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DEPARTMENT OF ECOLOGY
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MEMORANDUM
May 22, 1981

To: Carl Nuechterlein

From: Will Abercrombie

Subject: Deer Park Sewage Treatment Plant (STP) Class II Inspection

Introduction

A Class II compliance inspection was conducted at the Deer Park STP on November 18 and 19, 1980. Department of Ecology (DOE) representatives in attendance during the inspection were Will Abercrombie (Water and Wastewater Monitoring) and Carl Nuechterlein and Roger Ray (Eastern Regional Office). The STP representative present during the inspection was Gary Brummett (operator).

A receiving water study was performed in conjunction with this Class II inspection by Joseph Joy and Lynn Singleton (DOE, Water and Wastewater Monitoring Section). Findings of this receiving water study have been issued in a separate memorandum (Joy, 1981).

Setting

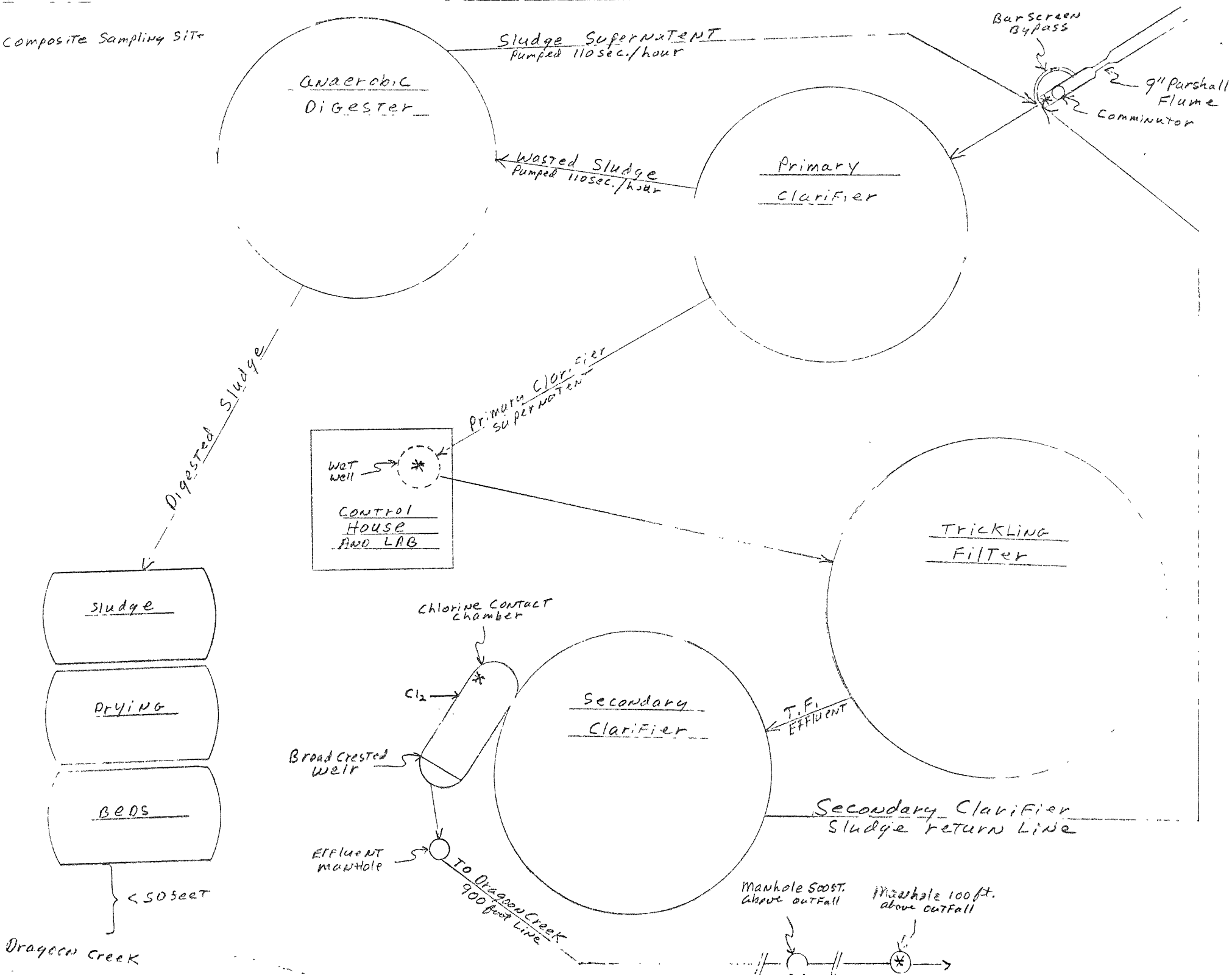
The Deer Park STP consists of a primary clarifier, trickling filter, secondary clarifier, chlorine contact chamber, and an anaerobic sludge digester (Figure 1).

Raw influent enters the treatment facility, passes through a 9-inch Parshall flume, then to a comminutor. The headworks area includes a parallel channel containing a bar screen to be used if the comminutor malfunctions. The circular primary clarifier is of standard design. Primary clarifier effluent travels to a wet well located in the control house. This wet well contains two pumps, one of which operates continuously. During periods of heavy hydraulic loading, the second pump is automatically activated. From the wet well the partially treated sewage is pumped to a small (40 feet in diameter, 3 feet deep) trickling filter. The trickling filter effluent travels to the secondary clarifier and eventually spills into the chlorine contact chamber where the final effluent is chlorinated before being discharged into Dragoon Creek (waterway segment number 24-55-02).

Figure 1

Deer Park. STP

* = Composite Sampling Site



Secondary clarifier sludge is gravity fed back to the headworks. Sludge is wasted to a heated anaerobic digester from the bottom of the primary clarifier, as needed. Sludge supernatant is pumped from the digestor to the headworks.

The three sludge drying beds are no longer in use due to severe disrepair. All three beds contained standing water and were observed to be full of weeds and debris. The base of the drying beds consists of six inches of large cobbles covered with six inches of pea gravel. No sealant has been used to prevent contamination of Dragoon Creek located less than 50 feet from the closest drying bed. Digested sludge is presently being disposed of at the local landfill.

Inspection Procedures

The Parshall flume was measured and found to vary slightly from standard design specifications (Figure 2). In order to gage the flow, a Manning dipper was installed on the influent Parshall flume on November 18, 1980 at 9:05 a.m. and removed on November 19, 1980 at 9:05 a.m. The dipper totalizer counter malfunctioned necessitating a 24-hour average flow determination derived from the dipper strip chart (Figure 3). This was accomplished by calculating hourly average flows and averaging these values on a 24-hour basis.

Twenty-four-hour composite samplers were installed on the raw influent, primary clarifier effluent, final unchlorinated effluent, and final chlorinated effluent. These samples were split with the STP operator and analyzed for field parameters on November 19, 1980 (Table 1). Grab samples were taken at composite sampler locations and analyzed for field parameters on November 19, 1980. Additional grab samples were taken at other locations and analyzed for various field and laboratory parameters (Table 1). Eight-hour grab composite samples, taken by the STP operator, were split with the DOE labroatory. Digested sludge samples were taken from the anaerobic sludge digestor to be analyzed for heavy metals of interest.

On November 19, 1980, 35 ml of Rhodamine WT dye was applied to the final effluent in order to check for leaks in the 900-foot-long outfall line. Of particular interest was a section of the outfall that crossed Dragoon Creek approximately 100 feet above the actual outfall.

