peak flow								**44%**					
23	52.6		9	48	74	60	50	41	34	28	23	19	16
24	54.2		14	70	124	93	74	60	48	38	31	25	20
25	46.2		0	0	0	0	0	0	0	0	0	0	0
26	45.9		9	48	42	37	33	29	26	23	20	17	15
27	57.6		9	39	113	83	68	56	47	39	32	27	22
28	57.2		26	98	233	130	96	75	60	49	40	32	27
29	45.1		0	0	0	0	0	0	0	0	0	0	0
30	44.8		3	21	19	16	13	11	9	7	6	4	4
31	38.2		0	0	0	0	0	0	0	0	0	0	0
Sub Area Total			**70**	**324**	**605**	**419**	**334**	**272**	**224**	**184**	**152**	**124**	**104**
Peak Flow subare as a % of total peak flow								**15%**					
32	38		98	146	110	92	78	67	58	50	43	37	32
33	36.6		71	85	56	41	31	24	18	14	11	9	7
34	30.2		0	0	0	0	0	0	0	0	0	0	0
35	30		219	146	115	92	74	60	49	40	33	27	22
36	18.4		172	105	76	58	45	35	28	22	18	15	12
37	6.7		44	30	23	19	15	13	12	10	9	8	7
38	9.2		53	40	33	28	24	21	18	16	14	12	11
39	0.3		0	0	0	0	0	0	0	0	0	0	0
40	0		28	21	17	14	11	10	9	8	7	6	5
Sub Area Total			**685**	**573**	**430**	**344**	**278**	**230**	**192**	**160**	**135**	**114**	**96**
Peak Flow subare as a % of total peak flow								**13%**					

APPENDIX F

MODEL ORDINANCE

MODEL ACT 167 STORMWATER MANAGEMENT ORDINANCE

PLEASE HAVE YOUR SOLICITOR REVIEW THE ENCLOSED ORDINANCE AND CHECK THE APPLICABILITY OF ALL SECTIONS TO YOUR MUNICIPALITY

If you have any questions, please call

Durla Lathia or Lynn Manahan of the DEP Stormwater Planning and Management Section

at (717) 772-4048

LITTLE SEWICKLEY CREEK WATERSHED

STORMWATER MANAGEMENT ORDINANCE

ORDINANCE NO.

ALLEGHENY COUNTY,
PENNSYLVANIA

Adopted at a Public Meeting Held on --/--/200-

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ARTICLE I- GENERAL PROVISIONS

Section 101. Statement of Findings

The governing body of the Municipality finds that:

A Inadequate management of accelerated stormwater runoff resulting from development throughout a watershed increases flood flows and velocities, contributes to erosion and sedimentation, overtaxes the carrying capacity of existing streams and storm sewers, greatly increases the cost of public facilities to convey and manage stormwater, undermines floodplain management and flood reduction efforts in upstream and downstream communities, reduces groundwater recharge, and threatens public health and safety.

B A comprehensive program of stormwater management, including reasonable regulation of development and activities causing accelerated erosion, is fundamental to the public health, safety, welfare, and the protection of the people of the Municipality and all the people of the Commonwealth, their resources, and the environment.

Section 102. Purpose

The purpose of this Ordinance is to promote health, safety, and welfare within the Little Sewickley Creek Watershed by minimizing the damages described in Section 101.A of this Ordinance through provisions designed to:

A Manage accelerated runoff and erosion and sedimentation problems at their source by regulating activities that cause these problems.

B Utilize and preserve the existing natural drainage systems.

C Encourage recharge of groundwater where appropriate and prevent degradation of groundwater quality.

D Maintain existing flows and quality of streams and watercourses in the municipality and the Commonwealth.

E Preserve and restore the flood-carrying capacity of streams.

F Provide proper maintenance of all permanent stormwater management facilities that are constructed in the Municipality.

G Provide performance standards and design criteria for watershed-wide stormwater management and planning.

Section 103. Statutory Authority

The Municipality is empowered to regulate land use activities that affect runoff by the authority of the Act of October 4, 1978 32 P.S., P.L. 864 (Act 167) Section 680.1 et seq., as amended, the "Stormwater Management Act", [and the applicable Municipal Code].

Section 104. Applicability

This Ordinance shall apply to those areas of the Municipality that are located within the Little Sewickley Creek Watershed, as delineated in Appendix D which is hereby adopted as part of this ordinance.

This Ordinance shall only apply to permanent stormwater management facilities constructed as part of any of the Regulated Activities listed in this Section Stormwater management and erosion and sedimentation control during construction activities are specifically not regulated by this Ordinance, but shall continue to be regulated under existing laws and ordinances.

This Ordinance contains only the stormwater management performance standards and design criteria that are necessary or desirable from a watershed-wide perspective. Local stormwater management design criteria (e.g., inlet spacing, inlet type, collection system design and details, outlet structure design, etc.) shall continue to be regulated by the applicable Municipal Ordinances or at the municipal engineer's discretion.

The following activities are defined as "Regulated Activities" and shall be regulated by this Ordinance:

A Land development.
B Subdivision.
C Construction of new or additional impervious or semi-pervious surfaces (driveways, parking lots, etc.).
D Construction of new buildings or additions to existing buildings.
E Diversion or piping of any natural or mar- made stream channel.
F Installation of stormwater management facilities or appurtenances thereto.

Section 105. Repealer

Any ordinance or ordinance provision of the Municipality inconsistent with any of the provisions of this Ordinance is hereby repealed to the extent of the inconsistency only.

Section 106. Severability

Should any section or provision of this Ordinance be declared invalid by a court of competent jurisdiction, such decision shall not affect the validity of any of the remaining provisions of this Ordinance.

Section 107. Compatibility With Other Ordinance Requirements

Approvals issued pursuant to this Ordinance do not relieve the Applicant of the responsibility to secure required permits or approvals for activities regulated by any other applicable code, rule, act, or ordinance.

ARTICLE II-DEFINITIONS

For the purposes of this chapter, certain terms and words used herein shall be interpreted as follows:

A Words used in the present tense include the future tense; the singular number includes the plural, and the plural number includes the singular; words of masculine gender include feminine gender; and words of feminine gender include masculine gender.

B The word "includes" or "including" shall not limit the term to the specific example, but is intended to extend its meaning to all other instances of like kind and character.

C The word "person" includes an individual, firm, association, organization, partnership, trust, company, corporation, or any other similar entity.

D The words "shall" and "must" are mandatory; the words "may" and "should" are permissive.

E The words "used or occupied" include the words "intended, designed, maintained, or arranged to be used, occupied or maintained.

Accelerated Erosion - The removal of the surface of the land through the combined action of man's activity and the natural processes of a rate greater than would occur because of the natural process alone.

Agricultural Activities - The work of producing crops and raising livestock including tillage, plowing, disking, harrowing, pasturing and installation of conservation measures. Construction of new buildings or impervious area is not considered an agricultural activity.

Alteration - As applied to land, a change in topography as a result of the moving of soil and rock from one location or position to another; also the changing of surface conditions by causing the surface to be more or less impervious; land disturbance.

Applicant - A landowner or developer who has filed an application for approval to engage in any Regulated Activities as defined in Section 104 of this Ordinance.

BMP (Best Management Practice) - Stormwater structures, facilities and techniques to control, maintain or improve the quantity and quality of surface runoff.

Channel Erosion - The widening, deepening, and headward cutting of small channels and waterways, due to erosion caused by moderate to large floods.

Cistern - An underground reservoir or tank for storing rainwater.

Conservation District - The Allegheny County Conservation District.

Culvert - A structure with appurtenant works which carries a stream under or through an embankment or fill.

Dam - An artificial barrier, together with its appurtenant works, constructed for the purpose of impounding or storing water or another fluid or semifluid, or a refuse bank, fill or structure for highway, railroad or other purposes which does or may impound water or another fluid or semifluid.

Design Storm - The magnitude and temporal distribution of precipitation from a storm event measured in probability of occurrence (e.g., a 5-year storm) and duration (e.g., 24-hours), used in the design and evaluation of stormwater management systems.

Designee - The agent of the Municipal Planning Commission and/or agent of the governing body involved with the administration, review or enforcement of any provisions of this ordinance by contract or memorandum of understanding.

Detention Basin - An impoundment structure designed to manage stormwater runoff by temporarily storing the runoff and releasing it at a predetermined rate.

Detention District - Those subareas in which some type of detention is required to meet the plan requirements and the goals of Act 167.

Developer - A person, partnership, association, corporation, or other entity, or any responsible person therein or agent thereof, that undertakes any Regulated Activity of this Ordinance.

Development Site - The specific tract of land for which a Regulated Activity is proposed.

Downslope Property Line - That portion of the property line of the lot, tract, or parcels of land being developed located such that all overland or pipe flow from the site would be directed towards it.

Drainage Conveyance Facility - A Stormwater Management Facility designed to transmit stormwater runoff and shall include streams, channels, swales, pipes, conduits, culverts, storm sewers, etc.

Drainage Easement - A right granted by a landowner to a grantee, allowing the use of private land for stormwater management purposes.

Drainage Permit - A permit issued by the Municipal governing body after the drainage plan has been approved. Said permit is issued prior to or with the final Municipal approval.

Drainage Plan - The documentation of the stormwater management system, if any, to be used for a given development site, the contents of which are established in Section 403.

Earth Disturbance - Any activity including, but not limited to, construction, mining, timber harvesting and grubbing which alters, disturbs, and exposes the existing land surface.

Erosion - The movement of soil particles by the action of water, wind, ice, or other natural forces.

Erosion and Sediment Pollution Control Plan - A plan that is designed to minimize accelerated erosion and sedimentation.

Existing Conditions - The initial condition of a project site prior to the proposed construction. If the initial condition of the site is undeveloped land, the land use shall be considered as "meadow" unless the natural land cover is proven to generate lower curve numbers or Rational "C" value, such as forested lands.

Flood - A general but temporary condition of partial or complete inundation of normally dry land areas from the overflow of streams, rivers, and other waters of this Commonwealth.

Floodplain - Any land area susceptible to inundation by water from any natural source or delineated by applicable Department of Housing and Urban Development, Federal Insurance Administration Flood Hazard

Boundary - Mapped as being a special flood hazard area. Also included are areas that comprise Group 13 Soils, as listed in Appendix A of the Pennsylvania Department of Environmental Protection (PaDEP) Technical Manual for Sewage Enforcement Officers (as amended or replaced from time to time by PaDEP).

Floodway - The channel of the watercourse and those portions of the adjoining floodplains, which are reasonably required to carry and discharge the 100-year frequency flood. Unless otherwise specified, the boundary of the floodway is as indicated on maps and flood insurance studies provided by FEMA. In an area where no FEMA maps or studies have defined the boundary of the 100-year frequency floodway, it is assumed - absent evidence to the contrary - that the floodway extends from the stream to 50 feet from the top of the bank of the stream.

Forest Management/Timber Operations - Planning and activities necessary for the management of forest land. These include timber inventory and preparation of forest management plans, silvicultural treatment, cutting budgets, logging road design and construction, timber harvesting, site preparation and reforestation.

Freeboard - A vertical distance between the elevation of the design high-water and the top of a dam, levee, tank, basin, or diversion ridge. The space is required as a safety margin in a pond or basin.

Grade - A slope, usually of a road, channel or natural ground specified in percent and shown on plans as specified herein. (To) Grade - to finish the surface of a roadbed, top of embankment or bottom of excavation.

Grassed Waterway - A natural or constructed waterway, usually broad and shallow, covered with erosion resistant grasses, used to conduct surface water from cropland.

Groundwater Recharge - Replenishment of existing natural underground water supplies.

Impervious Surface - A surface that prevents the percolation of water into the ground.

Impoundment - A retention or detention basin designed to retain stormwater runoff and release it at a controlled rate.

Infiltration Structures - A structure designed to direct runoff into the ground (e.g., french drains, seepage pits, seepage trench).

Inlet - A surface connection to a closed drain. A structure at the diversion end of a conduit. The upstream end of any structure through which water may flow.

Land Development - (i) the inprovement of one lot or two or more contiguous lots, tracts, or parcels of land for any purpose involving (a) a group of two or more buildings, or (b) the division or allocation of land or space between or among two or more existing or prospective occupants by means of, or for the purpose of streets, common areas, leaseholds, condominiums, building groups, or other features; (ii) any subdivision of land; (iii) development in accordance with Section 503(1.1)of the PA Municipalities Planning Code.

Land Earth Disturbance - Any activity involving grading, tilling, digging, or filling of ground or stripping of vegetation or any other activity that causes an alteration to the natural condition of the land.

Main Stem (Main Channel) - Any stream segment or other runoff conveyance facility used as a reach in the Little Sewickley Creek hydrologic model.

Manning Equation in (Manning formula) - A method for calculation of velocity of flow (e.g., feet per second) and flow rate (e.g., cubic feet per second) in open channels based upon channel shape, roughness, depth of flow and slope. "Open channels" may include closed conduits so long as the flow is not under pressure.

Municipality - [municipal name], Allegheny County, Pennsylvania.

Nonpoint Source Pollution - Pollution that enters a watery body from diffuse origins in the watershed and does not result from discernible, confined, or discrete conveyances.

NRCS - Natural Resource Conservation Service (previously SCS).

Open Channel - A drainage element in which stormwater flows with an open surface. Open channels include, but shall not be limited to, natural and mar-made drainage ways, swales, streams, ditches, canals, and pipes flowing partly full.

Outfall - Point where water flows from a conduit, stream, or drain.

Outlet - Points of water disposal from a stream, river, lake, tidewater or artificial drain.

Parking Lot Storage - Involves the use of impervious parking areas as temporary impoundments with controlled release rates during rainstorms.

Peak Discharge - The maximum rate of stormwater runoff from a specific storm event.

Penn State Runoff Model (calibrated) - The computer-based hydrologic modeling technique adapted to the Little Sewickley Creek watershed for the Act 167 Plan. The model has been "calibrated" to reflect actual recorded flow values by adjoining key model input parameters.

