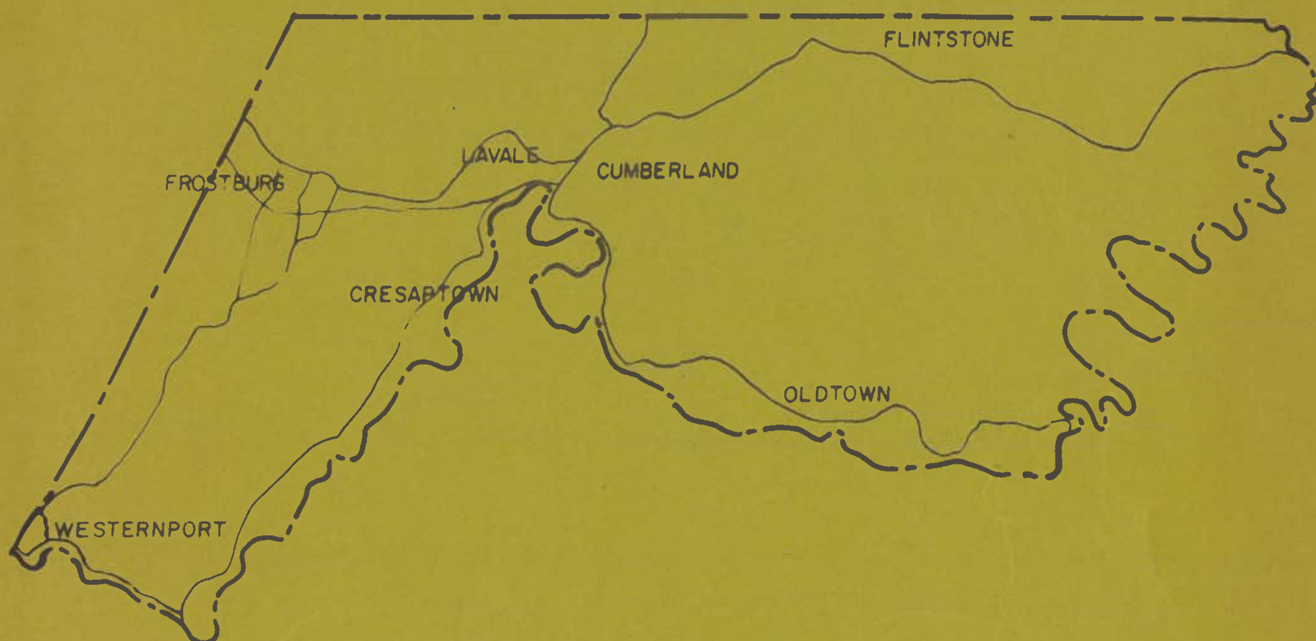
ALLEGANY COUNTY
FLOOD MANAGEMENT STUDY
FAIRGO BASIN



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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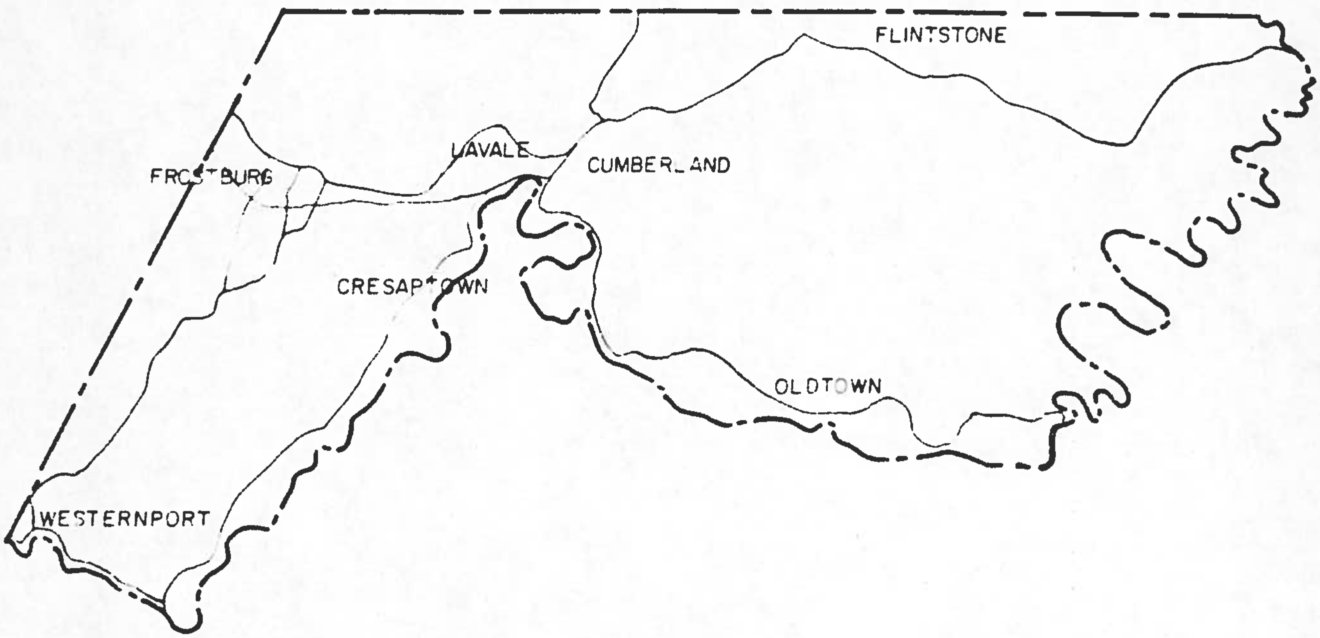

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September 30, 1986

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

Subject: Allegany County Flood Management Study
Fairgo Basin Watershed

Dear Mr. Bond:

We are pleased to submit herewith the final copies of the Fairgo Basin 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., P.E.
Partner

CGW/jm
Attachment

ALLEGANY COUNTY
FLOOD MANAGEMENT STUDY

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ALLEGANY COUNTY

FLOOD MANAGEMENT STUDY

FAIRGO BASIN

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 Fairgo Basin. 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 Fairgo Basin 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 Fairgo Basin drainage area is approximately 335 acres in size and is shown in Figure 1, Appendix A. The eastern boundary is at the main stream confluence with the North Branch of the Potomac River, adjacent to the Cumberland Fairgrounds. The southern boundary passes through the Potomac Park area. The western and northern boundaries extend into the Haystack Mountain Range.

B. SUBBASINS

The total drainage area of the Fairgo Basin is divided into nine subbasins ranging from nine acres to 114 acres, with 37 acres the average size. Subbasins are delineated so that stream flow rates can be computed to design points in the channel flow path. These design points are defined at changes in channel characteristics, bridges and culverts, road crossings, and at branch tributaries.

C. SOILS

Soil Conservation Service (SCS) Hydrologic Soil Groups B and C occur in the Fairgo Basin drainage area. Sixty-eight percent of the watershed contains Type C soil which has a slow infiltration rate and a high runoff potential. Group B, which occurs in approximately 32 percent of the area, has a moderate infiltration rate and a correspondingly moderate storm water runoff rate.

D. SLOPE

The watershed slopes vary considerably, ranging from 1.5 percent in low-lying areas near the main stream, to ten percent in hilly areas, to as high as 30 percent in wooded, mountainous regions.

E. LAND USE AND ZONING

Seventy-three percent of the watershed is wooded and pasture, which covers most of the western and northern areas. Residential and rural residential areas are located in the southern and eastern sections, which comprises 27 percent of the drainage area.

The central area of the watershed is zoned as residential and rural residential, which covers 64 percent of the drainage area. Commercial and industrial use is zoned in nine percent of the watershed, located generally in the southeast. Areas in the north and west are zoned for agriculture and conservation, which cover 27 percent of the watershed.

IV. FIELD INVESTIGATION

Field investigations were necessary to ensure proper modeling of the Fairgo Basin. 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 Fairgo Basin. 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 Fairgo Basin watershed the main stream was 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 Fairgo Basin watershed, Tributary No. 1 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 42 percent response from the questionnaires distributed. No first floor flooding was reported by any of the responses, but some basement flooding was reported. The undersized culverts were frequently mentioned as causing flooding problems.

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 Fairgo Basin watershed is shown as Point Number 1 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 the 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.

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 yields 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.

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.

c. In this study the normal bridge routine was used to model both Fairgrounds Roads, Moss Avenue, Pershing Street, Yuma Street, Poppy Street, Structure No. 19, Structure No. 11, and Mulberry Street. The B & O Railroad, Structure No. 5, Route 220, Crocus Street, Ginger Street, and Cresap Street were modeled with the special bridge routine.

VI. STREAM STUDY REACHES

A. DESCRIPTION OF STREAM STUDY REACHES

1. Main Stem

The Fairgo Basin main stream begins 1,000 feet northwest of Cresap Drive at the P.E. powerline. The stream flows in a southeasterly direction with culvert crossings under Cresap Drive and Mulberry Street. Streamflow extends to Route 220, paralleling Mulberry Street to the east. North of Route 220 the channel averages 20 feet in width and five feet in depth with a slope of 3.7 percent. The stream flows in a culvert under Route 220, and then along the west side of Moss Avenue. It has culvert crossings under Poppy, Yuma, and Pershing Streets. This reach has a slope of 3.3 percent, and the channel is four feet wide by two feet deep. The stream crosses Moss Avenue in a culvert system that extends to the B & O Railroad. The stream parallels the railroad until crossing in a culvert under the tracks. It then flows through the Cumberland Fairgrounds to the North Branch of the Potomac River, with two culvert crossings at Fairgrounds Roads. The channel in this section averages four feet in depth and five feet in width, and the slope is 1.2 percent.

The overbank areas consist of trees and brush in the upper and lower sections of the stream with the middle section consisting of lawns and grass areas. The Fairgo Basin main stream is a total of 7,340 feet long.

2. Tributary No. 1

Tributary No. 1 begins approximately 460 feet northwest of the Cresap Drive and Apache Street intersection. The stream is piped for a short distance parallel to Apache Street, and then crosses in a culvert under Cresap Drive. It then enters a pipe system that is parallel to Locust Street and extends past Heather Street. Tributary No. 1 continues in a southeasterly direction with flow in backyard culverts and culvert crossings at Marigold and Kite Streets. The stream enters a pipe system which crosses Route 220, and parallels the highway. Open channel flow resumes for a stretch along Route 220 until Tributary No. 1 reaches its confluence with the main stream. The reach is 2,880 feet long with an average stream slope of 4.8 percent.

The channel averages 1.5 feet in depth and three feet in width, with stream overbank consisting of lawns and high grass.

B. MANNING'S COEFFICIENT

Manning's 'n' 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

Twenty-four 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 Fairgo Basin 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 main stream Fairgo Basin flood zone averages 80 feet in width above U.S. Route 220. At the state highway and extending to Moss Avenue, the flood zone averages 110 feet. Backwater behind the B & O Railroad expands the flood zone width to a 2,100 feet maximum. In the Cumberland Fairgrounds, the flood zone recedes to an average 300 feet wide before its confluence with the North Branch Potomac floodplain.

The main stream of the Fairgo Basin has 10 houses in or on the edge of the 100-year flood zone. Five of these houses are above Route 220 of which three (W, X, Y) receive first floor flooding and two (AB, Z), basement flooding. The remaining five houses are along Moss Avenue, and four of these (P, Q, S, T) will receive basement flooding, while one (R) has first floor flooding.

All the bridge and culvert structures on the main stream are overtopped by the 100-year storm. The U.S. Route 220 box culvert can convey the 2 and 10-year storm without overtopping the road.

2. Tributary No. 1

The Tributary No. 1 flood zone averages 50 feet in width above Heather Street and also at the Route 220 culvert to the confluence with the main stream. From Heather Street to the state system the flood zone averages 100 feet in width. There are seven houses in or on the edge of the 100-year flood zone. Two of these houses (V-1 and V-4) will receive first floor flooding, four (V-2, V-3, V-5, and V-6) will have basement flooding, and the remaining house (V-7) will receive foundation flooding only.

All of the culverts on Tributary No. 1 are overtopped by the 100-year storm.

E. FLOOD ZONE COMPARISON

The Harris, Smariga & Associates Study presents a 100-year flood zone for the Fairgo Basin main stream to the B & O Railroad. Stream dimensions were determined from site investigations, and stream capacities were estimated using Manning's equation. The flood delineation of the study was similar to that produced by the HEC-2 model. Elevation comparisons could not be made from available information on the Harris, Smariga & Associates Study.

