Interbasin Transfers between the Potomac and Patuxent Rivers

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Introduction

The task of quantifying the interbasin transfers between the Potomac and Patuxent rivers is one of several being performed by ICPRB with funding support from the Maryland Department of Natural Resources - Water Resources Administration under the general subject of freshwater inflows to the Chesapeake Bay. The purpose of this project is to assess the net transfer of surface derived water between the Potomac and Patuxent river basins. The results may indicate an impact on the distribution of freshwater reaching the Chesapeake Bay. It has been determined that maintenance and/or enhancement of freshwater flows to the Chesapeake Bay would improve its living resources.

The combination of freshwater inflows and marine salt water under tidal influence makes the Chesapeake Bay a very productive estuary. Salinity is a major factor in determining the quality of water in the Bay and thus the quantity and variety of biological resources to be found there. An increase in salinity would aggravate the presence of MSX disease in oysters and reduce the spawning and nursery areas for the soft clam and several important varieties of finish. It would increase the range of the woodboring shipworm and reduce the habitat of food sources which are important to sportfish and waterfowl. Therefore, the need exists to ensure that future use will

progress in an orderly and economically efficient manner, and to balance the transfer of freshwater with the aggregate impact of that transfer on the resources of the Bay.

It has been determined that reductions in freshwater inflow to the Chesapeake are undesirable for the health of beneficial biological systems, but can be tolerated during average and high flow periods. However, severe stress and death may result from extreme low flows of even short duration. The main causes of the disruption to the natural pattern of freshwater flow to the Bay include increased diversion, consumptive losses, and land development leading to more flashy runoff and lower baseflows in its tributary streams and rivers.

Interbasin transfers between the Potomac and the Patuxent rivers are accounted for in the operations of the Washington Suburban Sanitary Commission (WSSC). Both the water supply and sewage disposal activities which straddle the watershed boundary are managed by WSSC. A water treatment plant is located adjacent to each of the rivers. Water is withdrawn, treated and distributed via pumping stations with the capability of interbasin transfers. The Commission collects (generally by gravity) and treats sewage at several plants in each of the basins. The largest of the flows goes to the Blue Plains sewage treatment plant (STP) on the Potomac which is operated by the Washington, D.C. government.

Analysis

The determination of the net interbasin transfer of surface water between the Potomac and Patuxent rivers was accomplished by analyzing monthly average water production and sewage flow data. The period of analysis covered the nine year period 1977 - 1985. The data were obtained from WSSC for the following treatment plants in its service area of Montgomery and Prince George's counties, Maryland.

Potomac River Basin:

withdrawals: Potomac water treatment plant

returns: Blue Plains (D.C.) STP
Damascus STP
Piscataway STP
Seneca STP

Patuxent River Basin:

