HAMDEN PIPELINE/ROUND VALLEY RESERVOIR STUDY - 1981

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
Division of Water Resources
Bureau of Monitoring and Data Management
Data Acquisition and Analysis Unit

November 1981

HAMDEN PIPELINE/ROUND VALLEY RESERVOIR STUDY - 1981

Written By: Jeffrey T. Reading

Sample Collection: Data Acquisition and Analysis Unit

Chlorophyll Analyses: Jack Kurtz

Phytoplankton Analysis: Kevin Berry

Chemical/Bacteriological Analyses: N.J.D.O.H. Laboratory

BACKGROUND

Round Valley Reservoir, located near Lebanon in Hunterdon County, is a state owned facility completed in 1965. The reservoir has a very minimal watershed and is filled by pumping water from the South Branch Raritan River at Hamden; the initial filling was completed in 1973.

The major outlet from the reservoir is via the Whitehouse Station Distribution Intake Pipeline which discharges into Rockaway Creek in the Raritan River Basin. There are two other controlled minor outlets, one feeds Prescott Brook and the other feeds an unnamed tributary to South Branch of Rockaway Creek. These release an average of about 0.83 and 0.17 MGD, respectively.

The reservoir was not utilized as a potable water source or for flow augmentation purposes throughout the 1970's. Due to that long retention time, water clarity greatly increased. By 1980 the reservoir had been developed into a major recreational resource.

In 1980, drought conditions forced the use of the Whitehouse Station Distribution Pipeline for the first time (except for testing) for Raritan River flow augmentation. It became necessary to renew pumping into the reservoir via the Hamden pipeline in early 1981. The Water Supply Facilities Element, which operates the reservoir, requested that the Bureau of Monitoring and Data Management monitor the reservoir system to determine the impact of renewed pumping of the lower quality river water on the reservoir's water quality. Releases via the Whitehouse Station Pipeline again occurred during the summer of 1981.

SAMPLING LOCATIONS AND METHODS

Five stations (below and Figure 1) were sampled during the course of the study:

Station No.	Location
1	S. Br. Raritan R. at River Rd. Lansdowne (upstream of Hamden)
2	Hamden Pipeline Outlet at South Tower into Reservoir
3	South Cove Area of Reservoir
4	Central Area of Reservoir
5	North Cove Area of Reservoir