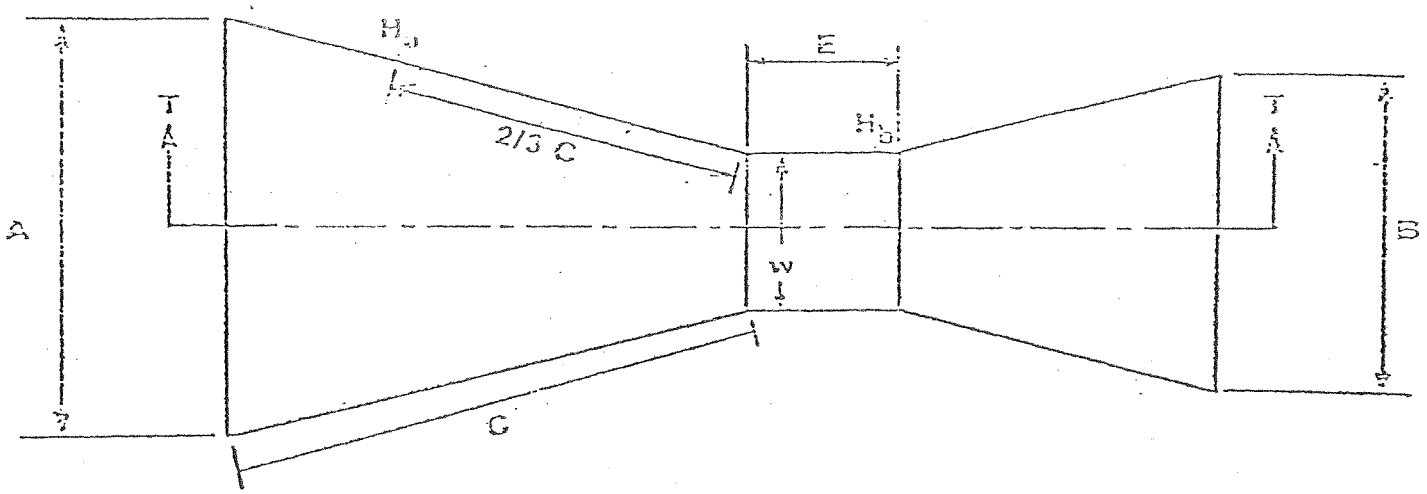
Results and Discussion

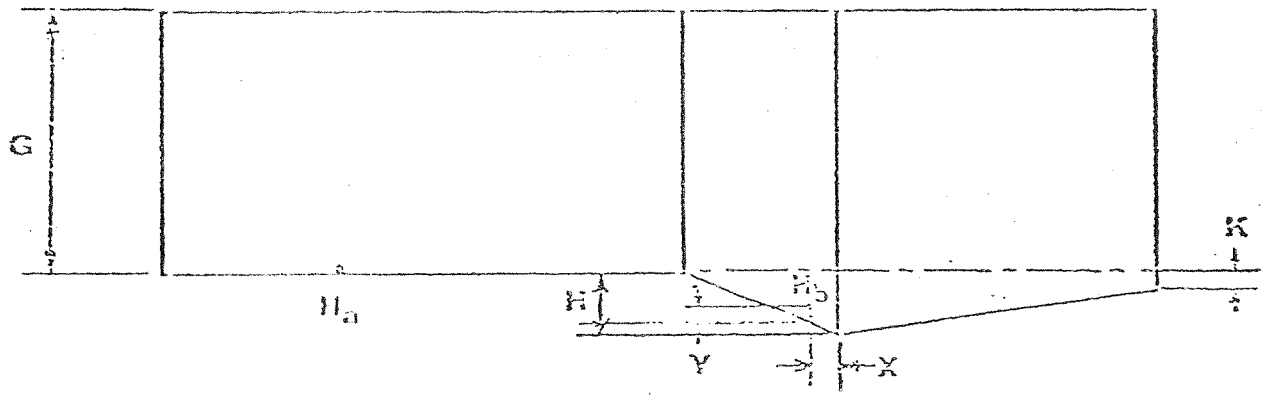
The Deer Park STP was constructed in the early 1950s. Presently, the concrete is worn and crumbling. Extreme rust is evident on nearly all

Figure 2

PARSHALL FLUME: Deer Park STP

Dimensions & Flow





Code	Spec's	Measured
A	22 5/8	23 1/2
B	15	16 3/4
C	34 5/8	38
2/3 C	23 1/8	20 1/2
E	12	11 1/4
G	24	23
H		
K		
W	9.0	TOP = 9.0 Bot. m = 9 1/8
X		
Y		

Time	H_a	H_b	Theoretical Flow	Recorded Flow

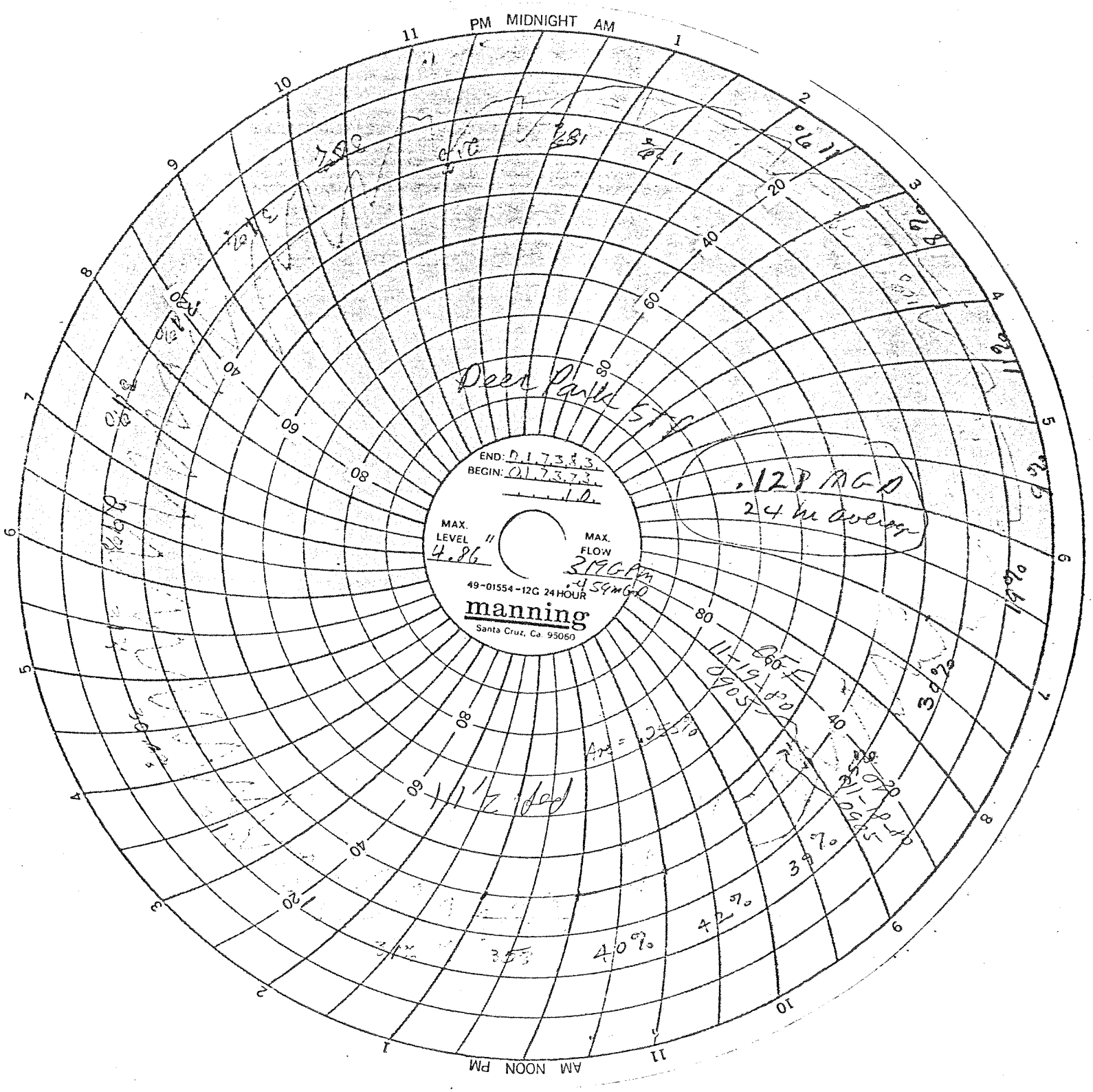

PM MIDNIGHT AM
AM NOON PM
END:
BEGIN:
MAX. LEVEL
4.86"
MAX. FLOW
3MGPM
.459MGD
49-01554-12G 24 HOUR
manning
Santa Cruz, Ca. 95060
Deer Park Site
.128 MGD
24 hr average

Table 1. Deer Park STP Class II Inspection Composite and Grab Sampling Schedule.

