# SAN FRANCISCO
# WASTEWATER TREATMENT PLANTS STUDY

U.S. Environmental Protection Agency
Region IX
San Francisco, California
September, 1980

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U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION IX
SAN FRANCISCO, CALIFORNIA
SEPTEMBER, 1980

# ENVIRONMENTAL PROTECTION AGENCY

REGION IX

SURVEILLANCE & ANALYSIS DIVISION

NPDES Compliance Monitoring Report

Permittee: City of San Francisco, California

Facility: San Francisco Wastewater Treatment Plants

Permit Nos.: CA0037664, CA0037672, and CA0037681

Date of Inspection: February, April, and June, 1980

Report Prepared by: Anthony V. Resnik

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PART ONE

# I. EXECUTIVE SUMMARY

The present level of San Francisco's Wastewater Program including facility management and facility operation was determined by a comprehensive investigation. Issues relating to the current operation of the plants together with projected transitional effects emerged during the study. Care was exercised to assure that the recommendations contained in this report are compatible with subsequent phases of the City's long-range management plan. Prudent responsibility was also used to assure that the recommendations are in harmony with the State and Regional Water Quality Boards' actions. Implementation of the recommendations will be beneficial not only to the present operation, but will also serve as a valuable adjunct in the fulfillment of the San Francisco Wastewater Program.

The City and County of San Francisco is embarked on a comprehensive wastewater program going from a simple basic treatment system to a dry weather/wet weather storage transport system feeding a high purity oxygen secondary treatment plant for the east side of the City and a large dry weather/wet weather plant system on the west side of the City.

San Francisco's three wastewater treatment plants are professionally managed by experienced wastewater engineers and chemists. Dr. A.E. Bagot and Robert Todd Cockburn, Superintendent, Bureau of Water Pollution Control and General Superintendent, T & P Divisions respectively are to be highly commended for optimizing treatment for primary plants constructed almost 30 years ago. The City acknowledges, however, by its proposed actions that major changes in the existing organization, staffing and training will be necessary to realize the full potential of the capital investment in the wastewater system with the resultant socio-economic and environmental benefits.

The City is presently pursuing a functional reorganization along the line of adding middle management positions and assigning technical engineering staff to the wastewater plants' organization. This process is presently before the various Commissions and Boards for approval. Not only are additional middle level management staff and additional engineering personnel necessary, the present operating staff must be trained in the activated sludge treatment process.

Plans are underway to provide training for the existing personnel in the basics of biological treatment at the City's small activated sludge plant in Golden Gate Park. It is proposed that this plant serve as a continuing training center for all new operators. This is in addition to the start-up training included in the various construction grants for facilities. This proposal merits favorable consideration as a cost-effective method of training. It is also recommended that consideration be given to sending key operating and management personnel to similar plants in size and treatment mode for "hands on" experience. For example, the knowledge and experience gained by the East Bay MUD personnel in the start-up and operation of their pure oxygen activated sludge facility would be extremely beneficial to the San Francisco personnel.

While there is no substitute for hands on experience, this must be supplemented with formal training courses. It is highly desirable, if not necessary, that selected key personnel including supervisory staff receive formal training at special schools such as the San Marcos Center. It must be noted that training does not preclude the need for special consultants. The City proposes to engage special consultants for assistance in areas of concern such as start-up and training. Experience has shown that the use of special consultants has proven valuable to wastewater program managers.

To minimize start-up problems the City proposes to have key personnel fuction in the construction inspection team. In this program the personnel will become thoroughly familiar with the new facilities minimizing orientation problems. These key people will participate in the dry-run and wet-run training for the other personnel.

The City's industrial waste source control program must be expanded. A more comprehensive quantification and characterization of the influent wastewaters will be necessary. Thirty-six priority pollutants were detected in the influent and effluent wastewaters of the three treatment plants. All of the metals included in the priority pollutants were present. The latest industrial waste report covering the period July 1, 1978 to June 30, 1979, shows that there has been an increase in the influent mass of arsenic, zinc, copper and cadmium. There is increasing evidence that many of the priority pollutants are not only detrimental to the environment but may greatly reduce treatment efficiency. The activated sludge treatment process used in the new 85 MGD Southeast secondary treatment plant will be much more sensitive to industrial wastes than the existing primary system.

The use of ferric chloride, presently used as a flocculant, will cease when the new plants go on line. Since arsenic and chrome are both impurities in the ferric chloride it is expected that the influent mass of arsenic and chromium will be reduced. However, the degree of reduction should be determined by appropriate tests and calculations prior to completion of the present building program.

San Francisco's wastewater system is unique. Essentially all municipal and industrial wastewaters are transported with storm runoff in combined sewers, most of which were constructed in the early 1900's. During storms, flow in the combined sewers increases to as much as 14,000 mgd. This is a 140 fold increase compared to the aproximate 100 mgd dry weather flow. Floatables and other solids of sewage origin have been noted on the beaches in San Francisco County for a number of years. Studies have documented the recreational uses of the beaches and projected the adverse effects of the pollution resulting from overflows containing sewage.

Both the number and design of the overflow structures which were based on criteria developed from data obtained from many comprehensive studies have been established. The complementary issue of the number of overflow events deserves additional emphasis. The lack of incentives in past NPDES permits and the lack of flow measurement instrumentation in the existing system have mitigated against minimizing overflow events. While the greatest number of overflow events will naturally occur during the wettest months of December and January, the number of overflow events will also be dependent upon the operational strategy for handling wet weather flows. This includes optimizing storage capacity, proper sequencing the start-up and shutdown of treatment modules and full utilization of all treatment facilities.

The California Regional Water Quality Control Board, San Francisco Bay Region, has required, in Order No. 80-11, that the City submit an operational strategy report by October 15, 1980 for handling wet weather flows. Automated storage level indicators and flow measurement instrumentation with computer programmed start-up and shutdown may be necessary to insure full compliance with the Regional Board Order.

The treatment and disposal of sludges is often the most difficult and costly portion of a water pollution control system. In San Francisco, not only will the quantities of solids greatly increase but the character of the solids will change with the activated sludge process. The problems will be compounded in that not only will the City be increasing sludge quantities by improving dry-weather treatment going from primary to secondary but the capture and treatment of large quantities of combined overflows, previously untreated, will add huge volumes of solids of indeterminate character.

Many of the present solids treatment units including the anaerobic digesters, elutriation tanks and vacuum filters will be used in the renovated system. Field studies by the author during the latter half of March, 1980 indicate that the rotating blade type scum skimmers in the elutriation tanks do not adequately remove the scum. The sludge digestion which starts in the thickening tanks continues in the elutriation tanks resulting in large sludge mats on the surface (photos 1-4). Periodically, the solids are vacuumed off by suction lines discharging into Public Works Department tank trucks (photos 5, 6). The operational efficiency of the elutriation tanks as they relate to existing and future operation merit additional study. While the overflow from the elutriation tanks is routinely sampled and analyzed, the results are not truly representative of the overflow due to the method of sampling.

Another point of interest is the capacity of the existing four vacuum filters. Dewatering of the conditioned sludge is accomplished by four vacuum filters located adjacent to the elutriation tanks. Present cake production is approximately 15,000 tons per year at an average solids concentration of 20 percent. Studies and operating data indicate that the percent solids in the sludge cake will decrease substantially with the treatment of activated sludges. Some municipalities are providing separate anaerobic digestion facilities for the activated sludges and the primary sludges to prevent frothing problems in the digesters. Also, EPA and State engineers have observed during O&M inspections of other plants many malfunctions in the sophisticated automatic control and instrumentation systems relating principally to solids removal and treatment. It is recommended that the final study of the solids handling for the Southeast facility be inmplemented as soon as possible.

The number of treatment units and appurtenances will greatly increase both in number and complexity. This dictates the need for a modern computerized maintenance program. At the present time, the records, inventory and ordering systems, together with the preventive maintenance program are maintained manually. The City recognizes the need for, and plans to computerize, the maintenance program.

The influent wastewaters have not been adequately characterized to determine the optimum treatability by the activated sludge process. Series of grab sample analyses are needed to determine the fluctuations in both the industrial and domestic waste loadings to the plants. Key pollution parameters should be profiled. It would be desirable to establish a permanent surveillance-monitoring system for sample collection from distinct interceptor areas. When the plant(s) experience upsets the previously collected samples from the network would be analyzed to determine the causative factors. The samples from the permanent detection system would be automatically discarded and the samplers would automatically reset until plant upsets and/or plant imbalances occur requiring analysis of the samples.

The degree or extent the permit parameters are exceeded may be more important than the number of times the NPDES permit limits have been exceeded. For example, facility data show a high percent compliance with NPDES permit limits for San Francisco's wastewater treatment plants. However, the data also indicates that there have been occasions where the amount of the permit excess was of critical concern. Facility data show that a 50.0 mg/l chlorine concentration was detected in the effluent from the North Point Plant in November, 1979. Records also show that a 18.4 mg/l chlorine concentration was detected in the effluent from the Southeast plant in January, 1980. NPDES permit limitations for both facilities stipulate a zero chlorine residual. Available data show that chlorine at these concentrations pose a serious hazard to marine and estuarine life and can result in formation of halogenated compounds toxic to human and aquatic life. Restoration of bay marine and ocean aquatic biota requires considerable time.

Records also show that wastewaters with an extremely low pH values have been discharged. pH values of 3.3 (Southeast plant November, 1978) and pH values of 4.2 and 4.6 were reported in the effluent from the North Point plant in February 1979 and February 1980, respectively. Wastewaters with these low pH values not only inhibit and/or destroy aquatic biota but also upset the biological treatment processes which may take weeks to completely recover. The need for a controlled environment and biological community is essential in the design and operation of a biological wastewater treatment plant. The pH of a solution is a key factor in the growth of organisms. Most organisms cannot tolerate pH levels above 9.5 or below 4.0. Generally, the optimum pH for growth lies between 6.5 and 7.5.

## II INTRODUCTION

### A. Purpose

On February 1, 1980, the Surveillance & Analysis Division, EPA, Region IX, received a request from the Enforcement Division to evaluate the 3 major Wastewater Treatment Plants which serve the City of San Francisco, California. The purposes of the investigation were to:

1. Determine compliance with the NPDES permit requirements.

2. Evaluate the operation and maintenance of the three wastewater treatment plants.

3. Recommend interim operational alternatives to improve effluent quality.

4. Recommend operational alternatives to provide an orderly transition from primary treatment to secondary treatment.

### B. Statement of Problem

NPDES permits numbers CA0037664, CA0037672, and CA0037681 for the Southeast plant, North Point Plant and Richmond-Sunset plant respectively were issued to the City and County of San Francisco (the permittee) on December 6, 1974. The California Regional Water Quality Control Board, San Francisco Bay Region, issued the permits Under Authority of Section 402(b) of the Clean Water Act, as amended [33 U.S.C. 1342(b)]. The permits were modified on June 21, 1977. The permits were further modified in 1979 by the San Francisco Regional Water Quality Control Board.

The NPDES permits contain both general and specific conditions. The permittee has, on occasion, discharged effluent in violation of the terms and conditions of the effluent limits. Records also indicate that the permittee failed to comply with provisions of the permits which required completion of secondary facilities to treat combined North Point and Southeast flows by July 1, 1977.

The Environmental Protection Agency, Region IX, on April 6, 1979, issued Findings of Violation with respect to violations of provisions of the following

NPDES permits: Southeast plant (NPDES No. CA0037664), North Point Plant (NPDES No. CA0037672), Richmond Sunset Plant (NPDES No. CA0037681), Richmond Sunset Sewerage Zone (NPDES No. CA00384115), and Southeast Sewerage Zone (NPDES No. CA0038423). EPA's April 6, 1979 letter to the permittee constituted notice pursuant to Section 309(a)(1) of the Clean Water Act.

On April 23, 1979, representatives of the City, Regional Water Quality Control Board and EPA met in the offices of the RWQCB to discuss the status of violations of the NPDES permits for the City's North Point and Southeast Water Pollution Control Plants.

On September 18, 1979, the Regional Board conducted a public hearing in the Assembly Room, State Building, 1111 Jackson Street, Oakland, at which the discharger appeared and evidence was received concerning the discharge. All paragraphs of Board Order Nos. 76-4 and 76-3 under item II (Northpoint plant and Southeast plant respectively) were rescinded. Additional paragraphs were added to Board Order Nos. 76-3 and 76-4 under Item II.

The Regional Board also ordered the Discharger to submit a report by November 1, 1979 documenting completion of all measures (both physical and manpower related), relative to the North Point plant headworks that will ensure use of maximum capacity during wet weather flow periods.

San Francisco presently discharges untreated and partially treated wastewater to the Bay and ocean. During rainfall periods, untreated wastewater may overflow at any of 39 overflow points discharging up to 2 billion gallons of untreated wastes in an average year, resulting in the build-up of floatables and other solids of sewage origin on the beaches. 6

Studies show that each overflow may contain a variety of pollutants including heavy metals, suspended solids, floatables and disease causing bacteria. Data indicates that, at times, such pollutants can present a significant public heatlh hazard as well as degrade the ecological communities and aesthetics of receiving waters. Studies also show that the Ocean beaches are used for water-contact recreation and that bacterial contamination may persist in Bay waters from 5 to 28 days after an overflow event.

C. Inspection Participants

1. Environmental Protection Agency

Anthony Resnik, Project Officer
Enforcement Investigations Section
Milton Tunzi and Helen Johnson
Sampling and Analysis Section
Water Branch, Surveillance & Analysis Division

2. City of San Francisco

Dr. A.E. Bagot, Superintendant, Bureau of Water Pollution Control
Robert Todd Cockburn, General Supt., T & P Divisions
Dan L. McNulty, Superintendant, Richmond-Sunset Plant
Roland Chin, Superintendant, North Point Plant
Eugene L. Mooney, Chief Engineer, WW Pump Division
Hyman Gurman, Superintendant, Southeast Plant
Lynwood Messer, Senior Stationary Engineer, SE Plant
Igor Tebneff, Chief Engineer, Southeast Plant
Jack Barrow, Director, Industrial Waste Program
Arvid Ekenberg, Stationary Engineer

3. Consultants for the City of San Francisco

Richard B. Meighan, $CH_2M$ Hill

D. Study Methodology

The study consisted of three phases. One part of the study consisted of the NPDES compliance sampling inspection. The second phase involved evaluation of the treatment facilities during wet weather conditions and the final phase of the study included the evaluation of the treatment facilities during dry weather conditions. The Project Officer met with operating and management personnel as well as with representatives of the two engineering firms retained by the City. Additional information was obtained through a review of the facility's records dating back to 1967-68 and information obtained from the Consulting Engineer's reports.

The findings noted in this report generally relate to conditions as they existed at the time of the inspections. The City has initiated several actions to upgrade the facilities. These are noted where deemed appropriate. However, the complete documentation of the ongoing operation and maintenance program must necessarily be the responsiblity of the permittee.

## E. Acknowledgements

EPA is grateful to the participating facility personnel of the City of San Francisco for their invaluable services provided during the study. Appreciation is extended to Dr. Teng-Chung Wu and Bill Dalke of the Regional Water Quality Control Board for their contribution to the study. Special recognition is extended to Mr. Cockburn for his cooperation and assistance.

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## III RECOMMENDATIONS (All Plants)

1. Develop and implement procedures for the characterization of the influent wastewaters to determine optimum treatability by the activated sludge process.

2. Determine the fluctuations in both the industrial and domestic waste loadings to the plants through the analysis of a series of grab samples.

3. Establish a permanent surveillance-monitoring system for wastewater characterization from distinct interceptor areas.

4. Profile key pollution parameters.

5. Strengthen the industrial waste program by:

   (a) Establish a regular monitoring program for the 36 priority pollutants previously identified in the influent wastewaters. Make necessary adaptions in program based on results of analyses.

   (b) Determine and abate the source(s) of the priority pollutants.

6. Characterize and quantify all return waste streams to each of the plants to determine the possible adverse effects on facility performance.

7. Carefully re-examine each plant's personnel needs recognizing that, due to the complexity of the solids handling and large plant area of the treatment units, existing manpower guidelines are not wholly applicable.

8. Consider employing additional middle management personnel.

9. Fill vacancies with permanent employees through timely completion of the necessary civil service examinations.

10. Establish and provide budgeting support for a formal training program for plant personnel including the regular attendance at EPA, State, and other training courses.

11. Utilize the City's activated sludge plant in Golden Gate Park as a training center for new operators.

12. Consider an exchange program to train operators at existing activated sludge wastewater treatment plants.

13. Develop and implement operational procedures for optimizing storage capacity, proper sequencing the start-up and shut-down of the treatment modules and for full utilization of all treatment units.

14. Conduct necessary studies to determine the solids processing capability of the present elutriation tanks and vacuum filters (Southeast plant).

15. Develop plans for emergency methods of disinfection during the period of transition to the liquid NAOCL and $NaHSO_3$ systems.

16. Determine the causative factors for the occasional high toxicity levels in the effluent of each plant.

17. Re-evaluate the reasons for the NPDES effluent violations relating to settleable solids, coliform, chlorine residual and pH requirements.

18. Develop written definitive coordination procedures with all contractors and agents working on site to minimize operating interruptions.

19. Minimize the number of bypasses and reduce the quantity of wastewaters bypassed by operating at established treatment capacity during rainy periods.

RECOMMENDATIONS (North Point Plant)

1. Establish the maximum wet weather treatment rate at 135 MGD.

2. Maintain the 135 MGD rate during wet weather:

   (a) Install new coarse racks.

   (b) Renovate the air agitation systems and provide additional air.

   (c) Investigate the feasibility of increasing the weight of the rake assembly for increased gripping capability.

   (d) Investigate the feasibility of increasing the "bite" of the rake teeth through sharpening.

   (e) Employ additional personnel for the bar rack operations during the wet weather months.

   (f) Investigate alternate means to keep the bar screen fully operative during the wet weather months.

3. Investigate methods for a more rapid closing (less than 6 minutes) of the inlet gate.

4. Maintain the influent pump sump level at greater than 17 feet.

5. Conduct necessary studies to evaluate if a higher ferric chloride feed rate would improve plant efficiency.

6. Maintain the recently established higher $SO_2$ dosage for the alleviation of the chlorine residual violations (Southeast).

## IV SUMMARY OF FINDINGS (Southeast Plant)

### A. NPDES Permit Compliance

The Southeast facility has, on occasion, exceeded the effluent limits contained in the NPDES permit for chlorine residual, settleable matter, pH, total coliform and toxicity The NPDES self-monitoring record for the reporting period July 1977 through February 1980 is provided in Table I. For the years 1976 through 1979 the facility reported the following compliance percentages:

The percent compliance for the maximum settleable matter limit of 1.0 ml/l/hr. has been greater than 99 percent in each of the last 4 years; 99.79% in 1979, 99.74% in 1978; and 99.84% in both 1977 and 1976. The percent compliance for the average settleable matter limit (6 daily grab samples) of 0.5 ml/l/hr. has also been greater than 99 percent in each of the last 4 years; 100% in 1979, 99.18% in both 1978 and 1977, and 99.73% in 1976.

There has been an improvement during the past two years in the percent compliance for the total coliform maximum day limit of 10,000/100 ml. In 1979 there was a 98.68% compliance with a 100% compliance in 1978 and a 83.60% and 79.30% in 1977 and 1976 respectively. The average coliform (5 day median) limit of 240/100 ml has been exceeded on numerous occasions. This is a recurring problem which has proven difficult to solve. The limit was exceeded on 47 of the 303 samples in 1979 which resulted in 84.49% compliance. There was a 90.40% compliance rate in 1978 and a 83.60% and a 85.11% compliance in 1977 and 1976 respectively.

The pH peak flow limits of 6.0 - 9.0 have generally been met with a compliance of 99.73% in 1979 and 98.80%, 99.60%, and 99.18% in 1978, 1977, and 1976 respectively.

The percent compliance with the zero chlorine residual limit in the effluent has shown improvement each succeeding year. There was a 99.03% compliance in 1979 with a 95.80% and a 91.74% compliance in 1978 and 1977 respectively. There was no requirement in 1976.

The foregoing data was collected and analyzed by facility personnel. However, both Regional Board personnel and EPA personnel have verified facility sampling results through their own analyses. During the EPA sampling inspection on March 14-15 and April 4, 1979, the pH, residual chlorine, settleable solids and total coliform met effluent limits.