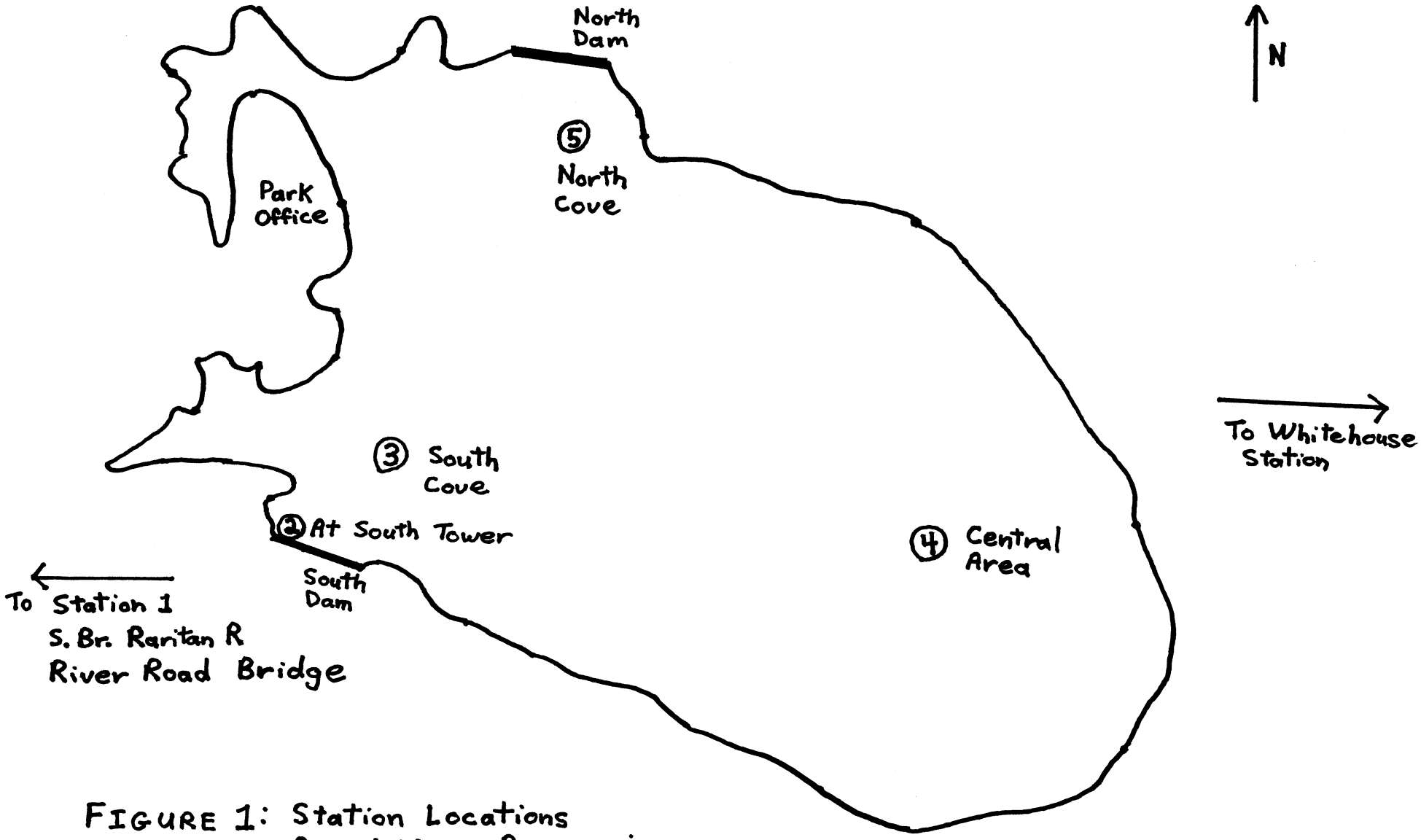

FIGURE 1: Station Locations
Round Valley Reservoir

At Stations 1 and 2 surface grab samples were taken. Both surface and sub-surface samples were taken at the three in-reservoir sites. The sub-surface samples were taken with a Kemmerer sampler and were taken below the thermocline after stratification.

Water quality sampling procedures followed were those outlined in the Field Procedures Manual for Water-Data Acquisition (NJDEP, 1980). Water temperature/dissolved oxygen profiles were limited to a maximum depth of 49 ft. due to the limitations of the dissolved oxygen meters (maximum cable length of electrode with agitator). Occasionally Winker dissolved oxygen samples were taken at 90 feet. Chlorophyll a and phytoplankton analyses were conducted by the NJDEP Sierra Laboratory, all other analyses were conducted by the NJDOH Laboratory. Samples for dissolved orthophosphates and total dissolved phosphorus determinations were filtered (0.45 micron filter) in the field.

RESULTS AND DISCUSSION

Pumping into the reservoir from Hamden began on February 19, 1981 and continued with a few interruptions until June 12, 1981 at a rate of 40 to 120 MGD. Discharges to Whitehouse Station at a rate of 5.8 to 100 MGD began June 29, 1981 and continued until September 13, 1981, due to continuing drought conditions (Water Supply Facilities Element). The sampling schedule and its relationship to the 1981 pumping and discharges is outlined in Figure 2.

Water quality data for the South Branch Raritan River (Station 1) is found in Table 1. The station is located approximately one-half mile upstream of the Hamden Pipeline intake. The consistently high nutrient concentrations in the river make it a poor source of reservoir water. The concentration of NO_2+NO_3-N was always greater than or equal to 1.0 mg/l. TKN concentrations also approached the 1.0 mg/l level. Total phosphorus as PO_4 ranged from 0.20 to 0.58 mg/l. Almost all of the phosphorus was in the form of orthophosphates.

Station 2, located where the Hamden pipeline enters the reservoir at the South Tower, was included in the study to monitor any changes in water quality (Table 2) due to passage through the pipeline. However, with a few exceptions, water quality at Station 2 was very similar to Station 1. The February 23 sampling, for example, showed an eight fold increase in non-filterable residues between Hamden and the South Tower. This increase was not seen on any other date and may possibly have been due to the initial scouring of the pipeline resulting from the renewed pumping. The April 20 and May 7 sampling results showed a water quality improvement compared to the earlier sampling dates and the data for Station 1. The NO_2+NO_3-N, orthophosphate, and TOC concentrations all decreased. It was not apparent what caused these changes in water quality. These stations were not again sampled before the pumping from Hamden was halted.

