City of Iqaluit
Solid Waste Management Plan

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Prepared by:

Exp Services Inc.
1595 Clark Boulevard
Brampton, ON
L6T 4V1
Canada

Executive Summary

The purpose of this plan is to select a new solid waste management site and program and identify the work that needs to be done to open the new site and implement the new program.

The City of Iqaluit is striving to be a leader in Northern waste management practices by identifying and implementing locally appropriate waste management solutions that maximize waste diversion and minimize environmental impacts.

Based on a detailed options analysis process and community input, a new solid waste management site and program have been identified for the City of Iqaluit:

> Site: Northwest site, adjacent to future granular source.
>
> Program: Landfill with open windrow compost program (curb-side pick-up), bulky recycling (scrap metal, appliances, etc.), end of life vehicle program, reuse center, hazardous waste management program and public education program.

This new solid waste management program can divert up to 44% of the waste from disposal and can extend the lifespan of the new solid waste management site by 14 years compared to the status quo. The recommended composting program provides environmental benefits by conserving landfill space, reducing odors, reducing leachate, and providing a suitable cover material for the landfill. Environmental impacts will be further limited through a run-off management program, hazardous waste management program, and the recycling of scrap metal and bulky items.

The recommended program is the most cost effective option over the lifespan of the new site. It is also the most affordable program option in terms of capital and operating costs. The recommended site is cost effective due to its ability to share access road capital and maintenance costs with the new granular source project, which is scheduled to be completed in a similar timeframe.

Resident and stakeholder feedback has been vital to the development of this plan. In order to address feedback received on the recommended site and program, which was presented in the final project newsletter, this plan makes several additional recommendations, including:

1. Allocate adequate resources and training to ensure that the new facility follows best management practices and protects the surrounding land and water;
2. Ensure that operating and maintenance procedures have specific measures to minimize blowing waste at the site, and to ensure that litter does not accumulate outside of the site boundary (e.g. cover material procedures, wind screens at active disposal area, regularly scheduled off-site litter cleanups);
3. Ensure that the operation and maintenance manual includes cover material guidelines to ensure that the material used meets the requirements of the site;

4. Require that the Design Brief investigate the option of baling and stacking the municipal waste in the landfill, and make a recommendation on whether this approach should be used at the new site;
5. Increase the Department of Public Works staffing and budget as required to properly maintain the access road to the new solid waste management site;
6. Ensure that measures are put in place to prevent the accumulation of litter along the access road (e.g. require that garbage being transported to the site is properly secured, regular clean-up of any litter that does occur);
7. Review and analyze the different components of the solid waste management program to identify which should be located closer to town (to reduce transportation costs and increase accessibility for the public);
8. Identify suitable sites for program components that can be relocated closer to town with a focus on using previously impacted sites (e.g. North 40, West 40); and,
9. Conduct a snow and wind study at the site and along the access route to ensure that the design and operating procedures adequately address snow drifting and other wind related impacts.

Although the options analysis process showed that incineration is not cost effective at this time, there remains a strong interest in this disposal technology from City Council, residents and stakeholders due to its potential to significantly increase the lifespan of the solid waste management site. City Council is interested in pursuing incineration as part of this plan. As a result, it is recommended that the City:

1. Investigate and pursue external funding opportunities that could help finance an incinerator for the community (Green Municipal Fund, etc.), and
2. Hire a qualified engineering firm to complete a detailed analysis of the options and develop a detailed plan for implementing incineration (or other thermal waste technology) in Iqaluit. This will include a *Request for Expression of Interest* process to collect relevant technical and costing information from suppliers.

The implementation of this new Solid Waste Management Plan will be a significant undertaking for the City and will require the coordination and cooperation of multiple departments over multiple years. Due to the high staff turnover rates typical of the North, the volume of capital projects anticipated during its implementation period, and the urgent need for a new solid waste management facility, it is recommended that a project management firm be hired to coordinate the implementation of this plan.

It is currently estimated that the capital cost of implementing this plan (including decommissioning of the West 40 Landfill) will be approximately $ 13,980,000 over a 5-year period. The City currently has access to capital funding through a variety of different sources (Gas Tax Funding, GN Capital Contribution Agreement, Reserves, Sanitation Fund, General Operating Fund, etc.). The source of funds for the various components and years of this project will be detailed in the City's upcoming 5-year Capital Plan (2014-2018).

