

TOWNSHIP OF WASHINGTON
COUNTY OF NORTHAMPTON
COMMONWEALTH OF PENNSYLVANIA

ORDINANCE NO. 191

AN ORDINANCE OF THE TOWNSHIP OF WASHINGTON, COUNTY OF NORTHAMPTON AND COMMONWEALTH OF PENNSYLVANIA TO COMPLY WITH ACT 167 - STORM WATER MANAGEMENT FOR THE MARTINS/JACOBY CREEKS WATERSHED AND DELAWARE RIVER SUB-BASIN 1.

BE IT ORDAINED AND ENACTED, AND IT IS HEREBY ORDAINED AND ENACTED by the Board of Supervisors of Washington Township, Northampton County, Pennsylvania, as follows:

SECTION 101. STATEMENT OF FINDINGS

The governing body of the municipality finds that:

- A. Inadequate management of accelerated runoff of storm water resulting from development throughout a watershed increases flood flows and velocities, contributes to erosion and sedimentation, overtaxes the carrying capacity of streams and storm sewers, greatly increases the cost of public facilities to carry and control storm water, undermines floodplain management and flood control efforts in downstream communities, reduces groundwater recharge, and threatens public health and safety.
- B. A comprehensive program of storm water management, including reasonable regulation of development and activities causing accelerated erosion, is fundamental to the public health, safety and 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 the public health, safety and welfare within the Martins/Jacoby Creeks Study area by minimizing the damages described in Section 101.A of this Ordinance by provisions designed to:

- A. Control accelerated runoff and erosion and sedimentation problems at their source by regulating activities which cause such problems.
- B. Utilize and preserve the desirable existing natural drainage systems.
- C. Encourage recharge of groundwaters where appropriate.
- D. Maintain the existing flows and quality of streams and water courses in the municipality and the Commonwealth.
- E. Preserve and restore the flood carrying capacity of streams.
- F. Provide for proper maintenance of all permanent storm water management structures which are constructed in the municipality.

SECTION 103. STATUTORY AUTHORITY

The municipality is empowered to regulate these activities by the authority of the Act of October 4, 1978, P.L. 8864 (Act 167), as amended, the "Storm Water Management Act" and the Pennsylvania Second Class Township Code.

SECTION 104. APPLICABILITY

This Ordinance shall only apply to those areas of the municipality which are located within the Martins/Jacoby Creeks Study Area as delineated on an official map available for inspection at the municipal office. A map of the Martins/Jacoby Creeks Study Area at a reduced scale is included in Appendix A for general reference.

This Ordinance shall only apply to permanent storm water management facilities constructed as part of any of the activities listed in this section. Storm water management and erosion and sedimentation control during construction involved with any of these activities are specifically not required by this Ordinance, but shall continue to be regulated under existing laws and ordinances.

This Ordinance contains only those storm water runoff control criteria and standards which are necessary or desirable from a total watershed perspective. Additional storm water management design criteria (i.e. inlet spacing, inlet type, collection system details, etc.) which represent sound engineering practice may be regulated either by separate storm water ordinance provisions or as part of the general responsibilities of the municipal engineer.

The following activities are defined as Regulated Activities and shall be regulated by this Ordinance, except those which meet the waiver specifications presented thereafter.

- A. Land development.
- B. Subdivision.
- C. Construction of new or additional impervious surfaces (driveways, parking lots, etc.).
- D. Construction of new buildings or additions to existing buildings.
- E. Diversion or piping of any natural or man-made stream channel.
- F. Installation of storm water systems or appurtenances thereto.

Any proposed Regulated Activity, except those defined in Section 104.E. and 104.F., which would create 10,000 square feet or less of additional impervious cover would be exempt from meeting the provisions of this Ordinance. Development plans qualifying for this waiver would still be regulated by Section 13 of the Pennsylvania Storm Water Management Act and other municipal ordinance provisions, as applicable. For development taking place in stages, the entire development plan must be used in determining conformance with this criteria. Additional impervious cover shall include, but not be limited to, any roof, parking or driveway areas and any new streets and sidewalks constructed as part of or for the proposed regulated activity. Any areas which may be designed to initially be semi-pervious (e.g. gravel, crushed stone, porous pavement, etc.) shall be considered impervious areas for the purpose of waiver evaluation. No waiver shall be provided for Regulated Activities as defined in Sections 104.E. and 104.F.

SECTION 105. REPEALER

Any ordinance 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**

Cistern - An underground reservoir or tank for storing rainwater.

Conservation District - The Northampton County Conservation District.

Culvert - A pipe, conduit or similar structure including appurtenant works which carries surface water.

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 semi-fluid.

DEP - The Pennsylvania Department of Environmental Protection (formerly the Pennsylvania Department of Environmental Resources)

Design Storm - The magnitude of precipitation from a storm event measured in probability of occurrence (e.g., 50-yr. Storm) and duration (e.g. 24-hour), and used in computing storm water management control systems.

Detention Basin - A basin designed to retard storm water runoff by temporarily storing the runoff and releasing it at a predetermined rate.

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.

Drainage Easement - A right granted by a land owner to a grantee, allowing the use of private land for storm water management purposes.

Drainage Plan - The documentation of the proposed storm water management controls, if any, to be used for a given development site, the contents of which are established in Section 403.

Erosion - The removal of soil particles by the action of water, wind, ice or other geological agents.

Freeboard - The incremental depth in a storm water management structure, provided as a safety factor of design, above that required to convey the design runoff event.

Groundwater Recharge - Replenishment of existing natural underground water supplies.

Impervious Surface - A surface which prevents the percolation of water into the ground.

Infiltration Structure - A structure designed to direct runoff into the ground; e.g. french drain, seepage pit or seepage trench.

Land Development - (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) 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) a subdivision of land.

"Local" Runoff Conveyance Facilities - Any natural channel or manmade conveyance system which has the purpose of transporting runoff from the site to the mainstream.

Mainstem (Main Channel) - Any stream segment or other conveyance in a Dual Release Rate or Conditional No Detention I subarea used as a reach in the Martins/Jacoby Creeks Study Area hydrologic model. In Conditional No Detention II subareas, the main channel is the Delaware River.

Manning Equation (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.

Martins/Jacoby Creeks Study Area - The area comprised of the Martins/Jacoby Creeks Watershed and Delaware River Sub-basin 1 (Mud Run, Oughoughton, Allegheny Creek, Slateford Creek, 5 unnamed creeks and 31 direct drainage subareas). See map in Appendix A.

Municipality - Washington Township, Northampton County, Pennsylvania.

NPDES Regulations - National Pollutant Discharge Elimination System Regulations.

NRCS - Natural Resource Conservation Service - U.S. Department of Agriculture (Formerly the Soil Conservation Service.)

Peak Discharge - The maximum rate of flow of stream runoff at a given location and time resulting from a specified storm event.

Penn State Runoff Model (calibrated) - The computer-based hydrologic modeling technique adapted to the Martins/Jacoby Creeks Study Area for the Act 167 Plan. The model has been "calibrated" to reflect actual flow values by adjusting key model input parameters.

Rational Method - A method of peak runoff calculation using a standardized runoff coefficient (rational 'c'), acreage of tract and rainfall intensity determined by return period and by the time necessary for the entire tract to contribute runoff. The rational formula is stated as follows: $Q = ciA$, where "Q" is the calculated peak flow rate in cubic feet per second, "c" is the dimensionless runoff coefficient (see Appendix C), "i" is the rainfall intensity in inches per hour, and "A" is the area of the tract in acres.

Reach - Any of the natural or man-made runoff conveyance channels used for modeling purposes to connect the subareas and transport flows downstream.

Regulated Activities - Actions or proposed actions which impact upon proper management of storm water runoff and which are governed by this Ordinance as specified in Section 104.

Release Rate - The percentage of the pre-development peak rate of runoff for a development site to which the post-development peak rate of runoff must be controlled to protect downstream areas.

Return Period - The average interval in years over which an event of a given magnitude can be expected to recur. For example, the twenty-five (25) year return period rainfall or runoff event would be expected to recur on the average once every twenty-five years.

Runoff - That part of precipitation which flows over the land.

Seepage Pit/Seepage Trench - An area of excavated earth filled with loose stone or similar material and into which surface water is directed for infiltration into the ground.

Soil-Cover-Complex Method - A method of runoff computation developed by NRCS which is based upon relating soil type and land use/cover to a runoff parameter called a Curve Number.

Storage Indication Method - A reservoir routing procedure based on solution of the continuity equation (inflow minus outflow equals the change in storage for a given time interval) and based on outflow being a unique function of storage volume.

Storm Drainage Problem Areas - Areas which lack adequate storm water collection and/or conveyance facilities and which present a hazard to persons or property. These areas are either documented in Appendix B of this ordinance or identified by the municipality or municipal engineer.

Storm Sewer - A system of pipes or other conduits which carries intercepted surface runoff, street water and other wash waters, or drainage, but excludes domestic sewage and industrial water.

Storm Water Management Plan - The plan for managing storm water runoff adopted by Northampton County for the Martins/Jacoby Creeks Study Area as required by the Act of October 4, 1978, P.L. 864 (Act 167), and known as the "Storm Water Management Act".

Stream - A watercourse.

Subarea - The smallest unit of watershed breakdown for hydrologic modeling purposes of which the runoff control criteria have been established in the Storm Water Management Plan.

Subdivision - The division or redivision 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 or ownership or building or lot ownership.

Swale - A low lying stretch of land which gathers or carries surface water runoff.

Watercourse - Any channel of conveyance of surface water having defined bed and banks, whether natural or artificial, with perennial or intermittent flow.