HAMDEN PIPELINE/ROUND VALLEY RESERVOIR STUDY
PUMPING AND SAMPLING DATES

Figure 2

	FEB				MAR				APR				MAY				JUN				JUL			
Item	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Pumping In From Hamden Station[A]																								
Discharging To Whitehouse Station[B]																								
Station 1 Sampling		X				X	X		X		X		X											
Station 2 Sampling		X				X	X		X		X	X	X											
Station 3 Sampling							X				X		X	X					X			X		
Station 4 Sampling							X						X	X					X			X		
Station 5 Sampling							X				X		X	X					X			X		

[A] No pumping for one shift on March 5, and all day May 28 through May 29.

[B] Pumping continued through September 13.

Sampling of the reservoir itself did not begin until March (Figure 2) due to the high winds and rough water. Tables 3, 5 and 7 contain the data for the surface sampling at the three in-reservoir stations (denoted as Stations 3A, 4A, 5A). Surface water quality was similar at all three stations and was of a much higher quality than the river. Surface NO_2+NO_3-N at all three stations was less than or equal to 0.36 mg/l. Total phosphorus as PO_4 indicated some spacial differences in surface waters, maximum values were 0.06, 0.15 and 0.18 mg/l at stations 3A, 4A and 5A respectively. The 0.18 mg/l total phosphorus as PO_4 value at Station 5A, occurred on May 28, and was the only instance where the state standard of 0.15 mg/l as PO_4 was contravened.

Secchi disk transparency data was similar at all three in-reservoir stations. Ranging from 3 to 5.5 meters, it also suggests that the reservoir is of good water quality. Water clarity increased during the May-June period.

Chlorophyll a concentrations were similar at all three stations suggesting a relatively even phytoplankton distribution in the surface waters. Surface phytoplankton data collected on May 28 also supports this conclusion (Table 10), with the chrysophytes (diatoms) Asterionella and Fragillaria dominating at all three stations. Although the chlorophyll a pattern was consistant at all three stations, concentrations varied greatly over time. Maximum chlorophyll a levels were reached on May 7 (average of 8.06 ug/l) and minimum concentrations seven weeks later (average of 0.55 ug/l). This temporal variation in chlorophyll a can probably be attributed to the normal phytoplankton perdiodicity rather than the pumping (F.B. Trauma, Rutgers University).

The sub-surface data denoted as stations 3B, 4B, and 5B may be found in Tables 4, 6 and 8. The depth of this sub-surface sample varied from 16 to 90 feet over the sampling period. This data can be divided into two periods, pre-stratification and post-stratification based on the water temperature/dissolved oxygen profile data for Station 4 (Table 9). Stratification of the reservoir occurred between May 7 and May 28. The thermocline was near the 30 ft. level on June 23 and July 23.

Using the stratification data, the data for March 26, April 20 and May 7 represents pre-stratified conditions, and the remainder post-stratified conditions. The nitrogen, phosphorus, carbon and residue data indicates very little change in water chemistry after stratification. In fact, with the exception of water temperature and dissolved oxygen there was very little difference in the water chemistry between the surface and sub-surface waters either before or after reservoir stratification.

As was expected some oxygen depletion in the hypolimnion did occur due to the biological and chemical oxygen demands of materials in the hypolimnetic waters and bottom sediments. There had been concern that the renewed pumping would increase the hypolimnetic oxygen demand to the point where the reservoir's newly established lake trout fishery would be threatened. The oxygen depletion, however, was not that serious. The July 23 oxygen percent saturation values ranged from 65.8 to 68.5 percent at the 49 foot depth. A Winkler dissolved oxygen sample taken at 90 feet at Station 4 was 6.5 mg/l.