EPA reported a zero percent survival on the analysis of the toxicity sample collected on March 13, 1979 and a 50 percent survival in the undiluted waste for the March 14, 1979 sample. EPA personnel conducted an evaluation of the sampling and analysis techniques employed at the Southeast plant laboratory on February 19-20, 1980. The evaluation team found all self-monitoring procedures in accordance with EPA requirements, EPA recommendations and NPDES permit specifications. EPA also provided a set of quality control samples to facility personnel. The unknowns included BOD, suspended solids, cyanide, and light metals. Except for cyanide, their results were within one standard deviation of the true values. No major deficiencies were noted.

B. Operation and Maintenance

The operation and maintenance of the facility is generally sound. There was a 72 percent removal of suspended solids during calendar year 1978 and 64.5 percent removal in 1979. As may be noted from graph No. 1 the average monthly removal for suspended solids during 1978 ranged from a low of approximately 62 percent in both March and April to a high of almost 82 percent in June. The percent removal for grease ranged from a low of 61 percent to a high of greater than 76 percent (Graph No. 2). The influent, effluent, and percent removals of BOD and COD are shown on graphs Nos. 3 and 4 respectively. The mimimum and maximum influent pH values are shown on graph No. 5.

The problems of meeting the coliform requirements were due in part to the turn-over of laboratory staff. This deficiency should be alleviated with the completion of the civil service examination for the series of chemist postions for permanent employees in both the Senior Sewage Treatment Chemist and the Water Quality Chemist positions.

There are insufficient process tests for the characterization and quantification of the return waste streams to determine the possible adverse effects on facility performance. There is also insufficient data to adequately determine the treatability of the influent wastewaters by both physical-chemical and the planned biological processes.

C. Industrial/Commercial Wastes

27 of the 129 EPA priority pollutants were detected in the influent during wet weather conditions at the SE plant. As may be noted from tables number 2 and 3; heavy metals,

chlorinated benzenes, chlorinated ethanes, the phthalates, phenols, cyanide and toluene showed the greatest concentration. All of the metals included in the priority pollutants were detected in the influent and effluent wastewaters.

A value of 3,000 ug/l of chromium was reported in the Southeast plant effluent during dry-weather flow. The City reported chromium levels rose dramatically during the sampling of a storm occurring on Tuesday, February 13, 1979. Before 8:00 A.M. chromium levels were ranging between 115 to 215 ug/l. Samples taken after 8:00 A.M. showed chromium levels of between 2750 and 4180 ug/l.

While there are a spectrum of highly effective methods available for the removal of heavy metals from water, precipitation appears to be capable of bringing the concentration of metals down to $\leq$ 0.5 mg/l, provided suspended solids concentration content is sufficiently low ($\leq$ 10 mg/l estimated).

D. Plant Design

The Southeast facility is, in effect, two separate treatment plants. One is a conventional primary treatment plant serving the SE portion of the City. The other provides solids treatment both to the sludge and scum pumped from the North point plant and to the solids removed at the Southeast primary plant.

The facility at an overflow rate of 2,000 gal/ft$^2$/day has a sedimentation tank capacity of approximately 70 MGD, however, the plant is limited to a peak capacity of between 32-38 MGD by the grit tank influent system.

E. Emergency Bypass

The Southeast and North point plants do not bypass in the conventional sense. Operators throttle to the maximum hydraulic capacity available resulting in overflows in the combined system at diversion structures upstream. Bypassing also occurs as the P.S.'s and interceptors are overloaded.

Bypassing takes place by throttling the inlet gates. The inlet gates were throttled 375.5 hours or an average of 12.9 hours per each day of the month for February, 1980. Maximum flow recorded during the month ranged from 31 to 42 MGD. Throttling causing flow diversion resulted largely from rainfall, however, evaluation of the operating records show malfunction of the bar rakes and also a power failure necessitated flow diversion.

Records indicate that these overflows occur 82 times a year (Citywide average). The excess flow is discharged through 39 shoreline overflow structures distributed around the periphery of the City. Studies note that the composition of these overflows can range from approximately 2 parts sanitary flow to one part runoff to greater than 50 parts runoff to one part sanitary and the duration of overflows can range from a few minutes to a few days.

During high tide, Bay water occasionally infiltrates if the flap gates of overflow bypass structure gates are not tightly closed due to debris caught in gates.

EPA sampled the discharge from the overflow structures in the SE tributary area during three storm periods on 2/28, 3/1, 3/26, and 3/28, 1979. Analyses were performed for the heavy metals, total and fecal coliform, oil & grease, TICH, pH and settleable solids. Fecal coliform counts up to 2,400,000/100 ml were recorded. The highest values reported for chromium, lead, zinc, nickel, and copper were 0.42 mg/l, 0.47 mg/l, 1.2 mg/l, 0.33 mg/l, and 0.27 mg/l respectively. Settleable solids up to 8.5 ml/l and pH values as low as 6.0 were reported.

F. Impending Changes

The chlorination-dechlorination system is being replaced by liquid NAOCL and $NaHSO_2$ systems.

G. System Failures Due to Construction

Liaison procedures with the construction management personnel and the City are being revised and strenghened to minimize treatment process disruption during the new construction period.

SUMMARY OF FINDINGS - North Point Plant

A. NPDES Permit Compliance

The NPDES self-monitoring record for the reporting period July 1977 through February 1980 is provided in Table IV. The following permit compliance percentages for the North Point facility were achieved for the year 1978 through the first quarter (March 1979):

Max. settleable solids = 99.41 percent compliance $(\frac{16}{2724})$

Ave. settleable solids = 99.12 percent compliance $(\frac{4}{455})$

Total coliform 5 day Medium = 94.06 $(\frac{19}{320})$

Total coliform (Max. day) = 100.00 $(\frac{0}{320})$

pH peak flow = 97.80 $(\frac{10}{455})$

$Cl_2$ residual = 99.93 $(\frac{9}{10,897})$

Toxicity (1978) = 83.3 $(\frac{4}{24})$

The pH, residual chlorine, and settleable solids met effluent limits during the time of the EPA sampling inspection on 3/13/79. EPA representatives collected composite samples of the effluent beginning at 9:00 A.M. on 3/13 and 3/14/79 for fish toxicity tests. There was no (zero) survival in undiluted wastes from both of the composite samples. A toxicity value of $\leq$ 1.2 was reported for the 3/13 test with a 1.3 toxicity value for the test conducted on the 3/14/79 sample.

Ten samples collected on 5/7/79 and analyzed for total coliform met permit limits.

B. Operation and Maintenance

There was a greater than 70 percent removal of suspended solids during calendar year 1978. The monthly average suspended solids removal ranged from a low of 60.1 percent in December to a high of 73.7 percent in September (graph No. 6). The grease removal ranged from a low of 54 percent to a high of 76.5 percent (graph No. 7). The influent, effluent, and percent removals of BOD and COD are shown on graph Nos. 8 and 9 respectively. The minimum and maximum influent pH values are shown on graph No. 10.

The two principal reasons for exceeding the settleable solids limit were (1) hydraulic overloading of the sedimentation tanks during wet weather and (2) the forced shutdowns of the NPWPCP during construction of the Southeast facility. The original design for the North Point WWTP is for a peak flow of 150 MGD.

Additional studies should be conducted to optimize the ferric chloride feed rate. The North Point plant does not have the waste streams associated with solids disposal. Furthermore, the treatability of the influent wastewaters are less adversely affected by industrial wastes than the Southeast facility. The ferric chloride feed rate is in the range of 12 to 16 mg/l while the ferric chloride feed rate at the Southeast plant is 28-32 mg/l. During calendar year 1978, the average percent removal of suspended solids from the Southeast plant was 72.0 percent removal and the percent removal at the North Point facility was 70.3 percent.

Inadequate chlorination facilities including mixing and feed controls together with improper sampling techniques have resulted in exceeding the coliform requirement at the NPWPCP.

C. Industrial/Commercial Wastes

26 of the designated priority pollutants were detected in the influent during wet weather conditions at the North Point plant.

D. Plant Design

The original design for the North Point WWTP, which was completed in 1951, is for a peak flow of 150 MGD with an overflow rate of 2200 gal/$ft_2$/day. Records indicate, however, that the NPDES permit limits for settleable solids are exceeded when the flow is greater than 135 MGD. This results in an overflow rate of 2,000 gal/$ft_2$/day with all the sedimentation tanks in service. The mean forward velocity at this rate is 4.8 fpm which is in the upper limits of design for compliance with settleable solids requirements.

The chlorination facilities are inadequate. No mixing is provided. Chlorine application is limited to approximately 150 lbs/day feed rate ahead of the sumps and 170 lb/day ahead of the sedimentation tanks.

<u>Emergency Bypass</u>

Bypassing is accomplished by throttling a 72 by 72-inch inlet gate to the plant.

Evaluation of plant records indicate that there have been periods when the peak flows have reached 185 MGD. This excessive flow rate resulted in solids washout over the weirs of the sedimentation tanks.

Plant records also show that during storm weather throttling and subsequent bypassing has occurred with flow rates less than 100 MGD being recorded. This is due to the clogging of the mechanical bar screens with rags and debris.

PHOTOGRAPHS .

TABLES .

GRAPHS .

Photographer: A.V. Resnik

Witness:

Date: 3-26-80

Time: 9:30 AM

Direction: N

No. 1 Subject: Scum and solids on surface of elutriation tanks

Facility: Southeast Plant, San Francisco, CA

Photographer: A.V. Resnik

Witness:

Date: 3-26-80

Time: 9:35 AM

Direction: N

No. 2 Subject: Similar to photo #1 Solids on surface of elutriation tanks

Facility: Southeast plant, San Francisco, CA

EPA-IX-FORM 753

Photographer: A.V. Resnik

Witness:

Date: 3-26-80

Time: 10:00 AM

Direction: NW

No. 3 Subject: Department of Public Works Employees skimming off solids from elutriation tanks

Facility: Southeast Plant, San Francisco, CA

Photographer: A.V. Resnik

Witness:

Date: 3-26-80

Time: 10:05 AM

Direction: NW

No. 4 Subject: Solids on elutriation tanks

Facility: Southeast Plant, San Francisco, CA

Photographer: A.V. Resnik

Witness:

Date: 3-26-80

Time: 10:10 AM

Direction: NW

No. 5 Subject: Department of Public Works Truck used in skimming elutriation tanks

Facility: Southeast Plant, San Francisco, CA

Photographer: A.V. Resnik

Witness:

Date: 3-26-80

Time: 10:15 AM

Direction: NW

No. 6 Subject: 8 inch suction line skimming solids from elutriation tanks

Facility: Southeast Plant, San Francisco, CA

TABLE I

Name of Discharger: City and County of San Francisco NPDES Permit No.: CA0037664

Location: Southeast Plant

Reporting Period: July 1977 through February 1980

| Permit Condition | Effluent Constituent | Effluent Limitation | Month | Value(s) Reported | # of Exceptions/ # of Samples |
|---|---|---|---|---|---|
| A.1.e | Chlorine Residual | 0.0 Instantaneous Maximum | Jul. 77 | 22.6 | 741/741 |
| | | | Aug. 77 | 20.6 | 744/744 |
| | | | Sep. 77 | 17.9 | ** |
| | | | Oct. 77 | 20.0 | 71/387 |
| | | | Nov. 77 | 5.3 | 5/379 |
| | | | Dec. 77 | 9.5 | 15/366 |
| | | | Jan. 78 | 9.0 | ** |
| | | | Feb. 78 | 6.8 | ** |
| | | | Mar. 78 | 6.0 | 8/231 |
| | | | Apr. 78 | 4.8 | ** |
| | | | May 78 | 0.8 | ** |
| | | | June 78 | 4.4 | 13/213 |
| | | | July 78 | 4.1 | 4/224 |
| | | | Aug. 78 | 5.0 | 9/224 |
| | | | Sep. 78 | 2.5 | 5/228 |
| | | | Oct. 78 | 1.1 | 3/233 |
| | | | Nov. 78 | 17.0 | 5/223 |
| | | | Jan. 79 | 11.9 | 2/206 |
| | | | Feb. 79 | 6.0 | 2/190 |
| | | | Mar. 79 | 0.7 | 3/215 |
| | | | Apr. 79 | 6.8 | 1/199 |
| | | | June 79 | 2.0 | 2/178 |
| | | | July 79 | 0.1 | 1/207 |
| | | | Aug. 79 | 0.6 | 4/207 |
| | | | Sep. 79 | 0.5 | 2/205 |
| | | | Nov. 79 | 0.8 | 1/204 |
| | | | Dec. 79 | 4.8 | 5/208 |
| | | | Jan. 80 | 18.4 | 1/206 |

** No data

Name of Discharger: City and County of San Francisco NPDES Permit No.: CA0037664

Location: Southeast Plant

Reporting Period: July 1977 through February 1980

| Permit Condition | Effluent Constituent | Effluent Limitation | Month | Value(s) Reported | # of Exceptions/ # of Samples |
|---|---|---|---|---|---|
| | | | | (Maximum) | |
| A.2 | Settleable Matter | 1.0 ml/l/hr maximum any sample | Aug. 77 | 10.0 | 1/372 |
| | | | Oct. 77 | 5.5 | 1/368 |
| | | | Dec. 77 | 2.0 | 2/372 |
| | | | Jan. 78 | 2.0 | ** |
| | | | Apr. 78 | 1.3 | ** |
| | | | June 78 | 1.5 | 1/358 |
| | | | Aug. 78 | 3.5 | ** |
| | | | Nov. 78 | 15.0 | 5/353 |
| | | | Dec. 78 | 3.0 | ** |
| | | | Jan. 79 | 9.0 | 3/367 |
| | | | Feb. 79 | 1.5 | ** |
| | | | June 79 | 3.0 | 2/354 |
| | | | Aug. 79 | 1.5 | 2/364 |
| | | | Jan. 80 | 2.0 | 1/367 |
| A.5 | Total Coliform | 240 MPN/100 ml median of five samples | Aug. 77 | 3300 | 6/23 |
| | | | Sep. 77 | 24000 | 19/20 |
| | | | Oct. 77 | 1100 | 3/20 |
| | | | Nov. 77 | 430 | 5/20 |
| | | | Jan. 78 | 330 | 1/21 |
| | | | May 78 | 790 | 4/21 |
| | | | Sep. 78 | 340 | 4/20 |
| | | | Nov. 78 | 790 | 2/21 |
| | | | Dec. 78 | 1700 | 13/24 |

** No data

Cont'd. TABLE I

Name of Discharger: City and County of San Francisco NPDES Permit No.: CA0037664

Location: Southeast Plant

Reporting Period: July 1977 through February 1980

| Permit Condition | Effluent Constituent | Effluent Limitation | Month | Value(s) Reported | # of Exceptions/ # of Samples |
|---|---|---|---|---|---|
| | | | | (Maximum) | |
| A.5 (cont.) | Total Coliform | 240 MPN/100 ml median of five samples | Mar. 79 | 2600 | 4/29 |
| | | | Apr. 79 | 2400 | 2/28 |
| | | | June 79 | 1700 | 3/20 |
| | | | Aug. 79 | 330 | 5/29 |
| | | | Sep. 79 | 220 | 8/24 |
| | | | Oct. 79 | 24000 | 11/23 |
| | | | Nov. 79 | 490 | 3/21 |
| | | | Dec. 79 | 24000 | 13/20 |
| | | | Jan. 80 | 1300 | 5/22 |
| | | | Feb. 80 | 330 | 3/17 |
| A.5 | Total Coliform | 10000 MPN/100 ml any single sample | Sep. 77 | 92000 | 1/20 |
| | | | Nov. 77 | 11000 | 1/20 |
| | | | Sep. 78 | 24000 | ** |
| | | | Nov. 78 | 24000 | ** |
| | | | Dec. 78 | 16000 | ** |
| | | | Aug. 79 | 24000 | 1/29 |
| | | | Oct. 79 | 24000 | 6/23 |
| | | | Nov. 79 | 24000 | 2/20 |
| | | | Feb. 80 | 16000 | 1/17 |
| | | | | (Min./Max.) | |
| A.6 | pH | 6.0 to 9.0 | Sep. 77 | 5.8 to 6.7 | 1/20 |
| | | | Jan. 78 | 5.9 to 6.9 | 1/4 |
| | | | Feb. 78 | 5.7 to 6.8 | ** |
| | | | Nov. 78 | 3.3 to 7.0 | 1/21 |
| | | | Jan. 79 | 5.2 to 6.8 | 1/30 |

** No data

TABLE II

| Parameter | NORTHPOINT WPCP Influent Wet-Weather Mixed | NORTHPOINT WPCP Influent Wet-Weather Sett. | NORTHPOINT WPCP Effluent Dry-Weather Mixed | NORTHPOINT WPCP Effluent Dry-Weather Sett. | SOUTHEAST WPCP Influent Wet-Weather Mixed | SOUTHEAST WPCP Influent Wet-Weather Sett. | SOUTHEAST WPCP Effluent Dry-Weather Mixed | SOUTHEAST WPCP Effluent Dry-Weather Sett. |
|---|---|---|---|---|---|---|---|---|
| antimony | < 1 | 3 | < 33 | < 33 | 2 | 2 | < 20 | < 20 |
| arsenic | < 5 | < 5 | 15 | < 30 | < 5 | < 5 | 15 | 40 |
| beryllium | < 5 | < 5 | < 15 | < 15 | < 5 | < 5 | < 15 | < 15 |
| cadmium | 3 | 1 | < 2 | < 2 | 5 | 2 | 4 | 3 |
| chromium | 20 | 10 | < 50 | < 50 | 180 | 75 | 3,000 | 1,190 |
| copper | 170 | 100 | 135 | 50 | 170 | 55 | 80 | 50 |
| lead | 220 | 56 | 23 | 56 | 180 | 42 | 300 | 100 |
| mercury | 5.1 | < 1 | < 2 | < 2 | < 1 | < 1 | < 2 | < 2 |
| nickel | 10 | 35 | < 50 | < 50 | 80 | 65 | < 50 | 50 |
| selenium | < 5 | < 5 | < 5 | < 5 | < 5 | 5 | < 5 | 5 |
| silver | 20 | < 10 | 30 | 17 | 15 | 20 | < 15 | < 15 |
| thallium | 10 | 6 | 21 | < 1 | 5 | 5 | < 1 | 14 |
| zinc | 1900 | 1700 | 201 | 61 | 520 | 200 | 724 | 333 |
| manganese | 120 | 95 | 140 | 100 | 220 | 180 | 510 | 420 |
| cyanide | .01 | <.004 | 10 | 16 | <.004 | <.004 | 48 | 31 |
| benzene | nd | nd | 5 | nd | 85 | nd | 9 | 6 |
| 1,2,4-trichlorobenzene | nd | nd | nd | nd | nd | 140 | nd | nd |
| 1,1,1-trichloroethane | 10 | 12 | nd | 320 | 12 | 20 | nd | 270 |
| 1,1,2,2-tetrachloroethane | nd | nd | nd | nd | nd | nd | nd | nd |
| chloroform | nd | nd | 45 | 25 | nd | nd | nd | 20 |
| 1,2-dichlorobenzene | 6 | nd | nd | nd | nd | nd | nd | nd |
| 1,4-dichlorobenzene | 7 | nd | nd | nd | nd | nd | nd | nd |
| 1,1-dichloroethylene | nd | nd | 14 | 6 | nd | nd | nd | nd |
| 1,2-trans-dichloroethylene | nd | nd | 30 | 15 | nd | nd | nd | 13 |
| ethylbenzene | 7 | 14 | 12 | 10 | 10 | nd | 17 | nd |
| bis (2-chloroethoxy) methane | nd | nd | nd | nd | nd | nd | nd | nd |
| methylene chloride | 45 | nd | 18 | 10 | 25 | 25 | nd | 9 |
| trichloroflouromethane | nd | nd | nd | nd | nd | nd | nd | nd |
| naphthalene | nd | nd | nd | nd | 9 | nd | 200 | 10 |
| phenol | nd | nd | 52 | 58 | nd | nd | 358 | 285 |
| bis (2-ethylhexyl) phthalate | 95 | 40 | 10 | nd | 90 | 45 | 60 | 30 |
| butyl benzyl phthalate | 95 | 50 | nd | nd | 25 | 9 | 10 | 15 |
| di-n-butyl phthalate | 14 | 10 | nd | nd | 14 | 12 | nd | nd |
| diethyl phthalate | 19 | 50 | nd | nd | 16 | 14 | nd | 5 |
| tetrachloroethylene | 6 | 16 | 7 | 5 | 13 | 18 | 40 | nd |
| toluene | 35 | 95 | 45 | 30 | 110 | nd | 85 | nd |
| trichloroethylene | 45 | 110 | 395 | 245 | nd | nd | 35 | 335 |