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 the Fairgo Basin for existing and ultimate conditions is $34,800 and $37,500, 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 the Fairgo Basin watershed is $392,000 and $422,000 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, project costs and benefits were determined. Project costs as defined in this study as labor, equipment, materials and construction costs, operation and maintenance costs, and administration costs. Benefits are defined as reduction in physical damage, reduction in emergency costs, and reduction in income losses. The project cost and benefits are compared on an 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. B & O Railroad Culvert Replacement

The B & O Railroad culvert is undersized causing the 10 and 100-year storms to overtop the railroad. Due to the size of this culvert, backwater at the railroad will reach an elevation that causes overtopping approximately 1,300 feet north of the culvert crossing. In order to convey the 10 and 100-year storms without overtopping the railroad, the existing culvert would have to be replaced by a 70-square-foot culvert. The cost of replacing the culvert would be approximately $41,000. The major benefit of this project is increased safety in the use of the B & O Railroad during the 10 and 100-year storm events.

2. Additional Moss Avenue Pipe System

The existing pipe system adjacent to Moss Avenue (Structure No. 4) is undersized for the 2, 10, and 100-year storm events. This condition causes flooding of Moss Avenue and property damage at House P. An improvement alternative is to have an additional pipe system parallel to Moss Avenue (on the west side of the road). The system will extend to the railroad tracks and then have a culvert crossing at Moss Avenue opening to ditch flow along the railroad. A system of two 48-inch RCP's would contain the 2-year storm, five 54-inch RCP's would carry the 10-year storm, and more than six 54-inch RCP's would be required to contain the 100-year frequency storm. The 10 and 100-year design systems of five or more pipes are not practical, so only the 2-year design was considered.

A 2-year storm design, a system of two 48-inch RCP's, would have an approximate cost of $130,000. The benefits of this project are reduction in both public sector and private losses for the 2-year storm. The present value of the average annual damage costs would be reduced by approximately $10,000 by this improvement.

3. Replacement of Main Stream Culvert at U.S. Route 220

The existing 5.1' by 5.7' box culvert under U.S. Route 220 will contain the 2 and 10-year storm events. However, the culvert is undersized for the 100-year storm, and the state road will be overtopped. Two 7' by 5' box culverts are required to contain the 100-year storm event.

The cost of this replacement project would be approximately $53,000. The reduction in public losses due to this project would be approximately $1,200 on a present value basis.

4. Replacement of Structure No. 10

Structure No. 10, the main stream private culvert upstream of U.S. Route 220, is undersized for the 10 and 100-year storms. This condition causes first floor flooding of Houses W and Y from the 10 and 100-year storms. House X has basement flooding due to the 10-year storm and first floor flooding from the 100-year storm. To contain the 10-year storm, two 66-inch RCP's are needed; and to carry the 100-year storm three 60-inch RCP's are required.

The cost of replacing the existing culvert with two 66-inch RCP's is estimated at $62,000. The benefits of this project are reductions in private sector losses and abstract losses which amount to approximately $56,000 on a present value basis. This is not economical.

Replacing the existing system with three 60-inch culvert costs about $75,000. The reduction to present value costs of the average annual benefits is $77,500. Although this may seem economical, it may not be practical.

5. Replacement of Tributary No. 1 Culvert at U.S. Route 220

The existing 24-inch pipe system that crosses U.S. Route 220 is undersized for the 10 and 100-year storms. This condition causes overtopping of the state road. House V-2 will receive two feet of flooding, and House V-1 will have 5.5 feet of flooding due to these storm events. A 48-inch RCP will carry the 10-year storm, and a 60-inch RCP will carry the 100-year storm.

The cost of the 48-inch system is approximately $114,000. The benefits of this project would include reductions in private and abstract losses to Houses V-1 and V-2 and reduction in public losses. The present value of these benefits is $53,000.

A 60-inch system would costs approximately $129,000. Benefits due to this project are approximately $67,000 on a present value basis.

6. Tributary No. 1 Storm Drainage System

The flow of Tributary No. 1 is obstructed upstream of U.S. Route 220 by various backyard culverts. Most of these culverts are undersized to adequately convey the 2, 10, and 100-year storms. Due to this condition, Houses V-3 and V-5 are subjected to basement flood damage, and House V-4 has first floor flooding. A supplementary storm drainage system would catch the flow north of V-5 at the dirt road west of Kite Street. The system would run parallel to the dirt road, cross Marigold Street, and then parallel a gravel road south of Marigold Street until meeting the state system. A 36-inch RCP pipe system is needed to carry a 2-year storm, a 48-inch RCP for the 10-year storm, and a 60-inch RCP system for the 100-year storm. The existing 24-inch state system downstream would not be adequate to connect with the proposed Tributary No. 1 storm drainage system for any of the design storms. The proposed Alternative No. 5 for U.S. Route 220 culvert replacement would have to be implemented before the Tributary No. 1 storm drainage system could be installed.

The 48-inch RCP storm drainage system would cost approximately $100,000. The benefits of this design are reductions in private sector and in abstract losses. The benefits amount to $93,000 on a present value basis.

A 60-inch storm RCP storm drainage system would cost approximately $173,000. Benefits of this project are approximately $105,000 in damage reductions.

IX. RECOMMENDATIONS

Table 6 in Appendix B lists the flood mitigation alternatives for the Fairgo watershed.

A. MAIN STREAM

Below U.S. Route 220 the two houses (Q, R) in the flood zone have already been purchased. The three other structures (P, S, T) are located on the edge of the flood zone and will experience basement and foundation flooding. These owners should consider floodproofing and insurance to mitigate their flood losses.

An additional culvert system parallel to the Moss Avenue culvert is not economically justified. The only flooding in this area is the road and some open areas adjacent to the road. Residents should try to remove vehicles from the road before flood conditions develop.

The backwater from the B & O Railroad does not cause any flood damage. To prevent the railroad from overtopping, the existing culvert needs to be replaced at a cost of approximately $41,000. The railroad currently is overtopped for a 300-foot stretch north of the fairgrounds. The depth will be only 0.34 foot for the 100-year storm. This depth will not cause any danger to a moving train. The replacement of the B & O Railroad culvert is not recommended.

The flooding of the fairgrounds property causes minimal property damage. No improvement alternatives are recommended for this area. The area should be evacuated during forecasted flooding conditions.

On the main stream above U.S. Route 220, three structures (X, Y, Z) receive first floor flooding due to an undersized private culvert located in the stream. The cost of replacing the culvert to prevent flooding during a 10 or 100-year storm is nearly equal to the reduction in flood damages. If culvert replacement is not warranted by the County, floodproofing and insurance should be obtained by the homeowners. The two remaining flooded structures on the main stream are on the edge of the flood zone and receive basement flooding. The homeowners should purchase flood insurance and practice floodproofing methods. 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 basement walls.

The U.S. Route 220 culvert is overtopping by the 100-year storm. Replacing the culvert is not economically justified. The culvert does safely convey the 2 and 10-year storms.

The remaining culverts on the main stream were investigated to see what size replacement culverts would be required to make the road passable during flood conditions.

At Pershing Street, three 57.8" x 35.5" CMPA's are required to pass the 2-year storm at a cost of $18,000.

At Yuma Street, two 65" x 40" CMPA's are required to pass the 2-year storm at a cost of $20,000.

On Poppy Street, two 65" x 40" CMPA's are also required to pass the 2-year storm at a cost of $15,000.

At Crocus Street the existing culvert will pass the 2-year torm. The 10-year storm will require a 80" x 48" CMPA at a cost of $15,000.

At Ginger Street the existing culvert will also pass the 2-year storm without flooding the road. The 10-year storm will require a 80" x 48" CMPA at a cost of $18,000.

At Mulberry Street the existing culvert will pass the 2-year storm. Two 51" x 32" CMPA's are required for the 10-year storm at a cost of $23,000.

The Cresap Drive culvert will convey the 2 and 10-year storm flows without flooding. The 100-year storm will require an 88" x 63" CMPA at a cost of $22,000 to prevent overtopping of the drive.

For the above-mentioned culverts, all other designs and sizes are impractical.

2. TRIBUTARY NO. 1

The flooding of Tributary No. 1 is due to the inadequate existing storm drainage system. Any improvement to the existing system depends on the state culvert paralleling U.S. Route 220. This culvert must be replaced with a larger culvert to allow replacement of culverts upstream. A combined effort of the State and County would be required to improve the flooding conditions. The cost for the State improvements are not economically justified.

The homeowners on Tributary No. 1 should, none the less, purchase flood insurance and use effective floodproofing measures for basements.

Houses V-1 and V-4 should be considered for purchase if no structural improvements are made. Both houses will receive first floor flooding and will also have access problems during flooding.

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APPENDIX A - FIGURES

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

FAIRGO BASIN WATERSHED

VICINITY MAP

2000 0 2000

SCALE: 1" = 2000'

