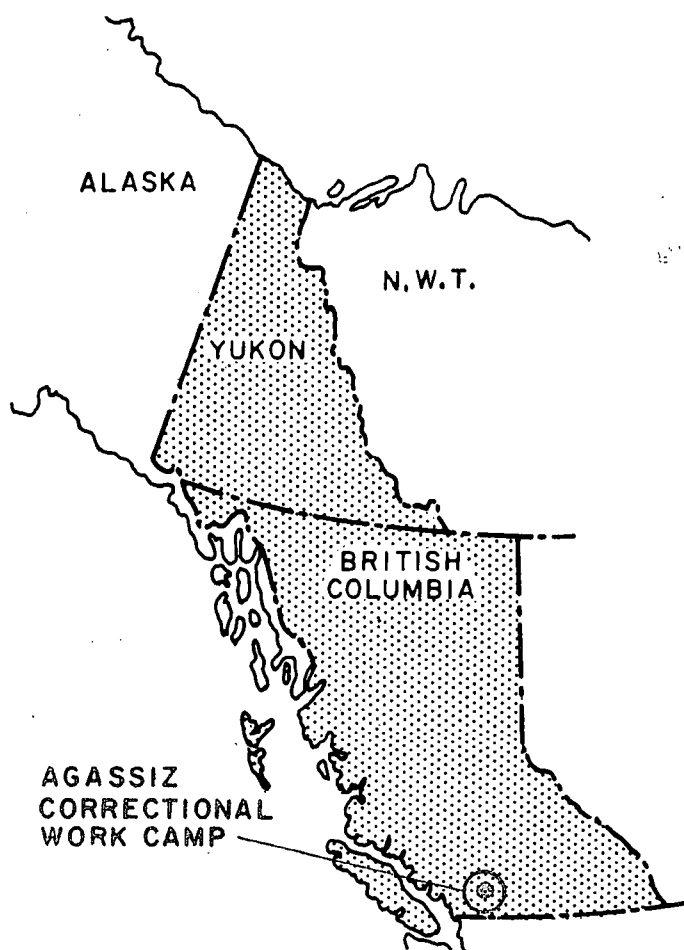




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ASSESSMENT REPORT

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AGASSIZ CORRECTIONAL WORK CAMP
SEWAGE TREATMENT ASSESSMENT REPORT

by

J.W. Atwater

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PACIFIC REGION

Vancouver, B.C.

April, 1974
July, 1973

SUMMARY.

Septic tank effluent from the Agassiz Correctional Work Camp, Agassiz, B. C., is being discharged into a small fresh water stream in the lower Fraser Valley. This discharge constitutes a potential health hazard. The installation of a wastewater treatment system incorporating a rotating biological disc is recommended to provide the necessary treatment and, at the same time, provide an opportunity to study and evaluate the rotating biological disc system.

Public access and the presence of fish in the receiving water will necessitate the need for chlorination and dechlorination of the effluent prior to discharge.

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AGASSIZ CORRECTIONAL WORK CAMP
SEWAGE TREATMENT ASSESSMENT REPORT

1. INTRODUCTION

In 1972 the Federal Government decided to demonstrate leadership in the environmental protection field and authorized a clean-up program of existing federal facilities that will assure that federal activities and installations will conform to provincial and federal environmental laws and standards.

The administration of this program is carried out by the Federal Activities Abatement Group of the Environmental Protection Service, Environment Canada.

This assessment report was prepared by the engineering staff of the Federal Activity Unit - Pacific Region - in cooperation with Canadian Penitentiary Service.

2. DESCRIPTION OF FACILITY

Agassiz Correctional Work Camp, a minimum security institution of the Office of the Solicitor General, is located in an agricultural area 4 1/2 miles northeast of Agassiz, B. C. The Camp is situated on land borrowed from the Department of Agriculture's #2 Agassiz Farm and is subjected to flooding from waters backing up from the Fraser River during the Spring run-off.

2.

The camp was constructed as a temporary facility 10 years ago, and has a life expectancy of another five years. (Plate 1) A permanent staff of 20 people supervise 80 - 90 inmates.

The wastewater collection and disposal system at the Agassiz Correctional Work Camp consists of a large septic tank and a tile field. Kitchen and laundry wastes are isolated from the domestic wastes and are fed to a separate chamber in the septic tank. The liquid from both chambers overflows through a syphon chamber to a wet well, from which the effluent was pumped to a tile field.

The Correctional Camp has a small incinerator in which they burn dry materials predominately paper and wood scrap. The kitchen scraps and other solid wastes are trucked two to three times a week to the Kent Municipal Dump.

The domestic water supply is normally brought off a hill west of the camp. When this water becomes turbid, well water is used.

3. PROBLEM

Subsequent to the installation of the septic tank system the tile field failed and the effluent now flows directly into a stream adjacent to the Correctional Camp (see Plate 2). Salmon have been reported in this stream. This effluent discharge is marked by a septic gray channel (Plates 3 & 4) from the top of the stream bank to the stream itself. A strong septic odour is associated with this channel. When the wet well pump is operating

3.

the septic tank effluent can be seen in the stream 100 - 200 feet below the point of discharge. The discharge is about 24 Igpm and the stream has a reported low flow in excess of 2,000 Igpm. There is also a small amount of seepage upstream but this appears to be less than one Igpm.

The BOD₅ nutrient, and coliform characteristics of the septic tank effluent and the stream are listed in Table I. Shown in Figures 1 and 2 are the sample locations and camp layout.

The high BOD₅ readings in the stream 100 feet down from the discharge were taken in that portion of the creek where the septic tank effluent could still be seen. As can be seen from Table I the effluent and receiving water quality does not meet the requirements of the Water Pollution Control Abatement Program.

In addition, the British Columbia Pollution Control Branch requires a minimum of secondary treatment and chlorination of any effluent discharged into "small streams, back waters or sloughs in the lower Fraser Valley". Access to the stream is restricted above #4 sample point, however, the mean MPN number of 16,000/100 ml at point #4 would indicate a possible health hazard.

4. WASTE TREATMENT

4.1 Discussion

Treatment of the septic tank effluent to a degree suitable for discharge to the adjacent stream appears to be the only

