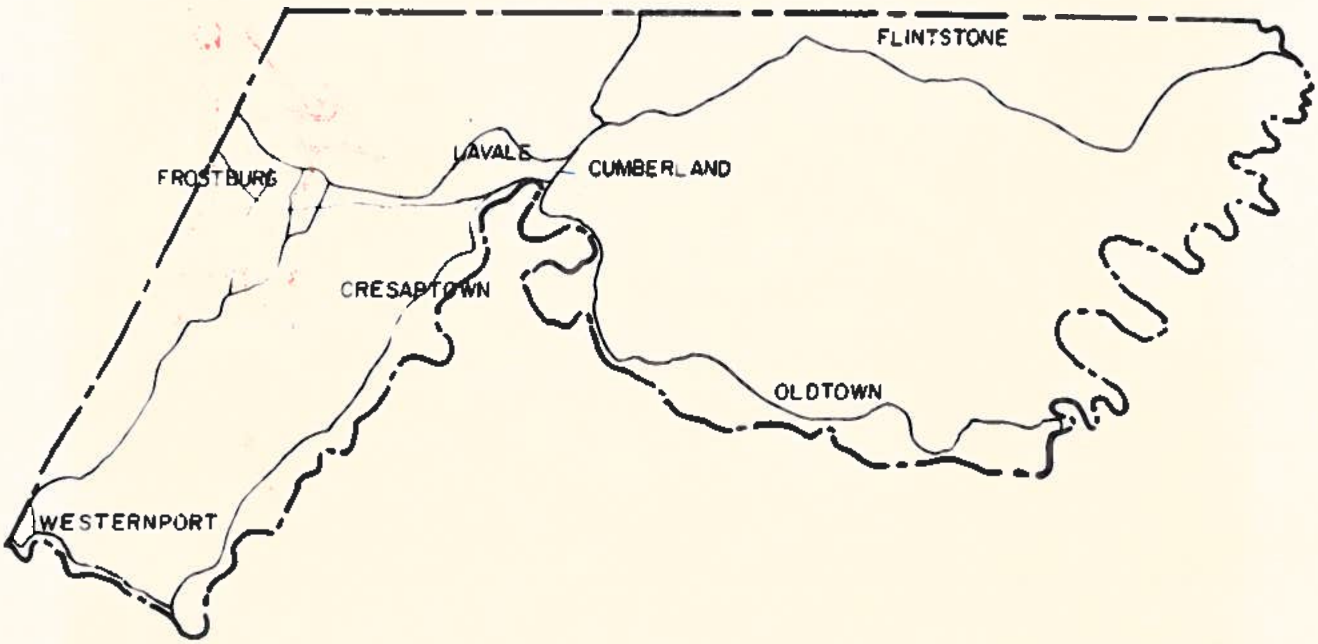
ALLEGANY COUNTY
FLOOD MANAGEMENT STUDY
TRIPLE LAKES



SEPTEMBER 1986

PREPARED FOR

WATER RESOURCES ADMIN.
MARYLAND DEPARTMENT
OF NATURAL RESOURCES

ALLEGANY COUNTY
COMMISSIONERS

PREPARED BY

PURDUM & JESCHKE
CONSULTING ENGINEERS

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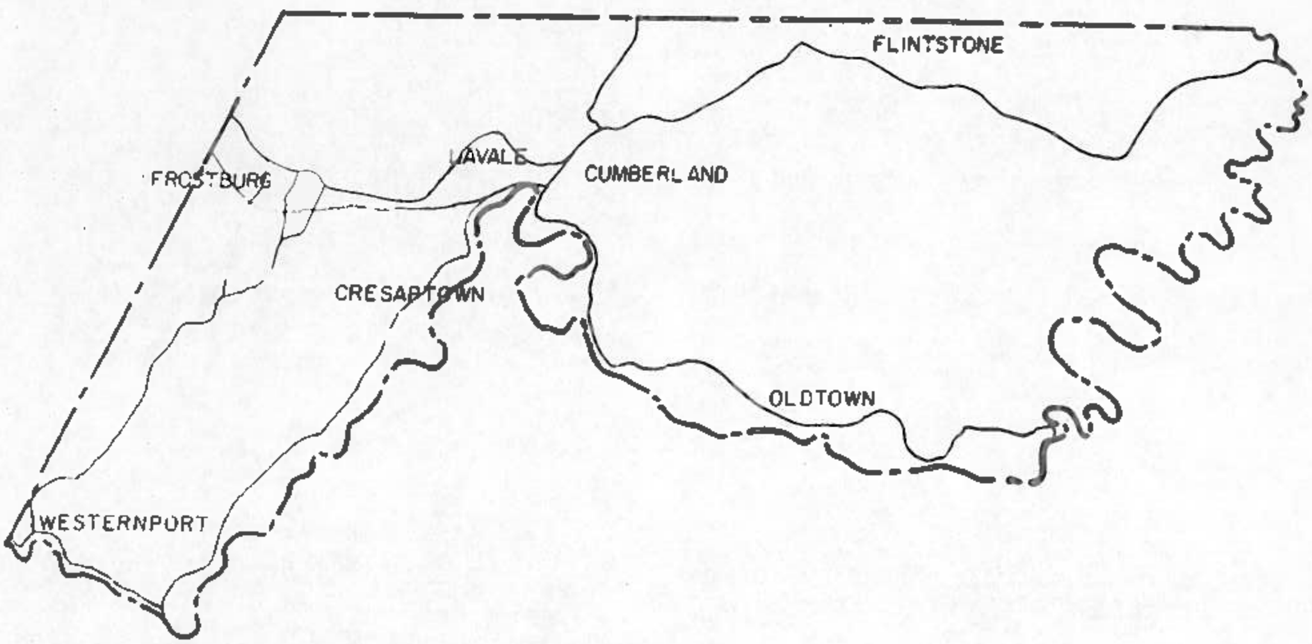

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CONSULTING ENGINEERS AND LAND SURVEYORS

September 30, 1986

Mr. Arthur T. Bond, President
Allegany County Commissioners
County Office Building
3 Pershing Street
Cumberland, Maryland 21502

Subject: Allegany County Flood Management Study
Triple Lakes Watershed

Dear Mr. Bond:

We are pleased to submit herewith the final copies of the Triple Lakes Watershed Flood Management Study.

We accomplished the following:

(1) Developed a hydrologic (TR-20) model of the watershed for existing and planned development conditions.

(2) Developed hydraulic (HEC-2) models of the designated stream reaches.

(3) Delineated the 100-year flood hazard zone.

(4) Defined and evaluated the effectiveness of flood hazard mitigation alternatives.

(5) Prepared a report summarizing the above efforts.

Purdum and Jeschke is pleased to have had the opportunity to perform this interesting and challenging study and stands ready to assist you in the future.

Very truly yours,

PURDUM AND JESCHKE

Cay G. Weinel, Jr.

Cay G. Weinel, Jr., P.E.
Partner

CGW/jm
Attachment

ALLEGANY COUNTY
FLOOD MANAGEMENT STUDY

TRIPLE LAKES WATERSHED

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TRIPLE LAKES WATERSHED

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ALLEGANY COUNTY

FLOOD MANAGEMENT STUDY

TRIPLE LAKES

I. INTRODUCTION

The Allegany County Planning and Zoning Commission and the State of Maryland Water Resources Administration, Department of Natural Resources, have contracted Purdum and Jeschke to perform a study of the Triple Lakes watershed. The purpose of the study is to identify the existing flood hazard areas and evaluate measures to prevent or reduce future flood damages.

The following items have been submitted under separate cover:

1. 1" = 200' mylar subbasin overlay maps to the County topographic maps.
2. 1" = 200' mylar TR-20 schematic overlay maps to the County topographic maps.
3. 1" = 500' mylar TR-20 schematic overlay map and subbasin map.
4. Bound computational data book containing subbasin data. This includes geographic data base attribute files, HYDPAR generated Soil Conservation Service (SCS) runs, runoff curve numbers (RCN), and time of concentration (t_c) computations.
5. The hydrologic (TR-20) computer model for the watershed for existing and ultimate conditions.
6. Bound computational book for the hydraulic data. This includes survey notes, cross-section location map and plots.

7. The hydraulic (HEC-2) computer model for the watershed for existing and ultimate conditions.

8. 1" = 200' scale floodplain delineation maps.

9. Bound computations for flood dollar damage computations.

10. 1" = 600' scale floodplain delineation maps for overlay on the County Tax Maps.

CITIZENS' PARTICIPATION

Two public meetings were held to coordinate the study activities with local and state officials, the consultant, residents, and interested and/or affected organizations. On July 31, 1985, an organizational meeting was held to explain and to coordinate the study effort. At the July 16, 1986 public meeting the results of the floodplain modeling were presented, and a discussion of the possible flood hazard mitigation alternatives prior to their detailed evaluation was undertaken.

A third public meeting will be scheduled following the completion of the final report. At this meeting the detailed evaluation of the alternatives and final report will be presented.

Through the course of this study citizen participation and input has been greatly received. Information on historical flooding was obtained from flood damage survey questionnaires distributed to the residents. Valuable information was also obtained from interviews in the field and at the public meetings.

II. SCOPE OF STUDY

Purdum and Jeschke's agreement with Allegany County and the Water Resources Administration requires that the following tasks be undertaken in order to define the flood hazard areas and evaluate alternative measures.

1. Collect and review all available information, mapping, and reports pertinent to the study. Determine the acceptability and applicability of the data.

2. Field reconnaissance of the watershed and designated stream study reaches. This will include examination of existing conditions, visual inspection of channels and overbanks areas, and interviews with residents.

3. Develop a hydrologic computer model (TR-20) for the Triple Lakes watershed and develop peak stream flows for the 2, 10, 50, 100, and 500-year frequencies for both existing conditions and ultimate development conditions based on the current zoning maps.

4. Develop a hydraulic computer model (HEC-2) for the designated stream reaches. This will include the delineation of the 100-year floodplain.

5. Investigate flood hazard mitigation alternatives for the watershed and recommend action to alleviate flooding problems.

6. Prepare a report summarizing the computations, data, alternatives, and recommendations.

III. DESCRIPTION OF WATERSHED

A. NATURAL DRAINAGE BOUNDARIES

The Triple Lakes drainage area is approximately 2,093 acres in size and is shown in Figure 1, Vicinity Map, Appendix A. The northern boundary of the watershed is Brant Road and continues westward into the Dans Mountains. The watershed is bounded by the mountain ridges in the west. The southern boundary of the watershed is at the Baltimore & Ohio Railroad.

B. SUBBASINS

The total drainage area of the Triple Lakes is divided into 25 subbasins ranging from 11 acres to 276 acres, with 84 acres the average size. Subbasins are delineated so that stream flow rates can be computed to design points in the main channel and tributary. These design points are defined at changes in channel characteristics, bridges and culverts, road crossings, and at branch tributaries.

C. SOILS

All four of the Soil Conservation Service (SCS) Hydrologic Soil Groups, A, B, C, and D, occur in the Triple Lakes watershed. Type A, covering six percent of the area, has the highest infiltration rate and lowest runoff potential of the four groups. Type B, comprising 30 percent of the drainage area, has a moderate infiltration rate and moderate runoff rate. Type C covers 60 percent of the area and consists of soils which have a slow infiltration rate and high runoff potential. Type D comprises four percent of the land and has the slowest infiltration rate and highest runoff potential of all the soils groups.

D. SLOPE

The watershed slopes vary considerably, ranging from five percent in low-lying areas near the main stream to seven percent in hilly areas and as high as 20 percent in the mountainous areas.

E. LAND USE AND ZONING

The existing land use of the watershed was determined from field reconnaissance, aerial photographs, and existing topographic mapping. Wooded areas comprise 62 percent of the watershed in the northern and western parts. Residential areas make up 21 percent in the southern and eastern areas. Meadows and pastures comprise 15 percent of the watershed. Two percent of the area is commercial along the major road network.

The current zoning maps indicated that 40 percent of the watershed is zoned for residential or rural residential use in the eastern part of the watershed. Conservation areas are zoned for the western part of the watershed covering 42 percent of the area. The remaining 16 percent is zoned for business and industrial use.

IV. FIELD INVESTIGATION

Field investigations were necessary to ensure proper modeling of the Triple Lakes watershed. The data gathered during field investigations are summarized as follows:

A. HYDRAULICS OF DESIGNATED STREAM REACHES

Field examinations were made of the designated stream reaches in the Triple Lakes watershed. Channel size and shape were noted in order to develop reach cross-section data for the TR-20 hydrologic modeling and for hydraulic analysis of the study reaches.

B. DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS

The main stream and tributaries, as shown on the Location Map, Figure 3, Appendix A, were examined to determine ground conditions of the channel and overbanks. Existing ground conditions were recorded on 1" = 200' scale Allegany County topographic maps. Photographs were taken at various points along the streams to document field conditions. This information was used to determine the Manning's roughness coefficients for the HEC-2 model flood depth calculations.

The procedure to estimate roughness coefficients is described in the Guide for Selecting Roughness Coefficient 'n' Values for Channels (SCS Manual TR-24). It involved selecting a base roughness coefficient and adding modifying values that reflect: (a) degrees of surface irregularity, (b) variation of shape and size of cross-section, (c) obstructions, (d) vegetation, and (e) meandering of channel within the flood plain. Photographs with assumed roughness coefficients were compared to similar photographs appearing in SCS Manual TR-24 and in Roughness Characteristics of Natural Channels (Geological Survey Water Supply Paper 1849).

C. EXAMINATION OF STRUCTURES

All structures along the main stream and tributaries were examined for evidence which might aid in better computer modeling. High water marks identified by debris suspended from the underside of a structure or along the brush on the stream banks indicated frequent flooding and provided insights into the hydraulic performance of the structure. Identification of likely flow paths for overtopping floods helped to later define the weir cross-section as well as other hydraulic modeling data for bridges and culverts.

D. STUDY METHOD DETERMINATION

From field investigations of the stream reaches and with the aid of existing topographic mapping, a determination was made as to which study method should be used to analyze each particular stream reach. The stream reaches were studied by either a detailed HEC-2 computer model or by other computational methods.

The HEC-2 computer model was used on stream reaches where a gradually varied flow condition and relatively similar cross-section existed. For these reaches, the surveying services of SPECS, Inc. of Cumberland, Maryland were used to obtain surveyed stream cross-sections, bridge and culvert measurements, and house first floor elevations.

In the Triple Lakes watershed the main stream, Tributaries No. 1, 3B, and 5 were studied using the HEC-2 computer program.

Computational methods such as Manning's equations, culvert headwater nomographs, and capacity charts were used for those stream reaches exhibiting any of the following characteristics:

1. The majority of the reach was a closed storm drain system.

2. The reach consisted of roadside ditches with culverts crossing under the streets.

3. The reach was a steep sloped swale which conveyed water only during flood events.

4. The reach was located in areas which were undeveloped and where flood damages were unlikely to occur.

In the Triple Lakes watershed, Tributaries No. 2, 3A, 4, and 4A met the above criteria.

E. DISTRIBUTION OF QUESTIONNAIRES

Questionnaires were distributed during the field reconnaissance to residents living adjacent to the stream reaches. The questionnaires were designed to obtain information on past flooding events. Questions asked included: the number of years in residence, type of home, dates of most severe flood events, depth of flooding in basement or first floor, and known high water marks inside or outside of the home.

A copy of the questionnaire is found in Appendix C of this report. There was a 8 percent response from the questionnaires distributed. No first floor flooding was reported by any of the responses.

V. COMPUTER APPLICATIONS

The use of microcomputers for digital mapping, automated computation of hydrologic parameters, and hydrologic and hydraulic computations greatly reduced the volume of manual work normally associated with watershed studies of this size. All applications were performed on an IBM PC with peripheral equipment including hard disk storage, digitizer, and color monitor.

A. DIGITAL MAPPING - GEOGRAPHIC INFORMATION SYSTEM

The Aeronca Electronics Geographic Information System (AE-GIS) was used to store, display, and analyze map data which included watershed boundaries, subbasins, existing land use, zoning classifications, Soil Conservation Service (SCS) soil types, and stream reaches. The microcomputer based AE-GIS stores map data as well as any form of demographic data in grid cell form based on any cell size and reference data. For the Triple Lakes watershed, a cell size of 100 feet by 100 feet (0.23 ac.) was selected as an appropriate size for calculation of hydrologic parameters for subbasins as small as eight acres. The reference datum selected was the Maryland State Plane Coordinate System.

B. IDENTIFICATION OF LAND COVER

Existing land cover identification was made from Allegany County 200-foot-scale topographic maps with updates from field observations and 1982 aerial photographs from the Soil Conservation Service. Ultimate land cover was determined from zoning maps. Land cover was classified into one of the following eight land cover classes: Wooded, Parks/Schools, Rural Residential, Residential, Commercial, Industrial, Meadow/Pasture, Water.

C. AUTOMATED COMPUTATION OF HYDROLOGIC PARAMETERS

Hydrologic parameters were computed by using HYDPAR, a program module added to the AE-GIS software. Utilizing the grid cell data bases created for soil types, land use, zoning, and subbasins; the HYDPAR program computes the runoff curve numbers (RCN) and area for each of the nine subbasins. RCN values were computed for existing and ultimate conditions. The RCN value for each subbasin is shown in the Drainage Area Summary, Table 1 in Appendix B.

D. WATERSHED HYDROLOGIC MODELS USING SCS TR-20

1. Description of TR-20 Model

The U.S. Department of Agriculture SCS program, TR-20 (1983 version), was used to model hydrology in the Triple Lakes watershed. This program uses the SCS runoff and unit hydrograph procedure, stage-discharge reservoir routing, and modified attenuation-kinematic routing procedure to generate stream flow rates at all design points along the main stream and tributary.

2. Times of Concentration

Times of concentration were determined by charting flow paths on Allegany County topographic maps with divisions for overland flow (forest, open, urban, or combined), swale or ditch flow, and stream flow. Velocities were obtained from:

Figure 3-1, SCS, Urban Hydrology for Watersheds, TR-55.

Figure SHA-61.1-402.2, Maryland State Highway Administration, Highway Drainage Manual, December 1981.

3. Reach Cross-sections

In order to route the runoff hydrograph through stream reaches, discharge-end area tables were input into the TR-20 model. The discharge-end area tables were developed by running multiple flows through the reaches using the HEC-2 computer program. Channel cross-section shapes and roughness coefficients for HEC-2 input were determined during field investigations.

4. Rainfall

The standard SCS Type II 24-hour rainfall storm distribution with a rainfall increment of 0.25 hours and a main time increment of 0.10 hours was initially used in the TR-20 modeling. The results of the modeling showed that the reach routings were defaulting, and no attenuation of flow was occurring due to the main time increment size. A smaller main time increment could not be used with this rainfall table because of the limiting value in the TR-20 program of 300 points per output hydrograph. This was not sufficient to obtain the peak flows for some subbasins.

A portion of the standard SCS Type II 24-hour rainfall distribution from hour 7.5 to 13.5 with a rainfall increment of 0.10 hours was used in the final modeling. This rainfall table allowed the use of a main time increment of 0.02 hours. The output hydrographs began at 7.5 hours because there is no runoff from hour zero to 7.5 hours. The peak flows for all subbasins were obtained within the 300 point limit of the program. The reach routings now were attenuating all flows.

5. Flow Comparison

The estimated 100-year frequency storm discharges for gaged streams of similar size watersheds in Allegany and the three neighboring counties of Frederick, Carroll, and Washington was obtained from the U.S. Geological Survey. The discharge versus drainage area was plotted for the gaged streams and is presented as Figure 2 in Appendix A. An upper and lower limit line was drawn for the gage data for the four counties along with a separate upper limit line for Allegany and Washington Counties. The 100-year discharge for existing development from the TR-20 model of the Triple Lakes watershed is shown as Point Number 4 on this plot.

The TR-20 discharge is above the upper limit line for all four counties, indicating that the TR-20 modeling is predicting higher 100-year flood discharges than would be expected based on stream gage data. Changing the TR-20 model watershed parameters within reasonable engineering limits could not produce discharges that were compatible with the regional gage information. This fact led to the examination of the standard Type II rainfall distribution. The Type II rainfall distribution contained rainfall intensities that were higher than what has been experience in the Allegany County area.[1] Input of the lower intensity rainfall into the TR-20 model produced 100-year frequency discharges which fall within the upper and lower limits of the regional gage data. The Type II rainfall distribution is required by State regulations.

E. HYDRAULICS

1. Description and Input Data Requirements

The HEC-2 program is designed to model the stream hydraulics. The program will compute the water surface profile, flow velocities, energy gradient, and friction losses. Additionally, it will accommodate hydraulic structures such as bridges, culverts, weirs, and any combination of flow through or over these structures. Input information used in programming HEC-2 includes cross-section geometry, Manning's roughness coefficients, stream flow rate, and minor losses due to expansion and contraction of the cross-sectional areas.

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[1] Maryland Department of Transportation, State Highway Administration, Highway Drainage Manual, Table S.H.A. - 61.1-403.1, December 1981.

Peak discharges for the 2, 10, 50, 100, and 500-year frequency storms for both existing and ultimate land use, developed by the TR-20 models, were programmed into HEC-2. Water surface profiles were calculated for each frequency storm.

2. Accuracy of HEC-2

The accuracy of any computer model is, in part, dependent on the basic assumptions inherent in the modeling technique. The HEC-2 computer program is a one-dimensional model based on the assumption of steady, gradually varied flow. The accuracy of the model is partially dependent on how closely the prototype conforms to these basic assumptions. As a general rule, the steady gradually varied flow assumption yeidls good results for streams with gentle slopes (10 percent or less) and relatively constant cross-sections. The main stream of Triple Lakes meets both of these requirements.

The other factors affecting the accuracy of the HEC-2 model are as follows:

a. Stream flow rate and variation along length of reach.

b. Manning's roughness coefficient for determining resistances to flow from channel and overbank surfaces.

c. Stream geometry - such as cross-sectional form and channel slopes.

The flow rates at design points along the length of the stream are computed by using the Soil Conservation Service computerized hydrograph method for runoff determination (TR-20) as described previously.

The assignment of Manning's roughness coefficients were chosen by applying data from careful field observation to the techniques presented in SCS publication, TR-24. Several roughness coefficients were chosen for each cross-section in the study areas.

Stream geometry is defined by locating cross-sections along the stream. The impact each cross-section has on the model is dependent on the distance between cross-sections. Sections were chosen where it was necessary to describe changes in cross-section shape, channel or overbank roughness coefficients, channel slope, or in flow rate at a location of stepped increase. Cross-section information was obtained from field surveys performed by SPECS, Inc. of Cumberland, Maryland.