ARTICLE III
STORM WATER MANAGEMENT REQUIREMENTS

SECTION 301. GENERAL REQUIREMENTS

- A. Storm drainage systems shall be provided to permit unimpeded flow in natural watercourses except as modified by storm water detention facilities or open channels consistent with this Ordinance.
- B. The existing points of concentrated drainage discharge onto adjacent property shall not be altered without written approval of the affected property owner(s).
- C. Areas of existing diffused drainage discharge onto adjacent property shall be managed such that, at minimum, the peak diffused flow does not increase in the general direction of discharge, except as otherwise provided in this Ordinance. If diffused flow is proposed to be concentrated and discharged onto adjacent property, the developer must document that there are adequate downstream conveyance facilities to safely transport the concentrated discharge or otherwise prove that no harm will result from the concentrated discharge. Areas of existing diffused drainage discharge shall be subject to any applicable release rate criteria in the general direction of existing discharge whether they are proposed to be concentrated or maintained as diffused drainage areas.
- D. Where a site is traversed by watercourses other than those for which a 100 year floodplain is defined by the municipality, there shall be provided drainage easements conforming substantially with the line of such watercourses. The width of any easement shall be adequate to provide for unimpeded flow of storm runoff based on calculations made in conformance with Section 304 for the 100-year return period runoff and to provide a freeboard allowance of one-half (0.5) foot above the design water surface level. The terms of the easement shall prohibit excavation, the placing of fill or structures, and any alterations which may adversely affect the flow of storm water within any portion of the easement. Also, periodic maintenance of the easement to ensure proper runoff conveyance shall be required. Watercourses for which the 100-year floodplain is formally defined are subject to the applicable municipal floodplain regulations.

- E. Any drainage facilities required by this Ordinance that are located on State highway rights-of-way shall be subject to approval by the Pennsylvania Department of Transportation.
- F. When it can be shown that, due to topographic conditions, natural drainage swales on the site cannot adequately provide for drainage, open channels may be constructed conforming substantially to the line and grade of such natural drainage swales. Capacities of open channels shall be calculated using the Manning equation.
- G. Storm drainage facilities and appurtenances shall be so designed and provided as to minimize erosion in watercourse channels and at all points of discharge.
- H. Consideration should be given to the design and use of volume controls for storm water management, where geology and soils permit. Areas of suitable geology for volume controls shall be determined by the municipality. Documentation of the suitability of the soil for volume controls shall be provided by the applicant. Volume controls shall be acceptable in areas of suitable geology where the soils are designated as well drained in the County Soil Survey. Other soils may be acceptable for use of volume controls based on site-specific soils evaluations provided by the applicant.

SECTION 302. STORM WATER MANAGEMENT DISTRICTS

- A. Mapping of Storm Water Management Districts - To implement the provisions of the Martins/Jacoby Creeks Watershed and Delaware River Sub-basin 1 Storm Water Management Plan, the municipality is hereby divided into Storm Water Management Districts consistent with the Martins/Jacoby Creeks Release Rate Map presented in the Plan. The boundaries of the Storm Water Management Districts are shown on an official map which is available for inspection at the municipal office. A copy of the official map at a reduced scale is included in Appendix A for general reference.
- B. Description of Storm Water Management Districts - Three types of Storm Water Management Districts may be applicable to the municipality, namely Conditional No Detention I Districts, Conditional No Detention II Districts and Dual Release Rate Districts as described below.

1. Conditional No Detention I Districts Within these districts, the capacity of the "local" runoff conveyance facilities (as defined in Article II) must be calculated to determine if adequate capacity exists. For this determination, the developer must calculate peak flows assuming that the site is developed as proposed and that the remainder of the local watershed is in the existing condition. The developer must also calculate peak flows assuming that the entire local watershed is developed per current zoning and that all new development would use the runoff controls specified by this Ordinance. The larger of the two peak flows calculated will be used in determining if adequate capacity exists. If adequate capacity exists to safely transport runoff from the site to the main channel (as defined in Article II), these watershed areas may discharge post-development peak runoff without detention facilities. If the capacity calculations show that the "local" runoff conveyance facilities lack adequate capacity, the developer shall either use a 100% release rate control or provide increased capacity of downstream elements to convey increased peak flows consistent with Section 303.M. Any capacity improvements must be designed to convey runoff from development of all areas tributary to the improvement consistent with the capacity criteria specified in Section 303.C. By definition, a storm drainage problem area associated with the "local" runoff conveyance facilities indicates that adequate capacity does not exist.
2. Conditional No Detention II Districts - Within these districts, the capacity of the "local" runoff conveyance facilities must be calculated in the same manner as the Conditional No Detention I Districts. In this case, however, adequate capacity must be demonstrated from the site to the Delaware River. After determining if adequate capacity exists, the developer shall use either no detention, a 100% release rate or provide capacity improvements as detailed in Section 302.B.1 - Conditional No Detention I Districts.
3. Dual Release Rate Districts - Within this district, the 2 year post-development runoff must be controlled to 30% of the predevelopment 2-year runoff peak. Further, the 10-year, 25-year and 100-year post-development runoff must be controlled to the stated percentage of the predevelopment peak. Release Rates associated with the 10- through 100-year events are 60%, 70%, 80%, 90% or 100% depending upon location in the watershed.

SECTION 303. STORM WATER MANAGEMENT DISTRICT
IMPLEMENTATION PROVISIONS

- A. Any storm water management controls required by this Ordinance and subject to a dual release rate criteria shall meet the applicable release rate criteria for each of the 2-, 10-, 25- and 100-year return period runoff events consistent with the calculation methodology specified in Section 304.
- B. The exact location of the Storm Water Management District boundaries as they apply to a given development site shall be determined by mapping the boundaries using the two-foot topographic contours provided as part of the Drainage Plan. The District boundaries as originally drawn coincide with topographic divides or, in certain instances, are drawn from the intersection of the watercourse and a physical feature such as the confluence with another watercourse or a potential flow obstruction (e.g. road, culvert, bridge, etc.). The physical feature is the downstream limit of the subarea and the subarea boundary is drawn from that point upslope to each topographic divide along the path perpendicular to the contour lines.
- C. Any downstream capacity analysis conducted in accordance with this Ordinance shall use the following criteria for determining adequacy for accepting increased peak flow rates:
 - 1. Natural or man-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* (April 1990). Permissible velocities for selected channels are presented in Appendix C of this Ordinance.
 - 2. Natural or man-made channels or swales must be able to convey the 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 have sufficient capacity to pass or convey the increased flows

associated with the 25-year return period runoff event, except for facilities located within a designated floodplain area which must be capable of passing or conveying the 100-year return period runoff. Any facilities which constitute stream enclosures per DEP Chapter 105 regulations shall be designed to convey the 100-year return period runoff.

- D. For a proposed development site located within one release rate category subarea, the total runoff from the site shall meet the applicable release rate criteria. For development sites with multiple directions of runoff discharge, individual drainage directions may be designed for up to a 100% release rate so long as the total runoff from the site is controlled to the applicable release rate.
- E. For a proposed development site located within two or more release category subareas, the peak discharge rate from any subarea shall be the pre-development peak discharge for that subarea multiplied by the applicable release rate. 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 re-combine 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.
- F. For a proposed development site located partially within a release rate category subarea and partially within a conditional no detention subarea, in no event shall a significant portion of the site area subject to the release rate control be drained to the discharge point(s) located in the no detention subarea.
- G. Within a release rate category area, for a proposed development site which has significant areas which drain to a closed depression(s), the design release from the site will be the lesser of (a) the total development site runoff times the applicable release rate or (b) the existing peak flow actually leaving the site.
- H. Off-site areas which 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.
- I. Where the site area to be impacted by a proposed development activity differs significantly from the total site area, only the proposed impact area shall be subject to the release rate criteria.

- J. Development proposals which, through groundwater recharge or other means, do not increase the rate or volume of runoff discharged from the site are not subject to the release rate provisions of the Ordinance.
- K. "No Harm" Option - For any proposed development site not located in a conditional no detention district, the developer has the option of using a less restrictive runoff control (including no detention) if the developer can provide that "no harm" would be caused by discharging at a higher runoff rate than that specified by the Plan. Proof of "no harm" would have to be shown from the development site through the remainder of the downstream drainage network to the confluence of the creek with the Delaware River. Proof of "no harm" must be shown using the capacity criteria specified in Section 303.C. if downstream capacity analysis is a part of the "no harm" justification.

Attempts to prove "no harm" based upon downstream peak flow versus capacity analysis shall be governed by the following provisions:

1. The peak flow values to be used for downstream areas for the design return period storms (2-, 10-, 25- and 100-year) shall be the values from the calibrated Penn State Runoff Models for the Martins Creek, Jacoby Creek, Mud Run, Oughoughton Creek, Allegheny Creek and Slateford Creek Watersheds and the watersheds associated with several unnamed creeks. For the Conditional No Detention II areas, the PSU-IV peak flow values will be used. These flow values would be supplied to the developer by the municipal engineer upon request.
2. Any available capacity in the downstream conveyance system as documented by a developer may be used by the developer only in proportion to his development site acreage relative to the total upstream undeveloped acreage from the identified capacity (i.e. if his site is 10% of the upstream undeveloped acreage, he may use up to 10% of the documented downstream available capacity).
3. 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.M.

Any "no harm" justifications shall be submitted by the developer as part of the Drainage Plan submission per Article IV.

- L. 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 version of the Penn State Runoff Model as developed for the Storm Water Management Plan.
- M. Capacity Improvements - In certain instances, primarily within the conditional no detention areas, local drainage conditions may dictate more stringent levels of runoff control than those based upon protection of the entire watershed. In these instances, if the developer could prove that it would be feasible to provide capacity improvements to relieve the capacity deficiency in the local drainage network, then the capacity improvements could be provided by the developer in lieu of runoff controls on the development site. Peak flow calculations are to be done assuming that the local watershed is in the existing condition and then assuming that the local watershed is developed per current zoning and using the specified runoff controls. Any capacity improvements would be designed using the larger of the above peak flows and the capacity criteria specified in Section 303.C. All new development in the entire subarea(s) within which the proposed development site is located shall be assumed to implement the developer's proposed discharge control, if any. Capacity improvements may also be provided as necessary to implement any regional detention alternatives or to implement a modified "no harm" option which proposes specific capacity improvements to provide that a less stringent discharge control would not create any harm downstream.

