TECHNICAL ASSISTANCE PROGRAM

Dartmouth, Mass.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION I

Operation and Maintenance Section

Water Programs Division

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INTRODUCTION

This report describes the results of an Environmental Protection Agency Technical Assistance project at the Dartmouth, Massachusetts Wastewater Treatment Facility. Personnel From EPA's Operation & Maintenance Section Region 1 and the Southeast Regional Office of the Massachusetts Division of Water Pollution Control participated in the training of Dartmouth personnel in Operation Control Testing and Process Control Procedures. The return sludge flow control method used was formulated by A.W. West of EPA's National Field Investigations Center in Cincinnati, Ohio, The request for assistance originated with the Town of Dartmouth, Massachusetts and was approved by the Massachusetts Water Resources Commission. The cooperation and assistance of the personnel at the Dartmouth Wastewater Treatment Plant and the Massachusetts Water Resources Commission, Division of Water Pollution Control are gratefully acknowledged.

PURPOSE

The purpose of the Dartmouth Technical Assistance Project was to create a focal point for interest in the West method by training the operator of a successfully operating plant. The project would train an operator, provide a training opportunity for State and Federal engineers, and potentially improve the quality of the plant effluent.

PLANT SELECTION

Following a series of technical assistance projects at troubled plants, the O & M Section decided to provide technical assistance and training at a plant more typical of New England. It was decided that a small, well-operating activated sludge plant with adequate controls would be good for this purpose.

In November, 1974, M. David Andrade, Chief Operator of the Dartmouth Wastewater Treatment Plant, called EPA directly to request training in West's return sludge flow control method. The Dartmouth Plant had a history of successful operation. (See Appendix)

PRELIMINARY EVALUATION

The plant was given a preliminary evaluation by the two senior members of the O & M staff in January, 1975. The plant appeared to have good potential as a focal point for interest in the West method. The operator was interested. The plant was modern, had adequate controls, and was located in an area surrounded by many new plants. There is an active operators' association in Southeastern, Massachusetts and there is need for training in plant process control.

PLANT DESCRIPTION

The Dartmouth Water Pollution Control Facility is a modified extended aeration plant that has been in operation since 1971. The design capacity is 2.0 mgd and current flow is 400,000 gpd. Processes include grit removal, comminution, aeration, sedimentation and chlorination.

All sewage is pumped to the influent pumping station from pumping stations at Tucker Road, Russells Mills Road, and Clarence Street. The two variable speed and one constant speed pumps at the treatment plant are equipped with automatic controls to smooth the flows to the treatment facility.

The plant is manned 40 hours a week by a staff of three. There is no night, weekend, or holiday coverage. No industrial wastes are treated at the plant.

PREPARATION

A final field reconnaissance was performed a week prior to the T.A. The plant was operating with only one aeration tank and one clarifier. The detention time in the aeration tank was typical of a plant running in the conventional activated sludge mode. The mechnical aerator was running 2 hours on, 2 hours off, during the 40 hour workweek and constantly the remainder of the time. There was a thick scum on the final clarifiers and over-oxidized sludge or ash was present in the effluent. Sludge was discharging onto the ground from grill work cover of the flow splitter box. A solid cover, added during February, prevented this from occurring again. Sludge was being wasted and dewatered on a weekly basis.

Preparation for the T.A. included instruction of the operator in use of the testing equipment. The operator then began to measure turbidity, and settled sludge concentration (SSC) and settled sludge volume (SSV). The performance data for the plant was reviewed and effluent improvement goals set. O & M staff members hoped that with the West method the plant would be able to attain 1 hour turbidities of 2.0 NTU and effluent concentrations of 5 mg/l BOD and SS. It was decided that it would be necessary to spend one week in resident work to teach the operator the testing techniques and how to interpret their results.

TECHNICAL ASSISTANCE IMPLEMENTATION

On February 11, 1975, the one-week resident phase of the technical assistance effort began. Emphasis was placed on teaching the control tests and interpretation of test results. During the 3 month non-resident phase the operator performed the tests twice daily and discussed the results daily

with the O & M personnel. Biweekly visits were made to the plant. The process and operational controls were modified.

The return sludge and wasting rates were adjusted using West's Clarifier Sludge Flow Demand Formula:

$$\text{Clarifier Sludge Flow} = X\frac{(\text{Return Sludge Concentrations} - \text{Aeration Tank Concentration})}{(\text{Settled Sludge Concentration} - \text{Aeration Tank Concentration})}$$

All concentrations in the above formula are measured by centrifuge

The following table indicates the changes that occurred.

Month	RSF mgd	RSFP	MLSS	RSSS
JAN.	0.511	0.68	4500	9.800
FEB.	0.615	0.83	5500	11.800
MAR.	0.540	0.70	4500	11.100
APR.	0.503	0.71	4100	10.400

When the staff arrived at the plant on February 10 the sludge blanket was within 4 feet of the clarifier surface and the sludge settled very slowly in the settlometers. There was a thick scum on the clarrifier surface and the aeration tank contents had the appearance of older sludge.

It was recognized that a high sludge blanket is subject to washout when there are surges in flow and that a lower blanket was desireable. A settling test performed on a mixture of mixed liquor and unchlorinated clarifier effluent confirmed that the poor settling was due to an excess of solids.

Wasting of solids and a decrease in return rate led to a marked increase in return sludge concentration. Mixed liquor suspended solids were reduced from 5,300 to 3,800 mg/l in the first week of March. At the same time return sludge flow was reduced from 0.615 mgd (83% of flow) to 0.491 mgd (58% of flow). The return sludge suspended solids concentration was from 10,800 mg/l to 14,300 mg/l during this period.

In response to these changes the scum cleared from the final clarifier, the rapidly settling sludge formed a blanket clarifier eight feet from the surface and the effluent turbidities, measured after one hour of additional settling, decreased to less than 1 NTU and averaged 1.5 NTU.

Two other changes were instituted to smooth operations. No timers were available for the aerators and the weir was at its lowest level. The aerators had been switched manually two hours on and two hours off during the workweek to help lower the disolved oxygen concentration.

It was decided it would be more beneficial to leave the aerators on constantly until such time as automatic timers could be purchased which could more closely control aeration. It was also suggested that rather than wasting large quantities of sludge at large intervals, smaller quantities could be wasted frequently. This was done during portions of the T.A. effort and had a noticeably smoothing effect on the settled sludge curves.

After this very successful week in March, however, the MLSS began to rise again. The return sludge flows increased and the return sludge suspended solids concentrations decreased. The blanket level was held down. Turbidities rose and were generally greater than 3 NTU for the remainder of the T.A. The morning 5 minute SSV's were generally greater than 900 ml/l. On a few occassions the 5 minute SSV's were less than 900 ml/l. A decrease in 1 hour turbidity values to less than 3 NTU followed the improved settling. These changes however, were only short term.

The technical assistance program concluded on April 30, 1975. However, the operator has agreed to continue sending in weekly reports of the control testing which will be reviewed by the O & M Section.

DATA SUMMARY

Initially, SSV's and SSC's fluctuated considerably, but the switch to more frequent wasting reduced variation somewhat. Turbidity was lowered to 0.8 NTU during the third week only to rise again as the SSV's increased. By the end of the T.A. the turbidities averaged over 4 NTU. The operator quickly learned to keep the return sludge concentration (RSC) between the 30 minute and 60 minute SSC values. Seven day moving averages showed that while there had been short-term changes in plant operation resulting in lowered turbidities, there was little lasting change in operation or effluent quality.

EVALUATION

As a focal point for interest in the West method the T.A. was quite successful. The chief operator, assistant operators, new State and Federal personnel received training. During this period, the chief operator trained his staff in the West method and gave a short presentation at the Naragansett Wastewater Treatment Plant Operators Association Meeting. Bristol Community College contacted the operator and EPA to learn more about the method.

Area treatment plant operators have visited the plant to watch the method in operation and the town has agreed to purchase the necessary laboratory equipment to continue the method at the plant.

The operator reports reduction in final clarifier scum and greater ease and efficiency in sludge wasting. The effluent at the end of the T.A. showed:

	1974			1975	
	BOD	SS		BOD	SS
JAN	12	25	JAN	21	21
FEB	24	24	FEB	16	13
MAR	19	14	MAR	16	14
APR	22	21	APR	22	15

RECOMMENDATIONS

It is recommended that the following changes be implemented to assist the plant in improving the effluent quality still further.

1. The MLSS concentration should be reduced to minimum and then raised to find the optimum value.

2. Increased control over mixed liquor DO through the use of timers should be provided.

CONCLUSION

The T.A. demonstrated that the improved plant efficiency attainable through the use of the West method can reduce the amount of pollutants being discharged to Buzzards Bay. The plant is successfully serving as a center for interest in the West method in the Southeastern Massachusetts area.

APPENDIX

Table II

South Dartmouth Wastewater Treatment Facility

Performance History

1974

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL VALUE
flow mgd	.585	.527	.475	.504	.416	.399	.358	.311	.304	.298	.284	.321	.398
Peak flow	.704	.578	.609	.645	.482	.495	.504	.554	.378	.380	.321	.376	.704
Set. Sol. In	0.5	0.5	0.5	1.3	2.0	1.5	2.5	1.5	2.0	2.5	3.0	1.5	1.6
Out	T	T	T	T	T	T	T	T	T	T	T	T	T
Susp. Sol. In	120	70	102	109	105	157	165	158	136	136	190	126	131
Out	25	24	14	21	9	7	6	6	11	13	8	8	12
% Removal	79	66	86	81	91	95	96	96	92	90	96	94	91
BOD In	71	88	105	100	104	153	158	142	168	187	210	121	134
Out	12	24	19	22	11	8	5	4	23	20	22	12	15
% Removal	83	73	82	78	89	95	97	97	86	89	89	90	89
Effluent DO	4.8	2.6	1.3	3.2	1.4	1.3	6.9	0.8	0.6	0.7	1.0	1.6	2.2
Chlorine Res.	1.0	0.5	1.0	1.0	1.5	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0
pH Minimum	6.7	6.7	6.9	6.9	6.8	6.4	7.1	6.8	6.5	6.8	6.9	6.8	6.8
Maximum	9.1	7.5	7.6	7.6	7.4	7.7	7.6	7.8	7.4	7.8	7.7	7.8	7.8

