

# Church of the Incarnation's Journey to Geothermal

*By Mac Morrison*

It began following a decennial inspection in January 2013, when there were observations as to the mixture of heating sources and associated costs of operation and control of these sources. At this time the Church of the Incarnation Oakville built in 1999, had been occupied for 13 years.

The heating and cooling system (HVAC) consisted of two 15-ton roof type units, four split type AC units, and no fewer than 23 electric baseboard heaters, most of which were not controlled by a thermostat, all to heat and cool a 722sm (square meter) single level facility built on a concrete slab with no basement.

The cost of gas and electricity in the early days was high; it continued to spiral upward to a range of \$19,000 by 2015.

The parish was forced to face facts in 2015 when it was found that one of the HVAC units (the northwest one) would have to be replaced. Prior to this failure, we had investigated the possibility of replacing the electric heaters with a gas fired boiler that would circulate through hydronic baseboard units and eliminate the need for the more expensive electric heating. The cost would be around \$42,000.

With the rooftop units (they were, in fact ground mounted on concrete slabs at either end of the church) The south unit provided heating and cooling to the worship and chapel areas, an area of approximately 231.4sm., while the northwest unit, the 4 AC units and the 23 electric units covered the remaining 491.1sm. Both of these units were approaching their best before dates, as a result it was decided to form a committee to research and recommend alternatives to the existing systems.

In the interim we managed to maintain sufficient heat during the winter by using the south unit in combination with all the electric units, although we saved a bit of gas, we sure saw a jump in our electrical bills. The two HVAC units continued to provide the cooling during the summer months.

At this point, geothermal was a word that few of us understood, it was suggested by our Rector that it may be something to be looked into. Those on the committee who did understand the concept were convinced that the cost would be prohibitive, despite our desires to be as ecologically progressive as possible.

It took three years and two engineering firms before we came up with a set of comparable options. These included variations on natural gas systems, air and water source Geothermal systems.

Regardless of which HVAC system, Incarnation was faced with a choice of whether we could afford to carry on as a viable religious community. At our first Special Vestry meeting (fall 2017) the question was put, and we voted overwhelmingly to support Incarnation as an ongoing community.

The committee then refined the cost factors and opted for a "Closed Loop Water Source Geothermal system". This would eliminate natural gas from our building and significantly reduce our electrical consumption.

At a second Special Vestry (March 2018) the Vestry gave a resounding approval to go ahead with a budget of \$410,000 (HST extra).

The actual costs when the installation was complete are as follows –

|  |                  |
|--|------------------|
| Engineering design & management -                                | \$29,750*        |
| Supply and install of all MITS components -                      | \$208,000        |
| (Includes all pumps and internal plumbing)                       |                  |
| Closed loop ground source drilling and piping installation -     | \$75,250         |
| Supply and install all required electrical circuits and wiring - | \$23,313         |
| Contingency -  | \$10,695         |
| Building permit -  | \$3,500 – no HST |
| Total HST -  | \$45,111         |
| Total HST recovery -   | \$30,834         |
| Total net project cost -   | <u>\$364,785</u> |

\* There was another charge of \$32,205 for engineering that could not be used because of the sudden death of that P.Eng.. We were not able to avail ourselves of any of his documentation from his estate.

The parish was also asked to commit and make pledges to support the project. By early April we confirmed pledges of \$263,000. Niagara Synod Council approved our request on April 6, 2018.

The second stage of our journey was not without hiccups, however we were able to get commitments from our contractors that kept the process within our budgeted plan.

The “Closed Loop Water Source Geothermal Source” consists of a total of six “holes” approximately 6 inches in diameter drilled to a depth of 198.12m. Each hole has a double loop of 5cm pipe with a U joint at the bottom. This provides the source system with a total of 2472 m within the exterior to building system. The top level of the system is a minimum of 2m below the ground surface prior to entering the church. The vertical holes are at a horizontal spacing of 7m and parallel the north face of the church at a distance of approximately 14m.

This provides a uniform temperature of 12C (52.5F) as measured in the spring. The solution of pure water and 25% glycol is circulated through the loop at a minimum rate of 130 L per minute via two pumps that cycle between each other every 24 hours. Should one pump fail the other takes over immediately to ensure a continuous flow.

The heat pumps extract approx. 4C degrees from the incoming solution and returns it to the loop which in turn returns it to the church at the original 12C temperature.

The water source exterior system was completed by mid-December 2018 and connected to the interior system in January 2019.

We started the system in partial operation by 22 January and shut down the gas and electric heating sources in early February.

Presently, the system is operating to its full expectations, having weathered minus 20C conditions during cold snaps without any loss of heat or variation to inside Church temperatures.

### **TIPS TO PARISHES**

Be patient – this takes time. Listen to all options and get as many quotes as possible as this is a very specialized industry.

Be cautious – Of those that say “of course we can do this”. Get references.

It is great to achieve rapid results, but it takes lots of patience to achieve the correct path.

Look long term – The more expensive up-front costs will quickly be recouped and in the long term you will save money. About 20% of Incarnation’s costs were for the deep well water source which has an unmaintained life expectancy in excess of 75 years.

### **UPDATE AS OF APRIL 2023**

It has been four full years since the startup of our Geothermal system, and we can only heap praise on our Engineer Mark Greenhill of Remy Engineering in Burlington who had a vision that was far clearer than our committee’s imagination at the time.

As of now we have had absolutely no natural gas even connected to the Church since the spring of 2019. Our annual average temperatures and consumptions are as listed below.

| Year | Avg Temp | NG cons M3 | Elect cons KWh |
|------|----------|------------|----------------|
| 2017 | +8.4C    | 8,544      | 85,752         |
| 2018 | +7.2C    | 11,909     | 88,447         |
| 2019 | +8C      | 2,930      | 94,409         |
| 2020 | +9.9C    | 0          | 80,169         |
| 2021 | +9.3C    | 0          | 91,470         |
| 2022 | +8.94C   | 0          | 97,354         |

**Note:** Because of the Covid issues the use of the church was very limited particularly during 2020, thus the significant drop in electrical usage during that period.

We have the thermostats set at 22C year round and do not have any overnight setbacks. We also have a very active day care occupying about 2/3rds of the total church space from 6.30AM to 6.30PM five days per week.

One recent Hydro billing, period 21 Dec 2022 to 20 Jan 2022 indicated an average daily temperature of minus 13.3C(the lowest temp for that period in many years) and an average daily elect consumption of 404KWh. The same period a year earlier showed an avg temp of minus .9C and an avg cons of 374KWh. We find that our system works very well at temps as low as minus 25C. and is extremely efficient during the summer cooling period.