- N. Waiver of Runoff Control Based On Minimum Additional Impervious Cover - Any proposed Regulated Activity, except those defined in Sections 104.E and 104.F., which would create 10,000 square feet or less of additional impervious cover would be exempt from meeting the runoff control provisions of this Ordinance. For developments which are to take place in stages, the entire development plan must be used in determining conformance with this criteria. Pre-development impervious cover is that which is in place as of the effective date of this Ordinance. Additional impervious cover shall include, but not be limited to, any roof, parking or driveway areas and any new streets, and sidewalks constructed as part of or for the proposed development. Any post-development areas which may be designed to initially be semi-impervious (e.g. gravel, crushed stone, porous pavement, etc.) shall be considered impervious areas for the purposes of waiver evaluation. Any semi-pervious predevelopment areas shall be considered pervious areas for purposes of waiver evaluation unless demonstrated otherwise by the applicant.
- O. Compatibility with NPDES Requirements - Any proposed Regulated Activity for which a permanent storm water quality control detention basin is required under the NPDES regulations shall use the more stringent runoff control criteria between this Ordinance and the NPDES requirements.

SECTION 304. CALCULATION METHODOLOGY

- A. Storm water runoff from all development sites shall be calculated using either the rational method or the soil-complex methodology.
- B. The design of any detention basin intended to meet the requirements of this Ordinance shall be verified by routing the design storm hydrograph through the proposed basin. For basins designed using the rational method technique, the design hydrograph for routing shall be either the Universal Rational Hydrograph or the modified rational method trapezoidal hydrograph which maximizes detention volume.
- C. All storm water detention facilities shall provide a minimum 1.0 foot freeboard, measured to the invert of the emergency spillway, above the maximum pool elevation associated with the 2- through 25-year runoff events. A 0.5 foot freeboard shall be provided above the maximum pool elevation of the 100-year runoff event. The 2- through

100-year storm events shall be controlled by the primary outlet structure. An emergency spillway for each basin shall be designed to pass the entire 100-year return frequency storm peak flow rate with a minimum 0.5 foot freeboard measured to the top of basin. The spillway should function to control overflows in the event of a complete blockage of the basin outlet system. If this detention facility is considered to be a dam as per DEP Chapter 105, the design of the facility must be consistent with the Chapter 105 regulations, and may be required to pass a storm greater than the 100-year event.

- D. The minimum circular orifice diameter for controlling discharge rates from detention facilities shall be three (3) inches provided that as much of the site runoff as practical is directed to the detention facilities.
- E. All calculations using the soil-cover-complex method shall use the Natural Resources Conservation Service Type II 24-hour rainfall distribution. The 24-hour rainfall depths for the various return periods to be used consistent with this Ordinance are taken from the *PennDOT Intensity - Duration - Frequency Field Manual (May 1986)* for Region 4:

<u>Return Period</u>	<u>24-Hour Rainfall Depth</u>
1 year	2.40 inches
2 year	3.00 inches
5 year	3.60 inches
10 year	4.56 inches
25 year	5.52 inches
50 year	6.48 inches
100 year	7.44 inches

A graphical and tabular presentation of the Type II-24 hour distribution is included in Appendix C.

- F. All calculations using the Rational Method shall use rainfall intensities consistent with appropriate times of concentration and return periods and the Intensity-Duration-Frequency Curves as presented in Appendix C.
- G. Runoff Curve Numbers (CN's) to be used in soil-cover-complex method shall be based upon the matrix presented in Appendix C.

- H. Runoff coefficients for use in the Rational Method shall be based upon the table presented in Appendix C.
- I. Proposed volume controls shall be designed with sufficient storage volume for a 100-year return period event. The storage volume shall equal or exceed the volume of the Universal Rational Hydrograph for the drainage area to the volume control.
- J. All pre-development calculations for a given discharge direction shall be based on a common time of concentration considering both on-site and any off-site drainage areas. All post-development calculations for a given discharge direction shall be based on a common time of concentration considering both on-site and any off-site drainage areas.
- K. The Manning equation shall be used to calculate the capacity of watercourses. Manning 'n' values used in the calculations shall be consistent with the table presented in Appendix C. Pipe capacities shall be determined by methods acceptable to the municipal engineer.
- L. The Pennsylvania DEP, Chapter 105, Rules and Regulations, apply too the construction, modification, operation or maintenance of both existing and proposed dams, water obstructions and encroachments throughout the watershed. Criteria for design and construction of storm water management facilities according to this Ordinance may not be the same criteria that are used in the permitting of dams under the Dam Safety Program.

ARTICLE IV DRAINAGE PLAN REQUIREMENTS

SECTION 401 GENERAL REQUIREMENTS

For any of the Regulated Activities of this Ordinance, prior to the final approval of subdivision and/or land development plans, or the issuance of any permit, or the commencement of any land disturbance activity, the owner, subdivider, developer or his agent shall submit a Drainage Plan for approval.

SECTION 402. EXEMPTIONS.

- A. Impervious Cover - Any Regulated Activity which would create 10,000 square feet or less of additional impervious cover is exempt from the Drainage Plan preparation provisions of this Ordinance.

This criteria shall apply to the total proposed development even if development is to take place in stages (i.e. the impervious cover associated with the total development shall be used to compare to the waiver minimum, not merely the individual stage impervious cover). Pre-development impervious cover is that which is in place as of the effective date of this Ordinance. Additional impervious cover shall include, but not be limited to, any roof, parking or driveway areas and any new streets and sidewalks constructed as part of or for the proposed Regulated Activity. Any areas designed to initially be gravel, crushed stone, porous pavement, etc. shall be assumed to be impervious for the purposes of comparison to the waiver criteria.

- B. Prior Drainage Plan Approval - Any Regulated Activity for which a Drainage Plan was previously prepared as part of a subdivision or land development proposal that received preliminary plan approval from the municipality prior to the effective date of this Ordinance is exempt from the Drainage Plan preparation provisions of this Ordinance *provided* that the approved Drainage Plan included design of storm water facilities consistent with ordinance provisions in effect at the time of approval. If significant revisions are made to the Drainage Plan after both the preliminary plan approval and the effective date of the Ordinance, preparation of a new Drainage Plan, subject to the provisions of this Ordinance, shall be required.

SECTION 403. DRAINAGE PLAN CONTENTS

The following items shall be included in the Drainage Plan:

- A. General
1. General description of project.
 2. General description of proposed permanent storm water controls.
- B. Map(s) of the project area showing:
1. The location of the project relative to highways, municipalities or other identifiable landmarks.
 2. Existing contours at intervals of two (2) feet. In areas of steep slopes (greater than 15%), five-foot contour intervals may be

used. Off-site drainage areas impacting the project including topographic detail.

3. Streams, lakes, ponds or other bodies of water within the project area.
4. Other physical features including existing drainage swales, wetlands, closed depressions, sinkholes and areas of natural vegetation to be preserved.
5. Locations of proposed underground utilities, sewers and water lines.
6. An overlay showing soil types and boundaries based on the Northampton County Soil Survey latest edition.
7. Proposed changes to land surface and vegetative cover.
8. Proposed structures, roads, paved areas and buildings.
9. Final contours at intervals of two (2) feet. In areas of steep slopes (greater than 15%) , five-foot contour intervals may be used.
10. Storm Water Management District boundaries applicable to the site.

C. Storm Water Management Controls

1. All storm water management controls must be shown on a map and described, including:
 - a. Groundwater recharge methods such as seepage pits, beds or trenches. When these structures are used, the locations of septic tank infiltration areas and wells must be shown.
 - b. Other control devices or methods such as roof-top storage, semi-pervious paving materials, grass swales, parking lot ponding, vegetated strips, detention or retention ponds, storm sewers, etc.

2. All calculations, assumptions and criteria used in the design of the control device or method must be shown.
- D. Maintenance Program - A maintenance program for all storm water management control facilities must be included. This program must include the proposed ownership of the control facilities, the maintenance requirements for the facilities, and the financial responsibilities for the required maintenance.

SECTION 404. PLAN SUBMISSION

- A. For Regulated Activities specified in Sections 104.A. and 104.B.:
1. The Drainage Plan shall be submitted by the developer to the municipal secretary (or other appropriate person) as part of the Preliminary Plan submission for the subdivision or land development.
 2. Three (3) copies of the Drainage Plan shall be submitted.
 3. Distribution of the Drainage Plan will be as follows:
 - a. One (1) copy to the municipal governing body.
 - b. One (1) copy to the municipal engineer.
 - c. One (1) copy to the Joint Planning Commission.
- B. For Regulated Activities specified in Sections 104.C. and 104.D., the Drainage Plan shall be submitted by the developer to the municipal building permit officer as part of the building permit application.
- C. For Regulated Activities specified in Sections 104.E. and 104.F.:
1. The Drainage Plan shall be submitted by the developer to the Joint Planning Commission for coordination with the DEP permit application process under Chapter 105 (Dam Safety and Waterway Management) or Chapter 106 (Flood Plain Management) of DEP's Rules and Regulations.
 2. One (1) copy of the Drainage Plan shall be submitted.

- D. For all regulated activities under Section 104 that propose to disturb more than five (5) acres of land, an NPDES permit application for discharge of storm water associated with construction activity shall be submitted to the Northampton County Conservation District.

SECTION 405. DRAINAGE PLAN REVIEW

- A. The municipal engineer shall review the Drainage Plan for consistency with the adopted Martins/Jacoby Creeks Watershed and Delaware River Sub-basin 1 Storm Water Management Plan as embodied by this Ordinance and against any additional storm drainage provisions contained in the municipal subdivision and land development or zoning ordinance, as applicable.
- B. The Joint Planning Commission shall provide an advisory review of the Drainage Plan for consistency with the Martins/Jacoby Creeks Watershed and Delaware River Sub-basin 1 Storm Water Management Plan.
- C. For Regulated Activities specified in Sections 104.A. and 104.B., the JPC shall provide written comments to the municipality, within a time frame consistent with established procedures under the Municipalities Planning Code, as to whether the Drainage Plan has been found to be consistent with the Storm Water Management Plan.
- D. For Regulated Activities specified in Sections 104.E. and 104.F., the JPC shall notify DEP whether the Drainage Plan is consistent with the Storm Water Management Plan and forward a copy of the review letter to the municipality and developer.
- E. The municipality shall not approve any subdivision or land development (Regulated Activities 104.A. and 104.B.) or building permit application (Regulated Activities 104.C. and 104.D.) if the Drainage Plan has been found to be inconsistent with the Storm Water Management Plan as determined by the municipal engineer.