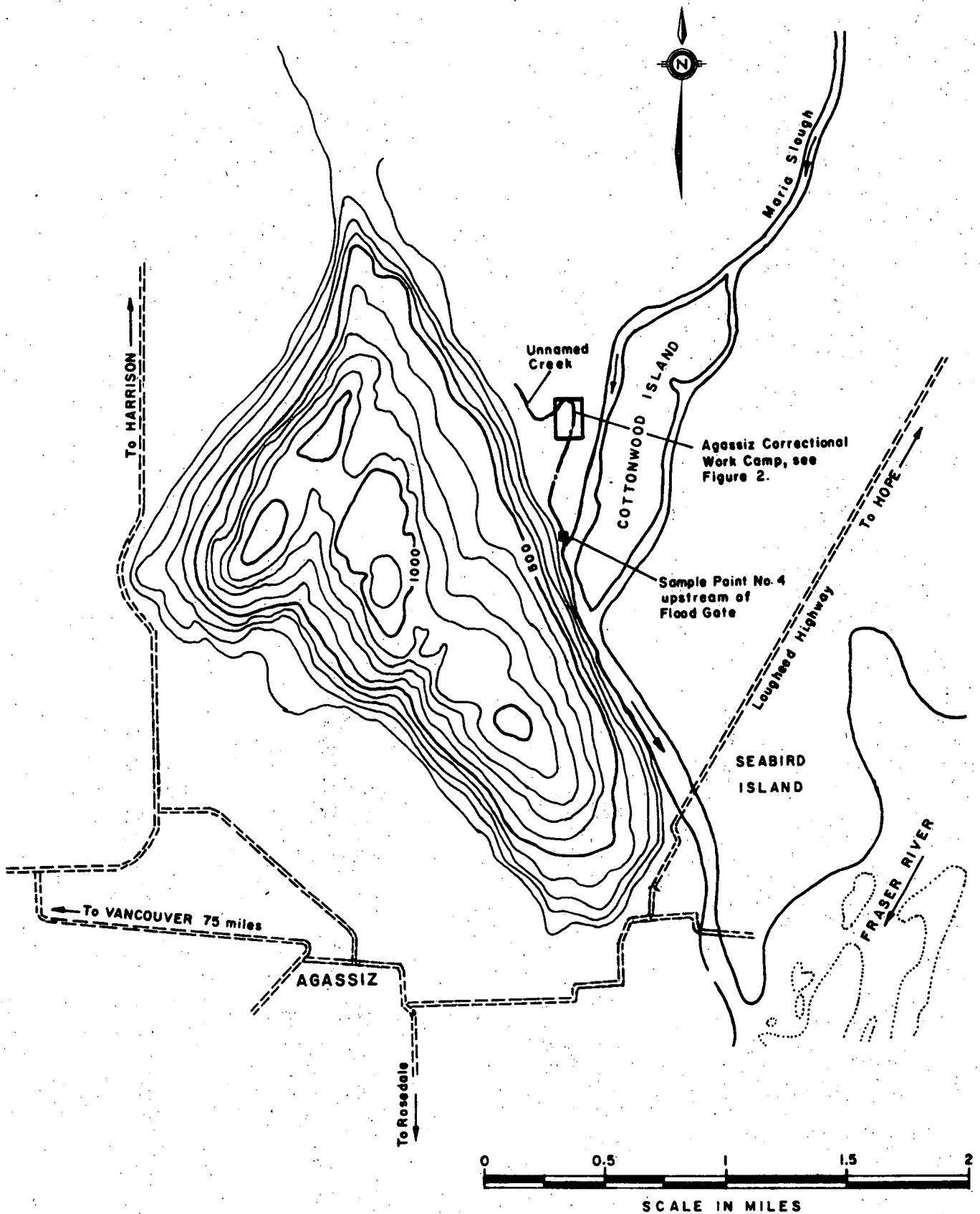


FIG.1 AGASSIZ CORRECTIONAL WORK CAMP - LOCATION MAP

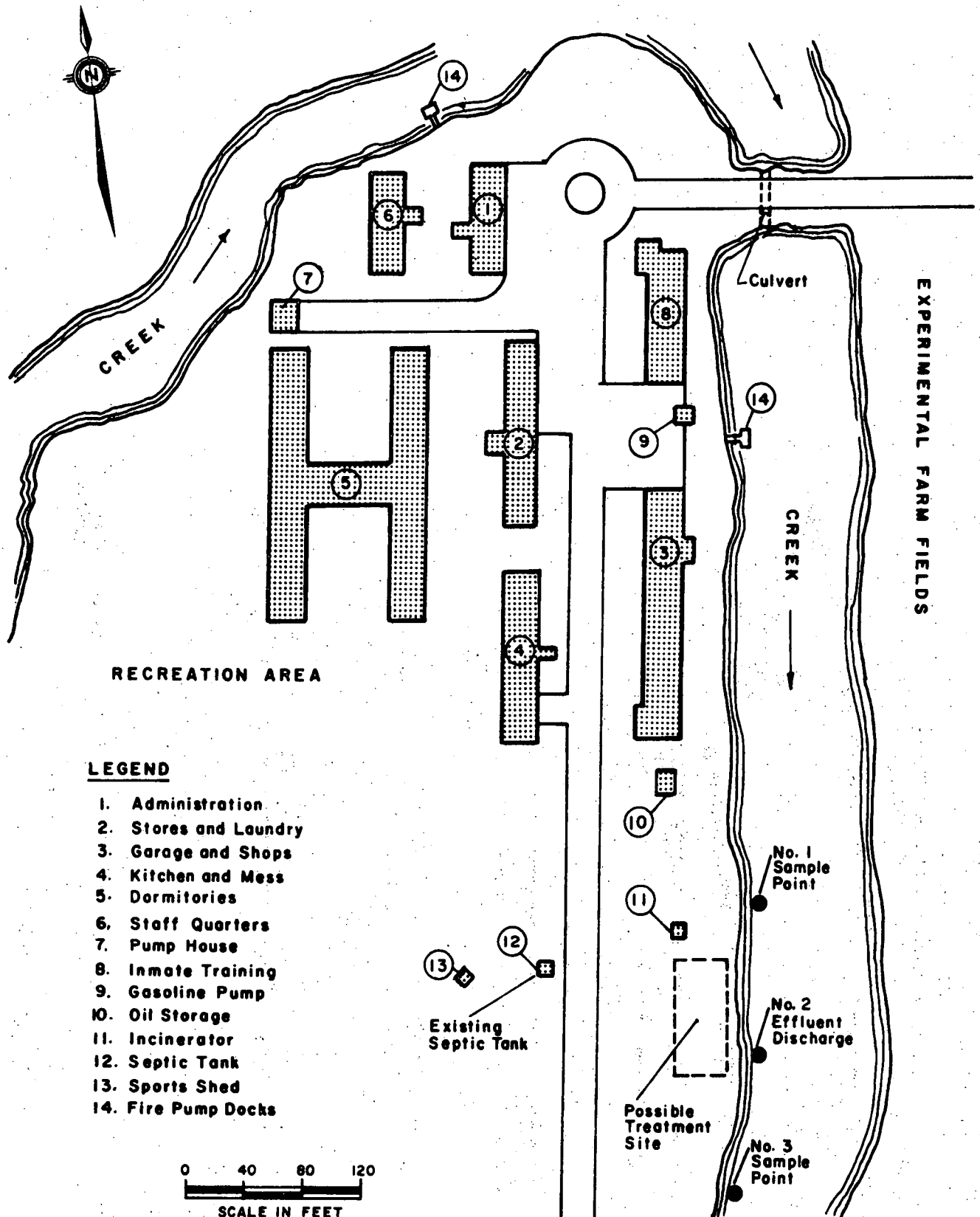


FIG. 2 AGASSIZ CORRECTIONAL WORK CAMP - SITE PLAN

viable solution. The reactivation of the existing tile field or the construction of a new tile field would not be feasible. The ground around the camp is tight and subjected to periodic flooding. Complete removal of the wastewater from the camp either by trucking or through connection to an existing sewer, while technically feasible, would not be viable on economic grounds. There are no sewage treatment facilities in the immediate area which could receive the camp sewage.

The effluent flow varies between 3,800 and 4,800 Igpd., assuming the seepage loss between the wet well and the point where the effluent flows out of the stream bank is negligible. About seventy-five percent of the flow occurs between 8:00 a.m. and 9:00 p.m. There is sufficient capacity in the wet well and syphon chamber so that the flow can be spread over the entire day. Therefore, a treatment system with a daily capacity of 5,000 Igpd would be adequate.

Three biological wastewater systems are reportedly capable of treating waste to a degree suitable for disposal to the creek. These are, a series of aerated lagoons, activated sludge, and a rotating biological disc.

4.2. Alternatives

- The suitability of a lagoon system would be limited by area restrictions, cold winter temperatures, and the possibility of the lagoon being flooded out.

- Activated sludge - (extended reaction) - operated properly will give a high degree of treatment. However, experience to date has shown that small extended aeration plants rarely operate properly without continued and experienced supervision. It is doubtful if such supervision would be available at the Agassiz Correctional Work Camp.
- The third biological treatment system is a biological rotating disc, which is reported to produce an excellent effluent without supervision for small flows under fluctuating hydraulic and organic loads. (A complete description of this system is appended.)

The disc system does not require an operator and the only maintenance necessary is greasing of the bearings and motor.

There are no disc installations in British Columbia but British Columbia Research and the Fisheries Research Board at Steveston have conducted pilot tests on industrial wastes, using rotating discs and have had favourable results.

4.3. Recommendations

A treatment system, incorporating a rotating biological disc, is recommended for the Agassiz Correctional Work Camp for two reasons:

8.

- (a) Where a consistent, high quality effluent has been required low flow conventional treatment systems have tended to fail. The rotating biological disc is compact, can be protected against the weather and does not require operational supervision and, apparently, does provide the required consistent, high degree of treatment.
- (b) The low maintenance, low power requirements and high consistent degree of treatment efficiency reported for the rotating biological discs would make them ideal systems for small isolated communities where the installation of conventional systems is not always feasible. An installation of a disc system at Agassiz would allow for an evaluation of such a system used in conjunction with a septic tank for primary settling and sludge digestion. The septic tank installation at Agassiz is typical of those in many small communities and, if feasible, the rotating biological disc would be a cheap and simple means of upgrading treatment in many of these communities.

5. CHLORINATION

5.1. Regulations

Under the B.C. Pollution Control Act, effluent discharges to fresh water, under 10,000 gal./day, do not have to be

TABLE 1

AGASSIZ CORRECTIONAL WORK CAMP
WASTE AND RECEIVING WATER DATA

DATE	TEST	SAMPLE POINT			
		1	2	3	4
May 1/73	BOD ₅	2.0	90.0	35.0	2.0
2		0.	135.	30.0	-
3		-	88.0	30.0	-
10		2.0	180.0	15.0	25.0
May 1/73	Nitrate Nitrogen (NO ₃)	0.8	0.9	1.3	2.1
2		1.7	1.6	1.6	1.8
3		1.4	1.1	1.5	1.5
10		0.5	1.3	0.6	0.5
May 1/73	Total Phosphate (PO ₄)	0.10	4.80	0.36	0.01
2		0.10	18.60	2.80	0.40
3		0.10	22.60	0.38	0.28
10		0.23	9.70	0.13	0.30
May 1/73	Total Organic Carbon (C)	10.0	72.0	16.0	4.0
2		9.0	120.0	15.0	8.0
3		8.0	62.0	9.0	9.0
10		8.0	140.0	9.0	8.0
May 10/73	Suspend. Solids				
	Volatile	N.D.	73.2	N.D.	12.0
	Total	4.8	87.6	4.8	32.0
	Most Probable Number Coliform Colonies(MPN)	700	64,000,000	6,600,000	16,000

N.D. - Not Detectable

chlorinated. However, under Federal guidelines¹ the maximum MPN permitted in secondary effluent is 1,000 MPN/100 ml, which implies effective disinfection.

In a brief presented by the Environmental Protection Service to the British Columbia Pollution Control Board Inquiry into Municipal Waste Disposal (April/73) two of a number of points put forward were:

- (a) In waters frequented by fish, chlorinated effluents be dechlorinated, and
- (b) where it can be shown that a public health hazard does not exist, treated effluent can be discharged without chlorination.

5.2 Alternatives

At the Agassiz Correctional Work Camp, four alternatives in terms of disinfection are available:

- (a) Chlorination with chemical dechlorination.
- (b) Chlorination with 3 days holding for dechlorination.
- (c) Ozonation, or
- (d) disinfection only if the coliform count in the receiving water exceeded 500 MPN/100 ml downstream of the effluent discharge.

¹ Objectives and Procedures Water Pollution Control and Abatement Program Federal Facilities 1968, Department of National Health and Welfare.

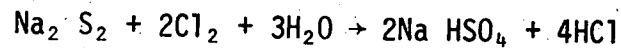
5.3 Recommendation and Discussion:

Access to the receiving water is restricted by the very nature of the Correctional Camp and, therefore, the preferred option would be to disinfect only if the coliform count, where there is public access, exceeds 500 MPN/100 ml. The coliform count at the first point of public access is 16,000 MPN/100 ml with the present septic tank operation. Even though the coliform count could be expected to be lower with secondary treatment, it will be necessary to provide for disinfection. Ozonation, particularly of small effluent flows, is not economically feasible, therefore, chlorination and dechlorination of the effluent will be necessary.

Chemical dechlorination can be accomplished using gaseous sulphur dioxide, sodium bisulphite, sodium metabisulphite, sodium sulphite or activated carbon. Sulphur dioxide and sodium metabisulphite are the most popular dechlorinating agents and for Agassiz, where hypochlorite would be used for chlorination, sodium metabisulphite would be the most suitable.

The sodium metabisulphite ($\text{Na}_2 \text{S}_2 \text{O}_5$) is fed at a rate of 1.34 parts/part of chlorine residual and can be introduced with any of a number of chemical solution feeders. For a small system the chemical feed pump can be tied in with the hypochlorinator.

As far as can be established there are no toxic effects associated with the metabisulphite or bi-products such as bisulphate at the levels which would be fed. However, the reaction shown below between sodium metabisulphite and residual chlorine will depress the pH:



Assuming an initial effluent pH of 7 the pH, after removing a 2.0 ppm chlorine residual, would be between 5 and 6. The pH could be adjusted by the addition of lime or caustic as another stage.

