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**Part I
BASIC DATA**

**Volume 1
CHESAPEAKE BAY WEST
DRAINAGE BASIN**

Prepared for
MARYLAND STATE PLANNING DEPARTMENT

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MARYLAND WATER SUPPLY AND DEMAND STUDY

STATE OF MARYLAND

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MARYLAND WATER SUPPLY AND DEMAND STUDY

Part I - BASIC DATA

Volume 1 - CHESAPEAKE BAY WEST DRAINAGE BASIN

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Maryland, Coastal Plain

CHESAPEAKE BAY WEST DRAINAGE BASIN

CHESAPEAKE BAY (WESTERN SHORE) BASIN

GENERAL DESCRIPTION

The Chesapeake Bay (Western Shore) basin comprises that part of Maryland and southern Pennsylvania bounded on the north by the Susquehanna River basin, on the west and south by the Potomac River basin, and on the east by the Chesapeake Bay itself. The Fall Line cuts through the basin in a northeast-southwest direction from Havre de Grace in Harford County, Maryland, through Baltimore City toward Washington, D. C., separating the Piedmont and the Coastal Plain provinces.

Physiographic Divisions

The Piedmont province extends westward from the Fall Line to the slopes of Catoctin Mountain, but only that portion of the Piedmont east of Parrs Ridge drains eastward into Chesapeake Bay. West of Parrs Ridge, the Potomac River basin collects the runoff from the Piedmont area. Parrs Ridge has an average elevation of 800 to 900 feet above sea level.

Below the Fall Line, the Piedmont province streams enter the Coastal Plain province, where the elevations and relief are low. In this subarea, the streams have relatively flat profiles and become tidal estuaries near the bay.

Political Subdivisions

The Chesapeake Bay West basin encompasses an area of 3,252 square miles, of which all but 11 square miles is in Maryland. This figure includes the water areas of those subdivisions adjacent to the bay and whose boundaries extend to approximately the mid-point of the bay. Land area of the basin totals approximately 2,516 square miles in Maryland and 11 square miles in York County, Pennsylvania. Total areas and areas within the drainage basin of the major political subdivisions are listed in Table 1.

Table 1. Area of Major Political Subdivisions Wholly or Partially in the Chesapeake Bay West Basin

Political Subdivision*	Land and Water Area square miles		Land Area square miles	
	<u>Total</u>	<u>In Basin</u>	<u>Total</u>	<u>In Basin</u>
Pennsylvania				
York	--	11	--	11
Maryland				
Anne Arundel	630	630	417	417
Baltimore City*	92	92	79	79
Baltimore	702	692	608	598
Calvert	369	369	219	219
Carroll	453	231	453	231
Charles	641	33	458	33
Harford	539	338	444	244
Howard	253	253	253	253
Montgomery	504	60	493	60
Prince George's	499	255	486	255
St. Mary's	799	299	367	127
TOTAL	<u>5,481</u>	<u>3,263</u>	<u>4,277</u>	<u>2,527</u>

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* Subdivisions are counties except for Baltimore City which is not within a county.

Major Sub-basins

The four largest sub-basins (Patuxent, Patapsco, Gunpowder, Bush) have a combined area of over 2,100 square miles or 65% of the total. The remaining sub-basins are all less than 100 square miles in area. The approximate areas of all sub-basins over 30 square miles and the counties within each sub-basin are listed in Table 2. It should be noted that the figures presented here are only rough estimates and as such, should be used with caution.

Table 2. Sub-basins of the Chesapeake Bay (Western Shore) Basin

<u>Sub-basin</u>	<u>County</u>	<u>Area in Square Miles</u>
Bush River	Harford	140
Gunpowder River	York, Pennsylvania	11
	Harford	55
	Baltimore	375
	Carroll	30
		<u>471</u>
Back River	Baltimore	43
	Baltimore City*	19
		<u>62</u>
Patapsco River	Baltimore	195
	Baltimore City*	70
	Howard	60
	Carroll	200
	Anne Arundel	85
		<u>610</u>
Magothy River	Anne Arundel	40
Severn River	Anne Arundel	69
South River	Anne Arundel	66
West River	Anne Arundel	32
Patuxent River	Anne Arundel	125
	Howard	190
	Montgomery	60
	Prince George's	255
	Charles	35
	Calvert	180
	St. Mary's	90
		<u>935</u>

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* Not in any county

HYDROLOGY

Precipitation and Temperature

The Western Shore basin is located in the generally humid eastern area of the United States. The average annual precipitation amounts to about 43 inches for the entire basin area, varying from 40.23 inches in Frederick County to 45.18 inches in Baltimore County. The mean annual temperature in the basin is 55.4° F, with Harford County having the lowest (53.3° F) and St. Mary's the highest (58.4° F).

Evapotranspiration

Much of the precipitation is returned to the atmosphere by evaporation from the surface of streams and other water bodies, from the surfaces of plants, and from the surface of the land. Transpiration, the loss of water exuded by plants, also accounts for a large part of the annual precipitation. These processes combined, known as evapotranspiration, remove about 25.5 inches or 60 per cent of the annual precipitation in the Little Gunpowder Falls watershed area, according to Dingman and Ferguson (1956). They estimated that evapotranspiration in this area varies from 33 per cent of monthly precipitation in February to 73 per cent in September. These estimates are probably good approximations of evapotranspiration for most of the Western Shore drainage basin.

Streamflow - Surface and Ground Water Runoff

Streamflows have been measured and reported by the U. S. Geological Survey for 38 gaging stations in the Western Shore drainage basin. Using these data, Darling (1962) has recently published a report on the discharge characteristics of Maryland streams, including frequency and duration of flows of various magnitudes. The average and minimum daily flows of record for most of the stream gaging stations in the Western Shore basin are listed in Table 3. Also shown are probable low flows for the two different design criteria; the 7-day, 10-year low flow,¹ and the daily

---

1 That discharge averaged over a period of seven consecutive days which is exceeded by all such seven-day flows in nine out of every ten years (on the average).

Table 3. Average and Low Flows at Stream Gaging Stations -
Chesapeake Bay (Western Shore) Drainage Basin

STREAMFLOW														
Stream and Location of Gage	Period of Record	Drainage Area, Square Miles	Average of Record ⁴		Minimum Daily of Record ⁴		Low Flow							
			cfs	cfsm	cfs	cfsm	7-day, 10-year		Probable ⁵					
							cfs	cfsm	cfs	cfsm	cfs	cfsm		
													cfs	cfsm
Bynum Run near Bel Air, Md.	1950-54	7.7	12.7	1.649	0.3	--	--	--	--	--				
Bynum Run at Bel Air, Md.	1944-51													
Little Falls at Blue Mount, Md.	1955-62	8.5	11.0	1.291	0.2	0.018	0.3	0.035	0.9	0.106				
Gunpowder Falls at Glencoe, Md.	1944-52	52.9	69.3	1.310	12.0	0.227	17.0	0.321	24.0	0.454				
Slade Run near Glyndon, Md.	1904-09	160.0	259.0	1.619	71.0	0.444	--	--	--	--				
Western Run at Western Run, Md. ¹	1947-62	2.1	2.4	1.124	0.3	0.144	0.4	0.191	0.7	0.335				
Gunpowder Falls near Carney, Md.	1944-62	59.8	68.8	1.151	7.5	0.125	15.0	0.251	21.0	0.351				
Little Gunpowder Falls at Laurel Brook, Md.	1949-62	314.0	399.3	1.272	99.3	0.316	1.7	0.005	2.9	0.009				
Little Gunpowder Falls near Bel Air, Md.	1926-62	36.1	47.4	1.313	5.8	0.161	9.0	0.249	14.0	0.388				
Whitemarsh Run at White Marsh, Md.	1904-09	43.0	80.0	1.860	13.0	0.302	--	--	--	--				
W. Branch Herring Run at Idlewylde	No Rec-ords	7.6	--	--	--	--	--	--	--	--				
Stemmers Run at Roseville, Md.	1957-62	2.1	2.2	1.047	0.0	0.000	--	--	--	--				
Brien Run at Stemmers Run, Md.	1958-62	4.9	6.7	1.348	0.1	0.020	--	--	--	--				
Cranberry Branch near Westminster	1958-62	2.0	2.2	1.096	0.0	0.000	--	--	--	--				
N. Branch Patapsco at Cedarhurst	1949-62	3.3	3.9	1.179	0.7	0.212	0.9	0.274	1.2	0.365				
N. Branch Patapsco near Reisterstown	1945-62	56.6	64.8	1.145	8.5	0.150	10.0	0.177	17.0	0.300				
N. Branch Patapsco near Marriottsville, Md. ²	1927-53	91.0	103.0	1.132	11.0	0.121	16.0	0.176	26.0	0.286				
S. Branch Patapsco at Henryton	1929-54	165.0	180.0	1.090	9.0	0.055	24.0	0.145	48.0	0.291				
Piney Run near Sykesville, Md.	1948-62	64.4	70.8	1.099	6.8	0.106	6.6	0.102	14.0	0.217				
Patapsco River at Woodstock, Md. ²	1931-58	11.4	12.9	1.132	1.2	0.105	1.6	0.140	3.1	0.272				
Patapsco River at Hollofield, Md.	1896-1908	251.0	409.0	1.629	50.0	0.199	--	--	--	--				
E. Branch Herbert Run at Arbutus	1944-54	285.0	348.0	1.221	15.0	0.053	31.0	0.109	64.0	0.225				
Gwynns Falls near Owings Mills	No Rec-ords	2.5	--	--	--	--	--	--	--	--				
	No Rec-ords	4.9	--	--	--	--	--	--	--	--				

Table 3. Average and Low Flows at Stream Gaging Stations -
Chesapeake Bay (Western Shore) Drainage Basin (Cont'd.)

Stream and Location of Gage	Period of Record	Drainage Area, Square Miles	STREAMFLOW							
			Average				Low Flow			
			of Record ⁴		Minimum Daily of Record	7-day, 10-year	Probable ⁵		Duration 95 Per Cent	
			cfs	cfsm			cfs	cfsm		
Gwynns Falls at Villa Nova, Md.	1957-62	32.5	32.2	0.991	3.6	0.108	--	--	--	--
Dead Run at Franklinton, Md.	No Rec- ords	5.5	--	--	--	--	--	--	--	--
Sawmill Creek at Glen Burnie, Md.	1944-52	5.1	8.3	1.620	3.6	0.706	--	--	--	--
North River near Annapolis, Md.	1931-62	8.5	10.7	1.258	1.5	0.176	3.4	0.667	4.5	0.882
Bacon Ridge Branch at Chesterfield	1942-52	6.9	10.4	1.503	3.0	0.434	2.3	0.271	4.7	0.553
Patuxent River near Unity, Md.	1944-62	34.8	37.4	1.075	2.8	0.080	2.9	0.419	3.6	0.520
Cattail Creek at Roxbury Mills, Md.	1944-56	27.7	28.6	1.032	3.2	0.116	4.1	0.118	7.6	0.218
Patuxent River near Burtonsville	1911-12						3.4	0.123	6.6	0.238
Patuxent River near Laurel, Md. ³	1913-45	127.0	--	--	--	--	9.2	0.072	24.0	0.189
Little Patuxent River at Guilford	1944-55	132.0	148.0	1.128	18.0	0.136	--	--	--	--
Little Patuxent River at Savage	1932-59	38.0	40.5	1.066	3.1	0.082	4.4	0.116	8.5	0.224
Little Patuxent River at Jessup, Md.	1939-58	98.4	102.0	1.037	7.0	0.071	12.0	0.122	23.0	0.234
Dorsey Run near Largo, Md.	1948-58	11.6	14.5	1.250	1.4	0.121	1.9	0.164	2.7	0.233
Western Branch near Largo, Md.	1949-62	30.2	30.0	0.993	0.6	0.020	1.3	0.043	3.0	0.099
Cocktown Creek near Huntingtown	1956-62	3.9	5.2	1.340	0.0	0.000	--	--	--	--
St. Leonard Creek near St. Leonard	1956-62	6.7	10.1	1.501	0.8	0.119	--	--	--	--

¹Average and low-flow data at Station 7 include diversions made above gage. "Probable" flows calculations do not include diversions.

²Data for Stations 17 and 21 represent conditions of flow prior to 1954 (construction of Liberty Reservoir).

³Data for Station 32 adjusted for diversion above gage.

⁴Average and low-flow calculations based on water-year data.

⁵Source: Darling (1962); probable low flows were adjusted by Darling to reference period 1913-1957

flow which is exceeded 95 per cent of the time.² These design-flow criteria have been selected for presentation here only as examples of such criteria which have been used by regulatory agencies for purposes of stream water quality control.

Data from the 33 stations of record are summarized in Table 4. As indicated, the arithmetic mean of the average streamflow value is about 1.2 cubic feet per square mile. This is equivalent to approximately 16.3 inches of precipitation per year, or 38 per cent of the average annual precipitation.

Table 4. Summary of Streamflow Data from the Chesapeake Bay Western Shore Basin

Criterion of Flow	Number of Gaging Stations	Flow, cfs/m			
		Minimum	Median	Mean	Maximum
Minimum daily of record	33	0.000	0.123	0.156	0.706
Probable low flow: 7-day, 10-year	23	0.005	0.145	0.187	0.667
95 per cent duration	23	0.009	0.272	0.304	0.882
Average of record	33	0.993	1.165	1.227	1.629

The value for streamflow or total runoff (in this case, 16.3 inches) represents the contribution of both surface and ground water runoff. Dingman and Ferguson (1956) found ground water runoff to account for 11.3 inches or 27 per cent of precipitation for the drainage area of Little Gunpowder Falls above Laurel Brook, Maryland. They also estimated ground water runoff for the Rock Creek sub-basin in Montgomery County to be 20 per cent of the mean annual precipitation. If a value of 25 per cent is assumed for the entire Western Shore basin, the ground water

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2 The lower five-percentile of the daily mean flows of record. This is the streamflow criterion used by the Maryland Department of Health as a basis for setting sewage treatment requirements for stream pollution control.

contribution to streamflow is equivalent to about 10.8 inches of precipitation. This leaves approximately 5.5 inches of precipitation becoming streamflow via surface runoff.³

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3 Expressed in terms of inches of precipitation:

Streamflow = Surface Runoff + Ground Water Runoff

16.3 = SRO + (25% x 43.1) (annual precipitation)

16.3 = SRO + 10.8

5.5 = SRO

INVENTORY OF SURFACE AND GROUND WATERS

The water resources of the Western Shore drainage area are found in its surface streams, lakes, reservoirs and estuaries and in the water-bearing formations underlying the watershed.

Surface Waters

Appendix A includes a list of streams and estuaries making up the surface drainage system of the Western Shore of the Chesapeake Bay. In addition to this listing, Appendix A includes stream gaging stations, water intakes, waste outfalls and other items of significance. A condensed list, including stream gaging stations, water intakes, and waste-water outfalls, is presented in Appendix B. For a more detailed description of this material, refer to the General Reference Section* - DESCRIPTION OF APPENDICES.

Reservoirs - There are no large natural lakes in the Western Shore watershed. However, several rather large man-made lakes, or reservoirs, have been created by the construction of dams. A list of impoundments is presented in Appendix C. The principal reservoirs are Pretty Boy and Loch Raven Reservoirs on Gunpowder Falls, Liberty Reservoir on the North Branch Patapsco River, and Triadelphia and Rocky Gorge Reservoirs on the Patuxent River. The Gunpowder Falls and Patapsco River Reservoirs supply water to the City of Baltimore and its satellite areas. These three impoundments have a combined usable storage capacity of 261,000 acre-feet (85.3 billions of gallons). Triadelphia and Rocky Gorge Reservoirs have a combined usable capacity of 38,400 acre-feet (12.5 billions of gallons).

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* In this report, reference is frequently made to a General Reference Section. This Section is included in the Summary Volume (Volume 6).

Additional storage capacity is provided in the Western Shore watershed by smaller reservoirs and hundreds of farm ponds scattered throughout the rural areas.

Estuaries - Not to be discounted in an inventory of the water resources of the Western Shore area are the saline and brackish waters of Chesapeake Bay and its numerous arms. These waters, though unsuitable for potable supplies, have great value for use in industrial cooling, and for instream uses such as recreation, navigation, fishing, and waste disposal. The quantity of these waters is virtually unlimited. They represent an asset which is probably no less important than the available fresh water supplies for the economic development of the Western Shore basin.

Ground Water

The ground water of the Western Shore basin has been studied rather extensively for many years by the U. S. Geological Survey in cooperation with the Maryland Department of Geology, Mines and Water Resources. The accounts of these studies have been presented in detailed reports published by the State cooperating agency. The counties of the basin covered by these reports are listed in Table 5, together with the authors and dates of publication. The complete references for these reports are listed in the bibliography at the end of this report. These reports are the principal sources of available information on ground water in the basin and should be consulted for detailed discussion on this subject. For convenience of the reader, abstracts of the several county reports, originally published as parts of the reports, are reproduced in Appendix H.

The following is a very generalized description of ground water occurrence in the Western Shore area of the Chesapeake Bay drainage basin.

Table 5. Published Reports on Ground Water,
Chesapeake Bay (Western Shore) Basin

<u>County or Area</u>	<u>Bulletin Number¹</u>	<u>Principal Author</u>	<u>Year or Publication</u>
Anne Arundel	5	Brookhart	1949
Anne Arundel	26	Mack	1962
Baltimore Area	4	Bennett	1952
Baltimore Area ²	--	Otton	1964
Baltimore County	17	Dingman	1956
Calvert	8	Overbeck	1951
Carroll	22	Meyer	1958
Charles	--	Overbeck	1948
Frederick	22	Meyer	1958
Harford	17	Dingman	1956
Howard	14	Dingman	1954
Montgomery	14	Dingman	1954
Prince George's	10	Meyer	1952
St. Mary's	11	Ferguson	1953
Southern Maryland	15	Otton	1955
Piedmont	--	McGuinness	1963
Coastal Plain	--	McGuinness	1963

1 Numbers are those assigned in a series of reports issued by the Department of Geology, Mines and Water Resources, State of Maryland.

2 This reference, entitled Water Resources of the Baltimore Area Maryland, was not published as a bulletin of the Department of Geology, Mines and Water Resources but as a U. S. Geological Survey Water Supply Paper (1499-F).

Ground water is found in varying quantities throughout the Western Shore area. Within the basin are two geologic and physiographic provinces having very different ground water characteristics. These two provinces, the Piedmont and the Coastal Plain, are separated by a northeastward-trending line called the Fall Line, or more properly the Fall Zone. The Fall Zone is roughly followed by the Baltimore and Ohio Railroad from Laurel in Prince George's County to Aberdeen in Harford County. The Piedmont lies north and west of the Fall Zone, and the Coastal Plain to the east and south.

As described by McGuinness (1963), the Piedmont is underlain by crystalline and sedimentary rocks which are generally reliable sources of the small supplies (5 to 10 gpm) needed for domestic and stock supply. Dingman and Ferguson (1956) reported that more than 70 per cent of the drilled wells in the Piedmont portion of Baltimore and Harford Counties yield no more than 10 gallons per minute with only 2 per cent having yields greater than 50 gallons per minute. There are a few wells in Piedmont Maryland yielding as much as 200 gpm - the source of these larger supplies is limestone and marble, and sandstone and shale of the Triassic belt. The yields of the more productive wells generally tend to decrease if pumping is heavy and continuous.

In a few localities, even domestic supplies are hard to get; well yields are low and water levels decline under prolonged pumping. Information is needed on the principles of occurrence of water in the crystalline rocks to explain these poorly productive localities and to enable predicting the best well sites in them.

The ground water in Piedmont Maryland is generally of good quality except that some of it is slightly corrosive, high in iron, or locally in areas of limestone or marble, excessively hard (McGuinness, 1963).

The Coastal Plain aquifers of the Western Shore area are much more productive than those of the Piedmont region. To summarize the ground water situation in this area, the abstract of McGuinness' report (1963) is reprinted in part.

On the Western Shore⁴ the yields of wells developed and equipped for maximum capacity range from a few hundred gallons per minute to as much as 1,200 gpm in the most favorable areas.⁵ Along the Fall Line the yields are small because the sediments are thin and also are dissected and tend to drain out rapidly. In the southwestern part of the Maryland Coastal Plain, from Washington, D. C., down to Indian Head, the water-bearing sands are generally thin and fine grained and well yields tend to be small. Water levels are declining in localities where pumping is heavy.

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The northern part of the Western Shore is more productive, at least where developed to date. Pumping is concentrated largely in the Baltimore industrial area and in the northern half of Anne Arundel County, and there is substantial pumping at military installations scattered over the whole Western Shore.

. . . . .

The water from the oldest sediments, the Cretaceous, commonly is slightly acid, corrosive, and high in iron content. As much as 50 ppm of iron has been measured in wells near Washington, D. C., a highly excessive value when the Public Health Service's recommended limit of 0.3 ppm for iron and manganese together is considered. The average iron content is much less, but it commonly exceeds 0.3 ppm.

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- 4 As used by McGuinness, the Western Shore area includes the Coastal Plain portions of Harford, Baltimore, Anne Arundel, Calvert, Prince George's, Charles, and St. Mary's Counties, and of Baltimore City.
- 5 Mack estimates that the yield of aquifers underlying Anne Arundel County is on the order of 130 mgd or about 0.31 mgd per square mile of land surface. Yields of individual wells for industrial and public supplies in the Baltimore area range from a few gallons per minute to as much as 1,000 gpm, (1.14 mgd) and average more than 200 gpm or 0.288 mgd (Otton, 1964). This same source estimates the sustained yield of the Piedmont region in the Baltimore area (900 square miles) to be 150 mgd; the Coastal Plain, (400 square miles) to be 80 mgd.

Saline water has encroached from the Patapsco River Estuary into the shallower Cretaceous aquifers along the shore in a large part of the Baltimore area. The ground water is contaminated also by industrial wastes which enter the aquifers through the corroded, leaky casings of wells. The pumping in the industrial area, formerly heavier, has become more or less stabilized at the present rate as a consequence of the contamination that has already occurred and of its tendency to spread at higher rates of pumping.

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WATER RESOURCES REGULATION AND DISTRIBUTION

Like all well-developed cultures, that of the Western Shore basin depends in great degree upon regulation of the natural flows of streams and upon the collection, storage, and distribution of the waters found in the streams and aquifers. A complex system of dams, reservoirs, and pipelines has been developed to serve water users at times and places within the basin when and where natural supplies would not be adequate otherwise. Waters are diverted from streams and conveyed many miles to the points of use, after which they may be discharged into an entirely different natural water system.

Regulation by Reservoirs

At this time (1965), the principal means by which the natural water supplies of the Western Shore basin are modified is by reservoirs on several of the larger surface streams. The relatively important reservoirs include Atkisson Reservoir on Winters Run, Pretty Boy and Loch Raven Reservoirs on Gunpowder Falls, Liberty Reservoir on the North Branch Patapsco River and Triadelphia and Rocky Gorge Reservoirs on the Patuxent River. Table 6 lists pertinent data for each of these reservoirs.

Other smaller reservoirs and farm ponds are found in the Western Shore basin, and although they provide significant regulation of streamflows in small waterways, they are relatively small and of only minor importance in relation to the basin as a whole. Appendix C lists all major reservoirs and lakes in the Chesapeake Bay (Western Shore) drainage basin. Farm ponds and small impoundments are discussed in the General Reference Section - WATER RESOURCE REGULATION AND DISTRIBUTION, which summarizes a State-wide pond inventory.

Although the waters of some of the streams in the Western Shore basin have been regulated to various degrees, when the entire basin is considered as a

Table 6. Major Reservoirs in Chesapeake Bay
(Western Shore) Drainage Basin

<u>Stream and Reservoir</u>	<u>Drainage Area (square miles)</u>	<u>Average Annual Flow (billions of gallons)</u>	<u>Storage Capacity (billions of gallons)</u>	<u>Storage Ratio (per cent)</u>	<u>Safe Yield² (millions gals/day)</u>	<u>Owner</u>
Winters Run						
Atkisson (mile point 5.9)	38	10.8	0.23	2.0	?	U. S. Army Chemical Center
Gunpowder Falls						
Pretty Boy (mile point 40.1)	80	24.0	20.0	83.0)		
Loch Raven (mile point 13.8)	303	90.9	23.0	25.3)	148	Baltimore City
North Branch Patapsco River						
Liberty (mile point 3.2)	164	42.4	43.0	100.0	95.0	Baltimore City
Patuxent River						
Triadelphia (mile point 92.8)	78	20.5	6.6	32.2)		
Rocky Gorge (mile point 81.0)	132	34.4	6.0	17.5)	45.0	Washington Sub-urban Sanitary Commission

¹ Storage ratio is the ratio of reservoir capacity to average annual flow.

² Safe yield is a technically derived practicable rate of perennial withdrawal from a reservoir.

³ Ratio of combined storage to annual flow at nearest gage below downstream reservoir.

unit, its runoff is found to be largely uncontrolled. Excluding farm ponds, the total reservoir storage capacity in the area is approximately 100 billions of gallons. This capacity will store only about 16 per cent of the average annual surface runoff of the basin, a small amount in comparison with storage ratios of 75 per cent and greater on many streams in Eastern United States.

The need for additional storage must be evaluated in terms of the adequacy of present water supplies, the effect of basin diversions, projected increases in water uses and anticipated changes in waste water treatment. These subjects are discussed in Part II of this study.

Regulation by Diversions

In the broad sense, any withdrawal of water from a water body can be called a diversion. For purposes of this report, however, diversions include those withdrawals of water which are (1) discharged to another stream before or after use; (2) discharged to the same stream only at a point greatly distant from the withdrawal point, so that the natural flow between the two points is affected; or (3) discharged to another watershed or drainage basin.

With respect to a given watershed, diversions may be classified as imports or exports.

Imports to Basin - At the present writing (July, 1965), there are no major import diversions of water into the Western Shore basin. However, the City of Baltimore is now constructing a pipeline, pumping station, and reservoir to divert water from the Susquehanna River upstream of Conowingo Dam. The intake is located about 1,000 feet above the dam in Conowingo Reservoir. The water will flow by gravity through a 108-inch pipe to a point near the mouth of Deer Creek. From there a pumping station will force the water against gravity through another 108-inch pipeline some 27 miles across Harford County and into a reservoir specially constructed near Fullerton, Baltimore County, not far from the northeastern corner

of the City of Baltimore. From the Fullerton Reservoir, which has only a short-term storage capacity of 250 million gallons, the water will flow by gravity through a 96-inch pipe to the Montebello Water Filtration Plant in Baltimore.

The Susquehanna diversion project is designed to have a yield of 250 mgd, more than the combined safe yields of the older Gunpowder and Patapsco systems of Baltimore City.

The Aberdeen Proving Ground diverts about 3.7 cfs (2.4 mgd) from Deer Creek, a tributary of the Susquehanna River in Harford County. After use, the waste water is discharged into Chesapeake Bay between Swan Creek and the Bush River. Although this diversion reduces the flow in Deer Creek, it does not add to streamflow in any fresh water stream of the Western Shore basin because the resulting effluents are discharged into the tidal waters of the Bay.

Exports from Basin - Relatively little water is diverted from the Western Shore drainage basin into adjacent watersheds. Two such export diversions are known, one from the Patapsco River sub-basin and one from the Patuxent River sub-basin. Both of these diversions transport water into the Potomac River basin.

The City of Westminster in Carroll County diverts water from Cranberry Branch, a tributary of the West Branch of the North Branch Patapsco River. The diversion point is 0.2 mile above the mouth of Cranberry Branch and 0.1 mile upstream of the highway bridge on Maryland Route 31 at Cranberry Station. After serving municipal purposes in Westminster, the used water (sewage) is discharged to Little Pipe Creek, which flows into Double Pipe Creek, a tributary of the Monocacy River in the Potomac River basin. According to the Geological Survey (1962), this diversion from Cranberry Branch averaged 1.4 cfs (0.90 mgd) during the water year ending September 30, 1962. The diversion represents about 33 per cent of the average runoff of Cranberry Branch as measured at the gaging station located at river mile 0.5.

The Washington Suburban Sanitary Commission, an agency established in 1918 by the Maryland General Assembly, diverts water from the Patuxent River at mile point 80.9 just below Rocky Gorge Dam. The Rocky Gorge Pumping Station has a total pumping capacity of 94 mgd. Three parallel pipelines with diameters of 30 inches, 36 inches, and 42 inches, convey the water from the intake to the Patuxent Water Filtration Plant about two miles away. After treatment, the water is delivered mainly to Montgomery and Prince George's Counties, with a comparatively small portion going to Howard County. After use for domestic and other municipal purposes throughout the three-county area, the water not consumed is collected as sewage, treated, and discharged into either the Potomac or the Patuxent Rivers. (Approximately 1 mgd is returned to the Patuxent via the Laurel Treatment Plant operated by the Washington Suburban Sanitary Commission.) The Geological Survey publishes data yearly showing the monthly and yearly mean diversions by the Rocky Gorge Pumping Station. Reports covering the year 1962 indicate an average monthly diversion of 51.6 mgd. This diversion accounted for 68 per cent of the mean flow in the Patuxent River immediately upstream of the intake during the year.

Net Diversion from Basin - The known diversions into and out of the Western Shore drainage basin are listed in Table 7. These data are for the year 1962. They show a single import of 3.7 cfs (2.4 mgd) and two exports totaling 81.3 cfs (52.5 mgd). Subtracting the smaller from the larger results in a net export of 77.6 cfs (50.1 mgd) from the basin.

After completion of the Susquehanna River diversion project of the City of Baltimore, a new importation of water into the Western Shore basin will begin, one which will eventually exceed the present (1965) exports of basin water. Thus the basin will in time become a net importer of water.

Table 7. Diversions of Water To and From Western Shore Drainage Basin, 1962

Source of Water: Basin Sub-basin Intake Stream	Water User	Water Diverted to: Basin Sub-basin Outfall Stream	Mean Diversion, 1962			
			Exported cfs	mgd	Imported cfs	mgd
SUSQUEHANNA RIVER Main Stem Main Stem	City of Baltimore	WESTERN SHORE Patapsco River, Back River Patapsco River, Back River	--	--	0.0**	0.0**
SUSQUEHANNA RIVER Deer Creek Deer Creek	Aberdeen Proving Ground	WESTERN SHORE Direct drainage and minor tributaries sub-basin	--	--	3.7	2.4
WESTERN SHORE Patapsco River Cranberry Branch	City of Westminster	POTOMAC RIVER Monocacy River Little Pipe Creek	1.4	0.90	--	--
WESTERN SHORE Patuxent River Patuxent River	Wash. Sub. Sanitary District	POTOMAC RIVER Main Stem Estuary Main Stem Estuary	79.9*	51.6*	--	--
TOTALS			81.3	52.5	3.7	2.4

* Approximately 1 mgd is returned to Patuxent River via the Laurel Treatment Plant, operated by the Washington Suburban Sanitary Commission.

** Diversion facilities, under construction in 1965, will have a capacity of 250 mgd (386 cfs) when completed.

Intra-Basin Diversions

There are several important diversions of water within the Western Shore drainage basin which significantly affect the flows in the source streams below the point of withdrawal. They are discussed in their land-to-seaward sequence of intakes and outfalls as listed in Appendices A and B, rather than in their order of importance.

Bynum Run - The City of Bel Air has a water intake and pumping station at stream mile 12.0 on Bynum Run, a tributary of the Bush River. Before April, 1955, water was withdrawn at this point for use in the public water system of Bel Air. However, since that time the Bynum Run pumping station has been in standby status. When the station was operated, it decreased the streamflow in Bynum Run as measured at the gaging station "near Bel Air," located at stream mile 8.9, where the flow was gaged from October, 1950, through September, 1955. However, a large part of the diverted water was returned to Bynum Run as municipal sewage at mile 8.2, which is 3.8 miles downstream of the pumping station's intake and 0.7 miles below the now-inoperative gaging station "near Bel Air." In a report for the water year ending September 30, 1954, the Geological Survey (1958a) reported an average diversion of 0.15 cfs (0.097 mgd) by the Bynum Run pumping station. For the succeeding six months through March, 1955, after which the station went on "standby," the Geological Survey (1958b) reported a slightly higher mean diversion, 0.18 cfs (0.116 mgd). As a measure of the stream-regulating effect of this diversion, the mean rate of withdrawal of 0.15 cfs during the water year 1953-1954 can be compared with the yearly minimum instantaneous flow of 0.2 cfs recorded at the gage on September 14 and 15, 1954.

When operated, Bel Air's pumping station on Bynum Run also influenced the flows at an older gaging station "at Bel Air" on that stream at mile 8.39,

just downstream of the bridge on Maryland highway 22. The period of record for this gage is June, 1944 to April, 1951 and July, 1955 to date.

Bel Air's sewage disposal plant, serving a sewered population of 5,000, discharged 0.45 mgd of treated effluent into Bynum Run at mile 8.2, about 0.2 mile downstream of the stream gage at Bel Air. This discharge rate is 50 per cent greater than the minimum flow of record, 0.3 cfs, for the gaging station at Bel Air (mile 8.39). Based on the streamflow criteria⁶ used by the Maryland Department of Health for purposes of designing sewage treatment facilities as reported by McComas (1957), the design flow of Bynum Run at the gage (mile 9.39) is 0.9 cfs, only slightly greater than the sewage discharge in 1962. These data indicate that the water diverted by Bel Air from Winters Run and discharged to Bynum Run has significant effects on the quantity and quality of water in the lower 8-mile reach of the latter stream.

Winters Run - Since placing its Bynum Run pumping station on standby status in 1955, the City of Bel Air, Maryland, has been diverting water from Winters Run at a point 10.1 miles above the mouth of that stream's conjunction with Otter Point Creek, a tributary of the Bush River. The water intake and pumping station are about 125 feet upstream of a "partial-record" stream gaging station at the bridge on U. S. Highway 1, above which the drainage area is 37.0 square miles. Low-flow measurements reported by the Geological Survey range from 6.49 cfs (4.19 mgd) on July 29, 1954 to 47.3 cfs (30.5 mgd) on June 6, 1958. In July, 1962, the Bel Air pumping station was diverting 0.8 cfs (0.5 mgd), or about 12 per cent of the minimum dry-season runoff recorded. With the effluent from Bel Air's sewage treatment plant being discharged into Bynum Run, this diversion results in a significant reduction of the dependable streamflow in the lower-10-mile reach of Winters Run, as well as an increase of streamflow in Bynum Run.

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6 Daily flow exceeded 95 per cent of the time.

A second diversion from Winters Run takes place at stream mile 2.5, where a pumping station withdraws water for use at the Army Chemical Center in Edgewood, Maryland. The treated waste waters from this establishment, about 1.5 mgd in 1963, are discharged into the Bush River at river mile 3.3. Since the waste outfall is in the brackish reach of the Bush River estuary, this diversion not only results in a reduction of dependable streamflow in Winters Run, but also permanently removes the water used from the total fresh water supply of the Western Shore basin. This is frequently the case in tidewater areas, unlike upland areas where diversions usually mean a transfer of water from one stream to another, where it remains fresh and available for reuse.

Gunpowder Falls - The City of Baltimore has diverted water for its public supply from Gunpowder Falls since 1881, when that stream was developed to supplement the older supply system on Jones Falls. The present point of diversion is at stream mile 13.8. Published records for the 13-year period from October, 1949, through September, 1962, show a mean diversion rate of 237 cfs (153 mgd) from Loch Raven Reservoir. This was about 61 per cent of the total runoff of 389 cfs during the same period. The maximum yearly diversion was 304 cfs (196 mgd) in water year 1952, before completion of the supplementary system on the Patapsco River. After 1953, when Baltimore began taking water from the Patapsco, Gunpowder diversions trended downward, reaching a minimum yearly value of 161 cfs (104 mgd) in 1958. For the water year 1962, the mean diversion from Gunpowder Falls was 176 cfs (114 mgd), or 45 per cent of the 13-year average runoff. The annual minimum monthly and maximum monthly diversions and the yearly mean diversions for water years 1949-1950 through 1961-1962 are listed in Table 8.

The water diverted from Gunpowder Falls is treated and distributed throughout a large part of metropolitan Baltimore. The waste waters from this area are collected and conveyed to sewage treatment plants, mostly to the Back River plant.

Table 8. Diversions of Water from Gunpowder Falls
for Water Supply of Baltimore, 1949-1962

Water Year (Oct.-Sept.)	DIVERSION				Mean, cfs
	Minimum		Maximum		
	Month	cfs	Month	cfs	
1949-50	Nov.	263	Aug.	309	281
1950-51	April	285	Aug.	325	302
1951-52	April	287	Aug.	321	304
1952-53*	March	281	June	310	296
1953-54	Feb.	262	July	306	279
1954-55	May	247	Oct.	304	276
1955-56	Jan.	155	Feb., May	304	271
1956-57	Sept.	171	Jan.	258	211
1957-58	May	150	Sept.	174	161
1958-59	Nov.	146	Sept.	197	175
1959-60	Nov.	165	Aug.	200	180
1960-61	Nov.	157	July, Aug.	193	174
1961-62	April	160	Aug.	189	176

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* Baltimore supplemented Gunpowder Falls supply with diversions from North Branch Patapsco River beginning February 26, 1953.

Until 1942, this plant discharged all of its treated effluent into Bread and Cheese Creek, a small tributary of Back River. The outfall is approximately 0.1 mile above the mouth of the creek, which in turn is 6.9 miles above the mouth of Back River. Because the effluent mingled with the tidal, brackish waters of Back River, it was no longer suitable for reuse for most purposes. However, beginning in 1942, part of the effluent from the sewage disposal plant was given additional treatment and was piped to the Bethlehem Steel Company's mills at Sparrows Point

where it was used primarily for cooling purposes. In 1943, the first full calendar year of this water-reclamation practice, the steel company used 23.5 mgd of effluent. By 1955, this use had increased to 68.9 mgd, about half of the total discharge from the disposal plant. In 1963, the steel company was reclaiming 113 mgd of the treated waste waters. After the reclaimed water serves its functions in the steel mills, it is discharged into the brackish waters near the mouth of the Patapsco River, and thus disappears as a fresh-water resource.

The diversion of water by the City of Baltimore from Gunpowder Falls has a marked effect upon the flow in that stream below Loch Raven Dam (mile 13.8). A measure of this effect can be obtained by comparing the diverted flow with the streamflow at the gaging station at river mile 11.0 near Carney, Maryland, 2.8 miles below the point of diversion. It has been stated already that the average diversion for a 13-year period amounted to 61 per cent of the runoff of the watershed above the gage. However, these averages show only part of the regulating effect. Although the purpose of the two reservoirs on Gunpowder Falls is to provide a relatively stable flow at the water intake, the system has the opposite effect on the streamflow below the intake and dam. This is because the reservoirs and diversion system have little relative influence on the higher rates of runoff, but greatly reduce the lower rates. The result is an increase in the frequency of low flows with only a minimal decrease in the frequency of flood flows. For example, during the year ending September 30, 1963, the daily streamflow at the "near Carney" gage ranged from 2.6 cfs to 2,540 cfs, giving a ratio of high to low of almost 980 to 1. In the water year 1952-53, the ratio of the maximum daily flow to the minimum was 1,303 to 1. In contrast, the high-to-low ratio for an unregulated stream, the South Branch of the Patapsco River at Henryton, was only 79 to 1 in 1961-62 and only 65 to 1 in 1952-53. Comparisons for other years give similar results. This merely illustrates that even though regulated to a relatively

high degree, the streamflows in Gunpowder Falls are largely diverted and therefore the regulation does not stabilize the flow below Loch Raven Dam, but greatly decreases the low flows. In comparing these ratios, it must be kept in mind that these reservoirs were not intended to serve a low-flow augmentation function - the City of Baltimore is not restricted in the use of the Gunpowder water and is not obligated to release any quantities for augmentation purposes.

Wolff and Whiteford (1958) have warned that with the Susquehanna River project completed, the low flows in the Gunpowder may be reduced further. As they explained it:

The proposed method of utilizing the new source from the Susquehanna will be to pump water over a distance of approximately 35 miles into Baltimore City upon demand. Demand will occur only when the Loch Raven Reservoir system comprising Prettyboy and the Loch Raven Reservoirs, as well as the new Liberty Reservoir, are virtually depleted. At that point, the Susquehanna will be drawn upon to firm up the required demands. The effect of this method of operation on the Prettyboy and the Loch Raven system will be to decrease even further the small downstream flows in the Gunpowder River which occur during the dry seasons.

This means that with the Susquehanna diversion project completed, Baltimore can increase the yield of the Gunpowder gravity system by drawing down Prettyboy and Loch Raven Reservoirs with constraint, knowing that the Susquehanna tunnel will be able to make up any deficiency that may occur. With the Gunpowder Falls Reservoir levels generally lower, empty storage capacity will be available to catch and hold some storm runoff that otherwise would pass over the spillway at Loch Raven Dam and rush unused into Chesapeake Bay. The result will be greater diversions for water supply and correspondingly less water flowing in the 14-mile reach of Gunpowder Falls below Loch Raven Dam.

North Branch Patapsco River - The City of Baltimore began diverting water for municipal purposes from the North Branch Patapsco River on February 26, 1953.

During the remainder of that year, the monthly mean diversions varied from zero in April and May to about 41 cfs in August, and averaged about 11 cfs. Two years later, during the water year 1954-55, the Baltimore diversion from Liberty Reservoir averaged 167 cfs, the highest for any water year through the period ending September 30, 1962. For water year 1962-63, the latest for which data have been published, the mean diversion was 163 cfs (104 mgd).

The point of diversion from the North Branch is at mile 3.2, just above Liberty Dam. This diversion greatly reduces the streamflow in the lower 3.2-mile reach of the North Branch, as well as in the length of the main stem of the Patapsco River from its head at the junction of the North and South Branches (mile 36.4) down to tidal waters. The flow reduction is revealed by the recorded streamflows at mile 2.3 on the North Branch, near Marriottsville, Maryland, where a stream gaging station was maintained from October, 1929, through September, 1960. Until diversion by Baltimore began, the minimum yearly mean flow observed was 75.8 cfs, (for water year 1930-31), and the 23-year mean flow was 179 cfs (116 mgd). After the diversion began, the minimum yearly flow observed was 0.53 cfs (for water year 1958-59), and the eight-year mean flow was 78.8 cfs. During the observed diversion period, there were three water years with mean flows of 1.07 cfs or less. These data and others selected from the record of the gage are listed in Table 9.

When compared with data for the preregulated stream, these data indicate a high degree of flow regulation at the gaging station near Marriottsville. The mean diversion of 168 cfs (107 mgd) during the water year 1954-55 was equal to 93.5 per cent of the 31-year mean flow of 180 cfs. Since Liberty Dam was first closed on July 22, 1954, no releases to the stream below the dam have been made except by overflow of the dam. This practice has resulted in lengthy periods of no streamflow at the gage, except for seepage and local runoff below the dam in the North Branch. However, the City of Baltimore has agreed to maintain a river flow of 13

Table 9. Selected Streamflow Data for North Branch Patapsco River for Period Since Beginning of Diversion for Municipal Water Supply of Baltimore

Water Year	Minimum Daily		Maximum Daily		Minimum Monthly		Mean Yearly, cfs
	Date	cfs	Date	cfs	Month	cfs	
1952-53 ¹	9/4/53	7.7	3/24/53	1,340.0	8/53	66.0	261.0
1953-54	Many	0.2	5/4/54	1,090.0	9.54	0.25	91.3
1954-55	10/2/54	0.2	8/13/53	27.0	10/54	0.29	0.68
1955-56 ²	11/18/55	0.5	7/21/56	4,100.0	12/55	20.8	118.0
1956-57	8/7/57	0.3	4/6/57	744.0	8/57	0.41	75.9
1957-58	11/22/57	0.2	2/28/58	1,100.0	11/57	13.2	82.1
1958-59	1/5/59	0.2	9/2/59	6.1	8/59	0.35	0.53
1959-60	10/7/59	0.2	4/5/60	7.9	10/59	0.42	1.07

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1 Diversion began February 26, 1953

2 Water overflowed crest of spillway at Liberty Dam for the first time on February 6, 1956.

mgd (20.1 cfs) in the main stem of the Patapsco River at the stream gaging station at Hollofield (river mile 28.3). This gage is 8.1 miles below the junction of the North and South Branches and 11.3 stream miles below Liberty Dam. The flow of 13 mgd is guaranteed by a decree of the Circuit Court of Baltimore County as a result of a suit instituted against the City of Baltimore by the New Haven Board and Carton Company, which operates a paper board mill on the Patapsco River at mile 22.2, about six miles downstream of the Hollofield gage. When the specified minimum flow is not supplied by runoff from the unregulated South Branch, the City is required to release water from Liberty Reservoir into the stream below Liberty Dam to make up the deficit.

The purpose of the guaranteed flow is to provide dilution of the wastes discharged by the mill. The specified minimum of 13 mgd (20.1 cfs) is only a fraction of the flow based on the criterion used by the State of Maryland for the purpose of waste-treatment requirements (McComas, 1957). This criterion, the flow exceeded by 95 per cent of the daily flows, results in a design streamflow at the Hollofield gage of 64 cfs (41 mgd), as computed by Darling (1962) for conditions of runoff before 1954. Darling also computed the daily flow exceeded 95 per cent of the time for the South Branch of the Patapsco at Henryton, which he estimated to be 14 cfs (9 mgd). Extrapolating the "design flow" at Henryton (64.4 square miles) to account for the unregulated drainage area above the Hollofield gage (121 square miles) results in a waste-treatment design flow of

$$\frac{121}{64.4} \times 14 \text{ cfs} = 26.4 \text{ cfs} = 17 \text{ mgd.}$$

Assuming no releases from Liberty Reservoir during low-flow periods except as required to maintain the court-decreed 13 mgd at the Hollofield gage, the unregulated "design flow" of 17 mgd is a reasonable streamflow for use as a dilution factor in computing treatment requirements for wastes to be discharged into the Patapsco River at the gage, and proportionately less or greater for locations upstream or downstream, respectively. Comparison of the pre-dam and present design flows, 64 cfs and 26 cfs, respectively, indicates much less dilution, and therefore much greater waste-treatment required now to maintain acceptable water quality than would be required in the absence of Liberty Dam.

In addition to the reduction of waste-assimilative capacity, of course, a reduction in the dependable yield of the Patapsco River for water supply results from the diversion of the North Branch by Baltimore.

The water taken by Baltimore from Liberty Reservoir flows by gravity through a tunnel 12 feet in diameter and about 12.5 miles in length to the Ashburton

Filtration Plant. The Ashburton Plant supplies water by gravity to the Second Zone of Baltimore's water distribution system, and by pumping to the Third, Fourth, and Fifth Zones. After use the unconsumed residual water (sewage) is collected, treated, and discharged into Back River (via Bread and Cheese Creek), or into the Patapsco River estuary via the Bethlehem Steel Company's sewage reclamation plant and steel mills, or into the Patapsco River estuary via the Wagners Point Sewage Treatment Plant. Once the used water mixes with the brackish waters of the estuaries, it is effectively removed from the fresh water supply available for use or reuse. Thus, as in the case of the water diverted from Gunpowder Falls, the diversion from the North Branch Patapsco River is equivalent to a consumptive use no less than if the water were removed by evapotranspiration.

Canals and Aqueducts

No canals are found in the Western Shore drainage basin, either for navigation or for conveyance of water. Chesapeake Bay and its many tributaries have afforded an easy means of water transportation to much of the area, and indeed, are largely responsible for the eastern concentration of population and industry within the basin. The Potomac River, though outside the Western Shore area considered in this report, provides navigable waters to within a short distance of the southern and southwestern portions of the Western Shore drainage basin. These waterways have obviated the need for canal development for transportation.

The existing aqueducts in the Western Shore basin have been discussed earlier in this report under the topic of diversions. They include the tunnel now under construction from the Susquehanna River to the City of Baltimore; the tunnel from Loch Raven Dam on Gunpowder Falls to the City of Baltimore; the tunnel from Liberty Reservoir on the North Branch Patapsco River to Baltimore's Ashburton Filtration Plant; and the pipeline through which water is conveyed from the

Patuxent River to the water treatment facilities of the Washington Suburban Sanitary District.

It is worthy of note that the tunnel which will bring Susquehanna River water to Baltimore, and the growing distribution system to the southwest of that city toward Washington, have counterparts in the system of the Washington Suburban Sanitary District which supplies Potomac River water to the area near the Potomac but growing northeastward toward Baltimore. It appears not at all unlikely that within a reasonably short time the two systems will meet somewhere between Baltimore and Washington. It is hardly less unlikely that there will be cross-connections between the two systems, so that some water users will be supplied with both Susquehanna River and Potomac River water, at times one or the other and at times a mixture of the two. With both systems now committed to heavy use of the Susquehanna and the Potomac Rivers as their respective major sources, the die is probably cast for further development of these out-of-basin sources for water supply in the Western Shore drainage basin.

Undeveloped Reservoir Sites

There has been no recent basin-wide study of potential sites for reservoirs in the Western Shore area of the Chesapeake Bay drainage basin. The only such study that can be classified as basin wide was carried out three decades ago, but this study was based on the single-purpose objective of water supply for the City of Baltimore. The modern concept of multiple-purpose reservoir development has received little consideration in this area to date.

Reservoir and dam sites which have been investigated in the past for one purpose or another include sites on most of the major streams discharging into the Chesapeake Bay between the Susquehanna and Potomac Rivers. They also include one site across a portion of Chesapeake Bay itself. the principal sites

will be discussed here in the upstream-to-downstream order used elsewhere in this report.

Susquehanna Flats - Engineers in the State of Delaware, in a search for water needed for that State's growing population and industries, have suggested two low dams across the northern end of Chesapeake Bay to create a tidal barrier. One of these dams would extend from the mainland across Spesutie Narrows to Spesutie Island. The other dam would extend from the east side of Spesutie Island, in Harford County, eastward to Turkey Point in Cecil County, Maryland. For the latter, a so-called "rubber dam" has been considered. These synthetic rubber dams have been used successfully elsewhere for creating heads of as much as 12 feet, much greater than is thought necessary for the upper bay tidal barrier.

The purpose of the tidal barrier would be to create a shallow fresh-water lake fed primarily by the Susquehanna River, but also by the Northeast River and minor streams in Harford and Cecil counties. The Delaware plan, still in a very preliminary stage, envisions a pumping station on the eastern shore of the impoundment which would force water eastward through a pipeline across Cecil County into the State of Delaware. The advantages and disadvantages of the tidal barrier have not been reviewed, but if physically, economically, and politically feasible, the plan would add considerable fresh water to the supply available not only to Delaware, but also to the eastern and western shore areas of Maryland.

Reservoir Sites (1934 Study) - About 30 years ago, a group of "Advisory Engineers" (Gregory, Requardt, and Wolman, 1934) carried out a study of potential sources of additional water supply for the City of Baltimore. Their study included at least cursory examination of all larger streams, and some not so

large, throughout the Western Shore basin from the Susquehanna to the Potomac and westward to the Monocacy River. Among the western shore streams studied were Winters Run in the Bush River sub-basin, Little Gunpowder Falls, Western Run (a tributary of Gunpowder Falls), Gunpowder Falls, the Patapsco River and the Patuxent River. Table 10 summarizes the major findings of the study. For more detailed information, consult the reference quoted.

It is of interest to note that the Advisory Engineers in their 1934 report recommended the Big Gunpowder Dam Site as the most favorable among those studies for the next addition to Baltimore's water storage facilities. However, they pointed out that urban development and land costs were increasing in the Gunpowder Falls area at such a rate that:

... it is our belief that, if the Loch Raven Reservoir is not raised to higher elevation as the next major development in securing additional water, it is doubtful if it ever will be raised (Gregory et al, 1934).

Almost 30 years have passed since that warning. The next major development undertaken by Baltimore was the Patapsco River project, Liberty Reservoir, followed by the Susquehanna diversion project, now under construction. These developments, together with recent residential development in the Gunpowder Falls watershed at a rate far in excess of anything anticipated in 1934, make it even more doubtful now that the level of Loch Raven Reservoir will even be raised to elevation 270 or higher.

Status of 1934 Sites in 1965 - With Liberty Reservoir completed and the Susquehanna diversion tunnel under construction, it is possible that Baltimore will not need to develop any additional water supply reservoirs during the present century. The choice of the Patapsco River project in the late forties, and the more recent choice of the Susquehanna project instead of the Gunpowder Falls

Table 10. Summary of 1934 Reservoir-Site Study*

<u>Stream and Site</u>	<u>Mile Point</u>	<u>Reservoir Area (acres)</u>	<u>Reservoir Capacity (billions of gallons)</u>	<u>Yield (mgd)</u>	<u>Comment</u>
Winters Run					
Pleasantville Upper Site 1	15.8	--	--	--	Site 2 most favorable; uneconomical to build any storage on Winters Run unless it were to be an integral part of a larger development including storage on Deer Creek in the Susquehanna Basin.
Pleasantville Upper Site 2	15.5	810	0.009	15	
Amoss Lower Site 3	12.5	--	--	--	
Western Run					
South Butler Dam Site 1	61.0	--	--	18	Unit cost considered excessive in comparison with costs of other available sources.
South Butler Dam Site 2	34.0	--	--	--	
Gunpowder Falls					
Big Gunpowder Dam Site					
(elev. 270)	11.3	6,200	85.0	61	Most favorable among sites studied
(elev. 280)	11.3	7,830	107.3	81	
Little Gunpowder Falls					
Covered Bridge Dam Site 3	12.6	--	--	--	Uneconomical as separate project. Part of larger development involving dams on Winters Run and Deer Creek.
Upper Covered Bridge					
Dam Site 7 (elev. 420)	12.9	1,815	20.55	--	
Dam Site 7 (elev. 410)	12.9	1,280	15.7	25	

* Source: Gregory, Requaardt and Wolman, 1934.

project and others considered by the 1934 report of the Advisory Engineers, indicate that the relative economic considerations have already changed markedly since 1934. Being relatively close to Baltimore, the watershed areas of Gunpowder Falls and Little Gunpowder Falls have been developed considerably for residential and other purposes in the last 30 years. Forty years from now, when Baltimore may need an additional water supply, further cultural developments in these watersheds will make it ever more costly to create large reservoirs. Economics would probably dictate the use of additional water from the Susquehanna, unless, of course, the unlikely situation occurs whereby this supply would not be available because of upstream withdrawals and diversions. In light of these considerations, the reservoir sites studied in 1934 will probably never be developed for the purposes originally intended, that of augmenting the Baltimore water supply. These impoundments, however, could serve purposes other than water supply or for water supply of areas nearer the dam sites than Baltimore.

It should be noted that the 1934 study by the Advisory Engineers was aimed at single-purpose reservoir developments. In recent years, however, the concept of multiple-purpose reservoirs has received widespread acceptance. It is possible that some of the 1934 dam sites, if restudied from the viewpoint of multipurpose use to meet regional needs, might be found to be economical and worthwhile projects. For such a study, the data compiled in the 1934 investigation, as published in the report by Gregory, Requardt, and Wolman (1934), as well as the unpublished material supporting that report, would be invaluable. The unpublished materials are to be found in the custody of the Bureau of Water Supply of the City of Baltimore. A list of these materials is given in the Appendix of the 1934 report.

Underground Storage Possibilities

With the exception of two industrial firms in the vicinity of Glen Burnie (Anne Arundel County) there is no use of artificial recharge of aquifers in the Western Shore basin at this time. Probably the most important reason for not using artificial recharge is the availability of more economic means of obtaining water. Other factors are also involved which tend to discourage this practice. In the Piedmont area, potential storage is generally limited to the thin, weathered mantle overlying firm rock. Withdrawals from this storage area are usually replaced by natural recharge during wet seasons. Although the capacity of aquifers in the Piedmont area is much less than those of the Coastal Plain, here again annual natural recharge can replace withdrawals. Furthermore, because much of the ground water in this region occurs under artesian conditions, there are no voids in the rock which could store water. Artificial injection of water in these aquifers would merely have the effect of increasing streamflow.

Although artificial recharge has not been generally accepted as a feasible solution to water supply problems, there are several specialized uses of this practice deserving further consideration.

Artificial recharge of aquifers in the Baltimore industrial area has been suggested by Bennett and Meyer (1952) as a means of increasing the supply of low-temperature water for industrial cooling purposes. This could be done, they point out, by injecting public-supply water into the ground during the winter, when it is colder than the naturally recharged ground water, for use during the summer.

A second specialized use of artificial recharge might be for protecting aquifers from salt-water intrusion. As practiced on the Pacific Coast for this purpose, fresh water is injected through wells strategically

located near the salt front. By raising the level of fresh water near the intruding salt water, the hydraulic gradient of the water in the aquifer can be reversed and the landward movement of the salt stopped, or the salt water may even be pushed back.

INVENTORY OF SURFACE WATER USES

Surface water uses can be classified as withdrawal uses or instream uses; the latter classification can be further subdivided into flow and on-site uses. These terms and others are described in the General Reference Section - INVENTORY OF SURFACE WATER USES. Tabular material concerning water use appears in the following appendices:

Appendix B - intakes, outfalls, gaging station records

Appendix E - surface water permits

Appendix F - ground water permits

The amount of water consumed (i.e. actually removed from available supply) is only a small part of the total used. Most of the fresh water taken from streams in the basin is used for public water supplies. Various authorities have estimated that from 5 to 20 per cent of water entering municipal distribution systems is consumed. The remainder, after use, is normally available for reuse after treatment to remove impurities or after purification by natural processes in surface streams or aquifers into which the used but unconsumed water is discharged.

In areas such as the Western Shore of the Chesapeake Bay, however, where much of the population and industry which use fresh water are located near brackish or saline water bodies, the usually necessary practice of discharging once-used fresh water into these salty waters constrains reuse. Once mixed with the salt-laden waters, the waste waters are no longer available for reuse as fresh water. With one important exception, this describes the situation throughout the area of the Western Shore drainage basin. The exception is the interception and reuse by the steel mills at Sparrows Point of a large part of the treated effluent from Baltimore Back River sewage disposal plant. Before this conservation practice began in 1942, all of the effluent was discharged to the estuarine waters of Back River via a small tributary. A considerable part of these wastes are still discharged without reuse into Back River.

Since the waste waters discharged into brackish or saline waters are removed from the available supply of fresh water as effectively as if they were evaporated or transpired, such discharge is similar in effect to a consumptive use. This is especially noteworthy in the Western Shore area and other parts of Maryland adjacent to the Chesapeake Bay, its tidal arms, or to the Atlantic Ocean. It is also worth noting at this time because recently it has become popular to argue that generally waste waters can be reused in preference to more expensive development of new supplies. This may not be generally true for the Western Shore drainage basin.

Withdrawal Uses

The withdrawal uses of surface waters can be classified as municipal, institutional, industrial, or agricultural uses. A fifth category sometimes employed is rural-domestic use, but this seldom involves surface water. Only the first four classifications need be discussed for the Western Shore drainage basin.

Municipal and Institutional Surface Supplies - Table 11 lists the communities and institutions which take water from surface streams of the Western Shore drainage area. The table also shows the stream on which each intake is located, and the latest available data on the amount of water withdrawn. Several of the intakes are maintained in a standby status for use when needed to supplement the regular facilities. Most of the water intakes are located in the Patapsco and Patuxent sub-basins. The two largest mean withdrawals in 1962, both for the Baltimore system, were from Gunpowder Falls and the North Branch Patapsco River. These two withdrawals together amounted to 218.3 mgd on the average during the calendar year ending December 31, 1962. During the same year, the Washington Suburban Sanitary District took 51.6 mgd on the average from the Patuxent River. Other withdrawals were relatively small, the largest being 4.0 mgd.

The total withdrawal of water from surface streams in the basin by the municipal and institutional systems was about 282 mgd in 1962. Of this amount, 270 mgd were accounted for by the systems of the City of Baltimore and the Washington Suburban Sanitary District. These water-supply systems served a large part of the population and industry of metropolitan Baltimore and the Maryland portion of metropolitan Washington.

Table 11. Municipal and Institutional Surface Water
Supplies in Chesapeake Bay (Western Shore)
Basin - 1962

Name of Community or Institution	Location of Intake, Sub-basin and Source Stream	Mean Withdrawal mgd
Annapolis	South River, Broad Creek	(standby)
Baltimore	Gunpowder River, Gunpowder Falls	113.100
Baltimore	Patapsco River, North Branch	105.200
Bel Air	Bush River, Bynum Run	(standby)
Bel Air	Bush River, Winters Run	0.500
Bowie Race Track	Patuxent River, Horsepen Branch	0.125
Edgewood Army Chemical Center	Bush River, Winters Run	3.900
Fort Meade	Patuxent River, L. Patuxent R.	4.000
Ilchester	Patapsco River, Main Stem	0.015
Md. House of Correction	Patuxent River, L. Patuxent R.	(standby)
Md. House of Correction	Patuxent River, Dorsey Run	0.820
Montrose School for Girls	Patapsco River, Unnamed Tributary	0.030
Sherwood Forest	Severn River, Brewer Creek	0.037
Springfield State Hospital	Patapsco River, Piney Run	1.300
Washington Suburban Sanitary District ^a	Patuxent River, Main Stem	(standby)
Washington Suburban Sanitary District ^a	Patuxent River, Main Stem	51.600
Westminster ^b	Patapsco River, Cranberry Branch	0.900
Westminster ^b	Patapsco River, North Branch	(standby)

a Part of water is used outside of Western Shore basin.

b All water is used outside of Western Shore basin.

Source: Geological Survey, 1962) Baltimore and Washington Suburban Sanitary District
Geological Survey, 1963)
Public Health Service, 1964) All other data

The Baltimore system serves, in addition to the City of Baltimore, that area surrounding the City in Baltimore, Anne Arundel and Howard Counties. The water works of the City supplied 1,405,000 water users in 1962 with an average of 155 gallons per person per day, a per capita rate influenced by industrial use of water.*

The monthly rates of water use from the public water system of Baltimore during 1962 are listed in Table 12. The total monthly withdrawals from the Gunpowder and Patapsco Reservoirs varied from a low of 200.3 mgd in November to a high of 236.5 mgd in July. The maximum daily rate of water use from the Baltimore distribution system for the year was 285.23 mgd on August 31, 1962.