Pipe - A culvert, closed conduit, or similar structure (including appurtenances) that conveys stormwater.

Planning Commission - The planning commission of [municipal name].

PMF - Probable Maximum Flood - The flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in any area. The PMF is derived from the probable maximum precipitation (PMP) as determined based on data obtained from the National Oceanographic and Atmospheric Administration (NOAA).

Rational Formula - A rainfall-runoff relation used to estimate peak flow.

Regulated Activities - Actions or proposed actions that have an impact on stormwater runoff and that are specified in Section 104 of this Ordinance.

Release Rate - The percentage of pre-development peak rate of runoff from a site or subarea to which the post development peak rate of runoff must be reduced to protect downstream areas.

Retention Basin - An impoundment in which stormwater is stored and not released during the storm event. Stored water may be released from the basin at some time after the end of the storm.

Return Period - The average interval, in years, within which a storm event of a given magnitude can be expected to recur. For example, the 25-year return period rainfall would be expected to have a 1/25 or 4% chance of occurring every year..

Riser - A vertical pipe extending from the bottom of a pond that is used to control the discharge rate from the pond for a specified design storm.

Rooftop Detention - Temporary ponding and gradual release of stormwater falling directly onto flat roof surfaces by incorporating controlled-flow roof drains into building designs.

Runoff - Any part of precipitation that flows over the land surface.

Sediment Basin - A barrier, dam, retention or detention basin located and designed to retain rock, sand, gravel, silt, or other material transported by water.

Sediment Pollution - The placement, discharge or any other introduction of sediment into the waters of the Commonwealth occurring from the failure to design, construct, implement or maintain control measures and control facilities in accordance with the requirements of this Ordinance.

Sedimentation - The process by which mineral or organic matter is accumulated or deposited by the movement of water.

Seepage Pit/Seepage Trench - An area of excavated earth filled with loose stone or similar coarse material, into which surface water is directed for infiltration into the ground.

Sheet Flow - Runoff that flows over the ground surface as a thin, even layer, not concentrated in a channel.

Soil-Cover Complex Method - A method of runoff computation developed by the NRCS that is based on relating soil type and land use/cover to a runoff parameter called Curve Number (CN).

Soil Group, Hydrologic - A classification of soils by the Natural Resources Conservation Service, formerly the Soil Conservation Service, into four runoff potential groups. The groups range from A soils, which are very permeable and produce little runoff, to D soils, which are not very permeable and produce much more runoff.

Spillway - A depression in the embankment of a pond or basin which is used to pass peak discharge greater than the maximum design storm controlled by the pond.

Storage Indication Method - A reservoir routing procedure based on solution of the continuity equation (inflow minus outflow equals the change in storage) with outflow defined as a function of storage volume and depth.

Storm Frequency - The number of times that a given storm "event" occurs or is exceeded on the average in a stated period of years. See "Return Period".

Storm Sewer - A system of pipes and/or open channels that convey intercepted runoff and stormwater from other sources, but excludes domestic sewage and industrial wastes.

Stormwater - The total amount of precipitation reaching the ground surface.

Stormwater Management Facility - Any structure, natural or mar-made, that, due to its condition, design, or construction, conveys, stores, or otherwise affects stormwater runoff. Typical stormwater management facilities include, but are not limited to, detention and retention basins, open channels, storm sewers, pipes, and infiltration structures.

Stormwater Management Plan - The plan for managing stormwater runoff in the Little Sewickley Creek Watershed adopted by Allegheny County as required by the Act of October 4, 1978, P.L. 864, (Act 167), and known as the "Little Sewickley Creek Watershed Action Act 167 Stormwater Management Plan.

Stormwater Management Site Plan - The plan prepared by the Developer or his representative indicating how stormwater runoff will be managed at the particular site of interest according to this Ordinance.

Stream Enclosure - A bridge, culvert or other structure in excess of 100 feet in length upstream to downstream which encloses a regulated water of this Commonwealth.

Subarea - The smallest drainage unit of a watershed for which stormwater management criteria have been established in the Stormwater Management Plan.

Subdivision - The division or re-division of a lot, tract, or parcel of land by any means into two or more lots, tracts, parcels or other divisions of land including changes in existing lot lines for the purpose, whether immediate or future, of lease, transfer of ownership, or building or lot development: Provided, however, that the subdivision by lease of land for agricultural purposes into parcels of more than ten acres, not involving any new street or easement of access or any residential dwellings, shall be exempt.

Swale - A low lying stretch of land which gathers or carries surface water runoff.

Timber Operations - See Forest Management.

Time-of-Concentration (Tc) - The time for surface runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed. This time is the combined total of overland flow time and flow time in pipes or channels, if any.

Watercourse - A stream of water; river; brook; creek; or a channel or ditch for water, whether natural or manmade.

Waters of the Commonwealth - Any and all rivers, streams, creeks, rivulets, ditches, watercourses, storm sewers, lakes, dammed water, wetlands, ponds, springs, and all other bodies or channels of conveyance of surface and underground water, or parts thereof, whether natural or artificial, within or on the boundaries of this Commonwealth.

Wetland - Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions, including swamps, marshes, bogs, ferns, and similar areas.

ARTICLE III-STORMWATER MANAGEMENT

Section 301. General Requirements

A All regulated activities in Little Sewickley Creek Watershed which do not fall under the exemption criteria shown in Section 402 shall submit a drainage plan consistent with the Little Sewickley Creek Watershed Stormwater Management Plan to the municipality for review. This criteria shall apply to the total proposed development even if development is to take place in stages. Impervious cover shall include, but not be limited to, any roof, parking or driveway areas and any new streets and sidewalks. Any areas designed to initially be gravel or crushed stone shall be assumed to be impervious for the purposes of comparison to the exemption criteria.

B Stormwater drainage systems shall be provided in order to permit unimpeded flow along natural watercourses, except as modified by stormwater management facilities or open channels consistent with this Ordinance.

C The existing points of concentrated drainage that discharge onto adjacent property shall not be altered without permission of the affected property owner(s) and shall be subject to any applicable discharge criteria specified in this Ordinance.

D Areas of existing diffused drainage discharge shall be subject to any applicable discharge criteria in the general direction of existing discharge, whether proposed to be concentrated or maintained as diffused drainage areas, except as otherwise provided by this ordinance. If diffused flow is proposed to be concentrated and discharged onto adjacent property, the Developer must document that adequate downstream conveyance facilities exist to safely transport the concentrated discharge, or otherwise prove that no erosion, sedimentation, flooding or other harm will result from the concentrated discharge.

E Where a development site is traversed by watercourses drainage easements shall be provided conforming to the line of such watercourses. The terms of the easement shall prohibit excavation, the placing of fill or structures, and any alterations that may adversely affect the flow of stormwater within any portion of the easement. Also, maintenance, including mowing of vegetation within the easement shall be required, except as approved by the appropriate governing authority.

F When it can be shown that, due to topographic conditions, natural drainage ways on the site cannot adequately provide for drainage, open channels may be constructed conforming substantially to the line and grade of such natural drainage ways. Work within natural drainage ways shall be subject to approval by PaDEP through the Joint Permit Application process, or, where deemed appropriate by PaDEP, through the General Permit process.

G Any stormwater management facilities regulated by this Ordinance that would be located in or adjacent to waters of the Commonwealth or wetlands shall be subject to approval by PaDEP through the Joint Permit Application process, or, where deemed appropriate by PaDEP, the General Permit process. When there is a question whether wetlands may be involved, it is the responsibility of the Developer or his agent to show that the land in question cannot be classified as wetlands, otherwise approval to work in the area must be obtained from PaDEP.

H Any stormwater management facilities regulated by this Ordinance that would be located on State highway rights-of-way shall be subject to approval by the Pennsylvania Department of Transportation (PaDOT).

I Minimization of impervious surfaces and infiltration of runoff through seepage beds, infiltration trenches, etc. are encouraged, where soil conditions permit, to reduce the size or eliminate the need for detention facilities.

J Roof drains must not be connected to streets, sanitary or storm sewers or roadside ditches to promote overland flow and infiltration/ percolation of stormwater where advantageous to do so. When it is more advantageous to connect directly to streets or storm sewers, then it shall be permitted on a case by case basis by the municipality.

Section 302. Stormwater Management Districts

A Little Sewickley Creek Watershed has been divided into stormwater management districts as shown on the Watershed Map in Appendix D.

In addition to the requirements specified below, the ground water recharge (Section 306), water quality (Section 307), and stream bank erosion (Section 308) requirements shall be implemented.

Section 303. Stormwater Management District Implementation Provisions (Performance Standards)

A General - Post-development rates of runoff from any regulated activity shall meet the peak release rates of runoff prior to development for the design storms specified on the Stormwater Management District Watershed Map (Ordinance Appendix D) and Section 302, of the Ordinance.

B District Boundaries - The boundaries of the Stormwater Management Districts are shown on an official map that is available for inspections at the municipal office. A copy of the official map at a reduced scale is included in the Ordinance Appendix D. The exact location of the Stormwater Management District boundaries as they apply to a given development site shall be determined by mapping the boundaries using the two-foot topographic contours (or most accurate data required) provided as part of the Drainage Plan.

C Sites Located in More Than 1 District - For a proposed development site located within two or more stormwater management district category subareas, the peak discharge rate from any subarea shall be the pre-development peak discharge for that subarea as indicated in Section 302. The calculated peak discharges shall apply regardless of whether the grading plan changes the drainage area by subarea. An exception to the above may be granted if discharges from multiple subareas recombine in proximity to the site. In this case, peak discharge in any direction may be a 100% release rate provided that the overall site discharge meets the weighted average release rate.

D Off-Site Areas - Off-site Areas that drain through a proposed development site are not subject to release rate criteria when determining allowable peak runoff rates. However, on-site drainage facilities shall be designed to safely convey off-site flows through the development site.

E Site Areas - Where the site area to be impacted by a proposed development activity differs significantly from the total site area, only the proposed impact area utilizing stormwater management measures shall be subject to the Management District Criteria. In other words, unimpacted areas bypassing the stormwater management facilities would not be subject to the Management District Criteria.

F "No Harm" Option - For any proposed development site not located in a provisional direct discharge district, the developer has the option of using a less restrictive runoff control (including no detention) if the developer can prove that "no harm" would be caused by discharging at a higher runoff rate than that specified by the Plan. The "no harm" option is used when a developer can prove that the post-development hydrographs can match pre-development hydrographs, or if it can be proved that the post-development conditions will not cause increases in peaks at all points downstream. Proof of "no harm" would have to be shown based upon the following "Downstream Impact Evaluation" which shall include a "downstream hydraulic capacity analysis" consistent with Section 303H to determine if adequate hydraulic capacity exists. The land developer shall submit to the municipality this evaluation of the impacts due to increased downstream stormwater flows in the watershed.

1. The "Downstream Impact Evaluation" shall include hydrologic and hydraulic calculations necessary to determine the impact of hydrograph timing modifications due to the proposed development upon a dam, highway, structure, natural point of restricted streamflow or any stream channel section, established with the concurrence of the municipality.
2. The evaluation shall continue downstream until the increase in flow diminishes due to additional flow from tributaries and/or stream attenuation.

3. The peak flow values to be used for downstream areas for the design return period storms (2, 5, 10, 25, 50, and 100-year) shall be the values from the calibrated model for the Little Sewickley Creek Watershed. These flow values can be obtained from the watershed plan.

4. Developer-proposed runoff controls which would generate increased peak flow rates at storm drainage problem areas would, by definition, be precluded from successful attempts to prove "no-harm", except in conjunction with proposed capacity improvements for the problem areas consistent with Section 303.H.

5. A financial distress shall not constitute grounds for granting a no-harm exemption.

6. Capacity improvements may be provided as necessary to implement the "no harm" option which proposes specific capacity improvements to provide that a less stringent discharge control would not create any harm downstream.

7. Any "no harm" justifications shall be submitted by the developer as part of the Drainage Plan submission per Article IV.

G "Downstream Hydraulic Capacity Analysis" - Any downstream capacity hydraulic analysis conducted in accordance with this Ordinance shall use the following criteria for determining adequacy for accepting increased peak flow rates:

1. Natural or mar-made channels or swales must be able to convey the increased runoff associated with a 2-year return period event within their banks at velocities consistent with protection of the channels from erosion. Acceptable velocities shall be based upon criteria included in the DEP *Erosion and Sediment Pollution Control Program Manual.*

2. Natural or man-made channels or swales must be able to convey increased 25-year return period runoff without creating any hazard to persons or property.

3. Culverts, bridges, storm sewers or any other facilities which must pass or convey flows from the tributary area must be designed in accordance with DEP Chapter 105 regulations (if applicable) and, at minimum, pass the increased 25-year return period runoff.

H Regional Detention Alternatives - For certain areas within the study area, it may be more cost-effective to provide one control facility for more than one development site than to provide an individual control facility for each development site. The initiative and funding for any regional runoff control alternatives are the responsibility of prospective developers. The design of any regional control basins must incorporate reasonable development of the entire upstream watershed. The peak outflow of a regional basin would be determined on a case-by-case basis using the hydrologic model of the watershed consistent with protection of the downstream watershed areas. "Hydrologic model" refers to the calibrated model as developed for the Stormwater Management Plan.

I Hardship Option - The development of the plan and its standards and criteria was designed to maintain existing peak flows throughout the Little Sewickley Creek watershed as the watershed becomes developed. There may be certain instances, however, where the standards and criteria established are too restrictive for a particular landowner or developer. The existing drainage network in some areas may be capable of safely transporting slight increases in flows without causing a problem or increasing flows elsewhere. If a developer or homeowner may not be able to possibly meet the stormwater standards due to lot conditions or if conformance would become a hardship to an owner, the hardship option may be applied. The landowner would have to plead his/her case to the Township Supervisors with the final determination made by the Township. Any landowners pleading the "hardship option" will assume all liabilities that may arise due to exercising this option.