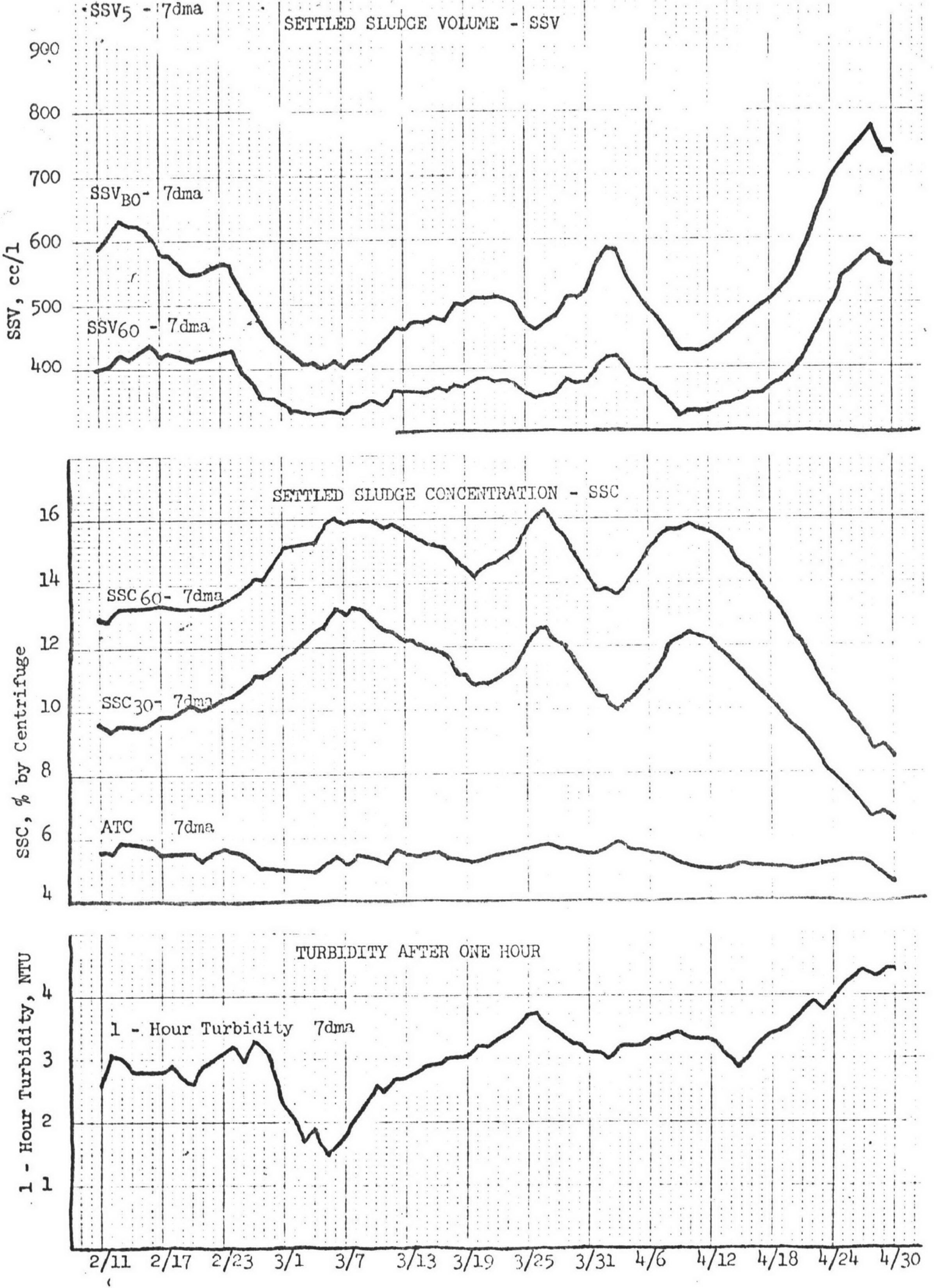
Log of the Resident Phase

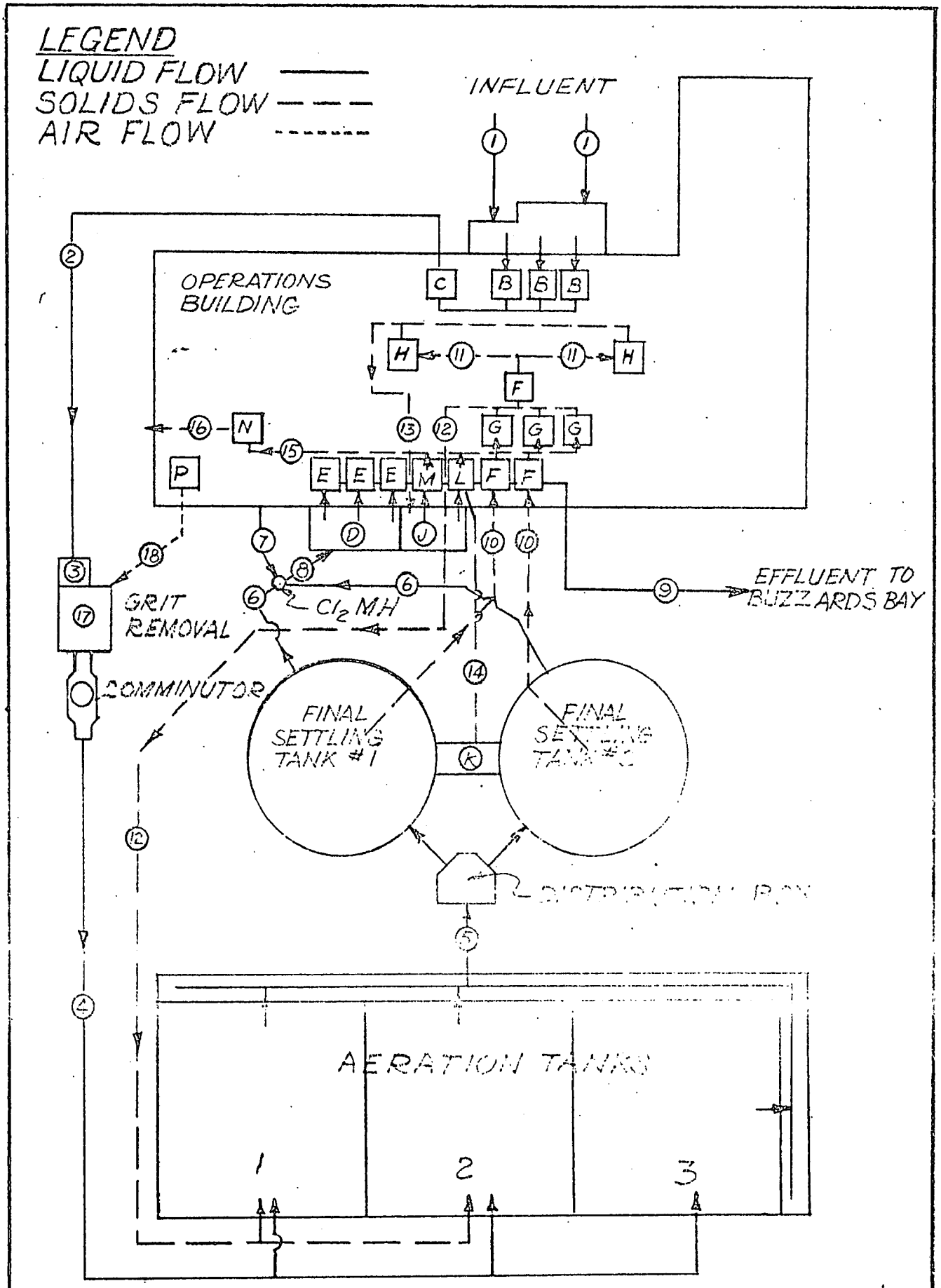
Of the

South Dartmouth Technical Assistance Project

Date/Time	Action/Condition
2-10 / 0930	Met with operator Began Control Tests RSF = 490 gpm MLTSS = 5600 mg/1
1030	Discussed DOB and Dilution Test
1200	Sludge units discussed
1400	Afternoon control tests began
1430	XSF calculated XSF = 19500 gal
2-11 0900	Arrive at plant control test started
0945	CSDT discussed and calculated
1000	Discussed and plotted trend charts stated SSC $\bar{30}$ RSC = SSC_{60} is good
1130	Discussion of return rate and sludge settling
2-11 1130	Sludge wasting to be continued. RSC expected to be reduced to 10
1300	Tour of plant and flotation thickner - concentrated sludge and clear subnatant
1330	Control tests begun
1400	Increased RAS

2-12	0930	Toured plant Ash considered indicated of over aeration Broken Floc considered sign of on-off aerators Scum considered sign of excess solids in system.
	1100	Discussion of equipment timers, centrifuge, turbidimeters
	1130	Discussed increase of return by 10%
	1150	Control tests begun
2-13	0800	Ran control tests ran both flotation thickners ran vacuum filter operator instructed to leave aerator on
	1430	RSF adjusted to 440 gpm control tests run aerator timers recommended
2-14	0840	Flotation thickner & vacuum filter run all day
	1330	Control tests run RSF adjusted to 410 gpm Prof. Capone of Bristol Community College called to discuss teaching Al West Method as part of a Sanitary Engineering Course


SETTLED SLUDGE VOLUME - SSV