The City's annual operating and maintenance costs are expected to increase as a result of implementing this plan. Depending on the amount of excess revenues available when the

program is implemented, user fees (both garbage collection and tipping fees) will need to increase by up to 63 % to cover the additional costs. It is estimated that over half of these increases will be related to increased operation and maintenance costs associated with incineration. More detailed information on these additional costs will be obtained during the Request for Expression of Interest process described above. It should be noted that a portion of the access road related costs that will be shared with the new granular supply, which could impact future royalty rates charged for granular materials.

As the new program is implemented, it will be important that these additional operational costs are addressed in the budgeting process. They must also be monitored over time so that adjustments can be made, if required. This monitoring is also necessary as the community and its waste generation rates continue to grow.

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ᓄᓇᓕᐸᐅᔭᖕᒋ ᐃᖃᓗᐃᑦ ᓯᕗᒃ ᑲᑕᖅᑎᐅᕆᓱᐊᖅᑐᑦ ᐅᑭᐅᑕᖅᑐᒥᑦ ᐊᑦ ᑕᑯᓂᑦ ᐊᐅᓚᑦ ᑎᓂᕐ ᒥᑦ ᐱᓕᕆᐊᖑᔪᑦ ᓇᓗᓇᐃᖅᑕᐅᓂᖏ ᓄᑦ ᐊᒻ ᒪ ᐊᑐᓕᖅᑎᑕᐅᓂᖏ ᓄᑦ ᓄᓇᓖ ᒧᑦ ᓈᒻ ᒪᑦ ᑐᒥᑦ ᐊᑦ ᑕᑯᓂᑦ ᐊᐅᓚᑦ ᑎᓂᕐ ᒧᑦ ᐋᖅᑭᒍᑎᓂᑦ ᐊᑦ ᑕᑰᔪᑦ ᐊᑐᖅᑕᐅᓪ ᓗᑎᑦ ᐊᒻ ᒪ ᐊᕙᑎᒧᑦ ᐊᑦ ᑐᐃᖕᖏᓂᖅᓴᐅᓪ ᓗᑎᑦ.

ᐱᔾ ᔪᑎᒋᔭᖕᒐᕐ ᓇᐅᑎᐅᔪᒧᑦ ᓂᕈᐊᕐ ᓗᑎᑦ ᓄᓖᒥᑦ ᑎᓯᔪᓂᑦ ᐊᑦ ᑕᑯᓂᑦ ᐊᓯ ᓯᕙᓪ ᒥᑦ ᐊᒻ ᒪ ᐱᓕᕆᐊᒥᑦ ᐊᒻ ᒪ ᓇᓗᓇᐃᕐ ᓗᒋᑦ ᐃᖅᑲᓇᐃᔮᖑᔪᓇᐊᓖᑦ ᒪᑐᐃᖅᓯ ᓗᑎᑦ ᓄᓖᒥᑦ ᐊᔾ ᓯᕙᓪ ᒥᑦ ᐊᒻ ᒪ ᐊᑐᓕᖅᑎᑕᐅᓗᓂ ᓄᓖᖅ ᐱᓕᕆᐊᖅ.

ᑐᓐ ᖓᕕᖅᑐᒋᑦ ᓇᓗᓇᐃᔭᖅᓯᒪᔪᓂᑦ ᓇᓛᕋᕐ ᓴᓂᑦ ᖃᐅᔨᓴᖅᑕᐅᕙᓪ ᓚᐊᓂᖏ ᓄᑦ ᐊᒻ ᒪ ᓄᓇᓖ ᒥ ᑐᓴᕐ ᕕᒋᓪ ᓗᒋᑦ, ᓄᓖᖅ ᑎᓯᔪᓄᑦ ᐊᑦ ᑕᑯᓄᑦ ᐊᓯ ᓯᕙᒃ ᐊᒻ ᒪ ᐱᓕᕆᐊᖅ ᓇᓗᓴᐃᖅᑕᐅᓯᒪᔪᖅ ᓄᓇᓕᐸᐅᔭᖕᒋᓄᑦ ᐃᖃᓗᐃᑦ:

> ᓇᒦᓐᓂᖕᖁᐅᐊᓐ ᓇᖕᒐ ᐱᖕᒋ ᓇᖕᒥ, ᐊᑦ ᑐᐊᓂᓚᒃ ᓯᕗᓂᓐ ᓴᒥᑦ ᓯᐅᕋᕐ ᑕᖅᕕᐅᐃᓛᖅᑐᒥᑦ.
>
> ᐱᓕᕆᐊᖅ: ᐊᓯ ᓯᕙᒃ ᒪᑐᐃᖕᒐᓗᓂ ᓄᖕᖑᑎᕆᔭᓐ ᓇᖅᑐᒥᑦ ᐱᓕᕆᐊᖅ (ᐊᑐᕆᐊᑉ ᑭᓪ ᓕᖕᒐᓂᑦ ᐊᐃᔭᐅᔪᑦ), ᐊᖕᕇᑎᑦ ᐊᑐᑲᓂᖅᑕᐅᓂᖏ (ᓴᕙᕋᔭᒥᓃᑦ, ᐃᓪ ᓗᒥᐅᑕᒥᓃᑦ, ᐊᓯᖕᖏ ᓗ.), ᓄᓇᓯᐅᑎᓄᑦ ᐊᑐᕋᔅ ᓴᐅᒍᓐ ᓃᖅᑐᓄᑦ ᐱᓕᕆᐊᖅ, ᐊᑐᒃ ᑲᓂᖅ ᕙᒃ, ᐊᑦ ᑕᓇᖅᑐᓄᑦ ᐊᑦ ᑕᑯᓂᑦ ᐊᐅᓚᑦ ᑎᓂᕐ ᒥᑦ ᐱᓕᕆᐊᖅ ᐊᒻ ᒪ ᑭᒃ ᑯᑐᐃᓐ ᓇᕐ ᓂᑦ ᐃᓕᓐ ᓂᐊᑎᑦ ᑎᓂᖅ.

ᓴᖑᑎᑦ ᑎᓂᕐ ᒧᑦ ᐱᓕᕆᐊᖅ ᐱᖅᑯᓯᐅᔾ ᔨᔭᖅ ᑕᕝ ᕙᓂ ᓄᓖᒥᑦ ᐱᓕᕆᐊᒥᑦ ᓴᖑᑎᑦ ᑎᔭᓐ ᓇᖅᑐᑦ 44% ᐊᑦ ᑕᑯᓂᑦ ᐊᓯᔅ ᓯᕙᓪ ᒥᑦ ᐊᒻ ᒪ ᐊᑯᓂᐅᑎᑦ ᑎᓂᖅᓴᐅᔭᓐ ᓇᖅᑐᖅ 14-ᓂᐊᕐ ᕿᒍᓂᑦ ᐊᔾ ᔨᕇᓐ ᖑᐊᑎᑦ ᑎᑐᒍᑦ ᒫᓐ ᓇᐅᔭᒧᑦ. ᐊᑐᓕᕐᑖ ᐅᓯᒪᔭᖅ ᓄᖕᖑᑎᕆᔫᖅ ᓂᖅᕿᒥᓂᑦ ᓂᑦ ᐱᓕᕆᐊᖅ ᐊᕙᑎᒧᑦ ᐃᑲᔫᑎᖅᑳᖅᑐᖅ ᐃᓗᓪ ᓚᓗᐊᖅᑕᐃᓕᓪ ᓗᒍ ᐊᓯ ᓯᕙᐅᔭᖅ, ᑎᐱᖅᑲᖕᖏᓐᓴᐅᓪ ᓗᓂ, ᒥᑭᓪ ᓕᕆᐊᖅᑎᑦ ᑎᔭᖅ ᐃᒪᖕᒐᐊᓯ ᓯᕙᓪ ᒦᖕᖁᖅᑐᒥᑦ ᐊᒻ ᒪ ᓈᒻ ᒪᑦ ᑐᒥᑦ ᐅᓕᖅᑳᑎᑎᓪ ᓗᓂ ᐊᓯ ᓯᕙᓪ ᒥᑦ. ᐊᕙᑎᖕᒐᓂᑦ ᐊᑦ ᑐᖅᑕᐅᔪᑦ ᒥᑭᓪ ᓕᕆᐊᖅᑕᐅᑲᓐ ᓂᓂᐊᖅᑐᑦ ᐊᐅᓚᑦ ᑎᓂᕐ ᒧᑦ ᐱᓕᕆᐊᒃ ᑯᑦ, ᐊᑦ ᑕᓇᖅᑐᓂᑦ ᐊᑦ ᑕᑯᓂᑦ ᐊᐅᓚᑦ ᑎᓂᕐ ᒧᑦ ᓕᓇᐊᖅ ᐊᒻ ᒪ ᐊᑐᒃ ᑲᓂᖅᑕᐅᓂᖏ ᓴᕙᕋᔭᒥᓃᑦ ᐊᒻ ᒪ ᐊᖕᕇᑎᑦ.