3. Development of HEC-2 Models

The HEC-2 models were developed in two steps. First, all bridges were analyzed individually to determine the best HEC-2 modeling application. Second, each reach between the structures was analyzed to determine general stage-discharge and flow regime characteristics which aided in development of the final stream model.

4. Structures

Each of the structures in the detailed study areas was analyzed separately to determine which of the following two techniques would provide the most accurate model for use in the final HEC-2 programs.

a. Calculating the energy loss using the HEC-2 normal bridge routine.

   The normal bridge routine handles a bridge cross-section in the same manner as a natural river cross-section with the following exception. The area of the bridge structure that is below the water surface is subtracted from the total area, and the wetted perimeter is increased where the water is in contact with the bridge structure. This routine is most applicable when friction losses are the predominant consideration.

   In this study, the Trailer Park Road on Tributary No. 1 and First Street were modeled by this routine.

b. Calculating the energy loss using the HEC-2 special bridge routine.

The special bridge routine computes losses through the structure for either low flow (water surface below low chord of structure), pressure flow (water surface above low chord of structure), weir flow (flow around bridge and/or over bridge deck), or for a combination of these. The profile through the bridge is calculated by using hydraulic formulas to determine the change in energy and water surface elevation through the bridge. Although this technique is capable of solving a wide range of flow problems, it is most applicable for structures operating under pressure flow conditions with road embankments having well-defined weir surfaces.

All U.S. Route 220 culverts and bridges and Pinto Road were modeled with the special bridge routine.

VI. STREAM STUDY REACHES

A. DESCRIPTION OF STREAM STUDY REACHES

The stream reaches studied in this watershed are described below and are depicted on Figure 3, Location Map, in Appendix A.

1. Main Stem

The main stream of the Triple Lakes begins at the pond west of Marshall Drive and flows in a southeasterly direction parallel to Lake Drive until U.S. Route 220. The stream then flows under U.S. Route 220 and turns to flow in a southerly direction parallel to it until Pinto Road. Below Pinto Road the stream flow is a southeasterly direction toward the Western Maryland Railroad. The stream flows in a box culvert under the railroad and then confluences with the North Branch of the Potomac River. The stream length is 9,260 feet, and the average stream slope is 1.8 percent.

2. Tributary No. 1

The flow for Tributary No. 1 begins at Barton Boulevard south of Bel Air Elementary School. The tributary flows in a southerly direction towards Miners Lane, and then turns to flow in a easterly direction parallel to the road until it reaches U.S. Route 220. Below U.S. Route 220 the tributary flows along the outer boundary of the trailer park and confluences with the main stream. This tributary is 4,080 feet in length and has an average slope of 2.5 percent.

3. Tributary No. 2

Tribuary No. 2 begins as a closed storm drainage system above Forest Street and flows in an easterly direction until Downing Street. Below Downing Street, the stream flows as an open ditch in an easterly direction toward U.S. Route 220. The stream then flows in a culvert from

U.S. Route 220 to the confluence with the main stream. The length of this stream culvert system is 1,700 feet.

4. Tributary No. 3A

Tributary No. 3A begins at a point south of Brandywine Drive and flows in an easterly direction as swale flow toward Shamrock Road. The tributary then enters a closed storm drain system at Shamrock Road and continues as a closed system until its confluence with the main stream. This drainage system is 2,700 feet in length.

5. Tributary No. 3B

Tributary No. 3B begins south of Greenfield Road. The tributary flows in a southeasterly direction toward First Street and, after going through a culvert, continues toward McMullen Highway (U.S. Route 220). At McMullen Highway, the runoff enters a culvert going under the highway, and then the tributary discharges into the main stream. This tributary is 1,600 feet in length with an average stream slope of 2.4 percent.

6. Tributary No. 4

Tributary No. 4 is comprised of roadside drainage ditches and street culverts. The study reach begins at Harold Drive. The road ditch flows in a southerly direction on the east side of Marshall Drive from Harold Drive to halfway between Yoder Drive and Oak View Drive. At this point, the tributary turns to flow in a southeasterly direction behind the homes on Yoder Drive to Cunningham Drive. A culvert exists from Cunningham Drive to Elton Avenue. An open ditch extends from Elton Avenue to Grace Avenue. At Grace Avenue, the runoff enters a culvert that discharges into the main stream. This drainage system is 3,300 feet long and has an average slope of 4.1 percent.

7. Tributary No. 4A

Tributary No. 4A is comprised of yard swales and culverts. The tributary begins as a culvert above Harold Drive. It then flows in a southwesterly direction in a swale until Yoder Drive. A culvert exists above and below Yoder Drive. The tributary confluences with Tributary No. 4. This drainage way is 1,120 feet long with an average slope of 6.3 percent.

8. Tributary No. 5

Tributary No. 5 begins above the Barton Boulevard culvert. It flows in a southeasterly direction toward U.S. Route 220. At U.S. Route 220 the stream flows between the trailer park and the new stores. The stream flows in a culvert under U.S. Route 220 and confluences with the main stream. This stream is 2,100 feet in length with an average slope of 2.5 percent.

B. MANNING'S ROUGHNESS COEFFICIENT

Manning's roughness coefficients average 0.06 for the channel section of the streams. A value of 0.06 for lawns, 0.07 for high grass and shrubs, and 0.10 for wooded areas was used in the overbank areas.

C. STRUCTURES

Thirty-three bridge and culvert structures were identified within the stream study reaches and were examined in the field. The size of each was determined from either field surveys or from field reconnaissance as indicated on Table 2, Appendix B.

D. IDENTIFICATION OF FLOOD HAZARDS

The water surface elevations for the 2, 10, 50, and 100-year frequency storms were developed for both existing development conditions and ultimate development conditions, based on the current zoning maps. The elevations are presented in Table 3, Appendix B. The water surface elevations for ultimate conditions showed an average increase of less than 0.5 foot over existing conditions. Hence, the full development of the Upper Georges Creek watershed based on the current zoning maps will show little change from the existing flooding conditions. Existing flooding conditions can, therefore, be said to equal the ultimate flooding conditions.

The water surface profiles for the 2, 10, and 100-year frequency storms, existing conditions, are shown in Appendix D. The water surface profiles also depict the first floor and basement elevations of flooded structures in the floodplain. These have a letter and/or number code. The bridges and culverts within the study reaches are also shown on the profiles.

The delineation of the 100-year flood zone, ultimate conditions, is presented in Appendix E. A description of the flooding conditions on each study reach is given below.

1. Main Stream

The 100-year floodplain north of the Baltimore & Ohio Railroad (Western Maryland) is the backwater from the railroad. This backwater extends 1,750 feet upstream. One structure (AW-1) is located on the edge of the flood zone. This structure is a garage-storage type building.

The floodplain upstream from the backwater area is the combined floodplain from the main stream and Tributary No. 1. The trailer park (typical trailers AW and BO) would be inundated by flood waters, but the depth would be below the trailer floor level.

The floodplain between the trailer park and Pinto Road averages 300 feet in width. In this reach of the stream there are five structures in the floodplain. Three of these are commercial buildings (AX, AY, AY-1) which will receive first floor flooding. The remaining two structures are residential homes (AZ, BB). One will experience first floor flooding (AZ) and one basement flooding (BB). The flooding is the natural floodplain of the stream.

The floodplain from Pinto Road upstream to where the stream crosses U.S. Route 220 is confined to the east side of U.S. Route 220. Above Pinto Road the floodplain averages 300 feet in width and narrows down to 200 feet at the U.S. Route 220 crossing. There are seven homes and a trailer sales park in the floodplain in this reach of the stream. In the trailer sales park, the trailers (typical trailer BC, BD, and BE) would experience first floor flooding. Three homes (BF, BL, BM) in this reach will experience first floor flooding, two homes (BG, BH) will experience basement flooding, and two homes (BI, BJ) will receive foundation flooding. This reach of stream is not aggrevated by any obstructions or restrictions. This is the natural floodplain of the stream.

The remaining floodplain on the main stream from U.S. Route 220 to the pond near Marshall Drive averages 100 feet in width. One structure (BM) is located in the floodplain and will receive first floor flooding. However, this is a rundown, abandoned building. The U.S. Route 220 culvert will be overtopped.

2. <u>Tributary No. 1</u>

The floodplain for Tributary No. 1 is combined with the 100-year floodplain of the main stream from the confluence to U.S. Route 220. The trailer park mentioned under the main stream description is located in this floodplain. There are four additional residential homes (BP, BQ, BR, BS) in this reach of flooding. All receive basement flooding during the 100-year storm.

The floodplain from U.S. Route 220 to Barton Boulevard averages 100 feet in width. There are no structures subject to flooding in this reach. The U.S. Route 220 culvert is overtopped by the 100-year flood.

3. Tributary No. 2

The flooding on Tributary No. 2 from Forest Street to Downing Street will be due to the overflow of the existing storm drainage system. The floodplain from Downing Street to U.S. Route 220 will be open ditch flow. U.S. Route 220 will be overtopped by the 100-year storm and will flood towards the confluence with the main stream. No residential structures are subject to flooding on this tributary.

4. Tributary No. 3A

The floodplain for Tributary No. 3A averages 50 feet in width upstream from the culvert above Shamrock Road. No damage will occur to any structures in this reach. Sheet flow will occur from the overflow of the culvert system from Shamrock Road to the confluence of the main stream.

5. Tributary No. 3B

The floodplain for Tributary No. 3B averages 100 feet in width. The First Street and the U.S. Route 220 culverts will be overtopped by the 100-year storm. Three structures are located in the flood zone. One will receive basement flooding (BV) and the other two (BM-1, BU) will receive foundation flooding.

6. Tributary No. 4

The flooding for Tributary No. 4 will consist of ditch flow between road culverts. The overflow of the ditches and culverts will result in sheet flowing. This will put flooding on the properties adjacent to ditches, but no structural damage will occur.

7. Tributary No. 4A

The flooding of Tributary No. 4A will consist of open swale flooding and culvert flow. The flooding condition is similar to that of Tributary No. 4. Overflow of the swales or culverts will result in sheet flow flooding of the properties.

8. Tributary No. 5

The floodplain of Tributary No. 5 from Barton Boulevard to the trailer park at U.S. Route 220 averages 100 feet in width. In the trailer park, three trailers (typical trailer CC) will be subject to first floor flooding, and nine trailers (typical trailers CA and CB) will experience flooding around the structures. The culvert at U.S. Route 220 will be overtopped during the 100-year storm, and the floodplain will combine with the main stream floodplain. Three residential structures (BY, BZ, BS-1) along U.S. Route 220 will experience foundation flooding.

VII. ESTIMATED FLOOD DAMAGE COSTS

The dollar damages that would be caused by a 2, 10, and 100-year storm were estimated. These damages consisted of public and private sector damages as well as abstract losses described below. The damages computed for these three storms were converted to an average annual flood damage cost. This is the amount of dollar damage that can be expected to occur on the average every year. The purpose of computing the average annual flood damage cost is to enable comparison with the annual cost of flood mitigation alternatives or projects. The average annual flood damage costs were converted to a single present value based on a nominal interest rate for a 30-year period. This present value represents the maximum expense that could be justifiably spent at today's dollars to alleviate all the flood damages. Spending this amount of money on improvements may not remove all flood damages.

A. PRIVATE SECTOR DAMAGE COSTS

Three types of flood damage costs are computed to determine the private sector losses. These costs consist of flood damages to the home and its contents, damage to exterior property, and damage to vehicles.

Flood damage losses for private homes are dependent on the depth of flood water within the home, the value of the home, and the value of its contents. The average value of each home and its contents are estimated based on the method found in the Corps of Engineers' Institute for Water Resources, Pamphlet No. 4 titled, "Cost Report on Non-Structural Flood Damage Reduction Measures For Residential Buildings Within the Baltimore District" (Reference 1).

The base structural value of a home is determined from the type of home, the structural composition, and type of foundation. Table III-2, shown in Appendix C, taken from Reference 1, gives a high and low base structural value of a home. This table reflects a seven percent annual inflation adjustment. Base value adjustment factors are used for location, quality of construction, condition of house, and size according to the age of the house. Table III-4, Appendix C, is used with the low base value of the home for structures over 25 years in age. Table III-5, Appendix C, is used with the high base value of the home for newer structures less than 25 years in age. The adjusted base values of the homes in the floodplain ranged from $39,000 to $68,000. The adjusted base value for trailers averaged $22,000.

The value of the contents of a home is based on the square footage of the first floor, shown in Table 2-5, Appendix C, taken from the Corps of Engineers "DAPROG2, Flood Damage Assembly Computer Program" (Reference 2). The values on this table also reflect a seven percent annual inflation adjustment. The average contents value of the homes and trailers within the study area ranged from $18,000 to $21,000.

The dollar damage to the home and its contents is based on the flood depth of the 2, 10, and 100-year frequency storms determined from the flood profiles and floodplain delineation. The computed flood depth is referenced to the first flood level (Stage Zero). Flood stage above the first floor is indicated by a positive value while flood stage below the first floor (basement flooding) is a negative value. The percent damage to the structure and its contents is based on this flood stage. The percent damage is determined from Table 5, Appendix C, taken from Reference 1. These percentages are multiplied by the house and contents values determined above to determine the dollar damages. Damages are calculated in this manner for the 2, 10, and 100-year frequency storms.

A clean-up cost for exterior flood damage is estimated for each property. This includes removal of debris left by the storm and repair of lawns and plantings. Also, an estimated cost to repair or replace damaged fences and sheds and their contents is included in the exterior property damages.

The final item considered under private sector losses is vehicular damages. One car per household is used for damage cost calculations.

The total private sector losses for the watershed are shown in Table 4, Appendix B, for existing conditions and Table 5 for ultimate conditions in Appendix B.

B. PUBLIC SECTOR DAMAGE COSTS

Public sector losses are computed for emergency police service to assist residents and divert traffic from flooded roadways, city clean-up services within the public rights-of-way, and private utility clean-up services.

The estimated cost of emergency police service includes one police car and two policemen for each flooded intersection. For the 2 and 10-year storms, one-half day of service is estimated. One day of service is estimated for the 100-year storm. The cost of a police car is based on a rental vehicle rate of $50 per day. The wages for a police officer is estimated to be $120 per day.

The clean-up costs of public road rights-of-way includes the labor and equipment costs for the community maintenance crews. It is estimated that a dump truck and a front-end loader would be the minimum equipment required to load and haul debris left by a storm. A rental rate of $44 and $54 per hour is used for the dump truck and front-end loader, respectively, which includes the cost of the equipment and driver. Laborers are also needed to pick up and clean up the debris prior to being handled by the equipment. It is estimated that two laborers would be required for one day to clean up the debris from a 2-year and 10-year storms. The 100-year storm would require four workers for two days of clean-up. The average wage cost is estimated at $10 per hour.

Estimated costs are also made for private utility clean-up and repairs. Lump sum estimates of $300 per day are used for telephone and electrical clean-up. This amount includes the cost of equipment and manpower. The 2-year and 10-year storms require one day of clean-up for each utility. The 100-year storm requires two days for telephone and gas and electric utilities.

The total public sector losses for the study area for existing and ultimate conditions are shown in Tables 4 and 5 of Appendix B.

C. ABSTRACT LOSSES

Flood damage costs are computed for a loss of income to homeowners who will take time off from work to clean their home and property after a storm.

The loss of income to homeowners is based on the days off from work and the average daily wage earned per household. The clean-up times estimated for the 2, 10, and 100-year storms are one, one, and two days, respectively. The number of flooded households is determined for each storm from the flood delineation maps. An average wage of $15 per hour ($120 per day) per household is multiplied by the days out of work and then by the number of households. The results are also shown in Tables 4 and 5 of Appendix B.

D. AVERAGE ANNUAL FLOOD DAMAGE COST

The total dollar damages for the private, public, and abstract loss are added together for the 2, 10, and 100-year storms. The computational method presented by the Corps of Engineers in "Computations of Expected Annual Damages" is used to convert the total dollar damages for the 2, 10, and 100-year storms to average annual damages (Reference 3). The average annual flood damages are costs that would occur every year on the average. The average annual damages for Triple Lakes for existing and ultimate conditions is $117,000 and $128,000, respectively.

E. PRESENT VALUE OF AVERAGE ANNUAL FLOOD DAMAGE COST

The amount of money you would need to have in the bank today at a nominal interest rate of 8 percent which would pay average annual flood damage costs every year for the next 30 years is called the present value of the average annual flood damages.

The present value of the flood damages can be estimated based on the calculated annual flood damages and a discount rate of eight percent. The present value is a lump sum equivalent to an unending annual series of payment or, in this case, losses. A discount rate of eight percent is customarily used for flood protection projects. It represents the relative value of money today compared to money in the future. The inflation rate can be ignored since it will not affect the calculations.

The present value of the average annual flood damages for Triple Lakes is $1,317,000 and $1,442,000 for existing and ultimate conditions, respectively.

These dollar values represent the maximum amount of money that could be spent on improvements. However, spending this amount of money may not eliminate all flood damages. There still may be residual damage costs.

VIII. FLOOD MANAGEMENT ALTERNATIVES

A. PRELIMINARY ALTERNATIVES SCREENING

The initial investigation of flood hazard mitigation alternatives involved a screening of possible alternatives to determine which measures may be applicable to the watershed. Both structural and non-structural measures were considered. Structural improvements involve construction in the floodplain to reduce damages, while non-structural considerations are plans and policies to control effects of flood damage without altering the floodplain itself. A combination of structural and non-structural measures are often utilized in flood mitigation projects. The following is a list of alternatives that were considered:

Structural Improvements:

(1) Bridge and culvert replacement
(2) Retention structure
(3) Detention structure
(4) Stream relocation
(5) Stream enclosure
(6) Levees
(7) Flood walls
(8) Channelization
(9) Foundation raising
(10) Floodproofing

Non-Structural Considerations:

(1) Acquisition
(2) Flood insurance
(3) Flood warning system
(4) Zoning and land use runoff characteristics and regulations
(5) Stormwater management regulations

Each of the above alternatives was evaluated for feasibility within the watershed, and a preliminary list of applicable alternatives was compiled. A meeting was held between the representatives of the Consultant, Allegany County, and the Water Resources Administration to review the preliminary list of alternatives, and a final list of improvement alternatives was developed for a more detail analysis.

B. COST BENEFIT COMPARISON

In order to assess the economic efficiency of each of the floodplain management mitigation alternatives, projects costs and benefits were determined. Project costs as defined in this study are labor, equipment, materials and construction costs, operation and maintenance costs, and administration costs. Benefits are defined as reduction in the areas of physical damage, emergency costs, and income losses. The project cost and benefits are compared on a present value basis. When project costs exceed benefits, it is an indication that the alternative is not economically justifiable.

C. PROPOSED FLOODPLAIN MITIGATION ALTERNATIVES

1. Main Stream

There is one structure (AW-1) located on the edge of the backwater flooding of the Baltimore & Ohio Railroad. This is a garage structure which may experience minor first floor flooding. Flood insurance and/or floodproofing is proposed to mitigate the flood losses.

The trailer park below Pinto Road (typical trailers AW and BO) located between the main stream and Tributary No. 1 will be completely engulfed by the flood waters. The flood depths will be shallow, not causing any first floor flooding. If a flood event of a magnitude greater than the 100-year event should occur, significant damage may result. These trailer owners should purchase flood insurance to be protected against flood damage costs.

There are five flooded structures between the trailer park and Pinto Road. Three of these structures (AX, AY, AY-1) are commercial structures subject to first floor flooding. To mitigate flood losses, the owner should purchase flood insurance. The one residential structure (AZ) which receives first floor flooding is a candidate for the purchase option. The remaining structure (BB) will experience basement flooding. The flood depth around the basement will be greater than one foot, and an access problem exists during flooding. This would make the structure elegible for the purchase option. In lieu of purchase, floodproofing and flood insurance are the only way to mitigate flood losses.

Pinto Road is overtopped by the 10 and 100-year storms. It would be very difficult to replace the box culvert to prevent the road from flooding without raising the road surface itself. The road currently is very level. Raising the road will back up the water to increase the flood damages upstream. It would take five 92" x 65" pipe arch culverts to convey the 10-year storm without raising Pinto Road. This is not practical to do. A bridge or larger box culvert are not feasible or economical.

The trailer sales park (typical trailers BC, BD, BE, BY and BZ) located above Pinto Road will be subject to first floor flooding. In lieu of moving from the site, the trailers should be adequately insured.

There are eight structures subject to flooding in the stream reach from the trailer sales park to the U.S. Route 220 crossing. The four structures (BF, BF-1, BK, and BL) which receive first floor flooding are candidates to be purchased. However, one of these structures is a gas station, and one is a convenience store. Purchase is not proposed for either (BF, BF-1); instead, flood insurance should be obtained by the owners. The two structures (BG, BH) which receive basement flooding should consider floodproofing and flood insurance to mitigate flood losses. Structure BG would have more than one foot of flooding around the basement. Due to the access condition, it could also be considered as a purchase candidate. The two structures (BI, BJ) which experience foundation flooding should also be protected by insurance and/or floodproofing.

There is one structure (BM) in the floodplain above U.S. Route 220. This is a rundown, abandoned structure. It should be torn down. If this structure were to be occupied, it would receive extensive first floor flooding and alternative improvements would be necessary.

2. Tributary No. 1

There are four structures (BP, BQ, BR, BS) which will experience basement flooding on Tributary No. 1 below U.S. Route 220. Improvements to the U.S. Route 220 culverts would not significantly reduce the flood damage to these four structures. It is proposed that these four homeowners look toward floodproofing and flood insurance to mitigate their flood losses. Structure BQ will have more than one foot of flooding around the basement and should also be considered for purchase.

3. Triburary No. 2

There is an existing storm drainage system on most of this tributary. No damage to residential structures is estimated. The overtopping of the First Street and U.S. Route 220 culverts is not of a magnitude to economically justify culvert replacement.

4. Tributary No. 3A

There is no flood damage estimated for this stream.

5. Tributary No. 3B

The flood damage on this stream consists of basement flooding to one structure (BU) and foundation flooding of two other structures (BM-1, BU). The overtopping on the First Street culvert does not significantly increase the flooding condition. It is proposed that all three homeowners consider floodproofing and flood insurance to reduce their flood losses.

6. Tributary No. 4 and No. 4A

The trailer park and residential areas adjacent to Tributaries No. 4 and No. 4A will be subject to minor property flooding from the overflow of the ditches and culverts. No significant damages are anticipated in these areas, and no improvements are proposed.

7. Tributary No. 5

The trailer park on the west side of U.S. Route 220, just above Pinto Road, will be subject to flood damage due to Tributary No. 5. Three trailers (typical trailer CC) will experience first floor flooding, and the other eight (typical trailers CA and CB) will be surrounded by the flooding. As with the other trailer park areas, the owners should be adequately insured. There is one other residential structure (BS-1) which will experience foundation flooding. This homeowner should floodproof the foundation.