FIGURE 1

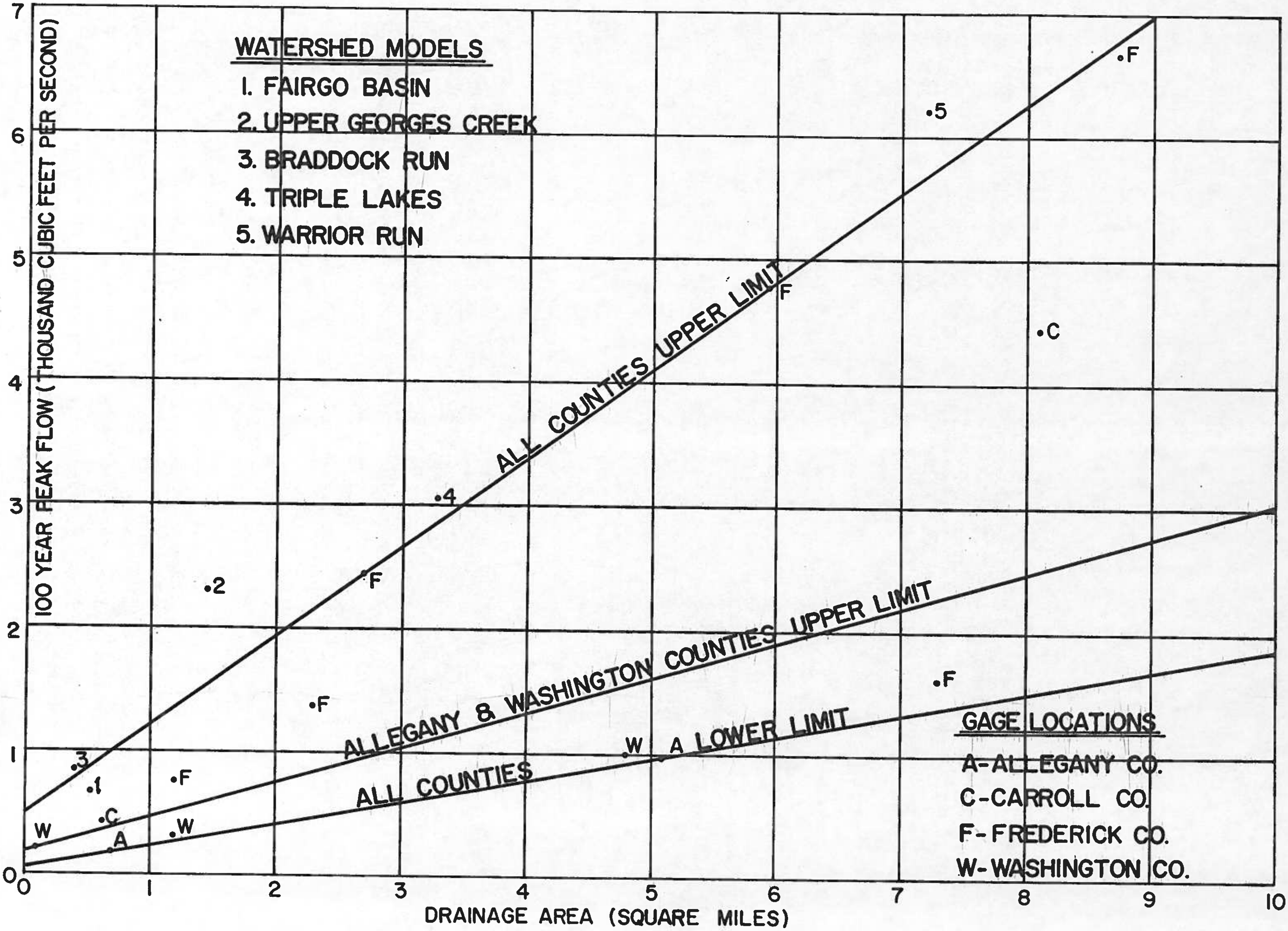
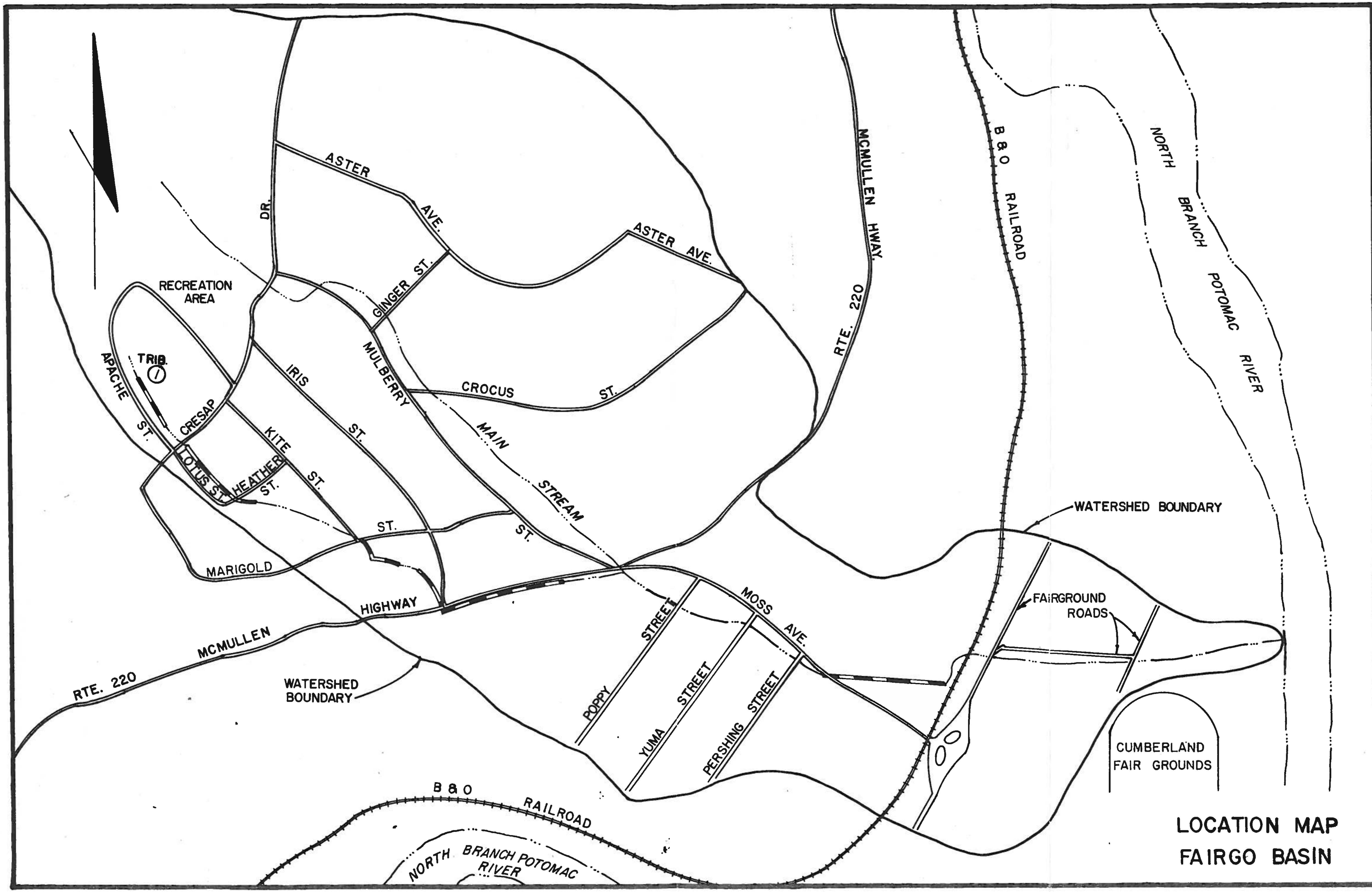
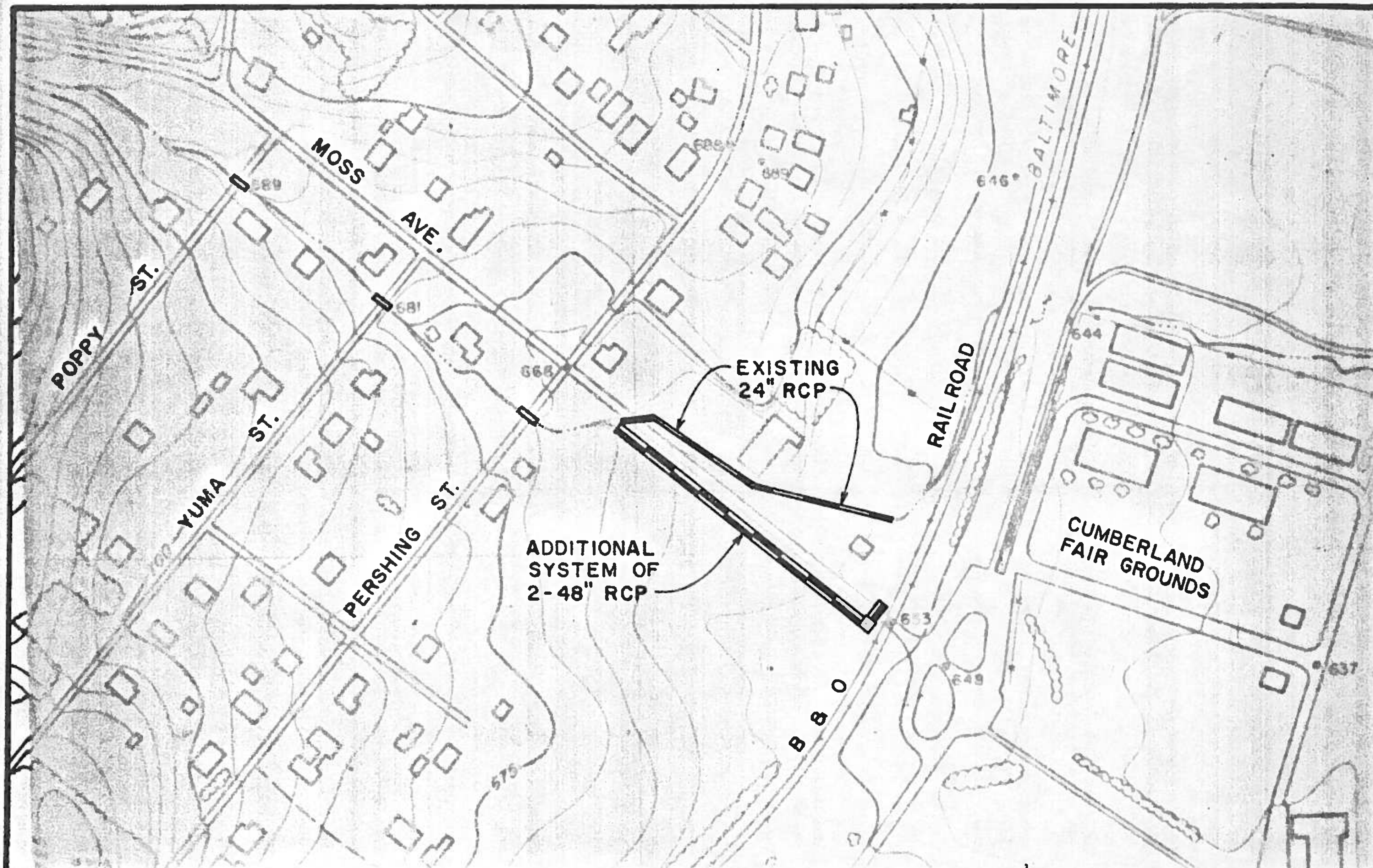

WATERSHED MODELS
1. FAIRGO BASIN
2. UPPER GEORGES CREEK
3. BRADDOCK RUN
4. TRIPLE LAKES
5. WARRIOR RUN
ALL COUNTIES UPPER LIMIT
ALLEGANY & WASHINGTON COUNTIES UPPER LIMIT
ALL COUNTIES LOWER LIMIT
GAGE LOCATIONS
A-ALLEGANY CO.
C-CARROLL CO.
F-FREDERICK CO.
W-WASHINGTON CO.
100 YEAR PEAK FLOW (THOUSAND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

FIGURE 2



LOCATION MAP
FAIRGO BASIN

FIGURE 3



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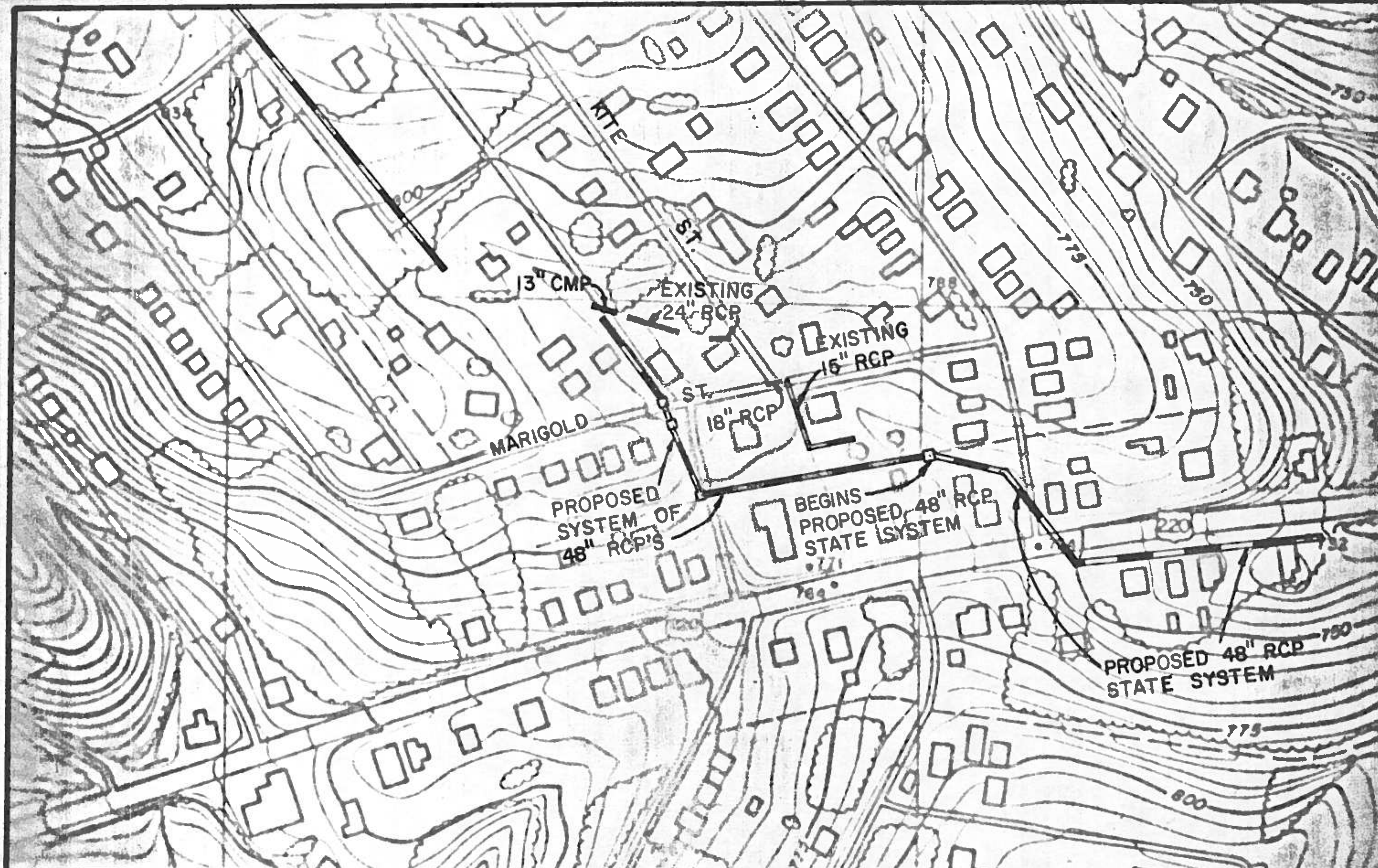
CONSULTING ENGINEERS
LAND SURVEYORS
1029 North Calvert Street
Baltimore, Maryland 21202

FAIRGO BASIN
PROPOSED IMPROVEMENTS
ADDITIONAL MOSS AVENUE PIPE SYSTEM

FIGURE 4



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Baltimore, Maryland 21202

FAIRGO BASIN
PROPOSED IMPROVEMENTS
TRIBUTARY NO. I STORM DRAINAGE SYSTEM

FIGURE 5

APPENDIX B - TABLES

TABLE 1- DRAINAGE AREA SUMMARY

FAIRGO BASIN

Area	Acreage	Existing CN	Ultimate CN	t_c (hrs.)
1.	113.60	62.0	64.1	.46
2.	55.01	72.6	81.0	.14
3.	62.13	78.0	82.5	.20
4.	11.91	72.4	78.6	.21
5.	15.05	79.9	82.0	.17
6.	8.49	76.9	83.5	.25
7.	11.40	79.8	90.0	.09
8.	31.52	77.2	81.9	.22
9.	23.94	72.9	88.2	.17
Total Acreage	335.34			
Weighted CN		71.1	76.4	

