APPENDIX A STREAM FLOW STUDIES

Computation of Available Drafts

In order to set up design parameter relative to the Proposed Treatment Facility, both on the Acid Mine Drainage Side and on the Potable Water Side, a Hydrological Study was made taking into consideration the various streams and storage facilities available.

As there are no long term records of the actual stream flows available, a synthetic stream flow was calculated using the existing records on the Frankstown Branch of the Juniata River as a base. The calculated stream flows were arranged in various combinations as follows:

1. Glen White, Kittanning and Scotch Runs.
2. Glen White, Kittanning, Scotch and Sugar Runs.
3. Glen White, Kittanning, Scotch and Mill Runs.
4. Glen White, Kittanning, Scotch, Mill and Sugar Runs.

As the records of flows are. extremely limited on these streams and there is some question as to the degree of accuracy when records are transposed from one point to another, an attempt was made to correlate this data with the actual records of reservoir depletion kept by the Altoona,City Water Department. Accordingly, a synthetic stream flow was constructed for the existing watershed drainage area and a depletion curve was constructed assuming a 5.0 MGD draft from the System.

Depletion records are available for the Reservoir System from 1944 to the present. Usage records are not as readily available and are not broken down, between the three (3) reservoir systems (Horseshoe Curve, Mill Run, Allegheny and Homers Gap). However, it is felt that a draft of 5.0 MGD from the system under consideration is adequate for this purpose. In 1954, Albright & Friel estimated the average daily draft from the Horseshoe Curve Reservoirs to be 4.5 MGD. City records show that the total draft to the System to be as follows:

1964 -	4.85	MGD
1965 -	5.14	"
1966 -	5.44	"
1967 -	5.47	"
1968-	6.64	" (Jan. to June)

The calculated depletion curve and the actual depletion curve of the reservoirs is shown on Exhibit A-1, Up until 1958 only the Horseshoe Curve Reservoirs were used and after .that date the Mill Run Reservoir was included. Examination of this curve indicates a fairly good correlation. The major discrepancies occur in 1943-44, 1952-53, and in 1958-59. We are unable to account for the 194.3-44 period but in 1952-53 there was a period of drought, and emergency pumping equipment was used taking water from the Mill Run-Allegheny System, which was prior to the construction of the Mill Run Dam. The discrepancy in, the 1958-59 period is indirectly due to the placing in service of the Mill Run Dam and the changes in usage which would naturally occur at that time.

Accepting the correlation between the actual reservoir depletion and the theoretically constructed depletion curve for the existing system, a series of depletion's were calculated for the various combinations of streams and at draft rates of 5,0, 7®5 and 10.0 MGD with and without stream release, based upon 0.15 CFS/sq. mile, The depletions in each case were then arranged in numerical order and a probability plot made in each case. Utilizing data from these probability curves, it is possible to determine the available draft from the Reservoir System. These curves are shown as Exhibits A-2 to A-14 and a summary of this data is as follows:

		Required Storage in Billion Gallons					
Stream Combinations	Draft	95%		98%		99%	
		W.R.	W.O.R.	W.R.	W.O.R.	W.R.	W.O.R.
Glen White, Kittanning, Scotch Run	5.0 MGD	1.09	0.68	1.32	0.82	1.51	0.93
	7.5 MGD	1.85	1.60	2.20	1.99	2.50	2.30
	10.0 MGD	--	--	--	--	--	--
Glen White, Kittanning, Scotch Run, Sugar Run	5.0 MGD	1.10	0.54	1.40	0.72	1.65	0.90
	7.5 MGD	1.68	1.06	2.08	1.30	2.40	1.49
	10.0 MGD	2.80	1.92	3.40	2.46	3.92	2.70
	12.5 MGD	4.35	--	5.49	--	6.40	--
Glen White, Kittanning, Scotch Run, Mill Run	5.0 MGD	0.92	0.54	1.10	0.70	1.26	0.84
	7.5 MGD	1.90	1.32	2.31	1.69	2.69	1.99
	10.0 MGD	2.81	1.94	3.60	2.49	4.23	2.90
Glen White, Kittanning, Scotch Run, Mill Run, Sugar Run	5.0 MGD	0.79	0.45	1.12	0.62	1.30	0.78
	7.5 MGD	1.45	0.94	1.72	1.18	1.95	1.32
	10.0 MGD	2.38	1.58	2.90	1.90	3.30	2.19
	12.5 MGD	3.60	--	4.50	--	5.20	--

W.R. - With Stream Release
W.O.R. - Without Stream Release

Note: Underlined numbers are those which most closely represent the Available Storage.

If we assume a useful storage of 1.0 billion gallons without Mill Run and 1.5 billion gallons with Mill Run, the following summary can be obtained from the plotted curves (Exhibits A-17 to A-24).

Examination of the above indicates that in most cases the inclusion of Sugar Run is of substantial advantage while the inclusion of both Mill Run and Sugar Run would give reliable yield of between 7.0 and 8.5 MGD and also permit the most efficient use of the Reservoir System, thus enabling the City to take water from any source with ease. (See description of Control in Plant Description).

No allowance was made in any of the above calculations for the increase in storage by use of the Fabridams now in use or under construction.

Stream Combination		Draft	
		With Release	Without Release
Existing	98%	4.25 MGD	5.40 MGD
	99%	3.85 MGD	5.10 MGD
Existing + Mill Run	98%	5.8 MGD	7.0 MGD
	99%	5.4 MGD	6.45 MGD
Existing + Sugar Run	98%	6.6 MGD	6.8 MGD
	99%	6.2 MGD	6.5 MGD
Existing + Sugar & Mill Run	98%	7.0 MGD	8.6 MGD
	99%	6.75 MGD	8.0 MGD

Calculation of Storm Flows

Since the Plant must be used to treat all waters coming off the watershed which are contaminated with acid mine drainage and the plan of operation calls for taking Kittanning Run directly from the stream, a calculation of expected high flows must be made.

Examination of the Water Supply Papers indicates that the Water Year 1937 had the highest average stream flow. From the flow records of this year a probability plot was made (See Exhibit A-16), and it was found that 91% of the time the flow in Sugar Run would be less than 10,000 GPM and 95% of the time the flow in Kittanning Run would be less than 10,000 GPM. A plot was then made for a 4.0 sq. mile watershed of flows over 6000 GPM for the period of record (1929-1965) and is shown as Exhibit A-15. If the System was designed to handle 10,000 GPM, we could then expect to take 90%95% of the daily flows in any one year and some 58% of the storm flows. It appears that this should be adequate since the average (50%) flows range between 1.000 and 2000 GPM, and also when flows are high the amount of contamination would be lessened and have minor effects.

Consequently, it is recommended that the Plant be designed to treat as Acid Mine Drainage some 15.0 MGD and to treat as Potable Water some 7.0 MGD.