The alternative to chemical dechlorination is a 3-day holding basin. The indicated retention of three days is arbitrary and can be increased if necessary. This alternative eliminates much of the complexity of the dechlorination system and is the most foolproof from the Fisheries standpoint. The danger of flooding could be accepted since flooding would only make this part of the system inoperative when there would be maximum dilution.

Dechlorination of wastewater effluent, like the revolving biological disc is an unknown in British Columbia. On purely an evaluation basis, chemical dechlorination should be attempted at Agassiz, whereas, on an operative and maintenance basis, the holding basin is recommended. The cost

of installing a chemical feeder for dechlorination and a contact tank, while not minimal, should not exceed \$1,000. and, therefore, could be installed in addition to the holding lagoon.

6. CONCLUSIONS:

- (1) Septic tank effluent is discharging directly into a small fresh water stream.
- (2) This discharge does not meet the requirements of the B. C. Pollution Control Branch or the objectives of the Federal Activities Clean-up Program.
- (3) A minimum of secondary treatment is required before this effluent should be discharged to the stream.
- (4) Ground disposal is not feasible.
- (5) A rotating biological disc may prove to be an ideal treatment for small flows.
- (6) The installation of a rotating biological disc at Agassiz is recommended to provide the necessary treatment and to serve as a test installation.
- (7) Chlorination and dechlorination of the effluent will be required prior to discharge to the receiving water. Two options are available:
 - (a) Chemical dechlorination and
 - (b) a 3-day holding basin.

7. RECOMMENDATIONS

- (1) The effluent at the Agassiz Correctional Work Camp be upgraded to meet the secondary treatment standards outlined in the Federal Activities Clean-up Program and the Pollution Control Branch of B. C.
- (2) A treatment system, incorporating a rotating biological disc, be used to upgrade the effluent quality.
- (3) Chlorination and dechlorination of the effluent be provided.
- (4) A 3-day holding basin be installed for dechlorination of the effluent prior to discharge into the stream.
- (5) A program be initiated to monitor the performance of the disc system.

CONTACTS

Canadian Penitentiary Service:

Jack Ward	- Works Engineering Coordinator
W. E. Hall	- Director, Agassiz Correctional Work Camp
T. Randall	- Works Officer, Agassiz Correctional Work Camp

Others:

Alex Robertson	- Ames Crosla Mills
H. Kelsey	- Northern Purification.



Plate 1 - Agassiz Correctional Work Camp
looking north.

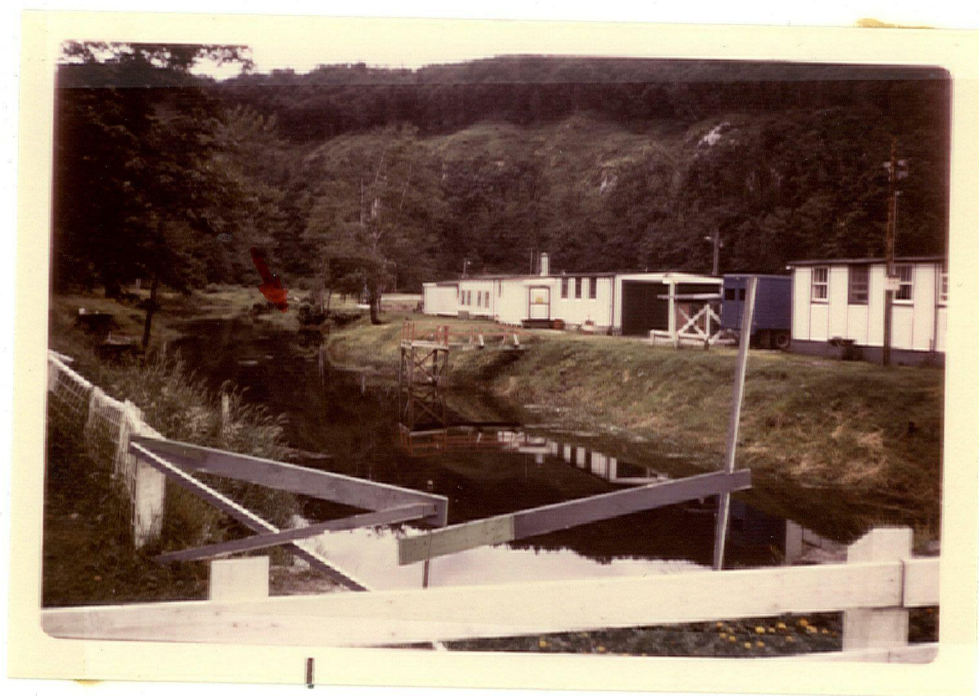


Plate 2 - Receiving Water during Spring
back-up looking south - location
of septic discharge indicated
by arrow.



Plate 3 - Septic tank effluent discharge.
Outfall restructured to facilitate
flow measurements.



Plate 4 - Discolouration in receiving water
due to septic discharge. Line of
demarkation can be seen in the tree
shadow - centre of plate.

18.

APPENDIX A

PROPOSED PLANT

APPENDIX "A"
PROPOSED PLANT.

1. INTRODUCTION

Shown in Figure A-1 is a schematic layout of the proposed system. The proposed plant consists of a secondary clarifier, a chlorine contact tank, a holding basin, a solids disposal line to the septic tank and an effluent recycle line for no flow periods, in addition to the disc units and septic tank.

The plant should have a tight fitting cover for weather and tamper proofing. The cover would be fitted with a vent at one end and an air fan at the other to overcome any odour problem.

2. DISC UNITS

From the available literature, domestic sewage loadings are given in terms of gallons per day per square foot assuming pre-settling with a range of 1.0-2.0 gal/ft²/day typical for a complete system to a 3.0 gal/ft²/day per stage of a multi-stage unit. Hydraulic retention times are usually 1-2 hours for 90% treatment. Ideally the proposed disc system should have 2 hours' hydraulic retention time and a hydraulic load of 1.0 gal/ft²/day. The disc speed should be variable. Rotating biological discs are currently available from three manufacturers:

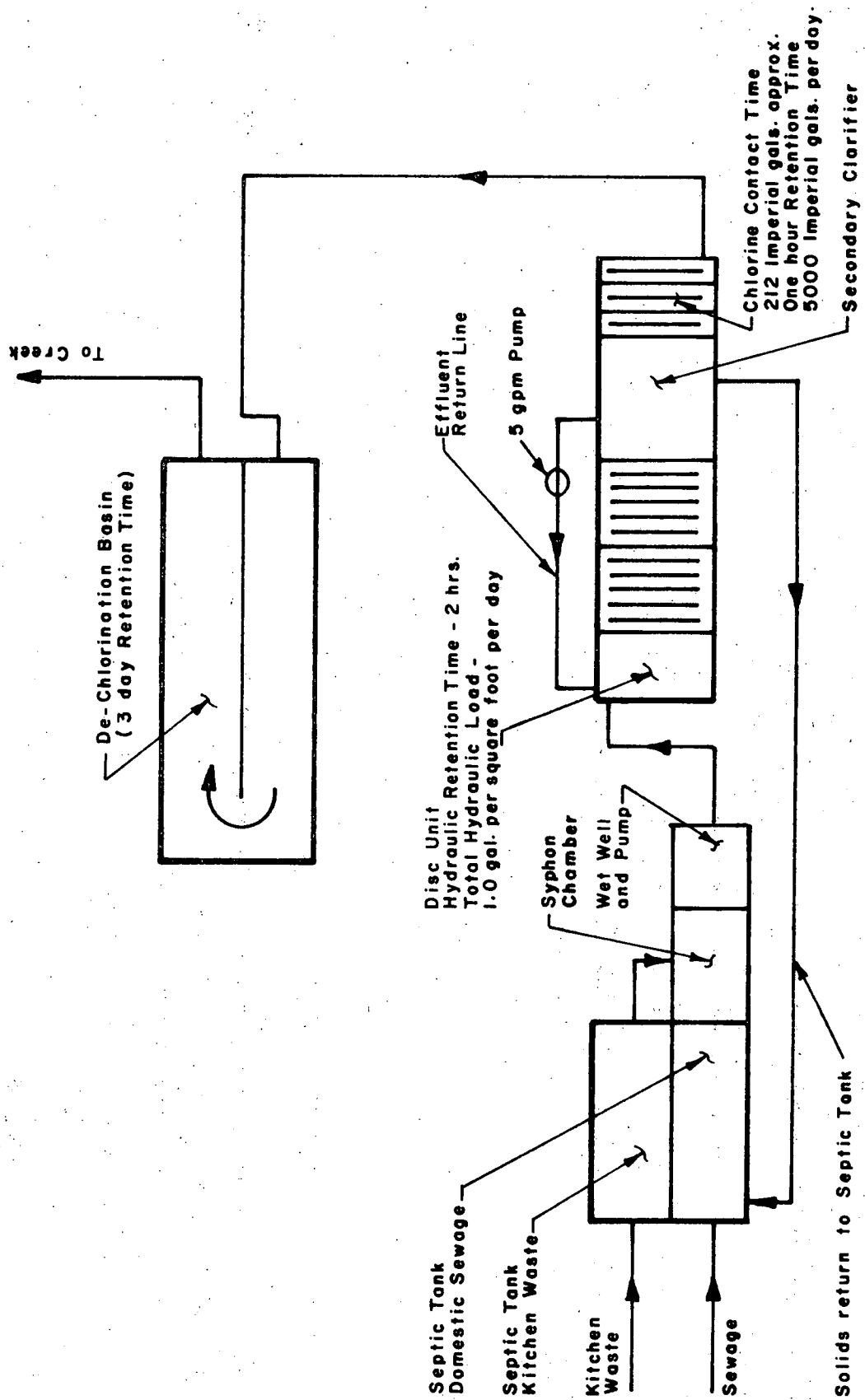


FIG. A-1 SYSTEM SCHEMATIC

- (1) Bio-Disc - Ames Crosla Mills, Toronto, Ontario
- (2) Bio-Surf - Autotrol Corp., Milwaukee, Wisc.
- (3) Environment Pollution Control } - Northern Purification Ltd.,
North Vancouver, B. C.

