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IN THE
WASHINGTON METROPOLITAN AREA

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This report describes a system of both raw and finished water interconnections between the two largest water supply systems in the Washington area, the Washington Aqueduct Division (WAD) and the Washington Suburban Sanitary Commission (WSSC). The advantages of interconnection systems for the Washington area have been demonstrated in several recent reports (1,2,3,4,5,6). Raw and/or finished water interconnections can be used to increase the water available during droughts. In addition, interconnection of finished water systems can increase reliability in cases of mechanical failure, such as occurred at the WSSC Potomac River filtration plant in July 1977.

The costs of these interconnections have been assumed to be substantial (7). However, this paper will show that in the case of the WAD and WSSC, interconnections can be substituted for facilities in currently proposed capital improvement programs, at comparable or less cost, with substantial increases in quality of service and reduction of environmental impact.

Concept Of The Interconnection System

The WAD, a division of the U.S. Army Corps of Engineers, Baltimore District serves residents in the District of Columbia, Arlington, and Falls Church. The WSSC supplies water to 1.5 million residents of suburban Maryland. By allowing more efficient use of existing excess capacity at the WAD water treatment plants and existing storage in the WSSC's Patuxent River reservoirs, this system will produce several benefits. It will provide substantially increased protection from water shortages during droughts. It will also greatly reduce the potential consequences of mechanical failures or contamination of water supply sources, and lessen the environmental impacts of water supply withdrawals on the free-flowing

Potomac River. Further, because this system makes use of existing water treatment capacity at WAD facilities, instead of constructing new capacity for the WSSC, the total capital costs of the system over the next twenty years will be shown to be comparable to (and possibly less than) the costs of the currently proposed WSSC Potomac River water treatment plant expansion. The major difficulty in creating the system would be obtaining the necessary regional agreements for construction and operation of an interconnected system. But the benefits for the individual water suppliers and the entire region could be substantial.

The basic concept of the system is as follows. Existing storage in the Patuxent reservoirs would be used to increase the dependable supply of raw water to the Washington Aqueduct Division's existing treatment facilities. The portion of those facilities not required to meet demands for the Aqueduct's present customers (the District of Columbia, Arlington, and Falls Church) would be made available to the WSSC, reducing the need for the construction of additional treatment capacity. This concept has been proposed by WSSC General Manager Robert S. McGarry in 1978 (8). The savings due to reduced construction of new treatment capacity can offset the total cost of the interconnections (both raw and finished water) necessary to make the concept operational. Further, because additional water is allowed to flow to the Little Falls intake (the farthest downstream point on the free-flowing Potomac), the impacts of water withdrawals on the free-flowing river will be reduced.

The system described below is not the only system which can be used to increase yields and reduce costs. Occoquan storage could be used in conjunction with Patuxent storage for the purpose of augmenting flows, and interconnections can be constructed in Virginia. These are the subjects of ongoing studies included in the Corps of Engineers-Washington Metropolitan Area Water Supply Study. The most efficient water supply system for the region will likely consist of interconnections

on both sides of the Potomac. The system below was chosen for use in this paper because: (1) it is an effective demonstration of possible savings, and (2) cost data were available from previous publications.

The system consists of a 118 million gallon per day (mgd) pipeline connecting the WSSC Patuxent water treatment plant and the WSSC Potomac River water treatment plant, with pumps for maintaining flow in either direction (Fig. 1), and two 67 mgd finished water interconnections, one from the Dalecarlia water treatment plant to the Montgomery main service of WSSC (Fig. 2), and the other from the McMillan treatment plant to the Prince George's main service (Fig. 3).

The interconnection assumes the WAD has 118 mgd of excess treatment plant capacity currently available which could be provided to the WSSC. While it is impossible to pin down a specific estimate of excess capacity, this estimate is supported by the recent testimony of Major General James A. Johnson, Division Engineer, North Atlantic Division, Corps of Engineers before Congress (9). Mr. Harry Ways of the WAD has also confirmed that approximately 118 mgd at capacity might be made available (10). To allow comparison with a 160 mgd expansion of the WSSC plant, an additional 42 mgd of new WSSC treatment capacity is also included in the interconnections system.