	Sample Aliquot	Sampling Period	Location	Field Parameters Tested
Composite Sampler				
Influent	240 ml/30 min.	11/18/80 - 0930 to 11/19/80 - 0945	Below comminutor	pH, Cond., Temp.
Primary Clarifier Eff.	250 ml/30 min.	11/18/80 - 0940 to 11/19/80 - 1015	Wet well just prior to trickling filter	pH, Cond., Temp.
Unchlorinated Effluent	230 ml/30 min.	11/18/80 - 0955 to 11/19/80 - 1030	Just prior to chlorination	pH, Cond., Temp.
Final Chlorinated Eff.	250 ml/30 min.	11/18/80 - 1110 to 11/18/80 - 1135	Manhole 100 yds. above outfall	pH, Cond., Temp.
Grab Samples				
Influent		11/18/80 - 1010	Below comminutor	pH, Cond., Temp.
Primary Clarifier Eff.		11/18/80 - 1020	Wet well just prior to trickling filter	pH, Cond., Temp.
Unchlorinated Effluent		11/18/80 - 1030 11/18/80 - 1345	Just prior to chlorination	pH, Cond., Temp. D.O. (Winkler)
Final Chlor. Effluent		11/18/80 - 1310 & 1715 11/18/80 - 0900	End of chlorine contact chamber	TCR
Final Chlor. Effluent		11/18/80 - 1320	Manhole 100 yds. above outfall	TCR
Final Chlor. Effluent		11/18/80 - 1330 11/19/80 - 1210 12/02/80 - 0925	Outfall Outfall	TCR D.O. (Winkler), F.C.* Fecal Coliform, TCR

*Non-ideal plate count - not used.

metal components of the treatment facility. The primary and secondary clarifiers are approximately three inches and one-half inch out of level, respectively. The efficiency of the clarifier sludge scraper arms is questionable. The sludge drying beds are in such disrepair that they are no longer functional. The continuous flow recorder has not been in operation for some time and, in fact, no longer exists. All of these factors contribute to a general lack of treatment efficiency.

Compliance with NPDES Permit Limits

In early 1977 the City of Deer Park submitted documentation to DOE stating that it could not meet existing NPDES discharge limitations, despite all reasonable best efforts. The DOE attached an amendment (Docket No. DE 77-279) to the existing and still effective NPDES permit, doubling permit limits for BOD and TSS. The fecal coliform permit limit was dropped completely and a TCR permit limit was added (.1 to .5 mg/L).

Table 2 shows DOE laboratory results for samples analyzed during this Class II inspection. The Deer Park STP was not in compliance with monthly permit limits for BOD (mg/L), TSS (mg/L), and total chlorine residual (TCR). Both BOD and TSS results were 18 percent (71 mg/L) above the monthly permit limit of 60 mg/L, even through permit limits for these parameters had been drastically increased. Although the accuracy of the Daily Monitoring Reports (DMR) is questionable (see split sample results and laboratory procedural survey sections), it is apparent that meeting BOD and TSS permit limits is a chronic problem.

The initial TCR taken at the outfall was extremely high (2.3 mg/L), well above the permit limit range of .1 to .5 mg/L. The operator was using only the #1 pillow (free chlorine) for TCR determination. As a result, the operator believed he was within the TCR permit limit range. At my request, Mr. Brummett reduced chlorine usage from 8 lbs/day to 4 lbs/day. This resulted in a TCR of .4 mg/L.

The analysis of the fecal coliform sample taken during the inspection period resulted in an estimated count (i.e., non-ideal plate count). In order to achieve a valid count, Carl Nuechterlein resampled for fecal coliform and TCR on December 2, 1980. At a TCR of 0.5 mg/L (the maximum permitted concentration), there were 460 colonies/100 ml. Even though no fecal coliform permit limit is in effect, there is some concern that the high number of organisms being discharged by this facility, coupled with cattle waste and runoff, may cause a water quality violation (see WAC 173-201-045 and Joy, 1981). Mr. Brummett agreed to keep a close eye on the TCR/fecal coliform concentrations in order to achieve maximum disinfection while remaining within the TCR permit limit range.

Table 2. DOE Laboratory Results.

Parameter	Influent 24-hour Composite	Influent 8-hour grab Composite	Primary Clarifier Effluent 24-hour Composite	Unchlorinated Eff. 24-hour Composite	Unchlorinated Eff. 8-hour grab Composite	Final Chlorinated effluent 24-hour Composite	Permit Limits Monthly	Permit Limits Weekly
Flow (MGD)	.121 4/	.130 5/					.185	
BOD5 (mg/L)	180	160	180	85	86	71	60	90
lbs/day	182	161	182	86	87	72	95	140
% Reduction						61		
TSS (mg/L)	120	140	140	76	77	71	60	90
lbs/day	121	141	141	77	78	72	95	140
% Reduction						41		
Fecal Coli. (col./100 ml)						460 2/		
D.O. (mg/L)				1.5 1/		5.0 1/		
TCR (mg/L)						2.3 1/ 0.4 1/	.1 to .5	
pH (S.U.)	8.0 3/	7.9 3/	7.8 3/	7.8 3/	7.7 3/	7.8 3/	6.5 to 8.5	
Sp. Cond. (umhos/cm)	710 3/	750 3/	760 3/	760 3/	760 3/	740 3/		
COD (mg/L)	290	380	400	240	270	230		
Turb. (NTU)	58	67	81	51	38	46		
NH_3-N (mg/L)	28	28	34	32	33	32		
NO_2-N (mg/L)	0.20	<0.20	0.20	<0.25	<0.25	<0.20		
NO_3-N (mg/L)	1.60	<0.20	0.80	<0.25	<0.25	0.40		
O-PO_4-P (mg/L)	5.6	7.6	8.2	9.0	8.8	9.0		
T. Phos.(mg/L)	9.6	12	12	11	11	10		
T. Solids (mg/L)	560	680	550	480	480	470		
TSS (mg/L)	120	140	140	76	77	71		
TNVS (mg/L)	260	390	290	280	280	380		
TNVSS (mg/L)	10	27	23	19	17	14		
Temp. (°C)	13.8 1/		13.6 1/	12.5 1/		12.8 1/		

lbs/day calculated using .121 MGD

1/ Grab sample - field analysis

2/ Grab sample - lab analysis

3/ Composite sample - field analysis

"<" = less than

4/ Manning Dipper 24-hr. average flow

5/ STP Grab sample

Condition S3 (Monitoring and Reporting) of the current NPDES states that a daily average flow will be reported. Deer Park STP presently is in violation of this condition in that a single instantaneous flow is taken daily. This value is reported as a daily average flow on the DMR. Also, 24-hour composite samples are not being taken for BOD and TSS analysis.