Section 304. Design Criteria for Stormwater Management Facilities

A Any stormwater facility located on State highway rights-of-way shall be subject to approval by the Pennsylvania Department of Transportation (PaDOT).

B Any stormwater management facility (i.e., detention basin) designed to store runoff and requiring a berm or earthen embankment required or regulated by this ordinance shall be designed to provide an emergency spillway to handle flow up to and including the 100year post-development conditions. The height of embankment must be set as to provide a minimum 1.0 foot of freeboard above the maximum pool elevation computed when the facility functions for the 100-year post-development inflow. Should any storm-water management facility require a dam safety permit under PaDEP Chapter 105, the facility shall be designed in accordance with Chapter 105 and meet the regulations of Chapter 105 concerning dam safety which may be required to pass storms larger than 100-year event.

C Any facilities that constitute water obstructions (e.g., culverts, bridges, outfalls, or stream enclosures), and any work involving wetlands as directed in PaDEP Chapter 105 regulations (as amended or replaced from time to time by PaDEP), shall be designed in accordance with Chapter 105 and will require a permit from PaDEP. Any other drainage conveyance facility that does not fall under Chapter 105 regulations must be able to convey, without damage to the drainage structure or roadway, runoff from the 25-year design storm with a minimum 1.0 foot of freeboard measured below the lowest point along the top of the roadway. Any facility that constitutes a dam as defined in PaDEP chapter 105 regulations may require a permit under dam safety regulations. Any facility located within a PaDOT right of way must meet PaDOT minimum design standards and permit submission requirements.

D Any drainage conveyance facility and/or channel that does not fall under Chapter 105 Regulations, must be able to convey, without damage to the drainage structure or roadway, runoff from the 10-year design storm. Conveyance facilities to or exiting from stormwater management facilities (i.e., detention basins) shall be designed to convey the design flow to or from that structure. Roadway crossings located within designated floodplain areas rust be able to convey runoff from a 100-year design storm. Any facility located within a PaDOT right-of-way must meet PaDOT minimum design standards and permit submission requirements.

E Storm sewers must be able to convey post-development runoff from a 10-year design storm without surcharging inlets, where appropriate.

F Adequate erosion protection shall be provided along all open channels, and at all points of discharge.

G The design of all stormwater management facilities shall incorporate sound engineering principles and practices. The Municipality shall reserve the right to disapprove any design that would result in the occupancy or continuation of an adverse hydrologic or hydraulic condition within the watershed.

Section 305. Calculation Methodology

Stormwater runoff from all development sites shall be calculated using either the rational method or a soil-cover-complex methodology.

A Any stormwater runoff calculations shall use generally accepted calculation technique that is based on the NRCS soil cover complex method. Table 305-1 summarizes acceptable computation methods. It is assumed that all methods will be selected by the design professional based on the individual limitations and suitability of each method for a particular site. The Municipality may allow the use of the Rational Method to estimate peak discharges from drainage areas that contain less than 200 acres. The Rational Method is recommended for drainage areas under 100 acres.

B All calculations consistent with this Ordinance using the soil cover complex method shall use the appropriate design rainfall depths for the various return period storms according to the region for which they are located as presented in Table B-1 in Appendix B of this Ordinance. If a hydrologic computer model such as PSRM or HEC-1 is used for stormwater runoff calculations, then the duration of rainfall shall be 24 hours. The SCS `S' curve shown in Figure B-1, Appendix B of this Ordinance shall be used for the rainfall distribution.

C For the purposes of pre-development flow rate determination, undeveloped land shall be considered as "meadow" in good condition, unless the natural ground cover generates a lower curve number or Rational 'C' value (i.e., forest), as listed in Table B-2 or B-3 in Appendix B of this document.

D All calculations using the Rational Method shall use rainfall intensities consistent with appropriate times-of-concentration for overland flow and return periods from the DesignStorm Curves from PA Department of Transportation Design Rainfall Curves (1986) (Figures B-2 to B-4). Times-of-concentration for overland flow shall be calculated using the methodology presented in Chapter 3 of Urban Hydrology for Small Watersheds, NRCS, TR-55 (as amended or replaced from time to time by NRCS). Times-ofconcentration for channel and pipe flow shall be computed using Manning's equation.

E Runoff Curve Numbers (CN) for both existing and proposed conditions to be used in the soil cover complex method shall be obtained from Table B-2 in Appendix B of this Ordinance.

F Runoff coefficients (c) for both existing and proposed conditions for use in the Rational method shall be obtained from Table B-3 in Appendix B of this Ordinance.

G Where uniform flow is anticipated, the Manning equation shall be used for hydraulic computations, and to determine the capacity of open channels, pipes, and storm sewers. Values for Manning's roughness coefficient (n) shall be consistent with Table B-4 in Appendix B of the Ordinance. Outlet structures for stormwater management facilities shall be designed to meet the performance standards of this Ordinance using any generally accepted hydraulic analysis technique or method.

H The design of any stormwater detention facilities intended to meet the performance standards of this Ordinance shall be verified by routing the design storm hydrograph through these facilities using the Storage-Indication Method. For drainage areas greater than 200 acres in size, the design storm hydrograph shall be computed using a calculation method that produces a full hydrograph. The municipality may approve the use of any generally accepted full hydrograph approximation technique that shall use a total runoff volume that is consistent with the volume from a method that produces a full hydrograph.

TABLE 305-1 Acceptable Computation Methodologies For Stormwater Management Plans

METHOD	METHOD DEVELOPED BY	APPLICABILITY
TR-20 (or commercial computer package based on TR-20)	USDA NRCS	Applicable where use of full hydrology computer model is desirable or necessary
TR-55 (or commercial computer package based on TR-55)	USDA NRCS	Applicable for land development plans within limitations described in TR 55.
HEC-1	US Army Corps of Engineers	Applicable where use of full hydrologic computer model is desirable or necessary.
PSRM	Penn State University	Applicable where use of a hydrologic computer model is desirable or necessary; simpler than TR-20 or HEC-1.
Rational Method (or commercial computer package based on Rational Method)	Emil Kuichling	For sites less than 200 acres, or as approved by the Municipality and/or Municipal Engineer
Other Methods	Varies	Other computation methodologies approved by the Municipality and/o Municipal Engineer. r

Section 306. Erosion and Sedimentation Requirements

A Whenever the vegetation and topography are to be disturbed, such activity must be in conformance with Chapter 102, Title 25, Rules and Regulations, Part I, Commonwealth of Pennsylvania, Department of Environmental Protection, Subpart C, protection of natural Resources, Article II, Water Resources, Chapter 102, "Erosion Control," and in accordance with the Allegheny County Conservation District.

B Additional erosion and sedimentation control design standards and criteria that must be or are recommended to be applied where infiltration BMPs are proposed shall include the following:

1. Areas proposed for infiltration BMPs shall be protected from sedimentation and compaction during the construction phase, so as to maintain their maximum infiltration capacity.

2. Infiltration BMPs shall not be constructed nor receive runoff until the entire contributory drainage area to the infiltration BMP has received final stabilization.

Section 307. Ground Water Recharge (Infiltration/Recharge/Retention)

A The ability to retain and maximize the ground water recharge capacity of the area being developed is encouraged. Design of the infiltration/recharge stormwater management facilities shall give consideration to providing ground water recharge to compensate for the reduction in the percolation that occurs when the ground surface is paved and roofed over. These measures are encouraged, particularly in hydrologic soil groups A and B and should be utilized wherever feasible. Soils used for the construction of basins shall have low-erodibility factors ("K" factors).

B Infiltration BMPs shall meet the following minimum requirements:

1. Infiltration BMPs intended to receive runoff from developed areas shall be selected based on suitability of soils and site conditions and shall be constructed on soils that have the following characteristics:

a. A minimum depth of 48 inches between the bottom of the facility and the seasonal high water table and/or bedrock (limiting zones).
b. An infiltration and/or percolation rate sufficient to accept the additional stormwater load and drain completely as determined by field tests conducted by the Owner's professional designer.

2. Infiltration BMPs receiving only roof runoff may be placed in soils having a minimum depth of 24 inches between the bottom of the facility and the limiting zone.

3. The size of the recharge facility shall be based upon the following equation:

Re,, = [(S) (R,,) (A)] / 12

Where:

Re_v = Recharge Volume (acre-feet)

S = Soil specific recharge factor (inches)

R,, = Volumetric runoff coefficient

A = Site area contributing to the recharge facility (acres)

And:

$$Rv = 0.05 + 0.009$$

(1) Where:

I = percent impervious area

And:
shall be obtained based upon hydrologic soil group based upon the table below:

Hydrologic Soil Group	Soil Specific Recharge Factor (S)
A	0.38 inches
B	0.25 inches
C	0.13 inches
D	0.06 inches

If more than one hydrologic soil group (HSG) is present at a site, a composite recharge volume shall be computed based upon the proportion of total site area within each HSG.

4. The recharge volume provided at the site shall be directed to the most permeable HSG available.

5. The recharge facility shall be capable of completely infiltrating the impounded water within 48 hours.

6. The recharge facility shall be capable of completely infiltrating the impounded water within 48 hours.

C A detailed soils evaluation of the project site shall be performed to determine the suitability of recharge facilities. The evaluation shall be performed by a qualified professional, and at a minimum, address soil permeability, depth to bedrock, susceptibility to sinkhole formation, and subgrade stability. The general process for designing the infiltration BMP shall be:

1. Analyze hydrologic soil groups as well as natural and mar-made features within watershed to determine general areas of suitability for infiltration practices.
2. Provide field test to determine appropriate percolation rate and/or hydraulic conductivity
3. Design infiltration structure for required storm volume based on field determined capacity at the level of the proposed infiltration surface.

D Extreme caution shall be exercised where infiltration is proposed in geologically susceptible areas such as strip mine or limestone areas. Extreme caution shall also be exercised where salt or chloride would be a pollutant since soils do little to filter this pollutant and it may contaminate the groundwater. It is also extremely important that the design professional evaluate the possibility of groundwater contamination from the proposed infiltration/recharge facility and recommend a hydro geologic justification study be performed if necessary. Whenever a basin will be located in an area underlain by limestone, a geological evaluation of the proposed location shall be conducted to determine susceptibility to sinkhole formations. The design of all facilities over limestone formations shall include measures to prevent ground water contamination and, where necessary, sinkhole formation. The municipality may require the installation of an impermeable liner in detention basins. A detailed hydro geologic investigation may be required by the municipality. The municipality may require the developer to provide safeguards against groundwater contamination for uses which may cause groundwater contamination, should there be a mishap or spill. It shall be the developers responsibility to verify if the site is underlain by limestone. The following note shall be attached to all drainage plans and signed and sealed by the developers engineer/surveyor/landscape/architect/geologist: certify that the proposed detention basin (circle one) is/is not underlain by limestone.

E E. Where pervious pavement is permitted for parking lots, recreational facilities, nor-dedicated streets, or other areas, pavement construction specifications shall be noted on the plan.

F F. Recharge/infiltration facilities may be used in conjunction with other innovative or traditional BMPs, stormwater control facilities, and nonstructural stormwater management alternatives.

Section 308. Water Quality Requirements

A In addition to the performance standards and design criteria requirements of Article III of this Ordinance, the land developer SHALL comply with the following water quality requirements of this Article unless otherwise exempted by provisions of this Ordinance. For water quality, provisions shall be made such as adding a small orifice at the bottom of the outlet structure so that the post-development 1-year storm takes a minimum of 24 hours to drain from the facility from a point where the maximum volume of water from the 1-year storm is captured. (i.e., the maximum water surface elevation is achieved in the facility. At the same time, the objective is not to attenuate the larger storms. This can be accomplished by configuration of the outlet structure not to control the larger storms, or by a bypass or channel to divert only the 2-year flood into the basin or divert flows in excess of the 2-year storm away from the basin. Release of water can begin at the start of the storm (i.e., the invert of the water quality orifice is at the invert of the facility). The design of the facility shall consider and minimize the chances of clogging and sedimentation potential. Orifices smaller than 3 inches diameter are not recommended. However, if the Design Engineer can provide proof that the smaller orifices are protected from clogging by use of trash racks, etc., smaller orifices may be permitted.

B To accomplish A. above, the land developer MAY submit original and innovative designs to the Municipal Engineer for review and approval. Such designs may achieve the water quality objectives through a combination of BMPs (Best Management Practices).

C In selecting the appropriate BMPs or combinations thereof, the land developer SHALL consider the following:

1. Total contributing area.
2. Permeability and infiltration rate of the site soils.
3. Slope and depth to bedrock.
4. Seasonal high water table.
5. Proximity to building foundations and well heads.
6. Erodibility of soils.
7. Land availability and configuration of the topography.

D The following additional factors SHOULD be considered when evaluating the suitability of BMPs used to control water quality at a given development site:

1. Peak discharge and required volume control.
2. Stream bank erosion.
3. Efficiency of the BMPs to mitigate potential water quality problems.
4. The volume of runoff that will be effectively treated.
5. The nature of the pollutant being removed.
6. Maintenance requirements.
7. Creation/protection of aquatic and wildlife habitat.

8. Recreational value.
9. Enhancement of aesthetic and property value.

Section 309. Stream Bank Erosion Requirements

Applying the water quality criteria in Section 308 above will also help the stream bank erosion problem. Thus, the 1-year post-development storm a minimum of 24 hours would therefore minimize the number of storms causing stream bank erosion. This is the same management criteria that has been recognized to also improve the water quality from stormwater runoff.

ARTICLE IV-DRAINAGE PLAN REQUIREMENTS

Section 401. General Requirements

For any of the activities regulated by this Ordinance, the preliminary or final approval of subdivision and/or land development plans, the issuance of any building or occupancy permit, or the commencement of any land disturbance activity may not proceed until the Property Owner or Developer or his/her agent has received written approval of a Drainage Plan from the Municipality.