Costs Under The Present Plan

The cost of the currently proposed WSSC Potomac treatment plant expansion is estimated to be about \$125 million, as shown in Table 1. The distribution system improvements include the construction of an 84-inch pipeline necessary to convey the additional 160 mgd of treated water from the expanded treatment plant to the WSSC distribution system. The need for this pipe and the additional treatment capacity is documented in a Report to the Bi-County Supply Task Force (Montgomery and Prince George's Counties) by Henningson, Durham and Richardson (HDR) (2). The

cost estimate for the pipe is taken from that report, and the cost of the treatment plant expansion is based on the cost curve given in the appendix to that report.

Construction of the WSSC expansion would neither increase the water available during droughts nor substantially improve the ability of the system to respond to mechanical failures of water source contamination. In addition, the withdrawal of an additional 160 mgd from the Potomac would have an adverse environmental impact as documented in the Draft Environmental Impact Statement Concerning Proposed Potomac River Water Supply Structures and issued by the Baltimore District, Corps of Engineers (11).

Costs Of The Interconnection Program

The raw and finished water interconnection system consists of the elements in Table 2. The WAD is assumed to have 118 mgd of excess treatment capacity in their Dalecarlia and McMillan treatment plants as discussed earlier. The cross-county raw water aqueduct is essentially Alternative 3 of the above-mentioned HDR report, and its estimated cost is based on HDR figures.

In addition to the raw water cross-county pipeline, the system includes two of the interconnections proposed in the 1974 report by Black and Veatch Consulting Engineers (6). The routes are shown in Figures 2 and 3. Each is capable of carrying 67 mgd of treated water. Necessary pumps are included in the cost estimates, as are engineering, legal, and contingency costs. Land costs are not included. Costs have been adjusted to December 1977 levels using the Engineering News-Record Construction Cost Index, making them comparable to the costs in the HDR report (2).

Because the proposed Potomac plant expansion is 160 mgd, and the WAD is assumed to have only 118 mgd excess capacity, an additional 42 mgd of treatment capacity must be added to the system to allow an adequate cost comparison. Again, this cost is

based on the HDR cost curve (2). The 42 mgd expansion could be located at either the WSSC Potomac or Patuxent treatment plant sites. It is not clear that any distribution system improvements will be necessary (in addition to the finished water interconnections) to transmit the treated water to the WSSC distribution system as was the case with the Potomac plant expansion. In any case, an \$18 million contingency fund is allowed in the interconnection system for such improvements.

With the contingency fund added, the cost of the system is estimated at \$125 million, comparable to the costs of the Potomac River water treatment plant expansion (\$125 million). Without the contingency, the system appears to be substantially less expensive.

Operation Of The System

The facilities in the system would be operated as follows:

* During periods of normal flow, the WAD plant and the WSSC Potomac plant would treat Potomac water, and the Patuxent plant would withdraw water from reservoirs on the Patuxent.

* During droughts, the cross-county pipeline would be used to deliver 118 mgd of Patuxent reservoir water to the WSSC Potomac treatment plant, allowing a corresponding 118 mgd of Potomac water to flow by the WSSC plant downriver to the WAD intakes at Little Falls. This water would be treated by WAD, using its extra capacity, and supplied to both WAD and WSSC customers through the finished water interconnections.

The additional flow between the WSSC intakes and Little Falls (about 11 miles) would lessen environmental impacts of low flow withdrawals on the Potomac in that area. The flow would be 118 mgd greater than it would be during droughts under the existing system. The flow would be 118 plus 160 (the proposed expansion) minus 42 mgd (the interconnections system expansion), a total of 236 mgd greater than it would be with an expanded WSSC Potomac River water treatment plant.

Analysis of the information contained in the senior author's "Perspective on the Washington Metropolitan Area Water Supply Problem" indicates that the ability to use reservoir water during droughts would increase the dependable yield of the Potomac River and the Patuxent reservoirs combined (3). The increase could reach almost 118 mgd if, following drought periods, water were pumped from the Potomac to the WSSC Patuxent treatment plant, and the reservoirs were allowed to fill naturally. It is important to note that this 118 mgd would be shared by all participants in the program under the terms of the Low Flow Allocation Agreement (12).