TABLE 2-FAIRGO STRUCTURES

Structure No.	Location	Description	From Surveys	From Field Reconnaissance
	Main Stream			
1	Fairgrounds Road	36" RCP	X	
2	Fairgrounds Road	36" RCP	X	
3	Baltimore & Ohio Railroad	3.5' x 6' Box	X	
4	Station 22+10	24" RCP	X	
5	Station 26+70	27" RCP	X	
6	Pershing Street	54" x 36" CMPA	X	
7	Yuma Street	54" x 39" CMPA	X	
8	Poppy Street	39" x 27" CMPA	X	
9	U.S. Route 220	5.1' x 5.7' Box	X	
10	Station 43+10	63" Steel Pipe	X	
11	Station 47+15	29" Steel Pipe	X	
12	Crocus Street	53" x 36" CMPA	X	
13	Ginger Street	66" x 50" CMPA	X	
14	Mulberry Street	52" x 30" CMPA	X	
15	Cresap Street	62" x 42" CMPA	X	
	Tributary No. 1			
16	U.S. Route 220	24" RCP		X
17	Marigold Street	15" CMP		X
18	Kite Street	18" RCP		X
19	Station 14+30	24" RCP		X
20	Station 15+10	24" RCP		X
21	Alley	24" CMP		X
22	Heather Street	13" CMP		X
23	Cresap Street	24" RCP		X
24	Station 25+50	18" Steel Pipe		X

TABLE 3

FAIRGO BASIN

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												
39.0	139	631.0	356	631.5	660	632.0	203	631.1	459	631.6	790	632.1
39.1		633.1		633.7		634.3		633.3		633.9		634.5
39.2		635.2		636.1		636.4		635.6		636.1		636.5
39.3		636.1		636.6		636.9		636.2		636.7		637.1
40.1		636.6		637.1		637.7		636.8		637.3		637.9
40.2		636.6		637.2		637.7		636.8		637.4		637.9
41.0		636.7		637.1		637.8		636.8		637.4		638.0
42.0		641.4		642.7		643.4		642.0		643.0		643.6
42.1		643.1		644.5		644.6		644.5		644.5		644.8
42.2		645.1		645.3		645.6		645.1		645.4		645.7
43.1		645.4		645.7		646.1		645.5		645.9		646.2

TABLE 3

FAIRGO BASIN

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}	$WSEL_{100}$
43.2	139	645.4	356	645.8	660	646.1	203	645.6	459	645.9	790	646.3
44.1	169	647.2	454	649.9	815	650.2	256	648.1	577	650.1	960	650.2
44.2		651.5		653.3		653.1		651.5		653.3		653.1
46.0		651.9		653.3		653.1		651.9		653.3		653.1
46.1		652.3		653.2		653.2		652.5		653.2		653.3
46.2		653.1		653.5		653.8		653.3		653.6		653.9
46.3		665.8		666.8		667.5		666.1		667.1		667.7
46.4		666.4		667.5		668.3		666.8		667.8		668.5
47.5		668.4		668.9		669.2		668.6		669.1		669.3
47.6		669.1		669.7		670.2		669.3		669.8		670.2
49.0		669.5		670.2		670.8		669.7		670.5		671.0
49.1		672.0		672.0		672.1		672.0		672.0		672.1
49.2		672.0		672.0		671.9		672.0		672.0		671.9

TABLE 3

FAIRGO BASIN

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}	$WSEL_{100}$
48.1	169	672.0	454	672.1	815	672.3	256	672.0	577	672.1	960	672.4
48.2		672.0		672.1		672.4		672.1		672.2		672.5
50.0		672.0		672.1		672.4		672.0		672.2		672.5
51.0		676.7		678.1		678.8		677.5		678.4		679.0
51.1		679.1		680.8		680.8		680.2		680.8		681.2
51.2		679.3		681.5		681.9		683.2		681.6		682.0
52.1		682.4		682.2		682.8		683.2		682.4		683.0
52.2		682.4		682.3		682.9		683.2		682.5		683.1
53.0		682.9		683.5		683.9		683.1		683.6		684.0
54.0		686.0		686.7		687.3		686.3		687.0		687.5
54.1	156	689.1	412	689.0	735	689.0	236	689.1	525	689.0	868	689.1
54.2		689.8		690.1		690.6		689.8		690.3		690.6

TABLE 3

FAIRGO BASIN

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}	$WSEL_{100}$
55.1	156	690.1	412	690.8	735	691.3	236	690.3	525	691.0	868	691.6
55.2		690.4		691.2		691.7		690.7		691.4		691.9
56.0		690.4		691.0		691.6		690.7		691.2		691.9
57.0	160	699.3	408	700.8	718	701.6	238	700.2	515	701.1	844	701.8
58.0		705.6		707.1		709.5		705.6		707.9		710.4
58.1		706.0		710.4		710.2		706.7		711.3		713.6
59.0	124	707.2	321	712.01	571	715.4	190	708.7	414	713.4	679	715.4
60.0		713.2		713.6		715.5		713.2		713.9		715.5
60.1		719.0		721.2		722.1		719.8		722.0		722.1
60.2		719.8		723.6		724.7		720.5		724.1		725.1
60.3		722.6		724.3		726.8		723.4		726.4		727.0
60.4		723.7		729.1		727.7		725.9		729.1		728.0

TABLE 3

FAIRGO BASIN

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}	$WSEL_{100}$
61.0	124	727.3	321	729.0	571	729.2	190	727.9	414	729.0	679	729.4
62.0		731.8		733.3		734.1		732.4		733.7		734.4
63.1		736.2		736.7		737.3		736.4		736.8		737.5
63.2		736.5		737.1		737.6		736.8		737.3		737.8
63.3		740.6		740.9		741.2		740.7		741.0		741.2
63.4		740.8		741.4		741.8		741.1		741.6		742.0
63.0		741.3		742.1		742.8		741.7		742.4		743.0
64.0	54	751.8	157	752.7	305	753.6	97	752.2	223	753.1	383	754.0
65.1		753.1		754.5		756.4		753.6		755.4		757.2
65.2		753.9		759.7		760.3		756.7		760.0		760.5
67.0		755.4		759.7		760.5		757.1		760.1		760.7
68.0		767.1		768.0		768.9		767.5		768.5		769.5

TABLE 3

FAIRGO BASIN

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}	$WSEL_{100}$
68.1	54	769.1	157	770.6	305	772.3	97	769.8	223	771.4	383	773.0
68.2		771.4		773.4		777.7		772.1		777.3		777.9
70.0		772.8		774.6		777.7		773.4		777.3		777.9
71.0		784.7		786.1		787.2		785.4		786.7		787.7
72.1		789.6		791.3		793.3		790.4		792.3		794.0
72.2		789.8		793.7		796.9		792.0		795.2		796.9
72.3		791.8		793.8		796.9		792.6		795.2		796.9
72.4		793.1		794.8		796.9		793.9		795.6		796.9
73.0		795.8		797.3		798.0		796.4		797.8		798.2
74.0	20	804.6	95	805.2	205	805.7	27	804.7	110	805.2	226	805.8
74.1		807.3		808.7		810.1		807.5		808.9		810.3
74.2		808.1		809.7		812.5		808.3		810.0		812.6
76.0		810.7		811.3		812.5		810.8		811.8		812.6

TABLE 3

FAIRGO BASIN

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. 1												
57.1	37	723.6	89	724.1	131	724.5	49	723.7	105	724.2	150	724.7
57.2	29	764.5	70	764.9	118	765.2	37	764.6	81	765.0	132	765.3
57.4	10	814.8	27	815.0	49	815.1	16	814.9	36	815.0	59	815.1
57.5	3	853.5	9	854.1	16	854.3	5	853.8	12	854.2	20	854.4

FBULSM

FAIRGO BASIN
TABLE 4 -FLOOD DAMAGE ESTIMATES EXISTING CONDITIONS

ITEMIZED LOSSES	2-YEAR STORM EXISTING CONDITONS	10-YEAR STORM EXISTING CONDITIONS	100-YEAR STORM EXISTING CONDITIONS
PRIVATE LOSSES			
-STRUCTURES	$ 12,331	$ 30,023	$ 43,393
-CONTENTS	5,323	15,616	23,536
-EXTERIOR PROPERTIES	1,950	6,500	11,050
-VEHICLES	3,500	14,000	28,000
TOTAL PRIVATE LOSSES	$ 23,104	$ 66,139	$ 105,979
PUBLIC LOSSES			
-EMERGENCY POLICE SERVICES	$ 290	$ 290	$ 580
-CITY CLEAN-UP SERVICES	944	944	2208
-UTILITIES REPAIR SERVICES	600	600	1200
TOTAL PUBLIC LOSSES	$ 1,834	$ 1,834	$ 3,988
ABSTRACT LOSSES			
LOST WAGES	$ 720	$ 1,560	$ 3,120
-EXTRA MILEAGE COST	0	0	0
TOTAL ABSTRACT LOSSES	$ 720	$ 1,560	$ 3,120
TOTAL OF ALL LOSSES	$ 25,658	$ 69,533	$ 113,087

AVERAGE ANNUAL DAMAGES = .45(2-YEAR TOTAL)+.245(10-YEAR TOTAL)+.055(100-YEAR TOTAL)= $ 34,801

PRESENT VALUE OF THE AVERAGE ANNUAL DAMAGES(TAKEN FOR 30 YEARS AT AN INTEREST RATE OF 8%)= $ 391,788

FBULSM

FAIRGO BASIN
TABLE 5- FLOOD DAMAGE ESTIMATES ULTIMATE CONDITIONS

ITEMIZED LOSSES	2-YEAR STORM ULTIMATE CONDITONS	10-YEAR STORM ULTIMATE CONDITIIONS	100-YEAR STORM ULTIMATE CONDITIONS
PRIVATE LOSSES			
-STRUCTURES	$ 13,911	$ 33,238	$ 47,888
-CONTENTS	6,043	17,596	25,696
-EXTERIOR PROPERTIES	1,950	6,500	11,050
-VEHICLES	3,500	14,000	28,000
TOTAL PRIVATE LOSSES	$ 25,404	$ 71,334	$ 112,634
PUBLIC LOSSES			
-EMERGENCY POLICE SERVICES	$ 290	$ 290	$ 580
-CITY CLEAN-UP SERVICES	944	944	2208
-UTILITIES REPAIR SERVICES	600	600	1200
TOTAL PUBLIC LOSSES	$ 1,834	$ 1,834	$ 3,988
ABSTRACT LOSSES			
-LOST WAGES	$ 720	$ 1,560	$ 3,120
-EXTRA MILEAGE COST	0	0	0
TOTAL ABSTRACT LOSSES	$ 720	$ 1,560	$ 3,120
TOTAL OF ALL LOSSES	$ 27,958	$ 74,728	$ 119,742

AVERAGE ANNUAL DAMAGES = .45(2-YEAR TOTAL)+.245(10-YEAR TOTAL)+.055(100-YEAR TOTAL)= $ 37,475

PRESENT VALUE OF THE AVERAGE ANNUAL DAMAGES(TAKEN FOR 30 YEARS AT AN INTEREST RATE OF 8%)= $ 421,889

Table 6. FLOOD MANAGEMENT ALTERNATIVES

FAIRGO BASIN

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: Flood Proof	Flood Insur.	Purchase Candidate	Structural Improvements	Comments
P		-		X	X			FF above flood elevation
Q	X	8.0						Already purchased
R	X	0	-					Already purchased
S	X	-5	-	X	X			
T	X	-6.5	-	X	X			
U		-						Out of flood zone
V		-						Out of flood zone
W	X	1		X	X		Replace private 5.3' steel pipe with three 60" culverts ($75,000). Not recommended.	
X	X	0		X	X			
Y	X	1		X	X			
Z	X	-3.5	-	X	X			
AA	X	-	-					Out of flood zone
AB		-5.5		X	X			
AC		-						Out of flood zone
AD		-						Out of flood zone
AE		-						Out of flood zone
V-1	X	2	-			X	Rte. 220 and Trib. No. 1 48" drainage system ($114,000). Requires improvement of State culvert along US Rte. 220 ($173.000)	
V-2	X	-5.5	-	X	X			
V-3	X	-4	-	X	X			
V-4	X	1.5	-	X	X	X		
V-5	X	-4	-	X	X			
V-6	X	-8	-	X	X			
V-7		-						FF above flood elevation
B & O Railroad Overtopping		Railroad overtopping. Depth of 0.34 feet during 100-year storm. Not overtopped for 2 and 10-year storms.					Replace B&O Railroad culvert with 70 sq.ft. box culvert. ($41,000)	Not economically justified, but may want to do for safety reasons.
Moss Avenue Flooding							Additional two 48" RCP's along Moss Avenue. For 2-year design ($130,000)	Not economically justified
U.S. Route 220 Overtopping on Main Stream		Not overtopped during 2 and 10-year storm.					Replace U.S. Rte 220 culvert with two 7'x5' box culverts ($53,000)	Not economically justified

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

FIA 1974 RESIDENTIAL DAMAGE CURVES
(VALUES IN PERCENT DAMAGE)

	1		2		3		4	
	1 STORY WITH BASEMENT		1 STORY W/O BASEMENT		1 1/2 & 2 STORY W/ BASEMENT		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.

