A PASSIVE FACULTATIVE WASTEWATER TREATMENT SYSTEM FOR SINGLE-FAMILY RESIDENTIAL USE

By NovaTec Consultants Inc.

For Denis Barker & Associates Limited

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HOUSING TECHNOLOGY INCENTIVES PROGRAM

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ABSTRACT

This paper describes the performance testing of a passive facultative treatment process for onsite treatment of wastewater from a single-family residential dwelling. The intent of the system design was to treat domestic wastewater to comparable quality as would be obtained with conventional, mechanical, secondary biological treatment plants, but in a passive manner. The process was based on the principal of solids separation and extended retention time for anaerobic digestion of biological materials.

The system used two tanks and a solids separating system. Influent was directed through a passive, self-cleaning screen. Solids greater than 3 millimetres in diameter, and approximately 5% of the liquid flow were diverted into a tank dedicated to the storage and passive digestion of solids, while the remainder of the influent that passed through the screen was directed to the liquids retention tank. Supernatant from the solids tank was directed to the liquids tank. The liquids tank utilized inlet piping designed to distribute the flow across the tank cross-section and an underflow clarifying weir.

The system successfully and reliably produced an effluent with a quality such that the total suspended solids (TSS) concentration was comparable to, or better than, effluent produced by conventional secondary treatment plants sized for single-family dwellings. The system was not able to reduce biochemical oxygen demand (BOD) concentrations to the same standard.

EXECUTIVE SUMMARY

Present options for the treatment of domestic wastewater generated by single-family dwellings can be grouped into two categories:

- Septic tank treatment
- Mechanical, biological secondary treatment

There is a need to develop alternate methods of obtaining better effluent quality with passive systems. A Passive Facultative Treatment System was developed by D. Barker and Associates, based on the principles of solids separation and extended retention in an attempt to produce effluent quality that would be comparable to secondary biological processes, without the addition of power consuming components.

The treatment system tested was comprised of the following components:

- Influent Sampling Chamber
- Solids Separator
- Solids Digester Tank (Digester)
- Liquids Detention Tank (Clarifier)

Liquid was extracted from the system at various locations in the flow path and tested at an independent laboratory for total and soluble five day Biochemical Oxygen Demand, (BOD), Total Suspended Solids (TSS), Nitrite and Nitrate (combined), Ammonia (NH_3), Total Kjeldahl Nitrogen (TKN), and Fecal Coliform (FC).

BOD removal efficiencies varied from 33% to 74%. The TSS removal efficiencies varied from 6% to 97%.

The prototype system was intended to be an alternative to conventional mechanical biological secondary treatment plants for individual homes. Mechanical systems are expected to achieve a 45 mg/L BOD and 60 mg/L TSS level. The system evaluation showed that the BOD level **cannot** be achieved, but the TSS level is consistently met or bettered.

The solids separation ability of the system, combined with the systems ability to mitigate hydraulic flushes past the solids retention area, will allow the system to perform better than a conventional septic tank with respect to solids transfer in the treated effluent.

The main potential barrier to use of the passive system in a current residential setting is the additional cost associated with the extra tank needed for the digester assembly. This tank also has to be placed slightly deeper in the ground than a

conventional septic tank to allow for the required vertical drop through the separator. This could be problematic in areas of low topographic relief or areas where there is either shallow rock or high groundwater tables.

The successes of the test system were:

1. The system reduced solids transfer to the disposal field.

2. The separator was an effective device for the separation of gross solids.

3. The inlet piping arrangement in the clarifier distributed flow through a greater cross-section of the tank than a conventional inlet pipe.

4. The baffle device in the clarifier effectively reduced the transfer of solids through the system.

5. The testing apparatus was convenient and reliable.

6. Testing showed that macerating the influent created higher BOD and TSS concentrations in the influent, but the system could reduce the concentrations of both parameters to levels which were comparable for both the unmacerated and macerated influent. Pumping of raw effluent to a treatment system, or use of garburators for kitchen wastes would produce similar impacts which would be effectively processed by the treatment system producing an effluent with a quality similar to that of unmacerated influent treated in the same system.

The failures of the test system were:

1. BOD concentrations were not reduced to a level that would qualify the system as an equivalent to a conventional mechanical biological secondary treatment plant.

2. The polyethylene tanks used were not suited for underground use.

SOMMAIRE

Le présent document décrit l'essai fonctionnel d'un procédé d'épuration facultatif passif pour l'épuration autonome des eaux usées d'une maison individuelle. Un système a été conçu pour épurer de façon passive les eaux domestiques avec une qualité comparable à celle obtenue par les stations d'épuration secondaires mécaniques et biologiques classiques. Le procédé repose sur la séparation des principales matières solides et la prolongation de la durée de rétention nécessaire à la dégradation des matières organiques par digestion anaérobie.

Le système emploie deux bacs et un séparateur de matières solides. L'influent passe par une grille passive autonettoyante. Les matières solides dépassant 3 millimètres de diamètre et environ 5 p. 100 des liquides sont déversés dans un bac destiné à la retenue et à la digestion passive des matières solides, tandis que le reste de l'influent passant par la grille se dirige vers le bac de rétention des liquides. Le liquide surnageant dans le bac des matières solides se déverse dans le bac des liquides. Le bac des liquides comprend un tuyau d'arrivée qui répartit l'influent en travers du bac et un dispositif d'évacuation du dépôt pour clarifier l'eau du déversoir.

Le système réussit à produire infailliblement un effluent d'une telle qualité que la concentration totale des solides en suspension (TSS) est égale ou inférieure à celle produite par les stations d'épuration secondaires classiques destinées aux maisons individuelles. Cependant, il ne peut pas réduire la demande biochimique en oxygène (DBO) avec autant d'efficacité que ces stations.

RÉSUMÉ

Les options d'épuration des eaux domestiques pour les maisons individuelles se divisent en deux catégories :

- Épuration par fosse septique
- Épuration secondaire mécanique et biologique

Il faudrait élaborer d'autres méthodes pour obtenir une meilleure qualité d'effluent à l'aide de systèmes passifs. Un système d'épuration facultatif passif a été élaboré par l'entreprise D. Baker and Associates selon les principes de la séparation des matières solides et de la prolongation de la durée de rétention pour produire un effluent de qualité comparable à celui que produisent les procédés biologiques secondaires sans avoir recours à des éléments énergivores.

Le système d'épuration testé renferme les éléments suivants :

- un regard d'échantillonnage de l'influent,
- un séparateur de matières solides,
- un bac destiné à la digestion des matières solides (digesteur),
- un bac destiné à la retenue des liquides (clarificateur).

Un laboratoire de l'extérieur a extrait du liquide du système à divers emplacements du circuit d'écoulement pour tester la demande biochimique totale et soluble en oxygène sur cinq jours (DBO), le total des solides en suspension (TSS), les concentrations en nitrite et en nitrate (combinés) et en ammoniaque (NH_3), l'azote total Kjeldahl (ATK) et les concentrations de coliformes fécaux (CF).

Le rendement d'élimination de la DBO varie de 33 à 74 p. 100 et celui du TSS, de 6 à 97 p. 100.

Le système type a été conçu comme solution de rechange aux stations d'épuration secondaires mécaniques et biologiques classiques pour des maisons individuelles. Avec les systèmes mécaniques, le niveau de la DBO s'élève à 45 mg/L et le niveau de TSS, à 60 mg/L. Notre évaluation a révélé qu'avec le système type, on ne peut pas atteindre ce niveau de DBO, mais on peut toujours atteindre le niveau de TSS et même le dépasser.

Puisque le système peut séparer les matières solides et réduire les chasses hydrauliques sortant de la zone de rétention des matières solides, il surpassera la fosse septique classique pour ce qui est de transférer les solides à l'effluent épuré.

L'obstacle principal empêchant l'adoption du système passif dans les maisons individuelles est le coût additionnel que présente le bac supplémentaire pour le digesteur. En outre, ce bac doit être enterré plus profondément qu'une fosse septique classique pour que la chute verticale vers le séparateur soit adéquate. Cela pourrait créer des problèmes dans les régions de relief émoussé, celles où du roc est près de la surface, ou celles où le niveau de la nappe souterraine est élevé.

Voici les points forts du système d'essai :

1. Le système a réduit le transfert de matières solides vers le champ d'épuration.

2. Le séparateur s'est avéré efficace pour la séparation des matières solides brutes.

3. Le tuyau d'arrivée dans le clarificateur a réparti l'influent sur une plus grande partie transversale du bac que ne l'aurait fait un tuyau d'arrivée classique.

4. La chicane du clarificateur a réduit efficacement le transfert de solides dans le système.

5. L'appareil d'essai était pratique et fiable.

6. L'essai a démontré que les concentrations en DBO et en TSS dans l'influent sont plus élevées si on laisse ce dernier macérer, mais que le système pourrait les réduire à des niveaux comparables à celles qui se trouvent dans l'influent macéré et l'influent non macéré. Le pompage d'effluents bruts vers un système d'épuration ou l'utilisation de broyeurs pour les déchets domestiques pourraient avoir des effets analogues sur les concentrations en DBO et en TSS, qui pourraient être réduites par le système d'épuration pour produire un effluent de la même qualité que l'influent non macéré traité par ce même système.

Voici les lacunes du système d'essai :

1. La DBO n'a pas été réduite à un niveau permettant d'affirmer que le système se place au même rang que les stations d'épuration secondaires mécaniques et biologiques classiques.

2. Les bacs en polyéthylène utilisés n'étaient pas faits pour être enterrés.

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TABLE OF CONTENTS

1.0 INTRODUCTION

The options for the treatment of domestic wastewater generated by single-family dwellings can be grouped into two categories:

- Septic tank treatment
- Mechanical, secondary biological treatment

The first option is an inexpensive, passive method of treating domestic wastewater prior to ground disposal. As such, the capital construction costs, as well as the operational and maintenance costs are relatively low. These have been the systems of choice in non-sewered areas. The major drawback of these systems is that the level of treatment is relatively low and the effluent still has high levels of Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS). Land area requirements for the disposal of effluent from these systems are as much as two to three times greater than those required for the disposal of effluent from a secondary treatment system.

There are several technologies utilized in single-family residential mechanical, secondary biological treatment plants. The majority of these systems can consistently produce effluent with a quality better than 45 mg/L of BOD and 60 mg/L of TSS. These treatment plants are expensive when compared to the septic tank systems and require mechanical components to either drive pumps for fluid transfer, or compressors for air injection. The improved level of treatment permits the use of smaller land areas for the disposal of effluent when compared to land areas required for the disposal of septic tank treated effluent. However, there is an ongoing requirement and associated operational cost for power and maintenance of mechanical treatment plants. In areas where power supply is unavailable or unreliable, and where technical expertise is not available, the mechanical treatment systems are often inappropriate for use. Lands that are suitable for ground disposal of septic tank treated effluent are becoming more scarce. Higher levels of treatment are required to protect human health in areas where the lands are marginally suitable for ground disposal of septic tank treated effluent. A passive system that could produce secondary level quality wastewater would be beneficial to landowners where the ability of the ground to accept wastewater is limited, or where power supply is often interrupted or unreliable.

The objective of the development of the passive treatment system was to achieve a 45 mg/L BOD and 60 mg/L TSS effluent level without utilizing electrical components and power.

2.0 PHYSICAL COMPONENTS

2.1 GENERAL DESCRIPTION

The treatment system that was tested consisted of the following components:

- Influent Sampling Chamber
- Solids Separator
- Solids Digester Tank (Digester)
- Liquids Detention Tank (Clarifier)

The flow path through the system is shown schematically in Figure 2.1. Raw wastewater originating in the residence was directed to the separator, where solids greater than 3 millimetres (0.125 inches) in diameter were removed from the influent. The solids, along with approximately 5% of the liquid stream, were directed to the solids retention tank. The remainder of the liquid stream was directed to the clarifier and then to the disposal field.

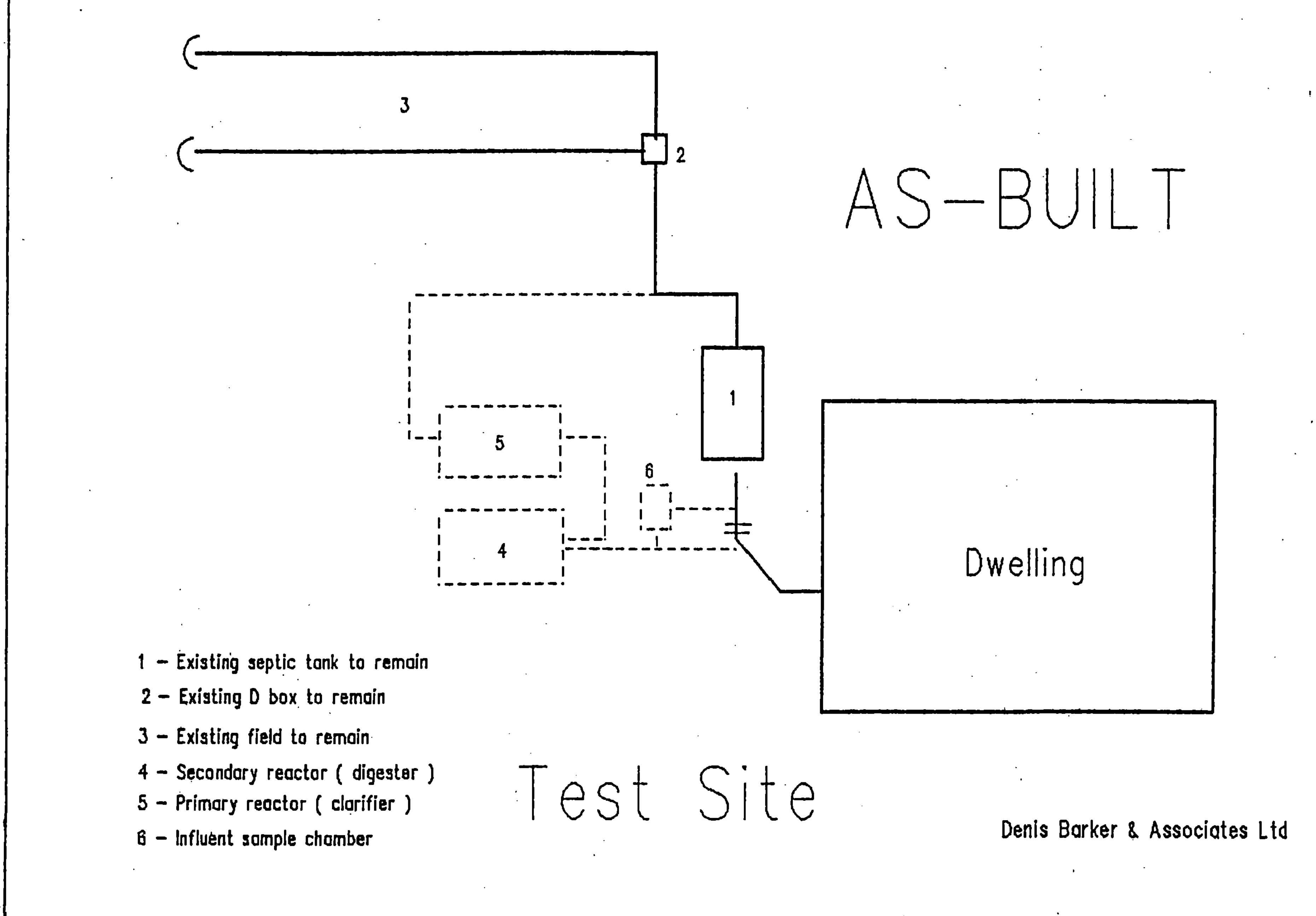
Supernatant overflow from the digester was directed to the clarifier. The general arrangement of the components and the interconnecting piping is also shown in Figure 2.1

A sampling station was installed in an adjacent building. Extraction tubes were installed into the influent sampling chamber, onto both sides of the "bio-brush" in the last chamber of the digester, and onto both sides of the "bio-brush" in the last chamber of the clarifier.

2.2 INFLUENT SAMPLING CHAMBER

The influent sampling chamber was used to take composite samples of the influent sewage, rather than taking grab samples elsewhere in the flow process. A sample was extracted from the chamber, and the remaining contents redirected back to a septic tank not connected to the test treatment system. This was done with a small discharge pump, recirculation piping, and valves. This had the effect of macerating the sewage making it less "separable". In some cases, the macerated influent was then pumped from the septic tank into the test treatment system to test the performance with macerated influent. Before and after the influent was macerated with the transfer pump, composite influent samples were taken to evaluate the impact of maceration on the BOD and TSS concentrations of the influent.

Figure 2.1



3
2
AS-BUILT
1
5
6
4
Dwelling
1 - Existing septic tank to remain
2 - Existing D box to remain
3 - Existing field to remain
4 - Secondary reactor (digester)
5 - Primary reactor (clarifier)
6 - Influent sample chamber
Test Site
Denis Barker & Associates Ltd

2.3 SOLIDS SEPARATOR

Influent sewage was passed through a passive self-cleansing separator / screen situated inside the solids digester tank (see Section 2.4). The separator, which had its design optimized before installation, was fitted with a screen capable of separating all solids greater than 3 millimetres (0.125 inches) in diameter from the flow stream. Approximately 5% of the influent liquid, followed the solids stream. Influent passing through the separator was directed to the liquids detention tank (see Section 2.5)

2.4 SOLIDS DIGESTER TANK (DIGESTER)

Solids extracted from the influent, and approximately 5% of the influent liquid portion, were directed into the solids digester tank. This tank consisted of two main compartments separated by an internal baffle wall. The second of the two compartments was further subdivided using a non-structural wall for the purposes of liquid separation. In one of these sub-compartments, a fixed-growth bacterial culture was encouraged by mounting a passive media "bio-brush". The tank had an internal capacity of 5,455 litres (1,200 Imperial gallons), but only retained approximately 3,600 litres (800 Imperial gallons) because of the space occupied by the separator. Supernatant from the digester tank was directed to the liquids detention tank. The general arrangement of the tank and piping is shown in Figure 2.4.

2.5 LIQUIDS DETENTION TANK (CLARIFIER)

The influent passing through the solids separator was directed to the liquid detention tank. The configuration of the clarifier was similar to that of the solids digester tank with three exceptions:

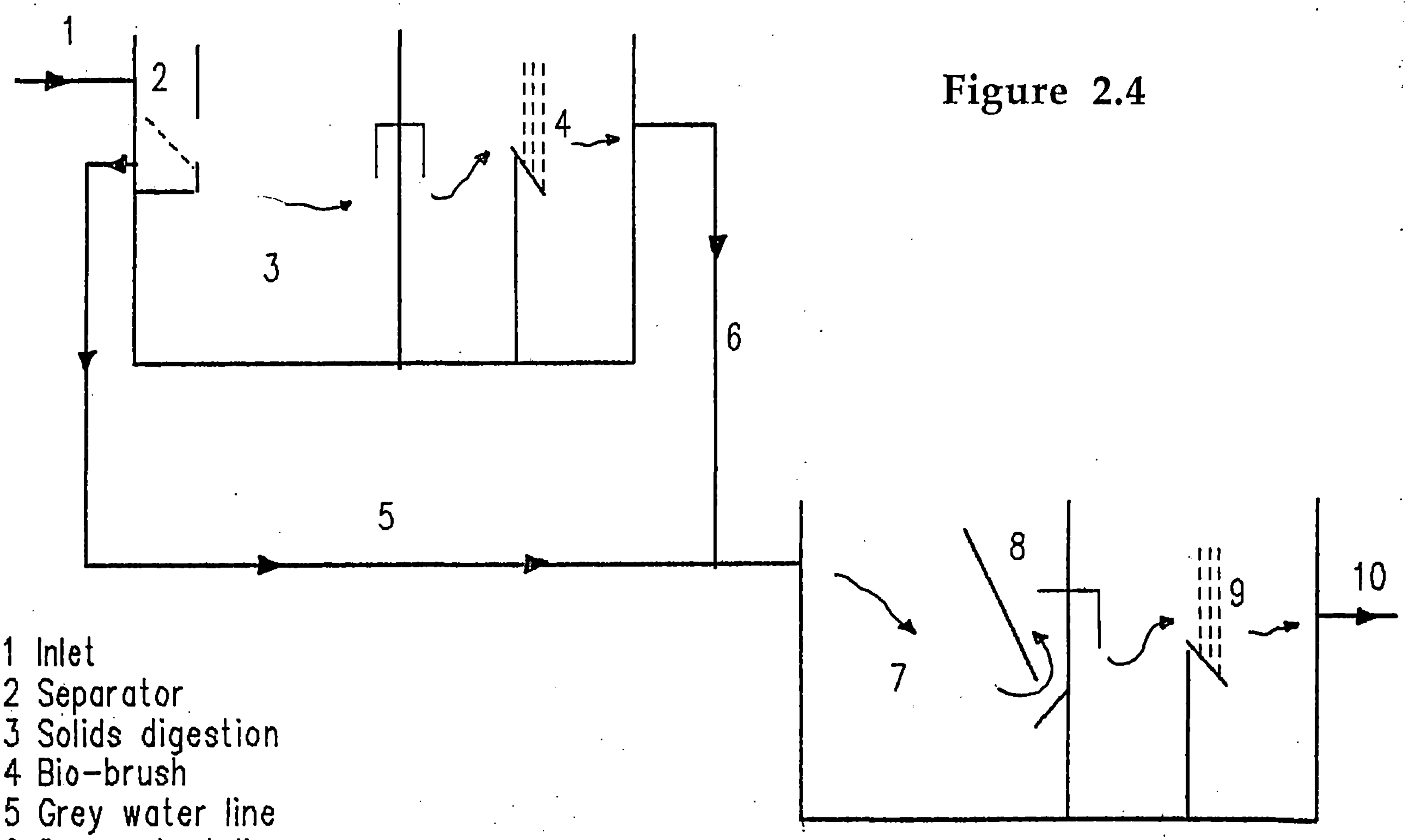
1. The liquid level was substantially higher. The tank was installed lower than the solids tank to allow gravity drainage from the separator to the normal operating level in the liquids tank.

2. To minimize any potential short-circuiting, the influent piping was fitted with a diffuser to spread the flow across the entire tank cross-section.

3. The internal baffle in the liquid tank was fitted with a clarifier weir designed to pass liquid from the clearest zone within the tank.

FACULTATIVE SYSTEM

Figure 2.4



1 Inlet
2 Separator
3 Solids digestion
4 Bio-brush
5 Grey water line
6 Supernatant line
7 Clarifier
8 V trough
9 Bio-brush
10 Outlet

Flow Diagram

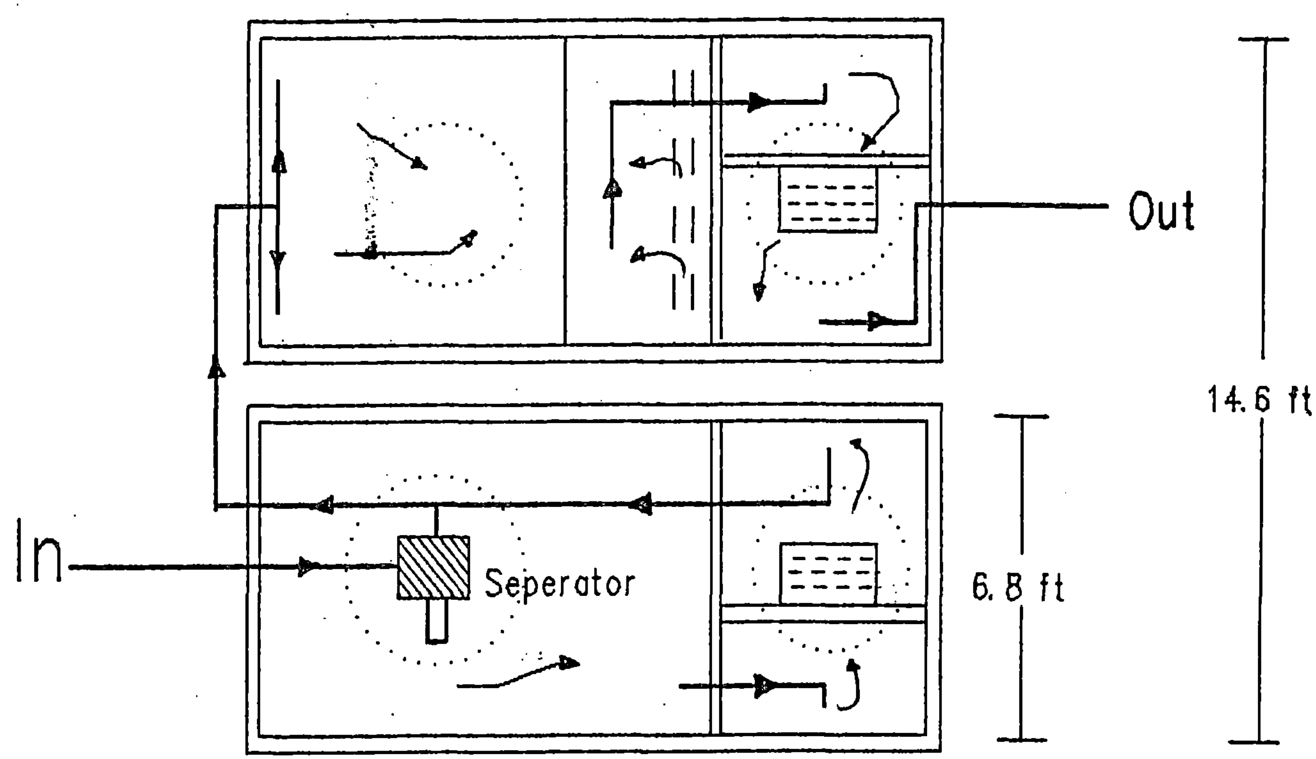
DENIS BARKER & ASSOCIATES LTD

Prototype #5

FACULTATIVE SYSTEM Max. 500 GPD

Figure 2.4

Clarifier



Digester

Note;
Inlet hght 55 inches
Drop thru system 10.5 inches

8.5 ft

Schematic

DENIS BARKER & ASSOCIATES LTD

3.0 TESTING AND ANALYSIS

3.1 TESTING

A sampling schedule was developed at the start of the project to ensure sample acquisition during conditions typical of all four seasons in the Victoria area. All analytical work was completed by JB Laboratories of Victoria, BC, using standard testing protocols.

All scheduled samples were tested for total and soluble five day Biochemical Oxygen Demand (BOD), and Total Suspended Solids (TSS). BOD and TSS are the standard tests used in evaluating treatment system performance. In addition, some samples were tested for Nitrite and Nitrate (combined), Total Kjeldahl Nitrogen (TKN) and Fecal Coliform (FC). The testing reports are enclosed as Appendix 1.

During different days of the week, influent samples were taken from the sampling chamber in both a raw and macerated form. Influent sampling was suspended when analysis indicated a consistency of influent quality (see Section 3.2.2).

Temperatures were measured in the discharge chambers of the clarifier using a mercury thermometer suspended in the liquid. pH was measured using a Hach titration kit, and dissolved oxygen (DO) was measured with a hand-held DO meter. Observations of sludge accumulation in the solids tank were made visually with the aid of a "sludge judge".

The sampling and testing procedure was adequate to evaluate the system for compliance with performance standards for conventional mechanical secondary biological treatment plants.

3.2 DATA ANALYSIS

3.2.1 Water Use

During the test period the residence was occupied by three adults. Water usage was evaluated by recording data from the domestic water meter on a daily basis. The supply line to the house developed a small leak in mid-September. Water use records were suspended at that time. Prior to that date, the total water use averaged 572 litres (126 Imperial gallons) per day or 191 litres (42 Imperial gallons) per person per day.

3.2.2 Influent Sampling And Analysis

Six influent samples were analyzed for total BOD and TSS. Five of the six BOD samples were also analyzed for soluble BOD. In addition, six influent samples were macerated and analyzed for total BOD and TSS. Five of the six macerated samples were also analyzed for soluble BOD. One sample of both the raw and macerated influent was analyzed for combined nitrite (NO_2^-) and nitrate (NO_3^-), Total Kjeldahl Nitrogen (TKN), ammonia (NH_3), and fecal coliform (FC).

The total BOD concentration of the unmacerated influent varied from 67 mg/L to 234 mg/L. The soluble BOD concentration of the unmacerated influent varied from 38 mg/L to 191 mg/L. The total BOD concentrations of the macerated influent samples were higher than those of the raw influent and varied from 133 mg/L to 540 mg/L. The soluble BOD concentrations of the macerated influent samples varied from 36 mg/L to 200 mg/L. This was expected as the surface area of the solids available for biodegradation was increased by the maceration process.

The TSS concentration of the unmacerated influent varied from 32 mg/L to 47 mg/L with the exception of one sample taken on laundry day where the influent TSS was found to be 300 mg/L. The TSS concentrations of the macerated influent varied from 176 mg/L to 510 mg/L. This was again expected as the maceration process decreased the size of the larger particles, but increased the overall surface area and number of smaller particles.

Table 3.2.2, shown on the next page, presents a summary of the data detailed in this section including the mean and median values. The analytical results for nitrogen and fecal coliform are presented and discussed in Sections 3.3.2 and 3.3.3 respectively. Graph 3.2.2, also shown on the next page, presents a graphical summary of this same BOD and TSS data.

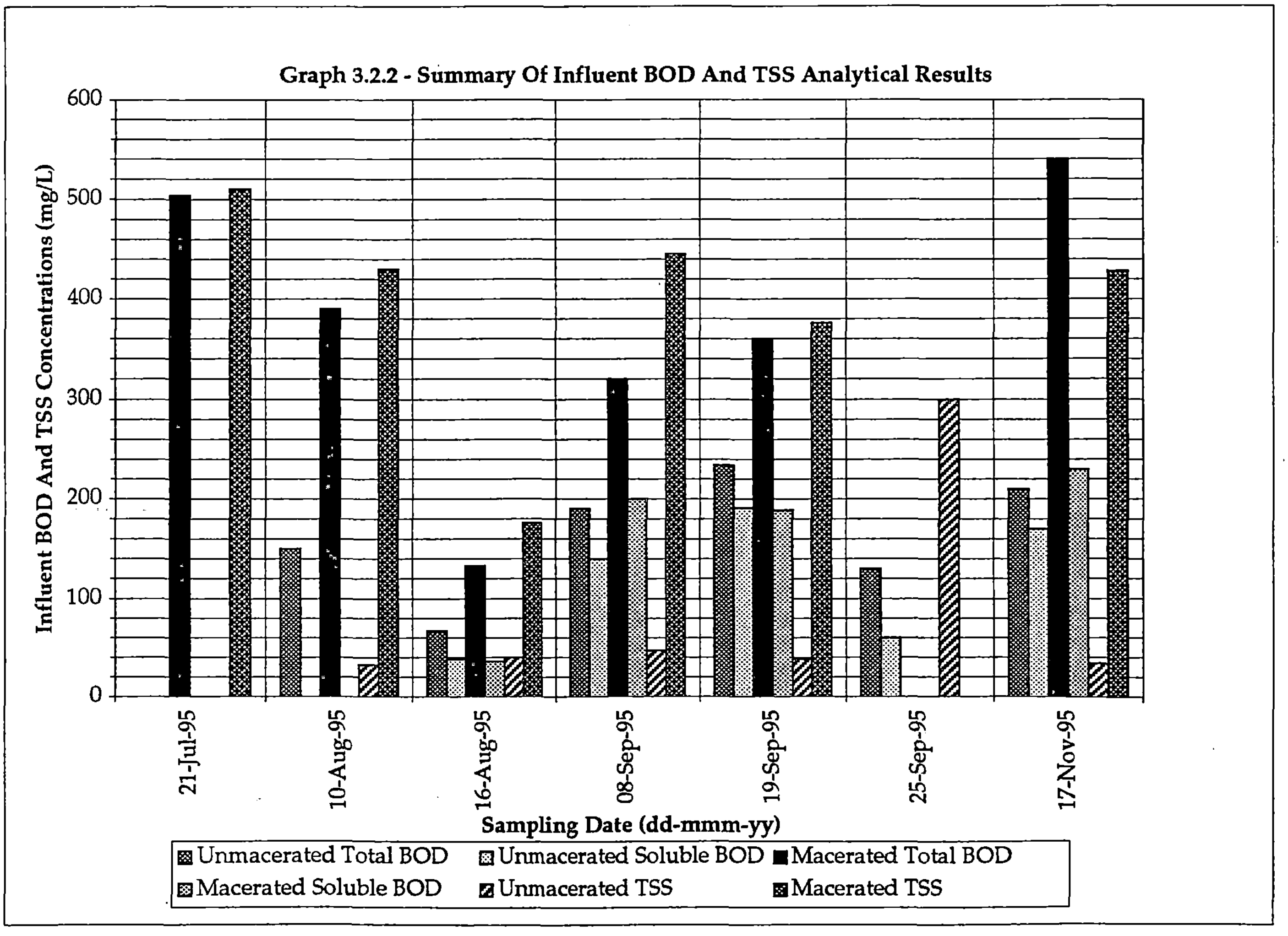
3.3. EFFLUENT SAMPLING AND ANALYSIS

3.3.1 Biochemical Oxygen Demand And Total Suspended Solids

Seventeen samples of effluent from the discharge chamber of the clarifier were analyzed for total BOD and TSS over a six month period beginning in August 1995. Twelve of the seventeen samples were also analyzed for soluble BOD.

September 25, 1995 was a laundry day. In this particular case, effluent sampling was undertaken 24 hours after influent sampling to allow the effects of the "wash day" cycle to manifest themselves in the clarifier sampling results. The total BOD

Table 3.2.2 - Summary Of Influent BOD And TSS Analytical Results						
Date (dd-mmm-yy)	**Unmacerated Total BOD (mg/L)**	**Unmacerated Soluble BOD (mg/L)**	**Macerated Total BOD (mg/L)**	**Macerated Soluble BOD (mg/L)**	**Unmacerated TSS (mg/L)**	**Macerated TSS (mg/L)**
21-Jul-95	-	-	504	-	-	510
10-Aug-95	150	-	390	-	32	430
16-Aug-95	67	38	133	36	40	176
08-Sep-95	190	140	320	200	47	445
19-Sep-95	234	191	360	189	38	376
25-Sep-95	130	60	-	-	300	-
17-Nov-95	210	170	540	230	34	428
Mean	**164**	**120**	**375**	**164**	**82**	**394**
Median	**170**	**140**	**375**	**195**	**39**	**429**



concentration of the influent sample on September 25, 1995 was the second lowest of the samples, but there was no appreciable difference in the effluent total BOD concentration for this date when compared to the others. The TSS concentration of the influent sample on September 25, 1995 was the highest of the influent samples but the effluent TSS concentration was not appreciably different than that of other samples.

Four of the samples were taken from the chamber ahead of the "bio-brush". The analytical results for these four samples showed that total BOD, TSS, and soluble BOD concentrations were marginally higher than those in the discharge chamber of the clarifier which suggested that the "bio-brush" was acting like a screening device. The brush was devoid of any culture which suggested that it was not supporting any biological activity capable processing organic matter resulting in a lower total BOD concentration in the effluent. It was determined that the effluent in this chamber did not have any dissolved oxygen, so it was not surprising that there was no attached growth.

Near the end of the testing program, a small air pump was added in an attempt to increase the DO concentration in the clarifier. Although a low concentration of DO was detected in the clarified effluent, it was insufficient to support biological activity.

Total BOD concentrations in the clarifier effluent ranged from 37 mg/L to 140 mg/L. Soluble BOD concentration in the clarifier effluent ranged from 26 mg/L to 142 mg/L. The clarifier effluent had a TSS concentration that ranged from 11 mg/L to 46 mg/L.

Table 3.3.1, shown on the next page, presents a summary of the data detailed in this section including the mean and median values. Graph 3.3.1, also shown on the next page, presents a graphical summary of this same BOD and TSS data.

3.3.1.1 BOD Removal Efficiencies

Six samples of influent and clarifier effluent were sampled either on the same day or within twelve hours of each other. The influent and effluent data from these dates is compared in order to determine the overall efficiency of the treatment system. The BOD removal efficiencies are presented on the next page in Table 3.3.1.1 and in Graph 3.3.1.1.

In considering the unmacerated influent, total BOD removal efficiencies varied from 33% to 71% with a mean of 54%. Total BOD removal efficiencies, when considering the macerated influent, varied from 72% to 86% with a mean of 79%.

Table 3.3.1 - Summary Of Effluent BOD And TSS Analytical Results				
Date (dd-mmm-yy)	**Total BOD (mg/L)**	**Soluble BOD (mg/L)**	**TSS (mg/L)**	**Remarks**
10-Aug-95	56	-	13	-
16-Aug-95	37	26	19	-
25-Aug-95	56	52	11	-
08-Sep-95	55	35	24	-
20-Sep-95	67	52	19	-
26-Sep-95	76	65	16	1 Day Lag - Laundry Day
03-Oct-95	73	81	15	-
19-Oct-95	97	71	22	-
26-Oct-95	93	-	13	House Empty
26 Oct 95	125	-	20	Pre-Bio-Brush, House Empty
27-Oct-95	99	84	20	Pre-Bio-Brush, House Empty
16-Nov-95	140	105	32	Pre-Bio-Brush
30-Nov-95	118	142	46	Pre-Bio-Brush
04-Dec-95	116	90	22	-
13-Dec-95	131	-	18	Post-Air
21-Dec-95	110	-	24	Post-Air
02-Jan-96	130	94	44	-
Mean	**93**	**75**	**22**	-
Median	**97**	**76**	**20**	-

Graph 3.3.1 - Summary Of Effluent BOD And TSS Analytical Results

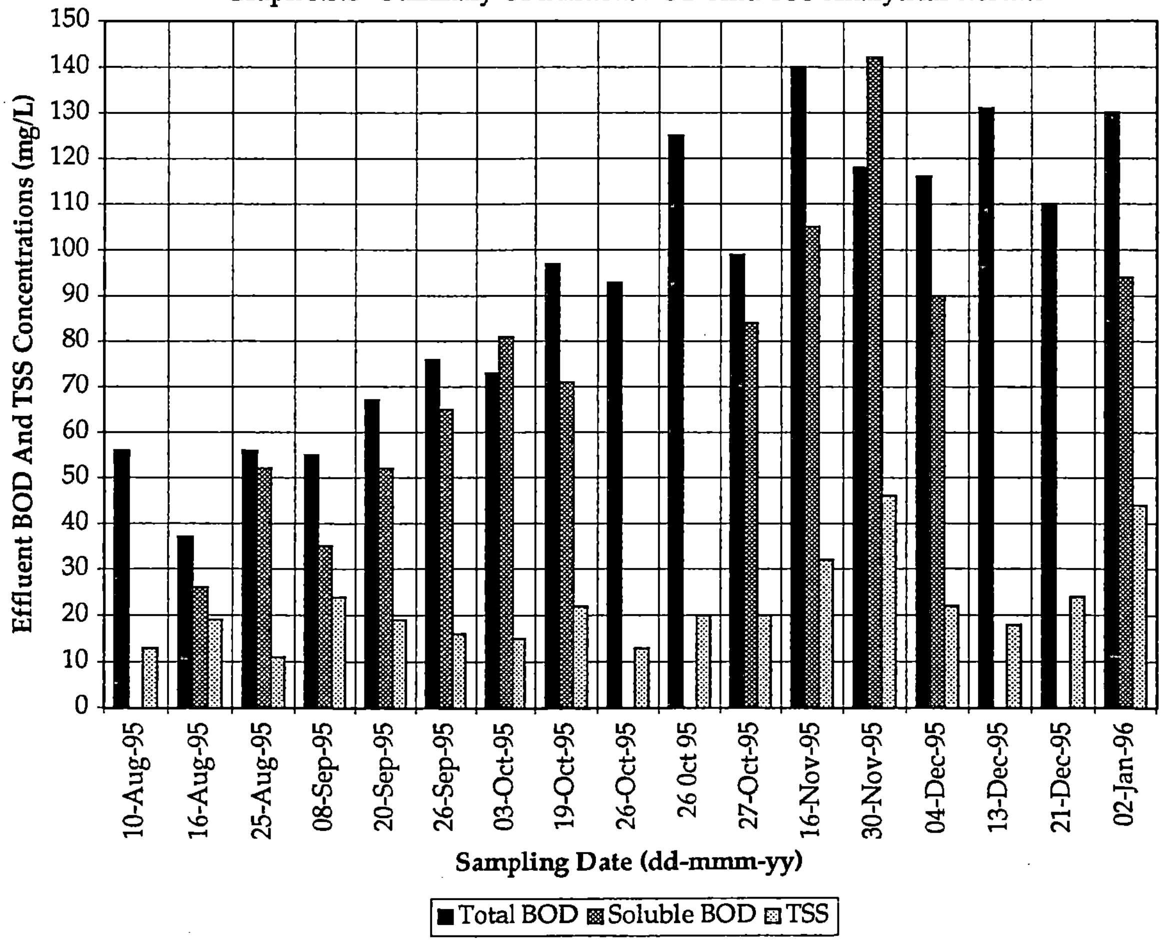
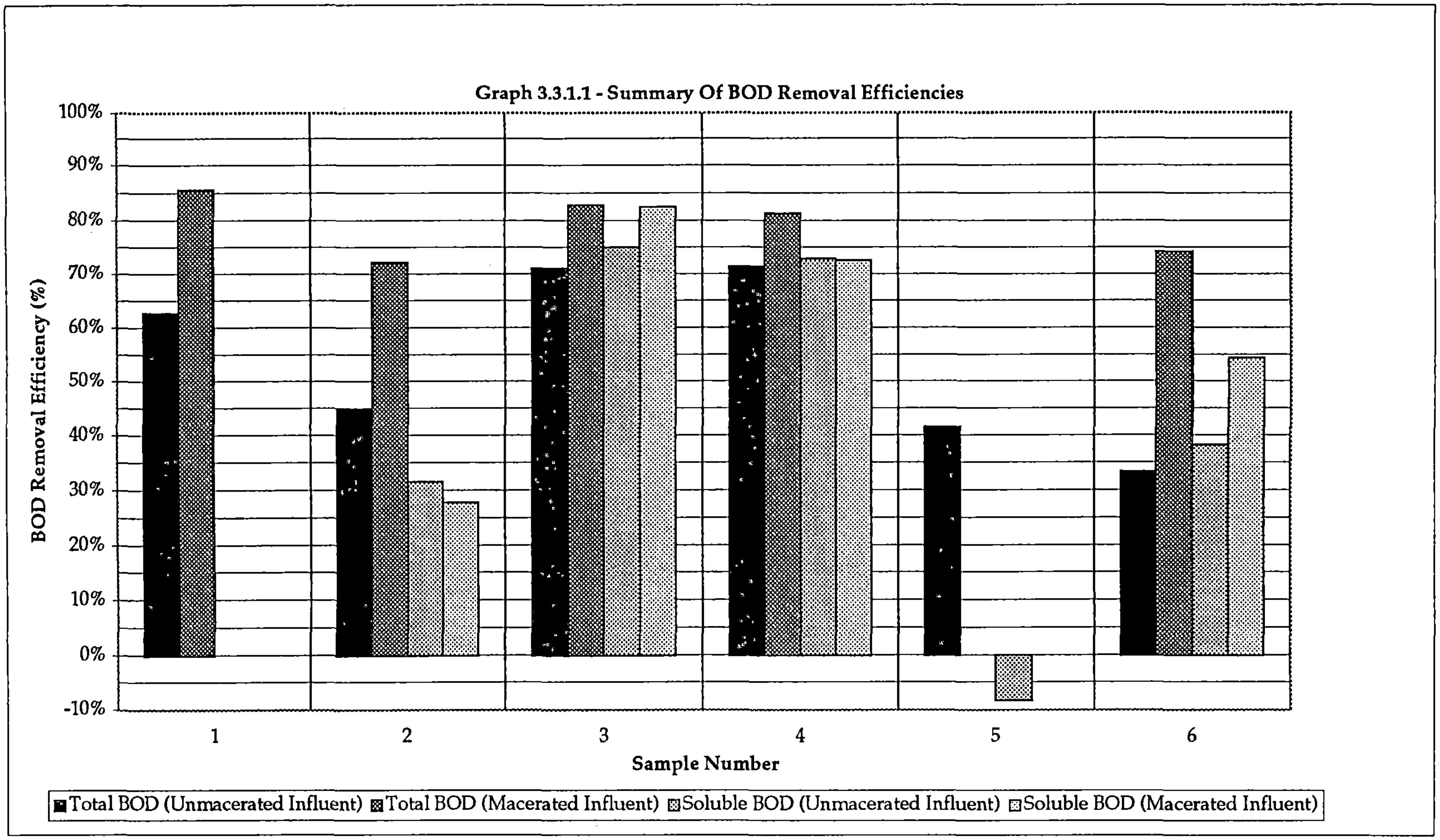


Table 3.3.1.1 - Summary Of BOD Removal Efficiencies									
Unmacerated Influent Total BOD (mg/L)	Macerated Influent Total BOD (mg/L)	Effluent Total BOD (mg/L)	Unmacerated Removal Total BOD (%)	Macerated Removal Total BOD (%)	Unmacerated Influent Soluble BOD (mg/L)	Macerated Influent Soluble BOD (mg/L)	Effluent Soluble BOD (mg/L)	Unmacerated Removal Soluble BOD (%)	Macerated Removal Soluble BOD (%)
150	390	56	63%	86%	-	-	-	-	-
67	133	37	45%	72%	38	36	26	32%	28%
190	320	55	71%	83%	140	200	35	75%	83%
234	360	67	71%	81%	191	189	52	73%	72%
130	-	76	42%	-	60	-	65	-8%	-
210	540	140	33%	74%	170	230	105	38%	54%
		Mean	54%	79%			Mean	42%	59%
		Median	54%	81%			Median	38%	63%



Soluble BOD removal efficiencies for the unmacerated influent ranged from -8% to 75% with a mean of 42%. No explanation for the negative removal efficiency can be given other than human sampling error. The macerated influent soluble BOD removal efficiency ranged from 28% to 83% with a mean of 59%.

3.3.1.2 TSS Removal Efficiencies

The TSS removal efficiencies are presented on the next page in Table 3.3.1.2 and in Graph 3.3.1.2. In considering the unmacerated influent, TSS removal efficiencies varied from 6% to 95% with a mean of 52%. The TSS removal efficiencies for the macerated influent ranged from 89% to 97% with a mean of 94%.

3.3.1.3 Impact Of The Digester

Six samples of effluent from the digester and the clarifier were sampled on the same day in order to determine the how the digester and clarifier components were functioning relative to each other. The samples were analyzed for total and soluble BOD, and TSS.

The results, presented in Table 3.3.1.3 and in Graphs 3.3.1.3a, b, and c, indicate that the total and soluble BOD concentrations of the samples from both the digester and the clarifier rose proportionately, until mid-September. The clarifier effluent had higher total and soluble BOD concentrations than the digester effluent until this time. In mid-September and at later dates, the clarifier effluent was found to have lower total and soluble BOD concentrations than the digester effluent.

The TSS concentrations were consistently higher in the digester effluent than in the clarifier effluent for all samples taken after September 8, 1995. The last comparative sample taken on November 16, 1995 indicated that the TSS concentration of the clarifier effluent was only marginally lower than that of the digester samples. The configuration of the settling weir in the clarifier is anticipated to encourage better settling of solids at all times. Any carryover of solids from the digester was expected to be reduced as the supernatant flows through the clarifier.

3.3.2 Nitrogen

One effluent sample was tested for nitrite, nitrate, and ammonia in October, 1995. One sample of influent and one of effluent were analyzed in November, 1995 to determine nitrogen removal efficiencies. The November samples were tested for nitrite, nitrate, ammonia, and TKN. There was no appreciable difference in nitrite and nitrate concentrations, but the ammonia concentration in the effluent increased

Table 3.3.1.2 - Summary Of TSS Removal Efficiencies				
Unmacerated Influent TSS (mg/L)	Macerated Influent TSS (mg/L)	Effluent TSS (mg/L)	Unmacerated Removal TSS (%)	Macerated Removal TSS (%)
32	430	13	59%	97%
40	176	19	53%	89%
47	445	24	49%	95%
38	376	19	50%	95%
300	-	16	95%	-
34	428	32	6%	93%
		Mean	**52%**	**94%**
		Median	**51%**	**95%**

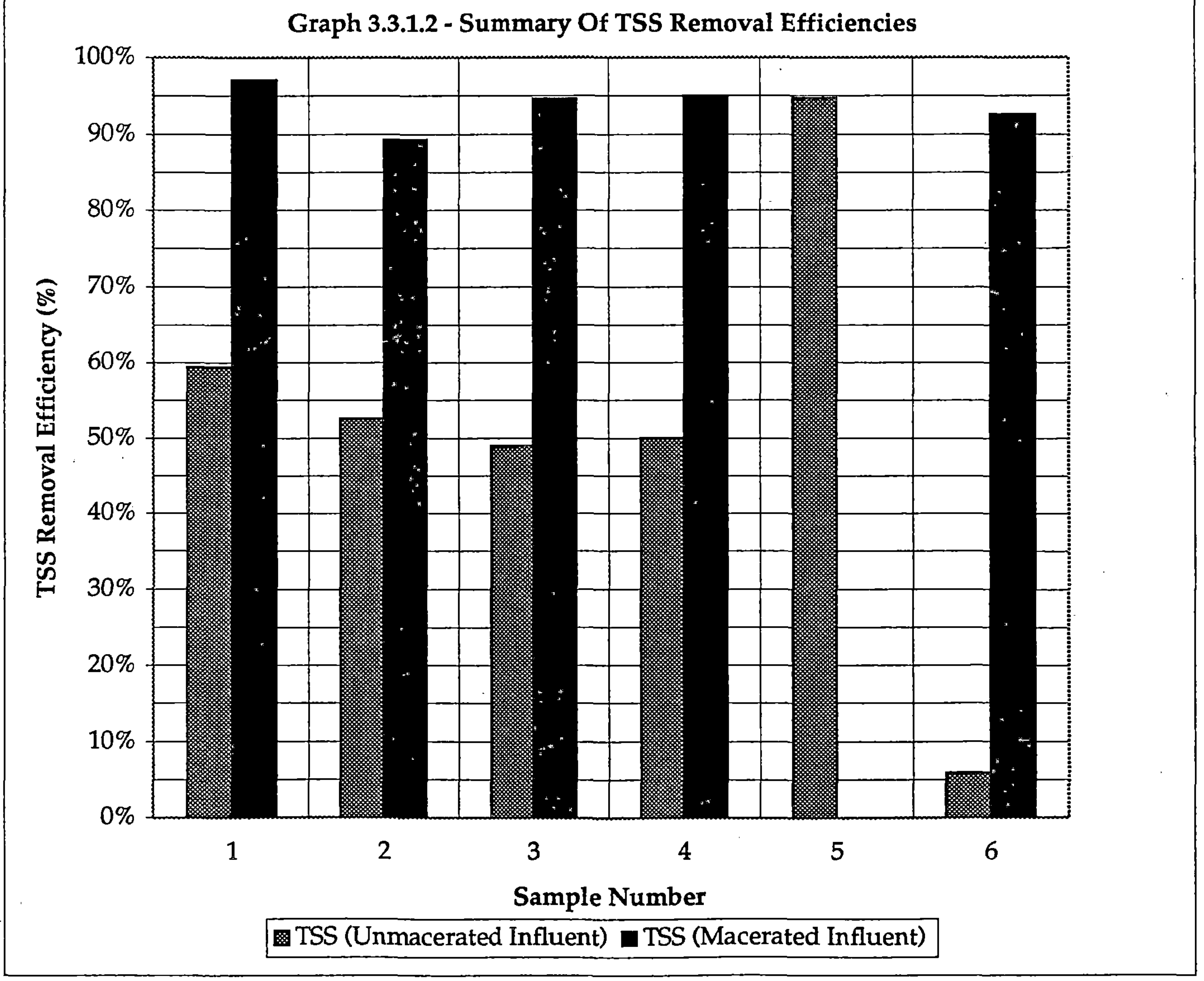
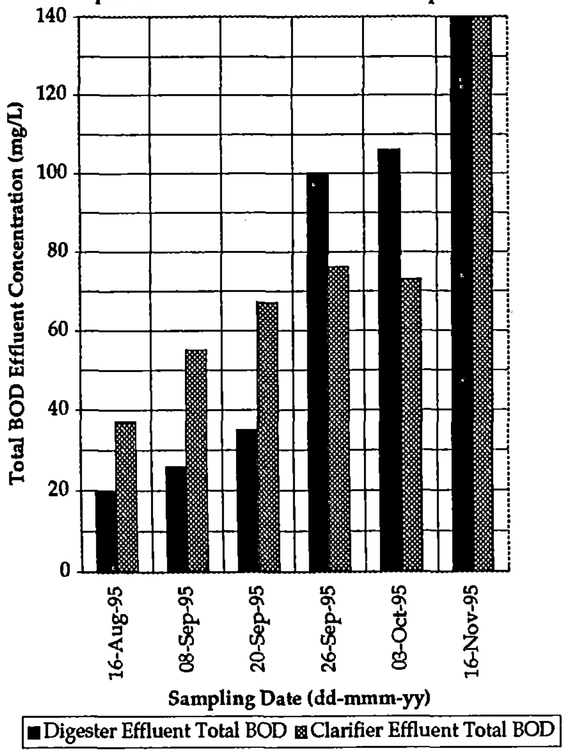
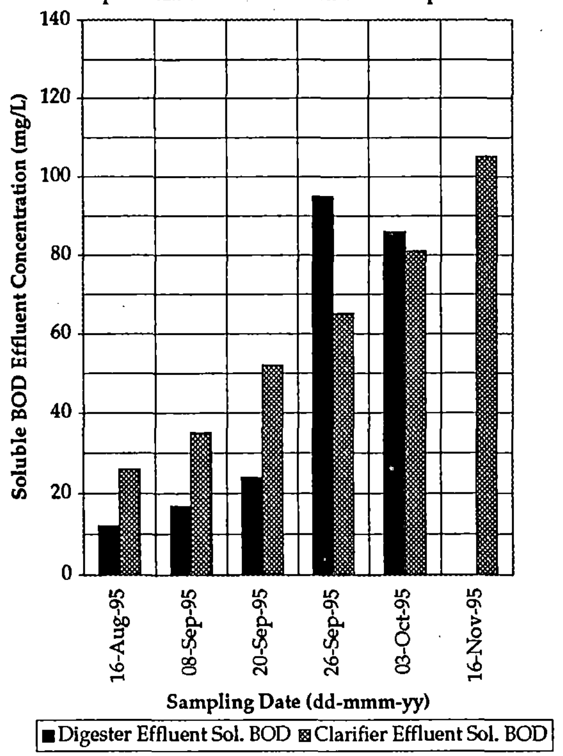


Table 3.3.1.3 - Summary Of Digester Effluent And Clarifier Effluent Comparison Data						
	Digester			Clarifier		
Date (dd-mmm-yy)	Total BOD (mg/L)	Soluble BOD (mg/L)	TSS (mg/L)	Total BOD (mg/L)	Soluble BOD (mg/L)	TSS (mg/L)
16-Aug-95	20	12	10	37	26	19
08-Sep-95	26	17	25	55	35	24
20-Sep-95	35	24	30	67	52	19
26-Sep-95	100	95	26	76	65	16
03-Oct-95	106	86	25	73	81	15
16-Nov-95	140	-	34	140	105	32

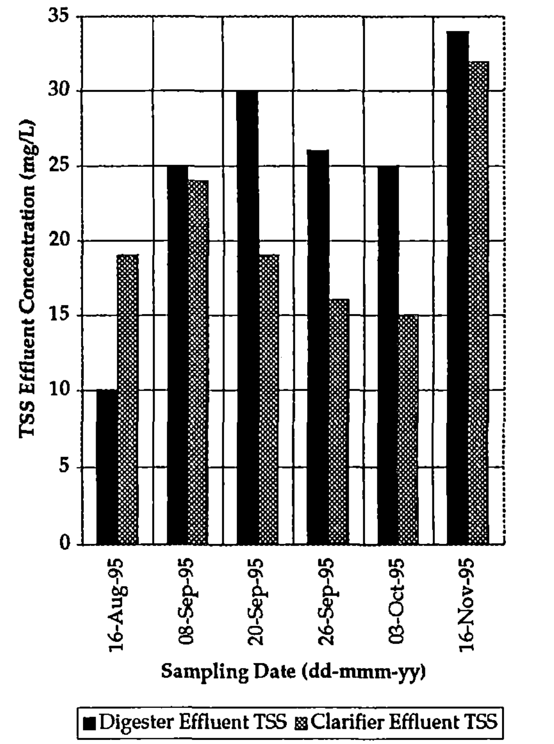
Graph 3.3.1.3a - Total BOD Effluent Comparison



Graph 3.3.1.3b - Sol. BOD Effluent Comparison



Graph 3.3.1.3c - TSS Effluent Comparison



by 72% while the TKN concentration in the effluent decreased by 54%. Table 3.3.2 presents a summary of the nitrogen data.

Table 3.3.2 - Summary Of Nitrogen Analytical Results

Date	NO_2^-, NO_3^-	NH_3	TKN
(dd-mmm-yy)	(mg/L)	(mg/L)	(mg/L)
19-Oct-95 (effluent)	0.050	62.4	-
17-Nov-95 (influent)	0.003	34.6	122
16-Nov-95 (effluent)	0.004	59.6	70.4

3.3.3 Fecal Coliform

Samples were analyzed for fecal coliform reduction during the November testing program. The system generally provided a one-log reduction in fecal coliform concentrations, from 2,200,000 CFU per 100 millilitres in the influent to 390,000 CFU per 100 millilitres in the effluent.

3.3.4 Visual Observations

The system was installed in early July, 1995 and the digester did not overflow until August. The digester was visually inspected several times during this period. The solids level was evaluated with a "sludge judge", the temperature of the clarifier was recorded at random times throughout the testing program, and general appearances were observed.

Neither the solids retention tank, nor the clarifier developed a "scum blanket" typical of a septic tank installation. The solids in the first chamber of the solids tank, did not turn black which would have indicated an absence of anaerobic activity in this cell. In the second cells, black bacteria were noted indicating that septic activity was occurring in the last cell of the digester. The sludge buildup in the solids tank over the course of the testing was less than 300 millimetres.

The temperature in the last compartment of the clarifier was 22.2 °C in July, falling to 20.0 °C on September 8, 17.8 °C on September 17, and 13.3 °C on November 30, 1995. The performance of the system was not noticeably affected by the temperature.

The test tanks were fabricated from polypropylene. These tanks were supposedly designed for underground installation. Even though the installation was only marginally below the ground surface (approximately 0.2 metres) the tanks suffered considerable distortion due to active earth pressure. Within one month of installation, it was impossible to seal the access manholes. By the end of the test period, the distortion was so severe that the differential displacement across the top of the inspection manholes was in the order of 50 millimetres. The polypropylene tanks were removed and replaced with concrete tanks at the end of the test program.

The system was noted to produce a sewage related odour in the immediate vicinity of the tanks. The smell was not septic, nor typical "sewage odour" but was similar to an ammonia / detergent odour. This condition was aggravated by the inability to seal the access ports of the test tankage. Odours are not expected to be detected from a properly sealed, buried installation.

The ground disposal system at the test site was quite small. The location of the gravity distribution piping was evident as a lush green grass cover grew immediately over the trench surfaces. Within weeks of the installation of the test system, the grass cover over the disposal piping trenches was the same as elsewhere in the yard. The reduction in "green area" could have been a result of the larger retention volume of the new system, or more likely, a reduction in transfer of TSS and BOD associated with instantaneous peak flows that will occur with a conventional septic tank system.

3.4 COMPARISON TO TRADITIONAL SYSTEMS

The prototype system was intended to be an alternative to conventional mechanical biological secondary treatment plants for individual homes. Mechanical systems are expected to achieve a BOD concentration of 45 mg/L and a TSS concentration of 60 mg/L. The system evaluation shows that the BOD level could not be achieved, but the TSS level was consistently met and bettered.

The analysis of the BOD concentrations in the digester and the clarifier indicate that the BOD levels in the effluent can be expected to continue to rise to ultimately match the BOD of the influent (unmacerated).

The passive system performed better than a conventional septic tank treatment system. The separator directed the majority of the gross solids to the digester. The "re-suspension" of solids, and the flushing of BOD through the system was minimized. A more consistent effluent quality is expected from a passive system with the noted configuration than from a conventional septic tank system.

3.5 APPROPRIATENESS OF THE TESTING

The sampling frequency and testing parameters were considered adequate to assess the performance of the system.

The installation was relatively straight forward and can be performed by anyone knowledgeable in the installation of conventional septic tanks. Maintenance of this type of passive system is expected to be comparable to that of a conventional septic tank treatment system.

The test system complies with Provincial standards and regulations pertinent to septic tank systems.

3.6 POTENTIAL BARRIERS TO USE IN CURRENT RESIDENTIAL SETTINGS

The main potential barrier to use of the passive system in a current residential setting is the additional cost associated with the extra tanks needed for the digester assembly. These tanks also have to be placed slightly deeper in the ground than a conventional septic tank to allow for the required vertical drop through the separator. This could be problematic in areas of low topographic relief or areas where there is either shallow rock or high groundwater tables.

4.0 CONCLUSIONS

4.1 SUCCESSES

The successes of the test system were:

1. The system reduced solids transfer to the disposal field.

2. The separator was an effective device for the separation of gross solids.

3. The inlet piping arrangement in the clarifier distributed flow through a greater cross-section of the tank than a conventional inlet pipe.

4. The baffle device in the clarifier effectively reduced the transfer of solids through the system.

5. The testing apparatus was convenient and reliable.

6. Testing showed that macerating the influent created higher BOD and TSS concentrations in the influent, but the system could reduce the concentrations of both parameters to levels which were comparable for both the unmacerated and macerated influent. Pumping of raw effluent to a treatment system, or use of garburators for kitchen wastes would produce similar impacts which would be effectively processed by the treatment system producing an effluent with a quality similar to that of unmacerated influent treated in the same system.

4.2 FAILURES

The failures of the test system were:

1. BOD concentrations were not reduced to a level that would qualify the system as an equivalent to a conventional mechanical biological secondary treatment plant.

2. The polyethylene tanks used were not suited for underground use.

Appendix 1

JB LABS

827 FORT STREET,
VICTORIA, B.C. V8W 1H6
Tel: (604) 385-6112
Fax: (604) 382-6364

DATE: August 30, 1995

JOB NO: JB 1624V
LR NO: 20187

SAMPLING DATE: See Below
SAMPLING AGENT: Client

The sample(s) submitted by the agent have been tested as requested and we report as follows:

CLIENT: NovaTec Consultants Inc.
#201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

Attn: Ivo Van Bastelaere

SAMPLE:
Sample # 1: Alderly - Influent Jul 21/95
Sample # 2: Alderly - Influent Aug 10/95
Sample # 3: Alderly - Effluent CLA
Sample # 4: Alderly - Influent MAC
Sample # 5: Alderly - Influent Aug 16/95
Sample # 6: Alderly - C
Sample # 7: Alderly - D
Sample # 8: Alderly - IM
Sample # 9: Alderly - CLA Aug 25/95

		Sample 1	Sample 2	Sample 3	Sample 4
Tot Suspended Solids	mg/L	510	32	13	430
BOD_5	mg/L	504	150	56	390

		Sample 5	Sample 6	Sample 7	Sample 8
Tot Suspended Solids	mg/L	40	19	10	176
BOD_5	mg/L	67	37	20	133
BOD_5, Soluble	mg/L	38	26	12	36

		Sample 9
Tot Suspended Solids	mg/L	11
BOD_5	mg/L	56
BOD_5, Soluble	mg/L	52

JB Laboratories Ltd.
water/wastewaters

John E. Evanoff, M.Sc.
Barbara M. Klassen, B.Sc.

"Analysis performed according to "A Laboratory Manual for the Chemical Analysis of water, Wastewaters and Biological Tissues", Chemistry Laboratory, Water Resource Service and/or "Standard Methods/Water and Wastewater", American Public Health Association.

JB LABS

827 FORT STREET,
VICTORIA, B.C. V8W 1H6
Tel: (604) 385-6112
Fax: (604) 382-6364

140-01

DATE: July 26, 1995

JOB NO: JB 1624V
LR NO: 20187

CLIENT: NovaTec Consultants Inc.
#201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

Attn: Andrew Clark

SAMPLING DATE: Jul 21/95
SAMPLING AGENT: Client

The sample(s) submitted by the agent have been tested as requested and we report as follows:

SAMPLE: Sample # 1: Alderly - Influent Jul 21/95

		Sample 1
Tot Suspended Solids	mg/L	510
BODs	mg/L	504

FEED FAX THIS END

FAXED

To: [illegible]
Dept..
Fax No.. 335-2442
No of Pages.
From. [illegible]
Date:
Company: NovaTec
Fax No.. 384-126[illegible]
Comments. influent 950721

Post-it fax pad 7903E

Dennis fyi -
First results of the influent strength - Obviously elevated above normal - I suggest that this is because of maceration in the pump. Next samples should be without mixing.

Jim

JB Laboratories Ltd.
water/wastewaters

John E. Evanoff, M.Sc.
Barbara M. Klassen, B.Sc.

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JB LABS

827 FORT STREET,
VICTORIA, B.C. V8W 1H6
Tel. (604) 385-6112
Fax: (604) 382-6364

DATE July 26, 1995

JOB NO. JB 1624V
LR NO. 20187

RECEIVED AUG 4 1995

SAMPLING DATE Jul 21/95
SAMPLING AGENT Client

The sample(s) submitted by the agent have been tested as requested and we report as follows

1450-01

CLIENT NovaTec Consultants Inc.
#201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

Attn: Andrew Clark

SAMPLE Sample # 1: Alderly - Influent Jul 21/95

		Sample 1
Tot Suspended Solids	mg/L	510
BOD_5	mg/L	504

JB Laboratories Ltd.
water/wastewaters

John E Evanoff, M Sc
Barbara M Klassen, B Sc

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1VO

1450-0
1000-35
0.8

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JB LABS

727 FORT STREET
VICTORIA, B.C. V8W 1H6
Tel: (604) 385-6112
Fax: (604) 382-6364

DATE: August 16, 1995

JOB NO: JB 1624V
LR NO: 20187

SAMPLING DATE: See Below
SAMPLING AGENT: Client

The sample(s) submitted by the agent have been tested as requested and we report as follows:

CLIENT: NovaTec Consultants Inc.
#201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

Attn: Andrew Clark

SAMPLE:
Sample # 1: Alderly - Influent Jul 21/95
Sample # 2: Alderly - Influent Aug 10/95
Sample # 3: Alderly - Influent CLA
Sample # 4: Alderly - Influent MAC

		Sample 1	Sample 2	Sample 3	Sample 4
Tot Suspended Solids	mg/L	510	32	13	430
BOD_5	mg/L	504	150	56	390

JB Laboratories Ltd.
water/wastewaters

John E. Evanoff, M.Sc
Barbara M. Klassen, B.Sc.

Analysis performed according to "A Laboratory Manual for the Chemical Analysis of water, Wastewaters and Biological Tissues", Chemistry Laboratory, Water Resource Service and/or "Standard Methods/Water and Wastewater", American Public Health Association.

1450-01

JB LABS

327 FORT STREET.
VICTORIA, B.C. V8W 1H6
Tel: (604) 385-6112
Fax: (604) 382-6364

DATE: August 23, 1995

JOB NO: JB 1624V
LR NO: 20187

SAMPLING DATE: See Below
SAMPLING AGENT: Client

The sample(s) submitted by the agent have been tested as requested and we report as follows:

CLIENT: NovaTec Consultants Inc.
#201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

Attn: Andrew Clark

SAMPLE:
Sample # 1: Alderly - Influent Jul 21/95
Sample # 2: Alderly - Influent Aug 10/95
Sample # 3: Alderly - Effluent CLA
Sample # 4: Alderly - Influent MAC
Sample # 5: Alderly - Influent Aug 16/95
Sample # 6: Alderly - C
Sample # 7: Alderly - D
Sample # 8: Alderly - IM

		Sample 1	Sample 2	Sample 3	Sample 4
Tot Suspended Solids	mg/L	510	32	13	430
BODs	mg/L	504	150	56	390

		Sample 5	Sample 6	Sample 7	Sample 8
Tot Suspended Solids	mg/L	40	19	10	176
BODs	mg/L	67	37	20	133
BODs, Soluble	mg/L	38	26	12	36

JB Laboratories Ltd.
water/wastewaters

John E. Evanoff, M.Sc.
Barbara M. Klassen, B.Sc.

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27 FORT STREET,
VICTORIA, B.C. V8W 1H6
Tel: (604) 385-6112
Fax: (604) 382-6364

DATE: August 23, 1995

JOB NO: JB 1624V
LR NO: 20187

SAMPLING DATE: See Below
SAMPLING AGENT: Client

The sample(s) submitted by the agent have been tested as requested and we report as follows:

CLIENT: NovaTec Consultants Inc.
#201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

Attn: Andrew Clark

SAMPLE:
Sample # 1: Alderly - Influent Jul 21/95
Sample # 2: Alderly - Influent Aug 10/95
Sample # 3: Alderly - Effluent CLA
Sample # 4: Alderly - Influent MAC
Sample # 5: Alderly - Influent Aug 16/95
Sample # 6: Alderly - ~~C~~ Clarifier
Sample # 7: Alderly - ~~D~~ Digester
Sample # 8: Alderly - IM

		Sample 1	Sample 2	Sample 3	Sample 4
Tot Suspended Solids	mg/L	510	32	13	430
BOD_5	mg/L	504	150	56	390

		Sample 5	Sample 6	Sample 7	Sample 8
Tot Suspended Solids	mg/L	40	19	10	176
BOD_5	mg/L	67 ✓	37 ✓	20 ✓	133 ✓
BOD_5, Soluble	mg/L	38 ✓	26 ✓	12 ✓	36 ✓

IM

INFL Clarifier Digester

Clarifier BOD/TSS 37/19

DIGESTER BOD/TSS 20/10

FAXED

To: DENIS BAKER
Dept.:
Fax No.: 385-2842
No. of Pages: 1
From: IVO VAN BASTELAERE
Date: AUG 23 1995
Company: NOVATEC CONS.
Fax No.: 384-1201
Comments:

Post-it fax pad 7903E

JB Laboratories Ltd.
water/wastewaters

John E. Evanoff, M.Sc.
Barbara M. Klassen, B.Sc.

Analysis performed according to "A Laboratory Manual for the Chemical Analysis of water Wastewaters and Biological Tissues", Chemistry Laboratory, Water Resource Service and/or "Standard Methods/Water and Wastewater", American Public Health Association.

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27 FORT STREET,
VICTORIA, B.C. V8W 1H6
Tel: (604) 385-6112
Fax: (604) 382-6364

DATE: August 24, 1995

JOB NO: JB 1624V
LR NO: 20187

SAMPLING DATE: See Below
SAMPLING AGENT: Client

The sample(s) submitted by the agent have been tested as requested and we report as follows:

CLIENT: NovaTec Consultants Inc.
#201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

Attn: Ivo Van Bastelaere

SAMPLE:
Sample # 1: Alderly - Influent Jul 21/95
Sample # 2: Alderly - Influent Aug 10/95
Sample # 3: Alderly - Effluent CLA
Sample # 4: Alderly - Influent MAC
Sample # 5: Alderly - Influent Aug 16/95
Sample # 6: Alderly - C
Sample # 7: Alderly - D
Sample # 8: Alderly - IM

		Sample 1	Sample 2	Sample 3	Sample 4
Tot Suspended Solids	mg/L	510	32	13	430
BOD_5	mg/L	504	150	56	390

		Sample 5	Sample 6	Sample 7	Sample 8
Tot Suspended Solids	mg/L	40	19	10	176
BOD_5	mg/L	67	37	20	133
BOD_5, Soluble	mg/L	38	26	12	36

JB Laboratories Ltd.
water/wastewaters

John E. Evanoff, M.Sc.
Barbara M. Klassen, B.Sc.

Analysis performed according to "A Laboratory Manual for the Chemical Analysis of water, Wastewaters and Biological Tissues", Chemistry Laboratory, Water Resource Service and/or "Standard Methods/Water and Wastewater", American Public Health Association.

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827 FORT STREET,
VICTORIA, B.C. V8W 1H6
Tel: (604) 385-6112
Fax: (604) 382-6364

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DATE: August 30, 1995

JOB NO: JB 1624V
LR NO: 20187

SAMPLING DATE: See Below
SAMPLING AGENT: Client

The sample(s) submitted by the agent have been tested as requested and we report as follows.

CLIENT: NovaTec Consultants Inc.
#201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

Attn: Ivo Van Bastelaere

SAMPLE:
Sample # 1: Alderly - Influent Jul 21/95
Sample # 2: Alderly - Influent Aug 10/95
Sample # 3: Alderly - Effluent CLA
Sample # 4: Alderly - Influent MAC
Sample # 5: Alderly - Influent Aug 16/95
Sample # 6: Alderly - C
Sample # 7: Alderly - D
Sample # 8: Alderly - IM
Sample # 9: Alderly - CLA Aug 25/95

		Sample 1	Sample 2	Sample 3	Sample 4
Tot Suspended Solids	mg/L	510	32	13	430
BOD_5	mg/L	504	150	56	390

		Sample 5	Sample 6	Sample 7	Sample 8
Tot Suspended Solids	mg/L	40	19	10	176
BOD_5	mg/L	67	37	20	133
BOD_5, Soluble	mg/L	38	26	12	36

		Sample 9
Tot Suspended Solids	mg/L	11
BOD_5	mg/L	56
BOD_5, Soluble	mg/L	52

JB Laboratories Ltd.
water/wastewaters

John E. Evanoff, M Sc
Barbara M Klassen, B Sc

Analysis performed according to "A Laboratory Manual for the Chemical Analysis of water, Wastewaters and Biological Tissues", Chemistry Laboratory Water Resource Service and/or "Standard Methods/Water and Wastewater", American Public Health Association

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27 FORT STREET,
VICTORIA, B.C. V8W 1H6
Tel: (604) 385-6112
Fax: (604) 382-6364

DATE: September 18, 1995

JOB NO: JB 1624V
LR NO: 20450

SAMPLING DATE: See Below
SAMPLING AGENT: Client

The sample(s) submitted by the agent have been tested as requested and we report as follows:

CLIENT: NovaTec Consultants Inc.
#201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

Attn: Ivo Van Bastelaere

SAMPLE: Sample # 1: Macerated Influent Sep 8/95
Sample # 2: Influent
Sample # 3: Clarifier
Sample # 4: Digestor

		Sample 1	Sample 2	Sample 3	Sample 4
Tot Suspended Solids	mg/L	445	47	24	25
BOD5	mg/L	320	190	55	26
BOD5, Soluble	mg/L	200	140	35	17

FEED FAX THIS END

FAX

To: DENIS BARKER
Dept..
Fax No.: 385-2842
No. o Pages
From
Date: 95.09.19
Company: 1450-01
Fax No.:
Comments: JB LAB RESULTS

FAXED

Post-it™ fax pad 7903E

JB Laboratories Ltd.
water/wastewaters

John E. Evanoff, M.Sc.
Barbara M. Klassen, B.Sc.

Analysis performed according to "A Laboratory Manual for the Chemical Analysis of water, Wastewaters and Biological Tissues", Chemistry Laboratory, Water Resource Service and/or "Standard Methods/Water and Wastewater", American Public Health Association

JB LABS

527 FORT STREET,
VICTORIA, B.C. V8W 1H6
Tel: (604) 385-6112
Fax: (604) 382-6364

DATE: September 28, 1995

JOB NO: JB 1624V
LA NO: 20450

SAMPLING DATE: See Below

SAMPLING AGENT: Client

The sample(s) submitted by the agent have been tested as requested and we report as follows:

CLIENT: NovaTec Consultants Inc.
#201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

Attn: Ivo Van Bastelaere

SAMPLE:
Sample # 1: Macerated Influent Sep 8/95
Sample # 2: Influent
Sample # 3: Clarifier
Sample # 4: Digestor
Sample # 5: Macerated Influent Sep 19/95
Sample # 6: Influent
Sample # 7: Clarifier Sep 20/95
Sample # 8: Digester

		Sample 1	Sample 2	Sample 3	Sample 4
Tot Suspended Solids	mg/L	445	47	24	25
BOD5	mg/L	320	190	55	26
BOD5, Soluble	mg/L	200	140	35	17

		Sample 5	Sample 6	Sample 7	Sample 8
Tot Suspended Solids	mg/L	376	38	19	30
BOD5	mg/L	360	234	67	35
BOD5, Soluble	mg/L	189	191	52	24

FEED FAX THIS END

FAX
To. Denis Barker
Dept.
Fax No. 385-2841
No. of Pages:
From: Ben. for Ivo
Date: 95.09.28
Company: NovaTec
Fax No.: 384-1201
Comments: RE: 1450-01

Post-it fax pad 7903E

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JB Laboratories Ltd.
water/wastewaters

John E. Evanoff, M.Sc.
Barbara M. Klassen, B.Sc.

Analysis performed according to "A Laboratory Manual for the Chemical Analysis of water, Wastewaters and Biological Tissues", Chemistry Laboratory, Water Resource Service and/or "Standard Methods/Water and Wastewater"; American Public Health Association.

1450-01

JB LABS
827 FORT STREET,
VICTORIA, B.C. V8W 1H6
Tel: (604) 385-6112
Fax. (604) 382-6364

DATE: October 2, 1995

JOB NO: JB 1624V
LR NO: 20450

SAMPLING DATE. See Below
SAMPLING AGENT. Client

The sample(s) submitted by the agent have been tested as requested and we report as follows

CLIENT: NovaTec Consultants Inc.
#201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

Attn: Ivo Van Bastelaere

RECEIVED OCT 3 1995

SAMPLE.
Sample # 1: Macerated Influent Sep 8/95
Sample # 2: Influent
Sample # 3: Clarifier
Sample # 4: Digester
Sample # 5: Macerated Influent Sep 19/95
Sample # 6: Influent
Sample # 7: Clarifier Sep 20/95
Sample # 8: Digester
Sample # 9: Laundry (Influent) Sep 25/95
Sample # 10: Clarifier Sep 26/95
Sample # 11: Digester

		Sample 1	Sample 2	Sample 3	Sample 4
Tot Suspended Solids	mg/L	445	47	24	25
BOD_5	mg/L	320	190	55	26
BOD_5, Soluble	mg/L	200	140	35	17

		Sample 5	Sample 6	Sample 7	Sample 8
Tot Suspended Solids	mg/L	376	38	19	30
BOD_5	mg/L	360	234	67	35
BOD_5, Soluble	mg/L	189	191	52	24

		Sample 9	Sample 10	Sample 11
Tot Suspended Solids	mg/L	300	16	26
BOD_5	mg/L	130	76	100
BOD_5, Soluble	mg/L	60	65	95

John E Evanoff, M Sc
Barbara M. Klassen, B Sc

JB LABS

7 FORT STREET,
VICTORIA, B.C. V8W 1H6
Tel: (604) 385-6112
Fax: (604) 382-6364

DATE: October 2, 1995

JOB NO: JB 1624V
LR NO: 20450

SAMPLING DATE: See Below
SAMPLING AGENT: Client

The sample(s) submitted by the agent have been tested as requested and we report as follows:

CLIENT: NovaTec Consultants Inc.
#201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

Attn: Ivo Van Bastelaere

SAMPLE:
Sample # 1: Macerated Influent Sep 8/95
Sample # 2: Influent
Sample # 3: Clarifier
Sample # 4: Digester
Sample # 5: Macerated Influent Sep 19/95
Sample # 6: Influent
Sample # 7: Clarifier Sep 20/95
Sample # 8: Digester
Sample # 9: Laundry (Influent) Sep 25/95
Sample # 10: Clarifier Sep 26/95
Sample # 11: Digester

		Sample 1	Sample 2	Sample 3	Sample 4
Tot Suspended Solids	mg/L	445	47	24	25
BOD_5	mg/L	320	190	55	26
BOD_5, Soluble	mg/L	200	140	35	17

		Sample 5	Sample 6	Sample 7	Sample 8
Tot Suspended Solids	mg/L	376	38	19	30
BOD_5	mg/L	360	234	67	35
BOD_5, Soluble	mg/L	189	191	52	24

		Sample 9	Sample 10	Sample 11
Tot Suspended Solids	mg/L	300	16	26
BOD_5	mg/L	130	76	100
BOD_5, Soluble	mg/L	60	65	95

FEED FAX THIS END

FAX
To: DENIS B.
Dept.:
Fax No.: 3852842
No. of Pages: 1
From:
Date:
Company: NOVATEC
Fax No.:
Comments: JB LAB RESULTS 1450-01
Post-it fax pad 7903E

FAXED

JB Laborato
water/wastew

John E. Evanoff, M.Sc.
Barbara M. Klassen, B.Sc.

Analysis performed according to "A Laboratory Manu... Wastewaters and Biological Tissues", Chemistry Labor... "Standard Methods/Water and Wastewater", A...

HET-01

JB LABS

827 FORT STREET,
VICTORIA, B.C. V8W 1H6
Tel: (604) 385-6112
Fax: (604) 382-6364

DATE: October 10, 1995

JOB NO: JB 1624V
LR NO: 20582

SAMPLING DATE: See Below
SAMPLING AGENT: Client

The sample(s) submitted by the agent have been tested as requested and we report as follows

CLIENT: NovaTec Consultants Inc.
#201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

Attn: Ivo Van Bastelaere

SAMPLE: Sample # 1: Alderly - Clarifier Oct 3/95
Sample # 2: Alderly - Digester

		Sample 1	Sample 2
Tot Suspended Solids	mg/L	15	25
BODs	mg/L	73	106
BODs, Soluble	mg/L	81	86

FEED FAX THIS END

FAX

FAXED

To: [illegible]
Dept.
Fax No: 385-3840
No. of Pages: 1
From: IVO
Date: [illegible]
Company: NTC
Fax No..
Comments: Latest - BODs 4
— as anticipated.

Post-it fax pad 7903E

JB Laboratories Ltd.
water/wastewaters

John E. Evanoff, M.Sc.
Barbara M. Klassen, B.Sc.

Analyses performed according to "A Laboratory Manual for the Chemical Analysis of water, Wastewaters and Biological Tissues", Chemistry Laboratory, Water Resource Service and/or "Standard Methods/Water and Wastewater", American Public Health Association.

1450-07

JB LABS

827 FORT STREET,
VICTORIA, B.C. V8W 1H6
Tel: (604) 385-6112
Fax: (604) 382-6364

DATE: October 25, 1995

JOB NO: JB 1624V
LR NO: 20582

SAMPLING DATE: See Below
SAMPLING AGENT: Client

The sample(s) submitted by the agent have been tested as requested and we report as follows:

CLIENT: NovaTec Consultants Inc.
#201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

Attn: Ivo Van Bastelaere

SAMPLE:
Sample # 1: Alderly - Clarifier Oct 3/95
Sample # 2: Alderly - Digester
Sample # 3: Alderly - Clarifier Oct 19/95

		Sample 1	Sample 2	Sample 3
Tot Suspended Solids	mg/L	15	25	22
BOD_5	mg/L	73	106	97
BOD_5, Soluble	mg/L	81	86	71
Nitrite + Nitrate	mg/L N			0.050
Ammonia	mg/L N			62.4
Faecal Coliform	CFU/100ml			5.7×10^4

FEED FAX THIS END

FAX
To: DENIS BARKER
Dept.
Fax No 385 2042
No. of Pages 1
From: DEV. FOR IVO
Date: 95.10.25
Company NOVATEC
Fax No. 384-1201
Comments: pls call Ivo re: Fri (27) sampling.
Post-it fax pad 7903E

FAXED

JB Laboratories Ltd.
water/wastewaters

John E. Evanoff, M.Sc.
Barbara M. Klassen, B.Sc

Analysis performed according to "A Laboratory Manual for the Chemical Analysis of water, Wastewaters and Biological Tissues", Chemistry Laboratory, Water Resource Service and/or "Standard Methods/Water and Wastewater", American Public Health Association.

1450-01 P.1

JB LABS

827 FORT STREET,
VICTORIA, B.C. V8W 1H6
Tel: (604) 385-6112
Fax: (604) 382-6364

DATE: November 1, 1995

JOB NO: JB 1624V
LB NO: 20582

SAMPLING DATE: See Below
SAMPLING AGENT: Client

The sample(s) submitted by the agent have been tested as requested and we report as follows:

CLIENT: NovaTec Consultants Inc.
#201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

File

Attn: Ivo Van Bastelaere

SAMPLE:
Sample # 1: Alderly - Clarifier Oct 3/95
Sample # 2: Alderly - Digester
Sample # 3: Alderly - Clarifier Oct 19/95
Sample # 4: Alderly - Clarifier Oct 26/95
Sample # 5: Alderly - Pre bio brush

		Sample 1	Sample 2	Sample 3	Sample 4
Tot Suspended Solids	mg/L	15	25	22	13
BOD_5	mg/L	73	106	97	93
BOD_5, Soluble	mg/L	81	86	71	
Nitrite + Nitrate	mg/L N			0.050	
Ammonia	mg/L N			62.4	
Faecal Coliform	CFU/100ml			5.7×10^4	

		Sample 5
Tot Suspended Solids	mg/L	20
BOD_5	mg/L	125

FEED FAX THIS END

FAX
To: Denis Barker
Dept.:
Fax No.: 385-2842
No. of Pages:
From:
Date: 95-11-02
Company: NovaTec.
Fax No.:
Comments: Copy of lab results
Post-it fax pad 7903E

FAXED

JB Laboratories Ltd.

water/wastewaters

John E. Evanoff, M.Sc.
Barbara M. Klassen, B.Sc.

Analysis performed according to "A Laboratory Manual for the Chemical Analysis of water, Wastewaters and Biological Tissues", Chemistry Laboratory, Water Resource Service and/or "Standard Methods/Water and Wastewater", American Public Health Association.

JB LABS
827 FORT STREET,
VICTORIA, B.C. V8W 1H6
Tel: (604) 385-6112
Fax: (604) 382-6364

Bsskor 1250 '01

DATE: November 1, 1995

JOB NO: JB 1624V
LR NO: 20582

RECEIVED NOV 20 1995

SAMPLING DATE: See Below
SAMPLING AGENT: Client

The sample(s) submitted by the agent have been tested as requested and we report as follows:

CLIENT: NovaTec Consultants Inc.
#201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

Attn: Ivo Van Bastelaere

SAMPLE:
Sample # 1: Alderly - Clarifier Oct 3/95
Sample # 2: Alderly - Digester
Sample # 3: Alderly - Clarifier Oct 19/95
Sample # 4: Alderly - Clarifier Oct 26/95
Sample # 5: Alderly - Pre bio brush

		Sample 1	Sample 2	Sample 3	Sample 4
Tot Suspended Solids	mg/L	15	25	22	13
BOD_5	mg/L	73	106	97	93
BOD_5, Soluble	mg/L	81	86	71	
Nitrite + Nitrate	mg/L N			0.050	
Ammonia	mg/L N			62.4	
Faecal Coliform	CFU/100ml			5.7×10^4	

		Sample 5
Tot Suspended Solids	mg/L	20
BOD_5	mg/L	125

John E. Evanoff, M Sc
Barbara M. Klassen, B Sc

JB Laboratories Ltd.
water/wastewaters

JB LABS

1450-01

827 FORT STREET
VICTORIA, B C V8W 1H6
Tel. (604) 385-6112
Fax: (604) 382-6364

DATE November 22, 1995

JOB NO. JB 1624V
LR NO: 20859

SAMPLING DATE: See Below
SAMPLING AGENT: Client

The sample(s) submitted by the agent have been tested as requested and we report as follows

CLIENT: NovaTec Consultants Inc.
#201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

Attn: Ivo Van Bastelaere

SAMPLE
Sample # 1: Alderly - Clarifier Oct 27/95
Sample # 2: Alderly - Clarifier Nov 16/95
Sample # 3: Alderly - Macerated Influent Nov 17/95
Sample # 4: Alderly - Influent
Sample # 5: Alderly - Digester

		Sample 1	Sample 2	Sample 3	Sample 4
Tot Suspended Solids	mg/L	20	32	428	34
BOD_5	mg/L	99	140	540	210
BOD_5, Soluble	mg/L	84	105	230	170
Nitrite + Nitrate	mg/L N		0.004	0.007	0.003
Ammonia	mg/L N		59.6	34.3	34.6
T.Kjeldahl Nitrogen	mg/L N		70.4	142	122
Faecal Coliform	CFU/100ml			3.1×10^6	2.2×10^6

		Sample 5
Tot Suspended Solids	mg/L	34
BOD_5	mg/L	140

FEED FAX THIS END

FAX
To DENIS BARKER
Dept
Fax No 385-2842
No of Pages 1
From
Date
Company NOVATEC
Fax No 384-1201
Comments

Post it fax pad 7903E

FAXED

JB Laboratories Ltd.
water/wastewaters

John E. Evanoff, M.Sc.
Barbara M. Klassen, B.Sc.

Analysis performed according to "A Laboratory Manual for the Chemical Analysis of Water, Wastewaters and Biological Tissues", Chemistry Laboratory, Water Resource Service and/or "Standard Methods/Water and Wastewater", American Public Health Association

1450-01

JB LABS

827 FORT STREET,
VICTORIA, B C V8W 1H6
Tel: (604) 385-6112
Fax: (604) 382-6364

3 rdg. for Pre bio

DATE: December 6, 1995

JOB NO: JB 1624V
LR NO: 20859

SAMPLING DATE: See Below
SAMPLING AGENT: Client

The sample(s) submitted by the agent have been tested as requested and we report as follows:

CLIENT: NovaTec Consultants Inc.
#201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

Attn: Ivo Van Bastelaere

SAMPLE.
Sample # 1: Alderly - Clarifier 1450-01 Oct 27/95
Sample # 2: Alderly - Clarifier Nov 16/95
Sample # 3: Alderly - Macerated Influent Nov 17/95
Sample # 4: Alderly - Influent
Sample # 5: Alderly - Digester
Sample # 6: Alderly - Clarifier Nov 30/95

		Sample 1	Sample 2	Sample 3	Sample 4
Tot Suspended Solids	mg/L	20	32	428	34
BOD5	mg/L	99	140	540	210
BOD5, Soluble	mg/L	84	105	230	170
Nitrite + Nitrate	mg/L N		0.004	0.007	0.003
Ammonia	mg/L N		59.6	34.3	34.6
T.Kjeldahl Nitrogen	mg/L N		70.4	142	122
Faecal Coliform	CFU/100ml			$3.1x10^6$	$2.2x10^6$

		Sample 5	Sample 6
Tot Suspended Solids	mg/L	34	46
BOD5	mg/L	140	118
BOD5, Soluble	mg/L		142

FEED FAX THIS END

FAXED

To: Denis Barker
Dept:
Fax No: 385-2342
No of Pages: 1
From: BV.
Date: 95.12.06
Company:
Fax No: results from
Comments: DO's
1450-01

Post-it fax pad 7903E

JB Laboratories Ltd.
water/wastewaters

John E. Evanoff, M Sc
Barbara M Klassen, B Sc

Analysis performed according to "A Laboratory Manual for the Chemical Analysis of Water, Wastewaters and Biological Tissues" Chemistry Laboratory Water Resource Service and/or "Standard Methods/Water and Wastewater", American Public Health Association

JB LABS

827 FORT STREET,
VICTORIA, B.C. V8W 1H6
Tel: (604) 385-6112
Fax: (604) 382-6364

DATE: December 11, 1995

JOB NO: JB 1624V
LR NO: 20956

SAMPLING DATE: Dec 4/95
SAMPLING AGENT: Barker

The sample(s) submitted by the agent have been tested as requested and we report as follows:

CLIENT: NovaTec Consultants Inc.
#201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

Attn: Ivo Van Bastelaere

SAMPLE: Sample # 1: Alderly - Clarifier Dec 4/95

		Sample 1
Tot Suspended Solids	mg/L	22
BODs	mg/L	116
BODs; Soluble	mg/L	90

FEED FAX THIS END

FAX
To. DENIS BARKER
Dept..
Fax No. 385-2842
No. of Pages
From.
Date 95.12.12
Company
Fax No..
Comments.
Post-it fax pad 7903E

FAXED

JB Laboratories Ltd.
water/wastewaters

John E. Evanoff, M.Sc.
Barbara M. Klassen, B.Sc.

Analysis performed according to "A Laboratory Manual for the Chemical Analysis of water, Wastewaters and Biological Tissues", Chemistry Laboratory, Water Resource Service and/or "Standard Methods/Water and Wastewater", American Public Health Association.

JB LABS
827 FORT STREET.
VICTORIA, B.C. V8W 1H6
Tel: (604) 385-6112
Fax: (604) 382-6364

DATE: December 18, 1995

JOB NO: JB 1624V
LR NO: 20956

SAMPLING DATE: See Below
SAMPLING AGENT: Client

The sample(s) submitted by the agent have been tested as requested and we report as follows:

CLIENT: NovaTec Consultants Inc.
#201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

Attn: Ivo Van Bastelaere

SAMPLE: Sample # 1: Alderly - Clarifier Dec 4/95
Sample # 2: Alderly - Clarifier, postair Dec 13/95

		Sample 1	Sample 2
Tot Suspended Solids	mg/L	22	18
BODs	mg/L	116	131
BODs, Soluble	mg/L	90	

FEED FAX THIS END

FAX

To. DENIS BARKER
Dept..
Fax No.: 385-2842
No. of Pages:
From:
Date:
Company:
Fax No.:
Comments:

Post-it

FAXED 95.12.18

JB Laboratories Ltd.
water/wastewaters

John E. Evanoff, M.Sc.
Barbara M. Klassen, B.Sc.

Analysis performed according to "A Laboratory Manual for the Chemical Analysis of water, Wastewaters and Biological Tissues", Chemistry Laboratory, Water Resource Service and/or "Standard Methods/Water and Wastewater", American Public Health Association.

JB LABS

827 FORT STREET,
VICTORIA, B.C. V8W 1H6
Tel: (604) 385-6112
Fax: (604) 382-6364

DATE: January 10, 1996

JOB NO: JB 1624V
LR.NO: 20956

SAMPLING DATE: See Below
SAMPLING AGENT: Client

The sample(s) submitted by the agent have been tested as requested and we report as follows:

CLIENT: NovaTec Consultants Inc.
#201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

Attn: Ivo Van Bastelaere

SAMPLE: Sample # 1: Alderly - Clarifier Dec 4/95
Sample # 2: Alderly - Clarifier Dec 13/95
Sample # 3: Alderly - Clarifier Dec 21/95

		Sample 1	Sample 2	Sample 3
Tot Suspended Solids	mg/L	22	18	24
BOD_5	mg/L	116	131	110
BOD_5, Soluble	mg/L	90		

JB LABS
827 FORT STREET,
VICTORIA, B.C. V8W 1H6
Tel: (604) 385-6112
Fax: (604) 382-8364

DATE: January 10, 1996

JOB NO: JB 1625A
LR NO: 21063

SAMPLING DATE: Jan 2/96
SAMPLING AGENT: Client

The sample(s) submitted by the agent have been tested as requested and we report as follows:

CLIENT: NovaTec Consultants Inc.
201 - 2840 Nanaimo St.
Victoria, B.C.
V8T 4W9

Attn: Ivo Van Bastelaere, PEng

SAMPLE: Sample # 1: Alderly - Clarifier Jan 2/96

		Sample 1
Tot Suspended Solids	mg/L	44
BOD_5	mg/L	130
BOD_5, Soluble	mg/L	94
Faecal Coliform	CFU/100ml	3.9×10^5

JB Laboratories Ltd.
water/wastewaters

John E. Evanoff, M.Sc
Barbara M. Klassen, B.Sc.

Analysis performed according to "A Laboratory Manual for the Chemical Analysis of water, Wastewaters and Biological Tissues", Chemistry Laboratory, Water Resource Service and/or "Standard Methods/Water and Wastewater", American Public Health Association.