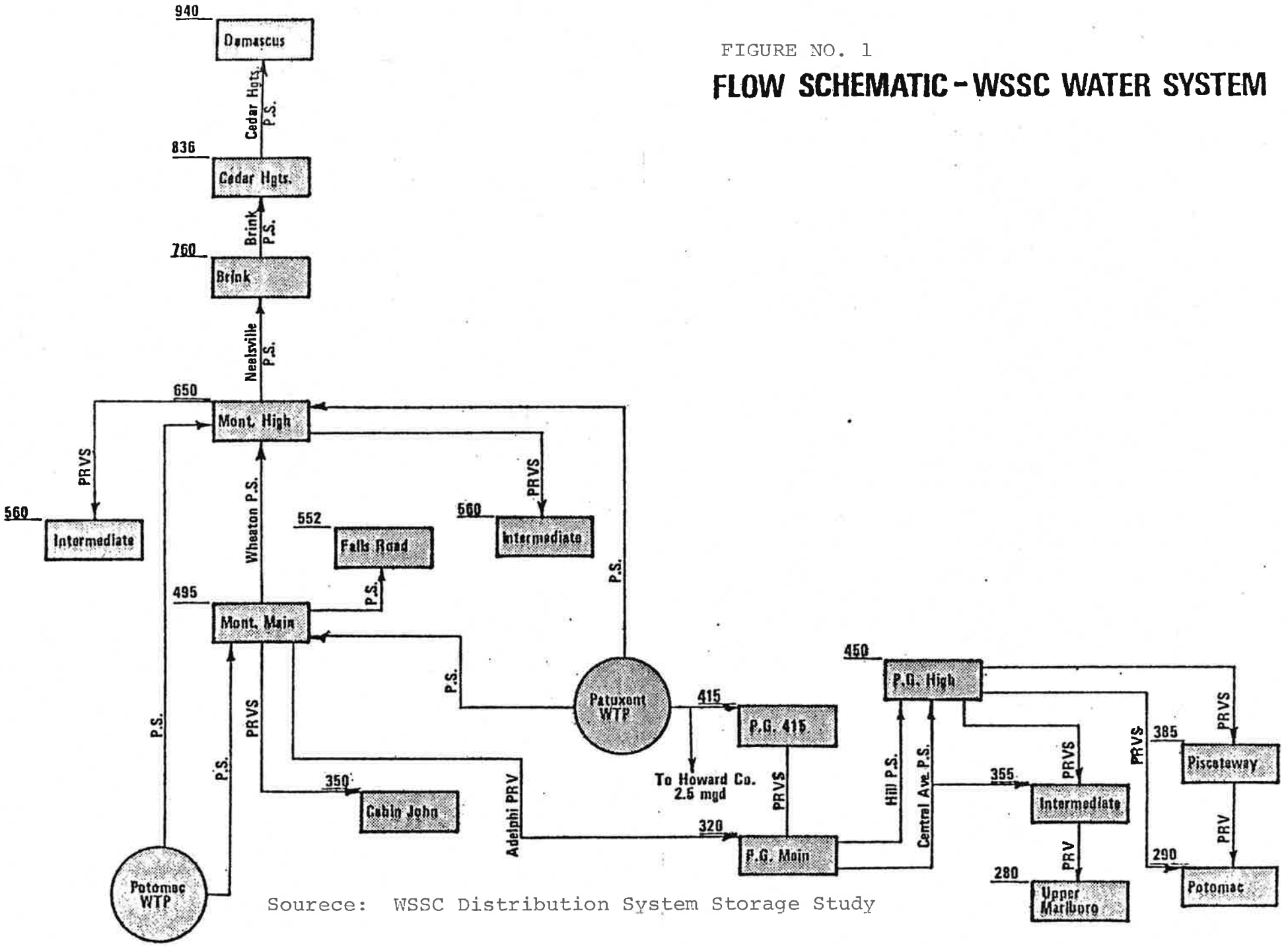
withdrawals: Patuxent water treatment plant

returns: Horsepen STP
Western Branch STP
Parkway STP

A schematic diagram of the water supply withdrawal and distribution system is presented in Figure No. 1. Howard County receives an average supply of approximately 2.5 mgd which is subtracted from the Patuxent water treatment plant data prior to the interbasin transfer analysis. Water production at the

FIGURE NO. 1

FLOW SCHEMATIC - WSSC WATER SYSTEM



Sourece: WSSC Distribution System Storage Study

Patuxent plant has been disrupted since early 1980 by a program of filterbed renovations. This renovation program has meant that 25 percent of the filter capacity has been out of service almost continuously during the past six years. The effect on production is evident in Figure No. 2 beginning in 1980, and is likely to continue for several more years.