HAMDEN PIPELINE/ROUND VALLEY RESERVOIR STUDY
WATER QUALITY DATA

Station 1: South Branch Raritan River

TABLE 1

PARAMETER*	2/23/81	3/10/81	3/26/81	4/2/81	4/15/81	5/7/81
Water Temp (°C)	6.0	5.0	6.0	11.0	7.8	16.0
Dissolved Oxygen	12.3	12.3	12.4	10.1	11.6	11.7J
pH (su)	7.8	-	8.6	7.4	7.7	8.2
NO_2-N	0.016J	0.023	0.029	0.061J	0.023	0.026
NO_2+NO_3-N	1.15	1.5	1.70	1.29	1.24	1.0
NH_3-N	0.13	0.12	0.15	0.49J	0.18	0.21
TKN	0.60	0.37	0.60	0.80	0.92	0.78
Ortho-PO_4 as PO_4	0.20	0.20	0.22	0.14J	0.21	0.20
Diss. Ortho-PO_4 as PO_4	0.08	-	0.12	0.11J	0.17	0.15J
Total P as PO_4	0.20	0.21	0.22	0.58	0.28	0.31
Total Diss. P as PO_4	0.09	0.18	0.22	0.15	0.19	0.28
TOC	11.3	5.9	11.9	2.7	4.9	1.0
Residue, Non-Filt.	10	6	1	27	5	33
Residue, Total	142	156	162	156	100	192
Residue, Filt.	140	150	152	142	92	166

* All values expressed as mg/l unless otherwise noted.

HAMDEN PIPELINE/ROUND VALLEY RESERVOIR STUDY
WATER QUALITY DATA

Station 2: Pipeline At South Tower

TABLE 2

PARAMETER*	2/23/81	3/10/81	3/26/81	4/2/81	4/15/81	4/20/81	5/7/81
Water Temp (°C)	6.1	4.5	5.5	8.2	7.0	8.0	12.0
Dissolved Oxygen	15.3	12.2	11.2	11.8	11.4	11.5	10.1
pH (su)	7.7	-	-	7.5	7.6	-	7.9
NO_2-N	0.018J	0.017	0.024	0.037J	0.015	0.006	0.020
NO_2+NO_3-N	1.35	1.2	1.19	0.90	0.73	0.24	0.44
NH_3-N	0.17	0.08	0.11	0.20J	0.12	0.04	0.21
TKN	0.84	0.54	0.52	0.67	0.59	0.76	0.68
Ortho-PO_4 as PO_4	0.14	0.08J	0.21	0.11J	0.10	0.03K	0.03K
Diss. Ortho-PO_4 as PO_4	0.05	-	0.12	0.03J	0.03K	0.03	0.03K
Total P as PO_4	0.15	0.15	0.22	0.15	0.12	0.03	0.12
Total Diss. P as PO_4	0.12	0.15	0.19	0.15	0.10	-	0.12
TOC	11.3	4.1	9.4	4.6	4.5	1.2J	1.6
Residue, Non-Filt.	82	8	5	10	6	1	16
Residue, Total	164	118	152	158	128	118	128
Residue, Filt.	102	110	144	102	102	92	120

* All values expressed as mg/l unless otherwise noted.

HAMDEN PIPELINE/ROUND VALLEY RESERVOIR STUDY
WATER QUALITY DATA

Station 3A: South Cove At Surface

TABLE 3

PARAMETER*	3/26/81	4/20/81	5/7/81	5/28/81	6/23/81	7/23/81
Water Temp (°C)	3.2	7.5	11.5	19.0	22.5	24.0
Dissolved Oxygen	11.4	11.6	11.6	9.6	8.6	7.2J
pH (su)	7.1	-	8.2	8.2	8.0	8.3
Secchi Disk (m)	-	-	3.0	3.7	4.9	5.2
Chlorophyll a (ug/l)	-	2.94	8.62	1.08	0.60	1.76
NO_2-N	0.010	0.003	0.005	0.009	0.009	0.003K
NO_2+NO_3-N	0.14	0.10	0.10	0.20	0.35	0.15
NH_3-N	0.07	0.05	0.16	0.11	0.07	0.10
TKN	0.36	0.46	0.53	0.59	0.76	0.40
Ortho-PO_4 as PO_4	0.03	0.03K	0.03J	0.05	0.03K	0.03K
Diss. Ortho-PO_4 as PO_4	0.03K	0.03K	0.03J	0.05J	0.03K	0.03K
Total P as PO_4	0.03	0.03K	0.03K	0.06	0.06	0.03
Total Diss. P as PO_4	0.03K	0.03K	0.03	-	0.06	-
TOC	9.7	1.3J	-	5.7	3.5	4.1
Residue, Non-Filt.	4	6	4	3	5	1
Residue, Total	86	98	120	114	108	160
Residue, Filt.	82	94	112	76	86	126

* All values expressed as mg/l unless otherwise noted.