SECTION 406. MODIFICATION OF PLANS

A modification to a submitted Drainage Plan for a proposed development site which involves a change in control methods or techniques, or which involves the relocation or redesign of control measures, or which 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 subject to review per Section 405 of this Ordinance.

SECTION 407. HARSHIP WAIVER PROCEDURE

The municipality (governing body) may hear requests for waivers where it is alleged that the provisions of this (Act 167) Ordinance inflict unnecessary hardship upon the applicant. The waiver request shall be in writing on an application form promulgated by the municipality and accompanied by the requisite fee based upon a fee schedule adopted by the municipality. A copy of the completed application form shall be provided to each of the following: municipality, municipal engineer, municipal solicitor and Joint Planning Commission. The application shall fully document the nature of the alleged hardship.

The municipality may grant a waiver provided that all of the following findings are made in a given case:

1. That there are unique physical circumstances or conditions, including irregularity of lot size or shape, or exceptional topographical or other physical conditions peculiar to the particular property, and that the unnecessary hardship is due to such conditions, and not the circumstances or conditions generally created by the provisions of this Ordinance in the Storm Water Management District in which the property is located;
2. That because of such physical circumstances or conditions, there is no possibility that the property can be developed in strict conformity with the provisions of this Ordinance, including the "no harm" provision, and that the authorization of a waiver is therefore necessary to enable the reasonable use of the property;
3. That such unnecessary hardship has not been created by the applicant; and
4. That the waiver, if authorized, will represent the minimum waiver that will afford relief and will represent the least modification possible of the regulation in issue.

In granting any waiver, the municipality (governing body) may attach such reasonable conditions and safeguards as it may deem necessary to implement the purposes of Act 167 and this Ordinance.

ARTICLE V INSPECTIONS

SECTION 501. SCHEDULE OF INSPECTIONS

- A. The municipal engineer or his designee shall inspect all phases of the installation of the permanent storm water control facilities and the completed installation.
- B. If at any stage of the work the municipal engineer determines that the permanent storm water control facilities are not being installed in accordance with the approved development plan, the municipality shall revoke any existing permits until a revised development plan is submitted and approved as required by Section 406.

ARTICLE VI FEES AND EXPENSES

SECTION 601. GENERAL

A fee shall be established by the municipality to defer municipal costs for Drainage Plan review and processing.

SECTION 602. EXPENSES COVERED BY FEES

The fees required by this Ordinance shall at a minimum cover:

- A. The review of the Drainage Plan by the municipal engineer.
- B. The site inspection.
- C. The inspection of required controls and improvements during construction.
- D. The final inspection upon completion of the controls and improvements required in the plan.
- E. Any additional work required to enforce any permit provisions, regulated by this Ordinance, correct violations, and assure the completion of stipulated remedial actions.
- F. Administrative and clerical costs.

**ARTICLE VII
MAINTENANCE RESPONSIBILITIES**

SECTION 701. MAINTENANCE RESPONSIBILITIES

The maintenance responsibilities for permanent storm water runoff control facilities shall be determined by reference to the provisions of the Washington Township Subdivision and Land Development Ordinance, as amended. This provision shall apply to both single entity ownership and multiple ownership properties.

**ARTICLE VIII
ENFORCEMENT**

SECTION 801. RIGHT-OF-WAY

Upon presentation of proper credentials, duly authorized representatives of the municipality may enter at reasonable times upon any property within the municipality to investigate or ascertain the condition of the subject property 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 other 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

Any person found by the municipality to have violated any provision of this Ordinance shall be subject to the enforcement provisions in Article V of the Pennsylvania Municipalities Planning Code and/or Section 15 of the Pennsylvania Storm Water Management Act (Act 167).

SECTION 901. EFFECTIVE DATE

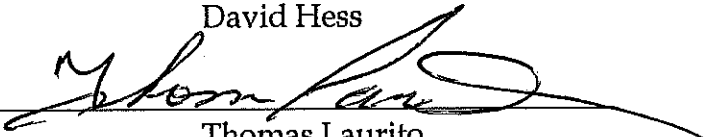
This Ordinance shall become effective immediately upon enactment.

ORDAINED AND ENACTED into an Ordinance this 15th day of August,
1996.

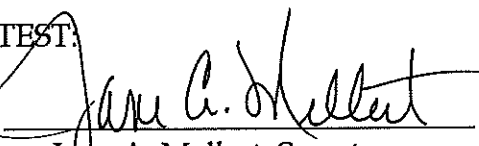
WASHINGTON TOWNSHIP BOARD OF SUPERVISORS

By: 
Ignatz Klausz, Jr., Chairman

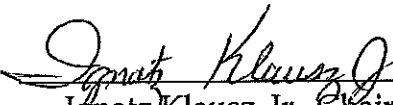
By: 
David Hess

By: 
Thomas Laurito

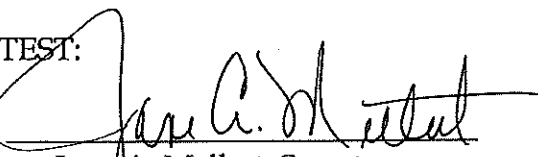
ATTEST:

By: 
Jane A. Mellert, Secretary

APPROVED AND CERTIFIED this 15th day of August, 1996.


Ignatz Klausz, Jr., Chairman

ATTEST:

By: 
Jane A. Mellert, Secretary

APPENDIX A

(Not Included in Plan Copy of Ordinance)

- A-1 Map of Martins/Jacoby Creeks Study Area**
- A-2 Municipal Map of Storm Water Management Districts**

APPENDIX B

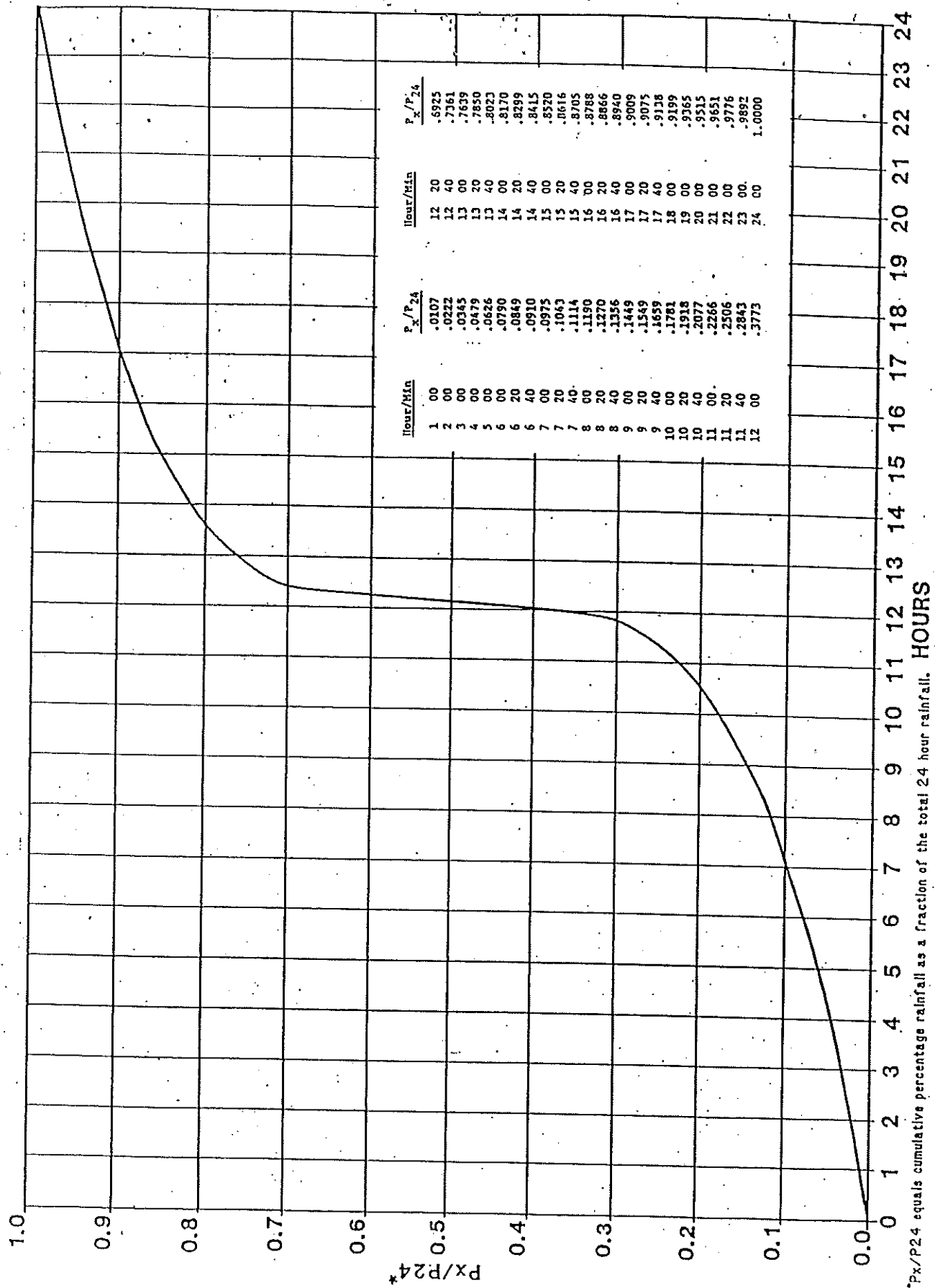
(Not Included in Plan Copy Text)

- B-1 Map of Storm Drainage Problem Areas**
- B-2 Description of Storm Drainage Problem Areas**