Advantages Of Interconnection

An interconnection such as this could provide substantially greater increases in dependable yield if its operation were coordinated with releases from Bloomington Reservoir (under construction in Western Maryland and West Virginia). Bloomington releases could be determined on a daily basis, with the objective of producing a given target flow at Little Falls. This flow would be large enough to satisfy both water supply and flow-by requirements. Unfortunately, because of the uncertainties of rainfall during the period it takes for the water to reach the metropolitan area, it is impossible to predict the required releases exactly. Without the proposed interconnections, operational problems would occur in the local water supply systems if the Bloomington releases were too low. Therefore, more water than is necessary would normally be released, with substantial waste of water. If the proposed interconnection were in operation, flows could be as much as 118 mgd below the target without causing operational problems. If releases from Bloomington had been low, water would be transferred from the Patuxent. If releases from Bloomington were as much as 65 mgd too high, water could be pumped for treatment to the Patuxent treatment plant, avoiding waste. The net result is that flows could vary within a range of 183 mgd without any loss of water or water supply shortage. Operational flexibility of this kind can provide substantial increases in dependable yields.

The system provides for increased ability to cope with mechanical failures of water source contamination by allowing water to be supplied to either WAD treatment plant (McMillan or Dalecarlia), in the event of failure. Both the Montgomery main and Prince George's main service could be partially served in case of WSSC outages. In the case of contamination of the Potomac, more than 300 mgd of capacity would be available for limited time using WSSC Patuxent water at both WSSC treatment plants. Substantial quantities of water could reach WAD customers through the finished water interconnections. Were the Patuxent reservoirs to be contaminated, the Patuxent treatment plant could operate on Potomac water.

Conclusion

As mentioned earlier, the system described in this report is not the only program which could provide similar benefits. Robert McGarry and Richard Shagogue of WSSC have suggested that the small reservoir on Dry Seneca Creek recommended by the Bi-County Water Supply Task Force might be substituted for the Cross-County Pipeline in the proposed system (13). While this would provide significant cost savings, it would also reduce the ability to make better use of Bloomington releases. Ongoing studies of Bloomington release rules at the Johns Hopkins University in cooperation with ICPRB staff may determine if this loss in flexibility is significant. Other pipeline routes and sizes, or interconnections between the WAD and the Fairfax County Water Authority, may well prove even more efficient. Studies now under way, funded by the Corps of Engineers' Washington Metropolitan Area Water Supply Study, are examining such possibilities (14,15).

The major difficulty in implementing interconnection systems is likely to be obtaining the regional agreements necessary for their construction and operation. These difficulties should not be insurmountable. Each of the major water purveyors in the metropolitan area is blessed with an excess of some of the ingredients necessary for solutions to the water supply problems of the region. This report demonstrates that

the physical facilities required to implement such solutions are technically feasible and economically attractive. The benefits of regional cooperation are great--an adequate, reliable water supply, minimal environmental impact, and no additional cost.

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TABLE 1

ESTIMATED COST OF 160 MILLION GALLONS PER DAY EXPANSION
POTOMAC RIVER WATER TREATMENT PLANT
WASHINGTON SUBURBAN SANITARY COMMISSION

	<u>Millions of Dollars</u>
Treatment Plant Expansion ¹	\$ 89.0
Distribution System Improvement ²	15.0
Engineering, Legal, Contingency Expense ³	<u>20.9</u>
TOTAL	\$ 124.9

¹From Figure G-1, Appendix G, Henningson, Durham & Richardson Report

²Henningson, Durham & Richardson Report

³20% of all other costs

TABLE 2

ESTIMATED COST OF INTERCONNECTIONS PROGRAM
WASHINGTON SUBURBAN SANITARY COMMISSION (WSSC) AND
WASHINGTON AQUEDUCT DIVISION, CORPS OF ENGINEERS (WAD)

Millions of Dollars

<u>Cross-County Pipeline Facilities (Potomac-Rocky Gorge Reservoir)</u>		
Cross-County Pipeline Intake (at Rocky Gorge Reservoir) ¹	\$ 4.0	
Rocky Gorge Pump Station Expansion ¹	2.9	
Pipeline ¹	29.1	
Potomac Pump Station ¹	2.0	
Land ¹	5.4	
Engineering, Legal Contingency ²	7.6	
	<u>SUBTOTAL 1</u>	\$ 51.0
<u>Finished Water Interconnections</u>		
Dalecarlia-Montgomery Main Service-Pipe & Pumping Stations, ³ 1973 Dollars	\$ 7.5	
Bryant Street Pump Station-Prince George's Main Service Pipes and Pump Stations, ³ 1973 Dollars	12.3	
	<u>19.8</u>	
Correction to Dec. 1977 Dollars (Eng. News-Record Construction Cost Index, 2728/1933.8 = 1.41)	x 1.41	
	<u>SUBTOTAL 2</u>	27.9
<u>Additional WSSC Treatment Capacity 42 mgd¹</u>		28.0
<u>Contingency Estimate (see text)</u>		<u>18.0</u>
	<u>GRAND TOTAL</u>	\$124.9

