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A COMPREHENSIVE STUDY OF THE

TOCKS ISLAND LAKE PROJECT AND ALTERNATIVES

URS/MADIGAN-PRAEGER, INC. AND CONKLIN & ROSSANT

C

ANALYSIS OF ALTERNATIVES TO SUPPLY RESOURCE NEEDS

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The purpose of this study is to help decision makers determine future water resource needs of the Delaware River Basin area and ways of meeting these needs. This report undertaken in 1975 for the U.S. Army Corps of Engineers by an independent consultant firm focuses on the indentification and evaluation of the full range of alternatives with respect to supplying water by means other than the Tocks Island Project, the recreation, electric power, flood control and other project alternatives.

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TOCKS ISLAND LAKE PROJECT AND ALTERNATIVES

JUNE 1975

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ANALYSIS OF ALTERNATIVES TO SUPPLY RESOURCE NEEDS

C

INTRODUCTION

This "Comprehensive Study of the Tocks Island Lake Project and Alternatives" is divided into five volumes or parts as follows:

A -- Analysis of Service Areas and Resource Needs

B -- Review of Tocks Island Lake Project

C -- Analysis of Alternatives to Supply Resource Needs

D -- Institutional Alternatives

E -- Land Use and Secondary Effects of the Tocks Island Lake Project

Brief descriptions of each of these five parts is contained in the Introduction in the Part A volume. Also presented in that volume is a summary of the project's background and development; a table of contents for the complete study; and listings of Study Management Team members and Consultants involved in the study effort.

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WATER SUPPLY ALTERNATIVES

XII.A. INTRODUCTION

This chapter is concerned with the identification and evaluation of the full range of alternatives with respect to supplying water by means other than the Tocks Island Project. Evaluation criteria were technical feasibility, cost effectiveness environmental soundness, public acceptability, and institutional considerations.

XII.B. EVALUATIONS OF ALTERNATIVES

The organization of the evaluation of water supply alternatives is based on the original listing of alternatives in the scope of work supplemented by those alternatives identified as being worthy of evaluation in the course of the study.

XII.B.1 GROUNDWATER

In evaluating groundwater as an alternative to the Tocks Island Project, it is important to distinguish between sources in the Delaware Basin and sources outside of the basin. A steady state pumping of groundwater within the Delaware River Basin will ultimately reduce surface water flow. Consequently a steady state groundwater withdrawal within the Delaware Basin is not a viable alternative to the Tocks Island Project.

There is a good deal more potential for groundwater development outside the Delaware Basin. The coastal plain of New Jersey and Delaware offers great possibilities for groundwater withdrawal. It has been estimated that one cubic foot per second of groundwater can be taken per square mile in the New Jersey coastal plain. There are, however, potential problems relative to groundwater withdrawals in terms of property rights, and consequently most of the suggestions for large groundwater withdrawals have been made relative to state-owned land, such as the Wharton Tract (175 sq. miles), the New Jersey Pine Barrens (2000 sq. miles) and the Lebanon State Forest (30 sq. miles).

The possibility of conveying groundwater from state-owned land has been investigated in connection with the NEWS Study. The Wharton Tract, mentioned above, was acquired to provide water supply for the Camden-Trenton area. Since present and future demands in these areas are relatively small, water could be exported advantageously to more densely populated areas of New Jersey, assuming arrangements are made to meet future demands in Southern New Jersey. Such a development was investigated based on 1 MGD - 50 ft. lift wells that would supply 200 MGD at a cost of 29 cents per thousand gallons. The water supplied would be soft with low chloride and dissolved solids concentrations but iron removal would be necessary and is included in the above estimate.

Groundwater is also a present and potential source of water in the Northern New Jersey and New York City system subareas. As indicated in Sections III.D.2 and III.D.3, the present public usage of groundwater in these subareas is 128 and 453 MGD respectively. Potential yields from groundwater sources are 134 and 5 MGD respectively. The largest single potential project is a development of the Raritan and Passaic basins that would yield 110 MGD (Table 3-35c, section III.D.2).

Groundwater development is a viable alternative to the Tocks Island Project and is included in Sections XII.C and XVI.F.1 below.

XII. B. 2 SURFACE WATER

This alternative refers to the further development of surface water sources suitable for supplying water to the water supply service area. The development of surface water sources within the Delaware River Basin is considered under sub-sections 6, 9, 13, 14 and 17 below. The development of surface water sources are identified for the Northern New Jersey and New York City System Subareas as discussed in sections III.D.2 and 3. In these sections, projects are broken down specifically into county sources, intra-subarea sources, and sources that can be developed outside of these subareas to meet water demands within the subareas.

Surface water is, therefore, a viable alternative to the Tocks Island Project and is included in the totals contained in XVI.F.1. Surface water is also included in Section XII.C, where it is disaggregated into more specific categories.

XII.B.3 WATER CONSERVING DEVICES

Water conserving devices such as water-saving toilets, shower-heads, and other appliances have been suggested as possible means of reducing water withdrawals. As discussed in Chapter III, water withdrawals are important in the New York City System and Northern New Jersey subareas but not important in the Delaware Basin itself because consumptive use is the limiting factor in the latter area. The implementation of water conserving devices can be brought about by:

1) incorporating requirements in building codes that require water conserving devices to be included in all new construction, and,
2) incorporating requirements forcing changes in the plumbing systems of existing buildings to accommodate these devices.

Policies could be imposed that would require water conserving devices to be installed in all new construction. It does not appear feasible from a public acceptance viewpoint that owners of existing buildings could be forced to replace their existing plumbing with water conserving appliances.[1]

To determine the amount of water that might be saved through the use of water conserving devices, it was assumed that if 50% of all new construction were equipped with water conserving devices, that 20 gpcd would be saved as discussed in Section III.B.1(d).

Table 3-23 in Section III.B.1(e) indicates the amount of water that could be saved through the installation of water conserving devices on 50% of the new construction for each year over the period 1985-2025. It can be seen that 35 and 14 MGD in the New York City System and Northern New Jersey Subareas, respectively, could be saved.

It is also important to point out that the use of water conserving devices in new construction is essentially a cost free alternative in that such devices (water conserving toilets, shower heads, etc.) are no more expensive than conventional fixtures.

Water conserving appliances are a viable alternative to a portion of the Tocks Island Project water supply output and are included in sections XII.C. and XVI.F.1 below.

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1 There is at least one essentially cost free water conserving device that might be somewhat implemented in existing construction. A filled bottle or brick could be placed in toilet tanks to reduce the amount of water used in each flush.

XII.B.4 DESALINIZATION

It has been suggested that by taking saline water from the ocean or the Delaware estuary and removing the salt, fresh water could be made available on a year-in-year-out basis or during periods of drought. To investigate the viability of this concept, desalting, through distillation, electrodialysis, reverse osmosis and freezing was evaluated. A brief description of each of these processes follows:

1. Distillation - Distillation is the oldest known method of desalting, and is currently the most popular process, particularly for the larger plants. Saline water is heated and then introduced into a chamber in which the pressure is maintained sufficiently low to allow the solution to boil. Some of the water flashes into vapor, resulting in a lowering of temperature of the remaining concentrated solution (brine). The brine then flows into the next chamber where the pressure is further reduced and the process is repeated. The vaporized water is condensed and cooled by heat exchange with incoming saline water. The cost of multistage flash distillation is about $0.80 per 1000 gallons of water, and does not include brine removal.

   A further development in distillation technology has been the use of vapor compression. The process generally employs one or more vertical tube evaporators. The steam produced is compressed and heated and then introduced .nto the evaporator chamber that surrounds the tubes. The steam condenses and transfers its heat to the solution, thereby promoting further boiling and producing more water. Recent proposals have recommended this multistage flash distillation process as a means of obtaining maximum process efficiency and water production. The cost per 100 gallons of water by this method is about $0.65, and does not include brine disposal.

2. <u>Electrodialysis</u> - Electrodialysis is an electrically driven membrane process which makes use of an alternating parallel array of cation and anion selective membranes. When a direct electric current is passed through the system, the cations pass through cation-permeable membranes while the anions move in the opposite direction and pass through anion-permeable membranes. This results in salt depletion in the water passing between alternate membrane pairs, while water passing through the intervening pairs is enriched. The necessary quantity of electric current, the required membrane area, and the cost of the process all depend on the amount of salt removed. Thus, electrodialysis is more economically advantageous for desalting brackish waters than sea water. The cost per 1000 gallons of water, not including brine disposal, is about $0.60.

There are a number of limitations which have restricted extensive commercialization of this particular electrodialysis process. Organic materials in naturally occuring waters cause fouling of the membranes, eventually rendering them useless. Salt concentration polarization induces precipitation of pH-sensitive salts that scale the membrane. Electrodialysis stack components have high capital and maintenance costs. Costs of the electrodialysis process are increased by the necessity of feed-water pretreatment to eliminate organics and other harmful constituents, particularly from hard water. Further research is being conducted to develop membranes with higher selectivity, longer life and lower cost. Operation at elevated temperatures is also being studied.

3. Reverse Osmosis - Reverse osmosis is a process in which the normal osmotic flow across a semi-permeable membrane has been reversed by applying a pressure to the saline water greater than its osmotic pressure. There is a transfer of water through the membrane, in contrast to the transfer of ions in the electrodialysis process, the salinity of the product water is usually reduced to only 500 ppm. It can then be blended with natural waters before being consumed. The reverse osmosis process has some important advantages: the only energy consumed is that needed to pump the salt water up to its operating pressure. The process equipment is relatively simple, operating at ambient temperatures and minimizing scale and corrosion problems. Four promising designs: plate and frame, spiral wound, and tubular,

and hollow fiber, have been developed and tested in pilot plant units. The process currently appears more applicable to the desalting of brackish waters than sea water. The cost is about $0.75 per 1000 gallons of water, not including brine disposal.

The importance of the membrane in this process necessitates the development of low - cost membranes which combine high salt rejection, high water transmission at reasonable pressure, and long life. Problems of membrane fouling and concentration polarization must also be overcome.

4. Freezing - Freezing processes have an energy advantage resulting from the direct accomplishment of the heat transfer; i.e., there are no barriers to resist heat transfer. Basically, the salt water is cooled until ice is formed. The ice is then separated from the brine and melted to yield the product water. Freezing methods produce water that contains 300 to 500 ppm of dissolved solids. Another advantage of the freezing process derives from its operation at temperatures approaching the freezing temperature in that scaling and corrosion are considerably lessened.

In the direct freezing method, the saline water is subjected to a low pressure, causing some of the water to vaporize. This in turn reduces the temperature of the brine below its freezing point and ice crystals form. The ice is then separated from the brine and melted. The most successful freezing process appears to be the vacuum freeze-vapor compression process. Ice crystals are formed as in the direct freezing method. However, the water vapor evolved is compressed and subsequently discharges to the melting unit in which the vapor condenses and the ice melts simultaneously to compose the product water. Various equipment configurations have been proposed and tested, and further developments are intended to increase the capacity and reduce the power requirements of the freezer, melter, and compressor units. The costs for this method are about $1.25 per 1000 gallons of water, not including brine disposal.

The problem of plant effluent disposal has frequently been neglected in technological development, in plant design, and in its effects on product water costs. It is becoming apparent that the future designs of desalting plants must consider the possibly harmful effects on natural features in the proximate area of the operation. Also the costs of disposal of the brine (the concentrated salt water solution left after water has been extracted) have not usually been evaluated in determining desalting cost estimates, and they may constitute a sizable share of the total cost.

At coastal plants for seawater desalting, the distillation process is most likely to be employed. Increased temperature, salinity, and heavy metals concentration (particularly copper) are likely to seriously affect marine organisms, natural shore features, and local marine ecology. Studies indicate that discharged effluents will almost certainly have a detectable impact on the local marine environment. The most critical change is in the copper concentration which may be twenty times that encountered in the open ocean. Such a composition would be toxic to many marine organisms. Recently a number of studies have been conducted to consider the advantages of building large dual purpose electric power-water desalting plants. Dual purpose plants provide reductions in the cost of energy supplied to the water plant, resulting in lower water production costs. For the distillation processes which are usually considered for large desalting plants, exhaust steam from the power plants is used to provide the process heat for the water plant. The power plant can be a nuclear or fossil-fueled facility.

Desalting is not cost effective in the water supply service area as costs range from $0.60 to $1.25 per 1000 gallons. The use of desalting plants during drought periods only, would not be economical either because while operating costs could be avoided, capital and maintenance costs would still be incurred.

Desalting, while technically feasible, is not considered to be a viable alternative to the Tocks Island Project at this time for reasons of excessive cost, high energy requirements, brine disposal problems and the lack of actual engineering, operation and cost data for large scale desalting plants.

XII.B.5 WEATHER MODIFICATION

Weather modification is an emerging technology that appears attractive because it promises water at very low costs. The major cost of weather modification is that of flying the airplane and the chemicals used to seed clouds. Previous cost estimates have been in the area of $10 per MGD in a recent study by the Temporary State Commission on the Water Supply Needs of Southeastern New York. This is only the cost of seeding the clouds, and does not allow for collection, treatment or distribution, which could be substantial.

There is also a great deal of uncertainty connected with cloud seeding, particularly in the water supply service area. The most successful cloud seeding to date has been in connection with orographic clouds in the western United States. Some success has been achieved with convective clouds, but the results cannot be reliably predicted. Cyclonic systems are the least favorable cloud types for precipitation modification. Because of seasonal shifting of the more productive cloud types, the water supply service area during summer drought periods does not attract the more productive varieties.

Weather modification before a drought, leads to two additional levels of uncertainty. One is predicting the drought and the other is the actual result of weather modification. When the unreliability of weather modification is considered along with the unreliability of predicting droughts, the total reliability of this alternative becomes quite low.

There are also considerable legal problems associated with weather modification. These problems would stem from the people in the area to be cloud seeded, as well as the people downwind from the cloud seeded area. The people downwind may consider that they are receiving diminished rainfall because of the cloud seeding activities upwind.

Because of reliability and institutional problems, weather modification is not considered a viable water supply alternative to the Tocks Island Project.

XVI.B.6 USE OF NEW YORK CITY RESERVOIRS

It has been suggested that the operation of the New York City reservoir system could be changed to enhance water supply in the Delaware Basin. Any modification of the city reservoir system that would change the present allocation of water would require a modification of the Supreme Court Decree of 1954. According to the 1954 Decree, New York City is allowed to divert up to 800 MGD for water supply purposes. As a condition of this use of the Delaware, New York City is required to release from its reservoirs, enough water to maintain a stream flow of 1,750 cfs at Montague, New Jersey. Additionally, in accordance with the "excess release" rule, the city is required to release a quantity of water equal to 83 percent of the difference between its annual water supply consumption from all sources and the "safe" yield (1,665 MGD) of its entire gravity system.

The excess release requirements tend to be counter-productive to any water conservation program employed in New York City because 83 percent of the "saved" water must be released to the Delaware Basin.

Because it appears to be infeasible to change the Supreme Court Decree and the Delaware Basin Compact, as discussed in Chapter XVII, a change in the operation of the New York City reservoir system is not considered to be a viable alternative to the Tocks Island Project.

XII.B.7 TRANS BASIN DIVERSIONS

This alternative would involve an inter-basin transfer of water as a means of enhancing supplies in the water supply area. Specific projects involving the interbasin transfer of water from the Susquehanna, Hudson and other adjacent basins have been proposed. Because each of these basins has its own in-basin demands to satisfy, it is not likely that adequate surplus water would be available for export.[1] Additionally, because of the interstate nature of many of the trans-basin projects that have been proposed, institutional problems would have to be overcome. For these reasons, trans-basin diversion is not considered as a viable alternative to the Tocks Island Project for present study purposes.

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1 The Hudson has the potential of supplying the Northern New Jersey and New York City System Subareas. Such projects listed in sections III.D.2 and III.D.3, would not technically involve a trans-basin diversion since water would not leave the Hudson Basin. The project for Northern New Jersey is considered to be a viable alternative to the Tocks Island Project and is included in Sections XII.C. and XVI.F.1 below.

XII.B.8 PRICING

XII.B.8(a) Introduction

The projections of gross water demands for municipal, domestic and industrial uses made in Section III.B.1 are predicated upon the modeling of the key components of change including the parameters of recirculation and technology and the utilization of both water consuming and conserving devices. In the development of these projections, no attempt was made to explicitly account for the price of water to the final consumer (domestic-commercial or industrial). The projections assume that the implicit changes in water price will not affect demand. This is especially true for the projections made under the "basic" case where an attempt was made to forecast demand based on conditions and factors most likely to prevail in the future. The "increased implementation" demand estimates which generally provide for the implementation of public policies that would reduce demand, implicitly assume that one of the techniques for achieving demand reduction could be through a water pricing policy.

Price as a means of managing total water demands is evaluated as an alternative to the Tocks Island Project. In the assessment to follow, price policy is related directly to the overall demand projections previously discussed wherever possible. The objective of the analysis is to determine the extent to which pricing policy may materially affect demand. It is not the purpose of this study to determine whether the broad range of equity questions involved in assuring those who benefit from the availability of water supply equitably share in the cost of its development or to determine the extent to which present water supply pricing policy in the water supply service area may be deficient in recovering costs. Rather, the thrust of the analysis and evaluation is to determine if price is likely to be a meaningful tool to control future demands.

A literature survey of previous work that relates price to water demand is made as a basis of assessing pricing formulations. Based upon these reviews, it was possible to develop several price policy concepts to determine their relevance and potential effectiveness as a tool to control and manage demand. The objective was to isolate those demand components that are most likely to be responsive to price change and would result in significant demand shifts. The final part of this section presents an evaluation of using price policy to affect industrial water demand.

XII.B.8(b) Price Consideration

As evidenced in the review of the literature, there are several important price considerations that are of interest. These range from equity questions, system operations, conservation incentives and, lastly, demand control impacts. Each of these are only briefly discussed below in order to explain their relevance or applicability to the purpose of this analysis.

Equity--

One of the major concerns that has been expressed with respect to water pricing is whether or not the beneficiaries of water supply repay the costs of those supplies through prices charged for water use. To the extent that the pricing policy of municipal purveyors reflect their long-term marginal cost for provision of water supply, it then can be argued that as a minimum the water user is paying, at least on strict financial terms, an equitable share of water supply costs. This, however, breaks down when one considers that self-supplied users, while benefiting from developments that assure adequate flow or from developments which provide additional sources such as groundwater, may incur some of the distribution costs, but do not participate in the full cost of making the source available for their use. In this instance, it can be argued that the self-supplied user should be levied a price that reflects a reasonable apportioned cost for programs for water supply development undertaken by public agencies.

While establishing a price for all beneficiaries that reflects long-term marginal cost is desirable, it is not clear that this alone would materially affect demand. The only instance where this might not be true is where it can be demonstrated that current self-supplied users are presently benefiting from major water resource development programs that assure the adequacy of their supplies.

A further thought on this question relates to the popular notion that because of its basic nature, water should be treated as an economic free good. It is felt that this approach, if broadly adopted, would clearly result in a misallocation of resources. Further, it is considered that while the current price of water may represent a relatively small portion of the domestic or industrial budget, this fact does not argue that water be treated as a free good.

System Operation--

The literature on water pricing policy appears to be concerned primarily with the effectiveness of pricing policy as a means to achieve improvement in the operations of particular municipal water supply and distribution systems. In these instances price policy is addressed to such issues as flattening peak-load demands, reducing demand during periods of drought, and to issues of scheduling or delaying capital improvements to reduce overall public and user costs in the long run.

Several investigations that address these issues, such as those undertaken by Gysi (1971,72), Hanke (1970), Gysi and Loucks (1971), Howe and Linaweaver (1967), generally conclude that there is sufficient elasticity with respect to residential demand and that the imposition of a price policy can be an effective tool to smooth out demand during peak-load periods or drought. It should be noted that the referenced investigations deal almost exclusively with the components of residential demand.

In the study undertaken by Gysi and Loucks (1971), the authors conclude that marginal cost pricing policy could have a much larger percentage effectiveness than any policy of meeting all demands at all times by always increasing capacity in advance of demand. The authors further conclude that price can play a major role in planning by delaying expansion and lowering system costs. Their suggestions would call for a combination of a summer differential plus an increased block rate structure.

In studies by Hanke (1970), and Howe and Linaweaver (1967), evidence is presented to support the contention that at least the sprinkling component of residential demand is price elastic. It is notable, however, in Hanke (1970) that the observation of price elasticity has been taken from examples where metering has been introduced and that as a result, overall residential demands were lowered and then stabilized at new levels. In the water supply service area adopted in this study (with the exception of New York City), a high proportion of residential use is already metered and it could be argued that in those areas the beneficial aspects of price policy through metering have been recorded. Howe and Linaweaver (1967) also concluded that while sprinkling demand may be price elastic, especially in the East, that domestic demands (in-house) are relatively inelastic with respect to price.

Accepting from the above referenced studies that the sprinkling portion of residential demand is elastic with respect to price, the question for the purposes of this analysis revolves around the effectiveness of capitalizing on such a price elasticity to regulate overall demand on a regional basis. Using the medium "basic" case demand projections contained in sub-section III.B.1(e) above, some interesting observations can be made. In that projection set, it is estimated that demand will rise from 395 gpcd in 1970 to 607 gpcd in the year 2025. It is further calculated that in the year 2025, of the total per capita demand including all industrial demands, sprinkling requires on the order of 24 gpcd. This represents about 4% of the demand component. Assuming that a pricing policy could result in halving that demand, the net effect would be to reduce total demand by only 2%. Because unsatisfied need is total demand minus total supply, 2% of total demand may be a relatively large percentage of the unsatisfied need.[1] In addition, this type of pricing policy might be very effective for an individual water supply system that has, at any point in time, a fixed capacity and backup system and where its demand is essentially domestic-commercial. In these cases, a price policy that could reduce the sprinkling demand would be very effective in utilizing that system's capacity over the short-run.

Conservation Incentives--

Closely related to the above concerns about system operations is the issue of imposing a price policy to stimulate awareness for conservation of water. As suggested in the studies previously referenced, the presence of price elasticity for water is a useful vehicle to highlight and impose on a non-voluntary basis, water conservation measures. Indeed, as suggested by the above analysis, it is possible to achieve reduced demand especially on the residential side through this technique. As a vehicle to make residential users more conscious of the conservation ethic, it portends as a very useful tool.

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1 On this basis, lawn sprinkling and other rationing measures were evaluated and found to be viable in Sub-section XII.B.19(b) below.

In Gysi (1972), the observation is made that depite the presence of price elasticity especially during the summer, residential water prices are relatively low and if the customer is not made aware of any price schedule modifications, he may not react too quickly to a doubling in his monthly water bill, if that bill is a small fraction of his income. If a water utility seeks to conserve supplies in this manner, the utility must be a very public orientea organization that advertises changes in price schedule and the reasons for those changes.

The achievement of conservation *per se* through price policy as well as through moral persuasion especially during drought periods, might be somewhat obtainable, but as a tool to effectively reduce total demand in the long-run in the water supply service area, it is likely to have limited impact.[1] This is further substantiated through the sensitivity analysis undertaken in making gross demand projections in sub-section III.B.1(f) above. In this sub-section, it is shown that with the imposition of a public policy regarding water conserving devices (excluding meters), that for 2025, a downward change of only 3 gpcd could be achieved.

Demand Control--

Price policy for water supply, as suggested above, has focused primarily on achieving equitable cost distribution, on achievement of short run system operations improvements, and on achievement of a measure of water

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[1] While the impact may be small in terms of alleviating year-in year-out conditions, it can be an effective means of dealing with drought shortage as indicated in Section XII.B.19 below.

conservation. The investigations have largely been bounded by the concept that price to consumers should equal long term marginal costs. At least from the standpoint of control of residential or domestic demand, while the evidence suggests that improvements can be made through price policy, these are likely to be small when viewing the water supply service area in its totality considering all demand components.

A breakdown of the projected 2025 demand for the entire region serves to illustrate this point. Under the "basic" case medium growth projection series, the overall regional demand on a per capita basis is distributed as follows:

Total	607
Domestic-Commercial	139
Industrial	468

More than three-fourths of the demand in the water supply service area is industrial and if control of overall water withdrawals is to be achieved on any substantial basis, it is the industrial sector that must be addressed. Unfortunately, there is less available evidence in this area that is sufficiently conclusive with respect to the impact of price policy on this component of demand as compared to the domestic-commercial component. Nonetheless, there is some indication of potential impacts.

In the study undertaken by DeRooy (1974) using survey data for a number of chemical manufacturing plants in Northern New Jersey during the year 1965, it was concluded that firms do adjust water demand in response to even small changes in unit cost (used here as a proxy for market price). This impact is essentially reflected in withdrawal rates. As the water required per unit of production does not change, the result is an increase in recirculation within a plant and a subsequent increase in additional plant expenditures. The significance of the findings, however, is that withdrawal rates can be potentially controlled through change in "withdrawal price" however achieved. The study further concluded that:

> "....as the cost of intake becomes greater, substitutes become more economical. The fact that many firms do not presently recirculate effluent indicates either that water is still very cheap or that industrial users (especially smaller ones) are not fully aware of the savings that could be realized..."

Despite the evidence suggested above, one of the major problems in further influencing industrial demand through price policy as it affects withdrawal, is the fact that even for heavy water using industries, water costs are a small proportion of overall production costs.

Table 12-1 presents for selected major water using industries, the estimated direct requirements for water and sanitary purposes per dollar of industry output together with similar estimates for other utility costs. As shown therein, water costs represent both a small fraction of total production costs and of total utility costs. These data were developed from 1963 Department of Commerce Input/Output Studies.

TABLE 12-1
DIRECT REQUIREMENT FOR UTILITY SERVICES FOR SELECTED WATER USING INDUSTRIES PER DOLLAR OF OUTPUT*

Industry Sector	Electric Utilities	Gas Utilities	Water & Sanitary Purposes	Total Utilities	Water as % of Total Utilities
Meat Packing Plants, Poultry Dressing Plants	.00256	.00095	.00070	.00421	16.6
Fluid Milk	.00483	.00140	.00067	.00690	9.7
Canned Fruit & Veg.	.00307	.00275	.00123	.00705	17.4
Frozen Fruit & Veg.	.00614	.00216	.00099	.00929	10.6
Breweries	.00229	.00155	.00120	.00504	23.8
Shortening & Cooking Oils	.00321	.00277	.00070	.00668	10.5
Weaving Mills-Syn., Weaving, Finishing Wool, Finishing, Cotton, Finishing, Syn.	.00744	.00132	.00079	.00955	8.3
Pulp Mills	.00616	.00791	.01202	.02609	46.0
Paper Mills	.01454	.00613	.00492	.02559	19.2
Paperboard Mills	.01210	.00943	.00489	.02642	18.5
Alkalies & Chloride, Indus. Gases, Intermed. Coal Tar, Inorganic Pigments, Organic Chemicals	.01727	.02265	.00281	.04273	6.6
Inorganic Chem.	.05801	.01663	.00029	.07493	.4
Plastic Materials	.00747	.00233	.00136	.01116	12.2
Cellulosic Man-Made Fibers	.00204	.00336	.00082	.00622	13.2
Organic Fibers-Non-Cell.	.00496	.00405	.00156	.01057	14.8
Pharmaceutical Prep.	.00366	.00068	.00026	.00460	5.6
Fertilizers	.01033	.00358	.00063	.01454	4.3

*Each column in the table shows input required by the industry named in each row from the utilities listed to produce a dollar of industry output.

Source: U. S. Dept. of Commerce Input-Output Structure of the U. S. Economy: 1963

TABLE 12-1 (Cont'd)

DIRECT REQUIREMENT FOR UTILITY SERVICES FOR SELECTED WATER USING INDUSTRIES PER DOLLAR OF OUTPUT*

Industry Sector	Electric Utilities	Gas Utilities	Water & Sanitary Purposes	Total Utilities	Water as % of Total Utilities
Petroleum Refining	.00505	.01140	.00146	.01791	8.2
Cement	.04992	.04714	.00078	.09784	.8
Blast Furnaces & Steel / Electrometal Products	.01336	.01114	.00148	.02598	5.7
Gray Iron Foundries	.01423	.00615	.00118	.02156	5.5
Primary Copper	.00357	.00480	.00046	.00883	5.2
Primary Zinc	.02053	.01679	.00201	.03933	5.1
Primary Aluminum	.05801	.01663	.00029	.07493	.4
Metal Stampings	.00600	.00190	.00089	.00879	10.1

*Each column in the table shows input required by the industry named in each row from the utilities listed to produce a dollar of industry output.
Source: U. S. Dept. of Commerce Input-Output Structure of the U. S. Economy: 1963

Based upon the fact that industrial water demand constitutes some 75% of total withdrawal requirement in the water supply service area, evidence that withdrawal rates are sensitive to changes in cost (or price), and that water costs are a relatively small proportion of total factor costs, it appears that demand control by influencing industrial water withdrawals through price policy offer a most promising prospect. This is discussed further in the concluding section of this analysis.

XII.B.3(c) Influencing Industrial Demands

As noted above, it appears that price policy could potentially influence industrial demands and currently represents the most promising of the price policy prospects for overall management and control of region-wide demands. While the available data and studies at this point in time are too limited to suggest specific policies that could quantitatively indicate the degree or costs and effectiveness of such controls, it is the purpose of this section of the analysis to indicate direction that such a policy should take. Further, at the conclusion of this section, several recommendations are made for further analysis.

The objective of a price policy or other mechanisms that would shift water costs, would be to encourage increased industrial recirculation or other technological improvements for industrial water use. Insofar as a major concern of the overall analysis of water supply relates to withdrawal rates, especially for the New York City System and Northern New Jersey subareas, price policy should directly influence those rates. Further, since one of the regional planning objectives for deriving alternatives for water supply are predicated upon maintenance of desirable levels of economic activity, any pricing policy to be pursued must be sensitive to the overall productive capacity and production costs for the major water using industries. A pricing policy that would reduce demand, but at the same time reduce output and income, is not likely to be an acceptable or viable strategy.

To a very large extent, the overall impact of current effluent controls (P.L. 92-500) provides a form of price policy for the water supply service area as well as other regions. Stevens and Kalter (1975) note the results of a survey by the American Petroleum Institute in 1967 that indicates that the degree of recirculation for the petroleum industry increased as this industry upgraded their waste treatment level. There is strong evidence to support the fact that recirculation will increase as environmental restrictions increase. This is further supported in the work of Bower (1966) who concludes that even when the cost of intake water may be low, extensive recirculation may be practiced because of effluent controls or the internal economies possible by recirculation.

Previous reference has been made in Section III.B.1 to the observation that the current recirculation rates for the major water using industries in the study region are generally below national averages. The reasons given for this are the relative age of industrial plants in the East compared to other parts of the country, the low cost and relative availability of water, and perhaps the lack of past incentive for more recirculation. If one of the major impacts of industrial water price policy is to effect recirculation rates and thereby maintain projected production and employment levels while reducing withdrawal requirements, there must necessarily be concern as to whether improvements in recirculation can be economically achieved. As an indication of what may be achievable, there is shown in Table 12-2, current recirculation rates for selected water using industries for the Middle Atlantic States in 1970 together with the highest and lowest recirculation rates for the 20 "best" plants on a national basis. This information was obtained by the Delaware River Basin Commission from the U.S. Department of Commerce.

This information tends to confirm that recirculation rates in the water supply service area are at the low end when compared to the 20 best plants nationwide and suggests that improvements over the long run are not unreasonable.

The import of the above is to suggest that there already appear to be forces at work that are likely to increase unit water costs which, in turn, will tend to initiate increased recirculation and technological improvements. Any additional incentives towards that objective through public policy affecting price or cost must build upon these forces that are already influencing water price.

One of the concerns that has been evidenced in the analysis, is the potential economic disruption that could be created as a result of increasing price through effluent controls or by other explicit price policy. This concern

TABLE 12 - 2

RECIRCULATION RATES FOR MAJOR WATER-USING
INDUSTRIES FOR MIDDLE ATLANTIC STATES AND SELECTED PLANTS NATIONWIDE
1970

Standard Industrial Classification		Middle Atlantic States		National "20 Best" Recirculation Rates	
Code	Name	Number of Plants	Recirculation Rate	Highest	Lowest
2011	Meat Packing Plants	13	1.02	7.05	1.85
2015	Poultry Dressing Plants	25	1.01	4.28	1.14
2026	Fluid Milk	49	1.18	71.71	3.96
2033	Canned Fruit & Veg.	37	1.15	18.24	1.76
2037	Frozen Fruit & Veg.	16	1.16	7.81	1.39
2082	Breweries	20	2.33	10.00	1.11
2096	Shortening and Cooking Oils	6	2.77	113.53	1.30
2221	Weaving Mills-Synthetics	5	1.04	558.25	48.53
2231	Weaving, Finishing-Wool	7	1.00	93.44	1.18
2261	Finishing-Cotton	7	1.04	2.13	1.12
2262	Finishing-Synthetics	4	1.00	2.78	1.67
2611	Pulp Mills	6	1.00	7.57	2.10
2621	Paper Mills	47	2.30	76.54	6.06
2631	Paperboard Mills	23	4.32	172.21	8.22
2812	Alkalies and Chloride	--	3.99	25.11	1.10
2813	Industrial Gases	17	1.12	157.83	46.23
2815	Intermediate Coal Tar	22	2.54	160.00	2.24
2816	Inorganic Pigments	9	1.44	15.22	1.11
2818	Organic Chemicals	44	1.30	48.18	15.80
2819	Inorganic Chemicals	28	1.06	70.95	23.81
2321	Plastic Materials	29	1.48	613.63	13.81

TABLE 12 - 2 (Con't)

RECIRCULATION RATES FOR MAJOR WATER-USING
INDUSTRIES FOR MIDDLE ATLANTIC STATES AND SELECTED PLANTS NATIONWIDE
1970

Standard Industrial Classification		Middle Atlantic States		National "20 Best" Recirculation Rates	
Code	Name	Number of Plants	Recirculation Rate	Highest	Lowest
2823	Cellulosic Man-Made Fibers	--	2.29	20.83	1.37
2824	Organic Fibers, Non-Cell.	--	1.15	28.06	1.16
2834	Pharmaceutical Prep.	30	4.88	104.73	1.11
2871	Fertilizers	5	2.07	90.60	2.25
2911	Petroleum Refining	24	2.20	251.05	34.36
3241	Cement	22	1.10	97.35	1.77
3312	Blast Furnaces and Steel	56	1.42	95.13	6.76
3313	Electrometal Products	4	1.38	65.81	5.07
3321	Gray Iron Foundries	12	2.74	15.23	1.82
3331	Primary Copper	5	1.59	6.41	1.18
3333	Primary Zinc	--	1.30	1.40	1.14
3334	Primary Aluminum	--	1.00	10.10	1.66
3461	Metal Stampings	19	2.84	22.51	1.10

has been manifested in terms of potential locational shifts of current industries and the prospect that expansions to present industry and new locations for future industry would be limited by the imposition of these costs. While this is a very legitimate concern, there is some evidence to suggest that this concern should be balanced by the fact that water costs are relatively low in proportion to total production costs and further, that industrial locations, even for major water using industries, appear to be driven more by transportation, markets, and labor costs. The imposition of effluent controls on a nationwide basis would also tend to narrow water use cost differentials on a regional basis.

In terms of application of pricing policy for this region, it will be necessary to address the very real question of how the public sector can further influence price for the majority of industrial use that is self-supplied. In these cases, the States would have to consider some form of intake charge or effluent charge to influence total demand.[1]

Because the industrial demands so dominate the total demand picture and are so sensitive to recirculation and technology changes, there is a very clear need to further explore in depth the major water using industries in the region with respect to the following:

- Present recirculation rates and potential improvements in recirculation and technology under specified costs.
- Industry perception of sources and costs for satisfying future water supply needs.
- Industry plans for achieving effluent controls.

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1 The DRBC has implemented a pricing policy based on consumptive withdrawals in the Delaware Basin. While it may be desirable to review this policy in light of Section III.E., it does represent an initial step in regulating water withdrawals.

- Industry options for future expansion and new locations in the region
- Industry response to incentives for achieving higher recirculation rates.

In particular, it would be useful to obtain the information identified above from both the chemical and petroleum industries since the magnitude and sensitivity of their demands to recirculation and price are likely to be very significant.

The overall effort in the above analysis has been to identify potential areas where price policy could affect, on a region-wide basis, total water demands. Based on the analysis, the best prospects appear in the industrial sector and, in particular, the chemical and petroleum industries.

It is important to recognize, however, that the large water using industries are largely self-supplied and under Scenario 3 discussed in subsection III.D.5(b) will continue to remain largely self-supplied.[1] A pricing plan would reduce water demands on public systems to the extent to which reduction in industrial demand for industries which could use both public and private sources will cause them to shift to self-supplied water and thus enhance the relative supply-demand balance of public systems. Because the foregoing relationships are not entirely known at this point, it is not appropriate to consider pricing as a viable alternative for present study purposes. Upon the collection of necessary data and further evaluation of the relationship between self-supplied industrial and publicly supplied water sources, the potential for pricing as a means of enhancing the overall supply-demand balance can be better established.

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1 It may be recalled that Scenario ? is believed to be the most reasonable scenario that can be developed with presently available data.

XII.B.9 RESERVOIRS ON THE TRIBUTARIES

XII.B.9(a) Selection of Sites

The Delaware River Basin was examined to identify suitable reservoir sites on tributaries. Several hundred major impoundment or development sites within the Delaware River Basin were reviewed by the Corps of Engineers as described in their comprehensive study of the Delaware River (U.S. C. of E., 1962, vol. IX). These sites were reduced to 70 and then to 48 with their order of merit identified for 1) comprehensive development, 2) development of long-term storage only (water supply), and 3) development of short-term storage only (flood control). This C. of E. screening process was reviewed and additional sites were investigated.[1]

Circumstances over the past 25 years such as real estate and park site development have affected many potential impoundment sites. These developments have precluded the use of some of the sites entirely or greatly increased the cost of the sites suitable for water supply purposes.

Consideration was given to available storage and the amount of drainage area intercepted. All potential projects intercepting a drainage area of less than 50 square miles were eliminated as not being economical. The sites were next evaluated according to environmental criteria. Contact was made with state agencies concerned with environmental affairs in Pennsylvania, New Jersey and New York to establish the environmental attributes of

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[1] State agencies particularly in New Jersey and Pennsylvania were also contacted to learn of state inventories of reservoir sites.

specific sites. Those sites that were located in the most environmentally sensitive areas were eliminated from further consideration.

The final selection of a system of reservoirs was made so as to provide a yield of 332 MGD, roughly equivalent to the proposed 300 MGD water supply diversion from Tocks Island. Section III.E.2 indicates that additional low-flow augmentation is not needed for the control of salinity intrusion in the estuary although alternative means of protecting the water supply systems of Philadelphia and Camden are addressed in sub-section 20 below. Should significant compensatory releases be required however, the above 332 MGD yield could not be fully realized.

The selection was also based upon the use of multi-purpose dams where feasible. After successive screening as discussed above, remaining project sites considered viable are as follows:

Project	Drainage Area (sq.mi.)	Purpose*	Water Supply Storage (Ac.Ft.)	Flood Control Storage (Ac.Ft.)	"Safe" Yield (MGD)
Hackettstown	70	ws	26,600	--	24
McMichael	63	ws,fc	19,500	25,500	17
Shohola Falls	59	ws,fc	18,000	24,000	16
Girard	58	ws,fc	18,000	24,000	16
Tobyhanna	224	ws	86,700	--	77
Hawley	80	ws,fc	28,000	31,700	25
Lackawaxen	595	ws	176,000	--	157
TOTAL	1,149		372,800	105,200	332

* ws - water supply, fc - flood control

the total cost of constructing the above system of 7 reservoirs is estimated at $288.3 million. This includes first cost plus interest during construction.

The project costs were escalated from the costs presented by the U. S. C. of E. (1962, vol. IX., Table Q-13). Based upon the Engineering News Record Construction Cost Index, a ratio of 2.26 was used to determine the January 1, 1975 costs. The average unit annual cost of 1000 gallons would thus be 16 cents. The needs for water supply would be satisfied by these reservoirs and the construction schedule could be timed in accordance to actual needs. The costs would then be distributed over a number of years.

Reservoirs on the tributaries are considered to be a viable alternative to the Tocks Island Project and are included in the alternative program formulation in Chapter XVI. They are also summarized in section XII.C. below. Six of the seven foregoing reservoir sites are located in Pennsylvania. As outlined in Chapter III, much of the possible need for future water supply is in the northern New Jersey subarea. Thus the development of the foregoing sites for water to be consumed in other states may contribute to some institutional concerns that, in turn, may affect the practicality of actually developing these sites.

XII.B.9 (b) Description of Sites

Hackettstown -- This site is located on the Musconetcong River in Warren and Morris Counties, New Jersey, about 30 miles above the junction of this river with the Delaware River. The contributing drainage area is 70 square miles.

McMichael -- This site is located on McMichael Creek in Monroe County, Pennsylvania, about 8 miles above the junction of this creek with the Delaware River. The contributing drainage area is 63 square miles.

Shohola Falls -- This site is located on Shohola Creek in Pike County, Pennsylvania, about 5 miles above the junction of this creek with the Delaware River. The contributing drainage area is 59 square miles.

Girard -- This site is located on Bushkill Creek in Monroe County, Pennsylvania, about 10 miles above the junction of this creek with the Delaware River. The contributing drainage area is 58 square miles.

Lackawaxen -- This site is located on Lackawaxen River in Pike County, Pennsylvania about 2 miles above the junction of this river with the Delaware River. The contributing drainage area is 595 square miles.

Tobyhanna -- This site is located on the Lehigh River in Carbon County, Pennsylvania, about 1 mile below the junction of this river with the Tobyhanna Creek. The contributing drainage area is 224 square miles.[1]

Hawley -- This site is located on Middle Creek in Wayne County, Pennsylvania, about 7 miles above the junction of this creek with the Lackawaxen River. The contributing drainage area is 80 square miles.

XII.B.10 WATER RECYCLING

Water recirculation along with wastewater reclamation and water reuse have been suggested by many as means by which overall water supplies may be increased while at the same time reducing wastewater discharges to receiving waters. In order to clarify the subsequent discussion, these terms are defined as follows:

1. Water reuse. This term is used in the context of this study to refer to water withdrawn from a surface or groundwater source, its use and its return to the surface or groundwater environment where it is subsequently withdrawn by another user.
2. Water recirculation. In the context of this study, this term is used to mean the repeated use of water or wastewater within a given industry. It refers to water initially withdrawn from a surface or groundwater source, its use for a given industrial purpose, its treat-

[1] Tobyhanna may be in possible drainage area conflict with the Francis E. Walter Reservoir, in which case, alternative sites could be either Sterling on Wallenpaupack Creek in Pennsylvania, or New Hampton on the Musconetcong River in New Jersey.

ment if necessary, and its use again for the same or different purpose but within the same industrial facility. Withdrawals can be circulated a number of times before discharge and it is possible to have a "closed cycle" system where water is added to the system only as necessary to make up for losses. Recirculation is discussed in more detail in the "Data for Increased Recirculation and Technological Change" section of Subsection III.B.1(d).

3. Wastewater reclamation. Wastewater reclamation in the context of this report refers to the direct use of a given user's wastewater by another user. For example, it could refer to the use of municipal wastewater by farmers for crop irrigation.

Each of the three categories of water recycling were investigated as to their viability as alternatives to the Tocks Island Project as follows:

1. Water reuse. It was found that the reuse of water in the Raritan and Passaic River Basins in the Northern New Jersey Subarea in the amount of 180 MGD is a viable alternative to the Tocks Island Project. This alternative is listed in Table 3-35c in Section III.D.2 and is included in the list of viable alternatives in Section XII.C and XVI.F.1 below.

2. Water recirculation. Industrial recirculation was considered in some detail in terms of its potential for reducing water demands in the water supply service area. Table 3-23 in subsection III.B.1(e) lists that demand reduction that could result from the imposition of policies by government requiring increased recirculation by industry.[1]

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[1] It is important to point out that a certain amount of increased recirculation can be expected without the imposition of policies by government. This amount is included in the "basic" demand projections in Table 3-19a Subsection III.B.1(e) above.

While the amounts shown are substantial, it must be realized that not all of the demand reduction identified in Table 3-23 is important relative to the issue of that portion of water demand that will have to be supplied by public systems in the year 2025. It will be recalled from subsection III.D.5(b) that under Scenario 3, industry will remain largely self-supplied in the year 2025, particularly the large water-using industries such as chemicals and petroleum. Nonetheless, it is possible to estimate the demand reduction that would be realized by public systems in the year 2025 through the imposition of policies by government requiring increased industrial recirculation in accordance with the "increased implementation" assumptions discussed in subsections III.B.1(a) and (e). The amount is determined by allocating the amounts in Table 3-23 in accordance with Table 3-40b in subsection III.D.5(a) (non-cooling water demand allocated to public systems in accordance with Scenario 3). The demand reduction relative to public systems on an industry-by-industry basis is as follows:

1.	Food	16 MGD
2.	Textile	2
3.	Paper	34
4.	Chemical	290
5.	Petroleum	35
6.	Primary Metals	7
		384 MGD

It is important to recognize that the above quantities are dependent on a double assumption. The first assumption is that Scenario 3 holds, and the second is that the imposition of policies by government requiring industry to increase recirculation could be implemented. Additionally, it is important to point out that the cost necessary to achieve the indicated recirculation is unknown at this time. Because of these three points, it is not possible to identify recirculation as a viable alternative to the Tocks Island Project. This alternative does, however, merit considerable additional evaluation because the potential demand reduction is considerable.

3. Wastewater reclamation. The greatest application of the wastewater reclamation concept has been in the arid West, where municipal wastewater effluents are used for agricultural purposes. There has been some industrial application such as in Baltimore where the Fairless Works of the United States Steel Corporation uses wastewater effleunt from the City of Baltimore wastewater treatment plant. There are other more limited applications of reclaimed wastewater such as for golf course and landscape watering but, by far the largest possibilities lie with large agricultural and industrial users. The application of reclaimed wastewater in the Northern New Jersey Subarea is limited because of the low level of agricultural and industrial demand potential for reclaimed wastewater. For this reason, wastewater reclamation cannot be considered to be a viable alternative to the Tocks Island Project.

XII.B.11 CONDENSERS

This proposed alternative refers to the use of equipment that would condense water from a moisture laden atmosphere. This proposal is not considered feasible because the technology does not exist to permit adequate quantities of water to be produced at a reasonable cost. This proposal is, therefore, not considered to be a viable alternative to the Tocks Island Lake Project.

XII.B.12 INSURANCE SCHEME

It has been suggested that the implementation of an insurance plan that would compensate those who suffer as a result of droughts could be an alternative to the Tocks Island Lake Project. Similar programs already are in existence, such as the flood insurance program This alternative was evaluated in terms of some of the mathematical aspects which would be necessary to resolve in order for this scheme to be considered a viable alternative. The mathematical evaluation, particularly o. the probabilistic aspects, is contained in Appendix A.

In considering an insurance policy as an alternative to the Tocks Island Lake Project, it is important to recognize that any insurance scheme, in an economic sense, is essentially a transfer payment scheme. Any insurance scheme may ignore the possible efficiency that would result if measures are taken to eliminate or reduce the likelihood of the event for which the insurance is designed. Thus, while it may be possible to develop an insurance scheme that would compensate those who suffer during periods of drought and thus eliminate the need for measures to provide water, it may not be economically efficient to do so.

It is also important to recognize that while a flood insurance scheme has been implemented in large portions of the United States, such a scheme is inherently more workable because it is much easier to quantify damages that result from floods than it would be to quantify such damages resulting from droughts.

Flood damages are obviously physical, and physical damages respresent a high percentage of the total damages that can be considered to stem from floods. Drought damages, on the other hand, are much less quantifiable and it is more likely that the intangible and therefore unquantifiable damages are a high percentage of total damages.

While an insurance scheme is worthy of further evaluation, it is not in itself an alternative to the Tocks Island Lake Project in that a commitment to programmed water shortage, i.e., rationing, must first be made. Rationing is evaluated in Section XII.B.19, below.

XII.B.13 OTHER LOCATIONS ON THE MAINSTEM

This alternative refers to the possibility of locating a mainstem reservoir somewhere other than at the Tocks Island site. The Corps of Engineers has completed extensive studies throughout the Delaware River Basin and has subsequently abandoned the original mainstem site at Wallpack Bend in favor of the Tocks Island site because of more favorable geological and environmental conditions at the latter site.

More importantly, the location of a mainstem reservoir at a site other than Tocks Island would involve the same type of environmental problems, such as the impairment of a free-flowing Delaware River. The location of a reservoir at a site other than Tocks Island is, therefore, not considered to be a viable alternative to the Tocks Island Project.

XII.B.14 RESERVOIR WITHIN THE DELAWARE RIVER

It has been suggested that a reservoir could be formed by a three-sided concrete dam located in the middle of the Delaware River. The front section of the dam would extend one-third of the distance across the river and the two side sections would extend northward within the river to a point upstream where the water impounded within the dam would equal the water supply storage of the proposed Tocks Island reservoir, or approximately 400,000 acre-feet. The purpose of such a configuration would be to provide for a dam, while at the same time allow for a free-flowing Delaware River (i.e., the main flow of the river would be allowed to flow around the dam). However, in order to provide the same storage capacity as would be provided by the Tocks Island reservoir, the walls of the dam would have to be unreasonably high. This alternative would thus not be a viable one to the Tocks Island Lake Project.

XII.B.15 LEAKAGE CONTROL

The amount of water lost through leakage in public water supply systems varies widely from place to place and only a few systems have been evaluated adequately to establish the amount lost through leakage. In those cities that have an unusually high percentage of leakage, say on the order of 20 percent, it might be possible to reduce such leakage to the order of 10 percent. It is important to recognize that it would never be possible to eliminate all leakage in any water system due to normal maintenance problems, but only possible to eliminate gross leakage problems and thus reduce the amount of water lost to manageable levels.

It has been estimated by the Temporary State Commission on the Water Supply Needs of Southeastern New York that a leakage control program in the City of New York might save in the order of 150 MGD. Other cities in the New York City System and Northern New Jersey subareas have not been evaluated adequately to determine the amount of water loss through leakage, although it is likely that the amounts lost are not high (i.e., not over 5-10 percent).

In evaluating the amounts of water that could be saved through a leakage control program in the City of New York, it is important to recognize that even if such leakage were controlled, it would not alter the City of New York's right to divert 800 MGD from the Delaware River Basin. A leakage control program would also not alter the need for water to be imported to the New York City System Subarea by the year 2025, even under Scenario 3, as discussed in Chapter III, Section D.5(b). Under Scenario 3, which implies a high level of self-supply for industry and a corresponding lower level water supply requirement for public systems, it would still be necessary to import water to the subarea by the year 2025. Consequently, a leakage control program would only displace 150 MGD of the requirement for imported water to the subarea. Leakage control is not considered as a viable alternative to the Tocks Island Project.

XII.B.16 METERING OF NEW YORK CITY WATER SYSTEM

The demand reduction that could be obtained through the implementation of a metering program for the City of New York is outlined in Table 3-23 in Section III.B.1(e). Table 3-23 indicates that 151 MGD could be saved by the year 2025 through a metering program. As discussed in the previous subsection, the implementation of any program that results in the reduction in demand, such as a metering program, would not change the right of the City of New York to divert 800 MGD from the Delaware River Basin.

It has been suggested in connection with both metering and leakage control programs for the City of New York, that while such programs would not alter the right of the City of New York to divert 800 MGD, it would help during periods of emergency when the city cannot divert 800 MGD and also meet its 1750 cfs flow maintenance requirement at Montague. While, in theory, it would appear that the completion of metering and leakage control prior to periods of drought emergency would be beneficial, it is important to recognize that only supplies of water needed to maintain a reasonably reliable balance between supply and demand will be developed by the City of New York. Consequently, a metering and leakage control program would not really help the overall supply-demand balance because, as discussed in the previous subsection, it would simply reduce the requirement for imported water from outside the New York City System Subarea, not eliminate it.

Possible sources of water for the New York City System Subarea are delineated in Section III.D.3. It can be seen that all but 20 MGD would be developed through a high flow skimming scheme on the Hudson River in the amount of 1575 MGD. Consequently, whether 1575 MGD is developed from this source without a leakage or metering program or whether 1275 MGD (1575 MGD minus the 300 MGD that might be saved through a leakage control and metering program) is developed, it is likely to make little difference as to the size of the required works.

Because the City of New York is entitled to divert 800 MGD, and will divert this amount from time to time, and because the implementation of a metering and leakage control program is not likely to affect the overall balance between supply and demand for the city, metering is not considered as a viable alternative to the Tocks Island Project.

XII.B.17 HIGH-FLOW SKIMMING

High-flow skimming has been suggested by many as an alternative to the Tocks Island Project. High-flow skimming involves the pumping of water from a river during high flow periods to an offsite reservoir. A number of locations for high-flow skimming were considered and past work such as Freeman and Schmid (1973), TAMS (1972) and Disko (1973) were reviewed relative to the possible application of the concept in the Delaware Basin.

High-Flow Skimming to Reservoirs Outside the Delaware Basin --

1. Round Valley. Various schemes have suggested that Round Valley Reservoir could receive high flows skimmed from the Delaware River via a pumping station at Frenchtown. Round Valley Reservoir, along with several existing and proposed adjacent reservoirs, is already formulated as a high-flow skimming reservoir,

but with flows from the Raritan rather than the Delaware. The configuration that would provide the greatest yield is as follows:

Round Valley (existing yield)		52.2 MGD
Round Valley outlet modification (Item 1a, Table 3-35c *)		80.0
Round Valley increase in dike and dam height (Item 1b, Table 3-35c *)		27.0
Spruce Run (existing yield)		27.8
Raritan Confluence Reservoir/Pumping Station (Item 8, Table 3-35c *)		50.0
	TOTAL	237.0 MGD

* Table 3-35c can be found in Section III.D.2

While the greatest potential for high-flow skimming at Round Valley is fulfilled by Raritan River flows, it would be possible to gain an additional "safe" yield of about 40 MGD by skimming flow from the Delaware during high flow periods.[1] While recreational use of Spruce Run Reservoir would be eliminated by Delaware high-flow skimming into Round Valley, the Raritan and Delaware high-flow skimming schemes are considered as viable alternatives to the Tocks Island Project and are in-

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1 Round Valley could also hold an approximate additional 100 MGD skimming from non-high Delaware River flows.

cluded in Sections XII.C and XVI.F.1 below.

High-Flow Skimming to Reservoirs Within the Delaware Basin --

1. Flat Brook. The Flat Brook site has a drainage area of 65 square miles, which could provide 22,500 acre-feet of water supply, or an equivalent "safe" yield of 20 MGD. Flat Brook Reservoir would have a maximum storage capacity of 248,000 acre-feet and a 220 MGD "safe" yield if high-flow skimming of the Delaware River is used to supplement the natural tributary flows.
The Flat Brook reservoir could be a single purpose water supply reservoir with a water surface elevation of 520 ft., and a 400 MGD pumping station at Flat Brook. The total cost of the project reservoir and pumping station would be $95,467,000, and amortization, operation and maintenance annual costs would be $7,671,000. Because of the particularly good environmental attributes of the Flat Brook site (according to many, it is the best trout stream in the Delaware Basin), high-flow skimming at Flat Brook is not considered to be a viable alternative to the Tocks Island Project.

2. Equinunk. Equinunk and Milanville, discussed below, should be considered together since it is unlikely

that sufficient river flow for both would be available. However, with the requirement for a minimum discharge of 1750 cfs for the City of New York at Montague there is little likelihood that reservoirs upstream from Montague are feasible because they might effectively relieve the city of required releases from their reservoirs.

Equinunk is located on Equinunk Creek adjacent to its confluence with the Delaware River. Equinunk would have a water supply yield of 32 MGD from its drainage area of 59 sq. miles, or 245 MGD by pumping the Delaware River. The cost for 1000 gallons of water would be 16 cents.

3. Milanville. Milanville is located on the confluence of the North and South Branches of Calkins Creek, off the Delaware River, and would have a water supply of 26 MGD from its drainage area of 13.3 sq, miles, or 275 MGD based upon pumping from the Delaware River. The cost per 1000 gallons of water would be 16 cents.

4. Pidcock Creek. The Pidcock reservoir would be located off the Delaware River at the confluence of Pidcock Creek. The water supply yield of Pidcock Creek reservoir would be 180 MGD from pumping the Delaware River.

The cost of the water supply would be 18 cents per 1000 gallons.

5. Cherry Creek. Cherry Creek reservoir, in Monroe County, Pennsylvania would use the Delaware (Alternative A, summarized below) or Broadhead Creek (Alternative B) as a water source. The hydrology for both alternatives are as follows:

	Alternative A		Alternative B	
	Cherry Creek	Delaware River	Cherry Creek	Broadhead Creek
Drainage area - square miles	18.8	3900	18.8	259
"Safe" yield - MGD	516		149	
Water supply storage - acre-feet	430,000		92,000	
Pump capacity - MGD	1800		516	

The total cost for each alternative, including land, relocations, dam, spillway, outlet, pump station and tunnel, and engineering is estimated as $141,000,000 for Alternative A and $51,900,000 for Alternative B.

Because of cost considerations or location above the Montague gage of sites 2 through 5 listed above, only site 5 (Cherry Creek) is considered to be a viable alternative to the Tocks Island Project. It is included in Sections XII.C and XVI.F.1 below.

XII.B.18 EMERGENCY PUMPING FROM THE HUDSON RIVER

It has been suggested that the existing pumping plant of the City of New York located at Chelsea on the Hudson River could be enlarged to pump additional water into the New York City System during periods of drought. It has been suggested that this would reduce the need for the city to draw from the Delaware Basin and thereby enhance water supply in the Basin during such periods. As discussed in subsections 15 and 16 above, any measures affecting water supply in the New York City System Subarea will not affect the right of the city to divert 800 MGD nor is it likely to materially affect the overall balance between supply and demand over the future. For these reasons, emergency pumping from the Hudson is not considered to be a viable alternative to the Tocks Island Project.

XII.B.19 RATIONING

XII.B.19(a) Increased Frequency of Rationing

Rationing has been suggested as a means of effectively reducing demand by not providing supply equal to demand. In considering rationing as an alternative to the Tocks Island Project, it is important to recognize that even if the 2025 water demands in the water supply service area were programmed to be met with a "safe" yield equivalent to the demand, it would still be necessary to ration if a drought occurred that was somewhat more severe than the drought of the early 1960's. This point gets to the heart of the false meaning of the "safe" yield concept in that there is truly no yield that is "safe" when yields are dependent upon random hydrologic events such as rainfall. Because it is extremely expensive to construct engineering works capable of providing for the maximum conceivable droughts, such works are designed to provide for a lesser drought, usually the drought of record. Consequently, the important decision is not whether to ration, but how frequently to ration and specifically if rationing might be acceptable on a more frequent basis than is implied by providing a "safe" yield supply equivalent to total demand.

Important to the question of how frequently to ration is the amount of demand reduction that could be realized if a less severe drought is provided for. The "safe" yield for both existing and potential projects, as listed in Section III.D above, is determined on the basis of the drought of the early 1960's which is generally the drought of record in the Northeast. This drought has been estimated by many investigators as having a return interval of several hundred years.

For the purposes of discussion, it is possible to estimate the reduction in water supply requirements that would be implicit in providing for a 100-year drought recurrence frequency rather than the drought of the early 1960's. As discussed in more detail in Section III.D.5(d), the yield of present and future projects could be conservatively increased by an estimated 5%, if they were recalculated to reflect a drought that would occur on the average of once in every 100 years.

The amount of water that would become available on this basis depends upon the economic growth level. This is because a higher growth level requires a greater implementation of projects in the future than a lower growth level, and consequently the amount of additional yield for a 100-year drought frequency would be larger (5% of a larger required supply). By the same token, the additional yield would be smaller for a lower growth level. For the Northern New Jersey Subarea medium growth level in the year 2025, an approximate 56 MGD demand reduction increased/yield could be realized if a 100-year drought frequency were provided for rather than the drought of the early 1960's.[1] The implications of this, of course, are that if a slightly worse drought, say a drought that would occur on the average of once every 110 years did occur, it would then be necessary to ration, whereas it would not be necessary to do so if the drought of the early 1960's were provided for.

XII.B.1(...) Demand Reduction Through Restrictions on Water Use

Related to the acceptance of an increased frequency of rationing is the concept of programmed water supply shortfalls. For example, instead of implementing projects that would have a yield adequate to provide for the drought of the early 1960's, a 100-year drought, or other design drought, projects would be implemented to meet less than the demand. Thus, even for the design drought it would be necessary to ration, much as was done during the drought of the early 1960's in the Northeast.

A considerable amount of operating experience was obtained relative to

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1 For low and high growth levels, 48 and 73 MGD would be available respectively.

rationing during this drought. Russell, et al (1970) provide a substantial amount of information concerning operating experience in Massachusetts. Operating experience in the water supply service area, particularly the Northern New Jersey Subarea, was reviewed. During the drought, an executive order was issued by the Governor of New Jersey that banned all lawn sprinkling. This measure resulted in substantial demand reduction. The executive order, while dealing specifically with sprinkling, had a secondary effect in that other consumption, such as car washing and general domestic use was reduced. The executive order resulted in a demand reduction in one part of New Jersey of 28 MGD (from 332 MGD to 306 MGD) for 1966, representing an annual average demand reduction of about eight percent.

Operating personnel who observed the effectiveness of the executive order during the drought of the early 1960's believe that it would be reasonable to expect that a three percent reduction in 2025 demand to be supplied by public systems would be achievable. It is furthermore believed that this amount is conservative. Under the assumption of Scenario 3, as discussed in Subsection III.D.5(b), the 2025 demand on public water systems would be 1635 MGD; three percent of this amount is approximately 50 MGD.[1]

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[1] Table 3-23 in Subsection III.B.1(e), indicates that 90 MGD could be saved in the Northern New Jersey Subarea in the year 2025 by reducing lawn sprinkling. The assumption regarding a reduction in lawn sprinkling in the "increased implementation" case displayed in Table 3-23, was that lawn sprinkling would be reduced by 50%. This is a realistic goal for the "increased implementation" case. However, in evaluating likely demand reductions it is prudent to take a more conservative approach and use a lower number and 50 MGD was, therefore, adopted in this chapter.

It is important to consider public tolerance relative to an enforced rationing of this nature and it is believed that if such an order occurred only on the average of once every hundred years, it would likely meet with public acceptance. It could thus be expected that public cooperation would be forthcoming as it was during the drought of the early 1960's, thus permitting the demand reduction to be achieved.

XII.B.19(c) Evaluation of the Viability of Rationing

Increasing the frequency of rationing from once every several hundred years to somewhat in excess of once every 100 years is considered to be a viable alternative to a portion of the Tocks Island Project water supply output. Demand reduction through restrictions on water use during periods of drought that would occur on the average of once every 100 years is also considered to be a viable alternative to a portion of the Tocks Island Project water supply output.

Both alternatives have the advantage in that they are essentially cost free means, insofar as public expenditures are concerned, of meeting unsatisfied water supply needs. While there may be a measure of public inconvenience associated with rationing, employment would not be significantly affected because the demand reduction identified in Subsections (a) and (b) above was almost entirely taken from the residential rather than the industrial component of supply and demand.

XII.B.20 PROTECTION OF PHILADELPHIA AND CAMDEN WATER SYSTEMS

It has been suggested that means of protecting the Philadelphia and Camden water supply systems from salt water intrusion during low flow conditions on the Delaware is an alternative to the 333 MGD low flow augmentation component of the Tocks Island Project. An evaluation of means of protecting each of these systems is discussed.

XII.B.20(a) Protection of the Philadelphia System

The Philadelphia system could be protected by either temporary or permanent measures.

Permanent Measures --

It would be technically feasible to move the Delaware River intake of the Philadelphia water supply system from its present location at Torresdale to a point upstream of the limit of salt water intrusion. The new point of intake would be just north of Morrisville, or above the tidal reach. Such a project was studied by a Board of Consulting Engineers to the Philadelphia Water Department in 1946.

A similar project has been considered herein. However, a diversion dam in the Delaware River as proposed in the 1946 study is a questionable feature because of possible navigational problems, raising of the river level upstream of the dam, fish passage and similar problems. Therefore, a pumped intake is considered instead.

A low pressure conduit (calculations suggest that 12' dia. would suffice) to the Torresdale plant with one intermediate pump station to offset line losses could be considered. The alignment would be along the low-lying areas west of the Delaware River, roughly following the route of the Pennsylvania Canal to Bristol, through Bristol following streets and then cross-country generally paralleling a state road. This alignment is longer than the direct route envisioned in the 1966 report, but would employ trenched excavation in lieu of tunneling and have relatively shallow trenches.

This project appears to be feasible provided that the necessary right-of-way can be acquired. The estimated cost is $60,000,000, including costs of right-of-way. Breakdown of this estimate is shown in Table 12-3. In addition, there would be the cost of augmenting the filtration facilities at the Torresdale plant. The cost of this work was estimated in 1946 at $7,000,000. Today, the cost would be about $40,000,000, if acquiring property is not a problem.

The cost of maintenance and operation of the intake, conduit and pump stations also was estimated in 1946 as $438,000 per annum, principally for power for the single pump station. Again, projecting to current costs, operation of the proposed facility would be about $1,645,000 per annum. The annual cost for this $100 million installation, requiring three years to construct with seven percent interest at 50 years, would be $9,652,000.

TABLE 12-3

ESTIMATED COST FOR PERMANENT CONDUIT AND INTAKE

TORRESDALE TO MORRISVILLE

1.	Excavation	-	$6,668,000
2.	Shoring	-	8,400,000
3.	Dewatering	-	800,000
4.	Service Road	-	160,000
5.	12' ID Pipe	-	22,500,000
6.	Pumping Stations	-	1,500,000
7.	Structures	-	72,000
8.	Crossings	-	4,250,000
9.	Repavings & Restorations	-	5,000,000
	Total (rounded)		$50,000,000
10.	Contingencies (including right-of-way) - 20%		10,000,000
	TOTAL		$60,000,000

Temporary Measure --

This plan was originally proposed and studied by the Philadelphia District of the Corps of Engineers in September 1965 (U.S. C of E (1965)). The study and preliminary design were coordinated with the City of Philadelphia Water Department. The plan provided for a quick-assembly (30-60 working days) for the first eight-mile section and a demountable system for extending the present intake point upstream in the Delaware River as required. Specifically, the system would use the discharge line from one or more hydraulic dredges that would be float-mounted and assembled, afloat, along the bank of the Delaware, extending as far upstream in the Delaware as required, to get above the limit of salt water intrusion. The dredge or dredges could be moved and the limits extended as the salinity front moved further north.

The cost analysis of the system is predicated upon the limiting of pipe size to 30" dia. (which is a moderately large size for a dredge discharge line). For a discharge of 100 MGD (155 cfs), and assuming a velocity in the pipe of 10 fps, a battery of three pipes and three dredges would be required. It also assumes that booster pump stations or booster dredges would be necessary every one and one-half miles. The estimated cost of materials and prefabrication is $1,400,000 · $1,800,000 per mile. The estimated cost of each cycle of installation and removal, for three pipes, to be $100,000 - $200,000 per mile.

For purposes of comparison, the cost for an intake of 333 MGD and an

18-mile pipe line would total $33,600,000, or about $1,900,000 per mile. It would not be necessary, however, to immediately invest $33,600,000 for the material and fabrication and then store this material and equipment in anticipation of a need that might not arise for a considerable period of time. The fabrication of the floating units would not be required until the need became apparent. The ordering of materials, fabrication and assembly would require several months or about two miles per week, depending upon availability of dredges and pipe. The first dredge and four miles of pipe line could be in operation within two to three weeks.

There would be ample lead time, because of salinity control points downstream from the Torresdale intake, to institute the first eight-mile section before the salinity at Torresdale became critical. In addition, the previous study by the Corps of Engineers indicates that the dredged water supply could be mixed with the water from the Torresdale intake in proportions to keep the combined salinity below the 250 mg objective.

Riverfront property owners might not welcome the existence of such a pipe that would cut them off from access to the river. Also, a submerged pipe line would reduce the available navigation depth into the riverside slips by at least three to four feet. However, the dredge could lay the pipe in a shallow trench below the existing channel bottom.

The installation would be prone to accidental damage if not submerged or placed below the present channel bottom. Any errant barge or other vessel could sever the lines. The temporary measure would be less costly to construct than the permanent installation and would not require real estate or right-of-way acquisition. Assuming that the system would be required once in every fifty years, the annual cost would be $2,623,000.

XII.B.20(b) Protection of the Camden System

Alternative means of water supply for the City of Camden were evaluated, including the groundwater resources of the state-owned Wharton Tract. Development could include the use of high yield, relatively shallow infiltration wells placed in well fields parallel and adjacent to the principal streams of the Wharton Tract. It is anticipated that such well would each yield upwards of one million gallons per day. They would normally draw most of their water by infiltration from streams, but could also draw from the large groundwater storage reserves in the event of an unusually protracted dry period.

Surface water resources not influenced by the Delaware River could also be developed to augment groundwater from the Wharton Tract. The Mullica River and its tributary, the Batsto River, could be developed. A surface supply from Rancocas Creek would also be feasible as a future supply in the event of need not to use the existing Camden wells. Water would be diverted from the streams above the tidal influence of the Delaware River. Treatment would, however, be required. The treatment plant and intake with transmission lines would cost $30,800,000. The total cost of developing water supplies from the Wharton Tract and from surface streams in the Camden area is estimated at $86,079,000 for a total supply of 160 MGD; and the annual cost would be $7,719,000.

The combined Philadelphia (permanent) and Camden systems would have a total capital cost of $186,079,000; and the combined annual cost would total $17,371,000.

The combined Philadelphia (temporary) and Camden systems would have a total capital cost of $119,679,000; and a combined annual cost of $10,341,976.

It has been suggested that surface-ground conjunctive use of water resources in the Camden area may also be a means of protecting the Camden water supply system from salinity intrusion. This possibility is discussed in the following subsection.

XII.B.21 SURFACE-GROUND CONJUNCTIVE USE

Several surface-ground conjunctive use options were evaluated. The first, as discussed in TAMS (1972), would be located in 50 square miles of glacial deposits in valleys northeast of Port Jervis. Design parameters from USGS (1964) would imply an aquifer thickness of 100 feet; a water yield of 15 percent of aquifer volume and a withdrawal of 20 percent at water yield. This would yield 175 MGD based upon a six-month withdrawal. Annual costs, including operation and maintenance costs would be $.15/1000 gallons. It should be noted that this estimate is based upon a low-flow augmentation operations and the system would be operational only on an estimate average of one year in ten, thereby allowing natural recharge of the aquifer.

In evaluating the engineering feasibility of the project, it should be noted that groundwater-surface conjunctive use concept has not had widespread application in the region and its success and reliability cannot be accurately determined. While not considered viable for present purposes, it is worthy of further study.

The second stems from a suggestion that the Camden well field be used conjuntively with withdrawals from the Delaware River. Delaware water would be used except during periods of drought when pumping from the existing well fields would take place. By using the well field only during periods of drought, it is thought that the aquifer underlying these fields would be fully recharged and that pumpage would deplete groundwater storage rather than the aquifer drawing from the Delaware River, as is now the case.

This alternative would require treatment of Delaware River water at a cost of 50 cents per 1000 gallons; this is much higher for example than bringing water from the Wharton Tract. For reasons of cost, this option also is not considered to be a viable alternative to the Tocks Island Project.

The third option evaluated stems from the suggestion that better management of groundwater resources in the Northern New Jersey Subarea, including surface-ground conjunctive use, could enhance water supply. Groundwater sources were included among the possible sources that could be developed as an alternative to the proposed 300 MGD diversion from the Delaware (as described in Section III.D.2). Groundwater surface conjunctive use was not specifically considered because it was not possible to determine the increased water supply that would result. It is believed, however, that significantly increased yield is unlikely because the projects identified in Section III.D, if developed, are likely to fully utilize both groundwater and surface sources. Because of the foregoing uncertainties, however, this particular option cannot be considered as a viable alternative to the Tocks Island Project.

XII.B.22 TUNNELLING OF KITTATINNY MOUNTAIN

This alternative refers to the proposed contruction of an underground reservoir in Kittatinny Mountain, with a storage capacity of 200,000 acre-feet and 180 MGD safe yield. The reservoir would consist of 200 40-mile-long, 16-foot diameter parallel tunnels, with inlet portals near Port Jervis and outlet portals in the vicinity of the Delaware Water Gap and Decker's Ferry. The proposal also includes an underground hydro-electric generation plant since the tunnel reservoir would have a drop or available head of about 100 feet to the Delaware River.

Not including the power plant, the 200 40-mile-long tunnels (unlined) would cost about $1.6 million per mile length, not counting side drifts or vertical air shafts. The basic cost for the proposed 200 tunnels would therefore cost about $13 billion. In addition to the prohibitive cost, the estimated construction time could be in the order of 30 years. This alternative is not considered to be a viable alternative to the Tocks Island Project.

XII.C SUMMARY OF VIABLE WATER SUPPLY ALTERNATIVES

Those water supply alternatives considered to be viable are summarized in this section. The summary includes only those that would meet unsatisfied needs of the Northern New Jersey Subarea. Alternatives are not listed for the New York City System Subarea because it will be necessary to import water into this subarea by the year 2025 even with the presently authorized 800 MGD diversion from the Delaware Basin. More important, the city will not be likely to increase or decrease its diversion because of the provisions of the Supreme Court Decree of 1954 and the Delaware Basin Compact of 1961, as discussed in Chapter XVII.

In connection with the Delaware Basin, protection of the Philadelphia and Camden water systems, as discussed in Section XII.B.20 above, is viable to the extent to which salinity is considered to be a problem in the Delaware estuary. In accordance with Section III.E(m), the presently programmed water supply projects in the DRBC Comprehensive Plan appear to be adequate to meet withdrawal demands in the Basin in 2025. Those reservoirs, excluding Tocks Island, are also adequate to meet increasing consumptive use demand in the Basin. Additional reservoirs beyond existing or programmed are not needed for the purpose of controlling salinity intrusion since the probability of significant salinity intrusion was found to be very low, as discussed in Section III.E.2.

Viable water supply alternatives are summarized in Table 12-4.

Table 12-4. Viable Alternatives to the Tocks Island Project for Meeting the Unsatisfied Water Supply Needs of the Northern New Jersey Subarea.

Alternative	"Safe" Yield (in MGD)	Report Reference
Conventional Reservoirs		
Northern New Jersey Subarea	384	III.D.2 (Tables 3-35 b & c)[1]
Delaware Basin	332	XII.B.9
New York State	200	III.D.2 (Table 3-35d)
Groundwater		XII.B.1
Northern New Jersey Subarea	134	
Southern New Jersey	200	
High-Flow Skimming		
Delaware Basin		XII.B.17
to reservoirs within Delaware Basin	516	
to reservoirs (Round Valley) in Northern New Jersey Subarea	40	
Within Northern New Jersey Subarea (included in "conventional Reservoirs" above)		III.D.2 (Table 3-35c)
Hudson River to Northern New Jersey Subarea	70	III.D.2 (Table 3-35d)
Rationing		XII.B.19
Increased Frequency	56	
Programmed Deficiencies	50	
Water Conserving Devices	14	XII.B.3
Water Reuse	180	III.B.10
TOTAL	2,176	

* * * * * * * * * * *

From those alternatives discussed in this chapter and indicated as viable, the reservoirs on tributaries in the Delaware Basin and the protection of the Philadelphia/Camden water supply systems were selected for inclusion

[1] Various alternatives are discussed in Chapter III as well as this Chapter, as noted in previous sections of this chapter.

in the Alternative Programs analyzed in Chapter XVI. These constitute representative Water Supply alternatives with respect to types and amounts of costs, benefits and impacts. They thus provide a sound comparison for the evaluation of the Tocks Island Project. Further discussion of the rationale and procedures for this selection are presented in Section XVI.A. Viable alternatives shown in Table 12-4, however, were included in the costs analyses and total yield figures in Chapter XVI.

APPENDIX A

MATHEMATICAL MODEL FOR INSURANCE SCHEME

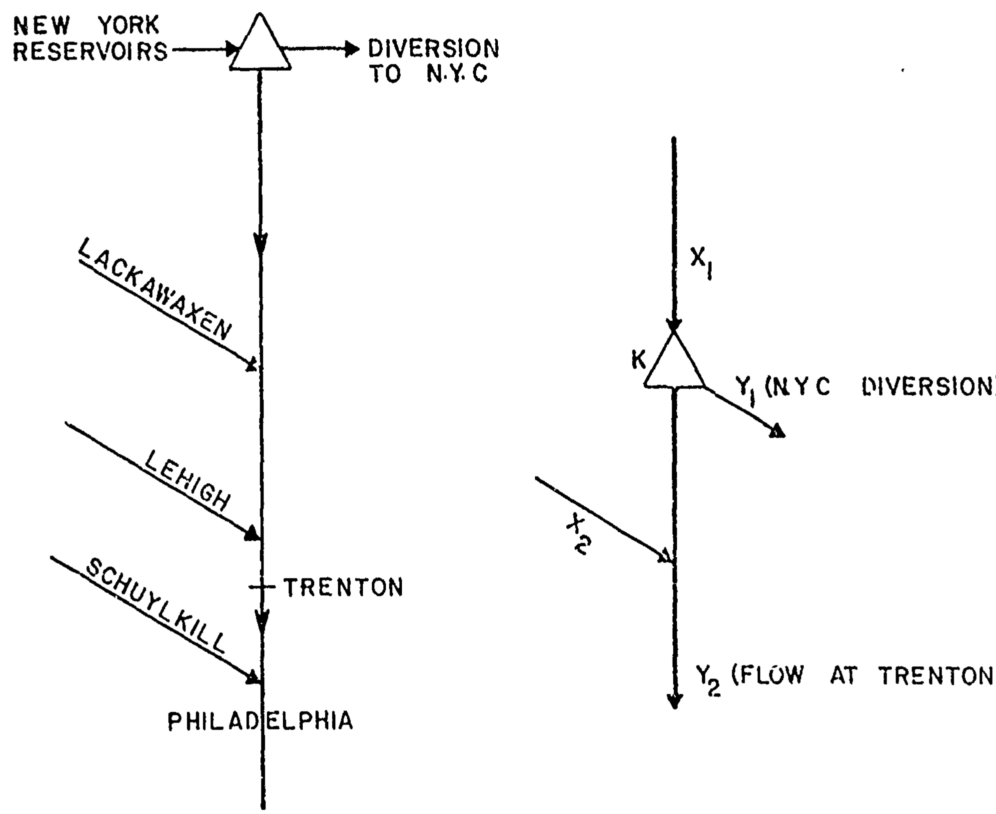
The following Appendix is not an essential part of this study, but is rather an exploration of the mathematical aspects of an illustrative insurance scheme.

This Appendix is not intended to be suggestive of any particular scheme, but rather how the mathematical basis of an insurance scheme could be developed.

The use of insurance as a means of resolving water shortage problem during periods of drought was investigated in section XII.B.12. This appendix presents some of the mathematical problems that would have to be solved in setting up a scheme and also contains a simplified model for such a scheme.

The basic parameters in this model consist of all inflows to the basin above the New York City reservoirs and all the inflows between the New York reservoirs and Trenton, which are annual values denoted as X_1 and X_2, respectively. The flow at Trenton consists of that which is released into the channel from the New York reservoirs plus the inflow from all tributaries above Trenton. The entire storage system for New York is collapsed into a single reservoir which makes diversions Y_1 to New York. The resulting flow at Trenton is Y_2. The simplified basin hydrology diagram and the corresponding model schematics are shown in Figure 12-1A and Figure 12-1B, respectively.

For this model, it is assumed that annual flows X_1 can take values of 0, 1, 2, 3 and that annual flows X_2 can take values of 0, 1, 2. Only integral values are used to simplify computations. It is further assumed that the inflows X_1 and X_2 are correlated so that the joint density function is given in the hydrology probability vector in Table 12-5. The elements in this vector have the significance that, for example, the probability, $p(X_1, X_2)$, that zero flow shall occur both at upstream ($X_1=0$) and at the



A. SIMPLIFIED BASIN HYDROLOGY

B. MODEL REPRESENTATION

SCHEMATIC DIAGRAM OF INSURANCE MODEL

Table 12-5 Hydrology Probability Vector

Q:	0,0	0,1	0,2	1,0	1,1	1,2	2,0	2,1	2,2	3,0	3,1	3,2
$p(X_1 X_2)$	.05	.05	.05	.05	.10	.15	.05	.15	.15	.05	.05	.10

Where Q is the paired inflows assumed to take the values of

$$X_1 = 0,1,2,3$$

$$X_2 = 0,1,2$$

p is the probability corresponding to the paired inflows $Q(X_1,X_2)$

tributaries (X_2=0) is 0.05 and the probability that each shall have a flow of one unit per year is 0.10 (p(1,1)=0.10). There are four possible values of X_1 and three of X_2 so the total number of elements in this probability vector is the product, or 12. Of course, these joint probabilities sum to unity.

From Table 12-5, it can easily be determined that the probabilities of the assumed upstream inflow density (X_1=0, 1, 2, 3) are:

$$P_0(X_1)=\Sigma\, p(0\ ,\ X_2)=.05+.05+.05=.15$$

$$P_1(X_1)=\Sigma\, p(1,\ X_2) \qquad =.30$$

$$P_2(X_1)=\Sigma\, p(2,\ X_2) \qquad =.35$$

$$P_3(X_1)=\Sigma\, p(3,\ X_2) \qquad =.20$$

The mean annual inflow in the upstream is:

$$\overline{Q}(X_1)=.15X0+.30X1+.35X2+.20X3=1.60 \text{ units}$$

Similarly, the probabilities of the assumed tributaries inflow density (X_2=0, 1, 2) can be determined to be:

$$P_0(X_2)=.2$$
$$P_1(X_2)=.35$$
$$P_2(X_2)=.45,$$

while the mean annual imflow in the tributaries, $\overline{Q}(X_2)$, is 1.25 units.

It should be pointed out that there is no effort in this numberical example to reproduce results which accord with real data. Greatly simplified numbers are chosen merely to demonstrate the method of calculating insurance premia. For a more realistic approach, it would clearly be necessary to use a much smaller grid spacing and consequently much larger matrices. These calculations would require the aid of a computer and in order to preclude this need for illustrative purposes highly simplified, integer values are used.

The object of the model simulation is to calculate the draft or release probabilities associated with Y_1, the diversion to New York City, and Y_2, the flow past Trenton. To simplify calculations for this example, units of annual flows are used for Y_1 and Y_2. Clearly, in application of this methodology, an appropriate transformation of units would have to be made so that all flows and storage capacities would have constant units and would be physically compatible and meaningful.

The combined New York City reservoir system is represented by the storage whose capacity is K. Again, this storage is measured in volume units so that the detention time in years is the ratio K/1.60 for the entire upstream portion of the system. The draft probabilities are then mapped into contributions to the insurance fund and withdrawals from the fund; the contributions are made by the "competitors" taken here to be New York and Philadelphia, during years when their targets are met. New York and Philadelphia were chosen because they represent the largest basin exporter and estuary users, respectively. The insurance model could be extended to cover any group of users, however. Withdrawals from the fund are made to cover costs associated with deficits. In this model, the cost associated with a particular deficit is not a function of the magnitude of the deficit but rather of the fact that the deficit exists at all. That is, any dificit, no matter how severe, is uniformly reimbursed.

Of course, in a more sophisticated model, the magnitude of reimbursal could be made as a function of the severity of the deficit; moreover, reduction of a premium could be allowed for those years in which the total demand were not taken (even though it is available) provided that the excess demand is put into storage for future use. This is a trivial numerical extension that will be demonstrated, but not actually undertaken, later in this appendix.

For purposes of this example, the capacity of the reservoir system is assumed to be K=2. Therefore the storage in any particular year can be 0,1 or 2 units. Again, for simplicity of calculations, non-integer values are not permitted in this model. The matrix in Table 12-6 is a conditional matrix which gives the probability that a certain amount of water will be available on the condition that a known amount is currently in storage at the start of that year. For example, the first row of the matrix, $S_i=0$, indicates a set of probabilities corresponding to the reservoir being initially empty. The column headings are the total amount of water available upstream (X_1+S) separated by a comma from the amount available from tributary inflow (X_2). The entries in the table correspond to hundredths, so they can be thought of as percentages. For example, for $S_i=0$, there is a probability

Table 12-6 Availability Matrix

S_i \ $Q(X_1+S_i, X_2)$	0,0	0,1	0,2	1,0	1,1	1,2	2,0	2,1	2,2	3,0	3,1	3,2	4,0	4,1	4,2	5,0	5,1	5,2
0	5	5	5	5	10	15	5	15	15	5	5	10	0	0	0	0	0	0
1	0	0	0	5	5	5	5	10	15	5	15	15	5	5	10	0	0	0
2	0	0	0	0	0	0	5	5	5	5	10	15	5	15	15	5	5	0

Where X_1 is upstream inflow

X_2 is tributaries inflow

S_i is storage of NY reservoir

Q is the paired available water, upstream of reservoir (X_1+S_i) and from the tributaries (X_2)

of 0.10 that the total amount of water available upstream will be 1 unit and the total amount of available downstream will also be 1 unit. This comes from the column headed 1,1. The entry is based on the fact that if there is initially no water in the system, the only way there can be one unit available upstream is to have 1 unit of inflow and the only way there can be 1 unit available downstream is to have 1 unit of inflow. Thus the only combination of inflows that gives rise to the availability pattern 1,1 is that $X_1=1$ and $X_2=1$; from the vector in Table 12-5, it can be seen that the probability of that combination is 0.10. Similarly, for $S_1=1$, the probability that there would be available a combination 1,1 is 0.05. This occurs because if there is one unit already in storage, the only way to have a total of 1 unit available upstream is to have zero inflow upstream and to maintain 1 unit downstream. This combination of inflows is again shown in Table 12-5 to have a probability of 0.05. Essentially, this matrix in Table 12-6 represents the relationships between the storage and the inflow hydrologies.

If it is further assumed that the target flows are $Y_1=1$ and $Y_2=1$, i.e., one unit is to be diverted to New York City and one unit is to flow past Trenton, the matrix in Table 12-7 gives a graphic representation of the operating policy associated with the system. The columns are headed by the values of storage which can be obtained: 0,1 and 2. The rows represent the combinations of available water (similar to the column headings in the matrix in Table 12-6. For example, if the total amount of water available is 1,2 (1 unit upstream and 2 units downstream), the operating policy dictates that the one unit available upstream (from whatever source, storage or flow)

Table 12-7 Operating Matrix

$Q(X_1+S_i,X_2)$	S_{i+1} = 0	1	2
0,0	1	0	0
0,1	1	0	0
0,2	1	0	0
1,0	1	0	0
1,1	1	0	0
1,2	1	0	0
2,0	1	0	0
2,1	0	1	0
2,2	0	1	0
3,0	0	1	0
3,1	0	0	1
3,2	0	0	1
4,0	0	0	1
4,1	0	0	1
4,2	0	0	1
5,0	0	0	1
5,1	0	0	1
5,2	0	0	1

shall be made available to New York while one of the two units available downstream (through the flow X_2) suffices to meet the water supply requirement at Trenton. It follows that the diversion to New York will leave the upstream reservoir empty, so that the storage available for the start of the following year, shown here as S_{i+1}, is necessarily zero. Thus the entry in the matrix, a probability, shows a value of one associated with a storage of zero. In other words, the operating rule dictates that the reservoir shall be left empty because it has to meet the water supply requirement at New York. If the availability pattern is 2,1, 2 units are available upstream of which 1 is diverted and 1 is stored. This means that there is a unit probability that the storage at the start of the next period will be 1, and because X_2 is not less than one, there is enough tributary flow to guarantee meeting the flow requirement at Trenton so none of the storage has to be withdrawn in this case. For an availability pattern 3,0, 1 unit is diverted to New York, 1 unit is released to meet the downstream flow requirement, and 1 unit is maintained in the upstream storage. Therefore the probability of having unit storage at the start of the next time period is 1, and there are zeros elsewhere in the row. The entire matrix can be filled in precisely this way.

By post-multiplying the availability matrix in Table 12-6 by the operating matrix in Table 12-7 and by Bayes theorem, the Markov or transition probability matrix shown in Table 12-8 is obtained. This is the matrix whose elements represent the probabilities that the reservoir (or system state) originally at 0,1 or 2 will, at the start of the following year, be in state 0, 1 or 2. It is to be noted that the sum of the elements in any

Table 12-8 Reservoir State Matrix

		S_{i+1}		
		0	1	2
S_i	0	.50	.35	.15
	1	.20	.30	.50
	2	.05	.15	.80

Where S_i represents state of reservoir storage at current year,

S_{i+1} represents state of reservoir storage for following year, i + i.

row of the matrix is necessarily unity, reflecting the fact that the system must terminate someplace, no matter where it starts.

Since the inflows and release patterns are assumed to be in steady state, it is a simple matter to solve the steady state equations and derive π_i-values representing the probability that the reservoir is in state i at any time period. Examination of the matrix in Table 12-8 indicates that the only way the reservoir can terminate in state 0 is to start in state 0 and then move with probability .5 to 0, to start in state 1 and then move with probability .2 to state 0, or to start in state 2 and move with probability 0.05 to state 0. This is a classical technique for establishing a set of simultaneous linear equations. However, the three equations which may be obtained from the matrix are not linearly independent. It is therefore necessary to disregard one of the three equations and replace it with the condition that the sum of all the reservoir steady state probabilities must necessarily be unity. The final set of the simultaneous equations are:

$$\pi_0 = .5\pi_0 + .2\pi_1 + .05\pi_2$$

$$\pi_1 = .35\pi_0 + .3\pi_1 + .15\pi_2$$

$$\pi_0 + \pi_1 + \pi_2 = 1.$$

Solution of the above equations yields:

$$\pi_0 = .149$$

$$\pi_1 = .212$$

$$\pi_3 = .639$$

which represent the probabilities that the New York City Reservoirs system is in state 0, 1 or 2 respectively. The sum of the three π's is 1, which serves as a check for the solution.