Review of recent DMRs indicates many of the monitoring and/or reporting schedules listed under Condition S3 of the permit are not being complied with. The following is a list of these apparent violations:

1. Dissolved oxygen (D.O.) and pH of the primary clarifier and trickling filter effluents are not being reported;

2. Settleable solids of the primary clarifier effluent is not being reported;

3. Total and volatile solids of the raw and digested sludge are not being reported on a monthly basis; and

4. Volatile acids and alkalinity of digester contents are not being reported.

Condition S4(A)(1) of the NPDES permit stipulates the treatment facility must have a qualified operator. At the present time, Mr. Brummett is a group I operator and Deer Park STP is a group II plant. Mr. Brummett stated he now has enough time as a group I operator to qualify for the group II test. The group II test is scheduled for June, 1981.

Split Sample Results

Table 3 shows DOE/STP split sample results for DOE 24-hour composite and STP 8-hour grab composite samples. For the most part, BOD and TSS split sample results compare within acceptable limits. BOD results of the raw influent 24-hour and 8-hour composite samples are significantly different. Due to the fairly good correlation of unchlorinated effluent BOD split sample results, it is difficult to speculate on why influent BOD results show a significant difference.

Under normal conditions, the operator uses flow proportional, 8-hour grab composite samples for BOD and TSS analysis. Due to my request to split samples, it became difficult for the operator to grab flow-proportional samples so a standard volume was taken every two hours, regardless of flow. However, the operator also grabbed flow-proportional samples and analyzed these samples for BOD and TSS as well as the split samples (Table 4). BOD results of STP analyzed, flow-proportional samples were nearly equal to 24-hour composite sample results obtained from the DOE laboratory.

Table 3. DOE/STP Split Sample Results.

Parameter	INFLUENT 24-hour Composite DOE Results	INFLUENT 24-hour Composite STP Results	INFLUENT 8-hr. Grab Comp. DOE Results	INFLUENT 8-hr. Grab Comp. STP Results	UNCHLORINATED EFF. 24-hour Composite DOE Results	UNCHLORINATED EFF. 24-hour Composite STP Results	UNCHLORINATED EFF. 8-hr. Grab Comp. DOE Results	UNCHLORINATED EFF. 8-hr. Grab Comp. STP Results	FINAL EFFLUENT DOE Results	FINAL EFFLUENT STP Results
BOD_5 (mg/L)	180	107	160	85	85	88	86	70		
% Difference		41% Low		47% Low		3% High				
TSS (mg/L)	120	114	140	169	76	87	77	83		
% Difference		5% Low		21% High		14% High		8% High		
Fecal Coliform (col./100 ml)									460	0

Table 4. STP Results of Flow Proportional Samples.

Parameter	Influent 8-hr. Grab Composite	Unchlorinated Effluent 8-hr. Grab Composite
BOD_5 (mg/L)	195	83
TSS (mg/L)	145	81

Fecal coliform split sample results indicate that the operator has some problems with fecal coliform analysis procedures (Table 2). On talking with the operator, it was learned that this sample was held for 48 hours before analysis which could account for the large discrepancy. The operator also indicated that the sodium thiosulfate he was using could be bad. Regardless of the reason, it is recommended that the operator review fecal coliform test procedures and make arrangements for another split sample with the Eastern Region DOE laboratory. Analysis for fecal coliforms should be run as quickly as possible after sample collection. In no case should samples be held longer than 24 hours.

Treatment Efficiency

As stated earlier, failure to meet relatively liberal BOD and TSS permit limits is probably due to a general loss of treatment efficiency. We believe that effluent quality can be improved without a large capital investment. Due to the length of time required for new facility construction, it behooves the City of Deer Park to attempt improving effluent quality.

The primary and secondary clarifiers have not, to our knowledge, been drained and maintained since their construction in the early 1950s. This has resulted in a loss of clarifier efficiency as can be seen from the DOE laboratory results in Table 2. Primary clarifier BOD and TSS concentrations are as high or higher than the raw influent concentrations. This is due, in part, to the recirculation of secondary clarifier sludge into the headworks, a common practice. Nonetheless, one would expect a substantial reduction in BOD and TSS after primary clarification. Both clarifiers should be drained, cleaned, and sludge scraper arms should be repaired. The rubber scrapers attached to the scraper arms have probably been worn down, resulting in a sludge buildup on the clarifier bottoms and, thus, a loss in clarifier volume.

Both clarifiers should be leveled, if possible. When a clarifier is not level some portion of the launder ring will usually be dry. This causes a "dead spot" in the clarifier which, in effect, reduces clarifier surface area and increases the effective overflow rate (GPD/ft^2). Leveling of launder rings can substantially increase clarifier efficiency.

In talking with Mr. Brummett it is believed that each clarifier can be drained and repaired separately. As one clarifier is being repaired the influent can be routed to the other clarifier. Mr. Brummett is confident that effluent chlorination will be possible while repairs are being made to each clarifier.

The Deer Park STP has the capability of recirculating secondary clarifier effluent back through the trickling filter. Mr. Brummett states

that recirculation is not the present practice because this would overload the trickling filter. We do not believe that this would be the case. Recirculation to trickling filters is a common practice resulting in increased BOD removal. The advantages of recirculation to the trickling filter are: (Albertson, et al., 1977):

1. Organic matter comes in contact with active biological material on the filter more than once resulting in increased contact efficiency and better "seeding" of the filter;

2. Reduction of shock load effects by diluting strong influent and supplementing weak influent; and

3. Recirculation reduces biological material on the filter. This reduces clogging and results in a more vigorous microorganism population which, in turn, increases BOD reduction. An added advantage is that filter fly larvae are washed away before they have a chance to reproduce. Many filter flies were observed at the Deer Park STP during this inspection.

The operator states that he presently spends between 24 and 48 hours per week on site or directly involved in STP operations. The operator needs to spend more time at the STP so that he becomes more familiar with operational/test procedures and so that plant conditions can be closely monitored. Hopefully, this will aid in the improvement of effluent conditions.

Expansion of STP Services

One of the more important aspects to be addressed by this Class II inspection is to determine the feasibility of allowing approximately 10 percent more hookups to the Deer Park STP. The City of Deer Park is in Phase I of the grant process at the present time. A lagoon system is planned and the effluent will be used for irrigation of hay which will be sold for cattle feed. This is a noteworthy option to the more conventional practice of discharging to surface waters. Nonetheless, the new facility will not be completed for 2 to 5 years. Thus the question of allowing an immediate expansion of STP services needs to be addressed prior to completion of the new facility.

The receiving water study performed in conjunction with this Class II inspection concludes that the Deer Park STP discharge is "exerting a negative influence on Dragoon Creek" and causing degradation of water quality resulting in state water quality violations (Joy, 1981). Paragraph (4)(a) and (b) of WAC 173-201-025 (Water Quality Standards) appears to be pertinent to the situation at Deer Park. Consequently, it would not be prudent to recommend allowing additional hookups to the existing facility with present effluent and receiving water conditions. In addition, there appears to be a serious exfiltration/service problem which, when solved, would drastically increase STP loading (discussed later).

In an attempt to predict the effects of a 10 percent service increase to the Deer Park STP, two prediction equations were used (Tables 5 and 6).

One characteristic both equations (NRC and Eckenfelder) have in common is that temperature is not incorporated into either formula. This could be part of the reason that the prediction equations do not more nearly equal present actual BOD removals. Of course, the lack of treatment efficiency discussed earlier also is a factor. It is interesting to note that both equations predict similar results due to increased loadings. Neither equation shows that a 10 percent service increase would result in an appreciable rise in effluent BOD concentrations. However, it must be remembered that, due to flow and treatment efficiency problems, the Deer Park STP is unique and probably does not relate to either equation very well.

Table 5. Prediction Equations.

	Actual[1/]	Media[2/] Design Criteria	NRC[3/]	Eckenfelder[4/]
Percent BOD Removal Present	61	50 - 70	71.9	72
Effluent BOD Present (mg/L)	71	90 - 54	51	50
Percent BOD Removal Future	--	50 - 70	70.4	71
Effluent BOD Future (mg/L)	--	90 - 54	53	52

[1/] Data from Class II inspection.

[2/] Criteria for sewage works design, DOE, p. 107.

[3/] Yake, 1979. Memorandum to Phil Williams.

$$1 - (1e/Lo) = 1/(1 + 0.0085\sqrt{W/VF}) \text{ where } F = (1 + R)/(1 + R/10)^2$$

[4/] Eckenfelder and O'Conner, 1961. p. 227-234 using figure 6-16 p. 230

Table 6. Parameters used in Calculation.

Symbol	Parameter	Units	Actual	Future (+20,000 gal/day)
r	Filter Radius	Feet	20	20
A	Surface Area	ft^2	1257	1257
		acre	.029	.029
D	Filter Depth	Feet	3.0	3.0
	Filter Volume	ft^3	3770	3770
V		Acre-feet	.086	.086
	Hydraulic loading	gpm/ft^2	.067	.078
		M gal/acre/day	4.17	4.86
W	Filter BOD Loading	lbs/day	182	212
	BOD Loading/Vol.	lbs/1000 ft^3/day	41.4	48.2
R	Recirc. Ratio		0	0
Qi	Plant Flow	MGD	.121	.141
		gpm	84	98
Qr	Recirc. Flow	MGD	0	0
		gpm	0	0
Qitr	Flow to Filter	MGD	.121	.141
		gpm	84	98
Lq	Raw Influent BOD	mg/L	180	180
Li	Primary Eff. BOD	mg/L	180	180
Le	Final Effluent BOD	mg/L	71	--

Present population = 2,111
Future population = 2,322 (increase of approximately 20,000 gal/day)

Table 7 uses the NRC equation to predict present and future BOD removal and effluent concentrations using increasing recirculation ratios. It is easy to see the advantage, depicted in increased BOD removal, of recirculation through the trickling filter. The largest increase is achieved with a 1:1 recirculation ratio (about 5%). A 4:1 recirculation ratio would hypothetically result in about a 9% increase in BOD removal. If recirculation is attempted at the Deer Park STP, it is suggested that various ratios be tried in order to achieve the maximum BOD reduction for the time/money required.

Table 7. NRC Equation Incorporating Recirculation Ratios.

	0	1:1	2:1	3:1	4:1
% BOD Removal Present	71.9	76.9	78.7	80.0	80.6
Effluent BOD Present (mg/L)	51	42	38	36	35
% BOD Removal Future	70.4	75.2	77.5	78.7	79.4
Effluent BOD Future (mg/L)	53	45	40	38	37

Flow

Presently, the Deer Park STP is serving a population of approximately 2,100 individuals. At 100 gal/day/capita, one would expect a daily average flow of .210 MGD. The Manning Dipper installed to record a 24-hour flow showed a daily average flow of only .121 MGD (Table 2 and Figure 3). Fourty-two percent (89,000 gal/day+) is not reaching the treatment facility. This raises some serious questions as to where this missing flow is going. The "loss" of influent is probably due to either a serious exfiltration problem or there are fewer individuals being served by the STP than is presently thought.

An infiltration and inflow analysis was conducted on the Deer Park sewage collection system during the winter of 1978/1979 (Haggerty, et al). Results of this analysis were inconclusive due primarily to the harsh winter and dry spring. After reviewing this report, it appears the data support my contention of exfiltration/less service if the abnormal weather conditions are taken into account. Further investigation is needed in order to resolve the flow discrepancy question. This would be required even though a new treatment facility is being built.

Laboratory Procedural Survey

The laboratory procedural survey form found at the end of this report gives detailed recommendations which should improve STP laboratory results. In general, with the exception of fecal coliform test procedures, Mr. Brummett is familiar with correct test procedures. However, it would be desirable for him to periodically review test procedures in order to assure adherance to accepted procedure. Periodic formal training in correct laboratory procedures at one of the local colleges would also be advantageous.

It appears the major problems with the STP laboratory results stem from a lack of adequate laboratory equipment. The balance is very old and not accurate enough to be used for weighing reagents. During the inspection period the fecal coliform incubator would not maintain a temperature of 44.5°C plus or minus 0.2°C. The operator has since acquired a crock pot for incubating fecal coliform samples. There is some doubt as to whether or not this device will adequately fulfill the operator's needs and maintain the proper temperature.

Mr. Brummett was not very familiar with proper fecal coliform analysis procedures (see Laboratory Procedural Survey). It is believed that his lack of knowledge is due to the fact that he has not taken the time to review proper fecal coliform analysis procedures. Proper procedures were reviewed with Mr. Brummett during the inspection. He stated he would review procedures and contact Carl Nuechterlein if he had any questions.

Dye Study

The dye study conducted on the 900-foot-long outfall line indicated that no leaks were present. It took approximately 20 minutes for the dye to reach the outfall at a flow of .180 MGD.

At the time of this inspection the operator took his fecal coliform and TCR samples at the end of the contact chamber. The original intention was to develop a curve with which the operator could predict outfall line detention time. Fecal coliform samples could then be held this added amount of time before dechlorination; thus, sample results would more closely represent true conditions at the outfall. Due to the fact that the outfall line is not entirely submerged and plug flow cannot be assumed, it became very difficult to accurately predict outfall line detention time. As an alternative it was suggested, whenever receiving water conditions are conducive, that fecal coliform and TCR samples be collected at the outfall. If Dragoon Creek is too high to reach the outfall, fecal coliform and TCR samples should be taken at the end of the chlorine contact chamber and held for 20 minutes before dechlorination and analysis.

Water Quality Index (WQI) - Segment 24-55-02

The Deer Park STP discharges into Dragoon Creek at River Mile (R.M.) 15. Dragoon Creek is a tributary to the Little Spokane River. According to "1980 Analysis of Receiving Water Segments" (Singleton, 1980), this segment has an overall WQI of 9.7 (Table 8).

Table 8. Water Quality Index for Segment 21-45-01.

Station	Temp.	Oxygen	pH	Bact.	Trohpic	Aesth.	Susp. Solids	NH_3-N	Overall Index Rating
55B070	8.9	10.7	13.1	12.5	15.9	23.0	(37.4)	3.3	9.7

( ) = not used in overall index rating calculations.

A WQI falling between 0 and 20 meets the goals of the Federal Water Pollution Control Act. This segment is well within these goals. It must be realized that ambient monitoring station 55B070, from which these indices were produced, is at the mouth of the Little Spokane River (36 river miles below Deer Park STP).

It is impractical to make any assumptions from the WQI for segment 21-45-01 concerning the water quality impacts of the Deer Park STP on Dragoon Creek.

Recommendations

The following is a list of recommendations which should be taken into consideration by the City of Deer Park/Eastern Region DOE with respect to the existing treatment facility:

1. Comply with condition S3 of the current NPDES permit as noted previously under Compliance with NPDES Permit Limits;

2. Maintain and repair both clarifiers in an attempt to increase clarifier efficiency. General periodic maintenance is suggested on all components of the plant;

3. Attempt to recirculate secondary clarifier effluent back through the trickling filter to reduce BOD levels of the final effluent;

4. Do not allow expansion of STP services until permit limits are met and receiving water quality is back within standard limits. When these conditions are met, any additional hookups should be reviewed on a case-by-case basis by the DOE Eastern Regional Office. Particular attention should be given to the effects of the added hookups on the receiving water;

5. Conduct an investigation into the loss of influent flow into the STP. Take corrective action to solve this problem;

6. Improve laboratory equipment and operator training. Implement the recommendations found in the Laboratory Procedural Survey (attached); and

7. Take fecal coliform and TCR samples (use total chlorine pillows) at the outfall whenever possible. When the outfall cannot be reached, sample for these parameters at the end of the chlorine contact chamber and hold these samples for 20 minutes prior to dechlorination and analysis.

WA:cp

Attachments

cc: Bill Yake
Dick Cunningham
W.Q. Invest. Section Files
Joe Joy

LABORATORY PROCEDURAL SURVEY

Discharger: Deer Park STP

NPDES Permit Number: WA-002255-1

Date: 11-18-80

Industrial/Municipal Representatives Present: Gary Brummitt - Operator

Agency Representatives Present: Will Abercrombie (Water & Wastewater)

I. COMPOSITE SAMPLES

A. Collection and Handling

1. Are samples collected via automatic or (manual) compositing method? 5 grabs / 8 hours, Model? _____

a. If automatic, are samples portable _____ or permanently installed _____?

Comments/problems Should use 24 hour composite as per permit for BOD + TSS analysis

2. What is the frequency of collecting composite samples? Weekly

3. Are composites collected at a location where homogeneous conditions exist?

a. Influent? yes - after comminutor

b. Final Effluent? yes - prior to chlorination

c. Other (specify)? _____

4. What is the time span for compositing period? 8 hours

Sample aliquot? approx. 300 mls per 2 hrs minutes

5. Is composite sample flow or time proportional? Flow

6. Is final effluent composite collected from a chlorinated or non-chlorinated source? NON-Chlorinated

7. Are composites refrigerated during collection? yes

8. How long are samples held prior to analyses? less than 24 hours

9. Under what condition are samples held prior to analyses?

   a. Refrigeration? X

   b. Frozen? _____

   c. Other (specify)? _____

10. What is the approximate sample temperature at the time of analysis? 20°C

11. Are compositor bottles ~~and sampling lines~~ cleaned periodically? yes

    a. Frequency? Before Each Use

    b. Method? Hot Water

12. Does compositor have a flushing cycle? NA

    a. Before drawing sample? _____

    b. After drawing sample? _____

13. Is composite sample thoroughly mixed immediately prior to withdrawing sample? yes

Recommendations:

_____

_____

_____

_____

_____

_____

_____

II. BIOCHEMICAL OXYGEN DEMAND CHECKLIST

A. Technique

1. What analysis technique is utilized in determining BOD_5?

   a. Standard Methods? _____ Edition? _____

   b. EPA? _____

   c. A.S.T.M.? _____

   d. Other (specify)? Lab Test Procedure For B.O.D. OF Water and Wastewater. DOE 77-24

B. Seed Material

1. Is seed material used in determining BOD? NO

2. Where is seed material obtained? _____

3. How long is a batch of seed kept? _____

   and under what conditions? (temperature, dark) _____

4. How is seed material prepared for use in the BOD test? _____

Recommendations:

C. Reagent Water

1. Reagent water utilized in preparing diultion water is:

   a. Distilled? Store Bought

   b. Deionized? _____

   c. Tap _____, chlorinated _____ non-chlorinated _____

   d. Other (specify)? _____

2. Is reagent water aged prior to use? yes

   How long? 24 hours to 1 Week, under what conditions? _____

   on lab shelf with cotton plug in top.

Recommendations:

Keep reagent water in dark while aging.

D. Dilution Water

1. Are the four (4) nutrient buffers added to the reagent water? yes

   a. 1 mls of each nutrient buffer per 1000 mls of reagent water

2. When is phosphate buffer added (in relation to setting up BOD test)? Just prior to test

3. How often is dilution water prepared? Just prior to use
   Maximum age of dilution water at the time test is set up.
   Fresh

4. Under what conditions is dilution water kept? Not Stored

5. What is temperature of dilution water at time of setup? 20°C

Recommendations:

E. Test Procedure

1. How often are BOD's being set up? weekly

   What is maximum holding time of sample subsequent to end of composite period? less than 24 hours

2. If sample to be tested has been previously frozen, is it reseeded? NA How?

3. Does sample to be tested contain residual chlorine? NO
   If yes, is sample

   a. Dechlorinated?

      How?

   b. Reseeded?

      How?

4. Is pH of sample between 6.5 and 8.5? yes

   If no, is sample pH adjusted and sample reseeded?

5. How is pH measured? Perkin Elmer pH meter

   a. Frequency of calibration? once/month

   b. Buffers used? 4 + 7

6. Is final effluent sample toxic? NO

7. Is the five (5) day DO depletion of the dilution water (blank) determined? yes, normal range? 0 TO 0.5

8. What is the range of initial (zero day) DO in dilution water blank? 8.0 TO 8.5

9. How much seed is used in preparing the seeded dilution water? NA

10. Is five (5) day DO depletion of seeded blank determined? NA
If yes, is five (5) day DO depletion of seeded blank approximately 0.5 mg/l greater than that of the dilution water blank? _____

11. Is BOD of seed determined? NA

12. Does BOD calculation account for five (5) day DO depletion of

a. Seeded dilution water? NA

How? _____

b. Dilution water blank? yes

How? D.O. depletion subtracted from D.O. after 5 day test.

13. In calculating the five (5) day DO depletion of the sample dilution, is the initial (zero day) DO obtained from

a. Sample dilution? X

b. Dilution water blank? _____

14. How is the BOD_5 calculated for a given sample dilution which has resulted in a five (5) day DO depletion of less than 2.0 ppm or has a residual (final) DO of less than 1.0 ppm? _____

Does not happen very often but when it does the BOD_5 value is calculated and put on DMR.

15. Is liter dilution method or bottle dilution method utilized in preparation of

a. Seeded dilution water? _____

b. Sample dilutions? Bottle dilution

16. Are samples and controls incubated for five (5) days at 20°C ± 1°C and in the dark? yes

17. How is incubator temperature regulated? Thermometer placed inside incubator in water - Thermostat Faulty

18. Is the incubator temperature gage checked for accuracy? yes

a. If yes, how? ~~yes~~ Thermometer on same shelf as BOD Bottles.

b. Frequency? 2/week

19. Is a log of recorded incubator temperatures maintained? NO

a. If yes, how often is the incubator temperature monitored/checked? _____

20. By what method are dissolved oxygen concentrations determined?

Probe _____ Winkler X Other _____

a. If by probe:

1. What method of calibration is in use? _____

2. What is the frequency of calibration? _____

b. If by Winkler:

1. Is sodium thiosulfate or PAO used as titrant? Thio.

2. How is standardization of titrant accomplished? as per standard methods

3. What is the frequency of standardization? 1/month

Recommendations:

Obtain pH 10 buffer for calibrating pH meter. Meter should be calibrated before each use. Review correct procedures for reporting BOD_5 when 5 day D.O. depletion is less than 2.0 ppm or residual (final) D.O. is less than 1.0 ppm (DOE manual pgs. 19 & 20). Maintain an incubator temperature log. Keep this log on the incubator door.

F. Calculating Final Biochemical Oxygen Demand Values Washington State Department of Ecology

1. Correction Factors

a. Dilution factor:

$$= \frac{\text{total dilution volume (ml)}}{\text{volume of sample diluted (ml)}}$$

b. Seed correction:

$$= \frac{\text{(BOD of Seed)(ml of seed in 1 liter dilution water)}}{1000}$$

c. F factor ∿ a minor correction for the amount of seed in the seeded reagent versus the amount of seed in the sample dilution:

$$F = \frac{\text{[total dilution volume (ml)] - [volume of sample diluted ml}}{\text{total dilution volume, ml}}$$

2. Final BOD Calculations

a. For seed reagent:

(seed reagent depletion-dilution water blank depletion) x D.F.

b. For seeded sample:

OK

(sample dilution depletion-dilution water blank depletion-scf) x D.F.

c. For unseeded sample:

(sample dilution depletion-dilution water blank depletion) x D.F.

3. Industry/Municipality Final Calculations

Recommendations:

_____

_____

_____

_____

_____

_____

III. TOTAL SUSPENDED SOLIDS CHECKLIST

A. Technique

1. What analysis technique is utilized in determining total suspended solids?

   a. Standard Methods? _____ Edition _____

   b. EPA? _____

   c. A.S.T.M.? _____

   d. Other (specify)? Waste Water Plant Operators Manual. St. of Wash. 1974

B. Test Procedure

1. What type of filter paper is utilized:

   a. Reeve Angel 934 AH? _____

   b. Gelman A/E? _____

   c. Other (specify)? Whatman GF/C

   d. Size? 9.0 cm

2. What type of filtering apparatus is used? Buchner Funnel — Suction Filtration

3. Are filter papers prewashed prior to analysis? yes

   a. If yes, are filters then dried for a minimum of one hour yes at 103°C-105°C yes?

   b. Are filters allowed to cool in a dessicator prior to weighing? yes

4. How are filters stored prior to use? IN Dessicator

5. What is the average and minimum volume filtered? 250 ml

6. How is sample volume selected?

   a. Ease of filtration? _____

   b. Ease of calculation? _____

   c. Grams per unit surface area? _____

   d. Other (specify)? all Samples are 250 mls.

7. What is the average filtering time (assume sample is from final effluent)? 1 min.

8. How does analyst proceed with the test when the filter clogs at partial filtration? NO problem (9cm Filter)

9. If less than 50 milliliters can be filtered at a time, are duplicate or triplicate sampe volumes filtered? NA

10. Is sample measuring container; i.e., graduated cylinder, rinsed following sample filtration and the resulting washwater filtered with the sample? yes

11. Is filter funnel washed down following sample filtration? _____

    yes

12. Following filtration, is filter dryed for one (1) hour, cooled in a desscator, and then reweighed? yes

13. Subsequent to initial reweighing of the filter, is the drying cycle repeated until a constant filter weight is obtained or until weight loss is less than 0.5 mg? NO

14. Is a filter aid such as cellite used? NO

a. If yes, explain: _____

Recommendations:

When Whatman GF/C Filter paper is used up order either Reeve Angel 934AH or Gelman A/E. IT is a good idea to occasionally repeat the drying cycle until a constant weight is obtained (See question 13).

C. Calculating Total Suspended Solids Values Washington State Department of Ecology

A. $mg/l\ TSS = \frac{A-B}{C} \times 10^6$ OK

1. Where: A = final weight of filter and residue (grams)

B = initial weight of filter (grams)

C = Milliliters of sample filtered

2. Industry/Municipality Calculations

Recommendations:

SPLIT SAMPLE RESULTS:

Origin of Sample _____

Collection Date _____

BOD		TSS		EPA BOD Standard	
DOE	IND./MUN.	DOE	IND./MUN.	DOE	IND./MUN

Deer Park

FECAL COLIFORM TEST - EQUIPMENT AND SUPPLIES CHECK LIST

Equipment

Hand tally counter _____

Vacuum source (pump, aspirator, or hand pump) _____

Vacuum tubing _____

Vacuum flask _____

Trap flask, with rubber stopper _____

Filter holder funnel (pyrex, stainless steel, or plastic) _____

Forceps, blunt tip _____

Flame source or bactincenerater _____

Ampoule breaker _____

Water bath incubator with gabled cover _____

Magnification source - 10-20 X mag. _____

Bottles with screw caps (minimum 125 ml capacity) (milK dilution bottles may be used) _____

Bottles or flask for buffer, 500 ml capacity _____

Sterilizer (pressure cooker will work) _____

Supplies

Membrane filters .45 µm 47 mm white gridded _____

Alcohol for flaming _____

Sodium thiosulfate $NA_2S_2O_3$ } small quantity _____
Potassium dihydrogen phosphate KH_2PO_4 } small quantity _____

Disposable petri dishes 50 x 12 mm _____

Pipets; 10 ml and 1 ml _____

Disinfectant for wiping counter tops (not alcohol - it is not effective enough; a phenolic disinfectant is preferred) _____

Whirlpak bags or other water-tight bags (must be sterile) _____

MFC broth (ampoules or dehydrated (rosolic acid required for dehydrated media) _____

1N NAOH (sodium hydroxide) _____

Foil _____

Magnesium Sulfate ($MgSO_4 \cdot 7H_2O$) _____

Kraft paper _____

REAGENT PREPARATION

1. What are the reagents prepared for the fecal test?
(two stock solutions made first. phosphate buffer and magnesium sulfate)

Phosphate buffer + Magnesium Sulfate

2. Describe the procedure used to make phosphate buffer.
(For 100 ml of stock solution, 3.4 g potassium dihydrogen phosphate (KH_2PO_4) in 50 ml distilled water. Adjust pH with 1N NaOH* and dilute to 100 ml with distilled water)

OK

- Correct pH for phosphate buffer is? (7.2) 7.2

- How is phosphate buffer stored?
(in the dark)

IN INCubator

- is phosphate buffer for BOD test used in fecal test?
(NO - because BOD buffer contains chemicals which interfere with the fecal coliform test.)

NO

3. Describe the procedure used to make magnesium sulfate.
(5 g $MgSO_4 \cdot 7H_2O$ in 100 ml of distilled water)

OK

4. How is working solution made?
(1.25 ml stock phosphate solution; 5 ml of stock magnesium sulfate; 1000 ml distilled water. mix thoroughly)

OK

* NaOH - NaOH = 4 g NaOH in 100 mls of distilled water.

5. How is dilution buffer prepared?
(fill screwtop bottles with a volume of working solution which will give 99 ml ± 2 ml of buffer after sterilization (102 ml will usually give 99 ml after autoclaving; 9.5 ml will usually give 9.0 ml))

OK

6. What items do you sterilize for fecal test?
(Everything)

Everything

What is the sterilization procedure?
(15 min at 15 lbs pressure (250°F)) dry heat, 2 hours at 170°C

15 min. @ 20 lbs.

- How are bottles cooled?
(allow pressure and temperature to come down slowly so liquids don't boil over - tighten caps after sterilization)

OK

Sample Bottles

1. Is a dechlorinating agent added to bottles before sterilization?
(Yes)
Agent? (Sodium thiosulfate)

15 mls of Thio / Sample — Explained correct procedure
ie. 1 ml thio / 4 oz sample. Thio. must be sterilized IN bottles.