The U.S. Route 220 culvert is overtopped by the 100-year storm. However, it does not aggrevate the upstream flooding condition. To prevent the road from flooding the following culverts would be required: three 72" x 44" pipe arches are required for the 10-year storm, and six 65" x 40" pipe arches are required for the 100-year storm. The existing system conveys the 2-year storm. The numerous amount of culverts are required because the area is very flat, and there is not much stream height to work with. Constructing six culverts under U.S. Route 220 is not feasible or practical. The cost to prevent flooding of U.S. Route 220 during a 10-year storm would be approximately $108,000. The cost of a box culvert or bridge would be higher and not feasible.

IX. RECOMMENDATIONS

The flood management alternatives for the Triple Lakes watershed are summarized in Table 6, Appendix B.

The three homes (AZ, BK, BL) which experience first floor flooding are recommended as candidates for purchase. If the homeowners are not willing to relocate, they should purchase flood insurance to mitigate their flood losses.

The three homes (BB, BG, BQ) which experience more than one foot of flooding around the outside of the structure are also recommended as candidates for purchase due to an access problem during flooding. If these homeowners are not willing to relocate, they should purchase flood insurance and definitely floodproof their home.

One abandoned structure (BM) which will experience first floor flooding should be torn down. If this structure is to be remodeled, flood insurance is a necessity.

The three trailer park areas are subject to flooding. The ideal solution to prevent flood damage is to relocate the parks away from the flat areas adjacent to the stream. In all likelihood, this may not be possible, and the only means to mitigate the flood damages will be flood insurance.

There will be first flood flooding of three commercial structures (AX, AY, AY-1) and one business structure (BF) in the watershed. Since these are non-residential structures, purchase is not recommended. These owners should buy flood insurance to be protected.

The remaining homes in the flood zone will experience either basement or foundation flooding. These owners should consider flood-proofing and flood insurance to mitigate their flood damage.

Homeowners can obtain flood insurance to cover any losses that may occur due to first floor or basement flooding. Floodproofing methods can be used for houses with basements. Some measures for floodproofing are the following: clearing basement of items subject to water damage, permanent blocking of basement openings, providing a sump pump, and waterproofing of exposed interior and exterior walls.

There are no economical structural improvements recommended in this watershed. Replacement of the Pinto Road culvert and the U.S. Route 220 culvert to prevent the roads from flooding is not practical.

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APPENDIX A - FIGURES

PURDUM & JESCHKE
CONSULTING ENGINEERS
1029 N. CALVERT STREET
BALTIMORE, MARYLAND 21202

TRIPLE LAKES WATERSHED

VICINITY MAP

2000 0 2000

SCALE: 1" = 2000'

FIGURE

1

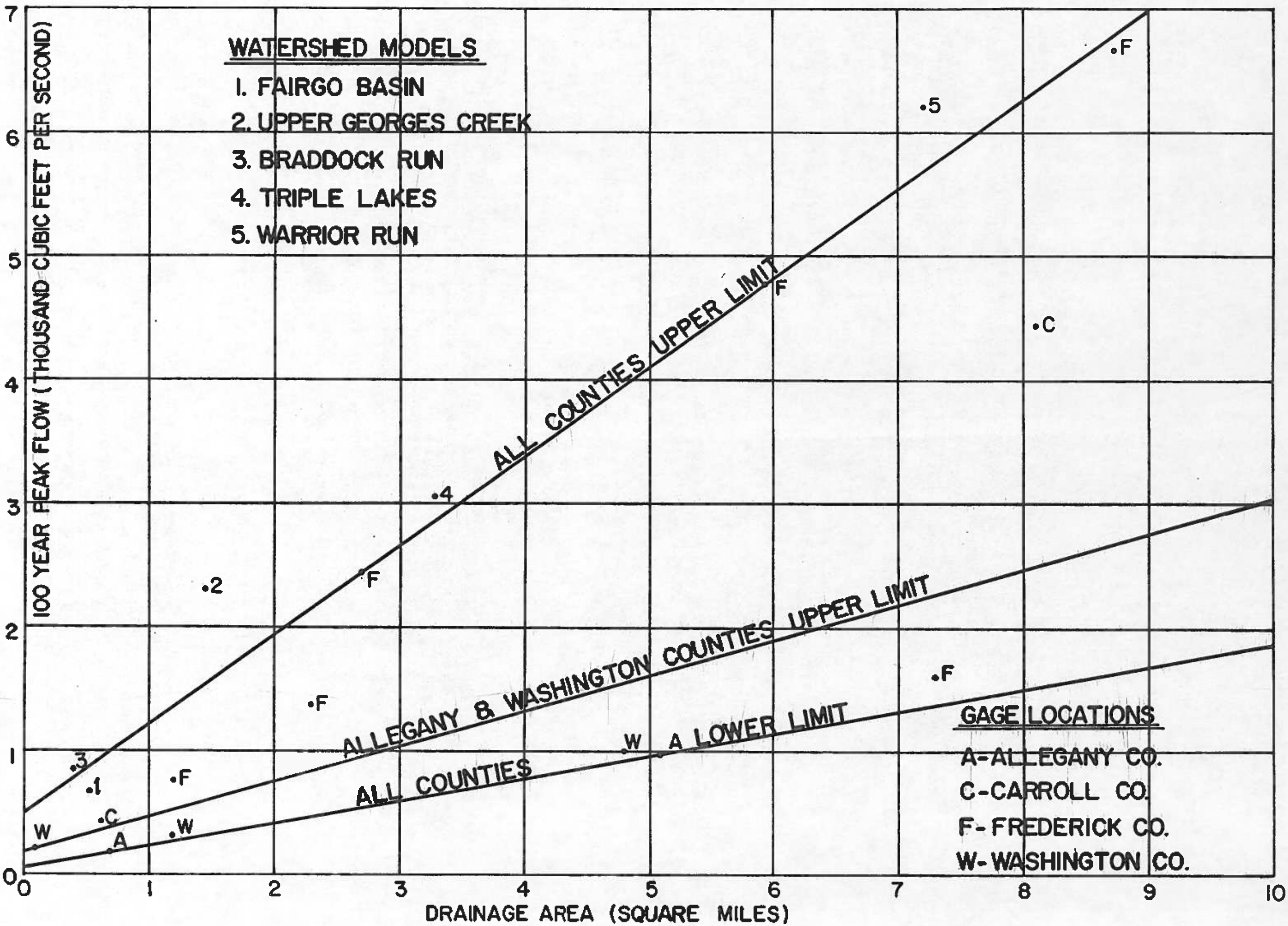
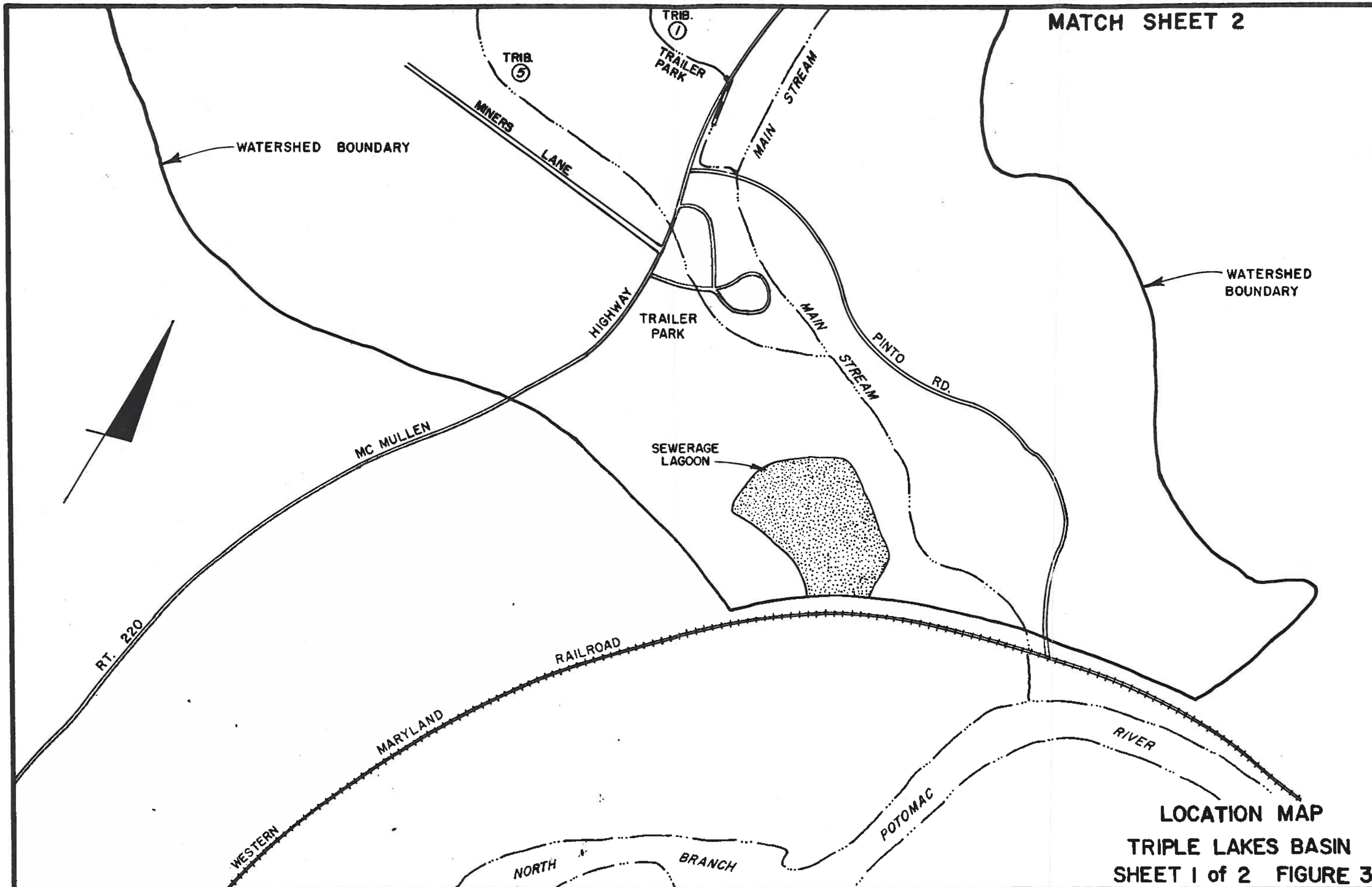
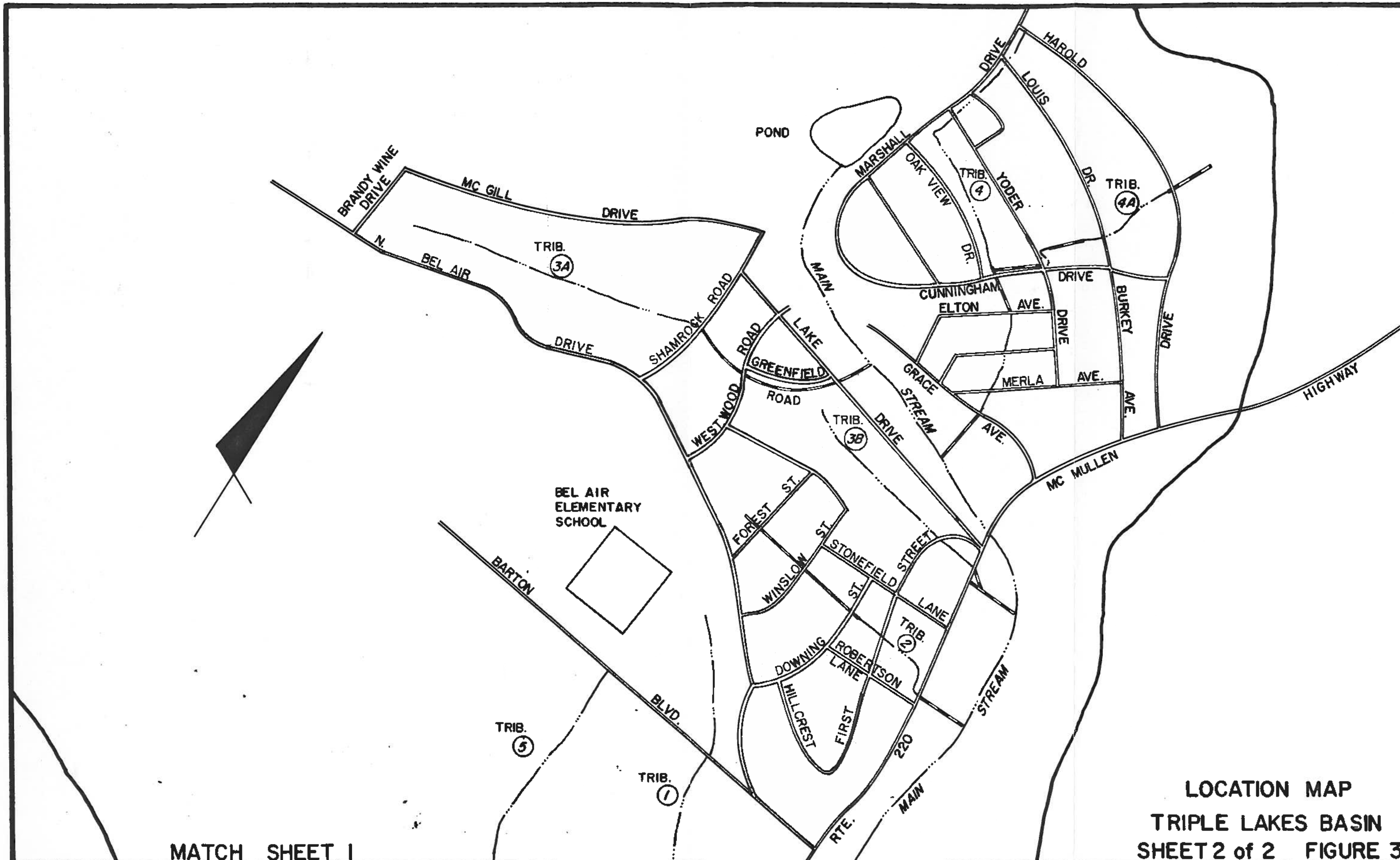

WATERSHED MODELS
1. FAIRGO BASIN
2. UPPER GEORGES CREEK
3. BRADDOCK RUN
4. TRIPLE LAKES
5. WARRIOR RUN
ALL COUNTIES UPPER LIMIT
ALLEGANY & WASHINGTON COUNTIES UPPER LIMIT
ALL COUNTIES LOWER LIMIT
GAGE LOCATIONS
A-ALLEGANY CO.
C-CARROLL CO.
F-FREDERICK CO.
W-WASHINGTON CO.
100 YEAR PEAK FLOW (THOUSAND CUBIC FEET PER SECOND)
DRAINAGE AREA (SQUARE MILES)

FIGURE 2



LOCATION MAP
TRIPLE LAKES BASIN
SHEET 1 of 2 FIGURE 3



LOCATION MAP
TRIPLE LAKES BASIN
SHEET 2 of 2 FIGURE 3

APPENDIX B - TABLES

TABLE 1- DRAINAGE AREA SUMMARY

TRIPLE LAKES

Area	Acreage	Existing CN	Ultimate CN	t_c (hrs.)
1.	276.46	64.2	64.2	.73
2.	270.71	62.5	62.9	.42
3.	156.17	60.2	60.2	.34
4.	271.17	73.9	76.5	.31
5.	86.48	68.3	77.1	.30
6.	36.34	73.9	77.3	.19
7.	56.35	81.3	82.0	.29
8.	13.80	82.0	82.0	.21
9.	12.65	82.0	82.0	.19
10.	14.03	82.0	82.0	.17
11.	17.94	82.0	82.0	.11
12.	27.60	82.0	82.0	.34
13.	21.16	82.4	84.7	.17
14.	73.37	77.2	81.8	.14
15.	34.50	77.7	85.2	.14
16.	11.04	81.8	82.3	.08
17.	87.86	68.1	85.8	.21
18.	190.67	73.2	82.0	.38
19.	48.76	75.4	81.4	.19
20.	51.75	77.5	86.5	.13
21.	31.74	66.4	89.3	.10
22.	102.12	63.1	83.4	.22
23.	140.53	76.4	87.9	1.11
24.	46.92	73.4	77.7	.27
25.	16.33	82.5	84.4	.24
Total Acreage	2092.52			
Weighted CN		70.1	75.4	

TABLE 2- TRIPLE LAKES STRUCTURES

Structure No.	Location	Description	From Surveys	From Field Reconnaissance
	Main Stream			
1	Western Maryland Railroad	10' x 10' Brick Box		X
2	Pinto Road	7.8' x 5.5' Concrete Box	X	
3	Station 51+30	6' x 8' Concrete Box	X	
4	U.S. Route 220	10' x 6' Concrete Box	X	
	Tributary No. 1			
5	Trailor Park Road	Two half sections 72" steel pipes	X	
6	Trailor Park Road	54" Steel Pipe	X	
7	U.S. Route 220	10' x 3.7' CMPA	X	
8	Barton Road	12" RCP		X
	Tributary No. 2			
9	Below U.S. Route 220	18" CMP		X
10	U.S. Route 220	18" CMP		X
11	First Street	15" CMP		X
12	Downing Street to Forest Street	15" CMP		X
	Tributary No. 3A			
13	Lake Drive	42" CMP	X	
14	Westwood Road	36" CMP	X	
15	Shamrock Road	36" CMP	X	
	Tributary No. 3B			
16	U.S. Route 220	24" RCP to 2.5" x 1.5' CMPA	X	
17	First Street	3.2' x 1.5' CMPA	X	

TABLE 2-TRIPLE LAKES STRUCTURES

Structure No.	Location	Description	From Surveys	From Field Reconnaissance
	<u>Tributary No. 4</u>			
18	Station 0+00	4' Steel Pipe		X
19	Grace Avenue	6' x 6.5' CMPA		X
20	Merla Avenue	2' x 4' CMPA		X
21	Dirt Road	30" Steel Pipe		X
22	Elton Road to Cunningham Drive	24" CMP		X
23	Yoder Drive	18" CMP		X
24	Glen Oaks Drive	18" CMP		X
25	Louis Drive	1' Steel Pipe		X
26	Harold Drive	1' Steel Pipe		X
	<u>Tributary No. 4A</u>			
27	Cunningham Drive to Yoder Drive	12" RCP		X
28	Station	15" RCP		X
29	Louis Drive	12" RCP		X
30	Harold Drive	15" RCP		X
	<u>Tributary No. 5</u>			
31	U.S. Route 220	4.5' x 3.0' CMPA	X	
32	Dirt Road	2' x 4' CMPA		X
33	Barton Road	36" RCP		X

TABLE 3

TRIPLE LAKES

Computed Water Surface
Elevations for Each Cross Section

Q in cfs; WSEL in feet

SECTION	EXISTING DEVELOPMENT CONDITIONS						ULTIMATE DEVELOPMENT CONDITIONS					
	Q_2	$WSEL_2$	Q_{10}	$WSEL_{10}$	Q_{100}	$WSEL_{100}$	Q_2	$WSEL_2$	Q_{10}	$WSEL_{10}$	Q_{100}	$WSEL_{100}$
MAIN STREAM												
77.0	578	659.7	1600	661.7	3046	663.5	887	660.5	2083	662.4	3643	664.0
78.0		664.7		666.1		667.6		665.2		666.7		668.1
79.0		668.8		669.5		670.2		669.0		669.8		670.5
80.0		676.7		677.5		678.3		676.9		677.8		678.5
89.0		678.1		678.8		679.7		678.0		679.1		680.0
90.0		680.8		682.7		683.3		682.3		682.9		683.6
91.0	439	688.8	1174	690.4	2235	691.1	554	687.6	1382	690.6	2510	691.2
92.0		692.0		693.9		694.9		693.2		694.0		695.1
93.0		692.5		695.2		696.2		692.9		695.5		696.3
93.1		692.7		696.1		697.6		693.3		696.5		697.9

TABLE 3

TRIPLE LAKES

Computed Water Surface
Elevations for Each Cross Section

Q in cfs; WSEL in feet

SECTION	EXISTING DEVELOPMENT CONDITIONS						ULTIMATE DEVELOPMENT CONDITIONS					
	Q_2	$WSEL_2$	Q_{10}	$WSEL_{10}$	Q_{100}	$WSEL_{100}$	Q_2	$WSEL_2$	Q_{10}	$WSEL_{10}$	Q_{100}	$WSEL_{100}$
94.0	439	695.6	1174	697.5	2235	699.0	554	696.1	1382	697.9	2510	699.3
95.0		699.7		700.5		701.2		699.9		700.6		701.3
99.0		708.0		709.8		711.3		708.3		710.1		711.5
100.0		718.2		720.7		721.9		718.6		721.0		722.2
101.0		721.0		723.5		724.2		721.4		723.7		724.3
101.1		721.6		724.1		725.1		724.3		724.3		725.4
101.2		721.8		724.8		726.0		724.4		725.0		726.2
101.3		723.4		725.3		726.6		724.5		725.6		726.9
102.0		723.7		725.5		726.9		724.7		725.9		727.2
103.0		726.8		727.5		728.4		726.9		727.7		728.8
105.0	422	734.8	1059	736.6	1912	737.6	483	735.2	1151	736.8	2023	737.8
107.0		744.3		746.3		747.2		744.4		746.4		747.3

TABLE 3

TRIPLE LAKES

Computed Water Surface
Elevations for Each Cross Section

Q in cfs; WSEL in feet

SECTION	EXISTING DEVELOPMENT CONDITIONS						ULTIMATE DEVELOPMENT CONDITIONS					
	Q_2	$WSEL_2$	Q_{10}	$WSEL_{10}$	Q_{100}	$WSEL_{100}$	Q_2	$WSEL_2$	Q_{10}	$WSEL_{10}$	Q_{100}	$WSEL_{100}$
TRIBUTARY NO. 3B												
107.9	26	751.8	53	752.3	84	752.7	29	751.9	57	752.4	88	752.7
108.0		754.3		754.3		754.4		754.3		754.3		754.5
109.0		759.4		759.5		759.6		759.4		759.5		759.6
109.1		763.1		763.9		764.9		763.2		764.0		765.0
109.2		763.6		765.2		765.2		763.7		765.4		765.2
109.3		764.0		765.3		765.3		764.2		765.4		765.3
109.4		764.7		765.3		765.3		765.1		765.4		765.3
110.0	26	764.8	53	765.3	84	765.3	29	765.1	57	765.4	88	765.3
111.0		774.4		774.6		774.7		774.4		774.6		774.8
112.0		781.5		781.7		781.9		781.6		781.8		782.0