Table 12. Monthly Rates of Water Use,
Baltimore Public Water System - 1962

Month	Mean Rate of Water Use (mgd)		Total
	Gunpowder Falls	North Branch Patapsco	
January	118.2	98.2	216.4
February	118.2	97.6	215.8
March	112.4	98.2	210.6
April	103.4	101.4	204.8
May	110.5	111.3	224.8
June	120.2	113.1	233.3
July	120.2	116.3	236.5
August	122.1	118.2	240.3
September	113.1	111.8	224.9
October	105.9	101.1	206.0
November	104.0	96.3	200.3
December	<u>107.9</u>	<u>97.6</u>	<u>205.5</u>
MEAN	113.1	105.2	218.2

Source: Geological Survey, 1962
Geological Survey, 1963

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* This calculation is based on the total amount of raw water withdrawn from the two sources, an estimated 218 mgd. Excluding transmission losses and water used in filter wash, approximately 208 mgd actually enter the distribution system.

The area served by the Washington Suburban Sanitary District includes parts of Montgomery, Howard and Prince George's Counties. As of 1962, the Public Health Service reported that the District served a population of 675,000 with 60.3 mgd of water from its several sources, the Patuxent and Potomac Rivers and two wells. More recent information (1965) indicates that the service area population is now 750,000 and water use has increased to 72 mgd. The per capita use of 96 gpd still is considerably less than the 155 gallons per capita daily cited for the Baltimore water service area, which reflects the heavy use of water by wet-process industries in Baltimore in addition to domestic and commercial requirements. The area served by the Washington Suburban Sanitary District is largely residential in nature, with little heavy industry.

The monthly rates of withdrawal from the Patuxent River by the Rocky Gorge Pumping Station for use in the Washington Suburban Sanitary District are listed in Table 13 for 1962. These data, reported by the Geological Survey (1962, 1963), show a minimum monthly rate of 46 mgd in January and a maximum of 61 mgd in August. The Rocky Gorge Station pumped an average of 51.6 mgd during 1962.

Table 13. Monthly Rates of Water Pumpage from Patuxent River by Rocky Gorge Pumping Station - 1962

<u>Month</u>	<u>Mean Rate in mgd</u>
January	46.0
February	46.3
March	48.3
April	50.1
May	57.2
June	54.7
July	55.3
August	61.0
September	53.7
October	50.7
November	48.2
December	<u>47.9</u>
	MEAN 51.6

Source: Geological Survey, 1962, 1963

It is noteworthy that the total 1962 use of water for municipal and institutional purposes from surface streams of the Western Shore basin, indicated to be on the order of 282 mgd, was no more than the long term average runoff from an area of only 366 square miles, based on the mean runoff observed at 33 gaging stations in Western Shore drainage area (see Table 3). This is only about 11 per cent of the total land area in the basin and is less than the respective drainage area of the Gunpowder, Patapsco or Patuxent Rivers. This means that any one of these stream systems, if developed so that the total runoff could be consumed for use, could more than meet the 1962 demand for municipal and institutional water supplies throughout the Western Shore drainage basin. Because of both physical and economic factors, a number of water sources are currently being used; nevertheless, the overall supply-demand situation supports statements by Singewald (1958) and others that water problems in Maryland are distribution problems, not resource problems.

Available data on municipal and institutional water supplies are not adequate to show the amounts of water used consumptively. To meet the need for tentative values, it is estimated that consumptive use varies from 5 per cent of the withdrawal rate in December to 20 per cent in August. Research is needed to provide more reliable information on consumption.

Industrial Surface Water Supplies - The largest known industrial withdrawal rate in the Western Shore basin is 478 mgd used by the Charles P. Crane steam-electric generating station of the Baltimore Gas and Electric Company. This plant takes water from Seneca Creek, a brackish-water arm of Chesapeake Bay, and uses it in a once-through condenser cooling system. Several older steam-electric stations in Baltimore Harbor (Patapsco River estuary) use large but undetermined amounts of brackish cooling water. Another electric generating station is now under construction at Chalk Point on the Patuxent River. Although these thermal electric generating stations account for a very large portion of total water use

within the Western Shore basin, cooling water use is practically nonconsumptive. The water is returned to the surface waterway from which it is withdrawn (or to a nearby stream) undiminished in quantity and unchanged in quality except for a temperature increase. Moreover, since they use brackish water for this purpose, these condensing systems have no effect on the fresh-water supplies of the basin.

Many other industrial plants take brackish water from Baltimore Harbor, primarily for cooling purposes. Garland (1952) reported more than a decade ago that well over one billion gallons of harbor water were being used daily by industry for cooling and cleaning. The fresh-water demands of these industries are supplied either by the public system of Baltimore (see Appendix G), by privately-owned wells, or by the use of treated municipal sewage.

Data are not available for an accurate accounting of surface water withdrawals or consumptive use by industries of the Western Shore basin. It is anticipated that better information will be collected as a result of current efforts of the Public Health Service and the State Planning Department who are conducting an industrial water-use study.

Known industrial withdrawals (excluding use for steam-electric generation) in the Chesapeake Bay West basin total 12.4 mgd. Probably another 1,500 mgd of saline water are used in the Baltimore Harbor area with about half of this amount used by public utility industries.

Agricultural Use of Surface Water - The use of water for agricultural purposes has never been extensive in the Western Shore drainage area. Farmers in this part of Maryland, as in the rest of the State and throughout the humid Eastern states, have depended until quite recently upon natural rainfall during the growing season plus water stored in the soil to supply the moisture needed by growing crops. Since World War II, however, there has been a trend of increasing use of water for supplemental irrigation in the East. For example, Reynolds (1955) reported that in the

entire State of Maryland, the number of acres irrigated increased from 700 in 1949 to 12,000 in 1954 and 20,000 in 1955. He did not specify the amounts of surface water included in these figures. Earlier, MacKichan (1951) had reported that 1,000 acre-feet of ground water and a "negligible" quantity of surface water were used for irrigation in Maryland in 1950. However, in 1957, according to Meyer (1957), Maryland irrigators used 206 acre-feet per day (67.2 mgd) to supplement rainfall on 12,233 acres with only 6 per cent of the water coming from wells; the rest was taken from streams, estuaries, and ponds.

Meyer presented his 1957 data for groups of counties according to the three physiographic provinces of the State, the Coastal Plain, Piedmont and Appalachian provinces. The Coastal Plain data included water use for Anne Arundel, Calvert, Prince George's, and St. Mary's Counties of the Western Shore, as well as for all of the counties of the Eastern Shore of Maryland. The Piedmont counties included Baltimore, Carroll, Harford, Howard and Montgomery Counties of the Western Shore drainage area, as well as several other counties outside this area. The Appalachian province includes the three westernmost counties of Maryland, outside the area considered in this report.

Meyer reported that an average of 50 mgd (153 acre-feet per day) of ground and surface water was used in the Coastal Plain and Piedmont provinces during the irrigation season in 1957. He stated that the principal months of supplemental irrigation were June, July, and August, with May and September less important. In the Coastal Plain counties, the average daily use was 29.4 millions of gallons (90 acre-feet), of which 39 per cent was taken from streams and estuaries, 53 per cent from ponds, and 8 per cent from wells.

In the Piedmont province counties, irrigators used an average of 20.6 mgd (63 acre-feet per day). Of this daily quantity, 64 per cent came from streams or estuaries, 34 per cent from ponds, and only 2 per cent from wells.

Meyer's data for the two provinces represented in the Western Shore basin are presented in Table 11. Other sources of data on the use of irrigation water in Maryland are MacKichan (1957), Galbreath (1960), Boyer (1958), Bureau of the Census (1956), Carbaugh, et al (1960), and Krewatch (1957).

Table 11. Water Use for Supplemental Irrigation
in Coastal Plain and Piedmont Provinces
of Maryland, 1957

Physiographic province:	Coastal Plain	Piedmont
Average use in irrigation season:		
mgd:	29.1	20.6
acre-feet per day:	90.0	63.0
Area irrigated, acres:	6,622.0	3,466.0
Average amount applied per acre:		
gallons per day:	4,400.0	5,900.0
acre-feet per day:	0.013	0.018
Increase in acreage irrigated		
1949-1957, per cent:	1,900.0	5,400.0
1954-1957, per cent:	73.0	17.0
Source of water, per cent:	100.0	100.0
streams or estuaries, per cent:	39.0	64.0
ponds, per cent:	53.0	34.0
wells, per cent:	8.0	2.0
Method of distribution, per cent:	100.0	100.0
sprinkler, per cent:	95.0	90.0
ditch, per cent:	5.0	10.0

Source: Meyer (1957)

A discussion of consumptive use in irrigation is found in the General Reference Section - INVENTORY OF SURFACE WATER USES. Also discussed is the effect of irrigation on streamflow records and certain administrative aspects of irrigation. Since there are considerable lands in the Western Shore basin near the tidal stream tributary to Chesapeake Bay, it is worth mentioning here that many of these tidal waterways at times contain fresh or only slightly saline waters in their upstream

reaches. By selectively withdrawing water at such times (for example, a low-water slack tide), farms near these upstream reaches may be able to obtain water adequate in quantity and satisfactory in quality to meet their irrigation needs (Law and Renfro, 1955). Water from these tidal streams will not as likely become the subject of conflicts or litigation as water from streams farther inland.

Instream Uses

Water uses which do not require removal of water from its natural surface waterway are frequently termed non-withdrawal or instream uses. These uses include hydroelectric power generation, navigation, fishing, recreation, and waste disposal. Although these instream functions are nonconsumptive, the use of water for any one of them may - and frequently does - conflict with uses for other non-withdrawal purposes, as well as with the various withdrawal uses. On the other hand, provision of water in a stream for one purpose may automatically provide more water for other purposes. For these reasons, instream water uses must be considered in any evaluation of water supply and demand.

Hydroelectric Power Generation - Historically, the use of falling water for the generation of electric power has not been very important in the Western Shore drainage area. Hydromechanical power was known throughout the Piedmont area, and especially on streams near the Fall Line, where the available hydraulic head was converted to mechanical energy primarily for the milling of grain. As late as 1929, Mathews and Watson (1929) reported that the Piedmont streams of Baltimore County "... develop considerably water power which is used locally for small milling and manufacturing purposes."

According to Wolman et al (1933), the Consolidated Gas, Electric Light, and Power Company operated a small hydroelectric power station on the Patapsco River at Avalon as late as 1933. This facility, which had a capacity of only 1,000 horsepower, is no longer in use. Wolman et al (1933) also reported that another hydroelectric

plant, owned by the Maryland Realty Company of Baltimore and inoperative since 1909, was located on the Patuxent River at Laurel. The capacity of this plant was reported as "unknown."

There are no large-scale developments in the Western Shore area for hydroelectric power production. Since they have been preempted for water supply, the largest streams, even if they were suitable otherwise, retain little or no potential for economically feasible production of conventional hydroelectric power. The smaller streams could not support such development because of insufficient flow, inadequate range of elevation, or both.

Recently, great interest has developed in this country in the production of hydroelectric power by the so-called pumped-storage method. This method uses off-peak power from another source, such as a steam-electric station, to pump water from a low-elevation source to a high-elevation reservoir. During periods of peak demand for energy, the high-level water is passed through the combination pump-turbines to supplement the base power capacity of the system. Since pumped-storage facilities use more energy when pumping than they produce when generating, they are economically feasible only if the overall value of the energy generated is greater than the cost of pumping. This is possible because of the difference between the prices of energy in periods of peak and low demand.

It should be noted that pumped-storage schemes usually rely upon recirculation of water, and therefore have little affect upon the average water supply available for other purposes. However, they may cause daily or weekly fluctuations of streamflow or reservoir elevation, depending upon the physical scheme employed.

Although there are no pumped-storage projects in existence in the Western Shore basin, there is probably a potential for development of such facilities, as evidenced by a recent license for a project of this type on Muddy Run, a tributary of the Susquehanna River not far beyond the northern limit of the Western Shore basin.

Navigation - Marine transportation is a very important feature of the water uses of the Western Shore area. Baltimore Harbor, formed by the estuary of the Patapsco River, is one of the busiest seaports in the country, ranking among the most important in terms of bulk cargo handled. Chesapeake Bay and its many tributaries form a direct link between the Maryland ports and others throughout the world. Maps and information on navigation projects in the basin are available in a recent report of the Corps of Engineers (1962).

Generally speaking, navigation in Chesapeake Bay waters is considered neither a consumptive nor a withdrawal use of water; it is significant, however, in its effects, both real and potential, on the quality of water available for other purposes.

Fishing - Although the fishery resources depend upon huge quantities of water in the streams and estuaries, the use of water by fish and fishermen is non-consumptive. Like navigation, fishing is important in a water resources survey mainly because of its water-quality aspects. Unlike navigation, however, fishing is of concern primarily because of its needs for water of reasonably good quality, rather than for its effects on water quality.

Chesapeake Bay and its Western Shore tidal arms support a commercial and sport fishery of great significance in the economy of the area. The Bay is well known for its oysters and other seafoods. Recently, the dredging of soft-shell clams has become an important new industry.

The Western Shore basin supports a fresh-water fishery as well as the salt-water variety. The division between the two types is not always distinct but regulations issued by the Department of Game and Inland Fish mark the legal point of division on each stream extending inland from the tidewater area on which fresh-water fishing is controlled by licensing. No license is required for tidewater fishing. The points of division, where known, are listed in their hydrologic sequence in Appendix A.

During extended periods of no flow over Loch Raven and Liberty Dams, the streamflows in Gunpowder Falls and in the North Branch Patapsco River are virtually cut off below these impoundments. These streams are undoubtedly degraded as fish habitats below the dams. However, this degradation has been offset by the creation of the large artificial lakes above the dams which support thriving fish populations. A successful sport fishery has been established for many years on Loch Raven Reservoir.

The important species of fish in the Chesapeake Bay region are described in reports by Hildebrand and Schroeder (1928) and the Fish and Wildlife Service (1945) of the U. S. Department of the Interior. Much of the available information on the fishery resources of the area can be traced through reference to a bibliography prepared by Mansueti (1955).

Recreation - Famed as a recreation area, the Chesapeake Bay, including its Western Shore sea-level tributaries, supports many activities pursued for fun and relaxation. These include, in addition to sport fishing, sailboating, motorboating, water skiing, bathing, "scuba" diving, and admiring the scenic views from the many miles of shoreline. The tidal waters of the area provide the sites of racing events for sailboats of all classes throughout the warm-weather period of each year. The yacht clubs and marinas dotting the shorelines attract boating enthusiasts from a wide area. Water skiing has become so popular that the State has had to enact laws to restrict this sport at certain times and in given areas.

All nonconsumptive users of water, these recreational pursuits find no shortage of water in the bay and its Western Shore tidal tributaries. The concern of water resources management for these purposes, therefore, must be directed toward quality of water rather than quantity.

The use of the fresh waters of the Western Shore drainage area is largely restricted to fishing. There are no large natural lakes in the area, and policy

decisions of the public water supply agencies prohibit the use of the reservoirs for recreation other than fishing and, to a limited degree, boating. However, the shores of these man-made lakes attract thousands of visitors who enjoy picnicking and sightseeing. In other areas of the country, the great demand for water-oriented recreation has created great pressure for revising the long-standing policy of water works officials (American Water Works Association, 1958) against more extensive use of water-supply reservoirs. However, in the Western Shore drainage area, such pressure has not developed, probably because of the availability of the vast recreational resources of the bay and its many tributaries.

Waste Disposal - General discussion of waste disposal may be found in the General Reference Section - INVENTORY OF SURFACE WATER USES.

Appendix B lists waste outfalls and, when known, quantities of wastes discharged. Data on municipal and institutional outfalls is fairly complete except for military installations. Discharge of municipal and institutional wastes totals approximately 187 mgd. The largest concentration of waste is found in the Back River estuary resulting from the discharge of the Baltimore sewage disposal plant. As already noted, increasing volumes of this effluent have been reused by steel mills. After this reuse, the waste waters are discharged into Baltimore Harbor.

Information on industrial waste discharges is incomplete and most inconclusive, especially with regard to a breakdown between discharges of cooling and process water. Appendix B does indicate, however, that a very large percentage of the used water is concentrated in or near Baltimore Harbor. The effluents discharged into the harbor are almost all from industrial plants.

A study of water quality in Baltimore Harbor was initiated in 1947 by the Department of Sanitary Engineering and Water Resources of The Johns Hopkins University. The results of the study, (discussed in more detail under WATER QUALITY) as reported by Garland (1952), indicated waste loadings as shown in Table 15.

Table 15. Distribution of Known Biochemical Oxygen Demand (BOD) Loading to Baltimore Harbor, 1950

<u>Source</u>	<u>5-day 20° C BOD (lbs. per day)</u>	<u>Population Equivalent¹</u>	<u>Per Cent of Total</u>
Antecedent natural and artificial pollution from tributary streams	8,200	50,000	15
Raw and treated domestic sewage	16,700	100,000	30
Manufacturing wastes and industrial sanitary sewage	<u>31,000</u>	<u>180,000</u>	<u>55</u>
TOTAL	55,900	330,000	100

1 Population equivalent is useful to establish a common denominator for certain types of waste discharges. Studies have shown that in the United States the average daily per capita sewage discharge of 5-day 20° C BOD is about 0.17 pounds.

Source: Otton et al, Water Resources of the Baltimore Area Maryland. U.S.G.S. Water Supply Paper 1499-F. 1964.

GROUND WATER USE

In terms of volumes, ground water plays a secondary role in the present use of water, far behind surface water, in both withdrawal and non-withdrawal uses in the Western Shore drainage basin. Available information indicates that only a small part of the total ground water resources are being utilized. McGuinness (1963) reported that the total pumpage for the entire Piedmont area, which covers about three-tenths of the State, was about 18 mgd in 1960. Only part of this pumpage is accounted for in the Western Shore drainage basin considered in this report. In the Western Shore portion of the Coastal Plain province of Maryland, McGuinness reported a total 1960 pumpage of about 54 mgd. The "Western Shore" area considered by McGuinness includes the portions of Prince George's, Charles, and St. Mary's Counties which are in the Potomac basin, in addition to the Western Shore drainage area as designated in this report. These data indicate a total pumpage of something less than 72 mgd for the basin, most of which can be assigned to the area near the City of Baltimore.

Bennett and Meyer (1952) studied the ground water of the "Baltimore area," which they defined as "... the City of Baltimore, and most of the area from the Susquehanna River south to Laurel, essentially between the Piedmont Plateau and the Chesapeake Bay." This area includes parts of Harford, Baltimore, and Anne Arundel Counties. Concentrating their investigation primarily in the industrial districts in and near Baltimore City, Bennett and Meyer reported a total pumpage in these districts of 47 mgd in the first part of 1942. This was decreased in late 1942 to 13 mgd, probably as a result of the inauguration of the practice of using treated effluent from the Back River Sewage Disposal Plant of Baltimore. A later study by Otton, Martin and Durum (1964) indicated that ground water use in the Baltimore industrial area increased to 34 mgd in 1945 and then dropped again in the next

decade to 24 mgd in 1955. The major reason for this 30 per cent decline appears to be the high cost of maintaining and operating wells which tap ground water contaminated with acid waste or with salty water from the bay. The area of greatest decline (Fairfield, Curtis Bay and the harbor districts) is also that of the greatest salt water contamination. The high cost of replacing wells, the relatively short useful life of pumps, well screens and casings, and the ready availability of water from the Baltimore City public supply all have been factors influencing the decline in use of ground water (Otton et al, 1964).

Subtracting the 24 mgd used in the industrial area leaves approximately 13.5 mgd of ground water used elsewhere in the Baltimore area as defined previously. This includes about 5.5 mgd used in the Piedmont region and 8.0 mgd used in the Coastal Plain of the Baltimore area outside the industrial sector. Table 16 summarizes ground water use and availability in the Baltimore area.

Table 16. Ground Water Use in the Baltimore Area
(1955-1956)

	<u>Piedmont</u>	<u>Coastal Plain</u>	<u>Total</u>
Ground Water Use (mgd)			
Public	--	2.6	2.6
Rural and domestic	4.5	3.0	7.5
Military installations	--	2.4	2.4
Industrial and commercial	0.7	24.0	24.7
Irrigation	<u>0.3</u>	<u>--</u>	<u>0.3</u>
TOTAL	5.5	32.0	37.5
Total Ground Water Available (mgd)	150.0	80.0	230.0
Per cent used	3.0	40.0	16.0
Total Surface and Ground Water Use (mgd)	248.0 ¹	32.5 ²	280.5
Per cent ground water	2.0	98.0	13.0

1 Approximately 200 of 248 mgd used by Baltimore City System.

2 1,500 mgd of saline water used in 1955-56 not included.

Source: Otton, et al Water Resources of the Baltimore Area Maryland, 1964.

A recent report by Mack (1962) presents data on the use of ground water in Anne Arundel County for the year 1960. He reported a total of 13.7 mgd for that year from wells and springs, including 8.6 mgd for public supply, 1.5 mgd for self-supplied industrial and commercial use, and 3.6 mgd for domestic and farm use. The ground water use was a large part, about 70 per cent, of the total water use in the County. However, the ground water used was only about 10.5 per cent of that available, 130 mgd as estimated Mack. The Baltimore area studies mentioned previously include part of Anne Arundel County. For this reason, their data on ground water use includes some pumpage in Anne Arundel County.

The use of ground water in Howard and Montgomery Counties was studied by Dingman and Meyer (1954). They reported a total pumpage of 4.5 mgd in the two counties, with 30 per cent of this being used for public or institutional supplies. Most of the active wells in Montgomery County are outside the area served by the Washington Suburban Sanitary District, which depends primarily on surface supplies. Much of Montgomery County lies outside the Western Shore drainage area and in the Potomac River basin. According to Dingman and Meyer, only about 10 per cent of the total pumpage in the two counties is for industrial or commercial purposes. Most of this is accounted for by a cannery at Gaithersburg, in the Potomac basin. Other commercial water users in the two counties include automobile service stations, shopping centers, roadside restaurants, and the like. Most rural homes and farms have wells, and some concentrated suburban areas are supplied by single wells or groups of wells. Dingman and Meyer reported very little use of water for irrigation in the early 1950's, but suggested an appreciable consumption by the large livestock population. The latter use depended only partly upon ground water, with some water being taken from streams and artificial ponds for this purpose.

Since the 1954 report cited above, conditions have changed in Howard and Montgomery Counties as a result of the expansion of the two great population centers of Baltimore and Washington. The two counties have steadily grown in population,

becoming less and less rural. The use of water has grown accordingly, but the increased use has depended more on surface water than on ground water.

The geology and ground water resources of Calvert County, in southern Maryland, were reported by Shattuck (1907) a half-century ago. This early study was supplemented a decade ago by Overbeck (1951) who assembled and analyzed the available data on ground water. He estimated that the use of ground water in Calvert County at that time was about 2.0 mgd. Overbeck assigned this water use chiefly to domestic and farm purposes as there were no large industries in the county. Between 1950 and 1960 the population of Calvert County increased from 12,100 to 15,826 (Maryland State Planning Department, 1961), a gain of 3,726 or 31 per cent. On the basis of the population increase, the ground water use is estimated to have been about 3.0 mgd in 1960. Calvert County is entirely within the Western Shore drainage area considered in this report.

The ground-water resources of Prince George's County were the subject of a report by Meyer, (1952). He estimated the ground water pumpage during 1949 and 1950 to have been 4.0 to 5.0 mgd for the entire County, 52 per cent of which is in the Western Shore drainage area. Population data for the County reported by the Maryland State Planning Department (1961) show an increase from 194,182 in 1950 to 357,395 in 1960. However, most of this gain occurred in the area supplied with surface water by the Washington Suburban Sanitary District system.

Abstracts of the various reports on ground water published by the Geological Survey of the U. S. Department of the Interior and by the Maryland Department of Geology, Mines and Water Resources are presented in Appendix H. These abstracts are as they appear in the published reports and are reproduced with permission of the two agencies. For more detailed information on ground water use, including data on many individual wells, the original reports should be consulted. Although some of these reports need up-dating in some of the details presented, they represent the most

complete summaries of information available on the ground water resources in Maryland. Each of the State publications covers one or more counties. For this reason, they do not lend themselves easily to the scheme of this report, based primarily on analysis of water supply and demand within the hydrologic units defined by surface drainage and runoff.

The latest published data on public water systems which use ground water from the Western Shore drainage area are in a report prepared by the Public Health Service (1964). The data in this report for Maryland, compiled in cooperation with the Maryland Department of Health, represent conditions as of January, 1962.

Appendix F contains a list of water users holding permits from the Department of Geology, Mines and Water Resources to take and use ground water. The law requiring such permits exempts several types of water users. Moreover, the law does not require permit-holding water users to report the amount of water actually used. Therefore, the list in Appendix F does not give any indication of the total amount of ground water withdrawn. Data are needed to show actual withdrawals for permit holders as well as for those not required to have permits.

WATER QUALITY

Water-Quality Criteria

A general discussion of water-quality criteria may be found in the General Reference Section - WATER QUALITY.

Water-Quality Problems - Natural

If the Chesapeake Bay were a fresh-water lake similar to the Great Lakes, the problem of water supply for withdrawal uses would be greatly simplified along the Western Shore. However, nature designed the bay as a brackish estuary with concentrations of sea salts varying from that of the ocean at the mouth of the bay in Virginia to undetectable concentrations in the headwaters of the many tidal arms of the bay, and at times of heavy runoff, in the extreme northern end of the bay itself.

Cumming (1916) conducted an extensive survey of water quality in the bay during February and March of 1914. A summary of his findings on chloride concentrations during February and March is as follows:

Table 17. Chloride Concentrations in the Chesapeake Bay and Tributaries during February and March, 1914

<u>Sample Location</u>	<u>Chloride Concentration ppm</u>
Hackett Point, Anne Arundel County	7,300
Baltimore Harbor between Ft. McHenry & Lazarette Point	5,950
Little Round Bay	7,250
Rhode River off Cadle Creek	6,400
Patuxent River	5,850
Sandy Point	7,250
Back River, mile point 6.5	1,800
Magothy River, mile point 5.0	6,500
Severn River, mile point 8.5	7,000
South River, Edgewater Branch	7,200
West River between Galesville & Cedar Point	6,050

The above data on chlorides represent a small part of the samples reported by Cumming (1916). They were selected for this report because they showed the chlorides in various tidal arms of Chesapeake Bay at the farthest inland stations sampled in that study. These data show the presence of sea salts in all of the Western Shore estuaries from Back River to the Patuxent River.

Since the investigation by Cumming (1916), many other studies of salinity distribution in the bay and its tributaries have been carried out. For additional data on this aspect of natural water quality, one may consult publications and reports by Cowles (1920, 1924), Wells, et al (1929), Truitt and Algire (1931), Schaefer (1931), Newcombe, et al (1939), Beaven (1946), Whaley and Hopkins (1952), Pritchard (1952), Carpenter (1960), and Stroup, et al (1961). According to Dobbin (1961), the U. S. Navy is studying sea-water characteristics in the bay. Many of the more recent publications of the Chesapeake Bay Institute emphasize the significance of Susquehanna River runoff to the salinity gradient. Runoff from tributaries to the bay (other than the Susquehanna which contributes an estimated 86% of the fresh water entering the bay above the Potomac River) does not influence the gradient to any great extent.

Although these tidal waters serve most of the instream uses, their brackish nature limits their usefulness for most withdrawal purposes. Their only extensive out-of-stream use is for cooling, primarily for condensing steam in several steam-electric generating plants (Federal Power Commission, 1962). Even one instream water use, fish production, has been detrimentally affected by salinity, according to Truitt and Algire (1931) and Schaefer (1931). During the very dry summer of 1930, fresh water inflow into the bay and its tributaries was so low that sea water intruded abnormally far into the tributaries. In the Magothy and Severn River, sea-water concentrations in the upper reaches, where the water was normally fresh or only slightly brackish, exceeded the tolerance levels of the resident fish species. This natural phenomenon resulted in the death of large numbers of fish.

Another problem related to natural salinity, discussed elsewhere in this report, is the permanent loss from fresh-water resources of sewage and industrial wastes discharged into the brackish tidal waters.

The presence of saline water in the estuaries of the Western Shore drainage area places a constraint upon the withdrawal of ground water from the aquifers near the shoreline because of the danger of sea-water intrusion. Such intrusion would accompany heavy pumping and lowering of fresh-water levels in those aquifers hydraulically connected with the estuaries. This possibility has become a reality in the Baltimore Harbor area.

Sea water, intruding up the bay and into the tidal tributaries each summer, brings with it an unwelcome visitor, the sea nettle. These pests, with their stinging barbs, literally drive bathers and water skiers from the water, thus severely damaging a valuable recreational use of the tidal waters.

Another aquatic pest, this one a weed of fairly recent introduction into the area, has gained a strong foothold in the bay and its tributaries. In some shallow parts of the estuary, this plant, Eurasian watermilfoil, grows so thickly that it blocks the passage of small boats. Some observations on the distribution of milfoil in Chesapeake Bay and methods of controlling it have been published elsewhere by Steenis et al (1962).

Another water-quality problem, apparently resulting from natural causes, is that of very low concentrations of DO (dissolved oxygen) in the deeper waters of the bay and its tributaries. Data collected by Newcombe et al (1939), the Chesapeake Bay Institute (1949), Garland (1952) and Carpenter and Cargo (1957) indicate that during each summer, oxygen concentrations are generally quite low in the bottom layers of water throughout the entire northern half of the bay. Although this condition may be aggravated by man-made wastes discharged into the bay or into its tributaries,

it is generally attributed primarily to natural causes, one of which is stratification of the bay water during the summer period (Olson, 1941). An article in a 1958 issue of the "Maryland Tidewater News" (Anonymous, 1958) describes this annual stratification in Chesapeake Bay with resultant depletion of dissolved oxygen at depths of 40 feet or more, limiting depths at which oysters can grow and in which crabs can remain during the summer season.

The relatively low concentrations of one impurity, fluoride, in the waters of the Western Shore drainage area are a water-quality "problem" in that these concentrations are lower than believed desirable in potable water for the prevention of dental caries (Public Health Service, 1962). The largest public water works in the area, that of Baltimore, corrects this deficiency by adding fluorides to the water taken from Gunpowder Falls and the Patapsco River. Hydro-fluosilicic acid is added to the water in sufficient quantities to bring the fluoride concentration up to 1.0 ppm (Baltimore Bureau of Water Supply, 1958). The Washington Suburban Sanitary District's water treatment plants also add a fluoride compound, sodium silicofluoride, to bring the fluoride concentration of the Patuxent River water up to 1.0 ppm (Washington Suburban Sanitary Commission, 1960). Many communities in the Western Shore drainage area add a fluoride compound to their potable supplies also.

Naturally caused ground water quality problems are generally not as serious as those of surface waters. According to McGuinness (1963), the ground water of the Piedmont is generally of good quality except that some of it is slightly corrosive, high in iron, or locally in areas of limestone or marble, excessively hard. In the Coastal Plain province, one of the most troublesome natural impurities found in ground water is iron. Bennett and Meyer (1952) report iron concentrations as high as 8 ppm in samples from wells ending in the pre-Cambrian crystalline rocks underlying the Coastal Plain sediments in the Baltimore industrial area. They found even higher concentrations in wells ending in the Patuxent and Patapsco Formation. In 22 samples

from Patuxent wells, iron ranged from 0.01 to 28 ppm, with an average of 5.0 ppm. In 11 samples from wells of the Patapsco Formation, iron concentrations ranged up to 14 ppm, with an average of 3.8 ppm. In three samples from wells taking water from the Pleistocene deposits, Bennett and Meyer found iron concentrations of from 0.03 to 14 ppm. The highest value for each formation is excessively high for many uses, especially for public water supplies. In its latest edition of "Drinking Water Standards," the Public Health Service (1962) recommends a maximum iron concentration of 0.3 mg/l (milligrams per liter, equivalent for all practical purposes to parts per million) for public water supplies. Many users of the ground waters of the Western Shore drainage area find it necessary to provide treatment for iron removal. A large number of individual household water systems include treatment units for this purpose. The supplying and servicing of such units is a thriving industry in the area.

Water-Quality Problems - Man-made

A general statement on this subject is found in the General Reference Section - WATER QUALITY. In the following narrative, specific water-quality problems resulting from unnatural causes are discussed for the various sub-basin areas of the Western Shore drainage basin.

Chesapeake Bay, Direct Drainage and Minor Tributaries Sub-basin (above Bush River) - Between the mouths of the Susquehanna and Bush Rivers, the Chesapeake Bay receives the drainage from a small area of Harford County. The area comprises roughly half of Election District Two. The population of the entire district was 23,236 in 1960. This included the population of Havre de Grace, which was 8,510. The latter town has tentative plans to construct a sewage treatment plant from which the effluent will be discharged into the bay a short distance south of the mouth of the Susquehanna River. The largest community in the area is Aberdeen, which had a 1960 population of 9,679. This town and the near-by Army Aberdeen Proving Grounds are the two principal sources of waste waters in this sub-basin. No water-quality problems are known for this area.

Bush River Sub-basin - The drainage area of the Bush River is entirely within Harford County. The Maryland Water Pollution Control Commission (1955) reported that no improvements were needed in industrial waste treatment facilities in 1955, indicating no significant water-quality problems related to industrial wastes at that time.

Bel Air, with a 1960 population of 4,300, is the largest town and the only incorporated community in the Bush River sub-basin. Edgewood, an unincorporated place, had a population of 1,670 in 1960. These two communities, along with the Edgewood Arsenal, are the major sources of wastes having sanitary significance in the sub-basin area.

Gunpowder Neck and Pooles Island - Between the Bush and Gunpowder Rivers, a short stretch of land on Gunpowder Neck in Harford County drains directly into the bay. In the center of the bay opposite Gunpowder Neck lies Pooles Island, also in Harford County. According to Cumming (1916), this island marks the uppermost part of the bay in which salinity is high enough to support productive oyster beds. Cumming noted that Pooles Island is only four miles from the upper mouth of Back River, seemingly suggesting that the oysters were subject to possible contamination by sewage from Baltimore Back River sewage disposal works. However, in discussing Back River contamination, he appeared to feel that the bay was affected by this disposal plant only in the "... immediate vicinity of the entrances to Back River."

Gunpowder River Sub-basin - As a source of water for the public supply of Baltimore, Gunpowder Falls, the major tributary of the Gunpowder River, is a subject of great importance and interest from the standpoint of water quality. Gunpowder Falls rises in York County, Pennsylvania, which contributes runoff from 11.1 square miles to this stream. No attempt has been made during this investigation to identify water-quality problems originating outside the State of Maryland.

Many of the water-quality problems existing or anticipated in the Gunpowder River sub-basin can be attributed to a phenomenal growth of population in the drainage area to the north and east of Baltimore City in Baltimore County. Although the city's population dropped slightly during the decade ending with 1960, Baltimore County increased in population from 270,273 in 1950 to 492,428 in 1960 (Maryland State Planning Department, 1961). Kaltenbach (1955) has described some of the problems, including those related to waste-water disposal, resulting from the rapid growth of this County. One of these problems results from the development of residential subdivisions in the drainage area above Loch Raven Dam. To protect the quality of water in the reservoir, the Department of Public Works of Baltimore County must provide sewerage to collect and treat the waste waters from these developments or convey them by means of pumping to the sewage system of the City of Baltimore. Kaltenbach noted that development was also taking place in areas beyond the reach of public sewers. Until recently, many such developments depended upon septic tanks for waste-water disposal. In some areas of rock or clay subgrades, the use of septic tanks has resulted in effluent overflowing to the ground surface, causing nuisance conditions and health hazards. The Department of Public Works has adopted the policy that it is better to construct public sewers and a small treatment plant for isolated housing developments than to permit septic tank construction.

The problem of household waste disposal in the Gunpowder River sub-basin has been discussed by Wolff and Whiteford (1958), who also noted the rapidly expanding population of Baltimore County. They observed that the reservoir watersheds in particular offer highly desirable locations for residential development. Much of this development has already taken place in the area draining into Loch Raven Reservoir, and they predicted similar development upstream on the Gunpowder Falls watershed above Prettyboy Dam. They stated that as a result of the high costs and

general dissatisfaction with septic tanks, widespread interest in sewers has been demonstrated by both property owners and developers in the area. Wolff and Whiteford observed that if sewerage systems are constructed in these watershed areas, the method of handling the effluent will become difficult as well as costly, partly because of the lack of flow for dilution purposes during minimum discharge periods downstream of the dams. This situation is attributable to the diversion by Baltimore of the dry-period runoff from the drainage area above Loch Raven Dam. No compensating flows are provided by the City for maintenance of minimum stream flows below the Gunpowder dams. Such compensating flows have been required elsewhere, for example, in the Patapsco River below Liberty Dam, and in the Delaware River below New York City's diversion projects.

Since its creation in 1947, the State's Water Pollution Control Commission has exerted its control efforts to prevent or correct industrial pollution problems in Gunpowder Falls, Little Gunpowder Falls, and their many tributaries. In a 1958 report issued by the Commission, Silbermann (1958) listed all known sources of industrial wastes in the area. The report describes waste treatment practices at each plant and notes occasional occurrences of pollution in the past. Generally, conditions were described as satisfactory in 1958. The report concluded that "... industrial water pollution problems of consequence do not now exist in the Gunpowder Falls drainage area." It also stated the Commission's belief that "... continued enforcement of an established policy and program of control which combines the determination to abate water pollution with reasonable standards to achieve such abatement, will make the possibility of additional pollution from new industrial locations most unlikely."

In 1962, the Water Pollution Control Commission issued a brief supplement (Silbermann, 1962) to the 1958 report. The supplement describes several instances of occasional pollution, one of which caused a fish kill in Merryman Branch which

drains into Baltimore's drinking water supply in Loch Raven Reservoir. According to the report, evidence indicated that the fish mortality had resulted from drainage of a toxic herbicide into the stream from a nearby truck farm. The supplemental report also noted that the wastes from an automatic car-washing establishment were being sampled and analyzed periodically as part of an extensive study of detergents and their effects on water quality. The wastes drain into Long Quarter Branch at stream mile 3.7 only 1.4 miles upstream of the head of the reach flooded by Loch Raven Reservoir.

Although the protection of the water supply of Baltimore remains an ever present problem of water-quality control in the Gunpowder River sub-basin, recent interest has developed in water-quality control downstream of Baltimore's intake. The primary reason for this interest is the need to provide and maintain water quality adequate for the protection of recreation and esthetic values of a proposed Gunpowder River Valley Park system, as described in a report issued by the Maryland State Planning Commission (1958). This system would include State parks in the Gunpowder Falls and Little Gunpowder Falls Valleys. Recognizing the possibility that residential developments in and near the park sites might preclude their development as recreational parks, the Maryland General Assembly (1962) passed a resolution early in 1962 requesting the State Planning Department to study the potential effect of housing developments on the planned parks. The Planning Department engaged consultants and the study was completed in late 1962. In the report of the study, prepared by Black and Veatch, Consulting Engineers (1962), the problems of waste-water collection and disposal for areas near the park sites were considered. Specific topics discussed in the report include future population, present water quality in the two streams, existing waste-water disposal practices, desirable water-quality objectives, methods of waste-water collection and treatment, and cost of works deemed necessary to protect water quality in the park areas.

The Black and Veatch report states that if the upland areas near the park sites are permitted to be developed with individual household septic tank systems, the results will not be satisfactory for either the residents or the park system. The consultants recommended instead long-range as well as interim plans for collection, treatment and disposal of the sewage in central or community works.

The long-range plan calls for interceptor sewers along Gunpowder Falls and Little Gunpowder Falls, with a sewage treatment plant located below the confluence of the two streams. The outfall sewer from the treatment plant would extend downstream and discharge into the Gunpowder River estuary below Piney Point.

An interim plan recommended by Black and Veatch calls for a series of small community sewage treatment plants of conventional design (primary and secondary treatment), followed by tertiary treatment to "polish" the effluent. Tertiary treatment would aim for a high-quality effluent suitable for discharge into the nearest stream during periods of minimum dilution. This scheme would be designed to protect the water quality of the streams for use in boating, fishing, and esthetic enjoyment. Swimming in the streams was not recommended, partly because of inadequate flow and partly because of water-quality consideration unrelated to sewage. The "tertiary-treatment" scheme would be a temporary measure to serve during the period before the interceptor plan becomes economically feasible through growth of the population to be served.

The report by Black and Veatch considered only the areas near the proposed State parks in the lower portions of the Gunpowder and Little Gunpowder drainage areas. It was emphasized that problems of waste-water disposal are not limited to these downstream areas. The report anticipated waste-water disposal difficulties and water-use conflicts farther upstream along both waterways.

The Baltimore Regional Planning Council (1959) has devised a scheme for relieving the lower reach of Gunpowder Falls of some of its potential sewage

load. Waste waters from the area south and west of Loch Raven Reservoir in the Gunpowder Falls sub-basin are now collected and pumped to the sewerage system of the City of Baltimore. It is planned that these wastes will eventually be conveyed by gravity to a pumping station about four miles downstream of Loch Raven Dam, where they will be pumped into the Whitemarsh-Stemmers Run System for delivery to Baltimore's Back River Sewage Disposal Plant. The report of Black and Veatch (1962) points out that much of the sewer construction called for in the Planning Council's plan would not be undertaken until 1970 or later, and therefore, it would still be possible to integrate this plan with the interceptor plan developed by Black and Veatch.

At present (1964), there are no known water-quality problems in the Gunpowder River estuary. The Charles P. Crane steam-electric generating station, with a capacity of 382 megawatts, discharges 478 mgd of heated condenser cooling water into Saltpeter Creek. This creek flows into the Gunpowder River at a point 2.5 miles above its mouth. The water used in this once-through system is taken from Seneca Creek, a small tidal stream south of the Gunpowder River. There are no reports of detrimental effects resulting from this discharge of waste heat, either in Saltpeter Creek or in the Gunpowder River. Data on water quality in the estuary are available from the Chesapeake Bay Institute of The Johns Hopkins University, which maintains more or less continuous surveillance of the physical and chemical characteristics of the Bay and its tidal tributaries.

Middle River - The Middle River estuary and its drainage area are entirely within Baltimore County. The drainage area lies east of Baltimore City in the County's Election District Number 15. This district is thickly populated, having grown from a 1950 population of 64,178 to 94,283 in 1960. The Middle River estuary is the site of several marinas and yacht clubs. The estuary and its tributaries, Darkhead Creek, Cow Pen Creek, and Frog Mortar Creek receive waste waters

from industrial sewers of the Martin Company. The most recent report of the Maryland Water Pollution Control Commission (1955) for this area is almost 10 years old, so the conditions described in that document are probably not representative of 1964 conditions. According to the report, improvements were needed in waste treatment practices at the Martin Company in 1955, to protect the extensive use of the estuary for fishing, boating, and swimming.

Back River - Back River is a tidal arm of Chesapeake Bay in Baltimore County east of the City of Baltimore. Its 62 square mile drainage area includes, in addition to a small portion of the County, the northeastern corner of Baltimore City. Herring Run, the largest fresh-water tributary, rises in the Towson area north of the city, flows across the northern boundary of the city, and then across the eastern boundary back into the County.

The portion of the Back River drainage area within Baltimore City is sewered, as is the portion in Baltimore County to the north of the city. Also sewered are the important areas of Essex and Middle River to the northeast of Back River, Edgemere to the southwest, and parts of Rosedale, Colgate and Fullerton to the northwest. Out of a total drainage-area population of approximately 298,000, more than 280,000 are serviced by public sewers (105,700 in Baltimore County and 175,400 in Baltimore City).

Baltimore City's major sewage treatment plant is located 7.0 miles upstream from the mouth of Back River and serves an estimated 1.7 million persons plus several hundred commercial and industrial establishments. Until 1942, the Back River estuary received the entire effluent from the treatment plant. Although the wastes were treated to a relatively high degree in the well-operated plant, the residual waste load, which increased from year to year as Baltimore grew, had a polluting effect on the tidal river. This river, with its small drainage area and small tidal range, receives relatively little flushing action. Consequently,

there have been numerous complaints from year-round residents and summer-cottage dwellers near the estuary. The City of Baltimore has been the defendant in numerous court actions brought about by these residents.

According to Cumming (1916), the Back River sewage disposal plant with discharge of the effluent into Back River was part of a general plan to relieve the Papapsco River and Baltimore Harbor of part of its pollution load by discharging the effluent elsewhere. Ironically, recent investigations by the Department of Sanitary Engineering and Water Resources (Garland, 1952) and the Chesapeake Bay Institute (Stroup et al, 1961), both divisions of The Johns Hopkins University, have indicated that Baltimore Harbor has a far greater capacity to assimilate wastes than Back River.

Fortunately, since 1942 the City of Baltimore has sold increasing quantities of the effluent from the Back River treatment plant to the Bethlehem Steel Company for industrial use at its Sparrows Point mills. This effluent reuse increased from an average of 24 mgd in 1943 to 113 mgd in 1963. Some years ago, an employee of the Research Department of the steel company predicted that at the present rate of expansion, Sparrows Point would be using 150 mgd of effluent before 1965 (Shingledecker, 1957). This practice has provided a much-needed water supply to the steel mills and has produced a substantial amount of revenue to the city. As Keefer (1956) has observed, a further advantage has been a great reduction of the organic load discharged into Back River.

Programmed improvements in the Back River sewage treatment plant over the past several years have resulted in improved effluent quality. The plant is operating within its capacity of 170 million gallons per day. Planned future development of the treatment facilities will handle the expected increased load from Baltimore County (Public Health Service, 1964).

Because of its proximity to the Baltimore Metropolitan Area as well as the access it provides to the Chesapeake Bay, Back River attracts a large number

of recreationists, particularly boating enthusiasts. At the same time, Back River, as previously indicated, is used for waste assimilation and transport which has somewhat limited its recreational value. Conflicts in use of the water (and the surrounding land area for residences) have increased in recent years to the point that Congressman Clarence Long (Baltimore County) in October, 1963, requested the Public Health Service to conduct a special study of pollution problems in Back River. The Public Health Service published its findings in January, 1964, which were, for the most part, a summary of previous water-quality investigations by cooperating State and local agencies.

The report indicated that a major factor contributing to pollution problems in the river was the lack of public sewerage and the failure of numerous individual septic tank systems. Although apparently designed for weekend and summer use, nearly 5,000 private residences bordering the river are inhabited year-round. Septic systems are being used by these residences in an area where the soil is generally unsuitable for absorption, resulting in sewage being discharged to the river by way of ditches, gullies and storm drains.

Although the need for public sewerage is recognized, difficulty arises in financing a project where such facilities must be self-supporting (as required in Baltimore County) and the area to be sewered has a low population density. The low density of the project area would necessitate a high and perhaps prohibitive cost per household for sewerage at this time and under the present financing arrangements.

Investigations of the Water Pollution Control Commission (now the Department of Water Resources) reported in the Public Health Service publication indicate that industrial waste discharges do not create a major pollution problem in Back River. No serious adverse conditions caused by industrial waste water have been detected in the past few years although there have been several complaints made in reference to discharges of oil.

The Public Health Service report does not attempt to evaluate the effluent discharged from the Back River sewage treatment plant. Data in the report does suggest, however, that even with very efficient treatment including chlorination, the residual waste loading into the stream (40 mgd) could be a major pollution factor. Coliform bacteria counts taken at the point of effluent discharge during the period May, 1962 through September, 1963 were as high as 110,000 (MPN/100 ml). Because of the lack of information concerning water movement within the estuary, the Public Health Service in its report was not in a position to implicate either this source of pollution or any of the others as the major contributor to poor water quality. During the summer of 1965, the Public Health Service will undertake tidal-movement and water-quality studies in the Back River sub-basin.

Patapsco River Sub-basin - Since 1953, Baltimore has used the North Branch Patapsco River as a source of water supply with the result that more attention has been focused on pollution problems above the intake at Liberty Reservoir. At the same time, the problem of controlling water quality in the Patapsco River downstream of Liberty Dam has been aggravated by the reduction of waste-diluting streamflows during periods of dry weather.

Concern over water quality in the lower Patapsco Valley preceded the construction of Liberty Dam. In a report prepared by a technical committee of the Patapsco River Valley Commission (1946), it was stated that the heavily polluted character of the river was one of the most serious deterrents to the comprehensive use of the lower Patapsco Valley for recreation. According to the committee, this was particularly true of the section downstream of Relay. However, the committee pointed out that projects then being planned (in 1946) would eliminate practically all of the pollution. The technical committee reported that elimination of pollution from municipal and industrial sources would not make the river safe for swimming because storm runoff from thickly populated areas would cause periodic pollution to a certain degree. According to the committee, such pollution

could not be eliminated. It was also stated that heavy turbidity from natural causes beyond public control made the river esthetically undesirable for bathing. As an alternative to swimming in the river, the committee suggested that swimming be restricted to regular swimming pools equipped with chlorination and re-circulation systems.

The Maryland Water Pollution Control Commission (1955) described most of the sources of industrial wastes in the Patapsco River sub-basin. Several of these sources, according to the Commission's report, were in need of improvements to avoid nuisance conditions and stream pollution, especially in the reach flowing through the Patapsco State Park.

In a later report, the Maryland Water Pollution Commission (1957) presented data on stream water quality collected from stations along a 32-mile stretch of the Patapsco River below Gaither Road Bridge.

Baltimore Harbor - In 1947, the Maryland Department of Research and Education requested the Department of Sanitary Engineering and Water Resources of The Johns Hopkins University to carry out a comprehensive investigation of water quality in Baltimore Harbor. Beginning in 1947, an extensive program of collecting and analyzing water samples was carried out until 1950. Other climatological, hydrological, bacteriological, biological, economic, and engineering data were also obtained from 1947 until 1951. During this period, several interim reports by Pohmer (1948), Garland (1949, 1950), Hull (1950), and Weiss (1950) recorded various findings of the study. (See also an Anonymous (1950) report which appeared in "The Vector" a magazine issued by the School of Engineering Sciences of The Johns Hopkins University.)

The final report of the Baltimore Harbor study by Garland (1952) indicated that industries discharged several tons of acid materials daily into the harbor. He found that the quality of water in Curtis Bay, Colgate Creek, and the

mouth of Bear Creek failed to meet specifications desirable for some industrial use and even for navigation. Degraded conditions in limited peripheral sections of the harbor were attributed to waste loads which exceeded local assimilative capacity. The relatively low waste-assimilative capacities of these peripheral areas were a result of the general lack of water exchange between these areas and the main sections of the harbor. Garland concluded that the Patapsco River estuary had the capacity to assimilate greater loads of acid wastes and organic matter than were then being discharged. He suggested that the existing undesirable conditions in localized tributary sections of the estuary could be improved by transferring waste loads from these sections to the principal fairway, where the assimilative capacity was greater, or by abating local waste discharges.

Although Garland noted that degradation of water quality in the fairways of the harbor was less extensive than in the peripheral areas, he found by comparing his data with data collected in 1906, as reported by the Baltimore Sewerage Commission (1906), that the long-term trend of water quality in the fairways was downward.

Garland (1952) also presented data indicating a total sediment load of more than 750,000 cubic yards per year being discharged into the harbor from its tributaries. He observed that the suspended solids in municipal and industrial wastes being discharged into the harbor would represent only a small increment of the total cost for sediment removal to maintain channel depths.

Although oil is organic matter in the chemical sense, some of its pollutional effects are unlike the usual effects of an organic pollutant. Garland reported that oil pollution was a constant source of difficulty in the harbor, producing unpleasant grease balls and slicks, and creating fire hazards by accumulating on water-front timber structures. (Oil pollution was still evident in the harbor as recently as 1961. A small research vessel belonging to the

Department of Sanitary Engineering and Water Resources of The Johns Hopkins University, berthed at a marina in the Middle Branch during the winter of 1960-1961, had to be cleaned frequently to remove heavy accumulations of oil and grease from the hull.)

According to Garland (1952), water uses which were being detrimentally affected by acid pollution included navigation and industrial cooling. The concern was primarily the result of excessive corrosion in vessels and shore facilities in Curtis Bay, and in other fixed installations adjacent to other peripheral areas of the harbor. Recreational and esthetic values of the harbor were also lowered by unpleasant physical conditions resulting from oil slicks, floating trash, and discoloration of the water caused by waste iron sulfate and silt. Garland noted that fishing and crabbing in the harbor, formerly a popular pastime among local residents, had virtually come to a stop. He suggested that this resulted from waste discharges.

Garland did not attempt to place a monetary value on the damages caused by pollution of the peripheral waters of the harbor. However, he pointed out that several industrial plants using acid water from the harbor would have to neutralize these waters. He observed that the cost of such treatment and the cost of replacing corroded cooling systems represented economic damage directly attributable to water pollution. On the other hand, Garland noted that the public and private benefits accruing from use of the harbor for waste disposal had a monetary value of several hundreds of thousands of dollars every year.

Garland (1952) found no indication that waste disposal as then practiced in the estuary had any significant effect on water quality in Chesapeake Bay.

Since the investigation reported by Garland, other studies of pollution and waste assimilative capacity of the Patapsco River Estuary have been carried out. Of particular note are the following: Boyd and Watson (1955) - discharge of ceramic-material wastes; Hydrotechnic Corporation (1959, 1960)-disposal of waste pickle liquor; Warner (1960)-disposal of titanium oxide wastes.

Carpenter (1960a, 1960b) and Stroup, et al (1961) have described intensive studies of Baltimore Harbor by the Chesapeake Bay Institute. Using advanced techniques of sampling and analysis, these investigators showed that the flushing rate of the harbor is much greater than had previously been thought. They found that about 10 per cent of the harbor water is renewed daily by exchange of water with Chesapeake Bay. An unusual three-layer estuarine circulation pattern was discovered in which the surface and bottom water layers move into the harbor from the Bay while a compensating movement of the middle layer is in the opposite direction.

Magothy River Sub-basin - Situated entirely within Election District Three of Anne Arundel County, the Magothy River sub-basin is a rapidly developing residential area, part of the Baltimore metropolitan district. Still semi-rural in nature, this sub-basin of the Western Shore drainage system has no incorporated towns. The 1960 population of Election District Three was 58, 992, almost eight times the 1930 population and more than double the 1950 number.

The Magothy River is a broad estuary used primarily for recreation, including bathing, water skiing, fishing, and boating. The Gibson Island Yacht Squadron near the mouth of the river is an important focal point for sailboat enthusiasts. Another yachting base, that of the Potapskut Sailing Association, is located on Black Hole Creek, a tributary of the Magothy. Forked Creek, another tributary, is the home port of the Belvedere Yacht Club. In addition to these yachting centers, several marinas, yacht-repair facilities, boat-rental agencies, and boat-launching ramps are listed by Matthews (1963).

There are no major waste discharges into the Magothy River. Cumming (1916) considered the possibility that sewage-polluted water from Baltimore Harbor was deflected into the Magothy by the shoreline extending eastward to Sandy Point just below the mouth of the Magothy. He concluded that there was some possibility for movement of water from the dredged Baltimore ship channel opposite the river

mouth toward the mouth, but the opportunity for dilution of Baltimore Harbor water with Bay water before any of the former could enter the river was very great. Cumming observed that B.coli concentrations inside the river were a little higher than outside the river, but showed no dangerous pollution. He indicated that Baltimore Harbor water "... does somewhat effect the chemical contents in the bight above Sandy Point, off the entrance to Magothy ...." This does not agree with the more recent statement by Garland (1952) that "there is no indication that waste disposal as normally practiced in the area (Baltimore Harbor) has any significant effect on water quality in Chesapeake Bay outside Baltimore Harbor."

The physical and chemical hydrography of the Magothy River estuary has been studied recently by the Chesapeake Bay Institute, as reported by Pritchard and Bunce (1959). They found that salinity differences between the water in the Magothy and that of the bay was an effective factor in flushing the Magothy. Based on normal tidal movements, they found that 50 per cent of the water in the Magothy would be replaced by bay water in from 22 to 32 days. However, salinity distribution in the river indicated that 50-per cent replacement was accomplished in 6 to 8 days. These data on flushing characteristics of the Magothy serve in assessing the capacity of the estuary to receive and assimilate wastes.

The rapidly growing population of the Magothy sub-basin is served largely by private wells and septic tanks. With the trend toward urbanization, these individual water-supply and sewage-disposal systems have created nuisances and health hazards. As a result, the Anne Arundel County Sanitary Commission has been forced to consider public sewerage for the area. In a report prepared for the Sanitary Commission, the consulting engineering firm of Rummel, Klepper and Kahl (1962) presented plans for collection and treatment of sanitary sewage from a larger area in the northern part of the county which includes all of the Magothy sub-basin. The plans call for two ultimate sewerage systems, one north and the

other south of the Magothy River. The north system, called the Mountain Road System, would serve an area of 34 square miles and would be designed for a population of 70,000. The south system, designated the Broad Neck System, would serve an area of 65 square miles and would be designed for a population of 115,300. The design populations are those estimated for the year 2000.

The Mountain Road System would collect the sewage from the area between the Patapsco and Magothy Rivers, convey it by gravity and pumping to a sewage treatment plant on the shore of Chesapeake Bay south of the Patapsco near Pinehurst, and discharge the effluent offshore into the Bay.

The Broad Neck System would collect the waste waters from the upper Severn River watershed and from the Broad Neck peninsula between the Magothy and Severn Rivers for treatment and disposal into Chesapeake Bay just northeast of Sandy Point.

The per capita sewage flows used by the consultants for design of the Mountain Road and Broad Neck Systems were 100 gallons per day. With an assumed tributary population of 70,000 and an allowance for infiltration of 25 gallons per capita daily, the Mountain Road System would be sized for a sewage flow of 8.8 mgd. The Broad Neck System, with a design population of 115,000 and the same infiltration factor, would call for a treatment plant to handle flow of 14.4 mgd.

Rummel et al (1962) pointed out that long before the population of the area justified the ultimate sewage systems discharging into the Bay, there will be sewage disposal problems requiring prompt answers. Local problems already exist in the Severna Park, Pasadena and Elvaton areas where the Maryland State Department of Health has found it necessary to restrict the number and location of new residential developments. To solve the immediate problems, the consultants to the Anne Arundel County Commission recommended a two-phase interim scheme for sewage disposal. The first phase, recommended for construction in the immediate future, would include a high-level interceptor along Ritchie Highway, a pumping station at Cypress Creek, an "interim treatment plant" in the Jones Station area on Broad Neck

and an outfall from the treatment plant discharging into the middle of Round Bay in the Severn River. Also recommended for early construction is an interceptor following the South Branch of Cattail Creek, a tributary of the Magothy River; a pumping station at Cattail Creek; and a force main to the Ritchie Highway interceptor. The first phase, designed to serve a population of 12,000, would be completed by 1965.

The second phase of the interim scheme would extend the phase-one system into the Upper Magothy District and serve Pasadena and Elvaton. Phase two would include an Elvaton interceptor; a pumping station at Pasadena and a force main; and an interceptor along the north branch of Cattail Creek. The phase-two additions, scheduled for construction between 1965 and 1975, will increase the population served by the interim system to an estimated total of 25,000.

Although most of the area to be served by the interim system is in the Magothy River drainage area, Rummel et al recommended that the effluent be discharged into the Severn River. The Severn was thought to be better than the Magothy as a receptacle for the treated effluent because of greater drainage area and volume of stream runoff; greater tidal exchange; greater depth; and greater surface area. Comparison of these factors for the two locations studied is shown in Table 18.

In analyzing the potential effects of discharging the treated sewage into the Magothy or Severn River, Renn (1962) calculated that the sewered population of 25,000, as assumed by Rummel et al (1962), would result in a raw waste load of 4,250 pounds of BOD per day as measured for five days at 20° Centigrade. Assuming 90 per cent treatment efficiency in the proposed sewage disposal plant, Renn estimated the BOD load in the effluent to be 425 pounds of 5-day, 20°C BOD, with a concentration of about 25 ppm (parts per million) in the effluent before mixing with the river water. He calculated that mixing the effluent with two local intertidal volumes of water per day would reduce the concentration in the Magothy near the outfall site to about 6.7 ppm. Similar calculations for the Severn River showed po-

tential BOD concentrations near the Round Bay outfall site of less than 1.0 ppm. Renn pointed out that the water in the outfall area would be constantly changing, and therefore the BOD concentrations would be decreased further by dispersion throughout a larger area.

Table 18. Comparison of the Magothy and Severn Rivers as Receiving Stream for Sewage Effluent

<u>Factor</u>	<u>Magothy River (near Crystal Beach)</u>	<u>Severn River (Round Bay)</u>
Drainage area:		
Total	31 sq. miles	50.0 sq. miles
Above site	23 sq. miles	39.4 sq. miles
Runoff:*		
Mean	15.4 mgd	26.4 mgd
Lower 5 percentile:	6.1 mgd	10.5 mgd
Tidal exchange ratio:**	0.028	0.068
Local tidal prism:	3.7 mg	30.0 mg
Mean depth at outfall	17.0 feet	23.0 feet

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* Estimated on basis of streamflow records for North River.

** Based on method of Ketchum (1951).

Renn (1962) suggested that the discharge of sewage effluent into the Magothy River would be more likely to promote the growth of attached water weeds such as water milfoil, *Myriophyllum spicatum*, than into the Severn River. He reasoned that the Severn is deeper with steeper shores, making the Severn a less favorable river for plant life.

Rummel et al (1962) presented Renn's arguments to support their choice of the Severn River as an "interim" receptacle of the sewage from the Magothy River drainage area.

In their report, Rummel et al (1962) qualified their findings by pointing

out their theoretical studies were open to question, and that the only reliable method of determining the total assimilative capacity of a tidal water body is by a field study of temperatures, densities, currents, and other characteristics of the body itself. They suggested that the Chesapeake Bay Institute, with its previously assembled data, developed techniques, and specialized knowledge, was the logical choice to make such an investigation.

The Chesapeake Bay Institute has recently reported the results of a study of the dispersion characteristics of the Magothy River, and also the Severn River and the Chesapeake Bay off Sandy Point. This study was carried out for the Maryland Department of Health and the Natural Resources Institute of the University of Maryland. As reported by Pritchard and Carpenter (1964), the study was based primarily on the use of a tracer dye released continuously at potential outfall sites in the Magothy, in the middle of Round Bay in the Severn River, and 530 yards north-northeast of Sandy Point Light House in Chesapeake Bay. This study indicated that the discharge of 2.6 millions of gallons daily of sewage effluent from a secondary (biological) treatment plant would result in phosphate nutrient concentrations of from 125 per cent to 150 per cent of natural concentrations throughout a significant portion of the Magothy River. Pritchard and Carpenter stated that the environmental effect of an increase of nutrients in this range cannot be predicted with any confidence.