APPENDIX C

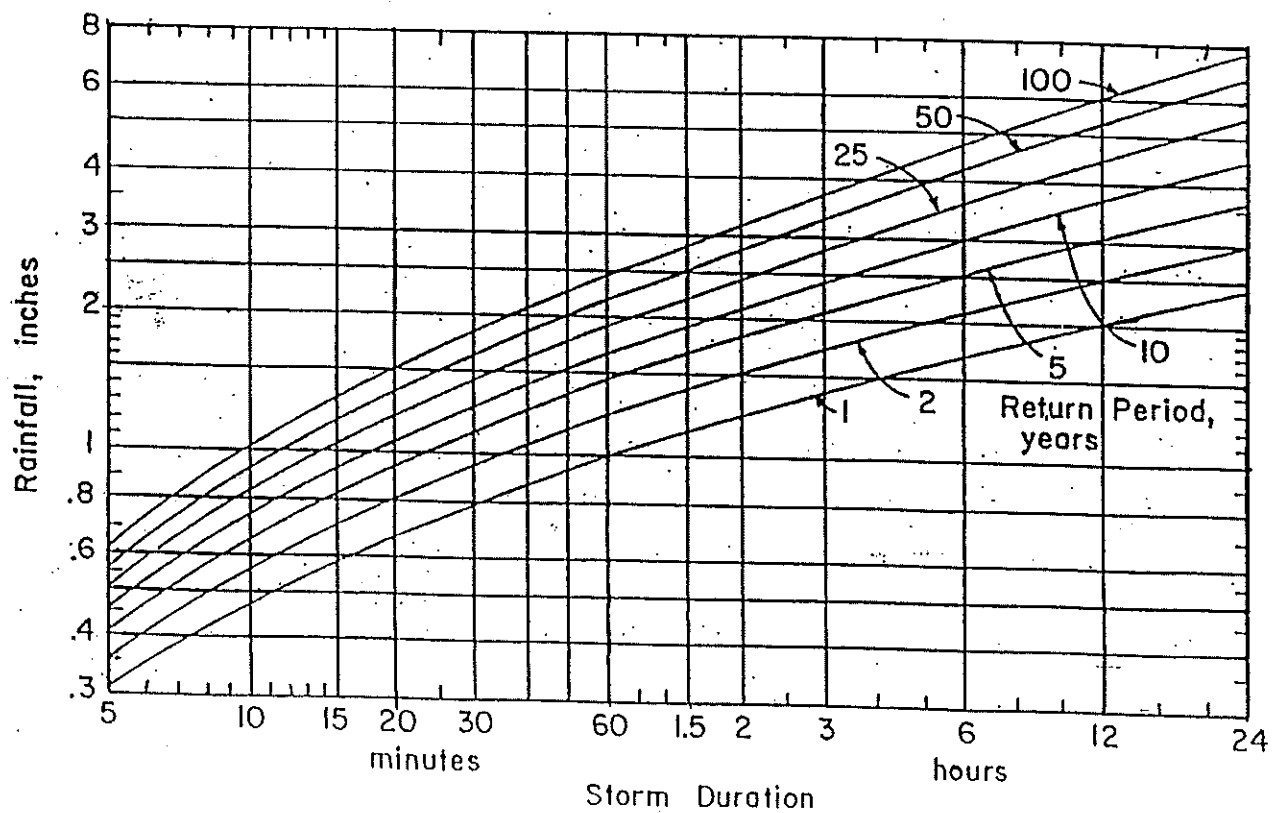
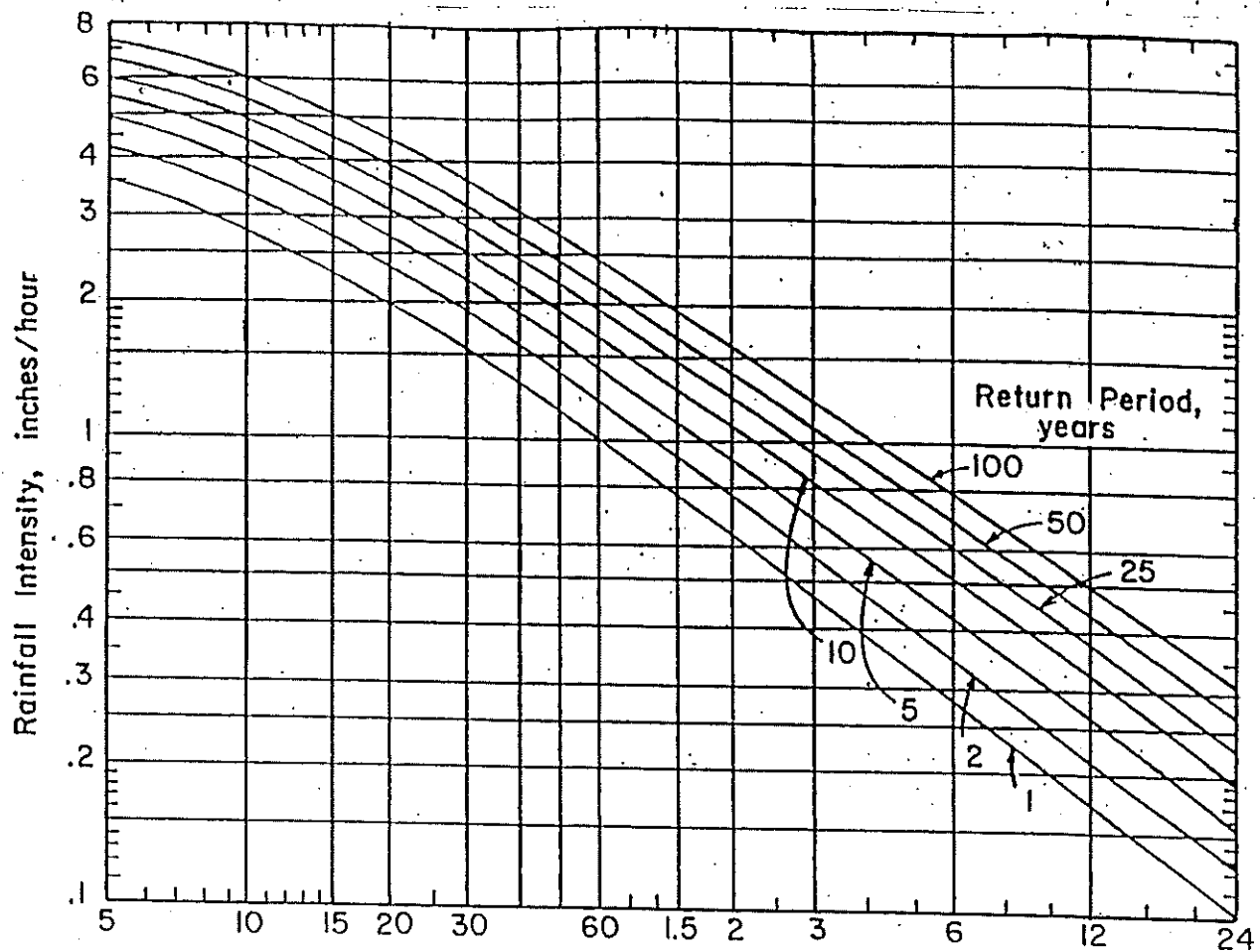
- C-1 NRCS Type II 24-Hour Rainfall Distribution
(Graphic & Tabular)**
- C-2 Intensity-Duration-Frequency Curves**
- C-3 Runoff Curve Numbers and Percent
Imperviousness Values**
- C-4 Runoff Coefficients for the Rational Method**
- C-5 Manning 'n' Values**
- C-6 Permissible Velocities for Channels**

NRCS TYPE II RAINFALL DISTRIBUTION



* P_x/P_{24} equals cumulative percentage rainfall as a fraction of the total 24 hour rainfall. HOURS

INTENSITY-DURATION-FREQUENCY CURVES*



*Source: Pennsylvania Dept. of Transp. Design Rainfall Curves (1986).

RUNOFF CURVE NUMBERS AND PERCENT IMPERVIOUSNESS VALUES*

Cover Description		Curve numbers for hydrologic soil group**			
Land Use/Cover Type	Average percent impervious area	A	B	C	D
Open space (lawns, parks, golf courses, cemeteries, etc.): Good condition (grass cover greater than 75%) . .		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way) . .		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (townhouses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Woods		30	55	70	77
Agriculture		Refer to Table 2-2b in source document (TR55) by crop type and treatment.			

*Source: Natural Resources Conservation Service Technical Release No. 55, Second Edition, June 1986.

**Hydrologic Soil Group based on the Northampton County Soil Survey latest edition.

RUNOFF COEFFICIENTS FOR THE RATIONAL METHOD*									
HYDROLOGIC SOIL GROUP AND SLOPE RANGE**									
LAND USE	A		B		C		D		
	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+
Cultivated ^a	0.18 0.23	0.23 0.29	0.28 0.34	0.24 0.30	0.29 0.36	0.33 0.40	0.30 0.36	0.34 0.41	0.38 0.45
Pasture ^b	0.09 0.12	0.13 0.17	0.17 0.23	0.19 0.24	0.24 0.30	0.29 0.36	0.27 0.33	0.31 0.38	0.36 0.43
Meadow, Lawn ^c	0.05 0.07	0.08 0.12	0.12 0.17	0.15 0.19	0.20 0.25	0.24 0.30	0.23 0.28	0.28 0.34	0.32 0.39
Forest, Woods	0.03 0.04	0.05 0.08	0.08 0.12	0.11 0.15	0.16 0.21	0.20 0.26	0.20 0.25	0.25 0.31	0.29 0.36
Gravel	0.24 0.30	0.29 0.36	0.33 0.40	0.32 0.38	0.36 0.43	0.40 0.47	0.35 0.42	0.39 0.46	0.43 0.50
Parking, Other Impervious	0.72 0.84	0.76 0.88	0.80 0.92	0.72 0.84	0.76 0.88	0.80 0.92	0.72 0.84	0.76 0.88	0.80 0.92
Residential, Commercial, Industrial And Other "Developed"	Runoff coefficients should be calculated based upon weighted average of impervious area coefficients and pervious area coefficients from above based upon soil type, slope and the particular development proposal.								

*Based on Rossmiller Equation for translating NRCS curve numbers into Rational Method 'c' values.

**Hydrologic Soil Group based on the county soil survey latest edition.

a—Runoff coefficients for storm recurrence intervals less than 25 years.

b—Runoff coefficients for storm recurrence intervals of 25 years or more.

^aRepresents average of cultivated land with and without conservation treatment from TR-55, January 1975. These values are consistent with several categories of cultivated lands from TR-55, June 1986.

^bRepresents grasslands in fair condition with 50% to 75% grass cover.

^cRepresents grasslands in good condition with greater than 75% grass cover.