TABLE 3

TRIPLE LAKES

Computed Water Surface
Elevations for Each Cross Section

Q in cfs; WSEL in feet

SECTION	EXISTING DEVELOPMENT CONDITIONS						ULTIMATE DEVELOPMENT CONDITIONS					
	Q_2	$WSEL_2$	Q_{10}	$WSEL_{10}$	Q_{100}	$WSEL_{100}$	Q_2	$WSEL_2$	Q_{10}	$WSEL_{10}$	Q_{100}	$WSEL_{100}$
117.0	422	755.8	1059	758.1	1912	759.5	483	756.2	1151	758.4	2023	759.6
118.1		758.1		760.8		761.5		758.4		760.9		761.6
118.2		758.9		762.0		762.8		760.6		762.1		762.9
119.0		761.4		763.1		763.7		762.0		763.2		763.8
120.0	221	774.8	599	776.4	1159	778.2	264	775.1	663	776.6	1234	778.3
121.0		786.8		788.6		789.1		787.1		788.8		789.2
122.0		805.9		807.0		808.3		806.1		807.2		808.4
123.0		818.8		820.2		821.3		819.1		820.4		821.5
TRIBUTARY NO. 1												
80.0	578	676.7	1600	677.5	3046	678.3	887	676.9	2083	677.8	3643	678.5
81.0	166	678.5	448	678.8	798	679.6	294	678.1	631	679.1	1010	679.9
81.1		678.6		679.1		679.6		678.7		679.3		679.7

TABLE 3

TRIPLE LAKES

Computed Water Surface
Elevations for Each Cross Section

Q in cfs; WSEL in feet

SECTION	EXISTING DEVELOPMENT CONDITIONS						ULTIMATE DEVELOPMENT CONDITIONS					
	Q_2	$WSEL_2$	Q_{10}	$WSEL_{10}$	Q_{100}	$WSEL_{100}$	Q_2	$WSEL_2$	Q_{10}	$WSEL_{10}$	Q_{100}	$WSEL_{100}$
88.2	166	715.2	427	716.3	746	717.0	286	715.8	595	716.8	941	717.4
88.3	52	736.2	129	737.0	222	737.4	77	736.5	164	737.2	262	737.6
88.4		762.6		763.4		764.1		762.9		763.8		764.3
TRIBUTARY NO. 2												
103.1	37	748.0	77	749.0	122	749.0	43	748.0	84	749.0	129	749.0
103.2	19	771.2	39	771.5	61	771.7	22	771.2	42	771.5	65	771.7
103.3	10	789.3	20	789.6	29	789.8	11	789.3	21	789.6	33	789.8
TRIBUTARY NO. 3A												
113	83	831.0	177	831.0	285	831.0	83	831.0	177	831.0	285	831.0
114	64	852.0	134	852.0	215	852.0	64	852.0	134	852.0	215	852.0
114.5		870.0		870.0		870.0		870.0		870.0		870.0
115	44	903.0	91	903.0	144	903.0	44	903.0	91	903.0	144	903.0
116		958.0		958.0		958.0		958.0		958.0		958.0

TABLE 3

TRIPLE LAKES

Computed Water Surface
Elevations for Each Cross Section

Q in cfs; WSEL in feet

SECTION	EXISTING DEVELOPMENT CONDITIONS						ULTIMATE DEVELOPMENT CONDITIONS					
	Q_2	$WSEL_2$	Q_{10}	$WSEL_{10}$	Q_{100}	$WSEL_{100}$	Q_2	$WSEL_2$	Q_{10}	$WSEL_{10}$	Q_{100}	$WSEL_{100}$
89.0	166	678.7	448	679.3	798	680.1	294	678.8	631	679.7	1010	680.4
90.0		679.9		681.5		682.5		680.8		682.4		682.6
83.0		684.9		685.7		685.7		685.3		685.7		685.9
84.1		685.3		685.8		686.1		685.6		686.0		683.3
84.2		685.4		685.9		686.2		685.6		686.0		686.3
84.3		685.6		686.0		686.4		685.9		686.2		686.6
84.4		685.7		686.1		686.4		685.9		686.3		686.6
85.0		685.4		686.6		686.6		686.6		686.6		686.7
86.0	178	688.8	472	689.1	834	690.5	312	688.8	661	689.9	1052	690.8
87.1		689.4		692.5		690.5		691.8		692.6		693.2
87.2		691.0		692.7		693.1		692.4		692.9		693.5
88.0		692.4		693.5		694.2		693.1		693.9		694.4
88.1		699.0		699.6		700.0		699.3		699.8		700.2

TABLE 3

TRIPLE LAKES

Computed Water Surface
Elevations for Each Cross Section

Q in cfs; WSEL in feet

SECTION	EXISTING DEVELOPMENT CONDITIONS						ULTIMATE DEVELOPMENT CONDITIONS					
	Q_2	$WSEL_2$	Q_{10}	$WSEL_{10}$	Q_{100}	$WSEL_{100}$	Q_2	$WSEL_2$	Q_{10}	$WSEL_{10}$	Q_{100}	$WSEL_{100}$
TRIBUTARY NO. 5												
95.0	439	699.7	1174	700.5	2235	701.2	554	699.9	1382	700.6	2510	701.3
98.0	117	699.8	274	700.9	484	703.9	165	699.5	348	701.7	579	704.1
98.1		703.4		704.0		704.4		703.6		704.2		704.5
97.0		704.2		705.5		706.9		704.7		706.0		706.9
96.0		712.2		712.6		712.8		712.5		712.7		712.8
96.1		718.4		718.8		719.6		718.7		719.2		719.8
96.2		743.0		744.1		744.9		743.4		744.4		745.2

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TRIPLE LAKES

TABLE 4 -FLOOD DAMAGE ESTIMATES EXISTING CONDITIONS

ITEMIZED LOSSES	2-YEAR STORM EXISTING CONDITONS	10-YEAR STORM EXISTING CONDITIIONS	100-YEAR STORM EXISTING CONDITIONS
PRIVATE LOSSES			
-STRUCTURES	$ 15,220	$ 61,470	$ 142,805
-CONTENTS	10,480	31,500	56,000
-EXTERIOR PROPERTIES	21,450	33,000	56,100
-VEHICLES	33,000	66,000	132,000
TOTAL PRIVATE LOSSES	$ 80,150	$ 191,970	$ 386,905
PUBLIC LOSSES			
-EMERGENCY POLICE SERVICES	$ 0	$ 1160	$ 1160
-CITY CLEAN-UP SERVICES	3,776	9456	16384
-UTILITIES REPAIR SERVICES	1,200	1200	1800
TOTAL PUBLIC LOSSES	$ 4,976	$ 11,816	$ 19,344
ABSTRACT LOSSES			
-LOST WAGES	$ 7,920	$ 7,920	$ 15,840
TOTAL ABSTRACT LOSSES	$ 7,920	$ 7,920	$ 15,840
TOTAL OF ALL LOSSES	$ 93,046	$ 211,706	$ 422,089

AVERAGE ANNUAL DAMAGES = .45(2-YEAR TOTAL)+.245(10-YEAR TOTAL)+.055(100-YEAR TOTAL)= $ 116,954

PRESENT VALUE OF THE AVERAGE ANNUAL DAMAGES(TAKEN FOR 30 YEARS AT AN INTEREST RATE OF 8%)= $ 1,316,640

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TRIPLE LAKES
TABLE 5 - FLOOD DAMAGE ESTIMATES ULTIMATE CONDITIONS

ITEMIZED LOSSES	2-YEAR STORM ULTIMATE CONDIONS	10-YEAR STORM ULTIMATE CONDITIONS	100-YEAR STORM ULTIMATE CONDITIONS
PRIVATE LOSSES			
-STRUCTURES	$ 21,825	$ 72,510	$ 179,995
-CONTENTS	14,240	35,520	69,060
-EXTERIOR PROPERTIES	21,450	33,000	56,100
-VEHICLES	33,000	66,000	132,000
TOTAL PRIVATE LOSSES	$ 90,515	$ 207,030	$ 437,155
PUBLIC LOSSES			
-EMERGENCY POLICE SERVICES	$ 0	$ 1160	$ 1160
-CITY CLEAN-UP SERVICES	3,776	9456	16384
-UTILITIES REPAIR SERVICES	1,200	1200	1800
TOTAL PUBLIC LOSSES	$ 4,976	$ 11,816	$ 19,344
ABSTRACT LOSSES			
-LOST WAGES	$ 7,920	$ 7,920	$ 15,840
TOTAL ABSTRACT LOSSES	$ 7,920	$ 7,920	$ 15,840
TOTAL OF ALL LOSSES	$ 103,411	$ 226,766	$ 472,339

AVERAGE ANNUAL DAMAGES = .45(2-YEAR TOTAL)+.245(10-YEAR TOTAL)+.055(100-YEAR TOTAL)= $ 128,071

PRESENT VALUE OF THE AVERAGE ANNUAL DAMAGES(TAKEN FOR 30 YEARS AT AN INTEREST RATE OF 8%)= $ 1,441,801

Table 6. FLOOD MANAGEMENT ALTERNATIVES

TRIPLE LAKES WATERSHED

House ID Code	Basement	100-Year Flood Elevation in Relationship to 1st Floor Elevation	100-Year Flood Depth Around Foundation or Basement Equal To or Greater Than One Foot	ALTERNATIVES				Comments
				Flood Proof	Flood Insur.	Purchase Candidate	Structural Improvements	
AW-1		1.5		X	X			Garage-storage structure
AW		-			X			Trailer park -
BO		-			X			33 units
AX		2.5			X			Commercial structure
AY		2.5			X			Commercial structure
AY-1		1.0			X			Commercial structure
AZ		1.0				X		
BB	X	-1.0	X	X	X	X		Access problem
BC		1.0			X			Trailer
BD		0.5			X			Sales
BE		-			X			Park
BY		-			X			
BZ		-			X			
BF		3.0			X			Gas station
BF-1		3.0			X			High's Store
BG	X	-1.0	X	X	X	X		Access problem
BH	X	-2.0		X	X			
BI		-		X	X			Foundation flooding
BJ		-		X	X			Foundation flooding
BK		1.0				X		
BL		3.5				X		
BM		4.5					Tear down	Abandoned
BN		-						Out of flood zone
BP	X	-6.5		X	X			
BQ	X	-2.5	X	X	X	X		Access problem
BR	X	-2.5		X	X			
BS	X	-3.0		X	X			
BM-1		-		X	X			Foundation flooding
BT	X	-						Out of flood zone
BU	X	-		X	X			Foundation flooding
BV	X	-4.0		X	X			
BW	X	-						Out of flood zone
BX	X	-						Out of flood zone
BS-1		-		X				Foundation flooding
CA		-			X			Trailer park -
CB		-			X			8 units
CC		0.5			X			Trailer park - 3 units
Pinto Road Overtopping							Five 92" x 65" CMPA required for 10-yr. design	Improvement not practical or economical
U.S. Route Overtopping on Trib. No. 5							Three 72" x 44" CMPA required for 10-yr. design ($108,000)	Not recommended

APPENDIX C

DAMAGE REFERENCE TABLES

NORTH BRANCH POTOMAC WATERSHED STUDY
FLOOD SURVEY

Name: ______________________________ Date: ______________________________

Address: ____

City: ______________________ State: ____________ Zip Code: __________

Phone (Optional): Home: ______________ Work: ________________

Please accept our thanks in advance for taking your time to read and complete this questionnaire.

1. Number of years at present residence? _____ Years

2. What type of house do you live in?

   ___ 1-Story with no basement ___ 1-Story with basement

   ___ 2-Story with no basement ___ 2-Story with basement

   ___ Other - Describe: ____

3. Where is your furnace or hot water heater located? ________________________________

4. What were the dates and depths of the most severe floods that affected your property?

Date	Depth of Water Outside of House	Depth of Water in Basement	Depth of Water Above First Floor
____Month ____Year	________feet	______feet	________feet
____Month ____Year	________feet	______feet	________feet
____Month ____Year	________feet	______feet	________feet
____Month ____Year	________feet	______feet	________feet

5. Where did the water enter your home? ______________________________

   ____

6. Are there visible watermarks from interior flooding? ___ Yes ___ No

   Indicate date. ________ Month ______ Year

   Describe location. ____

   ____

7. Can you indicate a definite water level on the outside of your home or on another landmark? ___ Yes ___ No

   Indicate date. __________ Month _______ Year

   Describe location. ____

   ____

8. Do you have photographs which show the flooding on or around your property? ___ Yes ___ No

   If yes, would you loan these photographs to the Allegany County Commissioners in order that we may reproduce them. ___ Yes ___ No

9. Do you have any other comments or information you can present? ____

   ____

   ____

   ____

   ____

Please return this questionnaire in the enclosed self-addressed, stamped envelope to our consultants:

Purdum and Jeschke
1029 North Calvert Street
Baltimore, Maryland 21202

(Attention: North Branch Potomac Watershed Study)

Table III-2 (Reference 1)
HOME PRICE RANGES

Type of Home	Structural Composition	Foundation Construction	Dwelling Only ($) Low - High
Split Level	Brick	Block	40,000 - 80,000
Split Level	Frame	Block	38,000 - 76,000
Slab on Grade	Brick	N/A	40,000 - 70,000
Slab on Grade	Frame	N/A	38,000 - 66,000
One or Two Story w/Basement	Brick	Block or Stone	32,000 - 80,000
One or Two Story w/Basement	Frame	Block or Stone	30,000 - 76,000
One Story w/o Basement	Brick	Block or Stone	36,000 - 74,000
One Story w/o Basement	Frame	Block or Stone	34,000 - 71,000

Table 2-5 (Reference 2)
RESIDENTIAL CONTENT VALUES

Total Square Footage	Furnishings Value	Content Value
$0 < x \leq 1000$	High	$33,000
	Average	18,100
	Low	10,200
$1000 < x \leq 1500$	High	$37,200
	Average	20,600
	Low	11,100
$1500 < x \leq 2000$	High	$46,400
	Average	25,700
	Low	14,000
$x > 2000$	High	$54,100
	Average	30,000
	Low	16,500

TABLE III-4 (Reference 1)
Numerical Rating Values
Houses Over 25 Years Old
Not Remodeled
Flood Plain Area

Adjustment Factors	Rating			
	Poor	Fair	Good	Excellent
Location	0.00	0.033	0.067	0.10
Quality of Construction	0.00	0.033	0.067	0.10
Condition of House	0.00	0.033	0.067	0.10
	Square Foot Area			
	Small 800 to 999	Sm/Med 1,000 to 1,199	Med/Lge 1,200 to 1,399	Large 1,400 to 1,600+
Size	0-0.06	0.06-0.12	0.12-0.18	0.18-0.24
	Years			
	100+	75-100	50-75	25-50
Age	0.00	0.033	0.067	0.10

TABLE III-5 (Reference 1)
Numerical Rating Values
Houses Less Than 25 Years Old
Or Completely Remodeled Old House
Flood Plain Area

Adjustment Factors	Rating			
	Poor	Fair	Good	Excellent
Location	0.10	0.067	0.033	0.00
Quality of Construction	0.10	0.067	0.033	0.00
Condition of House	0.10	0.067	0.033	0.00
	Square Foot Area			
	Small 800 to 999	Sm/Med 1,000 to 1,199	Med/Lge 1,200 to 1,399	Large 1,400 to 1,600+
Size	0.24-0.18	0.18-0.12	0.12-0.06	0.06-0.00
	Years			
	75-100+	50-75	25-50	New-25
Age	0.10	0.067	0.033	0.00

Table 5

FIA 1974 RESIDENTIAL DAMAGE CURVES
(VALUES IN PERCENT DAMAGE)

	1 1 STORY WITH BASEMENT		2 1 STORY W/O BASEMENT		3 1 1/2 & 2 STORY W/ BASEMENT		4 1 1/2 & 2 STORY W/O BASEMENT	
STAGE	STRUCTURE	CONTENT	STRUCTURE	CONTENT	STRUCTURE	CONTENT	STRUCTURE	CONTENT
-9	0.	0.	0.	0.	0.	0.	0.	0.
-8	0.	0.	0.	0.	0.	0.	0.	0.
-7	1.	1.	0.	0.	1.	1.	0.	0.
-6	3.	2.	0.	0.	2.	2.	0.	0.
-5	4.	3.	0.	0.	3.	3.	0.	0.
-4	5.	4.	0.	0.	4.	4.	0.	0.
-3	6.	5.	0.	0.	5.	5.	0.	0.
-2	7.	7.	0.	0.	6.	6.	0.	0.
-1	8.	8.	0.	0.	7.	9.	0.	0.
0	11.	15.	7.	10.	7.	11.	5.	7.
1	18.	20.	10.	17.	11.	17.	9.	9.
2	20.	22.	14.	23.	17.	22.	13.	17.
3	23.	28.	26.	29.	22.	28.	18.	22.
4	28.	33.	28.	35.	28.	33.	20.	28.
5	33.	39.	29.	40.	33.	39.	22.	33.
6	38.	44.	41.	45.	35.	44.	24.	39.
7	44.	50.	43.	50.	38.	49.	26.	44.
8	49.	55.	44.	55.	40.	55.	31.	50.
9	51.	60.	45.	60.	44.	61.	36.	55.
10	53.	60.	46.	60.	46.	64.	38.	58.
11	55.	60.	47.	60.	48.	71.	40.	65.
12	57.	60.	48.	60.	50.	76.	42.	72.
13	59.	60.	49.	60.	52.	78.	44.	78.
14	60.	60.	50.	60.	54.	79.	46.	79.
15	60.	60.	50.	60.	56.	80.	47.	80.
16	60.	60.	50.	60.	58.	81.	48.	81.
17	60.	60.	50.	60.	59.	81.	49.	81.
18	60.	60.	50.	60.	59.	81.	49.	81.
19	60.	60.	50.	60.	59.	81.	49.	81.
20	60.	60.	50.	60.	59.	81.	49.	81.
21	60.	60.	50.	60.	59.	81.	49.	81.
22	60.	60.	50.	60.	59.	81.	49.	81.
23	60.	60.	50.	60.	59.	81.	49.	81.
24	60.	60.	50.	60.	59.	81.	49.	81.
25	60.	60.	50.	60.	59.	81.	49.	81.
26	60.	60.	50.	60.	59.	81.	49.	81.
27	60.	60.	50.	60.	59.	81.	49.	81.
28	60.	60.	50.	60.	59.	81.	49.	81.
29	60.	60.	50.	60.	59.	81.	49.	81.
30	60.	60.	50.	60.	59.	81.	49.	81.

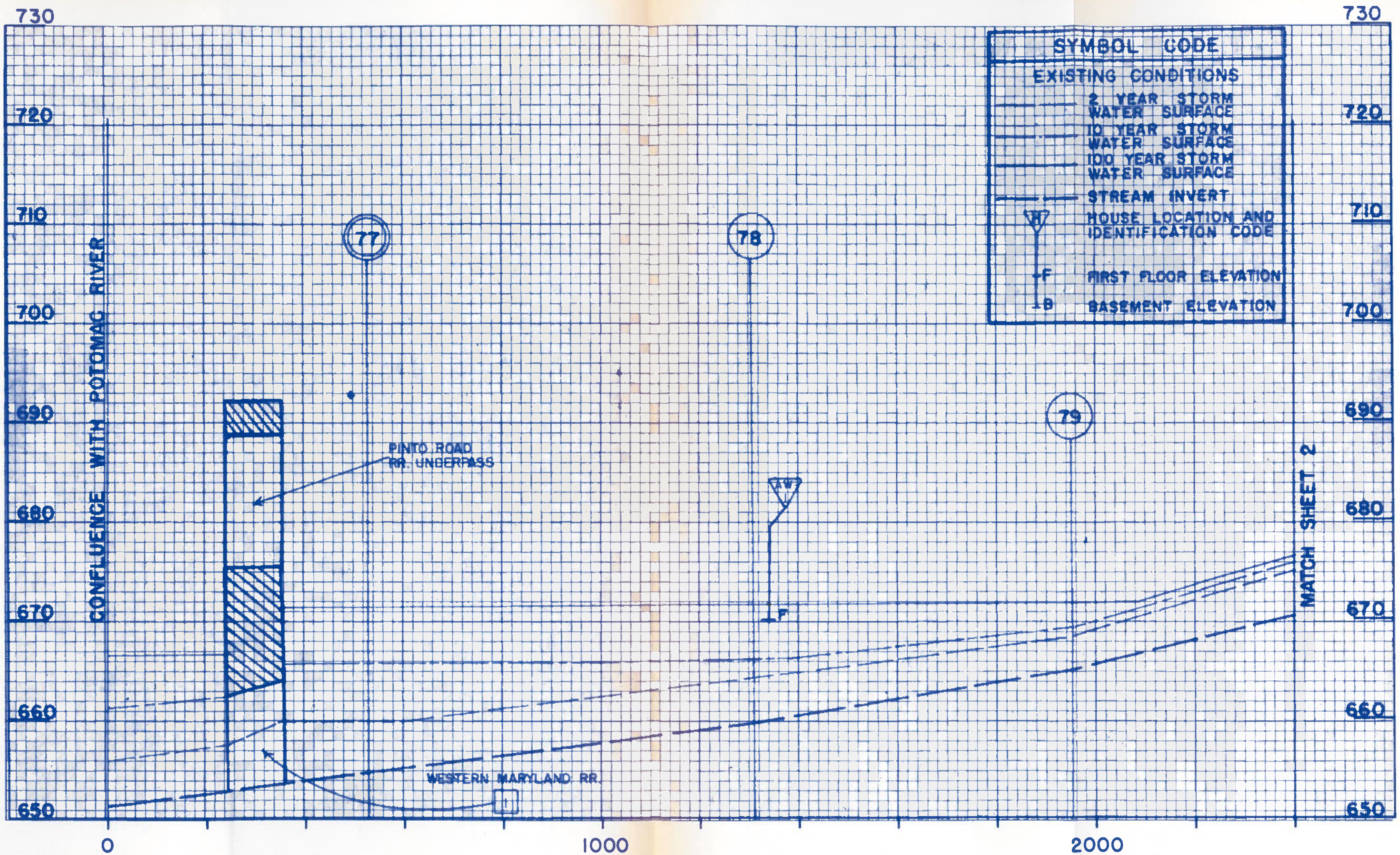
Table 5

FIA 1974 RESIDENTIAL DAMAGE CURVES
(VALUES IN PERCENT DAMAGE)

	5		6		7	
	SPLIT LEVEL W/ BASEMENT		SPLIT LEVEL W/O BASEMENT		TRAILERS	
STAGE	STRUCTURE	CONTENT	STRUCTURE	CONTENT	STRUCTURE	CONTENT
-9	0.	0.	0.	0.	0.	0.
-8	0.	0.	0.	0.	0.	0.
-7	1.	1.	0.	0.	0.	0.
-6	2.	2.	0.	0.	0.	0.
-5	2.	4.	0.	0.	0.	0.
-4	3.	6.	0.	0.	0.	0.
-3	3.	8.	0.	0.	0.	0.
-2	4.	10.	0.	0.	0.	0.
-1	5.	15.	0.	0.	0.	0.
0	6.	18.	3.	2.	8.	0.
1	16.	31.	9.	19.	45.	20.
2	19.	44.	13.	32.	64.	50.
3	22.	52.	25.	41.	74.	60.
4	27.	58.	27.	47.	79.	70.
5	32.	61.	28.	51.	80.	73.
6	35.	63.	33.	53.	81.	76.
7	38.	64.	34.	55.	82.	79.
8	44.	66.	41.	56.	82.	82.
9	48.	69.	43.	62.	82.	85.
10	50.	73.	45.	69.	82.	85.
11	52.	76.	46.	75.	82.	85.
12	54.	79.	47.	78.	82.	85.
13	56.	80.	48.	80.	82.	85.
14	58.	80.	49.	81.	82.	85.
15	59.	80.	50.	81.	82.	85.
16	60.	80.	50.	81.	82.	85.
17	60.	80.	50.	81.	82.	85.
18	60.	80.	50.	81.	82.	85.
19	60.	80.	50.	81.	82.	85.
20	60.	80.	50.	81.	82.	85.
21	60.	80.	50.	81.	82.	85.
22	60.	80.	50.	81.	82.	85.
23	60.	80.	50.	81.	82.	85.
24	60.	80.	50.	81.	82.	85.
25	60.	80.	50.	81.	82.	85.
26	60.	80.	50.	81.	82.	85.
27	60.	80.	50.	81.	82.	85.
28	60.	80.	50.	81.	82.	85.
29	60.	80.	50.	81.	82.	85.
30	60.	80.	50.	81.	82.	85.