Section 402. Exemptions

Any Regulated Activity that meets the exception criteria in the following table is exempt from the provisions of this Ordinance. This criteria shall apply to the total development even if development is to take place in phases. The date of the municipal Ordinance adoption shall be the starting point from which to consider tracts as "parent tracts" in which future subdivisions and respective impervious area computations shall be cumulatively considered. An exemption shall not relieve the applicant from providing adequate stormwater management to meet the purpose of this Ordinance; however, drainage plans will not have to be submitted to the municipality.

Stormwater Management Exemption Criteria

Impervious Area

Total Parcel Size	Exemption (sq.ft.)
≤ 1/4 acre	2,500 sq. ft.
>1/4 to 1 acre	5,000 sq. ft.
>1 to 2 acres	10,000 sq. ft
> 2 to 5 acres	15,000 sq. ft.
>5 acres	20,000 sq. ft.

Exemptions shall be at discretion of Municipal Engineer upon review of site conditions, topography, soils and other factors as desired appropriate.

Section 403. Drainage Plan Contents

The Drainage Plan shall consist of all applicable calculations, maps, and plans. A note on the maps shall refer to the associated computations and erosion and sedimentation control plan by title and date. The cover sheet of the computations and erosion and sedimentation control plan shall refer to the associated maps by title and date. All Drainage Plan materials shall be submitted to the municipality in a format that is clear, concise, legible, neat, and well organized; otherwise, the Drainage Plan shall be disapproved and returned to the Applicant.

The following items shall be included in the Drainage Plan:

A General

1. General description of project.

2. General description of permanent stormwater management techniques, including construction specifications of the materials to be used for stormwater management facilities.

3. Complete hydrologic, hydraulic, and structural computations for all stormwater management facilities.

a. Map(s) of the project area shall be submitted on 24-inch x 36-inch sheets and shall be prepared in a form that meets the requirements for recording at the offices of the Recorder of Deeds of Allegheny County (Lebanon/Lancaster). The contents of the maps(s) shall include, but not be limited to:

4. The location of the project relative to highways, municipalities or other identifiable landmarks.

5. Existing contours at intervals of two feet. In areas of steep slopes (greater than 15 percent), five-feet contour intervals may be used.

6. Existing streams, lakes, ponds, or other bodies of water within the project area.

7. Other physical features including flood hazard boundaries, sinkholes, streams, existing drainage courses, areas of natural vegetation to be preserved, and the total extent of the upstream area draining through the site.

8. The locations of all existing and proposed utilities, sanitary sewers, and water lines within 50 feet of property lines.

9. An overlay showing soil names and boundaries.

10. Proposed changes to the land surface and vegetative cover, including the type and amount of impervious area that would be added.

11. Proposed structures, roads, paved areas, and buildings.

12. Final contours a intervals of two feet. In areas of steep slopes (greater than 15 percent), five-feet contour intervals may be used.

13. The name of the development, the name and address of the owner of the property, and the name of the individual or firm preparing the plan.

14. The date of submission.

15. A graphic and written scale of one (1) inch equals no more than fifty (50) feet; for tracts of twenty (20) acres or more, the scale shall be one (1) inch equals no more than one hundred (100) feet.

16. A North arrow.

17. The total tract boundary and size with distances marked to the nearest foot and bearings to the nearest degree.

18. Existing and proposed land use(s).

19. A key map showing all existing mar-made features beyond the property boundary that would be affected by the project.

20. Horizontal and vertical profiles of all open channels, including hydraulic capacity.

21. Overland drainage paths.

22. A fifteen foot wide access easement around all stormwater management facilities that would provide ingress to and egress from a public right-of-way.

23. A note on the plan indicating the location and responsibility for maintenance of stormwater management facilities that would be located off-site. All off-site facilities shall meet the performance standards and design criteria specified in this Ordinance.

24. A construction detail of any improvements made to sinkholes and the location of all notes to be posted, as specified in this Ordinance.

25. A statement, signed by the landowner, acknowledging the stormwater management system to be a permanent fixture that can be altered or removed only after approval of a revised plan by the municipality.

26. The following signature block for the Municipal Engineer:

27. (Municipal Engineer), on this date (date of signature), have reviewed and hereby certify that the Drainage Plan meets all design standards and criteria of the Little Sewickley Creek Watershed Act 167 Stormwater Management Ordinance."

28. The location of all erosion and sedimentation control facilities.

B Supplemental Information

1. A written description of the following information shall be submitted. The overall stormwater management concept for the project. Stormwater runoff computations as specified in this Ordinance. Stormwater management techniques to be applied both during and after development. Expected project time schedule.
2. A soil erosion and sedimentation control plan, where applicable, including all reviews and approvals, as required by PaDEP.
3. A geologic assessment of the effects of runoff on sinkholes as specified in this Ordinance.
4. The effect of the project (in terms of runoff volumes and peak flows) on adjacent properties adjacent properties and on any existing municipal stormwater collection system that may receive runoff from the project site.
5. A Declaration of Adequacy and Highway Occupancy Permit from the PaDOT District Office when utilization of a PaDOT storm drainage system is proposed.

C Stormwater Management Facilities

1. All stormwater management facilities must be located on a plan and described in detail.
2. When groundwater recharge methods such as seepage pits, beds or trenches are used, the locations of existing and proposed septic tank infiltration areas and wells must be shown.
3. All calculations, assumptions, and criteria used in the design of the stormwater management facilities must be shown.

Section 404. Plan Submission

For all activities regulated by this Ordinance, the steps below shall be followed for submission. For any activities that require a PaDEP Joint Permit Application and regulated under Chapter 105 (Dam Safety and Waterway Management) or Chapter 106 (Floodplain Management) of PaDEP's Rules and Regulations, require a PaDOT Highway Occupancy Permit, or require any other permit under applicable state or federal regulations, the proof of application for said permit(s) shall be part of the plan. The plan shall be coordinated with the state and federal permit process.

A The Drainage Plan shall be submitted by the Developer as part of the Preliminary Plan submission for the Regulated Activity.

B Four (4) copies of the Drainage Plan shall be submitted.

C Distribution of the Drainage Plan will be as follows:

1. Two (2) copies to the Municipality accompanied by the requisite Municipal Review Fee, as specified in this Ordinance.

2. One (1) copy to the Municipal Engineers.

3. One (1) copy to the County Planning Commission/Department.

Section 405. Drainage Plan Review

A. The Municipal Engineer shall review the Drainage Plan for consistency with the adopted Little Sewickley Creek Watershed Act 167 Stormwater Management Plan. The Municipality shall require receipt of a complete plan, as specified in this Ordinance.

B. The Municipal Engineer shall review the Drainage Plan for any submission or land development against the municipal subdivision and land development ordinance provisions not superseded by this Ordinance.

C. For activities regulated by this Ordinance, the Municipal Engineer shall notify the Municipality in writing, within calendar days, whether the Drainage Plan is consistent with the Stormwater Management Plan. Should the Drainage Plan be determined to be consistent with the Stormwater Management Plan, the Municipal Engineer will forward an approval letter to the Developer with a copy to the Municipal Secretary.

D. Should the Drainage Plan be determined to be inconsistent with the Stormwater Management Plan, the Municipal Engineer will forward a disapproval letter to the Developer with a copy to the Municipal Secretary citing the reason(s) for the disapproval. Any disapproved Drainage Plans may be revised by the Developer and resubmitted consistent with this Ordinance.

E. For Regulated Activities specified in Sections 104.C and 104.1) of this Ordinance, the Municipal Engineer shall notify the Municipal Building Permit Officer in writing, within a time frame consistent with the Municipal Building Code and/or Municipal Subdivision Ordinance, whether the Drainage Plan is consistent with the Stormwater Management Plan and forward a copy of the approval/disapproval letter to the Developer. Any disapproved drainage plan may be revised by the Developer and resubmitted consistent with this Ordinance.

F. For Regulated Activities requiring a PaDEP Joint Permit Application, the Municipal Engineer shall notify PaDEP whether the Drainage Plan is consistent with the Stormwater Management Plan and forward a copy of the review letter to the Municipality and the Developer. PaDEP may consider the Municipal Engineer's review comments in determining whether to issue a permit.

G. The Municipality shall not approve any subdivision or land development for Regulated Activities specified in Sections 104 of this Ordinance if the Drainage Plan has been found to be inconsistent with the Stormwater Management Plan, as determined by the Municipal Engineer. All required permits from PaDEP must be obtained prior to approval of any subdivision or land development.

H. The Municipal Building Permit Office shall not issue a building permit for any Regulated Activity specified in Section 104 of this Ordinance if the Drainage Plan has been found to be inconsistent with the Stormwater Management Plan, as determined by the Municipal Engineer, or without considering the comments of the Municipal Engineer. All required permits from PaDEP must be obtained prior to issuance of a building permit.

I. I,____________The Developer shall be responsible for completing record drawings of all stormwater management facilities included in the approved Drainage Plan. The record drawings and an explanation of any discrepancies with the design plans shall be submitted to the Municipal Engineer for final approval. In no case shall the Municipality approve the record drawings until the Municipality receives a copy of an approved Declaration of Adequacy, Highway Occupancy Permit from the PaDOT District Office, and any applicable permits from PaDEP.

J. The Municipality's approval of a Drainage Plan shall be valid for a period not to exceed ( ) years. This____year time period shall commence on the date that the Municipality signs the approved Drainage Plan. If stormwater management facilities included in the approved Drainage plan have not been constructed, or if constructed, and record drawings of these facilities have not been approved within this______year time period, then the Municipality may consider the Drainage plan disapproved and may revoke any and all permits. Drainage Plans that are considered disapproved by the Municipality shall be resubmitted in accordance with Section 407 of this Ordinance.

Section 406. Modification of Plans

A modification to a submitted Drainage Plan for a development site that involves a change in stormwater management facilities or techniques, or that involves the relocation or re-design of stormwater management facilities, or that is necessary because soil or other conditions are not as stated on the Drainage Plan as determined by the Municipal Engineer, shall require a resubmission of the modified Drainage Plan consistent with Section 404 of this Ordinance and be subject to review as specified in Section 405 of this Ordinance.

A modification to an already approved or disapproved Drainage Plan shall be submitted to the Municipality, accompanied by the applicable review fee. A modification to a Drainage Plan for which a formal action has not been taken by the Municipality shall be submitted to the Municipality, accompanied by the applicable Municipality Review Fee.

Section 407. Resubmission of Disapproved Drainage Plans

A disapproved Drainage Plan may be resubmitted, with the revisions addressing the Municipal Engineer's concerns documented in writing addressed, to the Municipal Secretary in accordance with Section 404 of this Ordinance and distributed accordingly and be subject to review as specified in Section 405 of this Ordinance. The applicable Municipality Review Fee must accompany a resubmission of a disapproved Drainage Plan.

ARTICLE V -INSPECTIONS

Section 501. Schedule of Inspections

A. The Municipal Engineer or his municipal assignee shall inspect all phases of the installation of the permanent stormwater management facilities as deemed appropriate by the Municipal Engineer.

B. During any stage of the work, if the Municipal Engineer determines that the permanent stormwater management facilities are not being installed in accordance with the approved Stormwater Management Plan, the Municipality shall revoke any existing permits and issue a cease and desist stop work order until a revised Drainage Plan is submitted and approved, as specified in this Ordinance.

ARTICLE VI-FEES AND EXPENSES

Section 601. General

The fee required by this Ordinance is the Municipal Review Fee. The Municipal Review fee shall be established by the Municipality to defray review costs incurred by the Municipality and the Municipal Engineer. All fees shall be paid by the Applicant.

Section 602. Municipality Drainage Plan Review Fee

The Municipality shall establish a Review Fee Schedule by resolution of the municipal governing body based on the size of the Regulated Activity and based on the Municipality's costs for reviewing Drainage Plans. The Municipality shall periodically update the Review Fee Schedule to ensure that review costs are adequately reimbursed.

Section 603. Expenses Covered by Fees

The fees required by this Ordinance shall at a minimum cover:

A. Administrative Costs.
B. The review of the Drainage Plan by the Municipality and the Municipal Engineer.
C. The site inspections.
D. The inspection of stormwater management facilities and drainage improvements during construction.
E. The final inspection upon completion of the stormwater management facilities and drainage improvements presented in the Drainage Plan.
F. Any additional work required to enforce any permit provisions regulated by this Ordinance, correct violations, and assure proper completion of stipulated remedial actions.

ARTICLE VII-MAINTENANCE RESPONSIBILITIES

Section 701. Performance Guarantee

The applicant should provide a financial guarantee to the Municipality for the timely installation and proper construction of all stormwater management controls as required by the approved stormwater plan and this ordinance equal to the full construction cost of the required controls.

Section 702. Maintenance Responsibilities

A. The Drainage Plan for the development site shall contain an operation and maintenance plan prepared by the developer and approved by the municipal engineer. The operation and maintenance plan shall outline required routine maintenance actions and schedules necessary to insure proper operation of the facility(ies).

B. The Drainage Plan for the development site shall establish responsibilities for the continuing operating and maintenance of all proposed stormwater control facilities, consistent with the following principals:

1. If a development consists of structures or lots which are to be separately owned and in which streets, sewers and other public improvements are to be dedicated to the municipality, stormwater control facilities may also be dedicated to and maintained by the municipality (the municipality is not obligated to accept ownership).

2. If a development site is to be maintained in a single ownership or if sewers and other public improvements are to be privately owned and maintained, then the ownership and maintenance of stormwater control facilities shall be the responsibility of the owner or private management entity.

C. The governing body, upon recommendation of the municipal engineer, shall make the final determination on the continuing maintenance responsibilities prior to final approval of the stormwater management plan. The governing body reserves the right to accept the ownership and operating responsibility for any or all of the stormwater management controls.

Section 703. Maintenance Agreement for Privately Owned Stormwater Facilities

A. Prior to final approval of the site's stormwater management plan, the property owner shall sign and record the maintenance agreement contained in Appendix A which is attached and made part hereof, covering all stormwater control facilities that are to be privately owned.

