VISTA TEK LTD

Our File: 2007-200

June 19, 2007

Selkirk First Nation
P.O. Box 40
Pelly Crossing, YT
YOB 1P0

Attention: Mr. Danny Van Bibber, Manager Municipal Works

Re: SFN New Sewage Lagoon – Request for Additional Information

As requested, the following provides additional clarification and information as requested in the memo from Mr. Bob Lorimer, P.Eng. of Lorimer and Associates dated May 10, 2007 which was forwarded from the Water Board.

1. Design Information

It is understood that three documents were used to support the water licence application in addition to the design drawings and specifications provided by our firm.

a. EBA site selection reports sites 1 – 6
b. EBA site selection report site 7 (current site)
c. Vista Tek Ltd. Seepage Pit and Septic Failure Preliminary Evaluation, April 11, 2006

The final document included design information for both the temporary pit constructed last year and was the basis for design of the new disposal facility. There may be some confusion as the design rationale for the temporary pit was governed primarily for the

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need to accommodate emergency pump outs of failed septic systems as well as yearly sludge production from all septic fields.

Design information specifically for the new facility is summarized in the following sections.

2. Background

The Selkirk First Nation community of Pelly Crossing, YT has approximately 330 residents in three subdivisions

- Village area 54 residences, 14 commercial & institutional Individual water wells & septic fields, one residence trucked water, two residences and Link Building on sewage holding tanks
- Willow Creek 21 residences individual wells & septic fields
- Jon Ra 20 residences in old subdivision trucked water & individual septic fields, Jon Ra expansion area - 5 new homes on individual wells & septic fields with lots for additional 35 homes

The septic tanks are normally pumped out once every two years by eductor truck with the sludge deposited in an exfiltration pit located approximately 1 km to the south of the developed area of the community. The pit is located in a decommissioned land fill site with access off the Klondike Highway.

During March of 2006, the SFN Public Works Department identified that a number of residential septic fields in the "down town" area were failing resulting in sewage backing up into residences. The septic field servicing the SFN administration building also failed resulting in a sewage spill in the basement of this building.

As an interim measure, the Public Works Department pumped out the septic tanks with the liquid septage being deposited in the sludge exfiltration pit. Due to the number of septic system failures, the existing pit was filled to capacity requiring SFN to truck

sewage to Mayo until a new temporary disposal facility could be constructed adjacent to the old pit.

SFN received regulatory approvals to construct and use a temporary facility until a new permanent facility could be constructed at site 7 approximately 5 kilometers south of the community.

As part of the plan of action, the SFN undertook a major septic field replacement program to reduce the volume of raw sewage which was being trucked to the facility.

The basic design premise for the new sewage disposal facility is that the community will use individual septic fields for sewage treatment. The new sewage disposal facility is intended for treatment of sewage sludge from individual septic tanks which are pumped out as part of routine maintenance for this type of system.

3. Design Data

- 330 residents, 100 homes in three subdivisions
  - Village area 54 residences, 14 commercial & institutional
    Individual water wells & septic, one residence trucked water
  - Willow Creek 21 residences individual wells & septic
  - Jon Ra 20 residences in old subdivision trucked water & individual septic systems
    Expansion area - 5 new homes on individual wells & septic
    Room for additional 35 homes
- Design life minimum 20 years
- Design population in 2026 – 530 residents, 150 homes (community planning study, updated at 4 residents per house)
- Projected water consumption 2026 (water supply feasibility study, updated)
  - 45,000 m^3/yr piped or well
- Climatic conditions (historic data from Pelly Farms weather station)
  - daily mean low temperature in January -27.5°C

- daily mean high temperature in July of 15.5°C
- 145 frost free days per year
- mean annual rainfall 198 mm
- mean annual snowfall is 113 cm (113mm water equiv)
- Total yearly precipitation of 310 mm.

- Sludge production current
  - Assuming all siphon tanks volume 3400 liters per tank for 100 residences educted once every two years = 3400 x 100 x 0.5 = 170,000 liters per year.
- Sludge production at 2026 assuming 150 homes = 1.5 x 170,000 = 255,000 liters/year
- Maximum daily sludge production assuming one 14,000 liter eductor truck at 2 trips per day (8 houses per day) 28,000 liters per day
- Exfiltration: 25mm in 30 min (EBA site study)
- Solids production: 12.5 cubic meters per year (measured from existing pit 125 cubic meters in 10 years) current – 25 cubic meters per year at design assumed
- Sewage production data from failed septic fields 2005
  - 17 houses, administration building and community hall
  - Actual based on current haul (SFN Public Works) 3 loads per week at 14,000 liters – 6,000 liters per day

4. Design Calculations

Three factors were considered for sizing the primary cells

- Liquid volume from normal sludge production from septic fields at design horizon
- Liquid volume emergency storage if septic fields fail in future
- Solids accumulation

Liquid volume of septic tank pump outs

- 255 cubic meters per year 2026

Storage volume required

- Assume that minimal exfiltration for 7 months year due to freezing conditions

- Assume all pump outs during freeze conditions
- Evaporation data not available for this area – Whitehorse is 450 mm per year, Pelly Farms precip is 310 mm per year. Assume no net loss from evaporation (ie evap = precip)
- Storage required therefore equals total yearly pumpout at design conditions or 255 cubic meters