TABLE III

| Parameter | RICHMOND-SUNSET WPCP Influent | | | | RICHMOND-SUNSET WPCP Effluent | | | |
|---|---|---|---|---|---|---|---|---|
| | Wet-Weather | | Dry-Weather | | Wet-Weather | | Dry-Weather | |
| | Mixed | Sett. | Mixed | Sett. | Mixed | Sett. | Mixed | Sett. |
| antimony | | | < 20 | < 20 | < 1 | 2 | < 20 | < 20 |
| arsenic | | | 16 | 25 | < 5 | < 5 | 18 | 50 |
| beryllium | | | < 15 | < 15 | < 5 | < 5 | < 15 | < 15 |
| cadmium | | | 2 | < 2 | 4 | 3 | < 2 | < 2 |
| chromium | | | < 50 | < 50 | 10 | 10 | < 50 | < 50 |
| copper | | | 120 | 85 | 115 | 140 | 100 | 110 |
| lead | | | 150 | 550 | 183 | 50 | 5450 | 550 |
| mercury | | | 9 | < 2 | < 1 | < 1 | < 2 | < 2 |
| nickel | | | < 50 | < 50 | 70 | 40 | < 50 | < 50 |
| selenium | | | < 5 | < 5 | < 5 | < 5 | < 5 | < 5 |
| silver | | | < 15 | < 15 | 25 | 30 | < 15 | < 15 |
| thallium | | | < 1 | < 1 | < 1 | < 2 | < 1 | < 1 |
| zinc | | | 208 | 87 | 300 | 230 | 178 | 188 |
| manganese | | | 50 | 30 | 85 | 80 | 50 | 30 |
| cyanide | | | 0 | 0 | < .004 | .014 | 23 | 16 |
| benzene | | | 475 | nd | 95 | nd | nd | nd |
| 1,2,4-trichlorobenzene | | | nd | nd | nd | nd | nd | nd |
| 1,1,1-trichloroethane | | | nd | nd | nd | nd | nd | nd |
| 1,1,2,2-tetrachloroethane | | | 7 | nd | nd | nd | nd | nd |
| chloroform | | | 25 | 9 | nd | nd | nd | nd |
| 1,2-dichlorobenzene | | | nd | nd | nd | nd | nd | nd |
| 1,4-dichlorobenzene | | | nd | nd | nd | nd | nd | nd |
| 1,1-dichloroethylene | | | nd | nd | nd | nd | nd | nd |
| 1,2-trans-dichloroethylene | | | nd | nd | nd | nd | nd | nd |
| ethylbenzene | | | 375 | nd | 7 | nd | 9 | 7 |
| bis (2-chloroethoxy) methane | | | nd | nd | nd | nd | nd | nd |
| methylene chloride | | | 30 | nd | 7 | 5 | 270 | nd |
| trichloroflouromethane | | | 5 | nd | nd | nd | nd | nd |
| naphthalene | | | nd | nd | nd | nd | 5 | nd |
| phenol | | | 49 | 63 | nd | nd | 61 | 57 |
| bis (2-ethylhexyl) phthalate | | | 50 | 25 | 140 | 70 | 50 | 25 |
| butyl benzyl phthalate | | | 10 | nd | 25 | 14 | 10 | nd |
| di-n-butyl phthalate | | | nd | nd | 35 | 14 | 30 | nd |
| diethyl phthalate | | | 5 | nd | 50 | 60 | nd | nd |
| tetrachloroethylene | | | 40 | 5 | 10 | nd | nd | 7 |
| toluene | | | 605 | 6 | 270 | nd | 10 | 10 |
| trichloroethylene | | | nd | 7 | nd | nd | nd | nd |

All concentrations expressed in $\mu g$/liter

TABLE IV

Name of Discharger: City and County of San Francisco NPDES Permit No.: CA0037672

Location: North Point Plant

Reporting Period: July 1977 through February 1980

| Permit Condition | Effluent Constituent | Effluent Limitation | Month | Value(s) Reported | # of Exceptions/ # of Samples |
|---|---|---|---|---|---|
| A.1.e | Chlorine Residual | 0.0 mg/l Instantaneous Maximum | Oct. 77 | 6.6 | 5/31* |
| | | | Dec. 77 | 7.2 | 3/31* |
| | | | Mar. 78 | 5.0 | 1/31* |
| | | | Nov. 79 | 50.0 | 2/240 |
| | | | Dec. 79 | 5.4 | 5/248 |
| | | | Mar. 80 | 1.7 | 1/248 |
| | | | | (Min./Max.) | |
| A.2 | pH | 6.0 to 9.0 | Dec. 77 | 4.2 to 6.7 | 1/31 |
| | | | Jan. 78 | 5.4 to 6.9 | 1/31 |
| | | | Feb. 78 | 5.0 to 6.8 | 2/28 |
| | | | Apr. 78 | 5.8 to 7.0 | 1/30 |
| | | | Nov. 78 | 5.8 to 6.8 | 1/30 |
| | | | Jan. 79 | 5.5 to 6.8 | 1/31 |
| | | | Feb. 79 | 4.2 to 6.9 | 2/28 |
| | | | Nov. 79 | 5.2 to 6.9 | 1/30 |
| | | | Dec. 79 | 5.8 to 7.5 | 1/31 |
| | | | Feb. 80 | 4.6 to 6.9 | 1/29 |
| A.4 | Settleable Matter | 1.0 ml/l/hr any sample Maximum | Oct. 77 | 1.5 | 1/185 |
| | | | Jan. 78 | 2.6 | 1/184 |
| | | | Feb. 78 | 1.2 | 1/167 |
| | | | July 78 | 1.9 | 3/186 |
| | | | Feb. 79 | 3.0 | 9/168 |
| | | | Oct. 79 | 1.5 | 1/186 |
| | | | Nov. 79 | 3.5 | 1/186 |
| | | | Dec. 79 | 2.0 | 1/186 |

* No. of days exceeded limit/No. of sample days
** No data.

TABLE IV Cont'd.

Name of Discharger: City and County of San Francisco NPDES Permit No.: CA0037672

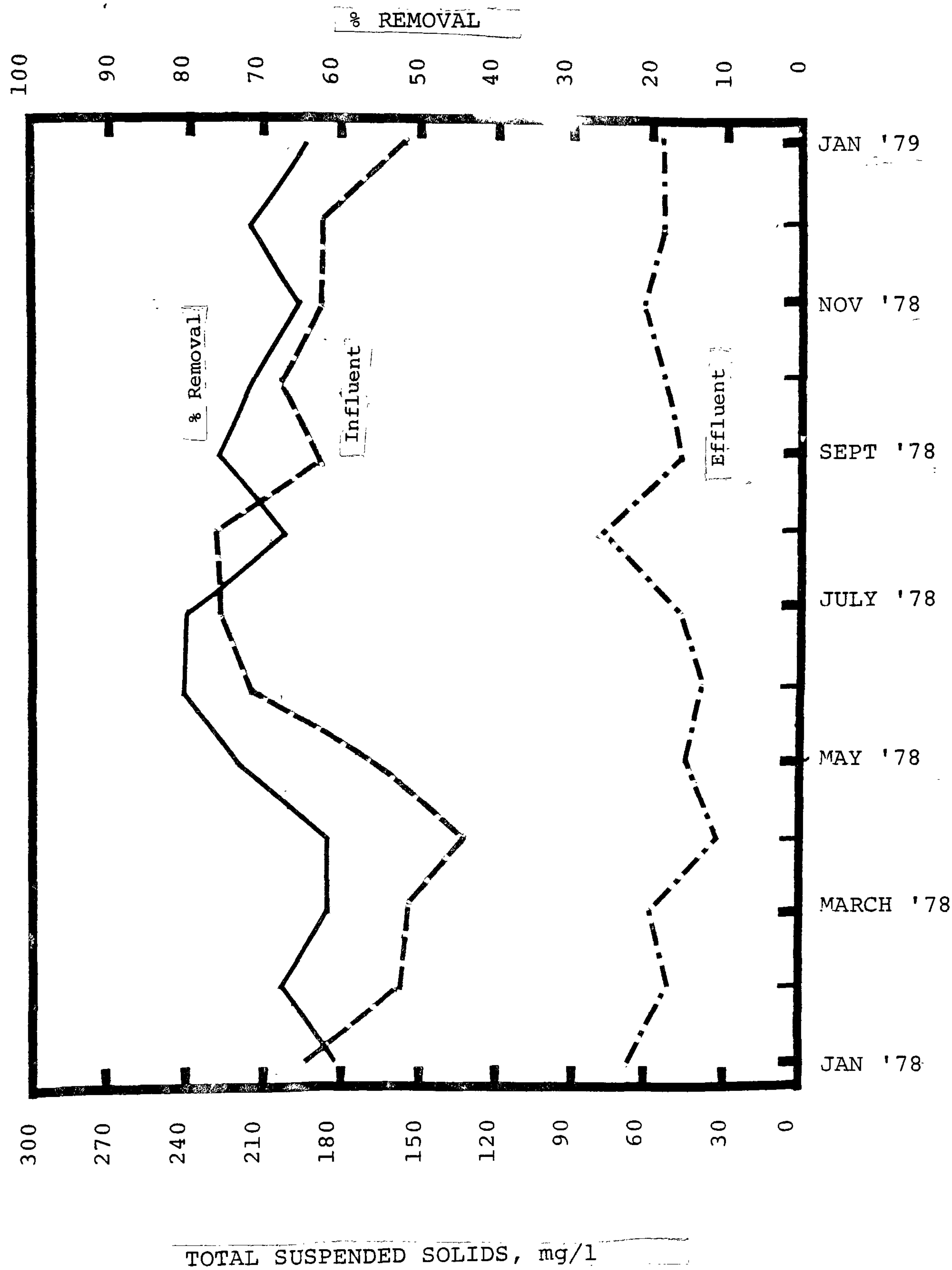
Location: North Point Plant

Reporting Period: July 1977 through February 1980

| Permit Condition | Effluent Constituent | Effluent Limitation | Month | Value(s) Reported | # of Exceptions/ # of Samples |
|---|---|---|---|---|---|
| A.7 | Total Coliform | 240 MPN/ 100 ml Median of five samples | July 78 | 350 | 2/20* |
| | | | Aug. 78 | 540 | 6/23* |
| | | | Sep. 78 | 920 | 7/21* |
| | | | Jan. 79 | 350 | 3/23* |
| | | | Nov. 79 | 540 | 3/22 |
| | | | Jan. 80 | 1400 | 5/23 |

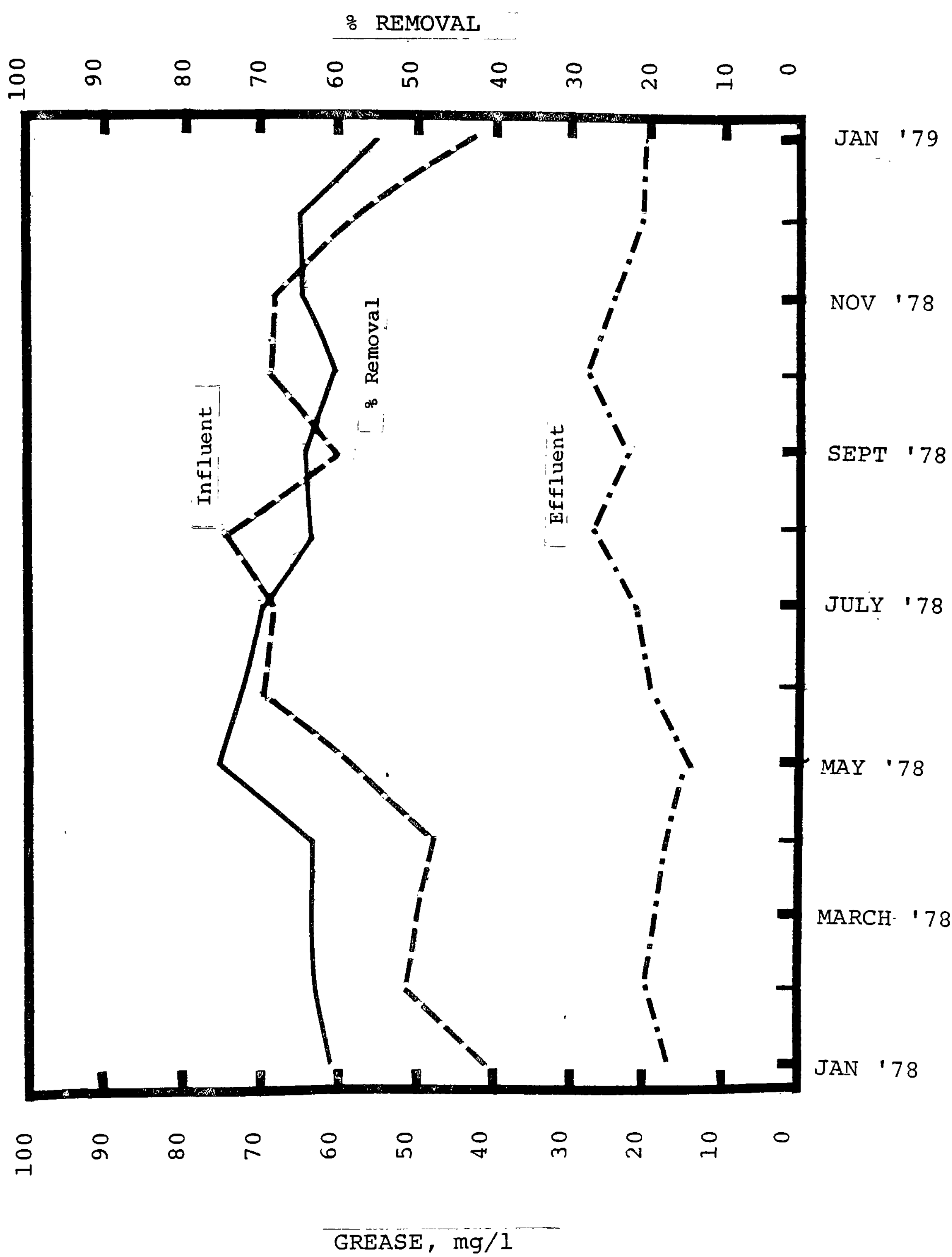
* No. of days exceeded limit/No. of sample days
** No data.