ᐊᑐᓕᕐᑖ ᐅᓯᒪᔭᖅ ᐱᓕᕆᐊᖅ ᓇᓛᕋᕐ ᓴ ᑎᐊᕙᐅᓛᖅᔪᖅ ᐊᑯᓂᐅᓂᕆᓂᐊᖅᑕᖕᒪᕐ ᐊᓯ ᓯᕙᒃ. ᐊᒻ ᒪᓗᑦ ᑕᐅᖅ ᖄᓇᐅᔭᖅᑐᖕᖏᖕᒐ ᓗᓂ ᐱᓕᕆᐊᓂᑦ ᓇᓛᕋᕐ ᓴᓂᑦ ᐊᑭᑐᔩᑎᓄᑦ ᐊᒻ ᒪ ᐊᐅᓚᔾ ᔨᑎᖏ ᓄᑦ ᐊᑭᖏ ᓄᑦ. ᐊᓯ ᓯᕙᐅᕐᑖ ᐅᓯᒪᔭᖅ ᖄᓇᐅᔭᓂᑦ ᐊᑐᑦ ᑎᐊᓛᖑᓂᐊᖅᑐᖅ ᐊᑐᓇᐊᓄᑦ ᐊᑭᑐᔭᓄᑦ ᐊᒻ ᒪ ᒪᑭᒪᐅᑎᖏ ᓄᑦ ᐊᑭᖏ ᓄᑦ ᓄᓖᒥᑦ ᓯᐅᕋᕐ ᑕᕐ ᕕᕐᓇᐊᖅᑐᓂ ᐱᓕᕆᐊᒥᑦ, ᐊᑕᐅᑦ ᑎᒃ ᑯᐸᓗᒃ ᐱᔭᕇᕐ ᕕᔅ ᓴᖅᑐᑦ.

ᓄᓇᓖᑦ ᒥᐅᑕᐃᑦ ᐊᒻ ᒪᓗ ᓇᖕᒥᓂᖅᑲᖅᑕᐅᔪᑦ ᐃᓯᒪᒋᔭᖏ ᓂᑦ ᐅᖅᑰᓯᐅᕚᑦ ᑐᓂᑦ ᐊᑐᖅᑐᒻ ᒪᓇᐅᕚᑦ ᑐᑦ ᐸᕐ ᓇᐅᑎᓕᐅᕈᑎᓄᑦ. ᐅᖅᑰᓯᐅᕚᓚᐅᖅᑐᑦ ᐃᓯᒪᒋᒋᐊᖅᑐᒋᑦ ᐱᔾ ᔪᑎᖃᖅᑐᑦ ᐃᓂᑦ ᓴᐅᕐᑖ ᐅᔪᒥᑦ ᐊᒻ ᒪᓗ ᐱᓕᕆᐊᑦ ᓴᒥᑦ, ᓴᖅᑭᑕᐅᓚᐅᖅᑐᑦ ᑭᖑᓕᖅᐸᒥ ᐱᓕᕆᐊᑦ ᓴᖅ ᐱᓪ ᓗᒍ ᑐᓴᑦ ᓴᓕᐊᖑᓚᐅᖅᑐᓂ, ᐸᕐ ᓇᐅᑎᒍᑦ ᓴᖅᑮᕙᑦ ᐃᓚᒋᐊᕈᑎᑦ ᓴᓂᑦ ᐊᑐᕐᖃᔾ ᔨᑎᓄᑦ ᐅᖅᑰᓯᐅᓯᒪᔪᓄᑦ, ᐅᑯᐊ ᐃᓚᒋᔭᐅᓗᑎᒃ:

10. ᐃᓕᓯ ᓗᓂ ᓈᒻ ᒪᑦ ᑐᓂᑦ ᑭᓯᓕᕐ ᔨᑎᓂᑦ ᐊᒻ ᒪ ᐱᓖ ᒪᔅ ᓴᐃᓂᕐ ᒥᑦ ᓄᓖᖅ ᐊᓯ ᓯᕙᒃ ᒪᓕᒍᓐ ᓇᓂᐊᕐ ᒪᑦ ᐱᐅᓛᓂᑦ ᐊᐅᓚᑦ ᑎᓂᕐ ᒧᑦ ᐊᒻ ᒪ ᓴᕗᔾ ᔨᓗᓂ ᓄᓇᖕᒥᐊᒻ ᒪ ᐃᒪᖕᒥ;
11. ᐅᔾ ᔨᓇᑦ ᑎᐊᕐ ᓗᒋᑦ ᐊᐅᓚᔾ ᔨᑎᖏ ᓄᑦ ᐊᒻ ᒪ ᒪᑭᒪᐅᑎᖏ ᓄᑦ ᐊᑐᐊᒐᐃᑦ ᓇᓗᓇᐃᖅᓯᒪᔭᓂᑦ ᐱᓕᕆᐊᖅᓯᐅ ᓗᑎᑦ ᑎᑦ ᑕᐅᓴᕐ ᓂᐊᖏ ᒪᑕ ᐊᑦ ᑕᑯᐃᖏ ᐊᓯ ᓯᕙᓪ ᒥᑦ ᐊᒻ ᒪ ᐊᑦ ᑕᑯᐃᑦ ᓯᓚᑖᓅᖏ ᓗᑎᑦ ᑭᓪ ᓕᖕᒐᓂᑦ (ᓘᕐ ᓗ, ᐅᓕᖅᑳᑎᑕᐅᓂᖏᖕᒐᓂᑦ ᐊᑐᐊᒐᐃᑦ, ᐅᖅᑯᐊᓐ ᓂᓕᓕᐅᕐ ᓗᒍ ᐊᓯ ᓯᕙᒃ, ᓯᓚᑖᓅᓂᑦ ᑐᓂᑦ ᓴᓗᓪ ᒪᖅᓴᖅᓯᑦ ᑕᕐ ᓂᖅ);
12. ᐅᔾ ᔨᓇᑦ ᑎᐊᕐ ᓗᒋᑦ ᐊᐅᓚᔾ ᔨᑎᖏ ᓄᑦ ᐊᒻ ᒪ ᒪᑭᒪᐅᑎᖏ ᓄᑦ ᐊᑐᐊᒐᐃᑦ ᐱᖅᑯᓯᐅᔾ ᔨᓗᑎᑦ ᐅᓗᖕᒐ ᖃᓇᐃᑦ ᑑᔭᓇᐊᖅᑯ ᓂᖕᒪᓂᑦ ᒪᓕᑦ ᑕᐅᔭᓇᐊᓖᑦ ᐅᓕᕆᔭᐅᔭᖅ ᑎᑭᑦ ᑎᒐᓗᐊᕐ ᒪᖕᒋ ᐱᑦᑕᖅᑲᓇᐊᖅᑲᖅᑎᑕᐅᔭᓂ ᐊᓯ ᓯᕙᓪ ᒧᑦ;
13. ᐱᑦᑕᖅᑲᓇᐊᖅᑲᖅᑎᑕᐅᓗᓂ ᓴᓇᓯᒪᓂᖕᒪᓂᑦ ᖃᐅᔨᓴᖅᑕᐅᔪᑎᑦ ᓇᓛᕋᕐ ᓴᐃᑦ ᐊᑦ ᑐᖕᖏᖅᑕᐅᓂᖏ ᓄᑦ ᐊᒻ ᒪ ᖁᕝᕙᓯᖅᑎᑕᐅᓂᖏ ᓄᑦ ᓄᓇᓖ ᒧᑦ ᐊᑦ ᑕᑯᐃᑦ ