

FEDERAL WASTE SURVEY
Water Pollution Control Facility
South Weymouth Naval Air Station
South Weymouth, Massachusetts
October 6, 1971
October 28, 1971
January 5, 1972

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At the request of the Federal Activities Section, the Technical Studies Section of Region I, Environmental Protection Agency conducted an efficiency study on the South Weymouth Naval Air Station Water Pollution Control Facility (WPCF) on October 6 and October 28, 1971 and January 5, 1972. A survey of French Stream at the Air Station was performed on October 6, 1971.

French Stream

French Stream which has a drainage area of 1250 acres, flows along the west fence line of the Air Station and eventually to the North River. The Air Station discharges wastes into the stream from two outfalls; the treatment plant's effluent line and a wastewater outfall containing detergents used in cleaning aircraft. These outfalls are shown in Figure 1. There was no flow on the survey dates at the wastewater outfall. The effluent from the WPCF flows in a ditch some 1200 feet to the west branch of the French Stream. Also another stream originates in a swamp on the east side of the Air Station and flows into French Stream south of the fence line.

Wastewater Treatment Plant

Figure 2 shows a schematic diagram of the primary and secondary stages of the WTP.

The wastewater treatment plant treats domestic wastes from a population of approximately 1100 people. Maximum load is placed on the plant during weekends when up to 1000 reservists are stationed at

the base. Maximum daily peak load, as can be seen from Figure 3, occurs between the hours of 0700 to 0900 and 2200 to 2400 with no appreciable flow between midnight and 0700 hours. Recorded effluent flow rates for the three sampling dates are:

	<u>Gallons per day</u>
Design capacity	375,000
October 6, 1971 (Wednesday)	65,000
October 28, 1971(Thursday)	66,000
January 5, 1972(Wednesday)	83,000

Since the actual flow is approximately 20 percent of the design flow standard operating procedure calls for fifty percent recirculation from the final clarifier to the stilling basin and operation of one of the two trickling filters. Information gained by the sampling crew regarding said recirculation indicates that recirculation was not occurring. The sampling crew observed the trickling filterarms to be static for long periods of time with little or no flow through the nozzles.

After passing through the trickling filter, the water is gravity fed to the secondary clarifier followed by disinfection by chlorination. Effluent chlorination proportionate to flow requires 8 to 12 pounds per day in the contact chamber having a detention of time of approximately 15 minutes to maintain a nominal chlorine residual of 1.0 ppm at the effluent.

Sludge is pumped to two sludge holding tanks originally designed as digesters. Open drying beds are used to dewater the sludge before being trucked to a sanitary land-fill for disposal.

Sample Information

Figure 1 shows the two outfalls as well as the stilling basin and the stream stations sampled. Table 1 locates and describes the stations. The field crew collected samples from the stilling basin (Station SWN-1), the effluent channel (SWN-2A), the effluent outfall to French Stream

(SWN-2), and the outfall from the plane washdown area (SWN-3). As stated previously, there was no flow at this location. However, a sample of stagnant water was collected in the event that residual washwater was present. The crew also collected stream samples from the French Stream above the discharge (FBO-1), below the discharge and upstream of the washwater outfall (FBO-2), at the south fence line (FBO-3), and the east branch of the French Stream at the south fence line (FBO-4).

Survey of October 6, 1971

Automatic samplers were set at the influent stilling basin (SWN-1), effluent (SWN-2A) from the WPCF, and on the French Stream at the south fence line (FBO-3). The samplers at the treatment plant were set to draw 250 milliliter aliquots per hour for 24 hours. The sampler at the fence line in French Stream (FBO-3) was set to draw 50 milliliter aliquots every 7.5 minutes for 24 hours. Sampling at stations SWN-2, FBO-1, FBO-2, and FBO-3 was accomplished by hand dipping the storage and transport containers directly into the sampling source; all stations sampled at approximately two hour intervals with the exception of SWN-2 which was sampled every hour. The stream at station FBO-4 and the washwater outfall at station SWN-3 was sampled only once since there appeared to be little or no flow in the stream or from the outfall.