The analysis of data and derivation of results is dependent upon several assumptions being applied to those data as follows:

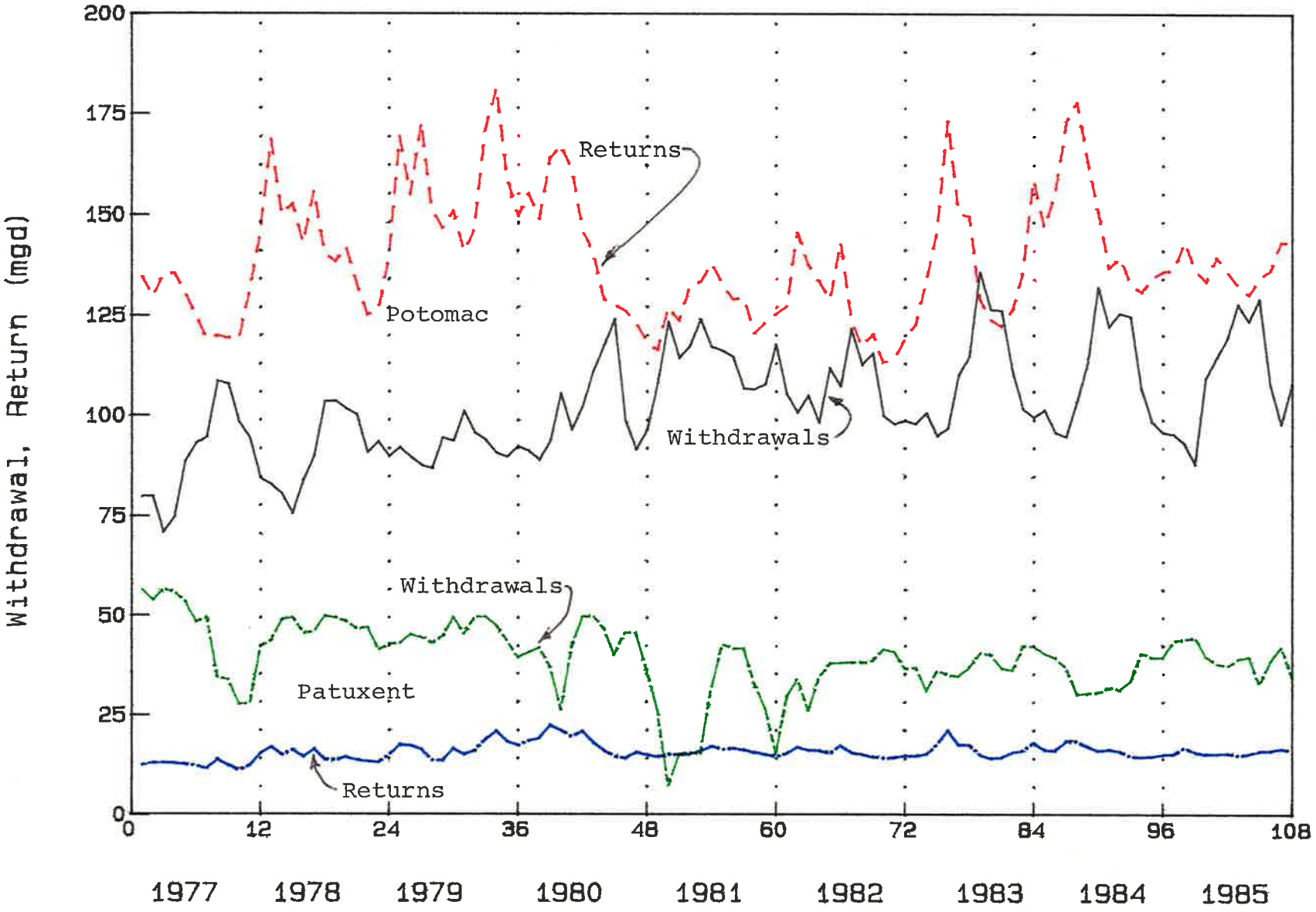
1. in support of the production and return flow data, water withdrawals from the two rivers are pooled and available for interbasin transfer via pumping,

2. return flows are not pooled (not pumped) and represent an indicator of actual water use in each of the two natural river drainage basins,

3. inflow and infiltration are consistently proportional to total return flow in each of the two natural river drainage basins.

More directly stated: water use in each of the basins is proportional to return flow in each of those basins.

