

# SURP Case Studies

## The Marwell Tar Pit Remediation



Source: Milestone Environmental Contracting (2021)

The Marwell Tarpit during remediation

### QUICK FACTS

- Location:**  
Marwell Industrial Area,  
Whitehorse, Yukon
- Project:**  
Petroleum Waste Remediation
- Site size:**  
2.5 acres
- Land uses:**  
Open space, recreation, employment
- Keywords:**  
Sustainable Remediation,  
Enhanced Thermal Conduction Treatment,  
Long-Term Risk  
Mitigation, Community Benefits
- Website:**  
[https://milestoneenv.ca/  
featured-projects/marwell-tar-pit-  
remediation/](https://milestoneenv.ca/featured-projects/marwell-tar-pit-remediation/)
- Owner:**  
Government of Yukon
- Remediation Work:**  
SLR Consulting, Milestone Environmental  
Contracting Inc.,  
Iron Creek Group
- Authors:**  
Andrew Clark & Porter Greatrex
- Editors:**  
Christopher De Sousa, Adam Gardner,  
Guillaume Perreault

Case studies were prepared as a course assignment by students enrolled in PL8312/PLE845: Brownfields & Sustainable Development, School of Urban and Regional Planning, Toronto Metropolitan University (Winter 2023). Information for the case studies was obtained from online sources, available reports, and, in some cases, site visits and direct communication with stakeholders. If you are aware of any errors or updates to the case studies, please contact chris.desousa@torontomu.ca. The opinions expressed in this case study are those of the authors only and do not represent the opinions and views of either Toronto Metropolitan University, the School of Urban and Regional Planning, or the Canadian Brownfields Network.



### PROJECT OVERVIEW

The Marwell Tar Pit project is an example of one of many post-war legacy contaminated sites whose risks were undocumented until later becoming a public health issue. The project involved the remediation of a 2.5 acre publicly-owned site in the City of Whitehorse that was historically used as an oil refinery and dumping ground for petroleum wastes, which consequently posed health risks to surrounding properties and environmental features. It involved decades of negotiations between government agencies to determine funding obligations and another decade to remediate and monitor the site. A considerable amount of time was dedicated to understanding the characteristics and risks of the site's contamination and to develop a plan that accounted for site constraints, eliminated health risks, and reduced costs, time, and impacts to the surrounding community. The remediation work, which occurred over an 11 month process, involved the identification and on-site thermal treatment of contaminated soil to conditions that complied with government regulations for commercial and industrial sites. The site is now being monitored and holds promise for future industrial, commercial, and even recreational development in the surrounding community.



## Project Summary

The Marwell Tar Pit project is a federal and territorial effort to remediate a publicly-owned contaminated site in the Marwell area of the City of Whitehorse, Yukon (Figure 1). The Marwell Tar Pit is the largest single source hydrocarbon contaminated site in the Yukon following its use as a refinery and illegal dumping ground for waste petroleum and oil products from the 1940s to the 1970s. This contamination resulted in the fatality of a bystander walking through the area in 1958<sup>1</sup>, prompting public attention to remediate the site.

Years of subsequent assessments and monitoring following an order from the coroner's jury to further explore the issue resulted in the identification of 27,000 m<sup>3</sup> of contaminated soil and groundwater that was believed to pose a risk to the health of the community and a nearby creek, which prompted a 10-year, \$6.8 million remediation plan to clean up the site and make it suitable for future industrial, commercial, and/or recreational uses. In 2010, the remediation agreement between the federal and territorial governments was finalized. The remediation plan was developed by SLR Consulting and the plan was implemented by Milestone Environmental Contracting and Ironcreek Group. This collaboration combined expertise in strategic environmental thinking and soil excavation and treatment to ensure that contamination risks were identified and that the appropriate equipment, technologies, and methods were available to remediate the site.

SLR designed a cost effective three-phased approach that would minimize disturbances to the local community. Unlike many full-scale remediation projects, off-site treatment or disposal of contaminated soils was not required. Instead, a majority of contaminated soils were excavated from the site and successfully cleaned through an enhanced thermal conduction process. The remediation was informed by three goals, including<sup>2</sup>:

1. *Protect human and environmental*



Figure 1. Map depicting the location of the Marwell Tar Pit site, shown in red.