The Bio-Disc unit has a primary settling chamber whereas the other two require primary settled effluent either septic or aerobic. The Bio-Disc was not recommended for treating septic effluent. Secondary clarifiers are built into these systems.

3. SEPTIC TANK MODIFICATIONS

During the 1972 flood seasons, high water covered the septic tank and flowed into the tank through the wet-well and manholes. To prevent a re-occurrence of this the manholes and wet-well should be extended to above the 1972 high water level and fill should be brought in to raise the ground level. Shown in Figure A-2 are proposed modifications to the existing septic tank.

4. CHLORINE CONTACT TANK

The chlorine contact tank should have a minimum of 1 hour hydraulic retention time at the design flow. The tank must be baffled.

5. HOLDING BASIN

The 3-day holding basin can be a small 2-pass cut and fill lagoon. A plastic divider can be used to form the two channels. Figure A-3 is a sketch of the proposed basin. If it becomes necessary the basin can be extended by either widening or lengthening.

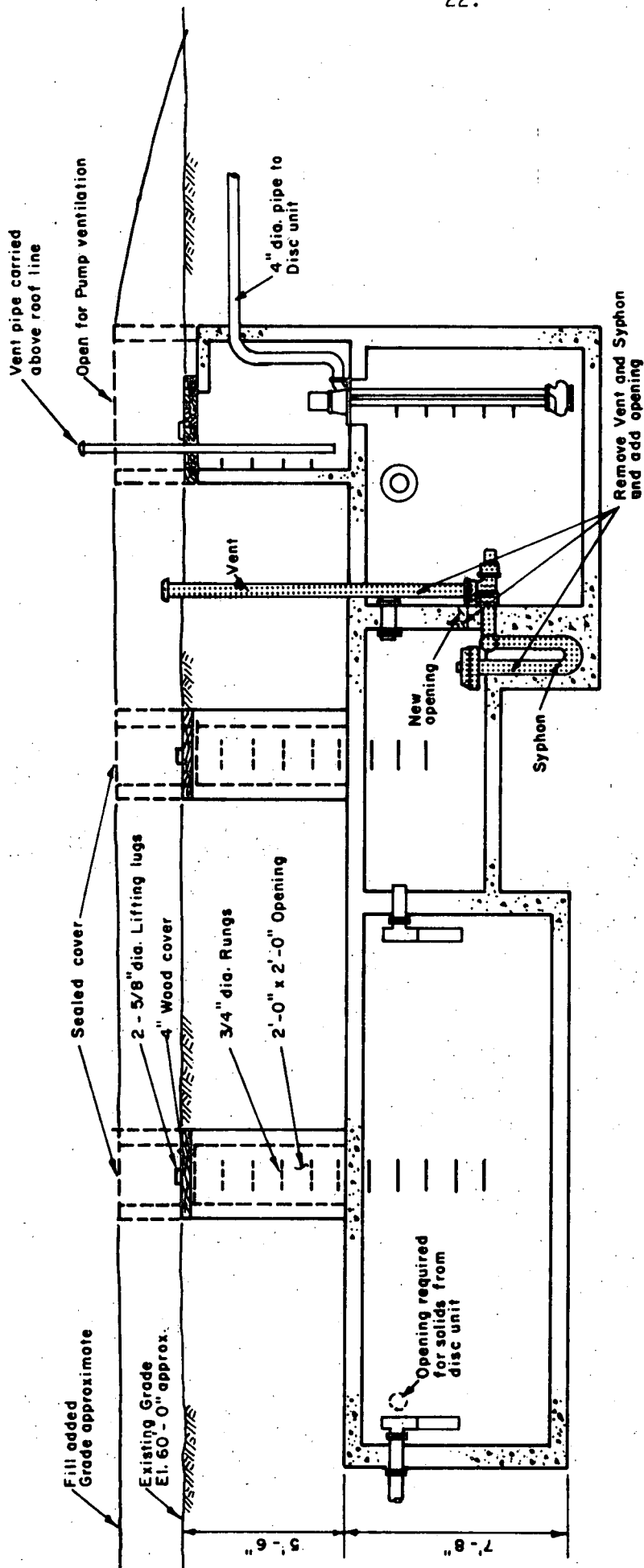


FIG. A-2 SEPTIC TANK MODIFICATIONS

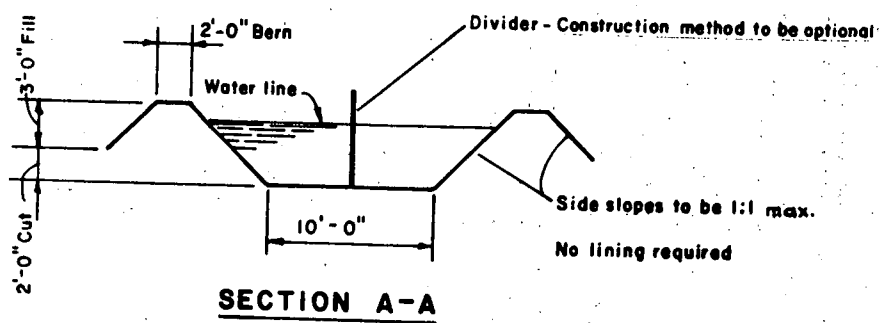
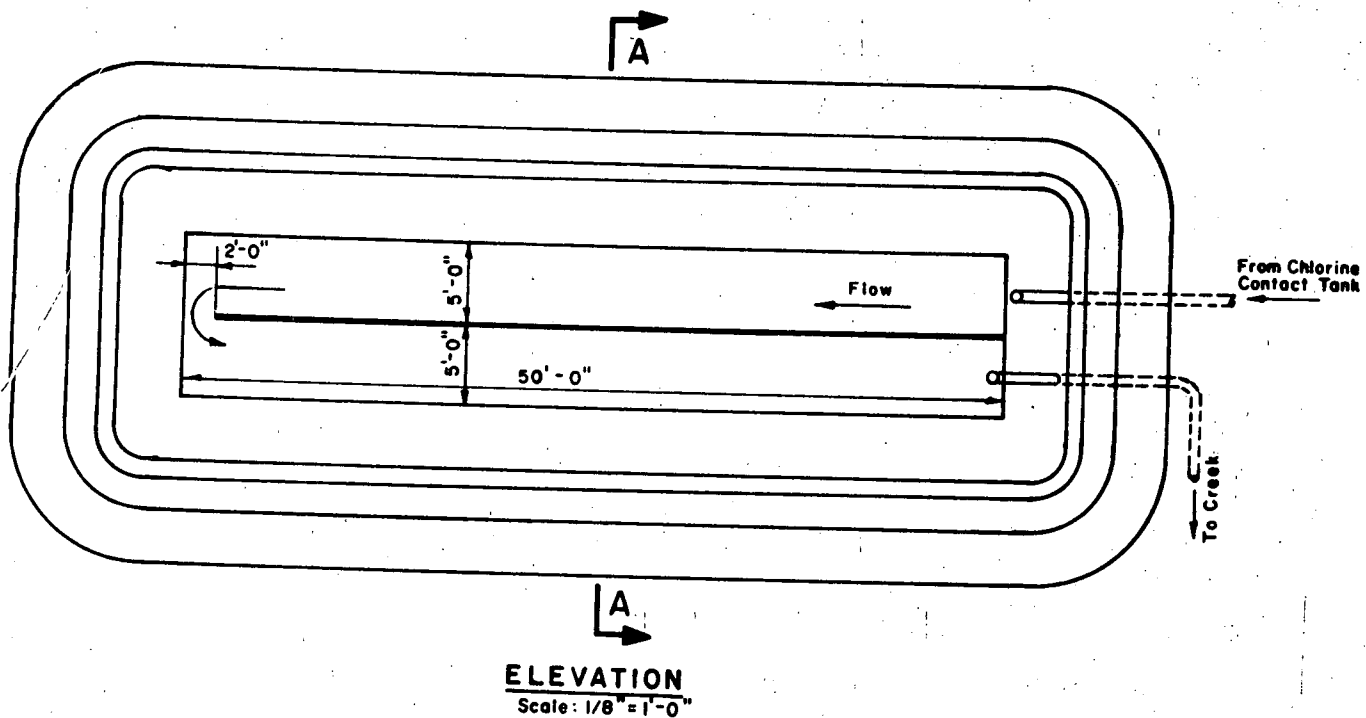


FIG. A-3 DE-CHLORINATION BASIN

6. COSTS

The costs presented are rough estimates only, but are felt to be conservative:

Disc-unit, including secondary Clarifier with cover and return lines	\$10,000
Chlorine contact tank and hypochlorinator cover	700
Concrete Pad for Discs and contact tank ~ 4 cu yd.	500
Basin and Plastic divider	1,000
Septic Tank Modifications. Extend 3 exist- ing manholes 2 feet and provide 25 cu.yds. of fill	1,000
Piping and trenching from disc to holding basin and from basin to creek: 150 Lin. ft. @ \$8/lin. ft	1,200
Contingencies and others	5,000
TOTAL	<u>\$19,400</u>

APPENDIX B

General Description of
Rotating Biological Discs
Copy
of
Biological Waste Treatment
Using Rotating Discs
by
Jack A. Borchardt

BIOLOGICAL WASTE TREATMENT
USING ROTATING DISCS

by

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Summary

This paper describes recent pilot plant experience with the rotating biological disc waste treatment device for municipal sewage. Some operational and economic aspects of the process are discussed, and recommendations for expanded adoption of the treatment scheme are suggested for certain applications. Accompanying disadvantages of the process are also presented.

This paper is an attempt to introduce the reader to a technique for secondary waste treatment which is relatively new to the U.S. In essence the system consists of passing the waste through a series of rotating biological discs. This technology is well established in Europe (where over 400 installations are in operation) and there is every reason to believe it deserves equal attention here.

Fig. 1 shows a pilot plant operation which has been running for an extended period at Ann Arbor, Michigan. The unit is operating on municipal sewage in parallel with the Ann Arbor activated sludge plant and in parallel with several extended aerators of the package type.