MANNING 'n' VALUES BY TYPICAL REACH DESCRIPTION

	<u>Reach Description</u>	<u>Manning 'n'</u>
1)	Natural stream, clean, straight, no rifts or pools	0.030
2)	Natural stream, clean, winding, some pools and shoals	0.040
3)	Natural stream, winding, pools, shoals, stony with some weeds	0.050
4)	Natural stream, sluggish with deep pools and weeds	0.070
5)	Natural stream or swale, very weedy or with timber under brush	0.100
6)	Concrete pipe, culvert or channel	0.012
7)	Corrugated metal pipe	0.012-0.027*

*Depending upon type and diameter.

PERMISSIBLE VELOCITIES FOR SELECTED CHANNELS

CHANNEL LINING	PERMISSIBLE CHANNEL VELOCITY (FEET PER SECOND)
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Vegetation¹

Grass Mixture	4.0	-	5.0
Kentucky Bluegrass	5.0	-	7.0
Kentucky 31 Tall Fescue	3.0	-	6.0
Red Clover or Red Fescue	2.5	-	3.5
Red Top	2.5	-	3.5
Red Canarygrass	3.0	-	4.0
Sericea Lespedeza	2.5	-	3.5
Sudan Grass	2.5	-	3.5
Weeping Lovegrass	2.5	-	3.5

Bare Earth, Easily Eroded²

Fine Sand	1.5
Sand Loam	1.75
Silt Loam or Alluvial Silts, Loose	2.0
Firm Loam	2.50

Bare Earth, Erosion Resistant²

Fine Gravel	2.5
Stiff Clay or Alluvial Silts, Firm	3.75
Loam to Cobbles (Graded)	3.75
Silt to Cobbles (Graded or Course Gravel)	4.0
Cobbles and Stones or Shales and Hardpans	6.0

Rock Lined

6" Rip Rap	9.0
9" Rip Rap	11.5
12" Rip Rap	13.0

¹ Maximum permissible velocities dependent on soil erodibility and slope.

² Maximum permissible velocities in bare earth channels - for straight channels where slopes <0.02 ft./ft.

Source: Department of Environmental Protection, *Erosion and Sediment Pollution Control Program Manual*, April 1990.

APPENDIX D

D-1 to D-4 Calibrated PSRM Peak Flow Values

D-5 PSU-IV Peak Flow Values

CALIBRATED PSM PEAK FLOW VALUES FOR THE MARTINS/JACOBY CREEKS STUDY AREA

SUBAREA NO.	2 YEAR			10 YEAR			25 YEAR			50 YEAR			100 YEAR		
	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	TOTAL PEAK
MOD RUN															
1	180.5(cfs)	180.5	525.9(cfs)	525.9	760.4(cfs)	760.4	1006.7(cfs)	1006.7	1343.9(cfs)	1343.9					
2	137.2	297.6	403.5	860.6	583.0	1259.0	779.4	1618.5	1044.5	1991.7					
3	146.7	146.7	443.9	443.9	651.0	651.0	873.3	873.3	1182.2	1182.2					
4	111.4	208.8	352.0	578.2	522.3	828.0	703.3	1086.0	954.5	1419.0					
5	59.9	445.0	186.4	1273.8	273.5	1847.5	365.0	2306.5	482.5	2862.9					
6	193.5	193.5	560.8	560.8	805.3	805.3	1079.5	1079.5	1440.8	1440.8					
7	178.1	362.8	509.9	1062.2	743.7	1529.3	994.6	2015.5	1319.2	2635.0					
8	159.6	861.0	473.2	2479.1	699.0	3579.4	938.7	4564.8	1248.5	5784.6					
9	235.0	927.5	758.8	2633.1	1126.1	3755.9	1540.8	4761.2	2083.2	6015.7					
10	208.9	999.1	670.6	2779.5	1011.4	3875.5	1384.1	4906.4	1875.6	6201.3					
11	71.8	1023.2	235.8	2808.0	367.6	3930.2	519.9	4983.8	732.2	6272.9					
12	173.9	1038.4	396.0	2819.3	557.8	3914.5	739.2	5011.1	986.5	6321.0					
MARTINS CREEK															
13	15.0(cfs)	15.0	110.5(cfs)	110.5	220.8(cfs)	220.8	368.6(cfs)	368.6	597.3(cfs)	597.3					
14	76.7	85.5	419.9	454.8	733.6	741.5	1105.8	1115.9	1628.8	1644.5					
15	98.8	167.0	368.9	767.1	603.6	1250.6	885.8	1786.8	1289.7	2538.7					
16	35.1	35.1	162.8	162.8	281.3	281.3	428.2	428.2	642.4	642.4					
17	57.6	76.0	193.3	275.5	307.1	436.0	441.4	628.2	628.2	898.1					
18	57.3	57.3	225.1	225.1	381.8	381.8	581.4	581.4	880.9	880.9					
19	43.5	65.7	184.7	251.7	303.4	426.2	441.2	632.6	632.6	917.0					
20	45.4	139.5	137.4	468.2	213.4	712.2	304.5	1012.1	436.7	1436.2					
21	59.0	59.0	255.5	255.5	429.8	429.8	640.7	890.5	1292.6	1436.2					
22	97.5	97.5	371.2	371.2	608.5	608.5	890.5	890.5	1292.6	1436.2					
23	28.1	28.1	123.0	123.0	210.1	210.1	319.2	319.2	479.9	479.9					
24	315.8	114.0	787.5	255.8	1151.6	389.6	1572.0	546.1	2156.7	766.3					
25	158.0	246.3	603.1	691.4	968.1	1056.4	1391.7	1480.0	1976.2	2064.5					
26	50.4	310.4	165.2	873.2	257.7	1323.0	363.8	1849.4	509.8	2579.9					
27	57.6	341.0	188.1	1112.1	301.4	1716.8	438.8	2399.5	639.9	3316.4					
28	206.9	370.3	684.5	1173.8	1066.5	1798.1	1500.5	2467.7	2092.2	3393.7					
29	57.9	57.9	191.6	191.6	309.5	309.5	455.1	455.1	671.3	671.3					
30	159.9	420.2	427.5	1317.7	632.7	1996.1	863.0	2703.9	1174.7	3661.1					
31	179.8	480.7	438.7	1379.4	641.5	2060.4	876.2	2768.7	1204.6	3756.0					
32	70.3	70.3	256.8	256.8	410.2	410.2	589.4	589.4	837.8	837.8					
33	178.5	179.6	623.4	624.9	983.7	985.6	1392.8	1395.3	1950.5	1955.0					
34	357.8	59.5	956.9	481.4	1424.1	943.4	1954.9	1876.1	2690.7	3447.5					
35	314.0	322.2	769.4	779.0	1123.5	1134.8	1528.8	2023.8	2091.1	3497.4					
36	294.1	908.3	619.8	2056.0	855.5	3202.4	1120.7	4162.6	1487.0	5349.3					
37	123.0	123.0	370.9	370.9	557.2	557.2	770.5	770.5	1064.6	1064.6					
38	173.7	1137.6	360.6	2540.4	492.9	3370.6	638.5	4535.7	834.5	5809.6					
39	284.3	1293.1	766.1	2924.8	1125.8	3911.8	1525.1	5133.5	2061.3	6494.5					
40	233.7	1433.0	703.1	3310.3	1074.1	4413.6	1493.8	5688.5	2065.1	7252.8					
41	245.7	1515.5	703.0	3466.0	1048.6	4603.5	1446.3	5938.3	1986.8	7575.7					

CALIBRATED PFRM PEAK FLOW VALUES FOR THE MARTINS/JACOBY CREEKS STUDY AREA

SUBAREA NO.	2 YEAR			10 YEAR			25 YEAR			50 YEAR			100 YEAR		
	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	TOTAL PEAK
WALTZ CREEK															
42	52.1(cfs)	52.1	145.6(cfs)	145.6	233.7(cfs)	233.7	350.6(cfs)	350.6	531.1(cfs)	531.1	847.7	847.7	1258.4	1258.4	1258.4
43	111.5	153.1	279.8	399.8	424.8	613.4	597.3	874.6	847.7	1219.8	1219.8	1219.8	1219.8	1219.8	1219.8
44	241.3	241.3	484.8	484.8	672.9	672.9	897.9	897.9	1100.3	1100.3	1651.6	1651.6	1651.6	1651.6	1651.6
45	131.6	249.0	224.1	512.3	305.4	750.0	427.2	1192.3	1625.4	1854.6	2270.6	2270.6	2270.6	2270.6	2270.6
46	167.3	357.4	576.0	841.0	915.0	1192.3	1307.9	1625.4	1854.6	2270.6	2270.6	2270.6	2270.6	2270.6	2270.6
47	28.8	28.8	199.7	199.7	382.5	382.5	624.8	624.8	987.1	987.1	1315.2	1315.2	1315.2	1315.2	1315.2
48	49.5	44.3	128.2	358.3	201.9	610.2	297.0	919.3	439.1	1430.7	1430.7	1430.7	1430.7	1430.7	1430.7
49	259.8	266.7	554.6	560.4	782.4	789.3	1048.2	1116.8	1430.7	1430.7	1747.1	1747.1	1747.1	1747.1	1747.1
50	30.9	291.5	114.1	660.9	190.7	954.4	283.7	1264.2	418.7	1474.1	1474.1	1474.1	1474.1	1474.1	1474.1
51	148.7	737.2	492.0	1689.4	772.2	2240.4	1099.5	2820.8	1555.6	3656.4	3656.4	3656.4	3656.4	3656.4	3656.4
52	72.2	72.2	204.0	204.0	342.1	342.1	515.1	515.1	767.7	767.7	1163.8	1163.8	1163.8	1163.8	1163.8
53	71.7	747.9	191.3	1783.0	299.5	2395.8	427.9	3031.6	615.0	3931.9	3931.9	3931.9	3931.9	3931.9	3931.9
54	103.6	791.9	321.3	1870.9	496.2	2522.3	699.2	3186.1	979.9	4106.1	4106.1	4106.1	4106.1	4106.1	4106.1
55	305.8	305.8	885.6	1870.9	1274.9	1274.9	1689.8	1689.8	2259.8	2259.8	2259.8	2259.8	2259.8	2259.8	2259.8
56	93.7	388.2	324.7	1131.3	497.7	1628.6	687.9	2155.2	939.6	2834.5	2834.5	2834.5	2834.5	2834.5	2834.5
57	177.6	1010.0	574.7	2232.6	860.7	2927.1	1167.7	3664.0	1580.7	4774.8	4774.8	4774.8	4774.8	4774.8	4774.8