GRAPH 1



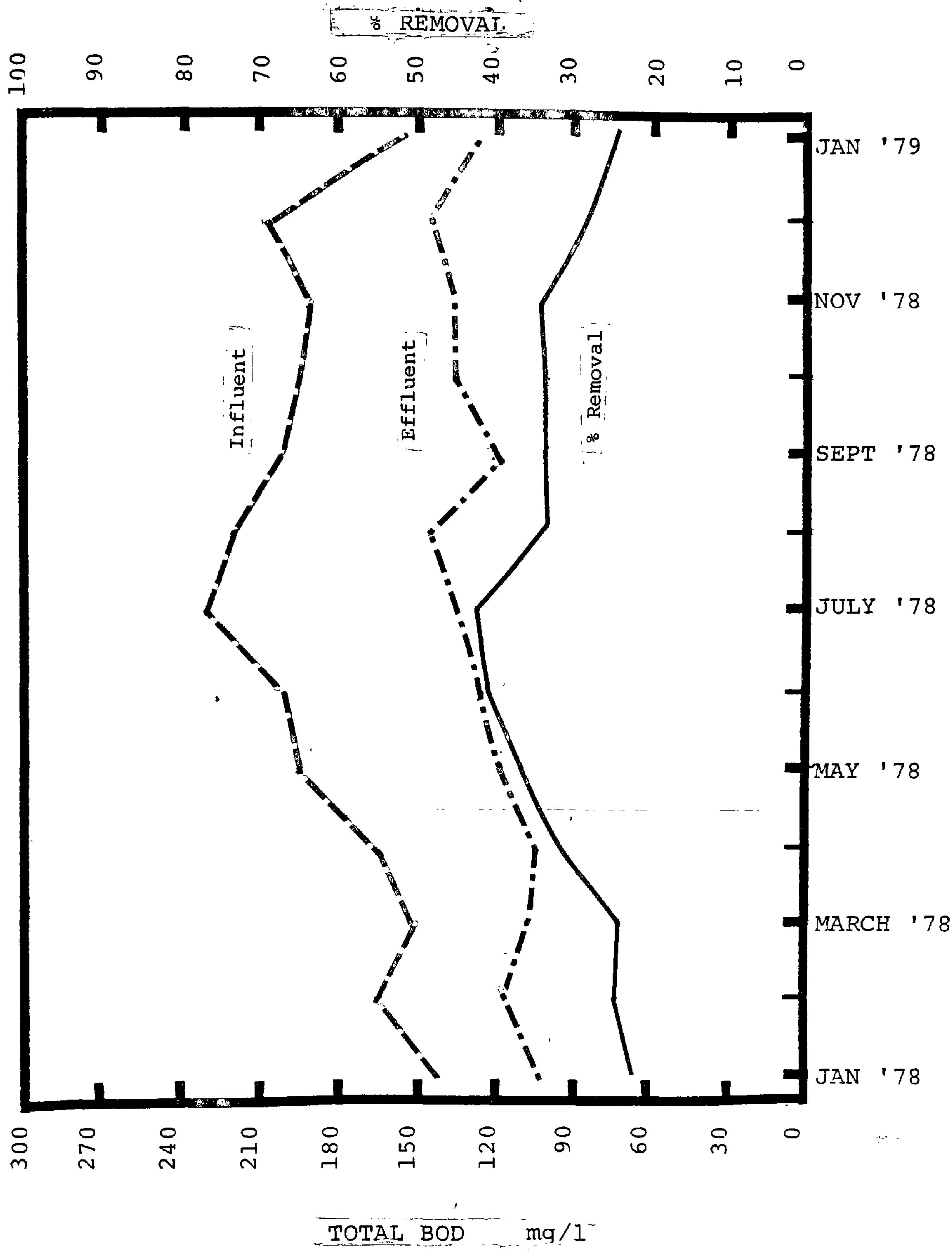

SOUTHEAST

GRAPH 2



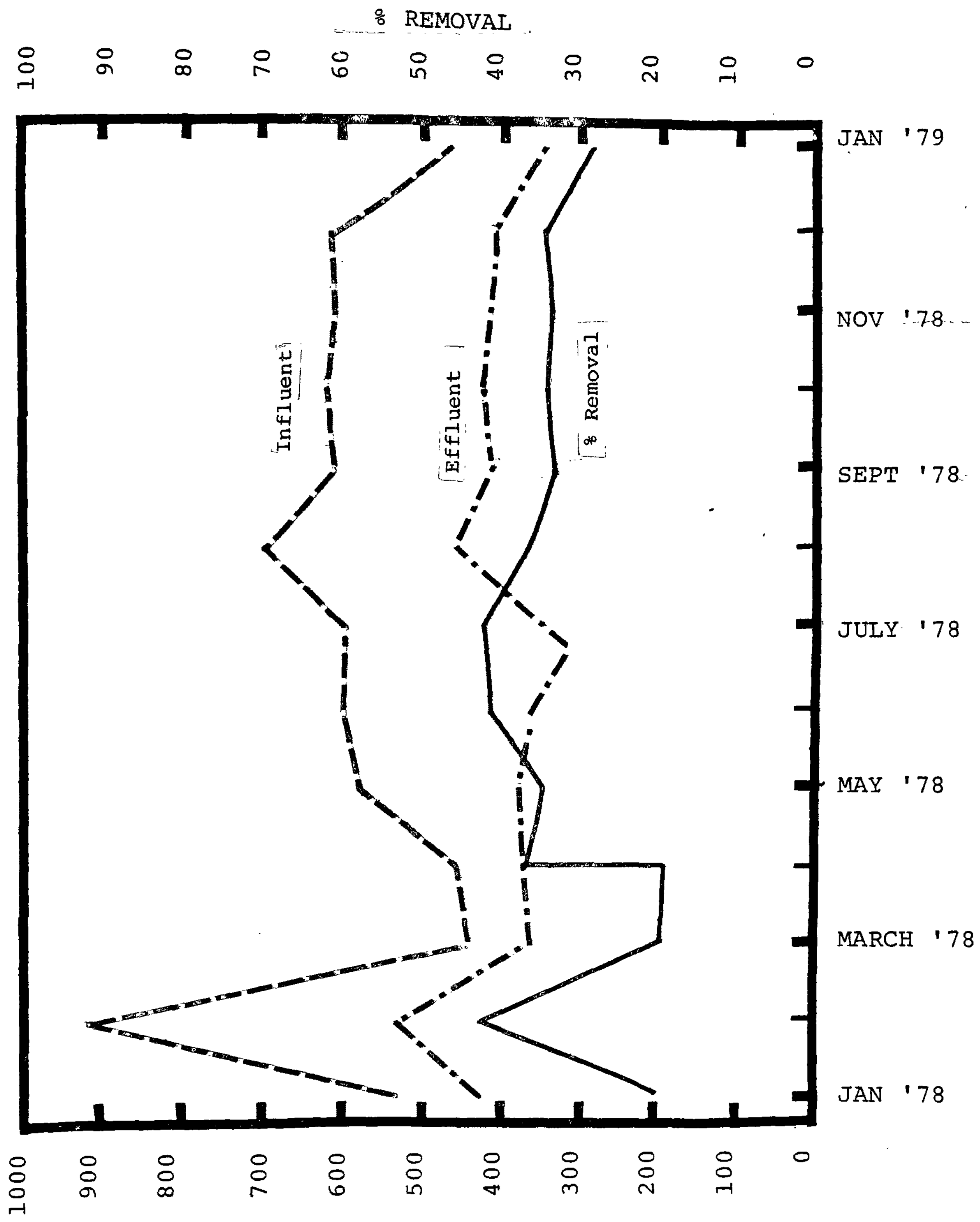

SOUTHEAST

GRAPH 3



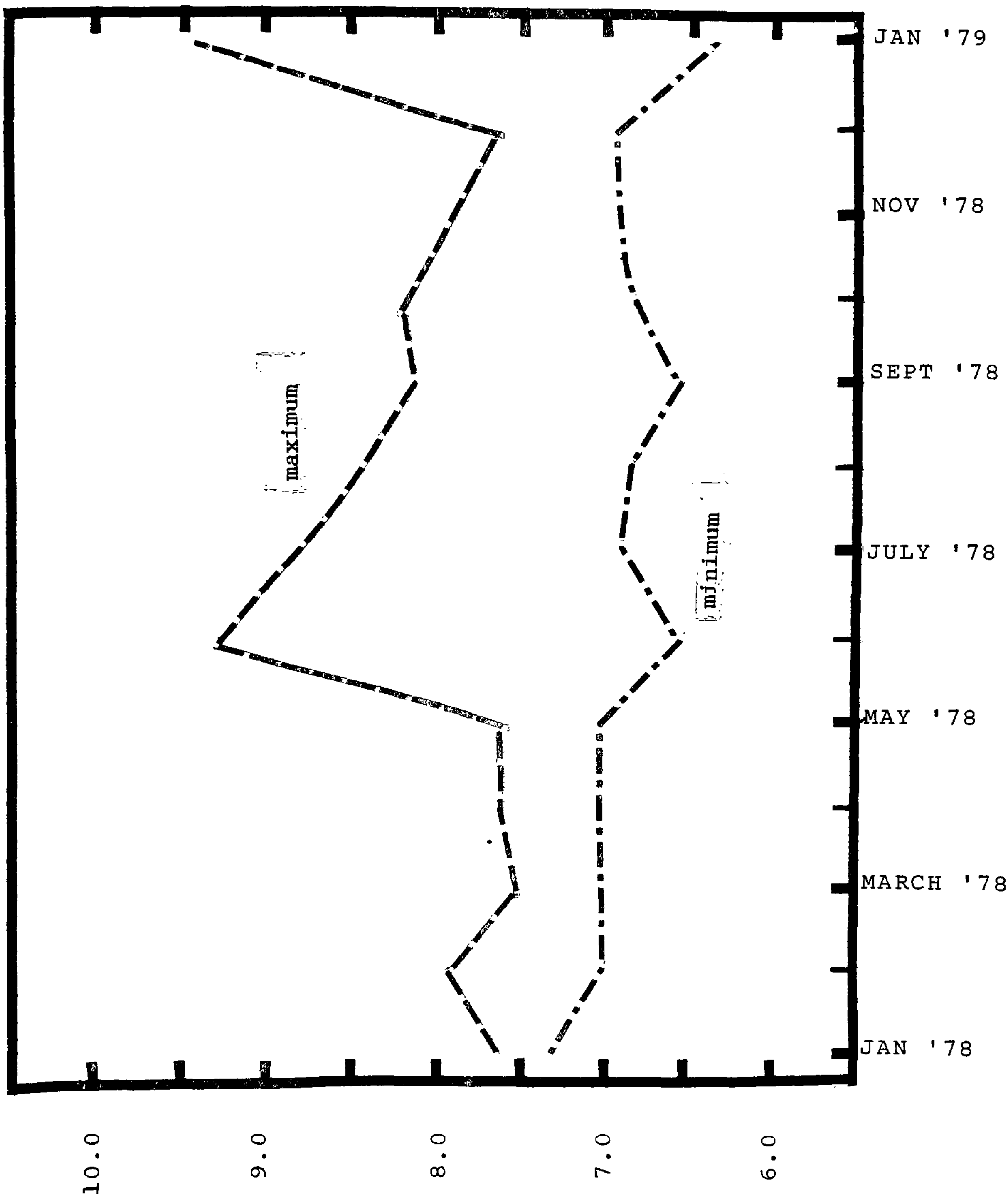

SOUTHEAST

GRAPH 4




SOUTHEAST

GRAPH 5

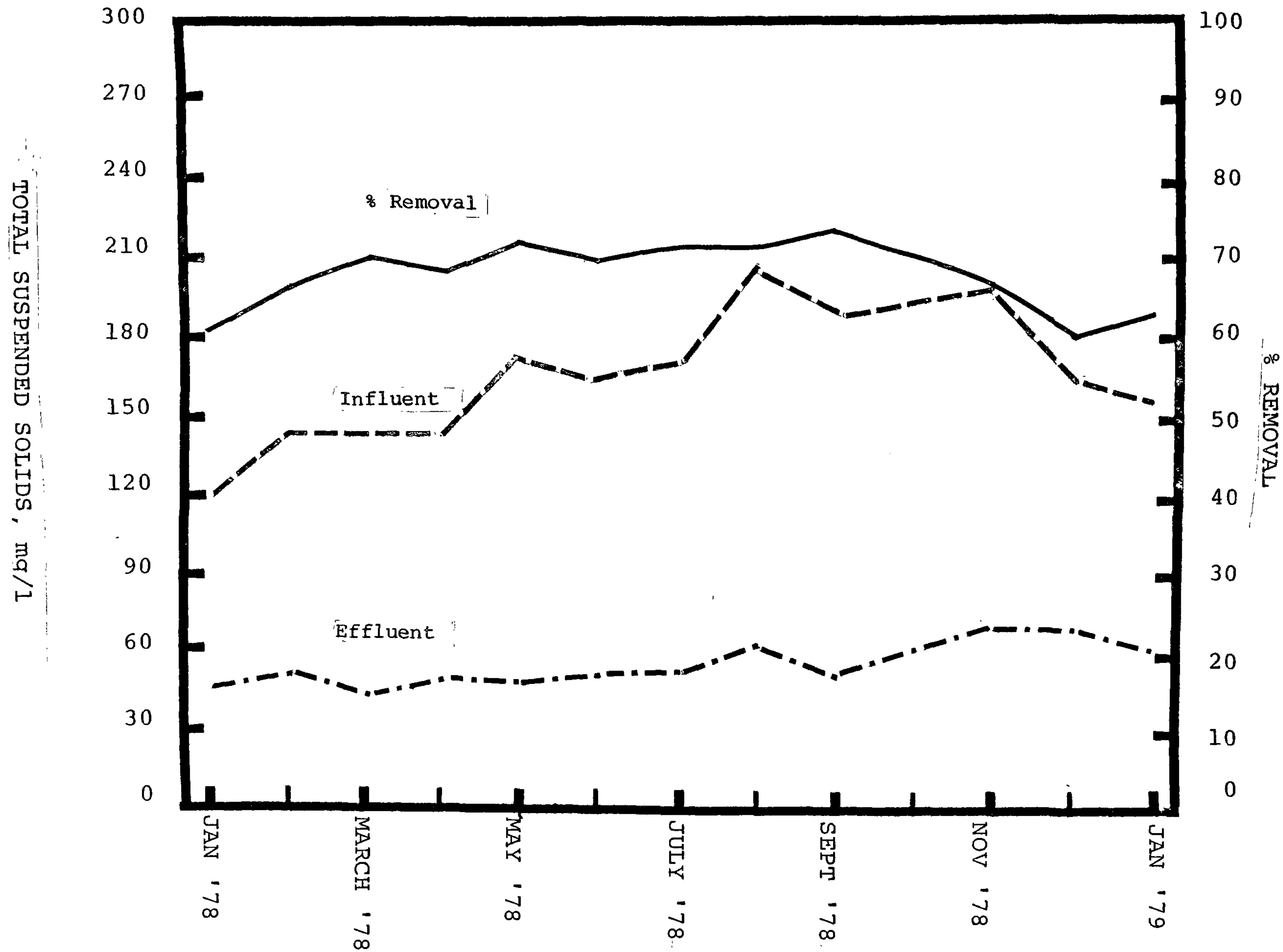



INFLUENT pH

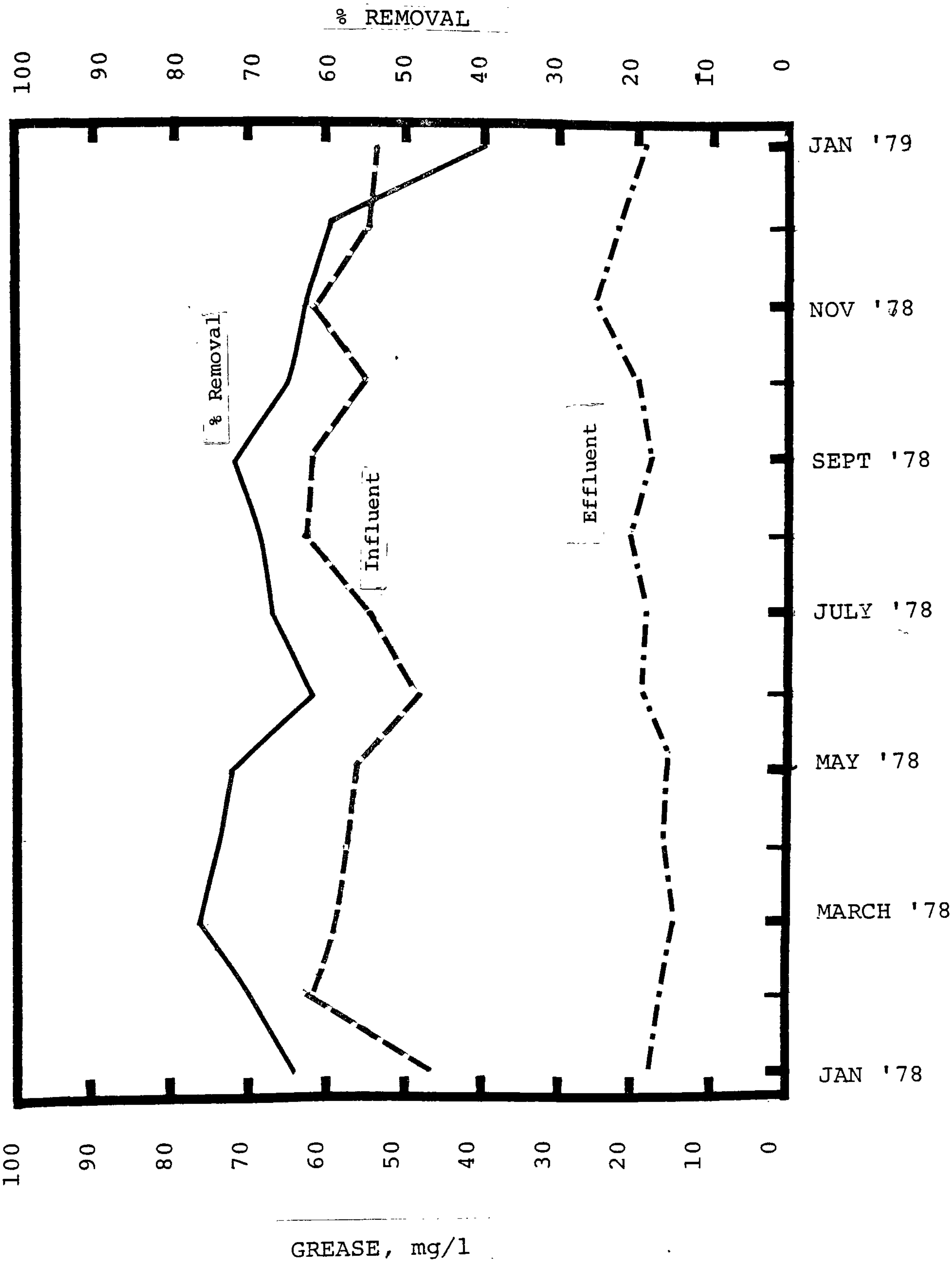
SOUTHEAST

NORTHPOINT

GRAPH 6



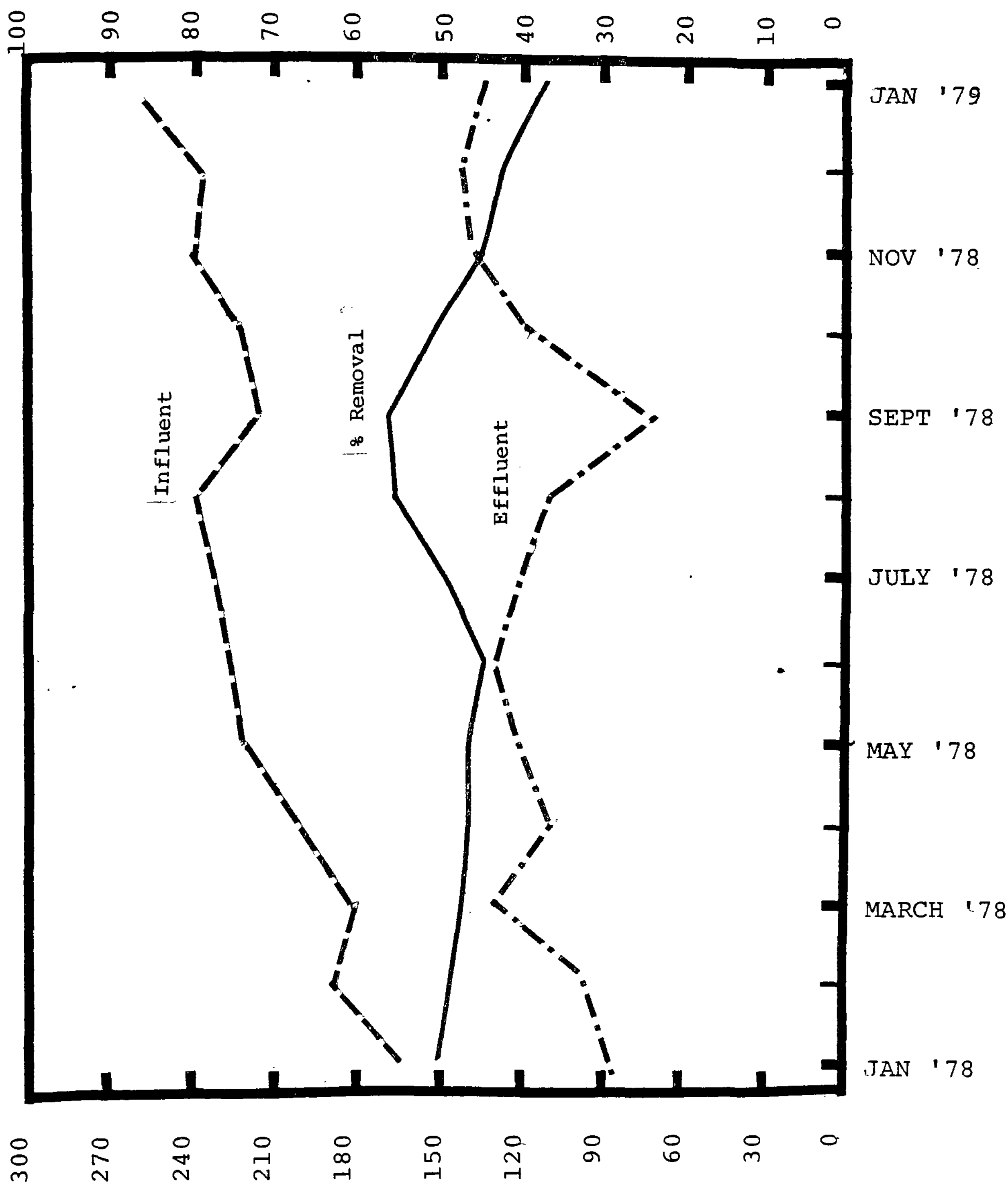
GRAPH 7




NORTHPOINT

GRAPH 8

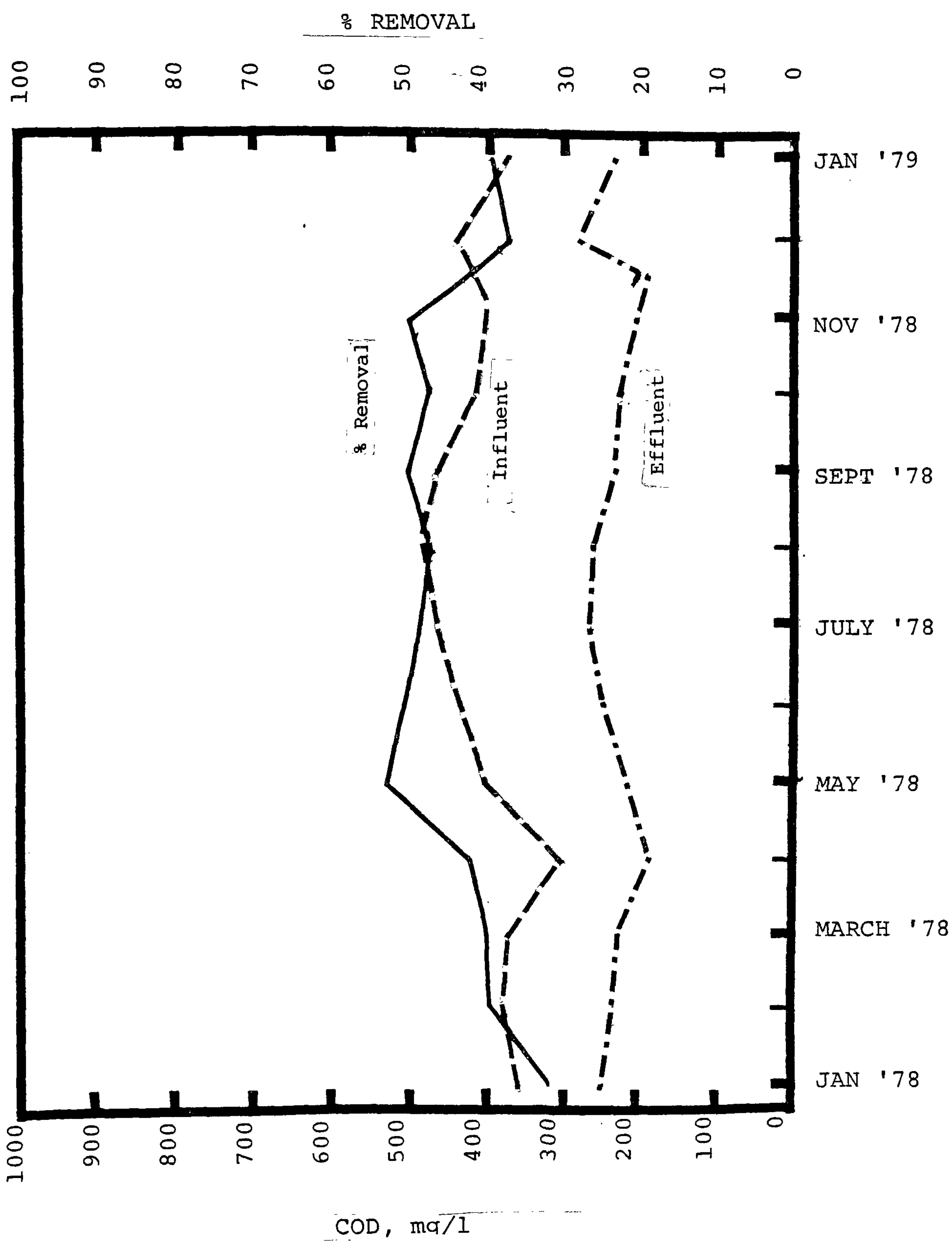
% REMOVAL




TOTAL BOD mg/l

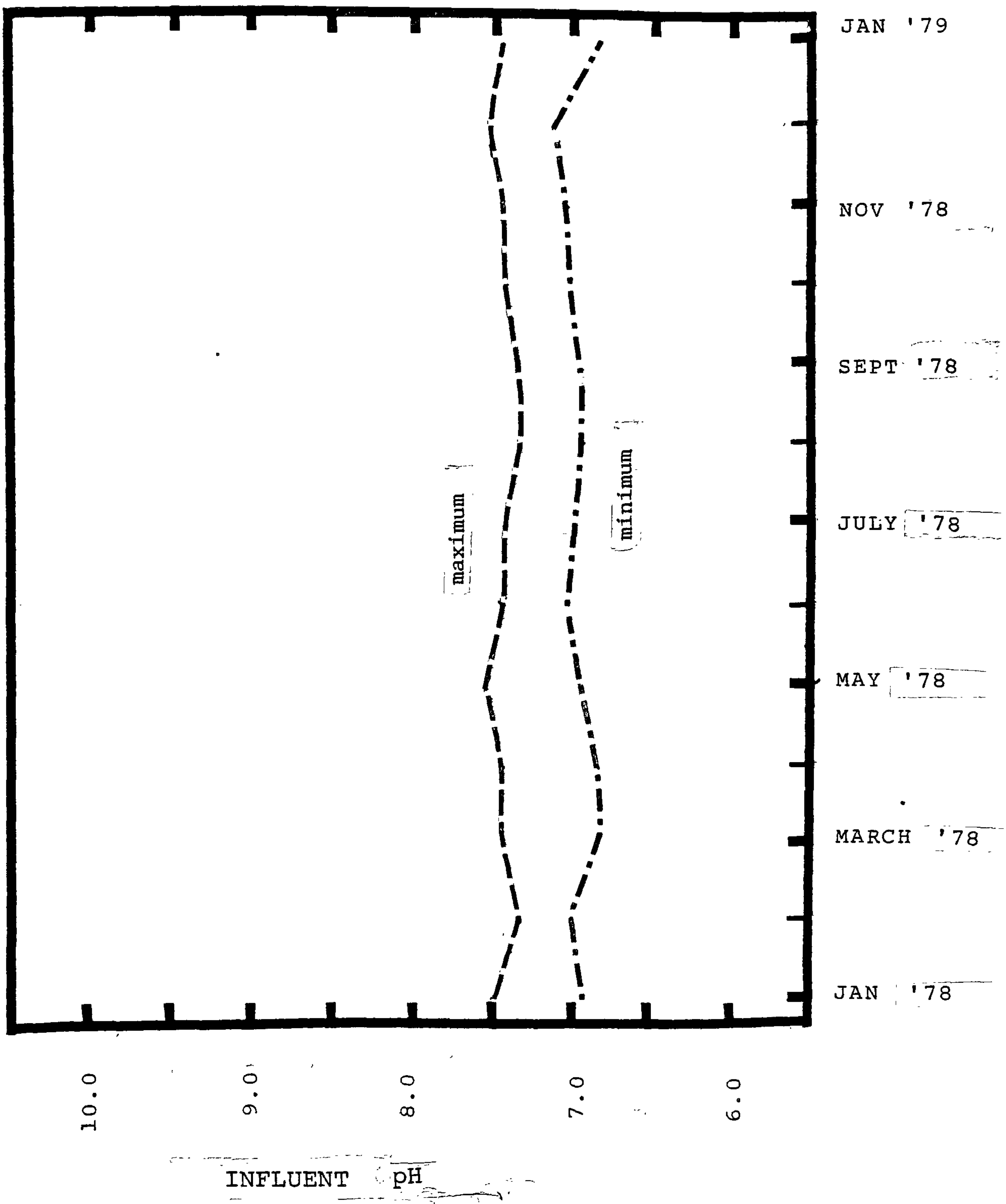
NORTHPOINT

GRAPH 9



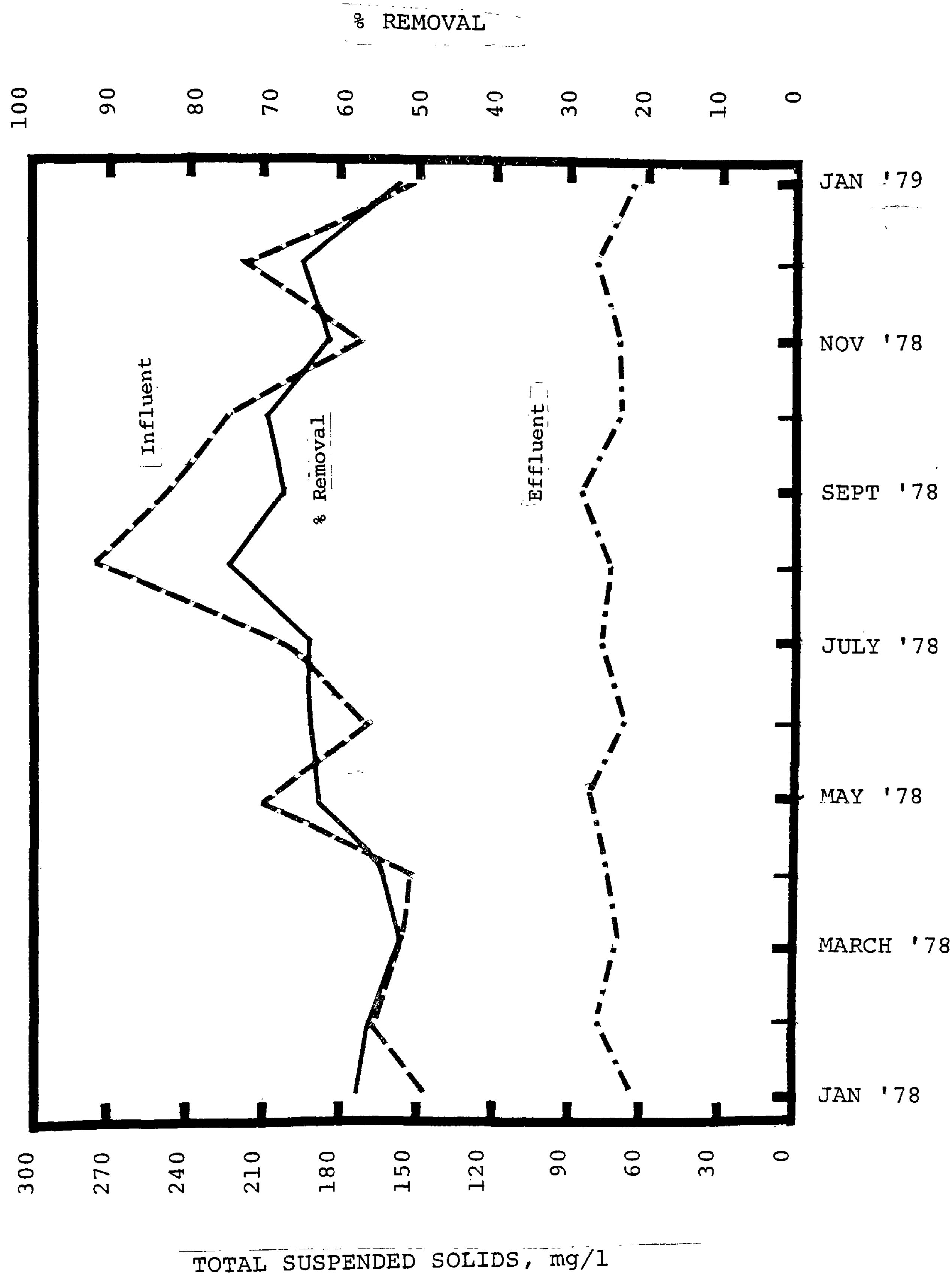

NORTHPOINT

GRAPH 10



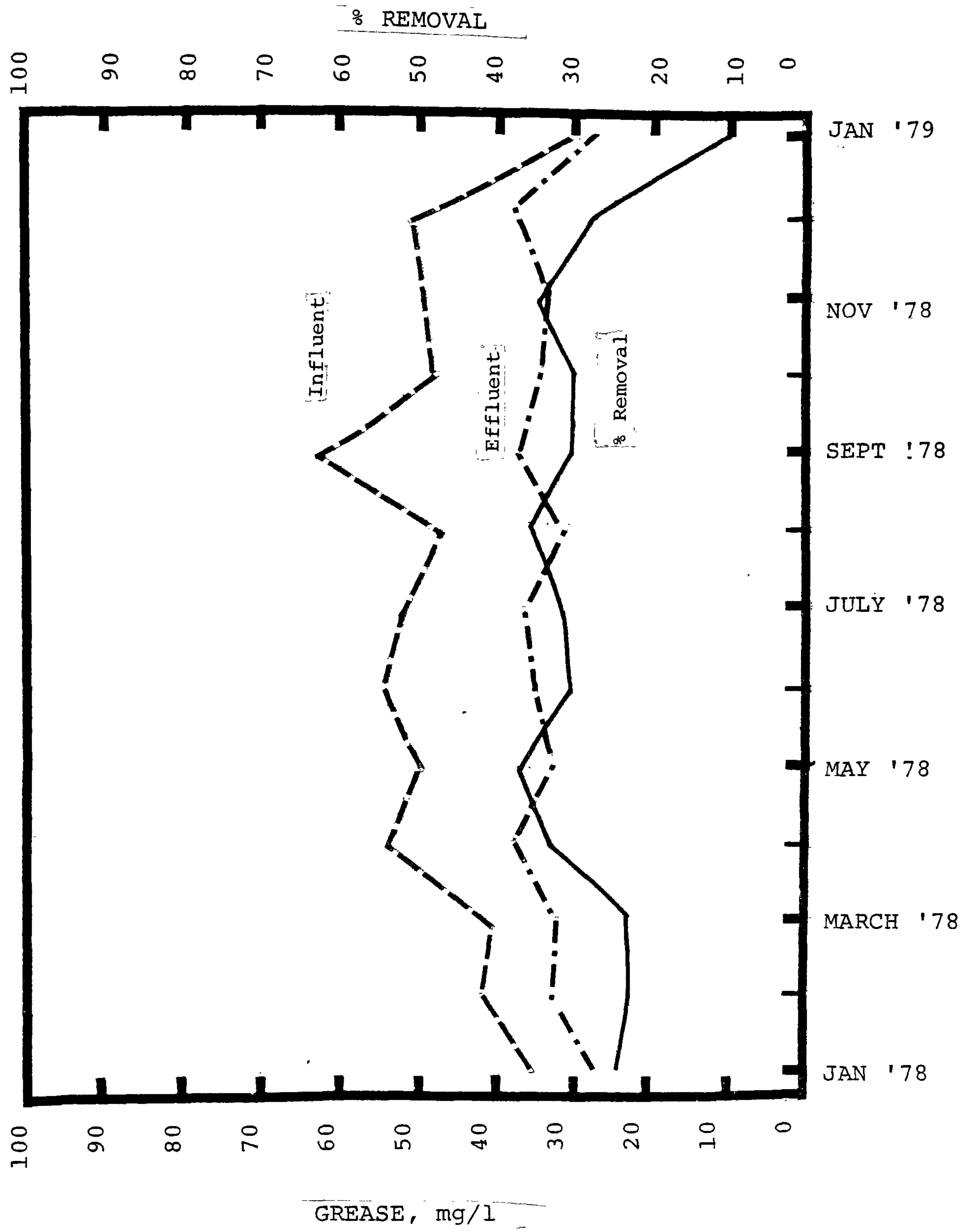

NORTHPOINT

GRAPH II



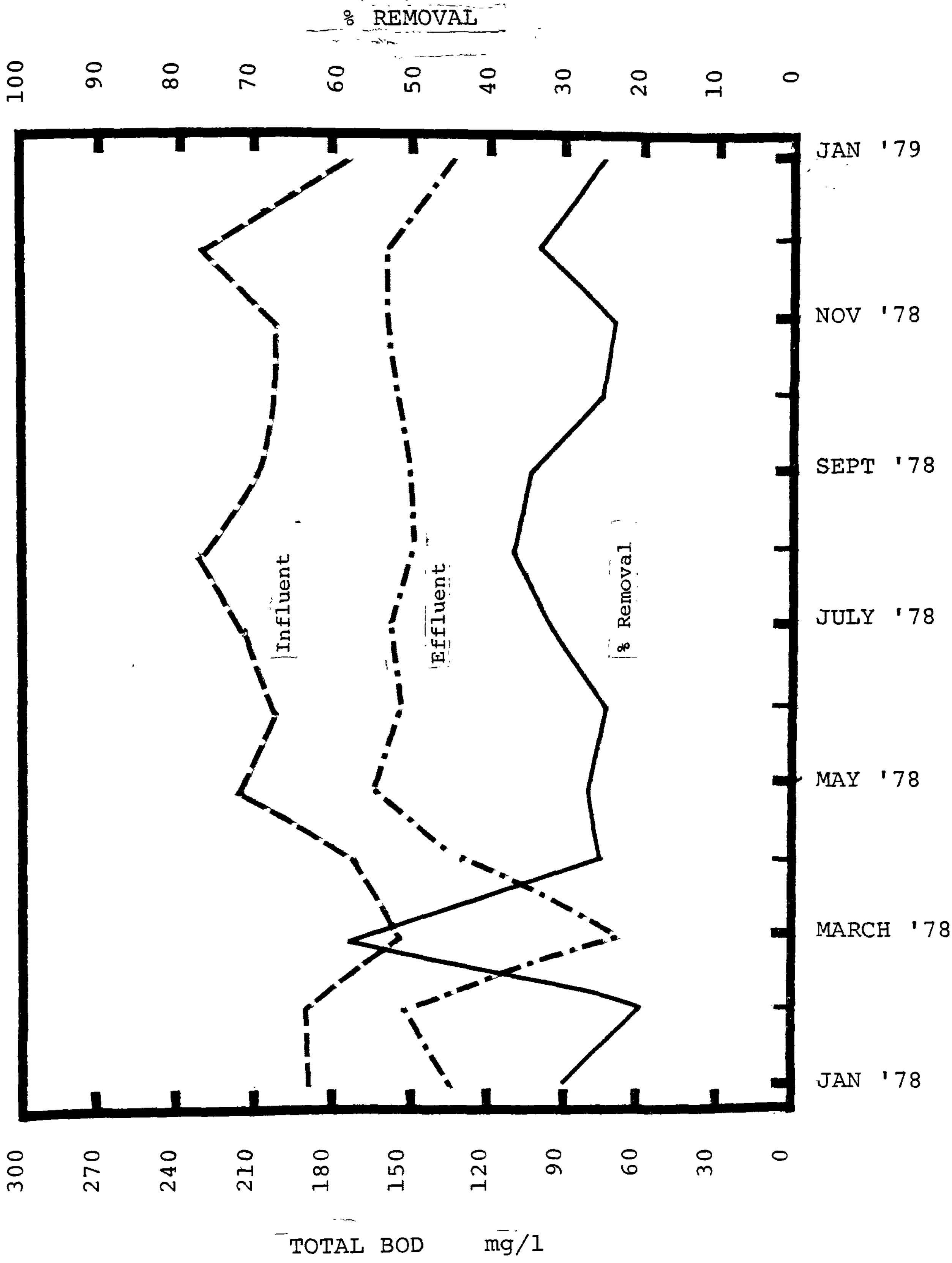

RICHMOND-SUNSET

GRAPH 12



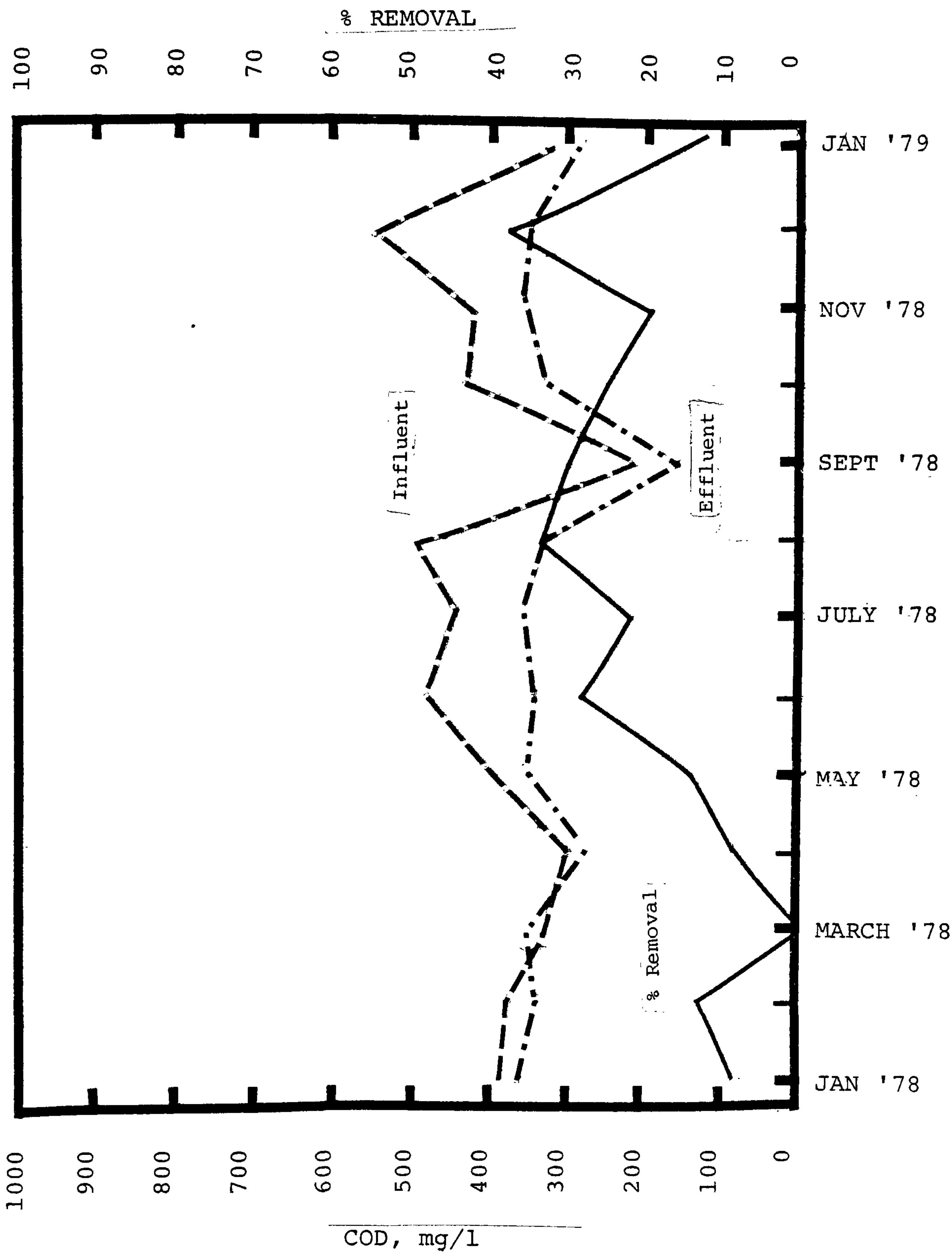

RICHMOND-SUNSET

GRAPH 13



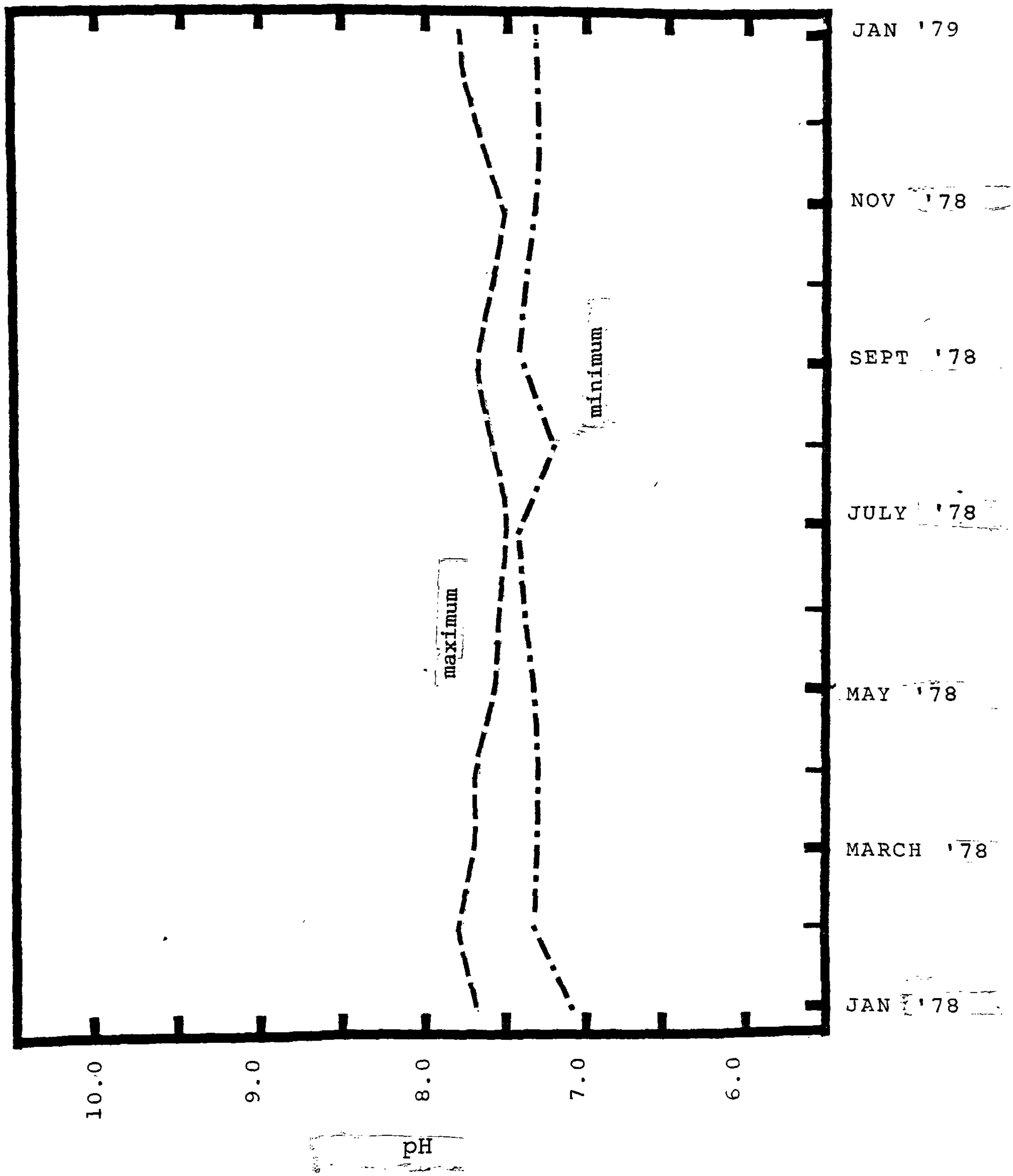

RICHMOND-SUNSET

GRAPH 14




RICHMOND-SUNSET

GRAPH 15




RICHMOND-SUNSET

# PART TWO

# EXISTING OPERATIONS

The City of San Francisco is divided into three sewerage service areas, each of which is served by a primary treatment plant. The three plants are the North Point, Richmond-Sunset and Southeast Water Pollution Control Plants.

## NORTH POINT WATER POLLUTION CONTROL PLANT

The North Point Water Pollution Control Plant, completed in 1951, serves a dry weather flow area of approximately 9,300 acres. The tributary area is mostly residential in character but also includes commercial and industrial developments along the Port of San Francisco.

The treatment units are arranged in two groups of buildings with the pretreatment building (screens and grit tanks) and the influent pumping station and administration building located on the south side of Bay Street and the preaeration and sedimentation buildings, postchlorination building and maintenance building on the north side.

### Sewage Treatment

The plant provides conventional primary treatment consisting of prechlorination, screening, grit removal, preaeration, primary sedimentation, postchlorination, and dechlorination. Due to the residential nature of the area where the plant is situated, all treatment units are housed for odor control.

### Emergency Bypass

The original design for the North Point WWTP is for a peak flow of 150 MG which has an overflow rate of 2200 gal/ft$^2$/day. To consistently meet NPDES permit limits for settleable solids the treatment capacity must be lowered to a peak flow of approximately 135-140 MGD with an overflow rate of 2,000 gal/ft$^2$/day with all the sedimentation tanks in service. The "AC" for the NP district is about 5,700. Thus at 150 MG peak WWF and 60 MG ADWF, the remaining 90 MGD is equal to 0.02 inches per hour (iph). Initially all plants, conveyances and appurtenances were designed to handle the larger of either ADWF + 0.02 iph rainfall, or PDWF + 0.01 iph rainfall.

Bypassing is accomplished by throttling a 72 by 72-inch inlet gate to the plant. It has been the practice to throttle depending upon the number of sedimentation or grit channels in service, i.e., 27 MG for each grit channel in operation. Efforts are made to keep all facilities in operation during the rainy winter months.

Evaluation of plant records indicate that there have been periods when the peak flows have reached 185 MGD. This excessive flow rate resulted in solids washout over the weirs of the sedimentation tanks.

Plant records also show that during storm weather throttling has occurred with flow rates in the 80-100 MGD range. This is due to the clogging of the mechanical bar screens with rags and debris. The mechanical bar screens are of the straight-line front-clean front-return type provided with one cleaning rake. To prevent grit from settling in the screen channels, compressed air is injected through diffuser plates both in front and behind the bar screens. These screens require constant attention during storm weather due to the large amount of screenings retained. The cleaning rake tends to ride over the screenings thereby failing to engage the bar screen. To prevent this, operators have to use wooden poles to force the cleaning rake in position as it reaches the channel bottom.

Recently, operating personnel have attempted to run the pumps at the 17' level instead of the usual 19'-21' level during storms to reduce an upstream flooding problem. Because of the loss of pumping efficiency, pumping is limited to a maximum of 135 MGD at which rate throttling occurs. This practice is being re-evaluated.

In case of a power failure a separate 72 by 72-inch inlet gate closes automatically and all the flow is bypassed to the bay. The hydraulic system for the inlet and throttling gates operates from the plant high pressure water system. It takes approximately 6 minutes for the gates to close fully under emergency conditions.

Screenings

After passing through the throttling sluice gate the flow is divided into four channels each provided with a 60 by 60-inch hydraulically operated inlet sluice gate, a 5-foot wide manually cleaned coarse bar rack and a 10-foot wide mechanically cleaned bar screen.

The inlet gates are used to select the in-service channel. The coarse bar racks extend only about two feet below the sewage surface at design flow. Their purpose is to protect the mechanical bar screens from damage caused by large floating debris which often finds its way into the incoming sewer. The mechanical bar screens run continuously when they are in service. Screenings are brought up from the bar screen by the cleaning rake and deposited into 20 cubic foot capacity storage ducts. Truck loads of grit and screenings are hauled to the city dump daily.

Grit Removal

Immediately after passing through the fine screens, the incoming sewage flows into the grit chambers. Each grit chamber is directly connected to a screen channel thereby requiring these two process elements to operate as a single unit.

Each of the four grit chambers is 96 feet long and 10 feet wide. Chamber depth varies in direct relationship to flow and is controlled by a 4-foot Parshall flume at the downstream outlet from the chamber. Each flume measures the flow through the chamber and operates with free discharge under all hydraulic flow conditions. A hydraulically operated sluice gate downstream of each Parshall flume provides a means of isolating each chamber from the system.

Settled grit is moved to the inlet end of each chamber by continuous chain flights which operate along the entire bottom of the chamber. At the inlet end of the chamber a screw conveyer picks up the grit and raises it to the operation floor level and dumps it into a sluice trough from where it is flushed to one of two grit collection sumps. Flights and screw conveyers operate continuously whenever the grit chamber is in service. Each grit collection sump serves two grit chambers and is located next to the outside chamber of each pair.