The releases are called R_N (to New York) and R_P (to Philadelphia). There are 10 combinations in all. The releases to New York can be either 0 or 1. The releases to Philadelphia, which are really the flows past Trenton, can be 0, 1, 2, 3 or 4. There is no way to have more than 4 units in the river at Trenton. For example, if the reservoir is full and the maximal inflow occurs upstream, there are available 2+3=5 units of water. Of these, one is diverted to New York, two are allowed to remain in storage, so that a maximum of two flows downstream from the upper reservoir. The maximal tributary inflow is X_2=2, and this, when added to the upstream release, makes a maximal flow of 4 past Trenton. The product of the number of upstream and downstream releases is 2X5=10. These are shown across the column headings of the matrix in Table 12-9. The row headings are, as usual, the combinations of water availability at the upstream and downstream points; these are X_1+S, X_2.

The operating policy is embodied in this matrix, whose elements are probabilities. For example, if the availability pattern is 0,1, no water is available upstream so that $R_N=0$ and one unit is available downstream so that $R_p=1$. Thus there is a probability of 1 that the release pattern 0,1 is attained; this is shown in the second row of the matrix. As another example, consider that the availability pattern is 1,2. One unit is available upstream, so that $R_N=1$; two units are available downstream so that $R_p=2$. This is shown by a unit element in the row 1,2 (and in the column 1,2). There is no ambiguity unless the availability pattern is 1,0. This means that one unit of water is available upstream and none are available from tributary inflow. The question is now to determine whether the one unit upstream should be released into the channel and made available downstream or whether it should be diverted to New York so that the downstream flow would necessarily be deficient. The notation chosen in the row identified by the availability pattern 1,0 contains a slash. The element above the slash results if the operating policy favors the upstream user (New York) while the lower value results if the operating policy favors the downstream user (Philadelphia). For example, if the upstream user is favored, the release pattern must be 1,0 because the release to New York is 1 while the release to Philadelphia is 0. Thus there is a unit entry under the column

Table 12-9 Reservoir Release Matrix

$Q(X_1 + S, X_2)$	Release Pattern (R_N, R_P)									
	0,0	0,1	0,2	0,3	0,4	1,0	1,1	1,2	1,3	1,4
0,0	1	0	0	0	0	0	0	0	0	0
0,1	0	1	0	0	0	0	0	0	0	0
0,2	0	0	1	0	0	0	0	0	0	0
1,0	0	0/1	0	0	0	1/0	0	0	0	0
1,1	0	0	0	0	0	0	1	0	0	0
1,2	0	0	0	0	0	0	0	1	0	0
2,0	0	0	0	0	0	0	1	0	0	0
2,1	0	0	0	0	0	0	1	0	0	0
2,2	0	0	0	0	0	0	0	1	0	0
3,0	0	0	0	0	0	0	1	0	0	0
3,1	0	0	0	0	0	0	1	0	0	0
3,2	0	0	0	0	0	0	0	1	0	0
4,0	0	0	0	0	0	0	1	0	0	0
4,1	0	0	0	0	0	0	0	1	0	0
4,2	0	0	0	0	0	0	0	0	1	0
5,0	0	0	0	0	0	0	0	1	0	0
5,1	0	0	0	0	0	0	0	0	1	0
5,2	0	0	0	0	0	0	0	0	0	1

1,0. Similarly, the entries are reversed if Philadelphia is favored because then the only available water is released in the channel so that the release pattern is 0,1. It is interesting to note the result if the availability pattern is 0,2. In this case, even though there is more water in the system, there is no way to get the downstream water into the upstream diversion system so the availability is mapped directly into the release pattern 0,2. As a final example, consider the availability pattern 5,1. One unit is diverted to New York, 2 are allowed to remain in storage, so that 3 units are withdrawn from the system flow. Two units remain, to be added to the single unit of inflow from the tributaries so that the total available flow at Trenton is 2 from the upstream sources and 1 from the tributary inflow, or 3. Thus a unit entry under the column 1,3 results. It is particularly interesting to note that there is no possible way to obtain release patterns resulting in allocations 0,3 and 0,4.

The conditional matrix shown in Table 12-10 is obtained by multiplying the availability matrix (Table 12-8) by the release matrix (Table 12-9). The elements of this matrix are probabilities if each is divided by 100. This matrix says that if the initial storage, for example, is 1 unit there is a probability of 0.45 that the release pattern will be 1,1 (1 unit to New York, 1 unit to Philadelphia) and a 40% chance that the release pattern will be 1,2 (1 unit to New York, 2 units to Philadelphia), etc. Again, if New York or Philadelphia is favored, the elements with a slash indicate which probability to select. Brief calculations shown below illustrate the steady state probabilities of the several release patterns:

Table 12-10 Conditional Matrix

		RN/Rp							
		0,0	0,1	0,2	1,0	1,1	1,2	1,3	1,4
S_i	0	5	5/10	5	5/0	40	40	0	0
	1	0	0/5	0	5/C	45	40	10	0
	2	0	0	0	0	30	40	20	10

P(0,0)=.149(.05)=.00745

P(0,1)= .149(.05)=.00745 (favoring New York)

or = .149(.1)+.212(.05)=.0255 (favoring Philadelphia)

P(0,2)=.149(.05)=.00745

P(1,0)=.149(.05)+.212(.05)=.01805 (favoring New York)

or =0 (favoring Philadelphia)

P(1,1)=.149(.4)+.212(.45)+.639(.30)=.3467

P(1,2)=.40

P(1,3)=.212(.10)+.639(.20)=.1490

P(1,4)=.639(.10)=.0639

The probabilities are obtained by multiplying all the conditional patterns given in the matrix of Table 12-10 by the reservoir state probabilities previously calculated, and summing them appropriately. Thus it is seen that the only way the system can release 0,0 is to start in state 0 and release 0,0 on that condition. The probability π_0=0.149, and this is multiplied by the transition or conditional probability 0.05, giving 0.00745. As another example, the release pattern 1,1 is obtained 40% of the time if the reservoir is initially in state 0, 45% of the time if it is initially in state 1 and 30% of the time if it is initially in state 2. By substituting the steady state probabilities for these reservoir cases, the probability of the release pattern 1,1 is calculated to be 0.3467. There is again some ambiguity associated with whether the operating policy favors New York or Philadelphia; these alternate calculations are shown in brackets.

Similar calculations have been made to obtain all the probabilities of meeting the targets for New York and Philadelphia (and the probabilities of deficits for each) on the basis of two operating alternatives: favoring New York and favoring Philadelphia. The results are summarized in a 2-by-2 matrix in Table 12-11. It shows that there is a probability of 0.9777 that New York will meet its target if the system is operated in its favor but that the probability falls to 0.9596 if Philadelphia is favored. The probability that both users will have simultaneous deficits is 0.00745, less than 1% of the time.

The simulation model may be extended to consider the effects of relative costs to each user when their demand targets are not met. If C_N is the cost to New York in the event of a shortage, and C_p is the cost to Philadelphia, it is assumed that the cost $C_p=1$ and that the cost C_N is 3 times greater, or 3 units. The symbols D_N and D_p are the donations or premiums paid by New York and Philadelphia, respectively, during the years that their targets are achieved. If the system is operated to favor New York, the annual expected contribution to the fund is given by the sum of products of premiums times probability of meeting the demand; the expected withdrawals are the sums of products of costs and the probabilities of sustaining deficits. The consequence is shown in Table 12-12.

As a matter of curiosity, the premiums charged to New York are indifferent to the operating policy when these two values D_N in Table 12-12 are equal; this occurs when $D_p=1.38$ units.

Table 12-11 Probability of Meeting Target

Operating Policy	New York Meets	Philadelphia Meets
Favor New York	.9777 (def.=.0223)	.9745 (def.=.0255)
Favor Philadelphia	.9596 (def.=.0404)	.9861 (def.=.0139)

Table 12-12 Establishment of Premium Costs

Operating Alternative Favoring New York

$$.9777D_N + .9745\ D_P - C_N(.0223) - C_P(.0255) = 0^*$$

Since, C_N is assumed to be 3 and

C_P is assumed to be 1

the above equation can be simplified to

$$.9777\ D_N + .9745\ D_P = .0699 + .0255 = .0924$$

or, $D_N = -.997\ D_P + .0945$

Operating Alternative Favoring Philadelphia

$$.9596\ D_N + .9861\ D_P - C_N\ (.0404) - C_P\ (.0139) = 0^*$$

Similarly, the above may be simplified to

$$D_N = -1.028\ D_P + .1351$$

*These equations illustrate possible approaches to establish the equitable premium costs to New York and Philadelphia.

Of course, this result merely gives some idea of the differing magnitudes associated with the contributions which might be assessed against each of the players. It says nothing at all about the investment of the cumulative funds, the discount rate, the problem of reinsurance should the fund go dry, or any of the other difficulties associated with a real insurance scheme. These are all avoided in this simple-minded scheme because to accommodate them it would be necessary to write a significant computer program which simulates the fund. But conceptually this is a very simple matter, and indeed it is straightforward numerically, even if somewhat tedious. The design decisions, consisting of the storage K, the diverseion Y_1 and the flow target Y_2 can be permuted in a number of combinations and the economic consequences deduced from the straightforward linear operations which have been outlined in the sample computation. A more complex scheme, which would identify the various negotiating positions and strengths of the proponents could be extended by matrix manipulation and possibly by simulation to develop a clearer picture of the negotiation frontier which is known as Paretian analysis.

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Chapter XIII

RECREATION ALTERNATIVES

XIII.A. INTRODUCTION

This discussion and evaluation of alternatives to the recreation component of the Tocks Island Lake project is subject to a number of qualifications brought about by the nature of the recreation activity. One of the most significant differences between recreation and the other authorized purposes is the lack of simple comparability between TILP and the alternatives. This lack exist even between alternatives. For example, unlike a kilowatt of electricity or a gallon of water which are the same anywhere, a recreation day moved to another location is changed in some significant way -- it may be a better or worse experience, or it may be the same experience but serve different people. The recreation component of TILP cannot be plugged into a network to meet service area needs irrespective of its location.

The recreation issue is further complicated by the public-service nature of the product. While there are numerous private and commercial facilities which are locations for a great deal of the region's recreation activity, it is certainly a long accepted obligation of the public sector to provide outdoor recreation opportunities (as described in the preface to Chapter IV) without strict regard to the marketability or benefit/cost aspects of the undertaking. The recent survey of Pennsylvania residents, described in Chapter IV, indicates that public facilities account for more than half of the total activity days in hiking, fishing, boating and picnicking, approximately one-third of all the swimming and camping activity and nearly one-fourth of all hunting. This already high degree of involvement by the public sector speaks well for the usefulness of alternative approaches to recreation but raises a point of caution. States and local areas are already heavily involved in the provision of outdoor recreation and it can be presumed that they are already giving recreation as much of their financial resources as they believe appropriate considering priorities of other present needs. Therefore, the determination of the viability of any recreation alternative will not assure its accomplishment in the absence of TILP. A congressional decision to deauthorize TILP is not necessarily a decision to undertake a viable alternative -- unless this specific question of funding alternatives is addressed by Congress.

Another aspect influencing the selection of recreation alternatives is the unlimited nature of recreation needs and possible responses to meeting them. Chapter IV demonstrated the recreation needs of the region and noted that TILP would only satisfy a small portion of this. Consequently, almost any recreation alternative suggested would get at some component of the need. Since it is not the task of the consultants to suggest solutions to the entire recreation needs of the Northeast United States, alternatives evaluated in this chapter have been limited to those which meet all or a portion of the need which would have been satisfied by TILP and are reasonably comparable in terms of geographic coverage and the type of recreation activity offered.

As a final introductory comment it should be noted that the alternatives are defined as alternative ways of satisfying a portion of the service area's recreation need, not alternative uses of the Tocks Island Lake project itself. As a matter of fact, it is assumed in this chapter that in the absence of the dam and the lake, the area would still serve as a major river-based recreation facility the nature of which will be defined further in this chapter. The bases for this assumption are outlined in Part D of the study which discusses the impacts of deauthorization and the alternatives for DWGNRA without TILP.

To present this discussion on the recreation alternatives in a logical manner, this chapter is organized into five sections. The first presents a listing of all recreation alternatives which are considered by the consultant team. The second presents a general description of those alternatives or combination of alternatives which seem to represent the spectrum of viable options. The third describes a general matrix evaluation which was performed on these alternatives in an attempt to cull from the list those not meriting detailed discussion. (In fact, all alternatives reaching this stage were given detailed evaluations). The fourth section is a discussion of the evaluation components used in the detailed analysis. These components include standards of capacities and visitation, costs and benefit calculations and impact criteria. Finally, a detailed description and evaluation of each of the viable alternatives is presented. It should be noted that the ultimate visitation capacities of these alternatives are discussed and evaluated. The development of alternatives selected for program formulation are then phased for comparability with the proposed three phases of DWGNRA with TILP (See XIII.F.9.).

XIII.B. IDENTIFICATIONOF RECREATION ALTERNATIVES

The initial list of recreation alternatives range from very specific suggestions regarding certain facilities to broad approaches. The list was compiled by the consultants from several sources ranging from public comment from previous hearings on the Tocks Island Lake project to conversations with recreation professionals in the region to the exchange of ideas among the consultant team. Alternatives in this initial list included:

1. Clean up the Hudson and use it for swimming and boating.
2. Let the New Jersey and Long Island oceanfronts meet the need.
3. Open the Cannonsville Reservoir for recreation.
4. Accelerate development of Gateway National Recreation Area.
5. Clean up and intensify use of the Delaware Bay.
6. Provide recreation opportunities closer to where the people live.
7. Spread the recreation impacts from a single large facility to scattered smaller ones.
8. Make better use of existing facilities.
9. Don't build any more facilities just use the natural wilderness.
10. Let the private market build lakes and parks.
11. Develop a park on the Tocks Island site but without a lake.
12. Build a major recreation lake in some other location.
13. Create major floating recreation rafts out offshore with ferry service.
14. Create federal subsidies through tax consideration or direct grants and aids for private recreation business.
15. Provide federal subsidies to enable families to participate in more distant recreation opportunities or build home facilities.

Some of the alternatives on this list were rejected but most could be generalized into a larger category for analysis.

Private lakes was rejected because of the limited market reached by this alternative. Private lakes are most frequently developed for the real estate value of homes along the shoreline. This restricts the scale of recreation activity and the market reached to a level unacceptably different than envisioned for TILP. Federal subsidies and tax incentives for home pools or recreation travel appears to be politically infeasible and not in line with national priorities. Recreation barges offshore were deemed unnecessarily expensive. Other suggestions such as Gateway NRA and some expansions of existing facilities were not considered proper alternatives if in fact they were to occur anyway; new facilities and expansions which have already been programmed were not considered legitimate alternatives. Finally, the creation of a new single large recreation lake elsewhere was considered to be not a legitimate alternative since this would merely transfer the same problems, issues and impacts to another location.

The other specific suggestions fell into one or more of the categories of alternatives developed by the consultant team for further evaluation. These alternatives are listed below:

1. No public expenditures beyond a river-based DWGNRA.
2. Piggyback recreation on smaller water supply and/or flood control dams.

3. New state parks and programs.

4. Open closed reservoirs for recreation use.

5. Neighborhood pools and mini-parks.

6. Expanded use of existing facilities.

7. More intensive development of DWGNRA without TILP.

XIII.C. DESCRIPTION OF EACH ALTERNATIVE

The following paragraphs generally describe the concept of each alternative and its potential level of service in comparison with TILP. A detailed analysis of recreation facilities, visitation, costs, benefits and impacts of each of these is developed in Sections XIII.E. and F. later in this chapter.

It should be noted that throughout this section each alternative is treated as a separate entity even though the first alternative, development of DWGNRA without a lake, would be combined with any of the other alternatives in the final testing and evaluation of total alternative programs in Chapter XVI.

XIII.C.1. RIVER-BASED DWGNRA

While this alternative has been described as "do nothing" in the development of this analysis, it really means to do no specific public activity as a substitute for the Tocks Island Lake Project beyond development of DWGNRA as a river-based recreation area. Nor does it assume that on-going state and local programs will not continue at a level consistent with state and local resources and the willingness of the citizens to fund new programs. It does mean, however, that there would be no other actions taken as a one-for-one substitute on deauthorization of TILP. The river-based DWGNRA concept used in the analysis in this chapter is that formulated by the Save the Delaware Coalition and is based on the assumptions that 1) absence of the dam and lake will enhance DWGNRA's potential for land-based recreation but 2) swimming and boating can still be provided along the river banks. The plan envisions a potential ultimate annual visitation comparable to DWGNRA with TILP (Phase I), that is approximately 4,000,000 visitors per year with land-based activities replacing much of the water-oriented activity of the TILP plan. In this concept there is an emphasis on hiking, bicycling, canoeing, historic and environmental interpretation and education.

This alternative is designed to provide a comparable level of output to Phase I of the Clarke & Rapuano plan for TILP although with a somewhat different mix of activities and a consequent difference in the degree of satisfaction of service area needs in different categories.

XIII.C.2. PIGGYBACK RECREATION ON WATER SUPPLY DAMS

The Delaware River Basin Commission's comprehensive plan for the basin includes some 70 projects for flood control, water supply and recreation of which Tocks Island is the largest. Chapters XII and XV deal with the use of several smaller projects as alternatives to TILP for flood control and water supply. Some of these are already in the planning stages or even in operation and are not considered legitimate alternatives, but there are a number of these dams which have potential for recreation use in addition to their primary function, and five of these (Hackettstown, McMichael, Shohola Falls, Tobyhanna and Lackawaxen) are large enough and geographically dispersed throughout the recreation service area to provide a reasonable alternative to TILP.

This alternative assumes recreation facilities will be developed on appropriate water supply or multi-purpose projects after they are in place. Wherever justified, basic services, utilities and roads would be constructed along with the dam and minimize the overall construction costs. The bulk of the expense for the recreation facilities would follow in due course, in a staged development similar to the Clarke & Rapuano plan. Sites would be selected from the package on the basis of their overall order of merit depending on which of the three or four basic functions was most needed relative to the project location within the basin.

XIII.C.3. NEW STATE PARKS AND PROGRAMS

This alternative envisions major new state recreation facilities. As opposed to the expansion of the existing facilities, discussed later, these would be on newly acquired sites. These parks would be of city-wide or regional significance and are quite different in concept from traditional rural-oriented state parks. The alternative envisions a series of "riverfront metroparks" developed on derelict land in and near the larger urban centers of the recreation service area and a number of larger, "super parks" at select locations. These new facilities would be placed throughout the service area to complement similar facilities now being developed, such as Roberto Clemente State Park in New York City and Penn's Landing in Philadelphia as prototypical metroparks and the Gateway National Recreation Area as a prototypical super park. This alternative would take maximum advantage of expected improvements in water quality in existing rivers to provide swimming and boating opportunities adjacent to the metropolitan areas. In terms of total recreation opportunities they could be designed to be statistically comparable to TILP but they are quite different in concept.

These urban parks are designed for day use only and provide maximum opportunity for social interaction. In this light they play a totally different role than does a rural park with its back-to-nature theme. In urban parks, some visitors might swim while other attend a performance at a little theatre. Still others might rent a boat, go for a stroll or visit a nature interpretation center. Visitors might come from nearby neighborhoods, suburban areas or even other cities. While not specifically programmed into the detailed evaluations developed later, these parks would provide the opportunity for reabilitation of older riverfront industrial structures into cultural and commercial activities supplementing the outdoor recreation programmed in this concept.

XIII.C.4. OPEN CLOSED RESERVOIRS

This alternative deals with the possibility of opening existing reservoir systems to the public for recreation use. There are a number of large reservoirs in the service area, some closer to population centers than Tocks Island Lake would be, which are not now used for recreation. There are very strong institutional reasons these reservoirs remain closed to the public. However, if these institutional problems can be overcome, the total acreage available in these lakes can be viewed as a sizeable resource for outdoor recreation, with an aggregate capacity larger than TILP itself and from which the impact would be dispersed over a larger area.

XIII.C.5. NEIGHBORHOOD POOLS AND MINI-PARKS

This alternative suggest constructing public swimming pools as a part of new mini-parks located in urban neighborhoods where the recreation need is greatest. This alternative addresses swimming as the major recreation activity for which an alternative is sought and does not, by itself, address boating, camping or other rural activities. Specific action required by this alternative would involve purchasing land and constructing numerous public pools in the area. The number of pools constructed and their locations would determine the degree to which this alternative provided a comparable level of service to TILP.

The Clarke & Rapuano plan for DWGNRA with TILP calls for a swimming capacity of 21,600 in Phase I (corresponding to 4,000,000 annual visitors). To provide a comparable swimming pool capacity using typical neighborhood-sized pools would require only about 60 pools. Clearly, such a small number of pools scattered throughout the entire service area could not provide the same type of service to the same number of people.

Nevertheless, it is clear that the urban areas are more deficient in swimming opportunities and this alternative squarely addresses this element of the need.

XIII.C.6. EXPANDED USE OF EXISTING FACILITIES

This alternative envisions an expanded role for existing facilities, primarily state parks and forests, in satisfying the recreation needs within the service area. This expanded activity would be brought about by an increase in the intensity of development of those facilities now in place such as adding more picnic tables and campsites, increasing the linear feet of developed beaches and either constructing more boat launching ramps or changing existing boating regulations to increase capacities. Many of the state forests and parks in the recreation service area could expand their capacities and allow for a more efficient use of their land and water acreage without damaging the ecological holding capacity or quality of the recreation experience -- at least according to the consultants' conversations with the various park superintendents.

Tabulation of expansion potential, as described later in this chapter, indicates that capacities comparable to TILP can be achieved through such expansions. Numerous smaller lakes, even though developed to the same or greater total capacity, would likely not have the regional attraction of a single major facility; however, this lack of regional drawing power may be more than offset by the more geographically dispersed pattern which would permit easier access.

XIII.C.7. INTENSIVE USE OF DWGNRA WITHOUT TILP

This alternative considers intensification of DWGNRA without TILP to a level of around 10,000,000 visitors a year in order to provide an output comparable to the full development of TILP (Clarke & Rapuano's Phase III). To reach such a visitation level, the DWGNRA envisioned under the baseline or "do nothing" alternative would have to be considerably changed to allow for high density activities. Swimming pools would be constructed or larger swimming beaches created along the river bank by low level dams or dredging out swimming areas. Bicycling and canoeing facilities and concessions would be extensive and all-in-all the level of activity could approach that of an urban park, as would some areas of DWGNRA with TILP.

XIII.D. GENERAL EVALUATION OF ALTERNATIVES

These alternatives were subjected to a general evaluation based on their likely environmental and social impacts, cost levels, institutional constraints and other factors to determine their viability. It is intended that this evaluation would result in the elimination of one or more from further consideration, but there were none that were clearly not viable.

Table 13-1 displays the matrix evaluation used in the preliminary analysis of alternatives based upon the conceptual descriptions of each alternative presented above. (It should be noted that this evaluation reflects some changes from the one presented at previous public meetings due to refinements in the concept of some of the alternatives developed in the detailed evaluations.)

XIII.D.1. ENVIRONMENTAL IMPACTS

Table 13-1 evaluates the alternatives against two categories of environmental impacts, changes to natural systems and automobile travel generated. Generally those alternatives causing the greatest change in natural systems are those which add manmade recreation facilities to presently natural areas; the piggyback of recreation on smaller dams and intensive use of DWGNRA have the highest impact in this regard. The alternatives which only add facilities to existing lakes have less impact on natural systems, and the

Table 13-1. Preliminary Analysis of Recreation Alternatives to DWGNRA With TILP

EVALUATION CRITERIA	River-Based DWGNRA	Piggyback	New State Parks and Programs	Open Closed Reservoirs	Neighborhood Pools and Parks	Expanded Use of Existing Facilities	Extensive Development of DWGNRA Without TILP
Environmental Impacts							
- Changes to Natural Systems	Medium	High	Medium	Low	Low	Medium	High
- Automobile Travel Generated	Medium	High	Medium	Medium	Low	Medium	High
Social Impacts							
- Impact on Local Lifestyles	Low	Medium	Low	Medium	Low	Low	High
- Serving Recreationally Disadvantaged Groups	NM	NM	NM	NM	Yes	NM	NM
- Quality of Recreation Experience Provided (in comparison to DWGNRA with TILP)	Equal	Equal	Equal	Equal	Lower	Equal	Lower
Service Level Comparable to TILP	No	Possible	Yes	Possible	No	Possible	Yes
Cost Levels (in comparison to DWGNRA with TILP)	Much Lower	Equal	Lower	Much Lower	Lower	Much Lower	Lower
Level of Institutional Constraints Likely to Be Encountered	Low	Low	Medium	High	Medium	Medium	High
Implementation Responsibility	Federal	Federal	State	Local and State	Local	State	Federal

Note: "NM" is No More than presently served by existing facilities unless special programs are undertaken.

neighborhood pools and parks, by their nature and location, have little impact in this area.

Automobile travel generated is generally proportional to the intensity of development in each alternative and its degree of concentration or scatteration. Again piggybacking and intensive use of DWGNRA would cause the greatest change in automobile patterns, and the impact would be minimal for neighborhood pools. Opening closed reservoirs and new state parks and programs, while perhaps generating as much visitation as piggybacking, are better distributed with respect to population concentrations and the travel distances are thus reduced.

XIII.D.2. SOCIAL IMPACTS

Three categories of social impacts were utilized in this preliminary analysis. The first, impacts on local lifestyles, reflects the relationship between the size and character of future recreation visitation and the current levels in the areas to be impacted. In this respect intensive use of DWGNRA has the greatest impact while alternatives closest to existing urban concentrations have the lowest. More extensive use of existing facilities also produces a minimal impact since it adds only an increment of growth on areas which have already been impacted.

In terms of the capability to serve recreationally disadvantaged groups, the analysis suggest that neighborhood pools and parks would best satisfy this objective while the other alternatives would do no more for these groups than is presently done by existing facilities unless special programs are instituted in conjunction with the physical development of the sites.

The quality of the recreation experience in comparison with TILP is a subjective factor, but it appears that any of the alternatives which provide a rural, open-space setting has the potential of providing equivalent quality if developed properly, except for intensive use of DWGNRA which crowds the ultimate capacity of a lake-based recreation area onto a park with less potential for water-based recreation and neighborhood pools and parks which, due to their scale and location, do not provide the same quality of experience as DWGNRA with TILP.

XIII.D.3. LEVEL OF OUTPUT IN COMPARISON TO TILP

As suggested in the introduction to this chapter, no recreation experience is directly comparable to TILP; however, it is possible in many of those alternatives to achieve a level of visitation comparable to the forecast full development of TILP. As described later in the more detailed evaluations, there is enough water area to create equivalent capacity in piggybacking, opening closed reservoirs and expanded use of existing facilities, if they are designed that way and institutional and cost factors permit their full development. These three alternatives could also be developed at any selected level of output less than TILP depending on the selection of reservoirs and existing facilities to be developed for recreation use. The alternatives for new state parks and programs and intensification of DWGNRA can both, as conceived, provide a comparable level of output. Neighborhood pools and parks while providing a statistically comparable number of swimming opportunities does not reach as broad a market and does nothing for the boating, camping and other rural-oriented activity. Development of DWGNRA as a river-based recreation area along the lines of the SDC Plan provides an output comparable to the currently approved 4,000,000 visitors at TILP, although with a different mix of activities. All of the alternatives provide for visitation in a range close to that provided by TILP, itself a very minor share of the demand forecast in Chapter IV; even 10,600,000 visitors per year is less than ten percent of the total growth in demand for the recreation service area between 1974 and 1985 to say nothing of current deficiencies.

XIII.D.4. COST LEVELS IN COMPARISON TO TILP

This preliminary analysis deals with costs in a general way only. In the preliminary analysis it was suggested that all of the alternatives except piggybacking would have a lower cost than TILP since they did not involve the construction of a dam or other major structural component. Those which involved only the addition of recreation facilities to already developed areas, such as opening closed reservoirs, increase use of existing facilities and development of a river-based recreation area at DWGNRA should cost less. It should be stressed that this is only a conceptual ranking of comparative cost levels; costs could very considerably with the mix of activities and facilities needed -- as shown in Section F of this chapter.

XIII.D.5. INSTITUTIONAL CONSTRAINTS LIKELY

This evaluation criterion refers to the likelihood of the alternatives being implemented if in fact it is deemed viable in other respects. The severest constraints seem to be on opening closed reservoirs where municipalities and special authorities have zealously resisted recreation activity on their lakes before. The intense use of DWGNRA would also seem to run counter to the policies of the administering agency, the National Park Service, although as noted in Chapter XIX, Congress could direct whatever policies it wanted to your deauthorization of TILP, should that occur. A less intense river-based recreation alternative would have minimal institutional constraints, and in fact the NPS is currently developing such plans (discussed in Part D, Chapter XVIII). The piggyback alternative also has a low institutional constraint since presumably these dams will be built by the Corps who could design and fund recreation activities into the project. The medium level institutional constraints on the other alternatives are in recognition of the funding difficulties of the state and local agencies even though the institutional mechanisms exist to implement the alternative.

XIII.D.6. IMPLEMENTATION RESPONSIBILITY

The final line on Table 13-1 indicates the governmental level having primary responsibility for implementation of each of the alternatives.

XIII.E. COMPONENTS OF DETAILED EVALUATION OF ALTERNATIVES

Each of the seven alternatives are given a systematic detailed evaluation in the next section of this chapter. To avoid duplication in those discussions, this section will describe the components of the evaluation and state the assumptions and factors used to calculate various components of the detailed evaluation. The factors described in this section include facility capacities and visitation, cost, benefits and impact evaluation criteria.

XIII.E.1. FACILITY CAPACITY AND VISITATION

Each of the alternatives is described in terms of its concept, function and other qualitative aspects. The common denominator for quantitative analysis is the "instant capacity" or the number of people that can be accommodated at any point in time for a given activity. Each of the alternatives has been programmed for a given instant capacity based on its physical configuration -- such as number of picnic tables, feet of developed beach, or other recreation measure. The instant capacities in terms of number of people have been developed using the standards presented in Part A, Chapter IV.

From these instant capacities, daily capacities were calculated using turnover rates (also developed in Chapter IV). Daily capacities were used to calculate annual visitations using the factors derived from Table 4-38 which dealt with weekly and seasonal variations of each activity. The table below summarizes these turnover and annual visitation factors as applied, in most cases, to the programmed instant capacities of the alternatives. In some cases variations in these factors were deliberately made by the consultants reflecting special circumstances of a particular alternative; these variations are noted in the evaluations of each alternative.

Table 13-2. Factors for Calculating Daily Capacity and Annual Visitation from Instant Capacity

	Daily Turnover	Design Day as a Percent of Annual Activity Days
Swimming Beach	1.5	2.3%
Swimming Pool	3	2.3%
Picnicking	1.5	2.2%
Boating	2	1.6%
Camping	1	1.6%

Source: Chapter IV.

Activity days derived in this way are not strictly additive since one person may engage in more than one activity on a given day. The approach to determining total annual visitors for each alternative varys somewhat but generally follows this format: first activity days in the primary activities (swimming, picnicking, boating and camping) are summed and divided by a factor to account for the overlap of multiple participants. In most cases this factor is 1.4, a figure determined from attendance and activity figures at several Pennsylvania State Parks. This reduced figure is then multiplied by another factor to account for other activities such as hunting, hiking and fishing.

This factor is also 1.4 in most alternatives, but higher in the case of the parks with an urban orientation and the more diverse DWGNRA without TILP. The final adjustment is a factor for "sightseers," people who drive around the facility but do not stop or use any of the facilities. This component varies among the alternatives ranging from none in the urban situations to 20 percent in most of the other alternatives.

XIII.E.2. COSTS OF RECREATION ALTERNATIVES

Cost estimates for each of the alternatives varied somewhat according to the location and character of the programmed facility, but all costs are considered proper guides for comparison. Cost estimates for the development of recreation facilities will vary considerably depending on many factors such as the quality and design of the facility; labor, transportation and materials cost within a particular area; and the conditions encountered at a particular site. At best, any standard cost figures can be only general approximations of costs which may actually be encountered. The consultant has developed a comprehensive list of cost estimates prepared by various state and federal agencies for recreation facilities but use of this list is limited by the lack of adequate description of the facilities actually built. For example, a bathhouse constructed for a city pool may be several times as expensive as a similar facility adjacent to a rural pond -- it may need to be of more permanent construction to meet local codes and to resist heavier use and abuse. Beyond such generalizations as the general location and quality of facility, detailed designs of the alternatives themselves are unwarranted and rules-of-thumb cost estimates must be used and are adequate for comparison of alternatives.

The consultants have compiled cost estimates for recreation facilities from several sources including the original cost estimates for TILP prepared by the Corps of Engineers, figures published by the Bureau of Outdoor Recreation in Outdoor Recreation, A Legacy for America, Outdoor Recreation Facility Cost Estimates, published in December 1973; cost estimates used by the Pennsylvania Department of Environmental Resources and the New Jersey Department of Environmental Protection in their recreation planning; and several specific facilities with which the consultants were familiar. A summary of the data compiled from these sources is presented in a series of tables in the appendix to this chapter.

In all cases cost indexes published by Engineering News Record were used to escalate costs to a November 1974 level. (Although not done at this stage in the analysis, all construction costs are later increased by a contingency factor of 25 percent used by the consultant in this study.) From these sources the consultant has developed unit cost factors for application to the programs developed for each alternative; these are summarized in Table 13-3 below along with estimated annual operating and maintenance costs.

Table 13-3 Unit Costs Used in Estimating Costs of Recreation Alternatives

	Construction Cost 1/	Operating and Maintenance 2/
Swimming Beach	$200-300	$ .35
Swimming Pool	$400-500	$ .35-50
Picnicking	$850	$ .25
Boating	$100-200	$ .50
Camping	$1,300	$1.00
Hiking	$500	$ .15
Bicycling	$1,000	$ .50

Note: These construction cost estimates are based on the data summarized in a set of tables in the appendix to this chapter. The unit costs in the above table are representative of that information on a per participant basis.

1/ Per person of instant capacity.

2/ Per annual activity day.

The operating and maintenance cost estimates are annual expenses per activity day in each of the indicated activities. The principal source for these estimates are detailed calculations done by the Pennsylvania Department of Environmental Resources of their actual costs during the 1973-74 fiscal year. These two cost components, construction and O&M, cover most costs associated with all the alternatives. The construction costs include development of the site and a pro rata share of roads, utilities, sanitary facilities and the like. For those alternatives which require land acquisition or some construction cost calculation different from the standard factors presented above, the detailed discussions will specify the factors used.

XIII.E.3. RECREATION BENEFITS

Such a large component of America's recreation need is provided by the public sector that there is not a large body of market experience which can be used to define the value of the recreation product produced by TILP or any of the alternative programs. While there have been surveys conducted and statutory standards referred to in the course of the project's history, there is no real agreement as to what the value of a recreation experience is. The latest federal guideline, the Water and Related Land Resources: Establishment of Principles and Standards for Planning by the Water Resources Council, in describing methods of calculating recreation benefits says that the "applicable rule to follow . . . is to use that procedure which appears to provide the best measure or expression of willingness to pay by the actual consumer of the recreation good or service provided by the plan." The Principles and Standards go on to suggest simulated prices per recreation day ranging from $.75 to $2.25 for general recreation activities (swimming, picnicking, boating and most warm water fishing) and $3.00 to $9.00 for specialized recreation activities (those for which opportunities are limited, intensity of use is low and often involve a large personal expense by the recreationist).

In contrast, the Corps of Engineers has used $1.35 per recreation day in its evaluation of TILP since the publication of Supplement #1 to Senate Document 97 in 1964; this was a reduction from the $1.65 which had been use in House Document 522. The Water Resources Council's Principles and

Standards suggests a range of benefits approximately 50 percent higher than those specified in Supplement #1 so a proportionate increase in the Corps' benefit estimate would call for using $2.03 per visitor day as a current measure of recreation benefit.

The term "willingness-to-pay" sounds straightforward but encompasses a wide range of possible definitions and economic concepts. A simple measure of private market charges for similar facilities has often been used to judge willingness to pay. The consultants surveyed numerous private facilities in the Tocks Island impact area to determine the extent to which commercial establishments do provide comparable recreation opportunities and what their charges are.

Camping provides the most comparable commercial market experience. Private campgrounds in the area charge between $4 and $5 for a basic campsite with an additional charge ranging from $.50 to $1.25 for electric and water hookups. Given a maximum of four persons per campsite, this would suggest a range of $1 to $2 per person. Most of these campsites included swimming facilities and other recreation amenities.

Charges at commercial swimming areas range from $.50 to $1.00 for adults and less for children -- not counting guest fees at private clubs which run much higher. At some areas, such as Lake Wallenpaupack, there is no specific charge for swimming but a parking fee of $1.00, picnicking fee of $1.50 or boat launching fee of $1.00 would also allow a person to swim. Note then that the effective fee per person could be as low as $.25.

Boat launching fees on private lakes runs as high as $4 for a ramp and $6 (each way) for hoist. Again, the per person charge would be in the range specified by the Water Resources Council.

The fees charged for use of private and some public facilities in the Tocks Island impact area are summarized in the appendix to this chapter. All in all, it would appear that these actual private market charges are somewhat less than the benefit figures recognized by the Water Resources Council; but such actual charges represent only one point on the demand curve and neglect two important considerations. First is the imputed value gained by those who would have paid more than the market price had they been asked, and the second is the average benefit to those who are not now willing to pay the fee but would use the facility if the fee were lower or free as would be the case with a public recreation facility. Whether in fact the private market price represents a true average benefit accruing to the number of people who would use the facility if it were free depends upon the shape of the demand curve for each activity.

Another concept of willingness to pay would be the willingness of society as a whole to pay for the availability of recreation opportunities whether they use them or not. By this measure it would be fair to say that the benefits of public recreation activities are at least equal to their costs or people would not continue to pass bond issues or re-elect legislators who are providing the current level of service. Using this concept, the "benefits" of the seven alternatives discussed in this chapter range from

$.55 to almost $3.00 per visitor day. This approach would certainly underestimate benefits for activities such as wilderness hiking and camping where there is little or no associated facilities cost.

On an activity-by-activity basis and using the cost and visitation figures described in Tables 13-2 and 13-3, this approach would suggest that the benefit per activity day is $.63 for swimming, $1.02 for picnicking, $2.29 for camping and $.60 for boating. Because these figures are for activity days (a participation in each activity) as opposed to visitor days to the park (the measure used in the benefit calculations) these figures would be additive depending on how many activities a visitor participated in on a given day. Using a factor of 1.4 to represent such multiple participation (an average figure described elsewhere in this chapter) the average value of a recreation day would be $1.50 based on facility development cost -- an understatement of true cost since this figure does not include land.

Hard conclusions concerning recreation benefits are difficult to make. The analytical techniques do not exist to define benefits precisely and it is questionable whether the public benefit should even be reduced to dollar terms at all. Nevertheless, the consultants have concluded that the $2.03 measure authorized by WRC's Principles and Standards is a reasonable estimate and a fair basis for comparison of alternatives -- but only if more subjective and nonquantifiable evaluations are given equal weight in the analysis.

XIII.E.4. IMPACT EVALUATION CRITERIA

This portion of the section introduces the broad criteria that were developed in order to evaluate each of the various recreation alternatives. In addition, the underlying assumptions and the method of criteria selection are also discussed. These general comments, at this point in the report, will alleviate much repetitive explanation in the section evaluating the alternatives by providing a common understanding of terminology and assumptions.

Selection of the impact evaluation criterion began from a long list covering some 134 economic, social, environmental, transportation, land use, planning and institutional aspects provided by appropriate members of the consultant team. This exhaustive list of criteria was culled to select the most significant points in each area and those most relevant to the recreation alternatives. The final matrix used for evaluation is shown in Table 13- 4 below.

The evaluation matrix covers the entire spectrum of criteria and is divided into six major headings: balanced development, social, institutional, economic, natural environment and recreation. Each of these major headings includes the major areas of possible impact that could occur should a particular alternative be implemented.

Table 13-4. Impact Evaluation Criteria for Recreation Alternatives

Balanced Development

1. Preservation of open space
2. Achieve land use objectives
3. Achieve transportation objectives

Social

1. Promote existing values and lifestyles
2. Preserve historical and archeological sites
3. Minimize displacement of people and business

Economic

1. Generate local employment opportunities
2. Generate local retail and service expenditures
3. Increase local property values

Institutional

1. Minimize local government public service needs
2. Increase property and sales tax base
3. Ability of local government to handle growth

Natural Environment

1. Minimize flora and fauna disturbance
2. Minimize solid and liquid waste generation
3. Minimize air, water and noise pollution

Recreation

1. Provide needed facilities
2. Provide high quality experience

It should be noted that each recreation alternative was evaluated in terms of the impacts it would create at the geographical location where it is to be located, not necessarily the same impact areas as TILP. For example, if neighborhood parks and pools are to be developed in New York City, the evaluation was based on the impact on New York City and the effect the alternative would have on its social, economic, institutional and natural setting there.

The first major area of impact is balanced development. This category evaluates impacts on preservation of open space and achievement of both land use and transportation objectives. The land use objectives to be reached include maintenance or enhancement of the local residential neighborhood's physical quality by providing recreation facilities designed not to generate heavy traffic loads, create parking problems or otherwise infringe on a residential area. The degree to which commercial or industrial areas will be induced without adequate development controls is also considered. In addition, the impact on balanced community growth within the capabilities of existing utilities is also a factor. The transportation objectives are minimizing private auto useage by recreationists and general suitability of the project to be served by public transportation. Also considered under the transportation section is the adequacy of the existing roads to serve the anticipated visitor loads.

The social factors considered include study of the impacts on existing values and lifestyles and whether the proposed project would introduce a recreation element that would alter these values or run counter to local citizen aspirations and desires. Promoting local historical and archeological site preservation is also a valid consideration but one that is dependent on how a project is carried out. If surface consideration is given to the problem but no positive steps are taken to ensure site preservation then the impacts would be negative. For this reason, the impacts on this criteria are often qualified depending on site selection. The final social component is the required relocation or displacement of people or businesses due to taking of private lands for recreation use. Much of the criticism of the Tocks Island project centers on this very point and is certainly a major impact on local residents.

The institutional impacts consider the problems the location of a major recreation facility can create on the local government. Of concern in this area is the anticipated project impact on the fiscal structure of the local government and the ability of the government to handle the non-financial aspects such as community planning and development. The question is whether the required increases in essential government services as police and fire protection or water and sewer treatment will be matched with increases in local tax revenues to pay for these additional services. To address this question, impacts on the economic sector must be evaluated since local revenues come mainly from property and sales tax. The nonfiscal aspect evaluates the local governments' ability to control anticipated growth (residential, commercial or industrial) through land use controls, zoning regulations and the like.

The economic impacts deal with the extent to which the proposed project will generate local employment opportunities of either a temporary nature in construction of facilities or more permanently in businesses serving the recreationist. In addition to jobs, increases in retail sales and service expenditures along with general increases in property values are evaluated.

Impacts on the natural environment are a major part of this overall investigation and the first component of this topic is the level of disturbance of flora and fauna. This question must be considered on a broad basis and does not include a detailed evaluation of impacts on delicate microcosoms or certain endangered species because most of the alternatives are not site specific. Solid and liquid waste generation is important because many rural areas rely on septic tanks or primary treatment systems and cannot handle large increases in their present load without severe fiscal impact on the local government. The third environmental factor is the impact on air and water quality. Pollution can come from many sources such as transportation by private auto, untreated sewage or waste disposal, or even from the recreationist himself through increased noise levels and litter. It is obvious that evaluation of this factor is highly interrelated with the evaluation of many other previously mentioned factors.

Under recreation, providing needed facilities and the quality of the experience are the components. Since these alternatives are recreation oriented it stands to reason that they would rank generally positive. However, there are some wide-ranging levels of service in the various plans and some idea of their relative level of service is important.

In conclusion, the evaluation matrix is an attempt to key in on the important impacts that are anticipated by these various alternatives and provide a basis by which to evaluate the impacts on the local community and set a framework for the more detailed evaluations of the alternative programs in Chapter XVI. In the evaluations of viable recreation alternatives presented in the remainder of this chapter, the general evaluation rating is moderate or high impact, applicable to either a positive or negative impact, or no impact thus providing a five point scale from high positive to none to high negative impacts.

XIII.F. DETAILED EVALUATION OF VIABLE ALTERNATIVES

The seven viable recreation alternatives have been programmed in terms of physical facilities, costs, institutional responsibility and, where appropriate, general location. These detailed components provide the basis for the impact assessment and the more refined evaluations of those recreation alternatives which are selected for combination with viable alternatives for the other authorized purposes in Chapter XVI.

Again it should be noted that each alternative is described separately; but it is assumed that the river-based DWGNRA, as described first, would be combined with any of the other alternatives implemented.

XIII.F.1. RIVER-BASED DWGNRA

This alternative is discussed in detail in Chapter XVIII of Part D and will be reviewed only briefly here. This alternative envisions a river-oriented recreation facility in DWGNRA. There are several different concepts based on this type of facility such as that proposed by the Save the Delaware Coalition and the several alternatives being developed by the National Park Service. SDC's plan was used for analysis of instant capacity and annual visitation in this chapter only because their plan was sufficiently developed to permit such calculations. It is important to know an approximate level of development especially for comparative purposes and overall impact evaluation; so the SDC plan was selected on that basis only and its selection does not necessarily imply that the consultant is recommending this development concept, which is shown graphically on Figure XIII-1.

XIII.F.1.(a) Detailed Description

This alternative envisions DWGNRA centering around a free flowing Delaware River and a relatively low intensity of recreation development. Specific action required by this plan would include continuation of land purchase within DWGNRA to complete the now proposed boundaries and development of recreation facilities to accommodate about 40,000 persons at one time.

The underlying philosophy of this plan is to preserve the Delaware River in its natural state and to concentrate the recreation facilities on land-based activities such as camping, river edge swimming, picnicking and hiking.

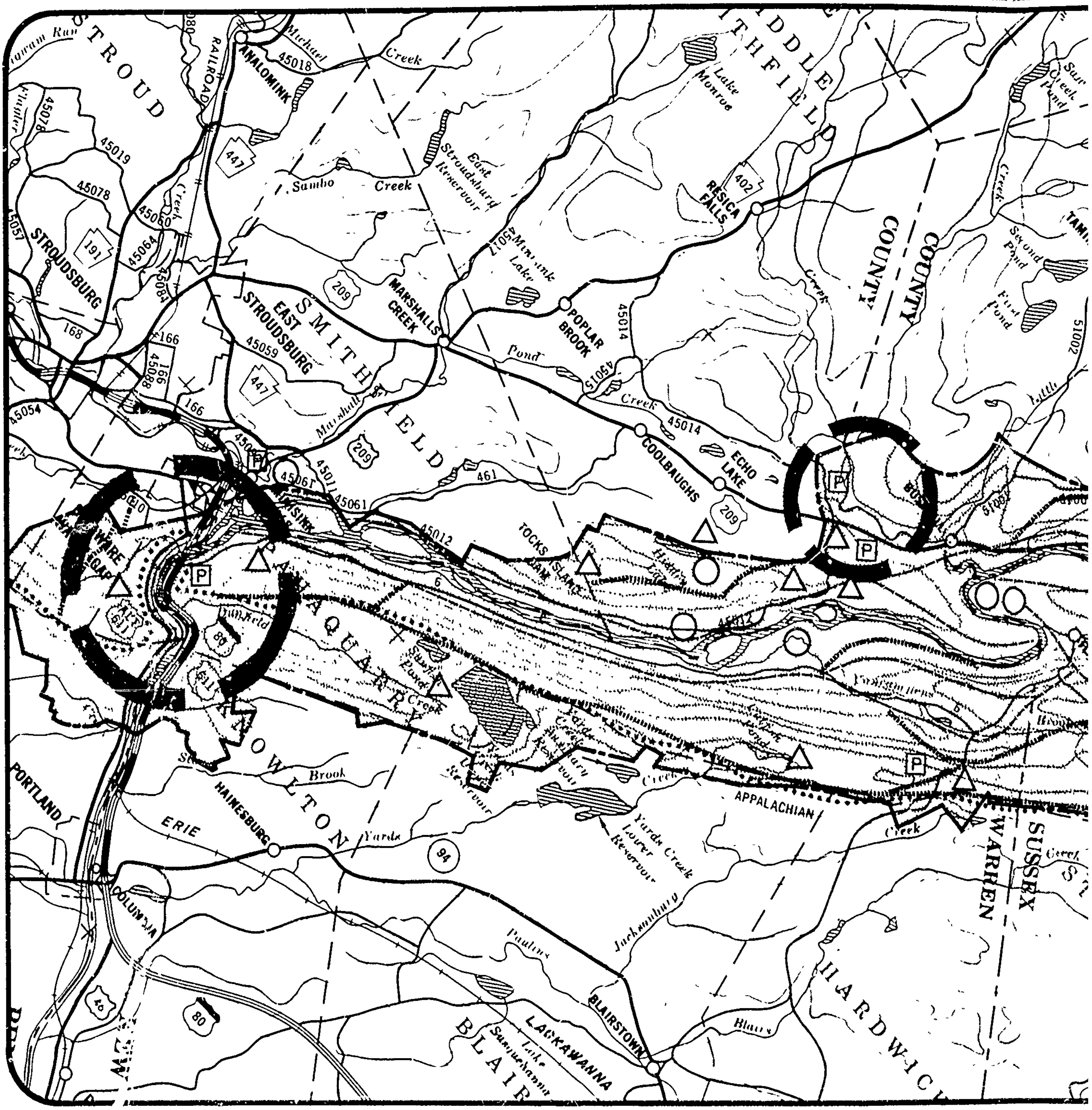
Boating would be allowed and would contribute much to the total recreation experience; however, this boating would differ from the kind expected in the DWGNRA with TILP plan. The differences are that this plan sees more canoeing and rafting as opposed to more active motorboating and waterskiing. The increases in land-based recreation are possible due to the 12,000 additional acres of land available that would otherwise be inundated by TILP.

The level of service that will occur under this plan is comparable to the first phase of the Clarke & Rapuano plan. The proposed instant capacity of 40,000 is very similar; but beyond capacity, the type and quality of recreation experience are very dissimilar. The river-based DWGNRA provides a variety of recreation alternatives, some comparable to DWGNRA with TILP, but in foregoing the water-based recreation opportunities it gains the opportunity to capitalize on historical and archaeological activities. By not flooding the Delaware Valley, these sites are preserved in their original setting and this additional land availability offers an opportunity for many nature study facilities that may otherwise be lost due to TILP.

As mentioned previously, the figures shown as the components of instant capacity are based on the concept plan presented by the Save the Delaware Coalition. This plan provides for a maximum DWGNRA instant capacity of 40,000 people participating in eight various recreation activities. The percentage of people participating in a particular activity on a typical summer Sunday was assumed to be proportional to the width of the perspective bars shown in Figure 1 of <u>A Concept Plan for the Delaware River Park,</u>

page 38. The instant capacity figures for each activity were translated into activity days and annual visitations using the formulas developed in Chapter IV. The resultant yearly activity days per visitor were adjusted by a factor which accounts for the number of secondary activities generated by one visitor. The derivation of this factor computation is shown in Table 13-5 and its subsequent application to the annual activity days per visitor is shown in the following table along with the instant capacities, activity turnover and yearly peak day capacity.

Note that in this alternative the term "active sightseer" refers to people visiting historic sites, museums, interpretive centers and similar facilities and are therefore included in the initial capacity and visitation estimates. The pure sightseer who drives through without stopping is then a smaller percentage of the total visitation than in other alternatives because of the availability of these additional attractions.


STROUD
STROUDSBURG
EAST STROUDSBURG
SMITHFIELD
MIDDLE SMITHFIELD
RAILROAD
ANALOMINK
Michael Creek
Lake Monroe
East Stroudsburg Reservoir
Sambo Creek
Marshalls Creek
MARSHALLS CREEK
POPLAR BROOK
RESICA FALLS
COOLBAUGHS
ECHO LAKE
COUNTY
COUNTY
Second Pond
East Pond
TOCKS ISLAND DAM
KNOWLTON
PORTLAND
HAINESBURG
ERIE
COLUMBIA
Yards Creek Lower Reservoir
APPALACHIAN
SUSSEX
WARREN
HARDWICK
Paulins
Jacksonburg
BLAIRSTOWN
LACKAWANNA
Lake Susquehanna
BLAIR
Brook
209
447
191
402
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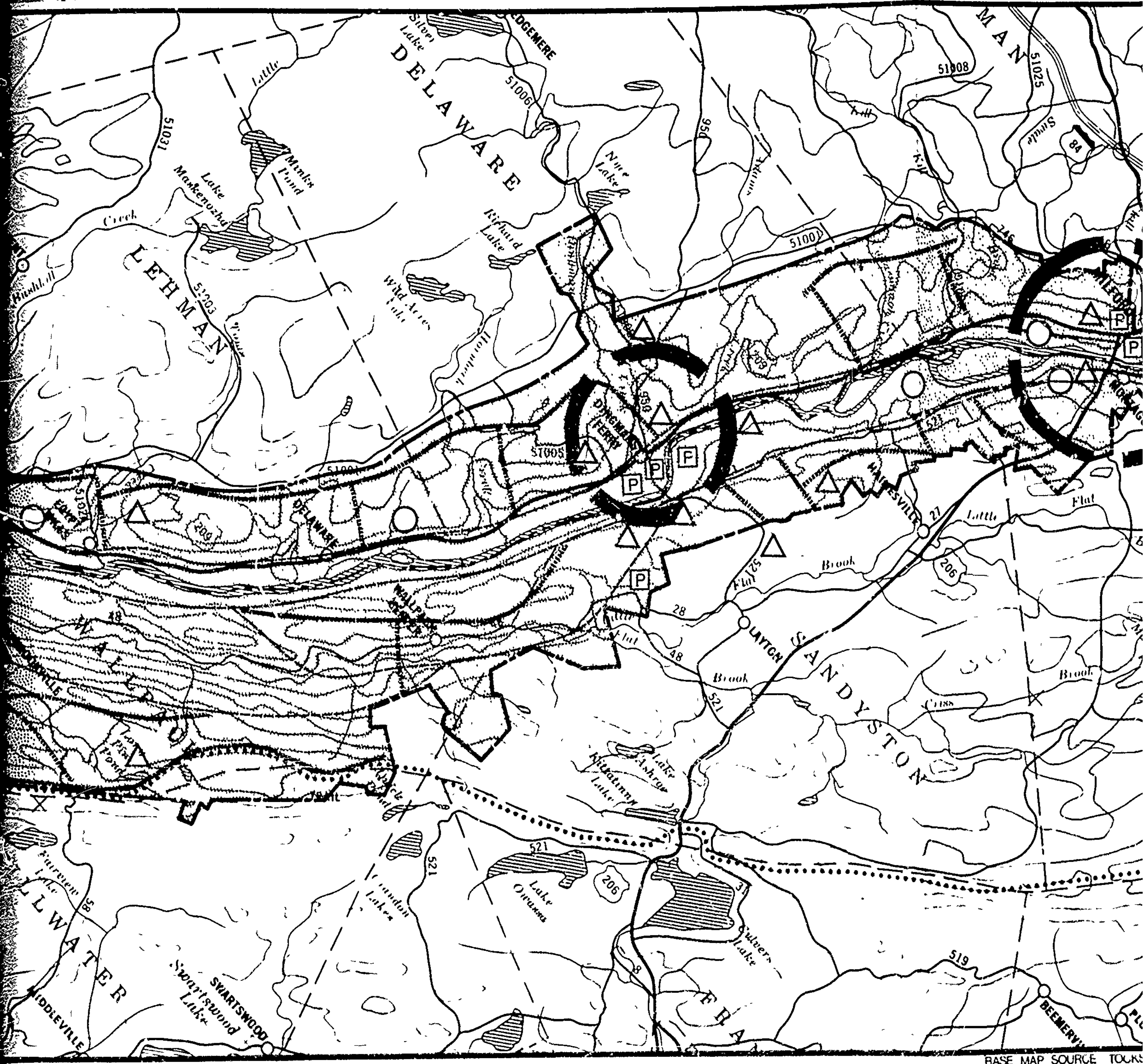

BASE MAP SOURCE TOCKS

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SCALE IN MILES

LEGEND

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- ○ RIVER EDG
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- APPALACHIA
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PLAN AS PER THE "S

ACTIVITY N

TOCKS I

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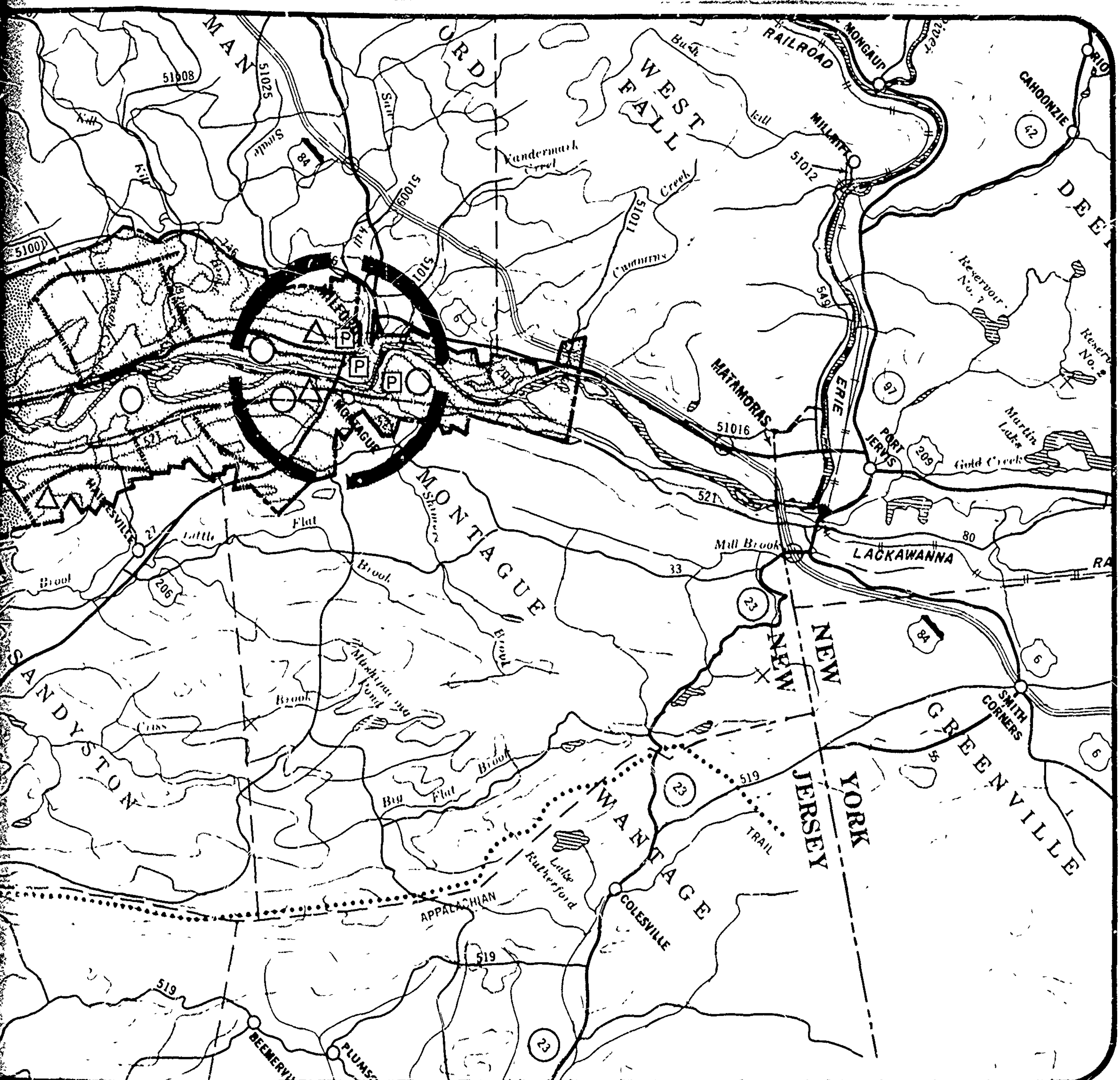


BASE MAP SOURCE TOCKS ISLAND REGIONAL ADVISORY COUNCIL

0 .5 1 1.5
SCALE IN MILES

N

DWGNRA WITH A FREE FLOWING RIVER (NO PUBLIC PROGRAMS)

XIII
1

LEGEND

- △ CLUSTERED CAMPSITES
- ○ RIVER EDGE SWIMMING
- HIKING TRAILS
- BIKING TRAILS
- APPALACHIAN TRAIL
- P PARKING - AVERAGE 700 SPACES PER LOCATION

PLAN AS PER THE "SAVE THE DELAWARE COALITION" PROPOSAL

ACTIVITY NODES

3

A COMPREHENSIVE STUDY OF THE

TOCKS ISLAND LAKE PROJECT & ALTERNATIVES

URS / MADIGAN-PRAEGER, INC. & CONKLIN AND ROSSANT

Table 13-5. Assumptions of Activity Days in Primary and Secondary Activities Generated by One Visitor in a Primary Activity

Primary Activities		Camping	Picnicking	Swimming	Boating	Sight-seeing	Biking/Hiking	Fishing	Other		Total
		Primary and Secondary Activities									
Camping	(1)	1.00	0.00	0.70	0.10	0.10	0.70	0.10	0.10		2.80
	(2)	1.00	0.00	0.667	0.307	0.725	0.888	0.319	0.251	(4)	2.58
	(3)	1.00	0.00	0.667	0.307	0.725	0.888	0.319	0.251		2.10
Picnicking	(1)	0.00	1.00	0.40	0.10	0.25	0.30	0.10	0.20		2.35
	(2)	0.263	1.00	0.667	0.307	0.725	0.888	0.319	0.251	(4)	2.71
	(3)	0.263	1.00	0.667	0.307	0.725	0.888	0.319	0.251		2.21
Swimming	(1)	0.15	0.60	1.00	0.20	0.20	0.10	0.10	0.15		2.50
	(2)	0.263	0.706	1.00	0.307	0.725	0.888	0.319	0.251	(4)	2.73
	(3)	0.263	0.706	1.00	0.307	0.725	0.888	0.319	0.251		2.23
Boating	(1)	0.15	0.25	0.40	1.00	0.15	0.10	0.40	0.05		2.25
	(2)	0.263	0.706	0.667	1.00	0.725	0.888	0.319	0.251		2.91
	(3)	0.263	0.706	0.667	1.00	0.725	0.888	0.319	0.251		2.42
Sightseeing	(1)	0.00	0.25	0.10	0.00	1.00	0.10	0.00	0.05		1.50
	(2)	0.263	0.706	0.667	0.307	1.00	0.888	0.319	0.251		2.70
	(3)	0.263	0.706	0.667	0.307	1.00	0.888	0.319	0.251		2.20
Biking/Hiking	(1)	0.20	0.30	0.25	0.10	0.30	1.00	0.10	0.10		2.35
	(2)	0.263	0.706	0.667	0.307	0.725	1.00	0.319	0.251		2.62
	(3)	0.263	0.706	0.667	0.307	0.725	1.00	0.319	0.251		2.12
Fishing	(1)	0.30	0.15	0.20	0.40	0.10	0.10	1.00	0.10		2.35
	(2)	0.263	0.706	0.667	0.307	0.725	0.888	1.00	0.251		2.90
	(3)	0.263	0.706	0.667	0.307	0.725	0.888	1.00	0.251		2.40
Other	(1)	0.05	0.05	0.05	0.05	-	-	0.25	1.00		1.25
	(2)	0.263	0.706	0.667	0.307	0.725	0.888	0.319	1.00		2.93
	(3)	0.263	0.706	0.667	0.307	0.725	0.888	0.319	1.00		2.43

(1) Consultants' estimate.
(2) Ide Associates percent of population participating for secondary activities divided by two (indicating their lesser importance) plus 1.00 for primary activity.
(3) Ide Associates percent of population participating for secondary activities plus 1.00 for primary activity; the sum divided by two.
(4) Sum of Ide Associates horseback riding and hunting (percent of population participation).

Table 13-6. Capacity and Visitation of DWGNRA Without TILP (Assuming 40,000 Instant Capacity)

	Swimming	Picnicking	Camping	Boating	Hiking/ Biking	Active Sight-Seeing 5/	Fishing	Other	Total
% of Total Instant Capacity 1/	15.6%	17.3%	15.2%	9.5%	15.2%	15.2%	6.2%	5.8%	
Instant Capacity	6,240	6,920	6,080	3,800	6,080	6,080	2,480	2,320	
Daily Turnover 2/	1.5	1.5	1.0	2.0	5.0	2.0	2.0	2.0	
Daily Activity Days/ Visitation (within 24-hour period)	9,360	10,380	6,080	7,600	30,400	30,400	4,960	4,640	
% Yearly Capacity 3/ on Peak Day	2.3%	2.2%	1.6%	1.6%	1.6%	1.6%	1.0%	1.6%	
Yearly Activity Days/Visitation	406,957	471,818	380,000	475,000	1,900,000	1,900,000	496,000	290,000	
Number of Activity 4/ Days/Visitor	2.50	2.35	2.80	2.25	1.50	2.35	2.35	1.25	
Annual Visitors	163,000	201,000	136,000	211,000	809,000	1,267,000	211,000	232,000	3,230,000
Plus Drive Through Sightseers									633,000
TOTAL ANNUAL VISITATION									3,863,000

1/ Source: Chapter XVIII assumptions from page 48 of the Save the Delaware Concept Plan.
2/ From Chapter IV.
3/ From Chapter IV.
4/ Consultants' estimate (1) taken from assumptions stated on Table 13-5.
5/ Excludes 25% of total sightseers assumed to drive through DWGNRA and not stop.

XIII.F.1.(b) Project Costs and Benefits

This alternative taken alone is the most costly of them all because of the need to acquire all of the land in the designated DWGNRA without other "authorized purposes" to absorb a share of the cost. But since this alternative is assumed to be a part of any final package of alternatives, this cost cannot be avoided.

As of March 31, 1975, a total of 47,750 acres had been acquired for both DWGNRA and TILP for a total cost of about $90.6 million, or nearly $1,900 per acre. For purposes of costing this alternative, the consultant has assumed an average cost of $2,000 per acre for the remaining 21,940 acres for a total land cost of $134.4 million. Since relocation of Highway 209 would be required to achieve a viable recreation area, some portion of this cost must be allocated to the recreation area. Out of an estimated cost of $31,550,000, the consultants have allocated $15,000,000 to DWGNRA. Facilities costs and annual operations and maintenance costs, calculated from the factor presented earlier are shown below, and benefits are shown at $2.03 per visitor.

Development Costs + 25%[1/]	$ 39,967,500
Land Costs	134,410,000
Total First Costs	$174,377,500
Annual O&M Costs	$ 1,377,000
Annual Benefits	$ 7,842,000

1/ Includes $15,000,000 for relocation of Highway 209.

XIII.F.1.(c) Institutional Aspects

The institutional aspects of this alternative should pose the fewest problems of any alternative. This alternative is the baseline of all alternatives and if nothing else happens at least this will, or at least in the sense of completing the land acquisition for DWGNRA. This is not to say this acquisition will occur within the budget, and in fact there is every indication that it will not. However, as addressed in Chapter XIX, completion of DWGNRA even if TILP is deauthorized seems likely. In addition, the NPS plan for development of a river-based DWGNRA fits in very well with the type of recreation facilities they provide elsewhere in the U.S. and little difficulty is foreseen in their continuation along these lines should this alternative be selected.

XIII.V.1.(d) Impact of River-Based DWGNRA

On balance the overall impacts of this alternative are positive. The quality of recreation is enhanced while most of the negative impacts associated with higher intensive use are either lessened or changed to positive impacts.

The impacts on balanced development are expected to be positive especially by the preservation of open space. The entire lands purchased by the Corps will be less intensively developed and can properly be termed open space with this level of development. Some land use objectives are sacrificed here in that extensive commercialization of the surrounding area is very possible. Transportation objectives can not be substantially met through public transit, and existing roads could be made adequate with a moderate level of improvement for forecast visitor levels, as indicated in Chapter XXV.

The social impacts are mixed. Historical and archaeological sites have a better opportunity for preservation and public exposure; but the continued displacement of local residents is inevitable with continued purchase of land for DWGNRA. The existing lifestyles on both sides of the Delaware River will be enhanced; Pennsylvania will benefit from some visitor increases over the present level and New Jersey may be able to retain its rural image -- depending, of course, on the physical design of the park.

Moderate gains in local employment growth are expected to accommodate new recreation visitor growth. Retail sales and property values should increase significantly and these in turn will increase the local tax base which may offset the required expenditures for government services. The reduced level of activity will create less growth pressure for development to occur in the area surrounding DWGNRA.

Flora and fauna disturbance will be held to a minimum and will probably be much less than if the area were left for private development. Minimal negative impacts are expected from increased waste generation, and with proper funding to provide sanitary facilities the problem should not degrade the environment.

Finally, the recreation impacts are very positive in both the level and quality of service. Needed recreation facilities are provided, and developed to the extent that they can fit well with the surrounding countryside. In fact, this scheme will allow significant numbers of visitors to enjoy the DWGNRA area without disturbing it environmentally.

Table 13-7. Impact of River-Based DWGNRA

Balanced Development	
1. Preservation of open space	Highly positive
2. Achieve land use objectives	Moderately negative
3. Achieve transportation objectives	Moderately negative
Social	
1. Promote existing values and lifestyles	Moderately positive
2. Preserve historical and archeological sites	Highly positive
3. Minimize displacement of people and business	Highly negative
Economic	
1. Generate local employment opportunities	Moderately positive
2. Generate local retail and service expenditures	Highly positive
3. Increase local property values	Highly positive
Institutional	
1. Minimize local government public service needs	Moderately negative
2. Increase property and sales tax base	Highly positive
3. Ability of local government to handle growth	Moderately positive
Natural Environment	
1. Minimize flora and fauna disturbance	Moderately positive
2. Minimize solid and liquid waste generation	Moderately negative
3. Minimize air, water and noise pollution	Moderately negative
Recreation	
1. Provide needed facilities	Moderately positive
2. Provide high quality experience	Highly positive

XIII.F.2. PIGGYBACK RECREATION ON WATER SUPPLY DAMS

If smaller dams on tributaries of the Delaware are built for flood control and/or water supply, it is logical to look to these facilities to also serve recreation needs. The analyses of alternatives for flood control and water supply in Chapters XV and XIII, respectively, identify seven dams which might be appropriate for recreation. These dams and their characteristics are listed in the table below and their locations are shown in Figure XIII-2, which follows.

Table 13-8 Water Supply and Multipurpose Projects Available for Recreation

	Permanent Pool Acres	Land Area 1/
Hackettstown	1,000	4,600
McMichael*	1,180	5,410
Shohola Falls*	1,190	5,455
Girard*	830	3,820
Tobyhanna*	2,600	11,960
Hawley*	850	3,910
Lackawaxen	1,140	5,225

1/ Does not include water acrease.

* Multipurpose water supply and flood control reservoirs. All others are water supply reservoirs only.

The land area shown in this table is that which consultants consider necessary to provide recreation opportunities comparable to TILP; if the facility was restricted to water supply and flood control, the land acreage could be limited to an amount equal to the pool size. This additional land need is then considered a part of the cost of the recreation alternative.

XIII.F.2.(a) Detailed Description

Considering the size, location and recreation capacity of these projects, it appears that a package of five of these, developed to the same level, relative to their size, as TILP represents the most viable configuration for this alternative: Hackettstown, McMichael, Shohola Falls, Tobyhanna and Lackawaxen. The potential instant capacity and annual visitations (derived from the factors discussed previously) are shown below. Additional recreation facilities could be developed in the floodplains protected or controlled by nonstructural means, but the dam-based facilities are the principal element of this alternative.

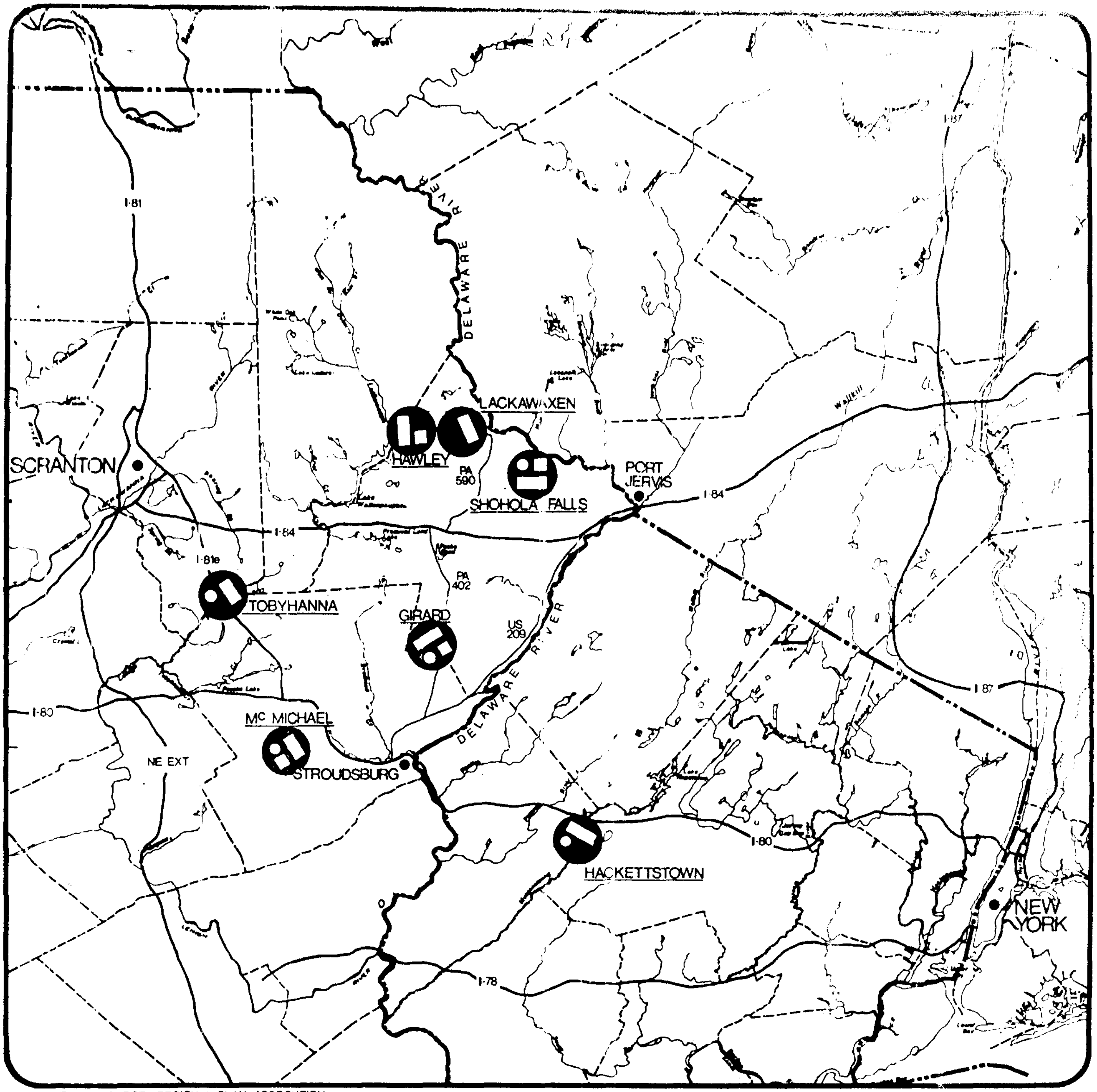
Table 13-9 Programmed Instant Capacity and Annual Visitation for Piggyback Alternative

	Instant Capacity	Activity Days
Swimming	27,715	1,808,000
Picnicking	30,825	2,102,000
Boating	4,880	610,000
Camping	11,830	739,000
Total Primary Activity Days		5,259,000
Total Annual Visitors 1/		6,574,000

1/ Overlap factor of 1.4; other activities factor of 1.4 and 20% sightseers.

XIII.F.2.(b) Project Costs and Benefits

Costs of implementing this alternative on the five reservoirs indicated come to nearly $115 million making it the most expensive alternative other than DWGNRA itself. This high cost is due to the additional land acquisition necessary. Total costs and benefits are summarized below:



BASE MAP SOURCE: REGIONAL PLAN ASSOCIATION

0 5 10 15
SCALE IN MILES

N

PIGGY BACK RECREATION ON WATER SUPPLY & MULTI-PURPOSE RESERVOIRS

XIII

2

LEGEND

- DAM SITE LOCATION
- MULTI-PURPOSE DAM/FLOOD CONTROL AND WATER SUPPLY
- DAM SELECTED FOR RECREATIONAL PIGGY BACKING

A COMPREHENSIVE STUDY OF THE

TOCKS ISLAND LAKE PROJECT & ALTERNATIVES

URS / MADIGAN-PRAEGER, INC. & CONKLIN AND ROSSANT

Development Costs + 25%	$ 63,588,450
Land Costs	51,080,000
Total First Costs	$114,668,450
Annual O&M Costs	$ 2,202,000
Annual Benefits	$ 13,345,000

XIII.F.2.(c) Institutional Aspects

Sites which involve flood control could be federally funded and built by the Corps. A few of the smaller projects might fall under the domain of the Soils Conservation Service. A problem with capital funding arises, however, with the larger projects which would not include flood control, and these might have to be delayed until state or local agencies could include them in their budgets.

Due to the scattered nature of these sites and their relatively small size, most if not all of these projects would not involve the National Park Service. Depending upon the exact location of each, the recreation areas would have to be maintained and operated by state, county or local recreation departments -- or the Corps itself. The willingness of each agency to add projects to their existing systems, and their ability to acquire additional funding would of course be a factor in the viability of this alternative.

XIII.F.2.(d) Impacts of Piggybacking

The overall rating of this alternative appears to be moderately positive; however, implementation of this project would cause some serious problems in the natural environment. On the other hand, it would provide much of the needed recreation facilities and offer the recreationist a high quality experience.

From the standpoint of balanced development, moderately positive impacts are anticipated with some offsetting negative impacts resulting from transportation problems. Since the areas are presently in a rural setting, government purchase of land and development of parks adjacent to the reservoirs would preserve much of the existing open space. Even though this open space would be developed for recreational use in varying degrees of intensity, the result will be more open space than if private second home development were to occur. Land use objectives will be achieved through preserving the character of local communities and to some extent by balancing growth commensurate with utility capabilities since the development of these areas is geographically dispersed. This dispersion, while creating lessened impacts on land use objectives, creates problems for the transportation objectives in that it encourages use of private cars since the more remote and scattered sites are less suitable for public transit.

The social impacts are mixed. Historical and archeological impacts should be moderately positive, if planned and developed well, while displacement of people and business when land is bought may be significant depending on actual site selection. The institutional impacts tend to be moderately positive overall and the increased requirements for governmental services are offset in the larger context. One offsetting factor is an increase in the tax base resulting from increased tourism and economic activity; however, the timing of the increased tax base could lag the required service needs and put some short term pressure on the local governmental fiscal posture. In addition, some land will be removed from the tax rolls when the recreation land is purchased by the government. The other off-setting positive impact comes again from the reduced size of the planned facility in that local governments will be in a better position to deal with new growth when it comes in smaller increments. In the economic category, some increases in local employment is expected, and also an increase in retail and service business as a result of the increased tourist business. Some increase in local property values is expected on the strength of the growth in recreation oriented businesses and second homes.

As mentioned previously, the natural environment will receive highly negative impacts in all aspects. Flora and fauna will be disturbed from both construction and visitor useage. Solid and liquid wastes will be generated in quantities that will probably require central treatment facilities, and the bucolic rural area will undoubtedly suffer increases in air, water and noise pollution compared to present standards. This critique is not to say that certain environmental problems can't be alleviated through proper planning and funding of corrective measures.

The level and diversity of recreation development that is possible in this alternative will certainly go a long way in providing needed facilities. If these facilities are well planned the quality of experience will be heightened if for no other reason than lessened facility crowding.

Table 13-10. Impacts of Piggybacking

Balanced Development	
1. Preservation of open space	Moderately positive
2. Achieve land use objectives	Moderately positive
3. Achieve transportation objectives	Moderately negative
Social	
1. Promote existing values and lifestyles	Little or none
2. Preserve historical and archeological sites	Moderately positive
3. Minimize displacement of people and business	Moderately negative
Economic	
1. Generate local employment opportunities	Moderately positive
2. Generate local retail and service expenditures	Moderately positive
3. Increase local property values	Moderately positive
Institutional	
1. Minimize local government public service needs	Moderately negative
2. Increase property and sales tax base	Moderately positive
3. Ability of local government to handle growth	Moderately positive
Natural Environment	
1. Minimize flora and fauna disturbance	Highly negative
2. Minimize solid and liquid waste generation	Highly negative
3. Minimize air, water and noise pollution	Highly negative
Recreation	
1. Provide needed facilities	Highly positive
2. Provide high quality experience	Highly positive

XIII.F.3. NEW STATE PARKS AND PROGRAMS

This alternative proposes major new state recreation facilities on newly acquired sites. This proposal is different from the other alternatives in several significant respects. It calls for an urban orientation and a new form of state park, quite different from the existing facilities whose use can be expanded under another alternative; and unlike the neighborhood pools and parks, the proposed facilities would be of citywide or even regional significance.

XIII.F.3.(a) Detailed Description

Rather than a utopian dream, this alternative actually reflects current recreation policy thinking within the recreation service area. Prototypes range from the 22-acre Roberto Clemente State Park in New York City (66 percent built) to the 26,000-acre Gateway National Recreation Area. Parks similar to these offer a vastly different set of recreation experiences than do those in rural hinterlands. Facilities are concentrated and designed for intensive use and accessible by urban public transit.

While swimming and boating are major activities, cultural enlightenment, environmental education, social interaction and exercise would be the primary recreation benefits accruing from such a park. Such activities, as well as simple reflection and contemplation, would heighten, rather than reject the pleasures of urban living. While being totally different, these parks would still provide visitors with the same sense of regeneration as rural parks.

The concept is a logical synthesis of several seemingly unrelated economic and social trends. This discussion is hypothetical only to the extent it bridges gaps between these trends, which include increased energy costs, increased leisure, ecological consciousness, and prudent public spending in a depressed economy.

The energy crisis dictates higher travel costs while increased leisure dictates greater recreation facilities. Pollution abatement is improving water quality and opening up rivers as recreation resources. Prudent public policy dictates efficient use, wherever possible, of available resources. Specifically implied is waterfront or riverfront rehabilitation, as a major recreation strategy.

A cursory look at such areas within the recreation service area shows under-exploited sites, often including the relics of yesterday's commerce. Huge obsolete piers, power plants, rail depots, sand quarries, spillways, canals, earthworks, and airports are in abundant supply. Many such installations are located on comparatively large tracts with excellent utilities and convenient access. With proper treatment some of these sites and their curious relics can be reused for recreation. Reuse of such tracts has been beyond the ability of the real estate business because of excessive site acquisition, clearance and preparation costs. It is clear, however, that the development value of such sites could increase dramatically for non-industrial uses with improved water quality.

The reuse of such sites and facilities for recreation purposes will visually express historical, social and political values unique to an urban area. In some cities, such facilities might be extensions of existing parks. Consolidation could occur administratively if not physically. Su'. a park might be administered by the State Park system, thus providing an allure absent from city and county facilities.

Considerable amounts of independent effort by such agencies is occurring within the recreation service area. An array of various projects exists, ranging from barest conceptual design to in-place facilities. These projects are discussed by size rather than location or state of implementation. The consistency of content of these disparate activities is amazing. Urban riverside parks include Roberto Clemente in New York (22 acres) Sherman Creek in New York (42 acres), Penns Landing (33 acres) in Philadelphia, and Liberty Park (500 acres) in Jersey City.

One l ~e regional type park presently exists: Gateway National Recreation Area in New York and New Jersey (26,000 acres). Several other regional-scale possibilities warrant discussion. These include: 1) the acquisition of the Warner Sand Quarries in southeastern Bucks County, Pennsylvania; 2) the installation of fibre dams along the Susquehanna River in Central Pennsylvania; and 3) the use of siltation basins on the Schuykill River between Philadelphia and Reading, Pennsylvania. These three examples cited above comprise this suggested recreation alternative. The comparable descriptions below provide some insights to the concept.

Roberto Clemente State Park comprises 22 acres along the Harlem River in the Bronx. Two-thirds completed, this park contains .75 mile of riverfront promenades; an activities building with a gymnasium and indoor game courts, an exhibition area and a gallery, an olympic swimming pool with kiddie and diving pool, covered by an inflated bubble. Other facilities include large open multi-use playfields, hard surfaced areas, an amphitheatre, and landscaped visual buffers. These facilities cost approximately $10,000,000 with no land acquisition costs. This park is the smallest of its type and is the closest to completion.

Sherman Creek State Park is located on 42 acres along the Harlem River across from Roberto Clemente, containing a similar facilities mix, plus 14.3 acres of boating lagoon and a marina. This project will feature an electric generating station converted to a year-round activities building including swimming pool complex, theatre, exhibition hall, gymnasium, restaurant and rooftop promenade. Site improvements will result in 1.5 miles of riverfront promenades, four restored Victorian boathouses, a picnic grove, a large sports field and a 600-seat amphitheatre. This project is projected to cost $26,500,000 excluding land acquisition. Approximately 55.9 percent will be for building recreation facilities, 21.6 percent for site work, 12.8 percent for lagoons and marina facilities, 8.1 percent for tennis decks and 9.7 percent for miscellaneous expenses.

Sherman Creek and Roberto Clemente will provide adequate public recreation for the 500,000 urban residents who live within 20 minutes travel time.

On the Philadelphia waterfront on the Delaware River, 33 acres is being developed by a joint city-state agency, Old Philadelphia Development Corporation. This development, known as Penns Landing, will be completed by June 1976. Included in the master plan are a ten-acre boat basin, a ten-acre quay with a cultural history museum, concert hall and promenades and 12 acres leased to developers for condominiums and an apartment-hotel complex. Approximately ten acres will consist of a lagoon for historic ships and small boats.

Liberty Park in Jersey City is a 500-acre site under development by the State of New Jersey. The master plan is scheduled for completion by early 1976. This site is currently an abandoned rail yard, approximately 167 acres will be reclaimed shoreline currently containing derelict piers. With water access, the park could become part of a water-borne shuttle system. It is likely the facilities mix will mirror that of previously discussed parks.

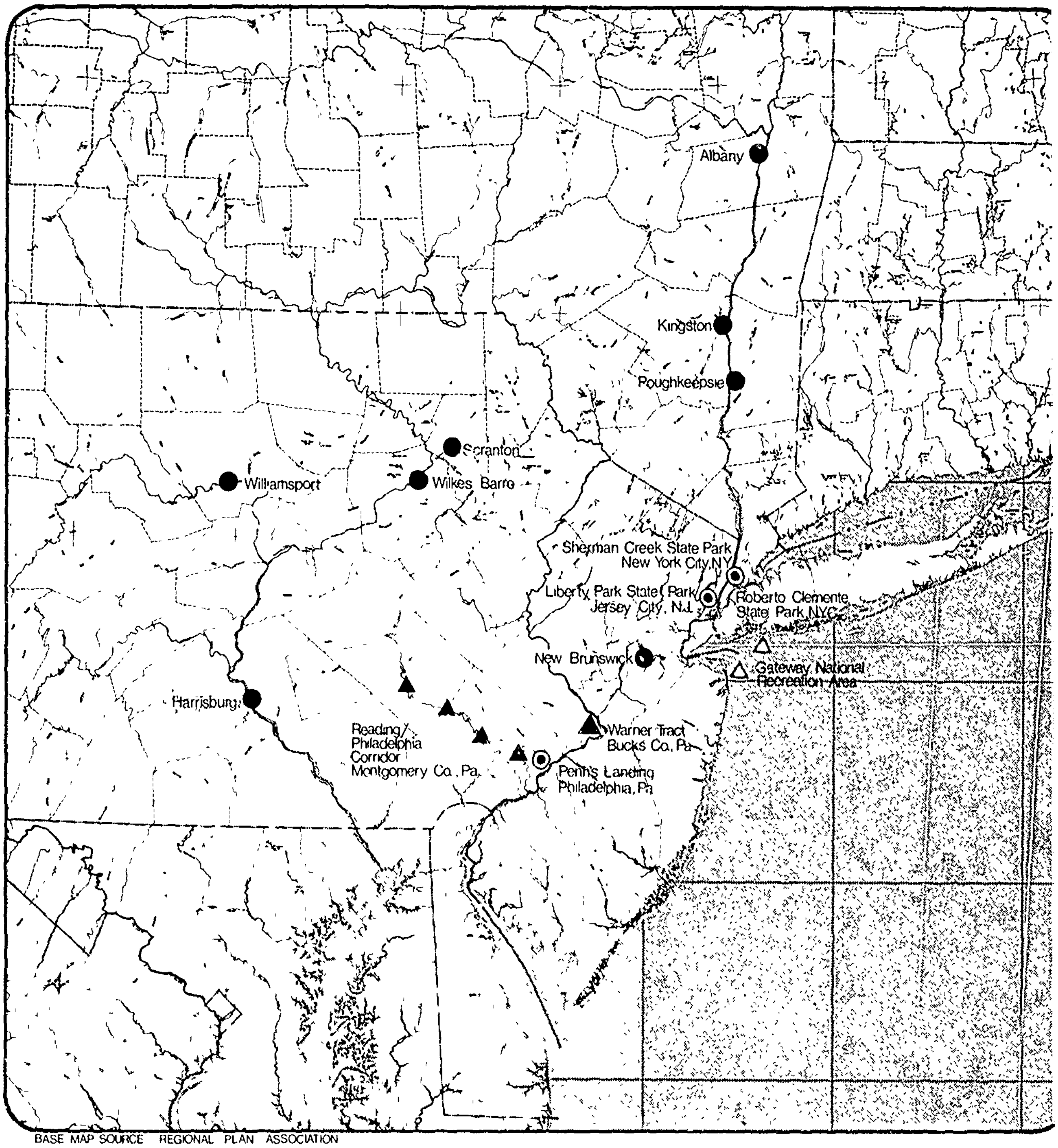
This park links conceptually with Gateway National Recreation Area, which uses beaches, marshlands and obsolete airfield in Queens, Kings, Richmond and Monmouth counties. The approximately 18,000 land acres within this park will be developed primarily for the benefit and use of residents of the New York metropolitan region. The plan will focus on rehabilitating existing structures to house activities. New facilities might include a regional sports complex including olympic pools, rowing, social clubs and court games.