POTOMAC/PATUXENT RIVERS
INTERBASIN TRANSFER ANALYSIS
FIGURE No. 2 ACTUAL WITHDRAWALS AND RETURNS



The assumptions are represented in the following statement of relationships:

$$Rpo = Spo + Ipo \qquad Rpa = Spa + Ipa$$

$$Ipo : Spo = Ipa : Spa$$

$$Spo : Upo = Spa : Upa$$

$$Upo : Rpo = Upa : Rpa$$

where:

R = return flows from sewage treatment plants
S = sewage produced, exclusive of inflow and infiltration
I = inflow and infiltration
U = assumed actual water use
po = Potomac river basin
pa = Patuxent river basin

Thus, it is possible to apportion the combined withdrawals to each of the basins. This is carried out on a pro rata basis in proportion to the relative fraction of total return flow:

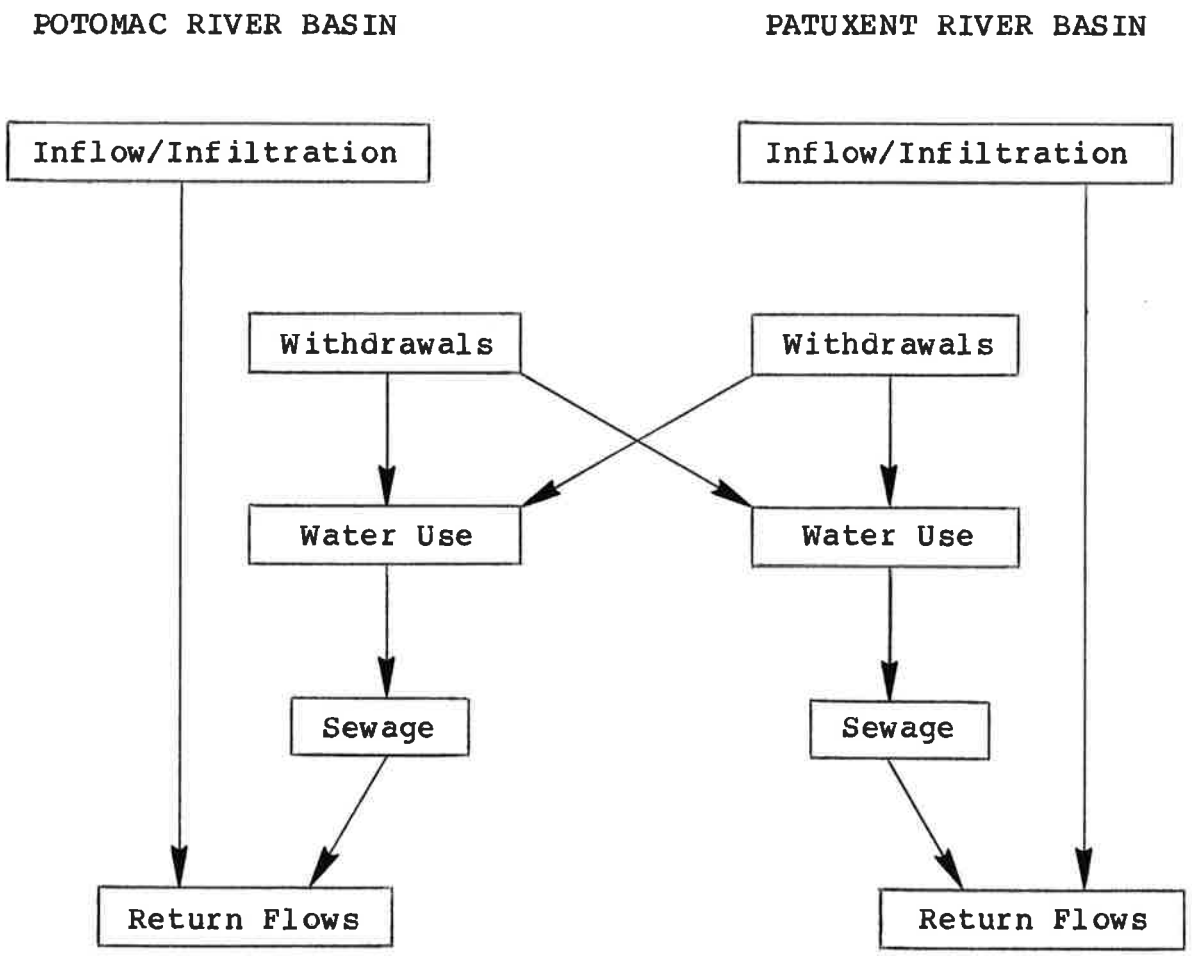
$$Upo = (Wpo + Wpa) \frac{Rpo}{Rpo + Rpa}$$