Normally at least two grit chambers are in service. When the flow entering the treatment plant reaches approximately 60 mgd a third unit is manually started by opening its inlet gate. If flow continues to increase, the fourth unit is placed in service when the flow reaches approximately 82 mgd. Equal flow distribution is attempted by throttling the inlet gate to each combination bar screen-grit chamber unit.

To prevent development of septic conditions in a grit chamber when it is out of service, compressed air is injected along its entire length through a system of 3/8-inch diffusers. Compressed air is supplied by five blowers with a total capacity of 2,500 cfm. In addition to supplying the air required for the grit chambers, these blowers also supply the air required by the diffuser plates located on either side of the mechanical bar screens.

## Grit Disposal

Grit disposal is achieved by pumping the grit from the collection sumps to grit washers that in turn deposit it into storage bins from which it is hauled to the city dump.

Adjacent to each grit collection sump is a dry well where two grit pumps are located. The grit pumps are constant speed units. Grit pump operation is controlled by a timer. A flow controlled valve admits water into the sump when the level drops below a preset elevation.

Grit pumps discharge grit slurry from the sumps into two grit washers of the reciprocating rake type. Washed and dewatered grit is dumped into two 300 cubic foot storage bins from which it is loaded in trucks and hauled away for disposal. Overflow from the grit washers is returned to the plant influent upstream of the coarse racks.

## Influent Pumping

Sewage leaving the grit chamber Parshall flumes flows via a 10-foot wide concrete channel to the receiving well of the influent pumping station located in the basement of the administration building. The structure is of the "wet-well" design generally associated with the use of constant speed pumps.

The receiving well is divided into two 111 by 43.5-foot sumps, east and west, with a combined storage volume of about 900,000 gallons. Originally, both sumps were equipped with scum skimming and grit removal systems. Scum and grit pumps are still used, but the continuous chain grit scrapers were removed in 1965. Design modifications for the grit scrapers have been tried but have not proved successful. The sumps are skimmed daily and the scum is pumped to the Southeast plant via the cross-town sludge main. Periodically, the sumps are drained and washed down. The sand is pumped back to the headworks.

The five raw sewage pumping units are of the mixed flow type and are located in a 6,000 square foot room approximately 36 feet below ground level. Four of the units are dual speed with two having a capacity of 15/30 mgd and two having a capacity of 20/40 mgd. The fifth unit is constant speed having a capacity of 50 mgd. The pumps are arranged so that one 15/30 mgd and one 20/40 mgd pump are connected to each sump while the 50 mgd unit can pump from either sump through a double gate arrangement. Grit, scum and sump drain pumps are located in a separate room at a lower elevation. Each influent pump discharges independently to a receiving structure on the north side of Bay Street through a 48-inch reinforced concrete pipe provided with a flap gate for backflow prevention. The scum and drainage pumps discharge into the channel that connects the receiving structure with the primary sedimentation tanks.

Under normal operating conditions both sumps are in service. At present, raw sewage pumping is controlled manually from the main control room situated in the administration building. The automatic control system originally provided was discontinued shortly after the plant was put in operation apparently due to surges caused by the starting and stopping of the pumps. Pumps are started and stopped according to flow variations trying to maintain sump level variations within a 2 to-3 foot range. Until recently the sump levels were held within the 19 to 21 foot range. The sumps will flood at 21.9 feet. To avoid large changes in output, the scum and sump drainage pumps are also used for raw sewage pumping.

Preaeration and Primary Sedimentation

Primary settling takes place in six combination preaeration-sedimentation tanks. Tanks are divided into two groups of three and housed in separate buildings. Each tank is 233 feet long, 38 feet wide with an average depth of 10.7 feet at the design flow of 65 mgd. Detention time at design flow is 2 hours.

The first 74 feet of each tank is provided with four longitudinal rows of air diffusion plates for preaeration of the incoming sewage prior to sedimentation. At design flow conditions the detention in this section of the tank is approximately 30 minutes. Compressed air is supplied by five positive displacement blowers rated at 870 cfm each.

Effluent sewage is collected from each primary sedimentation tank through four metal troughs provided with 90 degree V-notch weirs on both sides. Each trough has a weir length of approximately 138 feet and extends approximately 86 feet toward the influent end of the tank.

Each tank is equipped with two longitudinal sludge collectors and a cross collector for sludge removal. All are of the continuous chain and flight type. Longitudinal collectors run the entire length of the preaeration-sedimentation tanks. The longitudinal collectors transport settled sludge to the effluent end of the tank where a cross collector moves it to a 5-foot square collection hopper. The raw sludge pump takes its suction from the hopper. Both longitudinal and cross collectors run continuously when a preaeration-sedimentation tank is in service. Surface scum which accumulates on the surface of the sedimentation tanks is forced by water sprays into the skimming troughs located 100' from the influent end of the tanks. This scum is pumped to the

Southeast plant. The scum from the main sumps is no longer pumped to the sedimentation tanks. Skimming troughs are of the tipping trough types and are manually operated. Under normal conditions, all six tanks are in operation. Each sedimentation tank is taken out of service every year for inspection and minor repairs; each tank requires about one week. Every year two sedimentation tanks are completely overhauled. Over a three year period all tanks will have been rechained, etc. The average chain life at the North Point WPCP is about 4 years. It requires approximately 25 working days to overhaul each tank.

## Chlorination

Prechlorination is provided before the flow enters the plant. This is primarily for odor control. Since the dechlorination facilities were installed in 1975, the North Point Plant has been forced to rely on the chlorination of raw sewage in order to achieve disinfection of the effluent. The effluent disinfection system had to be abandoned because the contact time between the point of chlorine application to that at dechlorination was about 4 minutes.

Chlorine for disinfection is now applied at two points: (1) ahead of the main raw sewage pump sumps, and (2) ahead of the sedimentation tanks.