This recreation alternative consists of two types or urban parks -- "riverfront metroparks" and larger "superparks" modeled after Gateway National Recreation Area. Two such superparks are suggested here, one on the Warner Sand Quarry and Burlington Island on the Delaware and one along the Schuylkill Valley. Riverfront metroparks from 20 to 100 acres could be constructed in floo. lains or in urban renewal areas. Examples of such sites presently exist in Harrisburg's Seneca-Susquehana Urban Renewal Area. The location of the new parks suggested under this alternative as well as comparable facilities already planned are shown in Figure 13-3, which follows.

In New Jersey, New Brunswick's riverfront contains much land suitable for recreation, such as Elmer B. Boyd Memorial and Johnson and Donaldson Parks which could be expanded. In New York, riverfront parks at Kingston, Poughkeepsie and Albany would effectively utilize the Hudson River corridor's magnificant natural open space.

In virtually every new park, urban recreation activities would replace many other TILP visitations. Availability of strolling, quayside fishing, environmental education, performing arts and court and field sports might eliminate the need for some trips to DWGNRA (with or without TILP). Of part ular significance is the fact that the riverfront metroparks would be accessible to those without cars, the very old and the very young.

Unlike the riverfront metroparks, the facilities envisioned for the two regional superparks are limited to the key activities found at DWGNRA with TILP (boating, camping, swimming and picnicking). Although in these parks,



BASE MAP SOURCE REGIONAL PLAN ASSOCIATION

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SCALE IN MILES

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NEW STATE PARKS AND PROGRAMS

XIII

3

LEGEND

- ● RIVER FRONT METROPARKS PROPOSED
- ⊙ RIVER FRONT METROPARKS PROGRAMMED
- ▲ REGIONAL SUPERPARKS PROPOSED
- △ REGIONAL SUPERPARKS PROGRAMMED

A COMPREHENSIVE STUDY OF TH

TOCKS ISLAND LAKE PROJECT & ALTERNATIVES

URS / MADIGAN-PRAEGER, INC. & CONKLIN AND ROSSAN abundant acreage would exist for other activities -- some similar to those found in the riverfront metroparks. Except for limited camping, the regional superpark would be primarily for day users. The two examples are described below.

Between Philadelphia and Trenton, in southeast Bucks County, the 6,000-acre Warner Company Sand Quarry and Burlington Island could be acquired. Abundant natural sandy beaches with pure fresh water could be provided by sculpting and landscaping this area. This concept is envisioned in the 1961 Bucks County Comprehensive Plan. Presently, a 1,608-acre development containing 536 water acres is being considered for development. These facilities would make an ideal water recreation area, with ample boating and swimming acreage. For this alternative, a 2,000-acre recreation tract of which 33 percent or 667 acres would be water is programmed as part of this alternative.

The 50-mile Schuylkill River corridor between Reading and Philadelphia, located in Berks and Montgomery counties, contains a series of weirs and sedimentation basins which could be modified for swimming and boating if water quality improves as envisioned by current federal water quality requirements. It is assumed that recreation nodes could be developed around four such facilities on lands currently owned by various state agencies. While detailed analysis would be required to determine specific sites, proposals of this type are in accord with the recently published Montgomery County Resources Protection Plan (1975).

Each of eight riverfront parks will contain instant provision at any one time for 1,025 swimmers, 640 boaters and 833 picnickers. One superpark, the 2,000-acre Warner Tract in Bucks County, Pennsylvania, will have a capacity at any one time for 7,424 swimmers, 280 boaters, 800 campers and 6,163 picnickers. The other major superpark consists of four, 250-acre, Schuylkill River recreation nodes which will contain provision at any one time for 1,100 swimmers, 280 boaters, 400 campers and 3,504 picnickers, plus room for hiking and field and court games.

The total instant capacity and annual visitation for this alternative are shown in the table below. Although there is no "sightseeing" component in this urban scheme, the factor used to account for people who are hiking, promenading, playing frisbee and similar activities is much higher than in a rural park setting.

Table 13-11. Programmed Instant Capacity and Annual Visitation for New State Parks and Programs Alternative

	Instant Capacity	Activity Days
Swimming	19,725	2,089,000
Picnicking	16,330	1,114,000
Boating	5,680	710,000
Camping	1,200	75,000
Total Primary Activity Days		3,988,000
Total Annual Visitors 1/		5,982,000

1/ Overlap factor of 2.0; other activities factor of 3.0; and 0.0% sightseers.

XIII.F.3.(b) Project Costs and Benefits

Riverfront metroparks will require an average of 40 acres of which 25 percent would be water, in the form of lagoons and boat basins. Therefore, the land acreage would be 30 acres per park. Eight such parks would require 240 acres. It is assumed that none of this land is presently in public ownership and acquisition costs would be $12,000 per acre. A figure of $220,000 per acre has been estimated for site development including bulkheading, low dams and all recreation facilities except swimming pools which are calculated separately at $500 per person of instant capacity. Not included are any major cultural or commercial facilities which might be developed in conjunction with the public outdoor recreation component.

The Warner Tract would consist of 2,000 acres with an estimated acquisition cost of $8,000 per acre; recreation facilities would be developed at the cost standards described earlier. The Schuylkill River Corridor park would consist of four 250-acre nodes for a total of 1,000 land acres fronting on the river. It is assumed 60 percent of this land is presently in public ownership, and the remaining 400 acres could be obtained for $2,000 per acre. Total costs for the alternative and benefits are as shown below:

Development Costs + 25%	$ 88,285,200
Land Costs	19,680,000
Total First Costs	$107,965,200
Annual O&M Costs	$ 1,444,000
Annual Benefits	$ 12,143,000

XIII.F.3.(c) Institutional Aspects

This alternative envisions programs administered by state recreation programs. Capital costs would be borne by a variety of sources, including the Corps of Engineers (bulkheading, dredging, marinas and boating); the Bureau of Outdoor Recreation (grants for facilities construction); state recreation departments (bond issues); and local or county redevelopment authorities.

Operating and maintenance funds would be administered by the particular state recreation department which would develop a patchwork quilt of sources including federal, state and local recreation planning and social welfare agencies.

XIII.F.3.(d) Impacts of New State Parks and Programs

Examination of this alternative indicates a very positive overall impact, due to its accord with all categories of impact criteria. This alternative provides needed recreation close to home, while benefiting the local economy as well as the natural environment. Equally important, this alternative greatly enhances the liveability of many cities within the recreation service area by providing a focus for community activities.

This alternative is expected to generate highly positive impacts in achieving both land use and transportation objectives. Land use is furthered by local neighborhoods being greatly enhanced in their character and appeal and also by encouraging balanced growth within utility extension capacities.

Transportation objectives are met by this plan's suitability for public transit and minimizing dependence on the private auto.

Social and economic impacts are all positive to some extent and some highly so. A highly positive impact is expected from promoting and enhancing the existing lifestyles and community cohesive values. Opportunities will be provided for the adaptive reuse of some older, perhaps historic, structures. On the economic side, positive impacts are anticipated by generating more employment opportunities and also increasing the local retail sales and property values. These increases in turn are expected to increase the tax base for local governments and help them pay for the required community services they will have to provide.

This scheme will have a very positive effect on minimizing local plant and wildlife disturbance due to its limited acreage requirements. Even though the impacts on waste disposal and pollution generation are negative, they are only moderately so since most facilities are within the service limits of existing systems. Since most of the users are local residents, additional waste disposal facilities will be minimal. If public transportation is utilized this will lessen the possibility of increases in pollutant levels. From a recreation standpoint, positive impacts are anticipated by providing significant increases in capacity in a pleasant and unique setting.

Table 13-12. Impacts of New State Parks and Programs

Balanced Development	
1. Preservation of open space	Moderately positive
2. Achieve land use objectives	Highly positive
3. Achieve transportation objectives	Highly positive
Social	
1. Promote existing values and lifestyles	Highly positive
2. Preserve historical and archeological sites	Moderately positive
3. Minimize displacement of people and business	Moderately positive
Economic	
1. Generate local employment opportunities	Moderately positive
2. Generate local retail and service expenditures	Moderately positive
3. Increase local property values	Moderately positive
Institutional	
1. Minimize local government public service needs	Moderately negative
2. Increase property and sales tax base	Moderately positive
3. Ability of local government to handle growth	Moderately positive
Natural Environment	
1. Minimize flora and fauna disturbance	Highly positive
2. Minimize solid and liquid waste generation	Moderately negative
3. Minimize air, water and noise pollution	Moderately negative
Recreation	
1. Provide needed facilities	Highly positive
2. Provide high quality experience	Highly positive

XIII.F.4. OPEN CLOSED RESERVOIRS

This alternative deals with the possibilities of opening existing reservoir systems to the public for recreation use. Of all the alternatives it offers two major advantages; namely that existing systems tend to lie within relatively short distances from the urban areas which they serve; and that development costs of recreation facilities within the preserves could be held to a minimum since the water bodies already exist. To fully develop these resources may require additional water treatment in order to preserve water quality as in some cases simple cholorination is the only treatment given the water.

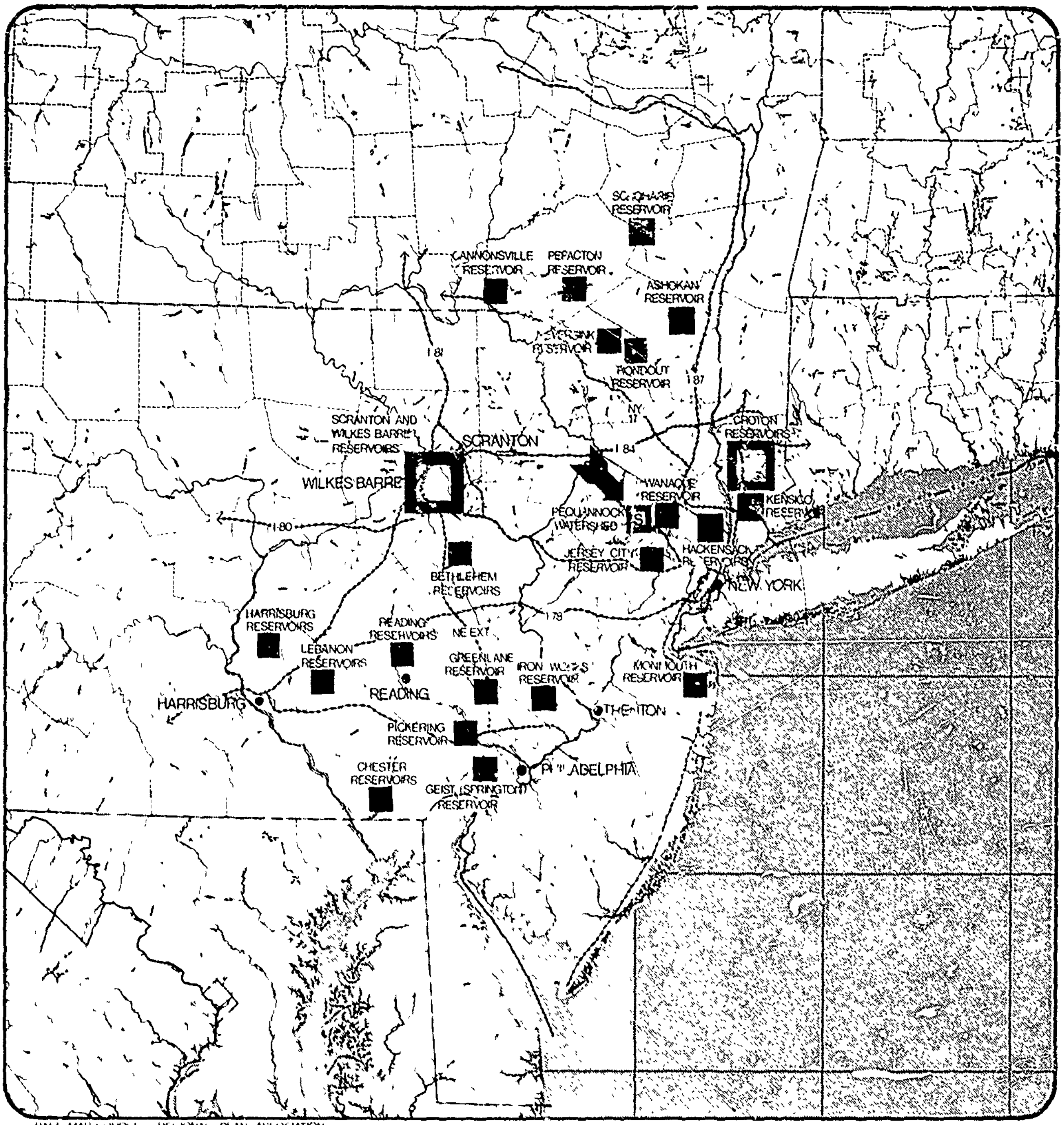
Against these advantages are strong institutional constraints. In addition to the possible problems of local opposition, traffic patterns and other impacts, there are widespread concerns of private water companies and public authorities for the damages to watershed areas, water contamination, and increased liability which they contend will occur if recreation is allowed and which will greatly overtax their already tight budgets.

If these institutional problems can in the future be overcome, the total acreage of existing water supply systems may be viewed as a sizeable resource for outdoor recreation, with a capacity larger than DWGNRA. For reasons discussed below, however, it is assumed that the constraints will not be dropped in the majority of cases. If this is true, the level of service provided by this alternative will be measurably lower than that planned by TILP, as regards the capacity and the type of facilities. It is anticipated that in no area will the operation of motor boats be tolerated, particularly the high speed variety; and due to the ratio of land area to water area, camping facilities would be severely limited.

XIII.F.4.(a) Detailed Description

Table 13-13 below and later paragraphs describe briefly the major reservoir and surface water supply systems within the recreation service area, and discuss present and future policies regarding public recreation on the watersheds adjacent to the reservoir. The reservoir systems and those selected as components of this alternative are shown on the accompanying figure.

For the purpose of evaluating the potential of their resource, it has been assumed that the institutional constraints will be removed from some, but not all of the various water supply systems. The actual selection of sites for evaluation is in some cases arbitrary since serious opposition to the development of recreation facilities exists within the authorities or companies which operate them. Issues involving specific facilities are discussed under institutional aspects.



BASE MAP SOURCE REGIONAL PLAN ASSOCIATION

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SCALE IN MILES

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OPEN/CLOSED RESERVOIRS

XIII
4

LEGEND

- EXISTING RESERVOIRS WITH RECREATION POTENTIALS
- SELECTED RESERVOIRS FOR THIS ALTERNATIVE
- SELECTED RESERVOIRS FOR COMBINED PLAN WITH 'MORE INTENSIVE USE OF EXISTING FACILITIES'

Table 13-13. Major Reservoir Systems in the Recreation Service Area

	Drainage Area (sq.mi.)	Land Area[1/] (acres)	Pool Area (acres)	Shoreline (miles)
New York City System:				
Delaware System				
Cannonsville Res.	-	19,995	4,800	53.5
Pepacton Res.	-	13,300	5,700	53.5
Neversink Res.	-	6,150	1,470	16.5
Rondout Res.	-	3,510	2,080	17.0
Catskill System				
Schoharie Res.	-	2,355	1,145	16.5
Ashokan Res.	-	13,725	8,320	40.0
Croton System				
Kensico Res.	-	-	2,240	30.0
Others (12 lakes and 3 reservoirs)	-	-	7,660	148.0
Total	-	(19,950)	(9,900)	(178.0)
TOTAL		78,985	35,655	405.0
Philadelphia Suburban Water Company				
Greenlane Reservoir	71.0	-	814	19.0
Geist Reservoir	21.5	-	391	11.0
Ironworks Creek Res.	6.4	-	172	4.3
Pickering Creek Res.	3.8	-	83	4.5
TOTAL	102.7		1,460	38.8
Bethlehem Water Authority				
Wild Creek Reservoir	21.5	10,891	-	7.0
Penn Forest Reservoir	18.5	7,496	-	7.0
TOTAL	39.9	18,387	765	14.0
Reading, Pennsylvania				
Lake Ontelaunee	-	3,142	1,080	15.0
Lake Antietam	-	506	43	-
TOTAL	-	3,648	1,123	15.0
Chester Water Authority				
Octoraro Creek Res.	149.0	2,200	400	8.0
City of Lebanon Bureau of Water				
1 Reservoir	-	-	500	3.0

Table 13-13. (Continued)

	Drainage Area (sq.ft.)	Land Area[1/] (acres)	Pool Area (acres)	Shoreline (miles)
Harrisburg Water Authority				
Clark Creek Reservoir	-	13,700	600	10.0
Penn. Gas and Water Co.				
77 Reservoirs	-	60,000	-	-
North Jersey District Water Supply Commission				
Wanaque Reservoir	90.4	90.4	2,310	15.0
Newark's Water Department Pequannock Watershed				
Oak Ridge Reservoir	21.7	-	482	-
Clinton Reservoir	10.5	-	423	-
Canistear Reservoir	5.6	-	350	-
Echo Lake	4.6	-	300	-
Charlotteburg Reservoir	18.4	-	375	-
Miscellaneous Ponds	2.9	-	-	
TOTAL	63.7	54.8		25.6
Hackensack Water Company				
DeForest Reservoir	26.8	-	1,020	-
Woodcliff Lake	20.0	-	170	-
Lake Tappan	49.4	-	1,255	-
Oradell Reservoir	115.0	-	620	-
TOTAL	211.2		3,065	
Monmouth Consolidated Water Company				
Swimming River Reservoir	48.0	-	620	-
Glendola Reservoir	16.0	-	160	-
TOTAL	64.0		780	
Jersey City Water Company				
Split Rock Reservoir	5.0	-	566	-
Boonton Reservoir	119.0	-	780	-
TOTAL	121.0		1,346	

Note: "-" means information not available.

1/ Land owned by the city or company, including pool.

Source: From various agencies and companies.

For purposes of developing a program for development, the space standards described earlier were used. Wherever possible, a mix of the four basic activities similar to the mix found in the Clarke & Rapuano Plan Phase III was projected. In some cases this was deemed unfeasible due to available land area. The components and instant capacity for each activity are shown in Tab -14 reflecting a likely maximum development level on the Pequan: Croton (except Kensico) and Pennsylvania Gas and Water Company systems.

Table 13-14. Programmed Instant Capacity and Annual Visitation for Open Closed Reservoirs Alternative

	Instant Capacity	Activity Days
Swimming	31,500	2,054,000
Picnicking	35,000	2,386,000
Boating	7,350	919,000
Camping	6,000	375,000
Total Primary Activity Days		5,734,000
Total Annual Visitors 1/		7,167,000

1/ Overlap factor of 1.4; other activities factor of 1.4; and 20% sightseers.

XIII.F.4.(b) Project Costs and Benefits

Land areas presently owned by public water authorities or private water companies have been used in developing the physical program. Although in many cases this restricts the development of certain land based activities, it is felt that acquisition of additional land areas adjacent to that already owned may prove in general to be impractical in some cases and unnecessary in others. In several areas reservoirs are surrounded by developments. Also, against the background of existing institutional resistance to their subject, additional land would in all probability have to be acquired by other agencies. Project costs and benefits are summarized below:

Development Costs + 25%	$60,587,500
Land Costs	none
Total First Costs	$60,587,500
Annual O&M Costs	$ 2,150,000
Annual Benefits	$14,549,000

XIII.F.4.(c) Institutional Aspects

New York

The City of New York Department of Water Resources maintains one of the largest open reservoir systems. Located in Westchester, Putnum, Ulster, Delaware, Sullivan and Schoharie counties, the three major subsystems contain over 35,000 acres of pools on nearly 80,000 acres of land owned by the municipality. Additional reservoirs on Long Island have not been used for water supply for some time due to pollution caused by adjacent developments. The city still retains ownership but would prefer to have the state take over control of these areas.

All of the property is patrolled, public use of lands and water is restricted in most cases to fishing from the shore (permits issued by the

Department of Water Supply on a limited basis) and hunting on a 6,000-acre tract adjacent to the Cannonsville Reservoir. Present treatment is limited to chlorination of the water as it leaves each reservoir.

With the exception of the Croton system and Kensico Reservoir, the majority of the system is 80 to 120 miles from the New York metropolitan area, approximately the same as DWGNRA. Aside from the institutional constraints, development of recreation facilities would be limited by the relatively small tracts of publicly held land surrounding each reservoir, which in most cases is about equal in area to the pool area it surrounds. If any increase in the present level of recreation takes place, it would be limited to day use.

Authorities have long remained adamantly opposed to permitting further use of the system for recreation purposes. It is felt that each encroachment upon the watershed has an adverse impact upon the water quality (which is reputed to be fairly good at present) and a proportional impact upon the treatment costs. Because of its vast scale, it is estimated that 100 percent treatment of water within the system which supplies over 10,000,000 people, would cost between one-half to two billion dollars. There is presently concern for the "esthetic" quality of water in the Croton system and eutrophication of the Cannonsville Reservoir.

Pennsylvania

The Pennsylvania Gas and Water Company presently administers 77 separate reservoirs on approximately 60,000 acres of primary rural wastershed near the Scranton and Wilkes-Barre area. Present policy allows limited fishing on some of these reservoirs. Some of the water is filtered at three or four major plants, and the remainder of the system has chemical treatment.

As a result of Federal Water Quality Standards, additional filtration plants may be required, and there has been consideration of allowing portions of the watershed to be developed if these plants are built. Also, a few of the smaller reservoirs may be abandoned if the company's request for water from the Susquehanna River is approved. However, due to the damage to watershed property and the accumulation of trash that has resulted from allowing the public to use the property, private rather than public development of available lands is anticipated.

The Harrisburg Water Authority's main resource has been the Clark Creek Dam since the 1972 flood washed out the filter system and thus the emergency water supply on the Susquehanna River. The only treatment at present is chlorination, lime and phosphate. The reservoir could be opened to a limited amount of recreation but only when the filtration system is rebuilt and the emergency supply system restored.

The City of Lebanon Bureau of Water has one reservoir located on mountain streams within a strip mining area. Esthetic quality of the water, once poor, is now clearing up as a result of replanting. No fishing is permitted; and as a result of vandalism within the picnic area maintained near the reservoir, no increase in recreation facilities is anticipated.

The two major sources for the Chester Water Authority are an intake on the Susquehanna River and a reservoir on Octoraro Creek. Small boats and fishing from the shore are permitted but not swimming or canoeing. Small groups of scouts have been permitted to camp on weekends.

Although the water receives 100 percent treatment at present, the Authority is opposed to opening the area to more recreation, even if some other agency would operate the facilities. Last year approximately $2,500 was collected in fees for parking, boat launching and rental, which did not pay for the maintenance costs. The social problems which accompany crowds and the sewage systems which would be required are the major factor which the Authority does not want to concern itself with, along with possible damage to the land and trees due to fires and accumulation of litter.

The Philadelphia Suburban Water Company has an extensive system of reservoirs located on Pickering, Crum, Iron Works and Nashaminy creeks. A limited amount of picnicking and fishing from the shore and small boats is all that is permitted.

The reservoirs which serve Reading, Pennsylvania are under the supervision of the Pennsylvania Game Commission. In spite of existing rapid filtration and plants, fishing from the shore only is permitted. It is felt that direct water contracts will result in additional treatment costs.

Bethlehem's water is unfiltered and the system remains closed to the public. The reluctance to open it is due to the costs of required filtration plants.

New Jersey

Within the northern portion of the state are numerous reservoirs of considerable size, most of which are essentially closed to the public for recreation purposes. Some of these are listed in Table 13-13. Of major interest for the purpose of this section is the Pequannock Watershed, one of the major sources of supply for the City of Newark which owns approximately 86 percent, or 35,000 acres, of the 63.7-square-mile drainage area.

Presently the water from this system is only minimally treated. However, as a result of development adjacent to and within the watershed, water quality has been impaired and plans are being developed for a filtration system. Authorities are therefore considering a revised policy for the watershed and may, in the future, permit limited development.

At present a limited amount of fishing and hunting permits are issued by the municipality for four of the five major reservoirs. Charlotteburg Reservoir remains closed. In addition, some swimming has been allowed in Echo Lake, which technically is no longer part of the system due to some pollution which has occurred.

None of the other major water supply systems within the area appear as suitable to recreation development. Both the Wanaque Reservoir, controlled by the North Jersey District Water Supply Commission, and the reservoirs operated by the Hackensack Water Company remains essentially closed to the public. The total acreage of their pools is substantial; however, the land preserve amounts to narrow strips around the shoreline. Although the water from the Wanaque may have to be filtered in three or four years to comply with state standards for quality, there are no plans afoot to alter the present policy of allowing only fishing and group hiking on a one day pass basis.

XIII.F.4.(d) Impacts of Opening Closed Reservoirs

Examination of this alternative indicates the net benefits to be moderately positive. Negative impacts in the natural environment category should be offset by other more positive impacts.

The open space consumed by the development of recreation facilities is minimal when compared with the private development that might take place in its stead. Development of private watersheds into parks which serve the general public would be preferable to the construction of a handful of private homes. Where practical, public transit systems could be used between reservoirs and the urban areas nearby. There is some question about the adequacy of existing roads to be able to serve the anticipated visitor volume.

It is doubtful that the local character of the neighborhoods or any historical or archeological sites will be much affected by this alternative. However, some local opposition may arise to urban crowds being bussed into those urban or rural areas. Minimal displacement and relocation of people or businesses in the impact area is expected.

Moderate economic gains are expected from this alternative, and most of those gains are anticipated from increases in retail sales and property values as a direct result of increased recreation activity in the area. These moderate gains will in turn have a positive impact on the local tax base and to some extent offset the increased expenditures of local government agencies for necessary public services increases.

The impact of this alternative on the natural environment will be considerable, particularly since most watersheds are now closed to the public. Treatment of the water will have to be increased especially considering the additional amounts of solid and liquid waste that will be generated by the visitors. It is reasonable to expect that the current levels of air, water and noise pollution will increase as a result of increased visitor use of the recreation areas.

A major concern regarding this alternative will be the effect recreation will have on water quality, specifically the eutrophication level and the treatment that will be required to meet federal and state standards. Without being site specific, it is impossible to determine either the contribution of the recreation component to this problem or the cost of required water treatment which can be attributed to it. However, a general discussion of this topic is in order.

The three basic factors which will determine eutrophication are the water turnover rate, shape of the reservoir and the nutrient input. Since the first two items have been discussed elsewhere, we are primarily concerned here with the nutrient input that could be generated by recreation within the reservoir and on the adjacent watershed.

Water quality may be degraded by the introduction of phosphorous, which exists in urine, and coliforms that live in human entrails. Both are sources of nutrients. In a recent study of a European lake, it was estimated that one out of ten bathers will urinate in the lake. It is assumed that regulations prohibiting this and provision of adequate facilities on shore can certainly reduce the level of occurrence, but not eliminate it entirely. Coliforms are relatively harmless, but their presence in a water supply system indicates the level of contamination by other forms of bacteria, which can contribute to eutrophication or health hazards. Sanitary facilities can minimize this problem, if they are the type which allow complete removal of the sewage. Leaching fields and septic tanks would not be permitted on the watershed.

Land based activities; picnicking, camping, hiking, etc., can be expected to result in increased erosion. This will result in topsoil, rich in nutrients, being washed into the reservoir. Precautions, such as low density development, restrictions on development in sensitive areas, and maintenance of park vegetation must be taken to keep erosion at a minimum.

In summary, the problem of eutrophication does not eliminate the possibility of opening reservoirs to public recreation. It does, however, require controls on both the number of visitors permitted and the physical design and location of facilities, as well as additional expenditures for both construction and operation of treatment plants.

From a recreation standpoint, this alternative is very acceptable. Large quantities of needed facilities of all types could be provided within easy access of urban areas. While the quality of experience will vary among sites depending on the density of development, the overall quality is expected to be high. The selection of appropriate reservoirs is based upon minimizing the institutional constraints. Those selected sites are those with levels of treatment incorporated or feasible, or environmental conditions such that recreational use is not detrimental.

Table 13-15. Impacts of Opening Closed Reservoirs

Balanced Development	
1. Preservation of open space	Moderately positive
2. Achieve land use objectives	Moderately negative
3. Achieve transportation objectives	Moderately positive
Social	
1. Promote existing values and lifestyles	Moderately negative
2. Preserve historical and archaeological	None
3. Minimize displacement of people and business	Little or none
Economic	
1. Generate local employment opportunities	Little or none
2. Generate local retail and service expenditures	Moderately positive
3. Increase local property values	Moderately positive
Institutional	
1. Minimize local government public service needs	Moderately negative
2. Increase property and sales tax base	Moderately positive
3. Ability of local government to handle growth	Little or none
Natural Environment	
1. Minimize flora and fauna disturbance	Moderately negative
2. Minimize solid and liquid waste generation	Highly negative
3. Minimize air, water and noise pollution	Highly negative
Recreation	
1. Provide needed facilities	Moderately positive
2. Provide high quality experience	Moderately positive

XIII.F.5. NEIGHBORHOOD POOLS AND PARKS

This recreation alternative suggests constructing public swimming pools as part of mini-parks located close to the population center within the recreation service area. This alternative addresses swimming as the major recreation activity for which an alternative is sought and does nothing for the boating or camping situation. Specific action required by this alternative would involve purchasing land and constructing numerous public pools near population concentrations. This alternative is based on the assumption that swimming is the primary recreation activity to be provided by the Tocks Island Lake Project and DWGNRA and provides an equivalent design capacity for swimming which will sufficiently replace these foregone facilities.

XIII.F.5.(a) Detailed Description

This recreation alternative foresees a concept of three types of pools distributed on an urban, suburban and rural basis according to the greatest need. The distinction between these various types of pools is primarily size. The urban pool is assumed to be a 25 meter pool in a two-acre park; the suburban pool is assumed to be 50 meters in a three-acre park and the rural pool is assumed to be a five-acre SCS pond with 200 linear feet of beach. This size distinction reflects the relative difficulties in land acquisition and other development problems.

In striving to satisfy the greatest need, numerous distribution patterns are rational and defensible. Since the number of pools which would match the swimming capacity at Tocks Island is so small, that some regional distribution must occur if it is to be considered an alternative -- even though, for example, all of these pools could be placed in New York City, and it would still have one of the lowest capacity to population ratios in the service area. The method chosen for distribution, even though somewhat arbitrary, is a rational approach to the problem.

In order to identify the areas with the greatest lack of swimming facilities, a ratio of swimming capacity to population was developed for each county based upon the supply inventory presented in Chapter IV. It was decided to assign the capacity to those counties whose swimming capacity to population ratio was less than one-half of their state average. On this basis six Pennsylvania counties, six New Jersey counties and seven New York counties would qualify for the additional pools. Over 40 percent of the pools were distributed to the five highly urban counties of New York City and if Philadelphia, Essex and other urbanized counties are included, these areas received nearly 90 percent of all the pools. There were a total of 12 suburban pools in New York and New Jersey and two rural pools in Pennsylvania. The table below depicts the distribution pattern for this alternative which is also shown in Figure XIII-5. The Phases I and III corresponds with the level of development proposed in the Clarke & Rapuano plan for DWGNRA with TILP.

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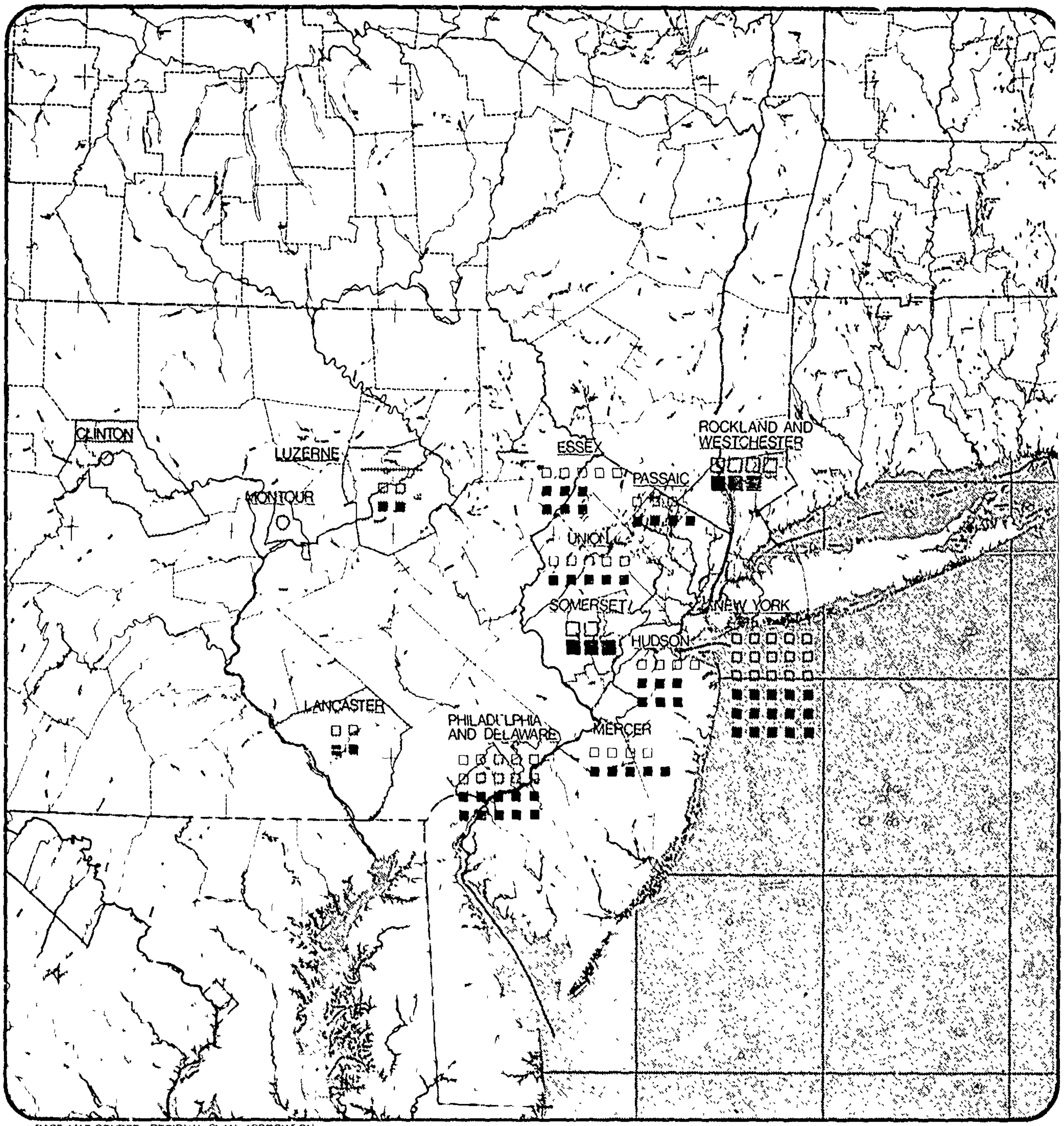

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NEIGHBORHOOD POOLS AND MINI-PARKS

XIII **5**

LEGEND

SWIMMING CAPACITY EQUIV TO TILP PHASE I
- ○ POND/RURAL
- □ LARGE POOL/SUBURBAN
- □ SMALL POOL/URBAN

SWIMMING CAPACITY EQUIV TO TILP PHASE III
- ■ LARGE POOL
- ■ SMALL POOL

Table 13-16. Distribution of Neighborhood Pools and Parks Within the Recreation Service Area

	Phase I	Phase III	Total
Pennsylvania			
Clinton	1	-	1
Lancaster	2	2	4
Luzerne	2	2	4
Montour	1	-	1
Philadelphia and Delaware	10	10	20
New Jersey			
Essex	5	6	11
Hudson	4	6	10
Mercer	4	5	9
Passaic	3	4	7
Somerset	2	3	5
Union	5	5	10
New York			
New York City	15	15	30
Rockland and Westchester	4	3	7
TOTAL	58	61	119

The th[illegible] varying sizes o[illegible] swimming pools [illegible] be distributed on an urban, suburban and rural basis [illegible]d their holding capacities are shown in the table below. The urban pool is envisioned as a 25 meter pool or 82 feet by 50 feet for a total of [illegible],[illegible]00 square feet of water surface. This pool will be developed on a two-acre park site. The suburban pool will be 50 meters in length or roughly [illegible] feet by 75 feet for a total of 12,300 square feet of water surface, situated on a three-acre park. The prototypical rural swimming facility is a Soil Conservation Service pond with five acres of surface water and 200 linear feet of beach on a ten-acre site.

The instant capacities and annual visitation for these pools are shown in the table below as calculated from standards discussed earlier. In the case of these pools, however, a factor of 2.0 percent rather than 2.3 percent was used to calculate annual from peak daily attendance reflecting a more even distribution of attendance during the week. There is obviously no overlap with other primary activities but a factor of 2.0 was assumed to account for park users who were not swimmers.

Table 13-17. Programmed Instant Capacity and Annual Visitation for Neighborhood Pools and Parks Alternative

	Instant Capacity 1/	Activity Days
Swimming	49,850	7,427,000
Picnicking	none	none
Boating	none	none
Camping	none	none
Total Primary Activity Days		7,427,000
Total Annual Visitors 2/		14,854,000

1/ Comparable to Phase III of TILP.

2/ Overlap factor of 1; other activities factor of 2; and no sightseers.

XIII.F.5.(b) Program Costs and Benefits

Total land acquisition for this alternative is about 265 acres to accommodate 105 urban pools and 12 suburban pools and two rural ponds. The urban pools would require about two acres per site and provide little or no parking on site, while the suburban sites would provide parking on one of their total three-acre sites. The SCS pond sites are expected to need ten acres for each site. Land costs have been assumed at $50,000 per acre in urban settings; $8,000 per acre in suburban areas, and $3,000 in the rural counties. Development costs of the parks themselves are calculated to be about $260,000 for each urban park (based on the Sound View experience in New York), $174,000 each for the larger suburban parks and $50,000 each for the rural ponds.

The main components of the development costs for this alternative are facility construction costs for the pools which were estimated at $500 per instant capacity for urban pools, $400 per instant capacity for suburban pools and $5,000 per acre plus $200 per instant capacity for rural ponds.

These total costs in addition to annual operation and maintenance costs and annual benefits are shown below.

Development Costs + 25%	$66,485,850
Land Costs	10,848,000
Total First Costs	$77,333,850
Annual O&M Costs	$ 3,426,000
Annual Benefits	$30,154,000

Given the normal course of events, those communities most able and willing to build neighborhood pools will be more affluent and these pools then would not serve the current areas of greatest need.

XIII.F.5.(c) Institutional Aspects

Institutionally, this may be a difficult alternative to implement, as the alternative implies implementation by either county or municipal recreation agencies. Communities are certainly aware of the need for swimming and it is fair to assume that they are providing as many new pools now as they can afford within the priorities of their budgets. Deauthorization of TILP in itself would not increase the commitment of these local governments to community recreation, but perhaps new federal programs or riders to proposed appropriations could channel funds to these local governments.

XIII.F.5.(d) Impact of Neighborhood Pools and Parks

Examination of the impacts of this alternative from an overall point of view indicate that most of the impacts are positive, and some strongly so. Although this is a recreation oriented alternative, it does not adequately address the recreation needs in their totality and consequently the impacts are rated very negative. This rating evolves because only swimming facilities are provided and demand for camping, boating and picnicking is not addressed. The underlying assumption that swimming facilities are the most seriously needed, is valid to a limited extent but this recreation evaluation must be made from a larger perspective.

This alternative does enhance the balanced development concept, most notably by not only maintaining the likely residential quality but also elevating it. In addition to providing residential areas with more extensive, and much needed, swimming facilities, there is less pressure for the user to come by auto since many urban pools will be serviced by existing mass transit.

Since many public utility capabilities are already in existance in the areas selected for these new pools a moderate positive impact is anticipated from this alternative. Preservation of open space will be furthered to a limited extent due to the purchase of these sites and inclusion of mini-parks to surround the pool.

Community cohesion will be enhanced mainly from the preservation of the character of the existing communities. Much of this positive impact is intertwined with the benefits accrued in balanced growth and maintenance of residential quality. Historic and archeological promotion is possible depending on what sites are selected; however, site selection, especially in urban areas, is expected to be based on other considerations. No negative impacts on historical or archeological considerations are expected, although extremely poor site selection could have such impacts.

The economic impacts are all very low whether positive or negative. Construction of the pools will most probably be handled by the existing labor force, and the same is true for local retail and service businesses. There may be some job creation, especially in the suburban and rural areas, which would be positive but minimal. As with construction of any new facility increased police and fire protection are required. Providing recreation facilities within easy access to urban ghetto areas should have a reduced reliance on other welfare programs.

Finally, one of the strongest favorable impacts is the lessened flora and fauna disturbance. All of the urban and suburban pools will go in areas where disturbance has already taken place and additional disturbance won't matter much. If the sites selected for the rural ponds is made with consideration for this point, disturbance can be minimized there also. There is no anticipated effect on either solid or liquid waste generation loads as the local system should be able to handle any increase.

In general, this alternative certainly neither positively nor negatively effects the local rural communities and the environment because of the urban location of the recreation development. For this same reason the alternative really does not provide a comparable experience to TILP despite its serving a very real need.

Table 13-18. Impact of Neighborhood Pools and Parks

Balanced Development	
1. Preservation of open space	Moderately positive
2. Achieve land use objectives	Moderately positive
3. Achieve transportation objectives	Highly positive
Social	
1. Promote existing values and lifestyles	Highly positive
2. Preserve historical and archeological sites	Moderately positive
3. Minimize displacement of people and business	Moderately positive
Economic	
1. Generate local employment opportunities	Moderately positive
2. Generate local retail and service expenditures	Little or none
3. Increase local property values	Moderately positive
Institutional	
1. Minimize local government public service needs	Moderately negative
2. Increase property and sales tax base	Moderately positive
3. Ability of local government to handle growth	Moderately positive
Natural Environment	
1. Minimize flora and fauna disturbance	None
2. Minimize solid and liquid waste generation	Moderately positive
3. Minimize air, water and noise pollution	Moderately positive
Recreation	
1. Provide needed facilities	Negative
2. Provide high quality experience	Moderately negative

XIII.F.6. EXPANDED USE OF EXISTING FACILITIES

This alternative envisions an expanded role for existing facilities, primarily state parks and forests, in satisfying the projected recreation demand within the recreation service area, brought about by an increase in the intensity of development of those facilities currently operating or under construction but without the addition of land.

XIII.F.6.(a) Detailed Description

Nearly all of the state forest and parks in the Tocks Island area could expand their capacities and allow for a more efficient use of their land and water acreage. As some measure of this expansion potential, the table below presents a comparison of representative state parks and forests within the recreation service area on a visitor per acre basis. This is a fairly rough measure, but one that provides a good overview on the relative level of utilization of state recreation areas.

It is not suggested by this comparison that each park should try to achieve over 500 annual visitors per acre; this comparison only identifies a potential for more expanded use on a broad scale. The level of increased development must be, and under this alternative was, tailored to each individual area and that area's natural capabilities.

Table 13-19. State Parks and Forests, Annual Visitor Days, Total Acreage and Visitors Per Acre in the Seven-County Impact Area

	Annual Visitor Days	Total Acres	Visitors Per Acre
New Jersey			
High Point	387,666	12,372	31
Stokes	205,082	14,232	14
Swartswood	107,702	1,253	86
Worthington	74,987	5,824	13
Stephens	121,367	133	912
Jenny Jump	41,757	967	43
Total	938,561	34,781	27
Pennsylvania			
Big Pocono	262,514	1,306	201
G.W. Childs	76,690	154	498
Promised Land	602,450	2,342	257
Gouldsboro	183,230	2,800	65
Tobyhanna	188,975	4,188	45
Total	1,313,859	10,790	122
New York			
Lake Superior 1/	15,000	1,409	10
Highland Lakes 1/	7,500	2,901	3
Storm King 1/	17,500	1,415	12
Bear Mountain 2/	2,160,000	5,066	426
Harriman 2/	1,933,000	46,181	42
Goosepond Mountain 1/	15,000	1,543	10
Total	4,148,000	58,515	71

Note: Years may vary but are most recent available.

1/ Undeveloped park, visitors usage is estimate from New York State Park officials.

2/ As Bear Mountain and Harriman State Parks are partially in both Orange and Rockland Counties, these totals reflect segments outside the seven county area in Rockland County.

Source: Appropriate state departments.

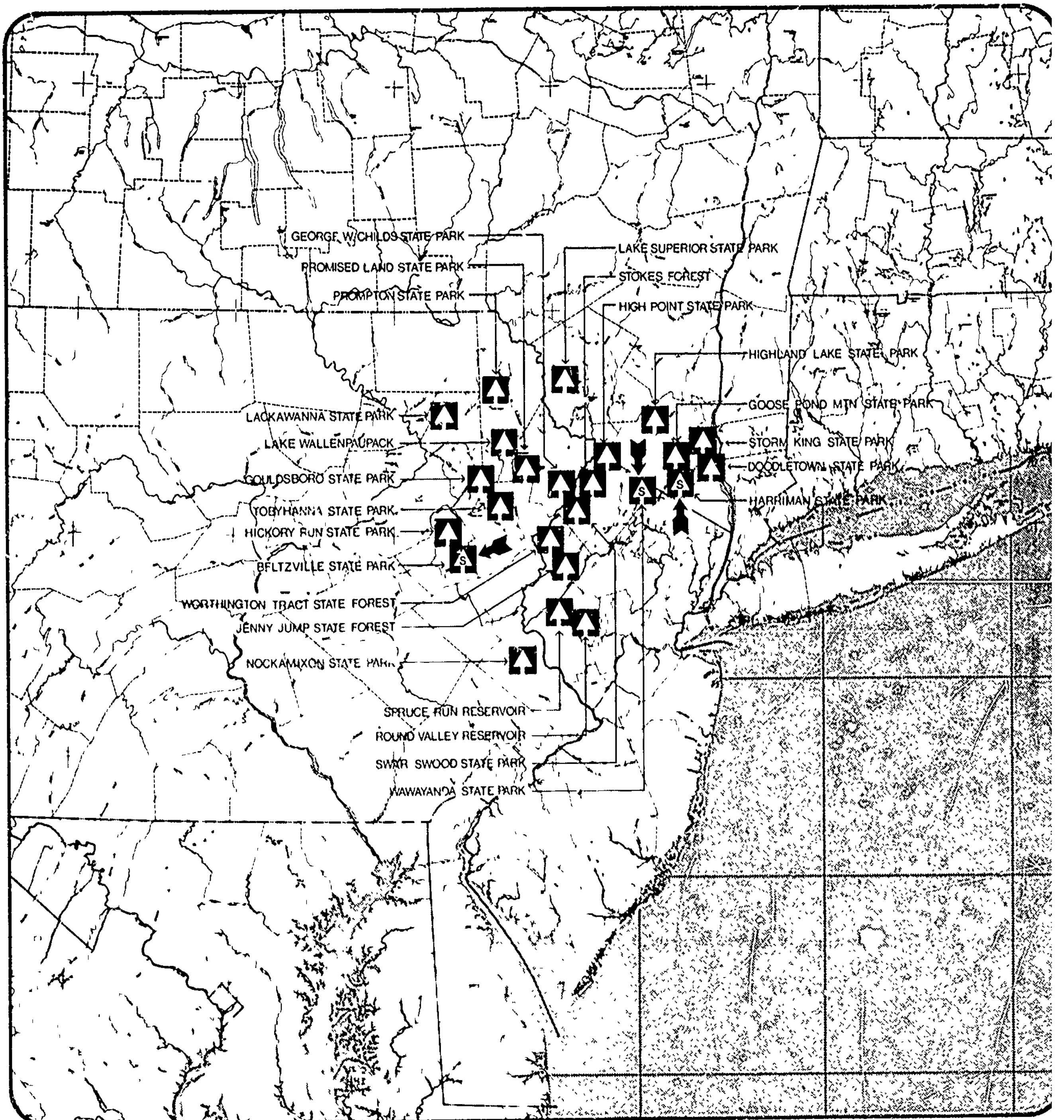
Under this alternative, no increase in the current size of the various parks or forests is considered and all proposed development is considered possible and without major negative impacts.

The underlying philosophy of this alternative is to provide a level of service comparable to TILP in terms of the total capacity of recreation facilities, with these facilities widely dispersed and in some cases closer to a bulk of the recreation service area population.

From telephone interviews with the park superintendent or regional supervisors, the expansion capabilities for each of the 26 parks or forests shown on Figure XIII-6 were estimated. Expansion of recreation facilities was investigated for four primary activities: swimming, boating, camping and picnicking. The potential for expansion was considered to be over and above the current facilities available at the particular park and did not include expansion that has already been approved, funded or now under construction.

In order to describe the process that was involved in developing these estimates, five state parks have been selected for a more detailed description. The five parks are Spruce Run and Wawayanda in New Jersey; Beltzville in Pennsylvania; and Lake Superior and Doodletown in New York. Doodletown is actually a separate area within Bear Mountain Park.

Spruce Run State Park could be further developed and the following facilities could be increased. An additional 150 boats could be put on the lake



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EXPANDED USE OF EXISTING STATE PARKS, FORESTS AND RESERVOIRS

XIII
6

LEGEND

UNDERUTILIZED STATE PARKS

SELECTED STATE PARKS FOR GREATER USE IN COMBINED PLAN WITH 'OPEN CLOSED RESERVOIRS' mainly by adding a boat ramp and one marina with 60 to 80 rental boats. The swimming instant capacity of 3,000 could be increased to 8,000 by developing a new beach area, while an additional 350 picnic tables and 60 camping sites could be added. Beyond this, additional development is possible but not without overcrowding and conflicting with other activities.

Wawayanda State Park in Sussex County, New Jersey, is an undeveloped park at this point which contains nearly 10,000 acres. The Appalachian Trail runs through the park and is one of its primary uses now. Further development of this park could occur on the following levels. There is a lake on the property which could provide a beach of at least 500 linear feet. A picnic area with about 500 tables could be integrated into this planned swimming area. A private concessionaire now operates a marina with about 40 boats and could be expanded to 100 boats. Restrictions prohibit outboard motors so the boating activity would center around sailing or fishing. There are presently no developed campsites in the park, but the park could accommodate about 250 sites in addition to the previously mentioned development.

Beltzville State Park in Pennsylvania has the capacity for significant expansion of its facilities. Under the present regulations of unlimited horsepower motors, an additional 50 rental boats and new marina are all that is feasible. However, if the lake rules were changed to restict all motors, except electric, the boating capacity could be increased by over 5,800 people at one time. The current picnic facilities could be gradrupled to 1,600 sites at the present site and by opening up new areas to picnickers.

The swimming beach area could be increased by 1,500 linear feet along the shoreline, and camping could be introduced to the park and provide 750 new campsites. Any expansion beyond these limits would exceed the current land area holding capacity.

Lake Superior State Park in New York is part of the Palisade Interstate Park System. This park is currently undeveloped and its primary users are backpack campers and hikers. If this park were developed to its full potential, it could accommodate 600 picnic tables, 200 campsites, 1,000 linear feet of beach and 300 nonmotorized boats. Development of this level would still maintain the park as one of low intensity use as envisioned by the Palisades Park System and provide a quality recreation experience.

Harriman State Park is one of the largest parks in the Palisades Interstate Park System and is within an hour's drive of New York City. Harriman has the capability of additional recreation development as follows: 1,000 picnic tables; 200 more rental boats and 300 linear feet of beach on various lakes; and 25 camping sites. This expansion is well within the physical holding capacity of current acreage of Harriman.

The above five state parks were selected only as sample descriptions of the expansion that could take place in such parks. Similar comments were obtained for all 26 of the parks listed. It should also be noted that there are other parks within the area that had no potential for increased usage and are not included in the list.

Table 13-20. Expansion Potentials Beyond Current Capacity in Various State Parks and Recreation Facilities

	Instant Capacity			
	Swimming	Boating	Camping	Picnicking
New Jersey				
High Point	500	0	400	750
Worthington	0	0	80	0
Stokes	0	0	400	2,100
Spruce Run	5,000	450	240	1,750
Round Valley	1,500	1,500	960	750
Voorhees	0	0	120	250
Jenny Jump	0	0	20	0
Swartswood	0	90	0	0
Wawayanda	1,000	180	1,000	2,500
Stephens	0	0	100	500
Pennsylvania				
George W. Childs	0	0	0	125
Tobyhanna	1,000	0	1,200	500
Beltzville	3,000	5,820	3,000	6,000
Promised Land	0	1,500	4,000	0
Wallenpaupack	1,200	3,750	0	0
Prompton	0	150	0	750
Gouldsboro	1,000	0	1,200	4,500
Nockamixon	5,000	1,500	0	5,000
Hickory Run	200	0	2,800	2,500
Lackawanna	2,270	150	1,240	3,300
New York				
Lake Superior	2,000	900	800	3,000
Highland Lakes	0	0	1,600	6,000
Storm King	0	0	60	0
Goosepond Mountain	0	0	1,600	6,000
Harriman	600	600	100	5,000
Doodletown	1,870	300	0	1,250

Source: Various state park superintendents or regional supervisors.

The basis for these possible expansions was generally the personal judgment of the local park superintendent or his immediate supervisor both of whom had intimate and detailed knowledge of the park in question. The pertinent parameters in their judgments were the holding capacity of the land and the point where development of one activity would begin to interfere with other activities. In fact, each activity could be expanded much more than stated in this alternative, but that expansion would be at the expense of other recreation activities. Therefore, this level of recreation activity is not unreasonable nor conflicting with the current activities of the park. It was further assumed, so as not to artificially constrain the estimates of development potential, that this level of expansion was fully funded for the development and also its operation and maintenance costs.

Table 13-20 on the previous page presents all of the parks, listed by state, and the additional level of development that could be achieved in each of the four activity areas. Figure 13-6 locates all these parks for which costs, benefits and impacts are described. Those indicated as "selected parks" are included as part of the recreation component of Program "B" described in XIII.F.8.(b). The total potential development assuming no budget constraints under this alternative is shown in the table below along with the annual activity days and total visitation calculated from the factors previously described.

Table 13-21. Programmed Instant Capacity and Annual Visitation for Expanded Use of Existing Facilities Alternative

	Instant Capacity	Activity Days
Swimming	26,140	2,261,000
Picnicking	52,525	3,581,000
Boating	16,890	2,112,000
Camping	20,920	1,308,000
Total Primary Activities		9,262,000
Total Annual Visitors 1/		11,577,000

1/ Overlap factor of 1.4; other activities factor of 1.4; and 20% sightseers.

XIII.F.6.(b) Project Costs and Benefits

Since this alternative envisions expansion of the current state parks without additional land, the total costs shown below are for construction of facilities only. Construction cost estimates were based on the instant capacities of the projected development, using unit costs similar to development costs found in the various state recreation department estimates described earlier. These total construction costs are shown below along with annual operation and maintenance costs and annual benefits calculated at $2.03 per visitor.

Development Costs + 25%	$104,896,050
Land Costs	none
Total First Costs	$104,896,050
Annual O&M Costs	$ 4,050,000
Annual Benefits	$ 23,501,000

XIII.F.6.(c) Institutional Aspects

The previously stated assumption, that money is not a constraining factor in estimating the level of development that would be possible for a given park, is unrealistic but served the purpose of permitting an objective evaluation of physical expansion potential. Taking a more realistic view of the situation, most of the park superintendents expressed concern for having sufficient funds to undertake these expansions. For this alternative to be viable there would need to be identified numerous project financing methods. State-wide bond issues, Bureau of Outdoor Recreation funds, and on-going state programs would be the primary sources unless Congress addressed the special needs of this area in conjunction with deauthorization of TILP should that occur.

XIII.F.6.(d) Impacts of Expanded Use of Existing Facilities

The evaluation matrix for this alternative summarizes the anticipated impacts that would occur if these expansions of facilities and visitors were carried out. On the whole this alternative appears to net out about even on its positive and negative impacts. The most significant negative impacts are in the areas of balanced development and natural systems while the positive effects come in the areas of economics and recreation.

The impacts on balanced development are generally negative because of the increased reliance on private autos since mass transit would be impractical in this dispersed scheme. While some pressure is placed on small, often ill-equipped, governmental entities to guide the growth that will occur when these areas are more intensely developed, this is not as great a problem as in alternatives where the visitation is more concentrated. Furthermore, the open space that now exists in these parks will be developed and no additional land will be purchased to replace the lost open space.

The natural system will suffer negative impacts mainly because of the problems associated with solid and liquid waste disposal. The most frequently mentioned restraining factor on further development was the limit of current sanitary facilities -- further development can only mean greater problems and more money to solve them.

On the positive side, the economic benefits to the local area residents, while not quantified at this point, are clear. Job growth, especially in the tourist retail and service areas, will occur as a result of the influx of more visitors. Although any growth in the population or real estate activity in the area is going to require increased police and fire protection, there will be an increased tax base from which to offset the expenditures.

Since this is a recreation-oriented alternative, it is not surprising that the strongest positive impacts are in solving the area's recreation needs. This alternative was designed to provide needed facilities already identified in a previous chapter, and they in fact do go a long way in satisfying some of the region's recreation demand. Also, the alternative was structured so as not to develop these parks beyond their natural holding capacity, and therefore provide a recreation experience comparable in quality to the existing facilities.

Table 13-22. Impacts of Expanded Use of Existing Facilities

Balanced Development	
1. Preservation of open space	Moderately negative
2. Achieve land use objectives	Moderately negative
3. Achieve transportation objectives	Moderately negative
Social	
1. Promote existing values and lifestyles	Little or none
2. Preserve historical and archeological sites	Little or none
3. Minimize displacement of people and business	Highly positive
Economic	
1. Generate local employment opportunities	Moderately positive
2. Generate local retail and service expenditures	Moderately positive
3. Increase local property values	Moderately positive
Institutional	
1. Minimize local government public service needs	Moderately negative
2. Increase property and sales tax base	Moderately positive
3. Ability of local government to handle growth	Moderately positive
Natural Environment	
1. Minimize flora and fauna disturbance	Moderately negative
2. Minimize solid and liquid waste generation	Highly negative
3. Minimize air, water and noise pollution	Moderately negative
Recreation	
1. Provide needed facilities	Highly positive
2. Provide high quality experience	Highly positive

XIII.F.7. INTENSIFICATION OF DWGNRA WITHOUT TILP

This alternative envisions the maximum development of DWGNRA without TILP. Since a river-based recreation area is assumed in the absence of the lake, this alternative seeks to accommodate in that area a visitation equal to the proposed full development of TILP, approximately 10 million annually. Quality of experience is traded, to some extent, for maximum accommodation of visitors. Likewise, the preservation of DWGNRA's natural systems equilibrium may be sacrificed somewhat to accommodate visitors. It is likely this alternative would result in well worn facilities, excessive solid and liquid waste, and a moderate quality of visitor experience, perhaps less than that available in comparable state parks.

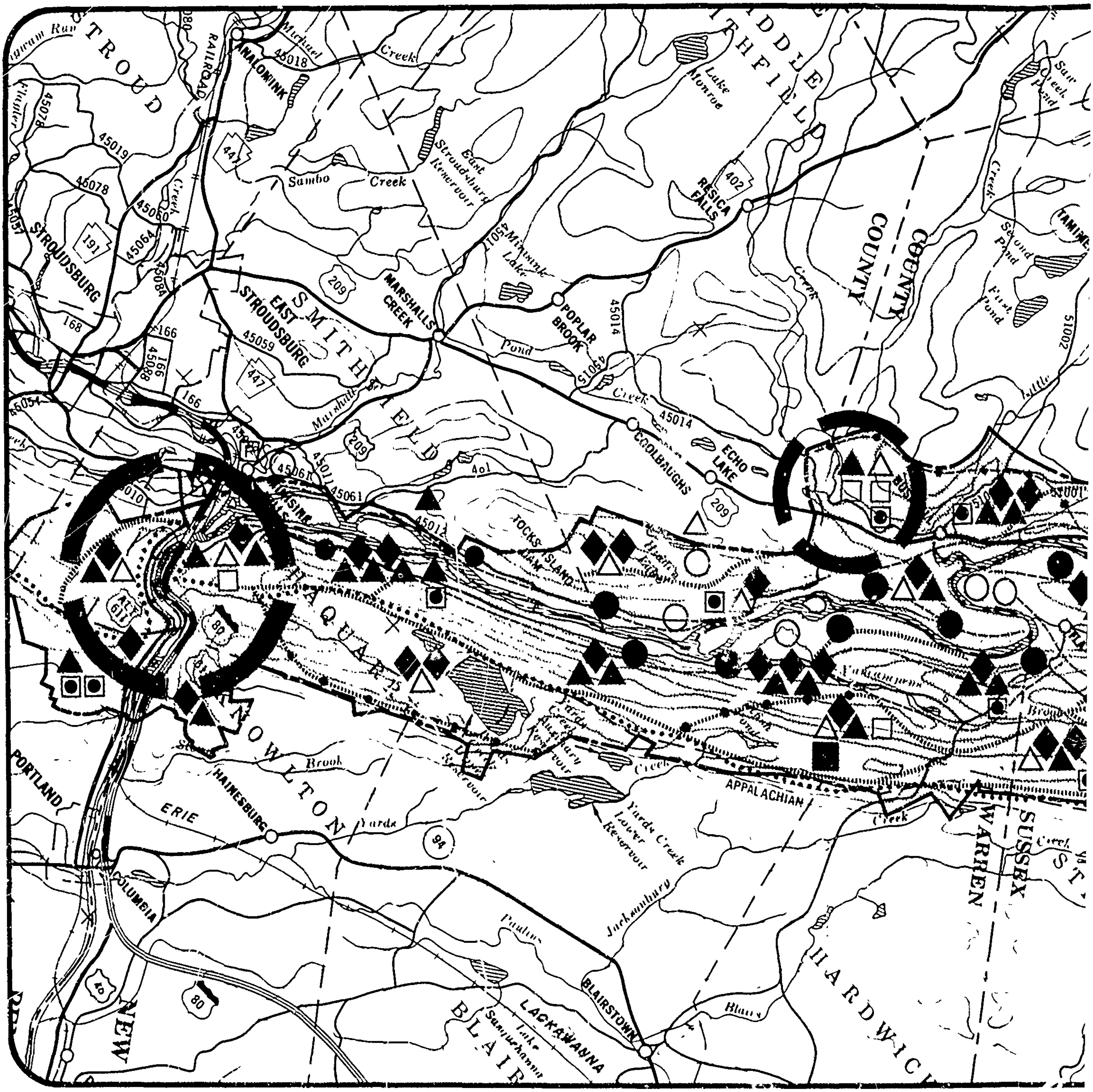
XIII.F.7.(a) Detailed Description

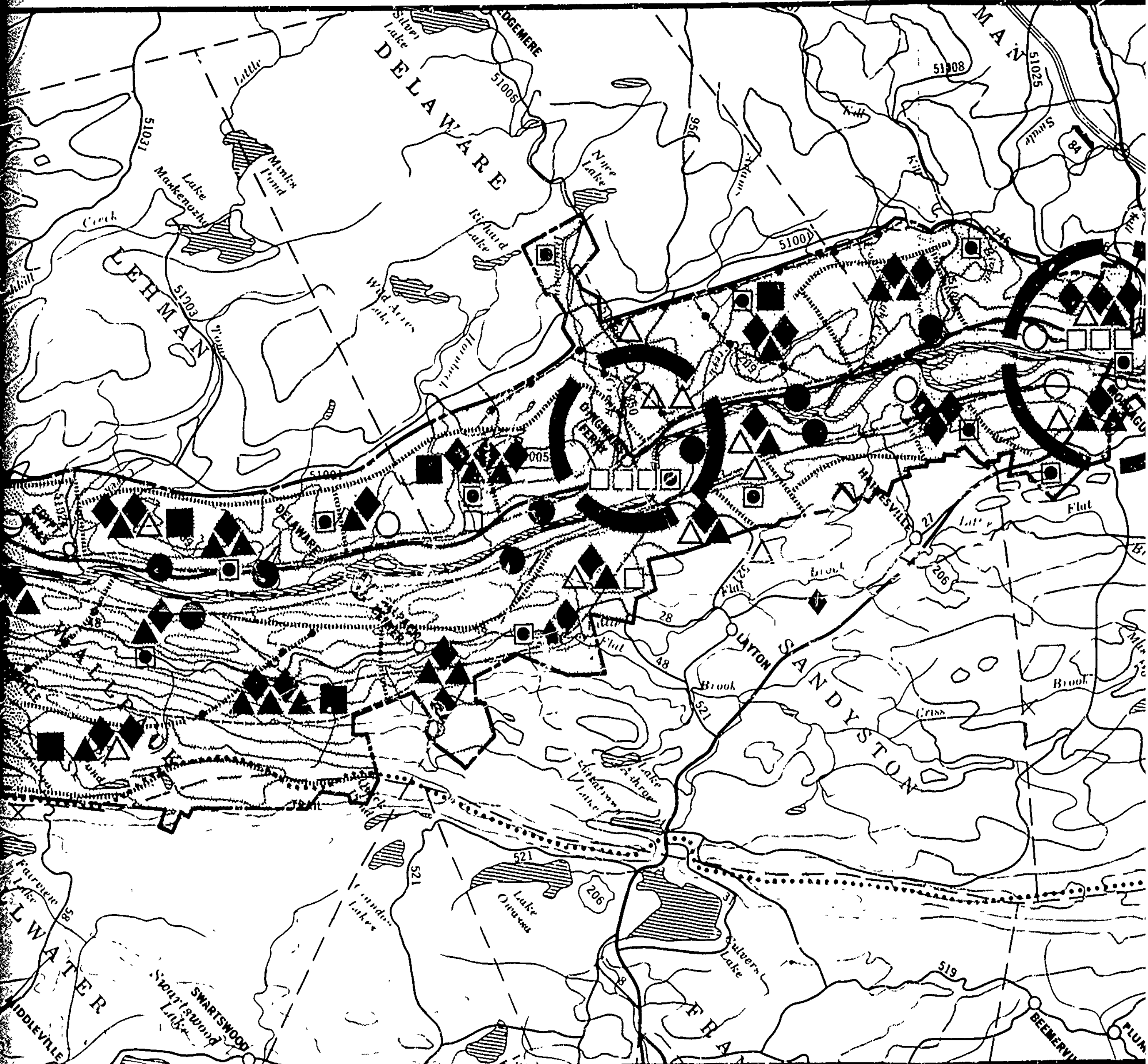
The feasible upper range of DWGNRA daily visitations without TILP is indicated in the table below. Intensification would require pools to increase swimming capacity plus extensive biking and hiking trails and additional family and group camping, field game areas for baseball, soccer or football, and game courts for tennis and basketball. With these changes the design load could range as high as 113,500 without TILP. This facility mix may be compared to the Clarke & Rapuano plan for DWGNRA with TILP first phase, which provides facilities for a design load of about 40,000 visitors or Phase III which provides an instant capacity of about 110,000. The facilities mix is shown conceptually on Figure XIII-7.

Table 13-23. Components of Instant Capacity and Annual Visitation for Intensive Development of DWGNRA Without TILP

	Instant Capacity	Annual Activity Days
Swimming		
Beach; 8,000 linear feet x 2 people	16,000	1,043,500
Pools; 6 x 1,475 people	8,850	1,154,350
Boating		
1,150 boats and canoes x 3 people	3,450	431,250
Camping		
Hike-in 4,000 sites		
Group 1,800 sites		
5,800 sites x 4 people	23,200	1,450,000
Picnicking		
11,000 sites x 5 people	55,000	3,750,000
Bicycle Trails		
100-mile loop		
50-mile loop		
50 miles short trails		
200 miles x 20 people	4,000	-
Hiking and Nature Trails		
250 miles x 12 people	3,000	-
TOTAL INSTANT CAPACITY	113,500	
TOTAL PRIMARY ACTIVITY DAYS		7,829,000
TOTAL ANNUAL VISITORS 1/		9,786,000

1/ Overlap factor of 1.4; other activities factor of 1.4; 20 percent sightseers.


STROUD
RAILROAD
ANALOMINK
45018
Michael
Creek
Lake Monroe
East Stroudsburg Reservoir
Sambo
Creek
45019
45078
191
STROUDSBURG
447
402
RESICA FALLS
COUNTY
COUNTY
209
EAST STROUDSBURG
SMITHFIELD
MARSHALLS CREEK
POPLAR BROOK
45014
Pond
45059
166
168
Creek
COOLBAUGHS
ECHO LAKE
Second Pond
First Pond
TOCKS ISLAND DAM
611
80
KNOWLTON
Brook
PORTLAND
ERIE
HAINESBURG
94
APPALACHIAN
Yards Creek Lower Reservoir
SUSSEX
WARREN
COLUMBIA
80
Paulins
Jacksonburg
BLAIRSTOWN
LACKAWANNA
BLAIR
HARDWICK



BASE MAP SOURCE TOCKS

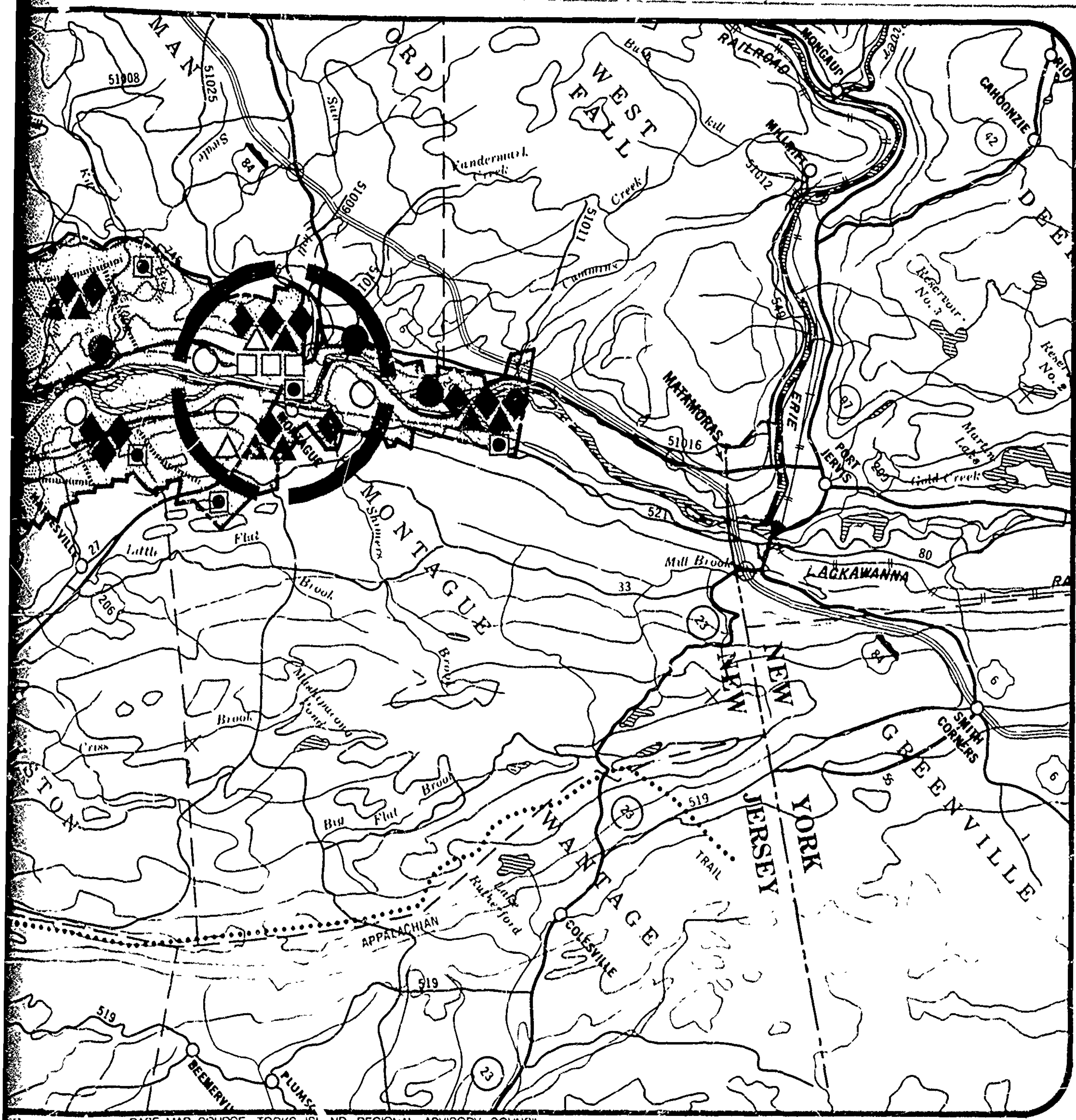
0 5 1 15
SCALE IN MILES

PROPOSED DEVELOPM

△ CLUSTERED
○ RIVER EDGE
HIKING TRAIL
BIKING TRAIL
APPALACHIAN
□ PARKING - AVE SPACES PE
PICNIC AREAS ACTIVITY NC CAPACITY OF 6

* AS PER "SAVE THE DEL

TOCKS IS



BASE MAP SOURCE TOCKS ISL'ND REGIONAL ADVISORY COUNCIL

0 .5 1 1.5
SCALE IN MILES

N

INTENSIFICATION OF DWGNRA WITH A FREE FLOWING RIVER

XIII **7**

PROPOSED DEVELOPMENT *		INTENSIFIED DEVELOPMENT
△	CLUSTERED CAMPSITES	▲
○	RIVER EDGE SWIMMING	●
....	HIKING TRAILS	·◆·····◆·
- - - - -	BIKING TRAILS	-◆- - -◆-
'''''''''	APPALACHIAN TRAIL	
□	PARKING - AVERAGE 700 SPACES PER LOCATION	▣
◌	PICNIC AREAS WITHIN ACTIVITY NODES (INSTANT CAPACITY OF 3920 PERSONS)	◆

▩ POOLS

3

* AS PER SAVE THE DELAWARE COALITION

A COMPREHENSIVE STUDY OF THE

TOCKS ISLAND LAKE PROJECT & ALTERNATIVES

URS / MADIGAN-PRAEGER, INC. & CONKLIN AND ROSSANT

XIII.F.7.(b) Project Costs and Benefits

This alternative would require development of nearly 16,000 acres within DWGNRA for various uses. The breakdown of land uses is shown below:

	Acres
Beach: 8,000' x 200'	37
Pools: 6 @ 2 acres	12
Boat Ramps	12
Camping: assumes 6 hike-in sites/acre,	167
10 group-camp sites/acre	180
Picnicking: 11,000 sites @ 6/acre	1,833
Trails: 450 miles x 200' easement	10,908
Other Activities	750
Parking Areas: assume 75% visitors come by car (74,250), 3.5 persons/car, therefore, 21,214 cars @ 300 sq.ft./car	146
Miscellaneous: 5% of above	703
Total developed acreage, excluding auto access roads	14,749
Auto access roads: 8% of above	1,180
Total developed area	15,929

The entire DWGNRA and TILP land would have to be acquired, given its present outages in order to achieve a viable and manageable recreation area. Land costs then would be the same as for the less-intense river-based DWGNRA discussed first.

The construction cost estimates are based on the proposed instant capacities of each of the activities. These construction cost estimates are a composite of the actual development costs that were incurred by various states in their recreation facility development. Since most of the boating under this alternative will be nonmotorized boats, light canoes or sail boats, the lower end of the cost range described earlier was used in estimating the boating costs. The other construction costs per instant capacity were estimated at their normal levels.

These development and land costs are shown below in addition to the anticipated annual operation and maintenance costs and annual benefits.

Development Costs + 25%	$113,868,750
Land Costs	134,410,000
Total First Costs	$248,278,750
Annual O&M Costs	$ 4,138,000
Annual Benefits	$ 19,866,000

XIII.F.7.(c) Institutional Aspects

This alternative envisions somewhat relaxed National Park Service policy regarding the range of facilities able to be provided. Intensification would require additional facilities not presently provided by the Park Service in National Recreation Areas, such as swimming pools, intensive overnight camping, field and court sports including baseball, soccer, football, tennis and basketball. Such reused policies could be directed by Congress in any act of deauthorization of TILP as noted in Chapter XIX.

Capital, as well as operating and maintenance costs, would be borne by the National Park Service. Deauthorization of TILP would remove virtually all responsibility from the Corps of Engineers. Due to the similarity of a non-TILP DWGNRA to existing state parks, some operating and maintenance arrangements might be established with appropriate state agencies. Concessionaires could run camping areas, jitneys, equipment rental, shops and cafeterias; thus further alleviating NPS burdens. Significant administrative burdens would be engendered by this alternative. Local public safety services as well as traffic control will require coordination between local, county and state agencies, and with NPS.

XIII.F.7.(d) Impacts of Intensive Use of DWGNRA Without TILP

Examination of the impacts of this alternative indicates a mix of positive and negative impacts, with no significant overall positive effect. Many of the ratings were high positive or high negative reflecting the extremes in impacts to be found with such intensive development. This mixed overall rating points up the trade-off inherent in this alternative -- recreation quality and the natural environment are sacrificed to accommodate the maximum number of park visitors.

This alternative has a negative impact on balanced development for a number of reasons. First, open space is lost through more intensive development, and also land use objectives are obscured by lowering the local residential quality in addition to increased pressure for strip commercial development to occur. The impacts on transportation are highly negative in that, even though the plan may be suitable for public transit, this level of visitors will increase the use of automobiles on roads that are presently inadequate.

Positive social impacts are expected through great exposure of local historic and archeological sites and even promotion of the existing tourist-oriented businesses. Displacement and relocation of people has already had major negative impacts and further land acquisition for DWGNRA will intensify these negative impacts, but as noted this would occur anyway. Economic gains are highly positive because of the growth in employment to accommodate the increased business. This increased business will have the positive effects of enhancing property values and local retail sales expenditures. These major economic benefits translate directly into increases in the local tax base which should help offset the increase in required government services.

The natural environment will suffer most seriously from this alternative. Both liquid and solid wastes will be generated in significant quantities -- such that improved sanitary facilities are mandatory. Because of the intensive recreation development, disruption of plant and wildlife patterns is inevitable and significant.

The above factors point up the trade off expected in this alternative between the quality and quantity of recreation. This alternative provides generous amounts of a variety of recreation facilities but does so at the expense of recreation and environmental quality. Without a lake to focus the activity of such a large number of visitors, the carrying capacity of the DWGNRA site is likely to be exceeded. This is not to infer, however,

Table 13-24. Impacts of Intensive Use of DWGNRA Without TILP

Balanced Development	
1. Preservation of open space	Moderately negative
2. Achieve land use objectives	Moderately negative
3. Achieve transportation objectives	Highly negative
Social	
1. Promote existing values and lifestyles	Moderately negative
2. Preserve historical and archeological sites	None
3. Minimize displacement of people and business	None
Economic	
1. Generate local employment opportunities	Highly positive
2. Generate local retail and service expenditures	Highly positive
3. Increase local property values	Highly positive
Institutional	
1. Minimize local government public service needs	Highly negative
2. Increase property and sales tax base	Highly positive
3. Ability of local government to handle growth	Highly negative
Natural Environment	
1. Minimize flora and fauna disturbance	Highly negative
2. Minimize solid and liquid waste generation	Highly negative
3. Minimize air, water and noise pollution	Highly negative
Recreation	
1. Provide needed facilities	Highly positive
2. Provide high quality experience	Moderately negative

that a recreation area with a lake could accommodate a similarly large number of visit rs without exceeding the area's carrying capacity. Merely from a . environmental standpoint, it is easier to provide for large numbe·.s of visitors on lake front beaches than dispersed throughout var .ous woodland areas.

XIII.F.8. SELECTION OF ALTERNATIVES

This detailed evaluation of the recreation alternatives has revealed characteristics of the alternatives which influence their viability and suitability. There are differences in the type of recreation offered, the amount of people who can be served, the costs and impacts. Two of these alternatives particularly seem to be inappropriate for further consideration. First, the neighborhood pools and parks, while fulfilling a vital recreation need, are not really legitimate alternatives to the type and range of facilities which TILP could provide. Second, the intensification of DWGNRA without a lake, developed to accommodate something near 10,000,000 visitors and thereby provide a comparable output to the originally planned recreation area, would seem to place too great a burden on the land resources. These two alternatives are not considered further in this analysis.

The remaining five alternatives still vary widely in their requirements and level of service. In Chapter XVI of this study, three programs are developed which combine viable alternatives to each of the authorized purposes into "packages" for detailed testing and evaluation. Each of these three combined programs is geared toward a slightly different objective. Program "A" is formulated to produce an output comparable to TILP and to be consistent with a policy of maximizing economic growth in the service area. Program "B" could produce an output somewhat less than TILP and should be consistent with a moderate growth level in the service area. Program "C" should represent the minimum cost alternatives which may produce an output less than

TILP and would be consistent with a low rate of regional economic growth and growth policies maximizing protection of environment.

XIII.F.8.(a) Recreation Alternatives in Program "A"

In this category the alternative calling for new state parks and programs best fits the objectives of the program. When combined with the less-intensive, river-based DWGNRA (as each alternative must be) there could ultimately be a total of 9,845,000 visitors per year and a variety of recreation experiences located, to a great extent, near the population centers where the need is greatest. The relatively high development cost of the riverfront metroparks and the two superparks in itself stimulates economic activity, but more important in this regard is the opportunity this alternative provides for the revitalization of older structures and the development of accompanying cultural and commercial facilities. The combined costs of the new state parks and programs and the river-based DWGNRA are shown below.

Table 13-25. Alternative Program "A" Recreation Component

Development Costs + 25%	$128,257,700
Land Costs	154,090,000
Total First Costs	$282,342,700
Annual O&M Costs	$ 2,821,050
Annual Visitors	9,845,000
Annual Benefits @ $2.03	$ 19,985 000

XIII.F.8.(b) Recreation Alternatives in Program "B"

There are three remaining programs (plus, of course, the river-based DWGNRA) to be considered for Program "B," piggybacking, expanded use of existing facilities and opening closed reservoirs. Of these three, the most appropriate for Program "B" appears to be a combination of expanded use of existing facilities and open closed reservoirs. The piggyback alternative is more expensive than either of the others because of the need to acquire additional lands. Furthermore, the locations of the reservoirs suitable for piggybacking of recreation activity are not as convenient to population concentrations nor as comparable to Tocks Island as can be achieved by a combination of the other two alternatives.

In order to express this program as a realistic alternative, not all of the closed reservoirs or existing facilities discussed in the detailed evaluations would need to be included in a combined package. Expansions of Beltzville, Wawayanda and Harriman parks discussed earlier would provide a broad range of activities and a geographically comprehensive pattern of service. Of the closed reservoirs considered for recreation development, the Pequannock Watershed can provide a balanced mix of facilities in close proximity to the population centers and appears to be the one with the least institutional constraints on opening it up for public recreation use. The watershed also has a great potential for providing group hiking and fishing on a one-day pass basis, a proven method of reducing vandalism while still allowing use of a resource. Table 13-26 below shows the instant capacity and annual activity days which would be generated by the development of these four selected areas.

Table 13-26. Programmed Instant Capacity and Annual Visitation for Combined Open Closed Reservoirs and Expanded Use

	Instant Capacity	Activity Days
Swimming	11,100	724,000
Picnicking	19,500	1,330,000
Boating	7,630	954,000
Camping	7,100	444,000
Total Activity Days		3,452,000
Total Annual Visitors 1/		4,315,000

1/ Overlap factor of 1.4; other activities factor of 1.4; and 20% sightseers.

When combined with the forecast visitation for a river-based DWGNRA, the total annual visitation would be 8,178,000. The total costs and benefits for this particular combination of recreation alternatives is shown below.

Table 13-27. Alternative Program "B" Recreation Component

Development Costs + 25%	$ 77,471,250
Land Costs	134,410,000
Total First Costs	$211,881,250
Annual O&M Costs	$ 2,883,030
Annual Visitors	8,178,000
Annual Benefits @ $2.03	$ 16,601,000

XIII.F.8.(c) Recreation Alternatives in Program "C"

The recreation alternative recommended for inclusion in Program "C" is to take no specific actions to develop substitute recreation facilities but rather to let the private market respond where it is so inclined and let the people seek out other recreation facilities or activities, except for the river-based DWGNRA which would be developed along the lines of the Save the Delaware Coalition plan providing a balance of hiking, camping, swimming, boating and cultural and archaeological interpretive experiences. These concepts are discussed in detail in Chapter XVIII and in the description and evaluation provided earlier in this chapter (XIII.C.1. and XIII.F.1.). The table below summarizes the costs, visitation and benefits of the recreation component of alternative Program "C" to be evaluated in Chapter XVI.

Table 13-28. Alternative Program "C" Recreation Component

Development Costs + 25%	$ 39,967,500
Land Costs	134,410,000
Total First Costs	$174,377,500
Annual O&M Costs	$ 1,377,000
Annual Visitors	$ 3,863,000
Annual Benefits @ $2.03	$ 7,842,000

This chapter has presented and discussed a number of alternative recreation programs for serving the area with facilities somewhat comparable to those proposed for the Tocks Island Lake project should that project be deauthorized. Although each has been discussed as if it were a separate entity, all have merit and all address an important regional need. It should not be concluded that any of the programs or suggestions seemingly dismissed in this section should not be pursued by those interested in improving the recreation opportunities in the region, and ongoing state and local programs should be considered a necessary complement to any alternative. The intent of this chapter is to select those alternatives most viable yet in some way comparable to TILP so that a fair evaluation of that project and potential alternatives can be conducted.

XIII.F.9. PHASING OF THOSE SELECTED RECREATION ALTERNATIVES WITHIN PROGRAMS

The alternatives presented in this chapter have been discussed on the basis of their full development capability which might be comparable to the ultimate development of DWGNRA with TILP (Phase III). However, for the Chapter XVI evaluations of alternative programs and TILP, the first phase (4,000,000 visitors per year) is used as the basis for comparison as this conforms with current authorization. As noted elsewhere in the study, DWGNRA with TILP can not advance to Phases II and III without appropriate public hearings, environmental assessments of Phase I impacts and amendments to the DRBC Comprehensive Plan and its resolutions. In order to compare these recreation alternatives with Phase I DWGNRA with TILP, a Phase 1 component of each alternative has been developed. Program "C" which provides a level of visitation less than TILP consists of DWGNRA without TILP at a first phase visitation level of 2,000,000. Program "B" contains, in addition to DWGNRA without TILP, opening closed reservoirs and expanded use of existing parks to accomodate an additional 1,000,000 visitors for a total visitation of 3,000,000. Program "A" also includes the creation of new state parks and programs to accomodate 2,000,000 visitors which when combined with DWGNRA without TILP (Phase I) provides for 4,000,000 visitors, which is comparable to Phase I of DWGNRA with TILP.

These programs and their visitations along with their associated costs are summarized in the following table.

Table 16-6 Assumed Level of Visitors and Related Costs and Benefit Data by Alternative Recreation Programs (In millions)

	Programs		
	A	B	C
Phase I			
Annual Visitors	4.0	3.0	2.0
Total Capital Costs 1/	$207.9	$171.1	$162.3
Annual O&M Costs	$ 1.2	$ 1.0	$ 0.7
Annual Benefits	$ 8.1	$ 6.1	$ 4.1
Phase III			
Annual Visitors	9.845	8.178	3.863
Total Capital Costs 1/	$282.3	$211.9	$174.4
Annual O&M Costs	$ 2.8	$ 2.9	$ 1.4
Annual Benefits	$ 20.0	$ 16.6	$ 7.8

1/ Includes $15.0 million as an amount roughly indicative of Route 209 relocation costs chargeable to DWGNRA.

APPENDIX A TO CHAPTER XIII

Cost Factors for Various Recreation Facilities Updated to November 1974 Price Levels

COST STANDARDS - SWIMMING BEACH

Source	Capacity	Beach Development	Site Development	Bath House	Pro Rata Share/Roads, Utilities, etc.	Total	Cost Per Participant
TILP (based on 1966 est.-updated)	50,000	$9,173,340	-	$2,633,440	$15,328,874	$27,135,614	$ 543
New Jersey*	2,400	$ 316,800	$1,250,400	$ 792,000	$ 4,026,000	$ 6,388,800	$2,662
Pennsylvania	3,500	$ 840,000	-	$ 160,000	(included)	$ 1,000,000	$ 286
B.O.R.	2,400	$ 54,100	-	$ 55,000	-	$ 205,000	$ 90

* Not representative - for luxury development.