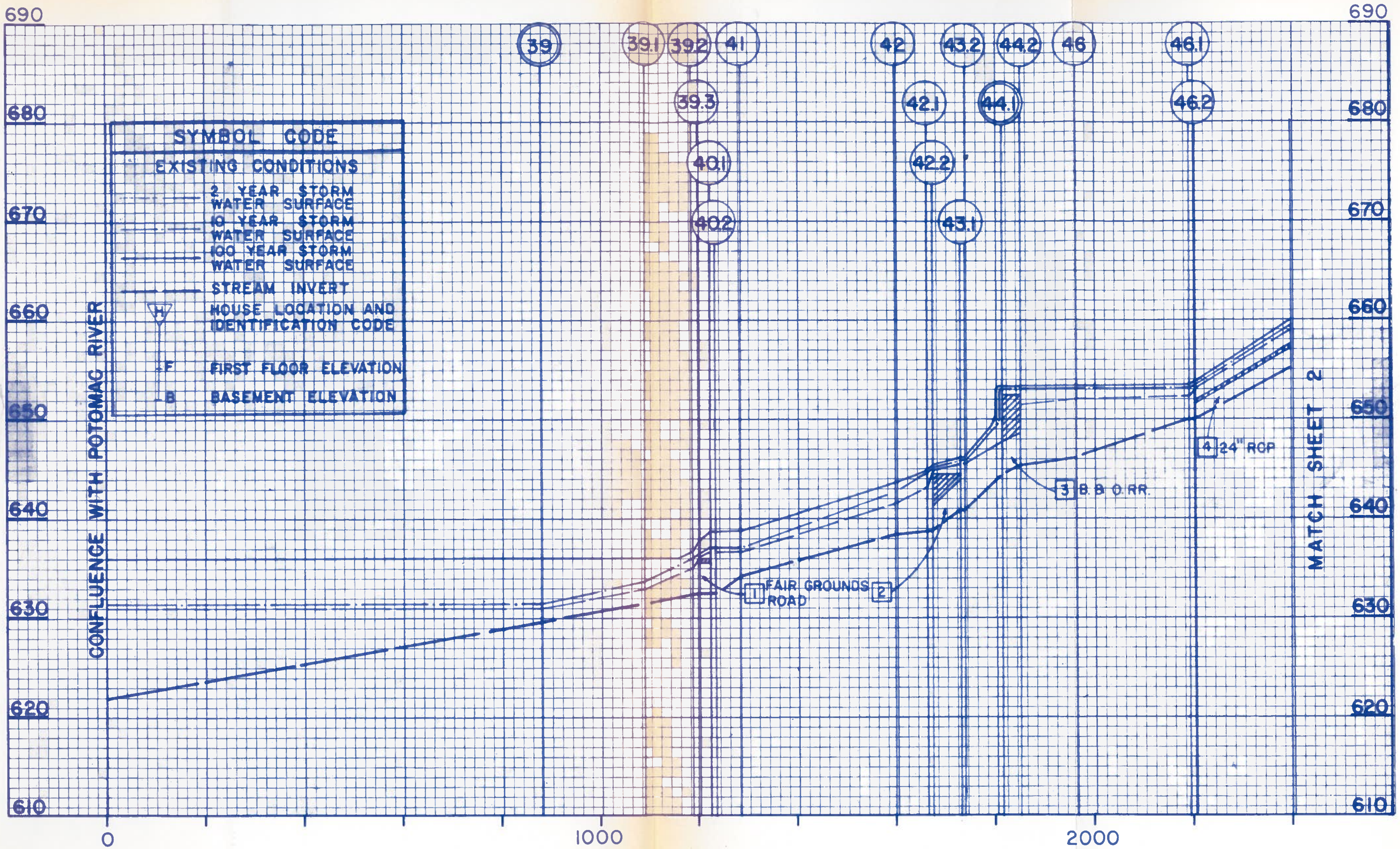
Table 5

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	36.	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

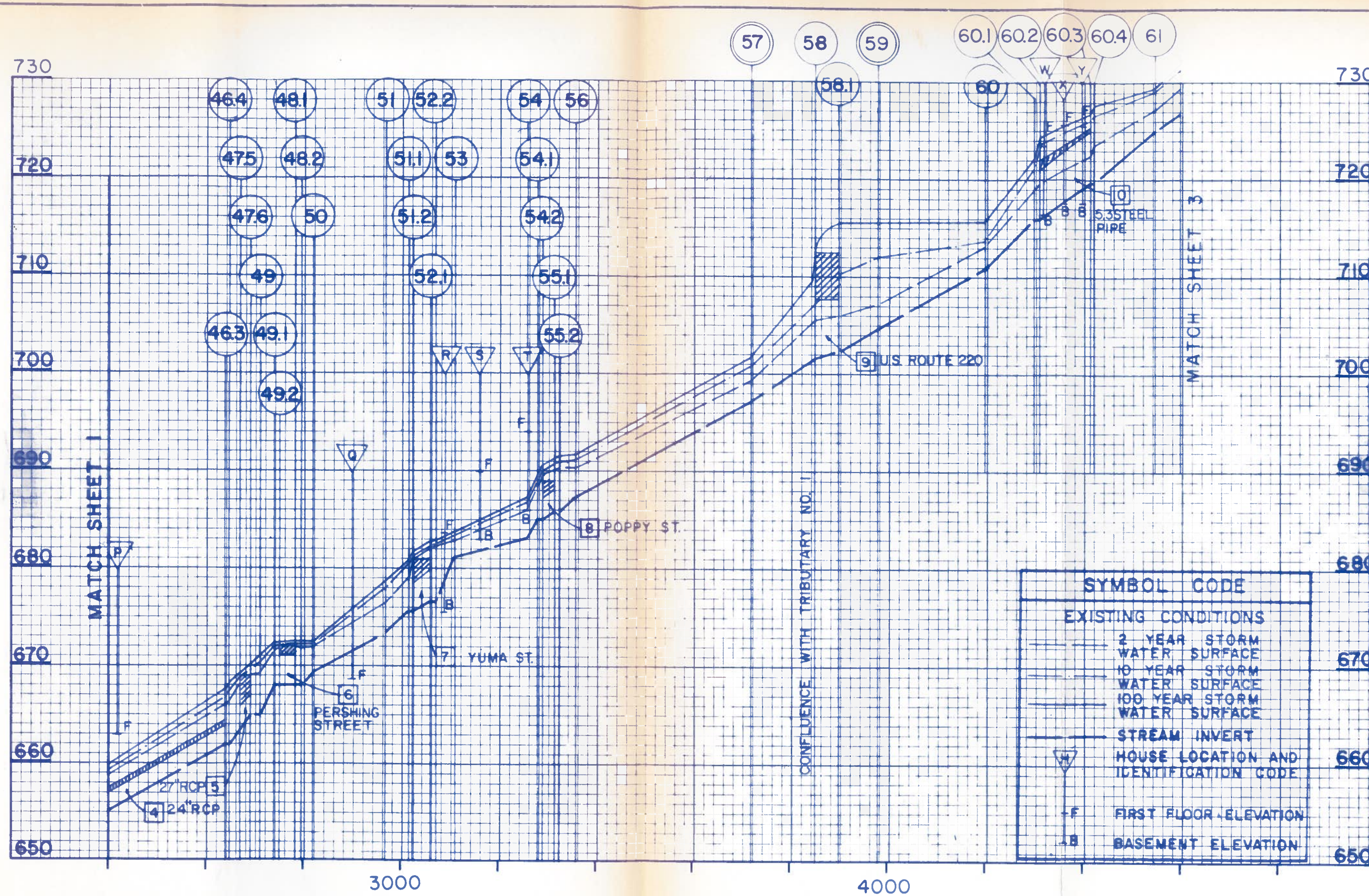
(4.0) CROSS SECTION WHERE STREAM FLOW HAS CHANGED

[3] STRUCTURE NUMBER

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

STREAM PROFILE
FAIRGO BASIN MAIN STREAM

SHEET NO. 1 OF 5



PURDUM & JESCHKE
CONSULTING ENGINEERS
LAND SURVEYORS

LEGEND

(4.0) CROSS SECTION NUMBER AND LOCATION

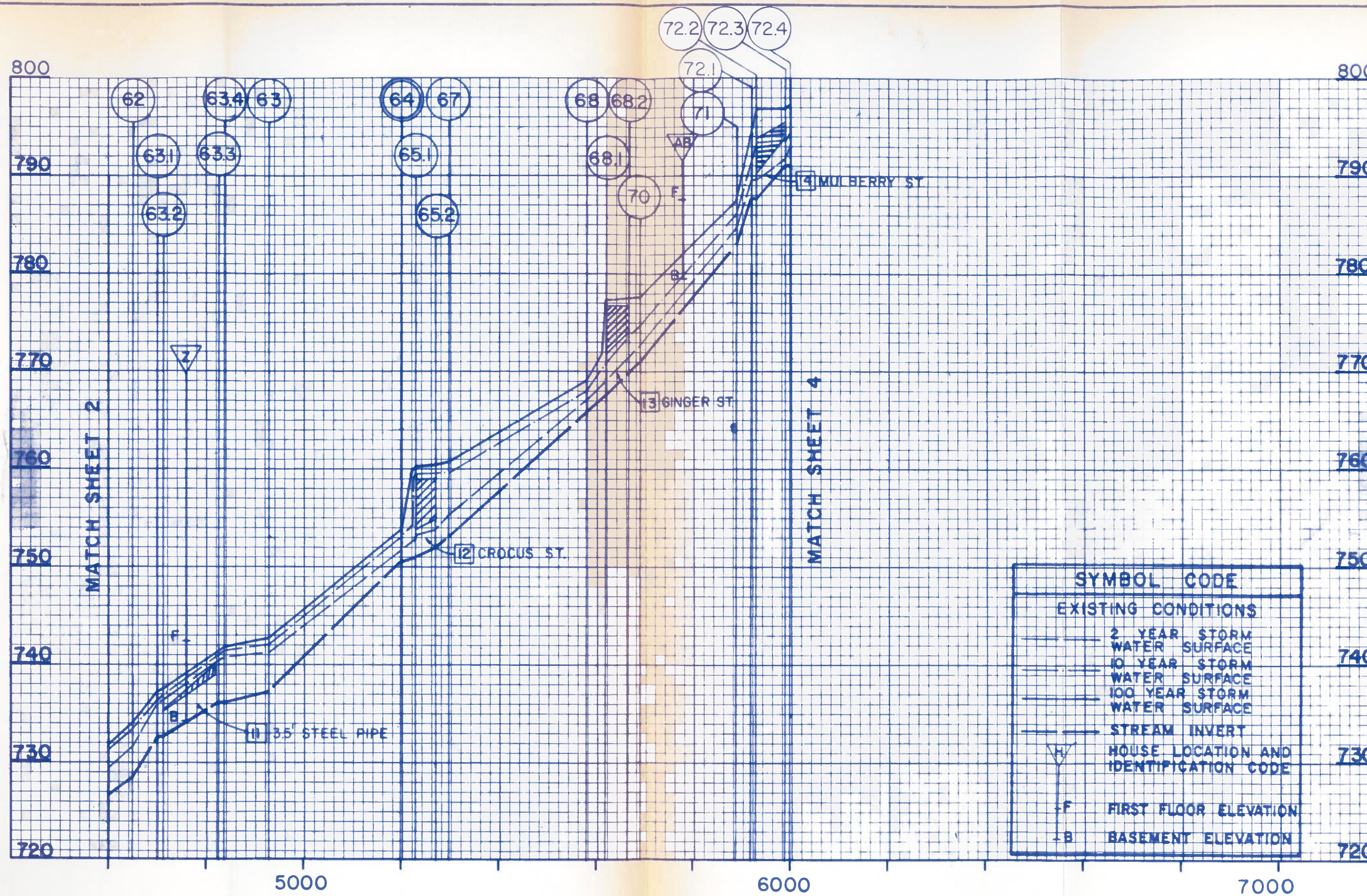
[3] STRUCTURE NUMBER

(4.0) CROSS SECTION WHERE STREAM FLOW HAS CHANGED

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

STREAM PROFILE
FAIRGO BASIN MAIN STREAM.