Surveys of October 28, 1971 and January 5, 1972

These surveys involved only the WPCF and automatic samplers were set at the stilling basin and the effluent from the chlorine contact chamber similar to the October 6 survey. Grab samples were obtained at the stilling basin and effluent channel (SWN-2A) by hand dipping the

storage and transport containers at one hour intervals.

Field Tests

Field tests included temperature measured with a metal thermometer, pH measured with an electrode pH meter and chlorine residual with a chlorine comparator (only October 6th survey). Also, settleable solids analyses were conducted using Imhoff cones.

Sample Preservation

All sample containers were either one gallon or one quart plastic containers except those for bacterial and dissolved oxygen analyses. Bacteria samples were collected in sterile, wide mouth bacteria sample bottles and dissolved oxygen samples were collected in standard 300 milliliter BOD bottles. All samples were preserved according to Environmental Protection Agency standard methods and returned to the Needham, Massachusetts laboratory for analysis.

Results

Tables 2 and 3 summarize the results of the laboratory analysis.

In all wastewater treatment plants, overall performance is gauged by the quality of the waste effluent compared to influent quality. The loading and efficiencies are shown in Table 4. Flow variation is apparent as seen from Figure 3, the flow for October 6, which is typical of the flow through the facility during the October 28 survey and January 5 survey.

The overall BOD efficiency of the WPCF on January 5, 1972 was 79 percent. The composite samples for the period from 1200 to 2400 hours on January 5, showed an efficiency of 88 percent. (See table 4 and 5) These efficiencies are similar to the efficiency noted by the grab samples on October 28, 1971.

The composite samples on October 6 and 28 were inconclusive.

The plant operators were reportedly maintaining 1.0 mg/l of chlorine residual in the plant effluent as it enters the ditch. Only one out of five chlorine residual tests on the effluent from the ditch showed any appreciable chlorine residual (see Table 2).

On October 6, the high bacterial densities in the effluent indicate inadequate disinfection. During that survey the total coliform bacterial density ranged from 300,000/100ml to 1,200,000/100ml.

These effluent bacterial densities are far above the values expected from the reported residual levels and contact time. The bacterial densities observed on October 28, 1971 are more representative of the expected effluent quality. If a minimum level of 1.0 mg/l chlorine residual was maintained then there exists a possibility of short circuiting in the chlorine contact chamber.