COST STANDARDS - SWIMMING POOL

Source	Capacity	Pool and Deck	Bath House	Pro Rata Share/Roads, Utilities, etc.	Total	Cost Per Participant
New Jersey	800	$198,000	$132,000	$ 66,000	$ 396,000	$495
Pennsylvania	1,200	-	-	-	$ 472,500	$395
	2,400	-	-	-	$ 682,500	$285
New York City						
Sound View Pool	3,000	$995,000	$819,600	$1,073,850	$2,888,450 (includes 4 additional park acres)	$960
New York State						
Roberto Clemente Park	2,400	-	-	-	$1,800,000	$750
B.O.R.	600	-	-	-	$ 213,000	$355
	2,400	-	-	-	$ 502,000	$210

COST STANDARDS - BOATING

Source	Capacity	Site	Pro Rata Share/Roads, Utilities, etc.	Total	Cost Per Boat	Cost Per Participant
TILP						
Total Facilities	2,585	$1,810,490	$2,342,410	$14,152,900	$1,606	$ 535
Ramp	40 boats	$ 6,820	$ 9,420	$ 16,310	$ 408	
Beach	1 boat	$ 110	$ 152	-	$ 262	
New Jersey						
Ramp	60 boats	$ 29,000	$ 17,200	$ 46,200	$ 769	
Dock	100 boats	$ 66,000	$ 132,000	$ 198,000	1,980	
Sanitary	-	$ 66,000	-	$ 66,000	-	
Total	-	-	-	-	$3,410	$1,470
Pennsylvania						
Ramp	40 boats	-	-	$ 7,350	$ 185	
Dock	-	-	-	-	750	
Total	-	-	-	-	$ 935	$ 310
B.O.R.						
Ramp	40 boats	-	-	$ 71,300	$1,780	$ 590

COST STANDARDS - PICNIC SITE

Source	Capacity	Site	Shelter	Sanitary	Pro Rata Share/Roads, Utilities, etc.	Total	Cost Per Table	Cost Per Participant
TILP	7,425	$3,103,650	$2,605,200	$993,300	$8,715,069	$15,417,220	$2,076	$415
New Jersey	100 Tables	$ 26,400	$ 19,800	$132,000	$ 283,800	$ 462,000	$4,620	$925
Pennsylvania	-	-	-	-	-	-	$4,200	$845
B.O.R.	50 Tables	-	-	-	-	$ 137,600	$2,750	$550
	400 Tables	-	-	-	-	$ 735,800	$1,840	$370

COST STANDARDS - CAMP SITE

Source	Capacity	Site	Wash House	Pro Rata Share/Roads, Utilities, etc.	Total	Cost Per Site	Cost Per Participant
TILP	978	$3,982,000	$616,000	$5,959,316	$10,557,316	$10,795	$2,700
New Jersey	150	$ 198,000	$211,200	$ 382,800	$ 792,000	$ 5,280	$1,320
Pennsylvania	100	-	-	-	$ 525,000	$ 5,250	$1,310
B.O.R.							
Tent	200	-	-	-	$ 743,200	$ 3,715	$ 930
Trailer	200	-	-	-	$ 839,850	$ 4,200	$1,050

COST STANDARDS - TRAIL

Source	Type	Cost Per Mile	Capacity	Cost Per Participant
TILP	Walk or Trail	$18,040	-	-
New Jersey	Hiking	$ 7,920	16	$ 495
	Equestrian	$ 9,240	12	$ 770
	Biking (8' wide-paced)	$66,000	8	$8,250
	Nature	$13,200	50	$ 265
Pennsylvania	Hiking (3'-4' wide)	$ 6,000	-	-
	Biking (8' wide-crushed stone surface)	$20,000	-	-
B.O.R.	Hiking	$10,200	-	-
	Bicycling	$23,165	-	-
	Nature	$27,225	-	-
	Equestrian	$13,552	-	-

COST STANDARDS - PLAYGROUND

Source	Size	Site	Pro Rata Share/Roads, Utilities, etc.	Total	Cost Per Acre
TILP	70.5 acres	$396,000	$516,700	$ 912,700	$12,950
New Jersey Department of Environmental Protection	10.0 acres	-	-	$ 356,400	$35,640
New York City (Soundview Park - Urban Park and Playing Field)	11.0 acres	-	-	$1,000,000	$90,000

OPERATING AND MAINTENANCE COSTS OF RECREATION FACILITIES*

	Size	Capacity	Annual Cost**	Cost/Unit Of Capacity
Swimming Beach	120,000 sq.ft.	2,400	$ 73,700	$ 30.50
Pool	5,000 sq.ft.	600	$ 77,000	$ 128.00
	20,000 sq.ft.	2,400	$133,600	$ 55.65
Boat Pump	-	40	$ 23,100	$ 192.00
Picnic Site	7.0 acres	250	$ 50,050	$ 200.00
	50.0 acres	2,000	$157,520	$ 73.75
Campground	35.0 acres	800	$149,160	$ 186.40
Trail				
Hiking	24.5 miles	16***	$ 2,705/mi.	$ 170.00
Bicycling	3.0 miles	8***	$ 18,480/mi.	$2,310.00
Nature	2.0 miles	50***	$ 16,720/mi.	$ 335.00
Equestrian	20.0 miles	12***	$ 73,200/mi.	$6,100.00

* Derived from Outdoor Recreation - A Legacy for America, U.S. Department of Interior, Bureau of Outdoor Recreation, December 1973.

** Includes a 50-year recovery of capital costs.

*** From New Jersey Department of Environmental Protection - not B.O.R.

COST STANDARDS - RESERVOIR OR POND

Source	Year Completed	Project Size	Total Cost Less Land	Unit Cost Per Acre	Escalated Unit Cost
Soil Conservation Service					
Brian Creek Watershed Columbia County, Pa.	1968	51 Surface Acres (1,152 acre/feet)	$ 207,400	$ 4,067	$ 6,830
Mauch Chunk Creek Carbon County, Pa.	1971	320 Surface Acres (5,824 acre/feet)	$ 625,400	$ 1,955	$ 2,660
Neshaminy Watershed Bucks County, Pa.	1973	365 Surface Acres (9,636 acre/feet)	$ 2,896,500	$ 7,935	$ 9,760
Brandywine Watershed Chester County, Pa.	1973	329 Surface Acres (6,071 acre/feet)	$ 3,989,500	$16,692	$20,530
Soil Conservation Service					
General Estimate for: Farm Ponds	-	1/2 to 1 Acre		$ 1,000 to $ 5,000	-
Small Reservoirs	-	50 to 400 Acres		$ 3,300	-
Pennsylvania	-	75 Surface Acres	$ 800,000	-	$10,650
		1,600 Surface Acres	$ 2,000,000	-	$ 1,250
TILP					
Items: 03, 04, 11, 16 and 30 on Project Cost Estimate	-	12,000 Surface Acres	$155,105,000	-	$12,925
Dam, Reservoir and Levees only	-	12,000 Surface Acres	$139,900,000	-	$11,658

OPERATING AND MAINTENANCE COSTS OF RECREATION FACILITIES*

	Cost Per Annual Activity Day	
	Entire State	Region 4**
Swimming Beach	$ .32	$ .35
Swimming Pool	$ .56	$ .33
Picnicking	$ .24	$ .35
Boating	$ .47	$ .35
Fishing	$ .26	$ .29
Hiking	$ .17	$ .20
Hunting	$ .66	$ .55
Pleasure Driving	$ .07	$ .09
Skiing	$22.19	–
Camping	$ 1.30	$1.03

* From Pennsylvania Department of Environmental Resources for July 1973-June 1974.

** Includes Tocks Island Area.

APPENDIX B TO CHAPTER XIII

Recreation Fees in the Tocks Island Lake Area

RECREATION FEES IN THE TOCKS ISLAND LAKE AREA

Name of Facility	Location	Fee Charge
Camping (Public):		
1. Pennsylvania State Parks	Pennsylvania	$2.00-$3.00, no electric or water
2. New Jersey State Parks	State of New Jersey	$2.50-$3.50, no electric or water
3. New York State Parks	State of New York	$2.50 plus $3.50 for electric hookup and water
Camping (Private):		
1. Camp Charles	Bangor, Pa.	$5.00, electric and water included
2. Shady Acres Campground	Portland, Pa.	$4.50 plus $1.25 for electric and water
3. Timothy Lake Camp-Resort	Stroundsburg, Pa.	$4.50 plus $.50 for electric, no water
4. Driftstone on the Delaware	Mt. Bethel, Pa.	$4.25 plus $1.00 for electric and water
5. Mount Pocono Campground	Mt. Pocono, Pa.	$5.00 plus $1.00 for electric and water
6. Scotrun-Safari Camp	Scotrun, Pa.	$5.00 plus $.50 for electric, no water
7. Mountain Vista Campground	East Stroudsburg, Pa.	$4.50 plus $.75 for electric and water
8. Old Dutch Mill Park	Kutztown, Pa.	$4.00 plus $1.00 for electric and water
9. Moyers Lake Campground	Coopersburg, Pa.	$3.00 plus $.75 for electric, no water
10. Mountain Springs Camping Resort	Shartlesville, Pa.	$3.50 plus $1.00 for electric and water
Fishing (Public):		
1. State of Pennsylvania (State-stocked lakes)	Public lakes and streams in Pennsylvania	No fee, but most have valid fishing license issued yearly. Resident (age 16-65) $7.50; Resident (over 65) $2.00: Nonresident (16 and up) $12.50; Non-resident (7-day tourist license) $7.50

RECREATION FEES IN THE TOCKS ISLAND LAKE AREA - (Continued)

Name of Facility	Location	Fee Charge
Fishing (Private):		
1. Moyers Lake Campground	Coopersburg, Pa.	Daily: Adult fee - $1.75; Children under 12 - $1.00. Trout caught under 10" - free; trout over 10" @ $1.35 each. All other fish free.
2. Camp Charles Campground	Bangor, Pa.	Daily: $1.00 per person, no license required, 4 trout limit per day
3. Kriss Pines Fisherman's Trout Paradise	Lehighton, Pa.	Daily: $1.00 per person plus $1.60 per pound of trout caught - no catch limit
4. Paradise Trout Preserve	Paradise Valley, Pa.	Daily: $1.00 per person plus $1.25 per trout caught, no catch limit
Swimming (Public):		
1. Municipal Pools	Villages of Monticello and Bloomingburg, N.Y.	$.50 per person
2. New York State Parks	State of New York	Pool (bathhouse included): $.50-adults; $.25-children under 12
3. New Jersey State Parks	State of New Jersey	No specific charge - part of $.25 admission fee for recreation area. Parking $1.00/car
Swimming (Private):		
1. Lake Wallenpaupack	Lake Wallenpaupack, Pa.	No specific charge for swimming but parking fee of $1.00/car. Picnicking fee of $1.50 and boat launching fee of $1.00
2. Pennsylvania Campgrounds	Same as Camping (Private)	No additional swimming fees

RECREATION FEES IN THE TOCKS ISLAND LAKE AREA - (Continued)

Name of Facility	Location	Fee Charge
Swimming (Private) - Continued		
3. Knoebles	Elysburg, Pa.	$1.00-adults; $.75-children under 12
4. Stroudsburg YMCA	Stroudsburg, Pa.	$1.50-adults; $.75-children under 12
5. The Quarry	Hamburg, N.J.	$4.00-adults; $2.00-children under 12 for picnic, scuba diving and swimming
6. Woodport Boat Basin	Lake Hopatcong, N.J.	$.50-adults; $.25-children under 12 for swimming and picnicking
7. Old Homestead Marina	Greenwood Lake, N.J.	$1.00-adults; $.50-children under 12; $40 per season; swimming and picnicking
Picnicking (Public):		
1. New York State Parks	State of New York	No fee for picnicking but a charge for picnic shelters: $3.00-$7.00 for large shelters; $.50-$1.25 for table
Picnicking (Private):		
1. Lake Wallenpaupack	Lake Wallenpaupack, Pa.	$1.50 per day (also parking fee of $1.00 per car)
Boating (Public):		
1. Pennsylvania State Parks	State of Pennsylvania	No boating fee but launching or mooring of watercraft on department waters requires the appropriate Pa. State Park Watercraft License: Annual launching - $2.00; Annual mooring - $5.00
2. New York State Parks	State of New York	No boating fee except for launching. Generally $1.00 in or out.

RECREATION FEES IN THE TOCKS ISLAND LAKE AREA - (Continued)

Name of Facility	Location	Fee Charge
Boating (Private):		
1. Lake Wallenpaupack	Lake Wallenpaupack, Pa.	No boating fee; launching fee $1.00
2. Lake Hopatcong Marina	Lake Hopatcong, N.J.	Dock rental - $600-250 per season; ramp fee - $3.00 week day; $4.00 weekend
3. Lake Mohawk (members only)	Lake Mohawk, N.J.	Boat hoist - $6.00 one way only; dock fee - $125 per season
4. Old Homestead Marina	Greenwood Lake, N.J.	Ramp fee - $3.50 weekdays; $4.00 weekends
5. Moosehead Marina	Greenwood Lake, N.J.	Ramp fee - $4.00 anytime; dock fee - $140 per season
6. Kittatinny Canoes	Digman's Ferry, Pa.	Canoe rental - $11 per day weekends; $10 per day week days
7. Double W	Honesdale, Pa.	White water river running $10-24 per person

Chapter XIV

ELECTRIC POWER ALTERNATIVES

INTRODUCTION

The purpose of this chapter is to investigate potential electric peak power alternatives to the proposed 1300 MWe Kittatinny Mountain Project. This proposed project is assumed to include the capability for developing an approximate 40 MWe of firm conventional hydroelectric capacity (see GPU, 1971; DRBC, 1972).

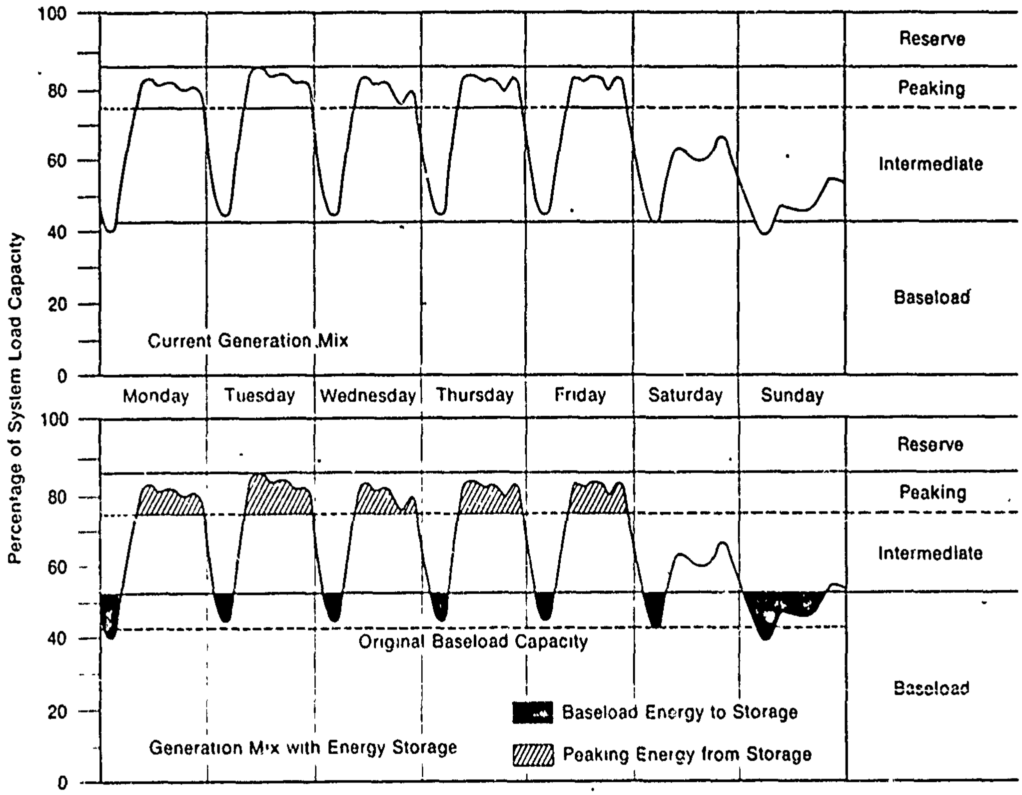
The 1300 MWe Kittatinny project is based on the pumped storage method, which stores excess off-peak base load electrical energy from fossil and nuclear plants for subsequent use during peak demand periods. Methods for storing off-peak energy are important in an electric utility system because they allow the system's base load plants to operate at higher, and more economic, capacity factors. In addition, using peak power facilities designed to supplement base load generation during peak demand hours means that new base load capacity does not need to be added at the same rate as the peak demand growth rate. Utilities need to develop new capacity to satisfy peak demand; hence, it is important for both economic and resource utilization reasons that such capacity be tailored to the system's demand curve. That is, achieving an optimum proportion of base load and peaking facilities provides significant economic and resource utilization benefits The reasons for this will be discussed throughout the remainder of this chapter. Figure 1 illustrates the basic concepts which are involved.

The proposed Kittatinny Pumped Storage plant includes five reversible pump-turbine units rated at about 260,000 kw (260 MW) each. During the pumping phase (late evening and early morning hours), energy would be stored by pumping water from the Tocks Island reservoir to an upper reservoir. During the generating phase (usually late morning through early evening hours), the water would be released from the upper reservoir through turbines to the Tocks Island (lower) reservoir, thus generating electricity. When the plant is generating at its maximum capability of 1300 Mwe, approximately 15,000 cfs would be released through the turbines from elevation 1,500 feet (approx.) to elevation 400 feet (approx.). GPU (1971) and DRBC (1972) describe the proposed project in detail.

The attention in this chapter is devoted to investigating alternative methods for developing the 1300 MWe of peak power without using the Tocks Island reservoir. The conventional hydroelectric capability (about 40 MW firm) could be used to provide capacity and energy during times of peak, intermediate, and baseload demand. An alternative method for obtaining this capacity without using Tocks Island reservoir, for example, is to build a 1040 MW fossil or nuclear plant instead of a planned 1000 MW plant. It is not necessary for purposes of this study to evaluate alternatives to obtain this relatively small and readily developable amount of conventional hydro capacity. This is not intended to detract from the very real benefits of this capacity, however.

A systematic procedure is used in the subsequent sections of this chapter to evaluate electric power alternatives. First, the full range of alternatives are identified and discussed (Section XIV.A.). Second, a quick screening is conducted of all the alternatives identified in Section XIV.A. in an

WEEKLY LOAD CURVE OF AN ELECTRIC UTILITY



Source: EPRI, 1975

The upper curve typifies the weekly load curve of an electric utility without energy storage, while the lower curve shows the situation if energy storage were available. Discharge of the stored energy (upper shaded areas) during periods of peak power demand would reduce (or replace) fuel-burning peaking plant capacity. If nuclear power provides the pumping energy (lower shaded area), there are significant savings in both costs and fossil fuel resources. The above representation does not imply that energy storage results in an overall energy saving. This would be the case if the base load plants have an overall efficiency greater than that of fuel-burning peaking plants by at least the amount of the storage system inefficiency.

effort to eliminate from further evaluation those which possess limited merit, or are doubtful for other reasons (Section XIV.B.). Third, a general evaluation is carried out for each alternative which is not discarded during the Section XIV.B. screening (XIV.C.). Finally, on the basis of the Section XIV.C. evaluations, viable alternatives are selected for detailed evaluation (Section XIV.D.). These detailed evaluations of viable alternatives include discussions of costs, economic impacts, environmental impacts, and reliability.

The resource material used specifically in these evaluations is in the bibliography. However, many results of Chapter V on Electric Power are basic to this chapter; hence, the Chapter V discussions and bibliography have an important background influence on the Chapter XIV considerations.

SUMMARY OF CHAPTER

Present day and innovative technologies have been identified, discussed, and evaluated to determine viable electric power alternatives to the proposed 1300 MWe Kittatinny Pumped Storage project. On the basis of analyses in Chapter V (Electric Power) and this chapter, there is an apparent need in the mid-1980's for the additional peaking power which could be provided by the proposed project or an alternative. The innovative technologies (battery storage, fuel cells, compressed air and others) are in various stages of research, development, and prototype investigation; consequently, there is no assurance at this time that any one or combination of them could provide commercial electric power on the scale needed in the mid-1980's. Should the additional peaking power prove not to be needed until the early 1990's, the innovative methods may be commercially available as competitive alternatives at that time. As a result of preliminary and general evaluations, the viable alternatives to the proposed project are considered to be:

- Gas turbines
- Combined cycles
- Pumped Storage without the Tocks Island Reservoir

The general advantages of both gas turbines and combined cycles relative to pumped storage (with or without Tocks Island Reservoir) are the following:

- Somewhat lesser effects on air quality*

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* However, this becomes an advantage of pumped storage if nuclear provides significant pumping energy in the 1990's.

- Lesser effects on water quality
- Lesser effects on land use

The general advantages of pumped storage (with or without Tocks Island Reservoir) relative to gas turbines and combined cycles are:

- Lesser cost
- Conservation of oil resources
- Greater reliability

In summary, conservation of the environment is the primary advantage of gas turbines and combined cycles, although the pumped storage environmental effects have not been found to be unacceptable. Conservation of resources (money and oil) is the primary advantage of pumped storage.

The availability of oil for operating future gas turbine and combined cycle plants may well be the critical factor in the decision as to whether these plants are better alternatives than pumped storage. Other than oil, fuels derived from coal gasification processes are being given high priority in the competition for energy research and development funding (see Chapter V, Section D.2). Although fuels have been and will be produced through these efforts, it is not clear whether the resulting fuel products will be economically competitive with oil, or available in large enough quantities to support gas turbine and combined cycle units. Experience has shown that after a new technology or process (i.e. gasification) has achieved commercial introduction it takes an additional 10 to 15 years before significant commercial use can be expected in order to gain operating experience, implement organizations, and gain the owner's confidence. Consequently, utilities planning to install such units for operation in the mid-1980's face an uncertain fuel situation. On the other hand, the natural resources essential to viable pumped storage operation (water; coal and/or uranium) are abundantly found in the United States, thus avoiding the fuel uncertainty facing the alternatives.

XIV.A. IDENTIFICATION AND DISCUSSION OF ALTERNATIVES

Potential electric power alternatives to both the pumped storage and conventional hydro purposes of the 1300 MWe Kittatinny Mountain pumped storage project are shown in Table 14-1. This table identifies the conventional hydro alternatives, but no further discussion or evaluation of them is given for the reasons noted earlier.

The objective of this section is to briefly discuss each peak power alternative. Three classes of alternatives are present in Table 1:

1. Project not needed (a result of using demand reduction techniques)
2. Energy conversion methods based on direct use of fossil fuels (Gas Turbines, Combined Cycles, Fuel Cells, MHD)
3. Energy storage methods based on indirect use of nuclear and fossil fuels (Flywheels, Compressed Air, Batteries, Other Pumped Storage)

Fuel cells could also be listed in Class 3, since in the future they could use hydrogen fuel, produced by off-peak nuclear energy.

XIV.A.1 PROJECT NOT NEEDED

Policies for reducing power demand have been discussed in some detail in Chapter V. These discussions will not be repeated here; the essence of them is that a great potential exists for reducing demand through voluntary and proscriptive constraints relating to peak demand price increases,

Table 14-1 Electric Power Alternatives

Identification of Alternatives

1. Peak Power Alternatives[1]

   (a) Reduce demand so that the project's power is not needed.

      1) Peak demand price increase.
      2) Conservation (includes more efficient appliances; such as heat pumps).
      3) Rationing.
      4) Solar energy (space conditioning and hot water heating).

   (b) Gas Turbine units.

   (c) Combined cycle units.

   (d) Fuel cells.

   (e) Flywheel storage.

   (f) Compressed air storage.

   (g) Battery storage.

   (h) Other pumped storage.

   (i) Magnetohydrodynamics (MHD)

   (j) Oil and coal-fired peaking thermal plants

2. Intermediate and Base Load Alternatives[2]

   (a) Same as (a) above.

   (b) Nuclear units.

   (c) Fossil units (includes coal gasification, mine-mouth plants, total energy systems, solid waste, natural gas, oil, coal).

   (d) Combined cycle units.

   (e) Other conventional hydro units.

   (f) Fusion.

   (g) Solar thermal plants.

   (h) Geothermal plants.

NOTES: (1) Alternatives to Kittatinny Pumped Storage Project
(2) Alternatives to 40 MWe Conventional Hydro capability included within the pumped storage project.

conservation, rationing, and use of solar energy. The level of reduction depends primarily on the willingness of political and regulatory agencies to establish constraints which are designed to achieve a given power demand objective. Whether or not such constraints, if applied, can be expected to reduce power demand in the electric service area (ESA) to such levels that the project is not needed is a matter for discussion in the next section. The ESA is defined in Chapter V, Part A, and shown in Figure XIV-II.

XIV.A.2 GAS (OR COMBUSTION) TURBINE UNITS

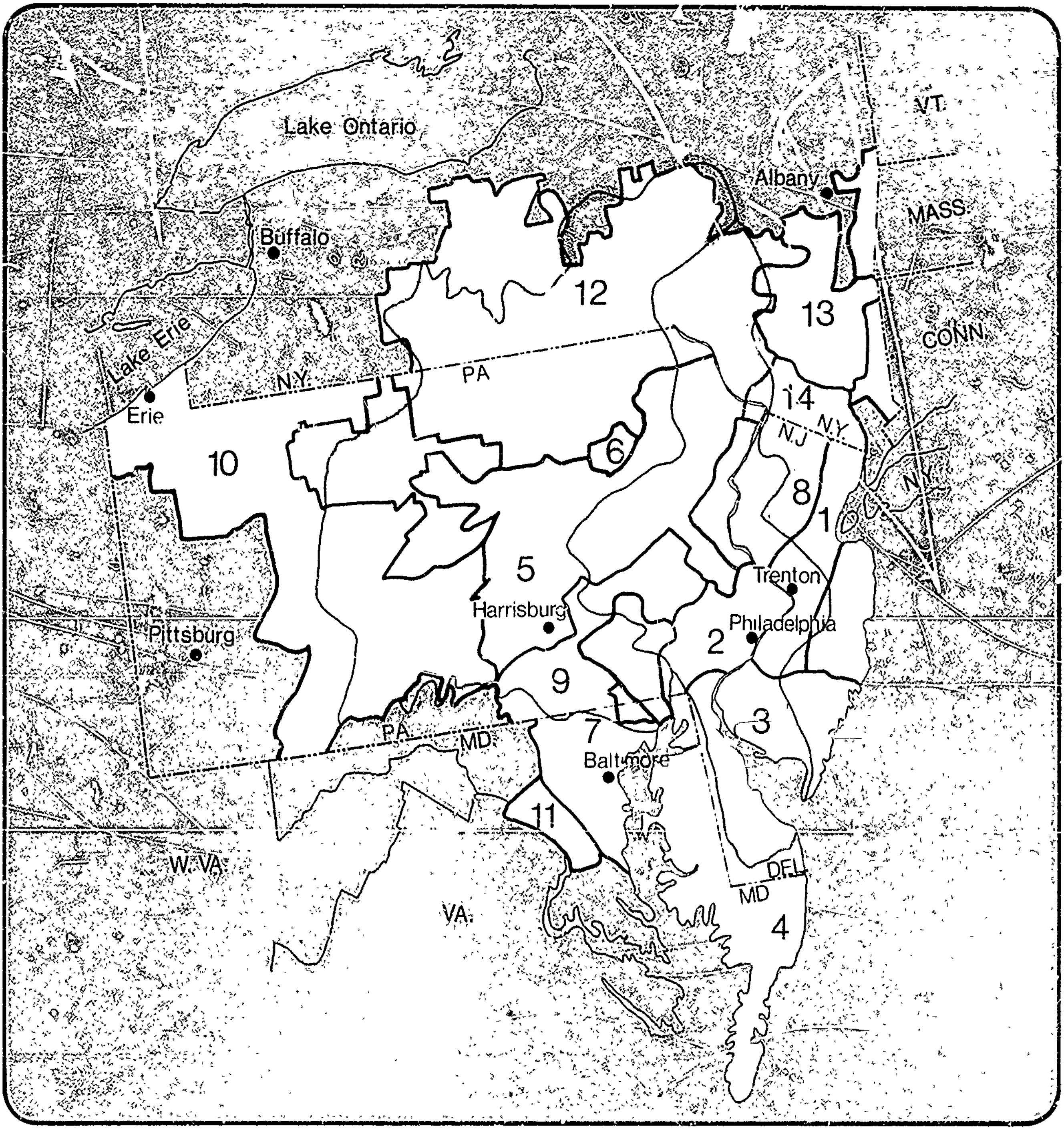
In recent years there has been a relatively rapid increase in the use of gas turbines for electric power generation. The Northeast power failure of November 1965 provided the initial impetus for the present extensive use of gas turbines for a variety of electric power generation requirements. A relatively common deficiency uncovered by the Northeast failure was the lack of emergency power for startup, continued operation, and safe shut-down of steam electric generating units during power failures, and for the subsequent restarting of the units when system power is not available. Also, because of the short lead time for manufacture and installation of gas turbines, many electric utilities have installed substantial amounts of such capacity to offset delay in the completion of desired generation, and to meet unexpected increases in load.

On large power systems, the principal applications of gas turbines include energy for peaking, standby service, and reserve. A few small electric systems use the gas turbine to meet both base load and peaking requirements.

The gas turbine is a machine which operates by firing a mixture of fuel and compressed air in a manner that forces the hot combustion gases to expand through turbines which drive both the compressor and the power-output shaft. Temperature of the gas entering the turbine is about 1800°F and exhaust temperature is around 950°F.

The gas turbine has demonstrated its suitability as a prime mover for supplying economical peaking, emergency and reserve power. It requires no boiler; needs no water for cooling; involves minimal siting, housing and foundation problems; and requires a minimum of power consuming external auxiliaries. Sulfur dioxide emission depends on the sulfur content of the fuel being used. Nitrogen oxide emissions are slightly higher per kwh of output than those of a comparable sized fossil fueled steam electric unit.

The principal fuels burned in gas turbines are natural gas, petroleum distillates, propane, blast furnace gas, and butane. Natural gas historically has been the primary energy source for gas turbine electric power generation. Prior to 1970 adequate supplies of natural gas were available to utilities for the operation of their gas turbine capacity for peak load and emergency requirements. However, since



0 12 24 36 48 60
SCALE IN MILES

N

LOCATIONS OF ELECTRIC SERVICE AREAS

XIV
2

LEGEND

1 Public Service Electric and Gas Company
2 Philadelphia Electric Company
3 Atlantic City Electric Company
4 Delmarva Power & Light Company
5 Pennsylvania Power & Light Company
6 UGI Corporation Luzerne Electric Division
7 Baltimore Gas and Electric Company
General Public Utilities Corporation
8 Jersey Central Power & Light Company
9 Metropolitan Edison Company
10 Pennsylvania Electric Company
11 Potomac Electric Power Company
12 New York State Electric & Gas Corporation
13 Central Hudson Gas & Electric Corporation
14 Orange and Rockland Utilities, Inc

COASTAL REGION
DELAWARE RIVER BASIN
SUSQUEHANNA RIVER BASIN
OTHER REGION
Boundary of Delaware and Susquehanna River Basins

A COMPREHENSIVE STUDY OF THE
TOCKS ISLAND LAKE PROJECT & ALTERNATIVES
URS / MADIGAN-PRAEGER, INC. & CONKLIN AND ROSSANT

1970, a growing shortage of natural gas has forced gas suppliers to curtail deliveries for power generation use. To replace this shortfall of natural gas, the electric utilities have switched to burning the costlier light distillate oils (FPC, 1974). For this reason, "gas turbines" are now often called "combustion turbines".

XIV.A.3 COMBINED CYCLE UNITS

A combined cycle unit consists of gas turbines integrated into the conventional steam cycle. Electrical output is obtained from the gas turbine, but the hot exhaust gases are then further used to fire a steam generator. The steam thus developed passes through turbines to produce electricity from the steam side of the combined cycle unit. Often, supplementary firing is used to create additional steam, and thus additional electricity. Typical overall efficiencies for combined cycles are on the order of 40 percent. The relative amounts of electricity produced by the gas turbine cycle in a given plant depend on fuel costs, equipment costs, environmental factors, and the type of load being served (whether it is peaking or intermediate).

Utility interest in the combined cycle is, for the most part, a recent development. The concept has obvious advantages that promise to give combined cycle gas turbine plants a growing role in the generating mix of many utilities. Now with the peaking dilemma requiring the operation of simple-cycle gas turbines far beyond economical durations - actually into the midrange portion of the load-duration curve - use of the exhaust heat from the gas turbines to generate steam to operate a turbogenerator becomes a more attractive option.

Combined cycle plants are being packaged in sizes from 200 MWe to 400 MWe. Siting flexibility is not nearly as great as for gas turbines alone, because a larger amount of land is needed and water is required for the steam side of the cycle. Assuming a 400 MWe plant with 50 percent gas turbines and 50 percent steam turbines, the cooling requirement would be around half of that needed for a conventional 400 MWe steam plant. This represents a significant reduction in water requirements, but a considerable amount is still needed for the 200 MWe steam portion of the combined cycle plant.

A chief disadvantage of the combined cycle and gas turbine alternatives is that each uses oil, which is becoming costlier and scarcer. A utility planning new generation faces uncertainty as to whether such plants will have the needed fuel to operate them.

XIV.A.4 FUEL CELLS

Like the familiar dry cell and lead-acid batteries, fuel cells work by virtue of electrochemical reactions in which the molecular energy of a fuel and an oxidant are transformed into direct current electrical energy. Unlike batteries, however, fuel cells do not consume chemicals that form part of their structure or are stored within the structure; the reactants are supplied from outside the cell. It can continue to operate as long as its fuel and oxidant are supplied and products removed, or at least until the electrodes cease to operate because of mechanical or chemical deterioration.

A fuel cell consists of a container of electrolyte, such as a water solution of potassium hydroxide. In it are immersed two porous electrodes, and through these the reactants; for example, hydrogen and oxygen; are brought into contact with the electrolyte. The hydrogen and oxygen react to release ions and electrons, and water is produced. The electrons are made to do useful work in an external circuit, whereas the ions flow from one electrode to the other to complete the internal circuit in the cell.

Attention is currently being focused on efforts to use fuel cell systems to generate large blocks of electrical power. Generally two alternatives are being pursued. One is for the central power station application and the other is for dispersed generation of electric power in substations. Work on the central station application is still in the laboratory and systems study phase and practical field hardware has not yet been built. Westinghouse Electric Corporation has been engaged in some development work and has prepared a preliminary design for a 100 kw electric system based on gasification of coal and a high temperature Zirconium electrolyte fuel cell. Energy system concepts using the thermal and electric output of nuclear reactors to produce hydrogen from the disassocation of water are currently under investigation.

Fuel cells have potential operational problems associated with the redistribution of catalyst, with the resulting reduction in the effect of reaction surface area. In addition to this dominant degradation mechanism, there is also a finite solubility of catalyst in the electrolyte which further reduces the active surface area. The secondary life limiting phenomena is corrosion of the seal and current collection compounds.

XIV.A.5 FLYWHEEL STORAGE

Flywheels are widely used, outside utility systems, to smooth pulsed power or, conversely, to generate large power pulses. However, their storage capacity is quite limited and very expensive compared with that of other methods proposed for storing energy on utility systems. Conventional flywheel losses due to bearing and windage drag are excessive for energy storage periods of interest to electric utilities.

In the last two years newly proposed flywheel concepts have suggested that storage of inertial energy might become economically feasible. In these designs - which include the concentric hoop and radial rod concepts - advanced anisotropic materials are used in configurations that allow circumferential stresses to be taken by the strongest direction of the structural materials. Also, these flywheels run on low-friction bearings and in a partial vacuum to minimize losses. Calculations by their proponents show substantial energy densities to be achievable. With potentially modest costs for the stressed materials, the cost per unit of energy storage might become acceptable for utility service.

Major development problems are in the composite materials area and in the engineering design of economical and safe systems. The next two or three years should resolve the basic question of flywheels for both utility systems and vehicle propulsion. Commercialization of advanced flywheel technology is not expected before the early 1980s (EPRI, 1975).

XIV.A.6 COMPRESSED AIR STORAGE

Compressed air has been under consideration by the utility industry for over 10 years as a possible alternative to pumped hydro storage. Compared with conventional pumped hydro, it provides greater energy storage capacity per unit volume. Additional energy is obtained from the fossil fuel burned to reheat the compressed air in the expansion (discharge) mode. By providing power beyond that from converting the stored mechanical energy alone, such a system has added value in terms of the reserve capacity it represents. On the other hand, dependence on fossil fuels could prove a disadvantage in the longer run.

Machinery components exist for compressed-air systems, but they have not been assembled into an operating configuration of compressor, motor generator, combustor, gas turbine, and drive system clutches. The clutches are needed for independent operation of motor and compressor or, alternatively, generator and turbine. The first large compressed-air storage system has been authorized for construction in Germany. This system will charge salt caverns of 300,000 cubic meters capacity to a pressure of 70 atmospheres, storing air for a 290 MW gas turbine generator. Completion is expected in mid-1977.

development at this time. Within two to three years present efforts should establish whether this system can meet utility criteria for cycle life and efficiency; another five years will probably be required to develop a commercial utility battery.

The most promising advanced systems include the sodium/sulfur solid electrolyte battery and the lithium/iron sulfide fused salt battery. Both require elevated operating temperatures (approximately 300°C and 400°C, respectively). Their further development for long cycle life will require solution of a variety of materials problems that are the focal points of several major R&D programs today. Technical progress has been encouraging, and the next several years should yield realistic indications of life and cost of these interesting systems. However, their commercial development is probably 10 years away (EPRI, 1975).

XIV.A.8 OTHER PUMPED STORAGE

A number of potential Electric Service Area pumped storage sites have been identified (see Section V.D.5 of Chapter V); however, the economics are not as favorable as those for a plant located at Kittatinny Mountain. Two potential pumped storage projects which do not depend on the Tocks Island reservoir are:

1. An approximate 1400 MWe Kittatinny Mountain project using the same upper reservoir as the proposed project, and generally the same basic equipment, but using a small storage lower reservoir on the Delaware River in place of the Tocks Island reservoir. A gate-type dam would be installed just upstream of Labar Island.
2. An approximate 1300 MWe Kittatinny Mountain project using the

same upper reservoir as the proposed project, and generally the same basic equipment, but using a lower reservoir created by tunneling Kittatinny Mountain.

XIV.A.9 MAGNETOHYDRODYNAMICS (MHD)

MHD is a direct conversion method for producing electricity. High temperature gases, formed by the combustion of fossil fuels, are passed through a channel (MHD generator) within a magnetic field. By seeding the gases with potassium or cesium salts, they are ionized and become electrically conductive. In effect, the electrons are collected on the inside channel surfaces, and electricity is produced for transmission from the MHD generator. Current research is directed toward developing materials to handle hot gases, improve the magnetic field, recover the seeding salts, and eliminate the sulfur and nitrogen oxide pollutants in the exhaust gases.

The first application of MHD will be to combine it with a conventional steam cycle generator. The exhaust MHD gases still contain a large amount of heat and can be used to fire a steam generator. MHD used as a "topping" unit for the steam cycle increases the overall efficiency by some 10 - 15 percent. This combination is analogous to the use of gas turbines with a steam cycle to form a "combined cycle" plant.

XIV.A.10 PEAKING THERMAL PLANTS

Specially designed oil- and coal-fired peaking thermal plants could be used as alternatives to pumped storage. However, the capital costs for such plants are known to be higher than those for gas turbines, while the fuel costs would be about the same. Consequently, there appears to be no reason to further evaluate peaking thermal plants for purposes of this review.

XIV.B. PRELIMINARY EVALUATION OF ALTERNATIVES

The primary screening criterion used in this section as a basis for setting aside, for present study purposes, any of the identified alternatives is the following:

- o A demonstration that the alternative could not satisfy the electric service area power needs at the time such needs will exist.

Based upon the analyses described in Chapter V, the accompanying assumption made at this point is that there is a bonafide need for the project's peaking power in the mid-1980s.

Thus, if one proceeds on this basis, any alternative which cannot provide the required peaking power by the mid-1980s should be rejected. However, the validity of this assumption needs to be tested, and the test really amounts to an early evaluation of the identified alternative "project not needed".

XIV.B.1. GENERAL EVALUATION OF "PROJECT NOT NEEDED"

Probable high and probable low power demand growth rate estimates for the period 1975 - 2000 were developed in Chapter V. These estimates were based on considerations of many factors which influence the growth of power demand:

- Personal income growth
- General economic growth
- Population growth
- Electricity prices
- Ability of future supply to meet future demand
- Effects of conservation policies

Figure 3 shows the estimates* which were made in Chapter V. The 3.0 percent average annual low growth rate during 1975 - 1990 reflects strong policy actions in the areas of electricity price increases and conservation, and is considered to be the lower limit which could be achieved in the ESA. A more probable growth rate is likely to be characterized by a gradual lessening of the growth rate with time, perhaps similar to the following:

- 5.5% during 1975 - 1982
- 4.5% during 1983 - 1990
- 3.5% during 1991 - 2000

Even for the 3 percent low growth rates of Figure 3, however, the peak demand in 1984 would be about 10,000 MWe greater than the 1974 peak demand. Thus, about 10,000 MWe of new base load and peaking capacity is needed between 1975 and 1984. It is likely that at least 1500 MWe of this should be peaking capacity. For the more probable growth rate case shown above, about 20,000 MWe would need to be added during 1975 - 1984, and at least 3000 MWe or so of this should be peaking capacity.

On the basis of the above analysis, it is concluded that the electric

* The probable demand curve shown has been added

power capacity to be generated by the project is needed in order to meet expected power demand in the mid-1980's. Therefore, the alternative "project not needed" is considered doubtful, and the assumption accompanying the screening criterion is considered validated. This also means that the identified structural alternatives can now be screened using the criterion and assumption.

The innovative alternatives (flywheel storage, battery storage, and MHD) are immediately suspect in meeting the criterion. Fuel cells may also be in this category, but further evaluation is required, because they are in an advanced stage of prototype development. Compressed air storage is also doubtful because fuel oil may not be available. Gas turbines, combined cycles, and other pumped storage satisfy the criterion.

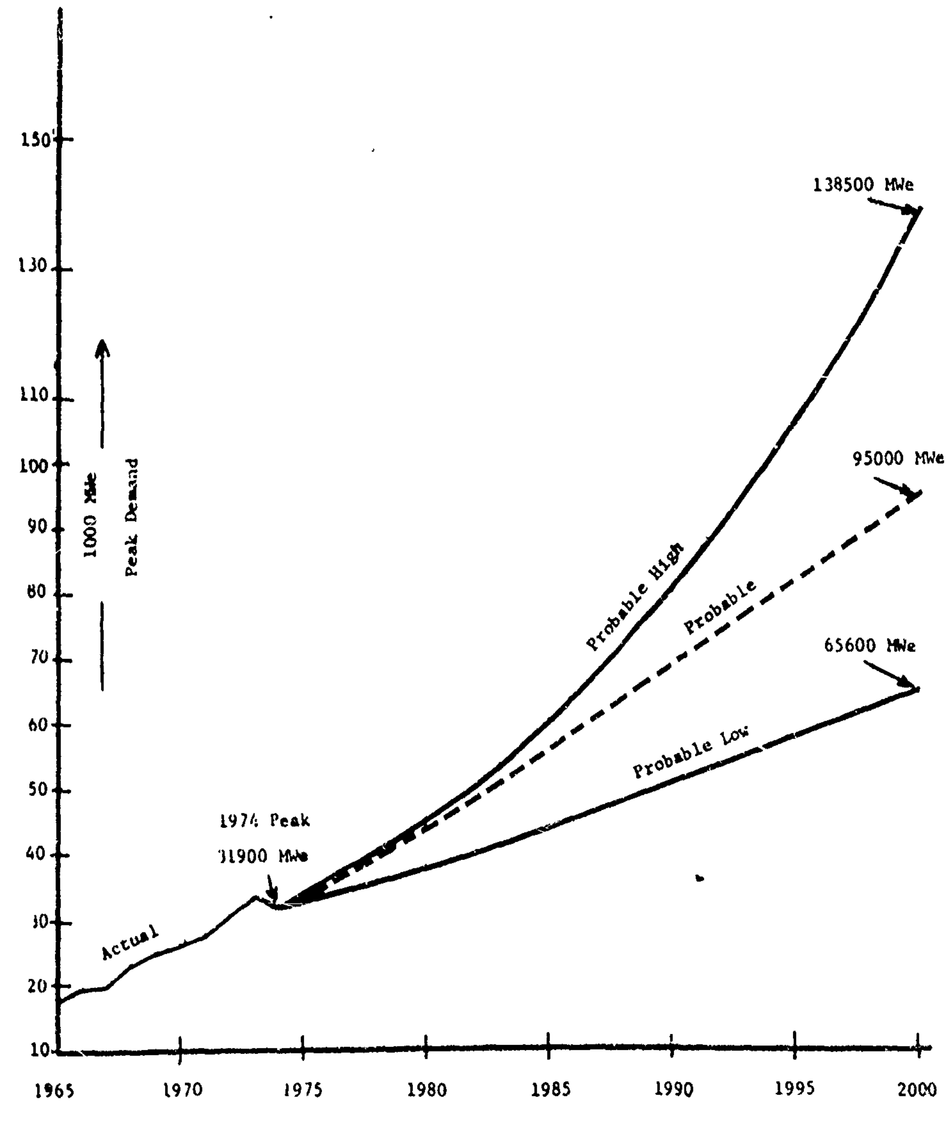
XIV.B.2 PRELIMINARY EVALUATION OF FLYWHEEL STORAGE, COMPRESSED AIR STORAGE, BATTERY STORAGE AND MHD

Before discussing these alternatives, it may be worthwhile to briefly examine the process for developing new technologies in the electric energy field. This process can be divided into four broad phases:

1. Demonstrate the scientific feasibility of the technology
2. Demonstrate engineering, technical, economic and environmental feasibility for the technology
3. Commercial introduction of the technology
4. Significant commercial use of the technology

The innovative, or advanced, electric power technologies being considered in this section have completed Phase 1, and are now receiving attention mainly in Phase 2. The exception is compressed air storage, which has entered Phase 3 as discussed in Section XIV.A.6. Experience has demonstrated that after a new technology has achieved commercial introduction it takes an additional 10-15 years before significant commercial use can be expected. This additional time is needed to gain operating experience, implement

ELECTRIC SERVICE AREA



refinements/optimizations and gain the potential owner's confidence. Providing for 1300 MWe of peak power in the electric service area requires technologies which have attained Phase 4 status.

The R&D support for these technologies has been accelerated during the past year, and technical feasibility has been demonstrated for each. Further R&D is required before prototype installations can be made to test whether they are practical and economically feasible as producers of large amounts of electric power. With the exception of compressed air storage, each technology requires further R&D on the materials and other technical aspects. For example, the sodium/sulfur and lithium/iron battery concepts require materials research to assure long cycle life, flywheels depend on development of composite materials for economical and safe systems, and the success of MHD depends in large part on the materials used in the channel to withstand high temperatures for long time periods. While the equipment components used in a compressed air peaking system are generally state-of-the-art, the storage options need further R&D; i.e., whether salt caverns, mined caverns, or other means for storing compressed air are better.

It is concluded that the above technologies will provide electric power in the future, but there is no assurance that such power will be available on the scale needed by the mid-1980s. Therefore, they are not considered further, for purposes of this study, as potential alternatives to the proposed project.

XIV.B.3. PRELIMINARY EVALUATION OF PUMPED STORAGE USING LOWER RESERVOIR FORMED BY TUNNELING KITTATINNY MOUNTAIN

This concept (Goordman, 1974) has been reviewed and it involves drilling 200 separate 40-mile long parallel tunnels (36 foot diameter) at an elevation of 400 feet. The tunnels would run from the Delaware Water Gap to the New York State line and would provide a total water storage of about 200,000 acre-feet. It is proposed that the approximate 100 feet of head relative to the Delaware River could be used to operate conventional hydro units and that the head of an upper reservoir relative to the tunnels could be used for pumped storage operation. Subsequent papers to Goordman-1974 have been published; however, they are mainly variations to the basic concept described above.

Based upon preliminary reviews of quantities and types of excavation and related costs, tunneling Kittatinny Mountain is not considered appropriate from the electric power standpoint, for purposes of this study, as a means of providing a lower reservoir for a pumped storage project.

XIV.B.4. REMAINING ALTERNATIVES

The alternatives not set aside in Section B.1 through B.3 satsify the criterion of this section and pass to the general evaluation stage without further discussion.

XIV.C. GENERAL EVALUATIONOF REMAINING ALTERNATIVES

The objective in this section is to examine the alternatives not set aside in Section B to determine if any of them should not be considered further for environmental, technical, cost, or other reasons.

The remaining alternatives are:

- Gas Turbines
- Combined Cycles
- Pumped Storage using lower reservoir other than Tocks Island
- Fuel Cells

XIV. C. 1 GENERAL EVALUATION OF FUEL CELLS

Environmental - Central station systems using fuel cells will produce pollutants similar to those obtained by conventional combustion of the same fuels. The fuel cell, however, is particularly sensitive to the same pollutants, primarily sulfur, now causing concern in conventional fossil-fired power plants. This sensitivity will require extensive fuel pretreatment to eliminate contaminants prior to electrochemical oxidation. For an equivalent electric power output, the higher operating efficiency of fuel cell systems will result in a reduction of the total quantity of fuel required and a reduction in the emission of nitrogen oxides because of the reduced temperatures to which the air streams are exposed. Waste

heat rejection is not a significant problem with fuel cell power systems since most of the waste heat is used in the fuel gasification or reforming process. Excess heat is rejected to the atmosphere and cooling water is not required. Fuel cells will have a very minimal effect on the envi-
ror

Technical - In spite of having no moving parts, fuel cells do wear out. Redistribution of catalyst, with a resulting reduction of effective reaction surface area, is the single most dominant degradation mechanism. This is closely followed by corrosion of seal and current-collection components. Erosion and blockage of ducts and manifolds are also seen in extended life tests. If fuel cells are to be economically applied to central station energy generation, the useful cell lifetimes must be extended beyond the 3,000-20,000 hours presently available. The fuel cell unit design must also be amenable to high-volume production techniques because hundreds of cells per system will be required for electric generating systems in the multi-megawatt range. Fuel cell system application in commercial power generation does not appear likely until the economic advantages have been realistically demonstrated. Presently, both government and industry studies are striving towards improving the potential for fuel cell utilization in power generation.

Evaluation - The electric utility industry is presently installing and operating 26,000 kw prototype fuel cells across the country to determine the technical, operating, and cost characteristics. Until the results of these operations are available, it is not possible to predict with certainty when fuel cells will be economically competitive with alternative electric generation methods. There are strong reasons for believing that this could occur in the mid-1980s time frame when the 1300 MWe Kittatinny Pumped Storage project would be operational. However, it is very unlikely that a decision could be made to use fuel cells in place of the Kittatinny project <u>prior</u> to the need to start construction of the latter.

Therefore, it is concluded that fuel cells should not be considered for present purposes as a viable alternative to the Kittatinny project.

XIV.C.2 GENERAL EVALUATION OF PUMPED STORAGE WITHOUT TOCKS ISLAND LAKE PROJECT (TILP)

Previous studies by the utilities, Corps of Engineers, and the Federal Power Commission have been reviewed in an effort to identify alternative pumped storage projects in the Delaware River Basin which are economically competitive with the proposed 1300 MWe Kittatinny Mountain Project using TILP. The most economical alternative is basically the same Kittatinny project using just enough Delaware River storage for the lower reservoir to serve the pumping and generating water flows of the plant. This storage would be created by building a gate-type dam about 1500 feet downstream from the lower end of Tocks Island. The plant's output would be increased to approximately 1400 MWe, because the available head is about 80 feet greater than that of the proposed Kittatinny plant, but there would be no conventional hydro capability. The lower reservoir would have the following approximate characteristics:

Top of Raised Gates, Elevation in feet	330
Normal Water Level, Elevation in feet	330
Minimum Water Level, Elevation in feet	314
Drawdown, feet	16
Usable Storage, acre-feet	15000
Total Storage, acre-feet	20000
Area at Normal Water Level, acres	1700

The effects of this alternative pumped storage arrangement on the upper reservoir would generally be the same as for the 1300 MWe Kittatinny project with TILP, but there would be a significant difference in the nature of the environmental impact at the lower reservoir.

The pumped storage concept described above is considered to be an alternative for which a detailed evaluation is needed, and it will be discussed in the next section.

XIV. C.3 GENERAL EVALUATION OF GAS TURBINES AND COMBINED CYCLES

Improvement in gas turbine efficiency over the past few years, together with expected improvements to come, have given both pure gas turbine plants and combined cycle plants a place in the generation of electricity. The degree of application, however, depends significantly on both the cost and availability of fossil fuels. The gas turbine has been an important generation resource for many utilities, and the combined cycle may become one, depending on oil availability. In the next section, the economic and environmental effects of both will be compared with those of pumped storage.

XIV.C.4 SUMMARY ANALYSIS

It is desirable to summarize the status of the electric power alternatives at this point of the analysis. This also provides an additional opportunity to check those being submitted for detailed evaluation against parameters other than just technical feasibility and commercial availabilty. Table 14-2 represents a "go" or "no go" qualitative analysis of the alternatives using both engineering and environmental parameters. This matrix shows why each alternative not undergoing detailed evaluation was set aside. For example, fuel cells were eliminated at the general evaluation stage on the basis that commercial development could not assure satisfaction of the power need in the mid-1980s. Flywheel storage was set aside at the preliminary evaluation stage for basic ly the same reason.

The relative comparison among the remaining alternatives outlined in Table 14-2 shows no cause for not submitting them to detailed evaluation. This matrix shows, for example, that on balance, a pumped storage project in comparison to gas turbine or combined cycle projects requires greater transmission line capability, more land, and has greater emissions to air and water.

Table 14-2 Analysis of On-Site & Support Requirements

Peak Load (1) Alternatives

ELECTRIC POWER ALTERNATIVES TO TILP	Gas Turbines	Combined Cycles	Fuel Cells	Kittatinny Pumped Storage Without Tocks Island Reservoir (2)	Pumped Storage (2) Using Lower Reservoir in Kittatinny Mountain	Flywheel Storage (2)	Compressed Air Storage (2)	Battery Storage	MHD	Project Not Needed
ENGINEERING										
• Costs?	C	C	N	C	N	N	N	N	N	- (Reduce Demand)
• Technical Feasibility?	Yes	Yes	Yes	Yes	(?)	Yes	Yes	Yes	Yes	-
• Commercial Development by 1984?	Yes	Yes	(P)	Yes	?	(No)	(No)	(No)	(No)	-
• Transmission Lines?	MN	GN	MN	SN	SN	MN	SN	MN	GN	-
• Land Required?	MN	GN	MN	GN	GN	MN	MN	MN	MN	-
ENVIRONMENT										
• Water Effects?	NN	GN	NN	GN	GN	GN	GN	GN	Yes	-
• Air Effects?	SN	SN	MN	SN	SN	SN	SN	SN	Yes	-
STATUS →	Detailed evaluation required	Detailed evaluation required	General evaluation completed	Detailed evaluation required	Preliminary evaluation completed	Preliminary evaluation completed	Preliminary evaluation completed	Preliminary evaluation completed	Preliminary evaluation completed	General evaluation completed (Project Needed)

KEY

C - Potentially competitive with Project

N - Not known if competitive with Project

P - Prototypes installed

NN - No need (or effect)

MN - Minimized need (or effect)

GN - Some need (or effect)

SN - Significant need (or effect)

UN - Unacceptable effect

○- Circled item means "No Go"

(1) Alternatives to Kittatinny 1300 MWe Pumped Storage Plant

(2) Assumes use of off-peak coal, oil, and nuclear energy.

However, as nuclear energy replaces fossil fuel pumping energy, the air emissions advantage shifts to pumped storage, and perhaps even more importantly, the latter will not be using non-renewable resources. The economic advantages of one alternative relative to another must also be weighed in the decision making process. These factors and others are evaluated for gas turbines, combined cycles, and pumped storage in the next section.

XIV.D. DETAILED EVALUATION OF VIABLE OR SELECTED ALTERNATIVES

XIV.D.1 COSTS

Cost estimates have been made for the fixed (capital) and variable (fuel, Operating & Maintenance) components for each alternative. Costs have been developed for current price levels (December, 1974) and for projected price levels in 1984. Assuming that an approximate 1300 MWe of additional peaking capacity is needed in the mid-1980's, any of the viable alternatives could be constructed and operated by that time with or without the Tocks Island reservoir.

Although 1984 was selected as the target date, the results of the economic comparisons are equally valid on a relative basis for a later date, such as 1986 or 1987. The equipment, labor, and fuel escalation rates assumed for 1974-1984 would be about the same as those which are applicable to 1974-1987. Similarly, technological improvements for an alternative are expected to be about equal for these two time periods. The point is that the relative results as determined for 1984 are valid for the mid-1980's time frame.

Table 14-3 is a summary of the 1984 fixed and variable costs for each alternative and the proposed Kittatinny Mountain Pumped Storage project (KPS). For the latter, the sensitivity of pumping costs to the pumping energy source has been investigated by comparing the case of no nuclear pumping

Table 14-3 Cost Summary, Electric Power Alternatives in 1984

	Gas Turbines	Combined Cycles	Kittatinny Pumped Storage W/O TILP and 20% Nuclear Pumping	Kittatinny Pumped Storage With TILP: No Nuclear Pumping	Kittatinny Pumped Storage With TILP: 20% Nuclear Pumping
FIXED COSTS ($/kw-yr)					
Capital Cost ($/kw)	220.0	340.0	315.0	320.0	320.0
Fixed Charge Rate(%)	16.0	15.5	14.5	14.5	14.5
Annual Capital Charge ($/kw-yr)	35.2	52.7	45.7	46.4	46.4
Annual O&M Charge ($kw-yr)	-	-	3.7*	3.7*	3.7*
SUB-TOTAL ($kw-yr)	35.2	52.7	49.4	50.1	50.1
VARIABLE COSTS (mills/kwh)					
Fuel Cost (mills/kwh)	38.1	29.7	-	-	-
Pumping Cost (mills/kwh)	-	-	23.7	26.3	23.7
O&M Cost (mills/kwh)	4.9	2.5	-	-	-
SUB-TOTAL (mills/kwh)	43.0	32.2	23.7	26.3	23.7

* Includes reservoir charge of 1.0 $/kw-yr

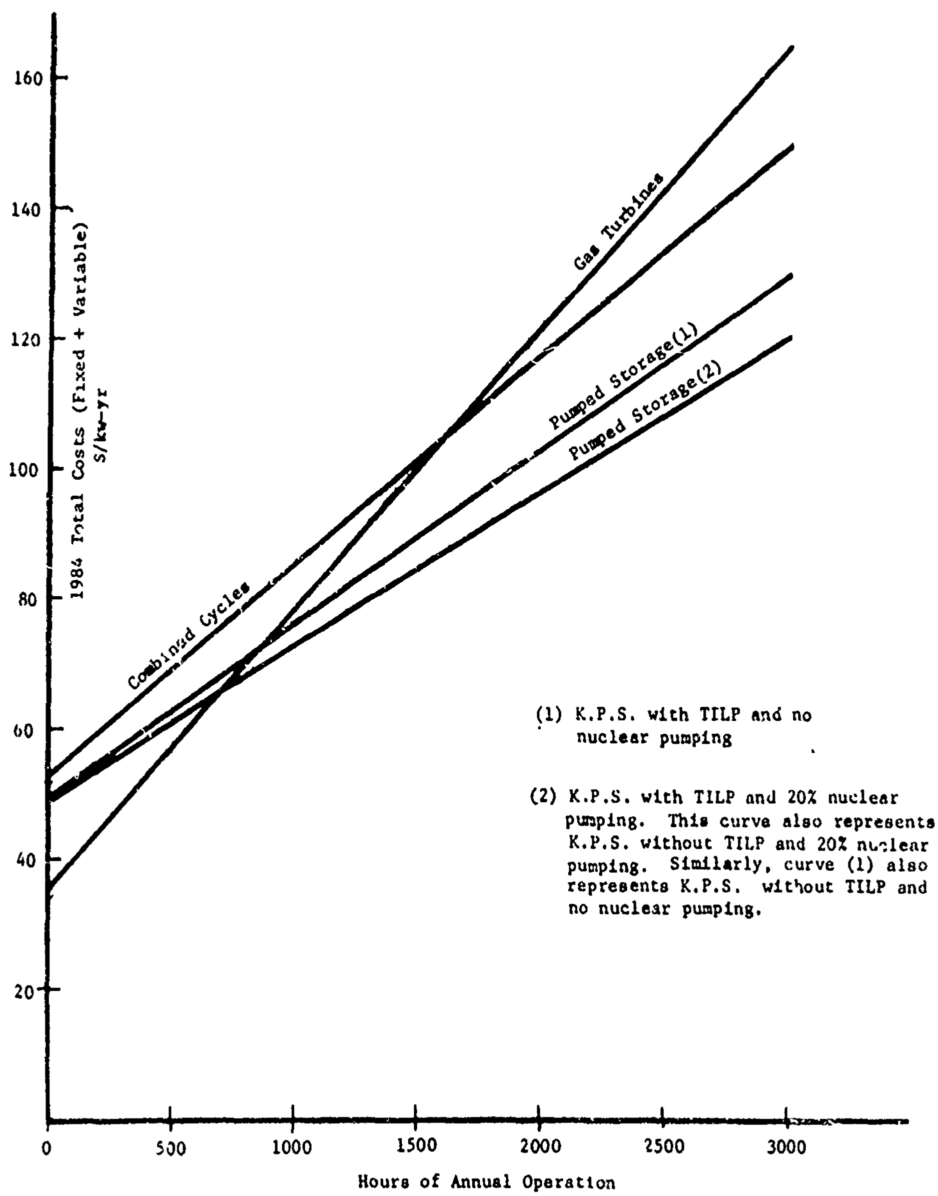
energy in 1984 with use of 20 percent nuclear pumping in 1984. The basis for these assumptions will be discussed subsequently.

The results shown in Table 14-3 are more meaningful when displayed in graphic form. Figure 4 shows the total annual costs in 1984 for varying hours of operation. There is very little difference between the economics of KPS with Tocks Island Lake Project (TILP) and KPS without TILP. Consequently, the two curves representing KPS with TILP for the cases of 20 percent nuclear pumping and no nuclear pumping also reflect KPS without TILP.

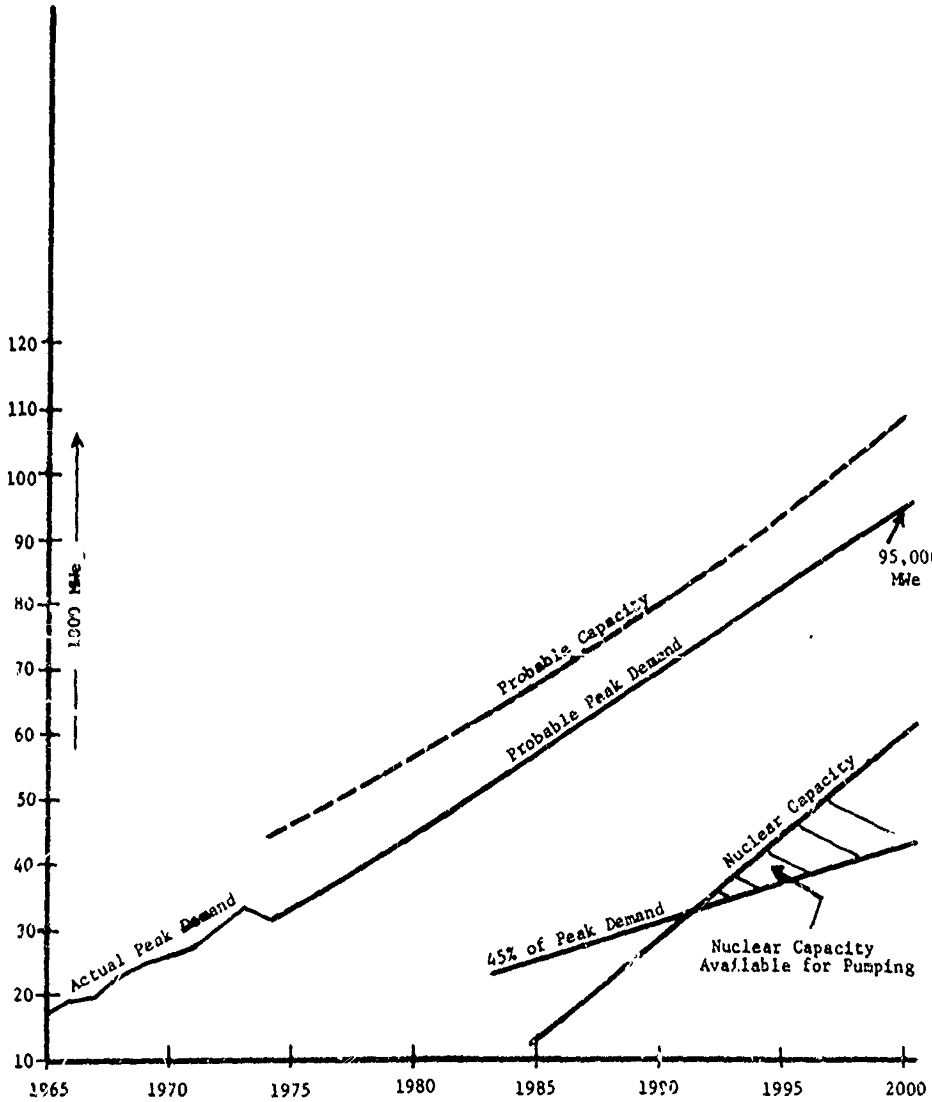
The detailed calculations supporting Table 14-3 are in the Appendix. This backup includes the escalation factors used, assumptions as to expected technological improvements, and analyses of the future fuel situation.

On the matter of future pumping energy sources, it is unlikely that electric service area (ESA) nuclear would be available for supplying pumping energy in the mid-1980s unless strong national actions are taken to accelerate nuclear installations more rapidly than that envisioned in Scenario "A" of Chapter V. However, assuming a national commitment to nuclear power, it is likely that this energy would start becoming available for pumping by the late 1980s or early 1990s. To illustrate, consider the probable power demand shown in Figure 5, which is the same as Figure 3. The total capacity needed to support the probable demand is shown, and the nuclear capacity is shown also. The 1990 and 2000 nuclear capacities are about 28,000 MWe and 60,000 MWe, respectively. The nuclear additions shown are consistent with the assumptions of Scenario "A".

1984 COSTS OF ALTERNATIVES



CAPACITY AND DEMAND



$130 million - $117 million = $13 million/yr

Note that using 1500 hours of annual operation is conservative, because using 1800 hours is much more realistic, in which case the net benefit is higher. The present worths of the alternative project costs for 50 years of operation are approximated in the Appendix. These results indicate that combined cycles are more economic than gas turbines, and that pumped storage is more economic than either.

XIV.D.2 ECONOMIC IMPACTS

The potential economic impacts in the ESA of the electric power alternatives would vary considerably. The significant reasons for this are:

- Locational

  Gas turbine plant sizes might be from 50 MWe to 400 MWe (or even larger), and the plants could be located in a dispersed manner throughout the ESA near load centers. Combined cycle plant sizes might be from 200 MWe to 400 MWe (or larger), but siting flexibility is limited in comparison to gas turbines because cooling water is needed. The plants would be located on the Delaware and Susquehanna Rivers and their tributaries. The 1300 MWe pumped storage plant, of course, is fixed in location.

- Schedule (Site selection to commercial operation)

  Gas turbine plants can be installed in about three years, combined cycle plants could be installed in about four years, and the pumped storage plant will take in excess of 5 years.

The economic impacts on local communities depend on where gas turbines and combined cycles are installed, and how large the plants are at each location. It is beyond the scope of this review to investigate the potential sizes and locations of such plants. However, because they would tend to be generally dispersed, there probably would not be a significant economic impact on any specific sector within the ESA.

The economic impact of KPS can be discussed with greater certainty. During construction of the Kittatinny project the local population and concomitant support facilities/services will expand. Assuming a six year construction schedule, the construction labor force could peak in the range of about 1,000 for a period mid-way through the schedule. The buildup to the peak and the subsequent decrease could be approximated by a normal distribution curve. Suitable housing and support services would need to be provided by local communities. The project would therefore stimulate economic activity in the local areas. Table 14-4 summarizes economic and institutional effects of the alternatives on the electric service area.

XIV.D.3 ENVIRONMENTAL IMPACTS

This section considers air and water effects, land use, and planning goal impacts.

Air - Gas turbines, combined cycles, and KPS would have effects on air quality. SO_x, NO_x, and particulate emissions are common to all three alternatives. During the early years of operation, nearly all of the pumping energy will be provided by fossil base load plants as discussed earlier; consequently the emissions attributable to pumped storage operation are

Table 14-4 Economic and Institutional Impacts Matrix for Electric Power Alternatives

	G.T.	C.C.	K.P.S. Without TILP
Short-Term Impacts			
o Construction Activity	Low	Low	Med
o Short-term Construction Employment	Low	Low	Med
o Other Pre-completion Construction Impacts			
Housing for employees	Low	Low	Med
Mobile homes and parks	Low	Low	Med
Origin of construction labor			
- from within the area	Med	Med	Med
- migrants	None	None	None
Permanent Long-Term Impacts			
o Total Permanent Employment Impact	Low	Low	Low
o Income Impact	Low	Low	Low
o Retail Sales Expenditures	None	None	None
o Population Impacts	Low	Low	Low
o Households	Low	Low	Low
o Property Values and Tax Base	Med	Med	Med
Life Style/Social Impacts			
o Population	Low	Low	Low
o Life Style Changes	Low	Low	Low
Institutional Impacts/Constraints			
o Local Government			
Use of existing agency to provide approvals	Med	Med	Med
Establishment of new agency to provide approvals	None	None	None
Requirement for regulation	Low	Low	Low
o State Government			
Use of existing agency to provide approvals	Med	Med	Med
Establishment of new agency to provide approvals	None	None	None
Requirement for regulation	Low	Low	Low

Institutional Impacts/Constraints (continued)	G.T.	C.C.	K.P.S. Without TILP
o Federal Government			
Use of existing agency to regulate	Med	Med	Med
Establishment of new agency to regulate	None	None	None
Requirement for additional regulation	Low	Low	Low
o Quasi Government			
DRBC responses and reviews mandated by their regulations	Med	Med	Med
Areawide planning agencies	Med	Med	Med
Private companies	Low	Low	Low
Special purpose districts	Med	Med	Med

KEY

HIGH - continual impact on
MED - moderate impact on
LOW - minimal impact on
NONE - , impact on (or not applicable)

greater than those for gas turbines and combined cycles. Table 14-5 is a matrix summarizing air emissions and other environmental effects for the alternatives. There are several factors which need to be considered in assessing the significance of the effects of the air emissions on people, other life, and other values:

(1) Gas turbine and combined cycle emissions generally are closer to population centers than are the larger base load plants which provide the pumping energy. Consequently, these emissions have a greater effect than do those resulting from pumped storage operation.

(2) Gas turbine and combined cycle emissions are released from short stacks, whereas the emissions from large base load plants are released from high stacks. Thus, the ground level pollutant concentrations in the vicinity of gas turbine/combined cycle plants can be greater than those of the base load plants, even though the latter plants' emissions are greater. High stacks are instrumental in reducing ground level concentrations because the airborne dispersion processes can work more effectively.

(3) As nuclear plants continue to come on line in the late 1980s and 1990s, increasing amounts of the pumping energy will be provided by them. The effect will be to significantly decrease the quantities of air pollutant emissions attributable to pumped storage operations.

In consideration of these factors, it is possible that the effects of the air emissions from pumped storage on life in the electric service

Table 14-5 Environmental and Land Use Impacts Matrix

Environmental Impacts	Gas Turbines (1300 MWe)	Combined Cycles (1300 MW)	Pumped Storage W/O TILP (1400 MW)	Pumped Storage W/ TILP (1300 MW)
AIR*				
o SO_x Emissions (tons/yr)	2000[c]	1600[c]	6700[a]	6200[a]
o NO_x Emissions (tons/yr)	3400[c]	2500[c]	8000[a]	7400[a]
o Particulate Emissions (tons/yr)	400[c]	400[c]	650[a]	600[a]
o Effects on People & Other Life	Low	Low	Low	Low
WATER*				
o Evaporation (A-F/yr)	0	1400	5000[b]	5000[b]
o Quality	None	Low	Med	Med
o Effects on People & Other Life	None	Low	Low	Low
LAND USE IMPACTS				
o Displacement of Existing Land Uses	Low	Med	High	Med
o Growth Patterns	Low	Med	High	Med
o Land Requirements (Acres)	125	175	1200[d]	400
PLANNING GOAL IMPACTS				
o Preservation of Critical Environmental Areas	Low	Low	Med	Med
o Preservation of Existing Character & Aesthetics	Low	Low	Med	Med
o Growth Objectives	Low	Low	Low	Low

KEY

HIGH - continual impact on
MED - moderate impact on
LOW - minimal impact on
NONE - no impact on (or not applicable)

NOTES:

a) Emissions from the oil and coal base load thermal plants providing pumping energy. Assumes 50% of pumping energy from coal plants, 30% from oil plants and 20% from nuclear plants. Assumes 0.6% sulphur oil and 2.5% sulphur coal with SO_2 removal at 85% efficiency.

b) Water evaporated by base load thermal plants providing pumping energy. Cooling towers assumed.

c) Assumes distillate oil (0.2% sulphur).

d) Includes 800 acres for lower reservoir.

*) Assumes 1500 hours annual operation; quantities are rough approximations.

area will not be significantly greater than those attributable to gas turbines or combined cycles.

Water - Gas turbines have no effects on evaporation or water quality. Combined cycles will have minimal effects on water quality if cooling towers are used, and the attendant water evaporation is not significant. Pumped storage will have effects on water quality, but the water evaporated by base load plants supplying pumping energy is not significant.

Water quality impacts for the pumped storage alternatives probably represent the most important environmental parameter to be evaluated. The pumped storage alternative without Tocks Island reservoir, as described previously, presents a different impact on water quality (as well as recreation and land use) than the proposed project because of the entirely different nature of the lower reservoir. However, based on previous experience in developing hydroelectric and pumped storage reservoirs with acceptable impacts on water quality, it seems that a lower reservoir, sized to serve the pumped storage plant, could be an acceptable alternative.

Land Use Impacts - The approximate land requirements for the alternatives are shown in Table 14-5. KPS without TILP requires the greatest amount of land, since about 800 acres are needed to form a small lower reservoir having a total surface area of about 1700 acres (900 acres consists of existing river channel). There could be significant effects on existing land uses and growth patterns.

Land use impacts for gas turbines and combined cycles are difficult to define since plant locations cannot be specified. A minimal to moderate impact could be expected.

Planning Goal Impacts - Gas turbines and combined cycles would have minimal impact on the preservation of critical environmental areas, preservation of existing character, and growth objectives. The plant and site sizes can be chosen to meet the power needs without adversely stressing these values. The pumped storage alternatives could have a moderate impact on such values because pumped storage is fixed in location and affects greater land areas.

XIV.D.4 RELIABILITY

Reliability, essentially, is the constant ability of an electric system to meet load demands and the ability to respond to and recover from emergency situations. The contribution of a certain type generating plant in the system to the system reliability depends on the availability of the plant to provide electric production. Availability in turn is a function of the scheduled and forced outage rates of the plant. On the basis of past experience, gas turbine and combined cycle availabilities have been in the 85 to 90 percent range; that is, 10 to 15 percent of the time these units could not be operated because of scheduled or forced outage. The availability of pumped storage units has been about 95 percent, with nearly all of the five percent unavailability being attributed to scheduled outages. Thus, approximately 5 to 10 percent more capacity is required for a gas turbine or combined cycle installation to meet a given load than for a pumped storage installation to meet it if the system reliability is to be maintained at the same level.

In addition to the reliability of an alternative's mechanical equipment, as discussed above, there is also the consideration of transmission and substation reliability. Gas turbines and combined cycles can be located at multiple sites which are near load centers, as discussed in earlier sections; consequently, they would inherently have greater transmission/substation reliability than would the larger pumped storage plant. However, transmission systems have very low outage rates (approximately 0.1%), and the electric utility experience has been that such outages have negligible effects on system reliability. The key consideration, then, is the reliability of the mechanical equipment in the generating plant.

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APPENDIX - COST EVALUATIONS OF ELECTRIC POWER ALTERNATIVES

1984 Gas Turbines

Capital Cost

The estimated costs in 1974 dollars of five gas turbine plants which have been evaluated for operation during 1974 to 1984 are as follows:

	$/kw(1974)
GPU (Gilbert 8) - Opn in 1974	170 (actual installed cost)
VEPCO (Bath County, FPC Exh W) - Opn in 1980	168
Vermont Power (Georgia Station E.R.) - Opn in 1974	130
PG&E (Internal estimate) - Opn in 1975	150
Modesto Irrigation District, Calif - Opn in 1984 (AD Little draft study)	152

AVERAGE = 154 $/kw

These capital costs are generally representative of a new plant at a new site, and include the added costs which the plant's owner incurs above the basic cost of the gas turbine equipment. These additional costs are for land, relocations, auxiliary equipment and labor, engineering, overhead and interest during construction. Also included is the cost to achieve equal reliability with a typical alternative pumped storage project. Thus, the owner's total installed cost is much greater than the purchase price of the basic gas turbine unit.

Using 150 $/kw as being representative, the escalated gas turbine cost is:

1984[1] total capital cost = $(1.04)^{10}$ x 150 = 220 $/kw

(1) See notes at end of Appendix

Fuel Cost

Present heat rates are between 12,000 - 14,000 Btu/kwh. Using representative cycles and with further increases in compression ratios and inlet temps, 1984 heat rate is assumed to be 10,000 Btu/kwh (34% efficiency), which is very liberal in favor of gas turbines.

Distillate (No. 2) oil cost(2) is \$2.13 per 10^6 Btu in 1974.* Assume 6% per year escalation.

$$1984 \text{ oil cost} = (1.06)^{10}\ 2.13 = 1.79 \times 2.13 = \$3.81/10^6 \text{ Btu}$$

1984 fuel cost for gas turbine = (10,000)(3.81) = 38.1 mills/kwh

Operating and Maintenance Costs

Based on data in FPC-72, O&M $\cong$ 5.0 mills/kwh

Assume improvements would reduce this to 3.0 mills/kwh in 1984 (but 1974 dollars)

$$1984^{(1)}\ O\&M = (1.05)^{10} \times 3 = 1.63 \times 3 = 4.9 \text{ mills/kwh}$$

* Fuels from coal gasification processes may be available for future use in G.T. and C.C; however, if they are available, the cost is expected to be about the same, or greater, than oil prices. See discussion in "Summary of Chapter".

1984 Combined Cycles

Capital Cost

Cost experience on combined cycles is almost non-existent. A study of eight planned C.C. plants provided costs as a percentage of G.T. costs. The range was 134% to 165%, so a conservative assumption is that Combined Cycles = 1.4 G.T.

1974 capital cost = 1.4 x 150 = 210 \$/kw

1984[1] capital cost = $(1.05)^{10}$ x 210 = 340 \$/kw

Using 210 \$/kw compares favorably with GPU's Gilbert 8 combined cycle plant. The installed cost of this 330 MW plant (on line in 1976) will be about 216 \$/kw in 1974 dollars.

Fuel Cost

Present day Combined Cycle heat rates are about 8500 Btu/kwh. For gas turbine heat rates of 10,000 Btu/kwh in 1984, Combined Cycle heat rates would be about 7800 Btu/kwh (44% efficiency), which again is very liberal in favor of combined cycles. Per gas turbine analysis, 1984 distillate oil = \$3.81/10^6 Btu. 1984 fuel cost* for Combined Cycle = (7800)(3.81) = 29.7 mills/kwh.

Operating and Maintenance Costs

Assumed to be about half G.T. O&M 1984 O&M = .5 x 4.9 $\cong$ 2.5 mills/kwh

* Although some residual oil can be used, its cost is estimated to be nearly as high as distillate.

Kittatinny Pumped Storage with TILP

Capital Costs

1971 cost estimate[3] (excluding IDC) = $113,650,000 (1969 dollars)

1974 cost[4] = $\frac{2099}{1306}$ x 113,650,000 = $182,660,000

1969 IDC was 10% (6.7% for 1½ years)

Assume 1974 IDC is 13.5% (Assumed 9.0% for 1½years)

Total 1974 cost = 182,660,000 + (.135) 182,660,000 = $207,320,000

1974 cost = $\frac{207,320,000}{1,300,000\text{kw}}$ = 159.50 $/kw (excl. land & transmission)

1979 transmission cost[5] = 26 $/kw

1984 transmission cost[1] = $(1.05)^5$ 26 = 33.2 $/k2

1984 land cost[5] assumed = 1.0 $/kw

1984 project cost[6] = $(1.06)^{10}$ x 159.50 = 286 $/kw

Total cost = 286 + 33 + 1 = 320 $/kw

Comparison of KPS 1974 capital cost with other pumped storage projects:

Using FPC (1973) and escalating[4] -

1974 capital cost for Yards Creek = 210 $/kw

1974 capital cost for Muddy Run = 187 $/kw

Using "Pumped-Storage Potential of the Pacific Northwest"

(Pacific N.W. River Basins Commission) and escalating[4] from 1972 to 1974 -

1974 capital cost for 242 site average = 169 $/kw

From above,

1974 Kittatinny capital cost = 160 + $\frac{26}{(1.05)^5}$ + 1 = 181 $/kw

Conclude that KPS cost estimate is reasonable.

Pumping Costs

Assume[7] for 1984: 50% of pumping energy from coal plants
30% of pumping energy from oil plants
20% of pumping energy from nuclear plants

1974 coal price[2] = \$0.81/per 10^6 Btu in October 1974

Assume 6% per year escalation -

1984 coal price = $(1.06)^{10} \times .81 = 1.45$ \$/10^6 Btu

Pumping energy from efficient fossil steam plants during off-peak hours normally can be done at about 90% of a units average heat rate. The average heat rate in the Electric Service Area was about 10,500 Btu/kwh in 1972 (FPC, 1974). This figure is higher than normal because about 20% of capacity is gas turbines, and there are also many older low pressure and non-reheat base load units. The average heat rate will probably improve to around 9500 Btu/kwh in 1984, but 10,000 will be used to be conservative. The pumping energy heat rate in 1984 is -

$.9 \times 10{,}000 = 9000$ Btu/kwh

1984 Coal pumping cost = 9000 x 1.45 \$/10^6 Btu = 13.1 mills/kwh

1974 residual oil price[2] = \$1.98/10^6 Btu in October, 1974

Assume 6% per year escalation -

1984 oil price = $(1.06)^{10} \times 1.98$ = \$3.54/10^6 Btu

1984 Oil pumping cost = 9000 x 3.54 = 31.9 mills/kwh

1974 nuclear production costs (fuel plus O&M) is about 3.5 mills/kwh (FPC, 1974). Approximately 30% of this is fixed, and the rest would be pumping cost. Expecting improvement in nuclear production costs, it is assumed they will escalate at 4% per year -

1984 nuclear pumping cost = $(.7)(3.5)(1.04)^{10}$ = 3.6 mills/kwh

For the weighting given above, the 1984 pumping cost would be:

Coal -	.5 x 13.1 = 6.55
Oil -	.3 x 31.9 = 9.57
Nuclear -	.2 x 3.6 = .72
	16.84 say 16.9 mills/kwh

Assuming no nuclear pumping, the 1984 pumping cost would be:

Coal -	.7 x 13.1 = 9.2
Oil -	.3 x 31.9 = 9.6
	18.8 mills/kwh

Every kwh generated by the pumped storage plant requires 1.4 kwh of pumping energy. Therefore, the actual pumping costs are:

1.4 x 16.9 = 23.7 mills/kwh (assuming 20% nuclear)

1.4 x 18.8 = 26.3 mills/kwh (assuming no nuclear)

Operating and Maintenance Costs

Using data in FPC-1973, five pumped storage plants (O&M costs for 1971) have been reviewed. It appears more appropriate to express O&M costs on a $/kw-yr basis rather than a mills/kwh basis. The plants reviewed were Yards Creek, Seneca, Muddy Run, Cabin Creek and Taum Sauk.

Based on these reported costs and considering the proposed project's large size, O&M costs would be about 1.40 $/kw-yr in 1971.

1984 O&M cost = $(1.05)^{13}$ x 1.40 = 2.64 $/kw-yr, say 2.7

Kittatinny Pumped Storage Without TILP

Capital Costs

The primary differences between K.P.S. without TILP and K.P.S. with TILP are:

- About 1700 acres are needed for the lower storage pool; 900 acres of this is existing river channel.
- The minimum gross head is 1150 feet instead of 1070 feet. By slightly increasing equipment size, the additional head can be used to increase the plant rating to 1400 MWe.

In 1969 dollars -

Added land cost = (1700 - 900) acres x 3100 \$/acre	≅	\$2,500,000
Added equipment cost	=	2,600,000
Added engineering overheads	=	1,800,000
SUB-TOTAL ADDERS	≅	6,900,000
1969 KPS (excluding IDC)	=	113,650,000
1969 KPS without TILP (excluding IDC)	≅	\$120,550,000

In 1974 dollars -

1974 KPS without TILP = $\frac{2099}{1306}$ x 120,550,000 = \$194,000,000

Assume 1974 IDC is 13.5%

Total 1974 KPS without TILP = 194,000,000 + (.135) 194,000,000 = \$220,000,000

1974 Cost = $\frac{\$220,000,000}{1,400,000}$ = 157 \$/kw

In 1984 dollars -

Assume same transmission and other land costs as KPS with TILP.

1984 total KPS without TILP = 1 + 33 + $(1.06)^{10}$ x 157 = 315 \$/kw

Pumping and O&M costs are same as KPS with TILP

Fixed Charge Rates

The fixed charge rate is composed of:

- rate of return on the capital investment
- project depreciation (depends on life of project)
- taxes (includes income and property taxes)
- insurance

The following assumptions are made for the 1984 time frame:

- rate of return is 10% (i.e. utilities need this rate to attract investment funds)
- project life:
  - gas turbines (25 years)
  - combined cycles (30 years)
  - pumped storage (50 years)

Using capital recovery factors based on 10% rate of return and differing project lives, levelized fixed charge rates would typically be as follows:

- Gas turbines -- 16.0%
- Combined cycles -- 15.5%
- Pumped storage -- 14.5%

The product of the levelized fixed charge rate and the initial capital investment gives the annualized capital cost over the project life.

Benefit - Cost

There are several approaches which can be used in evaluating the "benefits" and "costs" of alternative projects. Two approaches are outlined below:

Comparison of 1984 Annual Costs

Using the graph and assuming 1500 hours* of annual operation:

1984 G.T. Annual Costs = (100 \$/kw-yr) x (1,300,000 kw)
= 130×10^6 \$/yr

1984 C.C. Annual Costs = (102 \$/kw-yr) x (1,300,000 kw)
= 132.6×10^6 \$/yr

1984 K.P.S. Annual Costs = (90 \$/kw-yr) x (1,300,000 kw)
(no nuclear pumping) = 117×10^6 \$/yr

The 1984 net annual benefits could be defined as the difference between K.P.S. and the most economic alternative:

1984 Net Annual Benefit = $(130 \times 10^6) - (117 \times 10^6)$
= 13.0×10^6 \$/yr

There is little difference between the economics of G.T. and C.C. when viewed during the first year of operation. However, the next approach shows that C.C. is more economical than G.T. when viewed over the entire project life.

* The pumped storage benefits relative to the alternatives increase if 1800 hours of operation is assumed, which is the more likely case.

1974 Present Worth of Alternative Project Costs for the Next 50 Year Period

This approach represents an approximate comparison of the alternative projects' present worths. Fixed and ariable costs for each alternative during a 50 year period of operation .re present worthed to 1984 and 1974.

	G.T.	C.C.	K.P.S. (no nuclear pumping)
1984 Capital Cost (1300 Mwe)	$\$286.0 \times 10^6$	$\$442.0 \times 10^6$	$\$416.0 \times 10^6$
Assumed Life	25 yrs	25 yrs	50 yrs
2009 Capital Cost[1]	$\$143.0 \times 10^6$	$\$221.0 \times 10^6$	-
Variable Costs (1500 hrs)	$\$83.9 \times 10^6$	$\$62.8 \times 10^6$	$\$52.1 \times 10^6$
Assumed rate of return	10%	10%	10%

G.T. 1984 Present Worth $= 286.0 \times 10^6 + (143.0 \times 10^6)\ (P/F, 10\%, 25) + (83.9 \times 10^6)\ (P/A, 10\%, 50)$

$= 286.0 \times 10^6 + (143.0 \times 10^6)\ (.0923) + (83.9 \times 10^6)\ (9.915)$

$\cong \$1130.0 \times 10^6$

C.C. 1984 Present Worth $= 442.0 \times 10^6 + (221.0 \times 10^6)\ (.0923) + (62.8 \times 10^6)\ (9.915)$

$\cong \$1085.0 \times 10^6$

K.P.S. 1984 Present Worth $= \$416 \times 10^6 + (52.1 \times 10^6)\ (9.915)$

$\cong \$932.6 \times 10^6$

G.T. 1974 Present Worth $= \dfrac{1130.0 \times 10^6}{(1.10)^{10}} = \$436.0 \times 10^6$

[1] Assume that renewal costs for the gas turbine and combined cycle plants are 50% of the initial 1974 Capital cost. This is extremely conservative.

$$\text{C.C. 1974 Present Worth} = \frac{1085.0 \times 10^6}{(1.10)^{10}} = \$418.0 \times 10^6$$

$$\text{K.P.S. 1974 Present Worth} = \frac{932.6 \times 10^6}{(1.10)^{10}} = \$360.0 \times 10^6$$

This indicates that K.P.S. is the most economical, followed by C.C. and the G.T.

COST RECAP IN 1974 DOLLARS

Combined Cycles (Assume 1500 hrs annual operation)

1974 capital cost for 1300 MW plant = (210 \$/kw)(1,300,000 kw)

= $\$273 \times 10^6$

Renewal for 25 years in 2009 = $\$221 \times 10^6$
(assuming operation starts in 1984)

Renewal cost in 1974 dollars = $\frac{221 \times 10^6}{(1.10)^{35}} = \$7.9 \times 10^6$

1974 Capital Cost (50 year plant life) $\cong \$281 \times 10^6$

1974 Annualized capital cost* $\cong .15 \times (\$281 \times 10^6) \cong \$42 \times 10^6$

1974 Annual O & M cost (incl. fuel) = $\frac{\$62.8 \times 10^6}{(1.06)^{10}} \cong \$35 \times 10^6$

1974 Total annualized cost = $\$77 \times 10^6$

Kittatinny Pumped Storage (Assume 1500 hrs annual operation)

1974 Annualized capital cost = (.15)(181 \$/kw)(1,300,000 kw)
= $\$35 \times 10^6$

1974 O & M cost = $(1.05)^3(1.40)(1,300,000) \cong \$2.0 \times 10^6$

1974 Reservoir Charge = (0.77 \$/kw-yr)(1,300,000 kw) = $\$1.0 \times 10^6$

1974 Pumping cost = $\frac{\$52.1 \times 10^6}{(1.06)^{10}} = \$29 \times 10^6$

1974 Total Annualized Cost = $(\$35 + 2 + 1 + 29)10^6 = \$67 \times 10^6$

* For simplicity - 15% levelized fixed charge rate used for both C.C. and KPS.

SENSITIVITY ANALYSIS

The cost estimates for the fixed and variable components are considered to be accurate within $\pm 10\%$.

CASE I. The extreme unfavorable case for KPS compared to CC would be to decrease CC costs by 10% and increase KPS costs by 10%. Using Figure 3, the result would be:

$$\text{1984 CC Annual Cost} = \$132 \times 10^6 - (.10)(\$132 \times 10^6) \cong \$119 \times 10^6$$

$$\text{1984 KPS Annual Cost} = \$117 \times 10^6 + (.10)(\$117 \times 10^6) \cong \$129 \times 10^6$$

This represents 1984 net annual benefits in favor of CC by about $\$10 \times 10^6$. In the consultant's view, the extreme case is highly unlikely, but nevertheless is a remote possibility.