1. *health by managing impacts from the site;*
2. *Make the site safe for future industrial use, and;*
3. *Decrease financial liability resulting from the contamination.*

## Site History

The Marwell Tar Pit is a 2.5 acre publicly owned site, legally identified as Lot 263, CLSR Plan 8406<sup>3</sup>. In 1944, the pit was part of the development site of the Whitehorse Canol oil refinery, (Figure 2) which was a component of the Canol Project to develop aviation fuel for

Alaska during the Second World War<sup>4</sup>. The project was cancelled in March 1945 when the war was reaching its end, and the refinery was sold to Imperial Oil - who quickly dismantled the refinery and abandoned the site by 1947<sup>5</sup>. In the process, approximately four million litres of waste petroleum and oil from the refinery were left or drained into a bermed pit that originally contained an 800,000 barrel storage tank prior to decommissioning<sup>6</sup>. The contamination was not officially documented, and the site continued to be used as an unofficial dumping ground for liquid

Figure 2. Image of the Marwell Tar Pit site during its use as a refinery in the 20<sup>th</sup> Century.





wastes by the Canadian army and surrounding businesses<sup>7</sup>. It was not until 1958 when a pedestrian walking through the area became stuck in exposed tar (Figure 3) and died from hypothermia, that the contamination became a public health issue and the pit was recommended for remediation<sup>8</sup>. In 1960 it was estimated that approximately half the contamination deposited on the site remained; although there was no consensus on who should be responsible for cleaning it up<sup>9</sup>. The parcel was transferred to the Yukon Government in 1970 following a federal block transfer, who then drained, capped, and monitored it afterwards<sup>10</sup>. Subsequent sampling by Environment Canada in 1989 revealed that contamination was still present and moving towards a creek to the northeast<sup>11</sup>. In 1990, a Phase 1 and partial Phase 2 Environmental Site Assessment identified 27,000 m<sup>3</sup> of contaminated soil and groundwater that was migrating towards Jasper Road and the nearby creek, and the site was officially designated as a Contaminated Site by the Yukon Government in 1998 under the Contaminated Sites Regulation of the Environment Act<sup>12</sup>. Following years of talks between the two levels of

government, investigations into how the site became contaminated, remedial pilot projects, and growing concern about the contamination, the Government of Yukon and the federal Department of Indian Affairs and Northern Development (DIAND) agreed (in 2010) to both contribute to remediating the site, which was estimated at \$6.8 million over a 10-year timeframe<sup>13</sup>.

### Site Assessment and Cleanup

The remediation process was divided into three phases, including:

1. *Phase 1: Preliminary Analysis of Site Characteristics;*
2. *Phase 2: Engineering and Remedial Activities (2 years), and;*
3. *Post Remedial Activities (4 years).*

The first phase involved identifying the area of contamination, the risks associated with it, and cleanup options. Identified contaminants included benz[a]anthracene, heavy and light hydrocarbons, naphthalene, and heavy metals<sup>14</sup>. Contaminants of focus included heavy extractable petroleum hydrocarbons (HEPH) and light extractable petroleum hydrocarbons (LEPH), which were identified at

concentrations of 22,719 mg/kg and 7,021 mg/kg<sup>15</sup>. Contamination was primarily identified in soil and groundwater concentrated within a 'hockey puck' shaped formation in the centre of the site where waste had been dumped. Approximately 50,000 tonnes of contaminated material were identified at an average depth of 4 to 5 metres<sup>16</sup>. A risk assessment was also completed to address potential impacts to humans and the environment, and develop site specific remediation targets to support implementation. These targets were 13,900 mg/kg for HEPH and 5,900 mg/kg for LEPH<sup>17</sup>. The project team opted to remediate the soil on-site using enhanced thermal conduction due to community concerns, geological and topographical constraints, and the proven effectiveness of this technology to remove hydrocarbon contamination through volatilization.