APPENDIX D

WATER SURFACE PROFILES



PURDUM & JESCHKE
CONSULTING ENGINEERS
LAND SURVEYORS

LEGEND

(4.0) CROSS SECTION NUMBER AND LOCATION

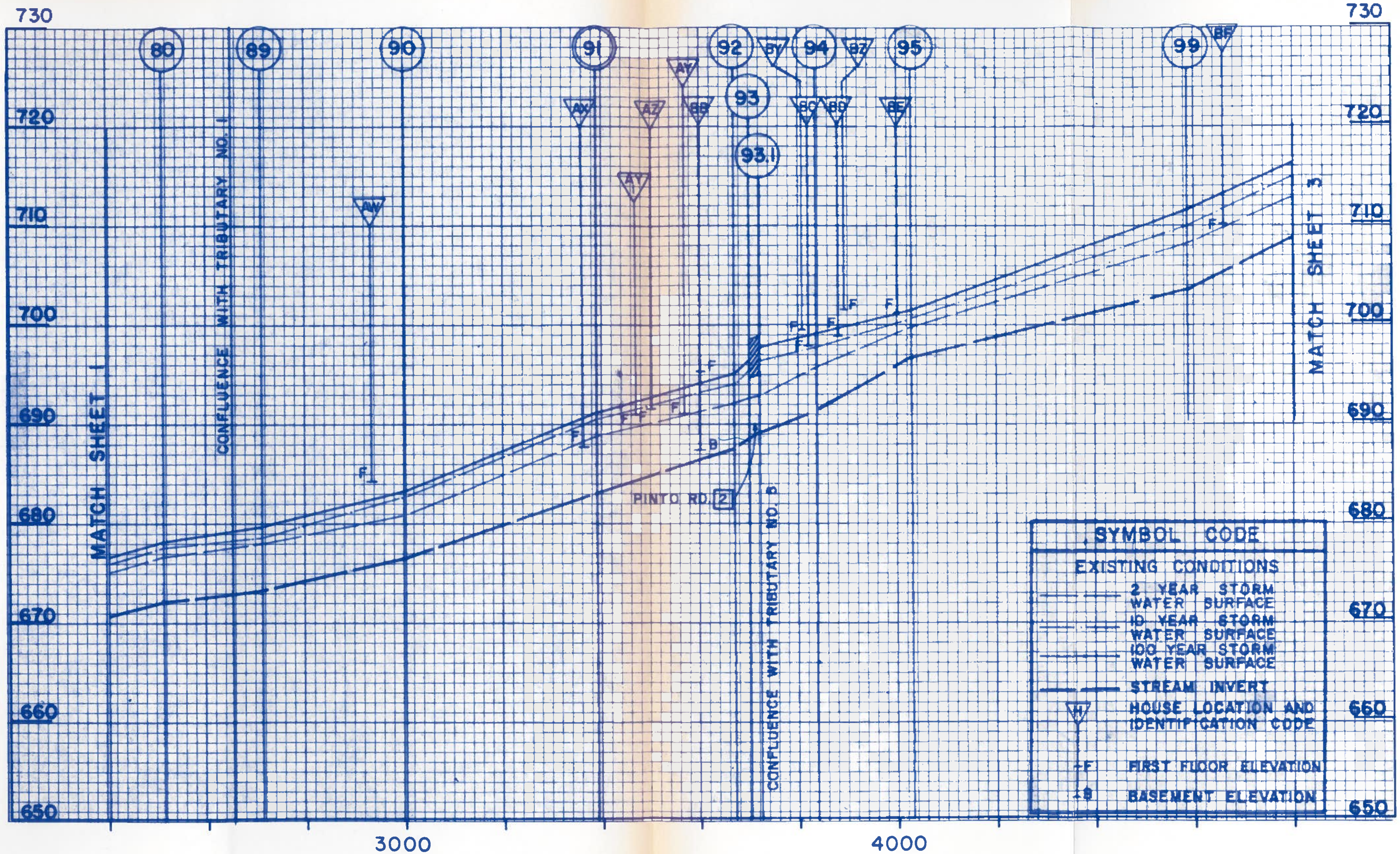
[3] STRUCTURE NUMBER

(4.0) CROSS SECTION WHERE STREAM FLOW HAS CHANGED

SCALE
HORIZONTAL :1"=200'
VERTICAL :1"=10'

STREAM PROFILE
TRIPLE LAKES MAIN STREAM

SHEET NO.
1 OF 4



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CONSULTING ENGINEERS
LAND SURVEYORS

LEGEND

(4.0) CROSS SECTION NUMBER AND LOCATION

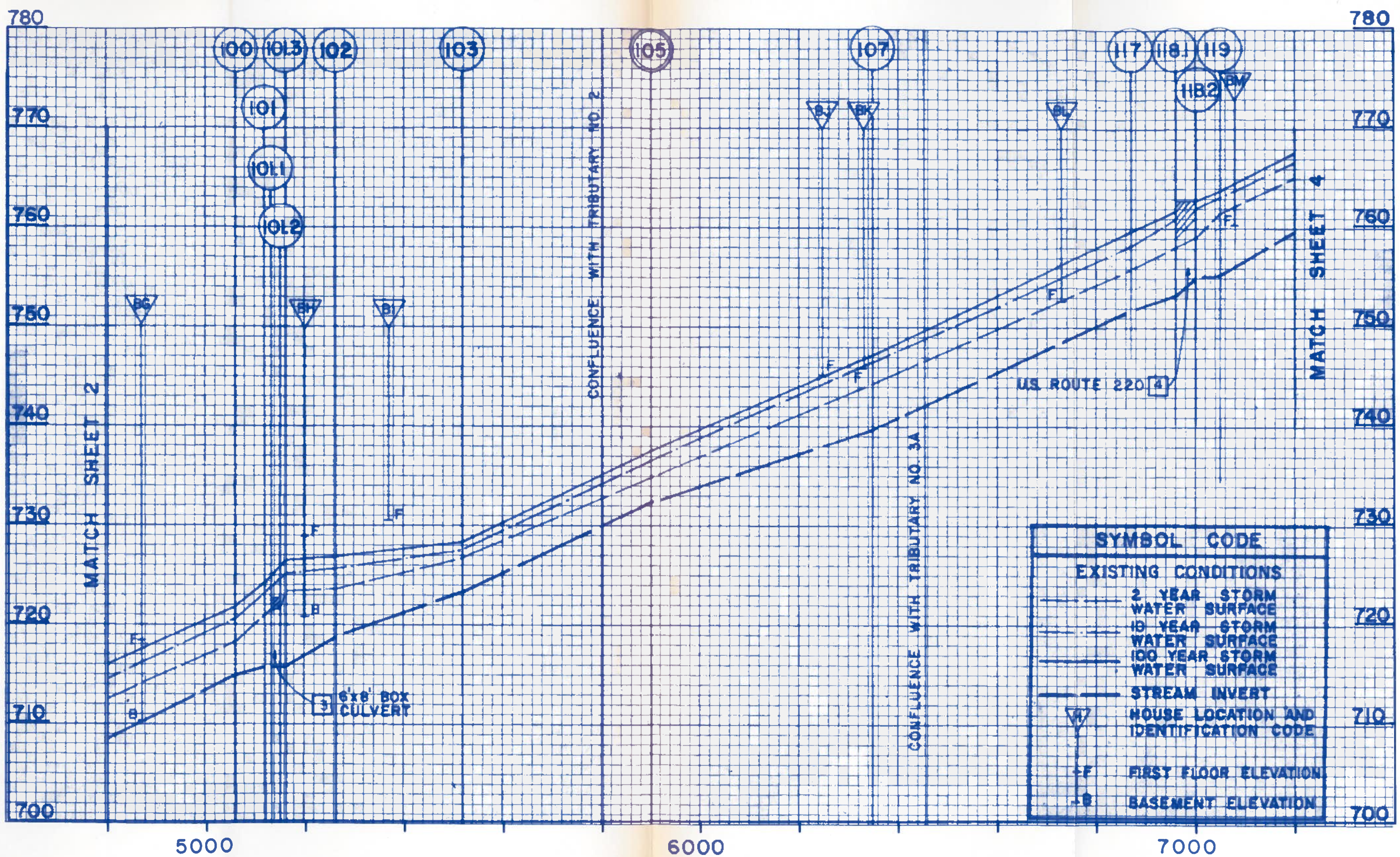
[3] STRUCTURE NUMBER

(4.0) CROSS SECTION WHERE STREAM FLOW HAS CHANGED

SCALE
HORIZONTAL :1"=200'
VERTICAL :1"=10'

STREAM PROFILE
TRIPLE LAKES MAIN STREAM

SHEET NO.
2 OF 4



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CONSULTING ENGINEERS
LAND SURVEYORS

LEGEND

(4.0) CROSS SECTION NUMBER AND LOCATION

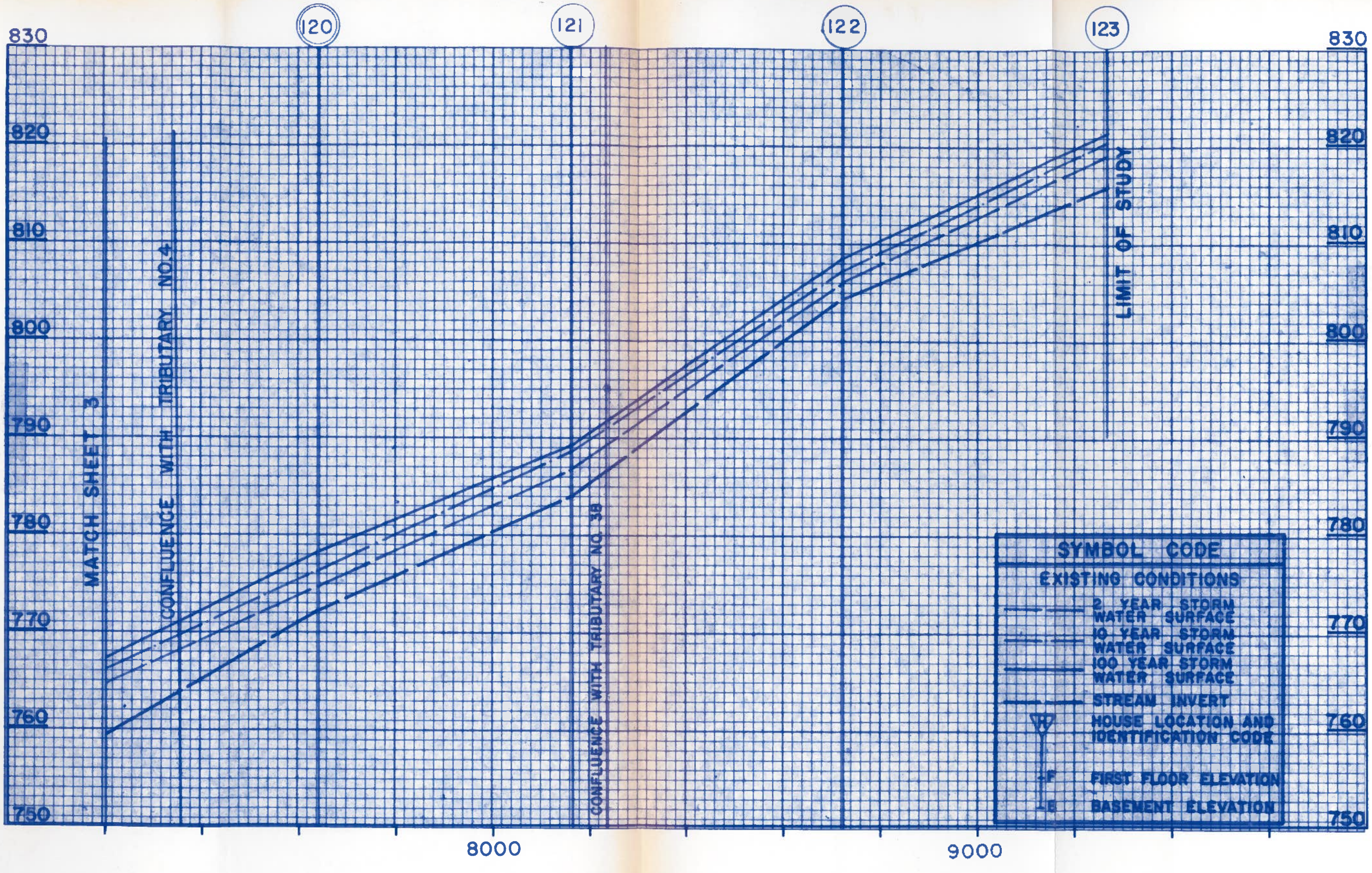
3 STRUCTURE NUMBER

(4.0) CROSS SECTION WHERE STREAM FLOW HAS CHANGED

SCALE
HORIZONTAL :1"=200'
VERTICAL :1"=10'

STREAM PROFILE
TRIPLE LAKES MAIN STREAM

SHEET NO.
3 OF 4



PURDUM & JESCHKE
CONSULTING ENGINEERS
LAND SURVEYORS

LEGEND

(4.0) CROSS SECTION NUMBER AND LOCATION

[3] STRUCTURE NUMBER

(4.0) CROSS SECTION WHERE STREAM FLOW HAS CHANGED

SCALE
HORIZONTAL : 1" = 200'
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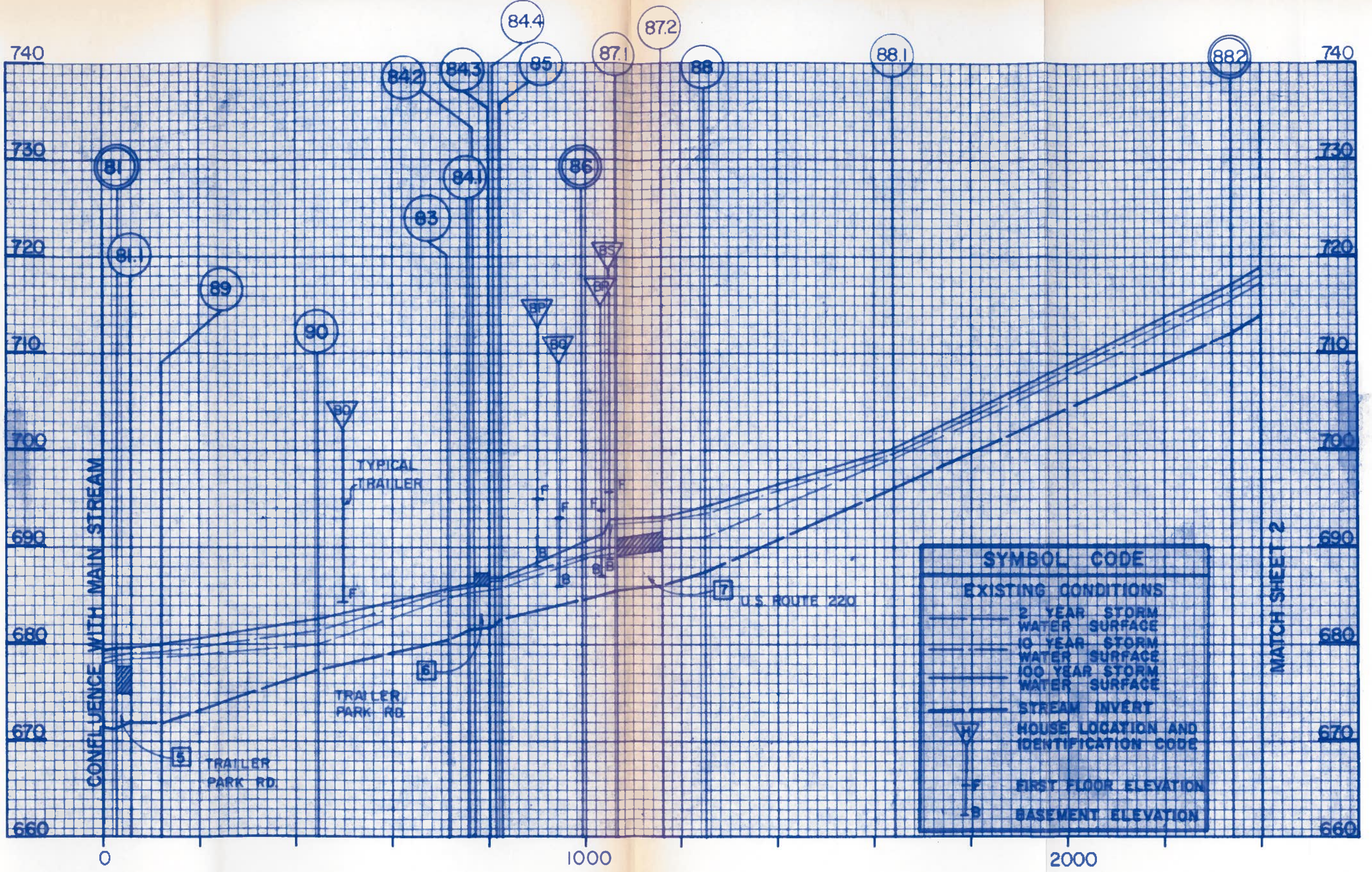
STREAM PROFILE
TRIPLE LAKES MAIN STREAM

SHEET NO.
4 OF 4



PURDUM & JESCHKE
CONSULTING ENGINEERS
LAND SURVEYORS

LEGEND

(4.0) CROSS SECTION NUMBER AND LOCATION

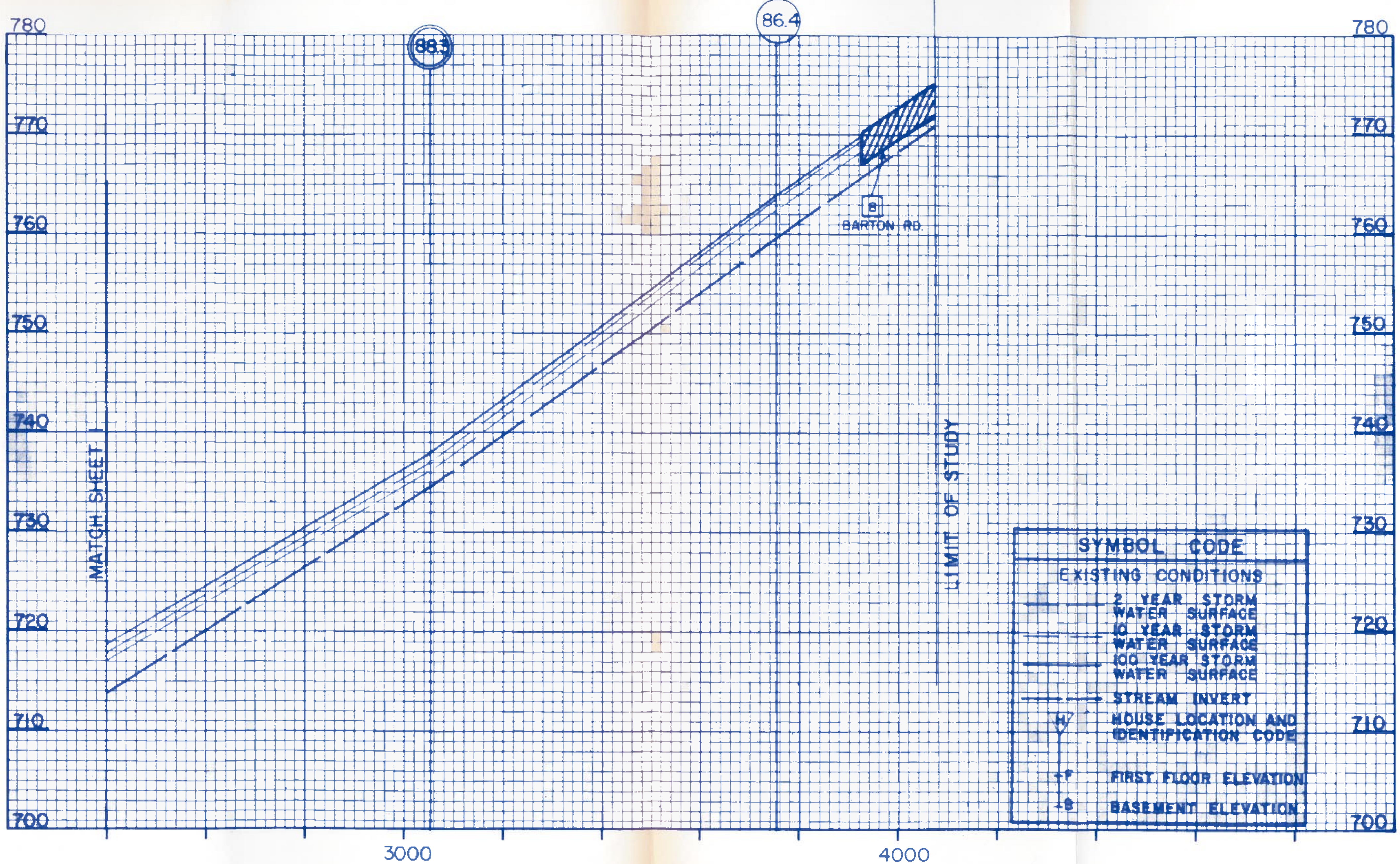
[3] STRUCTURE NUMBER

((4.0)) CROSS SECTION WHERE STREAM FLOW HAS CHANGED

SCALE
HORIZONTAL :1"=200'
VERTICAL :1"=10'