In a comparison of the three sites studied, Pritchard and Carpenter found the Magothy River to have better dispersion characteristics than the Severn, but not nearly as good as the bay near Sandy Point. The dye studies indicated that risks to health of swimmers resulting from a discharge of 2.6 mgd into the Magothy would be less than from the same discharge into Round Bay. These results contradict the preliminary findings of Rummel, Klepper, and Kahl (1962), and confirm their judgement that theoretical studies of estuarine characteristics are unreliable.

West Chesapeake Shore Between Magothy and Severn Rivers - There are no

large centers of population along the western shore of the Chesapeake Bay between the mouths of the Magothy River and the Severn River. The Sandy Point State Park, just north of the western end of the Chesapeake Bay Bridge, includes a bathing beach which requires maintenance of the sanitary and esthetic quality of the Bay waters in its vicinity. The area is an important source of crabs, oysters, and soft-shelled clams. Fin fish are also taken in large numbers by both commercial and sport fishermen. Many pleasure boats, powered by wind or motor, cruise and race in this portion of the Bay. Ships approaching and leaving Baltimore Harbor hug the western shore of the Bay north of the Bay Bridge.

There are no known major sources of pollution on the shore of the Bay in this area. The passing ships legally discharge untreated sewage not far from the bathing beach at Sandy Point and at least equally near some of the shellfishing grounds. Also, in spite of laws and regulations to the contrary, ships have been known to discharge waste oil along with bilge water. Such oil persists as a surface film for long periods and on occasion has been washed ashore to foul the beach at Sandy Point. The floating oil has also fouled the hulls of pleasure boats in the area. Oil eventually becomes dispersed or dissolved in the Bay waters or absorbed on suspended particles which sink to the bottom. When these conditions occur, the finfish and shellfish, if not harmed, are sometimes tainted, which lowers their market value or destroys it altogether.

The pleasure craft and commercial fishing boats are also sources of pollution. The larger ones are usually equipped with toilets which are flushed into the waters of the Bay. Although the total pollution load from these craft is small, it has significance as a health hazard because these shallow draft vessels can and do pass directly over shellfish beds and quite near the beach at Sandy Point.

The threat to shellfish from pollution is an important consideration in

this portion of Chesapeake Bay as well as in seaward portions. At a recent (1963) meeting of the Chesapeake Bay Section of the Atlantic States Marine Fisheries Commission, Salley (1963) of the U. S. Public Health Service reviewed the Shellfish Sanitation Program in the Chesapeake Region, which includes the entire Bay and its tidal tributaries. As recorded in the minutes of the meeting:

He reported that the major problems of the past year had arisen from the transporting of shellfish from the Gulf states into the Chesapeake Bay area. Members of the PHS (Public Health Service) have met with local health authorities of the Gulf states and received assurances of tighter local control over exports. Mr. Salley reported that the PHS would conduct bacteriological studies on lots of oysters traced from the Gulf through the Chesapeake area and into the midwest. This will be done with the cooperation of the local health authorities.

The Charlotte (Virginia) office of the PHS is completing an evaluation of shellfish sanitation practices in the Chesapeake area and has found practices, with the exception of bacteriological studies, to be excellent in the region.

In view of the major importance of bacteriological studies in any shellfish sanitation program, Salley's exclusion of this item from the practices described as excellent indicates faint praise for the program. It should be emphasized that Salley's remarks were not aimed specifically at the Sandy Point area of the Chesapeake Bay, but generally at the entire shellfish-producing area of the bay.

Although ships and boats are the primary sources of sewage pollution which constitutes a potential hazard to water uses in the Sandy Point area at present (1965), land sources will probably overshadow these floating sources at some indeterminate time in the future. For example, Rummel, Klepper, and Kahl (1962) have proposed a sewage treatment plant to be located near Sandy Point and which would discharge treated sewage into the Bay offshore northeast of Sandy Point. These facilities would be part of the so-called Broad Neck System designed to serve an area of 64.6 square miles in the Magothy and Severn River watersheds and the eastern end of Broad Neck. This area is expected to have a population of about 115,000 by the year 2000.

By means of a modern tracer technique, the Chesapeake Bay Institute has studied the dispersion of a contaminant introduced into the Bay at a location approximating the site of the sewage outfall for the Broad Neck System proposed by Rummel et al (1962). In a report of the dispersion study, Pritchard and Carpenter (1964) pointed out that tidal currents in this area of the Bay are quite strong, exceeding 3 knots on the ebb current and up to 2 knots on the flood. They found the dispersion characteristics to be very good in the Bay, less critical by an order of magnitude than either the Magothy River or the Severn River. Pritchard and Carpenter concluded that the risks to the recreational use of the Sandy Point shore from a discharge of treated sewage into the adjacent Bay are small compared to the corresponding risks along the shores of the Magothy River and of Round Bay in the Severn River from discharges into these water bodies.

Severn River Sub-basin - The drainage area of the Severn River, like that of the Magothy River, is entirely within Anne Arundel County. The only incorporated place in the Severn River sub-basin is Annapolis, which grew in population from 10,047 in 1950 to 23,385 in 1960. Parts of Election Districts 2, 3, and 4, and all of District 6 are in the sub-basin. These Districts had a 1960 combined population of 138,409, a 70% increase over the 1950 population of 57,263. As was the case in the Magothy River sub-basin, rapid population growth in the Severn drainage area has resulted in problems of waste-water disposal and water-quality control.

The interim plan proposed by Rummel, Klepper, and Kahl (1962) for collection of sewage from the area north of the Severn River, mostly within the Magothy River drainage area, treatment of the sewage, and disposal of the effluent in Round Bay on the Severn River has been described briefly in the discussion of the Magothy River sub-basin. As previously explained, Rummel et al chose the Severn for interim disposal because it was believed to have a greater waste-

assimilative capacity than the Magothy. Pritchard and Carpenter (1964) have since shown the reverse to be true.

Like the Magothy River, the Severn River is heavily used for all forms of water recreation, even more so than the Magothy. The City of Annapolis, near the mouth of the Severn, is the largest center of pleasure boating in the Chesapeake Bay area. The broad mouth of the Severn is the scene of frequent sailboat races. Large yachts travel up the river beyond the upper end of Round Bay, and smaller craft navigate up to the mouth of Severn Run. The larger vessels are equipped with toilet facilities, and thus are transient sources of contamination in the river. No withdrawal uses are affected by such contamination. The degree of hazard to the health of instream water users, such as bathers and water skiers, from yacht sewage is unknown. The safe disposal of sewage from pleasure boats is a matter of considerable concern among health authorities generally, but, so far, little concrete effort has been made to evaluate or correct the problem.

The Maryland State Board of Health (1951) has established bacterial standards for bathing waters. The Board holds that the bacterial quality of water at natural bathing beaches is acceptable when the water shows an average MPN (most probable number) of coliform bacteria not in excess of 1,000 per 100 milliliters in any one month during the bathing season. Rummel et al (1962) presented data on bacterial water quality at four cross sections between the upstream and downstream limits of Round Bay. During the period from July 24 through August 14, 1961, all four sections showed average "most probable numbers" of coliforms exceeding the acceptable standard for bathing waters. This indicates that from a bacteriological standpoint, the waste-assimilative capacity of the Severn River has been exceeded, if the use of the river for immersion sports is considered.

The protection of shellfish beds in the Severn River against contamination has been an important consideration for many years. Cumming (1916) investigated the sanitary quality of the river in relation to shellfish in 1914. At that time, Cumming found "... extensive and valuable oyster beds in Round Bay, at the head of the Severn River, and along the shoals of the River and Creeks all the way down to and in Chesapeake Bay." In the lower portion of the river, in the vicinity of Annapolis, he found the water polluted by raw sewage and recommended that the taking of shellfish for consumption be prohibited in the area from the railroad bridge above Annapolis to a line between Greenbury Point and the mouth of Lake Ogleton.

That shellfish sanitation remains a problem is evidenced by the 1960 Annual Report of the Division of Food Control of the Maryland State Department of Health (1960), which stated that the lower Severn River estuary was closed to shellfishing because of pollution from Annapolis and from the Severn River Naval Command.

The two principal sources of raw sewage at the time of Cumming's survey were the City of Annapolis and the United States Naval Academy. These and most of the onshore sources have long since been corrected, with treatment provided. At present, there are no known outfalls discharging untreated sewage into the Severn River from land sources. However, very large yachts and U. S. Navy vessels are based in or visit the river and Annapolis Harbor regularly. The naval vessels include barrack ships for station personnel at the Navy Academy, and visiting ships as large as destroyers. Each of the barracks ships and the larger visiting ships normally have several hundred crew members on board. The sewage from these vessels is discharged without any treatment into the river waters. The same is true of the yachts frequenting the river and harbor. Under present (1965) conditions, sewage from boats and ships is probably the most serious water-quality problem in the Severn River and its tidal tributaries.

If the plan to collect sewage from the Magothy and Severn River drainage areas, treat it, and dump it into Round Bay, as proposed by Rummel et al (1962), is carried out, this will undoubtedly degrade the Severn River as a recreational area. Even if it is assumed that perfect operation of the waste treatment plant will be attained - and this is seldom the case - the treated effluent will add plant nutrients to the river water, thus encouraging the growth of algae. A limited amount of such fertilization is harmless, and perhaps even beneficial. However, if heavy growths of algae occur in Round Bay, the water will lose some of its esthetic appeal to recreationists and shore residents. Moreover, it cannot be denied that the discharge of sewage into waters used for recreation, no matter how well the sewage is treated or how safe from a health standpoint, has an unfavorable psychological impact upon would-be recreationists which lowers the value of the water and shorefront property for recreational uses. This lowered value is a cost to society which should be considered in evaluation of the interim plan proposed by Rummel, Klepper, and Kahl (1962).

West Chesapeake Shore Between Severn and South Rivers - Between the mouth of the Severn River at Chinks Point and the mouth of the South River at Marshy Point, a small area drains into the Chesapeake Bay directly and through several tidal tributaries. These tributaries include Lake Ogleton, Blackwalnut Creek, Cyster Creek, and Fishing Creek. The number of beach resorts reflects the shallow, gently sloping bed of the Bay along this section of the shoreline, making the area ideal for bathing.

There is one significant waste discharge along this portion of the western shoreline of Chesapeake Bay. A sewage disposal plant serving the City of Annapolis discharges its treated effluent into the Bay a short distance below Chinks Point, between the communities of Bembe Beach and Elktonia. The various communities in the area depend upon septic tanks for sewage disposal and do not discharge wastes into surface waters.

Like other areas along the shores of the Bay, this area is exposed to the hazards of contamination from boats and ships. Generally, however, the waters in this part of the Bay are of good sanitary quality. Safeguards against contamination of oysters and clams are needed.

South River Sub-basin - The South River, with a drainage area of 66.1 square miles, forms one of the many indentations of the Western shoreline of Chesapeake Bay. Located entirely within Anne Arundel County, the drainage area is shared by Election Districts 1 and 2 having a 1960 combined population of 24,400. There are no incorporated towns in the South River sub-basin. There are many summer-resort communities along the shores of the South River estuary. The year-round populations of these resorts are low, but swell considerably every summer. Both the year-round residents and summer visitors are served by septic tanks for waste-water disposal.

There are no known land sources of wastes discharged into the river directly. The Crownsville State Hospital discharges treated sewage into a small unnamed tributary of Bacon Ridge Branch, which joins the North River to form the head of the South River. According to the Public Health Service (1958), the Crownsville Hospital provides primary and secondary treatment of its effluent.

The South River estuary is navigable for large yachts and is therefore subjected to untreated sewage from these craft, some of which are based in the river, and many of which visit from other areas. These mobile sources of sewage area threat to bathers and shellfish in the area.

West Chesapeake Shore Between South River and Patuxent River - The area draining into the Chesapeake Bay between the South River and the Patuxent

River includes the southeastern portion of Anne Arundel County and the eastern part of Calvert County. To the west of this drainage area in both counties lies the Patuxent River sub-basin.

The most prominent hydrographic features of the area are the Rhode River, the West River, and Herring Bay. The upstream limit of this sub-basin, Saunders Point at the mouth of the South River, is 137 miles above the mouth of Chesapeake Bay. The southern limit of the area, Drum Point at the mouth of the Patuxent River, is 95.6 miles above the mouth of the Bay. Thus, this area covers a distance of about 41 miles measured along the north-south axis of the Bay.

All of Election District 7 and parts of Election Districts 1 and 8 in Anne Arundel County are in the area between the South and Patuxent Rivers. Parts of Election Districts 1, 2 and 3 in Calvert County are also in this intervening area. The 1960 population of these 6 districts was 30,292, a 65 per cent increase over 1950. Chesapeake Beach and North Beach, having a combined population of 1,337 in 1960, are the only incorporated places in this sub-basin.

The shoreline of this portion of the Bay is dotted with bathing beaches and summer camps, both of which greatly increase the population of the area every summer.

There is only one known outfall discharging sewage in this sub-basin. The town of North Beach, just south of the northern boundary of Calvert County at Chesapeake Bay mile 124.0, discharges about 0.2 mgd of municipal sewage into the Bay. According to Loveless (1960), the summer population ranges up to 5,000, mostly visitors from the Washington area. The problem of sewage treatment arose in the 1930's and became acute after 1945. Numerous complaints regarding poor performance of septic tanks from residents and local health officials eventually led to directives from the State Board of Health to install sewerage. Because of difficulties in financing the project, it was not constructed until the late 50's. According to

Loveless, there were 322 houses and businesses connected to the system as of June, 1960. He estimated that a maximum of about 475 houses and 35 businesses were possible. A "package" sewage disposal plant was installed as part of the sewerage system.

Waste waters from processing of titanium ore are discharged at two locations along the Calvert County shoreline of the Bay. One of these is at Chesapeake Bay mile 101.2 and the other is at mile 99.9. No detrimental effects attributable to these wastes have been reported.

Patuxent River Sub-basin - The Patuxent River system drains an area of 932 square miles. Its drainage area, the largest of the sub-basin areas of the Western Shore basin between the Susquehanna and Potomac Rivers, includes parts of eight counties in central and southern Maryland. Wolman, Geyer, and Beavin (1961) estimated the 1960 population of the portion of the sub-basin above Lyons Creek to be 121,000. The population of the Southern Maryland counties within the sub-basin is probably about 25,000.

Situated between the growing metropolitan centers of Baltimore and Washington, the Patuxent River sub-basin is being urbanized rapidly. Much of the area is still relatively sparsely populated, but the rate of growth in the central area of the sub-basin has exceeded all predictions of the past. For example, in a 1940 report on the Patuxent River drainage area, the Corps of Engineers (1940) estimated that the four Maryland counties of Montgomery, Prince George's, Howard and Anne Arundel would have a combined 1960 population of 266,000. However, the census of 1960 showed an actual population of 941,109 for these four counties, more than three times the number predicted 20 years earlier. The rapid growth is continuing, creating new problems of water quality, including those related to waste-water disposal.

Since World War II, considerable thought has been given to water-quality

problems resulting from man's activities in the Patuxent sub-basin. One such problem is the suspended solids in the upper Patuxent River and its tributaries. According to the Soil Conservation Service (1952), soil erosion on the upper portion of the sub-basin has resulted in stream-carried solid materials which are deposited in the quiescent waters of Triadelphia Lake, a water supply reservoir of the Washington Suburban Sanitary District. Sediment surveys in 1950 and 1952 of this reservoir indicated a sedimentation rate of approximately 22,800 tons per year. The storage capacity of the Cattail Creek arm of Triadelphia Lake was estimated to have been reduced by 13 per cent as of June, 1952. In the Patuxent River portion of the reservoir, the capacity reduction was found to be 28 per cent. To remove sediments from the bottom of the reservoir near the dam, five 24-inch blow-off pipes were installed in Brighton Dam near the stream bottom. These pipes are equipped with valves, which are opened frequently to blow off accumulated silt.

In its report, the Soil Conservation Service (1952) recommended a plan of improvement consisting of a coordinated program for waterflow retardation and prevention of soil erosion. The plan called for various land treatment measures such as contour strip cropping, cover cropping, terracing, and contour furrowing. The recommended program also called for 250 farm ponds in the drainage area above Brighton Dam. According to the 1952 report, seven of the recommended farm ponds were already constructed as of 1952.

Post-war growth of population and other developments forced attention on the problem of waste-water disposal in the Patuxent River sub-basin. The Maryland State Department of Health conducted a survey of water quality in the Little Patuxent River from Maryland Route 602 to its mouth, and in the Patuxent River from Laurel to Maryland Route 214. Samples were collected and analyzed for dissolved oxygen concentration, biochemical oxygen demand, coliform bacteria count, and temperature. The Geological Survey cooperated in this survey by obtaining stream-flow data in the reaches studied by setting up temporary stream gaging stations.

The results of this survey were recorded in an unpublished report by Hsi (1955). Additional data collected the following year was discussed in another unpublished report by Zelinski (1956). The 1955 and 1956 surveys by the State Department of Health indicated that the two rivers have relatively good self-purification characteristics in the reaches studies, and therefore have considerable capacity to assimilate wastes.

Anticipating problems from the developing residential areas and other growth activities in Anne Arundel County, the Maryland General Assembly (1955) enacted a law authorizing the Anne Arundel County Sanitary Commission to investigate the need for future water and sewerage facilities. A year later, a report on sewage disposal in the Patuxent River drainage area of the County Sanitary Commission was prepared by Rummel, Klepper, and Kahl (1956). This report proposed a sewage treatment plant near the mouth of the Little Patuxent River serving most of Election District 4 of Anne Arundel County. It was calculated that the Patuxent River at the mouth of the Little Patuxent has an assimilative capacity adequate to receive the treated sewage from a population of about 80,000. The report proposed that sewage from over 30,000 persons residing outside the Patuxent sub-basin in Anne Arundel County be pumped to the sewer system tributary to the treatment plant. According to Rummel et al this would solve the problem of sewage disposal in the out-of-basin area, and at the same time, provide a broader tax base for financing the sewerage system in the Patuxent drainage area. The disposal works, named the Patuxent Sewage Treatment Plant, is now in existence. The outfall is located on the Little Patuxent River 3.1 miles above its mouth.

In 1956, Register (1956) prepared a report for the Washington Suburban Sanitary District describing the sewage disposal problem for Laurel, Maryland, and nearby areas. A treatment plant was proposed for a site east of the Washington-Baltimore Parkway, to be constructed in stages to serve an initial population of

10,000 in 1965 and ultimately 40,000 persons in the year 2000. The Laurel Sewage Treatment Plant has since been constructed. Its effluent is discharged into the Patuxent River at river mile 74.6.

In a report prepared for the Interstate Commission on the Potomac River basin, Wolman, Geyer, and Pyatt (1957) proposed a long-term future scheme for disposal of treated sewage from Washington, D. C., and its sewer service area. Their proposal involved a pipeline from Washington's treatment works at Blue Plains to the Chesapeake Bay near Chesapeake Beach in Calvert County. The pipeline would cross the Patuxent River near the mouth of Mataponi Creek. This proposed pipeline is of interest here because of the possibility it would offer for disposal of sewage from the Patuxent River basin.

The consulting engineering firm of Whitman, Requardt and Associates (1958) has conducted a study of sewerage needs in Howard County. The consultants found that the Howard County streams would not have waste capacity sufficient to receive the sewage from the future population, estimated to be 176,000 in the year 2000. They proposed that sewage from the upper watershed of the Little Patuxent River be pumped out of the sub-basin into the Baltimore City System. The report called for immediate construction to alleviate public health hazards and nuisances resulting from overloaded septic tanks. A pumping plant, to be located at Columbia, would pump the sewage to an interceptor sewer in the Patapsco River sub-basin.

Whitman, Requardt and Associates (1958) also recommended that sewage from the area around Savage be collected and pumped to the new treatment plant at Laurel.

In 1959, the Baltimore Regional Planning Council (1959a, 1959b, 1959c, and 1959d) issued a series of reports on land use, industrial development, highways, and water and sewerage in the Baltimore area. The water and sewerage report emphasized the need to consider an entire drainage basin in planning to

meet the future needs. The Patuxent River sub-basin was cited as an example in which a coordinated study of the entire drainage area, without regard to county boundaries, was needed. Actually, such a study was already underway by the firm of Benjamin E. Beavin, Consulting Engineers, supervised by a Board of Consultants. Serving on this Board of Consultants were Dr. Abel Wolman, Dr. John C. Geyer, and Mr. Benjamin E. Beavin.

The Patuxent regional sewerage study began in 1958, and three years later, Wolman, Geyer, and Beavin (1961) issued the final report. The study was limited to the portion of the Patuxent River sub-basin above Lyons Creek, which forms part of the boundary between Anne Arundel and Calvert Counties. The drainage area above Lyons Creek includes portions of Frederick, Howard, Montgomery, Prince George's and Anne Arundel Counties, but the investigation was concerned principally with Howard, Prince George's, and Anne Arundel Counties. The area below Lyons Creek was not considered because the investigators estimated that growth in this area during the period from 1960 until 2000 would not support public sewerage. This area includes portions of Prince George's, Calvert, Charles, and St. Mary's Counties.

According to the 1961 report,

The Patuxent River system is relatively free of pollution at this time. Control of the watershed, sparse developments, and construction of treatment plants have precluded any serious widespread problem. Some areas, such as that immediately below Savage, have local conditions of pollution, particularly during periods of low flow.

In order to provide waste disposal for an expected sewered population of 541,000 in the year 2000 in the study area, Wolman, Geyer, and Beavin (1961) recommended the construction of a system of interceptor sewers and five sewage treatment plants. The proposed plants would be located at Laurel, Bowie,

Patuxent, Savage, and Mataponi Creek. At the time of the 1961 report, the initial stage of the Laurel plant was already in existence, and the Bowie and Patuxent plants were under construction. The first stage of the Savage sewerage system would be needed sometime before 1973, when it was estimated the second stage should be constructed. The first stage of the Mataponi Creek sewage treatment plant would be needed before 1970, at which time the Board of Consultants expect the second state to be needed.

The report of Wolman, Geyer, and Beavin (1961) concluded that the Patuxent River and its tributaries have adequate capacity to assimilate the treated sewage from the population expected in the Patuxent River sub-basin in the year 2000.

A very significant development in the Patuxent sub-basin is the plan of Community Research and Development, Inc., to build a completely new town in eastern Howard County. Covering some 14, 1000 acres, the proposed town of Columbia will be located in the Clarksville (#5) and Guilford (#6) election districts, both of which are in the Little Patuxent watershed. According to the brief data available, Columbia will consist of 10 small villages around a central core area providing commercial, recreational and educational facilities. Each village will house 2,500-3,500 families plus schools, parks, churches, shops, businesses and other services. Spacing the villages from one another and from adjacent peoperties will be an extensive system of permanent open spaces. Centers of employment, largely in the form of research and development laboratories, offices and light manufacturing plants will be both clustered and isolated in suitable locations.

Although detailed plants are not available, preliminary information indicates that water will be supplied to Columbia from Baltimore via a line paralleling U. S. Highways 40 and 29. During the first five-year development stage,

the sewage load from an estimated population of 60,000 probably will be pumped out of the watershed and treated at a proposed plant in Ellicott City which is in the Patapsco River sub-basin. Ultimate development after a 15-year period (population 110,000) will include provision for treatment at the Savage treatment plant on the Little Patuxent River (mile point 16.9). A comprehensive study of water and sewage facilities for Columbia is presently being prepared under the direction of the Howard County Metropolitan Commission.

The development scheme for Columbia includes provision for five lakes, ranging in size from 21 to 320 acres of water surface. Originally considered for multiple purposes (water supply, flood control, recreation), these impoundments are now being planned for recreation use only. Some criticism has been expressed by state and federal agencies primarily because of the effect the regulated stream-flow would have on the operations of a sewage treatment plant at Savage, the main water supply at Fort Meade and the auxiliary supply at the House of Correction (Jessups).

Shellfish pollution remained a problem in 1960, no less than in 1914 as reported by Cumming (1916). In 1960, tidal waters of Back Creek and Mill Creek in Calvert County were closed to shellfishing, because of pollution, by the Maryland Department of Health (1961).

An extensive investigation of water quality in the Patuxent River estuary is currently underway (1965). A major aim of this study, being carried out by the Natural Resources Institute of the University of Maryland, is to determine the effects on the aquatic life of the waste heat discharged by the Chalk Point steam-electric generating plant recently constructed on the Patuxent River near the mouth of Swanson Creek in Prince George's County. The plant, owned by the Potomac Electric and Power Company, began power generation in one unit in the spring of 1964. A second unit is expected to be in production in 1965. It is anticipated

that cooling water from the estuary will be circulated through the condensers at a rate of 500,000 gallons per minute. In passing through the condensers, the water will be heated to a temperature 11.5 Fahrenheit degrees above its intake temperature in summer. In winter the temperature increase will be 23 Fahrenheit degrees.

The U. S. Geological Survey, which is cooperating in the investigation, has installed a totally integrated water quality data collection system. A preliminary report of the Patuxent River estuary study has been prepared by Mihursky (1963).

Tiller and Coker (1955) have called attention to an effect of man's activities on water resources of the Patuxent River which is unlike the routine pollution problems usually encountered. Explosions resulting from the testing of naval ordnance materials in the lower Patuxent estuary have caused the death of many fish.

West Chesapeake Shore Between Patuxent River and Potomac River - Below the mouth of the Patuxent River, the shore of Chesapeake Bay stretches southward and slightly eastward for about 17 miles, forming the eastern boundary of St. Mary's County. The shoreline is unbroken throughout most of the distance, with no large streams indenting the beach above Point No Point. Just below Point No Point, St. Jerome Creek forms an embayment. Very sparsely populated, the area contains only scattered houses and a few small communities. The communities include St. Jerome Beach, Airedale, Scotland Beach, and Point Lookout. Point Lookout marks the southern limit of the Western Shore drainage basin of Maryland.

The scattered homes are served by septic tanks for sewage disposal. Only two waste-water discharges to surface waterways are known in this area. One of these is from the Officers Club of the Patuxent Naval Air Station which discharges sewage directly into the Bay a short distance below the mouth of the Patuxent River. The other outfall is on Pine Hill Run, a small tributary of Chesapeake Bay. This outfall serves the Solomons Island Naval Air Test Center and surrounding

residential areas.

With no manufacturing industry and very little population, the area has no serious problems of water quality.

Interstate Problems

At this time (1965), there are no significant interstate problems of water quality in the Western Shore drainage area of Maryland. The only streams originating outside Maryland and flowing into the Western Shore area considered in this report are the Susquehanna River and its tributaries, and Gunpowder Falls.

The Susquehanna River drains large areas in the States of New York and Pennsylvania. As observed by Beaven (1946) and other investigators, the rate of flow of the Susquehanna River has a controlling influence on the salinity of the water in the northern part of Chesapeake Bay and in the western tributaries of the Bay. For this reason, any regulation of the flow of the Susquehanna River by diversions or impoundments in New York or Pennsylvania should be of interest to Maryland. The investigation of such regulation, though recognized as desirable, is beyond the assigned scope of this report.

Water-quality problems are known to exist in the Susquehanna River basin in both New York and Pennsylvania. However, the problems are generally solved by a combination of pollution-abatement measures, dilution, and natural stabilization in the river and its impoundments before the water reaches Chesapeake Bay.

Cumberland (1961) has called attention to the atomic power electric-generating station at Peach Bottom, Pennsylvania, on the Susquehanna River, as a potential source of radioactive contamination in Chesapeake Bay. However, extensive precautionary measures have been carried out in connection with this project, soon to begin operating, to minimize the danger to water users. Such users will include the City of Baltimore, which is soon to begin diverting water from the Susquehanna downstream of Peach Bottom to augment its public water supply.

The Gunpowder Falls drainage area includes a small area in the southern

part of York County, Pennsylvania. Largely farm land, this area of about 11 square miles contributes no known pollution to the waters of the Gunpowder system in Maryland.

Pollution of the tidal waters of the Western Shore area by ships and smaller water craft can be considered an interstate problem. These mobile sources of pollution cross State boundaries at will, discharging sewage without legal restriction, and not infrequently oil and garbage, which are prohibited by law.

The Bay waters in the lower part of the Western Shore area flow back and forth across the State boundary between Maryland and Virginia. There is no known man-made water-quality problem in the Maryland portion of the Bay which originates in Virginia, except for those problems caused by ships and other vessels. Similarly, there are no known land-based sources of pollution in Maryland's Western Shore area (north of the Potomac River) which have any significant effect on water uses in Virginia.

To the extent that salinity can be considered a problem, it has interstate aspects because the sea salts in Maryland's portion of Chesapeake Bay come from the Atlantic Ocean through the Virginia portion of the Bay. Another reason for considering salinity as an interstate problem is that salinity in the upper Bay is subject to control by flow regulation in the Susquehanna River basin in New York and Pennsylvania.

Intrastate Problems

Except for the interstate problems discussed in the section immediately above, the water-quality problems of the Western Shore drainage area can be characterized as intrastate problems. The effects of pollution from sources within the area are felt, if at all, by water users within the State of Maryland, and indeed, within the Western Shore drainage area itself. There is no evidence that pollution on either side of the Bay affects water use on the opposite side.

Similarly, there are no exchanges of pollution effects between the Maryland portion of the Susquehanna River basin and the Western Shore area. It is conceivable, however, that the diversion of water from the Susquehanna River by the City of Baltimore, the facilities for which are now (1965) under construction, could cause or aggravate water-quality problems in the lower Susquehanna River. Such problems might be related to a reduction of waste-assimilative capacity or increased salinity intrusion in the Susquehanna River as a result of the diversion.

Although the Potomac River estuary is directly connected with the waters of the Chesapeake Bay, there are no known sources of pollution in the Potomac River basin which influence water quality in the Bay. Neither are there pollution sources in the Western Shore area considered in this report which significantly affect water quality in the lower Potomac River estuary. However, there are intrastate, interbasin diversions of which which have water-quality aspects. Water is diverted from the Patuxent River for water supply in the Potomac River basin. This diversion tends to reduce the capacity of the Patuxent River to assimilate wastes. It also tends to increase the effects of salinity intrusion in the Patuxent River estuary.

The plan to extend a treated waste pipeline from the Blue Plains sewage treatment plant in Washington, D. C., to the Chesapeake Bay, as proposed by Wolman, Geyer, and Pyatt (1957), would create another intrastate, interbasin diversion with attendant effects on water quality in the Bay.

Most of the water-quality problems of the Western Shore drainage basin in Maryland begin and end within the basin area. These intrastate problems have been discussed elsewhere in this report.

Water-Quality Control

A general discussion of this subject is found in the General Reference Section.

Special Water-Quality Surveys

There have been **numerous** special surveys dealing with water quality in the Western Shore drainage area of Maryland. Most of these have been discussed elsewhere in this report. One of the earliest special-purpose surveys, that of the Public Health Service in 1914 and 1915, as reported by Cumming (1916), described the sanitary conditions of the Bay and its tidal tributaries as related to shellfish. Many studies of pollution in Baltimore Harbor have been carried out by various agencies. Several of these were performed by persons attached to the Chesapeake Biological Laboratory, as reported by Olson et al (1941), Stern (1942), Davis (1948), Stern and Davis (1948), and Sieling (1948). The Department of Sanitary Engineering of The Johns Hopkins University investigated water quality in Baltimore Harbor during the period from 1947 through 1951. Various aspects of this investigation have been reported by Pohmer (1948), Garland (1949, 1950, 1952), Hull (1950, 1961, 1963), and Weiss (1950, 1951). The Chesapeake Bay Institute of The Johns Hopkins University has recently completed a three-year study of Baltimore Harbor and the adjacent portion of Chesapeake Bay. The principal objective of this study was to determine the mechanisms and rates of flushing of the harbor, in order to allow the estimation of the effects of introducing waste materials into the harbor. The results of these studies were reported by Stroup et al (1964).

The Public Health Service is presently engaged in a six-year study of the Chesapeake Bay and Susquehanna River basin. The objective of the study is to develop programs for improving and maintaining water quality for all beneficial uses to the year 2020. Cooperating with state and local agencies, the Public Health Service will prepare a series of reports covering the several sub-basins of the study area. Project activities to date have included the collection and tabulation of data on community water supply and waste disposal, industrial water use, water supply and waste disposal practices at Federal installations, and

stream water quality; the collection of stream water quality data through field surveys, preliminary mathematical analysis of certain of those data; and the projection of population and economic growth. Available data from these studies were incorporated in this report.

Two project committees (one for the Chesapeake area and the other for the Susquehanna River basin) have been formed to facilitate coordination among Federal and State agencies concerned with water quality management. Considerable data included in the Maryland Water Supply and Requirements Study have been developed cooperatively with the Public Health Service Project.

Summary on Water Quality Throughout Basin

With some notable exceptions, the quality of available water supplies in the Western Shore drainage area has been generally satisfactory for most uses. The fresh-water streams have provided water of good chemical and physical characteristics suitable for municipal and industrial purposes after reasonable treatment. Rapid expansion of population centers has created problems of waste disposal on the watersheds draining into major water-supply reservoirs. Frequent and widespread failures of individual household systems for sewage disposal have prompted more stringent regulations controlling the design and installation of these systems.

Although water for instream uses is abundant in the Chesapeake Bay and in its tidal tributaries, these waters are unsuitable for most withdrawal uses because of their salt content. These brackish waterways, serving as disposal mechanisms for the used fresh waters of the cities and factories along the Western Shore of the Bay, render these fresh waters unfit for further use ashore by mixing them with the natural sea-water impurities. The brackish waters of the estuaries have also penetrated into heavily pumped aquifers, especially in the Baltimore Harbor area.

In areas of concentrated industrial and municipal developments, the brackish receiving waters are degraded by the sewage and industrial wastes discharged into them, thus lowering their value for instream water uses, particularly recreation and fishing. Shellfishing areas have been closed because of the danger to public health from sewage contamination. Untreated human wastes from ships and smaller vessels, including pleasure craft, present a potential health hazard to shellfish consumers, as well as to bathers and others using the estuarine waters for recreation. Large volumes of spent cooling water are discharged from steam-electric generating plants into Baltimore Harbor and into other parts of the estuarine system. The waste heat raises the temperature of the receiving waters, but this effect appears to be limited to relatively limited areas near the point of cooling-water discharge. Waste acid and oil have been causes of pollution in peripheral areas of Baltimore Harbor. Except for these peripheral areas, the harbor has a relatively great capacity to assimilate wastes without significant harm to other water uses, either within the harbor itself or in Chesapeake Bay.

Except for the degradation of water quality in peripheral areas of Baltimore Harbor, the detrimental effect on the estuary of Back River by treated sewage from the City of Baltimore has probably been the most critical water-quality problem within the Western Shore area. The increasing re-use of the effluent from the Back River sewage disposal plant for industrial purposes has alleviated this problem considerably in recent years.

Ground-water quality varies from good to unsatisfactory in the Western Shore drainage area. The most prevalent natural impurity in well waters of the area is iron, found in ground waters of both the Piedmont and Coastal Plain provinces. Some wells in both of these provinces yield slightly corrosive waters. Excessive hardness is a problem in limestone and marble areas of the Piedmont.

Saline-water intrusion is a factor limiting the use of ground water in areas adjacent to the Bay and its tidal tributaries. Heavy pumping by industries in the vicinity of Baltimore has drawn salt water into some aquifers, resulting in the abandonment of the wells.

Over the last 15-year period, the State agencies responsible for water-quality control have been expanding their activities with increasing effectiveness, but the rates of growth of both population and industry, together with the development of new types of chemicals, such as pesticides and synthetic detergents, which find their way into the waters of the State, have taxed the resources of these agencies. Since much of the State's growth and development has been within the Western Shore drainage area, this area has of necessity received a large share of the pollution control efforts.

INTERSTATE ASPECTS

As indicated previously, water resources of the Western Shore drainage basin are largely an intrastate matter. An exception is the interstate aspects of the Susquehanna River which were discussed in this report under diversions and water quality.

EVALUATION OF AVAILABLE DATA

A general discussion on this subject is found in the General Reference Section.

SUMMARY

The Western Shore drainage area, defined as that part of Maryland lying east of the Chesapeake Bay between the Susquehanna and Potomac Rivers, is generally well endowed with water resources. These resources have been developed and used only to a very limited extent. Many good sized streams in the area - for example, the Little Gunpowder Falls and the Little Patuxent River - have not been developed at all, because of the availability of other sources of water, considered better choices, which have been adequate to meet the demands for water in the past.

The recent developments of two water supplies from sources outside the Western Shore drainage area are likely to delay for many years the need for any major water-supply projects on streams within the Western Shore basin. The Susquehanna River supply is expected to serve the City of Baltimore and its suburbs until sometime after the year 2000. The Potomac River supply recently put into operation by the Washington Suburban Sanitary District will serve the Maryland suburbs of Washington, D. C. The Sanitary District includes in its water service area part of southern Howard County and the major portions of Montgomery and Prince George's Counties in the Western Shore basin.

In the not very distant future, the Baltimore water mains extending southwestward will meet those of the Washington Suburban Sanitary District system somewhere in Howard County, with interconnections between the two systems. When this happens, the entire corridor extending from the Susquehanna River basin through the Western Shore basin to the Potomac River basin will be served by interconnected water systems which draw their supplies from the two largest rivers in Maryland. This development will eliminate the need for any major water-supply projects on the small streams in the Western Shore basin.

In the Piedmont province portion of the Western Shore drainage area,

ground-water resources are available in adequate amounts for small supplies, such as for individual households. Where urbanization occurs, existing metropolitan water systems will be extended or new ones developed to meet the new demands for water.

A significant portion of water requirements in the coastal province will continue to be provided by ground water, notwithstanding an ever-expanding network of surface water supplies. Many communities as well as industrial users with requirements approximating 500 gallons per minute will find ground-water sources to be adequate. Reliance on ground-water supplies will continue in those areas where 1) aquifers are highly productive, 2) the effect of brackish water intrusion is minimal, and 3) surface-water supplies cannot feasibly be provided. These factors indicate the greatest potential for ground water use will be in regions of Southern Maryland most distant from the metropolitan service areas and from the Bay and brackish portions of its tributaries.

Water is taken from the streams and aquifers of the Western Shore drainage area and used for domestic, municipal, industrial, commercial and agricultural purposes. The largest quantity of fresh water used in the basin is by the City of Baltimore, which supplies water also to parts of Anne Arundel, Baltimore and Howard Counties. During 1962, Baltimore withdrew water from Gunpowder Falls and the North Branch Patapsco River at an average rate of 218 million gallons daily (mgd). The Washington Suburban Sanitary District took 51.6 mgd from the Patuxent River during the same year. Surface withdrawals by all municipal and institutional systems in the basin totaled 282 mgd in 1962; industrial withdrawals for which data were available totaled 12 mgd.

Most of the fresh water used in the Western Shore area is discharged after use into the brackish water of the Chesapeake Bay or its tidal tributaries. For this reason, there is little opportunity for successive re-uses of the same

water, as is common in inland areas where waste waters discharged into fresh-water streams are available to downstream water users after dilution and natural purification in the stream. In areas such as the tidewater region of the Bay, the re-use of waste waters as fresh-water supplies is only possible if these waste waters are intercepted before discharged into the brackish tide waters. An outstanding example of such re-use is found in the Western Shore area where a large part of the treated effluent from Baltimore's Back River sewage disposal plant is used for industrial purposes at the Sparrows Point plant of the Bethlehem Steel Company.

Brackish water from the Bay and its tidal tributaries is used for industrial purposes, especially cooling. The largest single quantity of water taken from the Bay is 478 mgd, used for condensing steam in the Charles P. Crane electric generating station of the Baltimore Gas and Electric Company. In the Patapsco estuary which includes the Baltimore harbor area more than 1,500 mgd of brackish water are used for industrial purposes. About half is used by public utility industries. The Potomac Electric Power Company began taking brackish water from the Patuxent River during the summer of 1964 for condensing steam in its Chalk Point electric generating station. This plant circulates Patuxent River water through its cooling system at the rate of about 500,000 gallons per minute (720 mgd).

Although most of the large volumes of water withdrawn from the surface streams of the Western Shore drainage area have been accounted for in this study, data on many smaller withdrawals are not available. These withdrawals may be significant in terms of the size of the stream from which water is taken and the location of the intake with respect to other water uses. The State Planning Department and the U.S. Public Health Service have jointly undertaken a survey to obtain more adequate data on water use in the Western Shore drainage area.

The water resources within the basin, or near enough for economically feasible transport into the basin, are far greater than any potential future use, principally because of the Susquehanna River. With development of this source, the foreseeable needs of the area for increasing quantities of water will be met without approaching the limits of supply.

This optimistic situation is marred somewhat by the views of biologists and ecologists who anticipate detrimental effects resulting from large inter- or intra-basin diversions. These diversions will be particularly significant in estuarine areas where changes in salinity profiles will alter ecological conditions. Of particular concern is the Patuxent River where much of the water withdrawn is eventually discharged outside the basin.

Although many criteria are used in defining water quality, the common objective of all is to describe conditions amenable or detrimental to various water uses. Domestic water supply and certain forms of recreation require the highest quality water. At the other extreme is the use of water for navigation and as a carrier of wastes. Generally, water quality in the Western Shore drainage area is adequate to meet most requirements; local problems do exist with the various watersheds, however, and improvements are needed to assure optimal use of the available water resources.

With industrial activity concentrated in the Baltimore area, problems of industrial wastes are most prevalent in the lower Patapsco and Baltimore Harbor areas. Domestic waste problems exist largely as a result of urbanization spreading more rapidly than sewerage improvements can be installed. Insufficient sewerage characterizes portions of nearly every watershed in the Western Shore area. Other quality problems of a more specialized nature are found also in streams of the Western Shore. These local situations as well as anticipated remedial measures are all discussed in the narrative section of the report entitled "Water Quality."

In addition to receiving some portion of upstream waste loads, estuarine areas receive discharges of untreated sewage from ships and smaller water craft. Public health is endangered by exposing bathers to sewage-borne disease organisms, and by contaminating shellfish used for human consumption. Restricting such uses in the interest of public health results in economic losses to important recreation and shellfish industries of the Bay.

The salinity of gradient of the Bay is controlled more by runoff from the Susquehanna River than that contributed from sources west in the basin drainage area itself.

Salt in the Chesapeake Bay and its estuaries limits the withdrawal use of these waters to industrial cooling, a purpose for which they are used in large quantities. The salinity of the tidal waters has increased during severe droughts to levels fatal to fresh water species of fish normally found near the head of tide in some arms of the Bay. Most instream uses of water are unharmed by the natural salinity of the total water bodies of the area.

There are two widespread aquatic pests in the waters of Chesapeake Bay which damage instream water uses. One of these, the oriental milfoil, grows so thickly in shallow areas that the passage of small boats through these areas is impeded or blocked. The presence of milfoil greatly accelerates the conversion of shallow areas into swamps. The other pest, the sea nettle, often virtually eliminates bathing in large areas of the Bay and its tidal arms. Other than fencing in small areas for bathing with fine-meshed nets or wire screens, no effective method of controlling the sea nettle has been found.

As indicated previously, the quantity and quality of water in the Western Shore area generally are adequate for most uses. Recreation and commercial fishing are the uses most severely harmed by degraded water quality. Evidence of the effect of pollution on the shellfish industry is the recent

closing of 11 oyster beds comprising 10,000 acres (6 per cent of the State's total acreage in oyster cultivation) by the State Health Department because of suspected contamination.

Recreation has always been considered of secondary importance to other water uses primarily on the basis of economics - i.e., the intangible and often non-reimbursable benefits from recreation could not limit more lucrative forms of economic activity. This attitude is rapidly changing, especially in the Western Chesapeake Bay drainage area, as evidenced by the creation of stream-valley parks along the Gunpowder, Patapsco and Patuxent Rivers. At the same time, these and other recreational developments bring more sharply into focus the possible conflicts and sometimes competitive nature of various water uses. To achieve a desirable pattern of water utilization which minimizes conflicts among uses, a planning and operational program must be initiated to accomplish the following:

1. Determination of water requirements for various uses,
2. Recognition of optimal use patterns within each water-course, and
3. Management and development of water resources to achieve desired objectives.

The Maryland Water Resources Law of 1933 declares that the policy of the State is to control the appropriation and use of the State's water resources. To implement the declared policy, the 1933 law established a permit system. Its effectiveness, however, is severely limited by the exemptions from the system, namely the use of water for domestic and farming purposes and for an approved water supply of any municipality. All uses in existence prior to January 1, 1934 also were exempted. These exemptions leave only industrial water uses established since 1933 covered by the law in any depth. There are only six holders of permits

for taking and using surface waters in the Western Shore drainage area; these total less than 12 mgd which is less than 1 per cent of the water used in the basin. (Baltimore City and the Washington Suburban Sanitary District, not covered by permit, use more than 90 per cent of the surface water known to be withdrawn in the Western Shore area.

The control and development of water resources on the Western Shore has been diffused among many state and local agencies each operating within a limited area of jurisdiction. The water development that heretofore took place resulted in few conflicts of use; as a result, little attention was given to comprehensive, multiple-purpose concepts of water and related land development. With increasing urbanization and ever-increasing industrial activity on the Western Shore, however, the need for a broader-based program of planning and management has been recognized.

A recent reorganization of the State's water agencies included the creation of a Department of Water Resources which is assigned many of the activities heretofore carried out by several agencies. The Department of Water Resources is specially charged with the responsibility of carrying out comprehensive planning studies for each basin in the State. These studies will not only guide future management and development of water resources in Maryland but will also provide the necessary supporting data for amending existing regulatory legislation which at present is a constraint on the Department's operation.

CHESAPEAKE BAY (WESTERN SHORE) DRAINAGE BASIN
MARYLAND

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APPENDIX A

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

See Description of Appendices (Appendix A) in the
General Reference Section for a narrative discussion
of this material.

Appendix A

CHESAPEAKE BAY, WESTERN SHORE

DRAINAGE BASIN

Direct Drainage and Minor Tributaries

SUB-BASIN

(From Concord Point* to Rickett Point**)

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
CHESAPEAKE BAY, WESTERN SHORE						192.8	/Head of Chesapeake Bay, Western Shore, at Concord Pt. Lighthouse, mouth of Susquehanna River, Havre de Grace, Harford County, Maryland				
CHESAPEAKE BAY						192.6	/Town Boundary, Havre de Grace, Md.				
CHESAPEAKE BAY						188.1	/Mouth of Swan Creek				
Swan Creek							/Head of Swan Creek				
Swan Creek						6.7	/Mouth of Carsins Run				
Carsins Run							/Head of Carsins Run				
Carsins Run						0.0	/Mouth of Carsins Run				
Swan Creek						6.7	/Mouth of Carsins Run				
Swan Creek						4.9	/Bridge, B. O. Railroad				
Swan Creek						4.8	/Bridge, U. S. Highway 40 (Pulaski Hwy)				
Swan Creek						4.8	/Gaging Station at Swan Creek, Md. (D. A. 13.2)				
Swan Creek						4.75	/Bridge, Pennsylvania Railroad				
Swan Creek						4.6	/Bridge, Maryland Highway 22				
Swan Creek						3.5	/Outfall, (3 plants) Aberdeen				
Swan Creek						3.1	/Mouth of Unnamed Tributary				
Unnamed Tributary							/Head of Unnamed Tributary				
Unnamed Tributary						0.4	/Outfall, Sewage Disposal Plant				
Unnamed Tributary						0.0	/Mouth of Unnamed Tributary				
Swan Creek						3.1	/Mouth of Unnamed Tributary				
Swan Creek						2.8	/Mouth of Gasheys Creek				
Gasheys Creek							/Head of Gasheys Creek				
Gasheys Creek						0.0	/Mouth of Gasheys Creek				
Swan Creek						2.8	/Mouth of Gasheys Creek				
Swan Creek						0.0	/Mouth of Swan Creek				
CHESAPEAKE BAY						188.1	/Mouth of Swan Creek				
CHESAPEAKE BAY						187.0	/Outfall, Aberdeen Proving Ground, Training Center				
CHESAPEAKE BAY						186.8	/Outfall, Aberdeen Proving Ground, Pusey Plant				
CHESAPEAKE BAY						184.5	/Mouth of Spesutie Narrows				
Spesutie Narrows						3.0	/Head of Spesutie Narrows				
Spesutie Narrows						2.9	/Mouth of Dipper Creek				
Dipper Creek							/Head of Dipper Creek				
Dipper Creek						0.4	/Outfall, Sewage Disposal Plant				
Dipper Creek						0.0	/Mouth of Dipper Creek				
Spesutie Narrows						2.9	/Mouth of Dipper Creek				
Spesutie Narrows						1.2	/Mouth of Woodrest Creek				
Woodrest Creek							/Head of Woodrest Creek				
Woodrest Creek						1.1	/Bridge, Aberdeen Road				
Woodrest Creek						0.1	/Bridge, Aberdeen Road				
Woodrest Creek						0.1	/Bridge, Railroad (Standard Gauge)				
Woodrest Creek						0.0	/Mouth of Woodrest Creek				
Spesutie Narrows						1.2	/Mouth of Woodrest Creek				

Direct Drainage and Minor TributariesSUB-BASIN

(From Concord Point* to Rickett Point**)

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
						0.4					Mouth of Back Creek
											/Head of Back Creek
						0.0					Mouth of Back Creek
						0.4					Mouth of Back Creek
						0.2					Mouth of Mosquito Creek
											/Head of Mosquito Creek
						0.1					Mouth of Little Mosquito Creek
						0.4					Head of Little Mosquito Creek
						0.0					Mouth of Little Mosquito Creek
						0.1					Mouth of Little Mosquito Creek
						0.0					Mouth of Mosquito Creek
						0.2					Mouth of Mosquito Creek
											/Outfall, Aberdeen Proving Grounds, Phillips Field
						0.0					Mouth of Spesutie Narrows
CHESAPEAKE BAY						184.5					Mouth of Spesutie Narrows
CHESAPEAKE BAY						178.2					Mouth of Old Womans Gut
						1.2					Head of Old Womans Gut
						0.0					Mouth of Old Womans Gut
CHESAPEAKE BAY						178.2					Mouth of Old Womans Gut
CHESAPEAKE BAY						177.9					Mouth of Delph Creek
											/Head of Delph Creek
						0.0					Mouth of Delph Creek
CHESAPEAKE BAY						177.9					Mouth of Delph Creek
CHESAPEAKE BAY						177.6					Mouth of Little Romney Creek
											/Head of Little Romney Creek
						0.0					Mouth of Little Romney Creek
CHESAPEAKE BAY						177.6					Mouth of Little Romney Creek
CHESAPEAKE BAY						175.9					Mouth of Romney Creek
											/Head of Romney Creek
						9.2					Bridge, Palmer Road
						7.2					Bridge, Old Baltimore Road
						3.5					Bridge, Romney Creek Road (Footbridge)
						2.7					Mouth of Bridge Creek
											/Head of Bridge Creek
						1.1					Bridge, A-a5 Road
						0.0					Mouth of Bridge Creek
						2.7					Mouth of Bridge Creek
						2.1					Mouth of Back Creek
						0.6					Head of Back Creek
						0.0					Mouth of Back Creek
						2.1					Mouth of Back Creek
						0.7					Mouth of Little Romney Creek
						1.3					Head of Little Romney Creek
						0.0					Mouth of Little Romney Creek
						0.7					Mouth of Little Romney Creek
						0.0					Mouth of Romney Creek (D. A. 25.2)
CHESAPEAKE BAY						175.9					Mouth of Romney Creek

Direct Drainage and Minor Tributaries

SUB-BASIN

(From Concord Point* to Rickett Point**)

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES

(Magnitude of Waterway)

LOCATION: RIVER MILE/DESCRIPTION

(Magnitude of Waterway)

1	2	3	4	5	6	1	2	3	4	5	6
CHESAPEAKE BAY						173.3	/	Mouth of Bush River			
Bush River						11.4	/	Head of Bush River			
Bush River						11.4	/	Mouth of Bynum Run			
Bynum Run						14.1	/	Head of Bynum Run			
Bynum Run						13.0	/	Bridge, Maryland & Pennsylvania Railroad			
Bynum Run						12.3	/	Bridge, Md. & Pa. Railroad			
Bynum Run						12.1	/	Bridge, Md. & Pa. Railroad			
Bynum Run						11.8	/	Bridge, Pump Road & Bynum and Md. & Pa. Railroad			
Bynum Run						10.4	/	Bridge, U. S. Highway 1			
Bynum Run						9.5	/	Bridge, Heighe Road			
Bynum Run						8.4	/	Bridge, Moores Mill Road, Gaging Station at Bel Air, Md.			
Bynum Run						8.4	/	Bridge, Md. Highway 22			
Bynum Run						8.39	/	Gaging Station at Bel Air, Md.			
Bynum Run						8.2	/	Outfall, Sewage Disposal-Bel Air			
Bynum Run						7.0	/	Bridge, McPhail Road			
Bynum Run						4.8	/	Bridge, Wheel Road			
Bynum Run						0.7	/	Bridge, Old Philadelphia Rd.			
Bynum Run						0.7	/	Gaging Station, at Bush, Md. (D. A. 22.5)			
Bynum Run						0.0	/	Mouth of Bynum Run (D. A. 23.8)			
Bush River						11.4	/	Mouth of Bynum Run			
Bush River						11.4	/	Mouth of James Run			
James Run						8.7	/	Head of James Run			
James Run							/	Outfall, Churchville Can Co.			
James Run						8.4	/	Bridge, Graftons Lane			
James Run						7.4	/	Bridge, Snake Lane			
James Run						6.6	/	Bridge, James Run Road			
James Run						6.5	/	Mouth of Broad Run			
Broad Run							/	Head of Broad Run			
Broad Run						1.7	/	Bridge, Edwards Lane			
Broad Run						0.7	/	Bridge, Md. Highway 136			
Broad Run						0.5	/	Bridge, James Run Road			
Broad Run						0.3	/	Bridge, James Run Road			
Broad Run						0.0	/	Mouth of Broad Run			
James Run						6.5	/	Mouth of Broad Run			
James Run						2.8	/	Bridge, Nova Scotia Road			
James Run						1.8	/	Bridge, Md. Highway 543			
James Run						0.3	/	Gaging Station at Bush, Md. (D. A. 11.1)			
James Run						0.3	/	Bridge, Md. Highway 7, Old. Philadelphia Rd. (D. A. 11.1)			
James Run						0.0	/	Mouth of James Run			
Bush River						11.4	/	Mouth of James Run			

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
Bush River						10.6	/	Bridge, B & O Railroad			
Bush River						10.5	/	Bridge, U. S. Highway 40			
Bush River						10.4	/	Outfall, Sewage Disposal, Perryman, Northeast Expressway Service Area and possibly Bata Shoe Co. (Proposed Treatment Plant)			
Bush River						10.0	/	Mouth of Bush Creek			
Bush Creek							/	Head of Bush Creek			
Bush Creek						0.0	/	Mouth of Bush Creek			
Bush River						10.0	/	Mouth of Bush Creek			
Bush River						9.7	/	Outfall, Belcamp, Md. (Bata Shoe Co.)			
Bush River						9.2	/	Mouth of Church Creek			
Church Creek							/	Head of Church Creek			
Church Creek						0.8	/	Mouth of Grays Run			
Grays Run							/	Head of Grays Run			
Grays Run						0.8	/	Bridge, Md. Highway 7, Gaging Station at Stepney, Md. (D. A. 5.35)			
Grays Run						0.3	/	Bridge, B & O Railroad			
Grays Run						0.1	/	Bridge, Federal 40			
Grays Run						0.0	/	Mouth of Grays Run			
Church Creek						0.8	/	Mouth of Grays Run			
Church Creek						0.0	/	Mouth of Church Creek			
Bush River						9.2	/	Mouth of Church Creek			
Bush River						8.2	/	Mouth of Otter Point Creek			
Otter Point Creek							/	Head of Otter Point Creek			
Otter Point Creek						1.9	/	Mouth of Winters Run			
Winters Run							/	Head of Winters Run			
Winters Run						16.0	/	Mouth of West Branch			
West Branch						5.4	/	Head of West Branch			
West Branch						5.1	/	Bridge, Schuster Road			
West Branch						3.8	/	Bridge, Furnace Road			
West Branch						3.2	/	Bridge, Dunhams Road			
West Branch						2.9	/	Bridge, Railroad			
West Branch						2.2	/	Bridge, Charles Street			
West Branch						1.4	/	Bridge, Md. Highway 165			
West Branch						0.4	/	Bridge, Putnam Road			
West Branch						0.0	/	Mouth of West Branch			
Winters Run						16.0	/	Mouth of West Branch			
Winters Run						16.0	/	Mouth of East Branch			
East Branch						10.2	/	Head of East Branch			
East Branch						9.8	/	Bridge, Cox Road			
East Branch						8.4	/	Bridge, Md. Highway 165			
East Branch						5.0	/	Bridge, Md. Highway 23			
East Branch						3.3	/	Bridge, Morse Road			
East Branch						2.2	/	Bridge, Poteet Road			
East Branch						1.7	/	Bridge, Phillips Mill Rd.			
East Branch						1.0	/	Bridge, Cosner Road			
East Branch						0.0	/	Mouth of East Branch			
Winters Run						16.0	/	Mouth of East Branch			

Direct Drainage and Minor Tributaries

SUB-BASIN

(From Concord Point* to Rickett Point**)

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
					Winters Run					15.8	/Pleasantville Upper Dam Site No. 1
					Winters Run					15.6	/Mouth of Hoops Branch
					Hoops Branch						/Head of Hoops Branch
					Hoops Branch					0.0	/Mouth of Hoops Branch
					Winters Run					15.6	/Mouth of Hoops Branch
					Winters Run					15.6	/Bridge, Pleasantville Road
					Winters Run					15.5	/Pleasantville Lower Dam Site No. 2
					Winters Run					13.7	/Mouth of Long Branch
					Long Branch						/Head of Long Branch
					Long Branch					1.0	/Bridge, Goggs Road
					Long Branch					0.0	/Mouth of Long Branch
					Winters Run					13.7	/Mouth of Long Branch
					Winters Run					13.5	/Mouth of Bread and Cheese Br. /Head of Bread and Cheese Branch
					Bread and Cheese Br.						
					Bread and Cheese Br.					1.0	/Bridge, Ryan Road
					Bread and Cheese Br.					0.0	/Mouth of Bread and Cheese Br.
					Winters Run					13.5	/Mouth of Bread and Cheese Br.
					Winters Run					12.6	/Bridge, Carrs Mill Road
					Winters Run					12.5	/Amoss Lower Dam Site No. 3
					Winters Run					12.3	/Mouth of Bear Cabin Branch /Head of Bear Cabin Branch
					Bear Cabin Branch					0.7	/Bridge, Graftons Shop Road
					Bear Cabin Branch					0.1	/Bridge, Carrs Mill Road
					Bear Cabin Branch					0.0	/Mouth of Bear Cabin Branch
					Bear Cabin Branch					12.3	/Mouth of Bear Cabin Branch
					Winters Run					12.0	/Bridge, Water Vale Road
					Winters Run					11.9	/Bridge, Md. & Pa. Railroad
					Winters Run					11.4	/Mouth of Elbow Brook /Head of Elbow Brook
					Elbow Brook					2.0	/Bridge, Connolly Road
					Elbow Brook					0.0	/Mouth of Elbow Brook
					Elbow Brook					11.4	/Mouth of Elbow Brook
					Winters Run					10.3	/Mouth of Heavenly Waters 2.0/Head of Heavenly Waters
					Winters Run					1.5	/Bridge, Md. & Pa. Railroad
					Heavenly Waters					0.5	/Bridge, Tollgate Road
					Heavenly Waters					0.0	/Mouth of Heavenly Waters
					Heavenly Waters					10.3	/Mouth of Heavenly Waters
					Heavenly Waters					10.1	/Intake, Bel Air pumping station
					Winters Run					10.0	/Bridge, U. S. Highway #1 (D. A. 37.0)
					Winters Run					10.0	/Gaging Station near Bel Air, Md. (partial-record) (D. A. 37.0)

THE UNIVERSITY OF CHICAGO
 

Direct Drainage and Minor Tributaries

SUB-BASIN

(From Concord Point* to Rickett Point**)

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
					Winters Run					9.8	/Power Plant
					Winters Run					8.3	/Bridge, Whitaker Mill Road
					Winters Run					8.1	/Northern Boundary of Atkisson Reservoir (Army Chemical Center)
					Winters Run					7.8	/Bridge, Ring Factory Road
					Winters Run					6.9	/Mouth of Plumtree Run
					Plumtree Run					3.8	/Head of Plumtree Run
					Plumtree Run					3.7	/Bridge, U. S. Highway #1
					Plumtree Run					2.1	/Bridge, Ring Factory Road
					Plumtree Run					1.4	/Bridge, Tollgate Road
					Plumtree Run					0.6	/Bridge, Plumtree Road
					Plumtree Run					0.2	/Northern Boundary of Atkisson Reservoir
					Plumtree Run					0.0	/Mouth of Plumtree Run
					Winters Run					6.9	/Mouth of Plumtree Run
					Winters Run					5.9	/Southern Boundary, Atkisson Reservoir (D. A. 38.0)
					Winters Run					5.8	/Bridge, Singer Center Road
					Winters Run					5.7	/Mouth of Mountain Branch
					Mountain Branch						/Head of Mountain Branch
					Mountain Branch					0.2	/Bridge, Singer Center Rd.
					Mountain Branch					0.0	/Mouth of Mountain Branch
					Winters Run					5.7	/Mouth of Mountain Branch
					Winters Run					5.3	/Reservoir (With Dam)
					Winters Run					3.0	/Bridge, Md. Highway #7
					Winters Run					2.7	/End, tidal upstream limit of license-free tidewater fishing
					Winters Run					2.7	/Bridge, B & O Railroad
					Winters Run					2.5	/Intake, Edgewood, Army Chemical Center, Reservoir Water Treatment
					Winters Run					2.4	/Bridge, Md. Highway #408
					Winters Run					2.1	/Bridge, U. S. Highway #40
					Winters Run					0.0	/Mouth of Winters Run
					Otter Point Creek					1.9	/Mouth of Winters Run
					Otter Point Creek					1.4	/Mouth of Haha Branch
					Haha Branch						/Head of Haha Branch
					Haha Branch					0.6	/Bridge, Md. Highway #7
					Haha Branch					0.2	/Bridge, B & O Railroad
					Haha Branch					0.1	/Bridge, U. S. Highway #40
					Haha Branch					0.0	/Mouth of Haha Branch
					Otter Point Creek					1.4	/Mouth of Haha Branch
					Otter Point Creek					0.0	/Mouth of Otter Point Creek
					Bush River					8.2	/Mouth of Otter Point Creek
					Bush River					7.6	/Bridge, Pennsylvania Railroad
					Bush River					7.1	/Mouth of Monks Creek

DRAINAGE BASIN

SUB-BASIN

(From Concord Point* to Rickett Point**)

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES						LOCATION: RIVER MILE/DESCRIPTION					
(Magnitude of Waterway)						(Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
					Monks Creek						/Head of Monks Creek
					Monks Creek					0.0	/Mouth of Monks Creek
					Bush River					7.1	/Mouth of Monks Creek
					Bush River					6.9	/Mouth of Sod Run
					Sod Run						/Head of Sod Run
					Sod Run					0.0	/Mouth of Sod Run
					Bush River					6.9	/Mouth of Sod Run
					Bush River					4.8	/Mouth of Lauderick Creek
					Lauderick Creek						/Head of Lauderick Creek
					Lauderick Creek					1.5	/Bridge, Pennsylvania Railroad
					Lauderick Creek					0.0	/Mouth of Lauderick Creek
					Bush River					4.8	/Mouth of Lauderick Creek
					Bush River					3.8	/Mouth of Kings Creek
					Kings Creek					1.0	/Head of Kings Creek
					Kings Creek					0.0	/Mouth of Kings Creek
					Bush River					3.8	/Mouth of Kings Creek
					Bush River					3.5	/Mouth of Redman Cove
					Redman Cove						/Head of Redman Cove
					Redman Cove					0.0	/Mouth of Redman Cove
					Bush River					3.5	/Mouth of Redman Cove
					Bush River					3.3	/Outfall, Sewage Disposal Plant, Army Chemical Center (Edgewood)
					Bush River					2.8	/Towner Cove
					Bush River					2.4	/Doves Cove
					Bush River					2.0	/Mouth of Cooper Creek
					Cooper Creek					0.7	/Head of Cooper Creek
					Cooper Creek					0.0	/Mouth of Cooper Creek
					Bush River					2.0	/Mouth of Cooper Creek
					Bush River					1.0	/Mouth of Cod Creek
					Cod Creek					0.7	/Head of Cod Creek
					Cod Creek					0.0	/Mouth of Cod Creek
					Bush River					1.0	/Mouth of Cod Creek
					Bush River					0.3	/Mouth of Abbey Creek
					Abbey Creek					1.5	/Head of Abbey Creek
					Abbey Creek					0.0	/Mouth of Abbey Creek
					Bush River					0.3	/Mouth of Abbey Creek
					Bush River					0.0	/Mouth of Bush River (D. A. 139.7)
					CHESAPEAKE BAY					173.3	/Mouth of Bush River
					CHESAPEAKE BAY					170.6	/Mouth of Boone Creek
					Boone Creek						/Head of Boone Creek
					Boone Creek					0.0	/Mouth of Boone Creek
					CHESAPEAKE BAY,					170.6	/Mouth of Boone Creek
					CHESAPEAKE BAY, WESTERN SHORE					169.0	/Rickett Point

* In Havre de Grace, Harford County, Maryland at mouth of Susquehanna River.