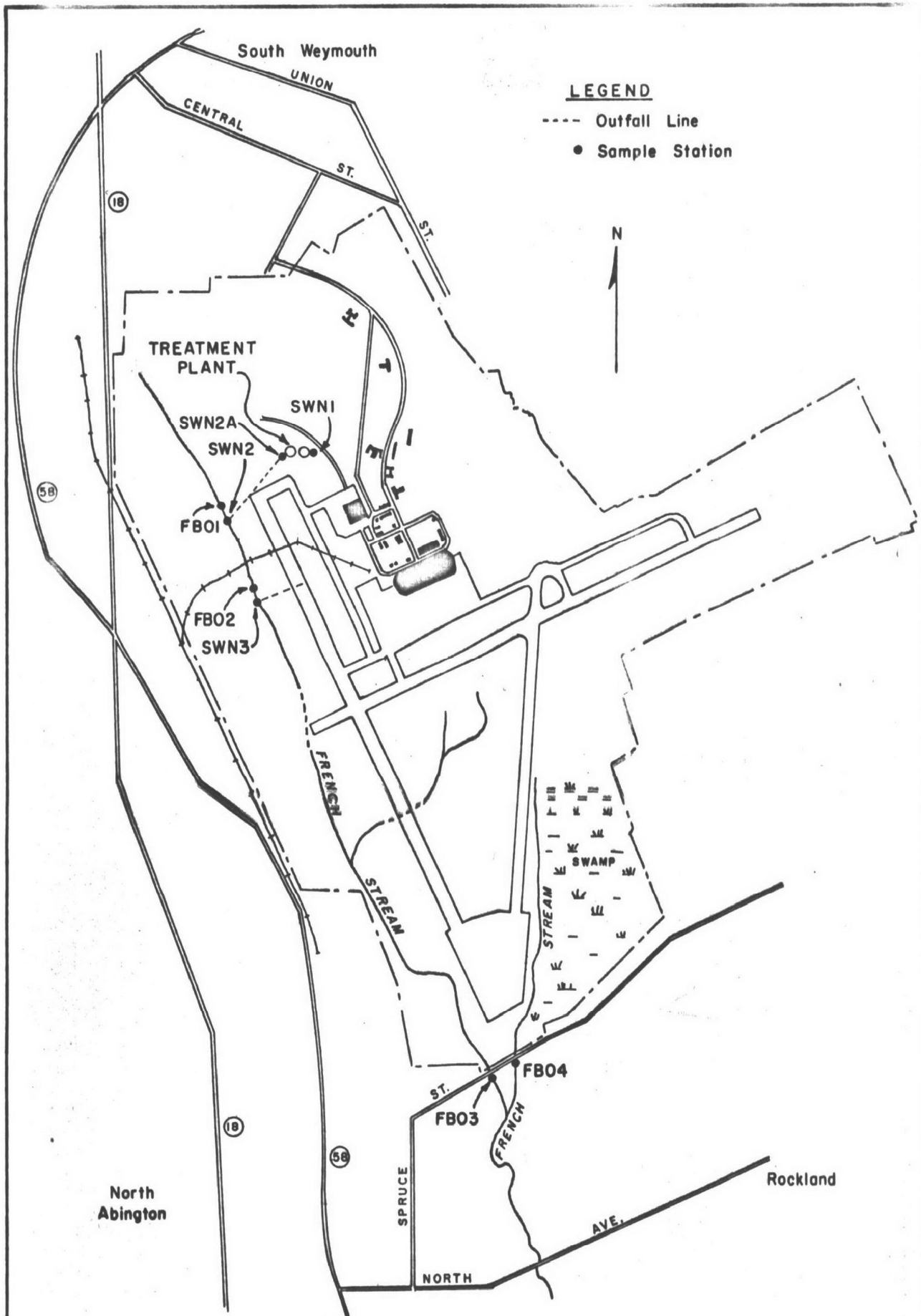
As noted previously the WPCF effluent is a major portion of the French Stream flow. The high bacterial densities in the French Stream below the WPCF discharge (FBO-2) are a direct reflection of the high bacterial densities in the WPCF effluent.

Executive Order 11507 requires federal installation to comply with the Federal Water Pollution Control Act which establishes stream classifications. The Commonwealth of Massachusetts has classified the French Stream as Class "B". As can be seen from Table 6, the bacterial, phosphorus, ammonia-nitrogen, dissolved oxygen, and oil and grease criteria were violated.

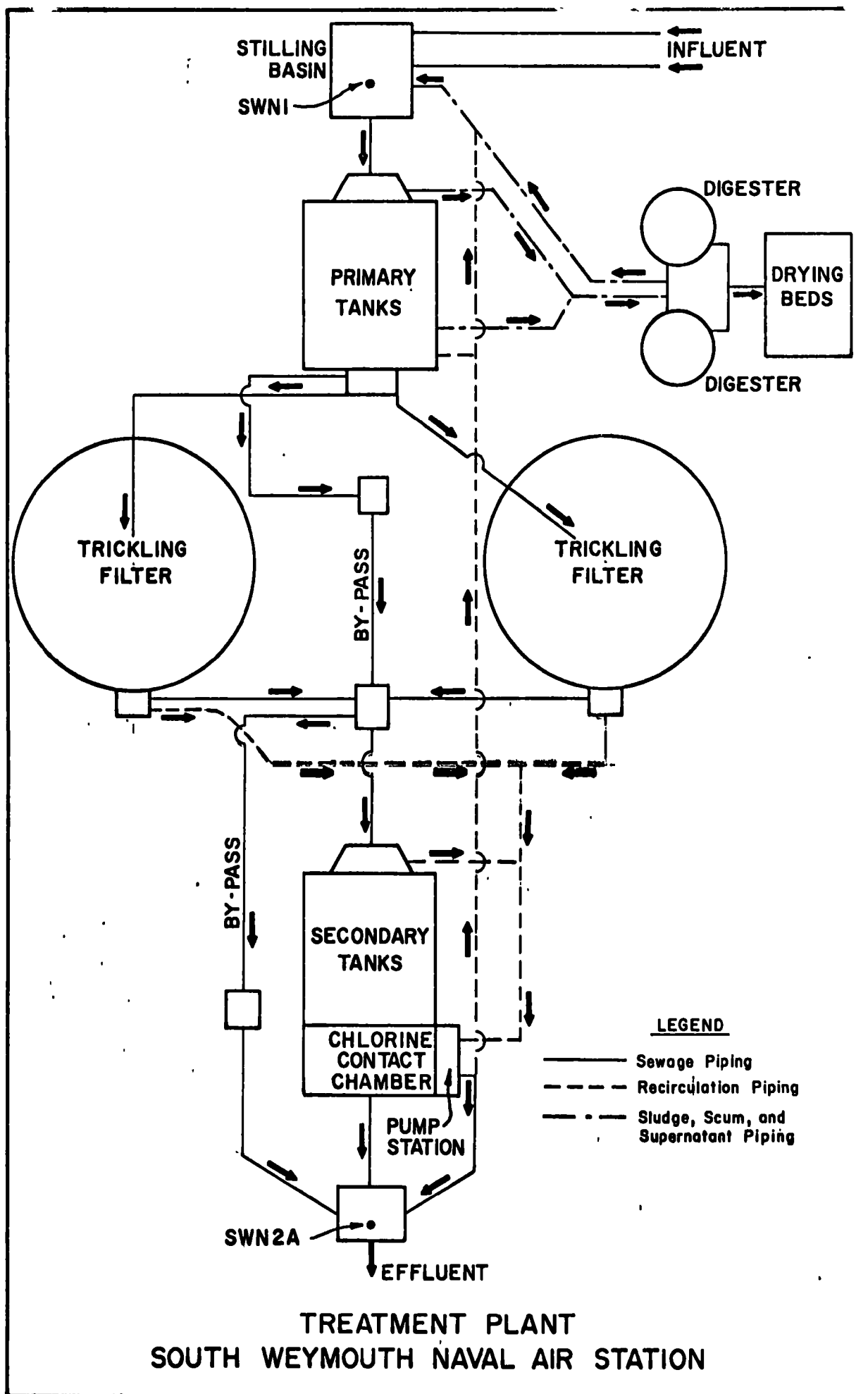
Also there is a pollutional load placed on the stream upstream of the WPCF outfall at station (FBO-1). The origin of this load is probably runoff from the surrounding area.

Sample analyses also shows excessively high concentrations of oil and grease (111.5 mg/l), phosphorus (8 mg/l), and ammonia-nitrogen (17.6 mg/l)

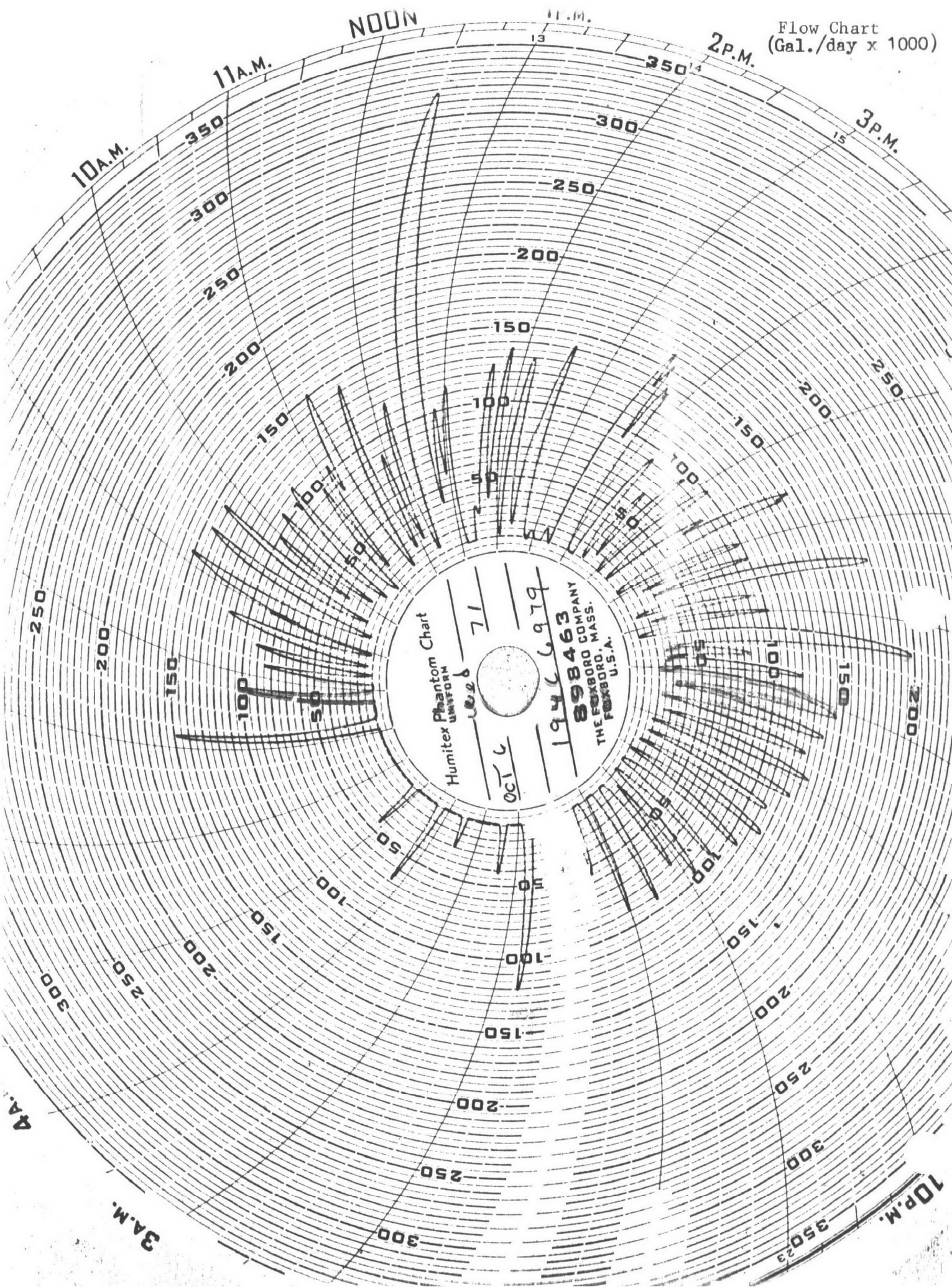
in the stagnant water at the aircraft washwater outfall which indicates the type of waste from the airplane washing. This waste should be tied into the WPCF. Since the percent reduction in the WPCF of phosphorus and ammonia nitrogen are only 21% and 11% respectively, the treatment of this aircraft washwater must be accompanied by adequate upgrading of the existing facility in order to meet stream standards.



SOUTH WEYMOUTH NAVAL AIR STATION



Flow Chart
(Gal./day x 1000)



Humitex Phantom Chart
UNIFORM

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Table 1

Sample Station Identification

<u>Station</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Description</u>
	° ' "	° ' "	
SWN1	42 09 32	70 56 39	Influent to treatment plant in stilling basin
SWN2	42 09 23	70 56 53	Treatment plant effluent out- fall to French Stream
SWN3	42 09 15	70 56 49	Washwater outfall to French Stream
SWN2A (Stream)	42 09 30	70 56 41	Treatment plant effluent from chlorine contact chamber
FB01	42 09 24	70 56 54	French Stream upstream from treat- ment plant, discharge
FB02	42 09 13	70 56 50	French Stream downstream of treat- ment plant discharge and upstream from Washwater outfall at culvert
FB03	42 07 09	70 56 08	French Stream at the south fence of Air Station
FB04	42 07 11	70 56 03	East branch of French Stream at South fence of Air Station