The second phase involved remedial activities for contaminated surface water and soil, which were completed by Milestone Environmental Contracting and Iron Creek Group between 2018 to 2019<sup>18</sup>. Soil was treated using enhanced thermal conduction (Figure 4). Contaminated soil was excavated and stored in temporary Quonset huts with multi-fuel burners, was heated to temperatures between 260-425°C for 4-12 day periods until contaminants vapourized, and vapours were further burned off into non-harmful by-products and removed through steam to meet air quality guidelines<sup>19</sup>. Soil was treated throughout all seasons over 11 months, and a majority of the contamination was addressed given 36,000 tonnes of soil were excavated, cleaned, and backfilled on-site<sup>20</sup>. The concentrations of HEPH and LEPH in treated soil decreased by ~98% following the remediation<sup>21</sup>. The treatment process was found to be more successful than believed, as the final concentrations of HEPH and LEPH were also ~97% lower than the original site specific



Source: Milestone Environmental Contracting (2021)

Figure 3. Exposed tar at the Marwell Tar Pit before remediation.



standards and were able to comply with the Yukon Contaminated Sites Regulation for Commercial/Industrial limits<sup>22</sup>.

The final phase involves four years of post-remedial activities that include contouring and seeding the site, and monitoring groundwater<sup>23</sup>. The site has recently been contoured and seeded to permit future development and groundwater contamination has not yet been identified.

## Project Financing

The Marwell Tar Pit remediation project is a prime example of government leadership and initiative with respect to the different forms of public funds that were committed to address key environmental issues while enhancing the overall urban sustainability of the City of Whitehorse<sup>24</sup>. A joint funding agreement was formed between the Government of Canada and the Government of Yukon. In 2010 the split between federal and territorial funding for the remediation was officially finalized, with the Government of Canada slated to cover 70% of the remediation cost, and the Government of Yukon providing the remaining 30%<sup>25</sup>. In total, the projected budget for the clean-up was \$6.8 million<sup>26</sup>. This works out to the federal government providing \$4.76 million and the territorial government providing \$2.04 million.

In 2004, the federal government allocated a total of \$500 million in order to cost-share the remediation of specific lands that were deemed contaminated on land not owned by the Government of Canada to benefit contaminated provincially and territorially owned land<sup>27</sup>. The following year, the federal government released the *Policy Framework for Shared-Responsibility Contaminated Site Project Funding*. This document was responsible for establishing criteria revolving around funding parts of land remediation on non-federal lands<sup>28</sup>. The rationale behind federal funds being dedicated to non-federal land

contamination stems from the fact that all the lands that qualify for these funds were previously federal land, and were technically federal when they were contaminated (or at least partially). In the case of the Marwell Tar Pit, federal government activity either directly or indirectly contributed to or mandated the activity that led to the site becoming contaminated<sup>29</sup>. This begs the question, how is this site eligible for the cost share program?

The Yukon Government applied for transfer payments directly from the federal government to support the remediation costs. The funding provided a basis for much of the remediation efforts and activities including site assessment, design, and implementation strategies<sup>30</sup>. At the request of Environment Canada, the Department of Indian Affairs and Northern Development (DIAND) was chosen to be the lead role in the project on behalf of the federal government due to its expertise with remediating contaminated sites in the Canadian North<sup>31</sup>. DIAND was then enabled to transfer funds to the Yukon Government as a “middle man” between the federal and territorial Governments. The rationale behind the DIAND taking the lead on this project, and ultimately why the site qualified for these governmental grants

was a result of the federal government seeing this site as an opportunity to help DIAND meet objectives set out in the organization’s strategy titled *The North*. These objectives include eliminating, reducing, and managing long-term risks to human health, safety, and the environment; and maximizing the social and economic benefits of land for First Nations and Yukoners<sup>32</sup>. Ultimately, the transfer of funds was intended to recognize the federal government’s responsibility in contaminating the site due to its prior management and usage by the military.