** On seaward end of Gunpowder Neck, Harford County, Maryland at mouth of Gunpowder River.

D. A. Drainage Area, square miles.

January, 1965

CHESAPEAKE BAY, WESTERN SHORE

DRAINAGE BASIN

Gunpowder River

SUB-BASIN

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
CHESAPEAKE BAY, WESTERN SHORE						169.0	Mouth of Gunpowder River				
Gunpowder River*						8.5	Head of Gunpowder River				
Gunpowder River						8.5	Mouth of Gunpowder Falls in Md.				
Gunpowder Falls						54.5	Head of Gunpowder Falls in Pa.				
Gunpowder Falls						52.7	State Line, Upstream - Pa. Downstream - Md.				
Gunpowder Falls**						52.7	Outfall, Lineboro Canning Co.				
Gunpowder Falls						52.6	Bridge, at Lineboro, Md. #86				
Gunpowder Falls						51.6	Mouth of South Branch				
South Branch							Head of South Branch				
South Branch							Mouth of Springs				
Springs							Head of Springs				
Springs							Intake, Manchester				
Springs						0.0	Mouth of Springs				
South Branch							Mouth of Springs				
South Branch							Outfall, Penn-Carroll Farmers Co-op.				
South Branch						0.0	Mouth of South Branch				
Gunpowder Falls						51.6	Mouth of South Branch				
Gunpowder Falls						50.5	Bridge, Western Maryland R.R.				
Gunpowder Falls						49.4	Bridge, Falls Road				
Gunpowder Falls						49.3	Mouth of Muddy Creek				
Muddy Creek							Head of Muddy Creek in Pa.				
Muddy Creek							State Line, Upstream - Pa. Downstream - Md.				
Muddy Creek							County Line, Upstream - Balto., Downstream - Carroll				
Muddy Creek						0.0	Mouth of Muddy Creek				
Gunpowder Falls						49.3	Mouth of Muddy Creek				
Gunpowder Falls						48.8	County Line, Upstream - Carroll Downstream - Baltimore				
Gunpowder Falls						47.5	Mouth of Walker Run				
Walker Run							Head of Walker Run				
Walker Run						0.0	Mouth of Walker Run				
Gunpowder Falls						47.5	Mouth of Walker Run				
Gunpowder Falls						46.7	Upper end of Pretty Boy Reser.				
Gunpowder Falls						46.7	Bridge, Clipper Mill Road				
Gunpowder Falls						45.5	Mouth of Georges Run				
Georges Run							Head of Georges Run				
Georges Run							Outfall, Dutterer's of Manchester, Inc.				
Georges Run							Outfall, Penn-Carroll Far- mers Co-op.				
Georges Run							County Line, Upstream - Carroll, Downstream - Balto.				
Georges Run						3.2	Bridge, Md. 25 at Armacost				

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES

LOCATION: RIVER MILE/DESCRIPTION

(Magnitude of Waterway)

(Magnitude of Waterway)

1	2	3	4	5	6	1	2	3	4	5	6
Georges Run						3.2/Gaging Station, Armacost, Md. (D. A. 13.0)					
Georges Run						0.0/Mouth of Georges Run (D. A. 20.9)					
Gunpowder Falls						45.5/Mouth of Georges Run					
Gunpowder Falls						43.8/Bridge, Beckleysville Road					
Gunpowder Falls						40.1/Lower end of Pretty Boy Reservoir (D. A. 79.8)					
Gunpowder Falls						38.7/Bridge Falls Road					
Gunpowder Falls						37.9/Bridge, Masemors Road					
Gunpowder Falls						37.8/Mouth of Cadin Run					
Cadin Run						/Head of Cadin Run					
Cadin Run						0.0/Mouth of Cadin Run					
Gunpowder Falls						37.8/Mouth of Cadin Run					
Gunpowder Falls						36.8/Mouth of Mingo Branch					
Mingo Branch						/Head of Mingo Branch					
Mingo Branch						0.0/Mouth of Mingo Branch					
Gunpowder Falls						36.8/Mouth of Mingo Branch					
Gunpowder Falls						36.5/Bridge, Bunker Hill Road					
Gunpowder Falls						35.7/Bridge, Harrisburg Expressway					
Gunpowder Falls						35.6/Bridge, Md. 45, York Road					
Gunpowder Falls						33.8/Mouth of Panther Branch					
Panther Branch						/Head of Panther Branch					
Panther Branch						0.0/Mouth of Panther Branch					
Gunpowder Falls						33.8/Mouth of Panther Branch					
Gunpowder Falls						33.4/Bridge, Big Falls Road					
Gunpowder Falls						32.6/Bridge, Blue Mount Road					
Gunpowder Falls						32.5/Mouth of Little Falls					
Little Falls						/Head of Little Falls					
Little Falls						15.0/Bridge, Keeney Mill Road					
Little Falls						14.0/Bridge, Freeland Road					
Little Falls						12.4/Bridge, Gores Mill Road					
Little Falls						12.0/Bridge, near Gores Mill Road					
Little Falls						11.7/Bridge, Gores Mill Road, near Gores Mill					
Little Falls						10.7/Bridge, Valley Mill Road					
Little Falls						10.6/Outfall, Freeland Paper Co.					
Little Falls						9.3/Bridge, Eagle Mill Road					
Little Falls						8.8/Mouth of Beetree Run					
Beetree Run						7.3/Head of Beetree Run, Pa.					
Beetree Run						6.6/Bridge, Secondary Road near New Freedom in York County, Pa.					
Beetree Run						6.2/Bridge, Secondary Road					
Beetree Run						6.1/State Line, Upstream - Pa. Downstream - Md.					
Beetree Run						5.6/Bridge, Secondary Road					
Beetree Run						5.2/Bridge, Oakland Road					
Beetree Run						4.3/Bridge, Md. #409					
Beetree Run						1.8/Bridge, Beetree Road					

Gunpowder River

SUB-BASIN

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
					Beetree Run					0.6	Bridge, Bentley Road
					Beetree Run					0.5	Bridge, Pennsylvania R.R.
					Beetree Run					0.0	Mouth of Beetree Run
					Little Falls					8.8	Mouth of Beetree Run
					Little Falls					7.8	Bridge, Walker Road
					Little Falls					7.4	Bridge, Stablers Church Road
					Little Falls					7.1	Bridge, Stablers Church Road
					Little Falls					6.6	Bridge, Baltimore-Harrisburg Expressway
					Little Falls					6.1	Mouth of Owl Branch
					Owl Branch						/Head of Owl Branch
					Owl Branch					0.0	Mouth of Owl Branch
					Little Falls					6.1	Mouth of Owl Branch
					Little Falls					5.7	Mouth of Fourth Mine Branch
					Fourth Mine Branch						/Head of Fourth Mine Branch
					Fourth Mine Branch					0.0	Mouth of Fourth Mine Branch
					Little Falls					5.7	Mouth of Fourth Mine Branch
					Little Falls					4.0	Mouth of Third Mine Branch
					Third Mine Branch						/Head of Third Mine Branch
					Third Mine Branch					0.0	Mouth of Third Mine Branch
					Little Falls					4.0	Mouth of Third Mine Branch
					Little Falls					2.8	Mouth of Second Mine Branch
					Second Mine Branch						/Head of Second Mine Branch
					Second Mine Branch					0.0	Mouth of Second Mine Branch
					Little Falls					2.8	Mouth of Second Mine Branch
					Little Falls					2.0	Outfall, Federal Paper Board Co.
					Little Falls					1.6	Mouth of First Mine Branch
					First Mine Branch						/Head of First Mine Branch
					First Mine Branch					0.0	Mouth of First Mine Branch
					Little Falls					1.6	Mouth of First Mine Branch
					Little Falls					0.6	Bridge, Pennsylvania R.R. (D. A. 52.9)
					Little Falls					0.6	Gaging Station, Blue Mount, Md. (D. A. 52.9)
					Little Falls					0.0	Mouth of Little Falls (D. A. 53.1)
					Gunpowder Falls					32.5	Mouth of Little Falls
					Gunpowder Falls					30.0	Bridge, Monkton Road
					Gunpowder Falls					29.2	Bridge, Pennsylvania R.R.
					Gunpowder Falls					28.4	Bridge, Corbett Road
					Gunpowder Falls					27.4	Bridge, Pennsylvania R.R.
					Gunpowder Falls					26.9	Bridge, Pennsylvania R.R.
					Gunpowder Falls					25.8	Bridge, Glencoe Road
					Gunpowder Falls					25.8	Gaging Station, Glencoe, Md. (D. A. 160.0)
					Gunpowder Falls					25.1	Mouth of Piney Creek
					Piney Creek						/Head of Piney Creek
					Piney Creek					0.0	Mouth of Piney Creek
					Gunpowder Falls					25.1	Mouth of Piney Creek
					Gunpowder Falls					25.0	Bridge, Sparks Road

Gunpowder River

SUB-BASIN

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
						24.2					Mouth of Carroll Branch
											/Head of Carroll Branch
						0.0					Mouth of Carroll Branch
						24.2					Mouth of Carroll Branch
						23.7					Bridge, Philpot Road
						22.5					Mouth of Green Branch
											/Head of Green Branch
						0.0					Mouth of Green Branch
						22.5					Mouth of Green Branch
						22.4					Bridge, Pennsylvania R.R.
						22.0					Bridge, Ashland Avenue
						21.5					Mouth of Western Run
											/Head of Western Run
						12.8					Mouth of Delaware Run
											/Head of Delaware Run
						1.1					Mouth of Slade Run
											/Head of Slade Run
						1.1					Gaging Station, near Glyndon, Md. (D. A. 2.09)
						0.0					Mouth of Slade Run
						1.1					Mouth of Slade Run
						0.0					Mouth of Delaware Run
						12.8					Mouth of Delaware Run
						12.8					Bridge, Belmont Road
						11.6					Mouth of McGill Run
											/Head of McGill Run
						0.0					Mouth of McGill Run
						11.6					Mouth of McGill Run
						10.8					Bridge, Mill Road
						10.7					Mouth of Deadman Run
											/Head of Deadman Run
						0.0					Mouth of Deadman Run
						10.7					Mouth of Deadman Run
						8.6					Bridge, Falls Road, Md. #25
						8.4					Mouth of Blackrock Run
											/Head of Blackrock Run
						1.6					Gaging Station, Coopersville, Md. (D. A. 9.38)
						1.5					Mouth of Indian Run (D.A.14.9)
											/Head of Indian Run
						0.0					Mouth of Indian Run
						1.5					Mouth of Indian Run
						0.0					Mouth of Blackrock Run
						8.4					Mouth of Blackrock Run
						8.0					Bridge, Cuba Road
						6.6					Outfall, Donald S. Stubbs Co.
						6.1					Dam Site, Butler No. 1
						5.3					Dam at Western Run
						5.1					Bridge, Western Run Road

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
					Western Run					5.0	/Gaging Station, Western Run, Md. (D. A. 59.8)
					Western Run					3.9	/Bridge, Harrisburg Expressway
					Western Run					2.8	/Outfall, Bonnie Blink Sewage Treatment Plant
					Western Run					2.6	/Bridge, York Road (Md. #45)
					Western Run					1.4	/Mouth of Beaverdam Run
					Beaverdam Run						/Head of Beaverdam Run
					Beaverdam Run					2.2	/Gaging Station, Coopersville, Md. (D. A. 20.8)
					Beaverdam Run					2.2	/Bridge, U. S. 111 (Balto. - Harrisburg Expressway (D. A. 20.8)
					Beaverdam Run					1.6	/Mouth of Goodwin Run
					Goodwin Run						/Head of Goodwin Run
					Goodwin Run					1.3	/Outfall, Harry T. Campbell Sons, Corp.
					Goodwin Run					0.0	/Mouth of Goodwin Run
					Beaverdam Run					1.6	/Mouth of Goodwin Run
					Beaverdam Run					1.4	/Outfall, Maryland Pigment and Research Corp.
					Beaverdam Run					1.2	/Outfall, Veneers, Inc.
					Beaverdam Run					1.1	/Outfall, Arrow Cartons
					Beaverdam Run					1.0	/Outfall, Beaverdam Veneer Mills
					Beaverdam Run					0.9	/Mouth of Parks Run
					Parks Run						/Head of Parks Run
					Parks Run					0.1	/Outfall, Md. Fine & Specialty Wire Co.
					Parks Run					0.0	/Mouth of Parks Run
					Beaverdam Run					0.9	/Mouth of Parks Run
					Beaverdam Run					0.6	/Outfall, Cockeysville Distilling Co., Inc.
					Beaverdam Run					0.5	/Outfall, The Williamson Veneer Co.
					Beaverdam Run					0.45	/Outfall, Hill House Dairy
					Beaverdam Run					0.0	/Mouth of Beaverdam Run (D. A. 21.2)
					Western Run					1.4	/Mouth of Beaverdam Run
					Western Run					0.0	/Mouth of Western Run (D. A. 85.4)
					Gunpowder Falls					21.5	/Mouth of Western Run
					Gunpowder Falls					20.6	/Bridge, Md. #143 (Warren Road)
					Gunpowder Falls					20.6	/Upstream end of Loch Raven Reservoir
					Gunpowder Falls					20.6	/Bridge, Dulaney Valley Road
					Gunpowder Falls					15.6	/Bridge, Loch Raven Road
					Gunpowder Falls					14.3	/Mouth of Long Quarter Branch
					Long Quarter Branch						/Head of Long Quarter Branch
					Long Quarter Branch					3.7	/Outfall, Towson Washmobile
					Long Quarter Branch					2.3	/Head of arm of Loch Raven Reservoir

SUB-BASIN

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
					Long Quarter Branch						0.0/Mouth of Long Quarter Branch
					Gunpowder Falls						14.3/Mouth of Long Quarter Branch
					Gunpowder Falls						13.8/Intake, Baltimore City (D.A. 303)
					Gunpowder Falls						13.8/Downstream end of Loch Raven Reservoir (D.A. 303)
					Gunpowder Falls						13.6/Old Dam, below Loch Raven Dam (D.A. 304)
					Gunpowder Falls						13.5/Mouth of Minebank Run
					Minebank Run						3.4/Head of Minebank Run
					Minebank Run						3.2/Outfall, The Murray Corp.
					Minebank Run						2.7/Outfall, The Bendix Corp.
					Minebank Run						0.0/Mouth of Minebank Run
					Gunpowder Falls						13.5/Mouth of Minebank Run
					Gunpowder Falls						/Outfall, Loch Raven Sewage Treatment Plant
					Gunpowder Falls						12.5/Bridge, Cromwell Bridge
					Gunpowder Falls						12.0/Mouth of Cowen Branch
					Cowen Branch						/Head of Cowen Branch
					Cowen Branch						0.3/Mouth of Unnamed Tributary
					Unnamed Tributary						/Head of Unnamed Tributary
					Unnamed Tributary						1.5/Outfall, North-Cliff Rest Home
					Unnamed Tributary						0.0/Mouth of Unnamed Tributary
					Cowen Branch						0.3/Mouth of Unnamed Tributary
					Cowen Branch						0.0/Mouth of Cowen Branch
					Gunpowder Falls						12.0/Mouth of Cowen Branch
					Gunpowder Falls						12.0/Outfall, Md. Training School for Boys
					Gunpowder Falls						11.9/Bridge, Md. and Pa. Railroad
					Gunpowder Falls						11.5/Outfall, Notch Cliff Sewage Treatment Plant
					Gunpowder Falls						11.3/Big Gunpowder dam site
					Gunpowder Falls						11.0/Gaging Station, Carney, Md. (D. A. 314.0)
					Gunpowder Falls						10.6/Sampling Station, Md. Water Pollution Control Commission
					Gunpowder Falls						10.6/Bridge, Md. 147 (Harford Road)
					Gunpowder Falls						10.4/Mouth of Jenifer Run
					Jenifer Run						/Head of Jenifer Run
					Jenifer Run						0.5/Outfall, Carney Sewage Treatment Plant
					Jenifer Run						0.0/Mouth of Jenifer Run
					Gunpowder Falls						10.4/Mouth of Jenifer Run
					Gunpowder Falls						7.5/Mouth of Long Green Creek
					Long Green Creek						/Head of Long Green Creek
					Long Green Creek						4.2/Bridge, Hydes Road
					Long Green Creek						3.2/Bridge, Long Green Road
					Long Green Creek						2.1/Bridge, Glenarm Road
					Long Green Creek						1.2/Bridge, Md. #147, Harford Road

Gunpowder River

SUB-BASIN

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
					Long Green Creek				1.0	/	Head of Perennial part of Long Green Creek
					Long Green Creek				0.0	/	Mouth of Long Green Creek
					Gunpowder Falls				7.5	/	Mouth of Long Green Creek
					Gunpowder Falls				7.3	/	Mouth of Sweathouse Branch
					Sweathouse Branch					/	Head of Sweathouse Branch
					Sweathouse Branch				0.0	/	Mouth of Sweathouse Branch
					Gunpowder Falls				7.3	/	Mouth of Sweathouse Branch
					Gunpowder Falls				6.1	/	Sampling Station, Md. Water Pollution Control Commission
					Gunpowder Falls				6.1	/	Bridge, Bel Air Road (U.S. #1)
					Gunpowder Falls				5.5	/	Outfall, Richlyn Manor Sewage Treatment Plant
					Gunpowder Falls				5.2	/	Mouth of Broad Run
					Broad Run					/	Head of Broad Run
					Broad Run				0.0	/	Mouth of Broad Run
					Gunpowder Falls				5.2	/	Mouth of Broad Run
					Gunpowder Falls				4.7	/	Outfall, Forge Heights
					Gunpowder Falls				3.7	/	Sampling Station, Md. Water Pollution Control Commission
					Gunpowder Falls				3.7	/	Bridge, Md. #7
					Gunpowder Falls				3.7	/	Upstream limit of license-free tidewater fishing
					Gunpowder Falls				3.2	/	Outfall, Paul Jones & Co.
					Gunpowder Falls				3.0	/	Bridge, B & O Railroad
					Gunpowder Falls				2.7	/	Bridge, U. S. #40
					Gunpowder Falls				2.7	/	Sampling Station, Md. Water Pollution Control Commission
					Gunpowder Falls				0.6	/	Mouth of Little Gunpowder Falls
					Little Gunpowder Falls***				24.5	/	Head of Little Gunpowder Falls
					Little Gunpowder Falls				22.6	/	Bridge, York Road
					Little Gunpowder Falls				21.8	/	Bridge, Houcks Mill Road
					Little Gunpowder Falls				21.6	/	Mouth of Thornton Branch
					Thornton Branch					/	Head of Thornton Branch
					Thornton Branch				0.0	/	Mouth of Thornton Branch
					Little Gunpowder Falls				21.6	/	Mouth of Thornton Branch
					Little Gunpowder Falls				20.6	/	Bridge, Hutchins Mill Road
					Little Gunpowder Falls				19.9	/	Mouth of Nelson Branch
					Nelson Branch					/	Head of Nelson Branch
					Nelson Branch				0.0	/	Mouth of Nelson Branch
					Little Gunpowder Falls				19.9	/	Mouth of Nelson Branch
					Little Gunpowder Falls				19.0	/	Bridge, Hess Road
					Little Gunpowder Falls				19.0	/	Gaging Station, Hess, Md. (D.A. 16.5)
					Little Gunpowder Falls				18.2	/	Bridge, Jarrettsville Road
					Little Gunpowder Falls				16.5	/	Mouth of Sawmill Branch
					Sawmill Branch					/	Head of Sawmill Branch
					Sawmill Branch				0.0	/	Mouth of Sawmill Branch
					Little Gunpowder Falls				16.5	/	Mouth of Sawmill Branch

DRAINAGE BASIN

Gunpowder River

SUB-BASIN

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
					Little Gunpowder Falls					15.4	/Bridge, Green Road
					Little Gunpowder Falls					13.8	/Sampling Station, Md. Water Pollution Control Commission
					Little Gunpowder Falls					13.8	/Bridge, Md. #165
					Little Gunpowder Falls					12.9	/Upper Covered Bridge Dam Site No. 7
					Little Gunpowder Falls					12.6	/Covered Bridge Dam Site No. 3
					Little Gunpowder Falls					12.4	/Bridge, Pleasantville Road
					Little Gunpowder Falls					11.7	/Bridge, Md. & Pa. Railroad
					Little Gunpowder Falls					10.7	/Gaging Station, Laurel Brook, Md. (D. A. 36.1)
					Little Gunpowder Falls					10.5	/Bridge, Bottom Road
					Little Gunpowder Falls					8.4	/Bridge, Md. #147 (Harford Road)
					Little Gunpowder Falls					8.4	/Sampling Station, Md. Water Pollution Control Commission
					Little Gunpowder Falls					8.1	/Outfall, E. H. Tolzman & Sons, Inc.
					Little Gunpowder Falls					7.9	/Outfall, Resolute Paper Co.
					Little Gunpowder Falls					7.5	/Bridge, U. S. #1 (Belair Road) (D. A. 43.0)
					Little Gunpowder Falls					7.5	/Gaging Station, Bel Air, Md. (D. A. Approximately 43.0)
					Little Gunpowder Falls					7.5	/Sampling Station, Md. Water Pollution Control Commission
					Little Gunpowder Falls					6.8	/Mouth of Wildcat Branch
					Wildcat Branch						/Head of Wildcat Branch
					Wildcat Branch					0.0	/Mouth of Wildcat Branch
					Little Gunpowder Falls					6.8	/Mouth of Wildcat Branch
					Little Gunpowder Falls					5.8	/Bridge, Jerusalem Road
					Little Gunpowder Falls						/Intake, The Belko Corp.
					Little Gunpowder Falls					4.5	/Outfall, The Belko Corp.
					Little Gunpowder Falls					4.1	/Sampling Station, Md. Water Pollution Control Commission
					Little Gunpowder Falls					2.5	/Bridge, Md. #7
					Little Gunpowder Falls					2.5	/Sampling Station, Md. Water Pollution Control Commission
					Little Gunpowder Falls					2.5	/Upstream limit of license-free tidewater fishing
					Little Gunpowder Falls					2.3	/Bridge, B & O Railroad
					Little Gunpowder Falls					2.2	/Bridge, U. S. #40
					Little Gunpowder Falls					2.2	/Sampling Station, Md. Water Pollution Control Commission
					Little Gunpowder Falls					2.0	/Outfall, Joppatowne
					Little Gunpowder Falls					1.9	/Intake, Joppa Sand & Gravel Co.
					Little Gunpowder Falls					1.4	/Outfall, Joppa Sand & Gravel Co.
					Little Gunpowder Falls					0.5	/Sampling Station, Md. Water Pollution Control Commission
					Little Gunpowder Falls					0.0	/Mouth of Little Gunpowder Falls (D. A. 58.3)
					Gunpowder Falls					0.6	/Mouth of Little Gunpowder Falls

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
					Gunpowder Falls						0.0/Mouth of Gunpowder Falls (D.A. 350.1)
					Gunpowder River						8.5/Mouth of Gunpowder Falls
					Gunpowder River						8.4/Days Cove
					Gunpowder River						8.1/Mouth of Bird River
					Bird River						2.1/Head of Bird River
					Bird River						1.9/Mouth of Whitemarsh Run
					Whitemarsh Run						8.4/Head of Whitemarsh Run
					Whitemarsh Run						6.3/Outfall, Ark Readi-Mix Concrete Corp. and Nottingham Farms
					Whitemarsh Run						6.2/Bridge, Belair Road (U. S. #1)
					Whitemarsh Run						6.0/Outfall, Perry Hall Sewage Treatment Plant
					Whitemarsh Run						2.9/Gaging Station, Whitemarsh, Md. (D. A. 7.61)
					Whitemarsh Run						2.9/Bridge, Md. #7 at Whitemarsh, Md. (D. A. 7.61)
					Whitemarsh Run						2.6/Outfall, H. T. Campbell Sons, Corp.
					Whitemarsh Run						2.5/Bridge, B & O Railroad
					Whitemarsh Run						2.4/Bridge, U. S. Highway #40
					Whitemarsh Run						1.8/Bridge, Secondary road near Whitemarsh, Md. (D. A. 15.9)
					Whitemarsh Run						1.0/Mouth of Honeygo Run
					Honeygo Run						/Head of Honeygo Run
					Honeygo Run						0.9/Bridge, Md. #7
					Honeygo Run						0.6/Bridge, B & O Railroad
					Honeygo Run						0.0/Mouth of Honeygo Run
					Whitemarsh Run						1.0/Mouth of Honeygo Run
					Whitemarsh Run						0.0/Mouth of Whitemarsh Run
					Bird River						1.9/Mouth of Whitemarsh Run
					Bird River						0.0/Mouth of Bird River (D. A. 26.7)
					Gunpowder River						8.1/Mouth of Bird River
					Gunpowder River						7.5/Bridge, Pa. Railroad (Electric)
					Gunpowder River						6.6/Mouth of Reardon Inlet
					Reardon Inlet						/Head of Reardon Inlet
					Reardon Inlet						0.0/Mouth of Reardon Inlet
					Gunpowder River						6.6/Mouth of Reardon Inlet
					Gunpowder River						5.5/Mouth of Wright Creek
					Wright Creek						/Head of Wright Creek
					Wright Creek						0.0/Mouth of Wright Creek
					Gunpowder River						5.5/Mouth of Wright Creek
					Gunpowder River						5.0/Mouth of Swaderick Creek
					Swaderick Creek						/Head of Swaderick Creek
					Swaderick Creek						0.0/Mouth of Swaderick Creek
					Gunpowder River						5.0/Mouth of Swaderick Creek
					Gunpowder River						4.4/Mouth of Cunninghamhill Cove
					Cunninghill Cove						/Head of Cunninghamhill Cove
					Cunninghill Cove						0.0/Mouth of Cunninghamhill Cove
					Gunpowder River						4.4/Mouth of Cunninghamhill Cove

DRAINAGE BASIN

Gunpowder River

SUB-BASIN

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES							LOCATION: RIVER MILE/DESCRIPTION						
(Magnitude of Waterway)							(Magnitude of Waterway)						
1	2	3	4	5	6		1	2	3	4	5	6	
						Gunpowder River	2.5					Mouth of Saltpeter Creek	
						Saltpeter Creek						/Head of Saltpeter Creek	
						Saltpeter Creek	1.3					Mouth of Dundee Creek	
						Dundee Creek						/Head of Dundee Creek	
						Dundee Creek	0.0					Mouth of Dundee Creek	
						Saltpeter Creek	1.3					Mouth of Dundee Creek	
						Saltpeter Creek	1.3					Outfall, Charles P. Crane Steam-	
												Electric Station (Baltimore Gas	
												and Electric Company)	
						Saltpeter Creek	0.0					Mouth of Saltpeter Creek	
						Gunpowder River	2.5					Mouth of Saltpeter Creek	
						Gunpowder River	0.0					Mouth of Gunpowder River (D. A. 471.5)	
CHESAPEAKE BAY, WESTERN SHORE							169.0					Mouth of Gunpowder River	

D. A. Drainage Area, square miles

* Gunpowder River is boundary between Baltimore and Harford Counties, Maryland.

** Gunpowder Falls is boundary between Baltimore and Harford Counties, Maryland.

*** Little Gunpowder Falls is boundary between Baltimore and Harford Counties, Maryland.

January, 1965

Appendix A

CHESAPEAKE BAY, WESTERN SHORE

DRAINAGE BASIN

Direct Drainage and Minor Tributaries

SUB-BASIN

(From Lower Island Point* to North Point**)

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)							LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)						
1	2	3	4	5	6		1	2	3	4	5	6	
CHESAPEAKE BAY, WESTERN SHORE							168.9	Lower Island Point at mouth of Gunpowder River, Baltimore County, Maryland					
CHESAPEAKE BAY							168.8	Mouth of Hawthorn Creek					
Hawthorn Creek								Head of Hawthorn Creek					
Hawthorn Creek							0.0	Mouth of Hawthorn Creek					
CHESAPEAKE BAY							168.8	Mouth of Hawthorn Creek					
CHESAPEAKE BAY							168.7	Mouth of Seneca Creek					
Seneca Creek								Head of Seneca Creek					
Seneca Creek							0.8	Intake, Charles P. Crane, Steam-Electric Generating Station					
Seneca Creek							0.0	Mouth of Seneca Creek					
CHESAPEAKE BAY							168.7	Mouth of Seneca Creek					
CHESAPEAKE BAY							168.5	Mouth of Middle River					
Middle River								Head of Middle River					
Middle River							4.9	Bridge, Md. Highway 493					
Middle River							4.8	Bridge, Pennsylvania Railroad					
Middle River							4.5	Bridge, Eastern Avenue (Md. 150)					
Middle River							3.5	Mouth of Hopkins Creek					
Hopkins Creek								Head of Hopkins Creek					
Hopkins Creek							0.3	Benjamin S. Markley Boatyard					
Hopkins Creek							0.0	Mouth of Hopkins Creek					
Middle River							3.5	Mouth of Hopkins Creek					
Middle River							3.1	Mouth of Darkhead Creek					
Darkhead Creek								Head of Darkhead Creek					
Darkhead Creek							0.8	Outfall, Martin Co., Division of Martin-Marietta, "D" Building					
Darkhead Creek							0.6	Mouth of Cow Pen Creek					
Cow Pen Creek								Head of Cow Pen Creek					
Cow Pen Creek							0.5	Outfall, Martin Co., Division of Martin-Marietta, "A" & "E" Buildings					
Cow Pen Creek							0.4	Outfall, Martin Co., "H" Bldg.					
Cow Pen Creek							0.3	Outfall, Martin Co., Division of Martin-Marietta, "A" Bldg.					
Cow Pen Creek							0.2	Outfall, Martin Co., "A", "M", & "P" Bldgs.					
Cow Pen Creek							0.0	Mouth of Cow Pen Creek					
Darkhead Creek							0.6	Mouth of Cow Pen Creek					
Darkhead Creek							0.0	Mouth of Darkhead Creek					
Middle River							3.1	Mouth of Darkhead Creek					
Middle River							2.3	Mouth of Norman Creek					
Norman Creek								Head of Norman Creek					
Norman Creek							0.0	Mouth of Norman Creek					
Middle River							2.3	Mouth of Norman Creek					
Middle River							2.1	Mouth of Hogpen Creek					
Hogpen Creek								Head of Hogpen Creek					
Hogpen Creek							0.0	Mouth of Hogpen Creek					
Middle River							2.1	Mouth of Hogpen Creek					

 

CHESAPEAKE BAY, WESTERN SHORE

DRAINAGE BASIN

Direct Drainage and Minor Tributaries

SUB-BASIN

(From Lower Island Point* to North Point**)

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
Middle River						2.0	/	Mouth of Frog Mortar Creek			
Frog Mortar Creek							/	Head of Frog Mortar Creek			
Frog Mortar Creek						2.0	/	Outfall, General Service Adminis-			
								tration			
Frog Mortar Creek						0.6	/	Long Beach Marina, Edwards Boat Yard			
Frog Mortar Creek						0.5	/	Outfall, Martin Co., Airport			
Frog Mortar Creek						0.5	/	Seaplane Base Ramp			
Frog Mortar Creek						0.2	/	Mouth of Stansbury Creek			
Stansbury Creek							/	Head of Stansbury Creek			
Stansbury Creek						0.0	/	Mouth of Stansbury Creek			
Frog Mortar Creek						0.2	/	Mouth of Stansbury Creek			
Frog Mortar Creek						0.0	/	Mouth of Frog Mortar Creek			
Middle River						2.0	/	Mouth of Frog Mortar Creek			
Middle River						1.1	/	Mouth of Galloway Creek			
Galloway Creek							/	Head of Galloway Creek			
Galloway Creek						0.0	/	Mouth of Galloway Creek			
Middle River						1.1	/	Mouth of Galloway Creek			
Middle River						0.6	/	Mouth of Sue Creek			
Sue Creek							/	Head of Sue Creek			
Sue Creek						0.0	/	Baltimore Yacht Club on Sue Island			
Sue Creek						0.0	/	Mouth of Sue Creek			
Middle River						0.6	/	Mouth of Sue Creek			
Middle River						0.0	/	Mouth of Middle River			
CHESAPEAKE BAY						168.5	/	Mouth of Middle River			
CHESAPEAKE BAY						167.6	/	Breezy Point Beach			
CHESAPEAKE BAY						167.2	/	Mouth of Browns Creek			
Browns Creek						0.5	/	Head of Browns Creek			
Browns Creek						0.0	/	Mouth of Browns Creek			
CHESAPEAKE BAY						167.2	/	Mouth of Browns Creek			
CHESAPEAKE BAY						167.0	/	Island View Beach			
CHESAPEAKE BAY						165.4	/	Mouth of Back River			
Back River						9.2	/	Head of Back River			
Back River						9.2	/	Mouth of Herring Run			
Herring Run							/	Head of Herring Run			
Herring Run						9.9	/	Outfall, Friez Instrument Division			
								Bendix Corp.			
Herring Run						9.9	/	Outfall, American Totalizator Co.			
Herring Run						9.9	/	Outfall, Black & Decker Company			
Herring Run						8.9	/	County Line, Upstream - Baltimore			
								County, Downstream - Balto. City			
Herring Run							/	Mouth of West Branch, Herring Run			
West Branch, Herring Run							/	Head of West Branch, Herring			
								Run			
West Branch, Herring Run						1.4	/	Outfall, Ready-mixed concrete			
								plant			
West Branch, Herring Run						0.0	/	Mouth of West Branch, Herring			
								Run			
Herring Run							/	Mouth of West Branch, Herring Run			

DRAINAGE BASIN

SUB-BASIN

(From Lower Island Point* to North Point**)

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
				Herring Run		7.4	/Bridge,	Echodale Avenue			
				Herring Run		6.6	/Mouth of Chinquapin Run				
				Chinquapin Run			/Head of Chinquapin Run				
				Chinquapin Run		2.0	/Bridge,	Northern Parkway			
				Chinquapin Run		1.5	/Bridge,	Belvedere Avenue			
				Chinquapin Run		1.2	/Bridge,	Beauregard Avenue			
				Chinquapin Run		1.0	/Bridge,	Woodburne Avenue			
				Chinquapin Run		0.6	/Bridge,	Loch Raven Boulevard			
				Chinquapin Run		0.2	/Bridge,	Hillen Road			
				Chinquapin Run		0.0	/Mouth of Chinquapin Run				
				Herring Run		6.6	/Mouth of Chinquapin Run				
				Herring Run		6.4	/Bridge,	Arlington Avenue			
				Herring Run		5.4	/Bridge,	Harford Road			
				Herring Run		4.4	/Bridge,	Belair Road			
				Herring Run		4.0	/Bridge,	Mannasota Avenue			
				Herring Run		2.9	/Mouth of Unnamed Tributary				
				Unnamed Tributary			/Head of Unnamed Tributary				
				Unnamed Tributary		1.2	/Outfall,	Lord Baltimore Press, Inc.			
				Unnamed Tributary		1.2	/Outfall,	O'Brien Corporation			
				Unnamed Tributary		1.1	/Outfall,	Continental Can Co., Plant No. 16			
				Unnamed Tributary		1.0	/Outfall,	Continental Can Co., Plant No. 79			
				Unnamed Tributary		1.0	/Bridge,	B & O Railroad			
				Unnamed Tributary		0.9	/Outfall,	Armco Steel			
				Unnamed Tributary		0.7	/Outfall,	McCall-Boykin Co., Inc.			
				Unnamed Tributary		0.7	/Bridge,	Erdman Avenue			
				Unnamed Tributary		0.6	/Outfall,	C. Hoffberger Co., Division of Gulf Oil Corp.			
				Unnamed Tributary		0.0	/Mouth of Unnamed Tributary				
				Herring Run		2.9	/Mouth of Unnamed Tributary				
				Herring Run		1.8	/Bridge,	General Pulaski Highway			
				Herring Run		1.6	/Bridge,	B & O Railroad			
				Herring Run		1.3	/County Line, Upstream - Baltimore City, Downstream - Balto. County				
				Herring Run		1.0	/Mouth of Moores Run				
				Moores Run			/Head of Moores Run, Balto. City				
				Moores Run		0.5	/Outfall,	Trailmobile, Inc.			
				Moores Run		0.5	/Bridge,	General Pulaski Highway			
				Moores Run		0.3	/Henry Siejac Sanitary Landfill				
				Moores Run		0.2	/Bridge,	B & O Railroad			
				Mocres Run		0.2	/County Line, Upstream - Balto. City, Downstream - Balto. County				
				Moores Run		0.0	/Mouth of Moores Run				
				Herring Run		1.0	/Mouth of Moores Run				
				Herring Run		0.1	/Mouth of Redhouse Creek				

DRAINAGE BASIN

SUB-BASIN

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

- 4 -

DRAINAGE BASIN

Direct Drainage and Minor Tributaries

SUB-BASIN

(From Lower Island Point* to North Point**)

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
					Bread and Cheese Creek			0.8			Bridge, Erdman Avenue
					Bread and Cheese Creek			0.1			Outfall, Baltimore Back River Sewage Treatment Plant
					Bread and Cheese Creek			0.0			Mouth of Bread and Cheese Creek
					Back River			6.9			Mouth of Bread and Cheese Creek
					Back River			6.3			Mouth of Deep Creek
					Deep Creek						/Head of Deep Creek
					Deep Creek			0.2			Mouth of Unnamed Tributary
					Dee Unnamed Tributary						/Head of Unnamed Tributary
					Unnamed Tributary			1.5			Outfall, Essex Hy-Grade Laundry I
					Unnamed Tributary			0.0			Mouth of Unnamed Tributary
					Deep Creek			0.2			Mouth of Unnamed Tributary
					Deep Creek			0.0			Mouth of Deep Creek
					Back River			6.3			Mouth of Deep Creek
					Back River			4.9			Mouth of Muddy Cut
					Muddy Cut						/Head of Muddy Cut
					Muddy Cut			0.0			Mouth of Muddy Cut
					Back River			4.9			Mouth of Muddy Cut
					Back River			3.0			Green Hill Cove
					Back River			0.3			Hawk Cove
					Back River			0.0			Mouth of Back River
					CHESAPEAKE BAY			165.4			Mouth of Back River
					CHESAPEAKE BAY			162.2			Mouth of Shallow Creek
					Shallow Creek						/Head of Shallow Creek
					Shallow Creek			0.0			Mouth of Shallow Creek
					CHESAPEAKE BAY			162.2			Mouth of Shallow Creek
					CHESAPEAKE BAY, WESTERN SHORE			161.7			North Point, Baltimore County

D. A. Drainage Area, square miles

** Lower Island Point is in Baltimore County, Maryland, at mouth of Gunpowder River.
** North Point is at Fort Howard in Baltimore County, Maryland, at mouth of Patapsco River.

January, 1965

Appendix A

CHESAPEAKE BAY, WESTERN SHORE

DRAINAGE BASIN

Patapsco River

SUB-BASIN

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
CHESAPEAKE BAY, WESTERN SHORE						160.4	Mouth of Patapsco River				
Patapsco River*						36.4	Head of Patapsco River				
Patapsco River						36.4	Mouth of North Branch Patapsco River				
North Branch						20.5	Head of North Branch, Carroll County				
North Branch						20.5	Mouth of East Branch of North Branch				
East Branch						8.9	Head of East Branch				
East Branch						7.4	Mouth of Unnamed Tributary				
Unnamed Tributary						1.2	Head of Unnamed Tributary				
Unnamed Tributary						1.2	Outfall, Greenmount Can Co.				
Unnamed Tributary						0.4	Outfall, Walsh Fuel Oil Co.				
Unnamed Tributary						0.0	Mouth of Unnamed Tributary				
East Branch						7.4	Mouth of Unnamed Tributary				
East Branch						7.2	Mouth of Unnamed Tributary				
Unnamed Tributary							Head of Unnamed Tributary				
Unnamed Tributary						0.9	Head of Cascade Lake near				
Unnamed Tributary							Snydersburg				
Unnamed Tributary						0.7	Dam, Cascade Lake near				
Unnamed Tributary							Snydersburg				
East Branch						0.0	Mouth of Unnamed Tributary				
East Branch						7.2	Mouth of Unnamed Tributary				
East Branch						7.1	Bridge, Md. 482				
East Branch						6.4	Mouth of Indian Run				
Indian Run							Head of Indian Run near				
Indian Run							Hampstead				
Indian Run						0.1	Bridge, Secondary Road near				
Indian Run							Shiloh				
East Branch						0.0	Mouth of Indian Run				
East Branch						6.4	Mouth of Indian Run				
East Branch						6.2	Bridge, Shiloh Road at Shiloh				
Aspen Run						4.4	Mouth of Aspen Run				
Aspen Run							Head of Aspen Run				
Aspen Run						2.8	Bridge, Md. 482 at Brummel				
White Oak Run						1.1	Mouth of White Oak Run				
White Oak Run							Head of White Oak Run				
Aspen Run						0.0	Mouth of White Oak Run				
Aspen Run						1.1	Mouth of White Oak Run				
East Branch						0.0	Mouth of Aspen Run				
East Branch						4.4	Mouth of Aspen Run				
East Branch						2.6	Bridge, Carroll Road				
East Branch						0.7	Bridge, Weley Road				
East Branch						0.0	Mouth of East Branch (D.A. 21.1)				
North Branch						20.5	Mouth of East Branch of North Branch				
North Branch						20.5	Mouth of West Branch of North Branch				
West Branch						9.3	Head of West Branch				
West Branch						8.0	Bridge, Lemmon Road				
West Branch						7.5	Bridge, Sullivan Road				
West Branch						6.5	Mouth of Unnamed Tributary				
Unnamed Tributary							Head of Unnamed Tributary				
Unnamed Tributary						1.0	Outfall, Koontz Dairy				

DRAINAGE BASIN

SUB-BASIN

MAIN WATERWAYS AND TRIBUTARIES

LOCATION: RIVER MILE/DESCRIPTION

(Magnitude of Waterway)

(Magnitude of Waterway)

- 2 -

DRAINAGE BASIN

SUB-BASIN

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
				North Branch		16.95					Dam, at Congoleum-Nairn Co., Inc.
				North Branch		16.9					Intake & Outfall, Congoleum-Nairn Co., Inc.
				North Branch		16.6					Gaging Station at Cedarhurst, Md. (D. A. 56.6)
				North Branch		16.5					Bridge, Md. 91 at Finksburg
				North Branch		16.5					Head of Liberty Lake Reservoir
				North Branch							Intake, Woodensburg, Md.
				North Branch		16.4					Outfall, Woodensburg School
				North Branch		15.7					Mouth of Unnamed Tributary
				Unnamed Tributary							Head of Unnamed Tributary near Reisterstown, Baltimore County
				Unnamed Tributary		0.6					Mouth of Unnamed Branch
				Unnamed Branch		1.6					Head of Unnamed Branch near Montrose School for Girls
				Unnamed Branch		0.71					Intake, Montrose School for Girls
				Unnamed Branch		0.7					Outfall, Montrose School for Girls
				Unnamed Branch		0.0					Mouth of Unnamed Branch
				Unnamed Tributary		0.6					Mouth of Unnamed Branch
				Unnamed Tributary		0.01					Bridge, Western Md. Railroad
				Unnamed Tributary		0.0					Bridge, Glen Falls Road
				Unnamed Tributary		0.0					County Line, Upstream - Baltimore Downstream - Carroll
				Unnamed Tributary		0.0					Mouth of Unnamed Tributary
				North Branch		15.7					Mouth of Unnamed Tributary
				North Branch		15.5					County Line, Upstream - Carroll Downstream - Baltimore
				North Branch**		15.4					Bridge, Westminster Pike, U. S. 140
				North Branch		15.0					Power transmission line crossing
				North Branch		13.7					Mouth of Keyzers Run
				Keyzers Run							Head of Keyzers Run
				Keyzers Run							Outfall, Child Rehabilitation Center, Reisterstown, Md.
				Keyzers Run		0.0					Mouth of Keyzers Run
				North Branch		13.7					Mouth of Keyzers Run
				North Branch		13.4					Mouth of Beaver Run
				Beaver Run							Head of Beaver Run
				Beaver Run							Mouth of Middle Run
				Middle Run							Head of Middle Run
				Middle Run		0.0					Mouth of Middle Run
				Beaver Run							Mouth of Middle Run
				Beaver Run		2.4					Gaging Station, Finksburg, Md. (D. A. 12.7)
				Beaver Run		0.01					Bridge, Md. 91 near Finksburg
				Beaver Run		0.0					Mouth of Beaver Run (D.A. 16.2)
				North Branch		13.4					Mouth of Beaver Run

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MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)

LOCATION: RIVER MILE/DESCRIPTION
(Magnitude of Waterway)

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DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES						LOCATION: RIVER MILE/DESCRIPTION					
(Magnitude of Waterway)						(Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
					Locust Run						0.0/Mouth of Locust Run
					North Branch						5.8/Mouth of Locust Run
					North Branch						5.1/Bridge, Highway Md. 26 (Liberty Rd.)
					North Branch						3.2/Intake, Baltimore City Bureau of Water Supply
					North Branch						3.2/Liberty Dam, Downstream end of Liberty Lake (D. A. 164.0)
					North Branch						2.3/Bridge, Marriottsville Road
					North Branch						2.3/Gaging Station, near Marriottsville, Md. (D. A. 165.0)
					North Branch						1.9/Mouth of Falls Run
					Falls Run						/Head of Falls Run near Hernwood
					Falls Run						1.6/Bridge, Powells Run Road
					Falls Run						0.6/Bridge, Marriottsville Road
					Falls Run						0.0/Mouth of Falls Run
					North Branch						1.9/Mouth of Falls Run
					North Branch						0.0/Mouth of North Branch (D. A. 171.0)
					Patapsco River						36.4/Mouth of North Branch Patapsco River
					Patapsco River						36.4/Mouth of South Branch Patapsco River
					South Branch						19.0/Head of South Branch in Howard Co.
					South Branch***						18.3/Bridge, Secondary Road near Parrsville
					South Branch						17.0/Bridge, U. S. Highway 40 near Parrsville
					South Branch						16.9/Bridge, Md. Highway 601
					South Branch						16.7/Bridge, Secondary Road near Mt. Airy
					South Branch						16.7/Bridge, B & O Railroad
					South Branch						14.8/Bridge, Md. Highway 532 at Watersville
					South Branch						14.1/Bridge, B & O Railroad
					South Branch						13.2/Mouth of Hay Meadow Branch
					Hay Meadow Branch						/Head of Hay Meadow Branch
					Hay Meadow Branch						2.9/Bridge, U. S. Highway 40 near Poplar Springs
					Hay Meadow Branch						1.6/Bridge, Md. Highway 532 near Watersville
					Hay Meadow Branch						0.0/Mouth of Hay Meadow Branch
					South Branch						13.2/Mouth of Hay Meadow Branch
					South Branch						12.5/Mouth of Gillis Falls
					Gillis Falls						/Head of Gillis Falls near Winfield, Carroll County, Md.
					Gillis Falls						8.4/Bridge, Md. Highway 26
					Gillis Falls						7.5/Bridge, Secondary Road near Winfield
					Gillis Falls						5.4/Bridge, Md. Highway 687 near Picketts Corner
					Gillis Falls						4.8/Mouth of Cabbage Spring Branch
					Cabbage Spring Branch						/Head of Cabbage Spring Br.
					Cabbage Spring Branch						0.0/Mouth of Cabbage Spring Br.
					Gillis Falls						4.8/Mouth of Cabbage Spring Branch

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
					Gillis Falls	3.8	/	Bridge, Secondary Road near Gosnell			
					Gillis Falls	2.9	/	Mouth of Middle Run			
					Middle Run		/	Head of Middle Run			
					Middle Run	1.3	/	Bridge, Secondary Road near Gosnell			
					Middle Run	0.0	/	Mouth of Middle Run			
					Gillis Falls	2.9	/	Mouth of Middle Run			
					Gillis Falls	0.1	/	Bridge, Unimproved road near New Port			
					Gillis Falls	0.0	/	Mouth of Gillis Falls (D.A. 19.3)			
					South Branch	12.5	/	Mouth of Gillis Falls			
					South Branch	12.4	/	Bridge, Secondary Road at New Port			
					South Branch	12.4	/	Mouth of Unnamed Tributary			
					Unnamed Tributary		/	Head of Unnamed Tributary			
					Unnamed Tributary	0.6	/	Outfall, J. Austin Pergory			
					Unnamed Tributary	0.0	/	Mouth of Unnamed Tributary			
					South Branch	12.4	/	Mouth of Unnamed Tributary			
					South Branch	12.3	/	Bridge, Md. Highway 94 at Woodbine			
					South Branch	12.2	/	Outfall, Hyman Viener & Sons Co.			
					South Branch	11.4	/	Outfall, Morgan Canning Co.			
					South Branch	11.4	/	Outfall, Essential Oils Co.			
					South Branch	11.3	/	Bridge, Md. Highway 476 at Morgan			
					South Branch	9.2	/	Bridge, Md. Highway 97 at Hoods Mill			
					South Branch	8.1	/	Mouth of Piney Branch			
					Piney Branch		/	Head of Piney Branch near Picketts Corner			
					Piney Branch	3.9	/	Bridge, Md. Highway 570 near Barrett			
					Piney Branch	3.2	/	Bridge, Secondary Road			
					Piney Branch	2.5	/	Mouth of Tuckers Branch			
					Tuckers Branch		/	Head of Tuckers Branch			
					Tuckers Branch	0.2	/	Bridge, Md. Highway 570			
					Tuckers Branch	0.0	/	Mouth of Tuckers Branch			
					Piney Branch	2.5	/	Mouth of Tuckers Branch			
					Piney Branch	0.0	/	Mouth of Piney Branch			
					South Branch	8.1	/	Mouth of Piney Branch			
					South Branch	7.7	/	Bridge, Secondary Road at Gaither			
					South Branch	6.3	/	Bridge, Md. Highway 32 at Sykesville			
					South Branch	5.5	/	Mouth of Unnamed Tributary			
					Unnamed Tributary		/	Head of Unnamed Tributary			
					Unnamed Tributary	0.6	/	Outfall, H. Renham & Sons			
					Unnamed Tributary	0.0	/	Mouth of Unnamed Tributary			
					South Branch	5.5	/	Mouth of Unnamed Tributary			
					South Branch	2.8	/	Outfall, Henryton State Hospital			
					South Branch	2.7	/	Bridge, Md. Highway 101 at Henryton			
					South Branch	2.7	/	Gaging Station, Henryton, Md. (D. A. 64.4)			
					South Branch	1.3	/	Bridge, Secondary Road at Marriotsville			

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
				South Branch						1.1	Mouth of Piney Run
				Piney Run							/Head of Piney Run
				Piney Run						12.6	Bridge, Secondary Road near Dorsey Crossroads
				Piney Run						11.4	Mouth of Buckhorn Run
				Buckhorn Run							/Head of Buckhorn Run
				Buckhorn Run						0.0	Mouth of Buckhorn Run
				Piney Run						11.4	Mouth of Buckhorn Run
				Piney Run						10.6	Bridge, Md. Highway 570 near Barrett
				Piney Run						6.1	Bridge, Md. Highway 32 near Sykesville
				Piney Run						6.1	Gaging Station, Sykesville, Md. (D. A. 11.4)
				Piney Run						6.0	Intake, Springfield State Hospital
				Piney Run						5.6	Bridge, Secondary road at Springfield State Hospital
				Piney Run						5.5	Outfall, Sykesville-Springfield State Hospital
				Piney Run						0.0	Mouth of Piney Run (D.A. 18.2)
				South Branch						1.1	Mouth of Piney Run
				South Branch						0.0	Mouth of South Branch (D.A. 85.7)
				Patapsco River						36.4	Mouth of South Branch
				Patapsco River****						34.7	Bridge, Md. 125 at Woodstock
				Patapsco River						34.7	Gaging Station, Woodstock, Md. (D.A. 260.0)
				Patapsco River						33.4	Mouth of Davis Branch
				Davis Branch							/Head of Davis Branch
				Davis Branch						0.0	Mouth of Davis Branch
				Patapsco River						33.4	Mouth of Davis Branch
				Patapsco River						32.2	Bridge, B & O Railroad
				Patapsco River						30.6	Mouth of Brice Run
				Brice Run							/Head of Brice Run
				Brice Run						2.0	Mouth of Granite Branch
				Granite Branch							/Head of Granite Branch
				Granite Branch						1.6	Bridge, Md. Highway 125 near Granite
				Granite Branch						0.0	Mouth of Granite Branch
				Brice Run						2.0	Mouth of Granite Branch
				Brice Run						0.0	Mouth of Brice Run
				Patapsco River						30.6	Mouth of Brice Run
				Patapsco River						29.8	Bridge, B & O Railroad at Daniels
				Patapsco River						29.75	Town of Albertain
				Patapsco River							/Outfall, Woodstock, Md.
				Patapsco River						29.6	Outfall, C. R. Daniels
				Patapsco River						29.4	Bridge, Secondary Road at Daniels

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
Patapsco River						28.6	/Mouth of Dogwood Run				
Dogwood Run							/Head of Dogwood Run				
Dogwood Run						0.5	/Bridge, Dogwood Road near Hollofield				
Dogwood Run						0.3	/Mouth of Bens Run				
Bens Run							/Head of Bens Run				
Bens Run						0.3	/Bridge, Secondary Road near Hollofield				
Bens Run						0.0	/Mouth of Bens Run				
Dogwood Run						0.3	/Mouth of Bens Run				
Dogwood Run						0.1	/Bridge, Secondary Road at Hollofield				
Dogwood Run						0.0	/Mouth of Dogwood Run				
Patapsco River						28.6	/Mouth of Dogwood Run				
Patapsco River						28.3	/Bridge, Secondary Road at Hollofield				
Patapsco River						28.3	/Gaging Station, Hollofield, Md.				
Patapsco River						27.5	/Upstream boundary of Patapsco State Park				
Patapsco River						26.7	/Mouth of Cedar Branch				
Cedar Branch							/Head of Cedar Branch				
Cedar Branch						0.0	/Mouth of Cedar Branch				
Patapsco River						26.7	/Mouth of Cedar Branch				
Patapsco River						26.5	/Mouth of Miller Run				
Miller Run							/Head of Miller Run				
Miller Run						0.0	/Mouth of Miller Run				
Patapsco River						26.5	/Mouth of Miller Run				
Patapsco River						26.5	/Bridge, U. S. Highway 40				
Patapsco River						26.4	/Union Dam				
Patapsco River						24.8	/Intake & Outfall, W. J. Dickey & Sons Corp. (Oella)				
Patapsco River						24.6	/Mouth of Sucker Branch				
Sucker Branch							/Head of Sucker Branch near Rockland, Howard County				
Sucker Branch						1.9	/Bridge, Md. Highway 99 near Rockland				
Sucker Branch						1.7	/Bridge, U. S. Highway 40 near Ellicott City				
Sucker Branch						0.2	/Upstream boundary of Patapsco State Park				
Sucker Branch						0.0	/Mouth of Sucker Branch				
Patapsco River						24.6	/Mouth of Sucker Branch				
Patapsco River						24.2	/Mouth of Tiber Creek				
Tiber Creek							/Head of Tiber Creek				
Tiber Creek						1.7	/Outfall, Howard County Farmers Coop.				
Tiber Creek						1.5	/Outfall, Ellicott City Area				
Tiber Creek						0.6	/Outfall, Howard-Baltimore Cleaners				
Tiber Creek						0.1	/Outfall, E. F. Harscher				
Tiber Creek						0.0	/Mouth of Tiber Creek				
Patapsco River						24.2	/Mouth of Tiber Creek				
Patapsco River							/Mouth of Hudson Creek				

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterways)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterways)					
1	2	3	4	5	6	1	2	3	4	5	6
											/Head of Hudson Creek
											/Outfall, Ellicott City
						0.0					Mouth of Hudson Creek
											/Mouth of Hudson Creek
						24.2					Bridge, Md. Highway 144 at Ellicott City
						24.1					Outfall, Doughnut Corp. of America
						23.9					Mouth of Cooper Branch
											/Head of Cooper Branch
						0.8					Outfall, Baltimore County Cooper Branch Treatment Plant
						0.4					Bridge, Railroad Bridge near Ellicott City
						0.0					Mouth of Cooper Branch
						23.9					Mouth of Cooper Branch
						22.2					Diversion Dam at Ilchester
						22.2					Intake & Outfall, Ilchester, Bartgis Div., New Haven Board & Carton Co.
						22.2					Intake, Ilchester
						21.9					Bridge, Secondary Road at Ilchester
						21.8					Bridge, B & O Railroad at Ilchester
						21.7					Outfall, St. Mary's College
						18.9					Bridge, Gum Road
						18.7					Upstream limit of license-free tide-water fishing
						18.6					Mouth of Rockburn Branch
											/Head of Rockburn Branch near Jonestown, Howard County
						0.0					Mouth of Rockburn Branch (D.A. 3.71)
						18.6					Mouth of Rockburn Branch
						18.6					Mouth of Soapstone Branch
											/Head of Soapstone Branch
						0.0					Mouth of Soapstone Branch
						18.6					Mouth of Soapstone Branch
						18.2					Bridge, B & O Railroad
						17.65					Bridge, Alternate Highway U.S. 1
						17.6					Bridge, U. S. 1
						17.4					Outfall, Elkridge Laundry
						16.9					Mouth of Deep Run
											/Head of Deep Run near Jonestown
											/Bridge, B & O Railroad at Dorsey
											/County Line, Upstream - Howard,
											Downstream - Anne Arundel
											/Bridge, Secondary Road near Han-
											over
						0.0					Mouth of Deep Run
						16.9					Mouth of Deep Run
						16.85					Outfall, Friendship Airport Sewage Treatment Plant

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
Patapsco River						16.8	Mouth of Stony Run				
Stony Run						---	Head of Stony Run				
Stony Run						---	Intake, Joseph Seagram				
Stony Run						0.0	Mouth of Stony Run (D. A. 3.05)				
Patapsco River						16.8	Mouth of Stony Run				
Patapsco River						16.5	Bridge, Pennsylvania Railroad				
Patapsco River						16.1	Mouth of Herbert Run				
Herbert Run						0.9	Head of Herbert Run				
Herbert Run						0.9	Mouth of East Branch				
East Branch						4.0	Head of East Branch				
East Branch						0.0	Mouth of East Branch				
Herbert Run						0.9	Mouth of East Branch				
Herbert Run						0.9	Mouth of West Branch				
West Branch						2.8	Head of West Branch				
West Branch						0.0	Mouth of West Branch				
Herbert Run						0.9	Mouth of West Branch				
Herbert Run						0.0	Mouth of Herbert Run				
Patapsco River						16.1	Mouth of Herbert Run				
Patapsco River						14.7	Bridge, Interstate 695				
Patapsco River						14.65	Mouth of Unnamed Tributary				
Unnamed Tributary						---	Head of Unnamed Tributary				
Unnamed Tributary						1.5	Outfall, Lansdowne Division Westinghouse Electric Corp.				
Unnamed Tributary						0.0	Mouth of Unnamed Tributary				
Patapsco River						14.65	Mouth of Unnamed Tributary				
Patapsco River						14.6	Bridge, Md. Highway 167 (Hammonds Ferry Road)				
Patapsco River						13.9	Bridge, Baltimore-Washington Expressway				
Patapsco River						13.4	Bridge, Md. Highway 648				
Patapsco River						13.1	Bridge, Baltimore & Annapolis Railroad				
Patapsco River						12.4	Bridge, For Spur to Harbor Tunnel				
Patapsco River						11.4	County Line, Upstream Anne Arundel & Baltimore County, Downstream - Baltimore City				
Patapsco River						11.2	Bridge, B & O Railroad				
Patapsco River						10.65	Bridge, Md. Highway 2, Northbound				
Patapsco River						10.6	Bridge, Md. Highway 2, Southbound				
Patapsco River						10.3	Mouth of Middle Branch				
Middle Branch						1.8	Head of Middle Branch				
Middle Branch						1.8	Mouth of Gwynn's Falls				
Gwynn's Falls						23.6	Head of Gwynn's Falls, Balto. County				
Gwynn's Falls						22.7	Bridge, Bond Avenue				
Gwynn's Falls						21.7	Bridge, Timber Grove Road				
Gwynn's Falls						19.4	Bridge, Gwynnbrook Avenue				
Gwynn's Falls						19.05	Bridge, Western Maryland Railroad				
Gwynn's Falls						19.0	Bridge, Reisterstown Road, U.S. 140				

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
					Gwynn's Falls				19.0	/Gaging Station, at Owings Mills, Md. (D. A. 9.12)	
					Gwynn's Falls				18.5	/Bridge, Dolfield Road	
					Gwynn's Falls				18.1	/Bridge, Painters Mill Road	
					Gwynn's Falls				17.6	/Mouth of Red Run	
					Red Run					/Head of Red Run	
					Red Run				0.0	/Mouth of Red Run	
					Gwynn's Falls				17.6	/Mouth of Red Run	
					Gwynn's Falls				16.2	/Gaging Station, McDonogh, Md. (D. A. 19.3)	
					Gwynn's Falls				16.2	/Bridge, McDonogh Road	
					Gwynn's Falls				15.9	/Mouth of Horsehead Branch	
					Horsehead Branch				3.2	/Head of Horsehead Branch	
					Horsehead Branch				1.0	/Outfall, near McDonogh School	
					Horsehead Branch				0.0	/Mouth of Horsehead Branch	
					Gwynn's Falls				15.9	/Mouth of Horsehead Branch	
					Gwynn's Falls				15.4	/Bridge, near Mt. Wilson State Hospital	
					Gwynn's Falls				14.0	/Bridge, Baltimore Beltway	
					Gwynn's Falls				14.0	/Bridge, Old Court Road	
					Gwynn's Falls				12.8	/Bridge, Scotts Level Road	
					Gwynn's Falls				12.7	/Bridge, Milford Mill Road	
					Gwynn's Falls				10.6	/Bridge, Md. Highway 26	
					Gwynn's Falls				8.0	/County Line, Upstream - Baltimore County, Downstream - Balto. City	
					Gwynn's Falls				4.8	/Bridge, Hilton Street	
					Gwynn's Falls				4.1	/Bridge, Edmondson Avenue	
					Gwynn's Falls				3.5	/Bridge, Railroad	
					Gwynn's Falls				2.7	/Bridge, Frederick Avenue	
					Gwynn's Falls				2.5	/Bridge, Wilkens Avenue	
					Gwynn's Falls				1.5	/Bridge, Washington Blvd. Alternate U.S. 1	
					Gwynn's Falls				1.3	/Outfall, Braun Rendering Co.	
					Gwynn's Falls				1.0	/Outfall, Maryland Glass Company	
					Gwynn's Falls				1.0	/Outfall, Baltimore Paint & Color Company	
					Gwynn's Falls				1.0	/Bridge, B & O Railroad	
					Gwynn's Falls					/Outfall, Baltimore Porcelain Steel Company	
					Gwynn's Falls				0.6	/Bridge, Baltimore-Washington Pky.	
					Gwynn's Falls				0.0	/Mouth of Gwynn's Falls (D.A. 65.5)	
					Middle Branch				1.8	/Mouth of Gwynn's Falls	
					Middle Branch				1.7	/Outfall, Sun Oil Company	
					Middle Branch				1.7	/Ellicott Machine Corporation	
					Middle Branch				1.7	/Baltimore Gas & Electric Company, Spring Garden Plant	
					Middle Branch					/Outfall, Cooperative Mills, Inc.	
					Middle Branch				1.5	/Outfall, General Chemical Company	
					Middle Branch				1.5	/Intake & Outfall, Baltimore Gas & Electric Company, Westport Power Sta.	