CASE II. The most likely unfavorable case for KPS economics compared to CC is considered to be the following:

CC capital cost – decrease 10%

CC fuel cost – increase 5% (low heat rate used in basic calculations)

KPS capital cost - increase 5%

KPS pumping cost - increase 10% (assumes higher than expected coal prices)

Using Table XIV-3, and assuming 1500 hours annual operation, 1984 C.C.

$$\text{Annual Cost} = (.9)(52.7)(1{,}300{,}000) + (1.05 \times 29.7 + 2.5)(1500)(1{,}300{,}000)\ 10^{-3}$$

$$= \$61.7 \times 10^6 + 65.7 \times 10^6$$

$$= \$127.4 \times 10^6$$

$$1984 \text{ KPS Annual Cost} = (1.05 \times 46.4 + 3.7)1{,}300{,}000$$

$$+ (1.1 \times 26.3)(1500)(1{,}300{,}000)10^{-3} = \$68.1 \times 10^6 + \$56.4 \times 10^6$$

$$= \$124.5 \times 10^6$$

For this case, the 1984 net annual benefits favor KPS by about $\$3. \times 10^6$ as compared with $\$15 \times 10^6$ (per Figure 14-3).

As a variation within Case II, consider the effect of using 1800 hours of annual operation, which is more realistic than using 1500 hours.

$$1984 \text{ C.C. Annual Cost} = \$61.7 \times 10^6 + \left(\frac{1800}{1500}\right) \$65.7 \times 10^6$$

$$= \$140.5 \times 10^6$$

$$1984 \text{ KPS Annual Cost} = \$68.1 \times 10^6 + \left(\frac{1800}{1500}\right) \$56.4 \times 10^6$$

$$= \$135.8 \times 10^6$$

NOTES

(1) A general escalation rate applicable to electric power alternatives has been assumed as 5% per year; however, gas turbines being equipment intensive are assumed at 4% per year.

(2) FPC News, February 7, 1975.

(3) 3d Supplement to Kittatinny Mountain 1300 MWe Pumped Storage Plant, DRBC, 1971.

(4) Escalation per Construction Cost Index, Eng. New Record, Dec. 19, 1974.

(5) DRBC, 1972 Environmental Report on Kittatinny Project

(6) Escalation at 6% per year to account for high labor input to pumped storage project.

(7) Very little, if any, nuclear pumping energy will be available in 1984; however, it will become available during the late 80s and 90s. Thus, assuming 20% in 1984 over-estimates nuclear's contribution; but probably under-estimates it in 2004.

Chapter XV

FLOOD CONTROL ALTERNATIVES

XV.A. IDENTIFICATION AND DISCUSSION OF ALTERNATIVES

XV.A.1 GENERAL

Flooding on the upper reaches of the Delaware River results in relatively minor property damage due to the extremely narrow valley with little development along the banks. The reach of river from the Port Jervis-Matamoras area down to the Delaware Water Gap widens and the Valley flood plain averages 1200 feet in width. Property damages in this reach would be confined to scattered residences and summer cottages along the banks as well as to several small communities. The remainder of the river down to the tidal section has a Valley flood plain averaging 1600 feet in width. The major flood damages in the basin occur in this reach principally in the urban areas of Belvidere, Easton, Riegelsville, New Hope and Yardley, Pennsylvania; and Phillipsburg, Trenton and Burlington, New Jersey. During the 1955 flood, flood damages in this reach approximated 85 percent of the total damages along the main stem of the Delaware River. Two thirds of these damages occurred in the above named urban damage centers. This dissertation is not intended to discount the need for flood control measures in the upstream reaches of the Delaware River.

However, it does point out that the major flood control needs are in the lower basin, downstream from the Delaware Water Gap. The preauthorization studies (House Document NO. 522) considered flood control measures and alternatives for the entire basin.

The recommended plan of development, which evolved from these studies, included eight reservoirs with major flood control storage capacity, of which Tocks Island was by far the largest. It is the intent and purpose of this chapter to list and evaluate viable alternative plans or combinations of alternative plans which will develop flood control benefits essentially similar to the authorized Tocks Island project, and which will have the minimum adverse affects physically and environmentally to the area.

XV.A.2 IDENTIFICATION OF ALTERNATIVES

The possible functional alternatives to the Tocks Island project include both structural and non-structural options, as follows:

I. <u>Structural Alternatives</u>

1. Dams on upstream tributaries of Delaware River.
2. Levees and floodwalls along the Delaware River below Tocks Island dam site.
3. Levees and floodwalls around the eight major damage centers only.

4. A dam on main stem of the Delaware River at a site other than Tocks Island.
5. Construction of dam or dams for flood control purpose only.
6. Diversion of floodwaters by high flow skimming to Round Valley Reservior.
7. Diversion of floodwaters by tunnel through Kittatinny Mountain.
8. Channelization of Delaware River below Tocks Island.

II. Non-structural Alternatives

1. Purchase of flood plain to prevent development.
2. Flood insurance as incentive not to build in flood plain.
3. Flood proofing of structures in flood plain.
4. Flood warning and evacuation system to prevent loss of life in flood plain.
5. Flood plain management to control development in flood plain.
6. Management of upstream lands to reduce runoff to Delaware Basin.

XV.A.3 NON-FUNCTIONAL ALTERNATIVE

In addition to the above, a non-functional alternative always exists, which is the NO ACTION alternative. Construction of Tocks Island Lake could be postponed indefinitely. The alternative of no development was an option that Congress had when the decision was made to authorize the project. Selection of the no-action alternative would not prevent water resource development or urban and industrial development in the basin by private or other public interests. It prevents the inundation by construction of the reservoir of agricultural and grazing lands, which also provide the food and cover for wildlife, and several miles of natural stream, and scattered residences and small communities. Also the impacts in the Port Jervis-Matamoras area would be avoided. This alternative would forego meeting the increasing needs of the area for flood control, water supply, power and recreation.

However, for the purpose of this chapter, no further consideration will be given to the non-functional NO ACTION alternative, since the purpose of the chapter is to explore functional alternatives.

XV.B. PRELIMINARY EVALUATION OF ALTERNATIVES

XV.B.1 STRUCTURAL ALTERNATIVES

1. Dams on upstream tributaries of the Delaware River could be developed for flood control purposes only, and numerous

sites have already been considered by the Corps of Engineers, as shown and itemized in the Order of Merit, Table Q-13, Appendix Q, of House Document No. 522. Sites considered as a substitute for Tocks Island would be over and above the ones that are already scheduled as a part of the integrated basin plan, or could include modification of existing sites that are proposed in the plan with Tocks Island and could be designed to a different scale without Tocks Island. This is a viable alternative and will provide benefits in many instances on tributaries that are not provided by Tocks Island Reservoir. However, this plan is a limited alternative in terms of flood control benefits on the downstream river. The main reason is that even though an equal amount of flood control storage is provided to that available within Tocks Island by virtue of a group of tributary reservoirs, these reservoirs would not have the same capability at intercepting a storm pattern. A viable group of tributary reservoirs with a total equivalent storage, to Tocks Island would only provide control of 30 or 40 percent of the drainage intercepted by the Tocks Island Project.

2. Levees and floodwalls along the Delaware River below the Tocks Island site is considered as an alternative. A system of levees and floodwalls considered for localized protection of major damage centers would provide an equivalent or greater degree of protection than the Tocks Island Project. These measures are suitable solutions to local flood problems

where flood control is the dominant need. However, in terms of protection provided and physical constraints the costs become prohibitive. Any levee system would change the flow characteristics of the Delaware River by confining the floodwaters, would increase flood heights locally, increase the velocity of flows and increase downstream peak flows. The limited width of the flood plain does not allow sufficient space for construction of earth levees, such as are used along the lower Mississippi River, and the cost of concrete flood walls along 80 miles or river would be prohibitive Accordingly, this alternative has been rejected as a viable substitute for the flood control function of the Tocks Island Project.

3. Levees and floodwalls around the eight major damage centers can be developed as an alternative. The high concentration of vulnerable and valuable properties in the major damage centers leads automatically to consideration of local protective structures, which must be viewed as a potentially viable solution to the flood control problem. Local protection structures have been used in many sections of the country where flood problems exist, and the possibility exists that a local community may choose to levee their own area even without Federal participation. Accordingly, this plan should be considered a viable alternative to Tocks Island unless detailed consideration of such factors as cost, which can reasonably be anticipated to be substantial

make the use of local protective structures inappropriate in a given situation.

4. The consultant has looked at the alternative of a dam on the main stem of the Delaware at a site other than Tocks Island. The conclusion reached by the Corps of Engineers that Tocks Island location is the best site is concurred with. If the dam site is too far upstream, the proper flood control effect is not achieved; if the site is too far downstream, more expensive relocations will result. There are constraints on the size of the project that limit its effectiveness, and in either case, going upstream or downstream really doesn't solve one of the main objections from the environmental viewpoint. The same concerns would still exist with just as much discontent at upstream or downstream sites as at Tocks. If a main stem site is to be selected, the Tocks Island site would have to be considered the best location. In view thereof, it is recommended that other sites on the main stem be eliminated as viable alternatives to the Tocks Island site.

5. Construction of a dam or dams as an alternate single purpose flood control project would be based on the use of the so-called "dry dam". Since water supply, recreation, and other purposes are excluded by definition, no consideration will be given to a permanent pool, other than a silt pool, which would provide for silt storage only. This is a valid concept for flood control and should be

considered a viable alternative to the multi-purpose Tocks Island project. A dam of this type could be located at the Tocks Island site, or several smaller dams could be located on tributary streams.

6. Diversion of floodwaters by high flow skimming to Round Valley Reservoir has been considered. This suggested alternative, which grew out of comments by interested parties to this project, was considered; and although it could be viewed as a valid scheme for water supply, from the point of view of flood control it is impractical. A tremendous volume of water would have to be diverted in a short time of about 60 hours. There is little opportunity in this narrow steep valley for diversion out of the Delaware River and the high flood flows would have to be pumped out. It is estimated that it would take about 25% of the total power capacity existing within the power service area to handle the water at a rate necessary for diversion, assuming there was a place to store it. Accordingly, this scheme has been deleted from further consideration.

7. The suggestion of diversion of floodwaters by tunnel through Kittatinny Mountain was advanced. However, it is totally infeasible as a flood control measure. The Tocks Island Reservoir provides 323,500 acre feet of flood control storage. If this much storage space were to be provided by "hollowing out a

mountain", it would require in excess of 500,000,000 cubic yards of rock excavation. Such a project appears to be outside the range of economic feasibility and will be dropped as a viable alternative for study purposes.

8. Channelization of Delaware River below Tocks Island. Channelization is a technique for passing flood waters rapidly downstream maintaining flood flows in the channel. This plan presents two basic problems. One is that the Delaware River is generally comprised of rock and would be difficult and costly to channelize. The other is that the water moves more rapidly downstream to the affected damage areas and accentuates the problems in these areas. Accordingly, it is recommended that no further consideration be given to this alternative.

XV.B.2 NON-STRUCTURAL ALTERNATIVES

1. Purchasing the flood plain to prevent future development and moving people and existing property out can be highly effective. This eliminates most major damages, but its effectiveness has to be ultimately evaluated with cost. The price paid to buy all the flood plain would greatly exceed the allocated cost of the flood control provided in the Tocks Island project. From the viewpoint of economics, this would have to be discarded as a total program. However, it might develop that, in isolated areas, purchase of some flood plain properties might be justified as a facet of an overall plan of protection.

2. Flood insurance as an incentive not to build on the flood plain can be considered an alternative. Adoption of enabling state legislation (New Jersey already has) is required if existing legislation is not adequate, before the program can be adopted and enforced either at the local or state government level. Associated land use regulations are required regarding location, elevation of structure, design, etc., on all new structures. These regulations must be met if structures are to be located in the developable portion of the flood plain. Of course, this does add to the development cost of the landowner or developer. The insurance premiums themselves add to the cost on existing as well as new construction and, in a sense, the insurance premiums become damages. Historically these costs have not been used in the B/C ration computation, because flood insurance is a new concept. However, the insurance premiums saved become a benefit for the Tocks Island type of flood control. Though it is not considered as of this moment, it is something that should be considered. If everything depends on insurance and, in effect, flooding is allowed to happen, then the cost in terms of insurance premiums and damage to existing structures becomes substantial. Thus, there are some definite deficiencies with it as a total "cure-all" program. But it should be encourage, particularly in connection with some structural measures, and should be given consideration in connection with other alternatives.

3. Flood proofing of structures in the flood plain is an effective method for minimizing flood damages that might otherwise be anticipated. Its primary application would be in connection with structures where design modifications could be implemented which would either limit the entry of water to the facility, or limit the degree of vulnerability when water does enter. For example, buildings can sometimes be raised on piers to reduce probability of flooding; windows and doors can be bulkheaded to prevent entry of water; or, sensitive equipment, such as electric motors, can be relocated at higher elevations, thereby limiting damages when water does gain access to the premises. The concept of flood proofing should also be incorporated, whenever appropriate, in connection with design of new structures which might be built in the flood plain. Flood proofing should also be considered in connection with other structural alternatives such as a system of tributary reservoirs. Structural alternatives which produce less stage reduction than would be achieved with the Tocks Island project can be supplemented by flood proofing techniques to provide for further damage reduction.

4. Flood warning and evacuation system to prevent loss of life in a flood plain is not be itself a viable alternative. There are several good reasons against this as an alternative. First, the existing flood warning system is effective, and the Delaware has not been a source of loss of life in flooding, even during the 1955 flood. This has not been the case on tributaries where major loss of life has occurred. Related to this, various

discussions have cited the Cheyenne Basin, where they had a disasterous loss of some 234 lives, even though they had a flood warning system. This project consists of an upstream flood control reservoir which controls about 323 square miles with an intervening drainage area of 91 square miles. The flood control reservoir has over 43,000 acre feet of flood control storage and the storm volume itself was about 10,000 acre feet. The storm concentrated on the limited 91 square miles with 10 to 14 inches of rain. The flood warning system worked; people heard it, but did not pay any attention. They had heard warnings many times before, but the largest flood that had ever occurred was 3,300 c.f.s. These people were suddenly hit with 50,000 c.f.s. It was 10:30 at night and they were getting ready for bed, watching TV and so forth, and said, "oh well, we've never been bothered by floods before", so they stayed inside their homes. A flood warning system sounded too often results in people not paying attention to it. If it is not sounded at all, someday people are going to be trapped by not only a major flood, but even by a minor one. Accordingly, a flood warning and evacuation system should not be considered by itself as a viable alternative to the positive protection afforded by a structural project. However, it should definitely be considered as a supplemental measure in connection with an overall program which might involve combinations of structural and non-structural measures.

5. Flood plain management to control development in the flood plain can be effective in terms of prevention of future damage, however it does nothing to protect existing development and in many cases, is difficult to administer. It has to be implemented at both the local and state level, and the chain of legislation involved is fairly overwhelming. But, if the assumption is made that all the necessary legislation will be enacted and properly enforced, then it is a viable alternative to consider for flood control purposes.

6. Management of upstream lands to reduce runoff to the Delaware Basin is a Soil Conservation Service concept, which consists of contour plowing, terracing and provision for small reservoirs to control runoff. It is effective in controlling soil erosion and for relatively small discharges, but not for major flooding. It is not effective for the scale necessary to replace the flood control function of Tocks Island.

XV.C. GENERAL EVALUATION OF SUITABLE ALTERNATIVES

XV.C.1 GENERAL

In considering possible alternatives to the Tocks Island project for flood control storage, reference has been made to Table Q-12 in Volume 9 of House Document No. 522 which enumerates 70 major impoundment or development sites. Of these 70 sites, 50 offer major impoundment potential which could be theoretically used to provide substitute flood control storage to that otherwise available from the Tocks Island project. Reference has also been made to Table Q-13 which lists 48 of these major impoundment potentials in accordance with their order of merit for comprehensive development, (long term and short term storage), for development of long term storage only, and for development of short term storage only. It should be noted that the projects listed do not reflect projects as given in the Delaware River Basin Commission Comprehensive Plan.

In searching for an appropriate combination of reservoirs to substitute for the Tocks Island flood control storage, consideration was given to the following aspects of the above referenced major impoundment sites.

(a) Those sites which are already incorporated in the plan of improvement, as presented in House Document No. 522, were not considered to be available as a substitute for the Tocks Island project. This resulted in the deletion of the following projects from further specific consideration. The numbering is the Corps' order of merit for development in House Document No. 522.

1. Hawk Mountain

39. Bear Creek (existing Francis E. Walter)

44. Beltzville (existing)

45. Aquashicola

46. Trexler

60. Moselem (Maiden Creek)

61. Bernville (Blue Marsh)

69. Newark

70. Christiana

(b) Those projects which were included in Stage 2 of the plan of development cannot be made available as a permanent substitute for Tocks Island although they could conceivably be used as a vehicle for temporary relief of flood problems if developed prior to the time scheduled in the recommended plan of development. These projects include the following:

34. Paulina

37. Pequest

50. Hackettstown

51. New Hampton

53. Tohickon (existing Nockamixon)

57. Newton (Deleted under (f) below)

64. French Creek (Delected under (f) below)

66. Evansburg (Deleted under (f) below)

The last three of these projects are, however, deleted from further consideration for reasons discussed below, so that only the first five remain as possible temporary impoundments which might be utilized to replace a portion of the flood control function of Tocks Island.

(c) Projects which have been indicated as having a low order of merit for comprehensive development in Table Q-13 have also been deleted from further consideration, these include the following:

2. Cannonsville
3. Equinunk
5. Gallicoon
8. Milanville
12. Masthope
16. Lackawaxen
31. Pine Mountain
32. Bartonsville
56. Crosswicks
58. Birmingham
59. Eayrestown

(d) Another factor of significance is the amount of storage impoundment provided. The Tocks Island Project itself provides 323,500 acre-feet of flood control storage. While it is not necessary that any single alternative reservoir project being considered have storage of this magnitude there would be little merit in considering impoundments with less than say 20,000 acre-feet of potential flood control storage. Accordingly, those projects with less than this amount of storage have been deleted from further consideration. These include the following:

8. Milanville
12. Masthope
32. Bartonsville
36. Sarapta
43. Mahoning
48. Belfast
49. Washington
58. Birmingham
59. Eayrestown
62. Monoc
70. Christiana

(e) In addition to the question of available storage an important consideration is the amount of drainage area intercepted. The Tocks Island Project intercepts a total of 3,827 square miles. Any system of reservoirs intended to provide a substitute for this flood control storage should also intercept a reasonable proportion of this total drainage area if the alternative system is to be in any sense considered a substitute for the Tocks Island Project. Accordingly, all projects intercepting drainage areas of less than 50 square miles have been deleted from further consideration. These include the following:

8. Milanville
12. Masthope
32. Bartonsville
36. Sarapta
48. Belfast
49. Washington
62. Monoc
67. Buck Run
70. Christiana

(f) The final consideration deals with the location of the project within the drainage basin. Projects which are upstream from the major damage centers can make their influence felt in stage reduction. However, projects which are located in the lower tributaries, such as the Schuylkill River, can have no influence on damages to upstream areas. Accordingly, all projects on tributary system below Trenton have been deleted from further consideration. The tributary systems involved include Crosswicks, Neshaminy, Brandywine, and Rancocas Creeks, and the Schuylkill River. Accordingly, the projects deleted are:

56. Crosswicks
57. Newtown

58. Birmingham

59. Eayrestown

60. Moselem (Maiden Creek)

61. Bernville (Blue Marsh)

62. Monoc

63. Fancy Hill

64. French Creek

65. Spring Mountain

66. Evansburg

67. Buck Run

68. New Castle

69. Newark

70. Christina

After considering projects deleted as discussed above, the remaining projects which are considered viable as a substitute storage for the Tocks Island Project include the following:

13. Hawley

14. Wallenpaupack

15. Sterling

17. Shoncla Falls

19. Knights Eddy (in area recommended for designation under Wild and Scenic Rivers Act.)

25. Bridgeville

26. Basherkill

27. Girard

28. Wallpack Bend

29. Flat Brook

33. McMichael

38. Tobyhanna

The possibility also exists that the following second stage reservoirs might be developed prior to the time scheduled in the recommended plan of development and use made of the flood control storage that could be provided in these reservoirs even though their contemplated roll in the plan of development does not include flood control storage. These projects are:

34. Paulina

37. Pequest

50. Hackettstown

51. New Hampton

53. Tohickon

The development of these sites for flood control storage at this time would probably have to be viewed as an interim measure since this would in effect be preempting recommended water supply development in the future. It is noted that the Tohickon project has been constructed. Evaluation of the groups of reservoirs considered in the various plans required that an escalation factor be determined to update costs presented in Houst Document No. 522. Therefore, a ratio of 2.26 was determined based on the current January 1, 1975 cost of the Tocks Island Project to the first costs as given in House Document 522. This was compared to the ratio of 2.21 derived from Engineering News Record indexed for the same time period. The two values are quite close, therefore, the ratio of 2.26 was utilized in escalating costs. Total costs of the various project combinations were approached on a per acre-foot cost of storage. Based on the flood control project at Tocks Island as given in Supplement No. 1 to General Design Memorandum No. 3, July 1969, the per acre-foot cost of flood control storage was $337 at a 1966 price level and escalated to a current price level is $636 per acre-foot. Table R-15 and R-16 of Appendix R, House Document 522 was used to determine that the cost per acre-foot of storage for small reservoirs was approximately $70 more than that in major impoundments. Retaining this same relationship results in a cost of $706 per acre-foot. Using an average of these two values a charge of $671 per acre-foot of storage for intermediate size reservoirs was applied to each system of reservoirs to obtain the total costs for each particular alternative. The downstream effects on flood stage reduction by project was determined by utilizing Appendix M, Hydrology, Plate 59, House Document No. 522 and modifying peak discharges in downstream damage reaches. A stage damage relation was developed for each of the damage reaches downstream based on data developed by the Corps of Engineers for their flood benefit analysis. The above data and an interest rate of 5 7/8 percent was used to determine costs and benefits for each plan considered.

XV.C.2 DAMS ON UPSTREAM TRIBUTARIES

PLAN 1

The following system of tributary reservoirs is designated as Plan 1. These were the projects which were listed by the Corps of Engineers in House Document No. 522, Appendix Q as a substitute for flood control storage in the Tocks Island Project.

Order of Merit	Project	Drainage Area (Sq. Mi.)	Storage (Ac-Ft)
3	Equinunk	59	24,000
5	Gallicoon	111	40,900
8	Milanville	46	19,400
12	Mastope	29	13,300
16	Lackawaxen	595	167,800
17	Shohola Falls	59	24,000
25	Bridgeville	160	56,000
27	Girard	58	24,000
29	Flat Brook	65	26,000
	Total	1,182	395,400

Based on the plan as given in the above tabulation, the total cost for the system would be $265,300,000. This represents an annual charge for the system of reservoirs of $15,652,000 and annual benefits of $1,690,730 having an overall benefit-cost ratio of 0.11. It is to be emphasized that this and other benefit-cost ratios in this chapter are for present comparison purposes only.

Plan I would result in reducing average annual damages by about 43%. The overall cost of this plan would be about 6 times that of the allocated flood control portion of the Tocks Island project or about 0.8 of the cost of the flood control only project at the Tocks Island site. This system of reservoirs could not be economically justified. Development of several smaller projects does provide protection to local upstream reaches that is foregone when compared with the single large main stem control structure. The multiple development tends to distribute recreation facilities over more area and prevents crowding of facilities. However, collectively they would inundate more acres and miles of natural stream with related stream-side flora and fauna than the single large project. Non-structural measures could be used in conjunction with this plan. However, the additional cost entailed would be proportional to the additional benefits, leading a total benefit-cost ratio for the overall project considerably below unity.

PLAN II

This system of reservoirs is designated as Plan II. The plan was based on elimination of projects as discussed in paragraph XV.C.1 above and resulted in a system of reservoirs as follows:

Order of Merit	Project	Drainage Area (Sq. Mi.)	Storage (Ac-Ft)
13	Hawley	80	31,700
15	Sterling	143	50,200
17	Shohola Falls	59	24,000
25	Bridgeville	160	56,000
27	Girard	58	24,000
29	Flat Brook	65	26,000
33	McMichael	63	25,500
	Total	628	237,400

The total costs of the above plan was $159,400,000. The annual charges for this system were $9,379,000 with annual benefits of $1,754,400 and a benefit-cost ratio of 0.19.

Plan II would result in reducing average annual damages by about 44%. The overall cost would be about 4 times the cost of the flood control allocated to the Tocks Island project or about 0.5 the cost of a "flood control only" project at the Tocks Island dam site. The discussion in Plan I above is also applicable to Plan II.

PLAN III

This system of tributary reservoirs is designated as Plan No. III. It is a composite of Plan II reservoirs plus the second stage projects as presented in House Document No. 522 is plan of improvement which would affect flood flows on the Delaware River above the urban areas.

Order of Merit	Project	Drainage Area (Sq. Mi.)	Storage (Ac-Ft)
	Plan II	628	237,400
34	Paulina	122	45,000
37	Pequest	100	37,800
50	Hackettstown	70	28,100
51	New Hampton	123	45,000
	Total	1,043	393,300

The total cost of the above plan was $264,000,000. The average annual charges for this system were $15,569,000 with an average annual benefit of $1,814,800 or a benefit-cost ratio of 0.12.

Plan III would result in reducing average annual damages by 46%. The overall cost would be about 6 times that of the allocated flood control portion of the Tocks Island project, or .87 times the cost of a "flood control only " project at the Tocks Island site. Again, as noted, the discussion on Plan I is applicable to Plan III also.

XV.C.3 FLOOD CONTROL ONLY - MAIN STEM TOCKS ISLAND SITE

This plan considered a "flood control only" project at the Tocks Island Dam site. The data contained in this plan came from Supplement No. 1 to Design Memorandum No. 3 July 1969, prepared by the Corps of Engineers. Three sizes of "flood control only" projects were analyzed. The pertinent data is given for each in the following tabulation.

Elevations			
Flood Control Pool (ft msl)	366	387	394
Storage (acre-feet)			
Flood Control	120,100	256,700	323,500
Sediment	19,000	19,000	19,000
First Cost (millions)			
Based on cost per foot of dam for pool @ 394	228.6	301.1	325.7
Average Annual Charges (millions)			
1 Jan 75	13.476	17.750	19.200
Average Annual Benefits (millions)			
1 Jan 75	1.915	2.286	2.517
Benefit-Cost Ratio (Comparative)	0.14	0.13	0.13

Total costs and benefits as given above indicate that these projects also can not be justified solely on the economic grounds of direct costs and benefits.

XV.C.4 FLOOD CONTROL ONLY - MAIN STEM - WALLPACK BEND SITE

This plan is a flood control only project at the Wallpack site. The top of the flood control pool was established at elevation 418 feet mean sea level, providing flood control storage of 323,500 acre-feet with 19,000 acre-feet of sediment storage. The total first cost of this project was $331,288,000. The average annual charges for the project were $19,529,000 and average annual benefits $2,517,000 with the resultant benefit-cost ratio of 0.13.

XV.C.5 LEVEES AND FLOODWALLS - URBAN AREAS

This plan considered levees and flood walls for the protection of the major urban damage centers. In Appendix Q, House Document No. 522, it is stated that the preliminary cost estimates for providing a reasonable degree of protection by levees for the major urban damage centers would be about $35,000,000 (January 1959 price level). The total flood losses in these areas if completely eliminated would justify an expenditure of less than $25,000,000. The EDF Report cited earlier indicates a significant reduction in damageable property in the flood plain. The current analyses made by the consultant based on 1962 and 1974 photography support these claims and go on to indicate that while there were significant reductions in the number of structures in various local areas between 1955 and 1962 overall, there is approximately the same general amount of property in the flood plain in 1974 as there was in 1962 when House Document No. 522 was published.

Based on the foregoing, considering the levels of change in the amount of property in the flood plain and the cost of local protection projects under current price levels and a higher interest rate than that used in House Document No. 522 the benefit-cost ratio would be considerably less than unity or comparable to that for other structural measures. This plan falls short in meeting the flood control needs in the lower Delaware River Basin other than in urban areas. Therefore, it will not be given further consideration as an alternative to the Tocks Island Project, other than as these measures might apply as a portion of nonstructural plans in localized areas.

XV.C.6 NONSTRUCTURAL FLOOD DAMAGE PREVENTION MEASURES

The effects of flood plain management measures such as flood plain zoning, flood insurance, permanent or temporary evacuation, early warning systems, floodproofing and other preventative measures are ecological factors important to the consideration of flood control alternatives, especially in urban areas. Although flood plain management measures would be a means of reducing the potential for increased future flood damages in the Delaware River Basin, the basic nature of such measures renders them ineffective as streamflow regulators and most of the existing development in the flood plain would remain subject to flooding.

XV.C.7 FEE PURCHASE OF THE FLOOD PLAIN

This alternative would consider buying all the lands in the flood plains and removing all damageable property therefrom. The cost estimates for this particular plan were based on land costs which were derived from Appendix B of Supplement No. 1 to Design Memorandum No. 3 of the Tocks Island project. These costs were: urban land $1,000 an acre; commerical land $500 an acre; recreational land $400 an acre; and rural farm land $200 an acre. Based on the review of the 1974 aerial mosaics, it was determined that there were 1,768 homes or residences within the flood plain. The cost for removal of properties was determined on the basis that the average value per house, (J. P. Mellan report March 3, 1966) would be $20,000. The maximum relocation cost for residences based on the 1972 Uniform Relocation Act would be $15,000 per residence for a total of $35,000 per residence. The total cost for these residential properties in the flood plain would be $61,880,000. The value of commercial and industrial properties that are in the flood plain were obtained from Flood Plain Land Use, Population and Damage Estimates prepared by Michael Baker and Associates which gives a total value of $22,400,000. Also in the flood plain are agricultural areas comprising 2,523 acres which would cost $504,600; woodland areas comprising 2,468 acres for a cost of $493,000; and transportation lands comprising 1,705 acres at a cost of $852,500. This would give a total cost to the removal of damageable property from the flood plain and land acquisition of $86,130,700. This represents about 2.1 times the cost of the allocated flood control storage in the Tocks Island project or 0.32 times the cost of a "flood control only" project at the Tocks Island dam site.

XV.C.8 FLOOD PLAIN ACQUISITION EASEMENT

In lieu of acquiring the flood plain in fee, restrictive easements could be obtained for approximately 10,850 acres (rural and urban) of flood plain lands. Changes to a higher more intensive use of the land would not be permitted nor would new construction be permitted. This plan would involve foregoing components of the total flood control benefits that accrue to the Tocks Island project. The easements, in effect, would be advance payment to land owners to allow flooding to continue and to allow the present level of land use to be continued or reduced to a lower level of economic activity. Considering the type of development in the urban areas the possibility of obtaining flowage easements seems remote. However, this could be implemented in the rural areas where there is not a high concentration of residential, commercial and industrial properties.

XV.C.9 FLOOD INSURANCE

If zoning regulations were implemented by the states or a local unit of government, flood plain residents could qualify for flood insurance on insurable structural items, but agricultural products such as crops and livestock are not insurable under the Federal Insurance Administration program. The Federal Crop Insurance Corporation is authorized to provide crop insurance for specific crops and counties if sufficient interest is shown. The corporation may limit or refuse insurance in any county or area, or on any farms, on the basis of the insurance risk involved. Assuming flood insurance was available and in effect, the damages and costs associated with the recurrence of the 1955 flood would be far greater then the allocated cost of flood control in the Tocks Island Project. The reliability of flood insurance as an alternate to flood control would depend on adequate state legislation. Also it would require action at the local government level for implementation; the option being with the individual on participation in the program.

XV.C.10 FLOOD PROOFING

Flood proofing involves designing or adapting structures and their contents to reduce potential flood damage. These measures include elevation proofing by landfill, raising buildings on "stilts", construction of low flood walls or levees, anchorage of structures, tanks, etc., shields or bulkheads on doors or windows, cutoff valves on sewer lines, etc. Flood proofing of existing structures generally is most effective in preventing losses for the more frequent flood events, as the economic cost of protecting against major flood events becomes disproportionately high. In many instances existing structures do not lend themselves to flood proofing. This is particularly true in rural areas. A combination of floodproofing and flood insurance can be used to reduce property damage and financial loss to existing structures on the flood plain. However, roads, crops, etc. would still be susceptible to flood damage. The reliability of flood proofing as an alternative to flood control storage would be dependent on adequate legislation and enforcement powers to accomplish the task. At present this vehicle is not available. From a cost viewpoint this would be a desirable alternative insofar as structures are concerned. However, as noted above, transportation facilities, crops, etc. would still be vulnerable to floods.

XV.C.11 FLOOD WARNING SYSTEMS AND TEMPORARY EVACUATION

A warning and evacuation system, in addition to the existing emergency procedures, could be developed for the Delaware River Basin. This would serve the purpose of saving lives and allow the removal of some goods, supplies, equipment, and livestock from the flood plain but would leave crops, roads, residences, and other permanent structures subject to flood damage. Public credibility tends to wane with time and the reliability of public response to a warning system could be questionable.

XV.C.12 UPSTREAM LAND USE AND AGRICULTURAL TREATMENT

These measures can be effective in reducing runoff from contributing areas to the individual water courses. This in turn reduces erosion and sediment movement. They are particularly effective for the minor or intermediate size storms. However, for major storms with high intensity rainfall and a large volume of runoff, the retention capability is quickly exceeded in the early portion of the storm and the impact on peak runoff from the watershed is not appreciably affected. Further, the terrain of the watersheds are relatively steep which would required extensive treatment (such as terracing) to be effective. In turn this becomes expensive and, considered on a total watershed basis, the overall costs would be prohibitive.

XV.C.13 RESULTS AND CRITERIA FOR FURTHER ANALYSIS

Review of the above plans indicate that structural measures for single purpose flood control are not economically justified. For purposes of this study, however, as detailed in XVI.A., three plans are considered as useful approaches to meeting the flood control needs of the basin. The first is entirely structural, the second is a combination of structural and non-structural measures and the third is all non-structural measures.

The analysis of non-structural measures must be somewhat hypothetical in light of existing legislation or lack of legislation, changing land use patterns, the impact of the Flood Disaster Protection Act of 1973, which extended the Flood Insurance Program, and the ongoing Flood Plain Management Program under Section 206 of the 1960 Flood Control Act which is administered by the Corps of Engineers. The above, plus other factors have impacted on the land use patterns and development in the flood plain. Therefore the assumption was made that all non-structural measures such as purchasing the flood plain, flood proofing, flood insurance, etc. would be considered as a package and one or more of these measures could be applied to various damage areas. An examination of the flood damage surveys conducted by the Corps of Engineers reveals that approximately 78% of the damages during the 1955 flood were inflicted on residential, commercial and industrial properties. These were considered to be susceptible to a non-structural solution. The balance of the damages were inflicted on roads, railroads, utilities, etc. These were considered as still being susceptible to damage and non-structural measures would not be applicable. The consultant considers that the damage relationship has not appreciably changed in the interim based on examination of the 1974 aerial photography. For the purpose of this analysis the total property value in the flood plain was adopted as developed in Section XV.C.7., or about $86,100,000. Therefore at the current time 78% of this or some $67,000,000 of damageable property in the flood plain would be susceptible to non-structural measures. Further, based on very limited information it was estimated that on the average the overall cost of non-structural measures would be equivalent to 25% of the value of the property involved. The 25 percent value reflects the consultants observations of situations where non-structural measures have been applied. For this study it was assumed 20 percent of 1783 residences in the flood plain would be purchased and residents relocated. The remaining properties would require some type of flood proofing. The cost of flood proofing commercial property would equal 10 percent of the total value. Also, some rural lands would be acquired in fee or flowage easements taken. The time frame to implement non-structural measures was considered as being equivalent to the time allotted for the construction period for structural measures. For this analysis, this was considered to be 10 years. Based on these premises the following three plans were derived.

XV.C.14 STRUCTURAL PLAN

This plan provides positive control for the floods of record at the major urban damage centers and would be a "flood control only" (dry reservoir) project at the Tocks Island site. The top of the flood control pool would be at elevation 394 feet mean sea level (See Sec. XV.C.3.), and provide storage equivalent to the flood control provided by the Corps of Engineers in the multi-purpose project outlined in General Design Memorandum, Number 3, July 1969. This plan would have a first cost of $325,700,000 with annual charges of $19,200,000 and benefits of $2,517,000, with a benefit-cost ratio of 0.13. This plan would reduce average annual damages about 60%. The objective of the dry lake alternative would be to provide the same degree of flood protection as the authorized project leaving the stream above the dam site free from a permanent impoundment. A dry lake would impound floodwaters behind the dam and discharge flood water at a non-damaging rate not to exceed 700,000 c.f.s. A significant environmental impact centers around the lake area rather than downstream. In a dry pool operation the lake would be drawn down to a minimum elevation the majority of the time. Since less storage capacity per foot of height is available at lower pool levels, the dry pool project would fluctuate more than the authorized project. This would be true with the same amount of inflow and releases. Therefore, the dry pool project would permit a maximum pool fluctuation of about 90 feet and intermittant inundation of about 10,295 acres. It should be noted that about 2000 acres or 20 percent of this land is occupied by the river at the present time.

A most proper concern, however, is the frequency with which the 70,000 cfs flow, which can be freely passed, occurs. Peak discharge frequency information of the Corps of Engineers indicates that a 70,000 cfs flow at the Tocks Island location may be exceeded to some degree, for a limited length of time, approximately once a year. However, in most years this typical annual storm would not create a significant area of actual flood water impoundment or land inundation.

In general corroboration of this, the 500 years of synthetic stream flow information developed for the salinity instrusion analysis indicates that the maximum monthly flow at Montague is 32,000 cfs. The Tocks Island flow corresponding to this figure is approximately 40,000 cfs. A review of stream flow information for the 1963-1972 period reveals that the maximum daily flow (24 hr. average) was 1.9 times its average monthly flow. Based upon the foregoing data, the maximum daily flow over (24 hrs.) at the Tocks Island site could be roughly 76,000 cfs. This level of maximum flow has not persisted for more than a single day over the decade examined and the next highest daily maximum flow figure is significantly less. It could, of course, be substantially exceeded for periods under 24 hrs. duration.

Therefore, since the 70,000 cfs. flow is within 10% of flows which only occur extremely infrequently, it appears likely that the frequency and extent of inundation behind the dry dam will not interfere with the recreational use of that area.

While the appearance of the occasionally inundated area will be adequate for recreational purposes, an ecosystem continually subjected to prolonged major changes from aquatic to terrestrial conditions because of fluctuating pool stages is unlikely to ever develop the diversity, stability or aesthetically pleasing appearance of either an aquatic or terrestrial system.

XV.C.15 COMBINATION PLAN STRUCTURAL AND NON STRUCTURAL

The structural portion of this plan would consist of the system of reservoirs as outlined in Plan II of Section XV.C.2 above. As noted the total first cost of the structural plan is $159,400,000. The annual charges for the system would be $9,397,000, with annual benefits of $1,754,000 and a comparative benefit-cost ratio of 0.19. The non-structural portion of this plan would consist of a combination of all non-structural techniques as discussed in Section XV.C.13. The structural portion of this plan will prevent about 44% of the average annual flood damages. Based on the rationale in Section XV.C.13, the remaining 56% of the property in the flood plain would be valued at about $48,000,000. Using the 1955 distribution of flood damages, 78% of this amount would be susceptible to non-structural techniques or $37,700,000. The cost of the non-structural techniques based on 25% of the property value involved gives a first cost of $9,400,000. With implementation over 10 years, average annual charges would be $1,270,000 and benefits $1,740,000.

A flood control program using both structural and non-structural measures is flexible and adjustments can be made over time if some elements of the plan are not functioning properly.

As noted above, when considered in light of providing the same degree of structural protection as Tocks Island, this plan has drawbacks. However, when one considers providing a smaller degree of positive flood control and utilizing non-structural techniques in conjunction with the upstream projects, the basin flood control needs (this includes damages both up and downstream from the Tocks Island site) are essentially met and average annual damages may be reduced up to 78%. As noted for the structural plan, Section XV.C.14., the dry pool operations of this system of reservoirs would be subject to the same maximum pool fluctuation with attendant impacts in the reservoir areas. Collectively the reservoirs would have about 8300 acres which would be subject to intermittent inundation. Apparently non-structural measures have already had some degree of success in such areas as Burlington, New Jersey and in other jurisdictions. State and local governmental entities have been and are continuing to be encouraged in the non-structural approach. However, there are apparent deficiencies in overall enabling legislation and in the local capabilities to fully implement the non-structural approach throughout the basin at the current time.

XV.C.16 NON STRUCTURAL PLAN

This plan would consist of a combination of the non-structural techniques discussed above. Again using the 1955 flood damage distribution, 78% of the total value of property in the flood plain would be susceptible to the non-structural approach; or about $67,000,000. Assuming it would cost 25% of this value to implement the non-structural approach gives a total first cost of $16,800,000. Considering a 10 year period to implement the plan, the average annual charges would be $2,270,000. The average annual benefits would be $3,077,000.

This plan could serve the needs for flood control, eliminating some 78% of the damages in the downstream reaches. However, as noted in the combination plan of structural and non-structural measures there is a deficiency in enabling legislation and local capabilities to fully implement the non-structural approach. The major advantage of this plan is that no major construction would be required and there would be no long term operational impacts. Some relocation and local construction would take place. Environmentally this plan would be the least harmful and presumably some corridor-type recreational areas would develop as the plan became implemented.

XV.C.17 CONCLUSIONS

Any conclusions drawn here regarding non-structural measures must reflect the hypothetical methodology utilized in deriving costs and benefits. Further, the implementation time for the measures can be considerable even after adequate legislation becomes available and local ordinances are adopted. In some instances there will be variations between local ordinances and enforcement policies which would preclude uniform results throughout an extensive area. The flood insurance program is somewhat illustrative of this when one considers exceptions to the established uniform regulations which are requested by individual communities.

Also some communities that were in the insurance program have been excluded because of lack of public acceptance and no action at the local level.

Consideration must also be given to future non-structural measures that may take place during the interim period or until a firm plan of action is adopted and the attendant reduction of benefits that would be assignable to upstream structural measures.

Review of the various <u>single purpose</u> flood control plans as analyzed above indicate that non-structural measures present the only approach that will show economic justification. The number of combinations of structural and non-structural alternatives that could be analyzed, are almost infinite. However,even on cursory examination, it becomes obvious that the benefit-cost ratio for the structural portion of any of them will be less than unity. Ignoring the economics and considering only the physical impacts on flood reduction in the major damage areas, then levees and flood walls could be utilized for the major urban damage centers. There would be no basis for federal participation in such a plan because capitalized costs would exceed damages prevented. Given the same basis, the possibility of construction by local entities would appear remote, except in very limited areas. Another factor in this approach is that the needs in other areas of the basin would not be satisfied and damages would continue.

When considering structural solutions such as dams, the plan exercising positive control over the most drainage area upstream from the major damage sources will be most effective. The dry lake at the Tocks Island site would be the most effective from this standpoint. When one considers a series of smaller dams on tributary streams scattered throughout the basin, it is impossible to obtain an equivalent degree of positive control as that provided by one large mainstem reservoir. The probability of a storm pattern occurring downstream from a series of dams, such as the incident that occurred at Rapid City, South Dakota (See Section XV.B.2 para. 4) is greatly increased as compared to the one downstream reservoir.

When considering less flood control storage than that provided in the Tocks Island project as detailed in Design Memorandum No. 3, General Design Memorandum, July 1969, residual damages in downstream reaches increase, which results in non-structural measures being utilized with the upstream plan, if an equivalent degree of protection is provided. The non-structural approach can be very effective in reducing damages and costs and would be comparable with results obtained by structural measures. However, the vehicle to implement these measures is not available at the present time. Also the limit of federal participation in the strictly non-structural approach or the combination structural and non-structural alternative has not been clearly defined.

Chapter XVI

DEVELOPMENT AND EVALUATION OF ALTERNATIVE PROGRAMS

The objective of this study is to analyze the water and related demands to be placed upon the resources of the basin and to identify and evaluate the alternative courses of action available to meet or modify them. The determinations and assessments of these alternative courses are presented in this chapter and consider the full range of economic, environmental, land use, public service, social and institutional impacts which will result from the implementation of each course of action. It is to be emphasized that each category of impact must be reflected in any overall judgments; one technical discipline or evaluation must not predominate. This study thus assembles and develops the information and supplies the perspective required to permit recommendations to be made to the Congress as to whether or not the Tocks Island Project should proceed to construction, be modified, be deferred, or be deauthorized.

XVI.A. PROGRAM DEVELOPMENT AND SELECTION

XVI.A.1. TECHNICAL ALTERNATIVES' SELECTION AND EVALUATION PROCEDURE

The process by which viable technical alternatives were determined, and the detailed evaluations of these alternatives in each of the four "authorized purpose" areas of water supply, recreation, electric power and flood control, is presented in the preceding four chapters, XII through XV. The full range of possible technical alternatives in each of the four pertinent areas were examined with respect to the levels and characteristics of need ascertained in Part A; output levels comparable to the Tocks Island Lake Project; and output levels of a lesser magnitude than that which might be supplied by the Tocks Island Lake Project. The identification and review of this full range of technical alternatives was based upon an examination of previously developed information and studies; many interviews with appropriate government officials, experts and other knowledgeable individuals; a thorough review of relevant professional literature; and the professional judgment of the Consultant's staff.

The next major step in the development of the viable technical alternatives was the preliminary evaluation of all the foregoing alternatives and the discarding of those alternatives which are clearly technically unsuitable or of doubtful effectiveness. Documentation of this phase of the Consultant's work is contained in the transcript of the March 6th meeting of the Study Management Team and in written material distributed at that and other Study Management Team meetings. The documentation notes the specific alternatives discarded and the reasons for which they were dropped from further consideration in the study process.

After the completion of the preliminary evaluation, more detailed evaluations were undertaken of the remaining alternatives. The results of these general or detailed evaluations for each of the remaining alternatives is, as noted previously, presented in Chapters XII to XV.

The foregoing alternatives were studied with respect to their technical feasibility and examined also with regard to such considerations as costs and benefits, environmental impacts, land use and transportation effects, and socio-economic impacts. The alternatives adjudged to be viable after the obviously unsuitable ones were discarded and others were put aside for present study purposes are the "building blocks" for the alternative programs to be analyzed in further detail in this chapter.

XVI.A.2. PROGRAM DEVELOPMENT PROCEDURE

To properly fulfill the stated study objectives, it is necessary to combine the technical alternatives into programs which possess merit, can be compared or contrasted to the Tocks Island Project, and are consistent with the various governmental or broad policy viewpoints that may be utilized as the basis for evaluating the Tocks Project and deciding upon the course of action to be taken regarding it. The range of possible policy viewpoints fall into three categories.

The first category of program formulation objectives is based upon various output or cost levels of possible alternative programs to the Tocks Island Lake Project. One objective in this category is for the selected alternatives to provide an output comparable to that which could be furnished by the proposed Tocks Project. This assumes that the decision makers will feel that that output level is appropriate to meet present and future water related needs of the Delaware River Basin and related service areas. A second and alternate policy objective is that the output to be provided by an alternative program be significantly less than that provided by Tocks. It is reasonable for decision makers to hold this point of view if they feel that the needs of the Basin do not approach the outputs provided by the Tocks Project. A third policy objective in this category is for the minimizing of costs to be an overriding factor in the selection of technical alternatives to the Tocks Project. This policy objective assumes that the water related needs of the Basin area are either not clear-cut or that the drawbacks to not meeting these needs are not serious enough for substantial expenditures to be incurred.

A second category of policy or program formulation objectives relates to consistency with various desired economic growth levels. In this category, decision-makers would select technical alternatives and alternative programs based upon needs associated in their minds with various desirable levels of economic activity for growth. Viewpoints in this category bypass the outputs and characteristics of the proposed Tocks Island Project and address directly the technical needs related to a specific economic policy.

The first policy objective in this category is concerned with maximizing economic growth. A decision maker under this policy would select alternatives consistent with or acceptable to that purpose, based either upon estimates of specific need associated with a certain maximum level of activity or upon the need not to preclude a high level of services or activities from being provided. A second policy viewpoint in this category is that associated with a minimum or low economic growth level. The alternatives selected to be consistent with this objective could differ significantly both in character and in degree of output or implementation from alternatives appropriate for or consistent with other economic growth levels. A third viewpoint in this category is an objective in between the two preceding ones in which alternatives are judged on their consistency or acceptability to an intermediate level of economic growth.

A third category of program formulation objectives is related to environmental conservation. The single objective in this category is based upon the maximization of environmental conservation goals and measures. Alternatives would be considered consistent with or acceptable to this viewpoint based primarily upon the nature and degree of environmental impacts associated with each.

Table 16-1, "Development of Alternative Program", outlines the relationship between the various viable alternatives developed in Chapters XII through XV and the program formulation objectives which were discussed above. The seven columns of the table correspond to the foregoing program formulation objectives and categories. The horizontal rows are technical alternatives found to be basically viable.

An "acceptable" mark at the intersection of a row and column indicates that that technical alternative is considered to be consistent with the program formulation objective at the top of the column. There is no ranking or degree of acceptance implied in this

TABLE 16-1: DEVELOPMENT OF ALTERNATIVE PROGRAMS

PROGRAM FORMULATION OBJECTIVES

FUNCTIONAL AREAS AND TECHNICAL ALTERNATIVES		OUTPUT/COST LEVELS: 1 Output Comparable to TILP	2 Output Less Than TILP	3 Minimum Cost	ECONOMIC GROWTH LEVEL: 4 High	5 Low	6 Intermediate	ENVIRONMENTAL CONSERVATION: 7 Maximum	PROGRAMS: Alternative A (1&4)	Alternative B (2&6)	Alternative C (3,5&7)
ELECTRIC POWER	Gas Turbine	○	○		○	○	○	○	○	○	
	Combined Cycle	○	○	○	○	○	○	○	[○]	[○]	[○]
	Fuel Cells	○	○	○	○	○	○	○	○	○	
	Other Pumped Storage	○	○	○	○	○	○		○	○	
WATER SUPPLY	Maintainance of Phila./Camden System at Low Flow		○	○		○		○			○
	Reservoirs on Tributaries		○				○	●		[○]	
	Combination of Above	○	○		◎	○			[○]		
RECREATION (ASSUMES DWGNRA WITHOUT TILP)	'Piggy Back' Facilities		○		○		○			○	
	State Parks and Programs	○	○		○		○		[○]	○	
	Opening Closed Reservoirs		○	○	○		○			[○]	
	More Swimming Facilities Closer to Pop Cntrs	◎	○		○			○	○		
	More Use of Existing Facilities		○	○	○		○			[○]	
	More Intensive Use of DWGNRA W/o TILP		○		○			●			
	No Public Programs	●	○	◎	●	◎		◎			[○]
FLOOD CONTROL	Dams on Tributaries		○	◎			○			○	○
	Levees Around Major Damage Centers		○					○			
	Construction of 'Dry' Dams		○					●	[○]		
	Non structural Combinations		○	○		◎	○	◎		○	[○]
	Structural/Non structural Combinations	○	○				◎	○		[○]	
	Structural Combinations	◎	○		○		○		○	○	

LEGEND

- ○ Acceptable
- ◎ Very Acceptable
- ● Definitely Not Acceptable
- [○] Included in Alternative Program

notation, it merely indicates which specific technical alternatives will probably be acceptable to that objective. The other marks, as indicated in the legend in Table 16-1, note whether or not an alternative is particularly acceptable or not acceptable with respect to a policy objective. The absence of a mark at the intersection of a column and row is not intended to imply non-acceptability, but merely to indicate that for present purposes that technical alternative cannot be assumed to be consistent with the specific policy objective of that column.

As shown in Table 16-1, virtually all of the electric power alternatives are consistent with all of the seven policy objectives. One exception to this is that the gas turbine alternative has a higher unit cost than the other alternatives. It was, therefore, considered to be not completely consistent with the minimum cost policy objective since the electric power alternatives are only to supply peaking power for a limited number of hours per year.

The other exception is that the pump storage alternative may not be acceptable to many environmental viewpoints since it is site-specific and in many cases sites for this purpose may be sensitive to environmental problems and concerns.

With respect to water supply, it is necessary for both of the viable alternatives noted to be employed in order to furnish an output roughly comparable to that which could be provided by the Tocks Project. The reservoirs on various tributaries of the Delaware River, as outlined in Chapter XII, could provide roughly the water supply output of the Tocks Project. For an output less than TILP, the tributary reservoir water supply alternative could be acceptable by itself. The minimum cost policy objective furnishing a lesser level of output than the above could be fulfilled without the implementation of a specific alternative to the Tocks Project.

The adoption of a higher economic growth strategy might require a higher level of water supply. The combination of both the viable water supply alternatives noted is thus consistent with this policy objective. A "low growth" policy objective could be met by implementing some of the other lesser water supply projects noted in Chapter XII and an alternative consistent with an intermediate level of economic growth would be that of constructing reservoirs on some Delaware River tributaries.

Because many otherwise desirable locations suitable for reservoirs on the tributaries may be environmentally sensitive and unique, this water supply alternative is not considered to be generally consistent with an environmental conservation policy viewpoint.

The substantial recreational capacity of the proposed Tocks Island Lake Project can only be roughly equalled by a major expansion of the state parks system and related programs or by a major program of construction of numerous swimming facilities in many parks closer to population centers throughout the recreational service area. The "piggybacking" of recreational facilities on top of other projects, the opening of closed reservoirs to recreation, the intensification of the use of DWGNRA without TILP and the greater use of existing facilities each individually are not likely to be able to provide the recreational capacity of the proposed Tocks Island Lake Project and its associated DWGNRA. The selection of the alternatives involving no public programs, except for the construction of DWGNRA without the Tocks Lake, is not acceptable from a policy viewpoint that is based upon providing outputs comparable to DWGNRA with TILP.

From the point of view of a policy maker who wishes to provide an output less than that contemplated by the proposed Tocks Island Lake Project, most of the recreational alternatives could be implemented to be consistent with this outlook. The alternatives acceptable to a "minimum cost" policy would be those in which the bulk of the costs have already been incurred. The opening of closed reservoirs and the greater use of existing facilities would be consistent with this objective. Having no public programs at all would be very acceptable from this viewpoint.

Where maximizing economic growth is of paramount concern to a policy maker, any of the recreational alternatives, as indicative of positive action, would be acceptable either singly or in combination. Where low economic growth could be a policy objective, the "no public program" alternative would be appropriate. For an intermediate level of economic growth the appropriate recreation alternatives are those involving specific actions in portions of the recreational service area not already provided with an existing broad distribution of facilities. The recreation alternatives consistent with environmental conservation viewpoints would be those that did not disturb the environment or general character of the Basin. The alternatives meeting this requirement would be those locating swimming facilities in many parks closer to population centers, i.e., outside the Basin generally, or not providing for any public programs at all. The more intensive use of the National Recreation Area without a lake would not be acceptable to this viewpoint, as it would impose significant impacts on the Delaware River area's natural resources.

Flood control alternatives which are acceptable to the policy viewpoint governing the first column are those structural or combined structural and non-structural measures which will provide flood protection comparable in character and level to that of the Tocks Island Project. The type of output is particularly significant here since the benefits to be realized by many non-structural solutions do not prevent damage, but only reimburse people who have suffered damages. The latter condition, even while it may be of comparable economic soundness, would not normally stimulate economic development to a comparable degree because people may not wish to build something if it is going to be damaged by a flood, even if they are fully insured. For an output or degree of protection less than that contemplated for the proposed Tocks Island Project, any of the viable alternatives noted could be appropriate, either singly or in combination. With respect to minimizing cost as a paramount policy objective, there are two viable alternatives which are consistent with this objective, though they provide significantly lower output. Dams on tributaries can provide some positive flood protection benefits, and nonstructural combinations, such as flood insurance and aspects of flood plain management, can be implemented to a moderate degree at a low cost.

The flood control alternative that is consistent with a policy of high economic growth is one which combines structural measures to provide a high degree of positive flood protection. A combination of nonstructural alternatives is consistent with a low economic growth policy, while a combination of both structural and nonstructural measures is considered to be generally consistent with an intermediate growth level.

The major structural alternatives involving dam construction would not be consistent with the point of view emphasizing environmental conservation. Dry dams, particularly on the main stem, would cause periodic inundations which would harm the environment in flooded areas. Nonstructural combinations that do not involve any significant construction would therefore be most consistent with this viewpoint.

Other policy viewpoints besides those discussed above and noted in Table 16-1 are those related to geographic areas. They are often, of course, similar to one or a combination of the preceding objectives. While it is somewhat presumptuous to over-generalize and indicate which technical alternatives may be acceptable or unacceptable to majority viewpoints in geographic areas, it is, nevertheless, useful for present discussion purposes.

The seven-county primary impact area is considered to favor, generally speaking, a low and controlled economic growth with an emphasis on the conservation of environmental resources. The technical alternatives acceptable to such a viewpoint would, therefore, be those that were acceptable to the low economic growth and maximum environmental conservation viewpoint discussed above. Broad policy viewpoints of New Jersey might also be generally comparable to those of the seven-county area, except that reservoirs on tributaries for water supply and the greater use of state parks and other existing facilities for recreation would probably also be consistent with their overall outlooks.

New York and Pennsylvania would generally consider any of the technical alternatives noted to be acceptable, except that New York might have reservations concerning the opening of closed reservoirs, and Pennsylvania might have reservations concerning the construction of dry dams, which would imply a lower priority on the development of new water supply sources, and the use of tributary reservoirs in Pennsylvania to supply New Jersey's water needs.

Regional and national viewpoints would not add any significant number of constraints to the selection of alternative programs. A regional viewpoint might not select the recreational alternatives developing the National

Recreation Area more rapidly than its infrastructure or support needs. Both regional and national viewpoints, being oriented towards the provision of recreational facilities, might not be consistent with a lack of new public recreation programs; and both regional and national viewpoints, for the same reasons, might not favor the construction of single-purpose dry dams when the possibility of multi-purpose facilities including recreation or water supply purposes is practical.

XVI.A.3. SELECTED ALTERNATIVE PROGRAMS

The information presented above and summarized in the first seven columns of Table 16-1 regarding the acceptability of various technical alternatives to possible policy objectives is consolidated in the "Alternative Programs" columns of Table 16-1. Alternative Program A represents the mix of technical alternatives found to be acceptable under the policy headings of columns 1 and 4. This program is thus composed of alternatives which could be selected by policy makers intent on providing an output comparable to the proposed Tocks Island Project, selecting alternatives which will not preclude a high rate of economic growth, or both.

Alternative Program B includes those technical alternatives which are viable but will provide an output somewhat less than that of the proposed Tocks Island Project (column 2) and are consistent with an intermediate level of economic growth (column 6).

Alternative Program C reflects the technical alternatives that would be desirable from a viewpoint of minimizing cost, being consistent with a low economic growth policy, or being acceptable to environmental viewpoints (columns 3, 5 and 7, respectively).

Generally, one alternative in each of the four technical areas is included in each of the three program columns. It is not possible to combine the programs into a smaller number since, even if the same alternatives were consistent with two programs, the degree or level of their implementation or output would be different. Since the costs, benefits and impacts are often dependent as much upon the degree of implementation as on the specific alternatives selected, the three alternative programs are all required for evaluation and comparison with TILP.

It is evident from the information presented and outlined in Table 16-1 that a limited number of alternative programs to the Tocks Island Project can be formulated and that these reflect virtually the full spectrum of possible policy views regarding potential alternatives to the Tocks Island Project. The specific viable technical alternatives included in each of the programs are noted in Table 16-1 and are reviewed here.

It is to be emphasized again that these alternative programs are basically intended to permit a full evaluation of the Tocks Island Lake Project and thus are only representative of the range of viable alternatives to it. There are many other alternative programs of comparable merit but their costs, benefits, impacts, and acceptability to various policy objectives would not vary sufficiently from those selected to appreciably improve the comparisons and evaluations of the Tocks Island Project. This is consiscent with the overall study objectives outlined on page XVI-1.

XVI.A (a) Alternative Program A

The electric power alternative selected for inclusion in Alternative Program A is that based upon the use of combined cycle power generation. This was selected because it appears that this electric power alternative will be attractive to utility companies over a wide portion of the possible load spectrum. That is, for the number of hours per year such peaking capacity will be utilized, the combined cycle units appear to be practical. There are some environmental concerns associated with combined cylces, although somewhat less than with pumped storage, and there is no doubt about its being an operational system. The output level is approximately 1,300 MWe, which is comparable to that for the proposed Tocks Island Project.

The water supply alternative selected for inclusion in Alternative Program B is a combination of reservoirs on Delaware River tributaries and the protection of the Philadelphia/Camden water supply system during low flow periods. These reservoir locations could be at Hackettstown, McMichael, Shohola Falls, Girard, Tobyhanna, Hawley and Lackawaxen. Protection of the Philadelphia/Camden system will be by temporary means to be implemented only when an extended period of low flow is imminent.

The recreation alternative selected for inclusion in Alternative Program A is the expansion of state park systems and programs together with the DWGNRA without the Tocks Lake. This expansion of facilities and capacities can be accomplished through the construction of a series of new riverfront, regional and metropolitan parks. The capacity or output so provided could range from 2,000,000 to over 6,000,000 visitors per year, and depending upon the number of parks programmed, be roughly comparable to the difference between the National Recreational Area with and without the Tocks Island Lake.

The flood control alternative selected for inclusion in Alternative Program A is a "dry" dam on the mainstem of the Delaware River at the location of the proposed Tocks Island dam. It would permit the normal range of river flows to pass freely, however, and have storage for flood control purposes only. The overall flood protection would be comparable to that of the proposed Tocks Island Project; the inundation of extensive areas behind it would be quite infrequent, and these areas would generally be usable for recreational purposes.

XVI.A.3(b) Alternative Program B

The electric power alternative included in Alternative Program B is also that based upon the use of combined cycle systems. The output of the electric power alternative is held at the 1,300 MWe figure for all three of the alternative programs as the unsatisfied needs over most of the forecast period substantially exceed this amount of output under the various economic growth levels and likely future conditions.

The water supply alternative under Program B consists of reservoirs on tributaries of the Delaware River, as under program A. The yields of these reservoirs will total roughly half of that which could be supplied for all purposes by the proposed Tocks Island Project.

The recreation alternatives included in Alternative Program B, besides DWGNRA without TILP, are the opening of closed reservoirs, specifically in the Pequannock watershed in New Jersey, and the greater use of existing recreational facilities throughout the recreation service area, such as Beltzville State Park in Pennsylvania, Harriman State Park in New York, and Wawayanda State Park in New Jersey. Again, the implementation of these measures should provide for roughly half of the recreational capacity of that attributable to the proposed DWGNRA with the Tocks Island Lake.

The flood control alternative in Alternative Program B is a combination of both structural and nonstructural measures. The flood control reservoir locations in this program could be at Flat Brook, Bridgeville, Sterling, Hawley, Girard, Shohola Falls and McMichael. The last four of these locations, at Hawley, Girard, Shohola Falls and McMichael, would be multi-purpose facilities for both water supply and flood control purposes. The nonstructural measures in this program will include an appropriate combination of insurance and flood plain management measures such as those discussed in Chapter XV. These should include physical modifications such as flood walls around structures and the flood-proofing of buildings. While these last noted points are physical rather than institutional, they are considered as parts of broader nonstructural flood control programs.

XVI.A.3(c) Alternative Program C

The electric power alternative selected for inclusion in Alternative Program C, as previously noted, is the use of combined cycles. The output of this capacity included in the program is 1,300 MWe.

No specific water supply alternative to the Tocks Project was selected for inclusion in Alternative Program C because the relatively low unsatisfied water supply demand forecasted for "low growth" conditions can be met through the staged development of some of the lesser size projects noted in Chapter XII.

The recreation alternative included in Alternative Program C is that which assumes no public recreation programs will be undertaken within the service area except for the development of the DWGNRA without the Tocks Lake.

The flood control alternative selected for inclusion in Alternative Program C is the combination of nonstructural measures, such as those outlined in Chapter XV, implemented to a substantial degree. These would include a range of insurance, flood proofing, zoning and other aspects of flood plain management.

XVI. B. ECONOMIC EVALUATION OF T.I.L.P. AND ALTERNATIVE PROGRAMS

The original and continuing economic evaluations of the Tocks Island Lake Project (TILP) by the Corps of Engineers have been the focus of major discussion on the overall project, particularly as it relates to the benefit-cost analysis. The Corps' economic evaluation procedures were first reviewed in the Part B submittal of this study and were found to have been carried out generally in accordance with the adopted policies and guidelines of the Federal Government.

The purpose of this section of Chapter XVI is to provide a basic understanding of the Corps' benefit-cost methodology and to review and evaluate the costs and related economic data for the TILP and the alternative programs developed by the study team in Chapters XII through XV. In addition to the comparative analysis of economic data this section will also summarize and ev. .ate the primary and secondary economic impacts resulting from TILP and the alternative programs.

The Corps' benefit-cost methodology is given extensive consideration in order to provide the reader with a general understanding of the methodology and the major areas subject to criticism. This is necessary because of the complexity of the separable cost-remaining benefit (SCRB) method of analysis for multiple-purpose projects. As the ensuing discussion shows because the alternatives to the various Tocks project purposes selected for analysis are basically single-purpose projects, the SCRB methodology can be applied only with substantial limitations as a public policy tool.

It must be noted however that the current state of the art does not provide a viable alternative. The new Principles and Standards drafted by the Water Resources Council provide guidelines for a more thorough and comprehensive basis for benefit-cost analysis, however, they have yet to be operationalized and therefore cannot be fully incorporated into this analysis. Application of the principles and standards to COE-TILP would probably not greatly affect the results of the economic analysis.

Based on cost and benefit inputs provided in Chapters XII-XV, an alternative method of analysis has been developed which provides, in a general way, a relative comparison between TILP and the alternatives. This evaluation is specifically designed to aid the public policy-maker and concerned citizen in understanding the economics of the TILP and the suggested alternatives. This section of Chapter XVI is organized in four parts which include the following:

1. Background and Theory of Benefit-Cost Analysis
2. The Corps of Engineers' TILP Benefit-Cost Analysis
3. Comparative Evaluation of Costs and Related Economic Data for TILP and Alternative Programs
4. Primary and Secondary Economic Impacts

XVI.B.1. BACKGROUND AND THEORY OF BENEFIT-COST ANALYSIS

Benefit-cost analysis can be generally defined as the quantitative examination of alternative prospective systems as to the potential trade-offs with regard to the benefits, or effectiveness, to be gained and the costs to be incurred along with the alternatives for the purpose of identifying the preferred system and its associated equipment and product. Benefit-cost analysis is, therefore, concerned with the economic evaluation of various alternative courses of action. Decisions regarding some expenditures need to be made far in advance of their products becoming operational, and faced with the traditional task of maximization of output from limited resources, planners and policymakers need to know the probable outcome of their actions.

This type of analysis has been applied to national water resource programs as far back as the late 1930's. As a distinct field of research though, it has only been in general use since the 1950's. By the mid-fifties an interagency task force had succeeded in standardizing most of the analytic programs and procedures applicable to water resources development. In the late 1950's, books by Otto Eckstein, Roland McKean and John Krutilla succeeded in refining the conceptual and empirical issues in water resource project evaluation and laid the base for a reserved theory of benefit cost analysis among economists.

Application to military problems has been a major driving force in the development of sophisticated techniques. Termed "cost-effectiveness analysis": and "systems analysis", it has been used in the analysis of various weapons systems and strategies being developed for the armed forces. The Rand Corporation and the Department of Defense have been influential in the development of most of the techniques used in modern-day applications.

The benefit cost analysis is comprised of five basic steps which are as follows.

1. Identification of primary purposes.
2. Description of alternatives.
3. Expressions of benefits and costs as characteristic of each alternative.
4. Estimation of appropriate values where data is lacking.
5. Computation, analysis, and presentation of results.

The information that results from this series of steps can be utilized in several major ways. The data can aid decision-makers in making the best choice among alternatives. It can point up the trade-offs between project purposes and tangible and intangible consequences. Benefit-cost analysis indicates the operating characteristics of the various alternatives where risk, viability and different distributional impacts exist. Areas where further study or development funds could reduce overall costs or improve project performance are highlighted. Potential use of components or alternative systems can also be indicated.

In summary, the benefit-cost analysis is essentially an investigation of any proposed project's economic soundness. The ratio that is the end result of the analysis provides some indication of the amount of social return per dollar invested that could be expected if a project were to be constructed. The benefit-cost analysis methodology currently used by the Corps of Engineers is basically the result of four years work in the late 1940's, by the Sub-Committee on Benefits and Costs of the Federal Inter-Agency Basin Committee. Prior to the 1950's, federal government expenditure programs rarely had a benefit-cost analysis performed either before the program was established or while it was in progress. This neglect was due primarily to a lack of readily accessible information about the composition and incidence of public programs. Also hampering the development of analysis were the problems caused by the extreme lack of appropriability inherent in public goods and presumed to characterize public works projects, plus the difficulties encountered in attempts to assign some market value to the impacts that are characteristic of public expenditure programs.

XVI.B.1(a) Application of Benefit-Cost Methods by the Corps of Engineers

One exception to this generalized non-use of economic analysis was the Corps of Engineers. The Corps has been required by the Flood Control Act of 1936 to evaluate the benefits and costs of all their projects "to whomsoever they accrue." Presumably the basis for this requirement was the desire that the Corps public works projects would provide a stimulus to the economy. While the Corps early analytical work lacked conceptual and empirical sophistication, it did serve to awaken and stimulate an interest in the development of an improved methodology.

In 1946 the sub-committee began its investigation of the various procedures that were being used in the early public sector cost-benefit analysis. The Inter-Agency River Basin Committee adopted and published the committee's findings in 1950. The resulting series of guidelines were little used until they were revised by the Sub-Committee on Evaluation Standards of the Inter-Agency Committee on Water Resources. Entitled Proposed Practices for Economic Analysis of River Basin Projects, the report was reissued in May of 1958. Known in government circles as the "Greenbook", it was the first officially accepted guidebook on benefit-cost proceedings. The "Greenbook" was the guideline document in force when the Tocks Island Lake project was first initiated.

The "Greenbook" was the accepted source until October of 1961 when a memorandum from President Kennedy to the Secretaries of the Departments of the Army, HEW, Agriculture and the Interior stated the need for an "up-to-date set of uniform standards." Acting as a result of this memorandum the four Secretaries who would comprise the Water Resources Council drafted a document with revised procedures. Entitled Policies, Standards and Procedures in the Formulation, Evaluation and Review of Plans for Use and Development of Water and Related Land Resources, it became the official guideline after its approval by the President on May 15, 1962. Commonly known as "Senate Document 97", its purpose was to serve as a technical handbook on benefit-cost analysis for water resource development projects.

In 1964, Senate Document 97 was expanded and annotated by the adoption of Supplement Number 1, also the result of a memorandum by President Kennedy, this time requesting the development of standards for the measurement of fish, wildlife and recreation benefits. Entitled Interim Evaluation Standards for Primary Outdoor Recreation Benefits, the supplement specifically deals with the evaluation of outdoor recreation costs and benefits within the overall procedures developed in Senate Document 97. The procedures outlined in the "Greenbook" and subsequently in Senate Document 97 and Supplement Number 1 constituted the methodology for the original economic analysis performed for the Tocks Island Lake Project. Senate Document 97 and Supplement Number 1 served as the accepted set of guidelines for river systems planning for the next ten years.

In October of 1973 the Water Resources Council adopted a new policy regarding analytical procedures for river systems planning. Published under the title Water and Related Land Resources: Estab--shment of Principles and Standards for Planning, this document represents the most up-to-date approach to benefit-cost analysis of water resources projects as performed by the Corps and other federal agencies. While basically an updated and revised continuation of the procedures outlined in S.D. 97 and Supplement Number 1, the effects of environmental impacts and secondary benefits on the benefit-cost ratio (BCR) have, for the first time, been officially recognized. Unfortunately these principles and standards have not been operationalized in the form of official "procedures" for evaluating current Federal projects including those of the Corps of Engineers.

The Tocks Island Lake Project was originally authorized by Congress in 1962, about 11 years prior to the conformance date set by the Water Resources Council for implementation of their principles and standards. Therefore, the Corps of Engineers has decided to officially "grandfather" the TILP as provided under the principles and standards which state in part, "For authorized but unfunded projects the principles and standards will be applied on a selective basis to be determined by the head of the Agency..." The Corps' reason for "grandfathering" the TILP is that to meet the test of the principles and standards would require a complete new project formulation plan and reauthorization by Congress, all of which would require extensive delays to a project that is now over fifteen years in the making.

The WRC principles and standards represented a move to shift the accounting stance used in benefit-cost analysis from a national to a regional basis and consequently to elevate regional benefits and income redistribution to primary status. The final version holds to a national accounting stance and subordinates the role of regional benefits and costs in project evaluations while at the same time preserving the information for those who would like to know. Discussion of the regional accounting issue is to be found in Jack L. Knetsch et.al. Federal Natural Resources Development: Basic Issues in Benefit and Cost Measurement, Natural Resources Policy Center, The George Washington University, Washington, D.C., May, 1969, and Robert J. Kalter et. al. Criteria For Federal Evaluation of Resource Investments, Water Resources and Marine Sciences Center, Cornell University, Ithaca, August, 1969.

The environmental account to be incorporated into future benefit-cost evaluation under the principles and standards recognizes the importance in the national viewpoint of the environmental impacts of water resources projects and represents an initial attempt to cope with an area where measurement and quantification are difficult at best.

The revised principles and standards attempted to change the formula for computing the discount rate used on water resource projects but an Act of Congress shortly after publication of the Water Resource Council's directives returned the discount rate formula to the basis which has been in use since December 1968 -- 5-7/8 percent. The Tocks Island project was authorized in 1962 and therefore comes under the discount rate formula contained in Senate Document 97 -- 3-1/8 percent.

New comprehensive principles and standards have been adopted by the federal government, and "procedures" are now being prepared by the Corps of Engineers for operationalizing these new standards. Those parts of the Corps of Engineers' benefit-cost methodology that are most subject to criticism, and which have the greatest potential impact on the comparative analysis to be conducted in XVI.B.3 are described in some detail below.

XVI.B.1.(b) Separable Costs -- Remaining Benefits Method of Cost Allocations

The Separable Costs -- Remaining Benefits (SCRB) procedure has been the method most commonly used by the Corps of Engineers to allocate the joint costs of multiple-purpose projects. In utilizing the SCRB method of multiple purpose cost allocation, separable costs -- the additional, incremental costs necessary to incorporate a specific purpose into the original project -- are assigned to that specific purpose. The remainder -- the estimated shared cost of common facilities that are utilized both by the specific purpose and along with other purposes -- are classed as joint costs. Allocations to joint costs according to project purpose are made in the following manner. An estimate is made of the total annual benefit that could be expected from each specific project purpose. If there is an acceptable alternative method of accomplishing any project purpose that would cost less than the estimated amount of benefits for that purpose, the cost of the alternative is used instead of the estimated amount of benefits. That is, benefits are limited by alternative costs.

The difference between the benefits for each project purpose of the cost of accomplishing a project purpose by an alternative method and the separable costs for each project purpose is referred to as the remaining benefits. The joint costs of the project are then allocated to each purpose on the basis of the relationship between the remaining benefits for each purpose and the remaining benefits for all purposes. The following hypothetical example should clarify this procedure. All dollar amounts shown represent annual costs or benefits.

	Flood Control	Water Supply	Power	Total
A. Total Cost of Project				$1,000
B. Estimated Benefits	$ 300	$500	$700	$1,500
C. Separable Costs	100	250	500	850
D. Remaining Benefits	$ 200	$250	$200	$ 650
E. Percent of Remaining Benefits (Percent Distribution of Line D)	30.77%	38.46%	30.77%	100.00%
F. Allocated Joint Costs (Line E.x Total Joint Costs-Line A. Less Line C.)	$46.15	$57.70	$46.15	$150
G. Total Allocated Project Cost (Line C.&F.)	$146.15	$307.70	$546.15	$1,000

Source: General Accounting Office review, June 11, 1969.

Taking one specific purpose of the total project -- in this example power generating facilities -- and looking at the preceding table, it can be seen in line G that of the $546.15 total cost of the specific purpose, $500 is directly attributable to power generation facilities -- power turbines, generator buildings and the like. The remaining $46.15 is the specific purpose's weighted share of common facilities such as the dam itself, spillways and other supporting facilities.

Utilization of the separable cost remaining benefit method precludes meaningful comparison of project purposes with those developed for alternative programs that have single-purpose components. A brief discussion of the definitions of separable costs, specific costs, joint costs, joint use costs, and alternative costs is outlined below:

1. Separable costs -- these are the costs which are made necessary because a purpose is included in the multiple-purpose project. These costs are normally determined in the process of project formulation in considering the economic feasibility of including a purpose in a joint project. The separable cost is the minimum amount which should be considered for allocation to a given purpose. The separable cost for any specified purpose is determined by subtracting from the cost of the multiple-purpose project the cost of the most economical alternative project to obtain the same benefits for the other purposes with the specified purpose omitted.

2. Specific costs -- specific costs are the costs of project features normally serving only one specific project purpose, such as the power house and switchyard. These costs are taken as the total cost of identifiable project features. The determination of specific costs, however, frequently involve the exercise of reasonable judgment.

3. Joint costs -- these costs are defined as the total project costs less the separable costs. In many cases, they are not readily identifiable with project features.

4. Joint use costs -- these are the costs of facilities used for more than one purpose. Normally, joint use costs are associated with facilities used for all project purposes such as the dam and the reservoir. Occasionally, special facilities are provided for the use of two specific purposes in a project serving three or more purposes. In such cases it is desirable to divide the cost of such special facilities between the specific uses by some appropriate method based on the specific circumstances.

5. Alternative costs -- these are the costs of alternative projects with one purpose eliminated to determine the separable cost as discussed above, or the costs of single-purpose projects necessary to obtain the same benefits for the corresponding purpose as the multiple-purpose project. The cost of the most economical alternative means which is expected to be provided for obtaining the same service for any one project purpose frequently is used as the measure of that project benefit, such as in the case of hydroelectric power. In such cases, it is not necessary to make further studies of the most likely alternative single-purpose project. In some cases such as flood control, the benefits are determined as the value of the damages prevented. In such cases, it will be necessary to determine the alternate costs of the most economical means of obtaining the same benefits.

From the preceding discussion it becomes clear that individual project purposes within a multiple purpose project being analyzed under the separable cost remaining benefit method cannot be effectively compared with individual projects carried out under an alternative single-purpose project approach. Only the total costs and benefits can be realistically compared.

XVI.B.1.(c) Period of Analysis

The period of analysis of a project covers the period of time over which the project is reasonably expected to serve a useful function. As a result of this, the period of analysis would be equal to the shorter of either the physical life span or the economic life span of the project. However, due to the inherent inaccuracy of long-term projections coupled with the difficulty in defining conditions existing at some remote future date and the discount rate of long deferred values, 100 years is normally considered the upper limit of the period of analysis.

A strong argument can be made that even this 100-year limit to the period of analysis is unrealistically long in light of the current pace of technological advancement and social change. While there is no question that a well constructed and well maintained earth fill dam has a physical life of far more than 100 years (witness several late Renaissance period European dams of similar construction that are still sound), the question is: One hundred years from now, will the dam be capable of serving any useful function without requiring extensive and, at this time, unforeseen modifications to its structure? If not, then the only purpose for such an extended period of analysis is to allow for an increased amortization period and a longer period during which benefits may be allowed to accrue.

On the basis of the analyses conducted in Chapters XII-XV, it was found that except for the flood control alternatives and two of the water supply alternatives the most realistic project life was 50 years. Several of the alternatives, in fact, have a physical life of only 25 years. We believe therefore that, with the exception of the main dam structure and lake, the TILP project life of 100 years was substantially overstated.

XVI.B.1.(d) Discount Rate

As stated in the preceding section, projects have a life of many years. They can be expected to yield some benefit during various periods of their lifetime, and they can be expected to incur some costs during their lifetime. Assuming costs and benefits were evenly distributed over a project's lifetime, determination of a project's feasibility would be simple -- add up any year's projected costs and benefits and if benefits exceeded costs then the project would be worthwhile. Unfortunately, this is not the case in the real world. Costs and benefits are very unevenly distributed during a project's life. Costs are very heavy during a project's initial construction period followed by some years of normal operation and maintenance costs which are then followed by a period of ever increasing maintenance costs. Benefits may be uniform from a project's in-service date, but normally they build up to a maximum over a period of time.

What is needed is a method of making a dollar spent or received 100 years from today have the value as a dollar spent or received today. The discount rate provides the factor for converting to a common or present value. The discount rate is defined as the average interest rate payable on U.S. securities that have a term to maturity of 15 years or more at the time of original issue, that are still outstanding at the end of the preceding fiscal year. Once the discount rate has been determined, the appropriate present value table can be used to convert any present or future monetary value into a common value.

When the Tocks Island Lake Project was authorized by Congress in 1962 the discount rate was set at 3-1/8 percent. Since that time the real discount rate has increased due to continual gains in interest rates. Currently, the discount rate set by Congress in the WRC principles and standards is 5-7/8 percent. Continued use of the lower discount rate has the effect of biasing the cost-benefit ratio toward a favorable number. The size of the discount rate is crucial in placing future benefits and costs on a present value basis as the following example will demonstrate.

XII.B.9 RESERVOIRS ON THE TRIBUTARIES

XII.B.9(a) Selection of Sites

The Delaware River Basin was examined to identify suitable reservoir sites on tributaries. Several hundred major impoundment or development sites within the Delaware River Basin were reviewed by the Corps of Engineers as described in their comprehensive study of the Delaware River (U.S. C. of E., 1962, vol. IX). These sites were reduced to 70 and then to 48 with their order of merit identified for 1) comprehensive development, 2) development of long-term storage only (water supply), and 3) development of short-term storage only (flood control). This C. of E. screening process was reviewed and additional sites were investigated.[1]

Circumstances over the past 25 years such as real estate and park site development have affected many potential impoundment sites. These developments have precluded the use of some of the sites entirely or greatly increased the cost of the sites suitable for water supply purposes.

Consideration was given to available storage and the amount of drainage area intercepted. All potential projects intercepting a drainage area of less than 50 square miles were eliminated as not being economical. The sites were next evaluated according to environmental criteria. Contact was made with state agencies concerned with environmental affairs in Pennsylvania, New Jersey and New York to establish the environmental attributes of

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1 State agencies particularly in New Jersey and Pennsylvania were also contacted to learn of state inventories of reservoir sites.

Using the WRC principles and standards basis for computing the discount rate we find that the current real cost of money in the current economy is about 7.5 percent. While critics of the Corps' use of 3-1/8 percent have advocated a higher interest rate -- as high as 10 or 11 percent -- we believe that 7.5 percent represents a real and legitimate rate for purposes of analysis. This discount rate was developed on the basis of actual long-term government securities issued during 1973, 1974 and 1975 generally in accordance with the requirements of the Water Resources Council principles and standards although the current WRC rate is 5-7/8 percent. These issues and their respective rates are summarized in the table which follows.

Table 16-2 Interest Rates on Long Term Government Securities 1/

Year Issued	Maturity in Years	Interest Rate
1973	20	6.75%
1973	25	7.0%
1973	20	7.5%
1974	25	8.5%
1975	25	7.8%
Average		7.52%

1/ Bonds

Source: U.S. Treasury Department.

XVI.B.1.(e) Recreation Benefits

Possibly the most vulnerable part of the Corps benefit-cost analysis is in the computation of recreation benefits. The Corps' methodology is described in the material which follows.

Full consideration of recreation as a purpose in project formulation and evaluation was not provided for until Senate Document 97 was approved by the President on May 15, 1962. It was not until Supplement Number 1 was passed in 1964 that there was an official set of values for determining recreational benefits.

The standard unit of measuring recreational benefits is the recreation day, which consists of a visit by one individual to a recreation development or area for recreation purposes during all or any reasonable portion of a 24-hour period. Determination of potential recreation days is a somewhat subjective procedure where various factors capable of influencing the extent of total recreation use are analyzed. The more important of these factors are:

1. Population residing within the project's zone of influence or market area.
2. Proximity of the project to major centers of population.
3. Socio-economic characteristics of the population such as age distribution, income and mobility.
4. Leisure-time and recreational habits that reflect consumer preferences as indicated by trends in hunting and fishing licenses, sales of recreation equipment, and trends in total recreation demand.
5. The recreation use potential of the project as reflected by its ability to provide for uniqueness, diversity, and access.
6. The availability and attractiveness of existing and potential alternative recreation sites.

In some cases, physical limitations of the site, or in the case of the Tocks Island Lake Project, political constraints may place an artificial limit on visitations that would be less than estimated future demand.

Currently, most public recreation projects provide their services free or for a nominal charge to the user. While it is obvious that there is a large and growing demand for these services, no formal market for them exists. Because of this it is necessary to derive a series of simulated market prices to provide a value for these services. In Supplement Number 1, the Water Resources Council has provided a series of values representing willingness to pay for both general and specialized forms of recreation. With a unit day value range of $.50 to $1.50, general recreation includes the type of activities most commonly entered into by the majority or recreationists. Examples of typical activities are: picnicking, camping, sightseeing, swimming and boating activities which involve a minimum of expense to the participant. A value at the lower end of the scale would be assigned to a project containing only a minimum of facilities, values at the higher range would be assigned to a project which is attractive and contains a very diversified range of activities.

Specialized recreation which includes those activities whose values are generally lowered, if not actually excluded in some cases, by the type of development that enhances the general recreation class have higher unit day values ($2.00 to $6.00). Thus, extensive or low-density use and development constitutes the higher end of this range of values, as for example, big game hunting and wilderness pack trips. Also included in the upper end of the range are relatively unique experiences such as inland and marine fishing for salmon and steelhead, white water boating and canoeing, and long-range boat cruises in areas of outstanding scenic value. Examples of activities to which values at the lower end of the range would be assigned include upland bird hunting and specialized nature photography.

Once the expected mix of high and low value range recreationists is determined, a weighted average of their willingness to pay is prepared and the resulting figure represents the estimated value of a typical recreation day at the project -- presumably based on empirical market data. However, our research found no rationale for selection of the general and special recreation charge range or any indication that the specific recreation values were based on empirical market analysis.

The value scale should be further adjusted according to the quality of the project. Criteria that should be considered are: the expected degree of fishing and hunting success, the overall attractivenss of the project in terms of water quality and scenery, and the effects of topography, climate and the presence of cultural and historical artifacts or the uniquenessness of the site. A final adjustment of the value scale should be made to reflect the abundance or absence of comparable recreation alternatives in the area.

Total monetary recreation benefits for the project are determined by applying the final adjustment unit values to the estimated patterns of annual visitation over the life of the project. The benefits are then converted to a common value by use of the discount factor. In the case of any intangible benefits or any benefits not assigned a monetary value, a discussion of their qualitative effects on the rest of the projects should be included. The Corps assignment of visitor day values for various recreation activities are shown as follows:

Activity	Percent of Visitors	Value	Benefit
Sightseeing	20	$0.65	$0.130
Fishing	6	1.20	0.072
Camping	7	1.40	0.098
Hunting	4	2.50	0.100
Swimming and Picnicking	50	1.50	0.750
Power Boating	9	1.50	0.135
Sailing and Canoeing	3	1.50	0.045
Hiking and nature study	1	2.00	0.020
Total	100		$1.0350

Source: General Accounting Office Review, June 11, 1969

The recreation benefits estimates employed by the Corps come from projections of net increases in visitor day use of the site valued at a fixed rate per visitor day. While the selection of a value for a day's use is somewhat arbitrary, typically the recreation analysis will account for changes in population and population characteristics in the service area and project population participation rates for boating, swimming, fishing, picnicking and the like. The Corps generally does not use a procedure for allocating water based recreation activity among the many alternative sites usually available to an area which takes into account relative measures of attractiveness in the alternative sites and their distance from populations. (Jack L. Knetsch, Outdoor Recreation and Water Resource Planning, Washington: American Geophysical Union, Water Resources Monograph 3, 1974.)

The value of a recreation day is based on interim standards first issued in connection with Senate Document 97 and updated by the WRC Principles and Standards. These values come from price control data available after World War II and applicable to pay fishing lakes, commercial hunting areas and the like in a few states. Although other procedures for estimating willingness to pay have been proposed none has been applied with sufficient consistency to allow its use here.

XVI.B.i.(f) Benefit-Cost Ratio -- Its Impact on the Decision-Making Process

Emphasis has been placed on the degree of economic efficiency of proposed Corps' projects almost from the beginning of their association with flood control projects. The first written evidence of this concern shows in the 1902 act which created the Board of Engineers for Rivers and Harbors. The act stated: "(The Engineers" shall have in view the amount and character of commerce existing or reasonably prospective which will be benefitted by the improvements -- (and) the relation of the ultimate cost of such work, both as to cost of construction and maintenance, to the public commercial interests involved..." In the Flood Control Act of 1936, Congress reaffirmed this position by stating that for a project to be approved, benefits must exceed costs, "to whomsoever they may accrue." As a result of this, all projects since then have been evaluated on a benefit-cost analysis basis.

Recent Congressional attitudes toward benefit-cost analysis appear to reflect mistrust and a desire to increase the accuracy of the analysis and use it as the primary criteria for decision making. However, in a study of Congressional action on Corps' proposals, performed by Robert H. Haveman, strict economic efficiency, as a decision factor, appears to be the least outstanding and most uncertain. While projects with a relatively high benefit-cost ratio (BCR) are often chosen before one with a low ratio, there is no real certainty that this is only the result of the favorable BCR. Even when similar projects with a more favorable BCR are available, money is still spent on projects with a low or unfavorable ratio. The driving motives for approval of a project appear to be aid for low-income or depressed areas and exploitation of resource development potential.

While the benefit-cost analysis provides some insight into basic issues such as the value of wildlife, the value of recreational opportunities and the effect of a project on the socio-economic composition of its service area, the state-of-the-art procedures are still fraught with disputes over basic assumptions and widely divergent choices as to the "right" solution. While there has been a great deal of improvement in the methodology of benefit-cost analysis, it still does not in the opinion of most analysts provide an impartial, unambiguous, indisputable and non-arbitrary solution to making public-expenditure decisions. It should certainly be noted that no other decision-making methodology has achieved such ambitious objectives.

Estimated benefits are achieved (theoretically) over a long period of time and the potential for not meeting assigned levels of future benefits is great in view of the rapidly changing, technologies related to the various project purposes. In addition our society's rapidly changing lifestyle preferences can impact on future demands for project outputs thereby dramatically affecting future benefits. A basic question to be asked of any project analysis is, is it responsive to the public need.