B. Other items may be included in the agreement where determined necessary to guarantee the satisfactory maintenance of all facilities. The maintenance agreement shall be subject to the review and approval of the municipal solicitor and governing body.

Section 704. Municipal Stormwater Maintenance Fund

A Persons installing stormwater storage facilities shall be required to pay a specified amount to the Municipal Stormwater Maintenance Fund to help defray costs of periodic inspections and maintenance expenses. The amount of the deposit shall be determined as follows:

1. If the storage facility is to be privately owned and maintained, the deposit shall cover the cost of periodic inspections performed by the municipality for a period of ten (10) years, as estimated by the municipal engineer. After that period of time, inspections will be performed at the expense of the municipality.

2. If the storage facility is to be owned and maintained by the municipality, the deposit shall cover the estimated costs for maintenance and inspections for ten (10) years. The municipal engineer will establish the estimated costs utilizing information submitted by the applicant.

3. The amount of the deposit to the fund shall be converted to present worth of the annual series values. The municipal engineer shall determine the present worth equivalents, which shall be subject to the approval of the governing body.

B If a storage facility is proposed that also serves as a recreation facility (e.g., ballfield, lake), the municipality may reduce or waive the amount of the maintenance fund deposit based upon the value of the land for public recreation purpose.

C If at some future time a storage facility (whether publicly or privately owned) is eliminated due to the installation of storm sewers or other storage facility, the unused portion of the maintenance fund deposit will be applied to the cost of abandoning the facility and connecting to the storm sewer system or other facility. Any amount of the deposit remaining after the costs of abandonment are paid will be returned to the depositor.

ARTICLE VIII-ENFORCEMENT AND PENALTIES

Section 801. Right-of-Entry

Upon presentation of proper credentials, duly authorized representatives of the municipality may enter at reasonable times upon any property within the municipality to inspect the condition of the stormwater structures and facilities in regard to any aspect regulated by this Ordinance.

Section 802. Notification

In the event that a person fails to comply with the requirements of this Ordinance, or fails to conform to the requirements of any permit issued hereunder, the municipality shall provide written notification of the violation. Such notification shall set forth the nature of the violation(s) and establish a time limit for correction of these violation(s). Failure to comply within the time specified shall subject such person to the penalty provisions of this Ordinance. All such penalties shall be deemed cumulative and resort by the municipality from pursuing any and all remedies. It shall be the responsibility of the Owner of the real property on which any Regulated Activity is proposed to occur, is occurring, or has occurred, to comply with the terms and conditions of this Ordinance.

Section 803. Enforcement

The municipal governing body is hereby authorized and directed to enforce all of the provisions of this ordinance. All inspections regarding compliance with the drainage plan shall be the responsibility of the municipal engineer or other qualified persons designated by the municipality.

A. A set of design plans approved by the municipality shall be on file at the site throughout the duration of the construction activity. Periodic inspections may be made by the municipality or designee during construction.

B. Adherence to Approved Plan It shall be unlawful for any person, firm or corporation to undertake any regulated activity under Section 104 on any property except as provided for in the approved drainage plan and pursuant to the requirements of this ordinance. It shall be unlawful to alter or remove any control structure required by the drainage plan pursuant to this ordinance or to allow the property to remain in a condition which does not conform to the approved drainage plan.

C. At the completion of the project, and as a prerequisite for the release of the performance guarantee, the owner or his representatives shall:

1. Provide a certification of completion from an engineer, architect, surveyor or other qualified person verifying that all permanent facilities have been constructed according to the plans and specifications and approved revisions thereto.

2. Provide a set of as-built (record) drawings.

D. After receipt of the certification by the municipality, a final inspection shall be conducted by the municipal engineer or designated representative to certify compliance with this ordinance.

E. Prior to revocation or suspension of a permit, the governing body will schedule a hearing to discuss the non-compliance if there is no immediate danger to life, public health or property. The expense of a hearing shall be the owner's responsibility.

F. Suspension and revocation of Permits

1. Any permit issued under this ordinance may be suspended or revoked by the governing body for:

a. Non-compliance with or failure to implement any provision of the permit.

b. A violation of any provision of this ordinance or any other applicable law, ordinance, rule or regulation relating to the project.

c. The creation of any condition or the commission of any act during construction or development which constitutes or creates a hazard or nuisance, pollution or which endangers the life or property of others, or as outlined in Article IX of this ordinance.

2. A suspended permit shall be reinstated by the governing body when:

a. The municipal engineer or his designee has inspected and approved the corrections to the stormwater management and erosion and sediment pollution control measure(s), or the elimination of the hazard or nuisance, and/or;

b. The governing body is satisfied that the violation of the ordinance, law, or rule and regulation has been corrected.

3. A permit that has been revoked by the governing body cannot be reinstated. The applicant may apply for a new permit under the procedures outlined in this Ordinance.

C C Occupancy Permit An occupancy permit shall not be issued unless the certification of completion pursuant to Section 803.C has been secured. The occupancy permit shall be required for each lot owner and/or developer for all subdivisions and land development in the municipality.

Section 804. Public Nuisance

A The violation of any provision of this ordinance is hereby deemed a Public Nuisance.

B Each day that a violation continues shall constitute a separate violation.

Section 805. Penalties

A Anyone violating the provisions of this ordinance shall be guilty of a misdemeanor, and upon conviction shall be subject to a fine of not more than $ for each violation, recoverable with costs, or imprisonment of not more than days, or both. Each day that the violation continues shall be a separate offense.

B In addition, the municipality, through its solicitor may institute injunctive, mandamus or any other appropriate action or proceeding at law or in equity for the enforcement of this Ordinance. Any court of competent jurisdiction shall have the right to issue restraining orders, temporary or permanent injunctions, mandamus or other appropriate forms of remedy or relief.

Section 806. Appeals

A Any person aggrieved by any action of the [Municipality] or its designee may appeal to [the municipality's governing body or Zoning Hearing Board] within thirty (30) days of that action.

B Any person aggrieved by any decision of [the municipality's governing body] may appeal to the County Court of Common Pleas in the County where the activity has taken place within thirty (30) days of the municipal decision.

Ordinance Appendix A

STANDARD STORMWATER FACILITIES MAINTENANCE AND MONITORING AGREEMENT

THIS AGREEMENT, made and entered into this day of , 20, by and

between , (hereinafter the "Landowner"), and

County; Pennsylvania,
(hereinafter "Municipality");

WITNESSETH

WHEREAS, the Landowner is the owner of certain real property as recorded by deed in the land records of County, Pennsylvania, Deed Book at Page , (hereinafter "Property").

WHEREAS, the Landowner is proceeding to build and develop the Property; and

WHEREAS, the Subdivision/Land Management Plan (hereinafter "Plan") for the

Subdivision which is expressly made a part hereof, as approved or to be approved by the Municipality, provides for detention or retention of stormwater within the confines of the Property; and

WHEREAS, the Municipality and the Landowner, his successors and assigns agree that the health, safety, and welfare of the residents of the Municipality require that on-site stormwater management facilities be constructed and maintained on the Property: and

WHEREAS, the Municipality requires, through the implementation of the

Watershed Stormwater Management Plan, that

stormwater management facilities as shown on the Plan be constructed and adequately

maintained by the Landowner, his successors and assigns.

NOW, THEREFORE, in consideration of the foregoing premises, the mutual covenants contained herein, and the following terms and conditions, the parties hereto agree as follows:

1. The on-site stormwater management facilities shall be constructed by the Landowner, his successors and assigns, in accordance with the terms, conditions and specifications identified in the Plan.

2. The Landowner, his successors and assigns, shall maintain the stormwater management facilities in good working condition, acceptable to the Municipality so that they are performing their design functions

3. The Landowner, his successors and assigns, hereby grants permission to the Municipality, his authorized agents and employees, upon presentation of proper identification, to enter upon the Property at reasonable times, and to inspect the stormwater management facilities whenever the Municipality deems necessary. The purpose of the inspection is to assure safe and proper functioning of the facilities. The inspection shall cover the entire facilities, berms, outlet structures, pond areas, access roads, etc. When inspections are conducted, the Municipality shall give the Landowner, his successors and assigns, copies of the inspection report with findings and evaluations. At a minimum, maintenance inspections shall be performed in accordance with the following schedule:

- Annually for the first 5 years after the construction of the stormwater facilities,
- Once every 2 years thereafter, or
- During or immediately upon the cessation of a 100 year or greater precipitation event.

4. All reasonable costs for said inspections shall be born by the Landowner and payable to the Municipality.

5. The owner shall convey to the municipality easements and/or rights-of-way to assure access for periodic inspections by the municipality and maintenance, if required.

6. In the event the Landowner, his successors and assigns, fails to maintain the stormwater management facilities in good working condition acceptable to the Municipality, the Municipality may enter upon the Property and take such necessary and prudent action to maintain said stormwater management facilities and to charge the costs of the maintenance and/or repairs to the Landowner, his successors and assigns. This provision shall not be construed as to allow the Municipality to erect any structure of a permanent nature on the land of the Landowner, outside of any easement belonging to the Municipality. It is expressly understood and agreed that the Municipality is under no obligation to maintain or repair said facilities, and in no event shall this Agreement be construed to impose any such obligation on the Municipality.

7. The Landowner, his successors and assigns, will perform maintenance in accordance with the maintenance schedule for the stormwater management facilities including sediment removal as outlined on the approved schedule and/or Subdivision/Land Management Plan.

8. In the event the Municipality, pursuant to this Agreement, performs work of any nature, or expends any funds in performance of said work for labor, use of equipment, supplies, materials, and the like on account of the Landowner's or his successors' and assigns' failure to perform such work, the Landowner, his successors and assigns, shall reimburse the Municipality upon demand, within 30 days of receipt of invoice thereof, for all costs incurred by the Municipality hereunder. If not paid within said 30-day period, the Municipality may enter a lien against the property in the amount of such costs, or may proceed to recover his costs through proceedings in equity or at law as authorized under the provisions of the Code.

9. The Landowner, his successors and assigns, shall indemnify the Municipality and his agents and employees against any and all damages, accidents, casualties, occurrences or claims which might arise or be asserted against the Municipality for the construction, presence, existence or maintenance of the stormwater management facilities by the Landowner, his successors and assigns.

10. In the event a claim is asserted against the Municipality, his agents or employees, the Municipality shall promptly notify the Landowner, his successors and assigns, and they shall defend, at their own expense, any suit based on such claim. If any judgment or claims against the Municipality, his agents or employees shall be allowed, the Landowner, his successors and assigns shall pay all costs and expenses in connection therewith.

11. In the advent of an emergency or the occurrence of special or unusual circumstances or situations, the Municipality may enter the Property, if the Landowner is not immediately available, without

notification or identification, to inspect and perform necessary maintenance and repairs, if needed, when the health, safety or welfare of the citizens is at jeopardy. However, the Municipality shall notify the landowner of any inspection, maintenance, or repair undertaken within 5 days of the activity. The Landowner shall reimburse the Municipality for his costs.

This Agreement shall be recorded among the land records of

County, Pennsylvania and shall constitute a covenant running with the Property and/or equitable servitude, and shall be binding on the Landowner, his administrators, executors, assigns, heirs and any other successors in interests, in perpetuity.

ATTEST:

WITNESS the following signatures and seals:

(SEAL) For the Municipality:

(SEAL) For the Landowner:

ATTEST:

(City, Borough, Township)

County of , Pennsylvania

I, , a Notary Public in and for the County and State

aforesaid, whose commission expires on the day of , 20, do hereby

certify that whose name(s) is/are signed to the

foregoing Agreement bearing date of the day of - 20, has acknowledged the same before me in my said County and State.

GIVEN UNDER MY HAND THIS day of , 20.

NOTARY PUBLIC

(SEAL)

ORDINANCE APPENDIX B - STORMWATER MANAGEMENT DESIGN CRITERIA

TABLE B-1 DESIGN STORM RAINFALL AMOUNT (INCHES) Source: "Field Manual of Pennsylvania Department of Transportation" STORM INTENSITY-DURATION-FREQUENCY CHARTS PDT- IDF" May 1986.

TABLE B-2 DESIGN STORM RAINFALL AMOUNT (INCHES/HOUR): The United States Department of Agriculture Technical Release 5 (TR-55) "URBAN HYDROLOGY FOR SMALL WATERSHEDS"

FIGURE B-1 SCS RAINFALL DISTRIBUTION - S CURVE Source: NRCS (SCS) TR-55

FIGURE B-2 PENNDOT STORM INTENSITY-DURATION-FREQUENCY CURVE REGION 4 Source: "Field Manual of Pennsylvania Department of Transportation" STORM INTENSITY-DURATION-FREQUENCY CHARTS PDT- IDF" May 1986.

TABLE B-3 RUNOFF CURVE NUMBERS Source: NRCS (SCS) TR-55

TABLE B-4 RATIONAL RUNOFF COEFFICIENTS Source : New Jersey Department of Transportation (NJ DOT)

TABLE B-5 MANNING ROUGHNESS COEFFICIENTS

TABLE B-1 Design Storm Rainfall Amount (Inches/Hr)

The design storm rainfall amount chosen for design should be obtained from the PADOT region for which the site is located according to Figure B-2.

Source: "Field Manual of Pennsylvania Department of Transportation" STORM INTENSITY-DURATION-FREQUENCY CHARTS CURVES FOR REGION 1" September 2001.

Design Storm Frequency	24-Hr Rainfall Intensity (Inches/Hr) Region 1
1-Year	3.7
2-Year	4.1
5-Year	4.6
10-Year	5.0
25-Year	5.5
50-Year	6.1
100-Year	7.1

TABLE B-2 Design Storm Rainfall Amount (Inches)

SCS Type II, 24-hour storm for storm water volumes.

Source: The United States Department of Agriculture Technical Release 5 (TR-55) "URBAN HYDROLOGY FOR SMALL WATERSHEDS" Synthetic Rainfall Distribution and Rainfall Maps for the Continental USA.