HAMDEN PIPELINE/ROUND VALLEY RESERVOIR STUDY
WATER QUALITY DATA

Station 3B: South Cove Below Thermocline

TABLE 4

PARAMETER*	3/26/81	4/20/81	5/7/81	5/28/81	6/23/81	7/23/81
Depth (ft.)	20	16	49	49	40	49
Water Temp (^{o}C)	3.2	7.5	11.0	10.0	11.0	11.5**
Dissolved Oxygen	11.2	11.6	11.9	8.7	8.8	7.4J**
pH (su)	6.9	-	8.2	7.6	7.4	7.7
NO_2-N	0.005	0.004	0.004	0.005	0.009	0.004
NO_2+NO_3-N	0.20	0.10	0.10	0.14	0.30	0.20
NH_3-N	0.07	0.05	0.15	0.04	0.06	0.11
TKN	0.45	0.45	0.48	0.38	1.09	0.46
Ortho-PO_4 as PO_4	0.03K	0.03K	0.03J	0.03J	0.03K	0.03
Diss. Ortho-PO_4 as PO_4	0.03K	0.03K	0.03J	-	0.03K	0.03K
Total P as PO_4	0.03K	0.06	0.03	0.09	0.06	0.09
Total Diss. P as PO_4	-	0.03K	0.03K	-	0.03	0.06
TOC	9.1	1.0J	1.1	5.9	2.9	3.7
Residue, Non-Filt.	5	5	4	1	4	2
Residue, Total	102	62	112	136	120	150
Residue, Filt.	80	60	108	96	78	92

* All values expressed as mg/l unless otherwise noted.

**Percent Oxygen Saturation = 67.6

HAMDEN PIPELINE/ROUND VALLEY RESERVOIR STUDY
WATER QUALITY DATA

Station 4A: Central Area At Surface

TABLE 5

PARAMETER*	3/26/81	5/7/81	5/28/81	6/23/81	7/23/81
Water Temp (^{o}C)	3.0	12.5	19.5	21.8	25.0
Dissolved Oxygen	11.4	12.2	10.2	9.4	9.1
pH (su)	7.1	8.1	8.5	8.0	8.5
Secchi Disk (m)	-	2.9	3.7	4.3	5.5L
Chlorophyll a (ug/l)	-	7.02	1.69	0.79	0.93
NO_2-N	0.009	0.006	0.008	0.013	0.007
NO_2+NO_3-N	0.16	0.10	0.20	0.36	0.15
NH_3-N	0.13	0.16	0.04	0.04	0.10
TKN	0.34	0.54	0.45	0.64	0.39
Ortho-PO_4 as PO_4	0.03K	0.04J	0.05	0.05	0.04
Diss. Ortho-PO_4 as PO_4	0.03K	0.04J	-	0.03K	0.03K
Total P as PO_4	0.03K	0.06	0.06	0.15	0.15
Total Diss. P as PO_4	0.03K	0.04	-	0.03	0.03
TOC	7.9	1.8	5.5	3.3	3.2
Residue, Non-Filt.	4	4	1	2	6
Residue, Total	132	124	114	118	82
Residue, Filt.	118	46	80	112	68

* All values expressed as mg/l unless otherwise noted.

HAMDEN PIPELINE/ROUND VALLEY RESERVOIR STUDY
WATER QUALITY DATA

Station 4B: Central Area Below Thermocline

TABLE 6

PARAMETER*	3/26/81	5/7/81	5/28/81	6/23/81	7/23/81
Depth (ft.)	20	49	49	33	90
Water Temp (°C)	3.0	9.0	11.5	13	-
Dissolved Oxygen	11.5	11.8	9.5	9.8	6.5
pH (su)	7.0	7.5	7.6	8.1	7.5
NO_2-N	0.009	0.005	0.004	0.012	0.003
NO_2+NO_3-N	0.16	0.15	0.14	0.26	0.26
NH_3-N	0.07	0.16	0.13	0.11	0.11
TKN	0.36	0.50	0.57	0.61	0.49
Ortho-PO_4 as PO_4	0.03K	0.03K	0.06	0.03K	0.03K
Diss. Ortho-PO_4 as PO_4	0.03K	0.03	0.03J	0.03K	0.03K
Total P as PO_4	0.03	0.04	0.06	0.09	0.03K
Total Diss. P as PO_4	0.03	0.04	-	0.03	0.06
TOC	7.0	1.0K	4.0	2.6	3.4
Residue, Non-Filt.	6	4	6	6	3
Residue, Total	100	198	98	114	96
Residue, Filt.	86	88	88	100	82