The prime usefulness in benefit cost analysis is in evaluating a project in comparison to alternatives. In this context the major value of the Corps' benefit-cost analysis is that it demonstrates that the proposed project is relatively efficient when compared to any alternative projects considered. While this use of benefit-cost analysis demands the same correctness and rigor as if it were a national justification test and not simply a comparison of alternatives, the fact is that the purpose is one of comparing alternatives. Having had the Corps set the stage of defining what it considers to be the desired outputs of a project, we can run through a series of analyses designed to test the Corps' judgment that they have indeed found the best way of solving a problem or set of problems. "Best way" can be used as roughly equivalent to a least cost for comparable levels of outputs. In short, the benefit-cost ratio (BCR) as formulated, tries to do a very difficult job: to reconcile incommensurable values in one qualitative, objective figure. It is our contention that a reasonable analysis of TILP and the proposed alternatives can be made on the basis of comparative costs, net benefits and cost/output relationships, in addition to considering the full range of indirect costs, benefits and impacts.

The following section will discuss some of the major comments on the Corps' benefit-cost-methodology and observed problems related to those methods.

XVI.B.2 THE CORPS OF ENGINEERS BENEFIT-COST ANALYSIS

In addition to the constraints imposed by federal policies and procedures described in Part B there are methodological inconsistencies and gaps which have been identified by critics of the benefit-cost methodology. Beyond the casual and often unsubstantiated criticisms of individuals, three fairly substantial research papers on the Corps' benefit-cost methodology have been prepared in recent years. These published materials include the "Evaluation of the Proposed Tocks Island Reservoir Project," prepared by the Environmental Defense Fund in 1972, "Benefits and Costs, Winners and Losers," by David F. Bradford and Harold A Feiveson, published by the Center for Environmental Studies at Princeton University in 1974 and "Tocks Island Dam" An Economic Critique of the Corps of Engineers Benefit Cost Analysis," by Charles J. Cicchetti. An additional report titled "Review of Tocks Island Reservoir Project," was prepared by the General Accounting Office (GAO) and submitted by the Comptroller General to the Chairman, Subcommittee on Public Works, Committee on Appropriations, United States Senate in 1969.

The Environmental Defense Fund report and the Cicchetti paper both argue against the project and were prepared by organizations that represent opposition to the project. The Bradford and Feiveson paper and the GAO report present a reasonable critique of those aspects of the Corps methodology reviewed. The latter two reports are reviewed briefly here, along with comments by the consultant to highlight the major problems related to evaluating the Corps' methodology.

XVI.B.2(a) The Bradford and Feiveson Paper

The paper titled "Benefits and Costs, Winners and Losers," by David F. Bradford and Harold A. Feiveson represents a comprehensive and relatively balanced look at benefit-cost analysis as applied to the Tocks Island Lake Project. Unlike other critiques this paper provides factual interpretive information on benefit-cost analysis and the Tocks Island Project and in addition to criticizing the Corps' methodology points out how the methodology might be improved. In evaluating the Corps' economic evaluation of the Tocks Island Lake Project the paper's authors raise several issues which are summarized as follows:

1. The fact that benefit-cost calculations for the Tocks Island Lake Project have not been formally undertaken in accordance with the adopted 1973 principals and standards of the Water Resources Council. The lack of an alternative plan "maximizing environmental quality" and the use of an outdated discount rate are the two major concerns.

2. The arbitrariness of the separable cost remaining benefit approach to analysis.

3. The sensitivity of the discount rate -- the higher the rate the lower the benefit-cost ratio. Continued use of the 3 1/8 percent discount rate is unrealistic.

4. The calculation of benefits in general and recreation and water supply benefits in particular are unrealistic and biased toward project implementation.

5. The lack of secondary and environmental cost and benefit analyses.

6. The fact that the Corps of Engineers has ignored the basic intent of benefit-cost analysis in terms of who benefits and who pays.

7. The fact that the Corps has totally ignored Governor Cahill's condition and the DRBC resolution limiting recreation visitor days to four million per year.

8. The apparent lack of consideration for the preferences of the people in the impact area. (The whole question of life styles and attitudes as related to the Tocks Island Lake Project are considered in this evaluation in Chapter XXIV.)

The main thrust of this extensive critique gets at the basic problems of the choice of discount rate and project life, the arbitrariness of water and recreation benefits and the lack of analysis of intangible benefits and costs -- environmental and secondary benefits and costs. The paper concludes on the basis that benefit-cost analysis of the TILP is an exercise in response to legal requirements that have relatively little impact on the decision making process. In the final analysis decisions on most major projects are made on a judgment and political basis rather than on economic analysis.

XVI.B.2(b) GAO Report

In 1969 the General Accounting Office under the direction of the Comptroller General of the United States prepared a report on the Tocks Island Lake Project at the request of the Subcommittee on Public Works, Committee on Appropriations of the United States Senate. The general findings and conclusions of this evaluation are summarized below:

1. "The Corps' estimate of the cost to construct the Tocks Island Reservoir project increased from $203 million in fiscal year 1969 to $214 million in fiscal year 1970. At the same time, estimated annual benefits to be obtained from the project increased from $14.4 million to $22.9 million. Increased recreation benefits accounted for about $8.1 million of the $8.5 million increase in benefits. As a result of the increased recreation benefits, the Corps' cost allocations to water supply and recreation changed significantly -- cost allocations to water supply, which are reimbursable to the Government, decreased by $15.2 million and cost allocations to recreation, which are not reimbursable to the Government, increased by $27.6 million."

2. "The Corps, in computing recreation benefits, estimated that present annual visitation to the Tocks Island Reservoir project was 183,000 annually. This estimate, which was based on 1957 data, had not been revised or updated by the Corps through fiscal year 1969. On the basis of more current data and discussions with Federal and local personnel knowledgeable of recreation in the Tocks Island area, GAO believes that the Corps' estimate of present annual visitation is understated and that a more realistic estimate for present visitation to the project area may be as high as 1,250,000."

3. "The Corps' plan for ultimate recreational development of 14 sites assumes that the Corps will fund $14.2 million for initial development of four sites and that the National Park Service (NPS) will fund $17 million for future development of the additional 10 sites. GAO found, however, that the Corps was limited to the expenditure of $14.2 million for recreational development of the Tocks Island Reservoir project and that NPS was precluded from funding recreational development at the Tocks Island Reservoir project.

4. "GAO developed revised cost allocations for the Tocks Island Reservoir project on the basis of a revised estimate of present visitation to the project area and of Corps and NPS funding limitations on recreational development. The GAO calculations showed that the costs allocated by the Corps to water supply should be increased by about $21 million and the

costs allocated to recreation should be decreased by about $25 million. The GAO calculations showed also that the annual recreation benefits should be decreased by about $8 million.

5. "The Water Supply Act of 1958 requires that not more than 30 percent of total project costs be allocated to future water-supply demands. In implementing the act, the Corps administratively decided that, prior to construction, it would enter into contracts for the sale of water in an amount equal to the costs allocated to water supply which exceed 30 percent of total project costs. On the basis of its calculations, GAO estimates that water-supply costs represent about 35 percent of total project costs. GAO believes, on the basis of its calculations, that the Corps, in order to comply with the Water Supply Act of 1958, is required to enter into water-supply contracts for all water-supply costs in excess of 30 percent of total project costs or about $11.2 million. As of July 1969 the Corps had not entered into any water-supply contracts."

6. "The Corps and NPS, which will administer the completed recreational facilities, have attempted to reach agreement on the recreational development in the Tocks Island Reservoir project since March 1966. As of August 1969, such agreement had not been reached. The Corps and NPS have prepared separate plans which differ significantly for the ultimate recreational development of the project. The preparation of separate plans has, in GAO's opinion, resulted in some duplication of effort and has resulted also in two recreation plans, neither of which can be implemented under existing legislation."

The main thrust of this report deals with the uncertainties of the Corps' computation of recreation benefits and, importantly the impact on the separable cost -- remaining benefit cost allocation to the water supply purpose. The overall impacts on costs and benefits of just these relatively minor inconsistencies in the Corps' calculations have a substantial impact on the overall economic analysis.

However, the main weakness of this method is the arbitrary means of allocating costs and the impact of benefit calculations on cost allocations -- particularly recreation benefits on water costs. As stated previously the SCRB cannot be effectively used in evaluating the single-purpose alternatives proposed in Chapters XII-XIV.

Perhaps one of the most sensitive ingredients of the benefit-cost methodology is that of the discount rate. The relationship of the discount rate to the period of analysis and the impact on the benefit-cost ratio reflect the need for a realistic interest rate. Certainly, the Corps' continued use of 3 1/8 percent is unrealistic and would seem to have had a biased impact on its calculations in recent years. Similarly, the period of analysis, set at 100 years tends to reduce costs and enhance benefits over a longer period of time. The longer period of analysis used in conjunction with a low discount rate obviously tends to bias the benefit-cost ratio toward a higher number.

The calculation of project benefits in the TILP, according to GAO, are judged to be arbitrary across-the-board, particularly in the case of recreation benefits and water supply benefits. Assuming a comparable level of need satisfaction between TILP and the alternatives proposed, the consultant concludes that comparable analysis of costs is the most efficient method with the data inputs available.

XIV.B.2(e) Conclusions

From the inputs provided in the Part B submittal of this study and from the preceding evaluation as well as the experience of the consultant in conducting this phase of the study it appears obvious that benefit-cost analysis of major public works in general, and as practiced by the Corps of Engineers, has major inherent methodological weaknesses which impact on the findings and conclusions to be drawn from such analysis. The general conclusions to be drawn from this phase of the study are as follows.

The fact that the basic economic analysis of the TILP has been carried out under the provisions of S.C. 97 and Supplement No. 1 when new principles and standards were adopted appears to be a justifiable basis for reviewing and reanalyzing the project. While much of the analytical analysis in the principles and standards builds on those of S.D. 97 and Supplement No. 1 it does provide a greatly expanded and much more comprehensive basis for analysis -- particularly in the critical areas of environmental and social well-being considerations. However, even if these new principles and standards were operationalized and applied to the TILP, such analysis could not be applied equally to COE-TILP and the alternative single-purpose programs proposed in Chapters XII-XV. Application of the principles and standards to COE-TILP would probably not greatly change the findings of this economic analysis. However, substantially more information would be provided the policy maker in the critical areas of environmental and social well-being impacts.

Finally, benefit-cost analysis as a decision-making tool in the area of major water resources projects can be important provided the data base is adequate, that realistic assumptions have been made and the analysis has been conducted on an unbiased basis. These criteria apply equally to the Corps, its critics and the evaluators of the Tocks Island Lake Project.

Section XIV.B.3. which follows presents a comparative evaluation of costs and related economic data for TILP and alternative programs. It attempts to present, in general terms, the financial or cost implications for each alternative and related benefits. It is presumed, however, that the decision of "go"-"no-go" pertaining to TILP will not solely be based upon the following benefit/cost factor analysis but rather will be more judgmental and will consider all other aspects of TILP and the alternatives which are not quantifiable.

XVI.B.3. Comparative Evaluation of Costs and Related Economic Data for TILP and Alternative Programs

This section of Chapter XVI.B. builds on the analysis conducted in Part B, Chapter VIII of the Comprehensive Review Study, the inputs -- costs and benefits -- developed and presented in Chapter XII-XV in Part C, and the preceding two sections of this chapter which presented a comparative evaluation of the TILP and suggested alternative programs. The preceding highlighted the complexity of benefit-cost analysis and the relative shortcomings of the benefit methodology previously applied.

The benefit-cost analyses presented in this section for the alternative programs under consideration are based upon specific benefit-cost data for each of the authorized purposes described in Chapters XII-XV respectively. The assumptions and methods used in deriving benefit and cost data are discussed in the respective chapters. The COE-TILP cost and benefit data are derived from Appendix H, Page 22, Supplemental Data Report and Supplemental Information to the Environmental Impact Statement, Tocks Island Lake Project, New York, New Jersey, Pennsylvania, prepared by the U.S. Army Engineer District, Philadelphia, Pennsylvania, 1974. The purpose of this section is to present, in as systematic a manner as possible, the available economic data on COE-TILP and the alternative programs for comparative analysis purposes.

Traditional benefit-cost analysis is but one of a number of methods available for analysis of major water resources projects. From the economic data contained in Chapters XII-XV, it appears that the best approach is one of comparative cost analysis and the development of comparative cost/output relationships. The policy objectives upon which each set of alternatives were evaluated and packaged into a program are first described below followed by a discussion of comparative cost analysis for each of the three alternative programs and TILP.

Alternative Program "A"

1. Output/Cost Levels -- to provide in the various project purpose areas outputs roughly comparable to those which could be furnished by proposed Tocks Island Lake Project.

2. Economic Growth Level -- to provide in each project purpose area the opportunity for maximizing economic growth.

Alternative Program "B"

1. Output/Cost Levels -- to provide in major project purpose areas a level of output somewhat less than that provided by the Tocks Island Lake Project.

2. Economic Growth Level -- to provide in each project purpose area the opportunity for an intermediate level of economic growth.

Alternative Program "C"

1. Output/Cost Levels -- to provide in each project purpose area the opportunity for minimizing costs.

2. Economic Growth Level -- to provide in each project purpose area the opportunity to minimize costs or be consistent with low economic growth objectives.

Assuming that each alternative program package has been selected in general conformance with these program formulation and policy objectives, then each alternative program may be compared to COE-TILP with regard to output/cost levels, economic growth levels and environmental conservation objectives in relation to total project cost. Conclusions can then be drawn as to the performance, impacts and desirability of TILP as a public investment in terms of meeting a specific level of need.

XVI.B.3(a) Comparative Cost Analysis of Alternatives A, B and C and COE-TILP

The Tocks Island Lake Project as recommended in House Document No. 87-522 (1962) is to provide for the specified authorized purposes of water supply, flood control, on-stream and pump-storage hydroelectric power, direct lake and indirect land recreation. These authorized project purposes were described and evaluated in some detail in Part B of this study.

The alternatives to the Tocks Island Lake Project developed in Chapters XII-XV under the previously described program and policy objectives relate directly to these authorized purposes. The material which follows presents the cost and related economic data for each of the authorized project purposes, for each of the proposed alternatives and for the Tocks Island Lake Project.

Analysis Methods

The analysis conducted in the following pages is based entirely on the cost (capital and annual operating and maintenance) and annual benefit data discussed in Chapters XII-XV. The methods and assumptions underlying these data are described in the respective chapters. The project life for each alternative was determined in each chapter and its rationale described accordingly. The analysis which follows is simple and straightforward and can easily be duplicated by those interested in doing their own analysis with different variations. Basically, the analysis involves reducing the total capital cost to an annualized cost based on a given project life (50 or 100 years), computed at 3-1/8 percent, 5-7/8 percent and 7.5 percent with a given amortization factor. The amortization factors used for varying project lives and varying discount rates are shown below:

Annual Cost-Computation (Amortization Factors)

Year	Interest Rates		
	3-1/8%	5-7/8%	7.5%
25	.058231	.077300	.089711
50	.039793	.062340	.077072
100	.032760	.058945	.075054

Factor to amortize $1.00 assuming level debt service. For example, the annual cost of $1,500,000 at 5-7/8 percent for 25 years is $115,950 computed at .077300 x $1,500,000.

The annual amortized cost is then added to the annual operating and maintenance costs to provide total annual costs. These total annual costs are then compared with total annual benefits for each project purpose for each alternative. Minor variations are described in appropriate footnotes, particularly as regards changes in COE-TILP figures.

Water Supply --

In order to provide for the water supply needs of the Delaware River Basin commensurate with those provided by the Tocks Island Lake Project, the study team has proposed one independent alternative and one combination alternative. These are described as follows:

Alternative "A" - the water supply components of this program will consist of reservoirs on tributaries, as described in Alternative "B" below, and maintenance of the Philadelphia/Camden system at low flow. The combined ouput of this alternative will be roughly comparable to that provided by TILP.

Alternative "B" - the water supply alternative in this program utilizes reservoirs on tributaries located at Hackettstown, McMichael, Shohola Falls, Girard, Tobyhanna, Hawley and Lackawaxen. Of these tributary reservoirs the McMichael, Shohola Falls, Girard and Hawley reservoirs would be constructed to provide for flood control use also. This system of reservoirs will provide a yield equivalent to the proposed 300 MGD water supply yield from the Tocks Island Lake but not the low flow augmentation component of 333 MGD.

Alternative "C" - No water supply measures are included as an alternative to TILP under this program since the overall level of water supply need, as noted in Chapter III, is not substantial and other sources for this amount of water are available. Salinity protection is also omitted under this program due to the low probability of its need.

The water supply economic data developed in Chapter XII are displayed in Table 16-3 following. Keeping in mind the program and policy objectives previously discussed this table clearly shows the relationship of capital costs to the productive output of the alternative. The annual operating and maintenance (O & M) costs, estimated annual benefits and project life figures are included for comparative purposes. Alternative "A" has a capital cost of $408.0 million, annual O & M costs of $1,000,000 and estimated annual benefits of $18.9 million over a 100 year project life for its reservoir component. Alternative "B" has a capital cost of $288.3 million, annual O & M costs of $1,000,000 and estimated annual benefits of $18.9 million. For comparison purposes, no specific water supply sources are included in Alternative "C".

Table 16-3. Water Supply Economic Data Developed in Chapter XII
(dollars in millions)

Alternative A		Alternative B	
Capital Cost	$408.0 1/	Capital Cost	$288.3
Annual O & M Cost	1.0	Annual O & M Cost	1.0
Annual Benefits	18.9 2/	Annual Benefits	18.9
Project Life	(100 years for reservoirs)	Project Life	(100 years)

Alternative C (Based on water supply and salinity protection not being required as an alternative to TILP.)

1/ Includes alternative B and salinity protection costs of $119.7 million. Salinity protection costs include only the initial first cost investment for 25-year project life and one installation and removal cost. The maintenance of the Philadelphia system other than installation and removal is not significant. O&M costs for the Camden system are assumed at $375,000 for three months during each 25-year period, and are included in the capital cost.

2/ Based on annualized costs (5 7/8% interest) and estimated up-dated wholesale water cost ranges.

It is to be noted that the above water supply costs are only those required to meet the specific objectives of the three alternative programs to TILP. They are not indicative or even proportional to the total costs of meeting the full unsatisfied demands developed in Chapter III. These total costs are discussed in Section XVI.D.

Flood Control --

In order to meet the flood control needs of the Delaware Basin the recommendations included in Chapter XIV provide for three independent alternative programs. These alternatives are briefly described as follows:

Alternative "A" -- This alternative proposes the construction of a "dry" dam on the main stem of the Delaware River that is designed to provide the same degree of flood protection as the authorized TILP project but leaving the stream above the dam site free from a permanent impoundment.

Alternative "B" -- This alternative proposes the construction of a series of seven tributary flood control dams to be located at Hawley, Sterling, Shohola Falls, Bridgeville, Girard, Flat Brook, and McMichael. Of these the Hawley, Shohola Falls, Girard and McMichael dams are proposed to be used for both flood control and water supply. In addition this alternative proposes the use of some non-structural measures that will include an appropriate combination of insurance and flood plain management, including physical measures such as flood walls around structures and the flood proofing of buildings.

Alternative "C" -- This alternative proposes a totally non-structural approach to the reduction of flood damages. It includes such flood plain management measures as flood insurance, flood plain zoning, permanent or temporary evacuation, early warning systems, flood proofing and other preventative measures. This alternative would provide some measure of reimbursement for actual damages to existing capital investments and would prevent inappropriate future development from occurring. It is, however, ineffective as a stream flow regulator and most of the existing development in the flood plain would remain subject to flooding.

The flood control economic data developed in Chapter XV are displayed in 16-4 following. Capital cost for each of the alternative flood control proposals reflect the close relationships of the program and policy objectives for output-cost levels, economic growth levels, and environmental conservation. Alternative "A", the "dry" dam, has a total first cost of $325.7 million, an annual operating and maintenance (O & M) cost of $160,000 and annual benefits of $2.5 million accruing over a 100-year project life. This plan will reduce average annual damages by about 60 percent.

Alternative "B" has a total first cost of $159.4 million for the structural component and $9.4 million for the non-structural component. Annual operating and maintenance (O&M) costs are $90,000 with estimated annual benefits at $3.5 million over the 100-year life span of the project.

Alternative "C" includes a total first cost of $16.8 million based on assumptions regarding relationships between total cost and the value of property in the flood plain. The $16.8 million in capital costs would be implemented over a 10-year period with annual benefits estimated at $3.1 million.

Table 16-4. Flood Control Economic Data Developed in Chapter XV

(dollars in millions)

Alternative A	
Capital Cost	$325.7
Annual O & M Cost	.16
Annual Benefits	2.5
Project Life	(100 years)
Alternative B	
Capital Cost	$168.8
Annual O & M Cost	.09
Annual Benefits	3.5
Project Life	(100 years)
Alternative C	
Capital Cost	$ 16.8 1/
Annual O & M Cost	- 2/
Annual Benefits	3.1
Project Life	(100 years)

1/ Capital costs distributed over a 10 year period.

2/ Recurring costs borne by public agencies after the initial implementation period not considered to be significant.

Electric Power --

In order to provide electrical power sources equal to the Kittatinny pumped storage project proposed to be developed in conjunction with Tocks Island Lake Project the study team has proposed a single alternative in the form of combined cycle units that would assist in meeting the energy requirements of the Delaware River Basin and larger electrical service area. A combined cycle unit consists of gas turbines integrated into the conventional steam cycle. Electrical output is obtained from the gas turbine, but the hot exhaust gases are then further used to fire a steam generator. The steam thus developed passes through turbines to produce electricity from the steam side of the combined cycle unit. As indicated above this combined cycle energy system is proposed to be used in all three of the alternative program packages being considered for analysis.

It is estimated that the capital cost for constructing a 1300MWe combined cycle alternative is about $273 million (assumes a plant life of 25 years). It would cost, very conservatively, $8 million (in 1974 dollars) to renew the plant for an additional 25 year life. Thu , the capital cost for a combined cycle plant having a 50-year life is about $281 million. Annual operating (including fuel) and maintenance (O&M) costs are about $35.0 million. These figures are shown in Table 16-5.

B d on the data developed and presented in Chapter XIV, the 1974 total annualized cost for combined cycle units is about $77 million, and for the Kittatinny pumped storage plant, about $67 million. Both figures are based on a "private" levelized fixed charge rate of 15.0 percent.

The annual benefit for both the combined cycle plant and the pumped storage plant is taken to be $81 million, based upon an arbitrary five percent mark-up of the combined cycle plants annual cost. For purposes of comparison it has been assumed that CO[illegible] electric power will generate an equivalent annual benefit.

Table 16-5 Electric Power Economic Data Developed in Chapter XIV

(dollars in millions)

Alternative A	
Capital Cost	$281.0 1/
Annual O&M Cost	35.0 2/
Annual Benefits	81.0 3/
Project Life	(50 years)
Alternative B	(Same as A)
Alternative C	(Same as A)

1/ Includes an amount for replacement at end of 25-year period.
2/ A substantial portion of this cost is for fuel.
3/ Based on annualized costs and estimated wholesale power rate charges.

Recreation --

In order to meet anticipated future recreation needs within the Delaware River Basin and the broad recreation service area as defined in Chapter IV of Part A and Chapter XIII of Part C, three alternative programs have been identified. All three assume the development of DWGNRA without TILP as part of the recreation component. They include the following:

Alternative "A" -- This alternative proposes the expansion of the state parks systems and programs. This plan proposes new park facilities in urban and suburban locations to increase the resource capacity of the state systems.

Alternative "B" -- This alternative is comprised of the increased use of existing recreation facilities and the opening of presently closed reservoirs in order to provide expanded water recreation resources.

Alternative "C" -- This alternative proposes that no public programs will be developed except for the Delaware Water Gap National Recreation Area without the Tocks Island Lake Project.

The benefit-cost factors pertaining to recreation are closely tied to the number of facilities which could or would be developed and the design scale of each developed facility to accommodate a level of demand without hindering the total recreation experience. It is also closely tied to the mix of facilities provided within a given area to accommodate a variety of recreation desires.

The COE-TILP analysis regarding recreation assumes an annual visitor level at 4,000,000. The review of alternative DWGNRA's presented in Chapter XVIII of Part D discusses the proposed development of DWGNRA with TILP in its three phases: phase one with annual visitation at 4,000,000; phase two with annual visitation at 7,700,000; and phase three having a maximum design capacity to accommodate 10,600,000 visitors annually in and beyond the year 2000. While the existing recreation plans and park design can ultimately accommodate 10,600,000 visitors annually, the Corps' basic cost and benefit analysis only assumes a visitor level of 4,000,000.

The analyses in XXII and XXV note that the required highway costs will be extremely high if 10,600,000 visitors were to be accommodated at TILP and DWGNRA. Similarly, the analysis in Chapter XXII indicates that the public service infrastructure necessary to support 10,600,000 visitors at TILP/DWGNRA would entail substantial cost burdens to local jurisdictions. For these reasons and for lack of cost-benefit data pertaining to the ultimate design capacity of TILP/DWGNRA (10,600,000 visitors annually), the cost-benefit information in this section is generally limited to 4,000,000 visitors or less levels.

The analysis of recreation alternatives presented in Chapter XIII identifies the estimated ultimate annual visitor levels for each of the three alternative programs. Two of these programs could eventually come close to satisfying and meeting the ultimate design capacity level of over 10 million visitors should this be desirable at such future time. However, for reasons of comparability with COE-TILP, the cost-benefit analysis for alternative recreation programs has been based upon the satisfaction of 4,000,000 in Program "A" and correspondingly cutback to 3,000,000 and 2,000,000 in Programs "B" and "C" respectively.

The annual visitor assumptions and the related development cost data for Phase I (4,000,000 visitors or less) for each of the three program alternatives are summarized in Table 16-6 following. The table also presents similar data for each of the alternatives based upon their maximum or ultimate visitor accommodation capacity for general reference purposes.

Table 16-6 Assumed Level of Visitors and Related Costs and Benefit Data by Alternative Recreation Programs and TILP (In millions)

	Programs A	Programs B	Programs C	Multi-Purpose TILP 1/
Phase I				
Annual Visitors	4.0	3.0	2.0	4.0
Total Capital Costs	$207.9 3/	$171.1 3/	$162.3 3/	$186.8 2/
Annual O&M Costs	$ 1.2	$ 1.0	$ 0.7	$ 1.1
Annual Benefits 4/	$ 8.1	$ 6.1	$ 4.1	$ 8.1
Phase III				
Annual Visitors	9.845	8.178	3.863	10,600
Total Capital Costs 3/	$282.3	$211.9	$174.4	NA
Annual O&M Costs	$ 2.8	$ 2.9	$ 1.4	NA
Annual Benefits 4/	$ 20.0	$ 16.6	$ 7.8	NA

1/ COE-TILP cost-benefit data developed only for 4,000,000 visitor level. Cost data for maximum design capacity of 10,600,000 not available.

2/ COE-TILP capital costs include an estimated $75.7 million for additional DWGNRA land; $12.0 million for additional recreation facilities; and an amount allocated for Route 209 relocation costs chargeable to TILP.

3/ Includes $15.0 million as an amount roughly indicative of Route 209 relocation costs chargeable to DWGNRA.

4/ Based on data provided in Chapter XIII.

Note: XIII. F. 8 develops ultimate Phase III costs for Programs A,B and C used above. Phase I costs were based on the same cost factors utilizing Phase I facilities and visitations noted above.

XVI.B. 3(b) Summary of Costs and Benefits for Alternative Programs and TILP

The foregoing sections presented estimates of costs and benefit for each of the alternatives. The following table summarizes this information. Regarding project lives, the Corps has been criticized for using a standard 100-year project life for its multi-purpose project including its components. The cost-benefit factor analysis has been carried out for specific purposes at variable project life assumptions. When doing so, the cost data pertaining to COE-TILP for that particular authorized purpose project has been adjusted to reflect the assumed project life. Similarly, an analysis has been undertaken to compare all alternative programs with the project life of 100 years as with COE-TILP. The table below also specifies specific project life assumptions for specific authorized project purposes.

It is to be emphasized that the costs and benefits presented herein are only those related to the specific limited objectives of the three alternative programs to TILP. They are not indicative of the costs and benefits associated with meeting the full unsatisfied demands projected under the three growth conditions. Further, b-c factor and net benefit values only measure economic performance with respect to meeting an established goal, not the adequacy of the goal itself. The adequacy of the goals of each alternative is addressed under "Satisfaction of Area Needs" in Section XVI. F.

Table 16-7 Comparative Summary of Economic Data Developed in Chapter XII-XV and COE-TILP Multiple-Purpose Alternatives (in millions of dollars)

Project Purpose	Alternative A	Alternative B	Alternative C	COE-TILP Multiple-Purpose 2/
Water Supply				
Capital Cost 5/	$ 408.0	$ 288.3	-	$ 170.1
Annual O&M	$ 1.0	$ 1.0	-	$ 0.3
Annual Benefits 8/	$ 18.9	$ 18.9		$ 17.1 7/
Assumed Project Life	100 yrs. 1/	100 yrs.	-	100 yrs.
Flood Control				
Capital Cost	$ 325.7	$ 168.8	$ 16.8	$ 72.2
Annual O&M	$ .16	$ .09	$ -	$ 0.1
Annual Benefits	$ 2.5 3/	$ 3.5	$ 3.1	$ 2.8 6/
Assumed Project Life	100 yrs.	100 yrs.	100 yrs.	100 yrs.
Electric Power				
Capital Cost	$ 281.0	$ 281.0	$ 281.0	$ 292.9 4/
Annual O&M	$ 35.0	$ 35.0	$ 35.0	$ 21.3
Annual Benefits	$ 81.0	$ 81.0	$ 81.0	$ 81.0
Assumed Project Life	50 yrs.	50 yrs.	50 yrs.	100 yrs.
Recreation				
Capital Cost	$ 207.9	$ 171.1	$ 162.3	$ 186.8
Annual O&M	$ 1.2	$ 1.0	$ 0.7	$ 1.1
Annual Benefits	$ 8.1	$ 6.1	$ 4.1	$ 8.1
Assumed Project Life	50 yrs.	50 yrs.	50 yrs.	100 yrs.
Total Program				
Capital Cost	$1,222.6	$ 909.2	$ 460.1	$ 722.0
Annual O&M	$ 37.4	$ 37.1	$ 35.7	$ 22.8
Annual Benefits	$ 110.5	$ 109.5	$ 88.2	$ 109.0

1/ Alternative includes two components: 1) tributary dams project life of 100 years; and 2) maintenance of Philadelphia/Camden system project life of 50 years.

2/ SCRB method does not include first cost of water supply and flood control purposes. The above figures were derived by applying Corps' "percent total construction expenditure" allocation to total cost of project.

3/ Differs from COE-TILP estimates due to the absence of upstream flood protection in the Port Jervis-Matamoras area and a lower estimate of future development benefits.

4/ Corps of Engineers estimate.

5/ Not based upon the capital costs required to meet the full water supply needs of the area. See Section III.D.5 and XVI. F. discussions.

6/ Includes protection of Port Jervis from natural flooding. Excludes protection from back-water effects.

7/ Based on the same benefits per MGD yield as alternatives A and B and a yield of 300 MGD rather than the 332 MGD of the seven reservoirs.

8/ Based on annualized costs and a 5 7/8 interest rate.

Source: Chapters XII-XV and Appendix II, page 22, Supplemental Data Report and Information to the Environmental Impact Statement, Tocks Island Lake Project, New York, New Jersey, Pennsylvania, prepared by the U.S. Army Corps of Engineers, Philadelphia District, Pennsylvania, 1974 (Draft Copy). Figures updated to December 31, 1974.

This part of the report summarizes the estimates of the direct annual costs and annual benefits generated by TILP and each of the three alternative program packages developed by the project team for the four project purposes included as a part of the "benefit-cost ratio" analysis of Corps of Engineer's project: water supply, flood control, power generation and recreation. The methods used for benefit and cost numbers for each alternative are explained in Chapters XII through XV of the report.

It is important to restate here that the consultant team does not mean to imply a great importance to benefit-cost analysis by its quantification and inclusion here. Indeed a major limitation to cost benefit analysis identified by many economists is the inability at this point in the state of the art to quantify all relevant variables including others such as environmental, local and regional economic, institutional, lifestyle and other impacts treated elsewhere in this section. This discussion of costs and benefits is not meant to be a summary evaluation but rather only one component to be included in the summary evaluation.

The data analysis basic to this discussion of costs and benefits is summarized in six tables (numbers 16-9 to 16-14) located at the end of this section. Each of the tables shows annual amortization of initial capital cost over a specific estimated life, annual operating and maintenance (O&M) costs, total annual costs and total annual revenues for each of the major project purposes under each of the three consultant team alternatives and TILP as proposed by the Corps of Engineers.

The tables vary in annual interest rate utilized and estimated economic life as follows:

Table 16-9 assumes cost recovery or economic life for TILP and all alternatives as estimated by the consultant team and an annual interest rate or opportunity cost of 3-1/8 percent as originally used in the Corps analysis except for electric power which is figured at a 15.0 percent fixed charge rate.

Table 16-10 assumes the same cost recovery or economic life period as the previous table but an interest rate of 5-7/8 percent as used in subsequent Corps analysis and the same electric power rate.

Table 16-11 assumes the same cost recovery or economic life period as the previous two tables but an annual interest or opportunity cost rate of 7.5 percent which we judge to be more in keeping with recent federal long-term borrowing experience except for electric power.

Tables 16-12 through 16-14 incorporate the same interest rate assumptions as tables 16-9 through 16-11 above but assume the economic lives of TILP and all alternative program package components at 100 years except for electric power. Electric power figures are based on 15.0 percent and 50 years.

Table 16-8 following, includes the total direct annual costs and annual benefits at each of the interest rates. The right-hand column assumes all purposes of COE-TILP would have economic lives of 100 years. Alternatives and COE-TILP are assumed to have 50-year lives for recreation and power and 100 years for flood control and water supply in the other columns.

Each of the COE-TILP alternatives at each interest rate results in a positive net annual impact when analyzed in this manner. On the other hand all of the A, B and C alternatives result in a net annual negative impact except for alternatives B and C when computed at 3-1/8 percent. This suggests that the multi-purpose project is more cost effective than comparable single-purpose projects. Although there is relatively little difference under any of the variables, benefit-cost ratios for each alternative under the conditions set forth in Table 16-8 are as follows:

	A	B	C	COE-TILP	COE-TILP 100 Year
3-1/8 percent	.92	1.01	1.04	1.24	1.26
5-7/8 percent	.81	.94	.99	1.17	1.18
7-1/2 percent	.77	.90	.96	1.14	1.14

Table 16-8 Summary of Annual Costs, Annual Benefits and Annual Net for Each Alternative and TILP for Each Interest Rate Under Varying Economic Lives (in millions of dollars)

	Alternative A 1/	Alternative B 1/	Alternative C 1/	COE-TILP 1/	COE-TILP 100 Year 2/
Rate at 3-1/8 Percent 3/					
Annual Costs	111.8	100.8	84.8	82.2	80.9
Annual Benefits	102.5	101.5	88.2	101.7	101.7
Net	(9.3)	0.7	3.4	19.5	20.8
Rate at 5-7/8 Percent 3/					
Annual Costs	135.6	116.7	88.8	92.7	92.1
Annual Benefits	110.5	109.5	88.2	109.0	109.0
Net	(25.1)	(7.2)	(0.6)	16.3	16.9
Rate at 7-1/2 Percent 3/					
Annual Costs	150.4	126.6	91.5	99.4	99.0
Annual Benefits	115.3	114.3	88.2	113.3	113.3
Net	(35.1)	(12.3)	(3.3)	13.9	14.3

1/ Economic lives of: water supply and flood 100 years; recreation 50 years and power generation 50 years.
2/ Assumes TILP to have 100 year economic life for all purposes except electric power.
3/ Electric power rate held at 15.0 percent fixed charge rate throughout.

Note: Does not include water supply or other costs to meet the full needs of the area. Costs are to fulfull objectives of alternatives.

While the information in Table 16-8 is significant it must be viewed only within the context of the total analysis presented in this section and elsewhere in the report which address such questions as:

1) Is the amount of need met by TILP or the alternatives the optimum target for the locality, the region and the nation;

2) Does TILP or the alternatives constitute the optimum method for meeting these needs; and,

3) What are the implications of TILP, and possible viable alternatives, with respect to the environment, economic growth, and social, lifestyle and other pertinent considerations.

Table 16-9 Annualized Costs and Benefit Factors at 3 1/8 Percent, Electric Power and Recreation Purposes with Project Life of 50 Years, Including TILP. All Other Purposes At 100 Year Project Life (In millions of dollars)

Project Purpose:	Alternative A	Alternative B	Alternative C	TILP Multi-Purpose
Water Supply				
Annual Amortized Capital Cost	13.4	9.4	—	5.6
Annual O&M Cost	1.0	1.0	—	0.3
(Annual Cost)	(14.4)	(10.4)	—	(5.9)
Annual Benefits	10.9	10.9	—	9.8
Flood Control				
Annual Amortized Capital Cost	10.7	5.5	0.6	2.4
Annual O&M Cost	.16	.09	—	0.1
(Annual Cost)	(10.9)	(5.59)	(0.6)	(2.5)
Annual Benefits	2.5	3.5	3.1	2.8
Electric Power 1/				
Annual Amortized Capital Cost	42.0	42.0	42.0	44.0
Annual O&M Cost	35.0	35.0	35.0	21.3
(Annual Cost)	(77.0)	(77.0)	(77.0)	(65.3)
Annual Benefits	81.0	81.0	81.0	81.0
Recreation				
Annual Amortized Capital Cost	8.3	6.8	6.5	7.4
Annual O&M Cost	1.2	1.0	0.7	1.1
(Annual Cost)	(9.5)	(7.8)	(7.2)	(8.5)
Annual Benefits	8.1	6.1	4.1	8.1
Total				
Annual Amortized Capital Cost	74.4	63.7	49.1	59.4
Annual O&M Cost	37.4	37.1	35.7	22.8
(Annual Cost)	(111.8)	(100.8)	(84.8)	(82.2)
Annual Benefits	102.5	101.5	88.2	101.7

1/ A, B, C and COE-TILP computed at 15.0 percent private fixed charge rate for 50 years.

Table 16-10. Annualized Costs and Benefit Factors at 5-7/8 Percent, Electric Power and Recreation Purposes with Project Life of 50 Years, including TILP. All Other Purposes at 100 Year Project Life (In millions of dollars)

Project Purpose:	Alternative A	Alternative B	Alternative C	TILP Multi-Purpose
Water Supply				
Annual Amortized Capital Cost	24.0	17.0	--	10.0
Annual O&M Cost	1.0	1.0	--	0.3
(Annual Cost)	(25.0)	(18.0)	--	(10.3)
Annual Benefits	18.9	18.9	--	17.1
Flood Control				
Annual Amortized Capital Cost	19.2	9.9	1.0	4.3
Annual O&M Cost	.16	.09	--	0.1
(Annual Cost)	(19.4)	(10.0)	(1.0)	(4.4)
Annual Benefits	2.5	3.5	3.1	2.8
Electric Power 1/				
Annual Amortized Capital Cost	42.0	42.0	42.0	44.0
Annual O&M Cost	35.0	35.0	35.0	21.3
(Annual Cost)	(77.0)	(77.0)	(77.0)	(65.3)
Annual Benefits	81.0	81.0	81.0	81.0
Recreation				
Annual Amortized Capital Cost	13.0	10.7	10.1	11.6
Annual O&M Cost	1.2	1.0	0.7	1.1
(Annual Cost)	(14.2)	(11.7)	(10.8)	(12.7)
Annual Benefits	8.1	6.1	4.1	8.1
Total				
Annual Amortized Capital Cost	98.2	79.6	53.1	69.9
Annual O&M Cost	37.4	37.1	35.7	22.8
(Annual Cost)	(135.6)	(116.7)	(88.8)	(92.7)
Annual Benefits	115.3	114.3	88.2	113.3

1/ A, B, C and COE-TILP computed at 15.0 percent private fixed charge rate for 50 years.

Table 16-11. Annualized Costs and Benefit Factors at 7-1/2 Percent, Electric Power and Recreation Purposes with Project Life of 50 Years, Including TILP. All Other Purposes at 100 Year Project Life (In millions of dollars)

Project Purpose:	Alternative A	Alternative B	Alternative C	TILP Multi-Purpose
Water Supply				
Annual Amortized Capital Cost	30.6	21.6	—	12.8
Annual O&M Cost	1.0	1.0	—	0.3
(Annual Cost)	(31.6)	(22.6)	—	(13.1)
Annual Benefits	23.7	23.7	—	21.4
Flood Control				
Annual Amortized Capital Cost	24.4	12.7	1.3	5.4
Annual O&M Cost	.16	.09	--	0.1
(Annual Cost)	(24.6)	(12.8)	(1.3)	(5.5)
Annual Benefits	2.5	3.5	3.1	2.8
Electric Power 1/				
Annual Amortized Capital Cost	42.0	42.0	42.0	44.0
Annual O&M Cost	35.0	35.0	35.0	21.3
(Annual Cost)	(77.0)	(77.0)	(77.0)	(65.3)
Annual Benefits	81.0	81.0	81.0	81.0
Recreation				
Annual Amortized Capital Cost	16.0	13.2	12.5	14.4
Annual O&M Cost	1.2	1.0	0.7	1.1
(Annual Cost)	(17.2)	(14.2)	(13.2)	(15.5)
Annual Benefits	8.1	6.1	4.1	8.1
Total				
Annual Amortized Capital Cost	113.0	89.5	55.8	76.6
Annual O&M Cost	37.4	37.1	35.7	22.8
(Annual Cost)	(150.4)	(126.6)	(91.5)	(99.4)
Annual Benefits	115.3	114.3	88.2	113.3

1/ A, B, C and COE-TILP computed at 15.0 percent private fixed charge rate for 50 years.

Table 16-12 Annualized Costs and Benefit Factors at 3-1/8 Percent With Project Life at 100 Years for All Authorized Purposes Except Electric Power (in millions of dollars)

Project Purpose:	Alternative A	Alternative B	Alternative C	TILP Multi-Purpose
Water Supply				
Annual Amortized Capital Cost	13.4	9.4	-	5.6
Annual O&M Cost	1.0	1.0	-	0.3
(Annual Cost)	(14.4)	(10.4)	-	(5.9)
Annual Benefits	10.9	10.9	-	9.8
Flood Control				
Annual Amortized Capital Cost	10.7	5.5	0.6	2.4
Annual O&M Cost	.16	.09	-	0.1
(Annual Cost)	(10.9)	(5.59)	(0.6)	(2.5)
Annual Benefits	2.5	3.5	3.1	2.8
Electric Power 1/				
Annual Amortized Capital Cost	42.0	42.0	42.0	44.0
Annual O&M Cost	35.0	35.0	35.0	21.3
(Annual Cost)	(77.0)	(77.0)	(77.0)	(65.3)
Annual Benefits	81.0	81.0	81.0	81.0
Recreation				
Annual Amortized Capital Cost	6.8	5.6	5.3	6.1
Annual O&M Cost	1.2	1.0	0.7	1.1
(Annual Cost)	(8.0)	(6.6)	(6.0)	(7.2)
Annual Benefits	8.1	6.1	4.1	8.1
Total				
Annual Amortized Capital Cost	72.9	62.5	47.9	58.1
Annual O&M Cost	37.4	37.1	35.7	22.8
(Annual Cost)	(110.3)	(99.6)	(83.6)	(80.9)
Annual Benefits	102.5	101.5	88.2	101.7

1/ Alternatives A, B, C and COE-TILP are held at 50 years and 15.0 percent.

Table 16-13 Annualized Costs and Benefit Factors at 5-7/8 Percent With Project Life at 100 Years for all Authorized Purposes Except Electric Power (in millions of dollars)

Project Purpose:	Alternative A	Alternative B	Alternative B	TILP Multi-Purpose
Water Supply				
Annual Amortized Capital Cost	24.0	17.0	-	10.0
Annual O&M Cost	1.0	1.0	-	0.3
(Annual Cost)	(25.0)	(18.0)	-	(10.3)
Annual Benefits	18.9	18.9	-	17.1
Flood Control				
Annual Amortized Capital Cost	19.2	9.9	1.0	4.3
Annual O&M Cost	.16	.09	-	0.1
(Annual Cost)	(19.4)	(10.0)	(1.0)	(4.4)
Annual Benefits	2.5	3.5	3.1	2.8
Electric Power 1/				
Annual Amortized Capital Cost	42.0	42.0	42.0	44.0
Annual O&M Cost	35.0	35.0	35.0	21.3
(Annual Cost)	(77.0)	(77.0)	(77.0)	(65.3)
Annual Benefits	81.0	81.0	81.0	81.0
Recreation				
Annual Amortized Capital Cost	12.3	10.1	9.6	11.0
Annual O&M Cost	1.2	1.0	0.7	1.1
(Annual Cost)	(13.5)	(11.1)	(10.3)	(12.1)
Annual Benefits	8.1	6.1	4.1	8.1
Total				
Annual Amortized Capital Cost	97.5	79.0	52.6	69.3
Annual O&M Cost	37.4	37.1	35.7	22.8
(Annual Cost)	(134.9)	(116.1)	(88.3)	(92.1)
Annual Benefits	110.5	109.5	88.2	109.0

1/ Alternatives A, B, C and COE-TILP are held at 50 years and 15.0 percent.

Table 16-14 Annualized Costs and Benefit Factors at 7-1/2 Percent with Project Life at 100 Years for all Authorized Purposes Except Electric Power (in millions of dollars)

Project Purpose:	Alternative A	Alternative B	Alternative C	TILP Multi-Purpose
Water Supply				
Annual Amortized Capital Cost	30.6	21.6	-	12.8
Annual O&M Cost	1.0	1.0	-	0.3
(Annual Cost)	(31.6)	(22.6)	-	(13.1)
Annual Benefits	23.7	23.7	-	21.4
Flood Control				
Annual Amortized Capital Cost	24.4	12.7	1.3	5.4
Annual O&M Cost	.16	.09	-	0.1
(Annual Cost)	(24.6)	(12.8)	(1.3)	(5.5)
Annual Benefits	2.5	3.5	3.1	2.8
Electric Power 1/				
Annual Amortized Capital Cost	42.0	42.0	42.0	44.0
Annual O&M Cost	35.0	35.0	35.0	21.3
(Annual Cost)	(77.0)	(77.0)	(77.0)	(65.3)
Annual Benefits	81.0	81.0	81.0	81.0
Recreation				
Annual Amortized Capital Cost	15.6	12.8	12.2	14.0
Annual O&M Cost	1.2	1.0	0.7	1.1
(Annual Cost)	(16.8)	(13.8)	(12.9)	(15.1)
Annual Benefits	8.1	6.1	4.1	8.1
Total				
Annual Amortized Capital Cost	112.6	89.1	55.5	76.2
Annual O&M Cost	37.4	37.1	35.7	22.8
(Annual Cost)	(150.0)	(126.2)	(91.2)	(99.0)
Annual Benefits	115.3	114.3	88.2	113.3

1/ Alternatives A, B, C and COE-TILP are held at 50 years and 15.0 percent.

XVI.B.4 PRIMARY AND SECONDARY ECONOMIC IMPACTS

The purpose of this analysis is to evaluate, compare and rate the primary and secondary economic impacts of alternative program packages with that of TILP. Chapters XII through XV present an initial evaluation of economic impacts of each of the alternatives considered under each of the authorized purposes. The analysis which follow, summarize the various kinds and levels of economic impacts that can be expected to occur for each of the selected alternatives formulating the program packages.

The nature and scale of economic impacts will vary in each alternative depending upon the following:

1. Needs met or satisfied by the alternative.
2. Specific siting of the alternative project or projects.
3. Design scale of the alternative.
4. Timing and phasing of the project development.
5. Markets served by the specific alternatives.
6. Economic and social characteristics of the general area where the project is sited.

In addition to the above factors, the primary and secondary economic impacts will vary with each alternative and the combination of alternatives formulating an alternative program package. This may depend on the existing and available local infrastructure and public service capacity to absorb the added service demands as specified by the ultimate design of a particular alternative and the ability of the local economy to absorb a portion of the implied impacts within its existing economic structure.

Definition of Impact Measures

Each of the selected alternatives and the program packages were evaluated against the following economic criteria:

1. Total employment generated.
2. Impacts on commercial activity; retail trade, hotels and motel type development.
3. Impacts upon the local tax base and property values.

The evaluation of alternative program packages in terms of their primary and secondary economic impacts is provided below following a summary of primary and secondary impacts resulting from the development of TILP and DWGNRA upon the defined seven-county impact area. The economic evaluation is made comparing the initial phase of development of the alternatives with the corresponding first phase (1985) of TILP/DWGNRA.

Summary of TILP/DWGNRA Related Impacts

Chapter XXII in Part E of the Comprehensive Review Study of the Tocks Island Lake Project and Alternatives evaluates and quantifies in detail the nature and scale of primary and secondary economic impacts resulting from the development of TILP and DWGNRA. These TILP related primary and secondary economic impacts are summarized below so as to compare and evaluate the implied nature of economic impacts under each alternative program package with TILP related impacts.

As detailed in Chapter XXII, the development of Phase I of TILP/DWGNRA and attendant other facilities will generate about 3,000 direct and indirect jobs and attract about 6,000 people to the seven-county area over the next decade. The induced population of 6,000 persons means an addition of about

2,000 households to the area and the same number of permanent housing units. Table 16-15 following, summarizes TILP related economic impacts for the year 1985 (corresponding with Phase I).

Table 16-15 Summary of Primary and Secondary Phase I TILP/DWGNRA Induced Economic Impacts, 7-County Impact Area

	~~Ultimate~~ Impact Scale
Potential Tourist Generated Retail Sales in the Area	$ 34,890,000
Direct Employment	1,960
Indirect Employment	985
Total Employment	2,945
Total Population	5,890
Permanent Housing	2,000
Second Homes	Development Accelerated. Net Increment Minimum.
Land Acquisition (acres)	
TILP	23,567
DWGNRA	41,927
Total	65,494
Estimated Annual Taxes Foregone	
TILP	$ 595,800
DWGNRA	626,400
Total	$1,222,200

As shown in the table above, the development of TILP and DWGNRA will remove nearly 65,500 acres of land from local tax roll resulting in approximately $1,222,200 of tax losses annually to local jurisdictions.

In addition to the economic impacts noted in the above table, an analysis of the transportation improvements (see XXV and XXII.A.4.) attributable to TILP and DWGNRA needs (Phase I, 1985) estimated a highway capital improvement cost of $240,000,000 (present dollars). An additional $400,000,000 would be required for highway improvements necessitated only by projected non-TILP/DWGNRA related growth by 1985.

As noted in Cahpter IX, a major factor in determining the trophic state of the Tocks Island Lake is the contribution of point and non-point sources to the drainage area. The capital costs of a program of sewerage treatment facilities for controlling point sources is estimated at roughly two million dollars. (85% phosphorous removal and about four million dollars if 95% phosphorous removal is required.)

The significance of these economic impacts, transportation infrastructure costs and environmental central costs can be ranked and compared according to their relative order of magnitude. Phase 1 transportation costs far exceed the other two factors.

The discussion of the primary and secondary economic impacts attributable to each of the three alternative program packages, which follow, is constrained by the definition and specificity of each alternative provided. The lack of siting data for some alternatives or only a general discussion of other alternatives preclude extensive economic evaluation of these alternatives. The evaluation of economic impacts, therefore, contain and are based upon professional judgments as to the extent and the nature of the impacts generated and are consistent with the level of detail of the program formulation procedure.

XVI.B.4(a) Alternative Program Package "A"

The alternative program package "A" which is based upon maximization of economic growth and satisfaction of needs comparable to TILP consists of the following four alternatives: 1) combined cycle for electric power; 2) maintenance of Philadelphia and Camden systems at low flow and reservoirs on tributaries for water supply; 3) state parks and programs for recreation; and 4) construction of "dry" dams for flood control purposes. Recreation also includes DWGNRA without TILP.

Combined Cycle Alternative

As a substitute to pump storage proposal of generating electric power in TILP, only one alternative -- combined cycle -- mode of generating peak level power demand has been incorporated in each of the three "A", "B" and "C" -- program packages.

According to available and provided information, the combined cycle plants can be characterized as follows:

1. Combined cycle plants are being packaged in sizes from 200 MWE to 400 MWE.

2. Siting flexibility is not nearly as great as for gas turbines alone, because a larger amount of land is needed and water is required for the steam side of the cycle.

3. Generally speaking, water usage in the combined cycle plant will be considerable -- be less than the traditional steam based plant but more than for a pumped-storage plant.

4. Combined cycle plant could be installed in about four years and a plant generating comparable output to proposed pump storage facility with TILP would require 175 acres as opposed to 400 acres of land for pump storage.

The impact of a combined cycle plant could be diffused over a number of sites since more than one plant will be built to achieve 1,300 MW of peaking power capacity. This would result in greater land demand than the pump storage proposal which is site specific in one facility. These variables are likely to result in greater construction employment and greater equipment costs made in specific local areas. The range of other impacts are based upon specific siting and plant size information.

Maintenance of Philadelphia/Camden Systems

Maintenance of Philadelphia/Camden systems are not expected to generate any significant local economic impacts. Construction impacts under this alternative will be negligible. Estimated storage yard and equipment expenditures, however, will create some positive impacts on the local area economy.

Reservoirs on the Tributaries

The construction of upstream dams as an alternative to TILP in terms of water supply will result in a significant amount of positive as well as negative economic impacts. The construction of Tocks Island dam will result in an employment of about 300 persons on the average per year over the eight-year construction period with peak employment in year 4, 7 and 8. The construction of alternative reservoirs [illegible] tributaries and the associated dams of different sizes will be comparable to TILP related construction employment.

The total cost of constructing reservoirs with outputs equal to TILP has been estimated at about $290 million including interest costs during construction. Expenditures of this large amount will, no doubt, create substantial impact on local and regional economy in terms of equipment and materials bought and payroll created.

The construction of upstream dams as an alternative to the Tocks Island Lake Project will reduce the real property tax base and therefore, the revenues of the jurisdictions in which they are located. The revenues lost will be in the form of real property taxes foregone due to substantial acquisition of land by the Federal Government. This land is removed from the local government's tax rolls, reducing income derived from real property taxes.

Most of the proposed alternative dams are estimated to necessitate the acquisition of between 4,000 and 6,000 acres. The total amount of land required for each dam and its attendant reservoir was estimated by adding to the acreage of land to be flooded 10 percent representing the easement necessary for support structures (roads, electric power lines, public access, launching ramps).

To estimate property taxes foregone due to each proposed dam, a factor representing property tax revenues per acre in 1973 was developed. This factor was derived by multiplying each local jurisdiction's effective (equalized value) tax rate by the average value of each acre in that jurisdiction. The resulting measure of property tax revenue per acre was multiplied by the estimated total acreage required for the dam and reservoir, to obtain an estimate of potential property tax revenue loss to local jurisdictions.

Table 16-16 Estimated Real Property Tax Revenue Losses, Land Acquisition, Alternative Program Requirements

State, County and Dam	Acreage Required	Property Tax Revenue per Acre	Estimated Property Tax Loss 1/	Program Alternative 2/ WS	FC	R
New Jersey						
Warren and Morris Counties						
(Hackettstown)	5,060	$52.20	$264,000	A/B		B
Sussex County						
(Flat Brook)	4,725	$34.01	$160,700		B	
New York						
Orange County						
(Bridgeville)	4,140	$21.12	$ 87,400		B	
Pennsylvania						
Carbon County						
(Tobyhanna)	13,156	$ 1.07	$ 14,000	A/B		B
Monroe County						
(McMichael)	5,951	$ 1.26	$ 7,500	A/B	B	B
(Girard)	4,202	$ 0.96	$ 4,000	A/B	B	
Pike County						
(Lackawaxen)	5,747	$ 0.77	$ 4,400	A/B		
(Shohola Falls)	6,000	$ 0.90	$ 5,400	A/B	B	B
Wayne County						
(Hawley)	4,301	$ 0.59	$ 2,500	A/B	B	
(Sterling)	855	$ 0.41	$ 40[illegible]		B	

Notes: 1/ Data in constant 1974 dollars.
2/ Program alternatives were selected in Chapter XVI.A. WS refers to water supply, FC to flood control and R recreation.

Sources: Pennsylvania Department of Community Affairs, New Jersey Department of Community Affairs, New York State Comptroller's Office

Table 16-17 Projected Total Federal Land Acquisition for TILP and DWGNRA and Resulting Estimated Loss of Property Tax Revenues, 1985

County/Township	Total Acres TILP	Total Acres DWGNRA	% of Total Acres in Twps.	Estimated Taxes Foregone TILP	Estimated Taxes Foregone DWGNRA	Estimated Taxes Foregone Total
Sussex County	(9,920)	(14,899)		($509,900)	($517,900)	($1,027,800)
Walpack	5,543	9,484	97.4	$277,800	$322,600	$ 600,400
Sandyston	2,050	4,537	24.9	$109,000	$163,800	$ 272,800
Montague	2,327	878	11.1	$123,100	$ 31,500	$ 154,600
Warren County	(2,544)	(10,410)		($ 23,800)	($ 60,400)	($ 84,200)
Pahaquarry	2,544	10,224	100.0	$ 23,800	$ 58,900	$ 82,700
Blairstown	--	154	0.8	--	$ 900	$ 900
Knowlton	--	32	0.2	--	$ 600	$ 600
Pike County	(7,929)	(11,284)		($ 52,600)	($ 41,700)	($ 94,300)
Lehman	3,353	5,265	27.9	$ 22,700	$ 20,300	$ 43,000
Delaware	2,495	4,332	23.6	$ 18,600	$ 18,400	$ 37,000
Dingman	799	1,649	6.7	$ 2,500	$ 2,900	$ 5,400
Milford	216	14	2.7	$ 1,300	--	$ 1,300
Westfall	1,066	24	5.4	$ 7,500	$ 100	$ 7,600
Monroe County	(3,174)	(4,138)		($ 9,500)	($ 5,000)	($ 14,500)
Stroud	--	102	0.5	--	$ 300	$ 300
Smithfield	26	2,498	16.3	$ 100	$ 2,400	$ 2,500
Middle Smithfield	3,148	1,538	13.8	$ 9,400	$ 2,300	$ 11,700
Northampton County	--	(1,196)		--	($ 1,400)	($ 1,400)
Upper Mount Bethel	--	1,196		--	$ 1,400	$ 1,400
Total	23,567	41,927	19.1	$595,800	$626,400	$1,222,200

Note: Estimated taxes foregone are in constant 1974 dollars.

Source: U.S. Army Corps of Engineers, Pennsylvania Department of Community Affairs, New Jersey, Department of Community Affairs

The dams proposed for New Jersey represent the greatest dollar amount of loss. This is primarily because New Jersey property taxes are levied at a higher rate than in the other two states and the average value of land per acre is higher. Pennsylvania jurisdictions would not be substantially impacted as the dollar amount of loss is slight and they depend much less on property tax revenues than do New Jersey counties. (For a full discussion of the revenue structure in the three states and an analysis of the impact of TILP on these revenues, see Chapter XXII.C.2(f) (2)).

In comparison to the TILF and DWGNRA the alternative program land acquisition requirements will have a much different impact. The proposed alternative programs require more land than the TILP, although additional lands to be acquired are scattered over a large area. Table 16-17 shows that $1,222,200 of property tax revenue will be lost annually to 15 townships following public acquistion of all lands for TILP and DWGNRA. Table 16-16 shows the estimated property tax losses for each tributary dam required to implement alternative programs A and B selected in Chapter XVI.A. The estimated annual loss for alternative program A dams, including the Tocks Island dry dam, is $301,800 to two townships in New Jersey and seven townships in Pennsylvania. The estimated annual loss alternative program B is $550,300 to one township in New York, three in New Jersey and nine in Pennsylvania.

Tax losses will be in proportion to new land acquisitions and local tax rates. However, in addition to these impacts, the loss of over $1.2 million due to DWGNRA without TILP must also be considered in the impact evaluation.

Construction of "Dry" Dams

The proposed alternative to control floods by developing a "dry" dam at the Tocks Island site or on tributaries will cost about $200,000,000 with $80,000,000 spent on construction and the remaining for other project related costs. An expenditure of this magnitude will generate employment at a site where this dam would be built.

New State Parks and Programs

Detailed discussion of likely impacts resulting from this alternative is presented in Chapter XIII. It identifies a number of potential areas where new state parks can be created to satisfy a recreation need of some 6,000,000 individuals. For comparative purposes with the first phase of development of DWGNRA with TILP, a first phase recreation component is scaled to provide for 2,000,000 annual visitation from new state parks and programs and 2,000,000 from DWGNRA without TILP. This alternative is expected to meet an equivalent amount of need for swimming, picnicking and boating to TILP in its first and ultimate phases.

Although such a visitor flow will generate substantial economic benefits via expenditures for transportation, lodging, food and other items, the overall primary and secondary impacts of this alternative will be shared by many localities, thereby reducing the induced employment and income impacts. Similarly, to the extent, visitor volume is split between a number of state parks and programs scattered over a wider region, the impacts on lodging, local community land use, public services and the like will be somewhat reduced.

In summary, the alternatives formulating program package "A" vary somewhat in terms of overall economic impacts from that of TILP. However, by and large, the overall primary and secondary impacts resulting from the development of program package "A" elements could well exceed those of TILP, but the structure and distribution of these impacts is likely to be substantially different from that of TILP upon the 7-county impact area.

XVI.B.4(b) Alternative Program Package "B"

The alternative program package "B" consists of the following component alternatives: 1) combined cycle; 2) reservoirs on tributaries; 3) opening closed reservoirs, more use of existing facilities and DWGNRA without TILP; and 4) structural and non-structural combinations for flood control purposes. Collectively, these alternatives are designed to satisfy a reduced level of need. The primary and secondary economic impacts for combined cycle, reservoirs on tributaries and "dry" dams have been discussed earlier and they will change only with respect to the specific siting and construction of a number of facilities to satisfy a reduced level of need. The following briefly discusses the nature of impacts for the recreation alternatives incorporated in this program package.

Open Closed Reservoirs

Examination of this alternative indicates the net benefits to be moderately positive. As detailed in Chapter XIII, the alternative proposes to open a number of currently closed public and private reservoirs in the Pequannock Watershed in New Jersey. These are protected reservoirs in public ownership for water supply purposes.

However, the capacity of these reservoirs together with the expanding of State Parks to handle 7,167,000 visitors annually in its ultimate phase will create development pressures in the retail and commercial sectors. If these reservoirs or part of them are opened for second home developments, the impact on the local community could be significant. However, since a number of existing closed reservoirs function as water supply and storage for parts of the urbanized areas in New Jersey, it is assumed that strict use and development control will be initiated to minimize adverse impacts upon the water bodies. Nevertheless, the opening of closed reservoirs at Pequonnock being close to major population centers and having large shore lines and water bodies will create substantial economic impacts in terms of new commercial and retail jobs and investments in select communities. The increased visitor traffic at specific reservoir sites could also pose problems similar to those cited for TILP/DWGNRA. In conclusion however, no one single jurisdiction will benefit substantially under this alternative. Economic impacts will be scattered and shared by many local jurisdictions. The overall impacts could well be comparable to or somewhat less than TILP. The variability in economic impacts will rest upon the overnight facilities to be provided at these reservoirs and the overall visitor volume attracted to any one particular facility.

Expanded Use of Existing Facilities

By itself this alternative appears to net out about even on its positive and negative impacts. The most significant negative impacts are in the areas of balanced development while the positive effects come in the areas of economics and recreation.

The impacts on balanced development are generally negative because of the increased reliance on private autos since mass transit would be impractical in this dispersed scheme. While some pressure is placed on small, often ill-equipped, governmental entitites to guide the growth that will occur when these areas are more intensely developed, this is not as great a problem as in alternatives where the visitation is more concentrated. Furthermore, the open space that now exists in these parks will be developed and no additional land will be purchased to replace the lost open space. On the positive side, the economic benefits to the local area residents, while not quantified at this point, are clear. Job growth, especially in the tourist retail and service areas, will occur as a result of the influx of more visitors. Although any growth in the population or real estate activity in the area is going to require increased police and fire protection, there will be an increased tax base from which to offset the expenditures.

Finally, the alternative is structured so as not to develop these parks beyond their natural holding capacity, and therefore provide a recreation experience comparable in quality to the existing facilities.

The estimated cost of opening these identified closed reservoirs and expanding the use of the three state parks is $10-$20 million. The expenditure of this magnitude in appropriate rights-of-oway acquisitions, road developments and other facilities over four scattered sites in the three state region will create only a small amount of primary construction employment.

Structural and Non-Structural Flood Control Programs

This alternative consists of the structural components of dams on tributaries each effectively used at critical areas to provide comparable flood protection benefits to that offered by TILP. The use of these structural combinations in a manner to limit damage around major flood prone urban centers will create economic impacts both via construction and benefits provided through flood protection. A number of proposed dams are sited in rural locations. This would certainly provide an economic boost to those communities over the short-term construction period via increasing jobs and income in the local economies.

The non-structural alternatives -- flood insurance, zoning and flood plain development; specific development and design controls and others will most likely create impacts upon local planning and enforcement institutions. Additional budgets and personnel may be required to develop and implement local non-structural alternatives. Many of the jurisdictions in the Basin already have such controls and can relatively easily expand their functions. Others who do not may be impacted both in terms of expanded budgets and personnel to develop and enforce such alternative flood protection plans. The enforcement of flood plain regulations may remove prime developable land from the inventory of some areas--primarily urban centers. This could result in direct or indirect pressures upon other land areas outside flood plain. In some areas where allowed, specially designed structures would be required resulting in additional development costs for a viable flood plain location. The overall economic impact -- primary and secondary -- is likely to be minor and scattered in select jurisdictions of the Delaware River Basin, however.

In summary, several aspects of Program "B" will have positive economic benefits on local communities in the seven county impact area. However, their scale and distribution will be substantially small and different in nature from that of TILP.

XVI.B.4(c) Alternative Program Package "C"

The alternative program package "C" which is based on a public policy objective of the minimization of cost and the preservation of environmental attributes consists of the following program elements:
1) combined cycle; 2) no public recreation programs except DWGNRA without TILP; and 3) non-structural combinations for flood control.

The previous discussion has evaluated the economic impacts of all of the above except for the recreation alternative. This is briefly discussed below.

No Public Programs

No public program alternative means to have no specific actions to develop substitute recreation facilities but rather to let the private market respond where it is so inclined and let the people seek out other recreation facilities or activities. In this case, the river-based DWGNRA would be developed along the lines of the Save the Delaware Coalition Plan or alternative plans currently being developed by the National Park Service.

The analysis in Chapter IV, XVIII and XIII identified the various scales of unmet recreation needs and specific alternatives that could provide comparable recreation service to that by TILP. "Do nothing" alternative as stated above, assumes the development of DWGNRA without TILP as does the recreation components of "A" and "B". The analysis shows that river-based DWGNRA (Phase I) could attract and accommodate some 2,000,000 visitors and 4,000,000 visitors in its ultimate phase. However, the composition of these visitors between day time and overnight is expected to be different than that projected for DWGNRA with TILP. This would result in reduced level of tourist related dollar expenditures in the area affecting the generation of direct and indirect employment and population impacts upon the seven-county area. It would also reduce the number of commercial, tourist related retail trade, lodging and other facilities that are projected to come about under TILP. (See Chapter XXII).

Relative Comparison of Impacts Among Alternatives and TILP

The following matrix compares the extent of primary and secondary impacts resulting from each of the alternative program packages with impacts developed for TILP in Chapter XXII. The measures are expressed as greater than TILP, similar to TILP or less than TILP.

	Alternatives		
Economic Impact Criteria	A	B	C
Construction Employment	Greater	Similar	Less
Permanent Employment	Similar	Less	Less
Permanent Housing	Similar/Less	Less	Less
Concentrated Impact	Less	Less	Less
Retail/Commercial Activity	Similar	Less	Less
Second Homes	Less	Similar	Less
Tax Base Losses	Greater	Less	Less

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XVI.C. ENVIRONMENTAL EVALUATIONS OF T.I.L.P. AND ALTERNATIVE PROGRAMS

XVI.C.1. INTRODUCTION

The environmental evaluation has been designed to equally assess environmental impact upon the service area (water quality) from construction and operation of the three alternative programs and the Tocks Island Lake Project. The Tocks Island Lake Project has been the subject to numerous investigations involving all aspects of the aquatic and terrestrial environment. Studies dealing with the potential effects of the Tocks Island Lake Project upon the contiguous area, and changes brought about by impounding a free flowing river, commenced prior to 1962. Studies have been performed by the states and the federal government to satisfy political and mandatory environmental requirements as well as by the numerous surrounding universities and colleges seeking to evaluate this project.

Alternative Brograms A, B, and C have evolved as a result of the ongoing Tocks Island Lake Assessment study and, as such, have not been subject to thorough investigation. The flood control and water supply reservoir sitings are generally confined to water-shed basins. Thus, actual positioning of the dam structure and the precise contour lines denoting the area of inundation are unavailable for environmental assessment. Similarly, the power generation element of combined cycles deals with a process which has a number of potential locations and is not confined to specific sites for the purpose of this study. Recreation alternatives included within the programs deal with various levels of user intensity and the opening of previously closed water supply reservoirs. While thorough studies would be necessary to define the implicit environmental impacts of each element of the alternative programs upon any segment of the ecosystem, they are not necessary to provide the comparative evaluation required for the purposes of this study. Therefore, the following matrix analysis have been designed to treat the alternative programs on an equal basis with the much studied Tocks Island Lake Project.

The matrix analysis is performed upon seven individual environmental elements. These elements and corresponding matrix numbers are:

- Water Quality -- Matrix #1
- Aquatic Biota -- Matrix #2
- Terrestrial Biota -- Matrix #3
- Vegetation -- Matrix #4
- Air Quality -- Matrix #5
- Noise -- Matrix #6
- Archaeology and History -- Matrix #7

The symbols used in determining the degree of impact are:

+	Positive Impact
0	No Discernable Impact
-	Minor Adverse Impact
=	Major Adverse Impact

It should be noted that the degree of difference between minor adverse and major adverse can only be derived via professional judgement.

To complete the composite environmental assessment, a number of assumptions had to be made. They are as follows:

1. All federal, state, and local construction guidelines and standards pertaining to environmental quality would be followed.
2. Water quality guidelines pertaining to free flowing rivers and lakes for the protection of wildlife and fisheries would be upheld by the DRBC signatory parties.
3. Flood control dams will pass normal flows without the selective withdrawal capability.
4. Water supply dams will pass normal flows with the selective withdrawal capability.
5. Water supply/flood control dual purpose dams are characterized by a taller crest height than normal water supply dams.
6. The dry dam to be constructed at the site of the proposed TILP (Alternative Program A) will not contain a pool except under flood conditions.
7. Fish passage facilities will be added where deemed necessary for the continuation of existing anadromous fisheries populations.
8. The provisions for passage of natural flows between April 1 and June 30 planned for TILP will apply to the water supply and flood control plans of the alternative programs such that significant adverse impact upon the oyster industry of Delaware Bay will be avoided.

XVI.C.2. SUMMARY OF APPROACH TO EACH OF THE ELEMENTS FORMING THE ALTERNATIVE PROGRAMS

Water Supply

Alternative Program A is composed of the maintenance of the Philadelphia/ Camden water supply systems (Torresdale intake), maintenance of the Camden well fields, and the construction of seven water supply reservoirs. The maintenance of the water supply system involves no environmental impacts above those already experienced in operating and maintaining the present system. Construction of a floating pipeline as a means of extending the Torresdale intake upstream thereby protecting the water supply from salinity encroachment in times of low fresh water flow, would yield primarily short term impacts during construction. If proper screening is utilized across the pipeline intake keeping fish out of the mechanism, long term impacts should be negligible. The amount of fresh water removed from the Delaware may have effect upon the oyster industry in Delaware Bay.

Maintenance of the Camden Well Fields consists of the construction of two separate pipeline; one pipeline extends from the Pine Barrens well fields to the Camden well fields; the other extends from Rancocs Creek to the Camden well fields. The pipelines will range from five to ten miles in length and involve the construction of pump stations at the necessary intervals. At the present time, detailed impacts from pipeline construction upon the ecosystem can not be fully determined. The pipeline corridors have not been mapped nor has pipeline size been determined. Therefore, the matrices do not consider the impact upon the environment from this portion of the alternative programs.

The construction will, in general, entail the preparation of a pipeline easement (if an existing corridor does not exist), application of trenching and the laying of aggregate were needed, construction of support structures (maintenance sheds, concrete pipeline supports, gage stations, and pump stations) and the building of a roadway for pipeline maintenance.

All normal short-term construction impacts upon the environment may be expected. These include vegetation clearing, noise and air pollutants from construction equipment, compacting of soils thereby inhibiting the re-establishment of vegetation, and forced movement of any terrestrial of aquatic biota in the area. Operational, long term impacts are expected to be minimal.

The sites of the proposed reservoirs and their capacities are expressed in Table 16-18 The reservoirs suggested in Program A,B, and TILP are compared in Table 16-19. TILP contains approximately twice the land acreage of the total proposed reservoirs in A and B. Water acreage is somewhat less relative to TILP.

Table 16-18 Locations of Proposed Alternative Water Supply and Flood Control Dams

Reservoir Location	Surface Acres of Permanent Pool	Land Area (Acres)	Alternative Programs A	Alternative Programs B
Hackettstown	1,000	4,600	WS	WS
McMichael	1,180	5,410	WS	FC+WS
Shohola Falls	1,190	5,455	WS	FC+WS
Girard	830	3,820	WS	FC+WS
Tobyhanna*	2,600	11,960	WS	WS
Lackawaxen	1,140	5,225	WS	WS
Hawley	850	3,910	WS	FC+WS
TOTALS	8,790	40,380		
Sterling	190	855		FC
Bridgeville	Dry- 920			FC
Flatbrook	Dry-1,050			FC

FC = Flood Control

WS = Water Supply

* Tobyhanna - The proposed reservoir is located on Tobyhanna Creek, which feeds into the Lehigh, which feeds into the Delaware River.

No additional Land Area is given for Bridgeville, and Flatbrook because they will be only flood control reservoirs, and no additional recreational land area is needed.

Table 16-19 omparison of Impondement Characteristics

	Alternative Programs		
	A	B	TILP/ DWGNRA
Total Surface Area of Permanent Pool	8,790	10,950*	12,000
Total Land Area Required	40,380	40,380+**	72,000
Total Acre-Feet	372,800	372,800+**	744,000

* Flood Impoundments Included.

** Water Supply Impoundment Only.

Flood Control

The dry dam to be constructed in Alternative Program A at the site of the Tocks Island Lake dam is designed to accommodate flows comparable to the 1955 flood. The estimated recurrence interval of 50 to 70 years and at such times would retain an amount of water behind the dry dam comparable to TILP.

Construction of the dry dam would entail all construction impacts contained in Chapter X. However, the construction impacts would be limited to the actual structure and do not include any of the clearing impacts involved in creating a permanent pool. Normal procedures involve clearing all structures, loose materials (uprooted trees, large floatable objects) and anything which would contribute floatable material to the flood pool.

When the dry dam is used for flood control, environmental impacts result from two conditions. The first can be brought about by a very high discharge rate and the second results from extended inundation of area behind the dam. At the maximum flood stage it is possible to discharge 70,000 cfs into the downstream section of the river. This would lower the water quickly and limit the inundation period. This high rate of discharge will cause substantial environmental downstream damage. It is more likely that a slower discharge rate will therefore be used, with the result that the inundation period may average 10 to 15 days. This extended period will have some impacts on much of the vegetation in the inundated area.

The single purpose flood control dams contained in Alternative Program B are expected to have small permanent pools. The pool size at Sterling is the only reservoir calculatable for surface acre and land area. Bridgeville and Flatbrook will, in all probability, act as semi-dry dams.

The clearing procedure for single purpose flood dams involves removal of vegetation within the permanent pool area. As with the dry dam, floatable material will be removed. Trees may be "topped" to flood pool levels to allow recreational access to fishermen using small fishing craft. The non-structural flood control alternatives act as "no-project" when considering environmental effects.

Power

All of the alternative programs involve "combined cycles." These units require use of coolant waters, atmospheric emissions, and support structures including substantial distances of transmission lines. The placement of the power generating facilities will greatly affect the distance transmission line must span and therefore the amount of transmission line corridor to be cleared and subsequently maintained.

The power generating facilities of TILP are presented in Chapter IX.E.

Recreation

The DWGNRA with a free-flowing river is to be considered a constant in all of the proposed alternative programs. Alternative Program A involves the construction of riverfront metroparks and regional superparks as part of the state parks systems. Environmental effects may include increased population pressures upon various natural environmental settings. Individual site analysis is necessary to fully analyze environmental impacts.

The expansion of recreational facilities in Program B is expected to include swimming, boating, camping, and picnicking. Structural support facilities are expected to be minimal. The most important aspect is proper treatment of solid and liquid (sewerage) waste. The NPS has recently established plans for treatment of wastes in the DWGNRA. These include temporary chemical treatment facilities, biological units to handle permanent loads, and rental units to suffice the needs of small out-of-the-way sites. If properly handled, impacts upon ambient water quality via population pressure should be minimal.

The opening of closed reservoirs within Alternative Program B raises important environmental questions. First, impacts upon the water quality from recreational usage may require more expensive treatment efforts. Second, the existing biological balance within a closed reservoir is one of an untapped natural resource. If these areas are opened to receive medium to large visitor populations, the "untapped" natural resource shifts to a "renewable" natural resource. A question which could arise deals with the ability of the resource (fish and wildlife) to renew itself and maintain a reasonable balance. The existing natural resources may be overburdened and lost before the question of "how much pressure" can be answered.

Lastly, non-point sources contributing nutrient or toxic loads to reservoirs undergoing "piggy back" usages or newly opened reservoirs must be considered. With use will follow development. Urban runoff from roadways, drainage gutters and storm drains may adversely affect the water body. Proper planning is the ultimate consideration if any programs are facilitated.

XVI.C.3. WATER QUALITY

The water quality impacts of the alternatives are discussed below. Primary, operational and secondary impacts of the alternatives are examined. Matrix #1, a matrix evaluation of the alternatives and Tocks Island Dam, reflects the discussion below and the water quality evaluation of Tocks Island Dam found in Chapter IX.

The primary or construction impact of the alternatives will be erosion of exposed and disturbed soils at the construction sites leading to a subsequent increase in receiving stream turbidity and increased siltation potential. Considering the rather constant rainfall pattern in the region, specific erosion control measures will have to be undertaken at the construction sites in order to decrease soil loss. Such measures include: (1) minimizing soil exposure by staging of grading and revegetation so that a minimum of soil surface is exposed; (2) decreasing runoff through special grading practices, staging of construction activities and preservation of natural vegetation; (3) shielding the soil surface from the impact of raindrops and the scouring effects of both overland and channelized flow through the use of various surface covers such as mulches or asphalt paving materials; (4) binding soil particles closer together to make them less susceptible to removal by rainsplash or runoff by using clays, organic matter, and the roots of growing vegetation.

MATRIX #1 WATER QUALITY

IMPACTS	ALTERNATIVES A	B	C	TILP
Primary				
Turbidity	=	=	-	=
Operational				
Eutrophication	-	-	0	=
Temperature	-	-	-	-
Flow augmentation	-	-	-	+
Secondary				
Turbidity	-	-	0	-
Urban runoff	-	-	0	-
Sewage and sludge	-	-	0	-
Solid wastes	-	-	-	-

New York, Pennsylvania and New Jersey all have regulations designed to limit the impact of such operations on receiving stream water quality. New Jersey Water Quality Standards limit the turbidity increase to a maximum of 110 to 150 Jackson Turbidity Units (JTU) at any time with the stipulation that turbidity increases cannot be detrimental to the natural biota. Pennsylvania regulations restrict the turbidity increase to a maximum of 150 JTU. New York also has regulations limiting turbidity increases as well as a permit system for work disturbing natural stream beds.

The extent that the construction contractors comply with these regulations will determine the degree of adverse impact expected. Alternative C would involve the least impact as proposed construction is minimal and erosion at construction sites can be controlled through site selection and precautionary measures. Erosion from the reservoir and flood control construction sites of Alternatives A and B and TILP would probably be considerable depending on the degree of erosion control provided. The most noticeable effects will be on the downstream areas. Staging of water supply dam construction in order to meet increased demand should insure that the mainstem of the Delaware will suffer only a minimal increase in turbidity. It should be noted that the effects of turbidity increases due to construction erosion are generally of a short-term nature.

Operational impacts would include the effects of thermal discharges from the electric power generating facilities, potential water quality degradation due to possible eutrophication of water supply and recreational reservoirs, and the ability of alternatives to augment Delaware River flows to maintain water quality.

Although the combined cycle generating facility requires less cooling water than a conventional steam plant (a 400 MWe combined cycle unit would require about 40 percent of the cooling needed by a conventional plant), cooling water will still be needed. At the present time, EPA new source performance standards for steam electric power plants prohibit discharge of heated effluent to receiving waters. A discussion of the alternative technologies available to process heated effluents is contained in V.D.4. T[illegible] NPDES permit applicant (National Pollutant Discharge Elimination System) can show that temperature changes in waters receiving heated effluents will be small and result in preservation and enhancement of a balanced, indigenous community of fish, shellfish and wildlife, EPA may allow him to discharge his effluent to the receiving water. In this case, appropriate effluent standards and a monitoring system would have to be designed to insure that no ecological damage was done. In addition, all states in the area have regulations limiting the water temperature increase caused by a thermal discharge.

Water quality degradation in the proposed reservoirs would result from basin and lake characteristics, including area geology, land use, agricultural practices, urban centers, recreational activity, lake depth, flushing rate, phosphorus loading rate, etc. Considering the amount of data collected and analysis performed on Tocks Island Dam and the lack of such analysis at the proposed sites of alternatives, trophic state projections would be open to considerable question. However, based on background information presented in Chapter IXA, some water quality changes could be expected, especially increases in algal biomass and decreases in hypolimnetic D.O. Similar decreases in water quality at reservoir sites not now allowed for recreation (Program B) would also occur if proper precautions are not taken to limit user impact. Proper sewage and solid waste disposal and minimization of erosion from campgrounds are needed to protect lake water quality. If well-designed facilities are constructed and maintained, recreational use should have minimal impact. Even if substantial degradation occurs, water supply systems may not be adversely affected. Hull (1974) reported that water supply operators treating water released from Tocks Island Dam expect no major difficulties in removing the additional algal concentrations. This observation would, of course, be site-specific and would depend on the water quality in the reservoirs, lakes and rivers now.

Another operational impact of the alternatives might result from the lack of low-flow augmentation capacity within the reservoirs of

Alternatives A and B. As mentioned in IX.H.2(a), Tocks Island Lake will provide about 333 mgd of capacity for low-flow augmentation, mainly for protection against saltwater intrusion. The low-flow augmentation would also insure that existing water quality objectives for DO would be met if required levels of treatment efficiency in the Delaware River Estuary can be implemented. Alternatives A and B will decrease both winter and summer flows in affected tributaries and the Delaware River. As more water is withdrawn from the Delaware to meet water supply needs both in and out of the basin, the violation of salinity and DO water quality objectives will increase.

The secondary impact on water quality caused by the alternatives will be very similar qualitatively to those caused by Tocks Island Lake, but dissimilar quantitatively. The increased availability of water, electric energy and flood protection will enable development to occur with attendant increases in sewage, solid waste, and urban runoff. As it appears that Tocks Island Lake will provide greater growth-inducing potential, its secondary impacts on water quality will be somewhat greater, although as mentioned in Chapter XXII, these will only be slightly adverse if the provisions of PL 92-500 are met. The secondary effects of Alternative A will be somewhat less, the effects of Alternative B even smaller and the secondary effects of C will be the least of all. A further discussion of the secondary effects of Tocks Island Lake is contained in Chapter XXII.

XVI.C.4. AQUATIC BIOTA

The Delaware River Basin contains many valuable fisheries including resident fish species which inhabit the flowing waters of the tributaries and mainstem year-round, shellfish of the Delaware Bay, and migratory species which move from the sea to spawn in fresh waters (anadromous) and those which migrate from fresh waters to the sea to spawn and complete their juvenille stages (catadromous). Therefore, any assessment of the environmental impacts upon the aquatic biota of the basin must consider both resident and transient organisms.

Dam-oriented construction operations will have short-term effects upon the aquatic environment. Increased silt loads, accidental gas and oil spills from construction equipment and channelization for construction bypass are a few of the short-term effects. Construction of tributary impoundments is not expected to affect mainstem water quality. Tributary impoundments in close proximity to each other such as Hawley and Lackawaxen should be constructed on a staged basis so as not to compound impacts.

The seven water supply reservoirs in Programs A and B are located with five of these reservoirs to be placed above Easton. The principal shad spawning territory exists in the mainstem and main branches of the

MATRIX #2 AQUATIC BIOTA

IMPACTS UPON:	ALTERNATIVE A	ALTERNATIVE B	ALTERNATIVE C	TILP
Fisheries from Construction Operations (short-term)	–	–	0	–
Tributary Anadromous Fish Spawning Grounds	–	–	0	0
Mainstem Anadromous Fish Spawning Grounds	0	0	0	=
Natural Anadromous Fish Passage	=	–	0	=
Natural Catadromous Fish Passage	–	–	0	–
Natural Tributary Fisheries	–	–	0	0
Natural Mainstem Fisheries	0	0	0	=
Lake Sport Fishing Potential in the DRB	+	+	0	+
Oyster Production	0	0	0	–

Delaware north of Easton. The proposed alternative reservoirs are expected to be located far enough upstream on the tributaries to allow most of the shad spawning grounds to remain in their natural state. Construction of these reservoirs will, however, have an effect upon any anadromous fish movement and spawning at or immediately below the proposed impoundments. Short-term water quality degradation due to construction operations, actual placement of the dam, and eventual inundation of the riffle areas uses for spawning would hinder the recruitment of shad from these tributaries. If the anadromous fish can negotiate the fish passage facilities, the natural riffle areas above the impoundment could be used for spawning.

The proposed Tocks Island dam potentially blocks the passage of the majority of the anadromous fish population migrating through the Delaware Basin waters (IX.C.2). Thus, TILP will have direct effects upon a significantly greater portion of the shad fishery above East Stroudsburg than either Program A or B. The dry dam proposed in Program A may present similar passage problems as the Tocks Island Dam. Without a fish passage facility, it is unlikely that many shad will move through. Surface or underwater lighting to encourage upstream migration represents a potential, though unproven, itigating measure. The catadromous American eel should pass readily through the dry dam although predation upon elvers in the reservoirs themselves is a potential minor adverse impact.

The specie composition of the tributary streams suggested for impoundment would be altered by inundation. Downstream water quality changes due to construction and operation of the dams could also affect the natural specie composition. Since the purpose of both flood control and water supply reservoirs is to impound water for human use and/or safety, demands will be placed upon the normal flow schemes by reducing flows in times of high user needs or natural flood cycles. The sport fish composition in the free-flowing streams below the dam sites may be altered to accommodate higher numbers of forage fish capable of withstanding increased temperatures and turbidity. Most adversely affected by widespread damming of the basin tributaries in either alternative program A or B will be the excellent stream trout fishing characterizing these waters. The Tocks Island Lake reservoir is not expected to change the specie composition of the tributaries except in the potentially inundated lower Flatbrook, Bushkill and Minisink.

Tributary impoundments are not expected to affect natural specie composition within the mainstem. As explained in earlier sections, the Tocks Island Lake Project will alter the specie composition within the area of the impoundment, slightly alter specie composition of the mainstem below the impoundment, and have no effect upon the specie composition of the mainstem above Port Jervis. The mainstem fishery is productive, though underfished, in the area of the proposed TILP impoundment. Coupled with high natural scenic quality, the improved access resulting from the DWGNRA will adequately fulfill the fishing needs of the basin's recreational fishermen. Therefore, the effects upon the natural mainstem river fisheries within the area of the TILP impoundment are considered to be major adverse. Whereas natural stream fishing will be lost, lake sport fishing will be enhanced by either Programs A and B or TILP.

Estuary productivity, especially concerning the oyster population, is expected to be maintained under the proposed natural flow augmentation scheme of any of the Programs or TILP. The loss of occasional storm-derived summer flushing activity which can restrict post-reproduction movement of the oyster drill and supply additional organic materials to the oyster beds can be considered as a minor adverse effect on TILP. However, passage of the April 1 - June 30 stream flows will prevent a major adverse impact upon the oysters (IX.H). The natural flow rhythm of the basin will be less affected by the alternatives than with TILP and consequently any adverse effects will probably not be detectable.

As noted in the above analysis, both tributary and mainstem impoundments will result in the loss of the natural fisheries in the immediate area. Because of the lack of site specific planning and biological data on the pertinent tributaries, it is impossible to delineate the precise effects of Programs A and B. Consequently, TILP may appear to be more destructive to the aquatic environment than A or B, even though a series of isolated projects may be more destructive to the basin fisheries than TILP. Program B would be the least damaging to the anadromous fish (except Program C) but it involves more extensive flood control damming. Without further study of Programs A and B, though, no definitive judgement can be made determining whether Program A, B, or TILP is least damaging. Nonetheless, it is clear that Program C, which leaves the basin waters in their natural state, is definitely the soundest approach to take when considering the future of the aquatic environment in the Delaware Basin.

XVI.C.5 WILDLIFE

Alternative Programs A and B differ only slightly in the wildlife impacts that would result from their implementation. The major concern in each case is the amount and type of habitat lost to clearing of vegetation for the creation of permanent pools behind flood control dams, multi-purpose dams, or within water-supply reservoirs.

Alternative Program A would inundate 8,790 acres of land. All vegetation will have to be completely cleared, in turn destroying all terrestrial habitat and faunal food resources with it. In its place, however, will be an expanded aquatic habitat. Program A would further have a dry dam located at the proposed site for Tocks Island Dam. Selective clearing of loose and dead vegetation prevents flotsam and jetsum in time of flood and would not necessarily constitute a detriment to food resources, but rather would remove habitat for such animals as rabbits and pheasants.