## Planning & Redevelopment

Over the years, the Marwell Tar Pit has encountered various challenges that have altered the remediation of the site by the involved government and non-governmental agencies. By overcoming these barriers, the project offers a handful of proven practices that can be considered at other legacy contaminated sites in Northern Canada. For starters, the location of the site on an irregularly shaped and highly visible lot within a northern climate limited the area that could be dedicated to soil storage and the length of suitable work conditions given the short field season<sup>33</sup>. The site’s hydrology also constrained subsurface cleanup efforts due to the presence of surface



Source: Milestone Environmental Contracting (2021)

**Figure 4. Image depicting the enhanced thermal conduction system used to treat contaminated soil at the Marwell Tar Pit.**

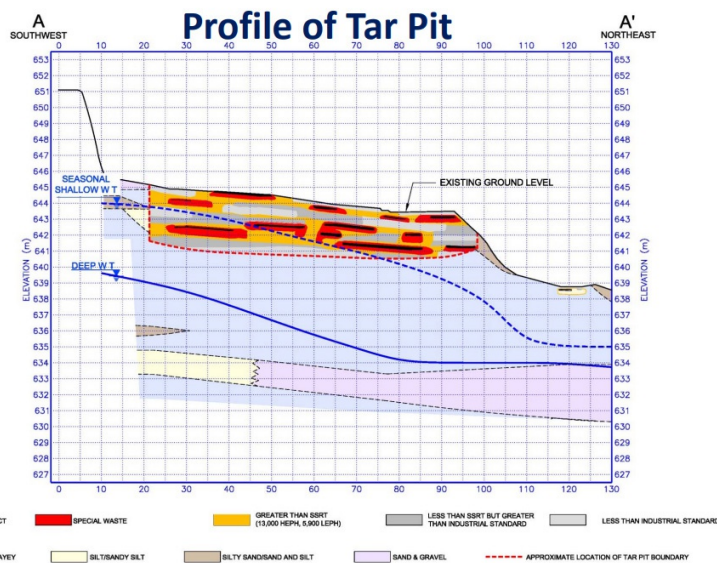
springs and a shallow and perched groundwater table<sup>34</sup>. In addition, the site's contaminated soil consisted of a mix of silt, clay, and sand, and was concentrated in specific pockets at varying depths where historic dumping was most frequent (Figure 5)<sup>35</sup>. This resulted in an uneven distribution of hydrocarbon contamination which limited the ability to use more conventional treatment approaches, such as in -situ chemical remediation or bioremediation<sup>36</sup>. Due to the site's complex history, the development also required the involvement and perspectives of several jurisdictions and stakeholders, including the federal, territorial, and local governments, First Nations communities, and nearby business owners and residents<sup>37</sup>. This required constant communication and collaboration between parties and made it difficult to identify what the site would become and who would be responsible for its outcome. These barriers were navigated through a careful planning process that identified goals, responsibilities, and the appropriate methods to ensure that risks were adequately and cost-effectively managed and that the future of the site would be open to further consultation opportunities with the community. A particular strength of the project was its ability to reduce costs and manage concerns identified during the community consultation process by conducting the remediation on-site to avoid the need for hauling soil off-site for treatment, and conducting regular air quality monitoring to ensure that risks to surrounding residents were not present or identified and addressed immediately.

While currently vacant, this land now offers many opportunities for the City of Whitehorse with respect to benefiting the Marwell community and its residents. The City has recently developed the Marwell Plan, which outlines a new vision for the community as the "Greater Downtown" of Whitehorse in order to ensure growth in the movement of people, continue the vitality of local businesses, and increase safety for all modes of travel in the area<sup>41</sup>. This is being accomplished through the development and connection of nearby greenways, trails, and green spaces, along with the promotion of mixed-use commercial, residential, and light industrial development<sup>42</sup>. While the Marwell Tar Pit site has not been officially designated as a specific land use under the plan, it remains close by to planned public realm improvement projects, including a

### Current State and the Future

The remediation efforts on the Marwell Tar Pit were officially completed in 2019<sup>38</sup>. Currently, the site is sitting vacant with no structures or official uses planned. However, it should be noted that the entire project was intended to serve as a first step in connecting planning processes between a diverse array of stakeholders, including the