STREAM PROFILE
TRIPLE LAKES TRIBUTARY NO. 1

SHEET NO.
1 of 2



PURDUM & JESCHKE
CONSULTING ENGINEERS
LAND SURVEYORS

LEGEND

(4.0) CROSS SECTION NUMBER AND LOCATION

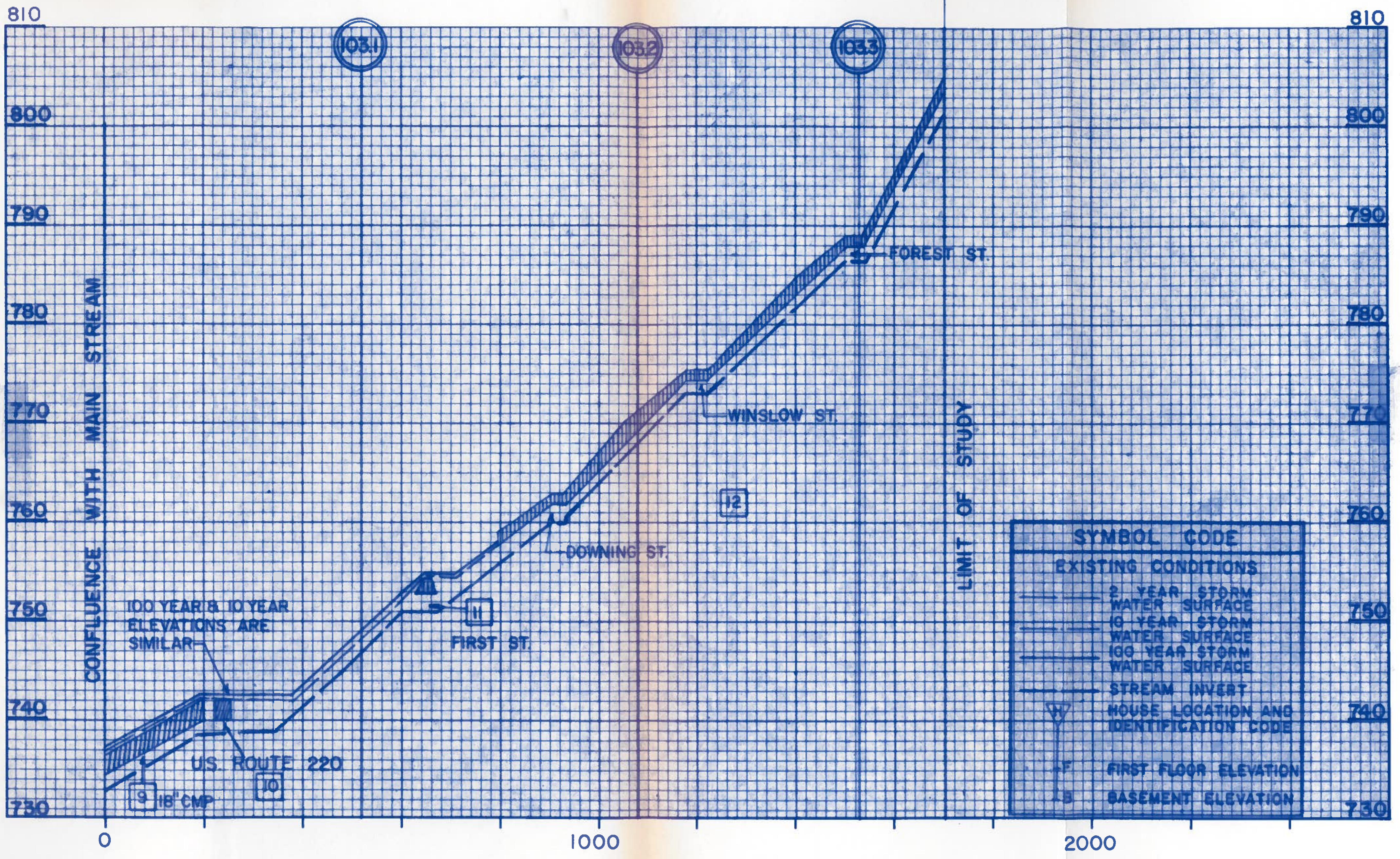
[3] STRUCTURE NUMBER

(4.0) CROSS SECTION WHERE STREAM FLOW HAS CHANGED

SCALE
HORIZONTAL : 1" = 200'
VERTICAL : 1" = 10'

STREAM PROFILE
TRIPLE LAKES TRIBUTARY NO. 1

SHEET NO.
2 OF 2



PURDUM & JESCHKE
CONSULTING ENGINEERS
LAND SURVEYORS

LEGEND

(4.0) CROSS SECTION NUMBER AND LOCATION

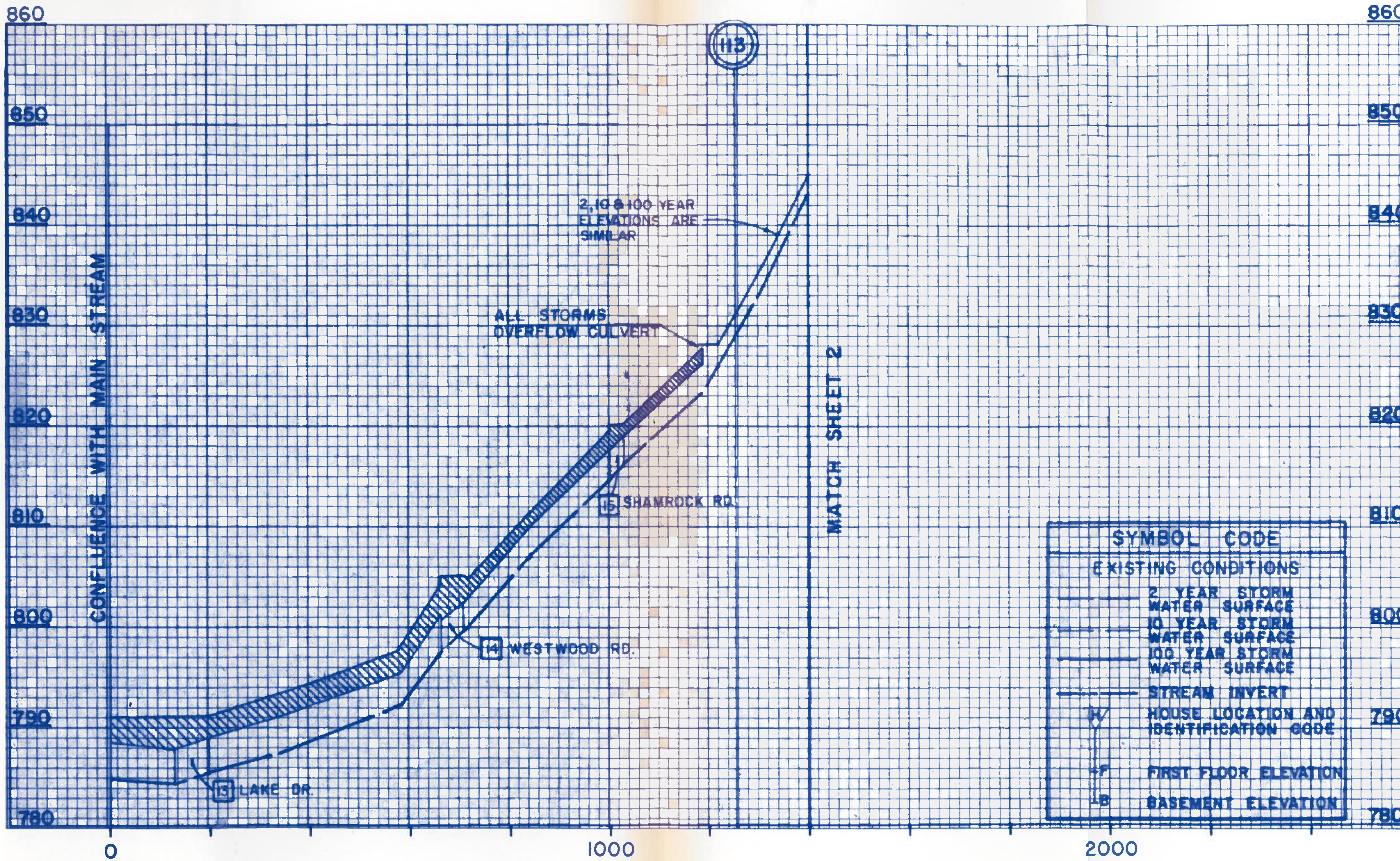
[3] STRUCTURE NUMBER

(4.0) CROSS SECTION WHERE STREAM FLOW HAS CHANGED

SCALE
HORIZONTAL : 1"=200'
VERTICAL : 1"=10'

STREAM PROFILE
TRIPLE LAKES TRIBUTARY NO. 2

SHEET NO.
1 OF 1



PURDUM & JESCHKE
CONSULTING ENGINEERS
LAND SURVEYORS

LEGEND

(4.0) CROSS SECTION NUMBER AND LOCATION

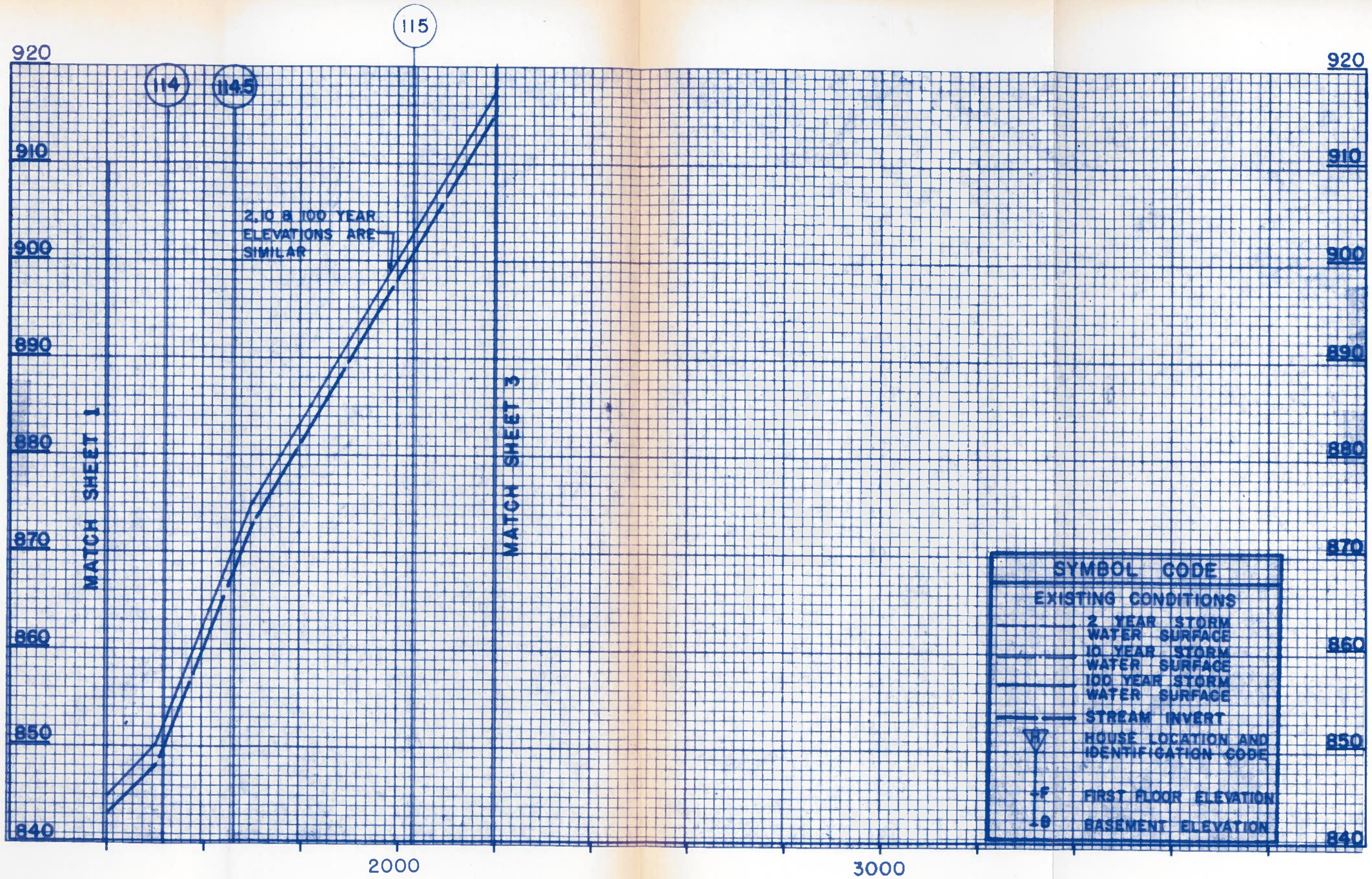
[3] STRUCTURE NUMBER

(4.0) CROSS SECTION WHERE STREAM FLOW HAS CHANGED

SCALE
HORIZONTAL :1"=200'
VERTICAL :1"=10'

STREAM PROFILE
TRIPLE LAKES TRIBUTARY NO. 3A

SHEET NO.
1 OF 3



PURDUM & JESCHKE
CONSULTING ENGINEERS
LAND SURVEYORS

LEGEND

(4.0) CROSS SECTION NUMBER AND LOCATION

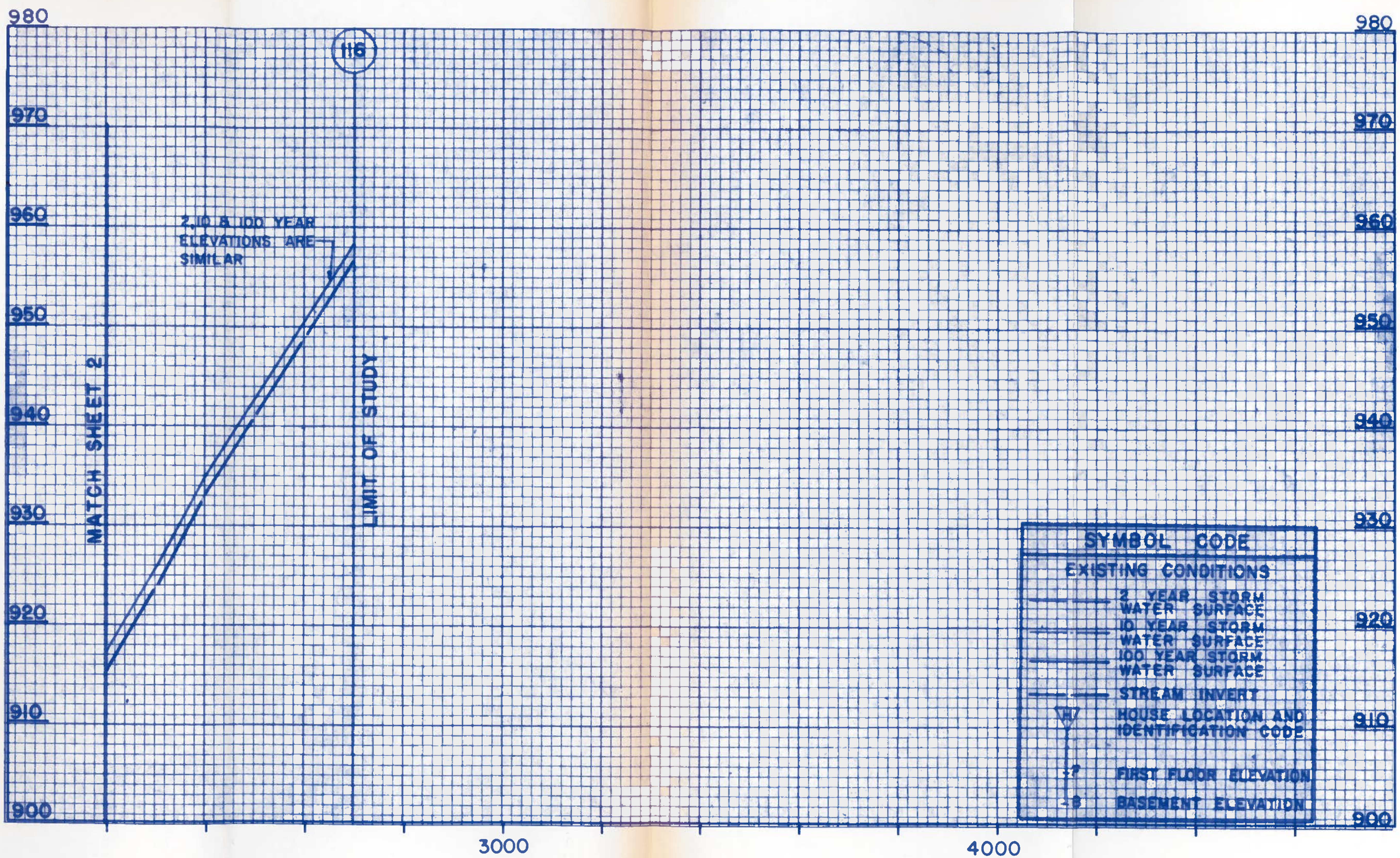
[3] STRUCTURE NUMBER

(4.0) CROSS SECTION WHERE STREAM FLOW HAS CHANGED

SCALE
HORIZONTAL :1"=200'
VERTICAL :1"=10'

STREAM PROFILE
TRIPLE LAKES TRIBUTARY NO. 3A

SHEET NO. 2 OF 3



PURDUM & JESCHKE
CONSULTING ENGINEERS
LAND SURVEYORS

LEGEND

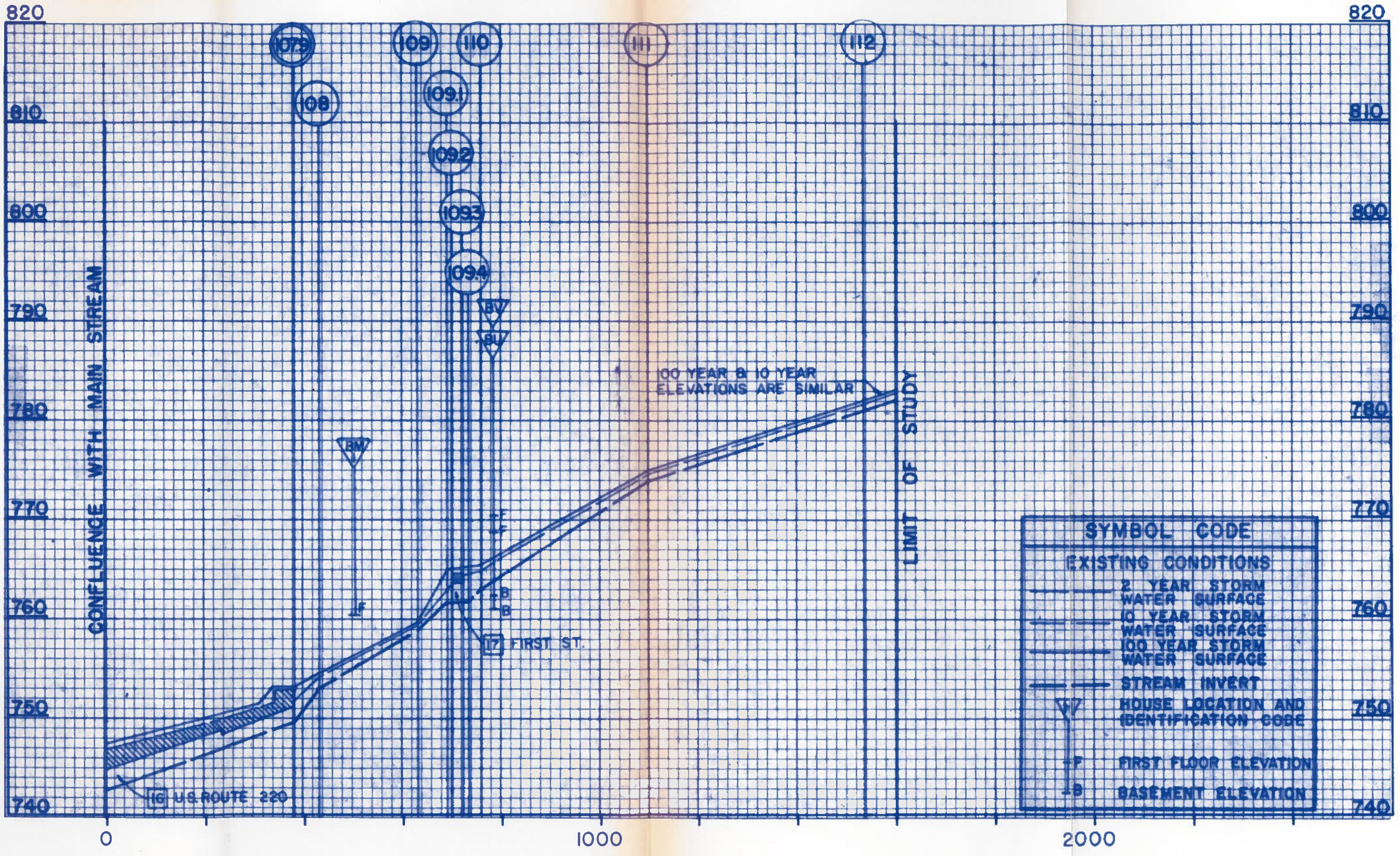
(4.0) CROSS SECTION NUMBER AND LOCATION

[3] STRUCTURE NUMBER

(4.0) CROSS SECTION WHERE STREAM FLOW HAS CHANGED

SCALE
HORIZONTAL : 1"=200'
VERTICAL : 1"=10'