$$Upa = (Wpo + Wpa) \frac{Rpa}{Rpo + Rpa}$$

Figure No. 3 shows the assumed elements and pathways of withdrawals and returns.

FIGURE No. 3

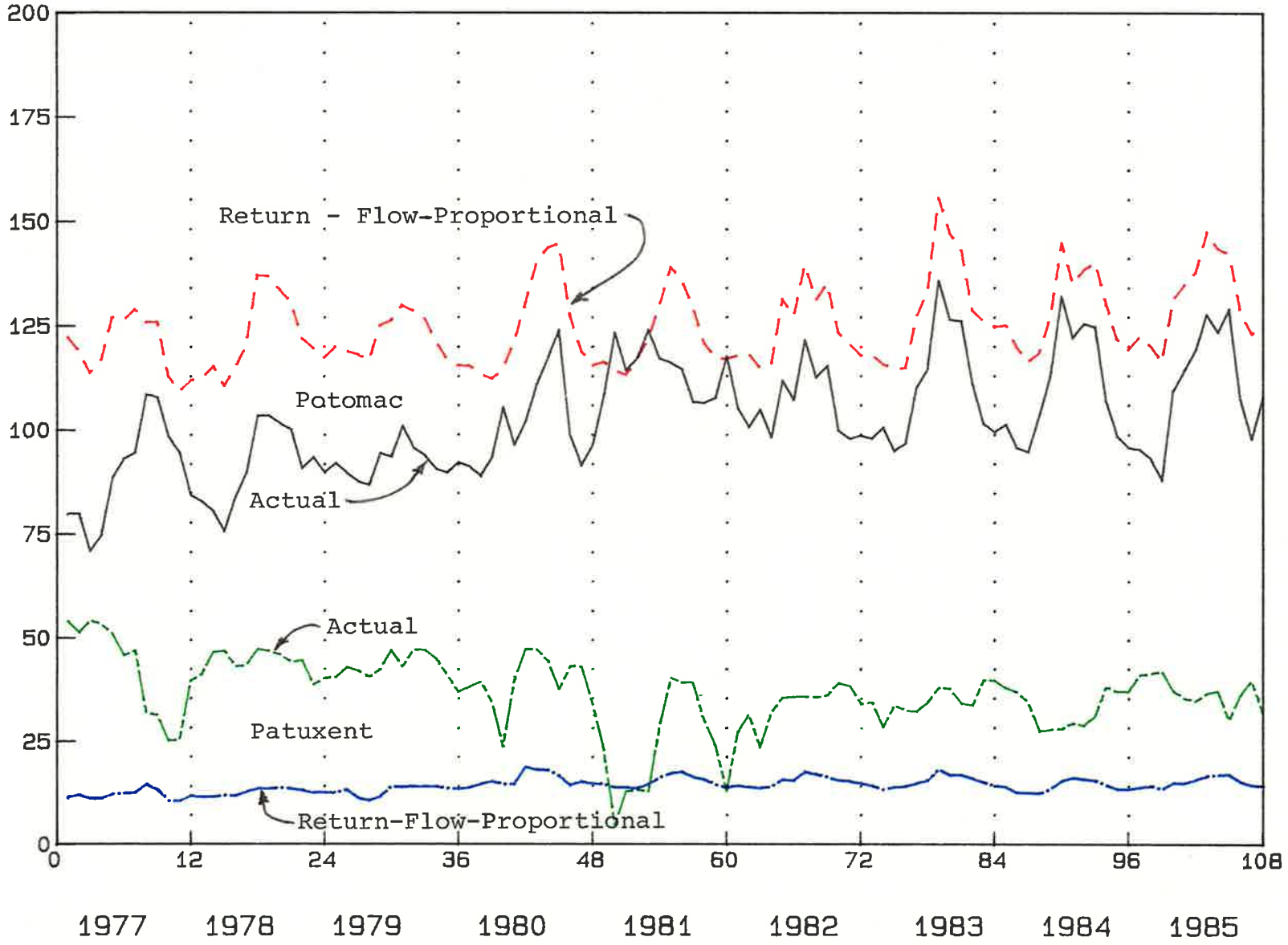
WITHDRAWALS AND RETURNS: SCHEMATIC OF ELEMENTS AND PATHWAYS



The actual and return-flow-proportional withdrawals are shown in Figure No. 4. The vertical difference between plots of Potomac basin data indicate the average transfer to that basin; conversely, those for the Patuxent basin indicate the same values as transfers from that basin. Had there been no transfers, less water would have been needed from the Patuxent (the lowest of the plotted lines) and more from the Potomac (the highest of the plotted lines). In this case, the Potomac is always the receiving basin except for a short period in 1981.

Average annual net transfers for the period 1977 - 1985 are plotted in Figure No. 5 and listed in Table No. 1. These show that prior to the 1980 commencement of renovations at the Patuxent water treatment plant, transfers from that basin averaged approximately 30 mgd. During the period of renovation, transfers have stabilized at approximately 20 mgd.