MARTINS CREEK

58	97.4(cfs)	2338.3	357.1(cfs)	5405.7	563.7(cfs)	7251.5	797.8(cfs)	9156.9	1114.4(cfs)	11664.8	11664.8	11664.8	11664.8	11664.8	11664.8
59	203.7	2362.4	652.4	5434.3	974.0	7268.7	1332.7	9225.2	1802.2	11745.1	11745.1	11745.1	11745.1	11745.1	11745.1
60	230.4	2352.1	726.4	5439.0	1076.2	7286.3	1480.0	9208.4	2016.3	11739.3	11739.3	11739.3	11739.3	11739.3	11739.3
61	252.7	2348.9	805.9	5424.9	1219.6	7256.3	1674.1	9192.3	2270.5	11722.5	11722.5	11722.5	11722.5	11722.5	11722.5
62	223.3	2341.3	689.3	5396.3	1015.3	7247.8	1379.5	9188.3	1855.1	11706.1	11706.1	11706.1	11706.1	11706.1	11706.1
63	136.3	2336.6	438.2	5368.7	663.0	7228.7	905.1	9160.5	1221.8	11638.4	11638.4	11638.4	11638.4	11638.4	11638.4

LITTLE MARTINS CREEK

64	153.5(cfs)	153.5	499.5(cfs)	499.5	765.5(cfs)	765.5	1064.5(cfs)	1064.5	1496.8(cfs)	1496.8	1496.8	1496.8	1496.8	1496.8	1496.8
65	121.8	213.2	336.2	605.6	483.3	888.9	642.2	1206.3	848.1	1637.8	1637.8	1637.8	1637.8	1637.8	1637.8
66	183.9	183.9	508.8	508.8	729.0	729.0	957.3	957.3	1248.5	1248.5	1248.5	1248.5	1248.5	1248.5	1248.5
67	284.8	500.5	883.6	1326.7	1306.1	1857.5	1756.6	2402.6	2365.3	3034.0	3034.0	3034.0	3034.0	3034.0	3034.0
68	109.9	109.9	322.8	322.8	474.0	474.0	636.2	636.2	858.5	858.5	858.5	858.5	858.5	858.5	858.5
69	122.4	598.1	363.1	1531.6	541.5	2086.2	734.9	2671.5	989.2	3364.9	3364.9	3364.9	3364.9	3364.9	3364.9
70	344.9	674.2	834.0	1641.0	1170.8	2241.0	1529.9	2839.9	1997.1	3623.3	3623.3	3623.3	3623.3	3623.3	3623.3
71	161.0	161.0	476.5	476.5	699.5	699.5	939.0	939.0	1251.8	1251.8	1251.8	1251.8	1251.8	1251.8	1251.8
72	293.2	829.3	875.5	1899.7	1270.7	2618.9	1711.9	3389.5	2284.2	4311.3	4311.3	4311.3	4311.3	4311.3	4311.3
73	166.5	166.5	481.5	481.5	697.0	697.0	933.6	933.6	1240.1	1240.1	1240.1	1240.1	1240.1	1240.1	1240.1
74	278.3	1067.3	851.3	2272.8	1244.9	2939.9	1687.3	3681.9	2264.0	4608.4	4608.4	4608.4	4608.4	4608.4	4608.4

MARTINS CREEK

75	73.8(cfs)	2352.7	249.8(cfs)	5441.7	378.4(cfs)	7326.4	521.7(cfs)	9276.3	709.2(cfs)	11825.7	11825.7	11825.7	11825.7	11825.7	11825.7
76	198.8	2350.5	541.8	5427.6	803.6	7304.3	1098.8	9252.8	1499.9	11762.0	11762.0	11762.0	11762.0	11762.0	11762.0
77	45.9	2346.7	114.5	5406.2	171.3	7285.6	238.7	9232.1	334.2	11760.0	11760.0	11760.0	11760.0	11760.0	11760.0

CALIBRATED PSM PEAK FLOW VALUES FOR THE MARTINS/JACOBY CREEKS STUDY AREA

SUBAREA NO.	2 YEAR			10 YEAR			25 YEAR			50 YEAR			100 YEAR		
	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	TOTAL PEAK
OUGHOUGHTON CREEK															
78	68.5(cfs)	68.5	212.5(cfs)	212.5	331.2(cfs)	331.2	472.1(cfs)	472.1	674.8(cfs)	674.8	674.8(cfs)	674.8	674.8(cfs)	674.8	674.8
79	160.2	220.8	495.4	684.8	744.3	1041.7	1018.6	1445.8	1384.1	2000.3	1384.1	2000.3	1384.1	2000.3	2000.3
80	159.3	337.1	489.2	960.2	741.4	1424.0	1024.9	1935.9	1409.3	2622.8	1409.3	2622.8	1409.3	2622.8	2622.8
81	232.6	459.5	698.8	1190.8	1019.8	1707.7	1358.0	2266.9	1829.6	3007.0	1829.6	3007.0	1829.6	3007.0	3007.0
82	381.5	603.9	1059.5	1555.1	1535.0	2069.9	2034.9	2699.9	2679.2	3480.3	2679.2	3480.3	2679.2	3480.3	3480.3
83	180.6	180.6	538.0	538.0	794.7	794.7	1073.0	1073.0	1439.4	1439.4	1439.4	1439.4	1439.4	1439.4	1439.4
84	298.1	872.0	835.8	2123.2	1192.2	3849.2	1586.7	3705.7	2109.2	4817.6	2109.2	4817.6	2109.2	4817.6	4817.6
85	218.5	951.1	663.8	2255.9	979.6	3020.8	1319.2	3894.9	1763.2	5043.8	1763.2	5043.8	1763.2	5043.8	5043.8
86	264.7	264.7	725.3	725.3	1042.8	1042.8	1379.6	1379.6	1813.4	1813.4	1813.4	1813.4	1813.4	1813.4	1813.4
87	72.2	1003.1	222.0	2344.5	325.1	3141.5	434.1	4005.5	576.0	5173.1	4005.5	5173.1	4005.5	5173.1	5173.1
88	59.5	1005.5	182.8	2348.1	270.2	3134.8	365.6	4023.0	489.5	5179.9	4023.0	5179.9	4023.0	5179.9	5179.9
89	215.5	215.5	624.2	624.2	906.2	906.2	1225.0	1225.0	1647.3	1647.3	1647.3	1647.3	1647.3	1647.3	1647.3
90	116.2	304.4	312.6	778.4	445.6	1087.9	583.8	1431.1	760.5	1882.2	1431.1	1882.2	1431.1	1882.2	1882.2
91	133.2	1072.1	452.4	2488.8	698.3	3333.2	973.8	4249.0	1345.0	5428.3	4249.0	5428.3	4249.0	5428.3	5428.3
92	76.6	76.6	278.6	278.6	441.2	441.2	628.9	628.9	888.2	888.2	888.2	888.2	888.2	888.2	888.2
93	6.0	1091.1	20.4	2529.2	30.5	3368.4	42.1	4309.3	57.7	5469.6	4309.3	5469.6	4309.3	5469.6	5469.6
94	115.7	115.7	392.1	392.1	603.8	603.8	841.8	841.8	1164.9	1164.9	1164.9	1164.9	1164.9	1164.9	1164.9
95	51.4	1130.0	164.8	2611.8	256.7	3458.4	364.6	4429.0	516.7	5615.8	4429.0	5615.8	4429.0	5615.8	5615.8
96	132.7	1141.1	299.5	2653.8	424.3	3511.1	569.4	4449.5	777.6	5694.9	4449.5	5694.9	4449.5	5694.9	5694.9

ALLEGHENY CREEK

97	119.6(cfs)	119.6	370.5(cfs)	370.5	558.9(cfs)	558.9	768.4(cfs)	768.4	1049.9(cfs)	1049.9	768.4	1049.9(cfs)	1049.9	1049.9	1049.9
98	68.7	68.7	194.6	194.6	294.2	294.2	407.3	407.3	563.0	563.0	407.3	563.0	407.3	563.0	563.0
99	117.2	188.4	379.9	557.5	587.8	808.4	825.3	1078.9	1148.3	1434.7	1078.9	1434.7	1078.9	1434.7	1434.7
100	183.0	249.6	451.5	665.3	640.2	982.7	843.2	1339.6	1108.8	1824.1	1339.6	1824.1	1339.6	1824.1	1824.1
101	96.3	317.5	305.8	849.6	469.9	1239.7	555.0	1668.4	905.3	2241.8	1668.4	2241.8	1668.4	2241.8	2241.8
102	146.4	407.2	460.9	981.4	685.8	1392.9	926.3	1848.1	1259.3	2448.5	1848.1	2448.5	1848.1	2448.5	2448.5
103	157.9	493.9	499.8	1127.5	754.9	1566.1	1037.2	2055.1	1415.8	2680.1	2055.1	2680.1	2055.1	2680.1	2680.1
104	92.6	92.6	302.2	302.2	465.4	465.4	650.7	650.7	904.4	904.4	650.7	904.4	650.7	904.4	904.4
105	208.3	258.3	611.6	662.6	879.2	954.7	1178.8	1263.4	1574.2	1702.6	1263.4	1702.6	1263.4	1702.6	1702.6
106	124.8	642.5	361.2	1408.5	524.2	1990.9	697.1	2855.2	920.9	3555.1	2855.2	3555.1	2855.2	3555.1	3555.1
107	189.4	698.4	561.3	1601.7	827.8	2240.3	1116.3	2899.0	1496.0	3689.7	2899.0	3689.7	2899.0	3689.7	3689.7
108	67.4	67.4	205.2	205.2	311.9	311.9	433.4	433.4	600.6	600.6	433.4	600.6	433.4	600.6	600.6
109	186.8	251.7	524.8	723.4	751.0	1053.9	1001.8	1409.6	1334.7	1876.3	1409.6	1876.3	1409.6	1876.3	1876.3
110	234.5	478.7	685.3	1395.1	989.9	2029.8	1311.9	2706.2	1758.3	3582.8	2706.2	3582.8	2706.2	3582.8	3582.8
111	239.1	649.9	741.4	1815.0	1087.1	2474.2	1457.0	3213.7	1970.7	4122.3	3213.7	4122.3	3213.7	4122.3	4122.3
112	247.6	1345.3	807.1	3409.0	1200.7	4876.2	1634.2	6319.8	2231.7	8124.3	6319.8	8124.3	6319.8	8124.3	8124.3
113	11.0	1348.6	43.1	3379.7	68.2	4823.4	96.2	6263.2	137.1	8076.2	4823.4	8076.2	4823.4	8076.2	8076.2