STREAM PROFILE
TRIPLE LAKES TRIBUTARY NO. 3A



PURDUM & JESCHKE
CONSULTING ENGINEERS
LAND SURVEYORS

LEGEND

(4.0) CROSS SECTION NUMBER AND LOCATION

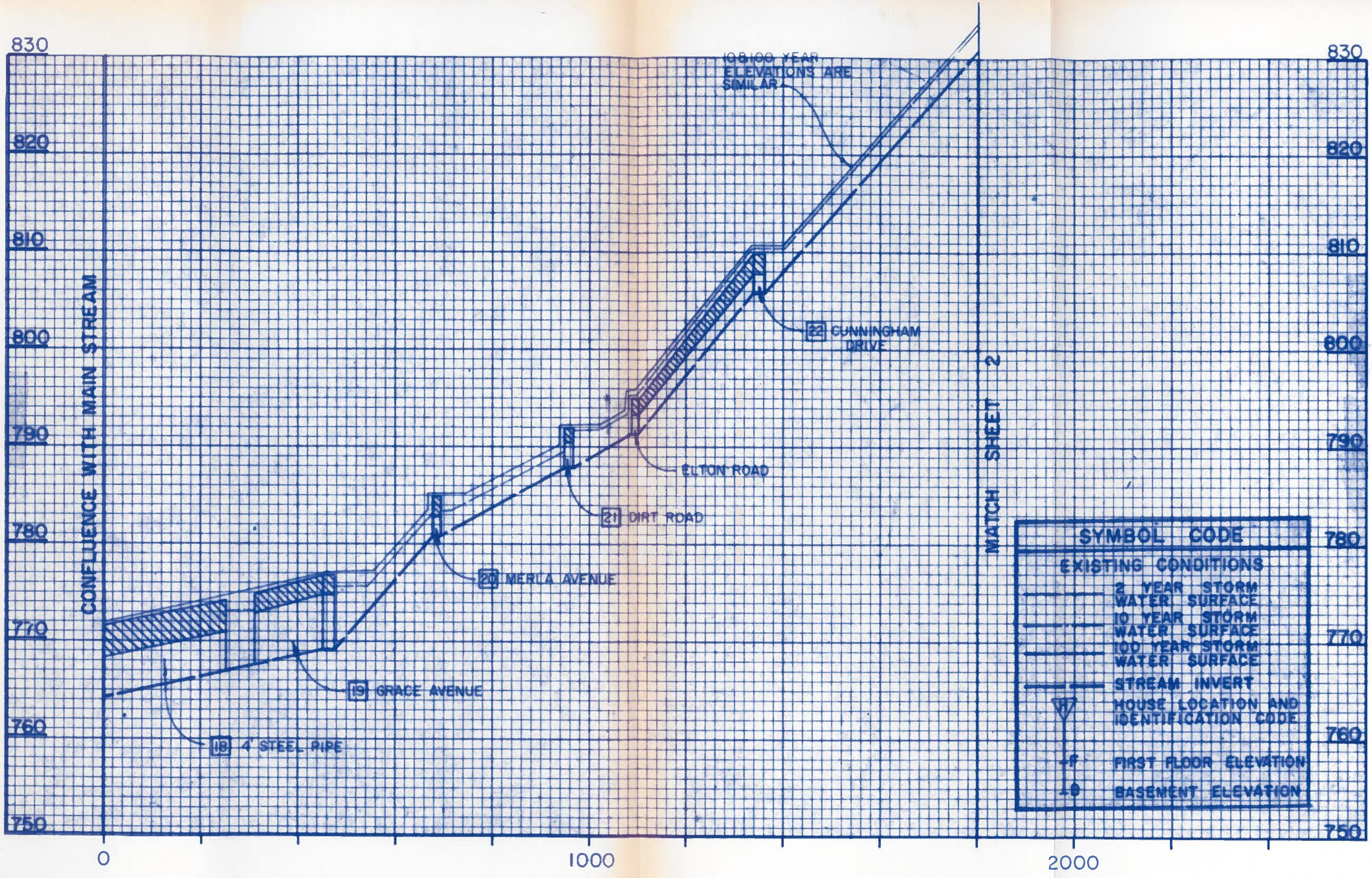
(4.0) CROSS SECTION WHERE STREAM FLOW HAS CHANGED

[3] STRUCTURE NUMBER

SCALE
HORIZONTAL :1"=200'
VERTICAL :1"=10'

STREAM PROFILE
TRIPLE LAKES TRIBUTARY NO. 3B

SHEET NO.
1 OF 1



PURDUM & JESCHKE
CONSULTING ENGINEERS
LAND SURVEYORS

LEGEND

(4.0) CROSS SECTION NUMBER AND LOCATION

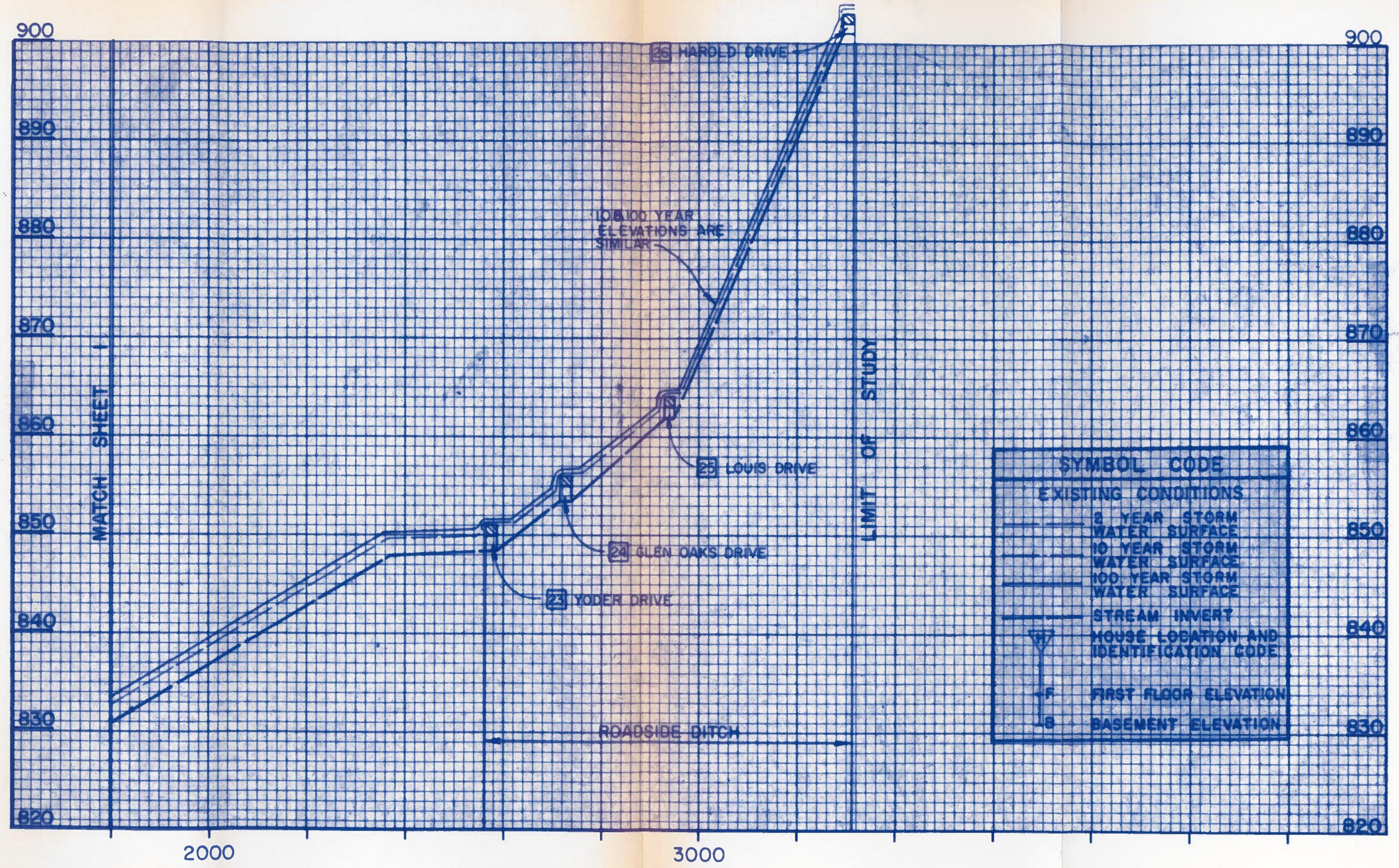
[3] STRUCTURE NUMBER

(4.0) CROSS SECTION WHERE STREAM FLOW HAS CHANGED

SCALE
HORIZONTAL : 1" = 200'
VERTICAL : 1" = 10'

STREAM PROFILE
TRIPLE LAKES TRIBUTARY NO. 4

SHEET NO. 1 OF 2



PURDUM & JESCHKE
CONSULTING ENGINEERS
LAND SURVEYORS

LEGEND

(4.0) CROSS SECTION NUMBER AND LOCATION

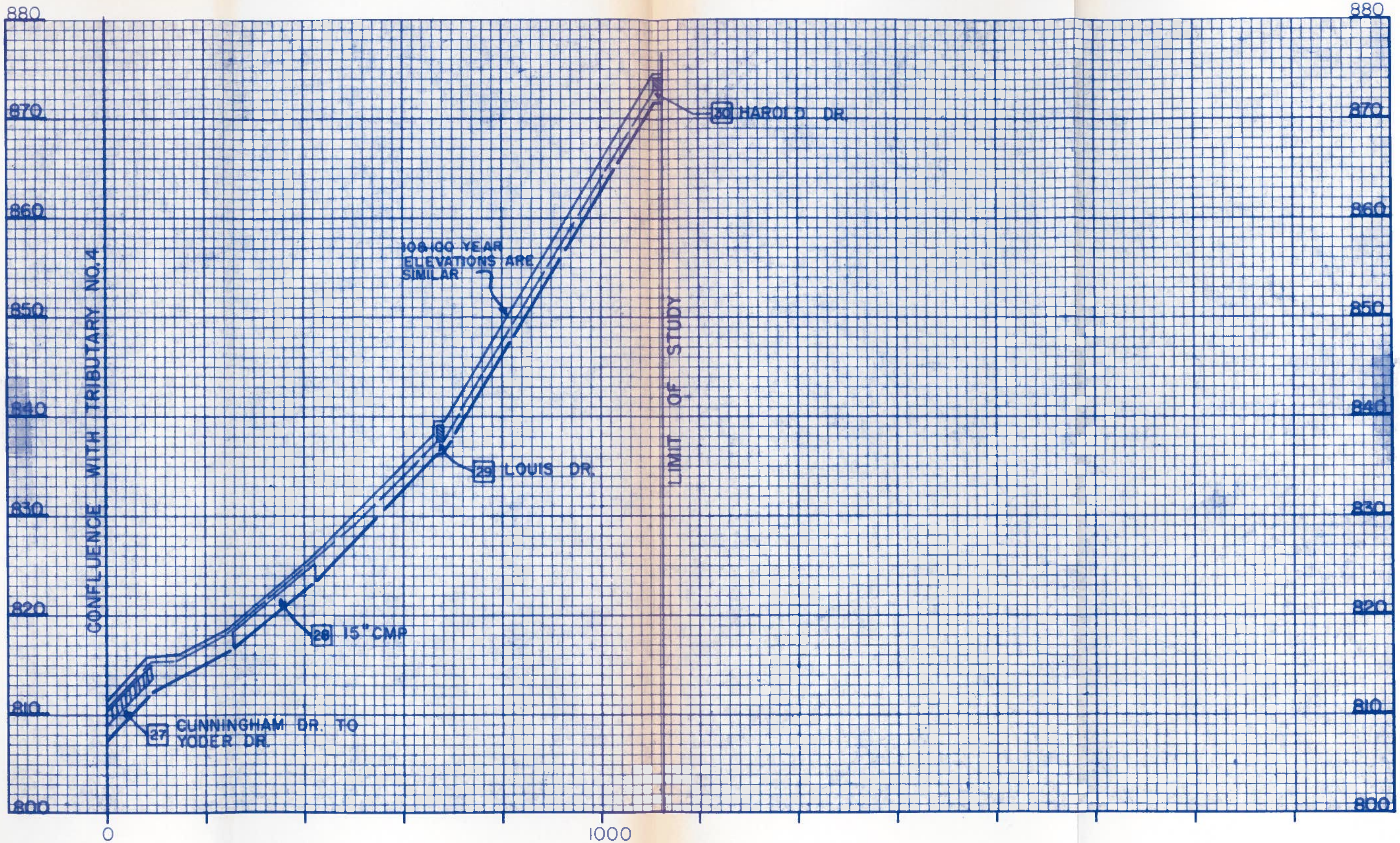
[3] STRUCTURE NUMBER

(4.0) CROSS SECTION WHERE STREAM FLOW HAS CHANGED

SCALE
HORIZONTAL : 1"=200'
VERTICAL : 1"=10'

STREAM PROFILE
TRIPLE LAKES TRIBUTARY NO. 4

SHEET NO.
2 OF 2



PURDUM & JESCHKE
CONSULTING ENGINEERS
LAND SURVEYORS

LEGEND

(4.0) CROSS SECTION NUMBER AND LOCATION

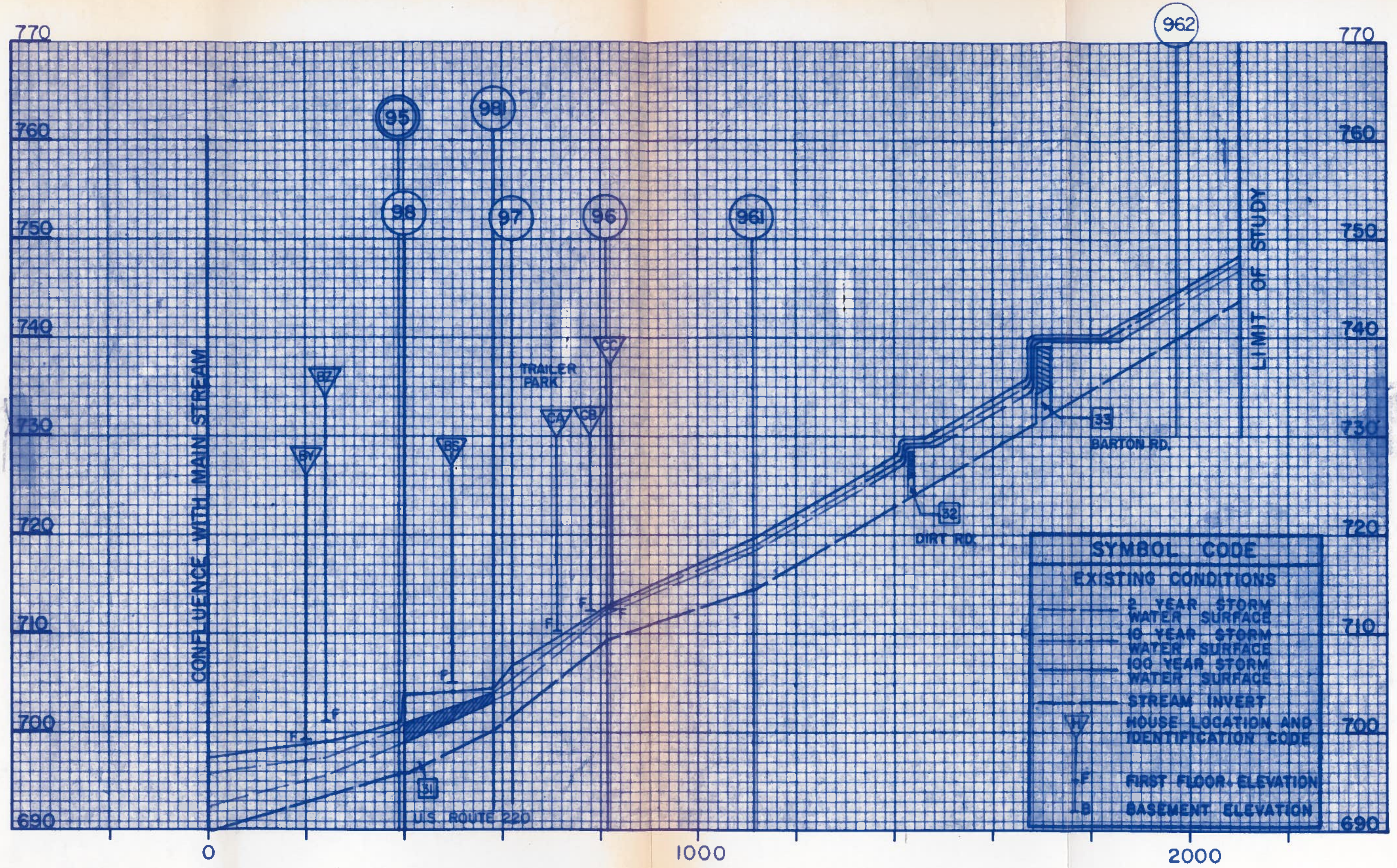
[3] STRUCTURE NUMBER

(4.0) CROSS SECTION WHERE STREAM FLOW HAS CHANGED

SCALE
HORIZONTAL :1"=200'
VERTICAL :1"=10'

STREAM PROFILE
TRIPLE LAKES TRIBUTARY NO.4A

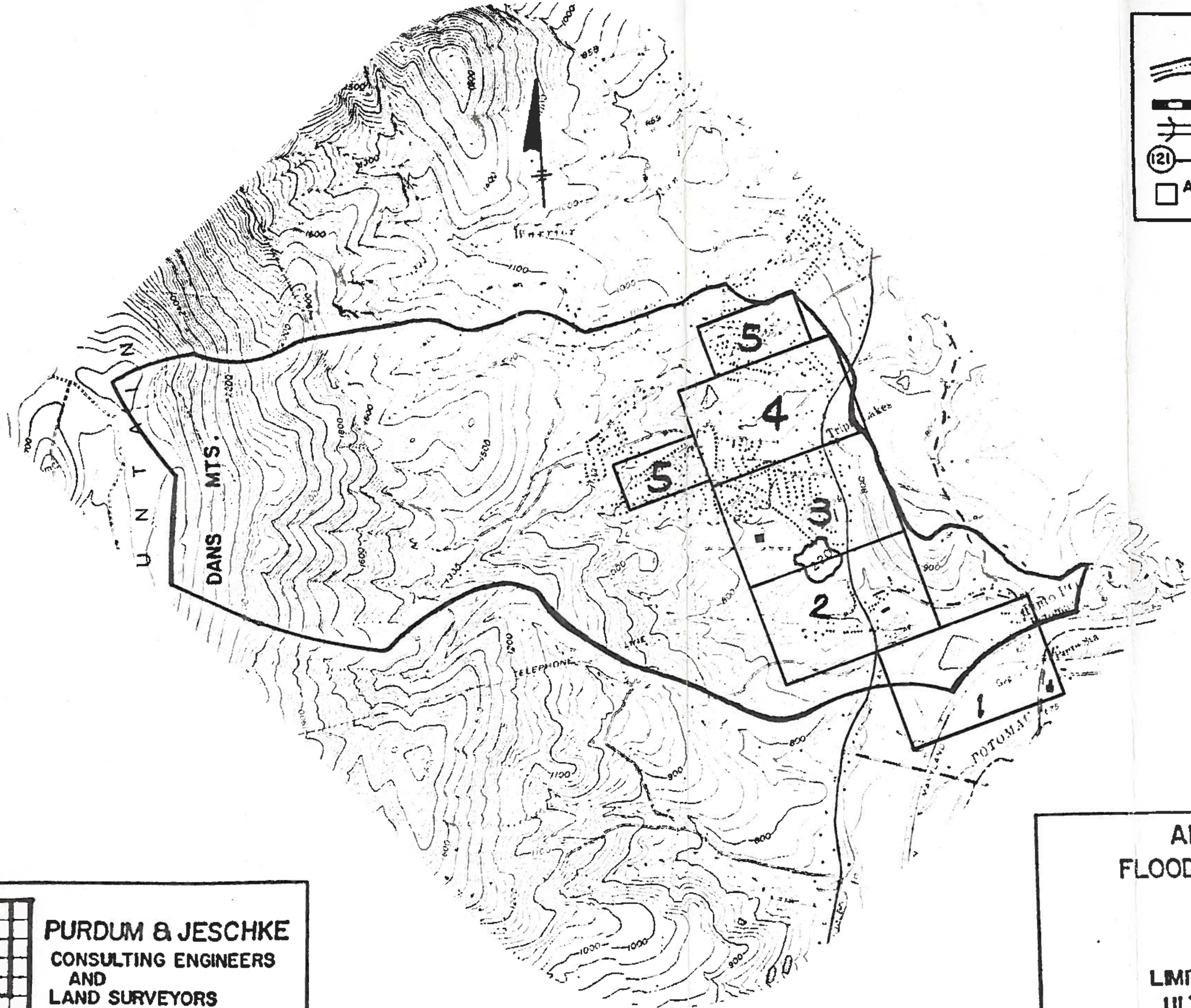
SHEET NO.
1 OF 1



PURDUM & JESCHKE CONSULTING ENGINEERS LAND SURVEYORS	**LEGEND** (4.0) CROSS SECTION NUMBER AND LOCATION [3] STRUCTURE NUMBER (4.0) CROSS SECTION WHERE STREAM FLOW HAS CHANGED	SCALE HORIZONTAL : 1"=200' VERTICAL : 1"=10'	STREAM PROFILE TRIPLE LAKES TRIBUTARY NO. 5	SHEET NO. 1 OF 1