Alternative Program B would inundate approximately the same number of acres as Alternative Program A. However, clearing may exceed the 8,790 acre figure to allow for the additional flood control capabilities of McMichael, Shohola Falls, Gerard, and Hawley.

MATRIX #3 WILDLIFE

IMPACTS UPON:	ALTERNATIVE A	B	C	TILP
Terrestrial Habitat	=	=	0	=
Food Resources - Terrestrial	-	-	0	=
Aquatic Habitat	+	+	0	+
Food Resources - Aquatic	+	+	0	+
Rare or Endangered Species	-	-	0	=
Natural Competition for Habitat	-	-	0	=
Hunter Man-Days	-	-	0	-
Wildlife Oriented Recreation	-	-	0	-
Land Migrations	-	0	0	-
Range of Activity	-	-	0	-
Wildlife Populations	=	=	0	=
Wildlife Diversity	=	-	0	-

Further, an additional 1,970 acres could be covered by water during the flood season, by use of the three proposed flood control dams. Some of the acreage will be completely cleared for flood waters and the remainder selectively cleared of vegetation.

The differences between these two Alternative Programs is slight when evaluating wildlife impacts. Great loss of habitat and food is common to both. Either will result in competition for new ranges with some loss to local faunal populations. Some endangered species may be regionally lost. The only notable difference between Programs A and B, and it is slight, would be in land migrations along the Delaware River. The physical presence of a 394 foot high dry dam in Program A would inhibit some migrating species, especially when flood waters are backed up.

Program A would induce or allow for approximately one-third more visitors in its initial phase to use the proposed recreation facilities as in Program B due to the construction of new state parks and programs (Chapter XIII). These visitors must be accommodated, but these accommodations will occur at minimum expense of more clearing for campgrounds, parks, resorts and other recreational areas not conducive to supporting a diverse array of wildlife (except for DWGNRA without TILP) as these facilities are primarily in urban/suburban locations. Program B, although not designed or planned for as many visitors as A, will entail the creation of similar accommodations and perhaps more disruption of habitat areas, breeding patterns, and range, as its recreational component is located in more rural/suburban settings, untampered by man.

In comparing and contrasting Alternative Programs A and B with Tocks Island Dam and Reservoir, there remains a high degree of similarity. Tocks Island will require decimation of 10,000 acres of primarily forested land, all in the same area. As this activity is concentrated in one localized region, there will be an added factor in the competition for adjacent, suitable habitat. The flood control pools and/or water supply reservoirs would be dispersed along tributary streams, in which much smaller individual tracts of land would have to be disturbed, except in the case of the Tobyhanna Reservoir. Initial competition would not be as acute, but total population losses would be proportional to the amount of habitat and food resources destroyed. Maintenance of the flood control dams and water supply reservoirs in Program A will be more extensive than Program B causing a greater disturbance of terrestrial vegetation, thereby disrupting associated wildlife communities therein.

Programs A and B would present somewhat less of a hazard to the rare bog turtle and copperhead snake than TILP, as less lowlying land would have to be cleared. Nesting bald eagles could be pushed out by flooding of the entire valley as it is their major nesting area and flyway. However, construction of a reservoir may in part be beneficial to the eagles (Chapter X.A.4).

Alternative Program C would have very little discernable effect on the existing wildlife situation. As no dams or major recreation areas would be built, no vegetation will have to be removed. Recreational activities, including hunting, would not be affected. Other human activities associated with campgrounds, parks and resorts would not change, except for the programs within the DWGNRA, thereby not perceptibly altering existing conditions. In terms of minimal effects of wildlife, Alternative Program C, coupled with proper management practices within the DWGNRA, is the most acceptable.

XVI.C.6 VEGETATION

The implementation of TILP or any of the alternate programs is not expected to have any beneficial impacts on vegetation. Purchase of portions of the flood plain for preservation, however, would be beneficial. Such measures are included as parts of Programs B and C.

Because the matrix rating values cover a wide range of anticipated impacts, Matrix #4 does not delineate the difference between an impact on vegetation that can be categorized as adverse in one alternative and an extremely adverse impact on an especially sensitive type of vegetation in another alternative. Thus an initial classification of alternative programs via the matrix by severity might be the following: TILP (most impact), A, B, C (least impact). However, a more detailed analysis of the plant communities that would be disturbed or lost indicate that in terms of total vegetation lost and values of communities involved, adversity of impact would be in the following order: B (most impact), TILP and A approximately equal, and C (least impact).

MATRIX #4 VEGETATION

IMPACTS UPON:	ALTERNATIVE			
	A	B	C	TILP
A. Construction				
Mainstream Riparian Vegetation	-	0	0	=
Mainstream Floodplain Vegetation	-	0	0	=
Tributary Riparian Vegetation	=	=	0	-
Tributary Floodplain Vegetation	=	=	0	-
Oldfield Vegetation	-	-	-	=
Cultivated Vegetation	-	-	-	=
Lowland Forest Vegetation	-	-	0	=
Slope & Upland Forest Vegetation	-/=	-/=	-	-
Scrub Oak Barren Vegetation (especially for power lines, possibly recreation)	-	-	-	0/-
Fresh Water Marsh Vegetation	-	=	0	=
Cliff Vegetation	0	0	0	-
Talus Vegetation	0	0	0	=
Ravine Vegetation	=	=	0	-
Rare or Endangered Species	-/=	-/=	0/-	-/=
Erosion of Devegetated Areas	-	-	0	-
B. Operation and Maintenance				
Permanent Inundation of Presently Vegetated Areas	=	=	0	=

MATRIX #4 VEGETATION
(continued)

IMPACTS UPON:	ALTERNATIVE			
	A	B	C	TILP
Intermittant Inundation of Presently Vegetated Areas	=	-	0	-
Erosion Due to Fluctuating Water Levels and Flows	-	-	0	-
Disturbance of Terrestrial Vegetation for Maintenance	=	-	-	-
Disturbance of Aquatic Vegetation for Maintenance	=	=	0	=
Floodplain Community Modification Due to Hydrology and Flow Modifications	= (tributary)	= (tributary)	0	= (mainstream)

MATRIX #4 KEY

Major adverse impact (=) involve:

Loss of 10 percent or more of a native (including successional) plant community in the vicinity of a given project (DWGNRA with TILP or tributary drainage areas for other programs if outside DWGNRA).

Loss of 25 percent or more of an economically important plant community in the vicinity of a given project.

Reduction of the range of any rare or endangered plant species by 10 percent or more in the seven county region.

The following are minor adverse impacts (-):

Loss of less than 10 percent of a native plant community.

Loss of less than 25 percent of an economically important plant community.

Program C would have the fewest and least severe impact on vegetation. The major impacts would be associated with the construction and maintenance of the electric power supply aspects of the program and DWGNRA without TILP.

Program A with its combination of dry dam and tributary dams would have impacts of approximately the same magnitude as TILP. Impacts of construction and operation of the tributary dams and reservoirs will have a greater impact than the mainstream dry dam. Annual flooding behind the dry dam would eliminate those species unable to withstand inundation and favor flood tolerant species so that species composition would gradually change (see discussion of flooding effects upon vegetation, Chapter IX).

Program B would have the severest impact on vegetation because it is estimated that the three tributary flood control dams would have more impact on vegetation than the dry dam. Tributary flood-plain vegetation is very interesting botanically and important as a wildlife resource. Tributary floodplain and riparian communities are generally less disturbed than mainstream communities. The matrix suggests that the impacts of Program B are less adverse than A or TILP. This is because fewer types of plant communities would be disturbed for B. The value of the plant communities and the estimated total amount of vegetation to be lost or disturbed, however, is greater, than for A and TILP, when one also considers the recreation components of greater use of existing facilities and opening closed reservoirs.

For several plant communities (e.g., "tributary riparian woodland" or "ravine") adverse impacts of Program A would have to be considered major although the impacts of B would be considerably more severe.

Effects of Flooding on Upper Slope Forests

Table 16-20 has been prepared to show the types of damage expected to occur with various periods of inundation. The maximum period of inundation in any year is the most critical factor in determining the fate of the forest slopes of the reservoir. A tree is effectively inundated if most of its roots are below the water table. Other factors affecting the future of the slopes are as follows:

1. Species -- flood tolerances of both upland and bottomland species vary considerably. A species found in both upland and bottomland communities is likely to tolerate upland flooding. Black oak is most flood tolerant of the trees characteristic of the slopes above Tocks Island. Tulip poplar is probably second-most tolerant. Hard maple, white pine and hemlock are least flood tolerant. The others are intermediate.

Table 16-20 Effects of Inundation on Slope Vegetation

Period of Inundation	Effects
One day to one week	Death of most seedlings Death of some herbaceous species Damage to sensitive species Damage and possibly death to unhealthy specimens
One to two weeks	Death of most seedlings Death of most herbaceous and some shrubby species Death of sensitive species such as hard maple, white pine, and some oaks Death and/or damage to already weakened specimens Damage to species with intermediate flood tolerance, such as black cherry, beech, and some oaks and hickories
Two to four weeks	Death of all but flood-tolerant species such as black oak and tulip poplar
More than four weeks	Death of 90 to 100% of vegetation. Eventual recolonization by terrestrial vegetation if flooding is very infrequent. Recolonization by aquatic and semi-aquatic vegetation if flooding is frequent.
Permanent	Replacement of plant community with aquatic and semiaquatic speices.

2. Age - seedlings of most or all upland forest trees including tulip poplar, which also grows in bottomland communities, are very sensitive to flooding. Tolerance of black oak seedlings to flooding is expected to be low also, although no information is available.

3. Season of inundation - trees in a dormant condition survive flooding better than those actively growing. Flooding in March or April would be less harmful than flooding in May or June.

4. Frequency of inundation - inundation of one week once during a season may cause little damage but inundation for several periods of one week or even three days would cause major damage or even total devegetation.

5. Vigor of individual-trees already diseased or weak will be more sensitive to flooding than more vigorous individuals.

6. Successional stage of stand - several of the early successional stage trees are quite tolerant to flooding. Aspen is very tolerant, and white birch and sassafras are fairly tolerant. Subclimax forests contain a mixutre of tolerant and sensitive species. Both dominants of the climax white pine-hemlock forest are very sensitive to inundation.

Slopes above reservoirs have been known to become devegetated as a result of flooding even when such flooding has been as infrequent as once in five to eight years. (More specific information as to the period of inundation or the composition of the forest is not presently available.) More commonly mortality is selective if the period of inundation has been shorter than four weeks. In some cases recovery takes place after initial dieback. In other cases apparently healthy trees become weakened or susceptible to root rot or parasites and die at a later time.

In order to avoid major damage to upper slope forests the water table will have to remain almost constantly several feet below the standing forest. Most upland trees can be considered, in effect, inundated if their roots are below the water table. Conifers (white pine, hemlock) usually have tap roots that may be half as long as the aerial portion of the tree, which makes them especially poorly adapted to flooding or to a high water table. Most broad-leaved trees have a diffuse root system and are better adapted to produce new roots above the table.

A permanent rise in the water level will result in a new devegetated zone. Trees will die at different rates and will have to be removed as they die if they become a hazard, or the entire lake may be cleared.

After flooding for any length of time (one week or more) periodic checks will have to be made to determine if any trees have died that may be either a hazard to recreation or a problem to dam operation.

Operation of Tocks Island Lake is not expected to cause total de-vegetation of the slopes above the cleared level. Some of the more sensitive species will be lost at the water line and for several feet above. More moisture-tolerant species are expected to replace the sensitive speices.

Effects of Tributary Dam Flooding

Tributary dam flooding will have more serious implications than mainstream dam flooding. Some of the tributaries have more climax vegetation than the mainstream and this is more sensitive to flooding. Most of the tributaries are located at higher elevations than the mainstream and have proportionately more upland vegetation than the mainstream, although the tributaries have floodplains also. If trees did die and fall into the reservoirs they are expected to cause more problems in the small tributary reservoirs than in the large mainstream reservoirs.

Effects of Dry Dam Flooding

Most bottomland species are adapted to flooding and will survive inundation. Those species not adapted to flooding will be replaced by species that are.

Inundation for a period of up to one week will have little adverse effect on the bottomland adult trees but many herbaceous species will die. Seedlings of some species will die but others will thrive. If flooding is frequent those species with flood-sensitive seedlings will be replaced by more tolerant species when the existing mature trees die. If flooding is less frequent, for example once in five years, seedlings will have a chance to become established before being inundated.

Where floodwaters reach upland slopes tree mortality will begin if inundation lasts for a week or more, and will begin to cause serious problems at approximately two weeks. It is expected that lowland trees will extend their ranges to the normal high water level or higher, and the more sensitive species will be replaced.

XVI.C.7 AIR QUALITY

XVI.C.7(a) Local Ambient CO

All Programs will produce local increases in carbon monoxide as increased traffic will be generated by the additional recreation facilities. Improved automobile emission control devices, however, will have a major effect on air quality and even with the increased travel it is expected that the level will be better than today, and will be well within acceptable limits.

Although these limits will not be exceeded with any of the four alternative programs, Program C with lower volumes of traffic will result in higher quality levels than A or TILP.

Because more pollutants are generated by stop-and-go traffic, air quality levels will be lowered if the required transportation program is not constructed. If there is extreme congestion due to limited facilities, it is possible that there may be localized areas with higher than acceptable CO levels. Since Program B and TILP require the greatest increase in the transportation system, these conditions are more likely for these programs.

While all alternatives are rated "0 - No Discernable Impact" it must be understood that this refers to acceptable levels of CO. In all cases there is come degradation to the air quality of the area due to the increased activity.

XVI.C.7(b) Regional Photochemical Oxidant

A regional increase in photo-chemical oxidants will accompany the various levels of project development. This will likely occur in spite of better emission control devices. Due to the area's presently low oxidant levels future concentrations will not exceed standards in the project area or downwind of the project.

XVI.C.7(c) Power Generation

While all alternatives will produce approximately equal levels of emission, the impact of TILP will be slightly less favorable due to the lower grade of fuel that will be used. Pumped storage will produce emissions indirectly at power generating facilities during off peak hours. It is in effect neither an energy conservation method nor an air pollution reduction method but is an economical method to make use of existing power generating facilities to their maximum capacity.

XVI.C.7(d) Construction

Particulate standards will likely be exceeded at times during construction of reservoirs, highway, and parks. Mitigation measures can be used to reduce the impacts such as using proper methods of brush disposal.

Since construction requirements for Program C are limited to the power plants, the effects would be the least for this alternative. The other programs which require the most construction will be A and TILP. The effects will not be limited to the dam sites and power plants, but will also extend to

MATRIX #5 AIR QUALITY

IMPACTS UPON:	ALTERNATIVE A	B	C	TILP
Ambient Local Carbon Monoxide Levels	0	0	0	0
Regional Increase of Photochemical Oxidants due to Automobile Traffic	C	0	0	0
Increased Emissions from Power Plants (SO_2, NO_x, Particulates)	–	–	–	–
Construction Effects (dust, smoke)	–	–	–	–

new recreational facilities and the highway system, as major improvements are required for handling the traffic.

XVI.C.8 NOISE

XVI.C.8(a) Traffic Noise

There will be increased traffic under all project alternatives. Those with the greatest traffic, TILP in particular, will obviously have a greater impact than Program C. It should be noted that Programs A and B spread the noise over a larger area, since they include recreation facilities in different geographical locations. Program C and TILP limit the impacted areas to the routes leading to the Tocks Island area.

XVI.C.8(b) Construction Noise

All project alternatives involving construction will produce noise. Those with the greater construction requirements, Programs A and TILP, will have the greatest impact. Program C will have the least.

MATRIX #6 NOISE POLLUTION

IMPACTS UPON:	ALTERNATIVE A	ALTERNATIVE B	ALTERNATIVE C	ALTERNATIVE TILP
Traffic Effect on Residences of Local Communities and Along Roadways.	-	-	-	-
Construction Noise	-	-	-	-

XVI.C.9 ARCHAEOLOGICAL AND HISTORICAL RESOURCES

Assessment of archaeological resources within the Delaware River Basin has been primarily restricted to the floodplain zone. The area extending from East Stroudsburg to Port Jervis has witnessed extensive archaeological surveys catalyzed by the planning efforts devoted to the Tocks Island Lake Project (see Chapter XXII.C.5(a)).

Alternative Programs A and B define the potential reservoir sites on tributary watersheds within the Delaware River Basin. The lack of a comprehensive archaeological survey inclusive of tributary areas makes it difficult to determine impacts upon archaeological resources brought about by reservoir construction and operation practices. However, sites have been identified at locations along the Lehigh River, Shohola Creek, and in the Lackwaxen Watershed.

Judging from the proximity of the tributaries to the Delaware River, and the frequency of recovered artifactual material at tributary locations, it is suggested that prehistoric sites are evident at the tributaries. Construction of dams and reservoirs at these tributaries will have substantial adverse impacts to archaeologic remains. Before any such alternatives could be implemented, site survey of the reservoir flood zone is stipulated in those Federal laws regarding preservation

MATRIX #7 ARCHAEOLOGICAL AND HISTORICAL RESOURCES

IMPACTS UPON:	ALTERNATIVE A	B	C	TILP
Soil Column (soil disturbance caused by the introduction of heavy machinery, causing precarious stratigraphic analysis of artifacts, C-14 dating, and pollen analysis) at the Delaware River	=	0	0	=
Soil Column at the Reservoir Sites	=	=	0	0
Artifactual Remains (breakage and exposure)	-	=	0	=
Historic Structures in pool zone (s)	=	=	0	=
Archaeologic and Historical Sites During Temporary Road Construction	-	-	0	-
Archaeological Sites from Inundation at the Delaware River	-	0	0	=
Archaeological Sites from Inundation at the Reservoir Sites	=	=	0	0
Sense of Location Relative to Natural Features and Other Sites	-	-	0	=
Archaeological and Historical Sites from Authorized Recreational Pressure (water-oriented recreation)	-	-	-	=
Archaeological and Historical Sites due to Unauthorized Pressures (vandalism, pothunting, etc.)	=	=	-	=
Border Sites due to Recreation Support Facilities (boat ramps, grading for beaches, etc.)	=	=	0	=

MATRIX #7 ARCHAEOLOGICAL AND HISTORICAL RESOURCES
(continued)

IMPACTS UPON:	ALTERNATIVE			
	A	B	C	TILP
Archaeology as a Science (increased salvage vs. resource conservation)	-	-	0	-
Allocations for Proper Preservation, Interpretation and Display for Archaeologic and Historic Resources	0	0	0	+
Non-structural Historical Sites by Inundation	-	=	0	=

of Archaeological and Historical resources. Survey of the proposed tributary reservoirs would more definitively identify the archaeological resources there.

XVI.C.9(a) Alternative Program A

Impacts to archaeological resources at sites located on the Delaware River under Alternative Program A, would be principally those due to construction of the flood control dry dam. Construction operations which would disturb soil are expected. Archaeological sites located near Tocks Island and throughout the immediate construction area will undergo intensive construction activity. Implementation of mitigation measures inclusive of salvage archaeology and further testing at construction site locations would be necessary. Archaeological sites at upstream locations within the Delaware River Basin should remain relatively undisturbed. It is probable, however, that in the process of using heavy machinery to clear the loose vegetation and wooden structures, archaeological sites will be disturbed.

Clearing of wooden structures implies that historic buildings will be cleared in the flood control area behind the dam. Survey of the historic structures in the flood control area is necessary for the preservation of historic culture resources. Mitigation measures for significant features should be implemented prior to clearing operations. If buildings are destroyed randomly without regard for their historic significance, adverse impacts to the historical resources in the pool zone will occur.

Inundation will be temporary, only during the spring, so archaeological sites will not be permanently inaccessible. Artifactual material in the upper soil would be occasionally exposed to damage by water and erosion, with a flood control reservoir on the Delaware River.

The introduction of an additional seven reservoirs poses the threat of adverse impacts to potential archaeological resources present along tributary rivers. Impacts at the seven sites of the tributary reservoirs would be those due to construction for the dams and inundation by the creation of the reservoirs. Likewise, the construction of new state parks may threaten existing resources particularly in the river-front settings.

XVI.C.9(b) Alternative Program B

Similar to Program A, Program B includes potential unsurveyed archaelogical resources at tributary locations which will be subject to construction and operational impacts. The only construction and operational impacts to the known archaeological sites on the mainstem of the Delaware River in Program B will be those due to the development of water and land oriented recreational facilities. Secondary impacts to potential archaeological sites at the reservoir borders due to population pressure may also occur in the water supply and non-DWGNRA recreation component of this Program.

XVI.C.9(c). ALTERNATIVE PROGRAM C

Alternative Program C is probably the least severe alternative with regard to archaeology. No discernible construction or operational impacts are expected to occur to sites along the Delaware River. Recreational impacts are expected due to increased visiting population with the implementation of the DWGNRA on a free flowing river.

The three alternative Programs "A", "B", "C" are listed here for reference. All assume DWGNRA without TILP under their recreation component. Abbreviations are used in order to make the listings brief:

Program A	Elect. Power:	Combined Cycle
	Water Supply:	Protection of low-flow at Phila/ Camden & reservoirs on tributaries
	Recreation:	New State Parks & Programs
	Flood Control:	"Dry" dam at Tocks
Program B	Elect. Power:	Combined Cycle
	Water Supply:	Reservoirs on Tributaries
	Recreation:	Open closed reserviors and greater use of exist. facil.
	Flood Control:	Structural/non-structural combination dams on tributaries
Program C	Elect. Power:	Combined Cycle
	Recreation:	No public rec. programs
	Flood Control:	Non-structural combination

XVI.D. LAND USE, PUBLIC SERVICE AND TRANSPORTATION EVALUATIONS OF T.I.L.P. AND ALTERNATIVE PROGRAMS

The objectives of this evaluation are to establish a simple framework for the making of value judgements based on carefully defined parameters and to make as few value judgements as possible on as consistent a basis as possible. The procedure is to take the three alternative programs and TILP, each with its own mix of components and compare them according to defined critical issue areas in the broad categories of land use and public infrastructure.

In the course of this study, two levels of basic land use and public infrastructure data has been collected. The more specific has been collected for the seven county impact area of TILP and the more generalized from the entire recreation service area. The various components of TILP obviously fall within the seven county area. The various components of the three programs, inasmuch as they are site specific, are located within the recreation service area.

The critical issue areas which become the evaluation criteria for this matrix are categorized under three major headings:

- Elements of Growth
- Land Use Goals
- Public Infrastructure

It is intended that the elements of growth are the physical results of the various programs and TILP. The goals are the desired future directions, as matters of policy. The public services are the means of achieving these goals through various administrative techniques and physical systems.

The following are the nine critical issue areas under these major headings:

A. Elements of Growth

1. Stimulates new and/or rehabilitated residential development
2. Stimulates commercial development
3. Stimulates industrial development

B. Land Use Goals

1. Disrupts community cohesion
2. Preserves critical open space
3. Preserves existing character and aesthetics
4. Stimulates local economy

C. Public Infrastructure

1. Increases the demand for additional public services relative to local capabilities.
2. Increases the demand for additional public utilities relative to local capabilities.

The evaluation procedure is as follows: Program "A" is examined, and its components which have a positive or negative or little or no impact are identified for each critical issue area. The definition of this issue area is expanded as necessary for this assessment. This step is repeated for Programs "B", "C", and TILP. These initial assessments are arrayed in the form that follows:

	Program A				Program B				Program C				TILP			
Issue Area	electric power	water supply	recreation	flood control	electric power	water supply	recreation	flood control	electric power	water supply	recreation	flood control	electric power	water supply	recreation	flood control
A 1																

An attempt is then made to define a spectrum of impacts to be followed by comparative statements relating the components of Programs "A", "B", "C", and TILP on this issue area. If possible, these impacts are quantified and presented in tabular form. The final step is the drawing of relevant conclusions, with an attempt to describe the total impact of each program and TILP relative to each other for each issue area.

The relative impacts upon the regional transportation system due to Programs "A", "B" and "C" and TILP are also outlined in this section. These comparative impacts are presented in terms of loads that would be placed upon transportation facilities and services; required transportation improvements; critical issue areas; and other broad considerations such as the amenability of recreation oriented transportation surcharges to mass transit solutions.

For reference purposes in the following evaluation, Figure 22-1 on XXII-4 depicts DWGNRA with TILP. It indicates the location of the major recreation facilities and entry points along with estimates of typical summer Sunday visitors and cars by each sub-area as proposed in the Clarke and Rapuano Plan for the Corps and NPS. It should be noted that all the evaluative comments concerning the recreation components compare Programs "A", "B" and "C" with Phase I. of DWGNRA with TILP.

XVI.D.1 ELEMENTS OF GROWTH

The following discussion groups the comparison of residential, commercial and industrial land use issue areas (A.1 - A.3) under Programs "A", "B", and "C" and DWGNRA with TILP. For electric power, the growth impacts in each program are related to the combined cycle proposal. For water supply growth impacts - Program "C" does not provide a water resources project given the projected level of need; Program "B" provides reservoirs on tributaries; and Program "A" includes both of the above. For recreation, growth impacts Program "C" considers DWGNRA without TILP, while Program "B" considers opening closed reservoirs, better use of existing facilities, and DWGNRA without TILP; and Program "A" proposes new state parks and programs and DWGNRA without TILP. For flood control impacts, Program "C" considers the non-structural combinations of flood insurance, flood plain zoning and flood proofing. Program "B" considers dams on tributaries in addition to non-structural measures, while Program "A" considers construction of a "dry" dam at the approximate location of Tocks.

These land use issue area impacts are expressed in four broad qualitative rankings, including high, medium, low, and minimal. The rankings reflect changes to the land use fabric in the immediate area caused by a particular Program. In all cases, the impact is limited to the locality where a particular facility would be situated. These assessements, indicated on the following table, are described in the subsequent text.

Table 16-21 Summary Impacts: Land Use Goals

Issue Area	Program A				Program B				Program C				TILP			
	electric power	water supply	recreation	flood control	electric power	water supply	recreation	flood control	electric power	water supply	recreation	flood control	electric power	water supply	recreation	flood control
A.1: Stimulates Residential Development	minimal	medium	medium	low	minimal	medium	medium	medium	minimal	--	medium	low	low	low	high	low
A.2: Stimulates Commercial Development	minimal	minimal	medium	low	minimal	minimal	medium	minimal	minimal	--	low	minimal	low	minimal	medium	low
A.3: Stimulates Industrial Development	minimal	minimal	minimal	minimal	minimal	minimal	minimal	minimal	minimal	minimal	minimal	minimal	minimal	minimal	minimal	minimal

Under Programs "A", "B", and "C", land use impacts of the electric power combined cycle plant would be minimal for issue areas A.1, A.2 and A.3. This is due to the relatively small sites required (30 acres maximum) and unobtrusive structures. While proper land use planning would dictate minimal 1,000 feet residential buffer zones and 500 feet commercial buffer zones, unobtrusive locations could minimize buffer widths. It is likely that power plants would locate near existing industrial nodes due to fuel transport and storage determinates. Overhead transmission lines would connect such plants with the power grid and these transmission line easements could be as narrow as 20 feet, depending on tower design. Careful siting would not infringe upon existing residential developements but may constrain the location of future developments. Combine cycle facilities as programmed for "A", "B", and "C" may stimulate some industrial growth within the power service area due to rate structures. However, there is no apparent relationship between the location of the facility and localized industrial growth which is what is of concern in this analysis. For TILP, the Kittatinny pump storage plant transmission lines would require a considerably wider, more obtrusive easements. It should be noted that short term construction of the facility will have significant impacts on residential and commercial development due to the need for temporary housing and related commercial services by 500 to 1,000 people over a six year period. The assessment of this impact is indicated as "low" for the duration of the project, however, this reflects a short peaking of significant impacts in issue areas A.1 and A.2.

As water availability is one key land use development determinate, some impact will occur from Programs "A", "B", and "C". Maintaining Philadelphia and

Camden systems at low flows (Program "A") will indirectly increase these cities' capacities to absorb additional industry, with consequent population increases. As construction of a temporary Philadelphia upstream intake would occur on the bottom Delaware riverbed, there will be minimal impact on riverfront land uses. As water lines to Camden will be installed underground, minimal land use impacts would also occur.

Reservoirs on tributaries within Programs "A" and "B", will have significant effects on the tiny Pocono Mountain townships where most are located. Seven reservoirs ranging from 830 to 3,000 acres with wide buffer strips would be located in townships ranging from 88 to 2,021 population as of 1970. These are detailed in the following table:

Table 16-22 Water Supply Impoundments Programs "A" and "B"

Reservoirs on Tributaries	Surface Acres	Township	1970 Population
Hackettstown	1,000	Allamuchy, N.J.	120
Shohola Falls*	1,190	Shohola Twsp, Pa.	574
Lackawaxen	1,140	Lackawaxen Twsp. Pa.	1,363
Hawley*	850	Palmyra Twsp. Pa.	1,204
Girard*	830	Porter Twsp. Pa.	88
McMichael*	1,180	Chestnut Hill, Pa.	2,021
		Jackson, Pa.	1,212
Tobyhanna	3,000	Coolbaugh, Pa.	1,626

* Multi-purpose water supply and flood control impoundments.

The effects would include the displacement of existing land uses in reservoir bed areas and the likely to be severe restrictions on development within buffer zones. Where permitted, the recreational use of such reservoirs would induce permanent and seasonal shoreline residential development. The above effects would create profound land use changes within host townships These changes would not be unlike those caused by building TILP, although at a smaller scale. Virtually no industrial changes can be attributed to reservoir construction, although commercial land uses would reflect net changes in population size and income. The seven additional reservoirs would tend to compound the Pocono region's pattern of thinly disbursed development.

The land use growth impacts of the water supply and flood control components of the proposed Tocks project are considered low or minimal, taken alone, in all three growth impact issue areas (residential, commercial and industrial). Water supply at Tocks, like electric power supply, would most likely reduce its price in the impact area. However, the major constraint is not its availability, but rather the provision of its distribution and treatment system, the major determination of growth patterns and the most costly factor. It should be noted that there are no municipalities which presently take their water from the river within the defined impact area. If there were, those municipalities would be in the best position to increase their allotment from Tocks, having already an intake, treatment and distribution system which would most likely need some modification. The topography of the immediate Tocks region defines those areas most likely to benefit from Tocks' water supply given gravity flow and the limitations of nominal pumping. These include the East Stroudsburg, Marshall Creek, Coolbaughs area of Monroe County, Pennsylvania, as depicted on Figure 4 of Volume I of the TIRES Study. Given the successful financing of this system and the cheaper than average price of raw water, this area may experience growth to a greater degree than the surrounding impact area because of these factors when considering only the water supply stimulus. Flood control provided by Tocks may improve ones psychological impression of the river being more controlled. However, with construction virtually prohibited in the floodway by New Jersey law and likely to be by Pennsylvania law, future structures in the floodway induced by this feeling of assurance from Tocks will be forbidden. The potential for devopment along the edge of the flood plain is likely to remain constant with or without TILP.

Land use impacts for the DWGNRA with a free flowing river portion of the recreation component found in Programs "A", "B", and "C" range from medium to minimal. Commercial development generated is estimated to comprise approximately 300 acres, to include primarily hotels/motels, restaurants, automobile service stations, various retail stores and entertainment facilities. Regardless of the magnitude, commercial development will tend to locate on primary DWGNRA access routes with concentrations occurring at DWGNRA entrances. Primary concentrations, accounting for approximately 75 percent of DWGNRA induced commercial development will occur at Port Jervis, Milford and the Stroudsburgs. There should be moderate residential growth and minimal industrial land use impacts in these locations as it is unlikely that a DWGNRA without TILP will generate many additional jobs or immigration. Induced residential growth is estimated at 1500 acres. These impacts are reflected in Program "C" where the No Public Program recreation alternative assumes only DWGNRA without TILP, and hence, the resultant assessments (A.1 residential: medium; A.2 commercial: low; and A.3 industrial: minimal) reflect the impacts of this recreation development alone. The generated land uses are summarized in Table 16-23 below.

Table 16-23 Estimated External Land Uses Generated by DWGNRA Without TILP

Land Use	Number of Sites	Average Site Size in Acres	Estimated Gross Acreage
Commercial:			
Hotel/Motel	8	5.0	40
Food	70	2.0	140
Entertainment	13	4.0	52
Dry Goods	17	2.0	34
Transportation	3	2.0	6
Total			272
Permanent Residential	2000	.75	1,500

Under Program "A", the recreation alternative of New State Parks and Programs, would improve the overall quality of life within the designated major cities in the recreation service area. Direct effects would include residential rehabilitation, and commercial expansion in the vicinity of both riverfront metroparks and regional superparks. Under Program "B", bringing more visitors to Harriman and Wawayanda State Parks, Pequannock Watershed, and Beltzville Reservoirs will cause some additional commercial development along access routes. The vacation home growth pattern in these areas, may actually be dampened by the additional influx of day users, due to possible road congestion and potential deterioration of the quality of experience. Under both Programs "A" and "B", DWGNRA without TILP is considered in operation, hence its impacts have to be summed to those noted above.

In comparison the land use impacts of the recreation proposal of TILP, a lake based DWGNRA, is summarized as follows. Residential development generated would consist of approximately 4800 acres or over three times that generated by DWGNRA without TILP. The majority of this development would consist of detached dwellings constructed in new subdivisions in the seven county impact area. Commercial development generated by DWGNRA with TILP will cover approximately 900 acres or again, over three times that generated by DWGNRA without TILP. It would likewise be comprised of the same mix of facilities located in a substantially denser fashion along the same access routes, entry locations, and existing centers. It appears that DWGNRA with TILP would have no apparent effect on industrial land usage in the seven county area. This is because TILP would not create any direct or secondary locational advantages for industry within the seven surrounding counties. The generated land uses are summarized in Table 16-24 below.

Table 16-24 Estimated External Land Uses Generated by DWGNRA With TILP

Land Use	Number of Sites	Average Site Size in Acres	Estimated Gross Acreage
Commercial:			
Hotel/Motel	30	5.0	150
Food	185	2.0	370
Entertainment	36	4.0	144
Dry Goods	69	2.0	138
Transportation	18	2.0	36
Total			838
Permanent Residential	6,450	.75	4,838

Source: Projected Establishments and Employment Supportable by Tocks Island-DWGNRA, Phase III (XXII-41)

Impacts of the flood control alternatives in Programs "A", "B", "C" and TILP vary considerably. Non-structural alternatives found in Programs "B" and "C" will have a definite long term impact on reducing flood plain land uses, causing a gradual attrition of the 1,768 dwellings in the flood plain as well as commercial and industrial land uses. A discussion of these impacts follows. The construction of flood control reservoirs in Program "B" will have similar impacts to those previously discussed regarding reservoirs on tributaries. Construction of a "dry" dam at Tocks in Program "A", will have little or no land use impacts beyond the DWGNRA land area although the "dry" dam itself may somewhat limit DWGNRA's location of recreation activities. The net effect would be to cause some day-use oriented development to locate elsewhere within the Poconos and the recreation service area. Program "B" flood control impoundments in addition to those multi-purpose impoundments noted in Table 16-22 include Sterling, with 190 surface water acres in Greene and Grove Towhship on the western edge of Pike County, Pennsylvania; Bridgeville, with 920 surface acres at Bridgeville, New York; and Flatbrook, with 1,050 surface acres in Walpack Township, Pennsylvania. Impacts from these flood control impoundments will be similar to those impacts previously discussed for the multi-purpose impoundments.

Summary of Non-Structural Flood Control Land Use Impacts

It is not practical within the purposes and constraints of this study to detail the specific non-structural measures of flood control appropriate for Programs "B" and "C". These will, of course, vary between programs, and each program will contain in all likelihood, a different mix of measures applied in different locations and patterns and implemented to provide varying degrees of protection. Precise definition of impacts is dependent upon these factors, and hence the following discussion is of a general nature.

The land use impacts of the non-structural flood control alternatives are divided into a discussion of the implications of flood plain management, flood insurance programs and flood proofing.

Of the above three techniques, flood plain management has the most significant land use effects as specific legislation regulates allowable land uses within the floodway and the flood fringe. The applicable federal and state flood plain legislation is discussed in detail in Chapter II.B.3 for the Delaware River Basin.

In summary, the full range of non-structural flood control techniques presently required are covered in the following federal legislation:

- Flood Disaster Protection Act of 1973 (PL 93-234) enacted December 31, 1973
- Water Resources Development Act (PL 93-251) enacted March, 1974

and the following state legislation:

- Article 36 of the New York State Environmental Conservation Law.
- Pennsylvania's Senate Bill 1 (1975) Section 103, Low Disaster Prevention Act
- New Jersey's State Law 8572

Flood plain land use management plans have been developed to varying degrees by both the states and some of their municipalities as a result of the stringent requirements of the above state and federal legislation. A state by state and DRBC summary of plans follows.

As a result of the flood control legislation New Jersey's Department of Environmental Resources is in the process of delineating the flood hazard areas in the state of New Jersey. The state will have direct control over new development in "floodway" and "flood hazard" areas. The floodway is defined as that area which is required to discharge water from a hundred year flood.

The flood hazard area is required for a discharge which is 25 percent greater than that required for a 100 year flood. Areas between the floodway limits and flood hazard area limits form the flood fringe areas. Proposed rules and regulations for development in floodways and flood fringes are currently being reviewed for approval and should appear in the State Register in April, 1975. In general, only open space uses, except for bridges and utilities will be permitted in floodways. A system requiring permits for all construction will control development. By law, the municipalities have jurisdiction over development of the flood fringe. The proposed state regulations, however, include minimum standards which will require flood proofing, raising structures two feet above the natural water level of a 100 year flood. While this program, which is supposed to be the strongest in the nation, will serve to limit land use in the future, it has little impact on existing structures.

New York's State Office of Planning has major responsibility for New York's flood protection program. At this time, it is not as strong as New Jersey's program and generally follows federal guidelines for flood plain delineation and flood proofing requirements. New York State Department of Environmental Conservation has the major responsibility for New York's flood protection program. In 1974 the State Legislature amended the Environmental Conservation Law to provide State assistance to localists to qualify for the National Flood Insurance Program. The State Law further provides that if a local government fails to qualify for participation under the national program or if their qualification is subsequently revoked by the federal government, the Commissioner of Environmental Conservation shall have authority to establish and administer flood hazard regulations to meet minimum federal requirements for program participation. With respect to building construction, the state only has direct control over construction of its own state buildings. Minimal participation of New York Delaware River Basin municipalities in the flood insurance program is attributed to their basically rural nature and a dislike of land use controls.

A study recently completed by Michael Baker and Associates, which delineates the 100 year flood plain and estimates its effects on land use in the flood plain will serve as the basis of Pennsylvania's Department of Environmental Resources program for managing flood plain land uses. This study shows that only 8% of the floodway is developed and recommends strong restriction of development of floodways in the future.

The Delaware River Basin Commission is in the process of developing criteria and methods for delineating flood plains, defining the Commission's role in flood plain management and developing the standards for future development in flood plains. The Anderson-Nichols study, Basin-Wide Program for Flood Plain Delineation, completed in 1973 was the beginning of this process. Anderson-Nichols' recommendation #4 suggests that: 1) development be tightly controlled in a Floodway area and, 2) most development be permitted in Flood Fringe areas if adequately protected against flood losses. Recommendation #5 suggests standards for delineating floodways, flood hazard areas and flood fringes and the uses that should be permitted in each. Other recommendations relate to the development of a land use plan and the role of the Delaware River Basin Commission in its implementation. Of some importance is Recommendation #3 which calls for adoption of Comprehensive Plan Goals and Objectives for Flood Plain Use and Regulations. It suggests that:

1) flood plain use should provide optimum benefits, including environmental and aesthetic benefits, and

2) a flood plain use should be required to bear the full economic and social losses of his flood plain use.

The Delaware River Basin Commission still has not acted on the Anderson-Nichols report. It is being studied by the Flood Plain Advisory Committee which is comprised of two representatives from each of the four states and two representatives of the federal government. Recommendations and suggestions to the Commission should be complete in late spring, 1975. It is believed that the Commission feels any recommendations will be to bring the Delaware River Basin Commission regulations closer to New Jersey's and emphasize the Delaware River Basin Commission's role in standardizing regulations for all four states and include the designing of minimum standards for flood-fringe development.

An analysis of existing and projected land uses within the Delaware River Basin flood plain appears in Chapter II.B.2 and 3. However, the lack of reliable data on the flood plain limits the following discussion to allowed and prohibited future land uses.

A review of the enacted and pending legislation indicates a common objective of prohibiting from both floodways and flood fringes any disposal of solid and liquid wastes and prohibiting from only the floodways all structures for occupancy by either humans or live stock. Within the flood fringe various non-regulated uses include proposed activities with low flood damage potential which do not obstruct flows which are undertaken with full risks accepted by the owner. Within the flood fringe various regulated uses require permits from either the municipality or, if it does not have an adopted plan and procedure, from the state. The regulated uses commonly include public and private recreation facilities, parking areas, utilities and transportation facilities, retaining walls, dams and bulkheads, etc. The issuing of a permit is contingent upon a determination that the proposal will not obstruct the flood flow capabilities nor degrade the environment of the flood plain. There are existing and likely future difficulties in interpretation of what constitutes non-regulated and regulated uses. However, within these uncertainties, general land use and public service impacts can be described.

As noted previously, major impacts are on future land use. The only impact on existing land uses noted in this preliminary analysis is the requiremtn under the National Flood Insurance Program that in order to qualify for flood insurance protection, all existing structures within the floodway must meet minimum requirements set forth in the Program. This is normally achieved with compacted fill beneath the structure with no basement on floor level allowed below. Where allowed, the flood protection elevation may also be achieved via flood-proofing or other measures or methods, usually allowed only upon issuance of a special-use permit by the local government unit.

Future land use impacts include the displacement of all new housing, commercial and industrial and manufacturing facilities which in the past had been allowed to locate in the floodway, a location often highly accessible to transportation, water supply sources and treated sewage discharge points, and often with a developable topography. Unless constructed at the flood protection elevation, the same set of land uses are displaced from the flood fringe allowing for only agricultural and open space development. This will alter, in some cases, dramatically, the present growth patterns in the flood plain. Most affected will be the towns and cities of Port Jervis, New York; Stroudsburg and East Stroudsburg, Pennsylvania; Belvidere, New Jersey; Easton, Pennsylvania; Phillipsburg, New Jersey; Lambertville, New Jersey; Trenton, New Jersey; Morrisville, Pennsylvania; Bristol, Pennsylvania; Burlington, New Jersey; Philadelphia, Pennsylvania; Camden, New Jersey Chester, Pennsylvania, and Wilmington, Delaware, and in particular their river's edge development. In all cases, open space preservation as parks and natural areas will replace previously possible structural development.

The Flood Disaster Protection Act of 1973 in conjunction with the National Flood Insurance Program of HUD, and other state administered insurance schemes effect land uses and public services only in that they make flood fringe construction more costly when one adds on the additional cost of premiums. However, HUD looks on the program as providing insurance at affordable rates to property owners who would not otherwise be able to get coverage through the private insurance industry, and,as an incentive for using the program, has the ability to withold Federal or federally related financial assistance for acquisition or construction purposes in identified hazard areas. In addition, federally regulated lending institutions must require flood insurance as a condition for a loan for property located or to be located in identified flood hazard areas. The above philosophical difference in the purpose and results of this act should be kept in mind in the following review of the program's implementation success and hence it's ability to control and limit future growth on the flood plain.

The list of municipalities participating in the flood insurance program is a good indication of the extent for which communities are managing development in flood plains. In calculating the cost/benefit ratio for TILT, the Corps of Engineers assumed that development on the flood plain would for the next 50 years, continue at previously experienced rates for the entire basin. In the interim, however, the Federal Insurance Protection Program and use of federal funds for relocation and urban renewal, have intervened to slow growth and in some cases even reduce the number of structures in the flood plain. Both the 1972 Environmental Defense Fund study, Flood Control and the Delaware River, and Table 2-7 based on aerial photography, show that the total number of structures on the flood plain has been declining. Abandoned and demolished structures are not being replaced. The Federal Flood Insurance Program has become a stronger tool for managing growth since the completion of the EDF study in 1972. At that time, the incentive to participate was not high due to the availability of funds from The Disaster Relief Act of 1972 in case of flood. However, by making insurance a prerequisite for federal funds, (including most likely, the Disaster Relief Act), and many loans, the Insurance Program is essential to any development in flood fringe areas. Unless they are successfully challenged in court, programs in New Jersey and Pennsylvania should prevent most development of floodways in the future. A strong Delaware River Basin Commission resolution should encourage New York to strengthen its direct control over the floodway.

As the above noted techniques for flood plain management would prevent the construction of future residential, commercial and industrial structures, their resultant impact in stimulating the above growth is assessed as minimal in Program "C" and the same for the non-structural flood control component of Program "B".

XVI.D.2 LAND USE GOALS

XVI.D.2(a) Community Cohesion

The land use policy objective of "maintaining community cohesion" refers here primarily to the physical fabric of the community and the prevention of disruptive major developments. Within this framework, the impacts of Program A's components are limited to the Water Supply's combination of Low Flow Maintenance System at Camden and Philadelphia and Reservoirs on Tributaries and the recreation proposal of State Parks and Programs, and to a lesser defined degree, the Dry Dam proposal for flood control. Program B's components with impacts in this issue area include the same set of Reservoirs on Tributaries for Water Supply, to a lesser degree both recreation proposals of "Opening Closed Reservoirs" and "More Use of Existing Facilities" and the structural aspect of flood control's structural/non-structural combination, specifically the seven proposed reservoirs, and to a limited extent the non-structural aspects of flood plain management. Program C's components with impacts in this issue area include the recreation proposal of "No Public Programs" and the flood control non-structural proposals of flood plain management and flood proofing. These assessments are indicated in the following table:

Table 16-25 Summary Impacts: "Disrupts Community Cohesion"

Issue Area	Program A electric power	Program A water supply	Program A recreation	Program A flood control	Program B electric power	Program B water supply	Program B recreation	Program B flood control	Program C electric power	Program C water supply	Program C recreation	Program C flood control	TILP electric power	TILP water supply	TILP recreation	TILP flood control
B 1	minimal	medium	medium	low	minimal	medium	low	medium	minimal	minimal	low	medium	medium	medium	high	medium

Under all three Programs, the impacts of the electric power combined cycle proposal is considered minimal. The facility itself may occupy a structure of 20,000 square feet but its total site area is more of a function of external land use constraints such as land cost and availability. Additional siting requirements usually include statutory limitations placed on the types of cooling and fuel combustion towers utilized, the availability of free-flowing water, transportation access for delivery of fuels, transmission line hook-ups to the power grid, and more importantly a location as close to the load center as possible. However, a major advantage of the combined cycle proposal is its flexibility in siting given the above constraints along with its ability to connect into the power grid at virtually an infinite number of urban, suburban and rural locations. With the present limited experience in combined cycle, specific siting can only be determined on a case by case basis. However, the following likely site requirements for various physical settings are given as a guide.

For urban sitings, a single 300-400 MWe unit is likely to fully occupy 30 acres with no buffer areas. This includes the ancillary facilities of cooling towers, a tank farm for oil supply, other buildings and an electrical switching yard. The 1300 MWe requirement would be satisfied by four units, and if all were separately sited in urban settings, 120 acres would be required. However, it is possible to locate additional units on a single 30 acre site due to the large proportion of support facilities. Rural sitings of a single unit would require approximately 60 acres and four individual rural sites, 240 nominal acres. Suburban sitings would approximate 45 acres per unit and 180 acres for four individual suburban sites. In the case of both suburban and rural settings, the land area in addition to the 30 acre cove facility can generally be assumed to be buffer preserved green space, and in all cases more than one unit can often fit on the 30 acre cove area.

The variation in locational power requirements of the combined cycle proposal within each of the three Programs, may result in differing distributions of facilities within the electric power service area and hence differing levels of land use impacts. If one assumes the minimum operating efficiency of a single combined cycle unit to be in the range of 200-400 MWe then the number of facilities in different locations could range from four facilities up to six within the service area. Given the nature of the impacts of a single facility with the siting constraints noted above, the likely differences in impacts between four and six separate facilities is considered minimal, hence differing aspects between the Programs due to combined cycles' contribution are not significant and further evaluation is not undertaken.

There are however, evaluative distinctions between the Programs' proposed combined cycle and TILP's proposed pump storage project. The land area required for the latter is over twice as much as the total land requirements for the former, the length of the construction period longer, and the number of construction workers larger. Major impacts on community cohesion will be from the construction phase and not the operational period. It is likely that Blairstown, New Jersey and the Stroudsburgs in Pennsylvania will bear the majority of the burden of providing the short term housing, education, recreation and entertainment facilities required for the five year plus construction period, conceivably altering these communities' present fabric for a short period of time and requiring a recovery period there after. These construction impacts are distributed under Programs A, B, and C dependent upon the distribution pattern of the combined cycle facilities and therefore potentially less significant.

Protection of low flows at Philadelphia and Camden, part of the water supply component in Program A, has by far the most insifnificant impact on community cohesion in comparison with reservoirs on tributaries and TILP. This temporary solution in Program A, whether on the surface or river bottom, is in a portion of the Delaware River where communities are substantially divided by the river itself, and hence by itself, the proposal does not contribute to this issue area. However, in Program A it is the other water supply component of reservoirs on tributaries, which also is provided in Program B, which generates significant impacts. On this basis, it is assumed that Program A and B water supply impacts in this issue area are similar and should be evaluated against TILP. The summary ranking in Table 16-25 is the same "medium". Differences can be concluded in terms of the smaller size (average of 1,000 acres of surface versus TILP's 20,000 acres) and distribution of seven facilities versus one, located in substantially more rural locations of Monroe and Pike Counties, Pennsylvania and Warren County, New Jersey versus the Stroudsburgs, Buhskill, Milford, Matamoras, Port Jervis 40 mile corridor. Given existing and projected growth patterns (see Chapter XXII), DWGNRA and TILP's disruption of existing life styles (see Chapter XXIV), and present way of life is considered more severe than that of Program A and B's dispersion of water supply reservoirs. The preliminary planning analysis undertaken for locating these reservoirs has included field reconnaissance to minimize both relocation requirements and the existence of adjacent inappropriate land uses.

Recreation's various proposals under Programs A, B and C result in a range of community cohesion impacts due to a variety of distribution patterns, but all of which are less significant than the impacts of DWGNRA and TILP at its single location at an equivalent level of recreation capacity. New State Parks and Programs require generally the revitalization of vacant or under-utilized urban lands along river fronts as described in the proposed metropolitan river parks and essentially vacant or no longer productive lands for the superparks. The proposal is intended to reinforce community cohesion in the case of the metropolitan river parks by providing an attractive mix of water based facilities, a segment often missing from metropolitan areas of the size and type of urban infrastructure indicated. In the case of the regional superparks, their size and level of required service are bound to cause some dislocations such as transportation linkages to regional networks in their presently suburbanized locations. There are, however, broad reaches of open spaces in both locations presently suitable for recreation development without major relocation of existing land uses.

The impacts of Program B's "Opening Closed Reservoirs" and "More Use of Existing Facilities" is considered to have less of an impact in this issue area than

Program A's recreation proposal as all facilities and required land areas presently exist and hence community development has already responded to their existence. Strains on their cohesion will result from the influx of primarily new day visitors and their requirements for a wide range of services. The dispersion of these requirements due to the dispersion of these water based facilities results in an impact level comparable to Program C's recreation proposal of "No Public Programs" except for the development of DWGNRA with a free flowing river. In this case, the visitor influx is designed for control at a peak level equivalent to an instant capacity of 40,000 visitors, a level at which the resultant transportation and other service requirements would not adversely impact this issue area of community cohesion (see Chapter XVI and XXV). An indication of the likely external services required for the DWGNRA with TILP is the following. It is estimated that the overnight visitor component to DWGNRA with TILP would be approximately 40% of the total visitation on an annual basis generating a demand for some 2,800 new hotel/motel rooms in its final Phase III. A full discussion of DWGNRA with TILP impacts is found in Chapter XXII and comparison of DWGNRA with and without TILP in Chapter XVIII.

The flood control alternatives within Programs A, B, C, and TILP have greater impacts in Programs B, C, and TILP than in A due to the presence of more pervasive non-structural controls in Program B and C and the flood pool consequences of the 40 mile lake in TILP. The "Dry" Dam alternative in Program A, by itself will only create a significant impact in this issue area with the frequency of a major flood. In contrast, Program B's structural/non-structural combinations include seven flood control reservoirs, which due to their rural locations (four in Pike County, Pa.; one in Sullivan County, N.Y.; one in Monroe County, Pa; and one in Warren County, N.J.) will not significantly impact in this issue area.

But this is compensated for by the likely impacts of the non-structural elements. These are obviously the same set of impacts as in Program C's non-structural combinations, which are discussed in a general fashion at the end of Chapter XVI.D.2.

The planning goals of maintaining community cohesion for many of these communities may be altered by the implementation of these non-structural flood control alternatives. Those communities which either span the river or function as half of twin cities, such as Phillipsburg and Easton, may find this flood plain legislation disruptive of their physical cohesiveness. On the other hand, in as much as the flood plain includes environmentally sensitive and sometimes scenic areas, this legislation would allow for their preservation and the ultimate control of incompatible uses, such as strip highway commercial development, from these areas. By these methods, the balanced urban/rural character of many of these communities can be maintained when these are acceptable goals of the area. It should be noted, however, that the potentials for physical development (housing, commercial, industrial) which existed within portions of the flood plain would in some cases be transferred to other locations given comparable degress of access, development constraints, and financial feasibility. Without this comparability, these development potentials may be lost.

XVI.D.2.(b) Preserves Critical Open Space

The land use objective under discussion here is the policy or desire to preserve existing open space for common use, particularly within communities or areas where it is in short supply. Portions of the alternate programs fall within densely developed urban areas or areas of medium development. Some will by necessity displace other potential uses of the sites. By contrast most of the Tocks Island Lake Project (TILP) will lie in relatively undeveloped rural areas. All but the recreation component of Program "B" and the flood control component of Program "C" will have an impact in this issue area. An assessment of these impacts is summarized in the table below. A high ranking indicates that the particular component of a Program or TILP either does not occupy significant amounts of open space itself or can be utilized as a technique for its preservation or both.

Table 16-26 Summary Impacts: "Preserves Critical Open Space"

	Program A				Program B				Program C				TILP			
Issue Area	electric power	water supply	recreation	flood control	electric power	water supply	recreation	flood control	electric power	water supply	recreation	flood control	electric power	water supply	recreation	flood control
B-2	medium	medium	medium*	minimal	medium	medium	minimal	medium	medium	minimal	medium	high	low	low	medium	medium

* This alternate adds to rather than subtracts from the existing supply of open spa

Program A:

Sites for combined cycle power plants, which are part of all three alternative programs, have not been specifically determined. Land requirements will vary depending upon the size of the plant and whether it is located in rural areas or near urban centers. Four to six plants will be required , with sites varying in size from 30 to 240 acres. Site selection can be made to reduce impacts in all aspects of land use issues. Rural and semi-rural locations can have large buffer areas of open space hence providing a method for its preservation. However, the amount of buffer is in direct portion to land availability and cost and thus is not a prime technique for achieving this objective. This assessment also applies for Programs "B's" and "C's" combined cycle alternative.

Maintenance of the Philadelphia/Camden water supply system during periods of low flow involves underground or submerged piping systems and a minimal amount of surface structures for pumping stations and expansion of existing treatment facilities. Again, site selection can be made to minimize impacts on land use goals. Reservoirs on tributaries will involve inundating extensive acreage. However, this will occur in rural areas removed from pressures from development, so impact on this issue area should also be minimal, except for preservation provided by the reservoirs circumferential buffer.

A "dry" dam at the Tocks Island site for flood control purposes only would occupy approximately 700 acres of existing woodland areas. Upstream, approximately 8,000 additional acres would be added to the flood plain, over half of which could be subjected to flooding every 10 years. Since this area is already part of DWGNRA, flood plain areas would remain undeveloped except for recreation facilities for river based activities. Impact is considered minimal on this issue area.

The urban locations of the new state parks and programs and the essentially rural location of DWGNRA without TILP, the two recreation components, would retain open space and control its use in critical locations, specifically nearly 3,300 acres in urban and suburban settings and 72,000 acres at DWGNRA, both locations greatly benefitting from this preservation.

Program B:

Water supply reservoirs on tributaries would require inundating approximately 8,000 acres of land, which at present is removed from substantial pressures of development. Space adjacent to these reservoirs might, however, gain in value and be targets of development for the private sector due to the possible future recreation potential of these reservoirs.

Further development of existing parks to their maximum potential and the opening of the Pequannock Watershed would require provision of sanitary facilities, roads and parking areas, in addition to the recreation facility itself. Since these areas are at present nominally closed to the public or already functioning as parks, the net loss of open space is minimal and is offset by the acreage of the reservoir system which would become available. Additional space would be required for construction of expanded treatment plants for water supply.

Structural projects used for flood control would involve some loss of land in rural areas for the dams themselves and inundation areas in times of flood. The extended flood plains, however, would remain open and development within them restricted. Wherever one project serves both flood control and water supply purposes, the total area required for short and long term storage would be less than that required by two single purpose projects. Again, effect on open space is minimal, except for the open space buffer. Non-structural solutions to flood control do, however, have a significant effect on preserving open space in the flood plain. A full discussion of these effects is found at the end of Section XVI.D.1. The resultant impact assessment is "medium".

Program C

As mentioned above, maintenance of the Philadelphia/Camden system at low flow requires a negligible amount of open space and is not considered a means of achieving open space.

The recreation component, including DWGNRA with a free flowing river, has two aspects as a means of achieving open space. If no public programs are developed, it is likely that a sizeable amount of unsatisfied demand will stimulate the private sector to react as they have in the past, by using available sites for vacation homes and private recreation facilities. This would result in a net loss of valuable resources for public use. On the other hand, DWGNRA is intended to preserve 72,000 acres of natural resources including 2,400 acres of the Delaware River.

Again as in Program "B", non-structural flood control measures have a significant effect described in detail at the end of Section XVI.D.1. As it is the only element of the flood control component of Program "C", its resultant impact assessment is "high".

TILP:

The pumped storage project for this program is located in a rural area, where property values are not at a premium nor is the space as critical as urban land. However, it requires somewhat more space than combined cycle plants, including the 350-acre upper reservoir which would be unsuitable for other uses or aquatic life. In as much as the facility is taking open space out of public use, its impact assessment is considered low. Half of the storage capacity of TILP and hence, over half of the 10,000 acres of land inundated by the lake is required for long-term water supply storage. The land area thus removed remains, in a sense, open water space. However, the loss here is not so much the open space as it is the archaeological and historic sites which will be submerged.

The recreation component of DWGNRA replaces some of the natural woodlands and prime agricultural areas with park areas and recreational facilities. The positive value of the project is the preservation of this open space for public use rather than private development. With the Tocks Dam, 3,000 to 5,000 acres of land will be periodically inundated in the expanded flood plain. Of all structural projects, it involves the least loss of open land for flood control purposes only, both as far as flood plain and dam construction are concerned.

In summary, relative to preservation of open space, Programs A and C would appear to have less of a positive impact than Program B or TILP. Relatively small areas would be used by power plants, but less space than the pumped storage project for TILP. Less area would be flooded, either temporarily or on a long term basis. Program C appears to have the highest cumulative rating as open space is preserved via the non-structural flood control measures and the land acquisition of DWGNRA. Its negative aspect is the loss of space preserved for additional public use due to the proposed lack of publica recreation programs.

XVI.D.2(c) Existing Character and Aesthetics

This critical issue of preserving existing character and aesthetics deals with the impact an individual component of TILP or an alternative program would have on the present character of its site. It has been assumed that the existing quality of a residential, rural, or natural undeveloped site, etc., into which the program's component will be placed, deserves to be preserved, with one exception, namely the sites within urban areas which would be used for new urban parks. It is assumed that development may in some instances change an aspect of an area without adversely affecting its character. For example, a power plant located within an industrial area is in keeping with the surrounding land uses and therefore has a minimal negative impact on the site character. The same site in a rural locale would have a much higher negative impact. The table below summarizes the assessment of each component of TILP and the three Programs' impact on this land use goal. Again, a high ranking indicates that the component either by itself does not disrupt the existing character, or is a means of preserving it, or both.

Table 16-27 Summary Impacts: "Preserves Existing Character and Aesthetics"

	Program A				Program B				Program C				TILP			
Issue Area	electric power	water supply	recreation	flood control	electric power	water supply	recreation	flood control	electric power	water supply	recreation	flood control	electric power	water supply	recreation	flood control
B 4	low	medium	medium	low	low	medium	low	medium	low	minimal	low	high	low	low	low	low

Program A:

Without determining exact site locations for combined cycle power plants, it is impossible to determine their exact impact. Where sufficient water supply and open space permits, it would be most beneficial to place them near urban areas in industrial parks where their impact on local character would be minimal. Owing to higher land costs and possible opposition from local residents to the emissions of air pollutants, it is probable that rural sites would be required for at least some installations. Here the impact would be much more negative (a lower assessment). The same is true for Programs "B" and "C".

The underground and submerged piping systems required for maintaining the Philadelphia/Camden system at low flow will not effect the character of surrounding sites at all. There may be problems arising from the site selection of pumping stations and filter plant extensions. Owing to other criteria for site selection such as land cost, there is the possibility of some conflict in this area. Water supply reservoirs on tributaries would have a moderate impact on the character of the site, although some change in vegetation types is anticipated. A water body, of course, removes the land area from private development pressures. The cumulative area for all reservoir sites is greater than the area which TILP would occupy.

New state parks in under-utilized urban areas, as previously mentioned, should have a positive impact in improving the neighborhoods adjacent to them, whether they are located in commercial or residential sections. Again, certain cities have been proposed as possible sites for this alternative, along with a portion of the Warner Tract, but sites within these cities have not been studied to the level of detail necessary to determine a definite impact. Generally, development of any site should be highly beneficial to the character of its locale.

The impact of DWGNRA with a free-flowing river in Programs "A", "B", and "C" would be quite different than DWGNRA with TILP. Many historic structures and archeological sites could be saved, without the expense of immediate exploration or relocation. Where appropriate, these structures may be used for some park purpose, such as interpretive centers or concessions, and would be consistent with the natural setting. Also, the smaller daily and annual visitation would reduce the possibility of crowding at most sites and be more in keeping with the area's rural character.

A "dry" dam at Tocks Island for flood control purposes would have some impact in two areas. The dam itself will form a huge wall across the valley, much the same way the dam for TILP would. While it would be somewhat scaled down, it would be more visible from the upstream side most of the time. Down stream there would be minimal disturbance of the scenery and character. Upstream, however, the flood plain would be greatly expanded. Many farm houses and out buildings which now dot the river's edge would either be removed or require flood proofing. Periodic flooding would not disturb some of the trees and other vegetation, but along the banks of the "lake" the common plants may disappear and be replaced by flood plain vegetation. The latter, being more fragile, is more susceptible to destruction from the park visitors, Sediment would be deposited behind the dam and would become visible after pool release. This aspect of the Program is considered to have therefore a moderate impact on the quality of the area but a low to medium impact on the character of the site.

Program B:

The same impacts mentioned in Program "A" above hold true for this Program, relative to reservoirs on tributaries, with the exception that additional storage would be required without provisions to maintain the Philadelphia/ Camden system. Approximately 8,000 acres of land would be flooded along miles of stream. As mentioned in Chapter XIII, the quality of the water and shoreline vegetation would be altered, but there is not a significant impact upon the character of the land with the exception of the reservoirs and surrounding buffers preserving land from growth pressures. With scattered sites in lieu of one large reservoir, more dams are needed. They would all be smaller than Tocks Island but their impact on local scenery would be disbursed to several sites.

The effect of increasing recreation capacity at existing parks would have a minimal impact on the local character. Programming of the new facilities would have to proceed carefully however, to avoid crowding and to preserve their natural setting. Opening existing reservoir sites to public recreation facilities, again would have some effect upon the type of vegetation which would best survive the pedestrian and vehicular traffic and upon the water quality. However, with careful design, the basic visual character of the watersheds would be preserved and destruction of vegetation, could be minimized.

A combination of structural and non-structural flood control projects would have a varied impact. The latter would limit new construction within existing flood plains, a proven technique of limiting growth and preserving existing aesthetics. Dams on tributaries, however, would have the same, if somewhat scaled down, negative impact as a flood control dam at Tocks Island. However, these same impacts would be disbursed to several areas. The total impact of all sites would be greater than the impact resulting from one large project.

Program C:

If no public recreation programs were instituted, with the exception of DWGNRA without TILP, the impact assessment in this area is low. If the private sector does respond by the increased building of second homes and backyard pools, the negative impacts will be spread throughout the entire recreation service area. However, impacts would be low compared to the effects of substantial visitation to a large regional park.

Flood control programs involving non-structural solutions only would have less negative impact on this issue area than any structural solution. The prevention of construction on flood plain sites in rural areas would be a highly effective means of preserving existing character.

TILP:

Because of the relatively large land area required for a pumped storage facility, site selection is limited and must by necessity occupy a rural site. The majority of this site, 350 of 400 acres, would be occupied by the upper reservoir. The upper reservoir would be unsuitable for aquatic life due to water quality and the fact that it is constantly being partially emptied and filled; and will when "empty", be a scare on the landscape. The plant itself, while relatively clean compared with base load generating facilities, and combined cycle plants, will be totally out of character with its surroundings. It is thus given a low assessment as being disruptive of the existing rural character of the Kittatinny area. The water supply and flood control components of Tocks Island lake occupy over 10,000 acres of rural land. While this will have an effect on the nature of of the water and adjacent vegetation, the basic character of the area is not significantly altered by the imposition of this water body alone.

The recreation components, however, will have a high impact on the character and aesthetics of the surrounding area. By Phase III of development, over 100,000 people will be arriving and departing each peak day, most by car. In addition to the visitors, 20,000 permanent residents will be added to the seven county area as a direct result of TILP, along with the necessary commercial development. These areas, along with portions of DWGNRA which will resemble a crowded urban park, will cease to have the quiet rural charm they now possess. As in the case of electric power, a low assessment is given due to the disruptive nature of this component on the local setting.

Summary:

All three alternatives would appear to have less negative impact on the character of their surroundings than TILP, particularly due to the electric power component and the recreation alternatives. The most negative impact within the Programs would probably be the "dry" dam at Tocks Island, the flood control component of Program "A", which is offset by the beneficial impacts of State Parks and Programs. Most of the other structural components of the alternative Programs would have a low to medium impact due to their relatively insignificant impacts in this issue area, whereas the electric power and recreation components of TILP would have a low impact due to their disruptive effects.

XVI.D.2(d) Local Economy

All of the components of the three alternative Programs with the possible exception of the "dry" dam of Program A are expected to have a low or minimal impact on local economies for one or more reasons which follow.

Few permanent jobs will be created by the various components in the local areas. This is especially true for Program C which envisions no public recreation programs and no structural flood control projects. The combined cycles power plants account for additional jobs, but these will be dispersed to several sites and much of the skilled labor force will be imported.

Within Programs "A", "B" & "C" the four components tend to be scattered throughout the various service areas, rather than concentrated in one location as TILP is. Thus while TILP would involve a surge of construction activity in one area over a period of 5 to 10 years during the initial phase, the other programs would disperse the construction activity over a large area, involving several sites and construction periods would vary in both duration and start up time. Programs "A" & "B" with their flood control and recreational facility construction would stimulate local economies to a greater extent than "C".

Several of the components of the alternate programs involve construction projects in or near urban centers where it is assumed an adequate supply of labor exists. This is especially true for State Parks and Programs, and for changes to the Philadelphia/Camden water supply systems. Such projects will certainly be beneficial to the general economy of the locale in which they are located, but are of such a scale compared with the population that no stimulus is anticipated.

The increase in commercial activity as a spin-off of the recreation components will be minimal, with the possible exception that opening a reservoir system the size of the Pequannock Watershed, might stimulate local business during the summer months.

By contrast, TILP is expected to have a major impact on the local economy. Construction of the power plant alone will involve 1,000 jobs at its peak, and may possibly drain the local labor market for years.
Many skilled technicians and tradesman will undoubtably be imported from other regions, and will provide a short term stimulus to local commercial establishments. A percentage will require housing. By the time construction activity begins to wind down, it is assumed a large portion of the recreation facilities will be in operation and will attract visitors sufficient to compensate, to some degree, at least seasonally, for the resultant loss of commercial activity generated by the construction crews.

A summary of the impacts of each program will have on local economy is shown on the table below:

Table 16-28 Summary Impacts: "Stimulates Local Economy"

	Program A				Program B				Program C				TILP			
Issue Area	electric power	water supply	recreation	flood control	electric power	water supply	recreation	flood control	electric power	water supply	recreation	flood control	electric power	water supply	recreation	flood control
B 3	low	low	low	medium	low	low	low	low	low	minimal	minimal	minimal	medium	medium	medium	medium

XVI.D.3 PUBLIC INFRASTRUCTURE

The evaluation of public infrastructure of Programs "A", "B", "C" and TILP is divided into a discussion of public services and public utilities in relationship to local capabilities where information has been collected in these capabilities and where Program components are site specific. All transportation aspects of public infrastructure are treated separately in the final part of this section.

XVI.D.3.(a) Public Services

The critical issue area is stated as the impact or requirement of a component of a Program or TILP which causes increases in the demand for additional public services relative to local capabilities. The following analysis indicates that the various critical elements of public services (fire, police, emergency medical and road maintenance services) must be individual bases for TILP and Program comparisons as summary conclusions cannot be considered the summation of individual rankings for separate services not of equivalent importance.

The table below summarizes the assessment of TILP's and the three Programs' impact on each of the above public services. Each Program and TILP is taken in total rather than the impact assessed by each component as in the previous format, as only certain of the components have meaningful impacts. These are described in the following text along with the analysis which results in these assessments. Fire protection services are divided into those for forest areas provided by state and federal forest and park agencies and those for buildings, provided by local fire departments. A medium ranking indicates that the Program of TILP would require a moderate increase in the indicated services; a low, a low increase over local capabilities.

Table 16-29 Summary Impacts: "Increases in the Demands for Additional Public Services"

	Program A	Program B	Program C	TILP
Fire:				
Forests	low	medium	low	low
Structures	low	low	low	medium
Police	low	medium	low	high
Emergency Medical	low	low	low	medium
Road Maintenance	low	low	low	medium

Impacts on public services are generally more significant from the operational phase of a component of TILP and the three Programs, due to their longer term requiring permanent solutions than from their construction phases. Certain of the components drop out of the analysis as their operational impacts are insignificant. These include the combined cycle components of the Programs and pump storage component of TILP as they are not labor intensive. However, their public service demands during the construction phase would be significant requiring short term solutions. It is difficult to compare these demands between combined cycle and pump storage Although the latter requires a larger labor force, the former would entail smaller projects but on several sites with perhaps an equivalent total labor force. Likewise, the low flow water supply measures at Philadelphia and Camden and the non-structural flood control measures, the water supply reservoirs on tributaries, the structural measures of a "dry" dam at Tocks and dams on tributaries have short term construction impacts on public services but insignificant long term impacts due to their operational employment.

Under TILP, fire protection provided by local municipal volunteer departments would have a moderate demand for additional services due to the structural growth attributed to DWGNRA with TILP estimated at 20,000 additional permanent residents. These services would actually improve within the public lands due to the substantial assistance of Federal NPS fire personnel assisting the state forest forces within DWGNRA and state forests. Thus, the low assessment. In comparison, an equivalent level of fire protection service would be provided for DWGNRA without TILP, the only component within Program C impacting this service. The same assessment, therefore, applies for forests. The reduction in adjacent park related growth would reduce its service demand on local volunteer fire departments from TILP's "medium" assessment. Likewise Program C's non-structural flood control component would reduce the number of both existing and future structures in the flood plain, hence reducing the future demand on fire fighting services. As the recreation component of programs "A" & "B" include DWGNRA without TILP (the recreation component of "C") their public service impacts are considered in addition to those of DWGNRA without TILP.

Under Program B, again the major impacts are from the recreation components. The major burden would fall on the state forest agencies. It should be noted that additional visitors to an open area does not necessarily increase the fire fighting load. Although more fires are started, it has been found that the presence of more people means that the fires are detected sooner. The additional demand is, however, considered greater than Program C, as no additional assistance is provided by federal agencies.

Under Program A, fire services are considered to experience minimal additional demands from the recreation component which is primarily urban oriented. Cities and suburban areas generally provide the highest present level of local service and the additional needs placed on them by urban and regional parks would be marginal given the size of their existing personnel. Likewise, the fire hazard of the proposed parks are minimal given the small proportion of natural areas to built areas.

Police protection is primarily related to the recreation components of the three Programs and TILP. The latter would have a high demand for increases in the present level of service given projected visitation levels. These requirements would be the responsibility of NPS rangers within DWGNRA and state law enforcement agencies and those existing municipal police forces within the immediate area.

In comparison with the dispersed water supply and flood control rural reservoirs on tributaries in Program B and the same water supply reservoirs in Program A, in which less incidents of crime may occur due to the dispersion, TILP would locate itself near to more local units (the Stroudsburgs, Milford, Matamores and Port Jervis) available to assist NPS rangers and state police. It has been noted that Pennsylvania state police forces has recently been operating with a limited training program reducing its available manpower.

More than law enforcement, which would require additional patrols, it appears that traffic control for DWGNRA with TILP would be the more critical concern for surrounding communities. As in fire services, Program "C" would reduce future demand on police protection due to lower visitation levels at DWGNRA. For the non-structural flood control component of "C", police protection is only impacted in as much as the flood plain is developed for outdoor recreation in response to local need. It can be assumed, nevertheless, that this level of development would be less intense than corresponding structural development in the flood plain. Hence, police requirements would be likely to be less significant under this alternative Program.

Program "B's" recreation component places the added burden on state park police and on the local police forces of adjacent communities. New Jersey's park force is presently functioning under severe budgetary constraints. To this impact is added the flood control and water supply reservoirs on tributaries which will require additional policing. This would most likely be the responsibility of state police as local forces are not presently available.

The new state parks and programs in Program "A" would impact the existing urban and suburban municipal police to a minimal degree. As is the case with fire protection, the city staffs should have adequate manpower to absorb these minimal increments, although residents never admit satisfaction, particularly with this form of public service and hence consider any increase an unjustified burden.

Again, emergency medical services would be related primarily to the "people intensive" recreation components of the Programs and TILP. The highest visitation level is generated by DWGNRA with TILP. Preliminary investigation indicates that hospital services in major centers would be adequate to provide needed facilities for even the Phase III level of development. However, at this level, ambulance services may be severely strained. The resultant impact assessment is moderate but greater than those of Programs "A", "B", and "C".

Program "C" provides insignificant impacts on emergency medical services in its power, water supply and flood control components. The ultimate requirements of DWGNRA without TILP would be equivalent to only the first phase of DWGNRA with TILP, hence the low impact assessment. Program "B" is more difficult to assess, as the recreation components are located outside the seven county TILP impact area where health care data is sketchy. The assumption is made that existing hospital and ambulance services are well distributed and hence the impact of these visitors on these services would be low. It should be noted that some of the remoted floor control and water supply reservoirs in Program "B" are on the outer edges of the 15 mile hospital travel time ring (see figure 22-13). Program "A" once again, with its urban recreation orientation, would have a minimal impact.

Impacts on road maintenance are considered to be low in Programs "A" & "B" as their incremental demand is considered small within the existing maintenance programs at their dispersed locations. In comparison, TILP's traffic generation (Chapter XXV) and construction impacts are greater than Program "C's" hence the difference in impact assessment.

In summary, although the impacts of each public service type cannot be summed, a review of Table 16-29 indicates that in terms of only the public services analyzed, the three Programs and TILP can be arranged in the following order from minimum to maximum impact: Program "A" and "C"; Program "B"; TILP.

XVI.D.3.(b) Public Utilities

This issue area of increasing the demand for additional public utilities relative to local capabilities is evaluated according to the three sub-areas of water, sewage and solid waste. These are the basis for comparative statements between the three Programs and TILP.

Water

Water supply is of course, only one component of an area's various water systems which are to be impacted by the components of TILP and the three alternative Programs. By itself, it can be a stimulus for growth, if this component is in short supply. However, as noted in XXII.C.4(b)1, in most cases it is the more costly elements of distribution systems and treatment which will function as growth determinants. Major impacts in this issue area stem from the recreation and water supply components and minimal impacts from flood control and electric power. The water demands of both the combined cycle and pumped storage generating plant are analyzed as a primary impact in Chapter XIV, and only the secondary impacts on existing and future utility systems are of concern here.

Due to these restrictive impacts, the previous format is foregone in favor of the following summary table. Here water supply and demand is in direct proportion to TILP's and its alternative Programs' water supply component and recreation component, the latter being the prime generator of future internal park oriented demand and external growth oriented demand. The table describes the effect on both supply and demand provided by TILP's and its alternative Programs' recreation and water supply components, and these are reflected in the third column's impact assessment.

Table 16-30 Effects on Water Supply and Demand of TILP's and Alternative Programs' Water Supply and Recreation Components.

	Effect on Water Supply	Effect on Water Demand	Resultant Impact on Increasing Demand for Public Water
Program A	moderate	moderate	low
Program B	moderate	increase	low
Program C	none	moderate	low
TILP	increase	significant	medium

Note: - Program "A" and "B" include Program "C's" recreation component of DWGNRA without TILP.
Ranking order: none, moderate, increase, significant.

DWGNRA and TILP are expected to generate a peak summer load of 36,500 persons outside of the NRA composed of 18,000 additional permanent population and 18,500 overnight visitors on a peak summer Saturday night. Within the NRA, NPS would be providing water from wells. As there is an adequate ground water supply for both this growth and non-TILP related growth in the region, TILP itself is not required for the neccsary water supply for both growth componets. However, its presence would provide a cost trade off for its own water versus ground water and would in some cases provide some local water supply. Thus TILP improves the water supply availability situation even though it would increase the demand.

Program "C" with DWGNRA without TILP and no surface water supply would be less of a growth generator but would not have the availability of TILP water. Program "B's" scattered smaller reservoirs would add to the local water supply of their immediate areas (four in Pike County, Pa.; two in Monroe County, Pa.; and one in Warren County, N.J.) and provide a minimal stimulus to the growth of the immediate area. On the other hand the recreation components of Program "B" provide a minimal increase in demand in dispersed locations that should be adequately served by available ground and surface water. Program "A" retains the impacts of "B's" scattered reservoirs, but locates the recreation functions primarily within urban/suburban areas where public water systems are available and have adequate expansion and supply potential. To Program "A" & "B's" recreation impacts are added those of DWGNRA without TILP.

Solid Waste

Solid waste collection and disposal is another critical public serv' e for which increases in the level of service is directly related to a region's growth measured in numbers of addtional people. Per-capita figures of solid waste generated are given in section XXII.C.4(c). These factors are less for day visitors and more for overnight visitors. Of concern here is the primary generation of solid waste by day and overnight visitors to the recreation components of TILP and the three alternative Programs. Related permanent development is a function of the amount of visitation generated. However, the state of flux of most counties' solid waste management plans required by EPA makes impact assessment of this aspect difficult. A synopsis of these plans is found in XXII.C.4(c). The other functional components of TILP and the alternative programs are considered to have a minimal effect on solid waste demands.

In summary, DWGNRA with TILP in its first phase of development would generate 8.5 tons on a peak summer day and 23 tons in its ultimate phase, generated by day visitors only. Overnight visitors would generate 145-150 tons on a peak summer day in TILP's ultimate third phase. The difficulty in all three Programs & TILP is the adequacy of present and the potential for future sanitary land fill sites which will meet EPA standards, as it is assumed that compaction, incineration and other developing technologies are less likely to be utilized in rural and suburban areas due to cost factors and operational problems at that density. Existing incineration facilities, likewise, have to be brought up to EPA air quality standards often a more difficult task.

For TILP, it is assumed that present and future land fill sites would be able to handle the increased load. In comparison, Program "C's" DWGNRA without TILP would generate a significantly lower amount due to the decreases in visitation. Program "B's" better use of existing parks and opening closed reservoirs is likely to generate a level greater than "C" but less than "A" because of its intermediate visitation capacities. Pequannock Watershed and Wawayanda State Park would most likely utilize the central land fill facility being planned for by Sussex County, N.J.; Harriman State Park, that location being planned for by Orange County,N.Y.; and the growth areas around the rural Pennsylvania multi-purpose reservoirs, that location being planned by Pike County.

Program "A's" new state parks and programs would generate a level of solid waste equivalent to TILP, having a similar level of visitation. However, as the solid waste collection is for an area in which a large number of these urban park visitors reside, the increased load to these well developed collection and disposal systems would be minimal.

These impact assessments are indicated in the following table.

Table 16-31 Summary Impacts: Public Services

Issue Area	Program A: electric power	Program A: water supply	Program A: recreation	Program A: flood control	Program B: electric power	Program B: water supply	Program B: recreation	Program B: flood control	Program C: electric power	Program C: water supply	Program C: recreation	Program C: flood control	TILP: electric power	TILP: water supply	TILP: recreation	TILP: flood control
Solid waste demands	minimal	minimal	low	minimal	minimal	minimal	low	minimal	minimal	minimal	low	minimal	minimal	minimal	medium	minimal

Sewerage

Impacts on the demand for additional sewage treatment of TILP and the three Programs is a factor of the numbers of additional people and their degree of concentration in relation to the requirements of the new Federal water quality law PL 92-500. The law calls for the "best practical treatment" which, as no further definition is given, is dependent on the constraints of particular locations. DRBC, previous to the enactment of this legislation, specified 95% removal of soluble phosphates and B.O.D.'s in its Resolution 72-2 and confirmed in 73-5. This requirement serves as an interpretation of PL 92-500 but only for the TIRES region.

Of general concern is point sources of pollution and non-point runoff into water bodies. Of specific concern to the TIRES region is the presence of a reservior versus a free flowing river. As in the case of the other public utilities, the recreation component as the prime growth and people generator and water supply with its water quality requirements both have major impacts on sewage treatment demands. TILP places the highest demand because of its ancillary growth creating the largest number of potential pollutant sources in conjunction with an impoundment which removes the flushing action of free flowing river. Programs "C's" dispersed pattern of growth and moderate level of development of recreation facilities would rely on existing systems which would be upgraded for meeting PL 92-500 requirements given a free flowing river and hence its impact assessment is low. Program "B" places a moderate demand due to the opening of a reservoir, which has treatment facilities, to recreation usage although for a smaller visitation. Program "B's" total recreation impact on sewage treatment demands is, of course, the sum of the above plus the impacts of DWGNRA without TILP described under Program "C" above. Program "A's" urban locations would have existing capacity and expansion potential within its sewage system, and with the impact of DWGNRA without TILP is assessed a low total impact.

Non-structural flood measures in Programs "B" and "C" have entirely different physical impacts on sewerage and other utilities. Impacts of flood plain management techniques on public services are not as clearly delineated as impacts and obviously occur only with the presence or future need of the service in the flood plain. Of major concern would be alterations to sewage treatment and solid waste discharge points so they would no longer be located within the floodway or flood fringe. These could generally be costly public works projects, however, their physical constraints and shared public funding possibilities are described in P.L. 92-500 and discussed elsewhere in this study. The existence of a large number of both sewage treatment plants, water intakes and discharge points (pumps and pipelines) within the flood plain would necessitate, under this program, proper flood proofing. This would be true also of power generation stations, often located within flood plains for access to nearby process and cooling water. Flood proofing can take the form of relocating mechanical equipment to second floor levels above the flood protection elevation, designed protective flood walls, the bulkheading of windows or doors, or the raising of structures on piers, etc. These additional public costs are a specific impact on public service utilities. However, these impacts are generally localized to a relatively small number of alterations. These impacts are reflected in the "medium" assessment for the flood control component of Program "B" and "C".

All of the above impact assessments in this issue area are indicated in the following table.

Table 16-32 Summary Impacts: Public Services

	Program A				Porgram B				Program C				TILP			
Issue Area	electric power	water supply	recreation	flood control	electric power	water supply	recreation	flood control	electric power	water supply	recreation	flood control	electric power	water supply	recreation	flood control
Sewage treatment demands	minimal	low	low	minimal	minimal	low	medium	medium	minimal	minimal	low	medium	minimal	medium	high	minimal

XVI.D.4. TRANSPORTATION

The types of degrees of impacts to be imposed upon the regional transportation system under Programs A, B, and C and TILP are identified, assessed and compared in this section. These comparative effects are described in terms of overall traffic loads which would be superimposed upon existing traffic and transportation facilities and services; required transportation improvements to accommodate this additional load; other broad considerations such as the practicality of mass transit solutions for the subject recreational travel; and critical issue areas.

XVI.D.4.(a) Regional Transportation System Usage

A useful measure of the burden placed upon the highway system of the region by the recreation components of the various Programs and TILP is additional vehicle-miles of travel. This was estimated on a comparative basis for the initial phases of each of the Programs and TILP considering: the distribution of population and recreation trip origins over the service area; the locations of TILP, DWGNRA, and alternative recreation sites; travel distances and times between sets of representative recreation trip origins and destinations; the capacity and projected annual and peak day visitation for each recreation facility; hourly distribution characteristics for recreational traffic; and related factors. The following table summarizes relative recreational travel surcharges.

Table 16-33 Comparison of Overall Highway Travel to Recreation Areas
(Percent of TILP Phase I Travel)

	% of Travel Annually	% of Travel At Peak Hours.
Program A, Expansion of State Park System	85. - 90.	80. - 90.
Program B, Opening Closed Reservoirs and More Use of Existing Facilities	70. - 75.	70. - 80.
Program C, No Public Programs, Except DWGNRA Without TILP	50.	40. - 50.
Tocks Island Lake Project (Phase I)	100.	100.

Note: Programs A, B and C include DWGNRA without TILP.

With regard to annual traffic loads, it is to be noted that the several sites of Program A, while permitting the same level of visitation as TILP, do not require as much total travel -- due, of course, to the dispersion of the recreational capacity somewhat closer to patron origins.

Program B sites are fewer and not quite as dispersed as those of "A" but the annual visitation is only 3 million, 25% less. Travel patterns associated with Program C, DWGNRA without TILP, are similar to TILP but annual visitation is 50% less.

Transportation improvements are generally not based on annual loads, however, but upon hourly travel demand and facility capacity or need values. Those recreation facilities not as oriented as TILP towards water based activities would hence not be expected to have quite as severe peak hour usage or departure factors. Thus Programs A and C impose a somewhat lesser relative impact on regional transportation when estimated on this hourly basis.

Another consideration in the comparative evaluation of travel patterns is average travel time. For recreation trips, a lower overall average travel time for a facility or group of facilities would indicate a likelihood that a larger share of its potential patron demand could be realized, since accessibility and ease of travel is often a major component affecting this. Given the same transportation system, a lower overall average travel time is also indicative of a more efficient matching of patron or user origins and recreation destinations and a more even and efficient use of the transportation system. The following table outlines average auto travel times for the alternatives and TILP.

Table 16-34 Comparison of Average Travel Times to Recreation Areas
(Phase I development of all facilities)

	Travel Time
Tocks Island Lake Project	Approximate average travel time of 1 3/4 hours.
Program A, Expansion of State Park System	Average travel times are significantly less than TILP due to location of 50% of total facility capacity near urban areas
Program B, Opening Closed Reservoirs and More Use of Existing Facilities	Somewhat lesser travel time than "C" and TILP due to dispersal of about 1/3 of the total facility capacity.
Program C, No Public Programs, Except DWGNRA Without TILP	Slightly lesser average travel time than to TILP as patronage will be slightly less urban-oriented.

Note: Programs A, B and C include DWGNRA without TILP.

The advantages of the larger number and more dispersed locations of the Program A recreation sites, and to a lesser extent the Program B facilities, are apparent from the values noted. The 10 minute or 10% differential is significant since it is calculated on a system-wide basis and is representative of overall travel conditions of substantial magnitude.

XVI.D.4.(b) Transportation Improvements

As discussed in Chapter XXV, the transportation improvements required to accommodate normal anticipated growth of population and travel in the study area are extensive. Indicative of this, a total of an estimated 256 additional lane-miles are required throughout the three state area for projected 1985 (Phase I) growth. Among the improvements required to handle base growth in the immediate DWGNRA area is the addition of two lanes and other improvements along Route 209 in Pennsylvania.

If the proposed DWGNRA and TILP combination is implemented it will not, of course, be possible to upgrade Route 209 in its present location; it must be relocated. Other improvements required to accommodate additional traffic attributable to Phase I of TILP are the addition of two lanes on Route 94 south of Newton and the construction of access routes and related improvements around the periphery of the National Recreation Area.

Under Program C, DWGNRA Without the Tocks Island Lake, it will still be necessary to relocate Route 209 and make spot improvements along Route 94 with respect to alignment and shoulders, for example, to improve the capacity of the existing two lanes. Improved access routes and related improvements in the vicinity of the National Recreation Area will still be required to handle the recreation traffic generated by the two million annual visitation projected for Phase I of DWGNRA without TILP.

Under the first phase of program A, which is the expansion of State Parks and Programs to accommodate an annual visitation of two million (and the first phase of DWGNRA without TILP), the foregoing improvements noted under Program C will be required. Other than local improvements to routes in the immediate areas of the proposed first phase riverfront parks in Harrisburg, Scranton, New Brunswick and Albany facilities, it is not anticipated that major highway improvement will be required for the new State parks component of Program A.

The initial phase of Program B consists of DWGNRA without TILP; the opening of the closed reservoir at Pequannock; and the greater use of existing facilities at Beltzville and Harriman. Annual visitation at Pequannock is estimated at 500,000 and at the latter two facilities, 250,000 each.

To accommodate additional recreation traffic created by the Program B facilities it will be necessary to upgrade Route 23 east and west of Pequannock to expressway standards. This would primarily involve the elimination of signals and the provision of grade separated crossings. Improvements along Route 94 between Routes 23 and 15 and local access route construction will also, in all likelihood, be necessary. The improvements noted above for Program C are also required under Program B as well as under Program A.

It is evident from the foregoing general discussion that the only major highway construction required under initial phases of any of the four courses of action is the relocation of Route 209 in Pennsylvania and, to a lesser extent, the provision of additional lanes on Route 94 south of Newton. These major improvements are required only to accommodate the level of traffic projected for Phase I of TILP. It is to be emphasized again, however, that the number, extent, and cost of highway improvements required to accomodate normal traffic growth particularly in the Delaware Water Gap area and in Sussex and Warren Counties in New Jersey, greatly exceeds any of improvements considered under initial phases of TILP o. the alternative programs.