Chlorine is received in 55 ton tank cars. A 55 ton storage tank is also provided. Chlorine is fed by 5-8000 lb/day chlorinators and evaporators. Chlorine is injected into the sewage by PVC diffusers. No mixing is provided. Chlorine application is limited to approximately 150 lb/day feed rate ahead of the sumps and 170 lb/day ahead of the sedimentation tanks. Feed rates higher than these result in "gassing off" and releasing eye irritating substances into the administration building or into the sedimentation tank buildings. The San Francisco Health Department, the State Health Department, and CAL/OSHA have conducted investigations of this problem.

Contact time through the sedimentation tanks varies from 0.5 hours (allowing for short circuiting) to 4 hours (at low a.m. flows).

Chlorination is flow paced controlled. Residuals are run hourly and the chlorine feed rates manual set. Residuals are very difficult to control due to the long contact time in the sedimentation tanks.

The bacteriological samples are taken from a channel just downstream from the combined flow of the sedimentation tanks.

## Dechlorination

Sulfur dioxide is delivered in 20 ton tank trucks and transferred into one of two 45 ton storage tanks. Sulfur dioxide is fed by three 6,000-lb/day sulfonators and evaporators. The sulfur dioxide is injected into the effluent by PVC diffusers in the post chlorination building. Control is feed forward residual flow placed. Chlorine residual tests are performed hourly and the chlorine feed is adjusted as necessary.

At the present time, liquid chlorine and liquid sulfur dioxide are being phased out. Sodium hypochlorite for disinfection and sodium bisulfite for dechlorination will be used. The hypochlorite facilities will consist of five 18,000 gallon storage tanks, 2 prechlorination feed pumps with a range of 9.6 to 96 gph. Feed rates will be set manually and flow paced controlled. Two 30-hp flash mixers will be provided at the presedimentation injection point. No chlorination will be provided before the main pump sumps.

The dechlorination system consists of three 4042-gallon storage tanks and 2 feed pumps with a range of 30.6 - 306 gph. Control will be feed forward/residual/flow paced. Sodium bisulfite will be injected at the same point as sulfur dioxide.

## Effluent Disposal

Plant effluent is measured in a 6-foot throat Palmer Bowlus flume located in the effluent channel just upstream of the chlorine contact tank. Turbulence through the flume mixes the chlorine with the effluent. From the chlorine contact tank the plant effluent flows over a 14-foot wide weir into an 8-foot reinforced concrete pipes. Each 6-foot line in turn branches into two 48-inch cast iron outfalls. These four lines discharge the effluent into San Francisco Bay approximately 10 feet below mean lower low water. Two outfalls are suspended under Pier 33 and two under Pier 35. All outfalls end in a 45 degree elbow about 800 feet offshore.

## Solids Treatment

The North Point plant does not include facilities for the treatment and disposal of any of the solids removed during the sewage treatment process. Sludge and scum removed in the primary sedimentation tanks are pumped six miles through a 10-inch diameter force main to the Southeast plant. At the present time the average flow of sludge pumped from the North Point plant to the Southeast plant is approximately 850,000 gpd at a solids concentration of about one percent.

Sludge and Scum Removal

Raw sludge is removed from the sedimentation tanks by six centrifugal pumps. Each raw sludge pump transfers the sludge from the sedimentation tank collection hopper to one of two sumps located at the effluent end of the preaeration and sedimentation buildings.

Each raw sludge pump was originally rated at 300 gpm and driven by a variable speed driver. At present, each pump is run only at constant speed. Pumps have their own independent discharge pipeline to the sumps and each pipeline is provided with a Venturi flow meter.

Raw sludge pump operation is sequential and is manually controlled from the sludge control center. During normal operation, two raw sludge pumping units run simultaneously. When the operator observes that the sludge is thinning out, he switches to the next two units.

Occasionally, depending on raw sludge concentrations, a third unit is put on line. When this occurs, the output of the three units exceeds the capacity of the disposal pump and sludge overflows from the transfer sumps to the influent sewer through a 16-inch overflow pipe.

Scum skimming troughs in the three sedimentation tanks in each sedimentation building are interconnected. Scum collected in the troughs is flushed to a sump located between the sedimentation buildings. The skimming troughs can be isolated by closing a slide gate at the sumps. A scum pumping unit, rated at 300 gpm, is provided at each sump. Scum from the sumps is pumped directly to the suction line of the sludge disposal pump which is in service. The scum removal operation is performed manually and independently of raw sludge pumping operation. When the scum pumps are discharging into the sludge disposal pump, its sludge pumping capacity decreases and the sludge sump level raises.

Solids Disposal

Sludge and scum are pumped to the Southeast plant by two dual speed sludge disposal pumps having capacities of 1050/600 gpm. The pumps are interconnected so each can pump from either sump. A venturi type flow meter is provided in the common discharge line from the pumps.

Under normal operation, one disposal pump runs continuously at low speed unless there is an obstruction in the 10-inch force main. The pump is speeded up when it is necessary to clear the line. Once a week, usually on Monday morning, a cleaning tool is inserted in the force main and the pump is run at high speed until the tool is recovered at the Southeast plant end of the line.

## Power and Control

Power is supplied by Pacific Gas and Electric Company. There is no source of emergency power and, as a consequence, the treatment plant has to be shut down in the event of a power failure.

Control of the treatment process is performed from control centers located in the pretreatment building, administration building and sludge control area. Station No. 1 in the pretreatment structure controls the operation of the main and throttling gates, fine screens, and grit tanks. Raw sewage, grit, scum and drainage pumps in the influent pumping station are all controlled from Station No. 2 in the administration building. Preaeration blowers, sludge collectors and raw sludge and sludge disposal pumps are controlled from Station No. 3 located in the sludge control center.

Indicators and recorders for the monitored processes are housed in the control centers. All treatment process operation, with the exception of chlorination, is manually initiated from these stations.

## Treatment Plant Personnel

The North Point plant has an operation and maintenance staff of 42. The plant is attended 24 hours a day. The following table lists the classes and numbers of personnel employed at the North Point plant during the 1978-1979 fiscal year.