Storm event	24-Hr Rainfall Intensity (Inches)
2-Year	2.6
10-Year	3.8
25-Year	4.4
100-Year	5.0

FIGURE B-1 NRCS (SCS) TYPE II RAINFALL DISTRIBUTION

Figure B-1 SCS 24-hour rainfall distributions

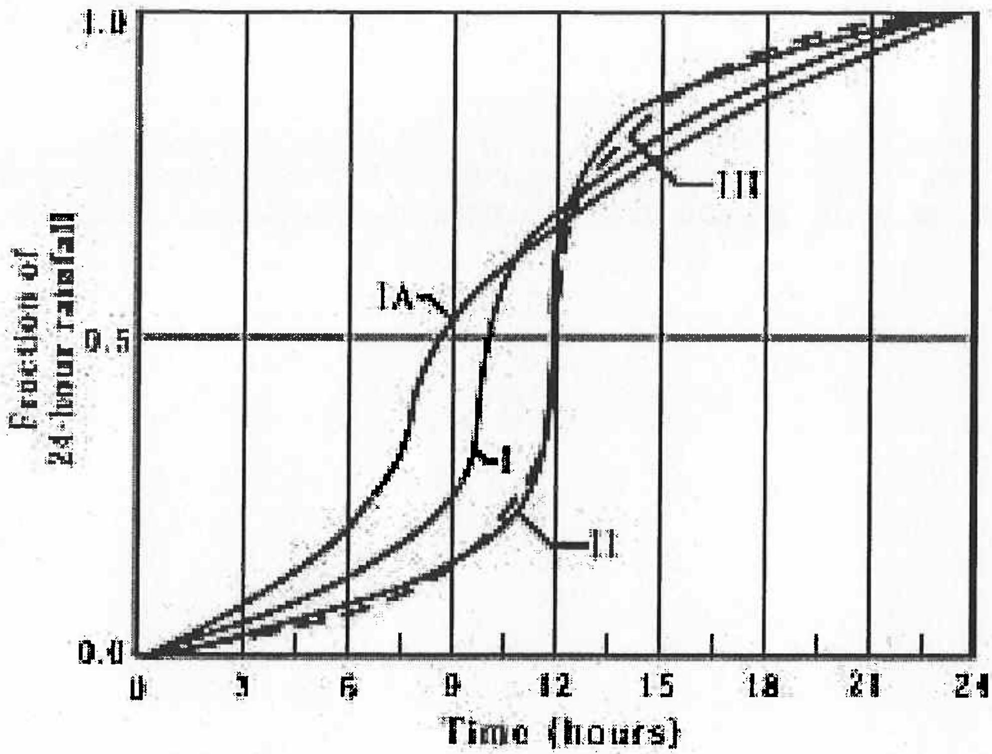

FIGURE B-2 Region 4 Frequency Curve

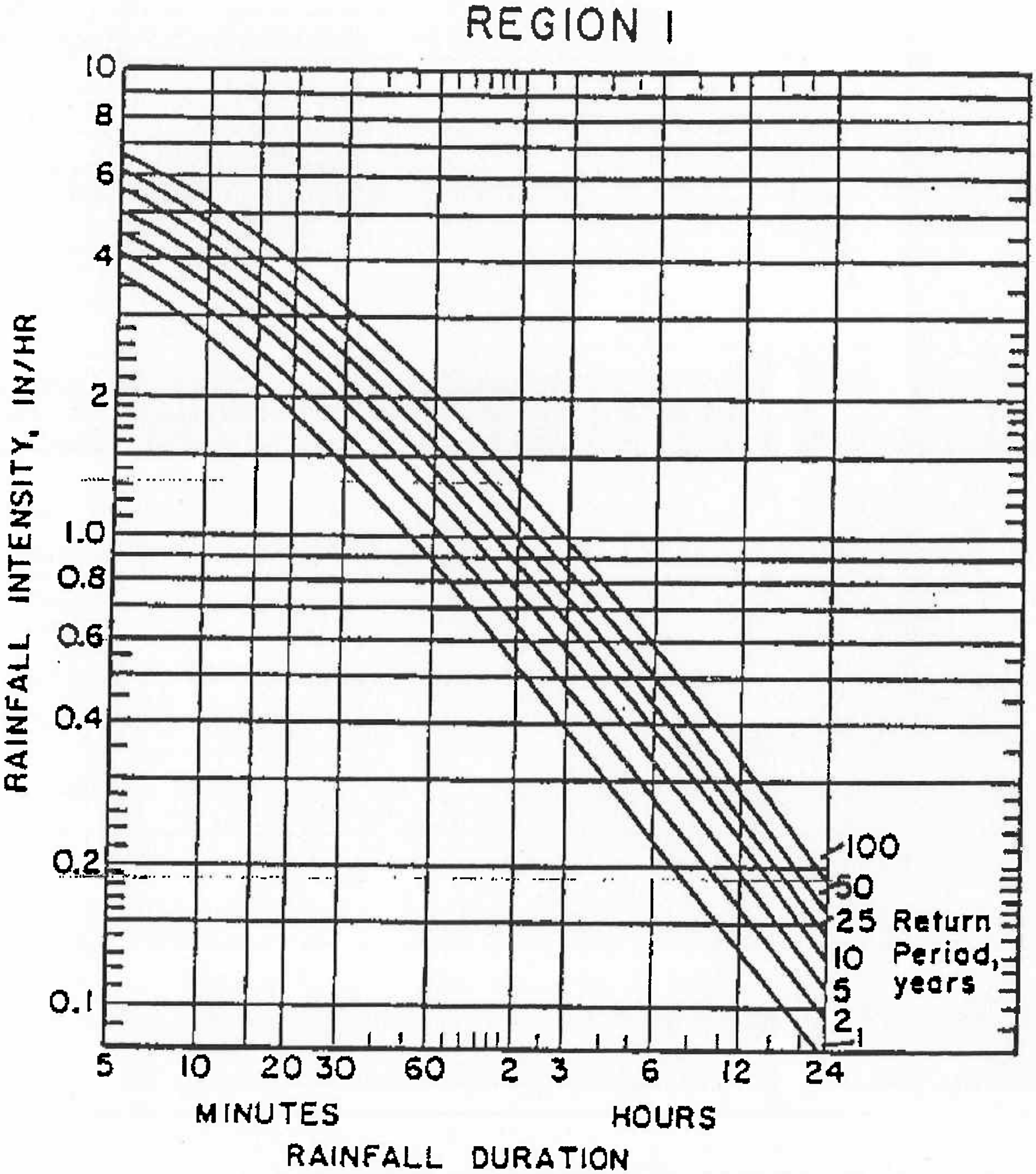

TABLE B-3 Runoff Curve Numbers (CN) (From NRCS (SCS) TR-55)

	HYDROLOGIC	SOIL GROUP		
LAND USE DESCRIPTION	A	B	C	D
Open Space	44	65	77	82
Orchard	44	65	77	82
Meadow	30**	58	71	78
Agricultural	59	71	79	83
Forest	36**	60	73	79
Commercial (85% Impervious)	89	92	94	95
Industrial (72% Impervious)	81	88	91	93
Institutional (50% Impervious)	71	82	88	90
Residential				
Average Lot Size % impervious				
1/8 acre or less* 65	77	85	90	92
1/8 - 1/3 acre 34	59	74	82	87
1/3 - 1 acre 23	53	69	80	85
1 - 4 acres 12	46	66	78	82
Farmstead	59	74	82	86
Smooth Surfaces (Concrete, Asphalt, Compacted Gravel or Bare Compacted Soil)	98	98	98	98
Loose Gravel	76	85	89	91
Water	98	98	98	98
Mining/Newly Graded Areas (Pervious Areas Only)	77	86	91	94

* Includes Multi Family Housing unless justified lower density can be provided. ** Caution - CN values under 40 may produce erroneous modeling results.

Note: Existing site conditions of bare earth or fallow ground shall be considered as meadow T choosing a CN value.

TABLE B-4 RATIONAL RUNOFF COEFFICIENTS (AMC II)

	HYDROLOGIC SOIL GROUP			
LAND USE DESCRIPTION	A	B	C	D
Cultivated Land : without conservation treatment	.49	.67	.81	.88
with conservation treatment	.27	.43	.61	.67
Pasture or range land : poor condition	.38	.63	.78	.84
good conditions	---*	.25	.51	.65
Meadow : good conditions	---*	---*	.44	.61
Wood or Forest Land : thin stand, poor cover, no mulch	---*	.34	.59	.70
good cover	---*	---*	.45	.59
Open Spaces, lawns, parks, golf courses, cemeteries				
Good conditions : grass cover on 75% or more of the area	---*	.25	.51	.65
Fair conditions : grass cover on 50% to 75% of the area	---*	.45	.63	.74
Commercial and business areas (85% impervious)	.84	.90	.93	.96
Industrial districts (72% impervious)	.67	.81	.88	.92
Residential				
Average lot size Average % Impervious				
1/8 acre or less 65	.59	.76	.86	.90
1/4 acre 38	.25	.49	.67	.78
1/3 acre 30	---*	.49	.67	.78
1/2 acre 25	---*	.45	.65	.76
1 acre 20	---*	.41	.63	.74
Paved parking lots, roofs, driveways, etc.	.99	.99	.99	.99
Streets and roads				
Paved with curbs and storm sewers	.99	.99	.99	.99
Gravel	.57	.76	.84	.88
Dirt	.49	.69	.80	.84

Notes : Values are based on S.C.S. definitions and are average values.

* Values indicated by "---" should be determined by the design engineer based on site characteristics.

Source : New Jersey Department of Transportation, Technical Manual for Stream Encroachment, August, 1984

TABLE B-4 MANNING ROUGHNESS COEFFICIENTS

Roughness Coefficients (Manning's "n") For Overland / Sheet Flow (From U.S. Army Corps of Engineers & NRCS TR-55)

Surface Description	n
Dense Growth	0.4 – 0.5
Pasture	0.3 - 0.4
Lawns	0.2 - 0.3
Bluegrass Sod	0.2 - 0.5
Short Grass Prarie	0.1 - 0.2
Sparse Vegetation	0.05 - 0.13
Bare Clay - Loam Soil (eroded)	0.01 - 0.03
Concrete/Asphalt -	
(less than 1/4 inch)	0.10 - 0.15
- small depths	
(1/4 inch to several inches)	0.05 - 0.10
Fallow (no residue)	0.05
Cultivated Soils	
Residue Cover Less Than or = 20%	0.06
Residue Cover Greater Than 20%	0.17
Grass	
Dense Grasses	0.24
Bermuda Grass	0.41
Range (natural)	0.13
Woods (Light Underbrush)	0.40

Roughness Coefficients (Manning's "n") For Channel Flow

Reach Description	_n
Natural stream, clean, straight, no rifts or pools	0.03
Natural stream, clean, winding, some pools or shoals	0.04
Natural stream, winding, pools, shoals, stony with some weeds	0.05
Natural stream, sluggish deep pools and weeds	0.07
Natural stream or swale, very weedy or with timber underbrush	0.10
Concrete pipe, culvert or channel	0.012
Corrugated metal pipe	0.012-0.027*

*depending upon type, coating and diameter

ORDINANCE APPENDIX CSAMPLE DRAINAGE PLAN APPLICATION AND FEE SCHEDULE

(To be attached to the "land subdivision plan or development plan review application or "minor land subdivision plan review application")

Application is hereby made for review of the Stormwater Management and Erosion and Sedimentation Control Plan and related data as submitted herewith in accordance with the Township Stormwater Management and Earth Disturbance Ordinance.

Plan

Final Plan Preliminary Plan Sketch

Date of Submission Submission No.

1. Name of subdivision or development

2. Name of applicant Telephone No.

(if corporation, list the corporation's name and the names of two officers of the corporation) Officer 1 Officer 2

Address Zip

Applicants interest in subdivision or development

(if other than property owner give owners name and address)

3. Name of property owner Telephone No.

Address Zip

4. Name of engineer or surveyor Telephone No.

Address Zip

5. Type of subdivision or development proposed:

Lot)

Single-Family Lots	Townhouses	Commercial (Multi
Two Family Lots	Garden Apartments	Commercial (One-Lot)
Multi Family Lots	Mobile-Home Park	Industrial (Multi Lot)
Cluster Type Lots	Campground	Industrial (One-Lot)
Planned Residential Development	Other (	)

6. Lineal feet of new road proposed? L.F.

7. Area of proposed and existing impervious area on entire tract.

   a. a. Existing (to remain) S.F. % of Property

   b. b. Proposed S.F. % of Property

8. Stormwater

   a. Does the peak rate of runoff from proposed conditions exceed that flow which occurred for pre-development conditions for the designated design storm?

   b. Design storm utilized (on-site conveyance systems) (24 hr.) No of Subarea___________ Watershed Name Explain:

   c. Does the submission and/or district meet the release rate criteria for the applicable subarea?

   d. Number of subarea(s) from Ordinance Appendix D of the Little Sewickley Creek Watershed Stormwater Management Plan.

   e. Type of proposed runoff control

   f. Does the proposed stormwater control criteria meet the requirement/guidelines of the Stormwater Ordinances? If not, what variances/waivers are requested? Reasons

   g. Does the plan meet the requirements of Article III of the Stormwater Ordinances? If not, what variances/waivers are requested? Reasons Why

   h. Was TR-55, June 1986 utilized in determining the time of concentration?

   i. What hydrologic method was used in the stormwater computations?

   j. Is a hydraulic routing through the stormwater control structure submitted?

   k. Is a construction schedule or staging attached?

   l. Is a recommended maintenance program attached?

9. Erosion and Sediment Pollution Control (E&S):

   a. Has the stormwater management and E&S plan, supporting documentation and narrative been submitted to the county conservation District?

   b. Total area of earth disturbance_______________________-S.F.