Description of Unit

In essence the device consists of a series of closely spaced discs anchored to a shaft which is supported just above the surface of the waste to be treated. The lower portion of each disc extends into the waste, while the upper portion of the disc rotates in the air. Thus a unit area of biological slime is alternately submerged to absorb food and then raised out of the liquid phase to oxidize the absorbed fraction. The waste passing between the discs flows parallel to the adjacent faces of the discs which support a luxurious biological flora. The discs rotate slowly (2 to 6 rpm) imparting a lifting action to the waste through the drag forces generated. This in turn causes the waste adjacent to each disc face to flow in a circular pattern over the submerged portion of the disc. Contact between waste and discs is thus not a single pass between adjacent surfaces but rather a rapid circulation of waste many times over

several quadrants of the disc before the waste leaves the tank for the next stage of discs.

The actual motion of the biological surface or solid phase is literally at right angles to the liquid path at most points. This fact permits exceptional transfer of food and oxygen into the biological slime and waste products from it. As a matter of fact in neither the recirculating high rate filter nor in the activated sludge process is the shear and turbulence at the solid-liquid interface as ideal as in the bio-disc application. It may therefore be speculated that improved rate constants for transfer across this boundary are at least partially responsible for the excellent treatment characteristics observed.

Three to four stages of discs are normally used in routine treatment. Fig. 2 shows the same pilot plant unit uncovered. In this case the installation consists of three stages of 4 ft. discs with fifty discs on each shaft. The simplest concept that could be used to describe the system, would be to call it a horizontal trickling filter. Its detention time can be quite similar to that of a trickling filter. At a nominal load, the unit shown has a total liquid detention time of 21 minutes, (seven minutes per stage) with about three inches of head loss. At this loading most of the B.O.D. results show efficiencies from 89 to 94 percent. Some few data points lie below this region in the range of 85 to 89 percent. These are always coincident with cold weather or extreme adversity in the waste stream itself.

The unit is actually remarkable for the stability of its performance. This is in part due to the high weight of biological growth exposed to the waste. It should be noted that because of

the design which involves storage of biological mass above the fluid as well as within the liquid volume, more than twice as much growth is available for shock load buffering as is actually present at any one time within the waste treatment tank itself. A recent scraping at three points on the disc surfaces revealed that about 18 gms dry weight of biological slime existed on each sq. ft. of disc surface. Thus in stage one of the pilot unit, with 1255 sq. ft. of discs, the total bio-mass would be:

$$\frac{1255 \times 18}{454} = 50\#/stage$$

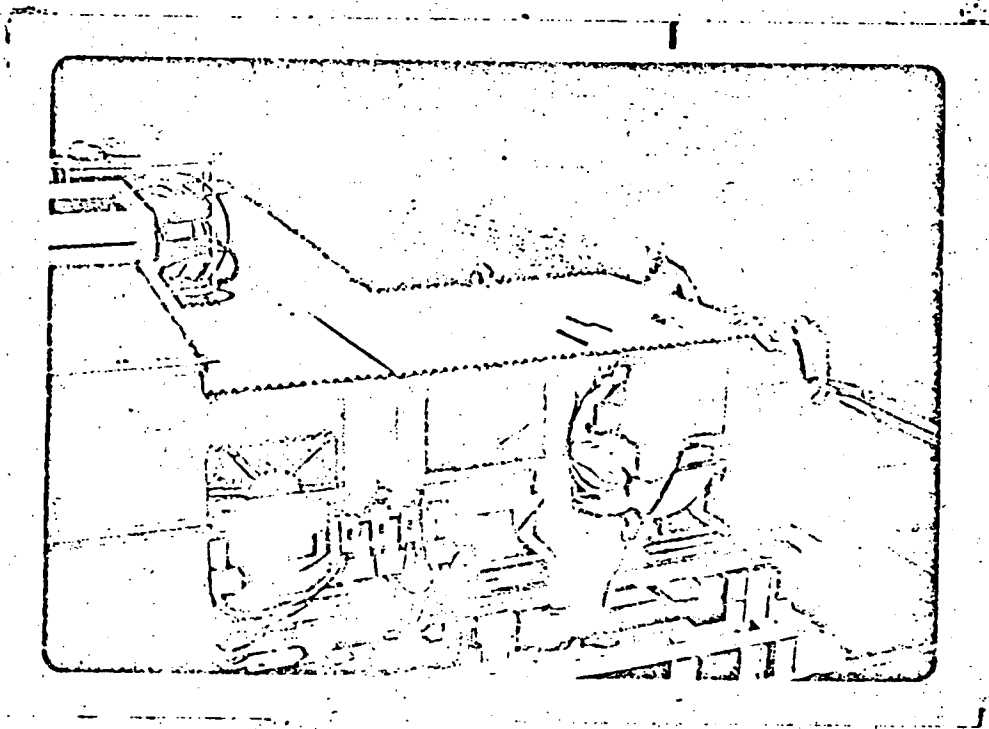


FIGURE 1. GENERAL VIEW OF THE BIO-DISC UNIT -
PRIMARY TANK TO LEFT - FINAL CLARIFIER
TO RIGHT

The nominal flow to this unit had been set at about 10,000 gal per day. On this basis, the bio-mass would consist of:

$$\frac{50 \times 10^6 \times 1440}{10,000 \times 8.3 \times 7} = 124,000 \text{ mg/l}$$

Since the solids are 50 percent volatile, the active bio-mass may be thought of as being equivalent to a mixed liquor volatile suspended solids value of 40 to 60,000 mg/l.

Each battery or stage of discs must be fitted into a tank which, in shape, closely approximates the dimensions of the submerged portion of the stack of discs. There are many reasons for this but the major reasons are:

- (a) To force a thin film of fluid to pass over the disc face.
- (b) To forestall short circuiting.
- (c) To cause high enough local velocities to carry all sloughed solids out of the tank and into the final clarifier.

Visitors to the research installation invariably ask about the accumulation of solids in the tank below the stack of discs. Fig. 3 shows the inlet flume to the first stage of the test unit. This picture was taken three years after operation of the unit was initiated. It should be observed that growth is as heavy on the outside edge of the discs as on the protected faces. If any solids were accumulating on the tank bottoms the edges of the discs would be wiped clean of growth. In short there is no accumulation of solids in the tanks. The suspended solids in the fluid passing to the final clarifier amount to about 250 mg/l and represent those solids sloughed from the discs and any entrained solids that were carried over in the

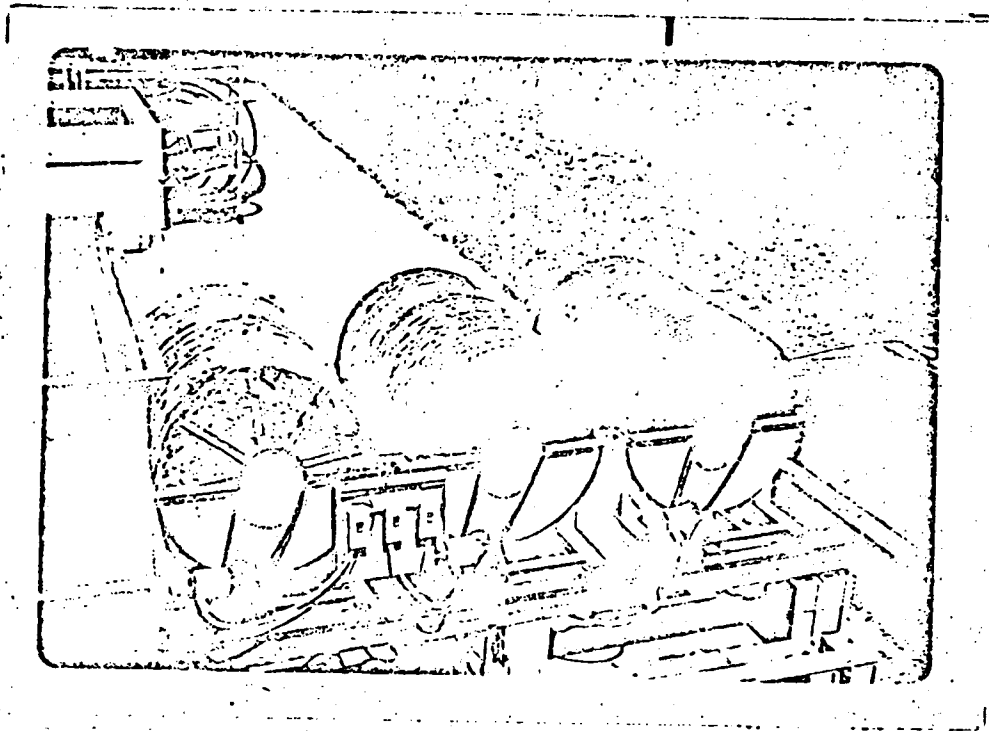


FIGURE 2. VIEW OF BIO-DISC UNIT WITH COVERS REMOVED

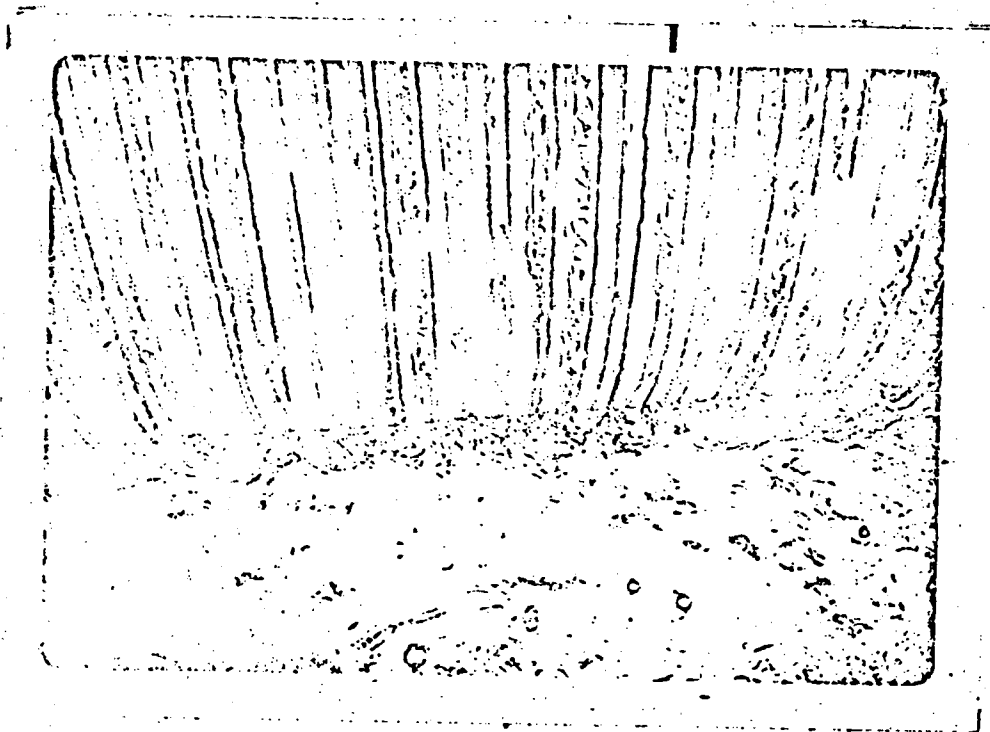


FIGURE 3. INLET TO FIRST STAGE SHOWING DISC SPACING AND EDGE GROWTH

primary effluent.