**SAMPLE ANALYSES
ABBREVIATIONS AND UNITS OF MEASURE**

<u>Analyses Reported</u>	<u>Description</u>	<u>Measured In</u>
Temperature	Sample temperature	Degrees centigrade (°C)
pH	Hydrogen ion concentration	Standard units (S.U.)
DO	Dissolved oxygen	Milligrams per liter (mg/l)
BOD 5	5-day biochemical oxygen demand, incubated at 20°C	Mg/l
Chlorine residual		Mg/l
Total Coliforms	Total coliform bacteria	per 100 milliliters
Fecal coliforms	Fecal coliform bacteria	per 100 milliliters
Total nonfilterable residue	Total suspended solids	mg/l
Fixed nonfilterable residue	Inorganic suspended solids	mg/l
Settleable Solids	Volume of matter that settles out in one hour	Milliliters per liter (ml/l)
Oil and grease	Hexane extractables	mg/l as oil and grease
NH ₃ -N	Ammonia-Nitrogen	mg/l as nitrogen
Total Phosphorus		mg/l as Phosphorus

Code

J - estimated as, value not accurate

K - less than

L - greater than

TABLE 2
Summary Sheet
South Weymouth Naval Air Station
October 6, 1971

Station	Time	Temp (°C)	DO (mg/l)	Field pH (S.U.)	BOD-5 (mg/l)	Cl ₂ Residual (mg/l)	Total Phosphorus (mg/l)	Total Coliform (/100ml)	Fecal Coliform (/100ml)	Oil & Grease (mg/l)	NH ₃ -N (mg/l)	Non-Filterable Residue	
												Total (mg/l)	Fixed (mg/l)
-----TREATMENT PLANT-----													
SWN1	Composite	-	-	-	200	-	-	-	-				
SWN2	0930	19.3	-	6.8	-	0.2	-	1,200,000	600				
"	1130	20.0	0.5	7.0	-	KO.1	-	710,000	200				
"	1330	20.5	-	7.0	-	KO.1	-	300,000	K100				
SWN2	1045	20.0	0.0	6.8	-	-	-	1,100,000	700				
"	1230	20.0	0.5	7.1	-	KO.1	-	390,000	200				
"	1430	20.0	0.7	7.0	-	KO.1	-	530,000	100				
SWN2A	Composite	-	-	-	320	-	11.04	-	-				
FB01	0915	15.0	-	6.7	8.5		0.08	15,000	50	99.60	-	138.8	3.0
SWN3	1130	16.5	1.5	6.7	28.0		8.00	830,000	300	111.50	17.60	12.2	69.1
FB01	1130	15.0	2.2	5.8	13.2		0.52	38,000	70	67.00	-	847.5	306.9
"	1330	16.0	1.9	6.3	12.5		2.00	44,000	60	59.30	-	63.1	29.8
FB02	1130	17.0	1.1	6.7	34.0		0.10	940,000	1000	62.30	13.80	55.1	14.3
"	1400	17.5	2.2	6.9	44.0		7.68	14,000,000	200	47.10	15.40	17.6	2.1
FB03	1215	16.0	6.5	7.2	-		-	29,000	110	-	0.64	-	-
"	1450	17.5	8.0	7.6	-		-	17,000	100	-	0.96	-	-
"	Composite	-	-	-	9.0		2.76	-	-	-	-	-	-
FB04	1300	16.9	7.3	6.6	60.0		-	18,000	400	14.10	0.14	6.5	3.5

TABLE 3
Summary Sheet
South Weymouth Naval Air Station
October 28, 1971

Station	Time	Temp (°C)	pH (S.U.)	BOD (mg/l)	Total P (mg/l)	NH ₃ -N (mg/l)	Total N.F. Residue (mg/l)	Fixed N.F. Residue (mg/l)	Settleable Solids (ml/l)	Total Coliform (/100ml)	Fecal Coliform (/100ml)
-----INFLUENT-----											
SWN1	0930	22.5	7.2	200	16.00	31.5	139.6	2.0	6.0	130,000,000	7,900,000
	1030	22.5	6.7	260	20.96	49.0	213.2	13.6	16.5	130,000,000	6,500,000
	1130	22.5	6.8	250	17.60	30.5	201.6	19.6	-	130,000,000	7,100,000
	1230	22.0	6.3	250	24.00	28.5	191.6	22.6	10.0	93,000,000	7,200,000
	1330	23.5	6.3	370	20.80	25.5	236.4	10.0	-	120,000,000	5,500,000
	Comp	-	7.0	230	15.52	-	182.2	13.3	-	-	-
-----EFFLUENT-----											
SWN2A	0930	22.5	6.6	24	14.88	26.0	31.7	1.9	0.4	5,000	K100
	1030	21.5	6.7	24	16.0	27.0	33.6	6.8	0.4	1,000	K100
	1130	22.0	6.6	24	14.08	28.0	33.5	2.3	-	1,000	K100
	1230	22.8	6.6	30	23.04	34.5	38.9	4.5	0.4	8,000	K100
	1330	22.0	6.8	J42	12.16	35.5	28.6	2.1	-	K1,000	100
	Comp	-	7.1	J280	12.80	-	38.1	3.7	-	-	-