¹Henningson, Durham & Richardson Report

²20% of all other costs except land

³Black & Veatch Report

Figure 1 -12-

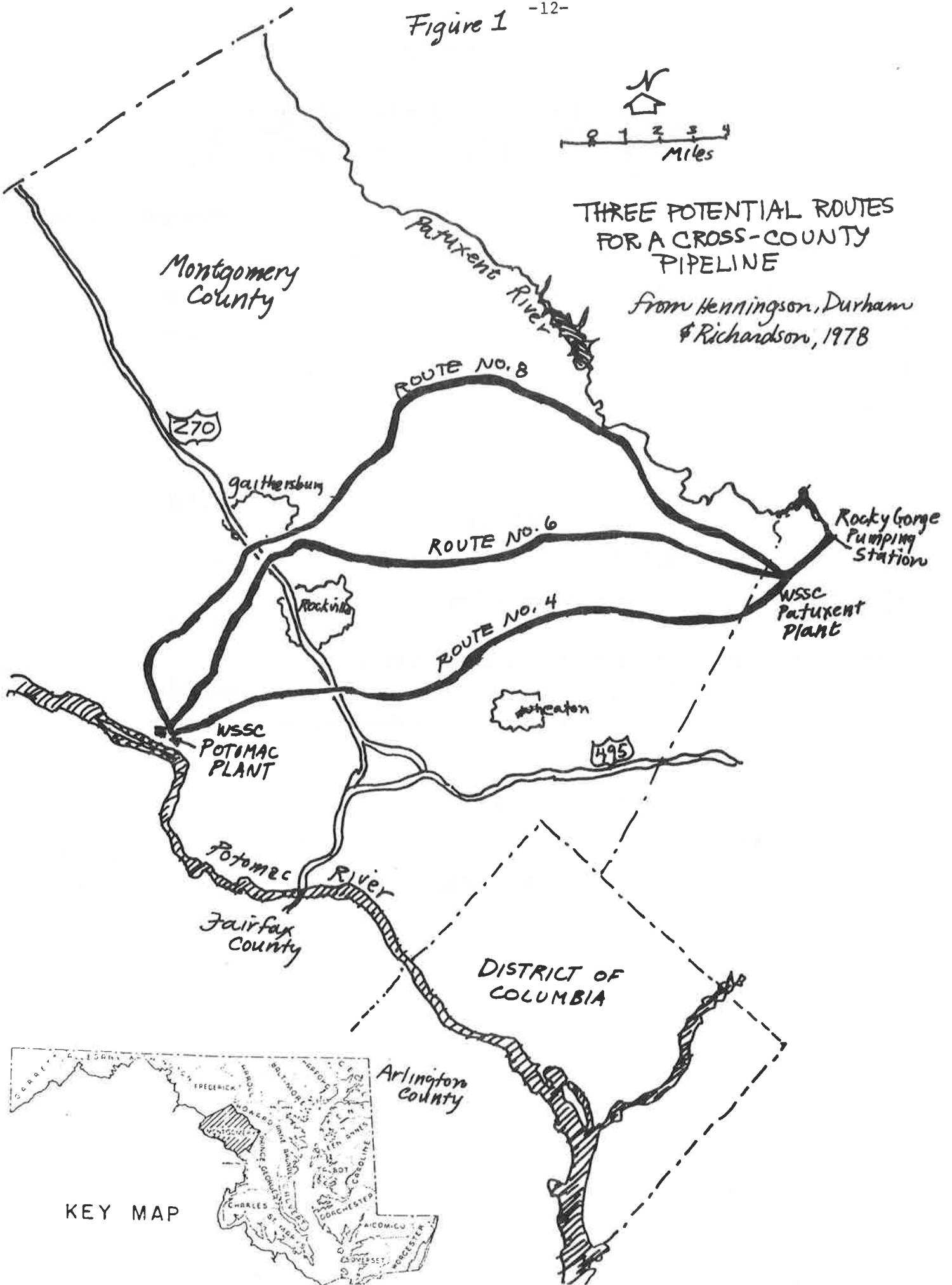
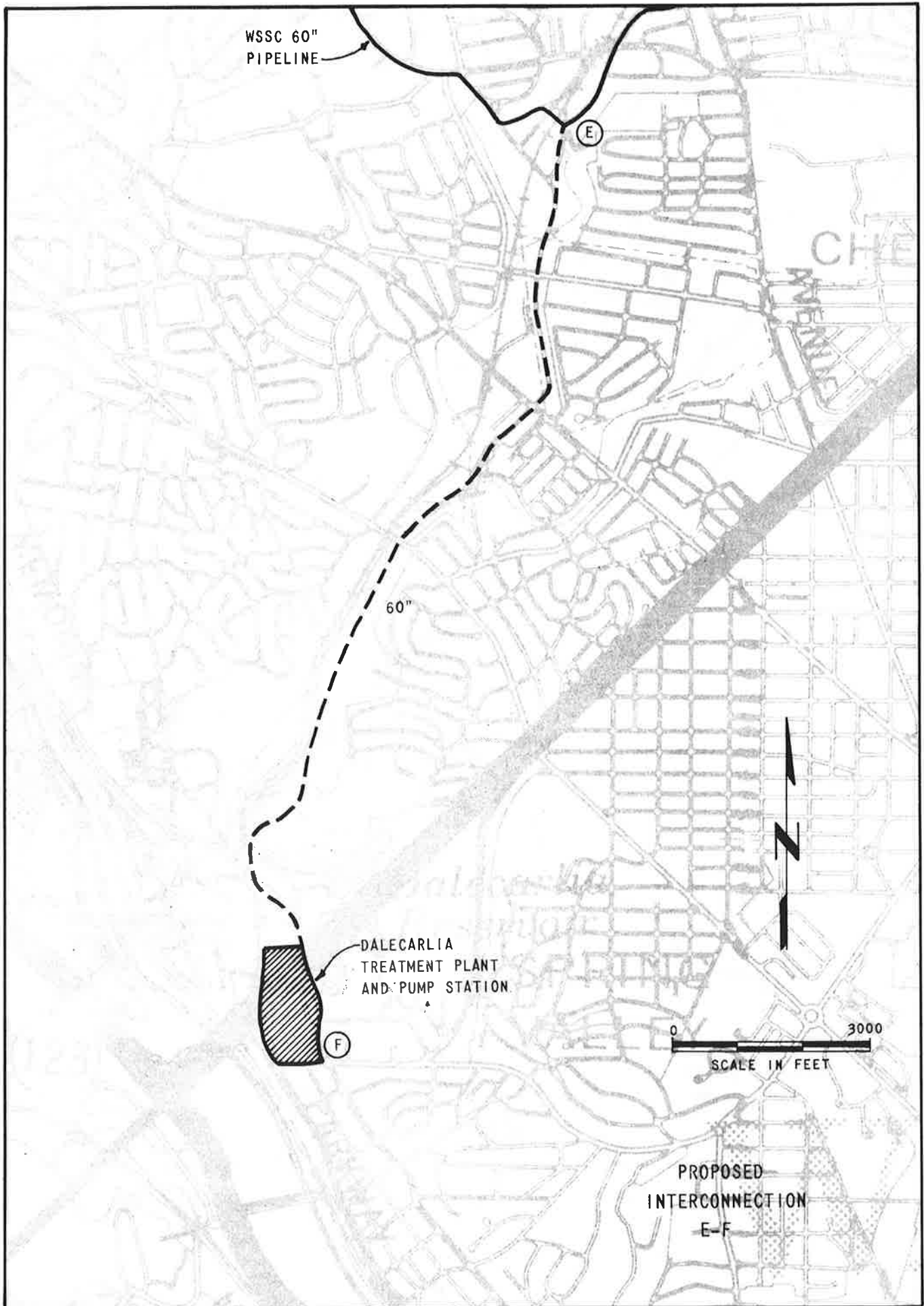


Figure 2



-14-
Figure 3