10. Wetlands

    a. Have the wetlands been delineated by someone trained in wetland delineation?

    b. Have the wetland lines been verified by a state or federal permitting authority?

    c. Have the wetland lines been surveyed?

    d. Total acreage of wetland within the property

    e. Total acreage of wetland disturbed

    f. Supporting documentation

11. Filing

    a. Has the required fee been submitted?

    b. Amount ______________________

    c. Has the proposed schedule of construction inspection to be performed by the applicant's engineer been submitted?

d. Name of individual who will be making the inspections

e. General comments about stormwater management at development

CERTIFICATE OF OWNERSHIP AND ACKNOWLEDGMENT OF APPLICATION:

COMMONWEALTH OF PENNSYLVANIA COUNTY OF SS

On this the day of , 20_, before me, the undersigned officer,

personally appeared who being duly sworn, according to law, deposes

and says that owners of the property described in this application and that the application was made with knowledge and/or direction and does hereby agree with the said application and to the submission of the same.

Property Owner

My Commission Expires 20 Notary Public

THE UNDERSIGNED HEREBY CERTIFIES THAT TO THE BEST OF HIS KNOWLEDGE AND BELIEF THE INFORMATION AND STATEMENTS GIVEN ABOVE ARE TRUE AND CORRECT.

SIGNATURE OF APPLICANT

(Information Below This Line To Be Completed By The Municipality) Township/Borough/City

official submission receipt: Date complete application received Plan Number

Fees date fees paid received by Official

submission receipt date

Received by

Township/Borough/City

Drainage Plan Proposed Schedule Of Fees

Subdivision name Submittal No.

Owner Date

Engineer.

1. Filing fee $

2. Land use

2a. Subdivision, campgrounds, mobile home parks, and family dwelling where the units are located in the same local watershed. $ multi

2b. Multi family dwelling where the designated open is located in a different local watershed from the proposed units. $ space

2c. Commercial/industrial. $

3. Relative amount of earth disturbance 3a. Residential road <5001.f. $

road 500-2,6401.f. $

road >2,6401.f. $ 3b.
Commercial/industrial and other impervious area <3,500 s.f. $

Impervious area 3,500-43,460 s.f. $

impervious area >43,560 s.f. $ 4. Relative size of project

4a. Total tract area <1 ac $ 1-5 ac
$ 5-25 ac

25-100 ac $

100-200 ac $

>200 ac $

5. Stormwater control measures

5a. Detention basins & other controls which a review of hydraulic routings ($ per control). $ require

Total

5b. Other control facilities which require volume calculations but no hydraulic routings. ($ per control) $ storage

6. Site inspection ($ per inspection) $

All subsequent reviews shall be 1/4 the amount of the initial review fee unless a new application is required as per Section 406 of the stormwater ordinance. A new fee shall be submitted with each revision in accordance with this schedule.

APPENDIX D - STORMWATER MANAGEMENT DISTRICT WATERSHED MAP

Pennsylvania Department of Environmental Protection

Rachel Carson State Office Building
P.O. Box 8555
Harrisburg, PA 17105-8555
May 31, 1996

717-783-7577

Bureau of Land and Water Conservation

Mr. Bud Schubel
Allegheny County
Department of Economic Development
400 Fort Pitt Commons
445 Fort Pitt Boulevard
Pittsburgh, PA 15219

RE: DEP File SWMP 165:02
Little Sewickley Creek Storm Water Plan

Dear Mr. Schubel:

Thank you for meeting on May 28, 1996 to go over our comments on the Flaugherty Run Watershed Plan and to review the status of the Little Sewickley Watershed Plan. This letter is to confirm what we agreed to during our meeting relative to the Little Sewickley Watershed Plan.

- Dave French, speaking on behalf of Rob Arnold and L. Robert Kimball Associates, agreed, within 60 days, to make the changes to the plan reflecting the Department's November 15, 1993 comments (copy enclosed). It was my understanding that the disk provided by Dave French included not only the PSRM computer model runs, but also an updated plan text incorporating our comments. A review of the disk shows no changes from the 1992 version. We believe the plan text needs revamped and the modeling runs thoroughly reviewed.

- We agreed that the County would need to conduct a public hearing for readoption after completion of the changes. We would recommend that the municipalities be contacted to determine if they adopted ordinances in conformance with the original plan. They need to know that revisions to the plan may require them to update their ordinances.

- Dave French promised that L. Robert Kimball would be doing the work free to the County and no invoices will be submitted to the Department.

We should plan on meeting at least one more time to review the changes with Dave French and Rob Arnold. Please make sure that this work is accomplished within the proposed time frame.

Please call me if you have any questions.

Sincerely,

David B. Jostenski, P.E.
Senior Civil Engineer Hydraulic
Division of Storm Water Management
and Sediment Control

Enclosure

Rachel Carson State Office Building
P.O. Box 8555
Harrisburg, PA 17105-8555
May 31, 1996

717-783-7577

Bureau of Land and Water Conservation

JUN 1996

Mr. Bud Schubel
Allegheny County
Department of Economic Development
400 Fort Pitt Commons
445 Fort Pitt Boulevard
Pittsburgh, PA 15219

RE: DEP File SWMP 165:02
Little Sewickley Creek Storm Water Plan

Dear Mr. Schubel:

Thank you for meeting on May 28, 1996 to go over our comments on the Flaugherty Run Watershed Plan and to review the status of the Little Sewickley Watershed Plan. This letter is to confirm what we agreed to during our meeting relative to the Little Sewickley Watershed Plan.

- Dave French, speaking on behalf of Rob Arnold and L. Robert Kimball Associates, agreed, within 60 days, to make the changes to the plan reflecting the Department's November 15, 1993 comments (copy enclosed). It was my understanding that the disk provided by Dave French included not only the PSRM computer model runs, but also an updated plan text incorporating our comments. A review of the disk shows no changes from the 1992 version. We believe the plan text needs revamped and the modeling runs thoroughly reviewed.

- We agreed that the County would need to conduct a public hearing for readoption after completion of the changes. We would recommend that the municipalities be contacted to determine if they adopted ordinances in conformance with the original plan. They need to know that revisions to the plan may require them to update their ordinances.

- Dave French promised that L. Robert Kimball would be doing the work free to the County and no invoices will be submitted to the Department.

We should plan on meeting at least one more time to review the changes with Dave French and Rob Arnold. Please make sure that this work is accomplished within the proposed time frame.

Please call me if you have any questions.

Sincerely,

David B. Jostenski, P.E.
Senior Civil Engineer Hydraulic
Division of Storm Water Management
and Sediment Control

Enclosure
bcc: Lynn Heckman, Dept. of Economic Development
Dave French, L. Robert Kimball Assoc. ✓
Lathia
Jostenski
File
30-day

P.O. Box 8555
Harrisburg, PA 17105-8555
November 15, 1993

717-783-7577

Bureau of Land and Water Conservation

Mr. David French
Allegheny County Planning Department
441 Smithfield Street
Pittsburgh, PA 15222-2219

RE: DER File No. SWMP 165:02
Little Sewickley Creek Watershed Plan

Dear Mr. French:

This is in response to your request of October 6, 1993 for the Department to review and approve the referenced stormwater management plan.

We have reviewed the adopted plan and have noticed several deficiencies. The document lacks information as required by the Storm Water Management Act and the Grant Agreement with the Department and shows inconsistencies within the text. Following are some of the deficiencies we have noted:

Page	Comment
Preface	A location map at the beginning of the plan is essential for quick reference.
1	2nd paragraph- the project of the plan preparation not to just compile information to prepare the plan. Ordinances provisions are for the implementation of technical standards to address future runoff from land development and <u>not</u> to reflect current conditions and technology. We are unable to comprehend what is the purpose of these statement and cannot understand the meaning.
3	Section 1.3- This section appears to be "priority of actions" and should be under Chapter 6.
4	Section 2.0- Describes collection of data, but we could not find any plates for this data as required by the Grant Agreement such as base map, floodplain areas, location of significant obstructions and/or problem areas, soils, existing and future land use and municipal ordinance review matrix. Also, summaries of the municipal questionnaires is needed.
	Section 2.1- we could not locate Figure 1.
5	Plan says development will take place in watershed. We could not locate map showing future land use conditions.

Last Paragraph is confusing: ". . . a large percentage of the developable area in the watershed has already been developed . . ."

6 Section 2.2- Second paragraph states obstruction data was difficult to coordinate because DER permit files do not have precise locations. This conflicts with page 12, 1st paragraph which describes that the primary purpose of field investigations was to obtain obstruction data. Field investigations should have included a drive through the watershed to locate and measure obstructions. Section 5(2) and Task 5 of the Grant Agreement require the collection of all significant obstructions and their capacities. No further studies, as suggested by the plan, is required.

We saw no identification of existing problem areas and proposed solutions as required by Section 5(b)(5) of the Act and Task 5 of the Grant Agreement.

Third paragraph- why does the plan recommend repair or maintenance work at this point in the plan? This should be under Chapter 6 dealing with implementation.

Section 2.3- Floodplain limits are to be provided on a Plate.

Section 2.4- Are there any stormwater collection systems? Section 5(b)(9) and Task 5 of the Grant Agreement require identification and analysis of these systems as well as identification of proposed collection systems. If there are any existing systems, were they analyzed in the modeling efforts for their effect on runoff? Explain.

What is meant that procedures for collection system design along with release rate percentages will continue under the requirements of the plan? The purpose of the plan is to provide design requirements for such systems. What do release rates have to do with collection systems? We are not sure if the plan preparer has understood theories supporting the concept.

7 The plan identified available stream flow and quality data. Where is the data in the plan?

8 This plan should discuss what data it has or does not have and not mention other plans.

Second paragraph- what are "relative" runoff rates?

What is meant by "providing a basis for future modeling and development evaluations"? The model is to be used to determine performance standards for stormwater control and how and where the standards would vary.

It is inappropriately stated that PSRM model is best applied to steeply sloped areas.

Evaluations of proposed new development is not applicable since there will be no need for municipalities or county to run PSRM for developers. The model information was input into program at a subarea basis and therefore would not be applicable for below-subarea sized developments.

9 Section 3.2- again, Figure 1 missing.

Section 3.3- This information should go into the technical backup volume retained by the County rather than located within the plan.

11 Section 3.4- It is unclear what the consultant was doing relative to use of rain gage data and Rainfall/ Duration/ Frequency information. First, it is said that rainfall data used in the plan was from gages "due to the general lack of design storm data developed specifically for this area". In the next paragraph, we read that the PDT-IDF charts were used as they provide a "consistent base" of information. Contradiction? If PDT-IDF charts were used, then why were X and Y coordinates used to input rainfall gage information into PSRM as shown on Table 3.1?

Last paragraph mentions the Little Sewickley Creek Update. This is a new plan, not an update.

12 Previous comments were made on obstruction. Why weren't the obstructions identified and measured during field investigations?

Second paragraph states that the PSRM out of bank time of travel values were changed to simulate channel storage which it really does not do. It merely provides a way for out of bank flow to be lagged, with realistic velocities, to the next node for combining with the in-bank flow hydrograph. No storage is provided.

Fourth paragraph mentions a Table 3.2. It is missing in the Plan.

Section 3 6, second paragraph stated the release rate percentage is intended to "mitigate the damaging effects of runoff . . .". How could this be? The release rates are intended to prevent additional problems due to hydrograph timing changes of detention basin or to keep the status quo, but <u>not</u> to mitigate, or make runoff conditions better.

The plan should include an explanation of the release rate concept with diagrams.

This section lacks any analysis of future land use conditions for the proper determination of standards.

13 Obstructions were chosen as point of interest. We are not sure how this was done without a complete obstruction survey or capacity analysis as described on p. 6.

Third paragraph says the release rate procedure allows for "innovative project designs" while controlling increased runoff to the "requirements of the model". What does this mean? Innovation of project designs have nothing to do with the performance standards including release rate criteria for detention basins.

We would like to evaluate the consultant's determination of release rates prior to approval of the plan.

15 Section 4.3 requires the rainfall depths specified in Table 4.2 to be used for all runoff calculations in the watershed. Are <u>all</u> storms recommended? That would require design for 5 return periods with 3 durations each return period for a total of 15 storms! It may not be practical to design a basin outlet for 15 storms.

If the 2, 5, 10, 50 and 100 year storms are being specified, then why are release rates shown in Table 4.1 for the periods 2-25? This table is unclear as to what storms are to be used.

16 Section 4.4 says discharges are listed in Table 3.1. No discharges are shown in Table 3.1.

Delete or rewrite Section 4.5.1. It is not clear what is intended to be said.

The second paragraph under Section 4.5 says the recommended procedures to be used for projects of any size are ones that develop hydrographs. This conflicts with the next paragraph that says the Rational Method (does not produce hydrographs) is allowable for projects under 20 acres.

Section 4.5.2 lists control criteria. We don't know what the consultant is recommending nor can we figure out what the true standards are. At one point the plan requires design for the 2, 5, 10, 25, 50 and 100 for post back to pre peak levels, then it requires application of release rates finally, it recommends picking three storms out of six to design a facility.

18 The plan does not provide assessment of alternative runoff control techniques and their efficiency in the watershed as required by Section 5(b)(7) of the Act.

Section 4.6.2 provides an exemption for farming operations. It should be made clear that construction of new buildings on a farm and creation of impervious surfaces are not exempt.

Section 4.6.3. It incorrectly says that the DER and County "must assure that any erosion and stormwater control facilities consistent with the approved watershed plan". It is not DER's or the County's, but the municipalities' responsibility to adopt ordinances consistent with the plan and provide drainage plan reviews to assure regulated activities are done in accordance with the ordinances and the plan. It is a developer's responsibility to comply with the local ordinances and the plan.

Section 4.7 change "The plan must be prepared . . ." to "The plan should be prepared . . .".

19 Sections 4.7.1 and 4.7.2 should be in the model ordinance not in the plan.

21 Last sentence- Table number is missing.

22 The first paragraph is confusing- the Tt's from the model are not relevant to a specific development site.

In second paragraph, what is reasoning and justification for accepting discharge values if they are within 20% of some other value? What are the "comparison" values?