TABLE 1
EFFICIENCY

Parameter	Average Loading on plant (lbs / day)	Average Influent Concentration (mg/l)	Average Effluent Concentration (mg/l)	Removal Efficiency
<u>October 6, 1971</u>				
Composite BOD ₅	108	200	320	-60%
(based on 65,000 GPD)				
<u>October 28, 1971</u>				
BOD ₅	137	270	29	89%
Total Nonfilterable residue	107	195	33	83%
Fixed Non- filterable residue	6	13	3.5	73%
Settleable Solids	5.5	10	0.4	96%
Total Phosphorus	10.5	19	15	21%
N H ₃ -N	18	33	30	11%
Composite BOD ₅	127	230	280	-22%
Composite Total Nonfilterable residue	100	182	38.1	77%
<u>January 5, 1972</u>				
BOD ₅	96	118	29	79%
1200-2400 Composite BOD ₅	122	160	19	88%

TABLE 5
ORGANIC LOADINGS
SOUTH WEYMOUTH NAVAL AIR STATION
JANUARY 5, 1972

TIME	Flow (Gallons)	SWN 1 BOD ₅ (mg/l)	SWN 2A BOD ₅ (mg/l)	BOD ₅ LOADING (lbs)	EFFLUENT BOD ₅ (lbs)
0000	4160	106	50.0	3.70	1.75
0100	2710	80	38.0	1.80	0.86
0200	1880	50	34.0	0.78	0.53
0300	2080	92	34.0	1.55	0.60
0400	1040	50	30.0	0.44	0.26
0500	416	36	25.0	0.13	0.09
0600	625	42	32.0	0.22	0.17
0700	1880	23	22.0	0.36	0.34
0800	4160	—	22.0	—	0.76
0900	5000	210	21.0	8.80	0.88
1000	6460	190	20.0	10.20	1.08
1100	5840	—	22.0	—	1.06
1200	5210	62	24.0	2.68	1.04
1300	4160	200	24.0	6.95	0.83
1400	5630	300	26.0	14.10	1.22
1500	1960	140	24.0	2.28	0.39
1600	4590	76	28.0	2.89	1.07
1700	4800	210	38.0	8.40	1.52
1800	5640	170	26.0	7.95	1.22
1900	4590	190	28.0	7.25	1.07
2000	5640	220	34.0	10.30	1.59
2100	1880	180	36.0	2.81	0.56
2200	835	80	25.5	0.55	0.17
2300	<u>1880</u>	120	28.5	<u>1.87</u>	<u>0.45</u>
Total	83,066			96.11	19.51

TABLE 6
STREAM ANALYSES

	<u>FBO 1</u>	<u>FBO 2</u>	<u>FBO 3</u>	MASS. W Q S CRITERIA <u>CLASS B</u>
Minimum Dissolved oxygen _____	2.1 mg/l	1.7 mg/l	7.2 mg/l	5.0 mg/l
Average Oil and grease	75.3 mg/l	55 mg/l	-	None allowable
Average Coliform bacteria	32,000 / 100 ml	12,470,000 / 100 ml	23,000 / 100 ml	1000 / 100 ml
Average Total phosphorus	0.86mg/l	3.89mg/l	-	0.05 mg/l as P*
Average Ammonia as nitrogen		14.6 mg/l	0.80mg/l	0.5 mg/l as N

CLASS B STANDARD: Suitable for bathing and recreational purposes including water contact sports. Acceptable for public water supply with appropriate treatment. Suitable for agricultural and certain industrial cooling and process uses; excellent fish and wildlife habitat; excellent aesthetic value.

* Massachusetts water quality standards set limits on total phosphate as phosphorus.