* All values expressed as mg/l unless otherwise noted.

HAMDEN PIPELINE/ROUND VALLEY RESERVOIR STUDY
WATER QUALITY DATA

Station 5A: North Cove At Surface

TABLE 7

PARAMETER*	3/26/81	4/20/81	5/7/81	5/28/81	6/23/81	7/23/81
Water Temp (^{o}C)	3.5	7.5	11.0	19.5	21.0	24.0
Dissolved Oxygen	11.4	11.6	11.9	9.4	9.1	8.2
pH (su)	7.5	-	8.1	8.2	8.1	8.1
Secchi Disk (m)	-	-	3.0	2.1	-	5.2
Chlorophyll a (ug/l)	-	3.43	8.53	0.29	0.27	1.38
NO_2-N	0.005	0.003	0.004	0.009	0.012	0.006
NO_2+NO_3-N	0.14	0.10	0.10	0.16	0.26	0.16
NH_3-N	0.07	0.05	0.16	0.05	0.03	0.11
TKN	0.39	0.39	0.41	0.50	0.77	0.47
Ortho-PO_4 as PO_4	0.03K	0.03K	0.03K	0.06	0.03K	0.03K
Diss. Ortho-PO_4 as PO_4	0.03K	0.03K	0.03K	0.08	0.03K	0.05
Total P as PO_4	0.03	0.06	0.03	0.18	0.06	0.03
Total Diss. P as PO_4	0.03	0.03	0.03K	0.18	0.03	-
TOC	7.4	1.0J	1.0K	4.1	2.8	2.6
Residue, Non-Filt.	17	5	6	3	1	1
Residue, Total	80	140	104	110	120	122
Residue, Filt.	68	106	100	90	114	68

* All values expressed as mg/l unless otherwise noted.

HAMDEN PIPELINE/ROUND VALLEY RESERVOIR STUDY
WATER QUALITY DATA

Station 5B: North Cove Below Thermocline

TABLE 8

PARAMETER*	3/26/81	4/20/81	5/7/81	5/28/81	6/23/81	7/23/81
Depth (ft.)	20	16	49	49	40	49
Water Temp (^{o}C)	3.1	7.5	9.0	12.0	11.0	11.0**
Dissolved Oxygen	11.4	11.6	11.9	9.1	9.5	7.3**
pH (su)	7.4	-	7.6	7.6	7.5	7.5
NO_2-N	0.007	0.004	0.004	0.005	0.010	0.004
NO_2+NO_3-N	0.16	0.10	0.10	0.14	0.26	0.20
NH_3-N	0.07	0.05	0.16	0.11	0.03K	0.10
TKN	0.44	0.50	0.47	0.64	0.84	0.46
Ortho-PO_4 as PO_4	0.04	0.03K	0.03K	0.04J	0.03K	0.04
Diss. Ortho-PO_4 as PO_4	0.03K	0.03K	0.03	-	0.03K	0.03
Total P as PO_4	0.06	0.03K	0.03K	0.06	0.06	0.04
Total Diss. P as PO_4	0.03	0.03K	0.03	-	0.03	0.06
TOC	6.0	1.0J	1.0	5.0	1.6	2.2
Residue, Non-Filt.	8	3	1	1	13	1
Residue, Total	100	90	126	136	100	154
Residue, Filt.	78	84	122	92	82	134

* All values expressed as mg/l unless otherwise noted.