SSV5 - 7dma
SSV80 - 7dma
SSV60 - 7dma
SSV, cc/l
900
800
700
600
500
400
SETTLED SLUDGE CONCENTRATION - SSC
SSC60 - 7dma
SSC30 - 7dma
ATC 7dma
SSC, % by Centrifuge
16
14
12
10
8
6
4
TURBIDITY AFTER ONE HOUR
1 - Hour Turbidity 7dma
1 - Hour Turbidity, NTU
4
3
2
1
2/11
2/17
2/23
3/1
3/7
3/13
3/19
3/25
3/31
4/6
4/12
4/18
4/24
4/30



FLOW DIAGRAM

LEGEND OF NORMAL OPERATIONS

1 Raw Sewage Influents (Gravity)

2 Raw Sewage (Force Main)

3 Cesspool Truck Unloading

4 Comminutor Effluent To Aeration Tanks

5 Aeration Tank Effluent To Final Settling Tank

6 Final Settling Tank Effluent To Chlorination Manhole

7 Chlorine Influent

8 Chlorinated Effluent To Effluent Well

9 Plant Effluent (Force Main)

10 Activated Sludge From Final Settling Tanks

11 Waste Activated Sludge To Thickener Tanks

12 Recirculated Sludge To Aeration Tanks

13 Thickened Sludge To Sludge Well

14 Scum Draw-Off

15 Scum And Thickened Sludge To Conditioning Tank And Vacuum Filter

16 Dried Sludge Conveyor

17 Grit Removal Hopper

18 Air To Grit Removal Tank

A Influent Well

B Raw Sewage Pumps

C Magnetic Flow Meter

D Effluent Well

E Effluent Pumps

F Sludge Flow Meters

G Sludge Recirculation Pumps

H Thickener Tanks

J Sludge Well

K Scum Well

L Scum Pump

M Thickened Sludge Pump

N Conditioning Tank and Vacuum Filter

P Air Blowers

NOTE: Sludge Recirculation Pumps Serve Dual Purpose:

1. Recirculate Sludge To Aeration Tanks
2. Pump Sludge To Thickeners

. Discharge Lines Have Motor Operated Plug Valves To Regulate Flow To Each Unit.

3. Individual Unit Bypass Lines Not Shown