In essence then the bio-disc is a secondary treatment device with a relatively short detention period which has a very low F/M ratio and yields extremely good B.O.D. removal efficiencies. These facts do generate many questions. Where has this device been over the past 20 years?

Actually, the rotating biological disc is the accumulation of many separate but related ideas. In Europe its designation of "Immersion Drip Filter" is credited by Hartmann to Prof. Pöpel (1). In this country in recent years the unit has been variously referred to as the RBC (rotating biological contactor)* and the RBS (rotating biological surface)**. Buswell evaluated a unit of this type back in 1929 and he referred to the unit as a biological wheel (2). Apparently an experimental unit was developed by Paige and Jones Chemical Company under patents held by A.T. Maltby filed in October of 1928 (3) and granted June 23, 1931.

According to Hartmann (1) the original thought behind the unit should be credited to Travis who in 1901 tried to increase the efficiency of his "Hydrolytic tank", a precursor of the Imhoff tank, by hanging thin wooden strips in the settling compartment. These strips he designated as colloid catchers, and he assumed that through the mechanism of adsorption, the cloudy non-settling portion of the sewage could be removed. After a period of accumulation the solids adsorbed on the wooden slats were supposed to reach a thickness and weight such that they would slough off the slats and fall into the

*(Product of Autotrol Corp., Milwaukee, Wisconsin)

** (Product of Environmental Control Inc., Oconomowoc, Wisconsin)

digestion hopper. Unfortunately, while the solids did accumulate they didn't always slough. In addition, decomposition of the older portions of the deposits of solids invariably reduced the quality of the tank effluent. Just after the slats were cleaned, the tank effluent was observed to be best.

From such observations came two divergent ideas. Buswell was convinced that the slime was biological in nature and that its rather immediate removal from the slats was important. To this end he proceeded with experiments which involved shaking the slats. The idea of motion of the biological support finally culminated in the biological wheel and the Maltby patent.

Along a somewhat different vein of thought, C.C. Hays of Waco, Texas worked out the principle of contact aeration. His basic premise was that decomposition of the older deposits of slime could be prevented with the presence of diffused air below the wooden slats. In practice, the wooden slats became cement-asbestos sheets. While in this country the Hay's process was known as contact aeration, in Europe the process was called an immersion filter. To the experts there, the idea merely involved a trickling filter which was completely immersed. From this beginning, it was a logical step some years later for Professor Pöpel to view the bio-discs rising from the waste with sewage dripping in thin films over the emerging slime and to conclude that this apparatus should be called an immersion drip-filter (Tauchtropfkörpern).

In this paper further references to the unit will designate this treatment device as a rotating biological surface (RBS).

Buswell's report of 1928 (2) concluded that there were three

major advantages of the RBS.

- (1) The actual area occupied by the unit was about $\frac{1}{10}$ of that required for a trickling filter.
- (2) The power cost was low compared to activated sludge.
- (3) Nitrification was accomplished.

Present and past research on this unit by the Sanitary Laboratories of the University of Michigan has validated these reported advantages as well as others but if this device has such a historical background, the question must still be asked, why hasn't the process been used more in the past?

Speculation on this question reveals that a combination of circumstances probably prevented its early adoption. First, the Maltby patent was at least 20 years ahead of the technology required for successful development of the mechanism. Maltby used sheet iron discs. The U.S. plastics industry just didn't exist in 1931. Then the depression and World War II practically stopped developments in the waste treatment field. Now we find a reluctance to use the process. Several industrialists have expressed the opinion that since they can't patent the idea, why go to the trouble of pushing for the adoption of the RBS system? The following observations are those of the author after approximately three years of operation of a pilot unit, and constitute a compendium of good and valid reasons for the construction and use of the RBS system in selected situations where a biological secondary seems desirable either as a total treatment device or as pretreatment for further polishing.

- (1) Shock load capabilities are excellent with a low F/M ratio.
- (2) Detention time can be low as 21 minutes minimizing tankage.
- (3) The head loss is low comparing favorably with the activated sludge process.
- (4) The power required is merely that needed to move the disc slowly through the fluid. Since the disc is totally counter balanced, power usage is quite low, being a fraction of that required for activated sludge.
- (5) Short circuiting is practically eliminated.
- (6) The feathery growth of sludge on the discs tends to break off at the root through the gentle twisting action imparted by the disc motion. This produces a controlled sizing of sludge particles which settle rapidly in the final clarifier. Final clarifier overflow rates might well be higher for such sludge as compared to activated sludge. Research has not progressed to the point where this factor can be evaluated.
- (7) The volume of this sludge is low and it dewateres more readily than waste activated sludge.
- (8) B.O.D. removal proceeds stage by stage thus excellent control over effluent quality may be designed into a system.

- (9) Bulking, foaming, or floating sludges are never a problem and no intense shear or turbulence can create a foam even with a foamy substrate.
- (10) The succession of organisms in such a unit is well established. Since the organic slimes are well anchored to the discs, washout as experienced in nitrification is easily controlled. (Fig. 4)
- (11) Lastly, it is important to note the many features of design which may be critical in the adoption of any process.
 - (a) For example, the largest disc that seems practical now would be about 11 feet in diameter. This would require a 5'-6" depth of tank. Where ground water, bed rock, or poor soil are problems, the RBS is an obvious solution to an otherwise serious problem.
 - (b) Or consider the control of odor which seems an ever present and increasing source of difficulty. The discs require a light weight cover to protect them against hail and this must be included as part of the adoption of RBS. Once the system is in use, a ventilating fan incorporating odor masking or ozone oxidation would be an

extremely simple addition.

- (c) Because of the odor control potential and the necessary cover, the unit is more aesthetically acceptable than other more widely used types of secondary treatment devices. It can be built in any urbanized area.
- (d) Operation can sometimes be a critical problem. The operation of the RBS consists of oiling motors and greasing chain. There are no mixed liquor solids to adjust, no sludge indicies to run, no pumps or recirculation with attendant piping. No foam ever forms on any tanks, so there is no need for foam suppression by chemicals or sprays. There is no bulking or loss of solids to the receiving water. In short the RBS runs virtually by itself.

Items 1 through 11 above, outline a series of advantages which would indicate that a region of acceptability probably does exist for the RBS unit. However, to recognize the strengths and not the weaknesses of such a system, would not be fair to all concerned. So, a word on the latter aspect of the RBS seems important.

- (1) There is not enough good data in existence at this time to permit a sufficiently wide latitude in industrial waste design. It may be speculated that any waste ameanable to activated sludge treatment

could also be treatable by the RBS unit. To make this assumption without pilot plant data would not be acceptable practice. As a result, a great deal of pilot work is needed in this area not only to define k factors but disc spacing, slime growth thicknesses, and ideal rotational speeds.

- (2) The requirement for a cover over the unit would pose a problem under some conditions. Any time a stack of discs must be removed for servicing, the entire shaft and disc assembly must be raised vertically and transported to a cradle which will provide adequate support. Admittedly this should never happen, but impossibles are usually the rule in waste treatment rather than the exception.
- (3) It is expected that the economy to be realized in constructing an RBS unit over a conventional activated sludge plant, would be best achieved in small to medium sized plants. In the larger activated sludge plant, a great deal of added volume can be obtained without adding much in the way of additional concrete.

In the case of the RBS, for each added cubic foot of tank volume the design must provide an additional two cubic feet of stacked discs. As a result costs for the RBS are more nearly linear with size. In the case of activated sludge, the economy of large size is an accepted fact. Where the economics would break is not well defined as yet. As more plants of the RBS type are built and priced out, these factors should be much more clear,

In summary, the area of biological waste treatment has over the years experienced problems. These may in general be categorized as susceptibility to shock loads. Trickling filters resist shock loads well but have the disadvantage of large head losses and consequent high operational expense. The activated sludge process minimizes the head loss problems but exhibits less resistance to shock loads and has an exceedingly great proclivity to foam, froth, bulk, and discharge solids to the effluent at the slightest provocation. The RBS seems to combine the advantages of both systems with few disadvantages. Its use would seem to offer the sanitary engineer the possibility of producing a more uniform quality of effluent.