Class and Number of Operating Personnel
North Point Plant

| Class Title | Number |
|---|---|
| Sewage treatment plant superintendent | 1 |
| Chief stationary engineer | 1 |
| Senior sewage treatment chemist | 1 |
| Sewage treatment chemist | 3 |
| Senior clerk typist | 1 |
| Senior stationary engineer | 6 |
| Stationary engineer | 22 |
| Truck driver | 1 |
| Janitor | 1 |
| CETA | 1 |
| General laborer | 4 |
| Total | 42 |

## SOUTHEAST WATER POLLUTION CONTROL PLANT

The Southeast Water Pollution Control Plant completed in 1951 serves a dry weather flow area of approximately 10,200 acres. The plant serves the heavy industrialized area situated in the southeast corner of the City of San Francisco. The tributary area also includes some residential developments.

The Southeast plant can be more accurately described as two separate treatment plants at a single site divided by a public artery, Jerrold Avenue. One is a conventional primary treatment plant serving the southeast tributary area. The other provides solids treatment both to the sludge and scum pumped from the North Point plant and to the raw sludge and scum removed at the Southeast primary plant.

### Sewage Treatment

The Southeast primary treatment plant consists of prechlorination, screening, influent pumping, grit removal, preaeration and primary sedimentation, postchlorination, dechlorination and effluent disposal. Sewage solids, removed both at the Southeast and North Point plants, are subjected to gravity thickening, digestion, elutriation, chemical conditioning, and vacuum filtration prior to disposal. All the treatment units, with the exception of the grit tanks, are housed for improved appearance and odor control. The main plant structures include a headworks building, two sedimentation buildings, a sludge control building, administration and maintenance buildings, and a chlorination building. An effluent pumping station is located at a separate site between Third Street and Arthur Avenue.

### Emergency Bypass

Initially all STP's, PS's and interceptors were sized to handle the larger of either:

ADWF + 0.02 iph rainfall, or
PDWF + 0.01 iph rainfall

whichever was larger.

This rule, however, was not consistently applied and thus each of the three plants have factors which determine the plant capacity.

The Southeast plant is limited to a peak capacity of between 32-38 MGD by the grit tank-influent system. The facility at an overflow rate of 2,000 gal/ft$^2$/day has a sedimentation tank capacity of approximately 70 MGD. During normal operation only two sedimentation tanks are in service. The "AC" for the district is 4,700. Thus at ADWF of 18 MGD and 36 MGD peak, the 18 MGD is equal to 0.006 inches per hour.

The treatment plant capacity during wet weather is based on a rainfall intensity of 0.02 inches per hour. This provides sufficient capacity to treat all dry weather flows. Storm flows in excess of plant capacity are bypassed directly to San Francisco Bay. Bypassing takes place by throttling the inlet gates. In case of a power failure these gates close automatically and all the incoming flow is bypassed to the Bay. Other conditions that may cause emergency flow diversion are breakdowns in the bar screens, influent pumps, grit removal tanks or sedimentation tanks.

The last month of record (February, 1980) the inlet gates were throttled 375.5 hours or an average of 12.9 hours per each day of the month. Maximum flow recorded during the month ranged from 31 to 42 MGD. Throttling causing flow diversion resulted largely from rainfall, however, evaluation of the operating records show malfunction of the bar rakes and also a power failure necessitated flow diversion.

It must be noted that under wet weather conditions the Northpoint and Southeast plants do not bypass in the conventional sense. They throttle to the maximum hydraulic capacity available and thus the combined system overflows at diversion structures upstream. Bypassing also occurs as the P.S.'s and interceptor systems are overloaded.

The number of hours and the number of days the influent flow was limited by throttling the inlet gates increased during each of the last three years of record. From March 1, 1977 through February, 1978 the inlet gates were throttled 1087 hours on 81 days. The inlet gates were throttled 1433 hours on 98 days from March 1, 1978 through February, 1979. For the latest 12 month period of record from March 1, 1979 through February 1980 the inlet gates were throttled 1495 hours on 105 days.

The periods of time for limiting the flow to the plant by throttling the inlet gates generally corresponded with the amount of rainfall, i.e., the greater the amount of rainfall received the more hours throttling occurred. For example, the inlet gates were throttled more hours (400) during the month of the heaviest rainfall (6.2 inches) in January, 1978.

The number of hours and the number of days the head gates were completely closed preventing any flow to the Southeast plant ranged from 30.95 hours for the period from March 1, 1977 through February, 1978 to 95.6 hours for the 12 month period from

March 1, 1978 through February, 1979. The plant was shut down for 67.4 hours for the 12 month period from March 1, 1979 through February, 1980. The days the head gates were completely closed for varying periods of time ranged from 18 days for the 1977-1978 period to 26 days for 1978-1979 to 25 days during the 1979-1980 period. The complete closing of the inlet gates resulted principally from interruptions of utility lines and/or damage to major treatment units.

Screenings

After passing through an influent chamber where chlorine is applied, the flow is divided into two channels located approximately 23 feet below ground level. Each channel is provided with a 5-foot diameter hydraulically operated sluice gate, a 6-foot wide manually cleaned coarse bar rack and an 8.5 foot wide mechanically cleaned bar screen.

Normally, only one inlet channel is kept in service. The large floating debris which is retained in the coarse rack is removed manually by lifting the rack assembly to an operation platform approximately 3.5 feet below ground level. After passing through the coarse screens, the incoming sewage flows through the original grit chamber and measuring flumes, now abandoned, and the mechanical bar screens. The mechanical bar screens are of the front-cleaned, back-return type provided with 18 cleaning rakes. The screens can be either operated on time control or run continuously. Continuous is the normal mode of operation during dry weather, while manual control is the normal wet weather operation mode. Screenings retained on the bar racks of the mechanical bar screens are lifted 57 feet to the headworks building roof by the cleaning rakes and dumped onto a covered belt conveyor. The belt conveyor carries the screenings to a storage bin from where it is hauled by truck periodically to the City dump.

Influent Pumping

Sewage leaving each mechanical bar screen flows into a small separate sump. A constant speed 11,700 gpm pump and a variable speed 18,500 gpm pump are connected to each sump through a common 33-inch suction line. The raw sewage pumps are located in a 1300 square foot room 36.5 feet below ground level.

The two sumps are interconnected with a sluice gate to provide standby for each other. Each influent pump discharges independently to the pump discharge chamber ahead of the grit removal tanks. The discharge lines from the constant speed units are 24 inches in diameter while the discharge lines from the variable speed units are 30 inches in diameter. Each discharge line is provided with a flap gate for backflow prevention.

Normally, the variable speed pumps run continuously with speed changing according to water surface variations in its related sump. With increasing water level, the constant speed pump starts and runs until the water surface drops to about 6 feet above the lower level in the screen channel.

Overflow from sludge thickening and elutriation tanks is returned to the pump discharge chamber.

Grit Removal

Grit is removed in two rectangular tanks, 40.5 feet long and 10 feet wide with a depth of about 13 feet at the present average dry weather flow of approximately 19 mgd. These units replaced the original grit chambers and were designed to operate as aerated grit chambers. The aeration system has been abandoned, however, and the tanks now operate as straight-through flow units.

Sewage from the pump discharge chamber flows through a connecting channel and enters each grit tank separately through two isolating cutoff gates. Effluent from the tanks passes over a full width transverse rectangular weir, free falling into a common collection channel and then to the sedimentation tanks.

Settled grit is moved to a collection hopper located at the inlet end of each tank by continuous chain flights which operate in a trough running along the entire bottom of the tank. Normally, both grit removal basins are in operation and collectors run continuously.

Grit Disposal

Grit disposal is accomplished by pumping from the collection hopper to a separator-dewatering unit. Three grit pumps and two detritor-dewatering units are included in the system.

The three grit pumps are located directly beneath the grit tank influent channels. The pumps are motor driven, constant speed units. Suction lines are manifolded to allow the middle pump to act as a standby for the other two units.

The dewatering units are mounted on the roof of the headworks building. Dewaterers are of the detritor type. Overflow from the dewatering units is returned to the headworks through the plant drainage system. Washed grit is dumped directly into the same hoppers used to store screenings and is hauled to the City dump each day.

Primary Sedimentation

Discharge from the grit tanks normally flows to four combination preaeration-sedimentation tanks. These units are arranged in pairs in two separate buildings.

Chemicals are used to improve primary sedimentation efficiency. Ferric chloride is added in the influent channel upstream of the bar racks prior to grit removal and the polymer is introduced ahead of the Parshall flumes, downstream from grit removal. Records show the ferric chloride dosage range from 25 to 35 mg/l (as $FeCl_3$) and the feed range for the polymer is from 0.2 mg/l to 0.6 mg/l.

Originally each preaeration-sedimentation tank was 262 feet long, 37 feet wide and had an average depth of 11 feet at present ADWF. After modification, the tanks are only 247 feet long, with the last 15 feet being abandoned.

The first 79 feet of each tank is provided with four longitudinal rows of air diffusion plates for preaeration of the incoming sewage prior to sedimentation. In the modified tanks, the diffuser plates were replaced by spargers. Compressed air for diffusers is supplied by four centrifugal blowers, each rated at 1520 cfm. Blowers are located on the ground floor of the headworks building.

Effluent is collected from each primary sedimentation tank through four metal launders provided with baffles on both sides. Effluent is collected through a system of vertical pipes located along the launder bottoms. Each launder has a weir length of approximately 73 feet, extends aproximately 92 feet toward the influent end of the tank and discharges through a 30-inch diameter submerged pipe into a common collection channel. Each discharge pipe is equipped with a backflow preventing flap gate at its point of discharge. Effluent is collected through a system of 56, 3-inch vertical pipes spaced at 16 inches and located along the bottom of the launders. Prior to the modification, all preaeration-sedimentation tanks were equipped with two full length longitudinal collectors and a cross collector for sludge collection. The cross collector was located at the effluent end of each tank. Modifications relocated the cross collector to the approximate middle of the tanks with the result that each tank has two sets of much shorter longitudinal collectors and the effluent end collector moves the sludge away from instead of towards the effluent end of the tanks. All sludge collectors are driven by a single common motor for each tank. Drives in the modified tanks are provided with individual speed adjustable hydraulic motors for each collector.

Scum collected on the water surface of the existing sedimentation tanks, upstream of the effluent launders, is moved by water sprays to a tipping trough located just downstream from the preaeration segment of each tank. Scum rising to the surface in the vicinity of the effluent launders is isolated from the weirs by redwood outboard baffles and collected near the tank end wall by manually adjustable skimming troughs provided for each tank. Modifications eliminated all existing skimming facilities and replaced them with two full width scum skimmers located at both ends of the effluent launders.

The unit at the upstream end of the launders is an electrically driven, double rubber blade rotating skimmer. The one at the downstream end is the manually operated tipping trough type.

Under normal conditions, two tanks are in operation. Tanks are taken out of service at annual intervals for maintenance and repair.

Chlorination

Chlorination facilities provide for prechlorination of influent sewage for odor control and hydrogen sulfide suppression and for post-chlorination of plant effluent for disinfection.

These facilities include 5 hot water type evaporators and 5 V-notch chlorinators each with a capacity of 8,000 lb per day. Evaporators and chlorinators are piped to operate as intergral units. One chlorinator is used for prechlorination and the others for postchlorination. All facilities are housed in a separate chlorination building. Chlorine storage is provided by 55-ton capacity tank cars located adjacent to the chlorination building. Liquid chlorine is delivered by these railroad tank cars to a spur track within the plant site.

Chlorine solution for prechlorination is applied through diffusers in the effluent channel just outside the sedimentation buildings. Dosage is set between 250 and 350 lb. per million gallons.

Dechlorination

Dechlorination of the SE effluent is continuous to provide an effluent residual of 0.0. $SO_2$ is delivered to the plant via 20 ton truck loads and stored in a 40 ton steel tank.

Liquid $SO_2$ is passed through one of three 6,000 lb/day evaporators and one of three 6,000 lb/day V-notch sulfonators. Gas then goes by 4" PVC line to the influent channel at the effluent Booster Pump Station. No mechanical mixing is provided and only the channel turbulence coupled with the diffuser system is available for mixing.

Detention time from point of $Cl_2$ application to $SO_2$ application is about 20 minutes at 30 MGD flow. The bacteriological sample (Coliform MPN) is manually grabbed from the entrance to the Booster Pump Station just downstream of dechlorination.

The chlorination-dechlorination system is being replaced by liquid NaOCl and $NaHSO_3$ systems. The NaOCl system will be much the same as the existing $Cl_2$ system except the liquid will be directly added to the diffusers under the effluent weir. The $NaHSO_3$ will be added about two blocks upstream of the Bay Pumping Station and all mixing will by in-channel turbulence.

Effluent Pumping

After passing over a lateral measuring weir, plant effluent is chlorinated and flows into a 6-foot diameter reinforced concrete sewer. The effluent sewer is approximately 2,900 feet long and terminates in the outfall booster pumping station built in 1968. Effluent flows into two 29.5 by 10-foot sumps, each provided with a 48 by 48-inch hydraulically operated inlet sluice gate. The sumps are separated by an overflow chamber that allows effluent to flow directly by means of a 6-foot pipeline into Islais Creek when the pumps are inoperative and the effluent cannot flow through the outfall by gravity. Two effluent pumps are housed in a 1,050 square foot room located directly above the receiving sumps, one pump for each sump. This room also houses the station control panel and the master hydraulic power unit. Pumping units are motor driven, variable speed mixed flow pumps. Each pump is capable of delivering approximately 32,000 gpm when operating at a maximum speed of 555 rpm against a head of approximately 32 feet. Each pump discharges into a 42-inch steel pipe to a 54-inch manifold. Two 30-inch gravity lines also interconnect the sumps to the 54-inch manifold. The manifold in turn divides into separate 42-inch and 36-inch lines which cross Islais Creek as a two-barrel inverted siphon. Pump discharge and gravity interconnecting lines are provided with hydraulically operated control valves. One pump is operated as a standby for the other pump.

When plant effluent can no longer discharge by gravity through the outfall to San Francisco Bay, the level in the pumping station sumps rises until a preset elevation is reached at which time one pump starts at low speed, the pump's discharge line control valve opens and the 30-inch gravity interconnecting line control valves close. Pump speed changes with flow variation to maintain a constant sump level. When the level drops below the minimum set elevation, the pump discharge line control valve closes, the pump stops, the 30-inch gravity interconnecting line control valves open and the plant effluent again flows by gravity through the outfall to the bay.

Effluent Disposal

From the outfall booster pumping station, the effluent flows through the Islais Creek inverted siphon and into a special manhole where the plant outfall begins. The outfall consists of approximately 4,250 feet of 54-inch diameter pipe and a 300-foot submarine diffuser section. The diffuser section reduces in size from 54 inches to 16 inches and is provided with 18 T-shaped diffusers, each with two lateral ports. The vertical section of each diffuser is about 8.5 feet long and 10 inches in diameter. The laterals are each 4 feet long and 6 inches in diameter.

Solids Treatment

As stated previously, the Southeast plant is provided with facilities to treat not only the sewage solids removed during the primary treatment process at the plant site but also the sludge that originates at the North Point plant. The processes include gravity thickening, sludge digestion, elutriation, digested sludge chemical conditioning and sludge dewatering.

Sludge and Scum Removal

Modifications made to the sedimentation tanks completely revised sludge and scum removal facilities. The modifications included construction of two sludge and scum removal facilities for these tanks. The modifications include construction of two sludge pumping stations and new scum collection system at each of the tanks. Each pumping station contains two sludge removal pumps with short suction pipes connecting to each tank's sludge hopper. The sludge removal pumps discharge into the new scum collection system troughs and the sludge and scum combination flow by gravity to two transfer sumps in the new sludge pumping station located between the two sedimentation buildings. Each transfer sump is equipped with a multi-bladed turbo-mixer. Two sludge transfer pumps are provided at each sump and pump the sludge and scum to the sludge thickeners through a new 6-inch force main.

## Sludge Thickening

Sludge from the North Point plant is discharged directly to the sludge thickening facilities. The flow is measured through 6-inch Parshall flumes prior to being discharged to the thickening tanks. The Southeast sludge is discharged directly to #10 digester.

Sludge thickening facilities consist of two gravity separation type thickening tanks and a thickened sludge pumping station. Each sludge thickener is 91 feet long by 18 feet wide and has an average water depth of approximately 12 feet. Tanks are provided with longitudinal sludge collectors of the continuous chain and flight type. Collectors run the entire length of each tank. The longitudinal collectors move the thickened sludge to two separate scum skimmers. One is a transverse continuous chain and flight type skimmer located at the inlet end of the tank while the other is the manually operated tipping trough type located near the effluent end of the tank. The transverse inlet skimmer operates intermittently and discharges directly into a large scum collection sump. Scum at the outlet end of the tank is removed manually once a day and flows by gravity to the same sump.

Thickening tank overflow is collected in a full width transverse trough near the outlet end of the thickeners. The overflow flows through a 22-inch return line to the raw sewage pump discharge chamber.

A sludge transfer pumping station is located at the inlet end of the thickeners. The station contains a pump room and a control room. The control room houses the process control and instrument panel and has direct access to the thickening tanks walkways. Two centrifugal pumps are provided in the pump room to pump thickened sludge to digester No. 10. The pumps are interconnected to be able to pump from either tank. Pump operation is timer controlled. Normally, only one pump is used to transfer sludge to the digester.

Scum from the collection sump is pumped manually at least once a day to the digesters using the sludge pumps. If either sludge or scum density is such that it is difficult to pump, the two pumps are connected in series. This operation is also manually performed. Total solids content of the thickened sludge and scum averages approximately 4-5 percent.

## Sludge Digestion

The Southeast treatment plant is provided with ten digesters divided in two groups of five tanks, each arranged around a central control building. Each tank is 100 feet in diameter with a side water depth of 20.5 feet and is provided with a floating cover. Digesters were originally designed as standard rate tanks, but four of them, tanks Nos. 6, 8, 9, and 10 have been converted to high rate operation by the installation of internal gas mixing systems. Each control building houses sludge circulation and transfer pumps, heat exchangers and control panels.

Present operation involves the normal use of only the four high-rate digesters with the remaining digesters in the group not available for standby service. Sludge can also be fed to the other group of five tanks but this is done only on an emergency basis. All sludge is pumped to #10.

Sludge from digester No. 10 is pumped to digesters Nos. 6, 8, and 9 every day in sequence, approximately three hours to each tank. Digested sludge overflows 6, 8, and 9 and goes by gravity to the digested sludge thickening tanks. Thickened digested sludge is pumped to digesters 4 and 5.

Solids Mixing

Mixing of the digester contents is accomplished by injecting compressed sludge gas through diffusers located at the tank bottom. Gas is compressed by three rotary type gas compressors, to 15 psi for injection into the digesters. Digester contents are also mixed by the sludge recirculation pumps operating in conjunction with the heat exchangers and the discharge piping ring around each high-rate digester.

Gas System

Sludge gas produced in the digestion process is metered and then goes to the gas compressor building where it is compressed to a pressure of 28 pounds per square inch. Gas is used for digester contents mixing and as fuel for two steam boilers. Excess gas is burned in four waste gas burners. A gas holder provided in the original installation is no longer used.

Heating System

The temperature of the digestion tanks contents is maintained at approximately 95°F. Digesting sludge is circulated continuously through spiral heat exhangers using vertical centrifugal pumps. Hot water provided by steam-to-water heat exchangers is used to heat the spiral heat exchangers. Heated sludge may be returned to any of 20 different points of digesters 6, 8, 9, and 10. Return points in digesters 6, 8, 9, and 10 are changed in sequence every hour.

## Solids Conditioning and Disposal

The final phase in the solids stabilization process involves the preparation of the digested sludge for its ultimate removal from the treatment plant.

### Elutriation

Digested sludge is thickened prior to vacuum filtration in tanks. The tanks are divided into two batteries of four each and are housed in the filtration building. Each tank is 60 feet long by 16 feet wide with an average water depth of approximately 12.5 feet. Each tank is preceeded by a 4 by 4-foot mixing box. Boxes are arranged in pairs and each is equipped with a mechanical mixer. Each tank is provided with a longitudinal sludge collector of the continuous chain and flight type. Four tanks, the two intermediate ones in each battery, are also provided with scum skimmers of the rotating blade type. Sludge transfer and scum pumps are located in an equipment gallery located underneath the filter room next to the inlet end of each tank.