**Figure 5. Chemical and topographical profile of the Marwell Tar Pit depicting site constraints.**



Source: Seammann (2016)

Government of Yukon, multiple First Nations communities, and the City of Whitehorse<sup>39</sup>. These parties have and will likely continue to work together to develop a common vision of transforming the site into a safe, accessible, and well-connected, employment, commercial, or recreational land use which is dynamic and can accommodate community needs in the area<sup>40</sup>.

connecting link between Two Mile Hill Road and the Waterfront Trail, and to trail connections leading to the Takhini Escarpment. The City of Whitehorse is currently working with the Kwanlin Dün First Nation, the Ta'an Kwäch'an Council, the Government of Yukon, local businesses, and residents to explore options to redevelop the Marwell area into a diverse mix of commercial, professional and community uses.

Future uses could be planned to align with established goals in the Marwell Plan, which seek to improve and enhance connectivity while also recognizing the changing role of employment to live/work/play functions, and to develop a more complete community for local residents<sup>43</sup>. This could include supporting and reinforcing the existing parks, recreation, and trail system in the area or encouraging mixed-use employment, residential, commercial and/or service-oriented developments. Since the site is publicly-owned and has access to transportation and trail networks, it could play a key role in supporting economic and/or cultural development, especially for Indigenous communities. It could also act as a recreational hub in the Marwell area that connects users from the surrounding community. Time will

Future uses could be planned to align with established goals in the Marwell Plan, which seek to improve and enhance connectivity while also recognizing the changing role of employment to live/work/play functions, and to develop a more complete community for local residents<sup>43</sup>. This could include supporting and reinforcing the existing parks, recreation, and trail system in the area or encouraging mixed-use employment, residential, commercial and/or service-oriented developments. Since the site is publicly-owned and has access to transportation and trail networks, it could play a key role in supporting economic and/or cultural development, especially for Indigenous communities. It could also act as a recreational hub in the Marwell area that connects users from the surrounding community. Time will



ultimately tell what benefits this site will provide to the Marwell community thanks to the efficient, effective, and collaborative remediation approach that was implemented to make future development possible.

### Lessons Learned

The Marwell Tar Pit project can provide practitioners with tangible lessons for remediating legacy postwar contaminated sites. First, a publicly-led financing strategy was imperative when working on a smaller, publicly owned lot to ensure it did not sit vacant. Next, this project highlights a successful process to navigate constraints seen during the remediation of a contaminated northern site, including site size and topographic restrictions, sporadic soil and contaminant characteristics, and climatic limitations (Figure 6). Lastly, the remediation approach was designed to reduce community impacts by storing soil away from public view, avoiding hauling soil off site, and maintaining strict air quality monitoring and noise mitigation standards (Figure 7).

However, this project was not without limitations. The remediation was set back for years due to a lack of government leadership and responsibility for the site's contamination, showing the need to develop more proactive and responsive public remediation projects. It is also unclear what benefits the site will bring through redevelopment. Since the project focused on remediation, a coordinated planning process was not established for the site's future. For example, if the site was better considered in the creation of the Marwell Plan, it could have been designated for a future use by the time remediation was completed. More work will be needed from the Government of Yukon, City of Whitehorse, and surrounding community members to create a vision for the site to ensure that it can be developed into a beneficial and compatible use for the surrounding community now that remediation is complete (Figure 8).



Figure 6. Image showing the site terrain at the beginning of remediation.

Source: Milestone Environmental Contracting (2021)



Figure 7. Image showing the storage and treatment of contaminated soil on-site.

Source: Milestone Environmental Contracting (2021)



Figure 8. Image showing the site after excavation and prior to backfilling.