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterways)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterways)					
1	2	3	4	5	6	1	2	3	4	5	6
					Middle Branch	1.5	/	Outfall, Carr-Lowrey Glass Company			
					Middle Branch		/	Outfall, Locke, Inc.			
					Middle Branch	0.0	/	Mouth of Middle Branch			
					Patapsco River	10.3	/	Mouth of Middle Branch			
					Patapsco River	10.0	/	Arundel Corp.			
					Patapsco River	9.9	/	Western Maryland Railway, Carfloat Bridge			
					Patapsco River	9.6	/	Outfall, Baltimore Gas & Electric Co., Gould Street Station			
					Patapsco River	9.6	/	Western Maryland Railway, Port Covington Terminal			
					Patapsco River	9.4	/	Martin G. Imbach, Inc.			
					Patapsco River	9.3	/	Griffith and Boyd			
					Patapsco River	9.2	/	McLean Contracting Company			
					Patapsco River	9.1	/	B & O Railroad Fruit Pier			
					Patapsco River	9.0	/	Boston Metals Co., Mooring Yard			
					Patapsco River	8.8	/	Maryland Shipbuilding and Drydock Co.			
					Patapsco River	8.5	/	Mouth of Northwest Branch			
					Northwest Branch	3.3	/	Head of Northwest Branch			
					Northwest Branch	3.3	/	Mouth of Jones Falls			
					Jones Falls	26.1	/	Head of Jones Falls, Balto. Co.			
					Jones Falls	20.9	/	Mouth of Deep Run			
					Deep Run	3.2	/	Head of Deep Run			
					Deep Run	0.5	/	Gaging Station at Brookland- ville, Md. (D. A. 19.7)			
					Deep Run	0.0	/	Mouth of Deep Run			
					Jones Falls	20.9	/	Mouth of Deep Run			
					Jones Falls	19.1	/	Outfall, Rockland Bleach & Dye Works			
					Jones Falls	18.4	/	Gaging Station, at Sorrento, Md. (D. A. 25.2)			
					Jones Falls	15.0	/	Upper End Lake Roland			
					Jones Falls	13.2	/	Lower End Lake Roland			
					Jones Falls	12.2	/	County Line, Upstream - Baltimore County, Downstream - Balto. City			
					Jones Falls	9.5	/	Mouth of Unnamed Tributary			
					Unnamed Tributary	0.45	/	Head of Unnamed Tributary			
					Unnamed Tributary	0.3	/	Intake, Baltimore Country Club			
					Unnamed Tributary	0.0	/	Mouth of Unnamed Tributary			
					Jones Falls	9.5	/	Mouth of Unnamed Tributary			
					Jones Falls	0.0	/	Mouth of Jones Falls (D.A. 59.0)			
					Northwest Branch	3.3	/	Mouth of Jones Falls			
					Northwest Branch	3.2	/	Municipal Pier No. 1			
					Northwest Branch	3.1	/	Municipal Pier No. 2			
					Northwest Branch	3.0	/	Municipal Pier No. 3 (Old Bay Line)			
					Northwest Branch	2.9	/	Municipal Pier No. 4			
					Northwest Branch	2.8	/	Bethlehem Steel Company			
					Northwest Branch	2.8	/	Municipal Pier No. 5			
					Northwest Branch	2.8	/	Outfall, Pepsi Cola Company			
					Northwest Branch	2.7	/	Outfall, Farboil Paint Company			
					Northwest Branch	2.7	/	Municipal Pier No. 6			

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
					Northwest Branch	2.6					Municipal Pier No. 7
					Northwest Branch	2.5					Outfall, Bethlehem Steel Shipbuilding
					Northwest Branch	2.4					Baltimore City Fire Department
					Northwest Branch	2.3					Outfall, Atlantic Refining Company
					Northwest Branch	2.2					Outfall, Allied Chemical Company
					Northwest Branch	2.2					Outfall, Hercules Company
					Northwest Branch	2.1					Outfall, Booz Brothers, Inc.
					Northwest Branch	2.1					James M. Fesmire & Sons
					Northwest Branch	2.1					General Ship Repair Company
					Northwest Branch	2.1					Oriole Ship Ceiling Co., Inc.
					Northwest Branch	2.0					Outfall, American Sugar Refining Co.
					Northwest Branch	2.0					Pennsylvania Railroad
					Northwest Branch	2.0					Rukert Terminals Corp. (Jackson's Wharf)
					Northwest Branch	1.9					Municipal Broadway Pier
					Northwest Branch	1.9					Rukert Terminals Corp.
					Northwest Branch	1.9					Terminal Warehouse Company
					Northwest Branch	1.8					Baltimore & Ohio Railroad Coal Pier
					Northwest Branch	1.8					Belt's Wharf Warehouses, Inc.
					Northwest Branch	1.8					Camden Warehouses
					Northwest Branch	1.8					Maryland Port Authority Recreation Pier
					Northwest Branch	1.8					Municipal Ann Street Pier
					Northwest Branch	1.7					Outfall, Arundel Brooks Concrete Co.
					Northwest Branch	1.7					Baltimore & Ohio Railroad Carfloat Bridge
					Northwest Branch	1.7					Lord-Mott Co., Inc.
					Northwest Branch	1.7					Outfall, Proctor and Gamble Co.
					Northwest Branch	1.6					Outfall, J. Langrall and Bros. Inc.
					Northwest Branch	1.6					Latex & Rubber Co., Inc.
					Northwest Branch	1.6					National Can Corp.
					Northwest Branch	1.6					Standard Marine Supply and Service Co.
					Northwest Branch	1.5					Outfall, Booth Packing Co.
					Northwest Branch	1.4					H. J. McGrath Co.
					Northwest Branch	1.3					Baltimore Towage & Lighterage Co.
					Northwest Branch	1.3					Outfall, Lord-Mott Co., Inc.
					Northwest Branch	1.2					Baltimore Contractors, Inc.
					Northwest Branch	1.2					Baltimore & Ohio Railroad, Locust Point Terminal
					Northwest Branch	1.2					Outfall, Chesapeake Marine Railway Co.
					Northwest Branch	1.2					J. S. Young Co.
					Northwest Branch	1.1					Continental Can Co.
					Northwest Branch	1.1					Pennsylvania Railroad Carfloat Bridge
					Northwest Branch	1.0					Charles H. Harper & Associates
					Northwest Branch	0.9					Bethlehem Steel Co., Shipbuilding Division
					Northwest Branch	0.9					Outfall, Esso Standard Oil Company
					Northwest Branch	0.8					B & O Railroad Carfloat Bridge
					Northwest Branch	0.8					Crown Central Petroleum Corp.

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
					Northwest Branch						0.7/Outfall, C. Hoffberger Co.
					Northwest Branch						0.6/Outfall, American Smelting Co.
					Northwest Branch						0.6/Fertilizer Manufacturing Cooperative, Inc.
					Northwest Branch						0.6/U. S. Naval Reserve Training Center
					Northwest Branch						0.5/Baltimore Fire Dept. Fireboat Station
					Northwest Branch						0.5/U. S. Army Corps of Engineers
					Northwest Branch						0.5/Upper Canton Terminal - Pennsylvania Railroad Piers Nos. 1, 6, and Coal Pier
					Northwest Branch						0.4/Rukert Terminals Corp.
					Northwest Branch						0.3/Outfall, American Agricultural Chemical Co.
					Northwest Branch						0.2/Lehigh Portland Cement Co.
					Northwest Branch						___/Outfall, H. C. Croft Sugar Co.
					Northwest Branch						___/Outfall, Pratt Corp.
					Northwest Branch						0.0/Mouth of Northwest Branch
					Patapsco River						8.5/Mouth of Northwest Branch
					Patapsco River						8.3/Baugh Chemical Company
					Patapsco River						8.3/Rukert Terminals Corp.
					Patapsco River						8.3/Weyerhaeuser Company
					Patapsco River						8.2/Harbor Tunnel, U. S. 40
					Patapsco River						7.9/Mouth of Colgate Creek
					Colgate Creek						___/Head of Colgate Creek
					Colgate Creek						___/Outfall, Glidden Paint Company
					Colgate Creek						0.0/Mouth of Colgate Creek
					Patapsco River						7.9/Mouth of Colgate Creek
					Patapsco River						7.8/Ashland Oil Company
					Patapsco River						7.8/Canton Railroad Carfloat Bridge
					Patapsco River						7.7/Canton Railroad Ore Pier
					Patapsco River						7.6/Canton Railroad Piers Nos. 3, 4, 5, 6, 7, 8, and 10
					Patapsco River						7.6/Patapsco Scrap Corp.
					Patapsco River						7.3/Arundel Corp., Fairfield Yard
					Patapsco River						7.3/National Gypsum Co.
					Patapsco River						7.3/Pennsylvania Railroad Pier No. 11
					Patapsco River						7.2/F. S. Royster Guano Co.
					Patapsco River						7.0/Hartol Petroleum Corp.
					Patapsco River						7.0/Western Electric Co.
					Patapsco River						6.8/Outfall, Sharps Continental Corp.
					Patapsco River						6.8/Shell Oil Company
					Patapsco River						6.5/Baltimore Fire Dept. Fireboat Station
					Patapsco River						6.0/Dundalk Marine Terminal
					Patapsco River						6.0/Eastern Box Co.
					Patapsco River						6.0/Outfall, Baltimore City Patapsco Sewage Treatment Plant, Wagners Point
					Patapsco River						5.9/American Oil Company
					Patapsco River						5.8/Mouth of Curtis Bay
					Curtis Bay						1.3/Head of Curtis Bay

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)							LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)						
1	2	3	4	5	6		1	2	3	4	5	6	
						Curtis Bay	1.3						Mouth of Curtis Creek
						Curtis Creek	2.7						Head of Curtis Creek, Anne Arundel County
						Curtis Creek	2.7						Mouth of Furnace Creek
						Furnace Creek	2.0						Head of Furnace Creek
						Furnace Creek	2.0						Mouth of Sawmill Creek
						Sawmill Creek	12.0						Head of Sawmill Creek
						Sawmill Creek							Gaging Station, at Glen Burnie, Md. (D.A. 5.1)
						Sawmill Creek	1.4						Head of Wagner's Pond
						Sawmill Creek	1.2						Lower End of Wagner's Pond
						Sawmill Creek	0.5						Bridge, Light Street Road
						Sawmill Creek	0.4						Bridge, Ritchie Highway
						Sawmill Creek	0.0						Mouth of Sawmill Creek
						Furnace Creek	2.0						Mouth of Sawmill Creek
						Furnace Creek	0.3						Mouth of Back Creek
						Back Creek							Head of Back Creek
						Back Creek	0.0						Mouth of Back Creek
						Furnace Creek	0.3						Mouth of Back Creek
						Furnace Creek							Outfall, Sunbrite Laundry
						Furnace Creek							Outfall, Western Electric Corp.
						Furnace Creek	0.0						Mouth of Furnace Creek (D. A. 13.5)
						Curtis Creek	2.7						Mouth of Furnace Creek
						Curtis Creek	2.6						Mouth of Marley Creek
						Marley Creek	6.0						Head of Marley Creek
						Marley Creek	4.8						Bridge, Jumpers Hole Road
						Marley Creek	3.4						Bridge, Ritchie Highway
						Marley Creek	2.6						Bridge, Md. Highway No. 648
						Marley Creek	0.3						Mouth of Tanyard Cove
						Tanyard Cove							Head of Tanyard Cove
						Tanyard Cove	0.0						Mouth of Tanyard Cove
						Marley Creek	0.3						Mouth of Tanyard Cove
						Marley Creek	0.0						Mouth of Marley Creek
						Curtis Creek	2.6						Mouth of Marley Creek
						Curtis Creek	1.9						Mouth of Arundel Cove
						Arundel Cove							Head of Arundel Cove
						Arundel Cove	0.0						Mouth of Arundel Cove
						Curtis Creek	1.9						Mouth of Arundel Cove
						Curtis Creek	1.9						Pittsburg Des Moines Steel Co.
						Curtis Creek	1.8						U. S. Coast Guard Yard
						Curtis Creek	1.5						Bridge, Railroad
						Curtis Creek	1.3						Outfall, Armour Fertilizer Works
						Curtis Creek	1.2						Whiting-Turner Contracting Co.
						Curtis Creek	1.05						County Line, Upstream - Anne Arundel, Downstream - Balto. City
						Curtis Creek	1.0						Bridge, Near Baltimore City - Anne Arundel County Line

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
					Curtis Creek					0.9/	Outfall, A. Smith & Sons Boatyard
					Curtis Creek					0.8/	Outfall, American Oil Co.
					Curtis Creek					0.7/	Atlantic Cement Co.
					Curtis Creek					0.5/	Hess, Inc.
					Curtis Creek					0.4/	Outfall, Davison Chemical Co., Rock Pier
					Curtis Creek					0.4/	Western Md. Railway Carfloat Bridge
					Curtis Creek					0.4/	B & O Railroad Carfloat Bridge
					Curtis Creek					0.4/	Outfall, Olin Mathieson Chemical Corp.
					Curtis Creek					0.4/	Mouth of Cabin Branch
					Cabin Branch						/Head of Cabin Branch in
					Cabin Branch						Anne Arundel County
					Cabin Branch					0.0/	Mouth of Cabin Branch
					Curtis Creek					0.4/	Mouth of Cabin Branch
					Curtis Creek					0.3/	Davidson Chemical Co., Sulphur Pier
					Curtis Creek					0.0/	Mouth of Curtis Creek (D. A. 35.7)
					Curtis Bay					1.3/	Mouth of Curtis Creek
					Curtis Bay					1.2/	Outfall, E. I. Dupont de Nemours Co.
					Curtis Bay					1.0/	Outfall, Boston Metals Co.
					Curtis Bay					1.0/	B & O Railroad Coal Pier
					Curtis Bay					1.0/	B & O Railroad Ore Dock
					Curtis Bay					1.0/	Empire Construction Co.
					Curtis Bay					0.6/	Western Maryland Railway Co. Carfloat Bridge
					Curtis Bay					0.4/	Outfall, Sinclair Refining Co.
					Curtis Bay					0.1/	Outfall, U. S. Gypsum
					Curtis Bay						/Outfall, Standard Wholesale Phos. & Acid Works, Inc.
					Curtis Bay						/Outfall, Pan American Refining Co.
					Curtis Bay						/Outfall, Petrol Terminal Co.
					Curtis Bay					0.0/	Mouth of Curtis Bay
					Patapsco River					5.8/	Mouth of Curtis Bay
					Patapsco River					5.6/	Outfall, Baltimore Gas & Electric Co., Riverside Plant
					Patapsco River*****					4.4/	Mouth of Bear Creek
					Bear Creek						/Head of Bear Creek
					Bear Creek					0.0/	Mouth of Bear Creek
					Patapsco River					4.4/	Mouth of Bear Creek
					Patapsco River					4.0/	Outfall, Hawkins Point, Kennecott Refin- ing Company
					Patapsco River					4.0/	Intake & Outfall, Baltimore Gas & Electric Co., Hawkins Point Plant
					Patapsco River					4.0/	Bethlehem-Sparrows Point Shipyard, Inc.
					Patapsco River					3.4/	Outfall, Glen Burnie Sewage Treatment Plant

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
Patapsco River						3.3	Mouth of Cox Creek				
Cox Creek							/Head of Cox Creek				
Cox Creek						0.0	Mouth of Cox Creek				
Patapsco River						3.3	Mouth of Cox Creek				
Patapsco River						2.6	Mouth of Stony Creek				
Stony Creek							/Head of Stony Creek				
Stony Creek						0.0	Mouth of Stony Creek				
Patapsco River						2.6	Mouth of Stony Creek				
Patapsco River						1.2	Mouth of Rock Creek				
Rock Creek							/Head of Rock Creek				
Rock Creek						0.0	Mouth of Rock Creek				
Patapsco River						1.2	Mouth of Rock Creek				
Patapsco River						1.0	Outfall, Maryland Slag Corp.				
Patapsco River						1.0	Mouth of Jones Creek				
Jones Creek							/Head of Jones Creek				
Jones Creek							/Outfall, Bethlehem Steel Company				
Jones Creek						0.0	Mouth of Jones Creek				
Patapsco River						1.0	Mouth of Jones Creek				
Patapsco River						0.5	Old Road Bay				
Patapsco River							/Outfall, Petrol Terminal Co.				
Patapsco River							/Outfall, Rasin Monumental Co.				
Patapsco River							/Outfall, Baltimore City Reed Bird Incinerator Plant				
Patapsco River						0.01	Outfall, Fort Smallwood,				
Patapsco River							/Outfall, Bethlehem Steel Company				
Patapsco River							/Outfall, Bethlehem Steel Company				
Patapsco River						0.0	Mouth of Patapsco River (D. A. 611.0)				
CHESAPEAKE BAY, WESTERN SHORE						160.4	Mouth of Patapsco River				

D. A. Drainage Area, square feet

- * The head of the Patapsco River is located at the corner of Baltimore, Carroll, and Howard Counties, Maryland.
- ** From mile point 15.4 to the mouth, the North Branch Patapsco River is boundary between Carroll and Baltimore Counties, Maryland.
- *** From mile point 18.3 to the mouth, the South Branch Patapsco River is boundary between Carroll and Howard Counties, Maryland.
- **** From mile point 34.7 to mile point 16.9, the Patapsco River is boundary between Baltimore and Howard Counties, Maryland.
- ***** From mile point 16.85 to mile point 11.4, the Patapsco River is the boundary between Baltimore and Anne Arundel Counties, Maryland.
- ***** From mile point 4.4 to the mouth, the Patapsco River is boundary between Baltimore and Anne Arundel Counties, Maryland.

January, 1965

Appendix A

CHESAPEAKE BAY, WESTERN SHORE	DRAINAGE BASIN
DIRECT DRAINAGE AND MINOR TRIBUTARIES	SUB-BASIN
From Rock Point* to Drum Point**	

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)	LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)
1 2 3 4 5 6	1 2 3 4 5 6
CHESAPEAKE BAY, WESTERN SHORE	158.5/Hines Pond
CHESAPEAKE BAY	158.2/Paradise Beach
CHESAPEAKE BAY	158.0/Letha Pond
CHESAPEAKE BAY	157.7/Boyd Pond
CHESAPEAKE BAY	157.4/Bayside Beach
CHESAPEAKE BAY	157.0/Mouth of Bodkin Creek
Bodkin Creek	1.1/Head of Bodkin Creek
Bodkin Creek	1.1/Locust Cove
Bodkin Creek	1.1/Mouth of Wharf Creek
Wharf Creek	/Head of Wharf Creek
Wharf Creek	0.0/Mouth of Wharf Creek
Bodkin Creek	1.1/Mouth of Wharf Creek
Bodkin Creek	0.8/Ashlar Pond
Bodkin Creek	0.6/Mouth of Main Creek
Main Creek	/Head of Main Creek
Main Creek	1.3/Mathias Cove
Main Creek	0.6/Jubb Cove
Main Creek	0.5/Goose Cove
Main Creek	0.0/Mouth of Main Creek
Bodkin Creek	0.6/Mouth of Main Creek
Bodkin Creek	0.3/Mouth of Back Creek
Back Creek	/Head of Back Creek
Back Creek	0.0/Mouth of Back Creek
Bodkin Creek	0.3/Mouth of Back Creek
Bodkin Creek	0.2/Old House Cove
Bodkin Creek	0.0/Mouth of Bodkin Creek
CHESAPEAKE BAY	157.0/Mouth of Bodkin Creek
CHESAPEAKE BAY	154.5/Town of Pinehurst
CHESAPEAKE BAY	/Proposed Outfall, Mountain Road Sewage Treatment Plant
CHESAPEAKE BAY	151.6/Gibson Island Beach
CHESAPEAKE BAY	149.3/Mouth of Magothy River
Magothy River	/Head of Magothy River
Magothy River	9.1/Dam, Lake Waterford
Magothy River	9.0/Bridge, Md. Highway 648
Magothy River	7.8/Bridge, Secondary Road near Royal Beach
Magothy River	6.5/Mouth of Old Man Creek
Old Man Creek	/Head of Old Man Creek
Old Man Creek	0.0/Mouth of Old Man Creek
Magothy River	6.5/Mouth of Old Man Creek
Magothy River	6.0/Mouth of Cockey Creek
Cockey Creek	/Head of Cockey Creek
Cockey Creek	0.0/Mouth of Cockey Creek

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
Magothy River						6.0	/	Mouth of Cockey Creek			
Magothy River						5.7	/	Mouth of Cattail Creek			
Cattail Creek							/	Head of Cattail Creek			
Cattail Creek						0.0	/	Mouth of Cattail Creek			
Magothy River						5.7	/	Mouth of Cattail Creek			
Magothy River						4.8	/	Mouth of Cypress Creek			
Cypress Creek							/	Head of Cypress Creek			
Cypress Creek						1.1	/	Bridge, Governor Ritchie Highway, (Md. 2)			
Cypress Creek						0.0	/	Mouth of Cypress Creek			
Magothy River						4.8	/	Mouth of Cypress Creek			
Magothy River						4.6	/	Mouth of Dividing Creek			
Dividing Creek							/	Head of Dividing Creek			
Dividing Creek						0.0	/	Mouth of Dividing Creek			
Magothy River						4.6	/	Mouth of Dividing Creek			
Magothy River						4.5	/	Mouth of Mill Creek			
Mill Creek							/	Head of Mill Creek			
Mill Creek						0.0	/	Mouth of Mill Creek			
Magothy River						4.5	/	Mouth of Mill Creek			
Magothy River						4.0	/	Mouth of Blackhole Creek			
Blackhole Creek							/	Head of Blackhole Creek			
Blackhole Creek						0.0	/	Mouth of Blackhole Creek			
Magothy River						4.0	/	Mouth of Blackhole Creek			
Magothy River						3.7	/	Spriggs Pond			
Magothy River						3.2	/	Mouth of Forked Creek			
Forked Creek							/	Head of Forked Creek			
Forked Creek						0.3	/	Coolspring Cove			
Forked Creek						0.0	/	Mouth of Forked Creek			
Magothy River						3.2	/	Mouth of Forked Creek			
Magothy River						3.0	/	Mouth of Broad Creek			
Broad Creek						0.6	/	Head of Broad Creek			
Broad Creek						0.0	/	Mouth of Broad Creek			
Magothy River						3.0	/	Mouth of Broad Creek			
Magothy River						2.6	/	Mouth of Park Creek			
Park Creek						0.3	/	Head of Park Creek			
Park Creek						0.0	/	Mouth of Park Creek			
Magothy River						2.6	/	Mouth of Park Creek			
Magothy River						1.6	/	Mouth of Sillery Bay			
Sillery Bay						1.3	/	Head of Sillery Bay			
Sillery Bay						1.3	/	Mouth of Magothy Narrows			
Magothy Narrows						0.8	/	Head of Magothy Narrows			
Magothy Narrows						0.8	/	Redhouse Cove			
Magothy Narrows						0.8	/	Inner Harbour			

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)							LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)						
1	2	3	4	5	6		1	2	3	4	5	6	
						Magothy Narrows	0.1						Mouth of Cornfield Creek
						Cornfield Creek							/Head of Cornfield Creek
						Cornfield Creek	0.0						Mouth of Cornfield Creek
						Magothy Narrows	0.1						Mouth of Cornfield Creek
						Magothy Narrows	0.0						Mouth of Magothy Narrows
						Sillery Bay	1.3						Mouth of Magothy Narrows
						Sillery Bay	0.9						Tar Cove
						Sillery Bay	0.4						Mouth of Grays Creek
						Grays Creek							/Head of Grays Creek
						Grays Creek	0.0						Mouth of Grays Creek
						Sillery Bay	0.4						Mouth of Grays Creek
						Sillery Bay	0.3						Cooleys Pond
						Sillery Bay	0.1						Long Cove
						Sillery Bay	0.0						Mouth of Sillery Bay (At Dobbins Island)
						Magothy River	1.6						Mouth of Sillery Bay
						Magothy River	0.7						Mouth of Deep Creek
						Deep Creek							/Head of Deep Creek
						Deep Creek	0.0						Mouth of Deep Creek
						Magothy River	0.7						Mouth of Deep Creek
						Magothy River	0.0						Mouth of Magothy River (D. A. 39.9)
						CHESAPEAKE BAY	149.3						Mouth of Magothy River
						CHESAPEAKE BAY	148.8						Mouth of Little Magothy River
						Little Magothy River							/Head of Little Magothy River
						Little Magothy River	0.0						Mouth of Little Magothy River
						CHESAPEAKE BAY	148.8						Mouth of Little Magothy River
						CHESAPEAKE BAY							/Proposed Outfall, Broad Neck Sewage Treatment Plant
						CHESAPEAKE BAY							/Outfall, Sandy Point State Prison
						CHESAPEAKE BAY							/Outfall, Sandy Point State Park
						CHESAPEAKE BAY	145.7						Sandy Point
						CHESAPEAKE BAY	144.5						Bridge, U.S. Highway 301 & U.S. 50
						CHESAPEAKE BAY	144.3						Moss Pond
						CHESAPEAKE BAY	143.6						Goose Pond
						CHESAPEAKE BAY	143.3						Mouth of Whitehall Creek
						Whitehall Creek							/Head of Whitehall Creek
						Whitehall Creek	3.4						Bridge, U.S. Highway 50
						Whitehall Creek	3.2						Bridge, St. Margarets Road
						Whitehall Creek	1.5						Mouth of Ridout Creek
						Ridout Creek							/Head of Ridout Creek
						Ridout Creek	0.5						Chesapeake Bay Institute
													Field Laboratory, Johns Hopkins Univ.
						Ridout Creek	0.0						Mouth of Ridout Creek

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
Whitehall Creek						1.5	/	Mouth of	Ridout Creek		
Whitehall Creek						0.7	/	Mouth of	Meredith Creek		
Meredith Creek								/	Head of	Meredith Creek	
Meredith Creek						0.0	/	Mouth of	Meredith Creek		
Whitehall Creek						0.7	/	Mouth of	Meredith Creek		
Whitehall Creek						0.0	/	Mouth of	Whitehall Creek		
CHESAPEAKE BAY						143.3	/	Mouth of	Whitehall Creek		
CHESAPEAKE BAY						143.1	/	Mouth of	Mill Creek		
Mill Creek								/	Head of	Mill Creek	
Mill Creek						2.2	/	Bridge,	St. Margarets Highway		
Mill Creek						0.8	/	Martins Cove			
Mill Creek						0.2	/	Mouth of	Burley Creek		
Burley Creek								/	Head of	Burley Creek	
Burley Creek						0.0	/	Mouth of	Burley Creek		
Mill Creek						0.2	/	Mouth of	Burley Creek		
Mill Creek						0.0	/	Mouth of	Mill Creek		
CHESAPEAKE BAY						143.1	/	Mouth of	Mill Creek		
CHESAPEAKE BAY						142.8	/	Mouth of	Severn River		
Severn River						12.9	/	Head of	Severn River		
Severn River						12.9	/	Mouth of	Severn Run		
Severn Run								/	Head of	Severn Run	
Severn Run						4.0	/	Bridge,	Gambrills Road		
Severn Run						2.4	/	Mouth of	Picture Frame Branch		
Picture Frame Branch								/	Head of	Picture Frame Branch	
Picture Frame Branch						1.1	/	Outfall,	National Plastics Products, Inc.		
Picture Frame Branch						1.0	/	Outfall,	National Store Fixtures		
Picture Frame Branch						0.0	/	Mouth of	Picture Frame Branch		
Severn Run						2.4	/	Mouth of	Picture Frame Branch		
Severn Run						1.2	/	Fish Hatchery,	Upstream of Bridge on Md. 3		
Severn Run						0.7	/	Mouth of	Jabez Branch		
Jabez Branch								/	Head of	Jabez Branch	
Jabez Branch						0.0	/	Mouth of	Jabez Branch		
Severn Run						0.7	/	Mouth of	Jabez Branch		
Severn Run						0.5	/	Bridge,	Md. Highway 3 at Benfield (D. A. 23.9)		
Severn Run						0.0	/	Mouth of	Severn Run		
Severn River						12.9	/	Mouth of	Severn Run		
Severn River						11.2	/	Whitneys Landing			
Severn River						10.5	/	Mouth of	Forked Creek		
Forked Creek								/	Head of	Forked Creek	
Forked Creek						0.0	/	Mouth of	Forked Creek		

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
Severn River						10.5	/	Mouth of Forked Creek			
Severn River						9.0	/	Mouth of Valentine Creek			
Valentine Creek							/	Head of Valentine Creek			
Valentine Creek						0.2	/	Mouth of Gumbottom Branch			
Gumbottom Branch							/	Head of Gumbottom Branch			
Gumbottom Branch						0.8	/	Mouth of Plum Creek			
Plum Creek							/	Head of Plum Creek			
Plum Creek						0.0	/	Mouth of Plum Creek			
Gumbottom Branch						0.8	/	Mouth of Plum Creek			
Gumbottom Branch						0.0	/	Mouth of Gumbottom Branch			
Valentine Creek						0.2	/	Mouth of Gumbottom Branch			
Valentine Creek						0.0	/	Mouth of Valentine Creek			
Severn River						9.0	/	Mouth of Valentine Creek			
Severn River						8.9	/	Mouth of Yantz Creek			
Yantz Creek							/	Head of Yantz Creek			
Yantz Creek						0.0	/	Mouth of Yantz Creek			
Severn River						8.9	/	Mouth of Yantz Creek			
Severn River						8.1	/	Mouth of Sullivan Cove			
Sullivan Cove							/	Head of Sullivan Cove			
Sullivan Cove						0.0	/	Mouth of Sullivan Cove			
Severn River						8.1	/	Mouth of Sullivan Cove			
Severn River						6.8	/	Mouth of Ringgold Cove			
Ringgold Cove							/	Head of Ringgold Cove			
Ringgold Cove						0.0	/	Mouth of Ringgold Cove			
Severn River						6.8	/	Mouth of Ringgold Cove			
Severn River						6.8	/	Mouth of Round Bay			
Round Bay						1.1	/	Head of Round Bay			
Round Bay						1.1	/	Mouth of Manderes Creek			
Manderes Creek							/	Head of Manderes Creek			
Manderes Creek						0.5	/	Mouth of Deep Ditch Branch			
Deep Ditch Branch							/	Head of Deep Ditch Branch			
Deep Ditch Branch						0.0	/	Mouth of Deep Ditch Branch			
Manderes Creek						0.5	/	Mouth of Deep Ditch Branch			
Manderes Creek						0.0	/	Mouth of Manderes Creek			
Round Bay						1.1	/	Mouth of Manderes Creek			
Round Bay						1.1	/	Mouth of Hopkins Creek			
Hopkins Creek							/	Head of Hopkins Creek			
Hopkins Creek						0.0	/	Mouth of Hopkins Creek			
Round Bay						1.1	/	Mouth of Hopkins Creek			
Round Bay						0.6	/	Mouth of Little Round Bay			
Little Round Bay							/	Head of Little Round Bay			
Little Round Bay							/	Fred's Marina and Boat Livery			
Little Round Bay							/	Outfall, Spring Overflow			
Little Round Bay						0.0	/	Mouth of Little Round Bay			

DRAINAGE BASIN

SUB-BASIN

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

- 6 -

CHESAPEAKE BAY, WESTERN SHORE

DRAINAGE BASIN

DIRECT DRAINAGE AND MINOR TRIBUTARIES

SUB-BASIN

From Rock Point* to Drum Point**

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
Severn River						2.9	/	Bridge, Baltimore & Annapolis Railroad			
Severn River						2.1	/	Bridge, Md. Highway 450			
Severn River						1.7	/	Mouth of College Creek			
College Creek						1.5	/	Head of College Creek			
College Creek						0.7	/	Bridge, Roscoe C. Rowe Highway			
College Creek						1.2	/	Bridge, Taylor Avenue			
College Creek						0.5	/	Bridge, King George Street			
College Creek						0.35	/	Bridge, Drawbridge			
College Creek						0.0	/	Mouth of College Creek			
Severn River						1.7	/	Mouth of College Creek			
Severn River						1.3	/	U.S. Naval Academy			
Severn River						1.0	/	Mouth of Spa Creek			
Spa Creek						2.4	/	Head of Spa Creek			
Spa Creek						1.7	/	Bridge, Spa Road			
Spa Creek						0.4	/	Bridge, Main Street			
Spa Creek						0.0	/	Mouth of Spa Creek			
Severn River						1.0	/	Mouth of Spa Creek			
Severn River						0.6	/	Seaplane Base			
Severn River						0.4	/	Mouth of Carr Creek			
Carr Creek							/	Head of Carr Creek			
Carr Creek						0.8	/	Outfall, Sewage Treatment Plant, Severn River Naval Command			
Carr Creek						0.0	/	Mouth of Carr Creek			
Severn River						0.4	/	Mouth of Carr Creek			
Severn River						0.3	/	Outfall, Annapolis Sewage Treatment Plant			
Severn River						0.2	/	Mouth of Back Creek			
Back Creek							/	Head of Back Creek			
Back Creek						0.0	/	Mouth of Back Creek			
Severn River						0.2	/	Mouth of Back Creek			
Severn River						0.0	/	Mouth of Severn River (Mouth at midpoint of line from Greenbury Point to Chinks Point) (D. A. 68.9)			
CHESAPEAKE BAY						142.8	/	Mouth of Severn River			
CHESAPEAKE BAY						140.4	/	Lake Ogleton			
CHESAPEAKE BAY						140.0	/	Town, Bay Ridge			
CHESAPEAKE BAY						139.5	/	Mouth of Blackwalnut Creek			
Blackwalnut Creek							/	Head of Blackwalnut Creek			
Blackwalnut Creek						0.0	/	Mouth of Blackwalnut Creek			
CHESAPEAKE BAY						139.5	/	Mouth of Blackwalnut Creek			
CHESAPEAKE BAY						139.3	/	Mouth of Oyster Creek			
Oyster Creek							/	Head of Oyster Creek			
Oyster Creek						0.0	/	Mouth of Oyster Creek			

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
CHESAPEAKE BAY						139.3	/	Mouth of Oyster Creek			
CHESAPEAKE BAY						139.0	/	Town, Arundel on the Bay			
CHESAPEAKE BAY						138.4	/	Mouth of Fishing Creek			
Fishing Creek							/	Head of Fishing Creek			
Fishing Creek						0.0	/	Mouth of Fishing Creek			
CHESAPEAKE BAY						138.4	/	Mouth of Fishing Creek			
CHESAPEAKE BAY						137.6	/	Mouth of South River			
South River						9.8	/	Head of South River (At mouths of North River and Bacon Ridge Branch)			
South River						9.8	/	Mouth of North River			
North River							/	Head of North River			
North River						0.8	/	Gaging Station near Annapolis, Maryland (D.A. 8.5)			
North River						0.3	/	Mouth of Tarnans Branch			
Tarnans Branch							/	Head of Tarnans Branch			
Tarnans Branch						0.0	/	Mouth of Tarnans Branch			
North River						0.3	/	Mouth of Tarnans Branch			
North River						0.0	/	Mouth of North River			
South River						9.8	/	Mouth of North River			
South River						9.8	/	Mouth of Bacon Ridge Branch			
Bacon Ridge Branch						5.0	/	Head of Bacon Ridge Branch			
Bacon Ridge Branch							/	Mouth of Unnamed Tributary			
Unnamed Tributary							/	Head of Unnamed Tributary			
Unnamed Tributary						1.5	/	Outfall, Crownsville State Hospital			
Unnamed Tributary						0.0	/	Mouth of Unnamed Tributary			
Bacon Ridge Branch							/	Mouth of Unnamed Tributary			
Bacon Ridge Branch						1.25	/	Gaging Station, at Chesterfield, Maryland (D. A. 6.92)			
Bacon Ridge Branch						0.3	/	Bridge, Md. Highway 450			
Bacon Ridge Branch						0.0	/	Mouth of Bacon Ridge Branch (D. A. 9.64)			
South River						9.8	/	Mouth of Bacon Ridge Branch			
South River						9.7	/	Bridge, John Hanson Highway (U.S. 50)			
South River						8.2	/	Mouth of Flat Creek			
Flat Creek							/	Head of Flat Creek			
Flat Creek						0.8	/	Bridge, Governor Bridge Road			
Flat Creek						0.0	/	Mouth of Flat Creek			
South River						8.2	/	Mouth of Flat Creek			
South River						7.1	/	Mouth of Broad Creek			
Broad Creek						2.3	/	Head of Broad Creek			
Broad Creek						2.3	/	Mouth of North Basin			
North Basin							/	Head of North Basin			
North Basin						0.0	/	Mouth of North Basin			

From Rock Point* to Drum Point**

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
Broad Creek						2.3/Mouth of North Basin					
Broad Creek						2.3/Mouth of South Basin					
South Basin						/Head of South Basin					
South Basin						0.0/Mouth of South Basin					
Broad Creek						2.3/Mouth of South Basin					
Broad Creek						2.3/Dam					
Broad Creek						2.3/Intake, Pumping Station, Sub. Station Water Works (On Md. 450, 2 mi. west of Annapolis)					
Broad Creek						2.2/Bridge, Md. Highway 450					
Broad Creek						2.0/Bridge, U.S. 50 (John Hanson Highway)					
Broad Creek						0.0/Mouth of Broad Creek					
South River						7.1/Mouth of Broad Creek					
South River						6.9/Bridge, Old Ferry Road (Riva Road)					
South River						6.6/Mouth of Beards Creek					
Beards Creek						/Head of Beards Creek					
Beards Creek						0.4/Hardesty's Cove					
Beards Creek						0.0/Mouth of Beards Creek					
South River						6.6/Mouth of Beards Creek					
South River						5.8/Mouth of Gingerville Creek					
Gingerville Creek						/Head of Gingerville Creek					
Gingerville Creek						0.0/Mouth of Gingerville Creek					
South River						5.8/Mouth of Gingerville Creek					
South River						5.7/Bridge, Md. Highway 2					
South River						5.6/South River Yacht Club					
South River						5.4/Mouth of Warehouse Creek					
Warehouse Creek						/Head of Warehouse Creek					
Warehouse Creek						0.0/Mouth of Warehouse Creek					
South River						5.4/Mouth of Warehouse Creek					
South River						5.0/Mouth of Church Creek					
Church Creek						/Head of Church Creek					
Church Creek						0.0/Mouth of Church Creek					
South River						5.0/Mouth of Church Creek					
South River						4.8/Mouth of Almshouse Creek					
Almshouse Creek						/Head of Almshouse Creek					
Almshouse Creek						0.0/Mouth of Almshouse Creek					
South River						4.8/Mouth of Almshouse Creek					
South River						4.7/Mouth of Crab Creek					
Crab Creek						/Head of Crab Creek					
Crab Creek						0.0/Mouth of Crab Creek					
South River						4.7/Mouth of Crab Creek					
South River						3.9/Mouth of Glebe Creek					

DRAINAGE BASIN

DIRECT DRAINAGE AND MINOR TRIBUTARIES

SUB-BASIN

From Rock Point* to Drum Point**

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

DISTANCES FROM MOUTH OF WATERWAY AND DISTANCE TO HEAD						LOCATION: RIVER MILE/DESCRIPTION					
MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						(Magnitude of Waterway)					
<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
Glebe Creek						/Head of Glebe Creek					
Glebe Creek						0.6/Mouth of Glebe Branch					
Glebe Branch						/Head of Glebe Branch					
Glebe Branch						0.4/Bridge, Md. Highway 214 (Central Ave.)					
Glebe Branch						0.0/Mouth of Glebe Branch					
Glebe Creek						0.6/Mouth of Glebe Branch					
Glebe Creek						0.0/Mouth of Glebe Creek					
South River						3.9/Mouth of Glebe Creek					
South River						3.8/Mouth of Aberdeen Creek					
Aberdeen Creek						/Head of Aberdeen Creek					
Aberdeen Creek						0.0/Mouth of Aberdeen Creek					
South River						3.8/Mouth of Aberdeen Creek					
South River						3.3/Mouth of Brewer Creek					
Brewer Creek						0.3/Head of Brewer Creek					
Brewer Creek						0.3/Mouth of Pocahontas Creek					
Pocahontas Creek						0.3/Head of Pocahontas Creek					
Pocahontas Creek						0.0/Mouth of Pocahontas Creek					
Brewer Creek						0.3/Mouth of Pocahontas Creek					
Brewer Creek						0.0/Mouth of Brewer Creek					
South River						3.3/Mouth of Brewer Creek					
South River						3.0/Mouth of Harness Creek					
Harness Creek						/Head of Harness Creek					
Harness Creek						0.0/Mouth of Harness Creek					
South River						3.0/Mouth of Harness Creek					
South River						1.8/Selby Bay					
South River						1.7/Mouth of Duvall Creek					
Duvall Creek						/Head of Duvall Creek					
Duvall Creek						0.0/Mouth of Duvall Creek					
South River						1.7/Mouth of Duvall Creek					
South River						1.2/Cherrytree Cove					
South River						0.8/Ramsay Lake					
South River						0.2/Big Pond					
South River						0.0/Mouth of South River (Mouth at mid- point of line from Marshy Point to Saunders Point (D.A. 66.1))					
CHESAPEAKE BAY						137.6/Mouth of South River					
CHESAPEAKE BAY						135.7/Town, Beverly Beach					
CHESAPEAKE BAY						134.8/Mouth of West River					
West River						/Head of West River					
West River						4.5/Bridge, Shady Side Road					
West River						3.4/Mouth of Johns Creek					
Johns Creek						/Head of Johns Creek					
Johns Creek						0.0/Mouth of Johns Creek					

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
West River						3.4	/	Mouth of Johns Creek			
West River						3.2	/	Mouth of Smith Creek			
							/	Head of Smith Creek			
						1.2	/	Bridge, Shady Side Road			
						0.0	/	Mouth of Smith Creek			
West River						3.2	/	Mouth of Smith Creek			
West River						2.9	/	Mouth of Lerch Creek			
							/	Head of Lerch Creek			
						1.5	/	Bridge, Shady Side Road			
						0.0	/	Mouth of Lerch Creek			
West River						2.9	/	Mouth of Lerch Creek			
West River						2.3	/	Mouth of South Creek			
							/	Head of South Creek			
						0.0	/	Mouth of South Creek			
West River						2.3	/	Mouth of South Creek			
West River						2.0	/	Mouth of Tenthouse Creek			
							/	Head of Tenthouse Creek			
						0.35	/	Outfall, B.M. Woodfield			
						0.3	/	Mouth of Cox Creek			
							/	Head of Cox Creek			
						0.0	/	Mouth of Cox Creek			
						0.3	/	Mouth of Cox Creek			
						0.0	/	Mouth of Tenthouse Creek			
West River						2.0	/	Mouth of Tenthouse Creek			
West River						1.5	/	Mouth of Popham Creek			
							/	Head of Popham Creek			
						0.0	/	Mouth of Popham Creek			
West River						1.5	/	Mouth of Popham Creek			
West River						1.3	/	Mouth of Scaffold Creek			
							/	Head of Scaffold Creek			
						0.0	/	Mouth of Scaffold Creek			
West River						1.3	/	Mouth of Scaffold Creek			
West River						1.2	/	Deadwood Cove			
West River						1.0	/	Mouth of Cheston Creek			
							/	Head of Cheston Creek			
						0.0	/	Mouth of Cheston Creek			
West River						1.0	/	Mouth of Cheston Creek			
West River						0.4	/	Mouth of Rhode River			
							/	Head of Rhode River			
						2.4	/	Mouth of Fox Creek			
							/	Head of Fox Creek			
						0.0	/	Mouth of Fox Creek			
						2.4	/	Mouth of Fox Creek			
						2.3	/	Mouth of Boathouse Creek			

CHESAPEAKE BAY, WESTERN SHORE

DRAINAGE BASIN

DIRECT DRAINAGE AND MINOR TRIBUTARIES

SUB-BASIN

From Rock Point* to Drum Point**

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)							LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)						
1	2	3	4	5	6		1	2	3	4	5	6	
						Boathouse Creek							/Head of Boathouse Creek
						Boathouse Creek	0.1						/Mouth of Muddy Creek
						Muddy Creek							/Head of Muddy Creek
						Muddy Creek	2.1						/Mouth of Mill Swamp Branch
						Mill Swamp Branch							/Head of Mill Swamp Branch
						Mill Swamp Branch	0.0						/Mouth of Mill Swamp Branch
						Muddy Creek	2.1						/Mouth of Mill Swamp Branch
						Muddy Creek	1.9						/Bridge, Muddy Creek Road
						Muddy Creek	0.0						/Mouth of Muddy Creek
						Boathouse Creek	0.1						/Mouth of Muddy Creek
						Boathouse Creek	0.0						/Mouth of Boathouse Creek
						Rhode River	2.3						/Mouth of Boathouse Creek
						Rhode River	2.2						/Mouth of Sellman Creek
						Sellman Creek	1.7						/Head of Sellman Creek
						Sellman Creek	0.0						/Mouth of Sellman Creek
						Rhode River	2.2						/Mouth of Sellman Creek
						Rhode River	1.7						/Mouth of Bear Neck Creek
						Bear Neck Creek	1.9						/Head of Bear Neck Creek
						Bear Neck Creek	1.5						/Bridge, Mayo Road, Md. 214
						Bear Neck Creek	0.6						/Mouth of Whitemarsh Creek
						Whitemarsh Creek	0.8						/Head of Whitemarsh Creek
						Whitemarsh Creek	0.0						/Mouth of Whitemarsh Creek
						Bear Neck Creek	0.6						/Mouth of Whitemarsh Creek
						Bear Neck Creek	0.0						/Mouth of Bear Neck Creek
						Rhode River	1.7						/Mouth of Bear Neck Creek
						Rhode River	1.0						/Mouth of Cadle Creek
						Cadle Creek	0.8						/Head of Cadle Creek
						Cadle Creek	0.0						/Mouth of Cadle Creek
						Rhode River	1.0						/Mouth of Cadle Creek
						Rhode River	0.0						/Mouth of Rhode River
						West River	0.4						/Mouth of Rhode River
						West River	0.2						/Mouth of Parrish Creek
						Parrish Creek	0.8						/Head of Parrish Creek
						Parrish Creek	0.0						/Mouth of Parrish Creek
						West River	0.2						/Mouth of Parrish Creek
						West River	0.0						/Mouth of West River
						CHESAPEAKE BAY	134.8						/Mouth of West River
						CHESAPEAKE BAY	133.8						/Mouth of Jack Creek
						Jack Creek	0.9						/Head of Jack Creek
						Jack Creek	0.0						/Mouth of Jack Creek
						CHESAPEAKE BAY	133.8						/Mouth of Jack Creek
						CHESAPEAKE BAY	132.4						/Town, Cedarhurst
						CHESAPEAKE BAY	131.0						/Mouth of Flag Pond Creek

CHESAPEAKE BAY, WESTERN SHORE

DRAINAGE BASIN

DIRECT DRAINAGE AND MINOR TRIBUTARIES

SUB-BASIN

From Rock Point* to Drum Point**

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)							LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)						
1	2	3	4	5	6		1	2	3	4	5	6	
						Flag Pond Creek							1.0/Head of Flag Pond Creek
						Flag Pond Creek							0.0/Mouth of Flag Pond Creek
						CHESAPEAKE BAY							131.0/Mouth of Flag Pond Creek
						CHESAPEAKE BAY							130.7/Mouth of Deep Cove Creek
						Deep Cove Creek							2.8/Head of Deep Cove Creek
						Deep Cove Creek							2.0/Bridge, Deale-Churchton Road, Md. 256
						Deep Cove Creek							0.3/Mouth of Deep Creek
						Deep Creek							0.8/Head of Deep Creek
						Deep Creek							0.0/Mouth of Deep Creek
						Deep Cove Creek							0.3/Mouth of Deep Creek
						Deep Cove Creek							0.0/Mouth of Deep Cove Creek
						CHESAPEAKE BAY							130.7/Mouth of Deep Cove Creek
						CHESAPEAKE BAY							129.9/Mouth of Broadwater Creek
						Broadwater Creek							0.6/Head of Broadwater Creek
						Broadwater Creek							0.0/Mouth of Broadwater Creek
						CHESAPEAKE BAY							129.9/Mouth of Broadwater Creek
						CHESAPEAKE BAY							129.7/Mouth of Carrs Creek
						Carrs Creek							1.4/Head of Carrs Creek
						Carrs Creek							0.0/Mouth of Carrs Creek
						CHESAPEAKE BAY							129.7/Mouth of Parker Creek
						CHESAPEAKE BAY							128.9/Mouth of Parker Creek
						Parker Creek							1.0/Head of Parker Creek
						Parker Creek							0.0/Mouth of Parker Creek
						CHESAPEAKE BAY							128.9/Mouth of Parker Creek
						CHESAPEAKE BAY							128.7/Long Marsh, Northern Limit of Herring Bay, Anne Arundel County, Maryland
						CHESAPEAKE BAY							128.3/Mouth of Rockhold Creek
						Rockhold Creek							3.9/Head of Rockhold Creek
						Rockhold Creek							3.8/Bridge, Md. Highway 468, Shady Side Rd.
						Rockhold Creek							3.0/Bridge, Swamp Circle Road
						Rockhold Creek							1.1/Bridge, Masons Beach Road
						Rockhold Creek							0.6/Mouth of Tracy Creek
						Tracy Creek							/Head of Tracy Creek
						Tracy Creek							8.1/Bridge, Owensville Road
						Tracy Creek							3.6/Bridge, Nutwell Road
						Tracy Creek							1.9/Bridge, Deale-Sudley Road
						Tracy Creek							0.3/Bridge, Deale Road
						Tracy Creek							0.0/Mouth of Tracy Creek
						Rockhold Creek							0.6/Mouth of Tracy Creek
						Rockhold Creek							0.3/Mouth of Trotts Branch
						Trotts Branch							/Head of Trotts Branch
						Trotts Branch							0.7/Bridge, Old Sudley Road
						Trotts Branch							0.0/Mouth of Trotts Branch
						Rockhold Creek							0.3/Mouth of Trotts Branch
						Rockhold Creek							0.0/Mouth of Rockhold Creek

CHESAPEAKE BAY, WESTERN SHORE

DRAINAGE BASIN

DIRECT DRAINAGE AND MINOR TRIBUTARIES

SUB-BASIN

From Rock Point* to Drum Point**

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)							LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)						
1	2	3	4	5	6		1	2	3	4	5	6	
CHESAPEAKE BAY							128.3	/	Mouth of Rockhold Creek				
CHESAPEAKE BAY							128.0	/	Town, Leitch				
CHESAPEAKE BAY							127.2	/	Fairhaven, Town on Herring Bay				
CHESAPEAKE BAY							125.6	/	Old Colony Cove				
CHESAPEAKE BAY							125.4	/	Red Lion Pond (Yacht Basin)				
CHESAPEAKE BAY							125.3	/	Holland Point, Southern Limit of Herring Bay				
CHESAPEAKE BAY							124.4	/	County line, Upstream - Anne Arundel, Downstream - Calvert				
CHESAPEAKE BAY							124.0	/	Outfall, North Beach, Sewage Treatment Plant				
CHESAPEAKE BAY							123.2	/	Town, West Beach				
CHESAPEAKE BAY							123.0	/	Mouth of Fishing Creek				
Fishing Creek								/	Head of Fishing Creek				
Fishing Creek							0.0	/	Mouth of Fishing Creek				
CHESAPEAKE BAY							123.0	/	Mouth of Fishing Creek				
CHESAPEAKE BAY							122.7	/	Town, Chesapeake Beach				
CHESAPEAKE BAY							121.6	/	Outfall, Randle Cliff Beach				
CHESAPEAKE BAY							121.0	/	U.S. Naval Reservation				
CHESAPEAKE BAY							118.1	/	Mouth of Plum Point Creek				
Plum Point Creek								/	Head of Plum Point Creek				
Plum Point Creek							1.2	/	Bridge, Md. Highway 263				
Plum Point Creek							0.0	/	Mouth of Plum Point Creek				
CHESAPEAKE BAY							118.1	/	Mouth of Plum Point Creek				
CHESAPEAKE BAY							114.4	/	Town, Dares Beach				
CHESAPEAKE BAY							112.7	/	Mouth of Parker Creek				
Parker Creek								/	Head of Parker Creek				
Parker Creek							3.5	/	Mouth of Sullivan Branch				
Sullivan Branch								/	Head of Sullivan Branch				
Sullivan Branch							1.2	/	Outfall, C. Bernard Fowler Speed Wash				
Sullivan Branch							0.0	/	Mouth of Sullivan Branch				
Parker Creek							3.5	/	Mouth of Sullivan Branch				
Parker Creek							3.4	/	Bridge, Md. Highway 2 & 765				
Parker Creek							0.0	/	Mouth of Parker Creek				
CHESAPEAKE BAY							112.7	/	Mouth of Parker Creek				
CHESAPEAKE BAY							109.5	/	Town, Kenwood Beach				
CHESAPEAKE BAY							107.1	/	Mouth of Kings Creek				
Kings Creek								/	Head of Kings Creek				
Kings Creek							0.0	/	Mouth of Kings Creek				
CHESAPEAKE BAY							107.1	/	Mouth of Kings Creek				
CHESAPEAKE BAY							107.0	/	Town, Calvert Beach				
CHESAPEAKE BAY							106.6	/	Mouth of Calvert Beach Run				

DRAINAGE BASIN

DIRECT DRAINAGE AND MINOR TRIBUTARIES

SUB-BASTN

From Rock Point* to Drum Point**

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
					Calvert Beach Run						/Head of Calvert Beach Run
					Calvert Beach Run			0.0			Mouth of Calvert Beach Run
					CHESAPEAKE BAY	106.6					Mouth of Calvert Beach Run
					CHESAPEAKE BAY	106.2					Town, Long Beach
					CHESAPEAKE BAY	102.5					Mouth of Grover Creek
					Grover Creek						/Head of Grover Creek
					Grover Creek			0.2			Mouth of Thomas Branch
					Thomas Branch						/Head of Thomas Branch
					Thomas Branch			0.0			Mouth of Thomas Branch
					Grover Creek			0.2			Mouth of Thomas Branch
					Grover Creek			0.0			Mouth of Grover Creek
					CHESAPEAKE BAY	102.5					Mouth of Grover Creek
					CHESAPEAKE BAY	102.3					Mouth of Grays Creek
					Grays Creek						/Head of Grays Creek
					Grays Creek			0.0			Mouth of Grays Creek
					CHESAPEAKE BAY	102.3					Mouth of Grays Creek
					CHESAPEAKE BAY	101.5					Mouth of Wilbur Creek
					Wilbur Creek						/Head of Wilbur Creek
					Wilbur Creek			0.0			Mouth of Wilbur Creek
					CHESAPEAKE BAY	101.5					Mouth of Wilbur Creek
					CHESAPEAKE BAY	101.2					Outfall, Titanium Ore Corporation
					CHESAPEAKE BAY	101.0					Cove Point
					CHESAPEAKE BAY	99.9					Intake, Titanium Ore Corporation
					CHESAPEAKE BAY	99.9					Outfall, Titanium Ore Corporation
					CHESAPEAKE BAY	99.2					Mouth of Purgatory Creek
					Purgatory Creek						/Head of Purgatory Creek
					Purgatory Creek			0.0			Mouth of Purgatory Creek
					CHESAPEAKE BAY	99.2					Mouth of Purgatory Creek
					CHESAPEAKE BAY	98.8					Mouth of Cobb Creek
					Cobb Creek						/Head of Cobb Creek
					Cobb Creek			0.0			Mouth of Cobb Creek
					CHESAPEAKE BAY	98.8					Mouth of Cobb Creek
					CHESAPEAKE BAY	97.8					Mouth of Calams Run
					Calams Run						/Head of Calams Run
					Calams Run			0.0			Mouth of Calams Run
					CHESAPEAKE BAY	97.8					Mouth of Calams Run
					CHESAPEAKE BAY	97.4					Mouth of Parker Moore Creek
					Parker Moore Creek						/Head of Parker Moore Creek
					Parker Moore Creek			0.0			Mouth of Parker Moore Creek
					CHESAPEAKE BAY, WESTERN SHORE	97.4					Mouth of Parker Moore Creek
					CHESAPEAKE BAY	96.7					Mouth of Fresh Creek
					Fresh Creek						/Head of Fresh Creek in Calvert County, Maryland

CHESAPEAKE BAY, WESTERN SHORE

DRAINAGE BASIN

DIRECT DRAINAGE AND MINOR TRIBUTARIESSUB-BASIN

From Rock Point* to Drum Point**

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIESLOCATION: RIVER MILE/DESCRIPTION

(Magnitude of Waterway)

(Magnitude of Waterway)

1 2 3 4 5 61 2 3 4 5 6

Fresh Creek

0.0/Mouth of Fresh Creek

CHESAPEAKE BAY

96.7/Mouth of Fresh Creek

CHESAPEAKE BAY

95.6/Drum Point in Calvert County, Maryland

D. A. Drainage Area, square miles.

* Rock Point is in Anne Arundel County at mouth of Patapsco River.