**Percent Oxygen Saturation = 65.8

HAMDEN PIPELINE/ROUND VALLEY RESERVOIR STUDY
WATER TEMPERATURE/DISSOLVED OXYGEN PROFILES

Station 4: Central Area

TABLE 9

Depth (ft.)	5/7/81		5/28/81		7/23/81	
	W. Temp (°C)	D.O. (mg/l)	W. Temp (°C)	D.O. (mg/l)	W. Temp (°C)	D.O. (mg/l)
SURFACE	12.5	12.2	19.5	9.5	25	9.4
5	-	-	19.5	9.6	25	9.2
10	12.5	12.2	19.0	9.7	24.5	9.0
20	-	-	16.5	10.0	24	8.9
25	11.5	12.0	-	-	-	-
30	-	-	14.0	9.8	18.5	9.1
35	-	-	-	-	13.7	9.0
40	-	-	13.0	9.6	11	8.2
47	9.0	11.8	11.5	9.5	11[A]	7.6[A]

NOTE: On 6/23/81 although a formal profile was not done the thermocline was determined to be at 30 feet.

[A] Percent Oxygen Saturation = 68.5

HAMDEN PIPELINE/ROUND VALLEY RESERVOIR STUDY
SURFACE PHYTOPLANKTON DATA

May 28, 1981

TABLE 10

Station 3 - South Cove	Station 4 - Central Area	Station 5 - North Cove
Dominant Taxa:		
Chrysophyta	Chrysophyta	Chrysophyta
Asterionella formosa 840 cells/ml (64 colonies)	Asterionella formosa 840 cells/ml (70 colonies)	Asterionella formosa 830 cells/ml (62 colonies)
Fragillaria carpucina 360 cells/ml (20 colonies)	Fragillaria carpucina 460 cells/ml (10 colonies)	Fragillaria carpucina 1180 cells/ml (14 colonies)
Other Taxa Present:		
Chrysophyta	Chrysophyta	Chrysophyta
Cyclotella sp. Mallomonas sp.	Dinobryon bavaricum Mallomonas sp.	Mallomonas sp.
Pyrrophyta	Pyrrophyta	Pyrrophyta
Ceratium hirundinella	Ceratium hirundinella	Ceratium hirundinella
Chlorophyta	Chlorophyta	Chlorophyta
Ankistrodesmus falcatus	Dictyosphaerium pulchellum Staurastrum quadricuspidatum	Dictyosphaerium pulchellum Staurastrum quadricuspidatum Volvox sp.
Cyanophyta		Cryptomonadales
Anabaena sp.		
Euglenophyta		
Phacus sp.		
Cryptomonadales		

CONCLUSIONS AND RECOMMENDATIONS

On the basis of the data collected in this study there appeared to be very little negative impact of the renewed pumping into Round Valley Reservoir. Water quality in the reservoir was still very good and there was little difference noted between the quality of surface waters versus sub-surface waters or pre-stratified versus post-stratified conditions. There was some hypolimnetic oxygen demand, but it did not threaten the trout fishery.

An important question, however, remains unanswered. Did water quality deteriorate at all when compared to previous years? A comparison of 1981 data to the 1977-78 Intensive Lake Survey data (NJDEP 1979) gives an inconclusive answer. Total phosphorus data for the central reservoir area (Station 4, 1981 study) ranged from 0.01 to 0.06 mg/l as PO_4 in 1977-78 and from 0.03 to 0.15 in 1981. A similar trend was observed for orthophosphates. This comparison suggests that some deterioration in reservoir water quality did occur between 1977-78 and 1981.

The crucial question for the fishery, however, is how much the late summer hypolimnetic oxygen levels have decreased. The central reservoir dissolved oxygen concentration at 104 feet was 6.0 mg/l in August 1977 and 6.5 mg/l in late July 1981 at 90 feet. This hypolimnetic dissolved data in contrast to the phosphorus data suggests that no deterioration in reservoir water quality has yet occurred. Thus, although the phosphorus concentrations appear to have increased somewhat, any increase in primary production has probably not yet resulted in a significant reduction in hypolimnetic oxygen levels.

Although the pumping caused no apparent problems in 1981, future problems can not be ruled out. This year's pumping only amounted to approximately 15% of the reservoir's volume (R. Ferrara, Princeton University). Since the current water supply situation in the northern part of the state makes renewed pumping into the reservoir likely, the Water Supply Facilities Element should be prepared to renew monitoring of the reservoir when pumping resumes. The state of New Jersey has too much of an investment in Round Valley Reservoir both as a recreational resource and a water supply resource to do otherwise.