# A camp of 580 sends a day's sewage in four hours.

Two shift changes, two hours each, 35 $m^3$/h. Within a cubic metre, that is the entire 139 $m^3$ design day, arriving at an Arctic site supplied by air and one tightly scheduled annual sealift, with no resident wastewater specialist. Komline Pure Water answered with 87.8 $m^3$ of equalisation ahead of a two-train membrane bioreactor, redundant UV and on-site dewatering, tested as one insulated plant before shipment.

Delivered | Commissioned | **Running**

| | | | | |
|---|---|---|---|---|
| **139** $m^3$/d | **35** $m^3$/h | **87.8** $m^3$ | **2** × MBR | **1+1** |
| Average daily flow, 580-person camp | Peak inflow, six times the nominal rate | Equalisation ahead of biological treatment | Trains, so one cleans while the other runs | Duty and standby on every rotating machine |

## 01 Characterising camp sewage

Influent design against the effluent licence

A work camp is a single building on a shift schedule, and its sewage behaves that way: concentrated, and delivered in bursts. The plant is sized on a domestic-strength design basis rather than on a season of sampling: $BOD_5$ at 500 mg/L, total Kjeldahl nitrogen at 100 mg/L, fats, oil and grease at 20 to 50 mg/L, with a grease separator upstream on the kitchen line. Industrial wastewater and septage sit outside the plant's scope. The constraint absent from any concentration table is temperature: sewage arrives between 10 and 25 °C, and biological rates fall with it.

| PARAMETER | INFLUENT DESIGN | EFFLUENT LIMIT | REDUCTION |
|---|---|---|---|
| $BOD_5$ to $cBOD_5$ | 500 | < 25 | 95% |
| Total suspended solids | 50–350 | < 25 | 93% |
| Total phosphorus | 5–12 | < 0.5 | 96% |
| Fats, oil and grease | 20–50 | < 5 | 90% |
| Ammonia as $NH_4$-N | 100 | < 1 un-ionized | |
| Fecal coliform | | < 200 CFU/100 mL | |
| pH and alkalinity | 250–500 alk. | 6–9.5, 60–80 | |

Concentrations in mg/L unless noted. Reduction is taken from the top of each influent design range to the licence limit.

The daily surge

**Two peak events a day carry the whole design flow**

| | |
|---|---|
| Nominal hourly | 5.80 |
| Maximum hourly | 8.70 |
| Peak, 2 h | 35.0 |

Flow in $m^3$/h. Two peak events of two hours at 35 $m^3$/h deliver 140 $m^3$ against a design day of 139, and a single event puts 70 $m^3$ into an 87.8 $m^3$ buffer.

The two tanks are interconnected and aerated, worked as a single volume, so the buffer is available wherever the level sits and solids stay in suspension while it fills.

| | |
|---|---|
| Two peak events, two hours each | **140 $m^3$** |
| Design day | **139 $m^3$** |
| Peak against nominal rate | **6:1** |

## 02 Why a membrane bioreactor alone does not close the licence

Three constraints that set the process

TP 12 to 0.5 mg/L

### Phosphorus does not leave with the sludge alone

Influent total phosphorus runs 5 to 12 mg/L against a limit below 0.5, and biological uptake into the sludge does not close that gap. Aluminium chlorohydrate is dosed into the aerobic tank, flow-paced to the feed, and the membrane retains the precipitate, so phosphorus removal is a chemical duty carried inside the bioreactor.

10 °C design minimum

### Nitrification is not credited in the design

Nitrifiers are the first population to slow in cold water, so the design does not depend on them for the nitrogen limit. That limit is written on un-ionized ammonia below 1 mg/L, a fraction set by pH and temperature rather than by total ammonia. Caustic holds effluent pH inside the 6 to 9.5 band, and holding pH is what holds the limit.

< 200 CFU/100 mL

### A second barrier behind the membrane

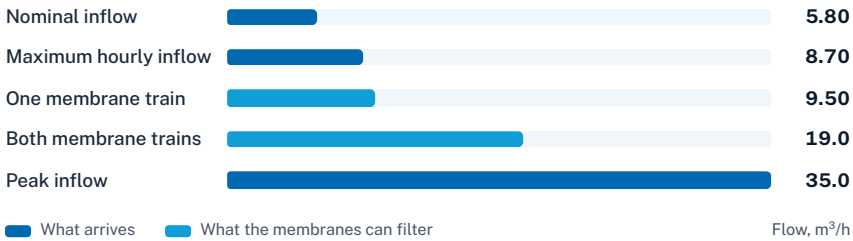
Flat-sheet pores are rated at ultrafiltration, and fecal coliform will not pass an intact sheet. Because sheet damage can occur without being visible, permeate turbidity is watched against the 0.25 NTU the plant normally produces, and two 1000 W UV units follow at full redundancy. The coliform limit rests on two independent barriers.