** Drum Point is in Calvert County at mouth of Patuxent River.

January, 1965

Appendix A

CHESAPEAKE BAY, WESTERN SHOREDRAINAGE BASINPatuxent RiverSUB-BASINDISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

<u>MAIN WATERWAYS AND TRIBUTARIES</u> (Magnitude of Waterway)							<u>LOCATIONS: RIVER MILE/DESCRIPTION</u> (Magnitude of Waterway)						
<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	
CHESAPEAKE BAY, WESTERN SHORE							95.4	Mouth of Patuxent River, Calvert County, Maryland					
Patuxent River 1 /							109.3	Head of Patuxent River on boundary between Howard County and Montgomery County, Maryland					
Patuxent River							108.5	Bridge, Md. Highway 27					
Patuxent River							106.0	Bridge, Long Corner Road (D.A. 7.31)					
Patuxent River							104.6	Bridge, Mullinix Mill Road					
Patuxent River							103.6	Mouth of Scott Branch					
Scott Branch								Head of Scott Branch					
Scott Branch							0.0	Mouth of Scott Branch					
Patuxent River							103.6	Mouth of Scott Branch					
Patuxent River							103.0	Bridge, Md. Highway 94					
Patuxent River							102.3	Bridge, Hipsleys Mill Road					
Patuxent River							100.5	Mouth of Cabin Branch					
Cabin Branch								Head of Cabin Branch					
Cabin Branch							0.0	Mouth of Cabin Branch					
Patuxent River							100.5	Mouth of Cabin Branch					
Patuxent River							98.3	Bridge, Near Roxbury Mills					
Patuxent River							98.2	Mouth of Hights Branch					
Hights Branch								Head of Hights Branch					
Hights Branch							0.0	Mouth of Hights Branch					
Patuxent River							98.2	Mouth of Hights Branch					
Patuxent River							97.2	Bridge, Md. Highway 97					
Patuxent River							97.2	Gaging Station, Near Unity, Maryland (D. A. 34.8)					
Patuxent River							96.6	Mouth of Cattail Creek (D.A. 35.5)					
Cattail Creek							11.0	Head of Cattail Creek					
Cattail Creek							8.5	Bridge U.S. #40					
Cattail Creek							7.2	Mouth of Unnamed Tributary					
Unnamed Tributary								Head of Unnamed Tributary					
Unnamed Tributary								Bridge, Maryland #96 at Carrs Mill, Maryland					
Unnamed Tributary								Gaging Station at Carrs Mill, Maryland (D. A. 3.93)					
Unnamed Tributary							0.0	Mouth of Unnamed Tributary					
Cattail Creek							7.2	Mouth of Unnamed Tributary					
Cattail Creek							6.3	Mouth of Little Cattail Creek					
Little Cattail Creek								Head of Little Cattail Creek					
Little Cattail Creek							0.0	Mouth of Little Cattail Creek					
Cattail Creek							6.3	Mouth of Little Cattail Creek					
Cattail Creek							1.9	Mouth of East Branch					
East Branch								Head of East Branch					
East Branch							1.0	Mouth of Dorsey Branch					

DRAINAGE BASIN
SUB-BASIN

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)

LOCATIONS: RIVER MILE/DESCRIPTION (Magnitude of Waterway)

- 2 -

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)							LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)						
1	2	3	4	5	6		1	2	3	4	5	6	
						Patuxent River	79.8	/	Mouth of Walker Branch				
						Patuxent River	79.4	/	Bridge, Md. Highway 216				
						Patuxent River	79.0	/	Laurel Dam (D. A. 135.5)				
						Patuxent River	78.4	/	Bridge, U.S. Highway 1				
						Patuxent River	78.4	/	Gaging Station, Laurel, Maryland (D. A. 137.0)				
						Patuxent River	78.3	/	County Line, Howard-Anne Arundel Counties				
						Patuxent River 3	78.2	/	Bridge, B. & O. Railroad				
						Patuxent River	78.1	/	Bridge, Md. Highway 602				
						Patuxent River	77.4	/	Outfall, Md. City Sewage Plant				
						Patuxent River	76.0	/	Mouth of Crow Branch				
						Crow Branch		/	Head of Crow Branch				
						Crow Branch	1.9	/	Mouth of Bear Branch				
						Bear Branch		/	Head of Bear Branch				
						Bear Branch		/	Intake, Laurel public water supply				
						Bear Branch	0.0	/	Mouth of Bear Branch				
						Crow Branch	1.9	/	Mouth of Bear Branch				
						Crow Branch	0.0	/	Mouth of Crow Branch				
						Patuxent River	76.0	/	Mouth of Crow Branch				
						Patuxent River	75.1	/	Bridge, Baltimore-Washington Expressway				
						Patuxent River	74.6	/	Outfall, Laurel (Washington Suburban Sanitary Commission)				
						Patuxent River	74.1	/	Upstream boundary of Patuxent Research Refuge				
						Patuxent River	70.9	/	Mouth of Thomas Branch				
						Thomas Branch		/	Head of Thomas Branch				
						Thomas Branch	0.0	/	Mouth of Thomas Branch				
						Patuxent River	70.9	/	Mouth of Thomas Branch				
						Patuxent River	70.8	/	Bridge, Duvall Bridge				
						Patuxent River	70.3	/	Downstream boundary of Patuxent Research Refuge				
						Patuxent River	68.9	/	Mouth of Unnamed Tributary				
						Unnamed Tributary		/	Head of Unnamed Tributary				
						Unnamed Tributary		/	Head of Redington Lake				
						Unnamed Tributary		/	Dam, Lower end of Redington Lake				
						Unnamed Tributary		/	Head of Cash Lake				
						Unnamed Tributary		/	Dam, Lower end of Cash Lake				
						Unnamed Tributary	0.0	/	Mouth of Unnamed Tributary				
						Patuxent River	68.9	/	Mouth of Unnamed Tributary				
						Patuxent River	68.6	/	Bridge, Lemon's Bridge				
						Patuxent River	68.1	/	Bridge, Pennsylvania R.R., near Bowie (D. A. 165)				

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
Patuxent River						66.1	/Mouth of Horsepen Branch				
Horsepen Branch						4.5	/Head of Horsepen Branch				
Horsepen Branch						4.0	/Bridge, Hill Meade Road				
Horsepen Branch						2.6	/Bridge, Pennsylvania R.R.				
Horsepen Branch							/Bridge, at High Bridge (D.A. 5.00)				
Horsepen Branch						2.4	/Mouth of Newstop Branch				
Newstop Branch							/Head of Newstop Branch				
Newstop Branch							/Bridge, at High Bridge (D. A. 1.87)				
Newstop Branch						0.0	/Mouth of Newstop Branch				
Horsepen Branch						2.4	/Mouth of Newstop Branch				
Horsepen Branch							/Reference point, at Bowie, Maryland (D. A. 6.03)				
Horsepen Branch						1.6	/Bridge, Md. Highway 197				
Horsepen Branch						0.5	/Bridge, Race Track Road				
Horsepen Branch						0.4	/Bridge, Pennsylvania R.R. Race Track Spur				
Horsepen Branch						0.4	/Intake, Bowie Race Track				
Horsepen Branch						0.3	/Mouth of Unnamed Tributary				
Unnamed Tributary							/Head of Unnamed Tributary				
Unnamed Tributary							/Outfall, Bowie State Teachers College				
Unnamed Tributary						0.0	/Mouth of Unnamed Tributary				
Horsepen Branch						0.3	/Mouth of Unnamed Tributary				
Horsepen Branch						0.0	/Mouth of Horsepen Branch				
Patuxent River						66.1	/Mouth of Horsepen Branch				
Patuxent River						66.0	/Bridge, at Bowie Race Track				
Patuxent River						65.0	/Outfall, Bowie Race Track				
Patuxent River						64.2	/Outfall, Bowie-Bel Air Sewage Treatment Plant				
Patuxent River						63.3	/Mouth of Little Patuxent River (D. A. 181.2)				
Little Patuxent River						36.4	/Head of Little Patuxent River, Howard County				
Little Patuxent River						34.0	/Bridge, Sandhill Road				
Little Patuxent River						31.8	/Bridge, Marriottsville Road				
Little Patuxent River						28.1	/Bridge, Bethany Lane				
Little Patuxent River						27.6	/Bridge, U.S. Highway 40 at Pine Orchard, Maryland (D.A. 7.03)				
Little Patuxent River						27.6	/Gaging Station, Pine Orchard, Maryland (D. A. 7.03)				
Little Patuxent River						27.4	/Bridge, U.S. Highway 40 Alternate				
Little Patuxent River						26.9	/Mouth of Unnamed Tributary				
Unnamed Tributary							/Head of Unnamed Tributary				
Unnamed Tributary						2.5	/Outfall, Doughoregan Manor Dairy				

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

DISTANCES FROM MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
										0.0	Mouth of Unnamed Tributary
										26.9	Mouth of Unnamed Tributary
										25.5	Mouth of Red Hill Branch
											/Head of Red Hill Branch
										0.0	Mouth of Red Hill Branch
										25.5	Mouth of Red Hill Branch
										25.4	Bridge, Old Annapolis Road
										25.0	Bridge, Md. Highway 108 (D.A. 21.4)
											/Outfall, Dunloggin, Maryland
										23.8	Proposed pumping station at Columbia in Howard County
										23.0	Bridge, Secondary Road
										22.4	Bridge, Secondary Road near Simpsonville
										22.0	Bridge, U.S. Highway 29
										21.5	Bridge, Owen Brown Road (D. A. 29.2)
										20.1	Gaging Station, Guilford, Maryland (D. A. 38.0)
										20.0	Bridge, Md. Highway 32, near Guilford
											/Proposed dam site (D.A. 39.0)
										17.8	Bridge, Vallmerhausan Road
										17.6	Mouth of Middle Patuxent River
											/Head of Middle Patuxent River
										20.8	Bridge, Md. Highway 97
										20.7	Bridge, Md. Highway 144
										16.5	Bridge, Md. Highway 32
										16.5	Gaging Station, West Friendship, Maryland (D. A. 11.4)
										15.5	Bridge, Secondary Road near Tollgate
										13.9	Mouth of Benson Branch
											/Head of Benson Branch
										0.0	Mouth of Benson Branch
										13.9	Mouth of Benson Branch
										13.8	Bridge, Carrolls Mill Road
										13.6	Pipe-line crossing
										13.1	Bridge, Md. Highway 98
										13.0	Outfall, University of Maryland Agronomy Dairy
										11.0	Bridge, Secondary Road near Elioak
										9.7	Bridge, Md. Highway 108 (D. A. 37.5)

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
						8.5	/	Mouth of Unnamed Tributary			
						1.3	/	Head of Unnamed Tributary			
						0.9	/	Bridge, Trotter Road			
								(D. A. 0.30)			
						0.0	/	Mouth of Unnamed Tributary			
						8.5	/	Mouth of Unnamed Tributary			
						7.9	/	Mouth of Unnamed Tributary			
						2.3	/	Head of Unnamed Tributary			
						1.2	/	Bridge, Trotter Road			
								(D. A. 6.47)			
						0.0	/	Mouth of Unnamed Tributary			
						7.9	/	Mouth of Unnamed Tributary			
						6.6	/	Intake, W.R. Grace & Co.,			
								near Simpsonville			
						6.5	/	Outfall, W.R. Grace & Co.			
						6.4	/	Bridge, Md. Highway 32			
								(D. A. 11.4)			
							/	Intake, Johns Hopkins			
								University Applied Physics			
								Laboratory			
						5.6	/	Outfall, Applied Physics Lab.			
								The Johns Hopkins University			
						5.3	/	Bridge, U.S. Highway 29			
						5.2	/	Bridge, Secondary Road			
						4.7	/	Bridge, Unimproved Road			
						2.6	/	Power Transmission line			
								crossing			
						2.2	/	Bridge, Secondary road near			
								Guilford			
							/	Intake, The Arundel Corporation			
							/	Outfall, The Arundel Corp.			
						0.0	/	Mouth of Middle Patuxent River			
								(D. A. 57.8)			
						17.6	/	Mouth of Middle Patuxent River			
						17.5	/	Intake, Savage Manufacturing Co.			
						17.5	/	Diversion dam at Savage			
						17.1	/	Intake, Savage			
						17.0	/	Bridge, B. & O. R. R. at Savage			
						17.0	/	Bridge, (upper bridge at Savage)			
								(D. A. 97.8)			
						16.9	/	Outfall, Savage, Maryland			
						16.8	/	Outfall, Savage Manufacturing Co.			
						16.5	/	Bridge, U.S. Highway 1 at Savage,			
								Maryland			
						16.5	/	Gaging Station, at Savage, Maryland			
								(D. A. 98.4)			

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)

[illegible]

1	2	3	4	5	6	1	2	3	4	5	6
Little Patuxent River						13.2/Mouth of Dorsey Run					
Little Patuxent River						13.1/Bridge, Baltimore-Washington Expressway					
Little Patuxent River						12.9/Bridge, Secondary Road near District Training School					
Little Patuxent River						11.2/Intake, Fort Meade low-lift pumping station (D.A. 126)					
Little Patuxent River						11.1/Bridge, Md. Highway 602					
Little Patuxent River						11.0/Outfall, Fort Meade Sewage Treatment No. 2					
Little Patuxent River						9.9/Bridge, Switchboard Road (Old Forge Bridge)					
Little Patuxent River						7.1/Bridge, Pennsylvania R.R.					
Little Patuxent River						7.0/Mouth of Rogue Harbor Branch					
Rogue Harbor Branch						____/Head of Rogue Harbor Branch					
Rogue Harbor Branch						____/Outfall, Fort George G. Meade					
Rogue Harbor Branch						0.0/Mouth of Rogue Harbor Branch					
Little Patuxent River						7.0/Mouth of Rogue Harbor Branch					
Little Patuxent River						7.0/Bridge, Highway near Woodwardville					
Little Patuxent River						5.3/Bridge, Md. Highway 170					
Little Patuxent River						4.5/Outfall, Alan E. Barton Sand & Gravel Co.					
Little Patuxent River						3.6/Intake, Baltimore Concrete Plank Co.					
Little Patuxent River						3.3/Mouth of Towsers Branch					
Towsers Branch						3.4/Head of Towsers Branch					
Towsers Branch						3.3/Outfall, U.S. Naval Academy Dairy					
Towsers Branch						2.1/Bridge, Waugh Chapel Road					
Towsers Branch						0.0/Mouth of Towsers Branch					
Little Patuxent River						3.3/Mouth of Towsers Branch					
Little Patuxent River						3.2/Bridge, Md. Highway 424					
Little Patuxent River						3.1/Outfall, Patuxent Sewage Treatment Plant					
Little Patuxent River						1.6/Intake & Outfall, E. L. Gardner Sand & Gravel Co.					
Little Patuxent River						1.0/Outfall, Anne Arundel Sanitary Commission					
Little Patuxent River						0.0/Mouth of Little Patuxent River (D. A. 161.4)					
Patuxent River						63.3/Mouth of Little Patuxent River					
Patuxent River						63.0/Bridge, U.S. Highways 301 & 50, also Md. Highway 3 (D.A. 348)					
Patuxent River						61.7/Mouth of Ropers Branch					

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
				Ropers Branch						/Head of Ropers Branch	
				Ropers Branch						0.0/Mouth of Ropers Branch	
				Patuxent River						61.7/Mouth of Ropers Branch	
				Patuxent River						60.3/Bridge, John Hanson Highway	
				Patuxent River						60.2/Bridge, Governor Bridge Road	
										(D. A. 350)	
				Patuxent River						60.1/Intake & Outfall, Bi-County Aggregate Co.	
				Patuxent River						59.9/Outfall, Carl L. Abend Sand & Gravel Co.	
				Patuxent River						Co.	
				Patuxent River						59.8/Mouth of Green Branch	
				Green Branch						/Head of Green Branch	
				Green Branch						0.0/Mouth of Green Branch	
				Patuxent River						59.8/Mouth of Green Branch	
				Patuxent River						/Intake, Annapolis Sand and Gravel Co.	
				Patuxent River						59.5/Outfall, Annapolis Sand and Gravel Co.	
				Patuxent River						58.5/Mouth of Mill Branch	
				Mill Branch						/Head of Mill Branch	
				Mill Branch						0.0/Mouth of Mill Branch	
				Patuxent River						58.5/Mouth of Mill Branch	
				Patuxent River						57.7/Mouth of Kings Branch	
				Kings Branch						/Head of Kings Branch	
				Kings Branch						0.0/Mouth of Kings Branch	
				Patuxent River						57.7/Mouth of Kings Branch	
				Patuxent River						57.3/Bridge, Md. Highway 214, Central Ave.	
				Patuxent River						56.2/Mouth of Davidsonville Branch	
				Davidsonville Branch						/Head of Davidsonville Branch	
				Davidsonville Branch						0.0/Mouth of Davidsonville Branch	
				Patuxent River						56.2/Mouth of Davidsonville Branch	
				Patuxent River						56.0/Bridge, Queen Anne Bridge	
										(D. A. 371.0)	
				Patuxent River						56.0/Head of tide and upstream legal limit of license-free tidewater fishing	
				Patuxent River						55.2/Mouth of Honey Branch	
				Honey Branch						/Head of Honey Branch	
				Honey Branch						0.0/Mouth of Honey Branch	
				Patuxent River						55.2/Mouth of Honey Branch	
				Patuxent River						55.1/Mouth of Stocketts Run	
				Stocketts Run						/Head of Stocketts Run	
				Stocketts Run						0.0/Mouth of Stocketts Run	
				Patuxent River						55.1/Mouth of Stocketts Run	
				Patuxent River						53.0/Mouth of District Branch	
				District Branch						/Head of District Branch	
				District Branch						0.0/Mouth of District Branch	

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)							LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)						
1	2	3	4	5	6		1	2	3	4	5	6	
						Patuxent River	53.0						Mouth of District Branch
						Patuxent River	53.0						Mouth of Rock Branch
						Rock Branch							/Head of Rock Branch
						Rock Branch	1.7						Bridge, Polling House Road (D. A. 4.01)
						Rock Branch	0.0						Mouth of Rock Branch
						Patuxent River	53.0						Mouth of Rock Branch
						Patuxent River	51.9						Mouth of Ferry Branch
						Ferry Branch							/Head of Ferry Branch
						Ferry Branch	0.0						Mouth of Ferry Branch
						Patuxent River	51.9						Mouth of Ferry Branch
						Patuxent River	51.7						Outfall, Charles F. Meyer Sand & Gravel Co.
						Patuxent River	49.4						Bridge, Md. Highway 4
						Patuxent River	48.8						Mouth of Galloway Creek
						Galloway Creek							/Head of Galloway Creek
						Galloway Creek	0.0						Mouth of Galloway Creek
						Patuxent River	48.8						Mouth of Galloway Creek
						Patuxent River	47.5						Bristol Bar, Upstream limit of Federal navigation project
						Patuxent River	46.6						Mouth of Western Branch
						Western Branch	16.0						Head of Western Branch, Prince Georges County
						Western Branch	16.0						Mouth of Folly Branch
						Folly Branch							/Head of Folly Branch
						Folly Branch							/Reference point at Buena Vista (D. A. 5.47)
						Folly Branch	0.0						Mouth of Folly Branch
						Western Branch	16.0						Mouth of Folly Branch
						Western Branch	16.0						Mouth of Lottsford Branch
						Lottsford Branch							/Head of Lottsford Branch
						Lottsford Branch	1.0						Bridge, John Hanson Highway (D. A. 1.88)
						Lottsford Branch	0.0						Mouth of Lottsford Branch
						Western Branch	16.0						Mouth of Lottsford Branch
						Western Branch	15.2						Bridge, Lottsford Vista Road
						Western Branch	15.0						Mouth of Bald Hill Branch
						Bald Hill Branch	6.0						Head of Bald Hill Branch
						Bald Hill Branch	2.1						Bridge at George Palmer Highway (D. A. 3.22)
						Bald Hill Branch	0.0						Mouth of Bald Hill Branch
						Western Branch	15.0						Mouth of Bald Hill Branch
						Western Branch	14.5						Bridge, Lottsford Road
						Western Branch	12.6						Bridge, Md. Highway 214
						Western Branch	11.1						Gaging Station, Largo, Maryland Prince George's County (D.A. 30.2)

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
Western Branch						11.0	/	Mouth of Southeast Branch			
Southeast Branch							/	Head of Southeast Branch			
Southeast Branch						0.0	/	Mouth of Southeast Branch			
Western Branch						11.0	/	Mouth of Southeast Branch			
Western Branch						10.9	/	Bridge, Md. Highway 202			
Western Branch						10.9	/	Mouth of Southwest Branch			
Southwest Branch							/	Head of Southwest Branch			
Southwest Branch						0.0	/	Mouth of Southwest Branch			
Western Branch						10.9	/	Mouth of Southwest Branch			
Western Branch						9.4	/	Mouth of Turkey Branch			
Turkey Branch							/	Head of Turkey Branch			
Turkey Branch						0.0	/	Mouth of Turkey Branch			
Western Branch						9.4	/	Mouth of Turkey Branch			
Western Branch						7.4	/	Mouth of Cabin Branch			
Cabin Branch							/	Head of Cabin Branch			
Cabin Branch							/	Outfall, Andrews Air Force Base			
Cabin Branch						0.0	/	Mouth of Cabin Branch			
Western Branch						7.4	/	Mouth of Cabin Branch			
Western Branch						5.6	/	Mouth of Federal Branch			
Federal Branch							/	Head of Federal Branch			
Federal Branch						0.0	/	Mouth of Federal Branch			
Western Branch						5.6	/	Mouth of Federal Branch			
Western Branch						5.5	/	Mouth of Collington Branch			
Collington Branch							/	Head of Collington Branch			
Collington Branch						0.0	/	Mouth of Collington Branch			
								(D. A. 21.9)			
Western Branch						5.5	/	Mouth of Collington Branch			
Western Branch						5.5	/	Bridge, Md. Highway 4 at Marlboro			
								(D. A. 5.67)			
Western Branch						4.0	/	Outfall, Upper Marlboro Sewage Treatment Plant			
Western Branch						3.7	/	Bridge, Pennsylvania R.R.			
Western Branch						3.7	/	Upstream limit of license-free tidewater fishing			
Western Branch						3.5	/	Bridge, U.S. Highway 301 (D.A. 90.6)			
Western Branch						0.4	/	Mouth of Charles Branch			
Charles Branch						8.2	/	Head of Charles Branch			
Charles Branch						5.3	/	Off Osborne Road (D. A. 3.11)			
Charles Branch							/	Outfall, Andrews Air Force Base			
Charles Branch						1.3	/	Mouth of Horse Tavern Branch			
Horse Tavern Branch							/	Head of Horse Tavern Branch			

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

<u>MAIN WATERWAYS AND TRIBUTARIES</u>						<u>LOCATION: RIVER MILE/DESCRIPTION</u>					
(Magnitude of Waterway)						(Magnitude of Waterway)					
<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
				Horse Tavern Branch					O.O/Mouth of Horse Tavern Branch		
				Charles Branch					1.3/Mouth of Horse Tavern Branch		
				Charles Branch					O.O/Mouth of Charles Branch		
				(D. A. 17.6)							
				Western Branch					0.4/Mouth of Charles Branch		
				Western Branch					0.0/Mouth of Western Branch (D.A. 109.5)		
				Patuxent River					46.6/Mouth of Western Branch		
				Patuxent River					46.4/Bridge, Abandoned railroad bridge		
				Patuxent River					46.0/Mouth of Juron Branch		
				Juron Branch					/Head of Juron Branch		
				Juron Branch					0.0/Mouth of Juron Branch		
				Patuxent River					46.0/Mouth of Juron Branch		
				Patuxent River					45.1/Mouth of Deep Creek		
				Deep Creek					/Head of Deep Creek		
				Deep Creek					0.0/Mouth of Deep Creek		
				Patuxent River					45.1/Mouth of Deep Creek		
				Patuxent River					45.0/Mouth of Swan Point Creek		
				Swan Point Creek					/Head of Swan Point Creek		
				Swan Point Creek					0.0/Mouth of Swan Point Creek		
				Patuxent River					45.0/Mouth of Swan Point Creek		
				Patuxent River					44.2/Mouth of Mataponi Creek		
				Mataponi Creek					/Head of Mataponi Creek		
				Mataponi Creek					2.6/Bridge, at Fenno Road		
				Mataponi Creek					0.0/Mouth of Mataponi Creek (D.A. 19.7)		
				Patuxent River					44.2/Mouth of Mataponi Creek		
				Patuxent River					43.7/Mouth of Lyons Creek		
				Lyons Creek <u>4 /</u>					/Head of Lyons Creek		
				Lyons Creek					0.0/Mouth of Lyons Creek (D.A. 19.5)		
				Patuxent River					43.7/Mouth of Lyons Creek		
				Patuxent River <u>5 /</u>					43.7/Lyons Wharf		
				Patuxent River					40.5/Mouth of Kings Creek		
				Kings Creek					/Head of Kings Creek		
				Kings Creek					0.0/Mouth of Kings Creek		
				Patuxent River					40.5/Mouth of Kings Creek		
				Patuxent River					40.4/at Nottingham (D.A. 581)		
				Patuxent River					40.1/Outfall, Proposed Mataponi Creek, Sewage Treatment Plant		
				Patuxent River					39.0/Mouth of Hotchkins Branch		
				Hotchkins Branch					/Head of Hotchkins Branch		
				Hotchkins Branch					0.0/Mouth of Hotchkins Branch		
				Patuxent River					39.0/Mouth of Hotchkins Branch		
				Patuxent River					38.9/Mouth of Spice Creek		
				Spice Creek					1.8/Head of Spice Creek		
				Spice Creek					1.8/Bridge, Md. Highway 382		

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

[illegible]

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						
1	2	3	4	5	6	

LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6

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DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)							LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)						
1	2	3	4	5	6		1	2	3	4	5	6	
						Locks Swamp Creek							1.7/Bridge, New Market Turner Road (D. A. 4.62)
						Locks Swamp Creek							0.0/Mouth of Locks Swamp Creek
						Trent Hall Creek							1.7/Mouth of Locks Swamp Creek
						Trent Hall Creek							0.0/Mouth of Trent Hall Creek
						Patuxent River							21.7/Mouth of Trent Hall Creek
						Patuxent River							19.9/Mouth of Washington Creek
						Washington Creek							/Head of Washington Creek
						Washington Creek							0.0/Mouth of Washington Creek
						Patuxent River							19.9/Mouth of Washington Creek
						Patuxent River							19.8/Mouth of Persimmon Creek
						Persimmon Creek							2.5/Head of Persimmon Creek
						Persimmon Creek							2.3/Bridge at Delobrooke Road ext. (D. A. 2.49)
						Persimmon Creek							1.2/Bridge, State Highway #6 (D.A. 5.62)
						Persimmon Creek							0.0/Mouth of Persimmon Creek
						Patuxent River							19.8/Mouth of Persimmon Creek
						Patuxent River							19.4/Mouth of Cremona Creek
						Cremona Creek							/Head of Cremona Creek
						Cremona Creek							0.0/Mouth of Cremona Creek
						Patuxent River							19.4/Mouth of Cremona Creek
						Patuxent River							18.6/Mouth of Spring Creek
						Spring Creek							/Head of Spring Creek
						Spring Creek							0.0/Mouth of Spring Creek
						Patuxent River							18.6/Mouth of Spring Creek
						Patuxent River							18.2/Mouth of Horselanding Creek
						Horselanding Creek							/Head of Horselanding Creek
						Horselanding Creek							0.0/Mouth of Horselanding Creek
						Patuxent River							18.2/Mouth of Horselanding Creek
						Patuxent River							17.9/Mouth of Coatigan Creek
						Coatigan Creek							/Head of Coatigan Creek
						Coatigan Creek							0.0/Mouth of Coatigan Creek
						Patuxent River							17.9/Mouth of Coatigan Creek
						Patuxent River							17.4/Mouth of Battle Creek
						Battle Creek							/Head of Battle Creek
						Battle Creek							0.0/Mouth of Battle Creek (D.A. 18.9)
						Patuxent River							17.4/Mouth of Battle Creek
						Patuxent River							16.4/Mouth of Cat Creek
						Cat Creek							/Head of Cat Creek
						Cat Creek							0.0/Mouth of Cat Creek
						Patuxent River							16.4/Mouth of Cat Creek
						Patuxent River							15.9/Jack Bay
						Patuxent River							15.3/Mouth of Ben Creek
						Ben Creek							/Head of Ben Creek
						Ben Creek							0.0/Mouth of Ben Creek

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
Patuxent River						15.3	Mouth of Ben Creek				
Patuxent River						14.6	Mouth of Second Creek				
Second Creek							/Head of Second Creek				
Second Creek						0.0	Mouth of Second Creek				
Patuxent River						14.6	Mouth of Second Creek				
Patuxent River						14.0	Mouth of Nan Cove				
Nan Cove							/Head of Nan Cove				
Nan Cove						0.0	Mouth of Nan Cove				
Patuxent River						14.0	Mouth of Nan Cove				
Patuxent River						13.6	Mouth of Cole Creek				
Cole Creek							/Head of Cole Creek				
Cole Creek						0.0	Mouth of Cole Creek				
Patuxent River						13.6	Mouth of Cole Creek				
Patuxent River						12.0	Mouth of Island Creek				
Island Creek							/Head of Island Creek				
Island Creek						0.0	Mouth of Island Creek				
Patuxent River						12.0	Mouth of Island Creek				
Patuxent River						11.2	Mouth of Thomas Creek				
Thomas Creek							/Head of Thomas Creek				
Thomas Creek						0.0	Mouth of Thomas Creek				
Patuxent River						11.2	Mouth of Thomas Creek				
Patuxent River						9.5	Mouth of St. Leonard Creek				
St. Leonard Creek							/Head of St. Leonard Creek				
St. Leonard Creek							Gaging Station, near St. Leonard, Maryland (D. A. 6.73)				
St. Leonard Creek							/Head of estuary at St. Leonard (D. A. 10.5)				
St. Leonard Creek						0.0	Mouth of St. Leonard Creek (D. A. 22.5)				
Patuxent River						9.5	Mouth of St. Leonard Creek				
Patuxent River						8.9	Mouth of Mears Creek				
Mears Creek							/Head of Mears Creek				
Mears Creek						0.0	Mouth of Mears Creek				
Patuxent River						8.9	Mouth of Mears Creek				
Patuxent River						7.3	Mouth of Hellen Creek				
Hellen Creek							/Head of Hellen Creek				
Hellen Creek						0.0	Mouth of Hellen Creek				
Patuxent River						7.3	Mouth of Hellen Creek				
Patuxent River						6.8	Mouth of Hungersford Creek				
Hungersford Creek							/Head of Hungersford Creek				
Hungersford Creek						0.0	Mouth of Hungersford Creek				
Patuxent River						6.8	Mouth of Hungersford Creek				
Patuxent River						6.2	Clarks Wharf				
Patuxent River						6.2	Mouth of Cuckold Creek				

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
											/Head of Cuckold Creek
										0.0	/Mouth of Cuckold Creek
						6.2					/Mouth of Cuckold Creek
						6.2					/Mouth of Mill Creek
											/Head of Mill Creek
										0.0	/Mouth of Mill Creek
						6.2					/Mouth of Mill Creek
						6.2					/Mouth of Nats Creek
											/Head of Nats Creek
										0.0	/Mouth of Nats Creek
						6.2					/Mouth of Nats Creek
						5.4					/Mouth of Little Kingston Creek
											/Head of Little Kingston Creek
										0.0	/Mouth of Little Kingston Creek
						5.4					/Mouth of Little Kingston Creek
						4.8					/Outfall, Solomons Island, Patuxent Naval Air Testing Station
						4.7					/Third Cove
						3.7					/Mouth of Town Creek
											/Head of Town Creek
										0.0	/Mouth of Town Creek
						3.7					/Mouth of Town Creek
						2.9					/Mouth of Homing Creek
											/Head of Homing Creek
										0.0	/Mouth of Homing Creek
						2.9					/Mouth of Homing Creek
						2.5					/Solomons Island Wharf (D.A. 909.0)
						2.4					/Mouth of Mill Creek
											/Head of Mill Creek
										0.0	/Mouth of Mill Creek
						2.4					/Mouth of Mill Creek
						1.9					/Millstone Landing
						0.25					/Mouth of Harper Creek
											/Head of Harper Creek
										0.0	/Mouth of Harper Creek
						0.25					/Mouth of Harper Creek
						0.25					/Mouth of Pearson Creek
											/Head of Pearson Creek
										0.0	/Mouth of Pearson Creek
						0.25					/Mouth of Pearson Creek
						0.1					/Outfall, Cedar Point Naval Officers Club
						0.0					/Mouth of Patuxent River (D.A. 931.8)
						95.4					/Mouth of Patuxent River

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
D.A. Drainage Area, square miles.											
1	/	From mile point 109.3 to mile point 81.0 Patuxent River is boundary between Montgomery and Howard Counties, Maryland.									
2	/	From mile point 81.0 to mile point 78.2 Patuxent River is boundary between Howard and Prince Georges Counties, Maryland.									
3	/	From mile point 78.2 to mile point 43.7 Patuxent River is boundary between Prince Georges and Anne Arundel Counties, Maryland.									
4	/	Lyons Creek is boundary between Anne Arundel and Calvert Counties, Maryland.									
5	/	From mile Point 43.7 to mile point 23.8 Patuxent River is boundary between Prince Georges and Calvert Counties, Maryland.									
6	/	Swanson Creek is boundary between Charles and Prince Georges Counties, Maryland.									
7	/	From mile point 23.8 to mile point 22.1 Patuxent River is boundary between Calvert and Charles Counties, Maryland.									
8	/	Indian Creek is boundary between Charles and St. Mary's Counties, Maryland.									
9	/	From mile point 22.1 to mouth Patuxent River is boundary between Calvert and St. Mary's Counties, Maryland.									

January, 1965

Appendix A

CHESAPEAKE BAY, WESTERN SHORE

DRAINAGE BASIN

Direct Drainage and Minor Tributaries

SUB-BASIN

(From Hog Point* to Point Lookout**)

DISTANCES FROM MOUTH OF WATERWAY AND DRAINAGE AREAS FOR SPECIFIC LOCATIONS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)					
1	2	3	4	5	6	1	2	3	4	5	6
CHESAPEAKE BAY, WESTERN SHORE						95.0/Hog Point in St. Mary's County, Md. At Mouth of Patuxent River					
CHESAPEAKE BAY						94.7/Outfall, Officers Club, Patuxent Naval Air Station					
CHESAPEAKE BAY						94.2/Cedar Point					
CHESAPEAKE BAY						91.7/Mouth of Pine Hill Run					
Pine Hill Run						/Head of Pine Hill Run					
Pine Hill Run						2.0/Outfall, Solomons Island Naval Air Test Center					
Pine Hill Run						0.0/Mouth of Pine Hill Run					
CHESAPEAKE BAY						91.7/Mouth of Pine Hill Run					
CHESAPEAKE BAY						87.1/Biscue Pond					
CHESAPEAKE BAY						85.7/Carroll Pond					
CHESAPEAKE BAY						83.0/Point No Point					
CHESAPEAKE BAY						81.7/Mouth of St. Jerome Creek					
St. Jerome Creek						/Head of St. Jerome Creek					
St. Jerome Creek						0.7/Taylor Cove					
St. Jerome Creek						0.4/Mouth of Northern Prong					
Northern Prong						/Head of Northern Prong					
Northern Prong						0.0/Mouth of Northern Prong					
St. Jerome Creek						0.4/Mouth of Northern Prong					
St. Jerome Creek						0.3/Malone Bay					
St. Jerome Creek						0.1/Mouth of Southern Prong					
Southern Prong						/Head of Southern Prong					
Southern Prong						0.0/Mouth of Southern Prong					
St. Jerome Creek						0.1/Mouth of Southern Prong					
St. Jerome Creek						0.0/Mouth of St. Jerome Creek					
CHESAPEAKE BAY						81.7/Mouth of St. Jerome Creek					
CHESAPEAKE BAY						80.3/Fresh Pond					
CHESAPEAKE BAY						79.5/Mouth of Deep Creek					
Deep Creek						/Head of Deep Creek					
Deep Creek						0.3/Mouth of Long Neck Creek					
Long Neck Creek						/Head of Long Neck Creek					
Long Neck Creek						0.0/Mouth of Long Neck Creek					
Deep Creek						0.3/Mouth of Long Neck Creek					
Deep Creek						0.0/Mouth of Deep Creek					
CHESAPEAKE BAY						79.5/Mouth of Deep Creek					
CHESAPEAKE BAY						78.6/Scotland Beach					
CHESAPEAKE BAY						78.3/Mouth of Tanner Creek					
Tanner Creek						/Head of Tanner Creek					
Tanner Creek						0.0/Mouth of Tanner Creek					
CHESAPEAKE BAY						78.3/Mouth of Tanner Creek					
CHESAPEAKE BAY, WESTERN SHORE						75.7/Point Lookout, St. Mary's County, Md., Mouth of Potomac River					

* Hog Point is in St. Mary's County, Md., at Mouth of Patuxent River.

** Point Lookout is in St. Mary's County, Md., at Mouth of Potomac River.

January, 1965

APPENDIX B

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED AND STREAMFLOWS

See Description of Appendices (Appendix B) in the
General Reference Section for a narrative discussion
of this material.

Appendix B

CHESAPEAKE BAY, WESTERN SHORE DRAINAGE BASIN

DIRECT DRAINAGE AND MINOR TRIBUTARIES SUB-BASIN

(From Concord Point* to Rickett Point**)

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)		Water intake mgd	Waste discharge mgd	Daily Stream Flow cfs	
1	2	3	4	5	6	1	2 - 3 - 4 - 5 - 6			Minimum	Lower 5 Percentile
CHESAPEAKE BAY, WESTERN SHORE											
	Swan Creek					188.1-	3.5/Outfall, Plant #1, Aberdeen		X		
	Swan Creek					188.1-	3.5/Outfall, Plant #2, Aberdeen		X		
	Swan Creek					188.1-	3.5/Outfall, Aberdeen, New Plant		0.325		
CHESAPEAKE BAY, WESTERN SHORE						187.0/	Outfall, Aberdeen Proving Ground, Training Center		X		
CHESAPEAKE BAY, WESTERN SHORE						186.8/	Outfall, Aberdeen Proving Ground, Pusey Plant		X		
	Spesutie Narrows					184.5-	____/Outfall, Aberdeen Proving Ground, Phillips Field		X		
	Bush River					173.3-11.4-	8.4/Gaging Station at Bel Air			0.3	0.9
	Bynum Run					173.3-11.4-	8.2/Outfall, Bel Air, Md.		0.450		
	Bynum Run					173.3-10.4/	Outfall, Sewage Disposal, Perryman, Northeast Expressway Service Area and possibly Bata Shoe Co., (Pro- posed Treatment Plant)				
	Bush River					173.3-	9.7/Outfall, Belcamp, Md.		X		
	Otter Point Creek								0.138		
	Winters Run					173.3-	8.2-1.9-10.1/Intake, Bel Air, Md.	0.50			
	Winters Run					173.3-	8.2-1.9-10.0/Gaging Station, Bel Air, Md.				
	Winters Run					173.3-	8.2-1.9- 2.5/Intake, Edgewood Arsenal	3.90		X	X
	Bush River					173.3-	3.3/Outfall, Army Chemical Center Sewage Disposal Plant		1.500		
* Concord Point is in Havre de Grace, Harford County, Md., at mouth of Susquehanna River.											
** Rickett Point is at seaward end of Gunpowder Neck, Harford County, Md., at mouth of Gunpowder River.											
X Data Not Available.											

October, 1964

Appendix B
CHESAPEAKE BAY, WESTERN SHORE DRAINAGE BASIN
Gunpowder River SUB-BASIN

WATER-QUALITY STATIONS, WATER WITHDRAWAL, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)	Water intake mgd	Waste discharge mgd	Daily Stream Flow cfs	
1	2	3	4	5	6				Minimum	Lower 5 Percentile
CHESAPEAKE BAY, WESTERN SHORE										
Gunpowder River						169.0-0.5-52.7/Outfall, Lineboro Canning Company		0.200		
South Branch						169.0-0.5-51.6-____/Outfall, Penn-Carroll Farmers Co-op.		X		
George's Run						169.0-0.5-45.5-____/Outfall, Dutterer's of Manchester, Inc.		0.024		
George's Run						169.0-0.5-45.5-____/Outfall, Penn-Carroll Farmers Co-op.		0.035		
George's Run						169.0-0.5-45.5- 3.2/Gaging Station at Armacost, Md.			X	
Little Falls						169.0-0.5-32.5-10.6/Outfall, Freeland Paper Co.		X		
Little Falls						169.0-0.5-32.5-____/Intake, Federal Paperboard Co.	0.100			
Little Falls						169.0-0.5-32.5- 2.0/Outfall, Federal Paperboard Co.		0.090		
Little Falls						169.0-0.5-32.5- 0.6/Gaging Station, Blue Mount, Md.			12.0 (1)*	24.0 X
Gunpowder Falls						169.0-0.5-25.8/Gaging Station, Glencoe				
Western Run						169.0-0.5-21.5-12.8-1.1-1.1/Gaging Station near Glyndon, Md.				
Delaware Run						169.0-0.5-21.5- 8.4-1.6/Gaging Station at Coopersville, Md.			0.3	0.7
Slade Run						169.0-0.5-21.5- 6.6/Outfall, Donald S. Stubbs Co.		X	X	X
Blackrock Run						169.0-0.5-21.5- 5.0/Gaging Station at Western Run, Md.		X		
Western Run									11.0	21.0
Western Run										

* See footnotes at end of table.

1. The first part of the report deals with the general situation of the country and the progress of the work during the year. It also mentions the results of the various expeditions and the collections made.

2. The second part of the report describes the various expeditions and the collections made. It mentions the names of the expeditions and the names of the collectors. It also mentions the results of the expeditions and the collections made.

3. The third part of the report describes the various expeditions and the collections made. It mentions the names of the expeditions and the names of the collectors. It also mentions the results of the expeditions and the collections made.

4. The fourth part of the report describes the various expeditions and the collections made. It mentions the names of the expeditions and the names of the collectors. It also mentions the results of the expeditions and the collections made.

CHESAPEAKE BAY, WESTERN SHORE DRAINAGE BASIN

Gunpowder River SUB-BASIN

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)	Water intake mgd	Waste discharge mgd	Daily Stream Flow cfs	
1	2	3	4	5	6				Minimum	Lower 5 Percentile
	Western Run					169.0-8.5-21.5- 2.8/Outfall, Bonnie Blink Sewage Treatment Plant		0.018		
	Beaverdam Run					169.0-8.5-21.5- 1.4-2.2 /Gaging Station at Cooper'sville, Md.			X	X
	Goodwin Run					169.0-8.5-21.5- 1.4-1.6 -1.3/Outfall, Harry T. Campbell Sons Corp.		0.008		
	Beaverdam Run					169.0-8.5-21.5- 1.4-1.4 /Outfall, Mary- land Pigment & Research Corp.		0.009		
	Beaverdam Run					169.0-8.5-21.5- 1.4-1.2 /Outfall, Veneers, Ind.		X		
	Parks Run					169.0-8.5-21.5- 1.4-0.9 -0.1/Outfall, Md. Fine & Specialty Wire Co.		X		
	Beaverdam Run					169.0-8.5-21.5- 1.4-0.6 /Outfall, Cockeys- ville Distilling Co., Inc.		0.010		
	Beaverdam Run					169.0-8.5-21.5- 1.4-0.5 /Outfall, The Williamson Veneer Co.		X		
	Beaverdam Run					169.0-8.5-21.5- 1.4-0.45/Outfall, Hill House Dairy		X		
	Long Quarter Branch					169.0-8.5-14.3- 3.7/Outfall, Towson Wash- mobile		X		
	Gunpowder Falls					169.0-8.5-13.8/Intake, Baltimore City	113.100			
	Minebank Run					169.0-8.5-13.5- 3.2/Outfall, The Murray Corp.		X		
	Minebank Run					169.0-8.5-13.5- 2.7/Outfall, The Bendix Corp.		X		
	Cowen Branch							(Cooling Water)		
	Unnamed Tributary					169.0-8.5-12.0- 0.3-1.5 /Outfall, North- cliff Rest Home		X		

Gunpowder River

SUB-BASIN

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)							LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)		Water intake mgd	Waste discharge mgd	Daily Stream Flow cfs	
1	2	3	4	5	6		1	2			Minimum	Lower 5 Percentile
							169.0-8.5-12.0/Outfall, Md. Training School for Boys			0.050	1.4	2.9
							169.0-8.5-11.0/Gaging Station near Carney, Md.				X	X
							169.0-8.5-10.6/Sampling Station, Md. Water Pollution Control Comm.					
							169.0-8.5-10.4- 0.5/Outfall, Carney Sewage Treatment Plant			0.140		
							169.0-8.5- 6.1/Sampling Station, Md. Water Pollution Control Comm.				X	X
							169.0-8.5- 5.5/Outfall, Richlyn Manor Sewage Treatment Plant					
							169.0-8.5- 4.7/Outfall, Forge Heights Station, Md.					
							169.0-8.5- 3.7/Sampling Station, Md. Water Pollution Control Comm.				X	X
							169.0-8.5- 3.2/Outfall, Paul Jones & Co. Station, Md.					
							169.0-8.5- 2.7/Sampling Station, Md. Water Pollution Control Comm.				X	X
							169.0-8.5- 0.6-19.0/Gaging Station at Hess, Md.				X	X
							169.0-8.5- 0.6-13.8/Sampling Station, Md. Water Pollution Control Comm.				X	X
							169.0-8.5- 0.6-10.7/Gaging Station at Laurel Brook, Md.					
							169.0-8.5- 0.6- 8.4/Sampling Station, Md. Water Pollution Control Comm.				5.8	14.0
							169.0-8.5- 0.6- 8.1/Outfall, E. H. Tolz- man & Sons, Inc.				X	X
							169.0-8.5- 0.6- 7.5/Gaging Station at Bel Air, Md.			X	(2)	X
							169.0-8.5- 0.6- 7.5/Sampling Station, Md. Water Pollution Control Comm.				X	X

DRAINAGE BASIN

SUB-BASIN

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)	Water intake mgd	Waste discharge mgd	Daily Stream Flow cfs	
1	2	3	4	5	6	1 - 2 - 3 - 4 - 5 - 6			Minimum	Lower 5 Percentile
						Little Gunpowder Falls 169.0-8.5-0.6-___/Intake, Belko Corp. Little Gunpowder Falls 169.0-8.5-0.6-4.5/Outfall, Belko Corp. Little Gunpowder Falls 169.0-8.5-0.6-4.1/Sampling Station, Md. Water Pollution Control Commission Little Gunpowder Falls 169.0-8.5-0.6-2.5/Sampling Station, Md. Water Pollution Control Commission Little Gunpowder Falls 169.0-8.5-0.6-2.2/Sampling Station, Md. Water Pollution Control Commission Little Gunpowder Falls 169.0-8.5-0.6-2.0/Outfall, Joppatowne Little Gunpowder Falls 169.0-8.5-0.6-1.9/Intake, Joppa Sand & Gravel Co. Little Gunpowder Falls 169.0-8.5-0.6-1.4/Outfall, Joppa Sand & Gravel Co. Little Gunpowder Falls 169.0-8.5-0.6-0.5/Sampling Station, Md. Water Pollution Control Commission	0.372	X		X
						Bird River Whitemarsh Run Whitemarsh Run Whitemarsh Run Whitemarsh Run Whitemarsh Run Saltpetrer Creek	1.440			
						169.0-8.1-1.9-6.3/Outfall, Ark Read- Mix Concrete Corp., Nottingham Farms Inc. 169.0-8.1-1.9-6.0/Outfall, Perry Hall Sewage Treatment Plant 169.0-8.1-1.9-___/Intake, H. T. Campbell Sons 169.0-8.1-1.9-2.9/Gaging Station at Whitemarsh, Md. 169.0-8.1-1.9-2.6/Outfall, H. T. Campbell Sons 169.0-2.5-1.3/Outfall, Chas. P. Crane Steam-Electric Generating Station minimum observed flow 71.0 cfs. 169.0-2.5-1.3/Outfall, Chas. P. Crane Steam-Electric Generating Station minimum observed flow 13.0 cfs. Based on only one year of observations (1959).	0.086	X		X
						(1) Minimum daily flow unknown; (2) Minimum daily flow unknown; (3) Based on only one year of observations (1959).				
						October, 1964				

(1) Minimum daily flow unknown; minimum observed flow 100 cfs.
(2) Minimum daily flow unknown; minimum observed flow 100 cfs.
(3) Based on only one year of observations (1959).

Appendix B
CHESAPEAKE BAY, WESTERN SHORE DRAINAGE BASIN

DIRECT DRAINAGE AND MINOR TRIBUTARIES SUB-BASIN
(From Lower Island Point* to North Point**)
WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)	1	2	3	4	5	6	LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)	Water intake, mgd	Waste discharge mgd	Daily Stream Flow, cfs	
										Minimum	Lower 5 percentile
CHESAPEAKE BAY, WESTERN SHORE	1	2	3	4	5	6	168.9/Lower Island Point at mouth of Gunpowder River, Baltimore County, Md.				
Seneca Creek							168.7-0.8/Intake, Baltimore Gas & Electric Co., Charles P. Crane steam - electric station	478.000			
Middle River							168.5-3.1-0.8/Outfall, Martin Company, "D" Building		X		
Darkhead Creek							168.5-3.1-0.6-0.5/Outfall, Martin Co., Yard "A" Building, "E" Building		X		
Cow Pen Creek							168.5-3.1-0.6-0.4/Outfall, Martin Co., Yard, "H" Building		X		
Cow Pen Creek							168.5-3.1-0.6-0.3/Outfall, Martin Co., "A" Building		X		
Cow Pen Creek							168.5-3.1-0.6-0.2/Outfall, Martin Co., Yard, "A", "M", "P" Buildings		X		
Frog Mortar Creek							168.5-2.0-2.0/Outfall, General Service Administration		0.023		
Frog Mortar Creek							168.5-2.0-0.5/Outfall, Martin Co., Air- port		X		
Back River							165.4-9.2-9.9/Outfall, Friez Instrument Division, Bendix Corp.		X		
Herring Run							165.4-9.2-9.9/Outfall, American Totali- zator		X		

DIRECT DRAINAGE AND MINOR TRIBUTARIES SUB-BASIN

(From Lower Island Point* to North Point**)

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)	LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)	Water intake, mgd	Waste discharge mgd	Daily Stream Flow, cfs	
				Minimum	Lower 5 percentile
1 2 3 4 5 6	1 - 2 - 3 - 4 - 5 - 6				
Herring Run	165.4-9.2-2-9.9/Outfall Black and Decker		X		
West Branch	165.4-9.2- - - - - /Outfall, Ready Mixed Concrete Plant		X		
Unnamed Tributary	165.4-9.2-2-2.9-1.2/Outfall, Lord Baltimore Press, Inc.		X		
Unnamed Tributary	165.4-9.2-2-2.9-1.2/Outfall, O'Brien Corp. Paint Manufacture		X		
Unnamed Tributary	165.4-9.2-2-2.9-1.1/Outfall, Continental Can Co., Plant #16		X		
Unnamed Tributary	165.4-9.2-2-2.9-1.0/Outfall, Continental Can Co., Plant #79		X		
Unnamed Tributary	165.4-9.2-2-2.9-0.9/Outfall, Armco Steel		X		
Unnamed Tributary	165.4-9.2-2-2.9-0.7/Outfall, McCall-Boykin Co., Inc.		X		
Unnamed Tributary	165.4-9.2-2-2.9-0.6/Outfall, C. Hoffberger Co., Division of Gulf Oil Corp.		X		
Moores Run	165.4-9.2-1.0-0.5/Outfall, Trailmobile Inc. (Makes, Repairs and Cleans Tank Trucks)		X		
Redhouse Creek	165.4-9.2-0.1-1.1/Outfall, Rosedale Passenger Lines		X		
Redhouse Creek	165.4-9.2-0.1-0.8/Outfall, Kennedy Manufacturing Co.		X		
Redhouse Creek	165.4-9.2-0.1-0.7/Outfall, Joseph J. Martin Company		X		
Redhouse Creek	165.4-9.2-0.1-0.4/Outfall, Champion Brick Company		X		

DIRECT DRAINAGE AND MINOR TRIBUTARIES SUB-BASIN

(From Lower Island Point* to North Point**)

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)	1	2	3	4	5	6	LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)	Water intake, mgd	Waste discharge mgd	Daily Stream Flow, cfs	
										Minimum	Lower percentile
1	2	3	4	5	6		1 - 2 - 3 - 4 - 5 - 6				
Back River							165.4-8.5/Outfall, Eastern Stainless Steel (I)		0.70		
Northeast Creek							165.4-8.0-1.3-1.0/Outfall, Perfection Laundry		X		
Stemmers Run							165.4-8.0-1.3-0.5/Intake, Truck Gardener at Stemmers Run, Md.	X			
Back River							165.4-6.9-0.1/Outfall, Baltimore, Back River Sewage Treatment Plant		160.0		
Bread and Cheese Creek							165.4-6.3-0.2-1.5/Outfall, Essex Hy-Grade Laundry I		X		
Deep Creek							161.7/North Point, Baltimore County, Maryland				
Unnamed Tributary											
CHESAPEAKE BAY, WESTERN SHORE											
* Lower Island Point is in Baltimore County, Md., at mouth of Gunpowder River.											
** North Point is in Baltimore County, Md., at mouth of Patapsco River.											
X Data not available.											
October, 1964											

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CHESAPEAKE BAY, WESTERN SHORE DRAINAGE BASIN

Patapsco River SUB-BASIN

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)	Water intake mgd	Waste discharge mgd	Daily Stream Flow cfs	
1	2	3	4	5	6	1 - 2 - 3 - 4 - 5 - 6			Minimum	Lower 5 Percentile
CHESAPEAKE BAY, WESTERN SHORE										
Patapsco River										
North Branch										
East Branch										
Unnamed Tributary						160.4-36.4-20.5-7.4-1.2 / Outfall, Greenmount Can Company		0.120		
Unnamed Tributary						160.4-36.4-20.5-7.4-0.4 / Outfall, Walsh Fuel Oil Company		X		
West Branch										
Unnamed Tributary						160.4-36.4-20.5-6.5-1.0 / Outfall, Koontz Dairy		1.500		
Unnamed Tributary						160.4-36.4-20.5-6.5-0.9 / Outfall, Finch Services Co.		X		
Unnamed Tributary						160.4-36.4-20.5-6.5-0.8 / Outfall, B. F. Shriver Co.		0.168		
Unnamed Tributary						160.4-36.4-20.5-6.5-0.2 / Outfall, Hahn Bros. Co.		0.025		
Cranberry Branch						160.4-36.4-20.5-6.1-0.5 / Gaging Station near Westminster, Maryland			0.7	1.2
Cranberry Branch						160.4-36.4-20.5-6.1-0.2 / Intake, Westminster Filtration Plant at Cranberry Station	0.900 ¹			
Deep Run						160.4-36.4-19.1-6.8 / Intake, Black & Decker Manufacturing Company	0.210			
Deep Run						160.4-36.4-19.1-6.8 / Outfall, Black & Decker Manufacturing Company		0.028		
North Branch						160.4-36.4-17.1 / Outfall, Finksburg Sewage Disposal Plant		X		
North Branch						160.4-36.4-17.0 / Intake, Westminster ¹	stand by			
North Branch						160.4-36.4-___ / Intake, Congoleum-Nairn	0.600			

CHESAPEAKE BAY, WESTERN SHORE DRAINAGE BASIN

Patapsco River

SUB-BASIN

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)							LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)		Water intake mgd	Waste discharge mgd	Daily Stream Flow cfs	
1	2	3	4	5	6		1 - 2 - 3 - 4 - 5 - 6				Minimum	Lower 5 Percentile
	North Branch						160.4-36.4-16.9/Outfall, Congoleum-Nairn			1.000	8.5	17.0
	North Branch						160.4-36.4-16.6/Gaging Station at Cedarhurst, Md.					
	Unnamed Tributary						160.4-36.4-15.7-0.6-0.71/Intake, Montrose School for Girls	0.030				
	Unnamed Branch						160.4-36.4-15.7-0.6-0.70/Outfall, Montrose School for Girls			0.035		
	Keyzers Run						160.4-36.4-13.7-___/Outfall, Child Rehabilitation Center, Reisterstown			0.008		
	Beaver Run						160.4-36.4-13.4-2.4/Gaging Station, Finksburg, Md.				3.25 ²	X
	North Branch						160.4-36.4-9.8/Gaging Station, Reisterstown, Md.				11.0	26.0
	Morgan Run						160.4-36.4-7.6-___/Gaging Station, Gamber, Md.				5.91 ²	X
	North Branch						160.4-36.4-3.2/Intake, Baltimore City Bureau of Water Supply	105.2				
	North Branch						160.4-36.4-2.3/Gaging Station near Marriotsville, Md.				0.2	48.0
	South Branch						160.4-36.4-12.4-0.6/Outfall, J. Austin Pergory			0.020		
	Unnamed Tributary						160.4-36.4-12.2/Outfall, Hyman Viener & Sons			0.050		
	South Branch						160.4-36.4-11.4/Outfall, Morgan Caning Co.			0.050		
	South Branch						160.4-36.4-11.4/Outfall, Essential Oils Co.			X		

Patapsco River

SUB-BASIN

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)	Water intake mgd	Waste discharge mgd	Daily Stream Flow cfs	
1	2	3	4	5	6				Minimum	Lower 5 Percentile
						1 - 2 - 3 - 4 - 5 - 6				
					Unnamed Tributary	160.4-36.4-5.5-0.6/Outfall, H. Renehan & Sons		0.014		
					South Branch	160.4-36.4-2.8/Outfall, Henryton State Hospital		0.040		
					South Branch	160.4-36.4-2.7/Gaging Station, Henryton, Md.			6.8	14.0
					Piney Run	160.4-36.4-1.1-6.1/Gaging Station, Sykesville, Md.			1.2	3.1
					Piney Run	160.4-36.4-1.1-6.0/Intake, Springfield State Hospital	1.300			
					Piney Run	160.4-36.4-1.1-5.5/Outfall, Sykesville-Springfield State Hospital		1.000	50.0	X
					Patapsco River	160.4-34.7/Gaging Station, Woodstock		0.020		
					Patapsco River	160.4- - -/Outfall, Woodstock		0.500 ³		
					Patapsco River	160.4-29.8/Outfall, C. R. Daniels				
					Patapsco River	160.4-28.3/Gaging Station, Hollofield			16.0	64.0
					Patapsco River	160.4- - -/Intake, W. J. Dickey, Oella				
					Patapsco River	160.4-24.8/Outfall, W. J. Dickey, Oella	1.000	X		
					Tiber Creek	160.4-24.2-1.7/Outfall, Howard County Farmers Co-op.		0.008		
					Tiber Creek	160.4-24.2-1.5/Outfall, Ellicott City Area, Howard County		X		
					Tiber Creek	160.4-24.2-0.6/Outfall, Howard-Baltimore Cleaners		X		
					Tiber Creek	160.4-24.2-0.1/Outfall, E. F. Harscher		X		
					Hudson Creek	160.4- - -/Outfall, Ellicott City		X		
					Patapsco River	160.4-24.1/Outfall, Doughnut Corp. of America		X ³		
					Cooper Branch	160.4-23.9-0.8/Outfall, Cooper Branch, Catonsville		0.100		

CHESAPEAKE BAY, WESTERN SHORE DRAINAGE BASIN

Patapsco River SUB-BASIN

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)							LOCATION:: RIVER MILE/DESCRIPTION (Magnitude of Waterway)		Water intake mgd	Waste discharge mgd	Daily Stream Flow cfs	
1	2	3	4	5	6		1	2 - 3 - 4 - 5 - 6			Minimum	Lower 5 Percentile
Patapsco River							160.4-22.2/Intake, Ilchester, Bartgis Div., New Haven Board & Carton Co.		4.500			
Patapsco River							160.4-____/Intake, Ilchester		0.015			
Patapsco River							160.4-22.2/Outfall, Bartgis Division, New Haven Board & Carton Co.			4.500		
Patapsco River							160.4-21.7/Outfall, St. Mary's College			X		
Patapsco River							160.4-17.4/Outfall, Elkridge Laundry			X		
Patapsco River							160.4-16.8/Outfall, Friendship Airport					
							Sewage Treatment Plant			0.100		
Stoney Run Creek							160.4-16.8-____/Intake, Joseph Seagram					
Unnamed Tributary							160.4-14.7-1.5/Outfall, Landsdowne		3.256			
							Div. Westinghouse Electric			X		
Middle Branch												
Gwynn's Falls							160.4-10.3-1.8-19.0/Gaging Station, (Crest Stage Partial Record Station), Owings Mills, Md.				X	
Gwynn's Falls							160.4-10.3-1.8-16.2/Gaging Station, (Crest Stage Partial Record Station), McDonogh, Md.				X	
Horsehead Branch							160.4-10.3-1.8-15.9-1.0/Outfall, McDonogh School			0.050		
Gwynn's Falls							160.4-10.3-1.8- 1.3/Outfall, Braun Rendering Company			X		
Gwynn's Falls							160.4-10.3-1.8- 1.0/Outfall, Maryland Glass Co.			0.145		
Gwynn's Falls							160.4-10.3-1.8- 1.0/Outfall, Baltimore Paint & Color Company			0.072		
Gwynn's Falls							160.4-10.3-1.8-____/Outfall, Baltimore Porcelain Steel Co.					
Middle Branch							160.4-10.3-1.7/Outfall, Sun Oil Corp.			0.130		
Middle Branch							160.4-10.3-____/Outfall, Cooperative Mills, Inc.			X		

CHESAPEAKE BAY, WESTERN SHORE DRAINAGE BASIN

Patapsco River

SUB-BASIN

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)		Water intake mgd	Waste discharge mgd	Daily Stream Flow cfs	
1	2	3	4	5	6	1	2			Minimum	Lower 5 Percentile
	Middle Branch					160.4-10.3-1.5/Outfall, General Chemical Company			X		
	Middle Branch					160.4-10.3-1.5/Intake and Outfall, Balto. Gas & Electric Co., Westport Power Sta.	X		X		
	Middle Branch					160.4-10.3-1.5/Outfall, Carr-Lowrey Glass Co.			X		
	Middle Branch					160.4-10.3-____/Outfall, Locke, Inc.			66,000		
	Patapsco River					160.4- 9.6/Intake and Outfall, Balto. Gas & Electric Co., Gould St. Station	X		X		
	Northwest Branch Jones Falls Deep Run					160.4- 8.5-3.3-20.9-0.5/Gaging Station, (Crest Stage Partial Record Station), Brooklandville, Md.				X	X
	Jones Falls					160.4- 8.5-3.3-19.1/Outfall, Rockland Bleach & Dye Works			0.020		
	Jones Falls					160.4- 8.5-3.3-18.4/Gaging Station (Crest Stage Partial Record Station), Sorrento, Md.				X	X
	Unnamed Tributary					160.4-88.5-3.3- 9.5-0.3/Intake, Balto. Country Club		0.170			
	Northwest Branch					160.4- 8.5-2.8/Outfall, Pepsi Cola Co.			X	Tidal	Tidal
	Northwest Branch					160.4- 8.5-2.7/Outfall, Farboil Paint Co.			X	Tidal	Tidal
	Northwest Branch					160.4- 8.5-2.5/Outfall, Bethlehem Steel Shipbuilding			X	Tidal	Tidal
	Northwest Branch					160.4- 8.5-2.3/Outfall, Atlantic Refining Company			X	Tidal	Tidal
	Northwest Branch					160.4- 8.5-2.2/Outfall, Allied Chemical			X	Tidal	Tidal
	Northwest Branch					160.4- 8.5-2.2/Outfall, Hercules Co.			X	Tidal	Tidal
	Northwest Branch					160.4- 8.5-2.1/Outfall, Booz Bros., Inc.			X	Tidal	Tidal

CHESAPEAKE BAY, WESTERN SHORE DRAINAGE BASIN

Patapsco River SUB-BASIN

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)	Water intake mgd	Waste discharge mgd	Daily Stream Flow cfs	
1	2	3	4	5	6				Minimum	Lower 5 Percentile
	Northwest Branch					160.4-8.5-2.0/Outfall, American Sugar Refining Company		X	Tidal	Tidal
	Northwest Branch					160.4-8.5-1.7/Outfall, Arundel Brooks Concrete Company		X	Tidal	Tidal
	Northwest Branch					160.4-8.5-1.7/Outfall, Proctor and Gamble Co.		X	Tidal	Tidal
	Northwest Branch					160.4-8.5-1.6/Outfall, J. Langrall & Bros. Co.		X	Tidal	Tidal
	Northwest Branch					160.4-8.5-1.5/Outfall, Booth Packing Co.		X	Tidal	Tidal
	Northwest Branch					160.4-8.5-1.3/Outfall, Lord-Mott Co., Inc.		X	Tidal	Tidal
	Northwest Branch					160.4-8.5-1.2/Outfall, Chesapeake Marine Railway Co.		X	Tidal	Tidal
	Northwest Branch					160.4-8.5-0.9/Outfall, Esso Standard Oil		102,000	Tidal	Tidal
	Northwest Branch					160.4-8.5-0.7/Outfall, C. Hoffberger Co.		X	Tidal	Tidal
	Northwest Branch					160.4-8.5-0.6/Outfall, American Smelting Co.		X	Tidal	Tidal
	Northwest Branch					160.4-8.5-0.3/Outfall, American Agricultural Chemical Co.		X	Tidal	Tidal
	Northwest Branch					160.4-8.5-___/Outfall, H. C. Croft Sugar Co.		X	Tidal	Tidal
	Northwest Branch					160.4-8.5-___/Outfall, Pratt Corp.		X	Tidal	Tidal
	Colgate Creek					160.4-7.9-___/Glidden Paint Co.		X	Tidal	Tidal
	Patapsco River					160.4-6.8/Outfall, Sharps Continental Corp.		6,000	Tidal	Tidal
	Patapsco River					160.4-6.0/Outfall, Baltimore City Patapsco Sewage Treatment Plant, Wagners Point		X	Tidal	Tidal
	Curtis Bay							8,990	Tidal	Tidal
	Curtis Creek									
	Furnace Creek									
	Sawmill Creek					160.4-5.8-1.3-2.7-2.0-___/Gaging Station, Glen Burnie, Md.				
	Furnace Creek					160.4-5.8-1.3-2.7-___/Outfall, Sunbrite Laundry		0,030	3.6	4.5

CHESAPEAKE BAY, WESTERN SHORE DRAINAGE BASIN

Patapsco River

SUB-BASIN

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)		Water intake mgd	Waste discharge mgd	Daily Stream Flow cfs	
1	2	3	4	5	6					Minimum	Lower 5 Percentile
						1 - 2 - 3 - 4 - 5 - 6					
					Furnace Creek	160.4-5.8-1.3-2.7- /Outfall, Western Electric Corp.			0.200		
					Curtis Creek	160.4-5.8-1.3-1.3/Outfall, Armour Fertilizer Works			X	Tidal	Tidal
					Curtis Creek	160.4-5.8-1.3-0.9/Outfall, A. Smith & Sons Boatyard			X	Tidal	Tidal
					Curtis Creek	160.4-5.8-1.3-0.8/Outfall, American Oil Co.			0.720	Tidal	Tidal
					Curtis Creek	160.4-5.8-1.3-0.4/Outfall, Davison Chemical Co., Rock Pier			4,000	Tidal	Tidal
					Curtis Creek	160.4-5.8-1.3-0.4/Outfall, Olin Mathieson Chemical Corp.			18,000	Tidal	Tidal
					Curtis Bay	160.4-5.8-1.2/Outfall, E. I. Dupont De Nemours Co.			5,000	Tidal	Tidal
					Curtis Bay	160.4-5.8-1.0/Outfall, Boston Metals Co.			X	Tidal	Tidal
					Curtis Bay	160.4-5.8-0.4/Outfall, Sinclair Refining			X	Tidal	Tidal
					Curtis Bay	160.4-5.8-0.1/Outfall, U. S. Gypsum			X	Tidal	Tidal
					Curtis Bay	160.4-5.8- /Outfall, Standard Wholesale Phos. & Acid Works, Inc.			X	Tidal	Tidal
					Curtis Bay	160.4-5.8- /Outfall, Pan American Refining Co.			X	Tidal	Tidal
					Curtis Bay	160.4-5.8- /Outfall, Petrol Terminal Co.			X	Tidal	Tidal
					Patapsco River	160.4-5.6/Outfall and Intake, Baltimore Gas & Electric Co., Riverside Plant			X	Tidal	Tidal
					Patapsco River	160.4-4.0/Outfall, Hawkins Point, Kenne-cott Refining Co.		X	0.030	Tidal	Tidal
					Patapsco River	160.4-4.0/Intake and Outfall, Baltimore Gas & Electric Co., Hawkins Point Plant		X	X	Tidal	Tidal
					Patapsco River	160.4-3.4/Outfall, Glen Burnie Sewage Treatment Plant (60,000 people)			3,000	Tidal	Tidal
					Patapsco River	160.4-1.0/Outfall, Maryland Slag Corp.			X	Tidal	Tidal
					Jones Creek	160.4-1.0- /Outfall, Sparrows Point			X	Tidal	Tidal
					Patapsco River	160.4- /Outfall, Petrol Terminal Co.			X	Tidal	Tidal

DRAINAGE BASIN

SUB-BASIN

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)						Water intake mgd	Waste discharge mgd	Daily Stream Flow cfs			
1	2	3	4	5	6	1	2	3	4	5	6			Minimum	Lower 5 Percentile		
				Patapsco River		160.4-			/	Outfall, Rasin Monumental Co.			X	Tidal	Tidal		
				Patapsco River		160.4-			/	Outfall, Baltimore City Reed Bird Incinerator Plant		0.851		Tidal	Tidal		
				Patapsco River		160.4-	0.01		/	Outfall, Fort Smallwood, Anne Arundel County			X	Tidal	Tidal		
				Bear Creek		160.4-			-	/	Outfall, Bethlehem Steel Co., Wire Mill	13,000		Tidal	Tidal		
				Patapsco River		160.4-			/	Outfall, Bethlehem Steel Co.		400,000		Tidal	Tidal		
				Patapsco River		160.4-			/	Outfall, Bethlehem Steel Co.		39,000		Tidal	Tidal		
1						Westminster takes total of 0,900 mgd from Cranberry Branch and North Branch Patapsco River.											
2						Low-flow partial-record gaging station, 1961 observation.											
3						Cooling water.											
X						Data not available.											
															October, 1964		

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Appendix B
CHESAPEAKE BAY, WESTERN SHORE DRAINAGE BASIN

DIRECT DRAINAGE AND MINOR TRIBUTARIES SUB-BASIN
(From Rock Point to Drum Point 2)

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS					
MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)		LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)	Water intake mgd	Waste discharge mgd	Daily Stream Flow cfs Minimum Lower 5 Percentile
1	2	3	4	5	6
CHESAPEAKE BAY, WESTERN SHORE					
CHESAPEAKE BAY, WESTERN SHORE					
CHESAPEAKE BAY, WESTERN SHORE					
CHESAPEAKE BAY, WESTERN SHORE					
Severn River					
Severn Run					
Picture Frame Branch					
Picture Frame Branch					
Brewer Creek					
Carr Creek					
Severn River					
South River					
North River					
Bacon Ridge Branch					
Unnamed Tributary					
Bacon Ridge Branch					

1	2	3	4	5	6
/Proposed Outfall, Mountain Road Sewage Treatment Plant ³					
/Proposed Outfall, Mountain Road Sewage Treatment Plant ⁴					
/Outfall, Sandy Point State Prison ⁴					
/Outfall, Sandy Point State Park ⁴					
142.8-12.9-2.4 -1.1/Outfall, National Plastics Products					
142.8-12.9-2.4 -1.0/Outfall National 1 Store Fixtures					
142.8- 5.4- /Intake, Sherwood Forest					
142.8- 0.4-0.8 /Outfall, Sewage Treat- ment Plant, Severn					
142.8- 0.3/Outfall, Annapolis Sewage Treatment Plant					
137.6- 9.8-0.8 /Gaging Station near Annapolis					
137.6- 9.8- /1.5/Outfall, Crownsville State Hospital					
137.6- 9.8-1.25/Gaging Station at Chesterfield, Md.					

