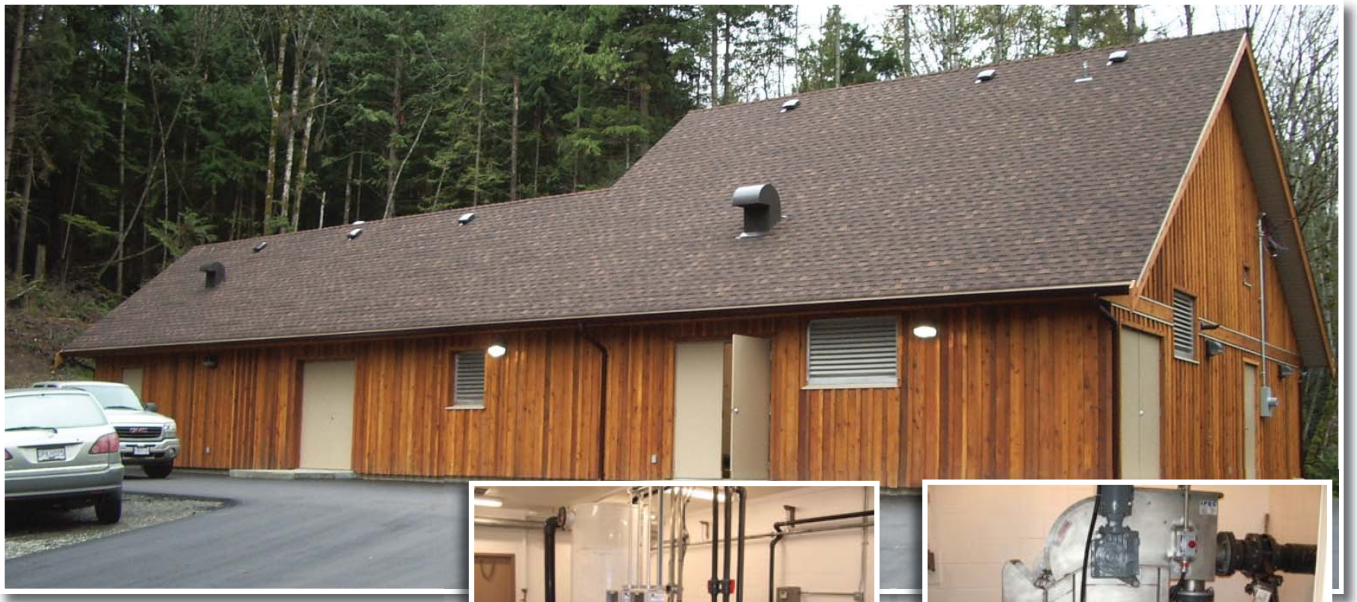
Nanoose Bay decentralized WWTP celebrates three years of successful operation



Mechanical room - sand filters and UV disinfection.

IPEC drum screen.

With the technological advances in small plant performance and reliability, decentralized wastewater treatment plants have now become eminently feasible. Smaller local treatment plants, instead of a large central facility, allow for considerable economical advantages including the reduction of costly collection infrastructure. They also provide the opportunity for smaller incremental-as-needed expansion phasing. Significant environmental and practical advantages also exist, including the possibility of reclaimed water re-use or disposal even in a very environmentally-sensitive locality.

In the early 2000s, Indian & Northern Affairs Canada (INAC) was evaluating the construction of a wastewater treatment plant to serve the Snaw-naw-as First Nation village in Nanoose Bay in British Columbia. The plant was to initially serve the village itself but expansions were anticipated because of growth of the village and future commercial developments alongside the nearby highway.

The treated effluent was to be discharged by an ocean outfall into the en-

Table 1 – First Samples and Analysis (Taken November 1, 2005).

BOD_5 mg/l	TSS mg/l	Nitrite Nitrate mg/l	Ammonia Nitrogen mg/l	TKN mg/l	Total Nitrogen mg/l	Fecal Coliform CFU/100ml
< 5	< 5	18.0	0.04	0.7	18.7	< 1

Table 2 – Annual average of plant samples and operating data.

Year	Influent			Effluent								Power	WAS
	Flow	BOD Mg/l	TSS Mg/l	BOD Mg/l	TSS Mg/l	N-NH_4 Mg/l	N-NOx Mg/l	TKN Mg/l	TN Mg/l	Turb. NTU	Fecal Coliform Count/100 ml	Average kWh/d	Kg WAS / Kg BOD
2005	48	111	138	<5	<3	-	12.9	1.4	14.3	-	<10	-	-
2006	51	178	273	<10	<1	0.06	11.4	1.2	12.5	0.6	<1	-	-
2007	55	119	149	<10	<1	0.05	20.5	1.1	20.9	0.5	<1	248	-
2008	56	118	143	<10	<1	0.19	18.9	0.8	19.3	0.7	<1	255	0.54

Notes: All data are annual averages of monthly sampling, testing and analysis which is performed by professional third party laboratory

vironmentally-sensitive Nanoose Bay.

In 2002, INAC commissioned Chatwin Engineering and Novatec Consultants to prepare Expression of Interest (EOI) and, later, Request for Proposal (RFP) documents, and, after the due evaluation process, the project was awarded in 2004 to the team of Knappett Construction Ltd., of Victoria (general contractor), and ECOfluid Systems Inc. (treatment technology designer and provider) that had previously delivered a number of wastewater treatment projects in British Columbia.

The project award, and the facility construction and operation included several innovative approaches, such as awarding the contract as a design/build/operate (DBO) contract, and the later inclusion of the development and implementation of training Band members to eventually become Environmental Operators Certification Program (EOCP) certified operators.

Design criteria

The design criteria for the new plant came directly from the decentralized facility order book:

- Produce high quality Class A effluent as stipulated by the Municipal Sewage Regulations (MSR), (BOD_5, TSS and Total Nitrogen of less than 10, 10 and 20 mg/l respectively, ammonia nitrogen of less than 1 mg/l, and fecal coliform of less than 14/100 ml.)
- Discharge the treated effluent into the environmentally-sensitive local recipient.
- Allow for future incremental plant expansion. The initial capacity of 119 m^3/d will be expanded in five future stages, each sized for an average flow of approximately 132 m^3/d to an ultimate future average capacity of 775 m^3/d. (In phases 4, 5 and 6, a mirror image plant is to be built).
- Build a decentralized treatment facility having a minimal visual, odor and noise impact on the neighbourhood.
- Design an operator-friendly plant, keeping in mind that the plant will be for the most part operated by the Band member operator trainees.
- Design a SCADA controlled plant

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that can be remotely monitored.
- Develop and implement an operators' training program for the Snaw-naw-as Band members, so that they can attain wastewater treatment plant operators' certificates as per the requirements of the EOCP.

The design

As mandated, the plant was designed to be simple and easy to operate. The influent is pumped into an IPEC drum screen with 6 mm openings, with a sealed, continuous bagging system. Screened influent drops into an equalization tank provided with a set of duplex equalization pumps which are controlled by float switches and timers.

The screened influent is then pumped through a flow splitter box into the anoxic compartments of two USBF bioreactors. Influent and recycled activated sludge mixed liquor flow to the aerobic compartment and the sludge and the treated water are eventually separated by the upflow sludge blanket filter (USBF).

From the sludge blanket filter the treated effluent flows to the filter feed tank, from which, controlled by flow switches, it is pumped through sand filters to the ultraviolet disinfection system overflow feed tank (which also serves as a reservoir for the sand filter backwash water). After flowing through the open channel Trojan UV disinfection unit, the effluent is discharged via ocean outfall into Nanoose Bay.

Waste sludge is thickened in the ECOfluid STP pre-thickeners to approximately 2% dry solids, and controlled by sludge pre-thickener pump timers; it is transferred to the sludge holding tank before being periodically hauled away for disposal.

The entire process is automatic and is SCADA monitored and controlled. Very little direct input by the operator is required.

The design underwent extensive and drawn-out reviews by INAC and INAC-appointed consultants. Construction was finally given the go-ahead and commenced in April 2005.

The plant

The first phase of the plant was built over the next six months. To follow the design criteria, the entire plant was installed within a building blending esthetically with the surrounding environment.

The small footprint of the bioreactors allowed them to be installed below ground and within the building. Noise from the plant was reduced, firstly, by the fact that the USBF's self-regulating hydraulics result in minimal motorized noise-emanating equipment, and, secondly, by the noise abatement design of the blower enclosure. In fact, the noise from the nearby highway is often higher than that emanating from the plant.

USBF bioreactors are odor free. The only other sources of odor, such as the screen room, and the equalization tank gas phase, are piped into an air fan which passes the collected gas through a biofilter bed. (The odor abatement system described was not ECOfluid's first and preferred choice. In most ECOfluid plants the odorous gas would be piped to the air blowers and, subsequently, stripped during the mixed liquor aeration).

Phase 1 of this advanced plant was completed in October 2005, and the

plant started to receive wastewater on October 20, 2005. The first sampling and analysis were performed within two weeks of the plant start-up and the data were well within the design parameters (Table 1).

Plant performance

In the last three years the plant performance has been consistently within the Class A design parameters. Table 2 summarizes annual averages of monthly sampling and analysis.

Prior to the sampling of the influent BOD, the operators and the designers were baffled by the elevated Total Nitrogen, which, while still within the design criteria, hovered higher than the 10 mg/l typically expected of the USBF plants.

Subsequent analysis of the influent BOD confirmed the initial suspicion that the consistently low influent BOD did not provide sufficient donor carbon necessary for denitrification. It is interesting to observe that the one year the influent BOD was higher (2006) resulted in much better denitrification and TN was reduced to an average of 12.5 mg/l. Although the plant still performs within the design criteria, the addition of supplemental carbon on a trial basis will be implemented.

To compound the denitrification process challenge, it was recently discovered through the construction photos, that a fine air bubble diffuser was installed in error within the anoxic compartment instead of a coarse air bubbler intended for mixing. The situation will be corrected in early spring of 2009.

Addition of supplemental carbon, and replacement of the fine air diffuser in the anoxic compartment will no doubt bring the Total Nitrogen levels closer to, or below the USBF customary 10 mg/l.

The plant's absolute power consumption is approximately 250 kWh/day. The specific power consumption (kWh/m^3 or kWh/kg BOD) will reach its optimum when the plant capacity loading increases.

Operator training

The development and implementation of the Band members' operating training program were a first for INAC and ECOfluid. The program's goal was to have two Band members attain wastewater treatment plant operators' certification as per the requirements of the EOCP. Two trainees were selected by the Band and the training started even before the plant construction was completed.

Based on the Sacramento State Office of Water Programs (OWP) and other sources, the training curriculum and methodology were developed entirely by ECOfluid, and included both classroom lectures and hands-on, practical education and training.

To date, both original trainees are still maintaining the day-to-day operations of the plant. They have shown great dedication to the job and have embraced the steep learning curve. Daily reports are submitted to the ECOfluid chief operator, who visits the plant periodically but who, in any case, is never more than a few hours away, outlining operating parameters and issues that need to be addressed.

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