SHEET NO.
2 OF 5



PURDUM & JESCHKE
CONSULTING ENGINEERS
LAND SURVEYORS

LEGEND

4.0 CROSS SECTION NUMBER AND LOCATION

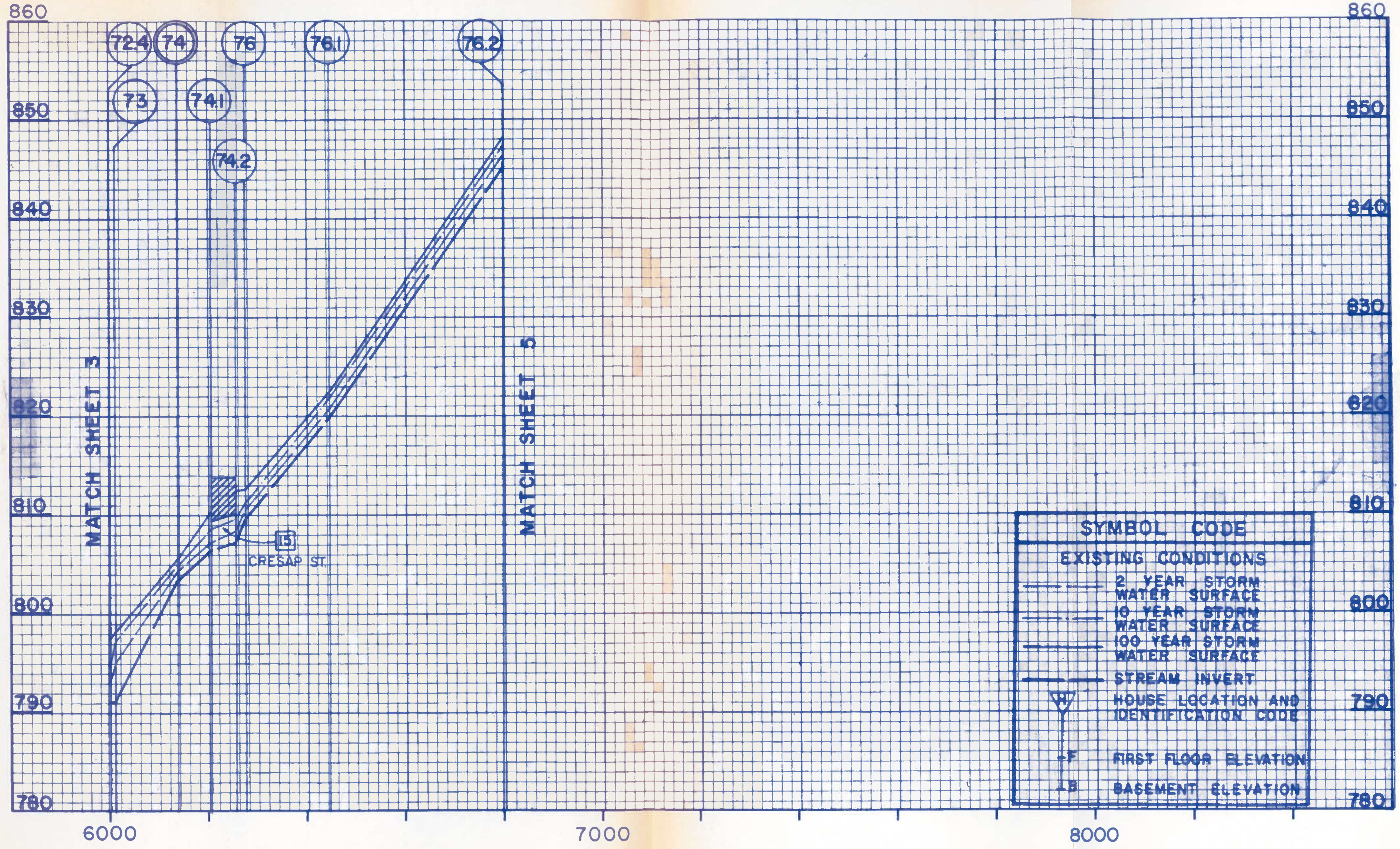
3 STRUCTURE NUMBER

4.0 CROSS SECTION WHERE STREAM FLOW HAS CHANGED

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

STREAM PROFILE
FAIRGO BASIN MAIN STREAM

SHEET NO.
3 OF 5



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LAND SURVEYORS

LEGEND

(4.0) CROSS SECTION NUMBER AND LOCATION

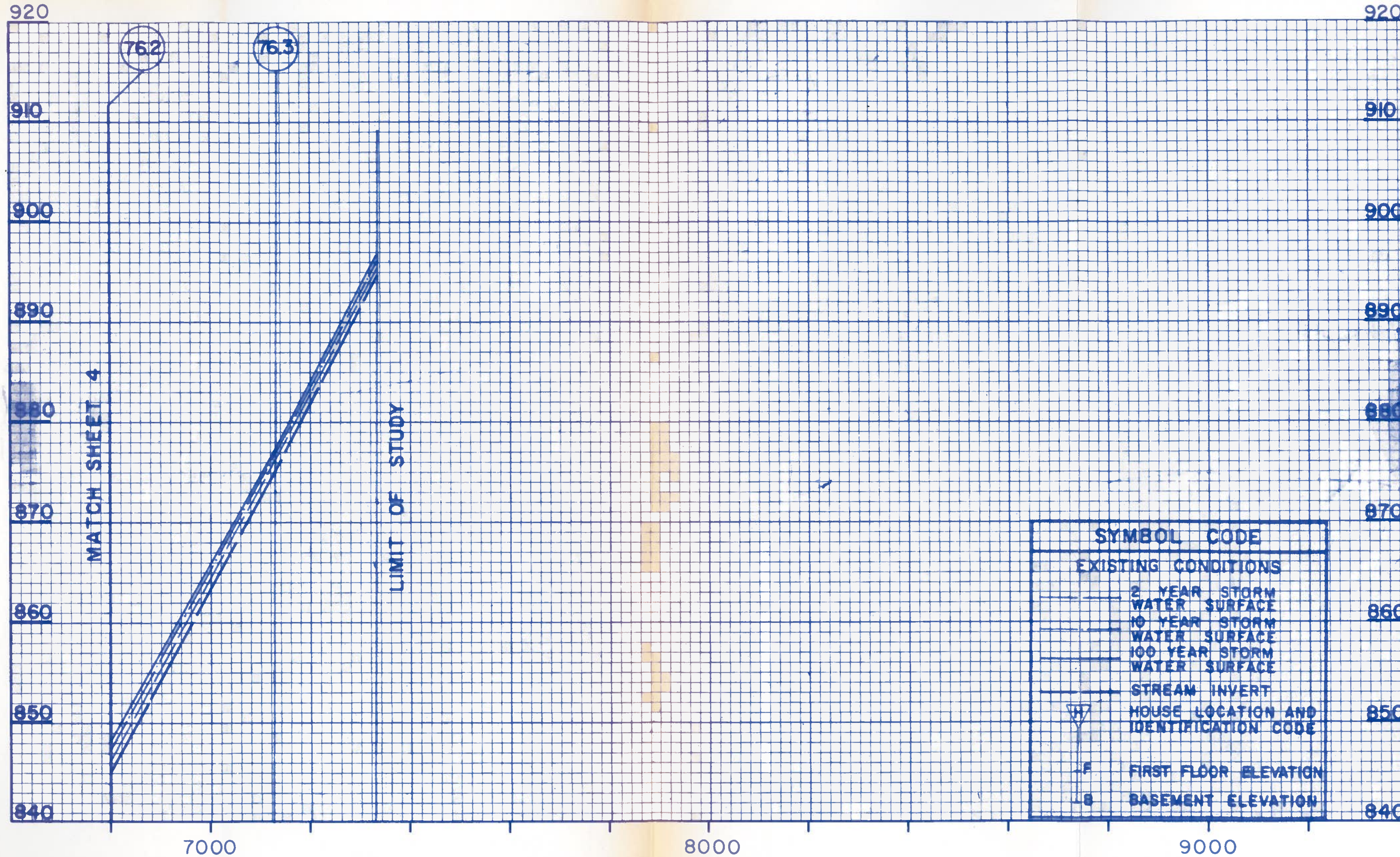
[3] STRUCTURE NUMBER

(4.0) CROSS SECTION WHERE STREAM FLOW HAS CHANGED

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

STREAM PROFILE
FAIRGO BASIN MAIN STREAM.