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CHESAPEAKE BAY, WESTERN SHORE DRAINAGE BASIN

DIRECT DRAINAGE AND MINOR TRIBUTARIES SUB-BASIN
(From Rock Point 1 to Drum Point 2)

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)	Water intake mgd	Waste discharge mgd	Daily Stream Flow cfs	
1	2	3	4	5	6				Minimum	Lower 5 Percentile
South River Broad Creek						137.6-7.1-2.3 / Intake, Pumping Station near Annapolis	X			
West River Tenthouse Creek						134.8-2.0-0.35 / Outfall, B. M. Woodfield Seafood Packing House		X		
CHESAPEAKE BAY, WESTERN SHORE						124.0 / Outfall, North Branch Sewage Treatment Plant		0.200		
CHESAPEAKE BAY, WESTERN SHORE Parker Creek						121.6 / Outfall, Randle Cliffs		0.030		
Sullivan Branch						112.7-3.5-1.2 / C. Bernard Fowler Speed Wash		X		
CHESAPEAKE BAY, WESTERN SHORE						101.2 / Outfall, Titanium Ore Corp.		X		
CHESAPEAKE BAY, WESTERN SHORE						99.9 / Intake, Titanium Ore Corp.	X			
CHESAPEAKE BAY, WESTERN SHORE						99.9 / Outfall, Titanium Ore Corp.		X		
1 Rock Point is in Anne Arundel County at mouth of Patapsco River.										
2 Drum Point is in Calvert County at mouth of Patuxent River.										
3 Proposed Mountain Road Sewage Treatment Plant located.										
3 Approximate location of Mountain Road Sewage Treatment Plant between milepoints 154.5 and 151.6										
4 Approximate location of Outfalls between milepoints 148.8 and 145.7										
X indicates data not available										
										October, 1964

Appendix B
CHESAPEAKE BAY, WESTERN SHORE DRAINAGE BASIN
Patuxent River SUB-BASIN

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)	Water intake mgd	Waste discharge mgd	Daily Stream Flow, cfs	
1	2	3	4	5	6				Minimum	Lower 5 Percentile
CHESAPEAKE BAY, WESTERN SHORE										
Patuxent River						95.4-97.2/Gaging Station near Unity, Md.			2.8	7.6
Cattail Creek						95.4-96.6-___/Gaging Station at Carrs Mill, Md.			1.85 ^a	X
Unnamed Tributary						95.4-96.6-1.3/Gaging Station at Roxbury Mills, Md.			3.2	6.6
Cattail Creek						95.4-91.0-___/Outfall, Montgomery Hospital, Olney, Md.		X	X	X
Hawlings River						95.4-90.3/Gaging Station near Ashton, Md.			4.8	24.0
Patuxent River						95.4-83.5/Gaging Station, Burtonsville, Md.				
Patuxent River						95.4-80.9/Intake, Washington Suburban Sanitary District, Rocky Gorge Pumping Station	51.600		18.0	X
Patuxent River						95.4-78.4/Gaging Station near Laurel, Md.		0.135		
Patuxent River						95.4-77.4/Outfall, Md. City Sewage Treatment Plant		1.000		
Patuxent River						95.4-74.6/Outfall, Washington Suburban Sanitary District, Laurel				
Horsepen Branch						95.4-66.1-0.4/Intake, Bowie Race Track	0.125			

Patuxent River

SUB-BASIN

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)	Water intake mgd	Waste discharge mgd	Daily Stream Flow, cfs	
1	2	3	4	5	6				Minimum	Lower 5 Percentile
						1 - 2 - 3 - 4 - 5 - 6				
						95.4-66.1-0.3- /Outfall, Bowie State Teachers College		0.031		
						95.4-65.0/Outfall, Bowie Race Track		0.100		
						95.4-64.2/Outfall, Bowie-Bel Air Sewage Treatment Plant		0.500		
						95.4-63.3-27.6/Gaging Station at Pine Orchard, Md.			2,44	X
						95.4-63.3-26.9-2.5/Outfall, Doughoregan Manor Dairy				
						95.4-63.3- /Outfall, Dunloggin, Md.		X		
						95.4-63.3-23.8/Proposed Pumping Station at Columbia in Howard County	X	X		
						95.4-63.3-20.1/Gaging Station at Guilford, Md.				
						95.4-63.3-17.6-16.5/Gaging Station near West Friendship, Md.			7.0	23.0
						95.4-63.3-17.6-13.0/Outfall, University of Maryland Agronomy Dairy		X		
						95.4-63.3-17.6-6.6/Intake, W. R. Grace and Co., near Simpsonville			4.62 ^c	X
						95.4-63.3-17.6-6.5/Outfall, W. R. Grace and Co.	0.108 ^d			
						95.4-63.3-17.6- /Intake, Johns Hopkins University Applied Physics Laboratory		X		
						95.4-63.3-17.6-5.6/Outfall, Scaggsville, Applied Physics Laboratory,	0.086			
						Johns Hopkins University				
						95.4-63.3-17.6- /Intake, The Arundel Corporation	X	0.080		

Patuxent River

SUB-BASIN

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)		Water intake mgd	Waste discharge mgd	Daily Stream Flow, cfs	
1	2	3	4	5	6	1	2			Minimum	Lower 5 Percentile
						1	2 - 3 - 4 - 5 - 6				
	Middle Patuxent River					95.4-63.3-17.6-	/Outfall, The Arundel Corporation				
	Little Patuxent River					95.4-63.3-17.5/	Intake, Savage Manufacturing Company	X	X		
	Little Patuxent River					95.4-63.3-16.9/	Outfall, Savage, Md.		0.048		
	Little Patuxent River					95.4-63.3-16.8/	Outfall, Savage Manufacturing Company		X		
	Little Patuxent River					95.4-63.3-16.5/	Gaging Station at Savage, Md.			7.0	X
	Hammond Branch					95.4-63.3-15.6-5.3/	Gaging Station at Scaggsville, Md. (Low-flow partial record station)				
	Hammond Branch					95.4-63.3-15.6-3.9/	Intake, Md.-Va. Milk Producers Association	X		X	X
	Hammond Branch					95.4-63.3-15.6-3.8/	Outfall, Md.-Va. Milk Producers Association				
	Hammond Branch					95.4-63.3-15.6-0.9/	Outfall, Laurel Harness Racing Track		X		
	Little Patuxent River					95.4-63.3-15.2/	Intake, Bridewell, Md. House of Correction	e			
	Dorsey Run					95.4-63.3-13.2-2.7/	Intake, Bridewell, Md. House of Correction				
	Dorsey Run					95.4-63.3-13.2-2.0/	Outfall, Bridewell, Md. House of Correction				
	Dorsey Run					95.4-63.3-13.2-1.0/	Gaging Station, Jessup, Md.		0.650		
	Little Patuxent River					95.4-63.3-11.2/	Intake, Fort Meade Low-Lift Pumping Station				
	Little Patuxent River					95.4-63.3-11.0/	Outfall, Fort Meade Sewage Treatment Plant No. 2	4.000		1.4	2.7
									0.630		

CHESAPEAKE BAY, WESTERN SHORE DRAINAGE BASIN

Patuxent River

SUB-BASIN

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)	Water intake mgd	Waste discharge mgd	Daily Stream Flow, cfs	
1	2	3	4	5	6				Minimum	Lower 5 Percentile
						1 - 2 - 3 - 4 - 5 - 6				
						95.4-63.3- 7.0- /Outfall, Fort George G. Meade		X		
						95.4-63.3- 4.5/Outfall, Alan E. Barton Sand & Gravel Co.		X		
						95.4-63.3- 3.6/Intake, Baltimore Con- crete Plank Co.	X			
						95.4-63.3- 3.3-3.3/Outfall, U. S. Naval Academy Dairy		X		
						95.4-63.3- 3.1/Outfall, Patuxent Sewage Treatment Plant		0.035		
						95.4-63.3- /Intake, Gardner Sand & Gravel Company	0.144			
						95.4-63.3- 1.6/Outfall, E. L. Gardner Sand & Gravel Co.		X		
						95.4-63.3- 1.0/Outfall, Anne Arundel County Sanitary Commission		0.035		
						95.4-60.1/Intake, Bi-County Aggregate Company	0.336			
						95.4-60.1/Outfall, Bi-County Aggregate Company		X		
						95.4-59.9/Outfall, Carl L. Abend Sand and Gravel Co.		X		
						95.4- /Intake, Annapolis Sand & Gravel Company	0.027			
						95.4-59.5/Outfall, Annapolis Sand & Gravel Company		X		
						95.4-51.7/Outfall, Charles F. Meyer Sand & Gravel Company		X		
						95.4-46.6-11.1/Gaging Station, Largo, Md.			1.0	3.0

Patuxent River	SUB-BASIN

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)	Water intake mgd	Waste discharge mgd	Daily Stream Flow cfs	
1	2	3	4	5	6				Minimum	Lower 5 Percentile
						1 - 2 - 3 - 4 - 5 - 6				
				Cabin Branch		95.4-46.6-7.4- /Outfall, Andrews Air Force Base		0.172		
				Western Branch		95.4-46.6-4.0/Outfall, Upper Marlboro Sewage Treatment Plant		0.120		
				Charles Branch		95.4-46.6-0.4- /Outfall, Andrews Air Force Base		X		
				Patuxent River		95.4-40.1/Outfall, Proposed Mataponi Creek Sewage Treatment Plant		X		
				Cocktown Creek		95.4-32.6-3.5/Gaging Station near Huntingtown, Md.			0.0	X
				Hunting Creek						
				Mill Creek		95.4-27.2- - /Outfall, Dick Lores Laundromat		X		
				Patuxent River		95.4-25.8/Intake, Chalk Point Steam-Electric Plant	X			
				Patuxent River		95.4-25.8/Outfall, Chalk Point Steam-Electric Plant		X		
				Trent Hall Creek						
				Locks Swamp Creek		95.4-21.7-1.7-5.3/Outfall, Charlotte Hall Sand and Gravel Company		X		
				St. Leonard Creek		95.4- 9.5- /Gaging Station, near St. Leonard, Md.			0.8	X
				Patuxent River		95.4- 4.8/Outfall, Solomons Island, Patuxent Naval Air Testing Station		0.071		

Footnotes:

^aGage at Carrs Mill is low-flow partial-record station. Streamflow shown is 1961 observation.

^bGage at Pine Orchard is low-flow partial-record station. Streamflow shown is 1961 observation.

^cGage near West Friendship is low-flow partial-record station. Streamflow shown is 1961 observation.

^dM. R. Grace Company's Research and Development Division is permitted to take average of 0.108 mgd and maximum of 0.144 mgd from May 1 through October 31.

^eMaryland House of Correction at Bridewell uses water from Dorsey Run when streamflow is adequate; Little Patuxent River serves as supplemental source to make up total supply of 0.82 mgd.

^xData not available.

October, 1964.

CHESAPEAKE BAY, WESTERN SHORE DRAINAGE BASIN

DRAINAGE BASIN

DIRECT DRAINAGE AND MINOR TRIBUTARIES SUB-BASIN

(From Hog Point* to Point Lookout**)

WATER-QUALITY STATIONS, WATER WITHDRAWN, WASTES DISCHARGED, AND STREAM FLOWS

MAIN WATERWAYS AND TRIBUTARIES (Magnitude of Waterway)						LOCATION: RIVER MILE/DESCRIPTION (Magnitude of Waterway)	Water intake mgd	Waste discharge mgd	Daily Stream Flow cfs	
1	2	3	4	5	6	1 - 2 - 3 - 4 - 5 - 6			Minimum	Lower 5 Percentile
CHESAPEAKE BAY, WESTERN SHORE						94.7/Outfall, Officers Club, Patuxent Naval Air Station		0.002		
Pine Hill Run						91.7-2.0/Outfall, Solomons Island Naval Air Test Center		2.000		
* Hog Point is in St. Mary's County, Maryland, at mouth of Patuxent River. ** Point Lookout is in St. Mary's County, Maryland, at mouth of Potomac River. 1 Includes sewage from surrounding residential areas.									October, 1964	

- 1 -

* Hog Point is in St. Mary's County, Maryland, at mouth of Patuxent River.

** Point Lookout is in St. Mary's County, Maryland, at mouth of Potomac River.

1 Includes sewage from surrounding residential areas.

APPENDIX C

RESERVOIRS, LAKES AND PONDS

See Description of Appendices (Appendix C) in the General Reference Section for a narrative discussion of this material.

APPENDIX C

RESERVOIRS, LAKES AND PONDS IN
CHESAPEAKE BAY, WESTERN SHORE DRAINAGE BASIN, MARYLAND*

Stream	Reservoir, Lake or Pond	Water Surface Area, Acres	Location of Dam	
			County	Maryland Coordinates
Chesapeake Bay, West				
Bush River				
Bynum Run	Forest Hill Pond	1.4	Harford	973-638
Bynum Run	Bynum Run Pond	2.0	Harford	984-620
Otter Point Creek				
Winters Run				
Elbow Brook	Benson's Pond	0.3	Harford	972-608
Winters Run	Atkisson Reservoir	91.0	Harford	991-605
Bush River	Churchville Pond	1.5	Harford	1012-630
Bush River	Forest Green Lake	5.0	Harford	1018-590
Gunpowder River				
Gunpowder Falls				
South Branch	North Carroll Pond	1.2	Carroll	830-680
Gunpowder Falls	Prettyboy Reservoir	1,500.0	Baltimore	0870-660
Western Run				
Beaverdam Branch				
Oregon Branch	Oregon Pool	0.8	Baltimore	878-604
Gunpowder Falls	Loch Raven Reservoir	2,400.0	Baltimore	923-588
Gunpowder Falls	Md. Train. Sch. (Boys)	1.0	Baltimore	943-579
Patapsco River				
North Branch				
West Branch				
Cranberry Branch	Westminster Pond	1.3	Carroll	---
North Branch	Liberty Reservoir	3,100.0	Baltimore	840-530
Patapsco River	Avalon Pond	2.5	Baltimore	878-508
Deep Run	Hanover Pond	1.0	A. Arundel	878-495
Stoney Run	Harmons State Nurs- ery Pond	1.0	A. Arundel	886-482
Stoney Run	Friendship Pond	1.0	A. Arundel	893-487
Patapsco River	Patapsco Ponds 1-4	13.5	A. Arundel	888-502
Middle Branch				
Gwynns Falls	Gwynnbrook Pond	1.3	Baltimore	862-576
Northwest Branch				
Jones Falls	Lake Roland Reservoir	80.0	Baltimore	901-561
Jones Falls	Druid Hill Lake	5.0	Balto. City	903-541
Curtis Bay				
Curtis Creek				
Furnace Creek				
Sawmill Creek	Wagners Lake	13.0	A. Arundel	907-489
Patapsco River	B. & O. Pond	2.5	A. Arundel	934-496

* Source: 1961 Maryland Impoundments Inventory, Department of Game and Inland Fish.
Impoundments included in the inventory are used for recreation.

CHESAPEAKE BAY, WESTERN SHORE BASIN (Cont'd)

Stream	Reservoir, Lake or Pond	Water Surface Area, Acres	Location of Dam	
			County	Maryland Coordinates
Magothy River	Waterford Lake	11.0	A. Arundel	---
Magothy River	Milo Pond	0.8	A. Arundel	945-464
Chesapeake Bay, West	Randals Cliff Pond	1.5	Calvert	934-303
Parker Creek	Morsell Lake	8.0	Calvert	919-258
Patuxent River	Triadelphia Reservoir	800.0	Howard	800-500
Patuxent River	Rocky Gorge Reservoir	810.0	Montgomery	850-450
Crow Branch				
Bear Branch	Laurel Reservoir	5.0	Pr. Georges	839-458
Unnamed Tributary	Blue Ponds 1, 2 and 3	7.5	Pr. Georges	---
Unnamed Tributary	Cash Lake	42.0	Pr. Georges	859-436
Little Patuxent River				
Midway Branch				
Franklin Branch	Kelly Pool Lake	10.0	A. Arundel	876-459
Midway Branch	Rieve Pond	1.0	A. Arundel	---
Midway Branch	Soldiers Lake	22.0	A. Arundel	876-456
Little Patuxent River	Plummers Ponds 1 & 2	3.3	A. Arundel	875-445
Western Branch				
Back Branch	Melwood Pond	1.3	Pr. Georges	849-354
Collington Branch				
Unnamed Tributary	Woodward's Lake	6.0	Pr. Georges	869-414
Collington Branch	Allen's Lake	10.0	Pr. Georges	874-401
Collington Branch	Upper Marlboro Lakes 1 and 2	55.0	Pr. Georges	873-358
Killpeck Creek	Horsehead Pond	3.0	St. Marys	863-235
Patuxent River	Lores Lake	5.0	Calvert	956-177
Patuxent River	Drum Point Lake	8.0	Calvert	964-180
Patuxent River	Patuxent Air Station (3 Ponds)	7.0	St. Marys	980-170

APPENDIX D

STORAGE REQUIREMENTS FOR SUSTAINED YIELDS

See Description of Appendices (Appendix D) in the General Reference Section for a narrative discussion of this material.

APPENDIX D

Storage Requirements for Sustained Yields

The following tables list the artificial storage requirements, computed as outlined in the Description of Appendices, General Reference Section, for streams on the Western Shore of the Chesapeake Bay.

The storage values are given in terms of mean annual flow, but can be converted easily into volumes by use of the relation:

in which
$$\frac{V_s}{M} = R_s$$

V_s = volume of storage required;

M = mean annual flow, in acre-feet; and

R_s = storage ratio (from table)

For example, the table for the Bush River Sub-basin gives a storage ratio of 0.826 for a gross yield of 0.9M on Bynum Run at Bel Air, Maryland.

$$M = 10.8 \text{ cfs (from column 3)}$$

$$= 10.8 \text{ ft.}^3 \times \text{sec.}^{-1}$$

$$= 10.8 \text{ ft.}^3 \times \text{sec.}^{-1} \times \frac{1.98 \text{ acre-feet} \times \text{day}^{-1}}{\text{ft.}^3 \times \text{sec.}^{-1}} \times \frac{365 \text{ days}}{\text{year}}$$

$$M = 10.8 \times 1.98 \times 365 \text{ acre-feet/year}$$

$$\begin{aligned} V_s &= R_s M = 0.826 \times 10.8 \times 1.98 \times 365 \text{ acre-feet/year} \\ &= 6,450 \text{ acre-feet/year} \end{aligned}$$

This means that a reservoir holding 6,450 acre-feet of water on Bynum Run above the stream gage at Bel Air, Maryland, will provide a gross yield of 9.7 cfs (equal to 10.8 cfs times 0.9) for 19 out of every 20 years, on the average. Except for seepage evaporation losses and diversions the 9.7 cfs would be sustained at the gage.

Storage Requirements for Various Gross Yields*

CHESAPEAKE BAY, WESTERN SHORE, DRAINAGE BASIN

Bush River Sub-basin, Maryland
(Recurrence Interval = 20 Years)

Stream and Gaging Station (1)	Drainage area, sq. miles (2)	Mean annual flow, cfs (3)	Coeff. of Variation (4)	Natural Storage Constant, days (5)	Storage in terms of mean annual flow for various yields			
					Yield in Terms of Mean Annual Flow			
					0.3 (6)	0.5 (7)	0.7 (8)	0.9 (9)
Bynum Run at Bel Air, Md. ^a	8.52	10.8	0.21	24	0.086	0.197	0.348	0.826

- * Gross yield includes evaporation losses and seepage losses.
- a Diversion above station for municipal supply of Bel Air.

Storage Requirements for Various Gross Yields*

CHESAPEAKE BAY, WESTERN SHORE, DRAINAGE BASIN
Gunpowder River Sub-basin, Maryland
(Recurrence Interval = 20 Years)

Stream and Gaging Station (1)	Drainage area, sq. miles (2)	Mean annual flow, cfs (3)	Coeff. of Variation (4)	Natural Storage Constant, days (5)	Storage in terms of mean annual flow for various yields		
					0.3 (6)	0.5 (7)	Yield in Terms of Mean Annual Flow 0.7 (8) 0.9 (9)
Little Falls at Blue Mount, Md. ^a	52.9	69.3	0.26	121	0.004	0.065	0.206 0.791
Slade Run near Glyndon, Md. ^b	2.09	2.46	0.30	108	0.020	0.092	0.291 1.043
Western Run at Western Run, Md. ^b	59.8	71.9	0.31	108	0.010	0.096	0.315 1.101
Little Gunpowder Falls at Laurel Brook, Md. ^b	36.1	47.4	0.31	117	0.012	0.084	0.298 1.691

* Gross yield includes evaporation losses and seepage losses.

a Slight diurnal regulation at low flow caused by mill above station.

b Unregulated.

APPENDIX D

Storage Requirements for Various Gross Yields^a

CHESAPEAKE BAY, WESTERN SHORE, DRAINAGE BASIN

Patapsco River Sub-basin, Maryland

(Recurrence Interval = 20 Years)

Stream and Gaging Station (1)	Drainage area, sq. miles (2)	Mean annual flow, cfs (3)	Coef. of Variation (4)	Natural Storage Constant, days (5)	Storage in terms of mean annual flow for various yields			
					Yield in Terms of Mean Annual Flow			
					0.3 (6)	0.5 (7)	0.7 (8)	0.9 (9)
Cranberry Branch near Westminster, Md.	3.29	3.95 ^b	0.32	127	0.008	0.075	0.303	1.114 ^f
North Branch Patapsco River at Cedarhurst, Md. ^c	56.6	65.5	0.29	96	0.022	0.104	0.300	1.019 ^f
North Branch Patapsco River near Reisterstown, Md. ^c	91.0	103	0.28	83	0.021	0.116	0.309	0.994
North Branch Patapsco River near Marriottsville, Md. ^c	165	156	0.46	223	0.025	0.099	0.521	1.714 ^f
South Branch Patapsco River at Henryton, Md. ^d	64.4	73.5	0.34	98	0.040	0.122	0.407	1.300 ^f
Piney Run near Sykesville, Md. ^d	11.4	12.8	0.26	96	0.027	0.099	0.255	0.854

CHESAPEAKE BAY, WESTERN SHORE, DRAINAGE BASIN

Stream and Gaging Station (1)	Drainage area, sq. miles (2)	Mean annual flow, cfs (3)	Coeff. of Variation (4)	Natural Storage Constant, days (5)	Storage in terms of mean annual flow for various yields			
					Yield in Terms of Mean Annual Flow			
					0.3 (6)	0.5 (7)	0.7 (8)	0.9 (9)
Patapsco River at Woodstock, Md.	260	414	0.29	--	--	--	--	--
Patapsco River at Hollofield, Md. ^e	285	362	--	--	0.044	0.130	--	--
Sawmill Creek at Glen Burnie, Md. ^d	5.1	8.02	0.18	157	0.000	0.015	0.076	0.390

Footnotes:

a Gross yield includes evaporation losses and seepage losses.

b Mean annual flow based on 10 years of record (adjusted for storage).

c Records do not include a mean discharge of about one cfs diverted above station for municipal supply of Westminster, which discharges sewage effluent into Little Pipe Creek.

d Unregulated.

e Storage requirements based on conditions of flow prior to 1954.

f A storage capacity greater than unity could not be filled every year by the natural runoff of the stream above the gaging station. Thus, a gross yield of 0.9 of the mean annual flow would require diversion (importation) of water from another drainage area.

Storage Requirements for Various Gross Yields*

CHESAPEAKE BAY, WESTERN SHORE, DRAINAGE BASIN
South River Sub-basin, Maryland
(Recurrence Interval = 20 Years)

Stream and Gaging Station (1)	Drainage area, sq. miles (2)	Mean annual flow, cfs (3)	Coeff. of Variation (4)	Natural Storage Constant, days (5)	Storage in terms of mean annual flow for various yields			
					Yield in Terms of Mean Annual Flow			
					0.3 (6)	0.5 (7)	0.7 (8)	0.9 (9)
North River near Annapolis, Md. ^a	8.5	10.9	0.21	127	0.009	0.057	0.150	0.573
Bacon Ridge Branch at Chesterfield, Md. ^b	6.92	10.4	0.16	124	0.002	0.061	0.131	0.405

* Gross yield includes evaporation losses and seepage losses.

^a Unregulated.

^b Records include sewage from Crownsville State Hospital, which obtains its water supply from wells.

Storage Requirements for Various Gross Yields*

CHESAPEAKE BAY, WESTERN SHORE, DRAINAGE BASIN

Patuxent River Sub-basin, Maryland

(Recurrence Interval = 20 Years)

Stream and Gaging Station (1)	Drainage area, sq. miles (2)	Mean annual flow, cfs (3)	Coeff. of Variation (4)	Natural Storage Constant, days (5)	Storage in terms of mean annual flow for various yields		
					0.3 (6)	0.5 (7)	Yield in Terms of Mean Annual Flow: 0.7 (8) 0.9 (9)
Patuxent River near Unity, Md. ^a	34.8	38.4	0.35	93	0.042	0.133	0.440 1.371
Cattail Creek at Roxbury Mills ^b	27.7	29.1	0.30	98	0.030	0.106	0.311 1.068
Patuxent River near Burtonsville ^c	127	117	0.35	95	0.049	0.130	0.436 1.366
Little Patuxent River at Guilford ^a	38.0	40.1	0.29	76	0.039	0.131	0.338 1.068
Little Patuxent River at Savage ^d	98.4	99.1	0.31	115	0.021	0.086	0.294 1.064
Dorsey Run near Jessup ^a	11.6	13.7	0.31	72	0.044	0.146	0.387 1.196
Western Branch near Largo ^a	30.2	30.9	0.29	26	0.082	0.197	0.429 1.169

* Gross yield includes evaporation losses.

^a Unregulated.

^b Diurnal fluctuation at low flow caused by mill at Roxbury Mills.

^c Flow regulated by diversion by pumps of part of low flow into Anacostia River basin since August 12, 1939. Flow regulated by Triadelphia Reservoir since June 27, 1942.

^d Some diurnal fluctuation caused by powerplant of Savage Manufacturing Co., 1 mile above gage.

Prepared by C. H. J. Hull, 27 March 1963.

APPENDIX E

SURFACE WATER PERMITS

See Description of Appendices (Appendix E) in the General Reference Section for a narrative discussion of this material.

APPENDIX E

CHESAPEAKE BAY, WESTERN SHORE, DRAINAGE BASIN
SURFACE-WATER APPROPRIATION PERMITS^a

<u>Permit Holder, Location</u> (1)	<u>County</u> (2)	<u>Standard Industrial Classification Number</u> (3)	<u>Supply Stream</u> (4)	<u>Sub-Basin</u> (5)	<u>Appropriation Amount, mgd.</u> (6)
Arundel Corporation	Howard	3731	Middle Patuxent River	Patuxent River	1.200
Baltimore Country Club	Baltimore	7947	Deep Run	Patapsco River	0.170
Baltimore Gas and Electric Co., Charles P. Crane Station ^b	Baltimore	4911	Seneca Creek	Seneca Creek	478
Black and Decker Mfg. Co., Hampstead	Carroll	3541	Tributary of Deep Run	Patapsco River	0.058
Catalyst Research Corp., Falls Road	Baltimore	3692	Jones Falls	Patapsco River	0.214
W. R. Grace and Company, Simpsonville	Howard	2871	Middle Patuxent River	Patuxent River	0.108 ^c
Harford Metal Products Incorporated	Harford	3585	Swan Creek	Swan Creek	0.003
Total					1.753 ^d

^a Information in columns 1,4, and 6 supplied by Department of Geology, Mines, and Water Resources, State of Maryland, Baltimore, Maryland.

^b Application filed; permit waived.

^c W. R. Grace Company's Research and Development Division is permitted to take and use for cooling and processing an average of 0.108 mgd from May 1 through October 31 and 0.072 mgd November 1 through April 30. Maximum withdrawals permitted are 0.144 mgd May 1 through October 31 and 0.108 mgd November 1 through April 30.

^d Total excludes amount used by Charles P. Crane electric generating station, for which permit was waived.

APPENDIX F

GROUND WATER PERMITS

See Description of Appendices (Appendix F) in the General Reference Section for a narrative discussion of this material.

MARYLAND WATER RESOURCES INVENTORY

GROUND-WATER APPROPRIATION PERMITS*

BY COUNTY, PARTLY OR WHOLLY WITHIN THE
CHESAPEAKE BAY WESTERN SHORE DRAINAGE BASIN

Permit Holder Name and Address <u>(1)</u>	Standard Industrial Classification Number <u>(2)</u>	Number of Employees <u>(3)</u>	Appropriation Permitted (m.g.d.) <u>(4)</u>	Actual Withdrawal (m.g.d.) <u>(5)</u>
Anchorage Motel, Revell Highway Arundel Arena, Inc., Brooklyn	7013 (U)	(N)	0.010 0.120	-- 0.040
The Annapolis Terrace Motel, Revell Highway Barber's Fairview Trailer Court, Laurel	7013 7031	(N) (N)	0.010 0.030	-- --
Chartwell Golf & Country Club, Severna Park	7947	(N)	0.010	--
Chesapeake & Potomac Telephone Co., Odenton	4811	(N)	0.012	--
Colony 7 Motor Inn, Fort Meade	7013	(N)	0.011	--
Colwill Construction Co., Inc.	1621	(N)	0.040	--
Brooklyn Community Sewer & Water Works, Clark Heights	(U)	(N)	0.050	--

* Data furnished by the Maryland State Department of Geology, Mines, and Water Resources, May, 1963.

(E) Classification number has been estimated

(N) Number of employees not listed in Directory of Maryland Manufactures, 1963 edition.

(U) Product or products unknown.

GROUND-WATER APPROPRIATION PERMITS

Permit Holder Name and address Anne Arundel County	Standard Industrial Classification Number	Number of Employees	Appropriation Permitted (m.g.d.)	Actual Withdrawal (m.g.d.)
(1)	(2)	(3)	(4)	(5)
Community Sewer & Water Service, Spring Valley	(U)	(N)	0.020	--
Cordelle Construction Co., Odenton	1621	(N)	0.060	--
Crownsville State Hospital, Crownsville	8061	(N)	0.293	0.300
DeSales Corp., Revell Highway	5812	(N)	0.010	--
District Training School, Laurel	(U)	(N)	0.0432	--
E. Donovan & J. Gomoljak, Crownsville	(U)	(N)	0.015	--
Milton Edelman, Glen Burnie	(U)	(N)	0.043	--
Fort Meade Pharmacy, Odenton	5912	(N)	0.024	--
Frank & Bill's Trailer Park, Pebble Drive	7031	(N)	0.030	--
Glen Burnie Shopping Plaza, Inc., Glen Burnie	(U)	(N)	0.360	--
Holy Trinity Church, Glen Burnie	8661	(N)	0.013	--
Hotel Corp. of America, Annapolis	7042	(N)	0.015	--
Layne Atlantic Co., Belvedere Beach	(U)	(N)	0.050	--
Melvin W. Madary	5812	(N)	0.010	--
D. Connor, Parkway Club, Laurel	(U)	(N)	0.025	--

GROUND-WATER APPROPRIATION PERMITS

Permit Holder Name and Address <u>(1)</u>	Standard Industrial Classification Number <u>(2)</u>	Number of Employees <u>(3)</u>	Appropriation Permitted (m.g.d.) <u>(4)</u>	Actual Withdrawal (m.g.d.) <u>(5)</u>
Anne Arundel County				
Manganese Chemicals Corp., Arundel Cover	2819	57	0.350	--
Clarence A. Martin, Harmans	(U)	(N)	0.013	--
Md., Del. & D.C. Elks Association, Inc.	8641	(N)	0.018	--
Chesterfield Maryland State Fair, Inc., Laurel	(U) (U)	(N) (N)	0.012 0.065	-- --
E. Brook Matlock, Inc., Belle Grove Road	(U)	(N)	0.9035	--
Meade City Sanitary Corp., Md. Rt. 602		(N)	0.010	--
National Capital Girl Scout Council, Lusby	8641			
The National Plastics Co., Odenton	3079	1130	0.840 1.040 0.5184 0.045	1.3 --
National Research Associates, Inc., Laurel	3799	18		
Pasadena Water Co., Pasadena	(U)	(N)	0.060	--
Piney Orchard Housing Development, near Fort Meade	(U)	(N)	0.830	--

GROUND-WATER APPROPRIATION PERMITS

Permit Holder Name and Address <u>Anne Arundel County</u> (1)	Standard Industrial Classification Number (2)	Number of Employees (3)	Appropriation Permitted (m.g.d.) (4)	Actual Withdrawal (m.g.d.) (5)
Ritchie Market, Ordnance Road	(U)	(N)	0.120	--
River Bay Co., Cape St. Claire	(U)	(N)	0.035	--
Robin Hood Mobile Homes Park, Ridge & Dorsey Roads	7031	(N)	0.020	--
Joseph E. Rose, North Beach	(U)	(N)	0.039	--
Sandy Point Bayside Park	(U)	(N)	0.125	--
Southdown Shores, Inc., Southdown Shores	(U)	(N)	0.105	--
Robert L. Suter, Conaways	(U)	(N)	0.011	--
Sylvan Shores Services, Inc. Transit Truck Stop, Inc., Laurel	(U) 5812	(N) (N)	0.144 0.012	-- --
Albert H. Waters, Severn	Housing	(N)	0.020	--
Wayson's Trailer Park, Wayson's Corner	7031	(N)	0.016	--
Woodfield Fish & Oyster Co., Galesville	2036	85	0.065	--

GROUND-WATER APPROPRIATION PERMITS

Permit Holder Name and Address Baltimore City	Standard Industrial Classification Number	Number of Employees	Appropriation Permitted (m.g.d.)	Actual Withdrawal (m.g.d.)
(1)	(2)	(3)	(4)	(5)
American Totalisator Co., Baltimore	3571	210	0.027	--
Baltimore Concrete Block Corp., Pulaski Highway	3271	40	0.030	--
John L. Bartenfelder, Pulaski Highway	5813	(N)	0.035	--
Braun Rendering Co., Ontario Avenue	2094	30	0.0288	--
Brookside Homes, Inc., Bershire Rd.	(U)	(N)	0.035	--
The Bunting Chemical Co., Falls Cliff Road	2844	137	0.0125	--
Mary & Sam Calvo, S. High Street	(U)	(N)	0.022	--
Chlorinated Products Co., Inc., E. Baltimore Street	2899	(N)	0.022	--
Continental Oil Co., Fairfield	2843	124	0.075	--
Cooper Dental Laboratory, N. Howard Street	8072	(N)	0.720	--
C. D. Denison Orthopaedic Appliance Co., W. 28th Street	3842	10	0.0144	--
E. I. du Pont de Nemours & Co., Benhill Avenue	2816	434	0.0125	--
Eastern Venetian Blind Co., Wicomico Street	2591	(N)	0.288	--
			0.360	--

GROUND-WATER APPROPRIATION PERMITS

Permit Holder Name and Address Baltimore City	Standard Industrial Classification Number	Number of Employees	Appropriation Permitted (m.g.d.)	Actual Withdrawal (m.g.d.)
(1)	(2)	(3)	(4)	(5)
Federal Yeast Corp., Colgate Creek	2099	111	0.9648	1.0
Food Machinery & Chemical Corp., Fairfield	2873	(N)	3.00	--
Loretta Friedman, Pennington Ave.	2818	(N)	0.023	--
Glidden Co., Broening Highway	5812	49	2.160	1.58
Hood Vinegar Co., Ashland Avenue	2816	6	0.050	--
Paul Jones & Co., N. Kresson Street	2099	(N)	0.1875	--
Monumental Printing Co., Elm Ave.	(U)	257	0.100	--
The Read Drug & Chemical Co., Baltimore 30	2732	(N)	0.0792	--
Receipe Foods, Inc., Baltimore	2834	93	0.0504	--
Rosen's, Inc., N. Gay Street	2035	(N)	0.065	--
Rubberoid Co., S. Ponca Street	2099	89	0.065	--
S. Schapiro & Sons, Inc. Unicon Ave.	(U)	(N)	0.0108	--
Wm. Schluderberg - T.J. Kurdle Co., E. Baltimore Street	2952	(N)	0.120	--
	(U)	(N)	0.012	--
	2011	(N)	0.450	--

GROUND-WATER APPROPRIATION PERMITS

Permit Holder Name and Address <u>Baltimore City</u> (1)	Standard Industrial Classification Number (2)	Number of Employees (3)	Appropriation Permitted (m.g.d.) (4)	Actual Withdrawal (m.g.d.) (5)
Shofer's Furniture Co., Inc., S. Charles Street The Surf Musical Bar, Pulaski Highway United Steel Workers Locals, Dundalk Avenue W.B. & A. Restaurant Western Electric Co., Baltimore 24	(U) 5813 (U) 5812 3661	(N) (N) (N) (N) 5500	0.066 0.048 0.072 0.170 1.00	-- -- -- -- 1.94
<u>BALTIMORE COUNTY</u>				
Stephen Androsko, Pulaski Highway Baltimore Yacht Club, Inc., Middle River Bay Shore Amusement Park, Inc. Hart's Island	(U) 7949 7949	(N) (N) (N)	0.012 0.024 0.040	-- -- --
Russell O. Beard, Pulaski Highway Beaver Springs Club, Cockeysville Marvin L. Benfield, White Marsh Bethlehem Steel Co., Sparrows Point	Garage 7947 (U) 3312 3316 3317 3315	(N) (N) (N) 28,000	0.012 0.012 0.0216 0.025 3.00 1.008 3.00 1.00 0.700	-- -- -- 12.5

GROUND-WATER APPROPRIATION PERMITS

Permit Holder Name and Address Baltimore County	Standard Industrial Classification Number	Number of Employees	Appropriation Permitted (m.g.d.)	Actual Withdrawal (m.g.d.)
(1)	(2)	(3)	(4)	(5)
Brook's Williamsburg Inn, White Marsh	5812	(N)	0.075	--
Builders & Developers, Inc. Catonsville	(U)	(N)	0.012	--
G.L. Bury, Old Annapolis Road	(U)	(N)	0.012	--
Harry L. Campbell Sons' Corp., Towson	3295	800	0.017	--
Charlotte's Fiesta Tavern, White Marsh	3273	(N)	0.026	--
Chestnut Ridge Country Club, Falls Road	5813	(N)	0.024	--
Cinder & Concrete Block Corp., Texas	7947	(N)	0.024	--
Civil Defense Agency, Woodensburg	3271	37	0.024	--
Diecraft, Inc., York Road	8641	(N)	0.045	--
Eastern Stainless Steel Corp., Rolling Mill Road	3591	258	0.120	--
William Faber, Holly Neck Road	3312	1323	0.120	--
Green Spring Inn, Lutherville	(U)	(N)	0.012	--
Gulden Brothers, Poplar	5812	(N)	0.0384	--
Community Sewer & Water Service Liberty Manor	(U)	(N)	0.030	--
Girl Scouts Council, Inc. White Hall	8641	(N)	0.030	--
			0.015	--

GROUND-WATER APPROPRIATION PERMITS

Permit Holder Name and Address Baltimore County	Standard Industrial Classification Number	Number of Employees	Appropriation Permitted (m.g.d.)	Actual Withdrawal (m.g.d.)
(1)	(2)	(3)	(4)	(5)
Paul Jones & Co., Dundalk	(U)	(N)	0.187	--
Laurel Hills Country Club, Marriottsville	7947	(N)	0.0125	--
Marrietta Concrete Corp., White Marsh	3241	(N)	0.025	--
Joseph S. Merritt, Inc., Dundalk	(U)	(N)	0.012	--
Metropolitan Sales Corp., Pulaski Highway	(U)	(N)	0.022	--
National Distillers Products Corp., Dundalk	2085	(N)	0.750	--
Our Lady of Perpetual Help, Ilchester	(U)	(N)	0.0216	--
Park & Gilford Distillers, Inc., Owings Mills	2085	(N)	0.060	--
The Read Drug & Chemical Co., Hillendale	2834	(N)	0.0576	--
Riverside Inn, Back River Neck	5812	(N)	0.012	--
Rockland Bleach & Dye Works, Inc., Brooklandville	2261	(N)	0.350	--
S. & S. Service near White Marsh	5812	(N)	0.015	--
Salvo Auto Parts Co., Essex	5531	(N)	0.065	--
Frank G. Schennitt Rubber Co., Railroad & Union Avenues	3011	420	0.096	--

(Revised September 10, 1963)

GROUND-WATER APPROPRIATION PERMITS

Permit Holder Name and Address Baltimore County	Standard Industrial Classification Number	Number of Employees	Appropriation Permitted (m.g.d.)	Actual Withdrawal (m.g.d.)
(1)	(2)	(3)	(4)	(5)
Silver Birch Swimming Club, Owings Mills	7947	(N)	0.018	--
Sparrows Point Country Club, Sparrows Point	7947	(N)	0.180	--
Spring Valley Country Club, Emblitz Road	7947	(N)	0.018	--
Standard Prestressed Concrete Corp., White Marsh	3241	(N)	0.020	--
Summit Surf & Supper Club, Smith Avenue	5812	(N)	0.0612	--
Tru-Rol Co., Inc. Poplar	(U)	(N)	0.020	--
Frank L. Wight Distilling Co. Lorely	2085	(N)	0.450	--
Worthington Valley Development Corp., Shawhan	(U)	(N)	0.030	--
<u>CALVERT COUNTY</u>				
A.B.C. Realty Corp., North Beach	65(E)	(N)	0.010	--
Calvert County Hospital, Prince Frederick	8061	(N)	0.045	--
A. I. Cassell Land Corp., Chesapeake heights	(U)	(N)	0.01875	--
Chesapeake Beach Park, Inc., Chesapeake Beach	(U)	(N)	0.020	--

GROUND-WATER APPROPRIATION PERMITS

<u>Permit Holder Name and Address Calvert County</u> (1)	<u>Standard Industrial Classification Number</u> (2)	<u>Number of Employees</u> (3)	<u>Appropriation Permitted (m.g.d.)</u> (4)	<u>Actual Withdrawal (m.g.d.)</u> (5)
Chesapeake Ranch Water Co., Drum Point	(U)	(N)	0.011	--
Denton, Warren & Co., Broomes Island	2036	90	0.024	--
G. F. Gravatt, Port Republic	(U)	(N)	0.018	--
Long Beach Water Co., Flag Harlor Heights	(U)	(N)	0.018	--
Robert Wm. Reid Trailer Park, Chaney	7031	(N)	0.027	--
The White Sands Beach & Country Club, near Lusby	7947	(N)	0.012	--
<u>CARROLL COUNTY</u>				
Black & Decker Mfg. Co., Hampstead	3548	(N)	0.0216	--
Killian Colbert Canning Co., Woodbine	(U)	(N)	0.030	--
Congoleum Nairn, Inc. Cedarhurst	3982	189	0.030	--
Howard County Farmers Cooperative, Sykesville	(U)	(N)	0.0216	--
Carl C. Lassiter Hillsdale Orchards	(U)	(N)	0.020	--
Shilling Bros. Finksburg	2033	(N)	0.035	--

GROUND-WATER APPROPRIATION PERMITS

Permit Holder Name and Address <u>Harford County</u> (1)	Standard Industrial Classification Number (2)	Number of Employees (3)	Appropriation Permitted (m.g.d.) (4)	Actual Withdrawal (m.g.d.) (5)
Armiger Construction Corp. Bel Air	1621	(N)	0.040	--
Bata Shoe Co., Inc. Belcamp	3141 3021	2477	0.010 0.010	-- --
Roy Bateman Abington	(U)	(N)	0.025	--
Hanlon P. Brown Hickory	(U)	(N)	0.0125	--
Children's Fresh Air Society Fallstown	8641	(N)	0.040	--
Greenridge Development Fountain Green	(U)	(N)	0.0432	--
Hales Trailer Village Edgewood	7031	(N)	0.125	--
W. Noble Hamilton Harford Furnace	(U)	(N)	0.040	--
Harford County Fair Association Bel Air	(U)	(N)	0.040	--
Harford County Highways Dept. Hickory	(U)	(N)	0.01975	--
Joppatowne Utilities Corp. Joppatowne	(U)	(N)	0.160 1.200	-- --
Melvin E. Kefauver Bel Air	(U)	(N)	0.045	--
Joseph Orr and Charles Durham Brynun	(U)	(N)	0.030	--
Wm. R. Schultz Joppa	(U)	(N)	0.060	--

GROUND-WATER APPROPRIATION PERMITS

Permit Holder Name and Address Harford County	Standard Industrial Classification Number	Number of Employees	Appropriation Permitted (m.g.d.)	Actual Withdrawal (m.g.d.)
(1)	(2)	(3)	(4)	(5)
Vista Water Co. Joppa	(U)	(N)	0.010	--
Western Maryland Dairy Churchville	2026	(N)	0.010	--
John Wilson Bel Air	7013	(N)	0.040	--
<u>HOWARD COUNTY</u>				
American Marietta Co. Jessup	(U)	(N)	0.030	--
Applied Physics Lab. Scaggsville	7391	(N)	0.025 0.033 0.042 0.020	0.050
Baltimore Aircoil Co. Montevideo Rd., Jessup	3443	150		--
Brennan and Beard, Inc. Clarksville	(U)	(N)	0.030	--
Edward Costello Trailer Park Ellicott City	7031	(N)	0.035	--
Fish Constructors, Inc. West Friendship	1621	(N)	0.065	--
Forest Hill Swim Club W.R. Grace and Co. Simpsonville	7947 2871	(N) (N)	0.0625 0.150	-- 0.035
Howard County Development Corp. Ellicott City	(U)	(N)	0.096	--
Maple Motel Waterloo	7013	(N)	0.010	--

(Revised September 10, 1963)

GROUND-WATER APPROPRIATION PERMITS

Permit Holder Name and Address Howard County	Standard Industrial Classification Number	Number of Employees	Appropriation Permitted (m.g.d.)	Actual Withdrawal (m.g.d.)
(1)	(2)	(3)	(4)	(5)
Scherwood Acres Mobile Home Village	7031	(N)	0.0105	--
Turf Valley Golf and Country Club	7947	(N)	0.108	--
Marriottsville Universal Concrete Pipe Co. Jessup	3272	79	0.012	--
<u>MONTGOMERY COUNTY</u>				
Cider Barrel Trailer Court	7031	(N)	0.026	--
Congressional Country Club	7947	(N)	0.030	--
Route #3				
Spring Lake Associates	(U)	(N)	0.026	--
Lakeview				
<u>PRINCE GEORGE'S COUNTY</u>				
Boy's Village of Maryland	(U)	(N)	0.120	0.120
Cheltenham				
Chesapeake and Potomac Co.	4811	(N)	0.020	--
Allentown				
Dewey M. Freeman	(U)	(N)	0.020	--
Laurel Harness Racing Corp.	7948	(N)	0.020	--
Laurel				
Levitt and Sons	(U)	(N)	5.00	--
Belair Farms			0.060	--
Safeway Stores, Inc.	2024	23	0.072	--
Upper Marlboro				

GROUND-WATER APPROPRIATION PERMITS

<u>Permit Holder Name and Address Prince George's County (1)</u>	<u>Standard Industrial Classification Number (2)</u>	<u>Number of Employees (3)</u>	<u>Appropriation Permitted (m.g.d.) (4)</u>	<u>Actual Withdrawal (m.g.d.) (5)</u>
Willie D. Sauerwein Upper Marlboro	(U)	(N)	0.014	--
Southern Maryland Tobacco Co. Upper Marlboro	2131	(N)	0.0675	--
John D. Swetman Marlboro Pike	(U)	(N)	0.054	--
Tucker's Restaurant Upper Marlboro	5812	(N)	0.015	--
U.S. Fish and Wildlife Patuxent Refuse	(U)	(N)	0.288	--
Washington Suburban Sanitary Commission, Laurel	(U)	(N)	0.072	--
Samuel A. Wyvill Upper Marlboro <u>ST. MARY'S COUNTY</u>	(U)	(N)	0.018	--
Mervell M. Dean Hollywood	(U)	(N)	0.020 0.036 0.040 0.048 0.020 0.033	-- -- -- -- -- --
Town Creek Manor Myres C. Dean Hollywood	(U) (U)	(N) (N)	0.024	--
James O. Hills Lexington Park Lexington Park Company Pearson	7216 (U)	(N) (N)	0.360	--
Patuxent Water Co., Inc. Lexington Park Town Creek Water Co. Town Creek Manor	(U) (U) (U)	(N) (N) (N)	0.125 0.030	-- --

GROUND-WATER APPROPRIATION PERMITS

Permit Holder Name and Address <u>Charles County</u> (1)	Standard Industrial Classification Number (2)	Number of Employees (3)	Appropriation Permitted (m.g.d.) (4)	Actual Withdrawal (m.g.d.) (5)
Girl Scout Council Hughesville	8641	(N)	0.014	--

Compiled July, 1963 by J. C. Meredith, U.S. Public Health Service; and E. S. Mills, The Johns Hopkins University. Data in columns 1, 2, and 5 obtained from the files of the Maryland Department of Geology, Mines, and Water Resources.

APPENDIX G

INDUSTRIAL WATER USERS SUPPLIED BY PUBLIC WATER SYSTEM, CITY OF BALTIMORE, MARYLAND

See Description of Appendices (Appendix G) in the General Reference Section for a narrative discussion of this material.

MARYLAND WATER RESOURCES INVENTORY

INDUSTRIAL WATER USERS

SUPPLIED BY PUBLIC WATER SYSTEM,
CITY OF BALTIMORE, MARYLAND

1959 - 1960

(Listed Alphabetically)

<u>Name of Industry</u> (1)	<u>Location</u>		<u>Standard Industrial Classification Number</u> (4)	<u>Number of Employees</u> (5)	<u>Water Used, m.g.d.</u> (6)
	<u>Community (Zone)</u> (2)	<u>County</u> (3)			
A & P Tea Co.	Western Second Zone	Balto. City	54 (E)	N	0.05
Abbotts Dairies Corp.	Western Second Zone	Balto. City	20 (E)	N	0.06
A. S. Abell Co.	First Zone	Balto. City	27 (E)	N	0.19
Samuel Abrams	First Zone	Balto. City	2311	10	0.02
Acme Steel Engineering Company	First Zone	Balto. City	3443	52	0.02
Adex Manufacturing Co.	First Zone	Balto. City	2891	3	0.01
Air Reduction Sales Co.	First Zone	Balto. City	2813	24	0.02
Alcolac Chemical Corp.	Broening Park Area				
	First Zone	Balto. City	2821	22	0.23
Alco Gravure, Inc.	First Zone	Balto. City	27 (E)	N	0.02
Allied Chemical & Dye Corporation	First Zone	Balto City	2819	N	0.18
Allied Paper Bag Corp.	Western Second Zone	Balto. City	2643	47	0.01
Allied Research Products, Inc.	First Zone	Balto. City	2899	140	0.15
			3559		
			3471		

KEY

X : Firm not listed in Baltimore Telephone Directory dated November, 1962.

E : Classification number has been estimated.

U : Product or products unknown.

(Revised: August 6, 1963)

N : Number of employees not listed in Directory of Maryland Manufacturers, 1963 edition.