Emergency storage requirements for septic field failure:

- Based on 2005 data actual haul data, 6 cubic meters per day were generated by 17 failed residential fields plus the administration building and community center
- All failed residential fields, the administration building and community hall have had new septic fields installed
- For planning purposes assume that maximum raw sewage generation in future will not exceed 8 residences and one institutional facility simultaneously or approximately one half the sewage generated in 2005 or 3 cubic meters per day
- Assume that impervious (frozen) conditions will exist for at least 7 months per year. Impervious conditions are expected to be significantly lower due to the heat of the sewage discharged to the cell
- Therefore estimated emergency storage capacity = 7 months x 30 days x 3 cubic meters per day = 630 cubic meters

Cell water balance:

- Assume no losses from evaporation for design purposes
- Exfiltration = 25mm in 30 minutes (1.2 meters per day)
- Projected area = 40 square meters at design depth
- Exfiltration = 40 x 1.2 = 48 cubic meters per day or 1,400 cubic meters per month
- Therefore exfiltration significantly exceeds both the normal sludge generation from septic tank pump outs as well as the allowance for emergency raw sewage generation from failed septic tanks

Sludge accumulation:

- 25 cubic meters per year at 20 year design horizon
- Assume two seasons required for full composting (cell use will be alternated every two years) therefore 50 cubic meters additional storage required in each cell

Total cell storage requirements:

- Normal use (septic sludge pumpout) full year storage to allow for seasonal impervious conditions = 255 cubic meters plus 50 cubic meters solids storage = 305 cubic meters
- Emergency storage for septic field failure at 3 cubic meters per day = 540 cubic meters plus 50 cubic meters solids storage = 590 cubic meters

Risk analysis

Based on the analysis above, it is clear that exfiltration from the cells is considerably in excess of the projected 20 year sewage sludge production. Exfiltration rates are also are considerably in excess of any historic or expected future generation of raw sewage from failed septic systems, particularly as the SFN has undertaken extensive reconstruction of failed septic fields. All new septic field construction conforms to new design standards developed to specifically accommodate Pelly Crossing climatic and subsurface conditions (4m frost penetration).

The primary risk that needs to be addressed is the potential use of the facility for disposal of raw sewage in the event of future septic field failure under freezing conditions which significantly reduces exfiltration from the cells. It is difficult to predict future failures and the design basis was based on conditions encountered in 2005 with allowance for SFNs program of septic field upgrades.

Although the design includes two cells in order to allow for composting of sludge and the second cell could be used for emergency storage, it was decided to include a third

cell for storage and treatment of liquids as a further backup due to difficulty in trying to accurately estimate the potential for future septic field failures.

The third cell provides containment and treatment of any liquid fraction which may exceed the capacity of the primary cells and at 800 cubic meters was designed to provide sufficient volume to store the total raw sewage produced during 2005 from septic tank failure during impermeable (frozen conditions).

4. Geotechnical data

EBA's report with logs is appended for reference. Two test pits were excavated to 3m and one borehole was drilled to 12m.

Percolation tests were completed on the two test pits with percolation rates of 25 and 30 minutes for 25mm of water. The lower percolation rate was used for design purposes.

The location of the pits was not plotted on the design drawings as the pits were located with a GPS in 1999 when SA (selective availability) of satellite signals was turned on. The circular error of probability could have been up to 30m and plotting these locations would infer an accuracy which would not be consistent with the data.

The specifications require that additional percolation tests be completed during construction to confirm the original field data.

It is agreed that the losses due to evaporation and exfiltration are not clear in the EBA report. The design as submitted assumes that precipitation equals evaporation (no losses) and the only loss from the system is from exfiltration.

5. Sludge Disposal

As noted previously, the primary function of the facility is to store and treat sludge from septic tanks by composting. Two cells have been provided with the intent to allow for composting of solids in place by alternating use of cells every 4 to 8 years. The resultant product should be suitable for use as compost. It was suggested a suitable use would be for restoration of the landfill site.

It is understood that the SFN will be constructing the new landfill site directly adjacent to the sewage lagoon facility where compost can be used to for reclamation of the facility. It is recommended that samples of the composted sludge be analyzed in a laboratory to confirm that the composting has been completed and the material suitable for use as cover for the landfill.

6. Cell volumes

The *operating* volume of the cells by prismoidal element analysis (not including freeboard) are:

Primary cells 1:	624 cubic meters
Primary cell 2:	624 cubic meters
Exfiltration cell 3:	805 cubic meters

7. Engineering Drawings and Reports

Sealed drawings and specifications were submitted. All engineering reports were completed by EBA Engineering Consultants Ltd., Neils Jacobsen, P.Eng. and Vista Tek Ltd.. All are registered engineering consulting firms with APEY.

If you should have any questions or require additional information on the above, please contact the undersigned directly at 393-3458.

Vista Tek Ltd.

Victor Menkal, P.Eng.