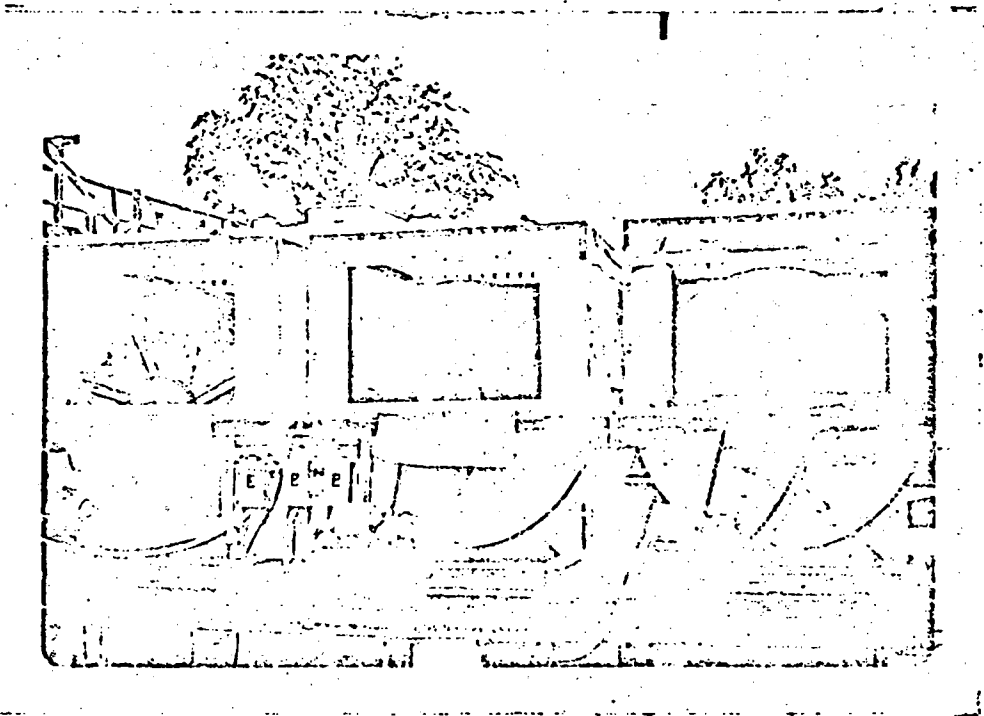


FIGURE 4. VIEW OF THE COVERED BATTERY OF DISCS EMPHASIZING THE SUCCESSION OF ORGANISMS IN EACH STAGE

REFERENCES

- (1) Hartmann, H., Untersuchungen über die biologische Rernigung
Von Absasser mit Hilfe Von Tauchtröpfkörpern
Kommissionsverlag R. Oldenbourg, München 1960
- (2) Abstract, "Sewage Disposal Bulletin", City of New York, Kenneth
Allen p. 14, July 1969 as reported in S.W.J., 1, 560 (1929)
- (3) Maltby, A.T., "Process and Apparatus for Treating Sewage or Other
Organic Matters", Patented June 23, 1931, Pat. No. 1,811,181

APPENDIX C

INVENTORY SHEETS



FACILITIES SURVEY
GENERAL INFORMATION

	DATE	SENSITIVITY	SEVERITY	PRIORITY
SEWAGE	6/73	HIGH		
SOLID WASTE	6/73	NIL		
AIR	6/73	NIL		

IDENTIFICATION INFORMATION

NAME OF FACILITY Agassiz Correctional Work Camp			ADDRESS P.O. Box 1300 Agassiz, B.C.		LONG 121°	LAT 49°
REGION Pac.	OWNED BY	OPERATED BY				
DEPARTMENT	SERVICE / BRANCH	CONTACT	TITLE	ADDRESS	TELEPHONE	
SGO	CPS	W.E. Hall	Director	P.O. Box 1300 Agassiz, B.C.	796-2712	
SGO	CPS	Jack Ward	Works Eng. Co-ordinator	Pacific Center Vancouver, B.C.	666-1081	
NATURE OR FUNCTION OF FACILITY work camp			YEAR COMPLETED 1962	NO. OF BLDGS see back	BLDG. DIMENSIONS POPULATION AVERAGE MAXIMUM 75 inmates 20 staff	

MUNICIPAL LOCATION INFORMATION

POPULATION OF REGION OR MUNICIPALITY	LAND USE OR ZONING AROUND FACILITY Agriculture	DISTINCTIVE GEOGRAPHIC FEATURES Due east Agassiz Mountain 5 miles from the prison. Flood Plain - Fraser River	SPECIAL CIRCUMSTANCES (Industrial Activity etc.) On #2 Agassiz Experimental Farm.
--------------------------------------	---	--	---

MUNICIPAL SEWAGE TREATMENT

TYPE -----	ADDITIONAL TREATMENT PLANNED Secondary for Town of Agassiz.	ANTICIPATED DATE OF COMPLETION After 1975.	COMMENTS
---------------	--	---	----------

MUNICIPAL SOLID WASTE PROGRAM

LANDFILL SITE LOCATION 1/2 mile East of Mountain Prison	TYPE OF LANDFILL OPERATION	CHANGES PLANNED	DATE OF CHANGES	COMMENTS
COMPLAINTS, PROBLEMS INVOLVING PUBLIC SENSITIVITY (Additional information on appropriate pages) Public complaints -re Septic tank discharge.		ANY DISEASES, POTENTIAL ECONOMIC OR OTHER PROBLEMS SUFFERED BY THE COMMUNITY DUE TO WATER, AIR OR SOLID WASTE POLLUTION. -Potential health hazard.		
VIOLATIONS OF FED. PROV. OR MUN. REGULATIONS Federal, Provincial.				

COMMENTS

Buildings

New Carpenter Shop & Weight lifting house.

Administration Bldg.

Stores & Laundry Bldg.

Maintenance Garage, Work Shop, Hobby Shop, Storage Bldg.

Kitchen & Mess Hall

Dormitory

Staff Quarters Bldg.

Pump House & Well

Root House

Inmate Training Bldg.

Greenhouse

Fire Shed.



Environment Canada
Environnement Canada

DATE OF
LAST ENTRY

1973

SEWAGE

REFERENCE TO
REPORTS, FILES, ETC.

IDENTIFICATION INFORMATION

NAME OF FACILITY Agassiz Cor. Work Camp				ADDRESS P.O. Box 1300 Agassiz, B.C.	
CONTACT	TITLE	ADDRESS	TELEPHONE		

GENERAL INFORMATION

TYPE OF SEWAGE TREATMENT Septic tank	EQUIVALENT POPULATION			PERIODS OF MAX. POPULATION	DAILY FLOW (I.G.P.D.)		
	NORMAL	MAXIMUM	MINIMUM		AVERAGE	MAX. HOURLY (Average)	MIN. HOURLY (Average)
	81				3500 - 5000	--	0.0
TYPE OF SEWAGE WASTE <input checked="" type="checkbox"/> DOMESTIC <input type="checkbox"/> OTHER Specify	STRENGTH OF RAW SEWAGE <input type="checkbox"/> > 250 ppm BOD <input checked="" type="checkbox"/> 150 - 250 ppm BOD <input type="checkbox"/> 50 - 150 ppm BOD <input type="checkbox"/> < 50 ppm BOD				SEWAGE/ WATER CON- SUMPT. RATIO 1.1	COMMENTS	
NAME OF CHIEF OPERATOR N.A.	IS HE CERTIFIED? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	YEAR SEWAGE TREATMENT SYSTEM INSTALLED	OPERATIONAL TESTS PERFORMED AND RECORDS KEPT BY OPERATOR			NO. OF HOURS PER DAY OF OPERATOR SUPER- VISION	
IS SYSTEM NOT CONNECTED TO MUNICIPAL SYSTEM GIVE DIS- TANCE TO NEAREST HOOK UP No System	INDICATE QUANTITIES AND PERI- ODS OF SEWAGE BYPASSING OR OVERFLOWING TREATMENT PLANT			IS THERE A FLOW MEASURING DEVICE <input type="checkbox"/> YES <input type="checkbox"/> NO	EFFLUENT SAMPLES SENT TO REG'N AGENCY <input type="checkbox"/> YES <input type="checkbox"/> NO		

ACTIVATED SLUDGE, TRICKLING FILTERS, PRIMARY SETTLING PLANTS ETC.

MANUFACTURER	TYPE AND MODEL	DESIGNED CAPACITY I.G.P.D.
--------------	----------------	-----------------------------------

LAGOONS

TYPE <input type="checkbox"/> Aerated <input type="checkbox"/> Facultative	<input type="checkbox"/> Anaerobic <input type="checkbox"/>	Nº CELLS	RETENTION TIME DAYS	SURFACE AREA ACRES	DEPTH FT.	DISCHARGE	
		<input type="checkbox"/> Series <input type="checkbox"/> Parallel				<input type="checkbox"/> Continuous <input type="checkbox"/> Intermittent	<input type="checkbox"/> Never

SEPTIC TANKS

CAPACITY I GALS	Nº CHAMBERS 2	DOSING SYSTEM <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	TILE FIELD LGTH Yes, but not operational	WATER TABLE DEPTH 0 - 8 FT.	SOIL TYPE --	PROXIMITY TO BODY OF WATER OR WELLS Discharged	FREQUENCY OF SLUDGE REMOVAL Yearly
------------------------	------------------	---	--	-----------------------------------	-----------------	---	--

COMMENTS

- 1) Lagoon should be built.
- 2) Recommend installation of rotating biological chlorination disc with dechlorination.

SPECIAL PROVISIONS FOR TOXIC WASTES OR CONTAMINANTS

N.A.

CHLORINATION <input checked="" type="checkbox"/> Not applicable <input type="checkbox"/> Applicable	SLUDGE TREATMENT AND DISPOSAL Not Applicable				
FACILITY CHLORINE CONTACT CHAMBER	CHLORINE CONTACT TIME (MIN'S) MIN AVERAGE	MEDIAN Cl ₂ RESIDUAL (ppm)	DIGESTERS <input type="checkbox"/> Heated <input type="checkbox"/> Not Heated <input type="checkbox"/> Not Applicable	SLUDGE DRYING BEDS? <input type="checkbox"/> YES <input type="checkbox"/> NO	DISPOSAL

MEDIAN EFFLUENT QUALITY

BOD 125 (90-180) (ppm)	SUSPENDED SOLIDS 70 - 90 (ppm)	pH	NITROGEN COMPOUNDS Nitrate NO.9 -1.6 (ppm)
PHOSPHATES Total 5-23 ppm	COLIFORMS (per 100 mls) 64,000,000	FECAL COLIFORM (per 100 mls) ---	Organic C Total - 62 - 140 ppm.

STORM SEWERS

DO DISCHARGES COMPLY WITH EFFLUENT GUIDELINES <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	COMMENTS
---	----------

RECEIVING BODY OF WATER

NAME Flood Plain Creek into Maria Slough - Maria Slough Fraser River Drainage.	FLOW (cfs.)		USES <input type="checkbox"/> Potable Water <input checked="" type="checkbox"/> Swimming <input type="checkbox"/> Comm. Fishing <input type="checkbox"/> Non Contact Recreation	<input checked="" type="checkbox"/> Migratory Salmon. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
	MAXIMUM	MINIMUM 2000 gpm			
EFFECT OF EFFLUENT			ARE THERE RECEIVING WATER STANDARDS FOR THIS BODY OF WATER	ARE THERE VIOLATIONS OF THESE STANDARDS	
NEGLIGIBLE	LOCALIZED X	MODERATE Coliform only.	EXTENSIVE	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO

ADDITIONAL INFORMATION

Ground disposal not feasible.
 Secondary treatment using rotating biological disc. chlorination - dechlorination because
 of Migratory salmon.