The third paragraph is again confusing since it asks to compute the post development discharges which was to be already accomplished under the second paragraph.

Last paragraph- is County going to continuously update the watershed model?

23 It would be more appropriate if Section 5.2 is moved to beginning of document.

Last paragraph- we note that DER was not given the opportunity to review the draft plan.

25 Typo under 6.1- "The following paragraphs do the tasks . . ."

Last paragraph- does County have the capability and available staff/time to maintain and update the model? We see no reason for this.

Administrative Information - No reason for this in the plan. It should be retained as backup information by the County. A tabulation of problems should be used.

PSRM Output - this does not have to be part of plan. It should be retained in a technical volume by County. Why were 6 hour storms utilized rather than 24 hour durations? See our previous comments on the modeling.

Model Ordinance - this was intended to be a model stand alone ordinance rather than provisions for a subdivision/land development ordinance. This ordinance should be completely rewritten due to the number of necessary revisions. Following are a few of our comments:

Sect. 101.B What are the activities covered by the ordinance? List the activities such as construction of impervious surfaces, land developments, subdivisions, etc.

Sect. 101.D Part of any section cannot be "unconstitutional" only invalid.

Sect. 102.C Why is "Turtle Creek" mentioned?

Sect. 102C.5 We are not sure how the user of this ordinance would understand the procedure under "No Harm" especially items 3 and 5.

Sect. 103.A Where are the descriptions of the runoff control techniques?

DER Chapter 105 requirements for Dam Safety and Encroachments are not mentioned anywhere.

Sect. 103.C.2 Typo- " with damaging . . ." Missing parenthesis.

Sect. 103.C.4 Caution should be given to use of wetlands for detention facilities due to environmental impacts. We suggest deleting this reference.

Sect. 105.A.1 Typo- " . . . site shall contain an operation . . ."

Attached Plate This plate provides no useful information as is. We recommend the following:

1. The watershed boundary and subareas be superimposed over a screened USGS topographic map which will provide landmarks and topography to anyone using the plan or plate for location of development sites in subareas.

2. Change title by deleting 2nd and 3rd line and inserting a description of what the plate represents.

3. Provide a legend identifying what circled numbers represent and include release rates for each subarea in tabular form.

The plan, as prepared, cannot be approved by the Department. It is unfortunate that the plan was completed, a public hearing held and the plan adopted by the Commissioners without providing the Department with an opportunity to review and comment on the draft. As such, we insist that Allegheny County correct the deficiencies at no additional cost to the Department. Please contact me within two weeks of receipt of this letter to arrange for a meeting with you and your consultant to discuss the arrangements for revision to the plan.

Thank you for your cooperation. Please call me at 717-783-7577 to schedule a meeting.

Sincerely,

Durla N. Lathia
Chief
Storm Water Management Section
Division of Storm Water Management
and Sediment Control
Bureau of Land and Water Conservation

bcc: Rob Arnold, URS Consultants
Lathia
File
30-Day

DJ:fms

PENNSYLVANIA
DER

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES

Post Office Box 8555
Harrisburg, Pennsylvania 17105-8555
October 29, 1993

Bureau of Land and Water Conservation

Mr. David French
Allegheny County Planning Department
441 Smithfield Street
Pittsburgh, PA 15222-2219

Re: DER File No. SWMP 165:02
Little Sewickley Creek Watershed Plan

Dear Mr. French:

The Department acknowledges receiving the following submission from Allegheny County regarding the subject matter.

1. A transmittal letter from the ACPD on behalf of the County requesting DER review and approval of the Plan.

2. Four copies of the Plan.

3. A copy of the "Official Request for Board Action" in lieu of the resolution by the Board of Commissioners officially adopting the Plan.

Please submit the following additional information to complete your submission:

1. A copy of the public hearing notice (newspaper article) showing the date and place of the public hearing on the Plan.

2. Minutes of the Public Hearing.

3. A copy of the municipal, public comments on the Plan and response of the County to address those concerns.

Thank you for your cooperation. If you have any questions, please call me at 717-783-7577.

Sincerely,

Durla N. Lathia

Durla N. Lathia, Chief
Storm Water Management Section
Division of Storm Water Management
and Sediment Control

Original Data from PSRM data entry

2yr6hr.dat

NHL	NA	NRES	NRG	NNRG	NPRT	NOBS	NPFP	NWG	EXW	IPCS
4	40	0	1	0	2	0	2	2	2.0	75

LITTLE SEWICKLEY CREEK WATERSHED
STORMWATER MANAGEMENT PLAN
NOVEMBER 1991
2-YEAR 6-HOUR STORM

TR	PRI	DT	DTR	TRI
720.0	12.0	1.20	12.0	1080.0

STDN1	STDN2	STCN1	STCN2	STDIA	STDS1	STDS2	STCTS	CBF
0.040	0.200	98.0	75.0	0.100	0.060	0.000	2.00	0.0010

Rain Gage Data	ID	NPT	STR	XRG	YRG	Raingage Name
1		24	0.0	0.00	0.00	PDT

```
0  0  0    0  0
0  0  0    0  0
0  0  0.25 0  0
0  0  0    0  0
0  0  0  . 0
```

Subareas for Hydrograph Output
26 40
Subareas for Peak Flow Presentation
26 40

Subarea ID	Area	Length	Slope	Imp.Fr.	X-Coord	Y-Coord
1	584.00	1825.0	0.210	0.03	13.20	8.30
2	415.00	1755.0	0.220	0.03	13.00	6.20
3	0.10	50.0	0.220	0.03	12.30	7.40
4	165.00	1350.0	0.280	0.03	11.70	7.70
5	229.00	1425.0	0.210	0.02	11.70	9.60
6	0.10	50.0	0.220	0.03	11.20	8.30
7	351.00	1500.0	0.240	0.03	10.40	9.20
8	218.00	935.0	0.200	0.03	8.50	9.50
9	211.00	1200.0	0.270	0.02	9.50	9.70
10	0.10	50.0	0.220	0.02	9.20	8.20
11	50.00	860.0	0.320	0.01	9.40	7.90
12	0.10	50.0	0.220	0.02	9.80	7.60
13	122.00	2050.0	0.260	0.04	9.50	7.20
14	215.00	1970.0	0.160	0.05	10.40	2.60
15	575.00	1300.0	0.200	0.04	10.40	4.10
16	253.00	965.0	0.210	0.02	11.30	6.00
17	0.10	50.0	0.220	0.03	10.40	5.30
18	342.00	2450.0	0.280	0.04	9.70	5.80
19	0.10	50.0	0.220	0.03	9.10	6.60
20	346.00	2500.0	0.300	0.03	8.20	6.70
21	170.00	1370.0	0.320	0.04	7.90	4.90
22	0.10	50.0	0.220	0.04	7.20	5.80
23	129.00	650.0	0.320	0.05	6.30	5.70
24	193.00	1000.0	0.360	0.02	7.20	7.40
25	0.10	50.0	0.220	0.02	6.30	6.30
26	143.00	2000.0	0.270	0.02	5.90	6.60

27	187.00	1350.0	0.180	0.08	4.70	8.30
28	233.00	1650.0	0.170	0.11	6.60	8.20
29	0.10	50.0	0.220	0.09	5.40	7.50
30	41.00	950.0	0.230	0.03	5.50	7.20
31	0.10	50.0	0.220	0.06	5.20	6.80
32	303.00	2950.0	0.170	0.09	4.20	7.00
33	106.00	900.0	0.170	0.11	3.60	6.30
34	0.10	50.0	0.220	0.10	4.50	5.70
35	282.00	2050.0	0.200	0.07	5.30	5.20
36	207.00	1800.0	0.170	0.19	4.00	4.70
37	67.00	800.0	0.050	0.48	3.20	4.30
38	121.00	1200.0	0.170	0.21	2.90	5.80
39	0.10	50.0	0.220	0.30	2.90	4.20
40	21.00	300.0	0.010	0.04	2.80	3.80

Parameters	n1	n2	CN1	CN2	IA	DEP1	DEP2	CTS
1	-1.000	0.100	-1.0	72.0	-1.0	-1.00	-1.00	-1.00
2	-1.000	0.080	-1.0	74.0	-1.0	-1.00	-1.00	-1.00
3	-1.000	0.090	-1.0	72.0	-1.0	-1.00	-1.00	-1.00
4	-1.000	0.090	-1.0	70.0	-1.0	-1.00	-1.00	-1.00
5	-1.000	0.100	-1.0	71.0	-1.0	-1.00	-1.00	-1.00
6	-1.000	0.090	-1.0	71.0	-1.0	-1.00	-1.00	-1.00
7	-1.000	0.090	-1.0	71.0	-1.0	-1.00	-1.00	-1.00
8	-1.000	0.100	-1.0	72.0	-1.0	-1.00	-1.00	-1.00
9	-1.000	0.100	-1.0	72.0	-1.0	-1.00	-1.00	-1.00
10	-1.000	0.090	-1.0	71.0	-1.0	-1.00	-1.00	-1.00
11	-1.000	0.100	-1.0	71.0	-1.0	-1.00	-1.00	-1.00
12	-1.000	0.090	-1.0	71.0	-1.0	-1.00	-1.00	-1.00
13	-1.000	0.090	-1.0	70.0	-1.0	-1.00	-1.00	-1.00
14	-1.000	0.070	-1.0	79.0	-1.0	-1.00	-1.00	-1.00
15	-1.000	0.070	-1.0	76.0	-1.0	-1.00	-1.00	-1.00
16	-1.000	0.080	-1.0	74.0	-1.0	-1.00	-1.00	-1.00
17	-1.000	0.090	-1.0	72.0	-1.0	-1.00	-1.00	-1.00
18	-1.000	0.090	-1.0	70.0	-1.0	-1.00	-1.00	-1.00
19	-1.000	0.090	-1.0	70.0	-1.0	-1.00	-1.00	-1.00
20	-1.000	0.090	-1.0	69.0	-1.0	-1.00	-1.00	-1.00
21	-1.000	0.090	-1.0	70.0	-1.0	-1.00	-1.00	-1.00
22	-1.000	0.090	-1.0	70.0	-1.0	-1.00	-1.00	-1.00
23	-1.000	0.100	-1.0	68.0	-1.0	-1.00	-1.00	-1.00
24	-1.000	0.100	-1.0	72.0	-1.0	-1.00	-1.00	-1.00
25	-1.000	0.090	-1.0	70.0	-1.0	-1.00	-1.00	-1.00
26	-1.000	0.100	-1.0	68.0	-1.0	-1.00	-1.00	-1.00
27	-1.000	0.080	-1.0	72.0	-1.0	-1.00	-1.00	-1.00
28	-1.000	0.080	-1.0	73.0	-1.0	-1.00	-1.00	-1.00
29	-1.000	0.090	-1.0	71.0	-1.0	-1.00	-1.00	-1.00
30	-1.000	0.090	-1.0	70.0	-1.0	-1.00	-1.00	-1.00
31	-1.000	0.090	-1.0	70.0	-1.0	-1.00	-1.00	-1.00
32	-1.000	0.080	-1.0	71.0	-1.0	-1.00	-1.00	-1.00
33	-1.000	0.080	-1.0	72.0	-1.0	-1.00	-1.00	-1.00

34	-1.000	0.090	-1.0	71.0	-1.0	-1.00	-1.00	-1.00
35	-1.000	0.080	-1.0	71.0	-1.0	-1.00	-1.00	-1.00
36	-1.000	0.080	-1.0	71.0	-1.0	-1.00	-1.00	-1.00
37	-1.000	0.040	-1.0	82.0	-1.0	-1.00	-1.00	-1.00
38	-1.000	0.080	-1.0	73.0	-1.0	-1.00	-1.00	-1.00
39	-1.000	0.090	-1.0	71.0	-1.0	-1.00	-1.00	-1.00
40	-1.000	0.100	-1.0	70.0	-1.0	-1.00	-1.00	-1.00

DRAINAGE ELEM. DATA	KP	CAP	PT	NAP(1)	NAP(2)	NAP(3)
1	0	90.0	0.2	0	0	0
2	0	90.0	0.2	0	0	0
3	2	175.0	11.9	1	2	0
4	1	200.0	0.2	3	0	0
5	0	35.0	0.2	0	0	0
6	2	230.0	14.9	4	5	0
7	1	275.0	0.2	6	0	0
8	0	55.0	0.2	0	0	0
9	0	50.0	0.2	0	0	0
10	2	90.0	6.0	8	9	0
11	1	100.0	0.2	10	0	0
12	2	350.0	14.4	7	11	0
13	1	355.0	0.2	12	0	0
14	0	75.0	17.7	0	0	0
15	1	215.0	0.2	14	0	0
16	0	80.0	0.2	0	0	0
17	2	285.0	13.3	15	16	0
18	1	325.0	0.2	17	0	0
19	2	615.0	17.6	13	18	0
20	1	630.0	0.2	19	0	0
21	0	50.0	0.2	0	0	0
22	2	645.0	8.5	20	21	0
23	1	635.0	0.2	22	0	0
24	0	50.0	0.2	0	0	0
25	2	650.0	8.8	23	24	0
26	1	655.0	0.2	25	0	0
27	0	60.0	0.2	0	0	0
28	0	80.0	0.2	0	0	0
29	2	135.0	6.6	27	28	0
30	1	130.0	0.2	29	0	0
31	2	695.0	7.0	26	30	0
32	1	700.0	0.2	31	0	0
33	0	50.0	0.2	0	0	0
34	2	705.0	8.1	32	33	0
35	1	720.0	11.7	34	0	0
36	1	730.0	3.8	35	0	0
37	1	725.0	0.2	36	0	0
38	0	75.0	0.2	0	0	0
39	2	730.0	4.6	37	38	0
40	1	9999.0	0.0	39	0	0

End of Input
□