Source: Milestone Environmental Contracting (2021)

## Endnotes

- [1]Midnight Arts. (1999). (rep.). Marwell Industrial Area Historical Research Project (pp. 1–57). Whitehorse, Yukon: Midnight Arts.
- [2]Seaman, R. (2016). Marwell Tar Pit [PowerPoint slides]. Government of the Ta'an Kwach'an Council Government of the Ta'an Kwach'an Council, Whitehorse, YK. [http://taan.ca/files/uploads/2016/11/Marwell-Tar-Pit-Presentation\\_Rick-Seaman.pdf](http://taan.ca/files/uploads/2016/11/Marwell-Tar-Pit-Presentation_Rick-Seaman.pdf)
- [3]Ibid
- [4] Dobrowolsky, H. (2000). World War II, The CANOL project and the Marwell Tar Pit: a case study. *Encompass (Drayton Valley)*, 4(3), 4-6
- [5]Ibid
- [6]Ibid
- [7]Ibid
- [8]Ibid
- [9]Ibid
- [10]Ibid
- [11]Ibid
- [12]Ibid
- [13]Kerr, J. (2011, December 23). Marwell tar pits cleanup expected to take years. *Yukon News*. Retrieved February 11, 2023, from <https://www.yukon-news.com/news/marwell-tar-pits-cleanup-expected-to-take-years/>
- [14]Wescott, T. (2018, March 19). Yukon prepares for second phase of Marwell Tar Pit Remediation. *Water Canada*. Retrieved February 12, 2023, from <https://www.watercanada.net/yukon-prepares-for-second-phase-of-marwell-tar-pit-remediation/>
- [15] Milestone Environmental Contracting. (2021). (rep.). *Brownie Awards 2021 Nomination Form: Marwell Tar Pit Remediation* (pp. 1–12). Markham, ON: Canadian Brownfields Network.
- [16]Ibid
- [17]Ibid
- [18] Howardson, J., & Belenky, C (2021). *Remediation of the Marwell Tar Pit Using Enhanced Thermal Conduction for the Remediation of Extreme Hydrocarbon Impacts in Whitehorse, Yukon Territory* [Power-Point slides]. Environmental Services Association of Alberta, Edmonton, AB. <https://esaa.org/wp-content/uploads/2021/04/19-Howardson.pdf>
- [19]Ibid
- [20]Ibid
- [21]Ibid
- [22]Ibid
- [23]Ibid
- [24]Marwell Creek: Hydrocarbons and aquatic quality. *Experiential Science Projects*. (n.d.). Retrieved February 12, 2023, from <https://experiential-scienceprojects.weebly.com/marwell-creek-hydrocarbons-and-aquatic-quality.html>
- [25] Morin, P. (2018, October 23). Whitehorse's infamous tar pit gets cleaned up after 73 years | CBC News. *CBCnews*. Retrieved February 12, 2023, from <https://www.cbc.ca/news/canada/north/whitehorse-s-infamous-tar-pit-gets-cleaned-up-after-73-years-1.4874821>
- [26]Ibid
- [27] Johnston, L. R. (2010, June 30). Marwell tar pit remediation plan to begin immediately. *Yukon News*. Retrieved February 12, 2023, from <https://www.yukon-news.com/news/marwell-tar-pit-remediation-plan-to-begin-immediately>
- [28] Government of Canada; Crown-Indigenous Relations and Northern Affairs Canada. (2013, December 3). *Transfer payments to the Government of Yukon for the remediation of the Marwell tar pit site to support the contaminated sites program*. Government of Canada; Crown-Indigenous Relations and Northern Affairs Canada. Retrieved February 12, 2023, from <https://www.rcaanc-cirnac.gc.ca/eng/1386081081616/1615725195975>
- [29]Ibid
- [30]Ibid
- [31]Ibid
- [32]Ibid
- [33]Ibid
- [34]Ibid
- [35]Ibid
- [36]Ibid
- [37]Ibid
- [38]Marwell Tar Pit – investigation, assessment and remediation. *SLR Consulting Limited*. (n.d.). Retrieved February 12, 2023, from <https://www.slrconsulting.com/en/case-studies/marwell-tar-pit-investigation-assessment-and-remediation#:~:text=The%20remediation%20was%20completed%20successfully,contaminants%20into%20the%20underlying%20aquifer.>
- [39]Ibid
- [40]Ibid
- [41]City of Whitehorse. (2018). (rep.). *Marwell Plan* (pp. 1–34). Whitehorse, YK: City of Whitehorse.
- [42]Ibid
- [43]Ibid