> Reagent strength was set by temperature rather than by chemistry: 50 per cent sodium hydroxide freezes at +12 °C, so the plant doses 25 per cent, which stays liquid to −18 °C.

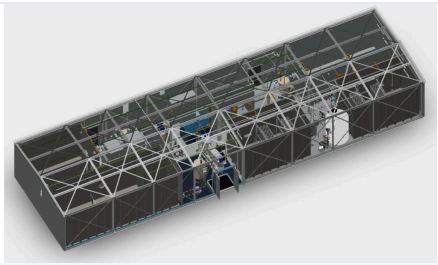
## 03 Sizing the plant around the surge

Equalisation sized so the surge never reaches the membranes

The membrane sets the ceiling. Each train filters at most 9.5 m³/h, so the two together carry 19 m³/h and a 35 m³/h surge cannot be filtered as it arrives. Two equalisation tanks totalling 87.8 m³, worked as one, absorb the peak and meter it downstream: 15.2 hours of storage against the average day.




Maintenance follows the same arithmetic: cleaning runs on one train while the other treats, blowers stepped from 330 to 165 scfm and feed held at 7.22 m³/h.



**The train inside one building**
Two membrane tanks sit mid-length, between the bioreactor and UV.

**Cleaning without stopping**

Called when transmembrane pressure rises 5 kPa above baseline: hypochlorite for biological fouling, then citric acid for scale, soaked in place.

## 04 Built for a lean crew and a long supply line

Nothing on site can wait for a part

**Duty and standby throughout** — Screens, transfer pumps, blowers, permeate pumps, UV units and dosing pumps are all installed in 1+1 pairs, so maintenance and a single fault cost capacity, not treatment.

**One PLC and HMI** — A process screen for each stage, with alarms and set points written for the operators who run it day to day. The inlet lift station is interlocked to stop the plant being loaded beyond its buffer.

**Treated water is reused** — Screen wash-down, press flushing and polymer dilution run on the plant's own permeate, which lowers what the site has to raise and heat.

**Reduction required**

### Design duty, influent to licence limit


12 to 0.5, 500 to 25, 350 to 25 and 50 to 5 mg/L respectively.

## 05 Plant configuration

One insulated plant, screening through dewatering

**01 Screening**
Duty and backup drum screens, with an auger compactor bagging the screenings.
**1 mm** aperture
**2** screens, duty and backup
Class 1 Div 2 area
Wash water from reuse

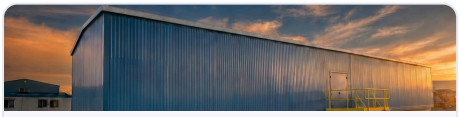
**02 Equalisation**
Two tanks worked as one, aerated to hold solids in suspension and odour down.
**87.8 m³** total
**15.2 h** of average flow
Coarse bubble, **2** blowers
Feed pumps flow-paced

**03 Biological treatment**
Carries the organic load, with sludge returned continuously from the membrane tanks.
**42 m³** aerobic tank
**10,000–12,000** mg/L MLSS
Sludge age about **21 d**
Return about **40 m³/h**

**04 Membrane separation**
Two independent trains, so cleaning takes one out without stopping treatment.
**2 × 35.7 m³** tanks
Toray **NHP210-XXX**
**2** modules per train
X **min** on, X **min** relax

**05 Disinfection and reuse**
Redundant UV ahead of discharge, treated water recovered for the plant's own duties.
**2 × 1000 W** UV
Full redundancy
Reuse to screen wash
Press flush and polymer

Sludge is dewatered on site by screw press to 18 or 20 per cent dry solids: about 0.23 m³ of cake a day, the only material that leaves the site.



**Staged for shipment**
Complete and weather-tight before it left the shop.

**Inside the plant**
Piped, wired and factory-tested.

**Installed on site**
Tied into the site's effluent discharge line.

| | |
|---|---|
| CLIENT | Confidential |
| SITE | Remote fly-in mining camp, Nunavut, Canada |
| SOURCE WATER | Camp domestic sewage. Industrial wastewater and septage excluded by licence |
| COMPLIANCE | Effluent criteria set under Nunavut Water Board licensing |
| TRAIN | Screening, equalisation, aerobic bioreactor, MBR, UV, effluent reuse, screw press dewatering |
| MEMBRANES | Toray NHP210-300S flat sheet, two modules per train, two trains |
| DISINFECTION | Two 1000 W UV units, duty and standby |
| SLUDGE | Screw press to 18 or 20 per cent dry solids, about 0.23 m³/d of cake |
| CONTROLS | Single PLC and HMI, duty and standby on every rotating machine |
| DESIGN BASIS | 139 m³/d average, 209 m³/d maximum, 580-person camp |
| STATUS | Delivered, commissioned and running. Operated by the client |

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**Potable, camp and process water, delivered as one scope**
The same camp also took a potable water treatment plant, separately contracted.

Potable · Camp sewage · Process water · Contact water