2. How is thiosulfate solution prepared?
(1% solution prepared by adding 1 g $Na_2S_2O_3$ to 100 ml water; stir until it dissolves)

OK

3. How much thio is added?
(1 ml per 4 oz of sample [4 oz = 125 mls])

See question 1 above

4. Describe bottle sterilization procedure.
(place cap loosely on bottle, sterilize by dry heat 2 hours at 170°C or under pressure 250°F, 15 pounds pressure for 15 minutes. If moist heat under pressure is used, at end of sterilizing time release pressure quickly and allow bottles to dry in the hot autoclave or pressure cooker) Remove bottles. Allow to cool. Tighten lids.

OK

5. How long are the bottles considered sterile?
(4 to 6 weeks) prepared weekly

6. Are filter funnels sterilized?
(Yes) yes

7. Describe procedure for cleaning dirty glassware.
(Clean in detergent solution; rinse 3 times in tap H_2O 3 times in DW)

OK

Test Procedure

1. How do you determine what dilutions to use?
(Should produce 20 to 60 colonies. If no previous data, filter 1 ml, 3 ml, and 10 ml. If past data are available, determine volume which produced 20 to 60 colonies. Filter that volume plus a smaller and larger volume (see Table 1))

Uses 2 dilutions only (25ml & 30ml). Explained correct procedure. See DOE Manual pgs 6 & 7.

2. Is working area disinfected? (Yes) NO — See DOE Manual pg. 7

How is media prepared?
(ampoules or dehydrated media)

Millipore ampoules

3. How are petri dishes prepared?
(Sterile absorbent pad placed with flame sterilized forceps. Add 2 ml broth. Pour off excess, leaving one drop excess only.)

OK

If broth is made from dehydrated media, how long is it stored?
(No more than 5 days). NA

Under what conditions?
(refrigerated) NA

How are ampoules stored?
(refrigerated) Caution operators against buying too much media at one time. It won't last forever.

Refrigerated - Ordered Every 3 months.

Filtration

1. Are forceps sterilized before use? (yes) yes

How? (flamed in alcohol) Flamed - No alcohol

2. Are sterilized forceps used to place membrane filter on filter holder? (Yes)

yes

3. Is filter placed grid side up? (yes) yes

4. How is sample mixed prior to filtration?
(Shaken vigorously straight up and down 25 times)

NOT mixed - Sample is dipped out. See DOE Manual pg. 8

5. What do you do if your sample volume is less than 1 ml?
(Sample must be diluted)

Incorrect procedure - See DOE Manual pg. 9

If sample is diluted, how is this done?
(1/10 = 1 ml sample add to 9 mls sterile dilution buffer. Shake vigorously 25 times. Add copy of Table 3 to questionnaire.)

Incorrect procedure - See DOE Manual pg. 9.

6. If volume is less than 20 ml, is sterile buffer added?
(Yes, a small amount of sterile buffer is added to ensure adequate bacterial dispersion)

Incorrect procedure - See DOE Manual pg 8

7. Is more buffer added to ensure a uniform suspension?
(Yes) Incorrect procedure - See DOE Manual pg. 8

8. Is the funnel rinsed after initial filtration?
(Yes - three times) yes

With what?
(20 to 30 ml sterile phosphate buffer.)

20ml phosphate buffer

Describe procedure.
(add buffer, swirl the holder and start the vacuum)

OK

9. How is filter transfered to dish?
(DO NOT SET FUNNEL BASE DOWN. With flame sterilized forceps - with care so no air is trapped between the pads and filter.)

OK

Incubation

1. Describe incubation procedure.
(dishes placed in whirlpak bag extra air pressed out. Submerge upside down in water bath.)

Uses electrical tape to keep water out. Has ordered Whirl-Pak bags.

2. What temperature is the waterbath?
(44.5 plus or minus .2°C - VERY IMPORTANT) Has trouble keeping water bath ± .2°C

Are samples weighted so that sample is beneath water surface?
(Yes) yes

3. How long are dishes incubated?
(20 to 24 hours) 24 hours

When are counts made? (Immediately) Immediately
(blue color fades after 1/2 hour)

Counting

1. How are colonies counted?
(see Table 4 in booklet) OK

What color? (any shade of blue) Be careful not to count Filter Fly eggs

How much magnification? (10 to 15 x) None - Should use 10X

2. Are used petri dishes sterilized prior to disposal?
(Yes - IMPORTANT because they may contain disease-causing organisms.)

Incinerate Immediately

(Count "fried egg colonies," but be careful not to count insect eggs which are also blue, but very tiny. Significantly smaller than coliform colonies. Insect eggs are also very round and tend to be in geometric packets and stain more evenly than coliform colonies and are flatter. Lagoons are most likely to have insect eggs. Operators should use magnification because it is easier to keep track of where they have counted and helps distinguish between oddly shaped colonies and colonies that have grown together.)

Calculation of Results

1. Count per 100 ml = $\frac{\text{\# of colonies counted}}{\text{vol of sample filt in ml}} \times 100$
count filters with 20 to 60 blue colonies only.
(include table 4 in questionnaire)

OK

2. If more than one dilution produces a count between 20 and 60, how is final count calculated?
(Calculate count for each plate [with acceptable count] separately and report the average of the final results.)

Incorrect procedure - See DOE Manual pgs. 11-15

3. If all plate counts have fewer than 20 colonies, how is count reported? (Select the most nearly acceptable count. Calculate the number of colonies/100 mls and report this value as an estimated count.)

Incorrect procedure - See DOE Manual pgs. 11-15

4. If all plate counts are zero? (Calculate using a count of 1 from largest filtration volume. Report as less than calc. value)

Incorrect procedure - See DOE Manual pgs 11-15

5. If all plate counts are above the upper limit of 60? (Calculate with smallest volume filtered. Report as estimated count.)

Incorrect procedure - See DOE manual pgs 11-15

6. Is result rounded to 2 significant figures? (Yes) yes

7. How is monthly average calculated? (Geometric mean not arithmatic mean give handout explaining how to calculate. Show example of difference this makes.)

Uses arithmatic mean. Explained and left operator with a chart for calculating geometric mean.

TABLE 1

Sample Volume (ml)	Organisms per 100 ml Represented by 20-60 Colonies on Membrane Filter		
.0001	20,000,000	–	60,000,000
.0003	6,700,000	–	20,000,000
.001	2,000,000	–	6,000,000
.003	670,000	–	2,000,000
.01	200,000	–	600,000
.03	67,000	–	200,000
.1	20,000	–	60,000
.3	6,700	–	20,000
1.	2,000	–	6,000
3.	670	–	2,000
10.	200	–	600
30.	67	–	200

LITERATURE CITED

Albertson, O.E., et al., 1977. Wastewater Treatment Plant Design, MOP/8, Lancaster Press, Inc., 560 pp.

Department of Ecology, 1977. Washington State Water Quality Standards, Office of Water Programs, DOE, WAC 173-201-025 and WAC 173-201-045

Department of Ecology, 1978. Criteria for Sewage Works Design, CH_2M-Hill, Inc., DOE 78-5, 156 pp.

Eckenfeider, W.W. and D.J. O'Connor, 1961. Biological Waste Treatment, Pergammon Press, Inc., 299 pp.

Haggerty, T., et al., 1979. "Infiltration/Inflow Analysis, City of Deer Park Facilities Plan," Project No. C-53 0855-01, Unpubl. Rpt., 3 pp.

Joy, J., 1981. "Dragoon Creek Receiving Water Study/Deer Park STP," memo to Carl Nuechterlein, Eastern Regional Office, DOE, 28 pp.

Leupold and Stevens, Inc., Stevens Water Resources Data Book, 1st Edition, Leupold and Stevens, Inc., 159 pp.

Yake, W.E., 1979. "Pasco Sewage Treatment Plant Class II Inspection," memo to Phil Williams, Eastern Regional Office, DOE, 24 pp.