Under normal operation, the thickening system is operated on a two-stage mode. Generally, only one group of tanks is used. Thickened sludge is pumped to digesters 4 and 5 for holding prior to vacuum filtration.

### Filtration

Dewatering of the conditioned sludge is accomplished by four vacuum filters located in a large room adjacent to the elutriation tanks. The filters are 11.5 feet in diameter and 16 feet long. The coil-type units are capable of dewatering 150 tons of solids per day. Each filter is provided with a small sludge flocculation tank adjacent to it where coagulants are added prior to filtration. Filter auxiliary equipment includes three vacuum pumps, four filtrate pumps, two air blowers and three polymer mixing and storage tanks. The vacuum filter operation is continuous except for a washdown and start-up period of two to three hours every morning. Normally, two of the larger filters are used.

Digested sludge is fed to the filter from digesters 4 or 5. Filter cake is carried in belt conveyors and stored in two bins from which it is trucked away to a land fill. All trucking is done in the morning hours. Bins have the capacity of storing 100 tons. Present cake production is approximately 15,000 tons per year at an average solids concentration of 20 percent.

Power and Control:

Plant power is supplied by Pacific Gas and Electric Company. There is no source of emergency power, consequently the treatment plant has to be shut down in the event of a power failure.

Control of each phase of the treatment process is performed at separate control centers located throughout the plant. There are control panels in the headworks building, sedimentation buildings, chlorination building, sludge control building, thickening building, digester control buildings, and filtration building. All treatment process operation is initiated from these control stations.

Treatment Plant Personnel

The Southeast plant has an operation and maintenance staff of 72. The plant is attended 24 hours a day. The following table lists the classes and number of personnel employed at the Southeast plant during the 1978-1979 fiscal year.

Class and Number of Operating Personnel
Southeast Plant

| Class Title | Number |
|---|---|
| Sewage treatment plant superintendent | 1 |
| Chief stationary engineer | 1 |
| Senior sewage treatment chemist | 1 |
| Sewage treatment chemist | 9 |
| Senior clerk typist | 1 |
| Senior stationary engineer | 6 |
| Stationary engineer | 40 |
| Apprentice stationary engineer | 2 |
| Truck Driver | 1 |
| Janitor | 1 |
| CETA | 3 |
| General laborer | 6 |
| Total | 72 |

## RICHMOND-SUNSET WATER POLLUTION CONTROL PLANT

The Richmond-Sunset Plant was completed in 1939 with a design peak wet weather flow (PWWF) capacity of 45 mgd. It was enlarged and modified in 1965 and 1971 to its present design PWWF capacity of 70 mgd. The plant is located in the southwest corner of the Golden Gate Park and serves a tributary area of about 10,600 acres, the development of which is almost entirely residential.

About 60 percent of the total flow to the plant arrives by gravity through two main interceptors. The remainder is pumped from the Mile Rock interceptor sewer by the Sunset pumping station to a receiving structure upstream of the plant overflow weir.

### Sewage Treatment

The plant provides conventional primary treatment consisting of screening, grit removal, primary sedimentation, effluent disinfection and dechlorination prior to its discharge to the ocean. Solids separated during settling are subjected to two-stage digestion, sludge conditioning and dewatering before disposal as a soil filler within the park. All the treatment units are housed in four buildings: pretreatment, sedimentation, administration and digester buildings.

### Sunset Pumping Station

The Sunset pumping station is incorporated into the treatment plant administration building. Incoming flow to the station is diverted from the 9 by 11-foot Mile Rock sewer through a 3.5-foot wide channel fitted with coarse bar racks. After passing through the bar racks, the flow enters a minimum sized receiving well. Modified and enlarged in 1964, the station contains three identical motor-driven variable speed centrifugal pumps and has a maximum capacity of 33 mgd. Each pump discharge is carried through a separate 20-inch force main to the plant headworks and each line is provided with a 14-inch magnetic flow meter. The three pumps are situated in the motor and pump control room approximately 17 feet below ground level. Access to the receiving well operating level, where the influent sluice gate and coarse bar racks are located, is through a sluice gate and coarse bar racks are located, is through a watertight door from this room. The hydraulic power unit for controlling the sluice gate is located in the receiving well.

Pump operation is automatically controlled by variations of sewage level in the sump as sensed and transmitted by means of a bubbler system. Pumps are programmed to start in sequence. The lead pump starts at minimum speed and increases its speed as the sump level rises until it reaches its maximum speed. If the sump depth continues to increase, a second pump starts and the two pumps operate at approximately the same pumping speed. In the event of a continuously rising water surface elevation, the third unit starts and the operation sequence repeats itself. Provisions are incorporated in the controls to throttle and finally close the influent sluice gate when the incoming flow exceeds the combined pumping capacity of the three units. The gate also shuts down during power failure. Pumps shut down with decreasing levels in the sump in reverse order to start-up.

Emergency Bypass

Bypassing in the Richmond-Sunset plant occurs at two locations: The overflow weir of the Sunset pumping station diversion structure in the Mile Rock sewer (weir crest elevation 0.0 feet City of San Francisco datum) when the flow exceeds the station capacity or upon power failure and (2) the overflow weir in the plant headworks bypass structure (weir crest elevation 21.3 feet) when the flow exceeds plant capacity. The influent sluice gate to the Sunset pumping station is throttled during periods of bypass at the Mile Rock sewer overflow weir. Throttling of the gate starts when the water surface elevation reaches the level of the overflow weir. Flows in excess of 33 MGD are bypassed to the Mile Rock outfall.

Without throttling, bypassing at the headworks overflow weir takes place when the total flow through the plant reaches approximately 70 MGD. At this time raw sewage overflows into a 6.5-foot wide channel, passes through a 4-foot throat Parshall flume and enters a 54-inch diameter bypass line that connects to the Mile Rock outfall. However, the maximum wet weather flows are throttled to 47 MGD.

The Richmond-Sunset plant at an overflow rate of 2,000 gal/ft$^2$ with all sedimentation tanks in service has a capacity of approximately 50 MGD. Using 20 MGD ADWF leaves 30 MGD for rainfall. With an "AC" of 5,000 the equivalent rainfall is 0.009 iph.

Provisions are available to chlorinate the headworks bypassed sewage. The point of application of the chlorine solution is immediately downstream from the measuring flume and the dosage will be varied in proportion to the flow. There are no facilities to chlorinate raw sewage bypassed at the pumping station diversion structure. Facility personnel state the reason the bypassed sewage is not chlorinated at this point is that 1300 feet downstream from the plant on the Mile Rock Outfall, the

Fulton Street Pump Station diversion structure will also overflow into the outfall line and no provisions are available to chlorinate at this point either.

## Screenings

The incoming sewage flows through a 6 by 5-foot influent channel past the overflow weir in the plant headworks bypass and is divided into three 36-inch diameter influent pipes each terminating in a 5-foot wide mechanically cleaned bar screen channel.

## Grit Removal

After passing through the bar screens, sewage flows into a common channel from which it enters four grit tanks through inlet ports provided with butterfly gates. The grit tanks were originally designed as grit and scum removal units, but the scum system was eliminated when the treatment plant was expanded in 1968. Each tank is 48 feet long and 10 feet wide at the top, with one wall sloping at a 45 degree angle to form a V-shaped cross section. Tanks are divided into four compartments by transverse baffles that extend approximately two-thirds the depth of the grit chamber.

Settled grit is moved to a hopper located at the end of the chamber by continuous chain flights which travel along the entire length of the tank.

The grit tanks have been slightly modified as part of the pretreatment building reconstruction project. These changes included new grit collectors and drives, new inlet butterfly gates, removal of a 5 by 3-foot portion in each transverse baffle, removal of a scum baffle at the tank's outlet end, and relocation of the aeration blowers. Also included is a 4-foot bypass line which connects to the Mile Rock outfall.

Degritted sewage leaves each tank by flowing over a full width weir. After passing over the weir, it is once again collected into a common channel and moved by gravity towards the sedimentation building.

## Grit Disposal

Material collected in the grit tank hoppers is pumped by four 200 gpm pumps to two grit concentration tanks. From the concentration tanks grit is lifted by two 300 gpm pumps to two combination cylcone/classifiers. Grit removed by these units is discharged into two storage bins. One of these bins is also used to store screenings. From the bins grit is hauled by truck to the city dump for disposal. Overflow from the cyclones and classifiers is returned to the grit tank pumps to discharge to either concentration tanks and the cyclone-classifier units to operate in series or parallel in combination with either grit concentration tank.

Primary Sedimentation

Primary settling takes place in five rectangular tanks housed in the sedimentation building. The first four tanks are identical units and were originally built as combination flocculation-sedimentation basins. A fifth tank was added in 1963 and the other four converted to conventional sedimentation basins. At that time, flocculation facilities were removed from the existing tanks. Each tank is now 135.5 by 33.5 feet with an average depth of 10 feet. Detention time at ADWF of 19 mgd is 2.1 hours. In January, 1980, the flocculation system was put back into service to alleviate settleable solids problems. A polymer (Percol 726) is used alone since trail tests with ferric chloride and polymer prove unsuccessful. The Southeast and North Point facilities add salt water (approximately 250 gpm for the S.E. plant) upstream of the facilities which enhances flocculation. The chloride level of the influent wastewaters at the Richmond-Sunset plant is low. This could be elevated by the addition of sea water, however, piers and other appurtenances are not available. Thus, ferric chloride used singularly or used in conjunction with a polymer does not appear to achieve good results until the ionic strength of the wastewaters are elevated.

Just prior to entering the sedimentation building an adjustable splitter gate divides the incoming channel flow into two parts. The splitter is adjusted so that three-fifths of the flow goes to the east battery of three tanks and two-fifths goes to the west battery of two tanks. Supernatant return from raw sludge thickening tanks is discharged upstream of the splitter gate. Automatic sampling takes place immediately upstream of the supernatant discharge. Incoming flow enters each sedimentation tank through one opening which is provided with an isolating gate and baffle.

Settled sewage is collected from each tank through four metal troughs provided with 90 degree V-notch weirs on both sides. Total weir length in each trough is approximately 83 feet and each trough extends about 43 feet toward the influent end of the tank.

Each of the four original tanks is equipped with two sets of double longitudinal sludge collectors and a single cross collector sludge removal. The fifth tank has only one set of double longitudinal collectors and cross-collector. The difference in arrangement is due to the fact that in the original four units the sludge hopper is located approximately 34 feet from the tank inlets between the original flocculation portion of the tank and the settling portion, while in the newer tank the hopper is situated directly next to the tank inlets. All sludge collectors are of the continuous chain and flight type. Longitudinal collectors run continuously, collecting and transporting settled sludge to the transverse valley where the cross-collector moves it to a small and deep hopper located at the side of the tank. From this hopper the sludge flows by gravity to the concentration tanks.

## Sludge Collection and Pumping

The original sludge pumping system was replaced by direct pumping from the sedimentation tanks hoppers to the digesters. Pumping is timer controlled and by Dorr-Oliver ODS pumps. The original gravity flow system to the thickening limits have been retained.

Scum which accumulates on the water surface is collected in scum troughs located upstream of the effluent launders. Each trough is equipped with rotating skimmers with two rubber blades. Scum is skimmed by the returning collector flights except in the first 34 feet of the older tanks, where water sprays are used for skimming. All rotating skimmers are electrically driven.

Under normal conditions, all five sedimentation tanks are kept in operation. Tanks are usually taken out of service once a year for routine inspection and maintenance. Sludge and scum lines are normally backflushed with No. 2 water once a shift.

## Chlorination

Chlorination facilities are provided for disinifection of the plant effluent and chlorination of raw sewage bypassed over the new headworks overflow weir. In March, 1980, sodium hypochlorite and bisulfite facilities replaced the gas chlorination and sulfur dioxide dechlorination facilities. The present hypochlorite system consists of three 10,000 gallon hypochlorite storage tanks with 3 positive displacement sumps each with a capacity of 25 to 450 gallons/hour. Flow indicator has a maximum range of 600 gal/hour.

Chlorine solution for effluent disinfection is applied through diffusers in a mixing chamber immediately upstream of the inlet to the 60-inch effluent line. The rate of chlorine application is presently controlled in response to variations in sewage flow. Chlorine residuals are controlled manually. $Cl_2$ feed is flow paced. Chlorine contact time is provided by the 60-inch effluent line and Mile Rock outfall sewer. At the present average flow of 19 mgd, the contact period is approximately 20 minutes.

Some problems with meters malfunctioning, adjustment of dosage rates and logistic ordering of the sodium hypochlorite and bisulfite have been encountered.

Previous chlorination facilities included three hot water type evaporators and two V-notch chlorinators. Evaporators and chlorinators were rated at 8,000 lb. per day. Chlorinators were fitted with 4,000 lb. per day orifices. A chlorine storage area provided space for 24 one-ton cylinders. Chlorinators and associated equipment and controls were housed in the chlorine equipment room located at the outlet end of the sedimentation building. Evaporators, storage cylinders and related piping occupied a covered open platform adjacent to the chlorinator room.

## Dechlorination

Dechlorination facilities, adjacent to the chlorination room, consisting of a 40-ton storage tank for sulfur dioxide, two 6,000 lb/day evaporators and two 6,000 lb/day sulfonators and control panel were replaced in March, 1980 by bisulfide facilities consisting of three 4,000 gallon storage tanks with 2 pumps each capable of delivering 210 gal/hour. Necessary metering and appurtenances are provided. The diffuser is located downstream in the Mile Rock Sewer below 48th Avenue and Cabrillo Street. This gives a chlorine contact time of over 20 minutes before $SO_2$ solution is added. The dosages are adjusted hourly after the chlorine residuals have been determined by the operators.

## Effluent Disposal

Plant effluent is measured in a 5-foot wide critical depth flume located near the junction of the 60-inch effluent line and the Mile Rock outfall sewer. After flowing through the flume, effluent drops into a junction vault and enters the outfall sewer. The 9 by 11-foot outfall discharges into the Pacific Ocean at the shore line near the entrance to San Francisco Bay, approximately 7,000 feet north of the treatment plant. The discharge is surface-shoreline without a diffuser system.

## Solids Treatment

As indicated previously, the Richmond-Sunset plant is provided with facilities for the treatment and disposal of all the solids removed during the sewage treatment process. Organic solids are first stabilized in anaerobic digestion tanks, then the digested sludge is conditioned by elutriation and coagulant addition, and finally it is dewatered by vacuum filtration and disposed of as a soil conditioner.

Sludge and Scum Removal

A new sludge removal system was recently installed. The concentration tanks (thickeners) are being eliminated and the solids will be pumped directly to the digesters.

Adjustment of pumping rates has proven difficult. At the time of the inspection, the old thickeners were still being used to determine the amount of sludge pumped. At the present time the average raw sludge flow to the digesters is approximately 100,000 gallons per day at a solids concentration of 2.0 - 2.5 percent.

Solids Digestion

Anaerobic sludge digestion takes place in two digesters with a combined volume of approximately 3,200,000 gallons. One tank is 100 feet in diameter with a fixed cover and the other is 80 feet in diameter with a gas holding cover. Both digesters are provided with external heat exchangers for sludge heating and with compressed gas diffusers for mixing of their contents. The digester control building, located between the digestion tanks, houses three sludge circulating pumps, two digested sludge pumps, two heat exhangers, two sludge gas compressors with their accessory equipment and both digester overflow boxes.

Digesters are normally operated as two-stage digesters with the larger tank acting as the primary digester and the smaller as the secondary. Raw sludge is pumped intermittently into the primary tank at two points which are alternated daily. Both tanks are maintained full, so when sludge is added there is an automatic transfer of primary sludge into the secondary digester and of secondary supernatant into the elutriation tanks. Sludge from the primary digester is continually circulated through the heat exhangers and the temperature maintained at about 95°F. Normally, the circulating pump draws sludge from only the intermediate level through sampling lines on the control building side of the digester and returns the heated sludge at the top. The tank contents of the primary digester are continuously mixed with compressed sludge gas fed through diffusers located at the tank bottom.

In the secondary digestion tank, transferred primary sludge is allowed to stratify and, with the exception of a periodic stir-up of the tank contents, the digester is not mixed. Secondary sludge is pumped to the primary tank periodically for a short period of time to maintain the desired level of buffering alkalinity in the primary digester. Digested sludge is withdrawn from the bottom of both tanks and pumped to the elutriation system. Digested sludge withdrawal pump operation is manually controlled to maintain maximum elutriation tank solids level. Both digesters are sounded periodically to determine grit build-up and scum formation.

Routine laboratory analysis are made on the sludge of each digester for pH, alkalinity, volatile solids, percent solids and temperature.

Solids Conditioning and Disposal

The final phase in the solids stabilization process involves the preparation of the digested sludge for its ultimate removal from the treatment plant.

Elutriation

Digested sludge and digester supernatant are conditioned prior to vacuum fitration in two elutriation tanks. Each tank is 50.5 feet long by 14.7 feet wide and operates at an average water depth of 9 feet. Each tank is provided with a longitudinal sludge collector of the continuous chain and flight type and 40-inch diameter influent mixing chamber. Two centrifugal pumps and a plunger pump are used to transfer sludge from one tank to the other and to the vacuum filters.

Under normal operation the tanks are run on a counter-current, two-stage elutriation basis. Digested sludge and/or supernatant from the digesters flows into the east mixing chamber where it is mixed and combined with effluent from the west elutriation basin before entering the elutriation tank. Settled sludge in the east tank is moved by the chain collectors to a hopper at the tank inlet end from where it is transferred continuously to the west mixing chamber. Effluent of the east tank flows over a full width sharp crested weir and returns to the Mile Rock sewer upstream of the Sunset pumping station diversion structure. Settled sludge from the east tank is mixed and combined with plant effluent in the west mixing chamber prior to flowing into the west elutriation basin. Settled sludge in the west tank is moved by the chain collectors to a hopper at the tank inlet end from where it is pumped to the vacuum filters when these units are in operation or stored in the elutriation tanks until the next fitration period. The operation of the vacuum filters is coordinated with the operation of the digested sludge pumps to avoid overloading the elutriation system.

## Filtration

Dewatering of the conditioned sludge is accomplished on two rotary drum vacuum filters. The filters are 8 feet in diameter by 8 feet long and are provided with Dacron filter media. One sludge flocculator is located next to the units. Filter auxiliary equipment includes two vacuum pumps, two filtrate pumps, one air blower and ferric chloride chemical storage tank. Sludge can be fed to the filters by pumping, using one of the transfer pumps.

Normally, filters are operated three or four days a week for 8 to 12 hours. Ferric chloride is added in the sludge flocculator just ahead of the filters. Filter cake is collected on horizontal belt conveyor which carries the cake to four bins or, when available, directly to a truck. From the bins, sludge cake is loaded into trucks and hauled away. Cake is used in the Golden Gate Park for filling and as soil stabilizer. Filtrate is pumped to the elutriation system or returned by gravity to the receiving well of the Sunset pumping station. Present cake production is approximately 1,200 tons of dry solids per year at an average solids concentration of approximately 25 percent.

Control of each phase of the treatment process is performed at separate contol centers located in the pretreatment building; sedimentation tank area, sludge control room and chlorination room in the sedimentation building; digester operating building; and vacuum filter room, elutration tank area, boiler room and Sunset pumping station motor and control room in the administration building. Plant power is supplied by Pacific Gas and Electric Company. There is no source of emergency power.

## Treatment Plant Personnel

The Richmond-Sunset plant has an operation and maintenance staff of 30. The plant is attended 24 hours a day. The following table lists the classes and number of personnel employed at the Richmond-Sunset plant during the 1979 fiscal year.

Class and Number of Operating Personnel
Richmond-Sunset Plant

| Class Title | Number |
|---|---|
| Sewage treatment plant superintendent | 1 |
| Chief stationary engineer | 1 |
| Senior sewage treatment chemist | 1 |
| Sewage treatment chemist | 3 |
| Senior clerk typist | 1 |
| Senior stationary engineer | 6 |
| *Stationary engineer (Includes 4 operators for Golden Gate Park facility) | 16 |
| Truck driver | 1 |
| General laborer | 3 |
| Total | 33 |

* Operating personnel of the Richmond-Sunset plant also operate and maintain a one MGD water reclamation plant in Golden Gate Park. This is an activated sludge facility without solids handling. All screenings, primary sludge and waste activated sludge ~~is~~ are returned to the sewer for conveyance back to the Richmond-Sunset plant.