<u>Name of Industry</u>	<u>Location</u>		<u>Standard Industrial Classification Number</u>	<u>Number of Employees</u>	<u>Water Used, m.g.d.</u>
(1)	<u>Community (Zone)</u>	<u>County</u>	(4)	(5)	(6)
American Agriculture	First Zone	Balto. City	2871	150	0.17
Chemical Company	First Zone	Balto. City	2951	129	0.04
American Bitumuls & Asphalt Company	Western Second Zone	Balto. City	3321	69	0.02
American Brakeshoe & Foundry Company	Eastern Second Zone	Balto. City	2082	207	0.26
American Brewery, Inc.	First Zone	Balto. City	3411	900	0.09
American Can Company	First Zone	Balto. City	3491	45	0.02
American Cooperage & Steel Drum Company	First Zone	Balto. City	2097	137	0.24
American Ice Company	First Zone	Balto. City	29 (E)	N	0.03
American Oil Company	First Zone	Balto. City	3431	822	0.41
American Radiator Std. Sanitary Corp.	First Zone	Balto. City	3331	943	0.83
American Smelting & Refining Company	Western Second Zone	Balto. City	2051	125	0.06
American Stores Company	First Zone	Balto. City	2062	800	1.43
American Sugar Refining Company	First Zone	Balto. City	2211	40	0.04
American Wiping Cloth Co.	First Zone	Balto. City	2051	122	0.02
Amrhein Brothers	First Zone	Balto. City	3481	2,455	0.03
Anchor Post Fence Co.	First Zone	Balto. City	3499	96	0.04
Aristocrat Dairies	Western Second Zone	Balto. City	2026	1,550	1.54
Armco Steel Corp.	First Zone	Balto. City	3312	91	0.06
Arundel Corp.	Broening Park area	Balto. City	3731		
Arundel-Brooks Concrete Corp.	First Zone	Balto. City	30 (E)	N	0.08

<u>Name of Industry</u> (1)	<u>Location</u>		<u>Standard Industrial Classification Number</u> (4)	<u>Number of Employees</u> (5)	<u>Water Used, m.g.d.</u> (6)
	<u>Community (Zone)</u> (2)	<u>County</u> (3)			
Arundel Ice Cream Co.	Western Second Zone	Balto. City	2024		
Baltimore & Ohio R.R.	First Zone	Balto. City	2051	210	0.06
F. Balmer Tractor Corp.	Eastern Second Zone	Balto. City	40 (E)	N	1.89
Baltimore Brick Company	First Zone	Balto. City	35 (E)	N	0.17
Baltimore Foundry & Machine Corp. (X)			3251	150	0.02
Baltimore Gas & Electric Company	First Zone	Balto. City	35 (E)	N	0.04
Baltimore News	First Zone	Balto. City	(U)	N	1.11
Baltimore News & Am.	First Zone	Balto. City	27 (E)	N	0.04
Baltimore Paint & Color Works	First Zone	Balto. City	2711	N	0.03
Baltimore Paper Box Co.	First Zone	Balto. City	2851	22	0.16
Baltimore Rustproof Co.	First Zone	Balto. City	26 (E)	N	0.02
Baltimore Salesbook Co.	First Zone	Balto. City	3471	8	0.02
Baltimore Steel Company	Western Second Zone	Balto. City	(U)	N	0.03
Baugh Chemical Company	First Zone	Balto. City	3491	200	0.01
	First Zone	Balto. City	2819		
			2871	248	0.12
Bauman Management Corp. (X)	First Zone	Balto. City	(U)	N	0.01
Bay Food Products Co.	First Zone	Balto. City	2031 (E)	15	0.01
Bendix Aviation Corp.	First Zone	Balto. City	3662	5,000	0.02
Bethlehem Ship Building Company	First Zone	Balto. City	3731	1,625	0.73
Bethlehem Steel Company	First Zone	Balto. City	(U)	N	0.06
Bordens Ice Cream Co.	First Zone	Balto. City	2024	N	0.05
Charles T. Brandt (X)	First Zone	Balto. City	3713 (E)	N	0.01
Braun Rendering Company	First Zone	Balto. City	2094	30	0.06
Bremner Biscuit Company	First Zone	Balto. City	2052	125	0.02

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<u>Name of Industry</u> (1)	<u>Location</u>		<u>Standard Industrial Classification Number</u> (4)	<u>Number of Employees</u> (5)	<u>Water Used, m.g.d.</u> (6)
	<u>Community (Zone)</u> (2)	<u>County</u> (3)			
Broom Factory for the Blind	Western Second Zone	Balto. City	3981	N	0.03
Bruning Brothers, Inc.(X)	First Zone	Balto. City	2851	60	0.01
Buck Glass Company	First Zone	Balto. City	3221	263	0.20
Bunting Chemical Co.	Eastern Second Zone	Balto. City	2844	137	0.01
Carling Brewery	Western Second Zone	Balto. City	2082 (E)	N	0.49
Carman & Wasserman, Inc.					
and E. Foam Rubber Co.	Eastern Second Zone	Balto. City	(U)	N	0.01
Carr-Lowrey Glass Co.	First Zone	Balto. City	3221	814	0.13
Chesapeake Chemical Co.	First Zone	Balto. City	28 (E)	N	0.09
Chesapeake Creamery	Western Second Zone	Balto. City	2021	34	0.05
Chesapeake Paperboard Co.	First Zone	Balto. City	2631	200	0.89
Chesapeake Shoe Mfg. Co.	First Zone	Balto. City	3141	269	0.01
Chevrolet Company	First Zone	Balto. City	3711	1,925	1.26
Cloverland Farms Dairy	Western Second Zone	Balto. City	20 (E)	N	0.12
Cinder Block Corp.	Western Third Zone	Balto. City	3271 (E)	N	0.02
City Baking Company	First Zone	Balto. City	20 (E)	N	0.15
Coca-Cola Bottling Co.	First Zone	Balto. City	2086	N	0.34
Continental Can Company	First Zone	Balto. City	3411		
			3079		
			3499	1,234	0.28
Continental Oil Company	First Zone				
	Droening Park Area	Balto. City	2843	124	0.48
Corkran Hill & Company	Western Second Zone	Balto. City	2011	453	0.37
H. S. Crocker Company	First Zone	Balto. City	2752	90	0.01
Gross & Blackwell, Inc.	First Zone	Balto. City	2033		
			2032		
			2035	352	0.19

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	<u>Community (Zone)</u> (2)	<u>County</u> (3)			
Cross Wiping Material Corp.	First Zone	Balto. City	2211 (E)	37	0.03
Crown, Cork & Seal	First Zone	Balto. City	3411		
			3551		
			3461	1,644	0.74
H. B. Davis Company	First Zone	Balto. City	2851	253	0.08
Delvale Dairies, Inc.	Eastern Second Zone	Balto. City	2024	177	0.07
Diamond Press	First Zone	Balto. City	2751	160	0.01
Diversified Equities Corp.					
Clifton Conduit Co.	First Zone	Balto. City	(U)	N	0.16
Dorchester Corp. (X)	First Zone	Balto. City	(U)	N	0.01
Dover Poultry Company	First Zone	Balto. City	2015	102	0.05
Dukeland Packing Co.	Western Second Zone	Balto. City	2013	247	0.06
E. I. duPont de Nemours & Company, Inc.	First Zone				
	Broening Park Area	Balto. City	2816	434	1.39
Eastern Box Company	First Zone				
	Broening Pk. Area	Balto. City	2653		
Eastern Products Corp.	First Zone	Balto. City	2591	305	0.03
Eckels Ice Cream Company	Eastern Second Zone	Balto. City	2024	N	0.56
Ellicott Fabricators (X)	First Zone	Balto. City	3443	50	0.03
Emerson Drug Company	First Zone	Balto. City	28 (E)	69	0.02
Farboil Company	First Zone	Balto. City	2834		
	First Zone	Balto. City	2834	209	0.09
Erdman Tire & Rubber Co.	First Zone	Balto. City	22 (E)	N	0.02
Federal Tin Company	First Zone	Balto. City	33 (E)	N	0.01
Federal Yeast Corp.	First Zone	Balto. City	2099	111	1.0
J. H. Filbert, Inc.	Western Second Zone	Balto. City	2096		
			2035	192	0.10

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	<u>Community (Zone)</u> (2)	<u>County</u> (3)			
Flavorex Company	First Zone	Balto. City	2087	N	0.01
Flynn & Enrich Company	Western Third Zone	Balto. City	3321		
Food Machine & Chemical Corp.			3559	232	0.02
	First Zone	Balto. City	2818		
Four Roses Distilling Co. Fuld Brothers			2873	422	0.08
	First Zone	Balto. City	2085	339	1.41
	First Zone	Balto. City	2842		
General Baking Company General Electric General Electric (Locke Dept.)			2841	69	0.01
	Eastern Second Zone	Balto. City	2051	333	0.09
	First Zone	Balto. City	32 (E)	N	0.03
	First Zone	Balto. City	3264	N	0.32
The General Refractory Company					
	First Zone	Balto. City	3255		
General Ship Repair Co.	Broening Park Area	Balto. City	3297	400	0.32
	First Zone	Balto. City	3731	38	0.01
Gilbert Cummins & Co.	Western Second Zone	Balto. City	2514	35	0.06
Glenhaven Limited	First Zone	Balto. City	23 (E)	N	0.02
Glickman Corp.	First Zone	Balto. City	2591	N	0.02
The Glidden Company	First Zone	Balto. City	2816	502	3.55
Globe Bottling & Sales Company					
Globe Venetian Blind Corp.	First Zone	Balto. City	2082	131	0.20
	First Zone	Balto. City	2591	188	0.02
Albert F. Goetz, Inc.	Eastern Second Zone	Balto. City	2011 (1)		
			2013 (1 & 2)		
			2015 (1)		
			2025 (1)	974	0.38

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	<u>Community (Zone)</u> (2)	<u>County</u> (3)			
Goetze Pickle Company	First Zone	Balto. City	2035	N	0.01
Good Humor Ice Cream Co.	Western Second Zone	Balto. City	2024	256	0.05
Harry B. Gorfine (Mrs. Bee's Commissary)	Western Second Zone	Balto. City	20	45	0.02
W. R. Grace & Company	First Zone	Balto. City	28 (E)	N	1.98
	Broening Pk. Area	Balto. City	3272	86	0.01
Gray Concrete Pipe Co.	First Zone	Balto. City	2026		
Green Spring Dairy, Inc.	Eastern Third Zone	Balto. City	2051		
			2024		
			2033		
L. Greif & Bros., Inc.	Eastern Third Zone	Balto. City	457	457	0.31
Hewy R. Gundlach	First Zone	Balto. City	2311	940	0.01
Hamm Brewing Company	First Zone	Balto. City	28 (E)	N	0.01
Harbison-Walker Refractory Company	First Zone	Balto. City	2082	318	0.82
Charles E. Harrison	Broening Park Area	Balto. City	3297	459	0.18
Hauswald Bakery	First Zone	Balto. City	2751 (E)	N	0.01
Hedwin Corp.	Western Second Zone	Balto. City	2051	132	0.01
Hendler Creamery Co.	Eastern Third Zone	Balto. City	3079	144	0.05
Henry T. Heinz Ice Machines	First Zone	Balto. City	2024	180	0.04
Heinz Riverside Abattoir	Western Second Zone	Balto. City	35 (E)	N	0.02
K. Hettelman & Sons, Inc.	First Zone	Balto. City	2011	54	0.05
	Broening Pk. Area	Balto. City	3362	78	0.04
			3369	N	0.09
High's Dairy Products Co.	Eastern Second Zone	Balto. City	20 (E)		

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	<u>Community (Zone)</u> (2)	<u>County</u> (3)			
Hinde & Dauche Paper Co.	Eastern Second Zone	Balto. City	26 (E)	N	0.02
A. Hoen & Company	First Zone	Balto. City	2752	144	0.02
Holtite Manufacturing Co.	First Zone	Balto. City	3069	908	0.21
Hood Vinegar Company	First Zone	Balto. City	2099	6	0.17
Wm. E. Hooper & Sons	Western Third Zone	Balto. City	2241		
			2261		
			2299	175	0.05
Johns Hopkins Hospital					
Estate	First Zone	Balto. City	(U)	N	0.02
Humble Oil & Refining Co.	First Zone	Balto. City	2911	159	0.98
W. T. Ihrie & Sons	Western Second Zone	Balto. City	2099	77	0.04
Independent Ice Company	First Zone	Balto. City	2097	37	0.07
Industrial Building Co. (X)	First Zone	Balto. City	39 (E)	N	0.02
International Paint Corp.	First Zone	Balto. City	28 (E)	N	0.01
Jencor Realty, Inc.	First Zone	Balto. City	65 (E)	N	0.03
Jersey Ice Cream Co. (X)	First Zone	Balto. City	20 (E)	N	0.09
The Joslyn Company	First Zone				
	Broening Park Area	Balto. City	36 (E)	N	0.02
D. Karavedas	First Zone	Balto. City	20 (E)	N	0.01
Kavanaugh Products, Inc.	First Zone	Balto. City	2094	20	0.02
Kay Foods Corp.	Western Second Zone	Balto. City	2033	40	0.02
Kingsley Realty Corp.	Western Second Zone	Balto. City	65 (E)	N	0.02
Kimball Tyler Company	First Zone	Balto. City	2445	63	0.05
David Kleiman	First Zone	Balto. City	65 (E)	N	0.02
Koester Baking Company	First Zone	Balto. City	(U)	N	0.06
Koontz Creamery Company	Western Third Zone	Balto. City	2026		
			2023	316	0.34
Koppers Company, Inc.	First Zone	Balto. City	(U)	N	0.53

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	<u>Community (Zone)</u> (2)	<u>County</u> (3)			
Kress Farm Dairy, Inc.(X)	First Zone	Balto. City	20 (E)	N	0.15
T. J. Kurdle Company	First Zone	Balto. City	(U)	N	0.40
J. Langrall & Bros., Inc.	First Zone	Balto. City	2033	68	0.09
Lapsley Window Shades	Eastern Second Zone	Balto. City	35 (E)	N	0.02
Lasting Paint Product Co.	Western Second Zone	Balto. City	2851	150	0.01
Lever Bros. Company	First Zone	Balto. City	2841	N	0.85
M. S. Levy & Sons	First Zone	Balto. City	23 (E)	N	0.02
Life-Like Products	Eastern Second Zone	Balto. City	3079	165	0.03
			3941		
Lord Baltimore Press	Eastern Second Zone	Balto. City	2651		
			2641		
Lord-Mott Company	First Zone	Balto. City	2752	716	0.06
			2033	118	0.31
P. Lorillard & Company	First Zone	Balto. City	(U)	N	0.01
Gordon Lovin Paper Box Company	First Zone	Balto. City	26 (E)	N	0.01
Lynn Conklin & Company	First Zone	Balto. City	3444	61	0.01
McCormick Company	First Zone	Balto. City	2090	N	0.13
H. J. McGrath	First Zone	Balto. City	20 (E)	11	0.21
Mangels Herald Company	First Zone	Balto. City	2099		
			2046		
			2842	85	0.02
			2899	26	0.02
Mrs. M. Manning Corp.	First Zone	Balto. City	2033	10,154	2.44
The Martin Company	First Zone	Balto. City	3799		
Mary Sue Candy Company	Western Second Zone	Balto. City	20 (E)	N	0.01
Maryland Cup Company	First Zone	Balto. City	2654	445	0.02
Maryland Dry Dock Company	First Zone	Balto. City	37 (E)	N	0.41
	Broening Park Area	Balto. City			

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	<u>Community (Zone)</u> (2)	<u>County</u> (3)			
Maryland Glass Corp.	First Zone	Balto. City	3221	734	0.19
Maryland Hotel Supply Co.	First Zone	Balto. City	5082 (E)	N	0.01
Maryland Bolt & Nut Co.	Western Third Zone	Balto. City	3452	144	0.02
Maryland Paper Products Company	First Zone	Balto. City	2654		
			3983	220	0.02
Maryland Terminals Corp.	First Zone				
	Broening Pk. Area	Balto. City	40 (E)	N	0.02
Menhaden Fish Products Co.	First Zone	Balto. City	2095	34	0.04
Merchants Terminal Corp.	First Zone	Balto. City	40 (E)	N	0.04
Metal Finishers, Inc.	Western Second Zone	Balto. City	3471	26	0.01
Metal & Thermat Corp.	First Zone				
	Broening Pk. Area	Balto. City	3341	27	0.02
Minerec Corporation	First Zone				
	Broening Park Area	Balto. City	2843 (E)	17	0.02
Monarch Rubber Company	First Zone	Balto. City	3069	224	0.06
C. O. Monk, Inc.	Western Second Zone	Balto. City	2751 (E)	N	0.01
Monroe Realty Co. (X)	First Zone	Balto. City	60 (E)	N	0.01
Mt. Vernon Woodberry Mills					
	Eastern Second Zone	Balto. City	2211		
			2221		
			2281		
			2282		
			(U)	271	0.03
Edwin C. Muhly	First Zone	Balto. City		N	0.02
Mutual Chemical Company	First Zone	Balto. City	28 (E)	N	0.66
National Brewing Co.	First Zone	Balto. City	2082	735	1.32
National Can Corp.	First Zone	Balto. City	3411	N	0.18
National Cylinder Gas Co.	First Zone	Balto. City	2813	N	0.04

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	<u>Community (Zone)</u> (2)	<u>County</u> (3)			
National Gypsum	First Zone	Balto. City	3275	224	0.18
National Starch Products	Western Second Zone	Balto. City	2046	37	0.03
O'Brien Corp.	Eastern Second Zone	Balto. City	2851	78	0.05
Olin Mathieson Chemical Corporation	First Zone				
	Broening Park Area	Balto. City	2819	353	0.17
V. Paturzo Bros., Inc.	First Zone	Balto. City	3271	58	0.02
Pemco Corporation	First Zone	Balto. City	2816	225	0.37
S. S. Pennock	First Zone	Balto. City	5099 (E)	N	0.01
Philadelphia Quartz	First Zone	Balto. City	2819	14	0.03
Pittsburgh Plate Glass, Division of					
Rennous Kleinle	Western Second Zone	Balto. City	3981	200	0.03
Potts & Callahan Paving Company	Eastern Second Zone	Balto. City	35 (E)	N	0.03
Proctor & Gamble Co.	First Zone	Balto. City	2841	467	0.49
Publication Press	Western Second Zone	Balto. City	2732		
			2752	80	0.01
Puritan Compressed Gas Corp.	First Zone	Balto. City	2813	N	0.02
Recipe Foods Company	Western Third Zone	Balto. City	2035		
			2099	93	0.05
Reid-Avery Company	First Zone	Balto. City	3623	217	0.12
Revere Copper & Brass Co.	First Zone	Balto. City	3351		
			3352	1,462	0.98
W. H. Roberts & Co.	First Zone	Balto. City	2033	100	0.04
Roberts Bros. Company	First Zone	Balto. City	2033	N	0.01
W. C. Robinson & Son	First Zone	Balto. City	2992	52	0.01

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	<u>Community (Zone)</u>	<u>County</u>			
(1)	(2)	(3)	(4)	(5)	(6)
Royal Crown Bottling Co.	Eastern Second Zone	Balto. City	2086	145	0.06
Royal Farms Dairy	Western Second Zone	Balto. City	20 (E)	N	0.07
Ruberoid Company	First Zone	Balto. City	2952	89	0.13
Rymland Realty Company	First Zone	Balto. City	65 (E)	N	0.02
S & S Investment & Realty Corp.	First Zone	Balto. City	65 (E)	N	0.02
Schenuit Rubber Company	Eastern Second Zone	Balto. City	3011	420	0.14
Schmidt Bakery, Inc.	Western Second Zone	Balto. City	2051	288	0.02
Chas. J. Schmidt & Co.	Eastern Second Zone	Balto. City	2011	8	0.01
I. Sekine & Company	Eastern Second Zone	Balto. City	3981	N	0.02
Shapiro Brothers	First Zone	Balto. City	2321 (E)	N	0.09
Jacob S. Shapiro United Iron & Metal Company	Western Second Zone	Balto. City	33 (E)	N	0.01
Shell Oil Company	First Zone	Balto. City	29 (E)	N	0.04
Silber's Bakery	Western Third Zone	Balto. City	2051	275	0.03
Southern Beef Company	First Zone	Balto. City	(U)	N	0.02
Southern Food Corp.	First Zone	Balto. City	2013	14	0.02
Southern Galvanizing & Plating Company	First Zone	Balto. City	3479		
Southern Packing Company	First Zone	Balto. City	3499	106	0.04
	First Zone	Balto. City	2033		
Southern Seafood Company	First Zone	Balto. City	2037	85	0.05
J. Spevak & Company	First Zone	Balto. City	50 (E)	N	0.03
Spevak Stinson Company	Western Second Zone	Balto. City	2011	N	0.01
	Western Second Zone	Balto. City	20 (E)	N	0.02
Standard Brands, Inc.	Western Second Zone	Balto. City	20 (E)	N	0.14
Standard Cap Molding Co.	First Zone	Balto. City	3079	102	0.03
State Bottling Company	Eastern Second Zone	Balto. City	2086	48	0.02

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	<u>Community (Zone)</u> (2)	<u>County</u> (3)			
Steel Specialties, Inc.	First Zone	Balto. City	17 (E)	N	0.03
C. E. Stevens Bros., Inc.	First Zone	Balto. City	2643	50	0.02
G. N. Stieff	Eastern Second Zone	Balto. City	3914	30	0.01
Suburban Club	First Zone	Balto. City	2086	267	0.10
Suburban Club Bottling Company	Eastern Second Zone	Balto. City	20 (E)	N	0.06
Swindel Brothers	First Zone	Balto. City	3221 (E)	N	0.07
Texas Company (X)	First Zone	Balto. City	(U)	N	0.02
	Broening Park Area	Balto. City	(U)	N	0.01
Harry Tsakalios	First Zone	Balto. City	2751	171	0.01
U. S. Printing & Lith. Company	First Zone	Balto. City	2752		
United American Metal Corp. (X)	First Zone	Balto. City	(U)	N	0.03
United Iron & Metal Co.	Western Second Zone	Balto. City	33 (E)	N	0.01
Virginia Do-Nuts, Inc.	First Zone	Balto. City	2051	83	0.01
T. C. Weiles(Howard Johnson's Ice Cream)	Western Third Zone	Balto. City	20 (E)	N	0.08
Ward Baking Company	Western Second Zone	Balto. City	2051	243	0.11
Warner-Fruehauf Trailer Company	First Zone	Balto. City	3713	134	0.01
Waverly Press	First Zone	Balto. City	3715		
	First Zone	Balto. City	2721		
			2732		
H. C. Weiskittel Co.	First Zone	Balto. City	2781	450	0.02
			3321		
			3433	160	0.03
			3631		

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	<u>Community (Zone)</u> (2)	<u>County</u> (3)			
O. E. Wentworth Co.	First Zone	Balto. City	2036	16	0.02
Western Electric Co.	First Zone	Balto. City	3661	5,500	1.49
Western Maryland Dairies	Western Second Zone	Balto. City	20 (E)	N	0.41
Westinghouse Elec. Corp.	Western Second Zone	Balto. City	3567		
			3569		
			3693	510	0.12
Westport Corp.	First Zone	Balto. City	2661 (E)	N	0.02
Weyerhaeuser Co.	First Zone	Balto. City	2421		
			2653	143	0.06
Wills Dairy	First Zone	Balto. City	2026	50	0.07
Wilton Farm Dairies	Western Second Zone	Balto. City	2000 (E)	N	0.03
J. S. Young	First Zone	Balto. City	2861	129	0.56
American Can Company	Western Second Zone	Balto. County	3411	275	0.08
Ancrods Corp.	First Zone	Balto. County	3623	217	0.05
Ark Radi-Mix Concrete Corporation	Eastern Third Zone	Balto. County	3273	31	0.01
Baltimore Gas & Elec. Co.	First Zone	Balto. County	(U)	N	0.14
Bendix Corp., Radio Div.	Fourth Zone	Balto. County	3362	5,000	0.36
Bendix Radio Corp.	First Zone	Balto. County	(U)	N	0.09
Bethlehem Steel Co.	First Zone	Balto. County	3312		
			3316		
			3317		
			3315	28,000	17.42
Black & Decker Mfg. Co.	Fourth Zone	Balto. County	3548		
H. T. Cambell Sons' Corp.	Fourth Zone	Balto. County	3273	2,647	0.04
Catalyst Research Corp.	Eastern Third Zone	Balto. County	3692	800	0.09
				N	0.45

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	<u>Community (Zone)</u> (2)	<u>County</u> (3)			
Clark Concrete Inc.	Eastern Third Zone	Balto. County	3273	N	0.01
DCA Food Industries, Inc.		Balto. County	205 (E)	N	0.04
Eastern Stainless Steel, Corp.	First Zone	Balto. County	3312	N	0.11
Electromotive Division, GMC	Western Second Zone	Balto. County	37	N	0.02
Four Roses Distilling Co.	First Zone	Balto. County	2085	N	0.03
Friez Instrument Division (Bendix)	Eastern Third Zone	Balto. County	3622 3811 3662	N	0.03
Glaco Potomac Corp.	Western Second Zone	Balto. County	3479	N	0.03
Head Ski Co.	Fourth Zone	Balto. County	2499 (E)	N	0.01
Hill House Dairy	Fourth Zone	Balto. County	20	N	0.01
J. Holzknacht & Son	First Zone	Balto. County	(U)	N	0.01
Mead Containers Division	First Zone	Balto. County	(U)	N	0.01
Jewett and Sherman	First Zone	Balto. County	2035	N	0.07
Paul Jones and Co.	First Zone	Balto. County	(U)	N	0.02
Kaiser Aluminum & Chemical Company	Western Second Zone	Balto. County	3352	N	0.11
Kennedy Manufacturing Co.	First Zone	Balto. County	37	N	0.02
Linde Air Products Co.	Western Second Zone	Balto. County	2813	N	0.04
Majestic Distilling Co.	Western Second Zone	Balto. County	2085	N	0.09
Maryland Etching Co.	Fourth Zone	Balto. County	3479	N	0.01
Murray Corp.	Fourth Zone	Balto. County	3714	N	0.03

Revised: August 6, 1963

<u>Name of Industry</u> (1)	<u>Location</u>		<u>Standard Industrial Classification Number</u> (4)	<u>Number of Employees</u> (5)	<u>Water Used m.g.d.</u> (6)
	<u>Community (Zone)</u> (2)	<u>County</u> (3)			
Owens Yacht	First Zone	Balto. County	37	N	0.09
Pipeline Service Corp.	First Zone	Balto. County	(U)	N	0.01
C.M. Pitt and Sons	First Zone	Balto. County	2071	N	0.10
Popular Club Beverage Co.	First Zone	Balto. County	2086	N	0.02
Proctor Electric Co.	Western Second Zone	Balto. County	3582	N	0.15
Rheem Manufacturing Co.	First Zone	Balto. County	26	N	0.34
			34		
Rockland Bleach & Dye Works	Eastern Third Zone	Balto. County	2261	N	0.40
Joseph Seagram Sons	Western Second Zone	Balto. County	2085	N	0.33
Seven-Up Bottling Co.	Fourth Zone	Balto. County	2086	N	0.05
Signobe Steel Scraping Co.	First Zone	Balto. County	3499	N	0.13
			3481		
Solo Cup Co.	Western Second Zone	Balto. County	2654	N	0.01
Thompson Wire Co.	First Zone	Balto. County	3316	N	0.01
Veneer Manufacturing Co.	Fourth Zone	Balto. County	24 (E)	N	0.02
Vulcan Hart Manufacturing Company	First Zone	Balto. County	3589	N	0.05
Washington Aluminum Co.	Western Second Zone	Balto. County	3499	N	0.02
			3449		
Westinghouse Electric & Mfg.	Western Second Zone	Balto. County	1941	N	0.10
O. H. Williamson	Fourth Zone	Balto. County	2432	N	0.01

<u>Name of Industry</u>	<u>Location</u>		<u>Standard Industrial Classification Number</u>	<u>Number of Employees</u>	<u>Water Used m.g.d.</u>
	<u>Community (Zone)</u>	<u>County</u>			
(1)	(2)	(3)	(4)	(5)	(6)
Baltimore Gas & Electric Co.	--	Anne Arundel County	(U)	N	--
Kennecott Copper Co.	--	Anne Arundel County	3331	N	0.40
Pittsburg-DesMoines Steel Co.	--	Anne Arundel County	3441 3443	N	--

Compiled July, 1963 by J. C. Meredith, Public Health Service, C. H. J. Hull, Water Resources Consultant; and E. S. Mills, Professor of Economics, The Johns Hopkins University. Data in columns 1,2,3 and 6 obtained from Bureau of Water Supply, City of Baltimore.

APPENDIX H

ABSTRACTS OF PUBLISHED REPORTS ON GROUND-WATER RESOURCES

See Description of Appendices (Appendix H) in the
General Reference Section for a narrative discussion
of this material.

APPENDIX H

GROUND-WATER SUPPLIES FOR INDUSTRIAL AND URBAN DEVELOPMENT

IN ANNE ARUNDEL COUNTY

by

Frederick K. Mack

- Abstract -

This report is an appraisal of ground-water resources in a rapidly growing area in the Maryland coastal plain. It was prepared to guide County and State planners in effectively locating new water-using industries, commercial establishments, and public water supplies.

Bounded on the north by Baltimore City, on the east by the Chesapeake Bay, and on the west by the Patuxent River, Anne Arundel County includes an area of 417 square miles of land surface and is situated on a part of the Atlantic Coastal Plain which is adjacent to the Piedmont province. About half of the land surface is less than 100 feet above sea level and less than one square mile is more than 300 feet above sea level. Estuaries of the Chesapeake Bay extend inland to the center of the County. The climate is humid and temperate with a mean annual temperature of 56° F and an average precipitation of about 44 inches.

The County is underlain by a wedge-shaped mass of unconsolidated coastal plain sediments of Cretaceous, Tertiary, and Quaternary age which overlie much older consolidated crystalline rocks. The wedge of sediments is less than 50 feet thick in the northwestern part of the County but thickens to about 2,000 feet in the southeastern part of the County. The five major aquifers of the County - the Patuxent, the Patapsco, the Raritan,

the Magothy, and the Aquia Formations - dip gently toward the southeast.

An average of 20 mgd (million gallons per day) of water were used in Anne Arundel County in 1960. About 70 per cent of that quantity was from ground-water sources within the County and 30 per cent was from surface-water sources.

The investigation shows that approximately 80 mgd is available from the artesian aquifers, and that an additional 50 mgd may be available from water-table aquifers. Thus, the limit of water available is on the order of 130 mgd.

A systematic appraisal of the ground water available from each of ten localities in the County shows that details of ground-water conditions vary from place to place. The thinness of the unconsolidated sediments in the northwestern part of the County limits the amount of drawdown available and thus the amount of water available from individual wells. Geologic conditions will permit the removal of large quantities of water from the eastern part of the County, but overexploitation of the ground water there would lower hydraulic heads in the aquifers and eventually induce contamination by brackish water from the Chesapeake Bay or its estuaries.

APPENDIX H
GEOLOGY AND GROUND-WATER RESOURCES
OF THE BALTIMORE AREA

by

Robert R. Bennett and Rex R. Meyer

- Abstract -

The Baltimore area comprises the city of Baltimore, and most of the area from the Susquehanna River south to Laurel, essentially between the Piedmont Plateau and the Chesapeake Bay. Most of the large ground-water developments are in the industrial districts in and near Baltimore; consequently that part of the area was investigated in greater detail. With the exception of the northern part of Baltimore, which is in the Piedmont Plateau, the area is chiefly in the Coastal plain.

The Piedmont Plateau is underlain by pre-Cambrian crystalline rocks consisting mostly of gabbro, schist, granite, and gneiss. Owing to their greater resistance to erosion the land surface of the plateau is higher and more rugged than the Coastal Plain, which is underlain by soft unconsolidated sediments of Lower and Upper Cretaceous and Pleistocene ages. The land surface of the Coastal Plain slopes gently southeastward toward Chesapeake Bay. In some places estuaries, which are tributaries of Chesapeake Bay, extend northwestward across the Coastal Plain to the Piedmont Plateau.

The Coastal Plain sediments were deposited on the southeastward-sloping surface of the crystalline rocks. They form a wedge-shaped mass that thickens progressively from west to east. The strike of the formations of Cretaceous age is approximately parallel to the boundary between

the Piedmont Plateau and the Coastal Plain (Fall Line). As these formations dip gently to the southeast they crop out as bands of irregular width trending northeast. The Pleistocene deposits are essentially flat lying and were deposited on the eroded surface of the pre-Cambrian and Cretaceous rocks.

In most of the area the sediments of Lower and Upper Cretaceous age, which consist essentially of irregular and lenticular beds of sand, gravel, and clay of continental origin, may be divided into three formations: The Patuxent formation of Lower Cretaceous age, and the Arundel clay and Patapsco formation of Upper Cretaceous age. Their combined thickness ranges from about 475 to 750 feet. The Pleistocene deposits, which consist chiefly of irregular beds of sand, gravel, and clay of continental and esturine origin, are divided, in this report, into an upland and lowland unit. The combined thickness of these units ranges from nearly nothing to 175 feet.

Owing to the great difference in water-bearing properties of the crystalline rocks in the Piedmont Plateau and the unconsolidated sediments in the Coastal Plain, ground water occurs under two widely different sets of conditions. In the crystalline rocks the water is contained chiefly in joints and other fractures which are not uniform in size and gradually disappear with depth, consequently the water-bearing zones are very irregular and inhomogeneous. The sand and gravel in the Coastal Plain sediments are considerably more porous and permeable and form relatively uniform and widespread aquifers. In general water-table conditions occur in the outcrop areas of the crystalline rocks and the Coastal Plain sediments, but down dip from the outcrops the ground water occurs under artesian conditions. Because of their low permeability, where they underlie a substantial thickness of unconsolidated sediments

the crystalline rocks are not considered to be an aquifer in most of the Coastal Plain area.

The reported yields from 106 industrial wells ending in the crystalline rocks in Baltimore show an average yield of 50 gallons a minute, and a median yield of 35; the mode, or most typical value, is 10 gallons a minute. The reported yields range from 0 to 350 gallons a minute.

Industrial wells in the Patuxent formation in and near its outcrop have yields of about 200 to 300 gallons a minute, whereas wells in this formation down dip in the southeastern part of the area have yields of about 500 to 900 gallons a minute. Pumping tests and flow net analysis show that the coefficient of transmissibility of the Patuxent formation, the principal water-bearing formation in the area, averages about 20,000 gallons a day per foot in the industrial districts near the outcrop, and about 50,000 in the industrial districts in the southeastern part of the area. The coefficient of storage of the Patuxent formation, under artesian conditions, is about 0.00026; under water-table conditions in the outcrop area, it is estimated to be 0.15 to 0.20.

The Patapsco formation is an important water-bearing formation in the southeastern part of the industrial area where it is separated by clay into a lower and upper aquifer. The lower aquifer yields as much as 500 to 750 gallons a minute to industrial wells. Its coefficient of transmissibility averages about 25,000 gallons a day per foot. The upper aquifer, which yields as much as 500 to 800 gallons a minute to wells, has a greater thickness than the lower aquifer, so that its coefficient of transmissibility probably is more than 25,000.

The upland unit of the Pleistocene deposits is thin and caps the

hills and ridges and is not an important aquifer. In some places, the lowland unit is sufficiently thick and permeable to yield large quantities of water to wells.

The large ground-water supplies in the industrial area have been developed since about 1900. The pumpage increased progressively to a peak of about 47,000,000 gallons a day early in 1942. Late in 1942 the pumpage was decreased by about 13,000,000 gallons a day and in 1945 was 34,000,000 gallons a day. From 1942 to 1945 the pumpage outside the industrial area increased from about 3,000,000 to 5,000,000 gallons a day. The total pumpage in 1945 for the entire area was 39,000,000 gallons a day. The pumpage, in gallons a day, from each water-bearing formation, is approximately: pre-Cambrian crystalline rocks, 1,000,000; Patuxent formation, 30,000,000; Patapsco formation, 6,000,000; and Pleistocene deposits, 3,000,000.

Originally the artesian head in the aquifers generally was within a few feet of the land surface, but with the progressive increase in pumpage during 1940 to 1942 the artesian head in the Patuxent and Patapsco formations, in and near the centers of pumpage, declined respectively to as much as 160 and 190 feet below the land surface. The decrease in pumpage late in 1942 resulted in a rise in the artesian head; and at present, in most of the industrial area, the artesian head in the Patuxent and Patapsco formations ranges, respectively, from about 40 to 100 and 10 to 50 feet below the land surface. Detailed records of water-level fluctuations in observation wells show that during 1943-1945 the general trend of water levels in most parts of the area was either slightly upward or essentially horizontal.

The ground water in the Baltimore area normally has a low mineral

content, but the lowering of the water table or artesian head has caused salt water, chiefly from the Patapsco River estuary, to enter the aquifers and spread laterally throughout a large part of the industrial area.

Industrial wastes, chiefly sulfuric acid, also have contaminated the ground water in a small part of the industrial area.

The contamination of aquifers through leaking wells is a serious ground-water problem in the industrial area. As the artesian head in the Patuxent formation is lower than it is in the Patapsco formation or Pleistocene deposits, highly mineralized water may enter a well through a defective casing or move downward outside an improperly sealed casing and contaminate the water in the Patuxent formation. Although this problem is now serious, the repair of leaking active wells and effective plugging of abandoned wells would appreciably reduce this contamination in a relatively short time.

Practically all ground water pumped in the Baltimore area is derived from precipitation on the outcrops of the aquifers. The potential rate of recharge to the aquifers in the Coastal Plain exceeds the theoretical maximum quantity of water that can be transmitted through them. The rate of recharge, therefore, does not limit the quantity of water that can be pumped in the artesian part of the area.

The concentration of pumping has caused the water table or artesian head in the Patuxent formation to be so low in and near some of the centers of pumping that very little additional water can be developed from that formation in those parts of the industrial area. The water table or artesian head between the centers of pumping, however, is relatively high and if the wells were spaced at greater distances additional water could be pumped. The heavy pumping from the Patuxent

formation, chiefly in and near its outcrop adjacent to the Patapsco River estuary, has caused local encroachment of salt water. However, as pumping in and near that part of the outcrop area prevents most of the salt water now in the formation from moving to major well fields in the other industrial districts, it would not be advisable to decrease or discontinue this pumping.

Heavy pumping over a period of many years throughout the industrial area has caused local encroachment of salt water in the Patapsco formation, so that most of the pumping from the formation has been discontinued. The present pumpage is chiefly from the aquifer in the lower part of the formation in the southeastern part of the area where a large part of the water is derived from areas in which the Patapsco formation contains fresh water. Although this pumping is still causing encroachment of salt water, it would not be desirable to discontinue the pumping at least until all leaking wells drilled to the Patuxent formation are repaired or plugged. Even if the pumping were discontinued, many decades would pass before the salt water in the formation would be flushed out. It would not be advisable, however, to develop additional supplies of ground water from this formation in the industrial districts up dip as they are near the main source of contamination.

The economic value of ground water in the industrial area is different for various types of uses and there is little uniformity in the chemical quality of water that can be used. The application of the term safe yield in the sense that it represents a single rate of pumping for the entire industrial area would be unrealistic. It is apparent that owing to the contamination of the water the safe yield has been exceeded for some industries.

Source: Bennett R. R. and Meyer R. R. 1952. Geology and Ground-Water Resources of the Baltimore Area: Maryland Department Geology, Mines and Water Resources. Bulletin 4.

APPENDIX H

THE WATER RESOURCES OF BALTIMORE AND HARFORD COUNTIES

The Ground-Water Resources of the Piedmont Part

by

R. J. Dingman and H. F. Ferguson

- Abstract -

Baltimore and Harford Counties lie in two physiographic provinces, the Coastal Plain to the southeast and the Piedmont to the northwest. This report deals with the Piedmont province, where the rocks are largely hard Precambrian or lower Paleozoic schist, quartzite, granite, gabbro, marble, and phyllite. Ground water in the crystalline rocks generally occurs under water-table conditions, although artesian conditions exist locally. The source of all ground water in the area is precipitation. The precipitation averages about 43 inches per year and is generally rather evenly distributed throughout the year.

More than 70 per cent of the drilled wells have yields of 10 gallons per minute or less, and only 2 per cent have yields in excess of 50 gallons per minute. The Baltimore Gneiss is an important aquifer in which the yields of 116 wells range from 0 to 110 gallons per minute and average a little better than 10 gallons per minute. A value for the coefficient of transmissibility obtained from a pumping test of a well in the gneiss was about 5,000 gallons per day per foot. The Wissahickon formation is divided into two rock types, an oligoclase-mica facies and an albite-chlorite facies. The yields of more than 230 wells in the oligoclase-mica facies average better than 11 gallons per minute. Generally, the best wells are in areas where the rocks are deeply weathered. The average yield

of 76 wells ending in the albite-chlorite facies is 10 gallons per minute. The average depth of the wells in the Wissahickon is 92 feet. The Cockeysville marble is the best squifer in the area. The marble weathers to a sand or sandy clay to depths locally in excess of 100 feet. The yields of 55 wells ending in the marble range from less than 1 to 80 gallons per minute and average about 19 gallons per minute. The average depth of wells in the marble is about 210 feet. The yields of wells are related to the topographic situation. The best wells are in the valleys and the poorest are on hilltops.

The total use of ground water in the area is about 4 million gallons per day, most of which is used for domestic or agricultural purposes. There are no public supplies (municipal) from a ground-water source in the Piedmont section of either county, although formerly several communities had public water supplies derived from wells.

The chemical character of the ground water is generally satisfactory for most uses, as shown by 61 chemical analyses of water from wells or springs. Dissolved solids in 51 samples average 105 parts per million. The hardness in 60 samples averages 59 parts per million. The hardest water is obtained from wells or springs in marble. The iron content is generally low, but it ranges from 0 to 3.5 parts per million.

Additional ground-water supplies are available for rural and domestic use, but supplies for industrial and irrigation use are limited to an estimated maximum of a few hundred thousand gallons a day.

Source: Dingman, R. J. and Ferguson, H. F. 1956. The Ground-Water Resources of the Piedmont part, in The Water Resources in Baltimore and Harford Counties. Maryland Department of Geology, Mines and Water Resources. Bulletin 17. pp. 1-128

APPENDIX H
THE GROUND-WATER RESOURCES OF CALVERT COUNTY

by
Robert M. Overbeck

- Abstract -

Calvert County is in southern Maryland, and hence in the Western Shore portion of the Coastal Plain province. The Chesapeake Bay lies along the eastern side of the county and the Patuxent River along its western side. Rocks that crop out in Calvert County are of Pleistocene, Miocene, and Eocene age. The Pleistocene formations consist of sand and sandy clay, but contain minor amounts of gravel; those of Miocene age consist chiefly of sandy clay, and at places are very fossiliferous and diatomaceous; the outcropping Eocene formation (Nanjemoy) consists chiefly of greensand. The Miocene and Eocene formations have strikes varying between north and east and very low dips to the east and south. The Pleistocene deposits are generally terrace deposits.

The sediments from which ground water is being produced in Calvert County are of Pleistocene, Jackson, Nanjemoy, and Aquia age. Cretaceous rocks underlie the county and are a possible source of water for deep wells. It is estimated that about 2,000,000 gallons of ground water are used per day in the county. This water is for domestic and farm purposes chiefly, as there are no large industries in the county. The Nanjemoy formation is the source of most of the water in the northeastern and eastern parts of the county, and the Nanjemoy formation and rocks of Jackson age in the southern part. The Aquia formation is the source in the northern

and western parts of the county and for a few wells in the southern part.

The aquifers yield water that is satisfactory for most uses.

Source: Overbeck, R. M. Ground-Water Resources, in The Water Resources of Calvert County: Maryland Department of Geology, Mines and Water Resources. Bulletin 8, pp. 4-95. 1951

APPENDIX H

THE GROUND-WATER RESOURCES

OF CARROLL AND FREDERICK COUNTIES

by

Gerald Meyer

- Abstract -

Carroll and Frederick Counties are in central Maryland and include parts of the Piedmont and Blue Ridge physiographic provinces. The Piedmont, which includes most of the area of these counties, is underlain by metamorphic rocks of Precambrian or Cambrian age, chiefly schist and phyllite and associated marble and limestone. At its west edge, along the east foot of Catoctin Mountain, the Piedmont is underlain by Cambrian and Ordovician limestone and Triassic shale and sandstone. The Blue Ridge includes the mountainous western part of Frederick County and is formed chiefly by metabasalt and quartzite and smaller bodies of shale, conglomerate, slate, and phyllite.

The average daily use of ground water in Carroll and Frederick Counties in 1956 and 1957 was about 6.6 million gallons, of which about 16 per cent was for institutional and public supplies, 15 per cent for industrial and commercial supplies, and 69 per cent for rural domestic and farm supplies. Ground water in small to moderate amounts is available nearly everywhere. Under especially favorable conditions of geology and hydrology, moderately large supplies are obtainable, but prospecting is required to outline the favorable areas. Application of available knowledge of the occurrence of ground water in the rocks of these counties may aid

substantially in the location and development of ground-water supplies in untried areas. Optimum development requires that well construction, well-field patterns, and pumping regimens be adapted to the local geohydrologic conditions.

In most of the rocks ground water occurs chiefly in pores and fractures in the mantle of semidecomposed rock that underlies the surface and in fractures in the fresh bedrock below. Solution by moving water has enlarged the openings in the carbonate rocks to a much greater degree (some of the openings being of cavernous dimensions) than in the siliceous rocks, and the wells of largest yield generally penetrate the carbonate rocks. Statistical analysis of well records shows a general relation among the yield of a well, ground-water levels in the vicinity, the geology, and the topography. Most wells yield 5 to 20 gpm, but those favorably situated geohydrologically may yield as much as several hundred gallons per minute. Owing to small storage capacity of the rocks resulting from their low porosity and to low permeability, continuous pumping may result in a substantial decrease in well yield. Pumping tests long enough to enable predicting the effect of long-term pumping should be made before it is concluded that a satisfactory yield is obtainable from a well. Test drilling, detailed geologic mapping, and aquifer and well-performance tests, should precede development of major ground-water supplies.

Geophysical methods used in the ground-water study of Carroll and Frederick Counties include electric and temperature logging and current-meter surveys. Drilling-time logs also were made. Aquifer tests and well-performance tests, particularly specific-capacity step tests, were made to determine the performance characteristics of wells and the water-bearing ability of aquifers.

Periodic measurements of water levels in wells show that ground-water levels fluctuate in a more or less uniform pattern from year to year, the levels being highest in the late winter and early spring and lowest in the late summer and early fall. The yields of wells vary with the amount of ground water in storage. When droughts occur during periods when ground-water replenishment normally begins, well yields may be seriously reduced. The water-level observations show no overall long-term upward or downward trend. In a few localities heavy pumping has lowered ground-water levels appreciably, reducing well yields.

Chemical analyses of well and spring water show that few problems of chemical quality of ground water exist in Carroll and Frederick Counties. The siliceous rocks yield water generally low in mineral content, with the exception of the Triassic sediments which yield hard water. The carbonate rocks yield hard water. Locally, high iron concentration may be an objectionable feature. Ground-water temperatures fluctuate seasonally, but generally not more than a degree or two. The average ground-water temperature is 53°F.

Source: Meyer, Gerald. 1958. The Ground-Water Resources. in The Water Resources of Carroll and Frederick Counties. Maryland Department of Geology, Mines and Water Resources. Bulletin 22, pp. 1-228

APPENDIX H
GROUND-WATER RESOURCES OF CHARLES COUNTY

by
R. M. Overbeck

- Abstract -

The close relation between the occurrence of ground water and the geology of a region was pointed out. In the early part of this report the geology of Charles County is described. The purpose of this section is to show specifically how the geology and the occurrence of ground water are related in Charles County.

In Charles County the rocks are unconsolidated sand, clay, gravel, and greensand. The openings in which ground water occurs are the pore spaces between the particles of clay, sand and gravel, which make up the beds. Since clays generally are of low permeability, they do not serve as aquifers or water supplying beds; thus the principal aquifers are the sand and gravel beds. Since, too, the rocks are unconsolidated, rain or snow water, which are the chief sources of ground water, will sink rapidly into them. It was shown that the older formations have a low dip or inclination toward the southeast. This together with the alternation of sand and clay beds affords the necessary condition for the occurrence of water under pressure or artesian water. In Charles County the principal water-bearing rocks are of Pleistocene, Eocene and Cretaceous age.

Source: Overbeck, R. M. 1948. Ground-Water Resources. in The Physical Features of Charles County. Maryland Department of Geology, Mines and Water Resources. pp. 138-184.

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Source: Overbeck, R. M. 1948. Ground-Water Resources. in The Physical Features of Charles County. Maryland Department of Geology, Mines and Water Resources. pp. 138-184.

APPENDIX H
THE WATER RESOURCES OF
HOWARD AND MONTGOMERY COUNTIES
The Ground-Water Resources*

by

R. J. Dingman and Gerald Meyer

- Abstract -

Howard and Montgomery Counties are in central Maryland, just west of a line joining Washington, D. C., and Baltimore. They are within the Piedmont province except for a narrow zone in the Coastal Plain province along the eastern edge of Howard County. The Piedmont part is underlain by crystalline rocks of pre-Cambrian (?) and early Paleozoic age and, in the western part of Montgomery County, by consolidated sedimentary rocks of Late Triassic age. The Coastal Plain part of Howard County is underlain by unconsolidated sedimentary rocks of Early Cretaceous age. In places thin unconsolidated sedimentary deposits of Tertiary and Quaternary ages cap hills, form valley-side terrace deposits, and occur as valley alluvium.

Approximately 4,500,000 gallons of ground water are pumped daily in Howard and Montgomery Counties. As most of the area is underlain by crystalline rocks, they are utilized more extensively for ground-water supplies than are the sedimentary rocks. The ground water occurs essentially under water-table conditions, but artesian conditions occur locally. Ground water is stored and transmitted chiefly through fractures in the unweathered crystalline and indurated sedimentary rocks, and through intergranular interstices in the weathered mantle rock and the

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* The geologic nomenclature in this report is that of the Department of Geology, Mines and Water Resources and differs somewhat from the official usage of the U. S. Geological Survey.

unconsolidated sedimentary rocks.

Depths of wells in the crystalline rocks range from 20 to 750 feet and yields range from a fraction of a gallon to about 180 gallons per minute. Specific capacities range from less than 0.1 to 7.5 gallons per minute per foot of drawdown. The magnitude of well yields is related to depth of the well, its topographic position and geologic setting, and the thickness of the weathered-rock mantle in its vicinity.

Stream-flow and precipitation data for the Rock Creek basin show that over long periods of time the discharge from, or effective recharge to, the ground-water reservoir of the basin is about 20 per cent of precipitation and loss by evaporation and transpiration is about 71 per cent of precipitation.

Measurements of water levels in observation wells show no appreciable net change in most wells. Locally, heavy pumping or cessation of heavy pumping have resulted in declines and rises, respectively, in water levels. Seasonal fluctuations correlate with precipitation and changes in rates of evaporation and transpiration.

The chemical character of the ground water is related to the chemical composition of the rocks. In general, the water is low in mineral content and is satisfactory for most uses; but locally the water is corrosive, contains large amounts of iron, or is hard.

Source: Dingman, R. J. and Meyer, Gerald. 1954. The Ground-Water Resources. in The Water Resources of Howard and Montgomery Counties. Maryland Department of Geology, Mines and Water Resources. Bulletin 14. pp. 1-139

APPENDIX H
GROUND-WATER RESOURCES OF PRINCE GEORGE'S COUNTY

by

Gerald Meyer

- Abstract -

Prince George's County is in the south-central part of Maryland near the western shore of Chesapeake Bay. The county is almost entirely within the Coastal Plain province; pre-Cambrian crystalline rocks which characterize the Piedmont Plateau are exposed only in some stream valleys near the north-western edge of the county. The geologic formations of the Coastal Plain in Prince George's County are of Early and Late Cretaceous, Paleocene, Eocene, Miocene, Pliocene (?), and Pleistocene age and consist chiefly of unconsolidated sand, gravel, and clay. Excepting the Pliocene (?) and Pleistocene deposits, which form a thin cover over the older formations, the Coastal Plain formations strike northeast and dip gently to the southeast. Ground water occurs under water-table conditions in and near the outcrops of the formations and under artesian conditions down dip from the outcrops.

During 1949 and 1950 approximately 4,000,000 to 5,000,000 gallons of ground water a day was pumped from wells in Prince George's County; about 65 per cent of this pumpage was used for domestic, agricultural, and public supplies and about 35 per cent for industrial and other commercial purposes. The important water bearing formations are the Patuxent, Patapsco, and Magothy formations, the Aquia greensand, and the Pliocene (?) and Pleistocene deposits.

The Patuxent formation generally yields about 10 gallons a minute to domestic wells, but a few public-supply and industrial wells yield as much as 250 to 540 gallons a minute. The total pumpage from this formation is approximately 1,000,000 gallons a day. Most wells ending in the Patapsco formation yield between 10 and 60 gallons a minute, but one well at Fort Washington is reported to yield 137 gallons a minute. The total pumpage from this formation is approximately 1,000,000 gallons a day. Wells ending in the Magothy formation generally yield 20 to 50 gallons a minute, but a well near Cheltenham is reported to yield 239 gallons a minute and a public-supply well at Upper Marlboro, 180 gallons a minute. Approximately 700,000 gallons of water a day is pumped from the Magothy formation. Yields of wells ending in the Aquia greensand range from 6 to 65 gallons a minute. The total pumpage from this formation is approximately 100,000 gallons a day. The Pliocene (?) and Pleistocene deposits are the chief source of water for domestic and farm use. Although the largest yield reported from wells ending in these deposits is only 12 gallons a minute, the total pumpage is approximately 1,300,000 gallons a day.

Old records of water-level measurements compared to recent measurements indicate that pumping has caused the piezometric surfaces to decline locally since the early part of the twentieth century, but in general periodic measurements made in observation wells show little net change in water levels during 1948-50.

The chemical character of the ground water is satisfactory for most uses, but in some places the water is acidic or contains a large amount of iron.

Source: Meyer, Gerald. 1952. Ground-Water Resources in Geology and Water Resources of Prince George's County. Maryland Department of Geology, Mines and Water Resources. Bulletin 10. pp. 82-254.

APPENDIX H
WATER RESOURCES OF ST. MARY'S COUNTY
GROUND-WATER RESOURCES

by
H. F. Ferguson

- Abstract -

St. Mary's County forms the southernmost part of the Western Shore of Maryland. Tidal water of the Chesapeake Bay and adjoining estuaries surrounds the county on the northeast, east, south, and west; Charles County adjoins it on the northwest. The county lies entirely within the Coastal Plain province and is underlain by unconsolidated sediments of Early and Late Cretaceous, Paleocene, Eocene, Miocene, and Pleistocene ages. These sediments consist chiefly of sand, clay, and gravel. With the exception of the Pleistocene deposits, which are essentially flat lying and form a thin cover over the underlying formations, the Coastal Plain formations dip gently to the east and southeast. In general, ground water occurs under water-table conditions in the Pleistocene sediments and under artesian conditions in the underlying formations.

The Coastal Plain sediments are 2,000 to 3,000 feet thick in St. Mary's County and contain many water-bearing formations; however, only the water-bearing formations in the Upper Cretaceous, Eocene, and Pleistocene deposits are utilized as sources of ground water. Most of the wells are less than 500 feet deep and draw water chiefly from one or another of three aquifers, the Aquia greensand of Eocene age, the Nanjemoy formation and sediments of Jackson age, also of Eocene age, and the Pleistocene sediments. The Aquia greensand yields water to domestic

and farm wells in the northern and western parts of the county and to most of the public-supply wells. The communities of Leonardtown, Lexington Park, and St. Clement Shores and the Patuxent Naval Air Station and the Naval base at Piney Point obtain a total of 1,500,000 to 2,000,000 gallons of water a day from the Aquia greensand. The Nanjemoy formation and the sediments of Jackson age yield water to domestic, farm, and some public-supply wells in the central and southern parts of the county. Approximately 1,000,000 gallons a day is pumped from this aquifer. The Pleistocene sediments yield adequate supplies of water for most domestic and farm wells in the upland parts of the county; the total pumpage is estimated at 400,000 to 500,000 gallons a day.

Water-level measurements and old records of water levels indicate that pumping has caused the artesian head of the artesian aquifers to decline in areas of heavy pumping. Water-level fluctuations in the water-table wells are caused chiefly by the seasonal and annual variations in precipitation.

The chemical character of the ground water is satisfactory for most uses. The Aquia greensand yields moderately hard calcium bicarbonate water in the northern part of the county and soft sodium bicarbonate water in the central and southern parts. The aquifer comprising the Nanjemoy formation and sediments of Jackson age yields moderately hard calcium bicarbonate water in the central part of the county and soft sodium bicarbonate water in the southern part. The Pleistocene sediments contain water usually low in total mineral content, but locally excessive in iron.

Water-bearing sands are present in formations of Cretaceous age below the Eocene formations but are tapped by few wells at present because

the Eocene aquifers have furnished adequate supplies to meet the needs so far. The Cretaceous aquifers constitute an important potential source of ground water in the county.

Source: Ferguson, H. F., 1953. Ground-Water Resources. in Water Resources of St. Mary's County. Department of Geology, Mines and Water Resources. Bulletin 11. 195 pp.

APPENDIX H

GROUND-WATER RESOURCES OF THE

SOUTHERN MARYLAND COASTAL PLAIN

by

E. G. Otton

- Abstract -

The Southern Maryland area, comprising the five counties of Anne Arundel, Prince George's, Calvert, Charles, and St. Mary's, includes more than 1,900 square miles, and had a population of about 375,000 in 1950. The area lies within the Coastal Plain physiographic province and has a maximum relief of only about 460 feet. Approximately 60 per cent of Southern Maryland is farmland. Tobacco is the chief crop.

The sedimentary rocks of Southern Maryland consist of sand, gravel, clay, sandy clay, shell beds, and marl, which range in geologic age from Early Cretaceous to Recent. They are underlain by a "floor" or "basement" of hard crystalline rocks, chiefly pre-Cambrian. The crystalline-rock floor slopes gently southeast from the Fall Zone along the northwestern boundary of the Coastal Plain, or roughly along U. S. Route 1 between Baltimore and Washington, D. C. The sedimentary rocks thicken wedge-like southeastward to a thickness of more than 3,000 feet at Solomons Island at the mouth of the Patuxent River in Calvert County.

The Patuxent, Patapsco, Raritan, and Magothy formations of Cretaceous age are the most important aquifers in the area. The yields of wells tapping the sand and gravels in these formations are, in a few localities, greater than 1,000 gallons per minute. The aquia greensand and the

Nanjemoy formation of Eocene age are the chief aquifers in Calvert and St. Mary's Counties although the yields of wells are seldom more than 400 gallons a minute. Many of the dug wells supplying farms and rural residents yield 5 to 20 gallons a minute from the sands and gravels of Pliocene (?) and Pleistocene age. Local precipitation is the source of essentially all ground water in Southern Maryland. The water in dug and drilled wells occurs under both water-table and artesian conditions. Some ground water moves vertically between the essentially horizontal beds, indicating the existence of so-called "leaky" aquifers. In some of the tidewater areas flowing wells are obtained when the deeper artesian strata are penetrated. In a few localities the artesian head has declined so that wells which formerly flowed at the land surface must now be pumped.

Of the slightly more than 20 million gallons of ground water pumped, or discharged, daily during 1951 in Southern Maryland, about $11\frac{1}{2}$ million gallons (54 per cent) was used for domestic and rural consumption, about $5\frac{1}{3}$ million gallons (24 per cent) for military and institutional purposes, and the remainder, $4\frac{1}{2}$ million gallons (22 per cent) was for public-supply and commercial purposes. The Patapsco and Raritan formations furnished about $6\frac{3}{4}$ million gallons (more than 30 per cent) and the Aquia greensand, the next important aquifer, furnished a little less than 4 million gallons (about 18 per cent). The remainder, about 11 million gallons a day, was withdrawn chiefly from the Patuxent, Magothy, and Nanjemoy formations, and from deposits of Pliocene (?) and Pleistocene age.

Chemical analyses of about 275 samples of water from the major aquifers show the quality of the ground water is satisfactory for most uses.

In a few localities the iron content is excessive (as much as 30 parts per million), and treatment for iron removal is necessary even for domestic use. Some of the water in eastern Anne Arundel County and northern Prince George's County contains free acid and has a low pH. The hardness of the water from most aquifers is below 100 parts per million. The chloride and nitrate contents of uncontaminated water are commonly below 25 parts per million. The relation of the chemical character of the water to the geology and hydrology of the area is discussed. Base exchange, or natural water softening, takes place in some of the water-bearing strata.

On the basis of hydrologic and geologic data from pumping tests, well records sample studies, and piezometric and geologic maps, the available ground-water supplies in four subareas of the Southern Maryland peninsula were estimated. The estimates indicate the untapped ground-water supplies are extensive and constitute one of the most valuable natural resources of the area.

The report contains records of representative wells, drillers' logs, and sample-study logs of key wells.

Source: Otton, E. G. 1955. Ground-Water Resources of the Southern Maryland Coastal Plain. Maryland Department of Geology, Mines and Water Resources. Bulletin 15.

APPENDIX H
GROUND WATER IN MARYLAND
PIEDMONT

by
C. L. McGuinness

The Piedmont is underlain by crystalline and sedimentary rocks which are generally reliable sources of the small supplies, 5 to 10 gpm, needed for domestic and stock supply. A few wells yield as much as 200 gpm. Limestone and marble, and sandstone and shale of the Triassic belt, are the sources of many of the larger supplies. Rather commonly, the yields of the more productive wells tend to decrease if the pumping is heavy and continuous.

In a few localities, even domestic supplies are hard to get; well yields are low and water levels decline under prolonged pumping. Information is needed on the principles of occurrence of water in the crystalline rocks to explain these poorly productive localities and to enable predicting the best well sites in them.

The ground water is generally of good quality except that some of it is slightly corrosive, high in iron, or, locally in areas of limestone or marble, excessively hard.

The total pumpage of ground water in the area, which covers about three-tenths of the State, was about 18 mgd in 1960. This is only a small fraction of the total that could be pumped from wells distributed over the whole area.

APPENDIX H

GROUND WATER IN MARYLAND

COASTAL PLAIN, WESTERN SHORE*

by

C. L. McGuinness

On the Western Shore the yields of wells developed and equipped for maximum capacity range from a few hundred gallons per minute to as much as 1,200 gpm in the most favorable areas. Along the Fall Line the yields are small because the sediments are thin and also are dissected and tend to drain out rapidly. In the southwestern part of the Maryland Coastal Plain, from Washington, D. C., down to Indian Head, the water-bearing sands are generally thin and fine grained and well yields tend to be small. Water levels are declining in localities where pumping is heavy.

The northern part of the Western Shore is more productive, at least where developed to date. Pumping is concentrated largely in the Baltimore industrial area and in the northern half of Anne Arundel County, and there is substantial pumping at military installations scattered over the whole Western Shore.

The total pumpage on the Western Shore in 1960 was about 54 mgd, about half of which was pumped at Baltimore. The total is likely to increase substantially in the future, and the available reports will help to promote the additional development by showing the areas within each county where the prospects are best.

The water from the oldest sediments, the Cretaceous, commonly is slightly acid, corrosive, and high in iron content. As much as 50 ppm

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* As used by McGuinness, the Western Shore area includes the Coastal Plain portions of Harford, Baltimore, Anne Arundel, Calvert, Prince George's, Charles, and St. Mary's Counties, and of Baltimore City.

of iron has been measured in wells near Washington, D. C., a highly excessive value when the Public Health Service's recommended limit of 0.3 ppm for iron and manganese together is considered. The average iron content is much less, but it commonly exceeds 0.3 ppm.

Baltimore obtains its public water supply from two impounding reservoirs on the stream known as Gunpowder Falls and one on the Patapsco River. The average daily intake of raw water in 1960 was 211 mgd. About 24 mgd of ground water is pumped, nearly all from industrial and commercial wells. About 70 mgd of treated sewage is used by industry, most of it at a steel mill at Sparrows Point.

Saline water has encroached from the Patapsco River Estuary into the shallower Cretaceous aquifers along the shore in a large part of the Baltimore area. The ground water is contaminated also by industrial wastes which enter the aquifers through the corroded, leaky casings of wells. The pumping in the industrial area, formerly heavier, has become more or less stabilized at the present rate as a consequence of the contamination that has already occurred and of its tendency to spread at higher rates of pumping.

The public water supply is to be supplemented about 1963 by water brought in a conduit from the Susquehanna River. The new supply will add about 500 mgd to the reliable yield, now estimated at 243 mgd.

A comprehensive quantitative report on ground water in the Baltimore area is available (Bennett and Meyer, 1952), but the work needs to be updated by means of an inventory of pumpage and quality-of-water data.

Source: McGuinness, C. L. 1963. The Role of Ground Water in the National Situation, Geological Survey Water-Supply Paper 1800, pp. 399-400).