CALIBRATED PFRM PEAK FLOW VALUES FOR THE MARTINS/JACOBY CREEKS STUDY AREA

SUBAREA NO.	2 YEAR			10 YEAR			25 YEAR			50 YEAR			100 YEAR		
	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	SUBAREA PEAK	TOTAL PEAK	TOTAL PEAK
JACOBY CREEK															
114	52.5(cfs)	52.5	197.4(cfs)	197.4	319.1(cfs)	319.1	460.9(cfs)	460.9	658.7(cfs)	658.7	658.7(cfs)	658.7	658.7(cfs)	658.7	658.7
115	75.6	4.5	143.3	59.3	193.9	128.1	254.2	209.9	342.4	387.8	342.4	387.8	342.4	387.8	387.8
116	33.3	33.3	132.4	132.4	220.9	220.9	326.6	326.6	476.9	476.9	476.9	476.9	476.9	476.9	476.9
117	20.6	51.0	80.7	203.5	133.1	334.9	194.0	481.0	278.4	678.5	278.4	678.5	278.4	678.5	678.5
118	8.4	53.8	16.8	207.0	22.4	341.8	28.2	490.7	35.5	689.3	35.5	689.3	35.5	689.3	689.3
119	44.1	36.2	139.2	184.7	242.2	420.6	379.3	733.8	591.1	1083.1	591.1	1083.1	591.1	1083.1	1083.1
120	55.7	55.7	237.5	237.5	408.2	408.2	612.2	896.3	575.1	1233.3	612.2	896.3	575.1	1233.3	1233.3
121	33.8	83.4	147.5	350.3	255.9	584.8	387.8	864.5	575.1	1233.3	387.8	864.5	575.1	1233.3	1233.3
122	28.2	110.3	102.7	502.9	185.9	1037.9	289.6	1521.1	435.1	2145.1	289.6	1521.1	435.1	2145.1	2145.1
123	38.5	38.5	120.0	120.0	192.8	192.8	282.1	413.4	413.4	413.4	282.1	413.4	413.4	413.4	413.4
124	83.1	107.2	215.8	261.0	343.8	413.6	505.0	593.8	743.0	850.1	505.0	593.8	743.0	850.1	850.1
125	58.9	68.5	210.6	316.7	365.4	591.2	563.2	809.8	855.7	1123.9	563.2	809.8	855.7	1123.9	1123.9
126	56.5	147.0	149.3	692.8	234.1	1221.1	341.2	1783.0	501.5	2719.1	341.2	1783.0	501.5	2719.1	2719.1
127	44.1	162.5	120.6	723.1	200.8	1284.6	306.3	1897.1	468.3	2854.5	306.3	1897.1	468.3	2854.5	2854.5
128	28.2	167.3	78.6	734.6	137.0	1316.8	217.4	1937.5	346.2	2918.7	217.4	1937.5	346.2	2918.7	2918.7
129	125.4	182.3	239.0	742.9	329.4	1342.3	442.4	1975.4	614.0	2963.8	442.4	1975.4	614.0	2963.8	2963.8
SLATFORD CREEK															
130	74.8(cfs)	74.8	284.9(cfs)	284.9	454.7(cfs)	454.7	647.7(cfs)	647.7	909.2(cfs)	909.2	647.7(cfs)	647.7	909.2(cfs)	909.2	909.2
131	61.0	120.1	250.4	394.4	402.8	588.9	575.4	812.5	810.2	1111.8	575.4	812.5	810.2	1111.8	1111.8
132	53.2	151.3	250.0	456.5	425.3	663.8	635.8	911.5	932.7	1238.5	635.8	911.5	932.7	1238.5	1238.5
133	79.0	189.0	310.7	520.9	512.1	792.4	753.4	1145.6	1093.3	1620.4	753.4	1145.6	1093.3	1620.4	1620.4
134	66.7	208.5	286.0	681.9	476.0	1073.4	694.6	1527.9	999.2	2210.7	694.6	1527.9	999.2	2210.7	2210.7
135	6.3	207.5	43.1	694.6	75.3	1089.2	115.6	1551.5	170.9	2204.9	115.6	1551.5	170.9	2204.9	2204.9
UNNAMED CREEK															
138	35.2(cfs)	35.2	171.2(cfs)	171.2	297.4(cfs)	297.4	455.2(cfs)	455.2	688.4	688.4	455.2(cfs)	455.2	688.4	688.4	688.4
139	17.8	51.9	75.3	244.2	129.6	411.7	199.7	626.5	306.4	929.5	199.7	626.5	306.4	929.5	929.5
140	31.7	53.9	101.7	263.3	168.9	439.7	255.7	664.6	386.5	984.7	255.7	664.6	386.5	984.7	984.7
UNNAMED CREEK															
151	90.9(cfs)	90.9	257.6(cfs)	257.6	367.3(cfs)	367.3	490.2(cfs)	490.2	651.3	651.3	490.2(cfs)	490.2	651.3	651.3	651.3
152	121.0	183.5	366.3	499.9	549.2	677.1	751.2	857.8	1019.7	1093.6	751.2	857.8	1019.7	1093.6	1093.6
153	79.2	227.3	234.1	562.8	345.7	747.2	464.7	964.2	619.4	1272.4	464.7	964.2	619.4	1272.4	1272.4
UNNAMED CREEK															
158	41.1(cfs)	41.1	118.4(cfs)	118.4	170.2(cfs)	170.2	225.0(cfs)	225.0	300.7(cfs)	300.7	225.0(cfs)	225.0	300.7(cfs)	300.7	300.7
159	213.8	241.7	634.6	679.8	921.0	982.2	1226.9	1300.5	1649.1	1712.2	1226.9	1300.5	1649.1	1712.2	1712.2
160	70.3	302.6	216.8	882.3	316.7	1286.4	426.8	1713.7	575.7	2264.0	426.8	1713.7	575.7	2264.0	2264.0
UNNAMED CREEK															
167	125.6(cfs)	125.6	405.7(cfs)	405.7	619.3(cfs)	619.3	858.2(cfs)	858.2	1180.8	1180.8	858.2(cfs)	858.2	1180.8	1180.8	1180.8
168	94.0	94.0	305.8	305.8	478.8	478.8	681.1	681.1	966.8	966.8	681.1	681.1	966.8	966.8	966.8
169	28.5	239.5	103.1	756.8	62.3	1131.5	229.4	1546.5	320.1	2112.1	229.4	1546.5	320.1	2112.1	2112.1
170	16.0	253.2	58.0	789.9	88.9	1176.1	122.1	1589.7	167.8	2170.1	122.1	1589.7	167.8	2170.1	2170.1
UNNAMED CREEK															
179	133.1(cfs)	133.1	284.7(cfs)	284.7	398.9(cfs)	398.9	531.7(cfs)	531.7	724.7(cfs)	724.7	531.7(cfs)	531.7	724.7(cfs)	724.7	724.7
180	68.8	196.4	213.0	486.8	340.2	717.0	500.2	980.0	744.1	1365.5	500.2	980.0	744.1	1365.5	1365.5

PSU-IV PEAK FLOW VALUES FOR THE MARTINS/JACOBY CREEKS STUDY AREA

SUBAREA NO.	2 YEAR		10 YEAR		25 YEAR		50 YEAR		100 YEAR	
	SUBAREA	PEAK	SUBAREA	PEAK	SUBAREA	PEAK	SUBAREA	PEAK	SUBAREA	PEAK
DELAWARE RIVER DIRECT DRAINAGE AREAS										
136	121.0(cfs)	185.00	186.0(cfs)	285.00	221.0(cfs)	348.00	256.0(cfs)	394.00	307.0(cfs)	473.00
137										
141	2.00		4.00		6.00		7.00		9.00	
142	6.00		13.00		17.00		21.00		26.00	
143	168.00		251.00		304.00		356.00		423.00	
144	278.00		425.00		506.00		598.00		687.00	
145	281.00		451.00		521.00		613.00		710.00	
146	33.00		75.00		102.00		125.00		150.00	
147	221.00		336.00		395.00		450.00		526.00	
148	19.00		37.00		49.00		59.00		70.00	
149	197.00		305.00		365.00		426.00		486.00	
150	206.00		331.00		396.00		462.00		538.00	
154										
155	24.00		49.00		65.00		79.00		94.00	
156	14.00		29.00		39.00		47.00		56.00	
157	36.00		79.00		107.00		130.00		155.00	
	16.00		31.00		40.00		48.00		57.00	
161	172.00		266.00		317.00		346.00		432.00	
162	151.00		232.00		275.00		318.00		377.00	
163	167.00		252.00		303.00		361.00		447.00	
164	128.00		200.00		241.00		278.00		327.00	
165	9.00		25.00		35.00		45.00		55.00	
166	5.00		13.00		18.00		23.00		29.00	
171										
172	5.00		14.00		21.00		26.00		33.00	
	225.00		343.00		404.00		459.00		539.00	
173	10.00		31.00		46.00		60.00		76.00	
174	364.00		562.00		655.00		703.00		883.00	
175	45.00		86.00		115.00		140.00		169.00	
176	18.00		41.00		56.00		70.00		85.00	
177	107.00		167.00		201.00		232.00		275.00	
178	211.00		330.00		396.00		448.00		547.00	
181	181.00		292.00		342.00		386.00		463.00	