XVI.D.4.(c) Other Consideration

The foregoing discussions and comparisons reflect conditions under Phase I of DWGNRA with TILP and under initial phases of Alternative Programs A, B and C. The practicality with respect to transportation of these alternatives and TILP under successive stages of development differs also, however.

The major difference is that expansion of Programs A and B would generally involve the development of additional recreation sites, whereas Program C (DWGNRA without TILP) and DWGNRA with TILP would both expand via more intensive development of DWGNRA. Thus the differences noted previously regarding the loads placed on the regional transportation system and the efficiency with which the recreation travel load is handled by the system under TILP and the alternative programs will be significantly increased.

As noted in Chapter XXV, serious doubts regarding the implementation of required improvements for Phases II and III of DWGNRA with TILP exist. Improvements needed for the subsequent development of DWGNRA without TILP, Program C, being not as extensive, are not as unlikely of full implementation. Because the additional recreation components of Programs A and B do not impose such a concentrated travel load on the regional system, and because further units for expansion would be set apart, the increase in transportation loads and impacts associated with the further development of these programs would be less. The likelihood of the improvements needed for these programs (A and B) being made, particularly since the judicious selection of sites could permit the use of the improvements for non-recreational travel purposes, is also felt to be significantly greater.

Related to the foregoing, of course, is the geographic distribution of traffic congestion and other transportation-related impacts. The greater the number of recreation destinations, the more evenly distributed are these effects and the less severe are impacts on individual affected areas. Thus the future expansion of Programs A and B is more desirable from this point of view.

The practicality of utilizing mass transit to carry a significant share of the projected recreation travel demand under both initial and subsequent phases of development is another major transportation criteria in the evaluation of TILP and alternative programs. As indicated in Chapter XXV, a few or a concentrated pattern of patron origins and destinations together with high volume peak periods is more amenable to the use of mass or public transit. The single recreation destination and the high visitation of TILP an DWGNRA combined could make it practical, again as noted in Chapter XXV, to serve a share of these patrons by transit. Special and charter buses could be suitable; rail transit would have limited appeal or recreational usage.

DWGNRA without TILP would have lower overall visitation, a somewhat lower fraction of its users travelling at peak periods, and slightly less of its visitors, in all likelihood, originating in urban areas. Mass transit still could be employed to serve it, however, though not to the extent of such service to TILP.

Those dispersed recreation components of Programs A and B, due to the above factors, would not be nearly as conducive to large scale mass transit service--though such service would not be impractical, particularly with respect to charter buses, and should be considered. As the overall demand for mass transit is dispersed among several recreation sites in Programs A and B, it would be significantly less than in Program C or TILP in which recreation is concentrated at a single location.

XVI.D.4.(d) Critical Issue Areas

The analyses summarized above and in Chapter XXV highlight certain critical issues which should be addressed. One is the absolute necessity for recreational facility siting and planning to be based upon, and constrained by, external transportation routes, capacities, facilities and service -- both those existing and others which can be realistically projected. Such coordinated planning will greatly reduce adverse impacts along approach corridors and in adjacent areas and will increase the overall attractiveness of a trip to the facility and hence, in all likelihood, its level of usage.

Planning for mass transit service, including estimates of demand, ridership and transit cost and feasibility, should generally also be an essential part of the recreational facility planning process. Related to this, since such transit service may not be attractive to private operators and since broader public benefits may be realizable if it is implemented, are questions of public subsidy. The investigation of public programs and funding sources and the precise determination of the types and extents of social and economic benefits which could be obtained should be pursued.

Another critical issue area concerns the construction of major highway improvements primarily for recreational travel which will occur only during a few hours on twenty to thirty weekend or holiday days each year. If the improvement is not used to any extent for non-recreational traffic at other times, a substantial investment will be idle and its feasibility open to question. If the improvement is not undertaken extensive traffic congestion results, together with the usual range of attendant impacts. The effects of a major highway improvement, particularly if often under-utilized, on regional and local land development patterns and intensity also require study, and planning approaches to make such improvements consistent with desired goals should be sought.

XVI.E. SOCIAL AND INSTITUTIONAL EVALUATIONS OF T.I.L.P. AND ALTERNATIVE PROGRAMS

In the following, social and institutional evaluations are considered separately. Under social evaluations, TILP and the three Programs are analyzed for their social impacts and for positive and negative social factors. Regarding institutional evaluations, TILP and the three Programs are examined in terms of institutional arrangements and constraints for the function areas of water supply, flood control, recreation, power generation, and water quality.

XVI.E.1. SOCIAL EVALUATIONS OF TILP AND ALTERNATIVE PROGRAMS

Below are analyzed the social impacts and the positive and negative social factors of TILP and the three alternatives.

XVI.E.1(a) Introduction

Social evaluations take into consideration those public actions which affect or alter the current lifestyle or pattern of human settlement. Indicators of social impacts include: changes in land use patterns, environmental alterations, disruptions of local residents and businesses, and shifts in an area's general livability. All of the above signal changes in the established social orders, affecting the lives of individuals directly, or making changes in the community which will eventually affect individual residents.

In the following, social evaluations will be made of the Tocks Island Lake Project and the three Programs. Social impact matrices will be utilized for each of the four functional areas examined. Ratings of low (barely noticeable social); medium (noticeable but not objectionable) and high (noticeable and objectionable) are used to quantify the differences in impact. Assessment of the social impacts of TILP can be more straightforward inasmuch as the programs are site specific (and well defined) and because community leaders and area residents (see Chapter XXIV Lifestyles and Attitudes) have been interviewed regarding their perception of lifestyle changes likely to occur if TILP is implemented. Thus the consultant is assisted in social evaluation in the case of TILP by local community inputs. The same, however, is not true of the three Programs which represent a scatteration approach (while TILP is concentrated) so that alternative Programs specified as A, B and C are not necessarily contiguous in location.

The purpose of this section is to perform a social evaluation of TILP and the three Programs as well as analyze positive and negative social factors of the above. It is significant that social and institutional evaluations are linked inasmuch as the institutional arrangements provide the context for social expression. Lifestyle values are frequently embodied in the particular institutions that are created.

XVI.E.1(b) Social Evaluation of TILP

The multi-purpose TILP contains the following program elements which are evaluated for their social implications:

Water Supply: To augment river flow in period of drought for maintenance of minimum flow of 3,000 cfs (cubic feet per second) at Trenton; to meet increased water demand in northern New Jersey (additional diversion from the Delaware Valley); to meet growing industrial, municipal and agricultural demands in the Delaware Valley.

Flood Protection: To reduce flood damage along the main stem of the Delaware River from the Tocks Island Dam to Burlington, New Jersey.

Power: To help meet peak energy demands through the building of a large pumped storage generating station on Kittatinny Mountain by a group of New Jersey utility companies; to provide 70,000 kilowatts (kw) through conventional hydroelectric generation at the dam.

Recreation: To provide the largest inland, water-based recreation attraction in the Northeast, consisting of a 37-mile long lake covering 12,000 acres. The total recreation area would be 69,000 acres. Of these,48,000 acres, which include the reservoir, would be under the National Park Service.

XVI.E.1(b)(1) Demographic Profile

The principal demographic findings for the seven-county impact area show that the area is rapidly growing (24 percent increase between 1960-1973); the population is evenly split between rural and urban, households are decreasing in size and increasing in number; and that total personal income increased by 154.7 percent between 1959-1972

Economically, the impact area experienced steady growth between 1960-1972, with 50,000 new jobs added; almost all in the nonmanufacturing category. New employment was mostly in the areas associated with tourism and recreation.

Data on social characteristics reveals that impact area residents are older (11.0 percent are 65 and over compared to 9.9 percent for the United States); that the area reflects the national scene in having slightly more females than males; and that the area's non-white population is 3.6 percent (compared with 12.5 percent nationally), roughly one-fourth of the non-white population represented by the national composition.

The area's work force is predominantly blue collar and income for most residents is concentrated in the lower-middle and middle-income brackets.

XVI.E.1(b)(3) Sociological Analysis

The following analysis and matrix below provides a social evaluation of the four functional areas of TILP.

The proposed dam and 12,000-acre lake would create a water resource which would have considered social impact on individuals and property. Documented elsewhere in this study are statements on properties and farms already taken as well as decriptions of the proposed inundation of some 10,000 acres of land which flanks the river. These actions have had considerable social impact and are rated "medium" in the matrix inasmuch as reservoirs or tributaries would likely have an even greater social impact.

Visitors to the TILP/DWGNRA would number 4,000,000 in Phase I and 10,000,000 in Phase III. Due to this concentration of recreation facilities in a relatively small geographical area, the social impact would be "high". The ripple effect of this visitation level would accelerate the area's urbanization trends. Without the necessary measures being implemented, traffic would crowd roadways; crime would increase due to population increases and changes ; and the environment would begin to experience degradation. Without adequate controls, new commercial developments -- motels, camping grounds, restaurants, service stations -- would be expected to surround access and entry points to the DWGNRA. New residential developments -- seasonal and permanent homes -- can also be anticipated spurred by TILP. The foregoing is an indicator that the seven-county area, currently rural, will be experiencing considerable urban pressures if TILP/DWGNRA is implemented.

Table 16-35 Social Evaluation Matrix-TILP

Programs	Impact Low	Medium	High
Power Generation	X		
Water Supply		X	
Recreation			X
Flood Control		X	

Tocks Island dam and lake, as a reservoir, is planned to provide flood protection in the Delaware River Basin area. Because the solution is "structural" and requires a lake, the same social evaluation comments would apply here as were previously made under the water supply. Thus, the social impact rating would be "medium".

Power generation in connection with TILP would have a "low" social impact inasmuch as the Kittatinny Mountain pumped storage project (KPS) would be developed at the project site without the necessity to relocate homeowners or businesses. The gas turbines as combined cycles alternatives would likely have a greater social impact because they would be developed closer to population centers and would have lower emission stacks which would increase air pollution.

XVI.E.1(c) Social Evaluation of Alternate Programs

The following analyzes the social impact of the three alternative programs; A, B, and C. Inasmuch as individual alternative "packages" are not concentrated in one defined geographical area, this section does not lend itself to specific demographic profiles (as was the case for TILP). Also, some programs with the A, B, and C packages are not site-specific, particularly electric power and recreation.

XVI.E.1(c)(1) Alternative Program A

This program alternative consists of combined cycle power generation; a combination of reservoirs on tributaries and the maintenance of the Philadelphia/Camden system at low flow; the expansion of the state parks and programs for recreation; and the construction of a main stem dry dam for flood control.

The reservoirs or tributaries which are used for water supply purposes are as follows: Hackettstown, McMichael, Shohola Falls, Girard, Tobyhanna, Hawley and Lackawaxen.

Inasmuch as plant specific locations cannot be presented for the combined cycle power generation alternative, it is difficult to rate its social impact. However, land use requirements and the system's "normal" operation relative to environmental impacts are unknown. Important factors for evaluating its social impact include: nearness of plant site to population center; character of development surrounding chosen site; capability of jurisdiction to accommodate new plant; and degree current lifestyles and values are altered by new development. It is assumed that these factors will be recognized in the actual siting and the impact is therefore considered "low".

The development of seven new reservoirs on tributaries (listed above) is the alternative program selected for water supply under "A". The collective impact of the development of seven scattered reservoirs is comparable in social impact to the development of one dam and lake for TILP. The same processes as TILP would have to be undertaken: land acquisition, relocation of homes and business, and disruptions due to construction. Therefore, the social impact rating is considered "medium". The second half of the water water supply alternative -- maintenance of the Philadelphia/Camden system at low flow -- would not have a social impact.

Table 16-36 Social Evaluation Matrix-Alternative A

Programs	Impact Low	Medium	High
Power Generation	X		
Water Supply		X	
Recreation	X	X	
Flood Control		X	

The recreation alternative envisioned under "A" is major new state parks and programs. These parks would be of a city-wide or regional significance and are quite different in concept from traditional rural-oriented state parks. The alternative envisions a series of "riverfront metroparks" developed on derelict land in and near the larger urban centers (of the recreation service area) and a number of larger "super parks" at select locations. The social impact is rated "low" inasmuch as park sites would provide the opportunity for rehabilitation of older riverfront industrial structures into new activities centers, and therefore would not adversely disrupt or alter existing lifestyles. To the contrary, the social impact would be beneficial in the reclaiming of urban land for positive cultural purposes. It is assumed that park sites chosen outside urban centers would also minimize disruptions, while adding positive amenities. The other part of the recreation package in Program A is DWGNRA with TILP. The effects of this element, as noted under Program C, is evaluated as "medium", and the rating in the matrix therefore reflects this condition.

Construction of a main stem "dry" dam (under the flood control alternative) would not require a permanent pool (other than a pool to provide for silt storage) and could be located at the Tocks Island site. The social impacts would be similar to TILP in that a major dam would be constructed, which would require the acquisition of land and family and business disruptions. However, the dry dam would be dissimilar in that there would be no impoundment and therefore no adverse social impacts along the river itself.

XVI.E.1(c)(2) Alternative Program B

For this program alternative, the electric power alternative selected is also combined cycle; water supply consists only of reservoirs on tributaries; recreation included in this program is a combination of opening closed reservoirs and more extensive use of existing facilities; and flood control as a combination of structural and non-structural alternatives with the structural being a set of dams on tributaries.

Inasmuch as the electric power alternative is also a combined cycle, the social impact evaluation indicated for alternative program A is the same "low" social impact here.

The reservoirs on tributaries utilized under both Programs A and B for water supply alternative are the following: Hackettstown, McMichael, Shohola Falls, Girard, Tobyhanna, Hawley and Lackawaxen.

Again, no additional social evaluations are required due to the fact that new reservoirs on tributaries were discussed under alternative program A.

Table 16-37 Social Evaluation Matrix-Alternative B

Program	Impact Low	Impact Medium	Impact High
Power Generation	X		
Water Supply		X	
Recreation		X	
Flood Control			X

In recreation, one component of this alternative deals with the possibility of opening existing reservoir systems to the public for recreation use. These large reservoirs are located in New York, New Jersey, and Pennsylvania (23 have been identified). Some are closer to population centers than Tocks Island and are not now being used for recreation. Depending upon the site's chosen and the number of new reservoirs opened, this alternative could have a considerable social impact. Obviously, each new site would need development which would include such items as a road system, packing lots, picnic areas, beaches and other appropriate facilities and services. If, for example, the new reservoirs opened, each with an average annual visitation of 200,000, this 2,000,000 would be half of the proposed Tocks Island visitation for Phase I. This amount of visitation should produce a "medium" impact inasmuch as the sites would be dispersed over a large area. In addition, the DWGNRA without TILP will also affect the social structure as noted elsewhere.

The second component of the recreation alternative would be to expand the role of existing facilities, primarily state parks and forests. Basically, this would be brought about by an increase in the intensity of development of those facilities now in place such as adding more picnic tables and campsites, increasing the length of developed beaches, and the like. Assessments indicate that existing facilities are capable of handling more people without damaging the ecological holding capacity or quality of the recreation experience. Therefore, it is estimated that the expansion of existing facilities would have a "low social" impact. The addition of more visitors for each site would be noticeable to some local elements (service station operators) but would likely go unnoticed by a majority of the population. To summarize the recreation impact, a "medium" and "low" impact is assigned a medium status in the matrix above.

In flood control, this alternative proposes the development of a number of dams on upstream tributaries of the Delaware River as a substitute for the Tocks Island dam. Those dams are the following: Flat Brook, Bridgeville, Sterling, Hawley, Girard, Shohola Falls and McMichael. The last four of those locations just noted, at Hawley, Girard, Shohola Falls and McMichael, are multi-purpose facilities combining both water supply and flood control purposes. This alternative is ranked "high" in terms of social procedures which are planned to develop the Tocks Island dam will have to be utilized in the development of each of the upstream tributary dams.

This would involve the acquisition of land (and the inevitable impact on businesses and families); the construction process; as well as disturbances both physically and ecologically of the areas chosen.

XVI.E.1(c)(3) Alternative Program C

This alternative consists of combined cycle power generation; the maintenance of the Philadelphia/Camden system at low flow; no public programs other than DWGNRA without TILP; and only non-structural combinations for flood control.

The combined cycle power alternative, as noted in Programs A and B, would result in a "low" social impact as indicated in the matrix below.

Regarding water supply, the alternative of maintenance of the Philadelphia/Camden system at low flow would result in a "low" social impact as was noted in Alternative A.

In recreation, DWGNRA without TILP would handle 2 million annual visitors in Phase I and 4 million ultimately. While not as severe as the conditions with TILP, this volume is bound to have serious effects and the social impacts are therefore rated "medium". Elsewhere in this report, impacts on roads, public service and environment have been enumerated.

Table 16-38 Social Evaluation Matrix-Alternative C

Program	Impact Low	Medium	High
Power Generation	X		
Water Supply	X		
Recreation		X	
Flood Control	X		

Non-structural flood control alternatives (as proposed for C) include purchase of flood plain properties, flood insurance as an incentive not to build in the flood plain, flood proofing of flood plain structures, and a flood plain management program. Of these program elements, purchase of flood plain properties and land (to prevent future development) would have the greatest social impact. This would require, in some cases, the relocation of residential and commercial properties. Also, the purchase of land which would alter established community lifestyles. Nevertheless, this alternative is designated as "low" social impact rating inasmuch as the land purchase program is only one component of this alternative.

XVI.E.1.(d) Summary of Four Evaluations of Social Impacts

The matrix below summarizes the social evaluation of TILP and the three alternatives. The combined cycle power alternative of A, B and C and the conventional hydroelectric power proposal of TILP are assessed to have a "low" social impact for the reasons that TILP is part of a multi-purpose project (no specific power impact has been evaluated) and the alternatives are not site specific so only broad estimates can be given.

Recreation (with TILP/DWGNRA and DWGNRA only) and water supply (with numerous dams proposed for the upper tributaries) rate "high" social impacts.

Table 16-39 Summary Social Evaluation

Programs	Power Generation			Water Supply			Recreation			Flood Control		
	Low	Med.	High	Low	Med.	High	Low	Med.	High	Low	Med.	High
TILP	X				X				X		X	
Alternative A	X				X			X			X	
Alternative B	X				X			X				X
Alternative C	X			X				X		X		

Only qualified conclusions relative to social impact should be drawn from the above summary which are largely qualitative estimates of non-site specific programs.

As the first of this section noted, the multi-purpose TILP is expected to eventually attract 10,000,000 annual visitors to one site. This concentration of activity will have a greater total social impact (within the seven-county area) than the combined social impacts of scattered developments in local communities throughout the Delaware River Basin.

XVI.E.1(d)(1) Positive Social Factors of TILP and Alternative Programs

Positive social factors are assumed to be those benefits which would reinforce and lend stability to existing lifestyles and community values with the least amount of disruptive changes. Accordingly, positive benefits can be derived from all four of the TILP and alternative program areas. Highlighting those benefits, new electric power resources and water supply would add stability and assure uninterrupted basic services to the residents of the Delaware River Basin area. Recreation would be beneficial to the residents, principally, of the four-state area but also serve as a national resource. Successful flood control programs would bring new confidence to those whose lines have been most adversely impacted by flooding.

XVI.E.1(d)(2) Negative Social Factors of TILP and Alternative Programs

Negative social factors include those adverse social impacts which would occur contiguous to program sites including changing in existing community patterns, new demands on public services, and accelerated adverse environmental impacts. The heaviest adverse impacts would result from implementation of the TILP within the seven-county area (see XVI.D for public service implications). Inasmuch as TILP is a multi-purpose project focused on one large site, this fact is all the more understandable. Negative social impacts would also be associated with scattered alternative programs insofar as existing communities were forced to change to accommodate those programs. As previously stated, because so many of the alternative programs are not site-specific, adverse social impacts have to be generalized.

XVI.E.1(e) Conclusion

The conclusion for the social evaluation component of the social and institutional evaluations of TILP and alternative programs follows.

XVI.E.1(e)(1) General Characteristics of Social Impacts

Social impacts result in the alteration of current lifestyles and the shape of community settlement pattern. Lifestyles are affected when properties change hands; when population increases exceed the community's ability to successfully absorb new residents; when commercial, residential, and governmental changes occur because of urbanization in general or in response to a major new development such as the TILP. The above changes alter a community's "general livability" and thus affect individual lifestyles and the way in which an individual relates to his community.

XVI.E.1(e)(2) Most Important Social Benefits Representing Social Change

Social benefits will accrue to Delaware Area Basin residents as a result of social changes occasioned by the various program elements discussed in this section. The most direct and tangible social benefits would be in the area of greater recreation opportunities throughout the above-noted area. These obvious social benefits for the general population would be in the areas of power generation and water supply (these resources are not appreciated until missed). For those living in or near the flood plain area, flood prevention programs would be an added benefit to those already mentioned.

XVI.E.1(e)(3) Negative Social Factors to be Dealt with Requiring Social Change

Programs are required to soften the impact and ameliorate concerns of individuals and communities that will be most affected by the programs discussed here. Local impact communities should benefit over-all rather than "lose" if new programs area-wide programs are implemented. Also, the environment must be protected to minimize environmental degradation. The impact area's general livability must be maintainted, so that new programs do not upset a community's desirability balance.

XVI.E.2 INSTITUTIONAL EVALUATIONS OF THE TOCKS ISLAND LAKE PROJECT AND ALTERNATIVE PROGRAMS

XVI.E.2(a) Introduction

Institutional implications of the Tocks Island Lake Project (TILP) and its alternatives include the responsibilities of governments and governmental agencies responsible for implementing TILP or one of its alternatives. The institutional arrangements and constraints with respect to the four authorized purposes of TILP will be discussed below. These authorized purposes are: (1) water supply, (2) flood control, (3) recreation, and (4) power generation. The institutional linkages associated with implementation of TILP and alternative programs for each of these purposes will also be explored. Definitions of TILP and its alternative programs are referenced below. Part B of this study (Chapters VII through XI inclusive) define TILP. The first four chapters (XII through XV inclusive) of Part C analyze alternatives to TILP described in Chapter XVI.A.3.

This section is divided into two major elements. The first describes the relative institutional impacts of the selected alternative programs and compares them to TILP. The discussion of these relative institutional impacts is summarized in the matrix presented in Table 16 - 46 . The second element of this section discusses the principal Federal Government institutions, including the Delaware River Basin Commission (DRBC), having principal responsibilities for capital investment and locational decisions associated with TILP and its alternatives. This discussion includes the points at which the nine institutions discussed interact with state and local institutions. In Chapter XXII.C.8(b) local and state institutional considerations of importance to the implementation of TILP are discussed. Together, chapters XVI.E.2 and XXII.C.8(b) represent the analysis of institutional implications of TILP and its alternatives to federal, state, local and quasi-governmental agencies.

XVI.E.2(b) Authorized Purposes Institutional Evaluations

Institutional evaluations of TILP and its alternative programs are set forth below for each of the four authorized purposes of TILP. A summary of the relative institutional impacts discussed here is presented in Table 16-40 on the following page. In that table each of the authorized purposes is listed. They are followed by line items for TILP and program alternatives A, B and C. In the body of the table are represented the relative institutional impacts ranging from L (low) to M (medium) to H (high). The relative impacts are determined by comparing the institutional role of the federal, state and local governments to each other. Thus, the capital investment role of the Federal Government is compared to the capital investment role of state and local governments in making the assignment of the L, M or H institutional impacts.

Water Supply. For TILP the water supply institutional impacts are high for the Federal Government which has a capital investment responsibility in the proposed dam and a major responsibility in determining its most appropriate location. These responsibilities have already been carried out by the Corps of Engineers (COE). Neither the state nor the local

Table 16-40 Relative Institutional Impacts by Level of Government for Program Alternatives and TILP/DWGNRA

Project Purposes and Program Alternatives	Federal Government		State Government		Local Government	
	Capital Investment	Location	Capital Investment	Location	Capital Investment	Location
Water Supply						
TILP/DWGNRA	H	H	L	L	L	L
Program A	H	H	M	M	M	M
Program B	H	H	M	M	M	M
Program C	L	L	L	L	L	L
Flood Control						
TILP/DWGNRA	H	H	L	L	L	L
Program A	H	H	L	L	L	L
Program B	M	M	H	H	H	H
Program C	L	L	H	H	H	H
Power Generation						
TILP/DWGNRA	L	H	L	H	L	L
Program A	L	L	L	H	L	L
Program B	L	L	L	H	L	L
Program C	L	L	L	H	L	L
Recreation						
TILP/DWGNRA	H	H	L	L	L	L
Program A	H	H	H	H	L	L
Program B	H	H	H	H	H	H
Program C	H	H	L	L	L	L

Keys: Programs A, B and C are explained in Chapter XVI.A. In the body of the table L means low, M means medium and H means a high degree of institutional impact.

governments had a major role to play in determining the precise location of the dam which would create the reservoir from which water will become available or in future capital investments for the project.

Program A. represents a combination of dams and reservoirs on tributaries and the maintenance of the Philadelphia/Camden water systems at low flow of the Delaware River. The dams required to implement this alternative are listed in Table 16-41 The Corps of Engineers' responsibility for locating and funding these reservoirs places the Federal Government in a relatively high (H) institutional impact responsibility for this alternative. Pennsylvania and New Jersey responsibilities for assisting Philadelphia and Camden respectively in the implementation of this alternative program are acknowledged in Table 16-41 by the designation of medium institutional impacts at the state government level. At the same time, those municipalities have roles to play in improving and maintaining their water systems. Therefore, the local government responsibilities are also shown with an M for this alternative.

Program B is construction of dams on tributaries as shown in Table 16-41 These seven dams would be located in Middle Smithfield, Lackawaxen, Hamilton, Kidder and Shohola townships, Pennsylvania and in Mount Olive, Alamuchy, Palmyra and Paupack townships, New Jersey. The Corps of Engineers would have a principal responsibility for locating and funding these tributaries reservoirs. The Pennsylvania and New Jersey state governments would share in this responsibility. Local governments would have the same responsibilities as in Program A for improving their water

Table 16-41 Local Government Locations of Tributary Dam Program Alternatives

Program Alternative 1/					Jurisdiction(s)	
WS	FC	R	Name of Dam	Creek or River	County/State	Township
	B		Bridgeville	Neversink	Orange/N.Y.	Deerpark
	B		Flat Brook	Flat Brook	Sussex/N.J.	Walpack
A/B	B		Girard	Bushkill	Monroe/PA.	Middle Smithfield
A/B		B	Hackettstown	Musconetcong	Warren/N.J.	Alamuchy
					Morris/N.J.	Mount Olive
A/B	B		Hawley	Middle	Wayne/PA.	Palmyra and Paupack
A/B			Lackawaxen	Lackawaxen	Pike/PA.	Lackawaxen
A/B	B	B	McMichael	McMichael	Monroe/PA.	Hamilton
A/B	B	B	Shohola Falls	Shohola	Pike/PA.	Shohola
	B		Sterling	Wallenpaupack	Pike/PA.	Greene
					Wayne/PA.	Sterling
A/B		B	Tobyhanna	Tobyhanna	Carbon/PA.	Kidder

Note: 1/ Program alternatives selected in Chapter XVI.A. WS refers to water supply, FC to flood control and R to recreation.

systems in order to properly avail themselves of the benefits of the tributary reservoirs, the water supply component of this Program.

Flood Control. Under the TILP proposal, flood control would be accomplished through the construction of a dam on the main stem of the Delaware River. This alternative has required a high degree of institutional responsibility by the Corps of Engineers in determining the location and costs of the dam. State and local governmental agencies have relatively few institutional responsibilities for this alternative. Program alternative A would place a dam at the same location but it would permit the river to continue flowing except during periods of high flow when flooding could be anticipated downstream from the dam. This alternative is called a main stream dry dam. Because of its similarities to the TILP the institutional impacts would remain the same.

Program B would consist of a combination of structural and non-structural alternatives described in more detail in Chapter XV. The structural portion of these alternatives would be a series of dams and reservoirs on tributaries as shown on Table 16-41 Two of these dams would be located in New Jersey, one in New York and four in Pennsylvania. The dissipation of institutional responsibilities for implementation of structural and non-structural elements of this program alternative result in each level of government having varying responsibility for its implementation. The Federal Government would have the principal role to play in locating and providing capital investment funding for the structural portion of this alternative. The state and local governments would have principal responsibility for implementation of the non-structural portions of this alternative.

Program C would only include non-structural solutions for flood control. Therefore the institutional impact is with the State and local governments where, the principal responsibility for implementation lies. One of the key elements of this program is flood plain zoning which is a function of township governments.

Power Generation. Under the TILP proposal there are two components of this project authorized purpose. The dam on the main stem of the Delaware River would include a hydroelectric component. In addition, a pumped storage power generation component would be located at Kittatinny Mountain. Implementation of this proposal requires a high level of institutional responsibility on the part of the COE and the Federal Power Commission. The respective state public utility commissions would also play a role.

Local governments would have very little institutional responsibility to implement this proposal.

All three program alternatives are the same for power generation. They consist of combined cycle power generation. Accordingly, the institutional impacts are the same for alternative Programs A, B and C. The principal role would be played by the state public utility commissions in determining the location and retail rate structure for the sale of power generated at the combined cycle facilities. The only locational constraint is that the combined cycle facility be near a source of water for cooling purposes. Since capital investment in power generation facilities is by private utility companies, no governmental institution has an important role to play in accuring capital and making the decision to spend it for this purpose.

<u>Recreation</u>. Both the TILP reservoir and the Delaware Water Gap National Recreation Area (DWGNRA) are critical elements of the proposed project. They provide a wide variety of recreation opportunities. Because of the important roles of the Corps of Engineers and National Park Service in this proposal the Federal Government has a high degree of institutional responsibility in the location and capital investment concerns prior to implementation. Both the state and local governments have a much lesser institutional responsibility.

Program A would expand the number of state parks and recreation programs available. Therefore the state governments would have an important role to play in determining the location and in funding these parks. In the event federal assistance was sought to acquire land and develop these parks the Federal Government would play at least a medium institutional role in implementation of this alternative. In addition, however, their involvement with DWGNRA with TILP as noted in Program C below, will result in a high level of Federal participation for both Programs A and B.

Program B would include a combination of opening closed water supply reservoirs and the more intensive use of existing recreation facilities. Changing the use of existing water supply reservoirs could have important institutional implications to those governmental agencies responsible for their maintenance and operation as discussed in Chapter XIII. Therefore there is a high level of state and local government institutional impact in the implementation of alternative Program B.

Program C would depend on DWGNRA without the TILP reservoir for providing recreational opportunities in the area. Since DWGNRA is a federal facility to be administered by the National Park Service, the Federal Government would have the principal institutional responsibility in the implementation of this alternative program. Much lesser roles would be played by the state and local governments who are not responsible for the acquisition, operation or maintenance of a federal recreation facility.

Conclusion. Conceptually the implementation of the alternative programs set forth above could be thought of as a "top down" approach, "bottom up" approach or a combination of the two. Table 16-40 , assists in determining which approach is used for the proposed project and the three program alternatives discussed. Generally, where the Federal Government has a high degree of institutional responsibility and the state and local governments do not, the approach may be thought of as being "top down." On the other hand, in cases where the local government level has a high degree of institutional responsibility and the state and federal governments have low degrees of institutional responsibility they may be thought of as being "bottom up" approaches. Applications of this typology to the proposed program and its alternatives results in the following classification:

1. Top down approach.

   a. TILP/DWGNRA for all four project authorized purposes.

   b. Flood control alternative Program A.

   c. Recreation alternative Program C.

2. Bottom up approach.

   a. Flood control alternative Program C.

Program alternatives not categorized above would be implemented by a combination of the "top down" and "bottom up" approaches. These approaches have implications for the governmental agencies at the federal, state and local levels. These implications are discussed below in terms of institutional responsibilities of all three levels of government. The local government institutional perspective is detailed in Chapter XXII.C.8(b).

XVI.E.2.(c) Federal Institutional Impacts

XVI.E.2.(c)(1) Introduction

In the following section federal institutional impacts on the Tocks Island Lake Project will be discussed from the standpoint of five functional areas: water supply, flood control, recreational, electric power generation and water quality. Each of these functional areas was chosen since the stated objective of the TILP is to improve the water supply, provide flood control, provide recreational opportunities, and increase electric power in the Delaware Basin. Although improving water quality is not one of the stated objectives of TILP, the improvement of water quality in the Delaware Basin is one of the most important objectives of all levels of government.

After an extensive review process of which federal agencies could affect the five functional areas, it was determined that the following eight federal institutions and one federal-state compact agency would be focused upon: Farmers Home Administration (FmHA), Soil Conservation Service (SCS), Federal Power Commission (FPC), Department of Housing and Urban Development (HUD), Environmental Protection Agnecy (EPA), National Oceanic and Atmospheric Administration (NOAA), National Park Service (NPS), the Office of Management and Budget, and the Delaware River Basin Commission. The latter institution is the federal-state compact.

The discussion which follows will be organized by the five functional areas. Under each functional area there will be a discussion of how the different federal agencies affect the functional areas, how the regulatory and capital investment functions work, and how the different federal agencies interrelate with other federal, state and local institutions. The Delaware River Basin Commission, which because of its unique and pervasive role in the Delaware River Basin, will be given separate treatment.

XVI.E.2.(c)(2) Water Supply

The provision of adequate water supply is one of the four major purposes of the Tocks Island Dam project. The Federal Government's role in water supply is principally carried out by the Environmental Protection Agency, the Farmers Home Administration and the Soil Conservation Service. It will be the objective of the following disucssion to show how these institutions impact on water supply from a capital investment and regulatory control standpoint.

The EPA plays the largest role in water supply, mostly through the "Safe Drinking Water Act" of 1974. The Act allows for grants to the states to carry out public water system supervision programs. The grants are subject to the following federal requirements: (1) the EPA administrator has determined that the state will establish within one year of receiving the grant a public water system supervision program; and (2) within that year assume primary enforcement responsibility for public water systems within the state.

The grant is allowed to cover up to 75 percent of the recipients costs in carrying out a public water system supervision program. The amount of grant funds available to each state is determined as the basis of population, geographical area, number of public water systems and other relevant factors.

EPA grants will in addition cover up to 75 percent of the recipients costs in carrying out underground water source protection programs. The recipient must establish within two years an underground water source protection plan and must assume primary enforcement responsibility for underground water sources within the state.

The "Safe Drinking Water Act" is the first Federal Act dealing in depth with providing safe drinking water for public use. Its coverage applies to each public water system in a state except if the water system: (1) consists only of distribution and storage facilities and does not have any collection and treatment facilities; (2) obtains all its water from, but is not owned or operated by, a public water system already covered by the Act;(3) does not sell water to any person or organization; and (4) is not a carrier which conveys passengers in interstate commerce.

The Act clearly contemplates that the states rather than the Federal Government will have primary responsibilities for assuring safe drinking water. For EPA to recognize the primary enforcement role of the states the administrator of EPA must determine that the state has adopted safe drinking water regulations that:

1. Are no less stringent than the federal regulations which fix among other things the maximum contaminant levels;

2. Provide adequate procedures for the enforcement of state regulations including conducting, monitoring, and making inspections as the EPA Administrator requires;

3. Include provisions for assuring safe drinking water in times of emergencies.

One of the basic assumptions embodied in the Act is that if the public is aware that the drinking water being provided is below federal standards they will request their local officials to remedy the situation. The federal regulation, therefore, requires that the water supplier must give notice within 36 hours of failure to meet federal requirements. This is done by publishing their failure in newspapers, giving the notice to television and radio stations, and printing a notice on the water bill.

The Farmers Home Administration (FmHA) of the Department of Agriculture plays a significant role in water supply primarily through the provision of loans and grants for the development, storage, or distribution of water. Eligibility is available for communities with a population of less than 10,000 people and loans and grants are restricted to include municipalities, counties, other political subdivisions of a state, districts, and cooperatives and corporations operated on a non-profit basis.

Applicants for grant funds must be without sufficient funds to carry out the project for which the grant is intended and must be unable to obtain credit from other sources at reasonable rates and terms. Applicants for loan funds must not only be unable to obtain sufficient credit at reasonable rates and terms elsewhere but must agree to refinance with certain other sources (a production credit association, a federal land bank, or other responsible cooperative or private credit source) if such credit becomes available.

Highest priority for grant funds must be given to applications of municipalities and other public agencies of rural communities having a population that does not exceed 5,500. The same priority applies to loan funds with the additional provision that highest priority for water system loans must go to communities with a community water system which has suffered an unanticipated diminution or deterioration of its water supply and thus needs immediate action.

In the seven-county impact area of the Tocks Island Lake Project (Pike, Monroe, Sullivan, Orange, Sussex, Warren and Northampton) there are approximately 156 political subdivisions as determined by the U.S. Census. Of these 156 subdivisions, 121 or 77.6 percent have populations of less than 5,500 people, and therefore these jurisdictions will be in the highest priority category for FmHA grants and loans.

Applicant projects for grant funds must be designed so that they are consistent with a comprehensive community water, waste disposal or other development plan and must not be inconsistent with any planned development provided in any approved state, multi-jurisdictional, county, or municipal plan. No loan funds may be made available to a project which is inconsistent with any multi-jurisdictional planning and development district areawide plan.

Grants may be made for up to 50 percent of the project development costs and up to 100 percent of project costs for loan funds.

The Soil Conservation Service (SCS) of the Department of Agriculture also advances funds to develop water supply for future municipal or individual use. These grants reach a maximum of 30 percent of the cost of a multiple-purpose reservoir. SCS defers payment for a maximum of 10 years without interest.

Whenever a project may have a substantial effect on the water resources of the Delaware Basin, it must be submitted to the DRBC to determine its impact. In the latter part of this section is a separate treatment of the operation and powers of the DRBC. Except in the following situations the DRBC will be responsible for reviewing all water supply project impacts in the Basin.

1. The construction or removal of impoundments when the storage capacity is less than 100 million gallons; and
2. A withdrawal from ground water impoundments or running streams as long as the daily average gross withdrawal during any month does not exceed 100,000 gallons.

XVI.E.2.(c)(3) Flood Control

One of the principal justifications for the Tocks Island dam is its expected ability to provide flood control. There are principally two federal agencies besides the Corps of Engineers which have an impact on flood control. In terms of structural flood control measures, the Soil Conservation Serivce of the Department of Agriculture constructs dams for farmers as part of its duties; in non-structural terms the Department of Housing and Urban Development has jurisdiction inasmuch as its Federal Insurance Administration administers the National Flood Insurance Program authorized by the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The SCS watershed projects are usually on the small tributaries or rivers. The SCS will pay for the entire cost of engineering services for flood prevention and the entire cost of construction of structural measures for flood prevention, including land stabilization measures. For SCS to finance such a project it must have been initiated at the local level and the local sponsor must be responsible for carrying out and maintaining the project; and it must be reviewed and approved at the state level by the governor or the concerned state agency.

SCS watershed projects are limited to an area no larger than 250,000 acres, and to structures providing less than 12,500 acre-feet of flood-water detention.

State agencies and qualified local organizations can sponsor watershed projects. These include soil and water conservation districts; municipalities; counties; and watershed, flood control, conservancy, drainage, irrigation, or other special-purpose districts.

State conservationists of the Soil Conservation Service can approve watershed work plans that do not involve a federal contribution to construction costs in excess of $250,000. The SCS administrator must approve any work plans that call for the project in two or more states.

If a watershed work plan exceeds either of the two limitations mentioned above it must be submitted to the appropriate Congressional committee.

The committee on Agriculture and Forestry of the U.S. Senate and the Committee on Agriculture of the U.S. House of Representatives are the approval authorities for any watershed project whose federal share exceeds $250,000 or structures having more than 2,500 acre-feet of total capacity but not more than 4,000 acre-feet of total capacity. The Committee on Public Works of the U.S. Senate and the Committee on Public Works and Transportation of the U.S. House of Representatives are the approval authorities for any watershed projects exceeding 4,000 acre-feet of total capacity.

The Federal Insurance Administration of HUD administers both the National Flood Insurance Act of 1968 and the Flood Disaster Act of 1973. The National Flood Insurance Program authorized by the Act of 1968 provides flood insurance which previously was unavailable from the private insurance industry. The program is divided into two stages depending on whether or not a flood insurance rate study has been completed by the administrator. For the first stage (before the development of the rate study) communities are eligible for the Emergency Program, under which only half of the program's total limits of coverage are available and all such insurance is sold at subsidized premium rates. The Emergency Program is available to communities that meet eligibility requirements, by adopting certain flood plain management regulations consistent with federal criteria designed to reduce or eliminate flood damage.

To qualify for the sale of federally subsidized flood insurance, a community must adopt and submit to the administrator of the Flood Insurance Program, flood plain management regulations. The Administrator of the Program is to develop comprehensive criteria designed to encourage the adoption of adequate state and local measures which (1) constrict the development of land exposed to flood damage; (2) guide the development of proposed construction away from locations threatened by flooding; and (3) assist in reducing damage caused by flooding.

It is the role of the communities to develop their own criteria based on the federal guidelines. These guidelines mention that the communities must review building permits and subdivision proposals to assure that proper construction is designed to withstand 100 year flooding; and that all public utilities and other facilities are constructed to minimize or eliminate flood damage. When floodproofing is utilized for a structure, it must be certified by a registered professional engineer or architect that it is adequate to withstand 100-year flood levels. In riverline situations (on the banks of a river) situations the community must coordinate its flood activities with upstream, downstream and adjacent communities which are adversely affected by any changes in a watercourse.

The Emergency Program limits the coverage to $35,000 on single-family dwellings and $100,000 on all other types of buildings, with $10,000 per unit available for residential contents, and $10,000 per building available for nonresidential contents.

After a flood insurance rate study has been completed by the administrator, and the community has already been accepted into the Emergency Program, a community enters the Regular Program, under which full limits of coverage are available.

In the seven-county impact area we have determined, for the purposes of this section, that there are 178 communities. The difference between the U.S. Census of 1970 which lists 156 political subdivisions and our present determination is due to the different political structure of the New York counties where both the political subdivision and the towns or villages within the subdivision are counted; the U.S. Census figure only counts the political subdivisions.

Of these 178 communities, only 44 participate in the Emergency Program and one in the Regular Program. Of the remaining 133 communities, 108 are within the flood plain zone and many of these in the worst flood areas. Thus, most of the communities that are most highly susceptible to the worst flooding are not covered by the National Flood Insurance Program.

In 1973 the Congress enacted the Flood Disaster Protection Act of 1973 which expanded the flood insurance program to:

1. Substantially increase the limits of coverage authorized under the National Flood Insurance Program;
2. Provide for the expeditious identification of, and dissemination of information concerning flood prone areas;

3. Require states and local communities, as a condition of future federal financial assistance for acquisition or construction of property after July 1, 1975, to participate in the flood insurance program and to adopt adequate flood plain ordinances with effective enforcement provisions consistent with federal standards to reduce or avoid future flood losses; and

4. Starting 60 days after enactment, require purchase of flood insurance by property owners who are being assisted by federal programs or by federally supervised, regulated, or insured agencies or institutions in the acquisition or improvement of land or facilities located in flood hazard areas.

The President gave the Office of Management and Budget (OMB) responsibility for coordinating and monitoring federal efforts to reduce flood losses.

FmHA issued guidelines in June of 1972 requiring that flood hazards be evaluated in the community services programs. The community services water and sewer program guidelines stated that, as far as practical, facilities will not be located in flood plains. The guidelines also stated that if it was necessary to locate facilities in a flood plain area, applicants were to evaluate the proposal from the standpoint of special design and additional initial and maintenance costs. Officials in FmHA state offices said that in approving sites for sewage facilities they normally relied on state regulatory agencies to evaluate the flood hazards.

February 1973 guidelines issued for the rural housing program provided that no structure shall be located in the 100-year flood plain. The guidelines stated that delineation of flood plain areas could be obtained from agencies such as the Corps of Engineers and SCS.

The Delaware River Basin Commission (DRBC), which will be fully discussed in a later section of this report, was set up to manage the water resource needs of the Delaware River Basin. It is not directly involved in flood control except where such flood control measures may change the quantity of water available to the various states. Before a structural flood control method can be put into effect, agreement must be obtained from the states. Therefore, although the Basin Commission does not directly come into play, the states who are members of the Commission have virtual veto power over such flood control measures they do not find desirable.

XVI.E.2(c)(4) Recreation

Federal participation in recreational projects is focused on the National Park Service (NPS). It is responsible for the adoption and implementation of policies with respect to the designation and use of natural and historical uses. For the purposes of this section, we will only discuss those parks in the recreational area category.

To understand how the NPS will impact on the TILP and its alternative programs it will be necessary to discuss NPS policies with respect to: resource management, fish and wildlife management, physical development and roads and trails.

Resource Management Policy

In the management of recreation areas, outdoor recreational pursuits shall be recognized as the dominant or primary resource objective. Managing an area to emphasize its recreational values, however, does not mean that its natural and historical values are to be ignored. On the contrary, management provides for the conservation of natural or historical features when they are of such value to enhance the recreational opportunities of the area.

Consistent with the recognition of outdoor recreation as the dominant resource management objective, other resources within recreation areas shall be managed for such additional uses as are compatible with fulfilling the recreation purpose of the area.

Fish and Wildlife Management Policy

Wildlife population will be controlled when necessary to maintain the health of the species and to safeguard public health and safety. Fish and wildlife management involves two principal functions: (1) the management of the habitat -- soil, water, and vegetation; and (2) the management of harvesting of fish and wildlife population by the public in recreation areas. The latter function is recognized as being within the regulatory authority of the individual states. The first function is recognized as the responsibility of the NPS.

Wildlife management programs will be directed toward maintenance and enhancement of habitat for game animals and other wlidlife whose pressence in the recreation area is of aesthetic, recreational, interpretive, or educational value.

Management of aquatic resources will have as its primary objective the improvement of habitat for game fish, shellfish and waterfowl. The re-introduction of native species into recreation areas may be permitted where it poses no obvious danger to human life or property or where it contributes to recreational enjoyment.

Public hunting and fishing will be permitted as long as it is compatible with the primary objectives of the area as established. Public hunting, fishing and possession of fish and resident wildlife must be in accordance with state laws and regulations.

The NPS may designate zones where no hunting or fishing shall be permitted for reasons of public safety, administration, or other public use of the area.

Physical Development Policy

An architectural theme shall be prepared for each area or major development site within an area. The purpose is to develop guidelines for the design of structures that will further the realization of the area purpose in terms of materials to be used, the spirit or feeling to be conveyed by the facilities, and the kind of relationship to be developed between facilities and their surroundings.

Facilities for cultural programs, spectator sports, and special events may be provided. As a rule, these facilities should be part of an intensive use area in order to make use of existing parking lots, comfort facilities, food and other services.

Permanent camping facilities, including buildings for use by organized groups and for hostel-type use, may be provided in recreation areas. Operation of these facilities should be either by concessioners, organizations under permit, or by the service. Space for organized group camping should be allocated to serve the greatest number of groups interested. To accommodate demand, advance reservation of facilities and limitations on length of continuous use by one camping party may be imposed. In allotting camping privileges, preference should be given to public groups over semi-public groups, and semi-public groups over nonprofit groups, and nonprofit groups over private groups.

Road and Trail Policy

In each area there should be a "good sensible road system" to serve the needs of management and the reasonable requirements of visitor use. Types of roads which may be provided within the recreation area road system are: major roads, minor roads, special purpose roads, interpretive roads, administrative roads, and parkways. Two-way roads should be de-emphasized and one-way roads should be emphasized.

In deciding upon road locations, maximum advantage should be taken of interpretive and scenic values. A professional determination must be made that the resulting effects on recreational values -- including such aspects as wildlife habitat and mobility, drainage, stream flow, and the climate effects of paved areas -- will be minimal. A professional determination must be made that the means of transportation, and its location, will provide maximum opportunity for visitor enjoyment and appreciation of an outdoor recreational experience.

Where volume of use warrants, separate trails should be provided for foot and horse use. Moreover, where intensity of use threatens recreational values, limitations on size of parties and frequency of trips to specific locations may be imposed.

XVI.E.2(c)(5) Power Generation

Another purpose of the Tocks Island Lake Project is to provide electric power. There are three federal agencies that play a regulatory role: the Federal Power Commission (FPC), the Nuclear Regulatory Commission (NRC) and the Environmental Protection Agency (EPA).

The FPC has the major regulatory responsibilities. It does the following: regulates the rates and services of public utilities selling electricity in interstate commerce at wholesale (does not regulate retail power rates); prescribes accounting systems and reporting procedures for interstate electric power companies; issues and administers permits and licenses for construction and operation of non-federal hydroelectric projects on waters or lands subject to Federal jurisdiction; in emergencies, directs the interconnection of electric power systems; regulates certain issuances and sales of securities by electric public utilities and the merger or consolidation of such utilities; regulates the holding of interlocking positions between electric public utility companies and between public utilities and electric supply companies or companies authorized to underwrite securities; in order to assure an abundant supply of electric energy, has authority under certain conditions to order utilities under its jurisdiction to sell or exchange power.

The Nuclear Regulatory Commission (NRC) was created by Congress in 1974 and began operation in 1975. Its functions were formerly performed by the Atomic Energy Commission. The Nuclear Regulatory Commission has jurisdiction over the construction and operation of nuclear power plants in the United States. These regulatory powers include those associated with safety as well as environmental effects. The NRC requires that before construction begins on a nuclear project, a safety analysis report and an environmental report be submitted to the commission for review. This permit licensing action can take as long as two years. Once a construction permit is issued, construction on the project can begin. Prior to star - up however, the applicant must submit to the NRC supplements to the safety analysis reporting and the environmental report which include updates describing the final design characteristics of the plant and detailed environmental technical specifications. The NRC reviews this operating license application in conjunction with the Advisory Committee Reactor Safeguards (ACRS) and the Atomic Safety and Licensing Board (ASLB). The NRC responsibilities are carried out by a central office located in Washington, D.C. In the case of nuclear power plants the NRC has been responsible for assessing water quality as it relates to the Environmental Protection Agency requirements.

The Environmental Protection Agency (EPA) has the responsibility for regulating air and water quality and as a result is responsible for granting permits to applicants who are proposing power plant projects. The requirements enforced by EPA do not generally cause projects to be cancelled. Permitting by EPA is carried out in the offices of the regional administrators.

The Delaware River Basin Commission with power to review power projects that may affect the Delaware River Basin requires that an application for an electric generating project with a design capacity of 100,000 kw or more include: (1) a master siting study, (2) a site selection analysis for the project, and (3) the environmental statement otherwise required.

XVI.E.2(c)(6) Water Quality

Improving water quality is not one of the major purposes of TILP. However, the federal government is becoming increasingly more involved in the Delaware River Basin through EPA, the National Oceanic and Atmosphereic Administration and FmHA. In the following discussion we will outline the principal forms of capital investment and regulatory controls of each agency.

The National Oceanic and Atmospheric Administration of the Department of Commerce pursuant to the provision of the Coastal Zone Management Act of 1972 provides grants to coastal states in order to assist them in the development of a management program for the land and water resources of its coastal zone; and grants are made available after the management program has been approved to help the states administer their management program. The federal government will provide up to 66 2/3 percent of the cost of developing and administering the management program; it does specify, however, that no other federal funds can be utilized for these purposes and that grant funds will only be made available for three years in the development of the management program.

To receive a grant the states must submit their management program to the Secretary of Commerce for his review and final approval. To be approved the following provisions are required:

1. The Coastal Zone will include those lands where any existing or potential use will have a direct and significant impact on the coastal waters and any such use will be subject to the management program. It is the state's obligation to develop an operational definition of direct and significant impact.

2. The state must show that it has the means for controlling each permissable land and water use and for precluding land and water uses in the coastal zone which are not permissable with the management program. This requires a certification from the Governor of the state specifying that the state has such authority and that the Governor is prepared to implement the activities.

3. Lastly, for federal approval the states must provide sufficient evidence to the Secretary of Commerce that in the development of the management program there was full participation by all relevant federal agencies, state agencies, local governments, regional organizations, port authorities and other interested bodies, both public and private. In addition, the states must provide mechanisms in their program for continued coordination with the planning of other interested parties. In the event of serious disagreement between any Federal agency and the state in the development of the program the Secretary of Commerce, in cooperation with the Office of Management and Budget, mediates differences.

The "Water Pollution Control Act" of 1972 sets a national goal of eliminating all pollutant discharges into U.S. waters by 1985 and an intermdeiate goal of making all waters safe for fish, shellfish, wildlife and people by July 1, 1983. To carry out these goals Congress established the following policies: that the discharge of toxic pollutants in toxic quantities be prohibited; that federal financial assistance be provided to construct publicly owned waste treatment works; that areawide waste treatment management planning processes be developed and implemented in each state; and that a major research and demonstration effort be instituted to eliminate the discharge of pollutants.

Grants for construction of waste treatment works are made to state, municipal or intermunicipal or interstate agencies on the following conditions: that after June 30, 1974, no grant shall be made unless the applicant demonstrates that the proposed system uses the "best practicable waste treatment technology" over the life of the works and unless the system utilizes, where appropriate, technology which will at a later date allow for reclamation or recycling the water or will otherwise eliminate the discharge of pollutants.

The federal share of the cost of treatment works construction is up to 75 percent and requires that the EPA administrator allot funds among the states on the basis of need. The ratio to be used in determining need is the cost of constructing all needed publicly owned treatment works in a state to the cost of constructing all needed publicly owned treatment works in all the states.

There are a number of requirements which a proposed system must meet prior to receiving funds: it must conform to the relevant state's areawide waste treatment management plan; it must conform to any applicable state plan as determined by EPA standards; and it must be certified by the appropriate state water pollution control agency as being entitled to priority over other works in the state in accordance with the applicable state plan. Other requirements deal with the operation and maintenance of the system, its reserve capacity and user charges.

EPA will pay up to 100 percent of the costs of waste treatment management plans through June of 1975. After that date it will pay up to 75 percent of the costs.

Another objective of EPA is to assure that waste treatment management is applied on an areawide basis. The EPA administrator is required to issue guidelines for the identification of areas which as a result of urban-industrial concentrations and other factors have substantial water quality control problems. Using these guidelines the state governors are to identify areas within their states with substantial water quality problems. They must then designate the boundaries of the area as well as a single representative organization in each area capable of developing effective areawide waste treatment management plans for the area.

Within one year of the date of designation of the organization it is required to have in operation an ongoing areawide waste treatment management process. The process must result in plans containing alternatives for waste treatment management and applicable to all wastes generated within the area involved. The plan must be certified by the Governor within two years of beginning operation and must be submitted to the EPA administrator for his approval.

Among the statutory requirements for the content of the plan are the following:

1. Identification of treatment works, updated annually, necessary to meet the anticipated municipal and residential waste treatment needs of the area over a 20 year period.

2. Establishment of construction priorities for treatment works and time schedules for their initiation and completion.

3. Identification of the agencies necessary to construct, operate, and maintain the needed facilities.

4. Identification of measures necessary to carry out the plan (including financing), the period of time necessary to carry out the plan, the costs of carrying it out within that period of time, and its social, economic, and environmental impact.

After the process is completed and both the waste treatment management agency and its plan have been approved by the EPA administrator, statute forbids the making of any construction grants for publicly owned treatment works in the relevant area except to the designated agency and for works in conformity with its plan.

The overall purposes of the areawide waste treatment plans is to correct what Congress has perceived to be an important cause of poor wastewater treatment: the lack of coordinated, comprehensive planning of the pollution control effect. Thus, by establishing a mechanism to provide each state with a planning and management capability it is EPA's intention to bring an end to the fragmentation of water quality control plans between adjacent communities and industries.

The Farmers Home Administration (FmHA) may make grants and loans for construction of works for the development, storage, treatment, purification or distribution of water on the collection, treatment, or disposal of wastewater in rural areas. Eligibility includes municipalities, counties, other political subdivisons of a state, districts, and cooperatives and corporations operated on a non-profit basis.

The facilities funded by Farmers Home must serve and be located in a rural area -- defined as an area which does not include any city or town in excess of 10,000 people. Although the facilities must serve farmers and rural residents and be used primarily by or generate substantial tangible benefits for farmers and rural residents, projects may be proposed to serve both rural and urban or urbanizing areas in which event funding is limited to the part of the project serving the rural area.

Applicants for grant funds must be without sufficient funds to carry out the project for which the grant is intended and must be unable to obtain credit from other sources on reasonable rates and terms. Applicants for loan funds must not only be unable to obtain sufficient credit at reasonable rates and terms elsewhere but must agree to refinance with certain other sources (a production credit association, a federal land bank, or other responsible cooperative or private credit source) if such credit becomes available.

Highest priority for grant funds must, according to the law, be given to applications of municipalities and other public agencies of rural communities having a population that does not exceed 5,500.

Applicant projects for grant funds must be designed so that they are consistent with a comprehensive community water, waste disposal or other development provided in any approved state, multijurisdictional, county, or municipal plan. No loan funds may be made available to a project which is inconsistent with any multi-jurisdictional planning and development district areawide plan.

Grants may be made for up to 50 percent of the project development costs, according to the legislation. Development costs are defined in the regulations as the cost of construction of the proposed facility, including land rights, easements, rights-of-way, necessary water rights, engineering fees, legal fees, administrative costs in connection with construction and acquisition, and estimated interest during the development period on any funds borrowed to perform such development. The same definition applies to loan funds, which may be provided for 100 percent of the project costs.

The Farmers Home Administration may also make grants to public bodies and other agencies with the authority to prepare comprehensive plans for the development of water or wastewater disposal systems in rural areas. A rural area is, again, defined as an area which does not contain a city or town larger than 10,000 persons.

In order to qualify for planning grants, the applicant organization must not have the resources immediately available to finance the planning for which the grant is proposed. As a prerequisite to awarding the grant, the state Farmers Home director must examine the application to determine also that the area in question is the logical one for treatment as a comprehensive area. Provision is made in the regulations for coordination with and consideration of relevant comprehensive and special use plans for the area.

EPA requires that each state submit its current water quality standards applicable to interstate waters to the EPA Administrator for approval and requires those states not having such standards to adopt and submit them as well.

Each state is required to identify the waters within its boundaries for which effluent limitations, as established elsewhere by Congress and EPA, are not stringent enough to allow implementation of the water quality standard applicable to the waters. The state is then required to establish a priority system for these waters taking into account the severity of the pollution and the uses to be made of the waters and, in accordance with the priority system, establish the maximum daily load for a series of pollutants to be identified by the EPA administrator. Both the list of waters identified and the maximum daily load calculation must be submitted to and approved by the administrator.

Each state must also establish a continuing planning process which is to be approved and periodically reviewed by the EPA administrator. Any planning process resulting in plans for all navigable waters within the state must include the following:

1. Effluent limitations and schedules of compliance at least as stringent as those required by the Water Pollution Control Act of 1972.

2. The incorporation of all elements of any applicable areawide waste treatment plans and applicable basin plans.

3. Total maximum load for pollutants in accord with the Water Pollution Control Act of 1972.

4. Procedures for revision.

5. Adequate authority for intergovernmental cooperation.

6. Adequate implementation, including schedules of compliance for new or revised water quality standards.

7. Controls over the disposition of all residual water from any water treatment processing.

8. An inventory and ranking, in order of priority, of needs for construction of waste treatment works required to meet the applicable effluent limitation requirements established by the Water Pollution Control Act of 1972.

All treatment works funded by the EPA must be in conformity with these state plans and must be entitled to priority.

The most important aspect of the waste water treatment facility construction grants is the continuing planning process and priority system required of each state. EPA has issued implementing regulations dealing with their planning process.

The planning process, as set forth in the regulations, provides for an annual state strategy containing a statewide assessment of water quality problems and the causes of the problems. Based on this assessment, the state is required to rank each river basin segment (the approved planning area) in priority order taking into account the severity of the pollution problem, the population affected, the need for preservation of high quality waters and the national priorities as determined by the EPA administrator. This ranking of basin segments is to generally govern the development of plans, construction of publicly owned treatment works, and issuance of permits.

Each state, in addition, is required to establish a State Municipal Discharge Inventory containing a ranking of significant municipal discharges. This inventory is to be used in establishing priorities for municipal facility construction and is to contain the ranking and categorization of all significant municipal discharges consistent with the basin segment rankings discussed above. The inventory must be revised at least yearly.

XVI.E.2.(c)(7) Delaware River Basin Commission

The Delaware River Basin Commission (DRBC) was created as a Federal Interstate Compact organization consisting of the U.S. Government and the states of Delaware, New Jersey, New York and Pennsylvania by an act of Congress and by laws adopted by the individual states.

The DRBC's major responsibilities are to develop and maintain a comprehensive plan and to program and control projects within the Delaware River Basin which provide regulation and development of ground and surface water supplies; for abatement of stream pollution; for flood damage reduction; for promotion of forestry, soil conservation, and water shed projects; for the propagation of fish and wildlife; for the development of water-related recreational facilities; and for the development of hydroelectric power potentialities.

The Comprehensive Plan. This plan plays a pivotal role in the RBC since no project having a substantial effect on the water resources of the Basin can be carried out unless it has been first submitted to and approved by the Commission. The Commission will approve a project whenever it finds that the project will not substantially conflict with the comprehensive plan.

The comprehensive plan will provide for the immediate and long-range development and use of the water resources of the Basin. The plan will include all those projects, both public and private, which are required for the optimum planning and development of the Basin's water resources. It will consist of statements of policy and standards as well as including the principal projects and programs involved in the river basin's development.

For the purposes of avoiding conflicts of jurisdiction and giving full effect to the Commission as a regional agency, federal, state and local agencies will follow the requirements of the compact. For federal, state and local agencies the compact provides that no expenditure or commitment can be made for any project unless it has been first included in the comprehensive plan. In addition the planning of all projects related to the Commission's delegated powers must be undertaken with the consultation of the Commission.

Projects can either be deleted or added to the comprehensive plan. A proposal for such a change must include the following information:

1. Purpose including quantitative measures of physical benefits anticipated from the proposal.
2. Approximate location, dimensions (if a structural project) and land area required.
3. Description of a proposed standard or policy.
4. Forecast of the cost (if structural) or effect on the utilization of water resources (if a non-structural measure).
5. Relation to other parts of the existing comprehensive plan.
6. A description of the construction procedures to be followed in excavating, backfilling, retention of sediment, reseeding and landscaping with particular reference to minimizing soil erosion and sedimentation in streams.

The Delaware River Basin Commission shares with federal, state and local institutions the responsibility for the maintenance of water quality in the Delaware Basin, and has enforcement rights although they have not been used to date. Only under the following circumstances will DRBC not be responsible for the water supply:

1. The construction of new plants or alternatives to municipal sewage facilities when the capacity of the facility is less than the daily average rate of 50,000 gallons, and all local sewage collector systems discharge into authorized trunk sewage systems; and

2. The construction of new plants or alteration of facilities which discharge of industrial wastewater having a capacity of less than 50,000 gallons per day, except when the wastewater contains toxic concentrations;

Federal agencies have delegated their authority in the Delaware Basin to the States of Delaware, Pennsylvania and New Jersey and these states, in turn, have their authority vested in DRBC.

Project Review. A project having a substantial effect on water resources of the basin must be submitted to the DRBC to determine its impact:

1. Where a project is subject to review by a state or federal agency which has entered into an administrative agreement with the Commission, the project will be referred to the Commission in accordance with the terms of the administrative agreement.

2. If no administrative agreement exists with the Commission, the project sponsor will apply directly to the Commission.

3. Any project proposal can be reviewed informally by the Commission staff in order to assist the sponsor develop his project in accordance with the Commission's requirements.

4. Whenever a project is in the highest priority classification of the water resources program, it will be considered approved for the purposes of the Commission.

5. Whenever a project is subject to review and approval by the Commission, there can be no substantial construction activity or related preparation of land until the project has been approved by the Commission. This will not apply to the drilling of wells for the purposes of obtaining geohydrologic data nor to in-plant control and pretreatment facilities for pollution abatement.

Project Classification. Projects in the following classes, except as directed by the Commission or as determined by a state or federal agency, will be deemed not to have a substantial effect on the water resources of the basin and therefore are not required to be reviewed by the Commission:

1. The construction or removal of impoundments when the storage capacity is less than 100 million gallons.

2. A withdrawal from ground water impoundments or running streams as long as the daily average gross withdrawal during any month does not exceed 100,000 gallons.

3. The construction of new or alternatives to municipal sewage treatment facilities when the capacity of the facility is less than the daily average rate of 50,000 gallons, and all local sewage collector systems discharging into authorized trunk sewage systems.

4. The construction of new or alteration of facilities for the direct discharge of industrial wastewater having a capacity of less than 50,000 gallons per day, except when the wastewater contains toxic concentrations.

5. A change in land cover on major ground infiltration areas when the land to be altered is less than three square miles.

6. Deepening, widening, or dredging existing stream beds or relocating any channel, and the placement of fill or construction of dikes on streams within the basin except the Delaware River and its tidal portion and streams draining more than one state.

7. Periodic maintenance dredging.

8. Electric distribution lines, communication lines, gas distribution lines, sanitary sewer mains unless these lines would significantly disturbs the ground cover affecting water resources and if they would pass

close to a proposed reservoir or recreation project area specified in the comprehensive plan.

9. Landfill projects limited to the disposal of solid inert wastes as long as the project is not located in a flood plain designated by the Commission or one of the signatory states;

10. Altering marshes or wet lands when the affected area is less than 25 acres.

All other projects which are considered to have a substantial impact on the water resources of the basin must be submitted to the Commission.

Preparation and Processing Environmental Impact Statements. A DRBC responsibility is to, in consultation with other appropriate federal, state, and local agencies and the public, assess the environmental impacts of any porposed action. Alternative action that will minimize adverse impacts will be explored so as to avoid, to the fullest extent possible, undesirable consequences as they relate to the quality of the human environment. This assessment will take place as early as possible and in all cases prior to any decision that may significantly affect the environment.

An applicant for any action within the following classification shall submit not later than the preliminary engineering or feasibility studies, an environmental report:

1. All actions required by the regulations to include an Environmental Impact Statement;

2. Major actions the Commission may indicate;

3. Action to include in the Commission's Comprehensive Plan the following:

a. Major policy or regulations significantly affecting the quality of the human environment; and

b. Master plans including a sequence of the contemplated projects which together may have a significant effect upon the quality of the human environment.

4. When requested by the Executive Director based upon an environmental review of the action.

Upon receipt of the report, the Executive Director shall prepare an environmental assessment of the action. The environmental assessment will be the basis for the determination of the need for an environmental impact statement.

Inclusion of a project in the Comprehensive Plan prior to January 1, 1970, does not exempt the action from an environmental impact statement. Action identified as requiring an environmental impact statement includes the following:

1. Any project, plan, regulation or policy identified by the environmental assessment as having a significant effect upon the quality of the human environment;

2. Major large-scale programs or master plans involving a sequence of contemplated projects, including new towns, watershed programs, wastewater, water supply plans, and recreation plans;

3. Impoundments;

4. Diversions;

5. Fossil-fueled electric generating stations;

6. Draining, filling or otherwise altering marshes and wetlands;

7. substantial encroachments upon a stream or upon the 100 year flood plain of the Delaware River or its tributaries;

8. Any other action which the Executive Director determines will have a substantial effect on the quality of the human environment.

XVI.E.2 (c)(8) Conclusion

Under each of the functional areas there was a relatively detailed discussion of the different federal institutions and how they impacted on the particular functional category. Water supply is primarily affected by the "Safe Drinking Water Act" of 1974 whose primary emphasis is to make the states administer an active program of improving water quality. In addition the FmHA and the SCS provide grant and loan funds to essentially rural areas for the provision of water supply facilities.

Under flood control both the SCS and the National Flood Insurance Program of HUD have the major federal institutional impacts on flood control. The SCS is primarily involved with smaller projects than are the case with the Corps of Engineers' projects. In order to initiate more awareness about flood plain zoning the National Insurance Program has a series of requirements before a community can be accepted into the insurance program. Although the program provides very low cost insurance, few of the communities in the most hazardous flooding zones in the TILP area participate in the program.

Federal participation in recreation in the Tocks Island Lake Area will be focused on the National Park Service. The discussion of the NPS was primarily concentrated on the internal administrative procedures for a national recreational area.

In the generation of electric power the FPC has the largest impact. The FPC reviews, very thoroughly, any new power project proposing to engage in interstate commerce. DRBC reviews applications for electric generating projects and if they are nuclear fueled NRC reviews them. EPA reviews proposed power plants for their environmental effects and grants permits if they meet EPA standards.

The federal government is becoming increasingly more active in water quality. The Coastal Zone Management Act of 1972 administered by NOAA provides grants to coastal states to develop management plans for their land and water resources. In order to receive grants the Act dictates that certain requirements be met. The emphasis is to get the coastal states to prepare comprehensive plans of their water and land resources and coordinate these plans with other governmental agencies.

The "Water Pollution Control Act of 1972" administered by EPA also endeavors to motivate the states to act to improve their water quality. The objective of the Act is to eliminate all pollutant discharges into U.S. waters by 1985. In order to carry out the objective, grant funds are available to states for the construction of waste treatment works and for the development of areawide waste treatment management plans. To receive the grants, however, the states must comply with a series of relatively stringent federal requirements.

In addition to the roles of EPA and NOAA in improving water quality, the FmHA also has a role, though much smaller, which is focused in rural areas. Finally, there was a discussion of the role of DRBC in the Basin. The DRBC's major function is to develop a comprehensive plan and determine which projects can be legitimately included or added to the plan. Every project having a substantial effect on the water resources of the Basin must be submitted to and approved by the Commission.

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XVI. F. SATISFACTION OF SERVICE AREA NEEDS

One of the most important single considerations in determining the wisdom of one course of action or another to meet future water-related needs of the Delaware River area is the degree to which projected unsatisfied needs of the area are fulfilled by each alternative course.

Future demands to be placed on the resources of the Basin are discussed in Chapters II through V of Part A. The assumptions underlying these estimates, as well as the uncertainties and the general level of precision, are also discussed.

The capability of the technical alternatives and alternative programs to provide or develop supplies of resources to meet these demands is presented in Chapters XII through XV of this Part C as well as in Section XVI.A., above. Under the following four functional headings, therefore, are described the relationships between additional resources or supplies furnished under each of the four courses of action (Programs A, B and C and TILP) and the previously outlined future unsatisfied needs of the area (overall demand less existing and scheduled supplies).

Additional points pertinent to the following discussion are that, as noted previously, the alternative programs developed are not "optimal" but are forwarded as reasonable alternatives for the purpose of evaluating the Tocks Project. Thus, where their usefulness or feasibility is indicated, it is not intended as a recommendation for that specific course of action.

Further, and most importantly, the alternative programs and TILP must be evaluated considering the full range of economic, environmental and other performance measures and impacts, as described in the preceding Sections XVI.B. through XVI.E. The nature and degree to which service area needs are addressed by the four alternative courses of action presented in this Section XVI.F. must be considered together with these associated performance measures and impacts.

XVI.F.1. WATER SUPPLY

The water supply service area consists of the Delaware River Basin plus subareas in Northern New Jersey and Southeastern New York State which are now served or which may be reasonably expected to be served in the future by water from the Delaware River Basin. The total projected demand to be placed upon the water supply resources of the basin is thus based upon pertinent characteristics of these geographic areas, the range of economic growth and development patterns which may occur in these areas, and the need to protect the water supply systems of Philadelphia and Camden from excessive saline intrusion.

Major factors considered in the estimation of total demand also included: population and employment; the present and future extent of public water and sewer systems; water-related characteristics of specific major industries in the service area; present and likely future recirculation rates in these industries; the future use of water conserving devices; lawn sprinkling requirements; electric power cooling; agricultural water demands; and the development of consumptive use coefficients indicative of the portions of water withdrawals that are permanently lost through evapotranspiration.

At the present time, water resources of the Delaware River Basin are meeting the demands placed upon them from within the basin and from the other portions of the service area. Within a limited period of time, however, and increasingly through the forecast period to 2025, needs or unsatisfied demand in the Northern New Jersey and Southeastern New York State subareas will be significant and may have to be met by increased diversions or exports of water from the basin. Diversions, as noted in Chapter III, unlike in-basin water use which is largely returned to the river eventually, represent water resources which are completely removed or lost with respect to the basin's water system.

XVI.F.1(a) Northern New Jersey Subarea

Estimates of public water supply need in the Northern New Jersey Subarea in 2025 range from 282 MGD to 810 MGD (Scenario 3, Subsection III.D.5.(b)) depending upon the regional development strategy implemented and the economic growth level achieved. This future unsatisfied water supply demand or need of Northern New Jersey must be met from sources such as the following which were noted in Sections XII.C. and III.D.2. These subarea and out-of-subarea projects can constitute technically viable alternatives to all or part of the Tocks Island Lake Project.

Subarea Projects

Round Valley Modifications
Confluence Reservoir (Somerset City)
Six Mile Run Reservoir
Longwood Reservoir
Monksville Reservoir
Groundwater Development in the Raritan and Passaic River Basins
Two Bridges Reservoir, Passaic River in Morris County
Pumping from Passaic to Wanaque Reservoirs
Washington Valley Reservoir
Increased Diversion from Ramapo River to Wanaque Reservoir
Reuse of Raritan and Passaic Basin Water
Misc. wources on County by County basis

Out-of-Subarea Projects

South Jersey Groundwater
Hudson-Ramapo Reservoirs
Hudson River high flow skimming
Reservoirs on Delaware River Tributaries
High flow skimming of the Delaware River into DRB and Round Valley reservoirs

Tocks Island Lake Project

Water supply yield of 300 MGD plus 333 MGD for low flow augmentation
Water supply yield in excess of 300 MGD with low flow augmentation of less than 333 MGD.

Another set of actions which can contribute to the satisfaction of water supply needs, though they do not have a "yield" in the true sense, are demand reducing measures. Examples of these include the installation and use of water conserving devices; rationing during periods of drought (via lawn watering restrictions, etc.); and providing for only a 100 year drought rather than the drought of record as is now done. Unsatisfied needs could be reduced by about 120 MGD were these measures to be utilized.

The total yield of the subarea projects is estimated at 700 MGD and the approximate capital cost per MGD of yield for these projects is $586,000.

Table 16-42. Order-of-Magnitude Capital Costs to Meet Water Supply Needs of the Northern New Jersey Subarea - Year 2025
(No Implementation of Demand Reducing Measures)

Economic Condition → Water Supply Needs →	High Growth 810 MGD		Medium Growth 457 MGD		Low Growth 282 MGD	
	Amount (MGD)	Cost ($Mil.)	Amount (MGD)	Cost ($Mil.)	Amount (MGD)	Cost ($Mil.)
50% of the Total Subarea Yield Developed						
1. Subarea Projects	349.	205.	349.	205.	282.	165.
Out-of-Subarea Projects	461.	599.	108.	140.		
Total Yield	810.		457.		282.	
Total Capital Cost		804.		345.		165.
Annual Cost		47.		20.		10.
2. TILP at 300 MGD	300.	174.	300.	174.	282.	174.*
Subarea Projects	349.	205.	157.	92.		
Out-of-Subarea Projects	161.	209.				
Total Yield	810.		457.		282.	
Total Capital Cost		588.		266.		174.
Annual Cost		35.		16.		10.
3. TILP at 466 MGD**	466.	174.	457.	174.*	282.	174.*
Subarea Projects	344.	202.				
Total Yield	810.		457.		282.	
Total Capital Cost		376.		174.		174.
Annual Cost		22.		10.		10.
100% of the Total Subarea Yield Developed						
1. Subarea Projects	698.	409.	457.	268.	282.	165.
Out-of-Subarea Projects	112.	146.				
Total Yield	810.		457.		282.	
Total Capital Cost		555.		268.		165.
Annual Cost		33.		16.		10.
2. TILP at 300 MGD	300.	174.	300.	174.	282.	174.*
Subarea Projects	510.	299.	157.	92.		
Total Yield	810.		457.		282	
Total Capital Cost		473.		266.		174.
Annual Cost		28.		16.		10.
3. TILP at 466 MGD**	466.	130.	457.	174.*	282.	174.*
Subarea Projects	344.	202.				
Total Yield	810.		457.		282.	
Total Capital Cost		332.		174.		174.
Annual Cost		20.		10.		10.

* The unit cost does not apply since TILP is considered only at the proposed scale and cost.

** Assumes that only 50% of the unused original TILP low flow augmentation allowance is available to the Northern New Jersey Subarea.

Note: Annual costs are based upon a 100-year project life and a 5 7/8% interest rate.

The total yield of the out-of-subarea projects, including the seven tributary reservoirs noted in Chapter XII, is over 1,000 MGD and the approximate capital cost per MGD of yield is $1,300,000. The capital cost allocated to water supply for each MGD of yield from TILP is about $580,000 if low flow augmentation provisions reduce the water supply yield to 300 MGD and roughly $280,000/MGD if low flow augmentation requirements are significantly reduced and those yields are included in the estimation of water supply unit costs.

Using these unit costs (i.e., capital cost per MGD of yield), the accompanying table outlines the order of magnitude of the total capital costs required to meet the subarea's water supply needs in the year 2025 for various hypothetical combinations of sources under the three economic growth conditions. Since the development of all the subarea sources is unlikely due to the controversial nature of some of the projects, the total capital costs are estimated assuming both 50 percent and 100 percent of the subarea's potential yield is actually developed. Equivalent annual costs are also noted.

Based upon the information outlined in the table, even if most of the potential yield of the proposed Northern New Jersey Subarea water supply sources were developed within the forecast period, and if the assumptions used regarding the future supply of industrial water prove to be valid (cooling water self-supplied, process and sanitary water publicly supplied), it appears that under high growth conditions direct water supply costs could be reduced by the development of the Tocks Island Lake Project together with subarea and some out-of-subarea sources.

If low growth economic conditions are to be planned for or realized, then the development of about half the yield obtainable from subarea sources could be sufficient to meet water supply needs of the Northern New Jersey Subarea through the 50-year forecast period at a relatively low overall cost. If this degree of water supply development was not possible, or if it was undesirable for any reason to implement the necessary subarea water supply projects, then the construction of the Tocks Island Lake Project or other out-of-subarea sources would appear to be required.

If the demand reducing measures referred to above and discussed in Chapter XII are implemented within the forecast period, then the need to develop water supply sources would, of course, be comparably reduced. However, under high economic growth conditions, unless virtually all of the subarea projects were developed, it appears that direct water supply costs could still be reduced by the provision of a 300 MGD yield from the Tocks Project.

Under low or medium economic growth conditions and the implementation of demand reducing measures, the development of about half of the subarea projects' yield could be sufficient to meet all of Northern New Jersey's water supply needs at a generally lower cost than if Tocks or other out-of-subarea projects were used.

Also pertinent are the various sources of capital funds for different types or categories of water supply sources. Projects in the subarea and out-of-subarea categories would generally be financed by municipal, county or state governments or by the authorities, other governmental or quasi-governmental agencies, or by private companies. The Tocks Island Lake Project would be Federally financed with charges levied against water users after a period of years to repay with interest the project costs allocated to water supply.

XVI.F.1(b) Southeastern New York Subarea

Estimates of water supply need in the Southeastern New York Subarea in 2025 range from 803 MGD to 1,516 MGD (Scenario 3, Subsection III.D.5(b)), again depending upon the regional development strategy followed and the economic growth level achieved. This unsatisfied demand must be virtually completely met through the increased use of water imported from sources outside the subarea.

However, since it is unlikely that the authorized diversions of the New York City System from the Delaware River Basin will be either increased or reduced, the future needs of this subarea will not, in all likelihood, be met from water resources of the Delaware Basin.

Proposed future sources for New York's water needs are noted in Section III.D.3 and are composed of the high flow skimming of the Hudson River and the development of Schaghticoke, Hinckley, Forestport and McKeever Reservoirs. Together these could produce a total yield of between 1,000 and 2,000 MGD.

It must be emphasized again, however, that the foregoing estimates are extremely sensitive to: changes in the assumptions made regarding future sources of industrial water and the portion that will be self-supplied rather than publicly supplied; and the possibility, and even likelihood in some cases, of appreciable difficulties with respect to the development of intra-New Jersey Subarea water supply sources.

XVI.F.1(c) Salinity Intrusion

Another need to be met by the water resources of the Delaware River Basin is the maintenance of both the Philadelphia water supply system intake in the Delaware River Basin and the Camden aquifer free from serious saline intrusion. Extensive analyses performed in the course of this study (III.E.2) indicate that salinity intrusion into the Philadelphia and Camden water systems has a very small probability of occurrence even under conditions of high consumptive use and diversion from the Basin that could be expected in 2025.

While the recalculation of such probabilities is appropriate as the amount and distribution of projected depletive uses becomes better known over time, present analyses indicate that the probability of significant intrusion will remain very low. Thus, any actions contemplated in this regard should be considered against this very low probability of occurrence; the extent of potential hardships and damages which could result from such saline intrusions; and the likelihood that measures undertaken solely for this purpose would rarely ever be utilized.

A related point of significance is that while the study evaluations have shown that salinity intrusion will not be a problem at Torresdale under likely conditions of future comsumptive use, these results cannot be directly used to determine if additional run-of-the-river diversions can be taken from the Delaware River.

The Tocks Project provides reservoir storage for 333 MGD of yield for low flow augmentation. This is intended to furnish protection from saline intrusion during protracted periods of low flow and would also be beneficial with respect to the maintenance of ecological balances downstream and the assimilative capacity of the Delaware estuary, which are dependent upon certain minimum flow levels.

Alternative Program A, with outputs comparable to TILP, provides directly for the protection of the Philadelphia/Camden water supply system by relocating the Torresdale intake and providing an alternative water supply source for Camden.

Alternative Programs B and C do not provide for the protection of the Philadelphia/Camden water supply system. If some of the reservoirs on the Delaware River tributaries were built ahead of the time at which they would be required to meet water supply needs, however, then some low flow augmentation and water supply system protection could be furnished under Program B.

XVI.F.2. RECREATION

Outdoor recreation as a "commodity" does not have a fixed measurable output and is, in economic terms, highly substitutable. That is, a person may enjoy and seek out one recreational pursuit but not necessarily be considered deprived if it is unavailable and another recreational activity is engaged in instead.

The need generally to travel to a recreational opportunity and thus have the attractiveness and use of the facility significantly dependent upon its location and accessibility is another factor affecting the demand, supply and use of recreational facilities. A third point affecting estimates of recreation demand and use is the number of subjective or non-quantitative factors such as personal motives and desires which clearly influence them.

Considering these and related factors such as trends in population, leisure time, personal mobility, income levels, recreation preference and participation rates and the existing and programmed supply of outdoor recreation facilities, future outdoor recreation needs were projected.

An assessment of the needs in relation to existing opportunities indicates that:

- There is a growing popularity for rustic recreational activities such as hiking and camping, even though state forests and underdeveloped park areas are still underutilized, often because of their relative inaccessibility.

- Swimming is the most popular outdoor recreational activity and is likely to remain so. It is also the one with the greatest indicated need.

- Freshwater boating is severely restricted by the size of existing facilities and horsepower limitations, and this activity often conflicts with swimming.

Considering these specific findings on recreational activities, the most significant factor affecting the evaluation of alternatives is that there is a substantial unsatisfied demand or need for all recreational facilities, particularly in the urban areas of the recreation service area. This need is projected to increase significantly after the mid-1980's. As the demand levels are so high relative to existing supply, they are relatively independent of the three alternative growth strategies postulated.

The Tocks Island Lake Project effectively addresses each of these four major recreation needs and could contribute substantially to the supply of recreation facilities within the entire service area required to meet these projected needs. it would not, however, even with improved transportation connections, be utilized by urban area residents to the extent necessary to significantly increase their overall recreation participation rates and TILP would not be an effective substitute, for example, for neighborhood swimming facilities.

The recreational facilities outlined under Program A -- the construction of state parks and programs in addition to the implementation of DWGNRA without the Tocks Island Lake -- similarly address all of the four major recreation needs noted above. With respect to the first need, the output provided is comparable to TILP and its wider geographic distribution of new recreation supply could permit urban areas to be somewhat better served and transportation and other local impacts to be more evenly distributed and reduced in intensity.

The National Recreation Area without a lake would permit more and higher quality "rustic" recreational activities than a more intensely utilized facility oriented towards water-based activities. The need for boating under Program A would be met by rivers and a number of smaller lakes rather than the large Tocks impoundment.

Recreational aspects of Program B -- the opening of closed reservoirs, the more intensive use of existing facilities, and DWGNRA without the Tocks Lake -- also address the basic recreational needs of the service area in much the same manner as Program A, though to a lesser degree. The lower output level, the consequent reduction in unsatisfied demand, and impacts associated with this lower usage are all substantially less than under the Program A measures.

Program C is limited with regard to recreation to only the DWGNRA without the Tocks Island Lake. It would not provide swimming or boating capacities which would be significant with respect to overall service area needs, but it would provide, as noted above, a substantial amount of higher quality land-based recreational opportunities.

XVI.F.3. FLOOD CONTROL

The need for flood control and flood damage reduction are measured by potential damages of both a tangible and intangible nature. The former include physical damages attributable to inundation, flood fighting costs, and business and financial losses resulting from flood-caused disruption of normal activities. Intangible damages may include health considerations and founded and ill-founded concerns affecting people's well-being and individual and business plans.

Tangible damages are indicated by estimates of: prior or possible flood damage; the translation of such values into equivalent average annual damages; acreage or areas inundated; and the number and type of properties and structures involved.

The flood of August 1955 caused an estimated $104,716,000 in damages (1955 dollars) throughout the Delaware River Basin, including $22,766,900 in the eight major damage centers along the main stem between Belvidere and Burlington, N.J. Approximately 5,000 acres were inundated in the Basin, including 1,600 in the eight damage centers. Residences affected exceeded 5,700 in the Basin and 2,000 in the above damage centers. Commercial and industrial structures totaling over 1,200 in the basin were also flooded. Average annual damages at present for the Delaware River flood plain above the Tocks Island site are estimated (in 1975 dollars) to be $557,900 and for below the site, $3,945,000.

Future average annual damages or flood exposure are dependent upon projected land use in the Delaware River flood plain. This in turn is dependent upon passage of proposed flood plain legislation in Pennsylvania and the extent to which existing flood plain legislation is enforced in New Jersey. The Federal Flood Disaster Protection Act of 1973 and Federal

Water Resources Development Act of 1974 will also play major roles in determining the future growth.

In spite of the foregoing, and while development in the flood plain will not proceed as fast as growth in surrounding areas, it is likely that growth in the flood plain will still occur. Estimates of average annual damages and related impacts may thus increase. This development is most sensitive to the degree of implementation of nonstructural flood protection measures.

Both the Tocks Island Lake Project and the main stem dry dam in Alternative Program A will provide substantial positive flood control with storage of over 300,000 acre-feet. Under either of these projects annual damages would be reduced by about 60 percent. This reduction, or the benefits so obtained, would amount to approximately $2.5 to $2.8 million annually.

The flood control structures on the Delaware River tributaries included in Program B would reduce average annual damages by about 44 percent. Benefits for this structural portion of Program B would total about $1.8 million. The nonstructural measures comprising part of Program B and all of Program C include flood plain management techniques such as flood plain zoning, flood insurance, permanent or temporary evacuation, early warning systems, floodproofing and other preventive measures. While these flood plain management measures would to a large extent be a means of reducing the potential for increased future flood damages in the Delaware River

Basin, the benefits, once a substantial degree of implementation is achieved, could be significant. Under Program B, the annual benefits which could be realized after implementation of a comprehensive non-structural set of measures is estimated at $1.7 million. Under Program C, the fuller implementation of a broad range of nonstructural measures could yield annual benefits of up to about $3.1 million.

It is to be noted that the full implementation of nonstructural measures requires a range of physical, legal, governmental and community actions and hence is an involved process. It is also to be noted that the flood insurance portions of estimated nonstructural benefits reflects actual damages sustained and subsequent compensation for this monetary loss. Such damages are thus not avoided and intangible non-monetary concerns and losses are also sustained. Other non-structural measures also differ from structural measures in that they do not prevent flooding but reduce the damages incurred.

XVI.F.4. ELECTRIC POWER

The range or probable future peaking power demand in the electric power service area was evaluated independently of past demand trends and considered the potential effects of future population growth; ranges of economic growth; personal income growth; peak demand price increases; political, environmental and other constraints relating to the future power supply; the potential electrification of end uses which presently use fossil fuels; and various conservation measures. The probable high and probable low values for peak power demand in the year 2000 are estimated to be 138,500 MWe and 65,600 MWe, respectively. The 1974 demand, in comparison, was 31,900 MWe. While the compounding of a large number of uncertainties makes it inappropriate to project these values beyond the mid-point of the total forecast period, it is anticipated that the demand for peak electric power will continue to increase.

Two basic power plant resource mix options were evaluated. One is based upon the assumption that most of the new power generation capacity added between 1975 and 2000 would be nuclear, while the other option assumes that a nuclear slowdown will occur and much of the new power generation capacity would be non-nuclear. Both consider advanced energy conversion alternatives and the R and D status and expected commercial availability of the advanced technologies.

Major factors affecting the evaluations performed are:

- Future power demand, both base and peak load, will be influenced by a series of causal factors which are not represented in past demand levels: projections of future demand must, therefore, be analyzed essentially independently of past trends.
- It is generally within the power of federal and state legislators and regulators to set constraints and standards which will substantially affect both the composition of future power resource mixes and demand levels.

Considering the foregoing and other factors noted, it is estimated that additional electric peaking power substantially in excess of that which could be provided by the proposed Tocks Project will be required under all of the conditions examined in the electric power service area within the forecast period. This need will probably develop during the 1980's or, under one set of conditions, during the 1990's.

Proposed electric power developments associated with the Tocks Island Lake Project would provide 1,300 MWe of peaking power. This is considered to be, under most sets of possible future circumstances, only a portion of the total peak power requirements of the electric service area. The general advantages of the Tocks Island pumped storage facilities relative to combined cycle facilities are that a lesser unit cost would be incurred; oil resources would be coserved as the pumping power would be developed largely from coal-fired units; and the pumped storage facility would possess greater reliability.

Electric power components of Programs A, B and C are composed of combined cycle electric power generation units, with a total capacity also of 1,300 MWe. The general advantages of such combined cycle units relative to pumped storage are that they have a somewhat lesser effect on air quality due to the higher quality fuel utilized; a lesser effect on water quality; and usually have lesser impacts on adjacent land uses.