POTOMAC/PATUXENT RIVERS
INTERBASIN TRANSFER ANALYSIS
FIGURE No. 4 ACTUAL AND RETURN-FLOW-PROPORTIONAL WITHDRAWALS



POTOMAC/PATUXENT RIVERS
INTERBASIN TRANSFER ANALYSIS
FIGURE No. 5 NET TRANSFER: PATUXENT TO POTOMAC

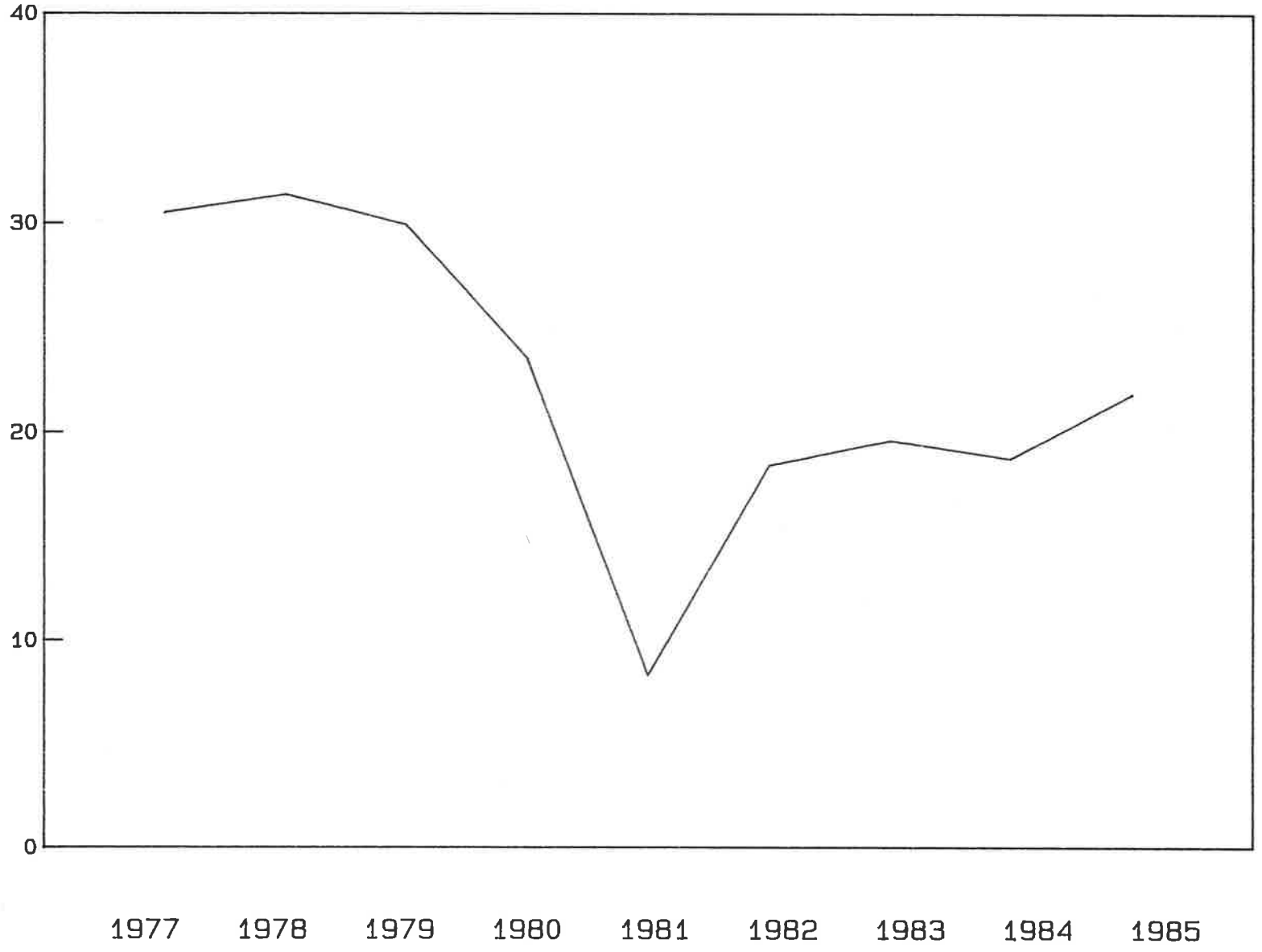


TABLE No. 1 AVERAGE ANNUAL INTERBASIN TRANSFERS:
PATUXENT TO POTOMAC RIVERS

Year	Transfer (mgd)
1977	30.5
1978	31.4
1979	29.9
1980	23.5
1981	8.3
1982	18.4
1983	19.6
1984	18.7
1985	21.8

In order to assess the relative importance of 20 mgd and 30 mgd to the Potomac and Patuxent rivers at approximately the head of tidal influence, these transfer values are compared with annual average flows. The comparisons are shown in Table No. 2.

TABLE No. 2 TRANSFERS COMPARED WITH ANNUAL AVERAGE FLOWS

	Annual Average Flow (mgd)	30 mgd as percent	20 mgd as percent
Potomac River nr D.C.	7,470	0.4%	0.3%
Patuxent River, Bowie	270	11.1%	7.4%

With regard to the future, no projections of water withdrawals or return flows are made in this study. It is an analysis of conditions in the recent past. However, the renovation of the Patuxent water treatment plant is expected to be complete in a few years. The return to full capacity may affect the net interbasin transfer; it was approximately 30 mgd prior to the start of renovation, and has been approximately 20 mgd during the work period. In addition, there are plans for a new sewage treatment plant to come on line in the late 1990's in western Montgomery County (Rock Run). This plant will return flow to the Potomac and reduce flows to Blue Plains STP by a similar amount; thus, there is no implied shift in the balance of interbasin transfers.

Conclusions

The principal conclusion to be drawn from this analysis is the existence of consistent and significant interbasin transfers from the Patuxent River to the Potomac River. The transfers are on the order of 20 mgd to 30 mgd, which is between 7.4 and 11.1 percent of the annual average flow in the Patuxent at the head of tide. Compared with the average flow in the Potomac, the same transfer values are only 0.3 and 0.4 percent respectively. The effect on the Chesapeake Bay is one of shifting 20 mgd to 30 mgd of freshwater inflow a distance of approximately 25 miles down the Bay before it enters the main stem.

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