FACILITIES SURVEY - CORRECTION PROCEDURES

☒ WATER☐ AIR☐ SOLIDS☐ OTHER (specify)

PRIORITY

IDENTIFICATION INFORMATION

NAME OF FACILITY Agassiz Cor. Work Camp			ADDRESS P.O. Box 1300 Agassiz, B.C.
DEPARTMENT SGO	REGION PAC	SERVICE/BRANCH Penit	
PROJECT Secondary Treatment			
PLANNING BY: <input type="checkbox"/> DEPARTMENT OR AGENCY <input type="checkbox"/> CONSULTANTS <input checked="" type="checkbox"/> F.A.P.B.			
CONSULTANTS			CONTRACTOR

REPORT

	ESTIMATED		ACTUAL		COMMENTS
	Cost	Completion Date	Cost	Completion Date	
PROJECT STUDY PLANS		July 1973		July 1973	Demonstration Project.
CONTRACT 1					
CONTRACT 2					
PHASE I					
PHASE II					
TOTAL					

T.B. SUBMISSIONS

PROGRESS REPORTS

DATE					
% COMPLETE					
EXPENDITURES TO DATE					
EXTRAS					
REVISED TOTAL ESTIMATES					
ANTICIPATED COMPLETION DATE					

SPECIAL CIRCUMSTANCES AND PROBLEMS

EST.COST \$ ~~25,000~~ 20,000 F.Y. ~~1974/75~~ 1973/74March 1973 - no action
July 1973 - assessment

Some public complaints about discharge into creek. EPS approached FAPB regards to correcting situation.

VENTING INTO STACK NO.	TYPE OF EQUIP. forced air furnace	MANUFACTURER	MODEL	RATED H.P. OR CAPACITY 250,000 BTU	DATE INSTALLED	FUEL TYPE Lt. oil	FUEL RATE gall/hr lbs/hr c.f./hr
FUEL CONSUMPTION/ANNUUM					COMPLAINTS		
DEC - FEB 15,000 MAR - MAY 5,000 TOTAL 30,000 JUN - AUG 2,000 SEPT - NOV 8,000 <input type="checkbox"/> TONS <input type="checkbox"/> MCF <input checked="" type="checkbox"/> GALS.					<input type="checkbox"/> ODOUR <input type="checkbox"/> SMOKE <input type="checkbox"/> TOXICITY <input type="checkbox"/> HEAT <input type="checkbox"/> PARTICULATES <input type="checkbox"/> CORROSION		
AUXILIARY EQUIPMENT		BREECHING DIA	BREECHING LTH	NO. OF BENDS	FLUE GAS VOL.	FLUE GAS TEMP.	
INDUCED DRAFT FAN <input type="checkbox"/> YES <input type="checkbox"/> NO OTHER FORCED DRAFT FAN <input type="checkbox"/> YES <input type="checkbox"/> NO		inside in. outside in.	FT.		CFM	°F	
EMISSION CONTROL OR HEAT RECOVERY EQUIPMENT							
TYPE	MANUFACTURER	MODEL	CAPACITY	EXIT FLUE GAS VOLUME TEMP.			
				CFM °F			

COMMENTS

8 forced air furnaces are in use with approximate capacity of 250,000 BTU output each.

VENTING INTO STACK NO.	TYPE OF EQUIP.	MANUFACTURER	MODEL	RATED H.P. OR CAPACITY	DATE INSTALLED	FUEL TYPE	FUEL RATE gall/hr lbs/hr c.f./hr
						SULPHUR CONT. WT. %	
FUEL CONSUMPTION/ANNUUM					COMPLAINTS		
DEC - FEB MAR - MAY TOTAL JUN - AUG SEPT - NOV <input type="checkbox"/> TONS <input type="checkbox"/> MCF <input type="checkbox"/> GALS.					<input type="checkbox"/> ODOUR <input type="checkbox"/> SMOKE <input type="checkbox"/> TOXICITY <input type="checkbox"/> HEAT <input type="checkbox"/> PARTICULATES <input type="checkbox"/> CORROSION		
AUXILIARY EQUIPMENT		BREECHING DIA	BREECHING LTH	NO. OF BENDS	FLUE GAS VOL.	FLUE GAS TEMP.	
INDUCED DRAFT FAN <input type="checkbox"/> YES <input type="checkbox"/> NO OTHER FORCED DRAFT FAN <input type="checkbox"/> YES <input type="checkbox"/> NO		inside in. outside in.	FT.		CFM	°F	
EMISSION CONTROL OR HEAT RECOVERY EQUIPMENT							
TYPE	MANUFACTURER	MODEL	CAPACITY	EXIT FLUE GAS VOLUME TEMP.			
				CFM °F			

COMMENTS

C. AIR POLLUTION SOURCES NOT COVERED ABOVE Eg. Stone Quarry, Grain Elevator etc.

Small incinerator - paper, wood scraps, no complaints.

COMPLAINTS	
<input type="checkbox"/> HEAT	<input type="checkbox"/> SMOKE
<input type="checkbox"/> ODOUR	<input type="checkbox"/> PARTICULATES
<input type="checkbox"/> TOXICITY	<input type="checkbox"/> CORROSION

Environment Canada
Environmental ProtectionEnvironnement Canada
Protection de l'EnvironnementDATE OF
LAST ENTRY

January, 1973

REFERENCE
TO FILES,
REPORTS ETC.**AIR** (STATIONARY SOURCES)

IDENTIFICATION INFORMATION

NAME OF FACILITY Agassiz Correctional Work Camp			ADDRESS P.O. Box 1300 Agassiz, B.C.	
CONTACT • W.E. Hall	ADDRESS Director	TELEPHONE 796-2712		

STACK DETAILS

STACK NUMBER	STACK HEIGHT ft.	STACK DIAMETER inside..... in. outside..... in.	STACK CONE DIA. IN.	STACK FLUE GAS VOL. CFM	STACK FLUE GAS T. °F
STACK EXIT VELOCITY OF FLUE GAS F.P.S.	MAX. HEIGHT OF ADJACENT BUILDINGS FT.	IS THERE A VISIBLE PLUME? <input type="checkbox"/> YES - <input type="checkbox"/> NO	NO. OF CONTRIBUTING SOURCES	STACK SHELL MAT'L steel <input type="checkbox"/> brick <input type="checkbox"/> concrete <input type="checkbox"/>	STACK LINING MAT'L none <input type="checkbox"/> brick <input type="checkbox"/> fire brick <input type="checkbox"/> refractory <input type="checkbox"/>
EMISSION CONCENTRATIONS					
SULPHUR OXIDES	HYDROCARBONS	CO	PARTICULATES	other	other
HALOGENATED COMP'DS	NITROGEN OXIDES	ALDEHYDES	CO ₂	H ₂ S	OTHER:.....

COMMENTS (eg - Meteorology, Prevailing Wind Directions, Geographical Features, Range and Area of Fallout, Land Use of Area Affected)

STACK NO.	STACK HEIGHT ft.	STACK DIAMETER inside..... in. outside..... in.	STACK CONE DIA. IN.	STACK FLUE GAS VOL. CFM	STACK FLUE GAS T. °F
STACK EXIT VELOCITY OF FLUE GAS F.P.S.	MAX. HEIGHT OF ADJACENT BUILDINGS FT.	IS THERE A VISIBLE PLUME? <input type="checkbox"/> YES <input type="checkbox"/> NO	NO. OF CONTRIBUTING SOURCES	STACK SHELL MAT'L steel <input type="checkbox"/> brick <input type="checkbox"/> concrete <input type="checkbox"/>	STACK LINING MAT'L none <input type="checkbox"/> brick <input type="checkbox"/> fire brick <input type="checkbox"/> refractory <input type="checkbox"/>
EMISSION CONCENTRATIONS					
SULPHUR OXIDES	HYDROCARBONS	CO	PARTICULATES	other	other
HALOGENATED	NITROGEN OXIDES	ALDEHYDES	CO ₂	H ₂ S	OTHER:.....

COMMENTS

FLUE GAS SOURCES (Use Additional Form(s) If Necessary)

INCINERATORS <input checked="" type="checkbox"/> NOT APPLICABLE							
VENTING INTO STACK NO.	MFG'D BY	MODEL	TYPE <input type="checkbox"/> 1 chamber <input type="checkbox"/> controlled <input type="checkbox"/> 3 chamber <input type="checkbox"/> air	RATED CAP. lbs/hr	NO. HRS DAILY OPERATION	DATE INSTALLED	
INDUCED DRAFT FAN? <input type="checkbox"/> NO <input type="checkbox"/> YES	FORCED AIR FAN? <input type="checkbox"/> NO <input type="checkbox"/> YES	IGNITION BURNER? <input type="checkbox"/> NO <input type="checkbox"/> YES btu's/hr	AFTER BURNER? <input type="checkbox"/> NO <input type="checkbox"/> YES btu's/hr	AUX. FUEL <input type="checkbox"/> NONE <input type="checkbox"/> GAS <input type="checkbox"/> OIL (type.....)	COMPLAINTS <input type="checkbox"/> ODOUR <input type="checkbox"/> SMOKE <input type="checkbox"/> HEAT <input type="checkbox"/> PARTI.		
MAJOR TYPES OF WASTE INCINERATED AND ESTIMATED WEIGHT IN PERCENT paper..... % plastics..... %		BREECHING DIA'S inside..... in. outside..... in.	BREECHING L'GTH FT.	NO. OF BENDS	FLUE GAS VOL. TEMP. CFM		

EMISSION CONTROL OR HEAT RECOVERY EQUIPMENT

TYPE	MANUFACTURER	MODEL	CAPACITY	EXIT FLUE GAS VOL. CFM	EXIT FLUE GAS T. °F
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COMMENTS