SHEET NO. 4 OF 5



PURDUM & JESCHKE
CONSULTING ENGINEERS
LAND SURVEYORS

LEGEND

(4.0) CROSS SECTION NUMBER AND LOCATION

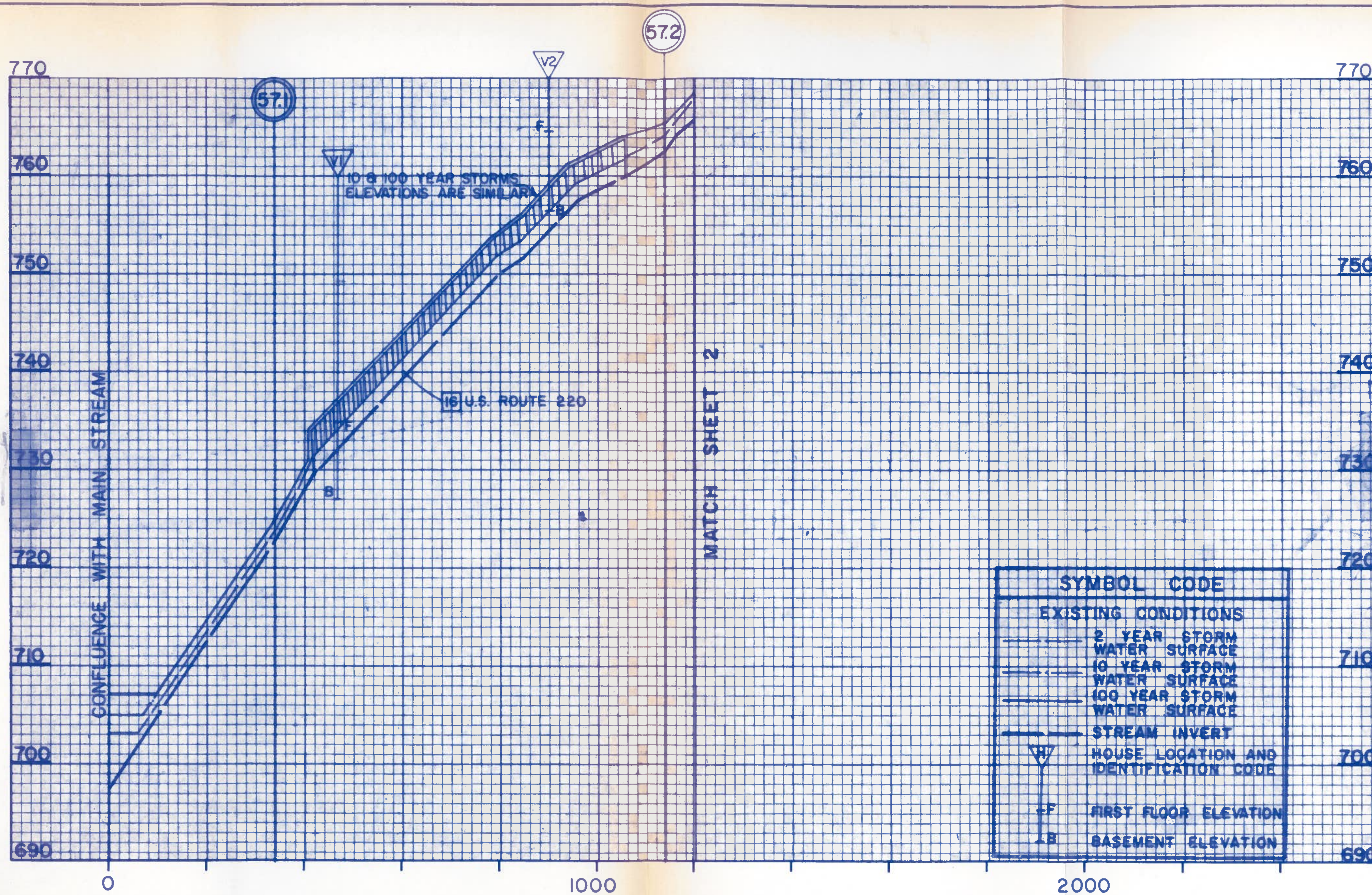
[3] STRUCTURE NUMBER

(4.0) CROSS SECTION WHERE STREAM FLOW HAS CHANGED

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

STREAM PROFILE
FAIRGO BASIN MAIN STREAM

SHEET NO. 5 OF 5



PURDUM & JESCHKE
CONSULTING ENGINEERS
LAND SURVEYORS

LEGEND

(4.0) CROSS SECTION NUMBER AND LOCATION

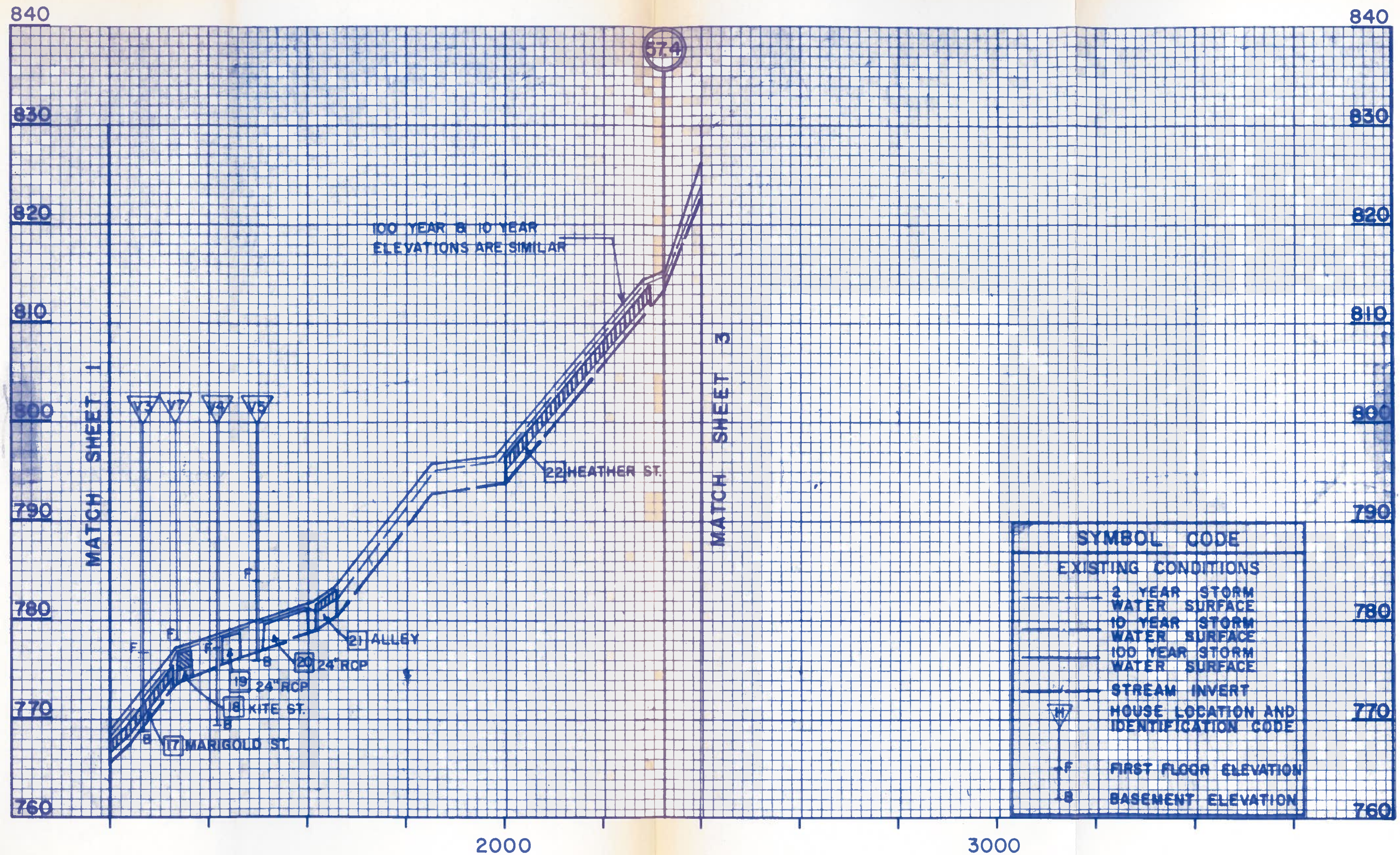
[3] STRUCTURE NUMBER

(4.0) CROSS SECTION WHERE STREAM FLOW HAS CHANGED

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

STREAM PROFILE
FAIRGO BASIN TRIBUTARY NO. 1

SHEET NO. 1 OF 3



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CONSULTING ENGINEERS
LAND SURVEYORS

LEGEND

(4.0) CROSS SECTION NUMBER AND LOCATION

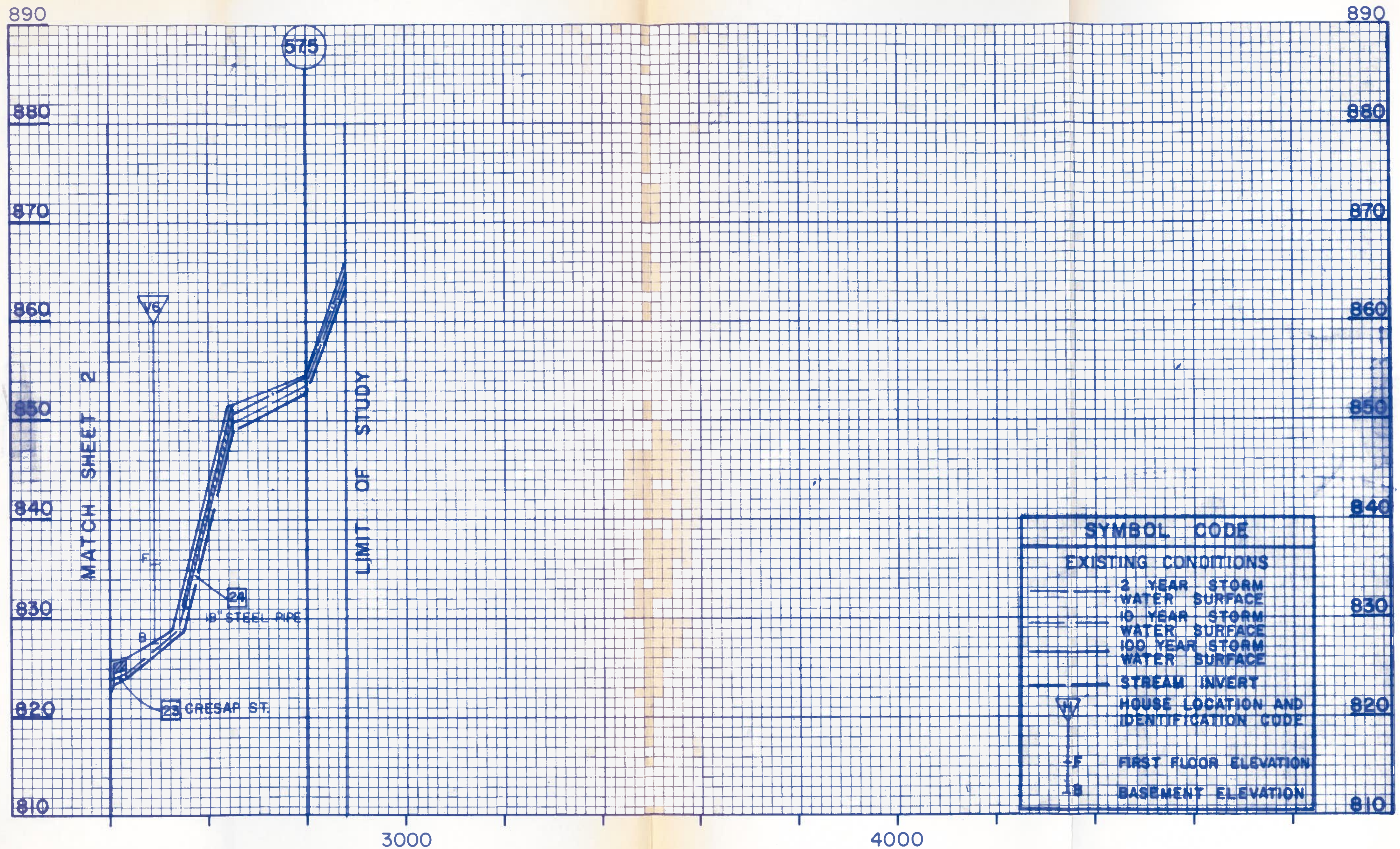
[3] STRUCTURE NUMBER

(4.0) CROSS SECTION WHERE STREAM FLOW HAS CHANGED

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

STREAM PROFILE
FAIRGO BASIN TRIBUTARY NO. I

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

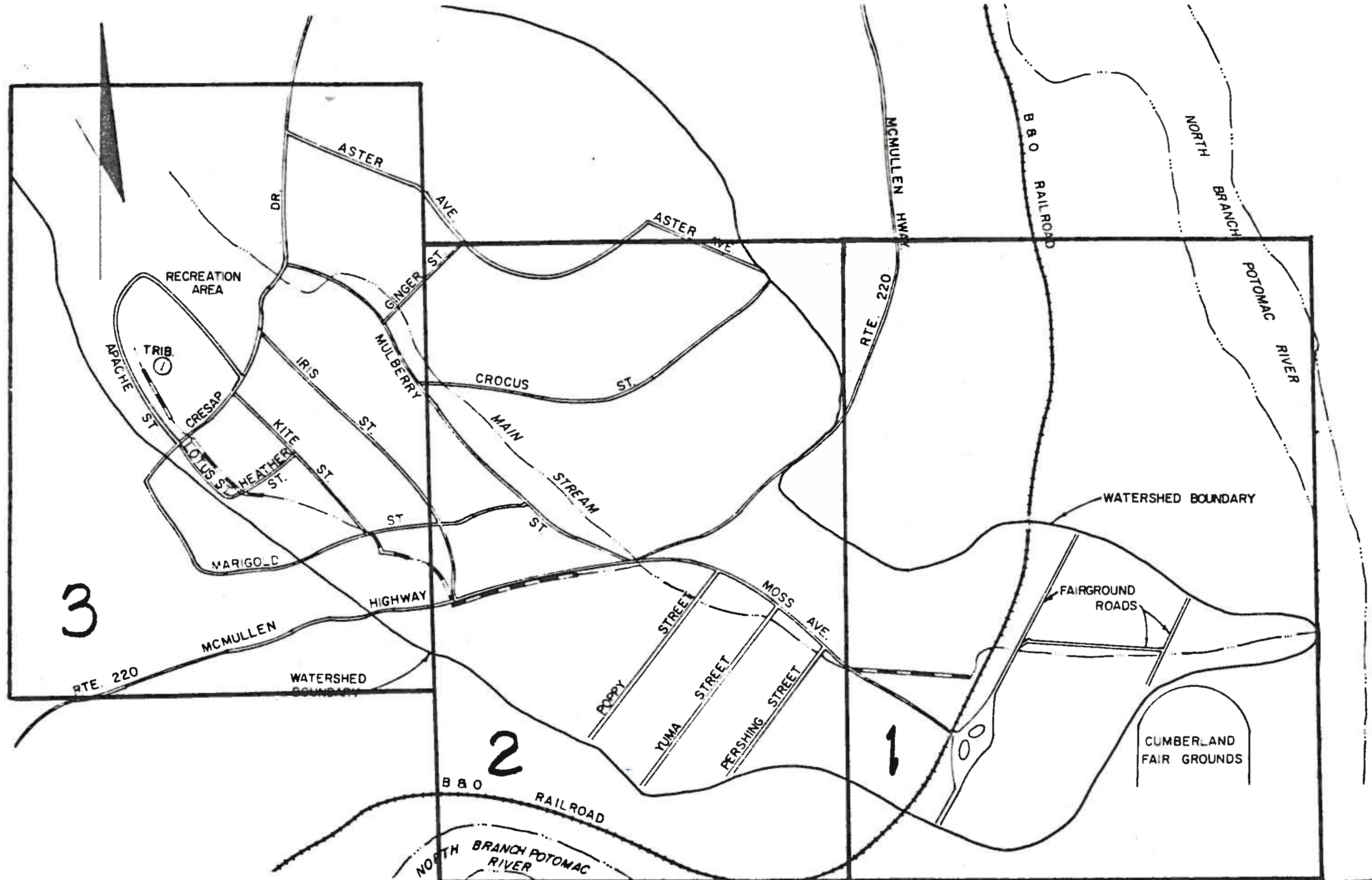
SCALE
HORIZONTAL : 1" = 200'
VERTICAL : 1" = 10'