APPENDIX E

100-YEAR FLOOD DELINEATION



LEGEND

STREAM AND 100-YEAR FLOOD LIMITS
CULVERT
BRIDGE
CROSS SECTION NUMBER AND LOCATION
HOUSE IDENTIFICATION CODE

ALLEGANY COUNTY
FLOOD MANAGEMENT STUDY
TRIPLE LAKES

INDEX MAP

LIMITS OF 100-YEAR FLOOD
ULTIMATE DEVELOPMENT

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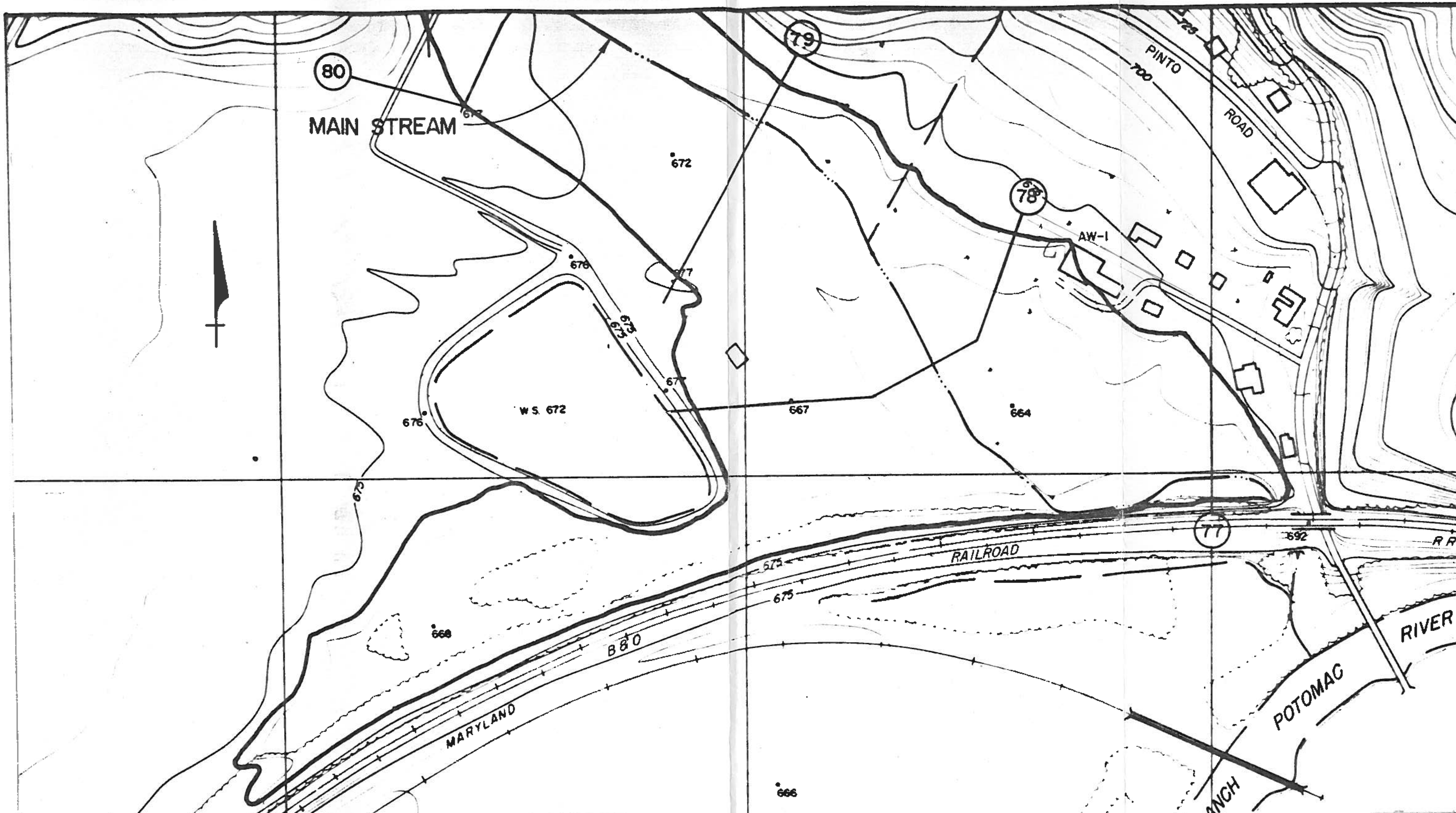
AND
LAND SURVEYORS

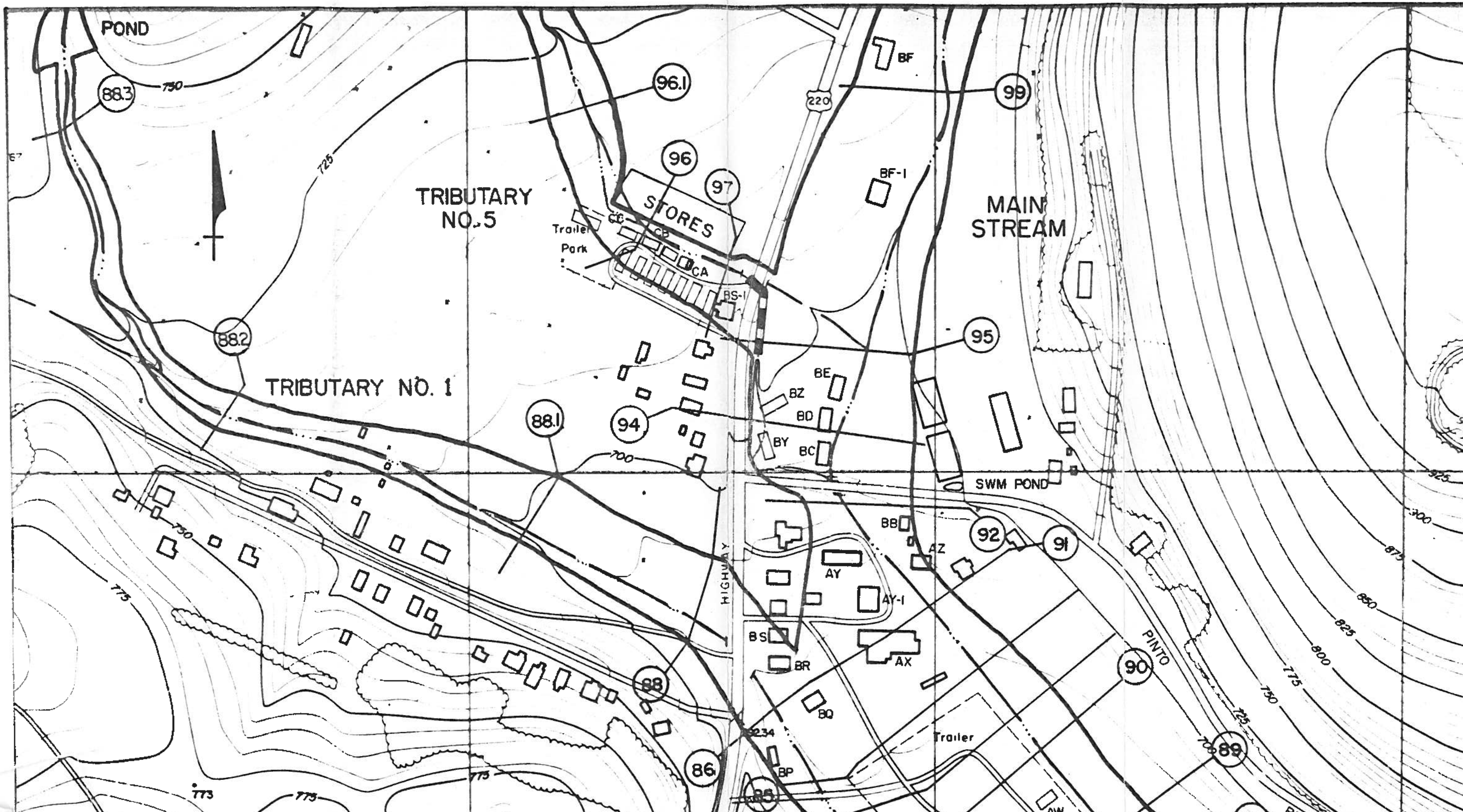


PURDUM & JESCHKE
CONSULTING ENGINEERS
1029 N. CALVERT STREET
BALTIMORE, MARYLAND 21202

TRIPLE LAKES
LIMITS OF 100 YEAR FLOOD
ULTIMATE DEVELOPMENT

200 100 0 200
SCALE: 1" = 200'

SHEET NO.
1 OF 5



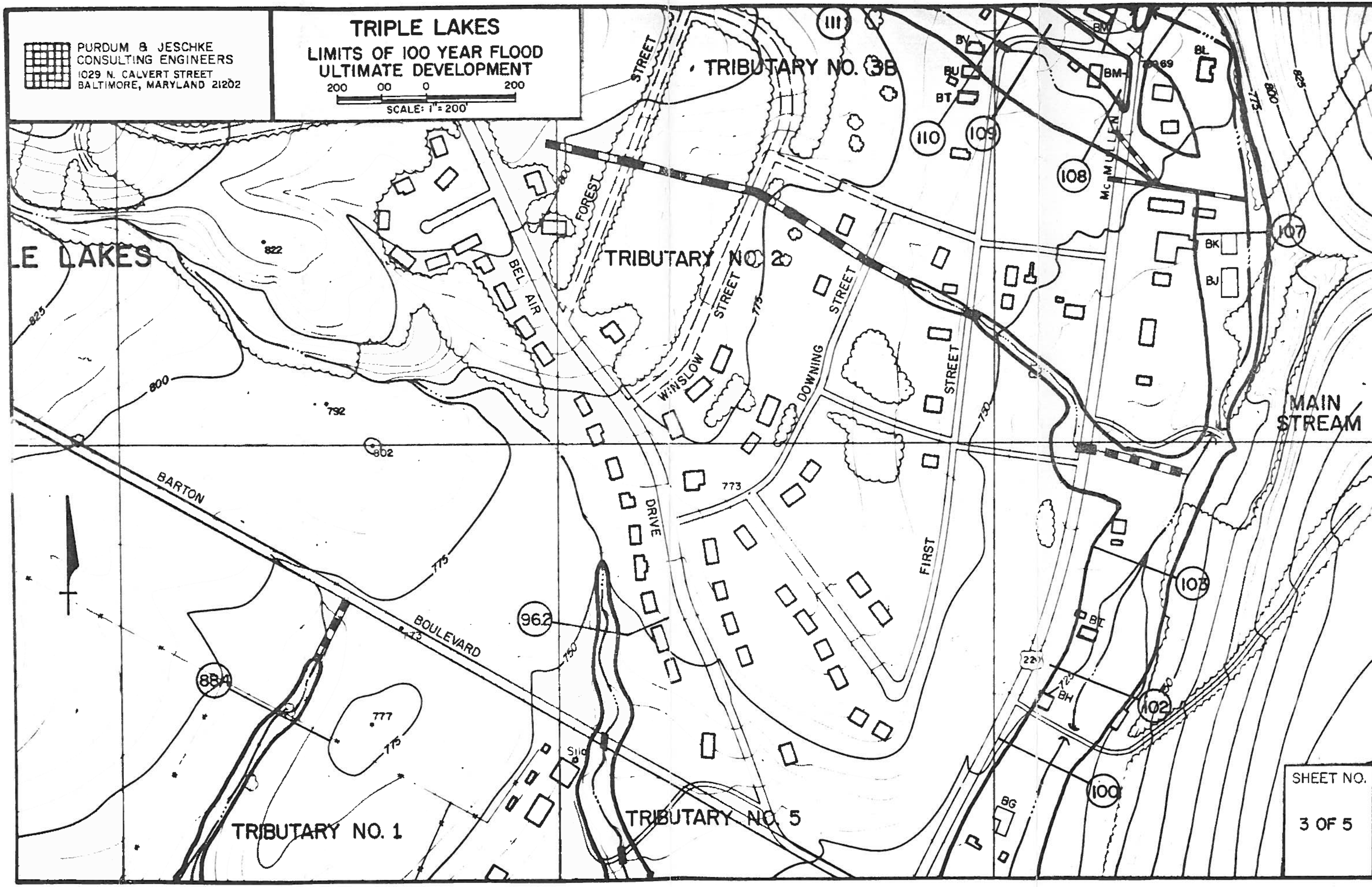
PURDUM & JESCHKE
CONSULTING ENGINEERS
1029 N. CALVERT STREET
BALTIMORE, MARYLAND 21202

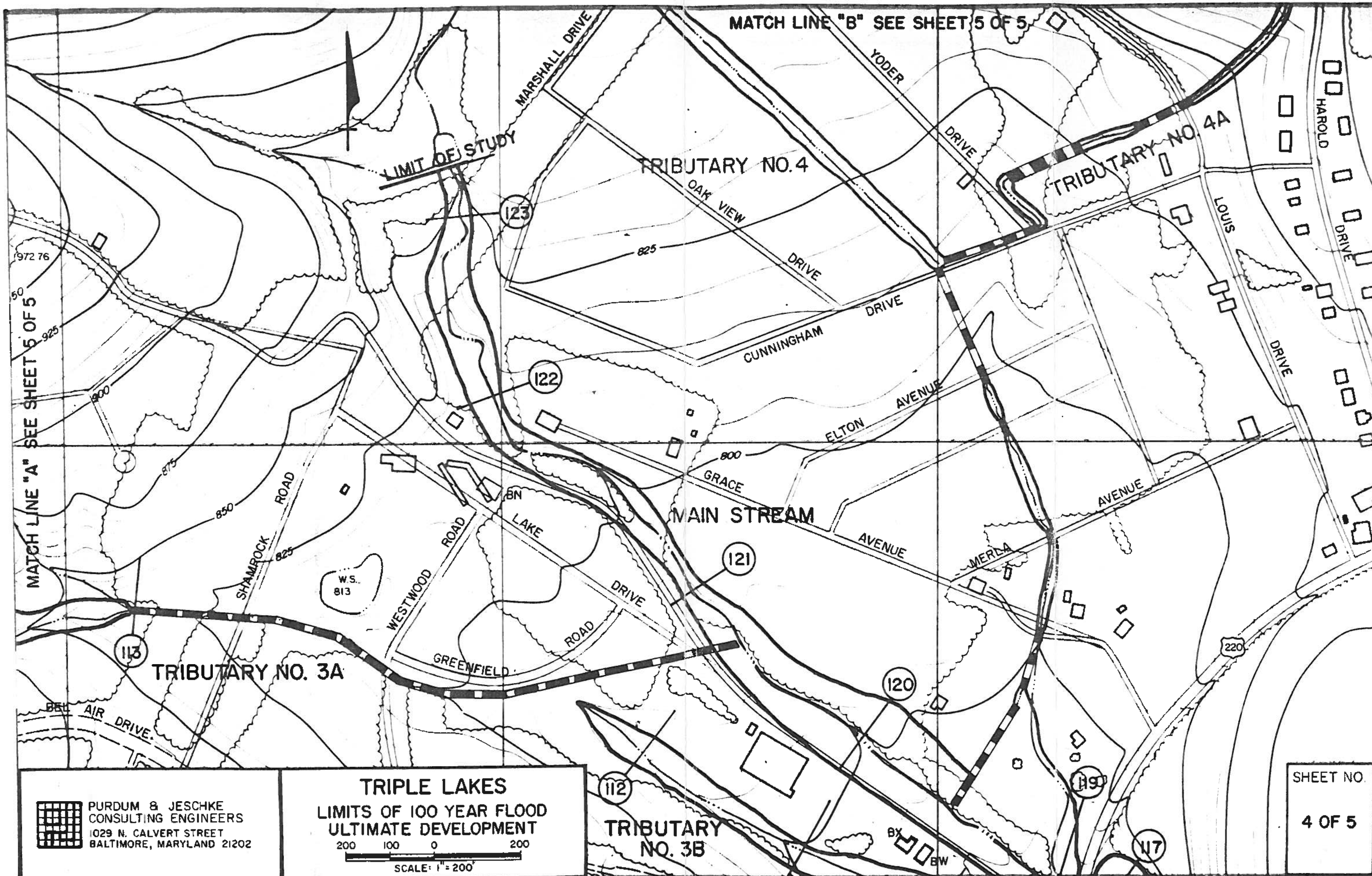
TRIPLE LAKES

LIMITS OF 100 YEAR FLOOD
ULTIMATE DEVELOPMENT

200 100 0 200
SCALE: 1" = 200'

SHEET NO.
2 OF 5


PURDUM & JESCHKE
CONSULTING ENGINEERS
1029 N. CALVERT STREET
BALTIMORE, MARYLAND 21202
TRIPLE LAKES
LIMITS OF 100 YEAR FLOOD
ULTIMATE DEVELOPMENT
200 00 0 200
SCALE: 1" = 200'
LE LAKES
TRIBUTARY NO. 3B
TRIBUTARY NO. 2
TRIBUTARY NO. 1
TRIBUTARY NO. 5
MAIN STREAM
FOREST STREET
WINSLOW STREET
DOWNING STREET
FIRST STREET
BEL AIR DRIVE
BARTON BOULEVARD
McMULLEN
111
110
109
108
107
103
102
100
962
884
SHEET NO.
3 OF 5



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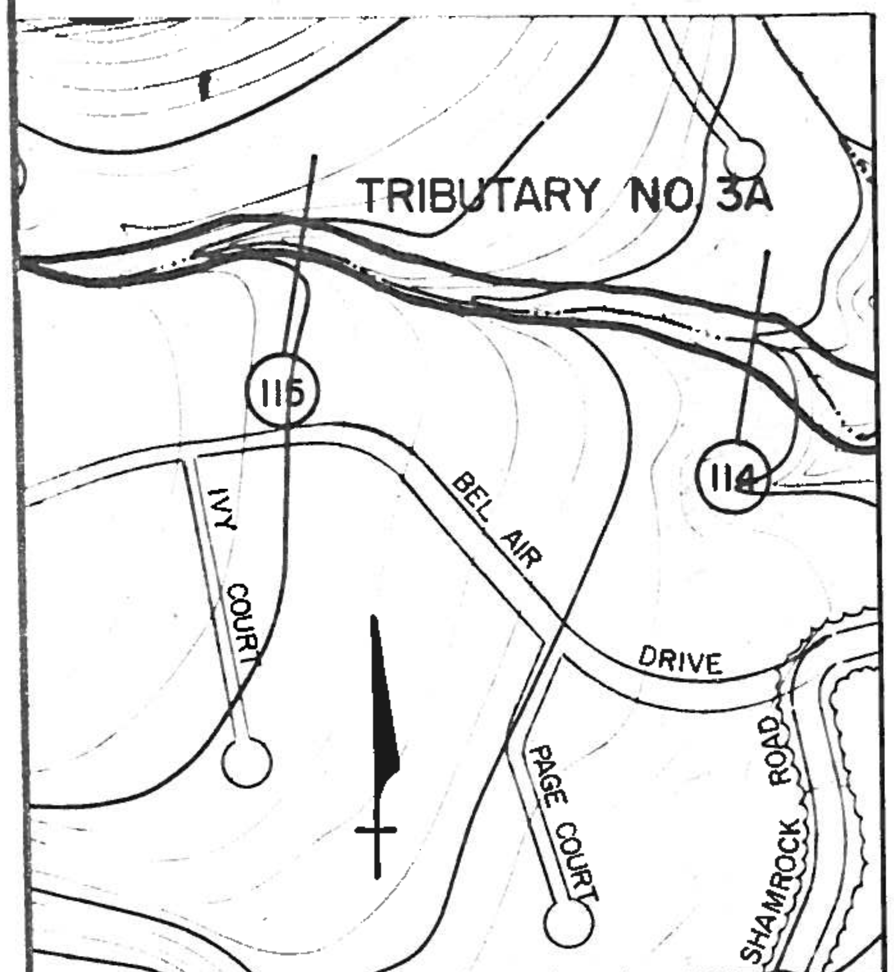
BALTIMORE, MARYLAND 21202

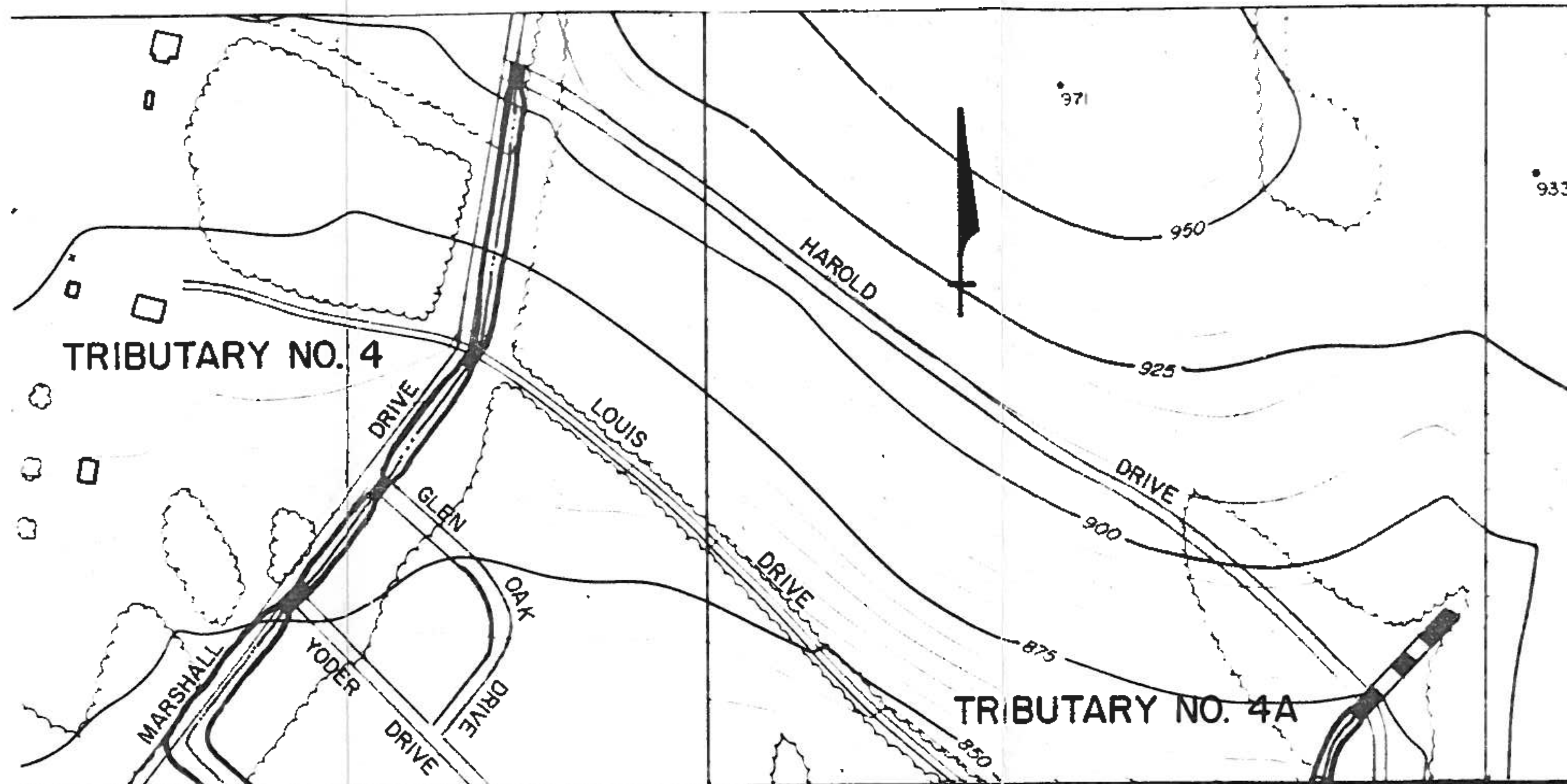
TRIPLE LAKES
LIMITS OF 100 YEAR FLOOD ULTIMATE DEVELOPMENT

200 100 0 200
SCALE: 1" = 200'

SHEET NO.
4 OF 5



MATCH LINE "A" SEE SHEET 4 OF 5



MATCH LINE "B" SEE SHEET 4 OF 5

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CONSULTING ENGINEERS
1029 N. CALVERT STREET
BALTIMORE, MARYLAND 21202

TRIPLE LAKES

LIMITS OF 100 YEAR FLOOD
ULTIMATE DEVELOPMENT

200 100 0 200

SCALE: 1" = 200'

SHEET NO.

5 OF 5