STREAM PROFILE
FAIRGO BASIN TRIBUTARY NO. 1

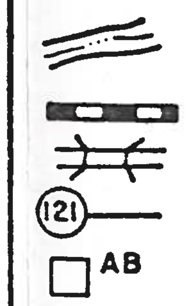
SHEET NO. 3 OF 3

APPENDIX E

100-YEAR FLOOD DELINEATION



LEGEND



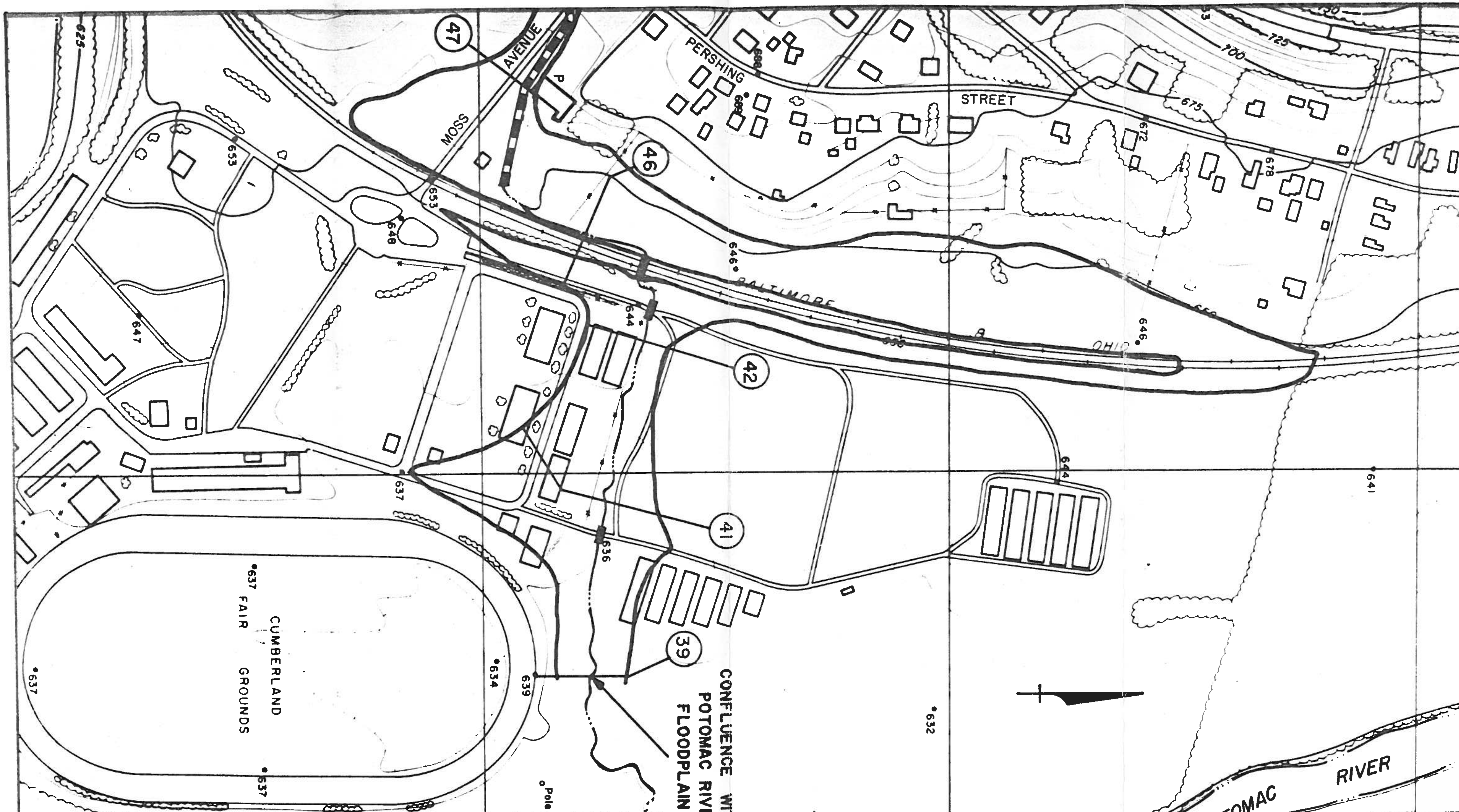
STREAM AND 100-YEAR FLOOD LIMITS
CULVERT
BRIDGE
CROSS SECTION NUMBER AND LOCATION
HOUSE IDENTIFICATION CODE

PURDUM & JESCHKE
CONSULTING ENGINEERS
AND
LAND SURVEYORS

ALLEGANY COUNTY
FLOOD MANAGEMENT STUDY
FAIRGO BASIN

INDEX MAP

LIMITS OF 100-YEAR FLOOD
ULTIMATE DEVELOPMENT

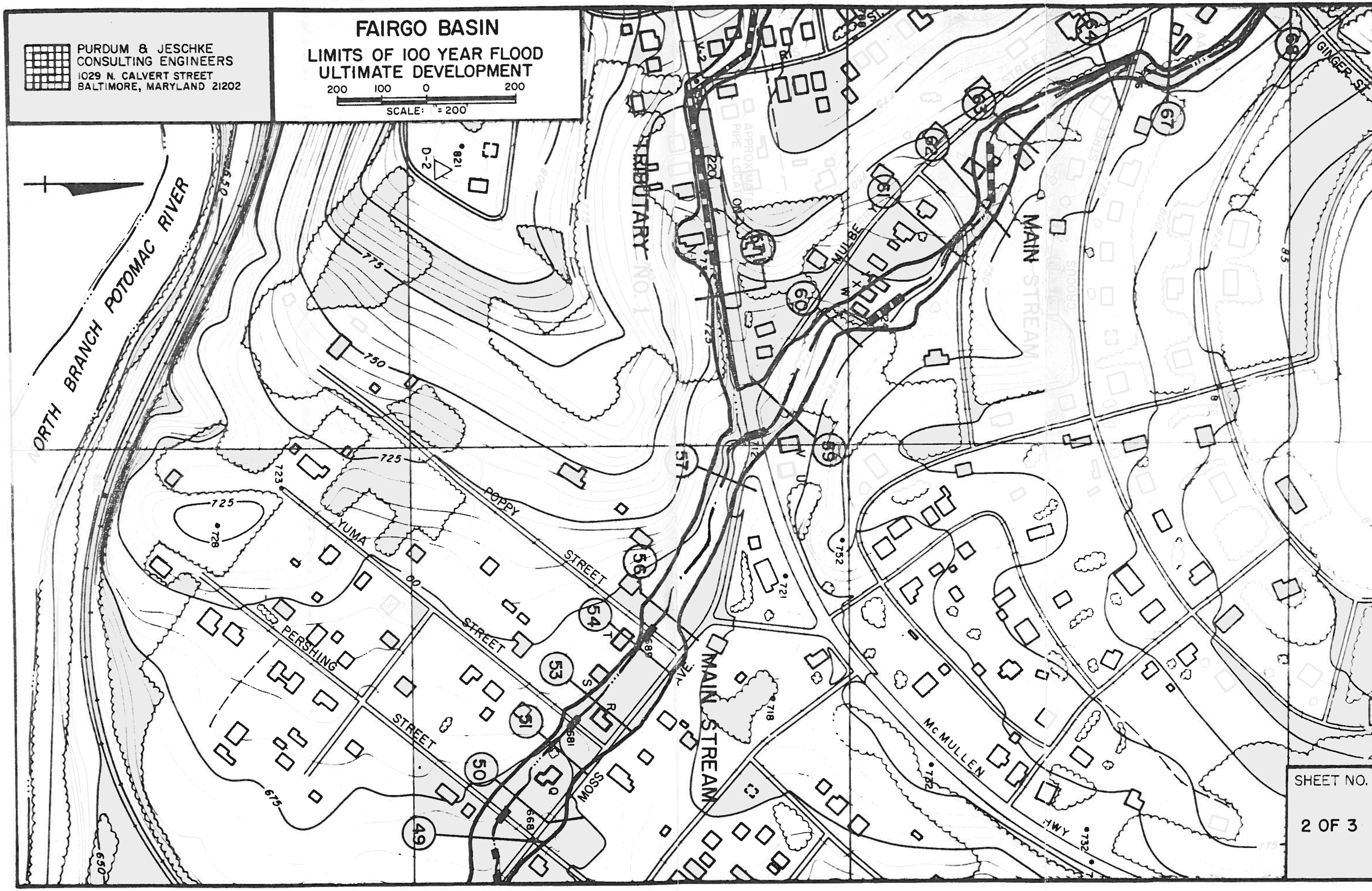


PURDUM & JESCHKE
CONSULTING ENGINEERS
1029 N. CALVERT STREET
BALTIMORE, MARYLAND 21202

FAIRGO BASIN
LIMITS OF 100 YEAR FLOOD
ULTIMATE DEVELOPMENT

200 100 0 200
SCALE: 1" = 200'

SHEET NO.
1 OF 3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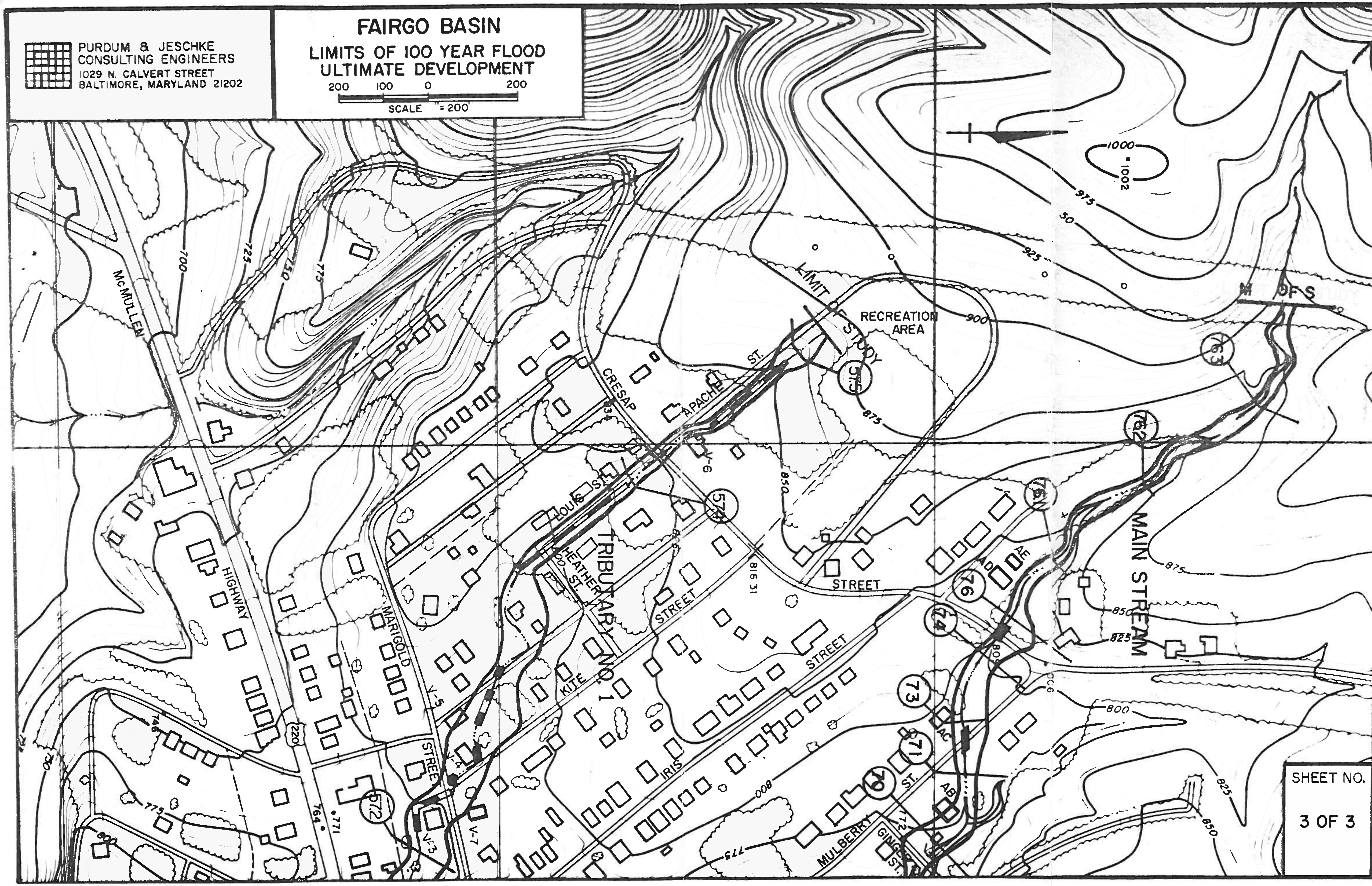
CONSULTING ENGINEERS
1029 N. CALVERT STREET
BALTIMORE, MARYLAND 21202
FAIRGO BASIN
LIMITS OF 100 YEAR FLOOD
ULTIMATE DEVELOPMENT
200 100 0 200
SCALE: 1" = 200'
NORTH BRANCH POTOMAC RIVER
TRIBUTARY NO. 1
MAIN STREAM
MAIN STREAM
APPROXIMATE PIPE LOCATION
POPPY STREET
YUMA STREET
PERSHING STREET
MOSS AVE.
McMULLEN HWY
CROCUS STREET
GINGER ST.
MULBERRY
D-2
49
50
51
53
54
56
57
59
60
61
62
63
64
67
68
SHEET NO.
2 OF 3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CONSULTING ENGINEERS
1029 N. CALVERT STREET
BALTIMORE, MARYLAND 21202
FAIRGO BASIN
LIMITS OF 100 YEAR FLOOD
ULTIMATE DEVELOPMENT
200 100 0 200
SCALE "=200'
McMULLEN
HIGHWAY
220
MARIGOLD
STREET
CRESAP
APACHE
ST.
LOUIS ST.
HEATHER ST.
TRIBUTARY NO. 1
KITE
STREET
IRIS
STREET
MULBERRY
ST.
STREET
MAIN STREAM
RECREATION AREA
LIMIT OF STUDY
LIMIT OF STUDY
V-3
V-4
V-5
V-6
V-7
572
574
575
70
71
73
74
76
761
762
763
AB
AC
AD
AE
816.31
771
764
1000
1002
975
925
900
875
850
825
800
775
750
725
700
746
772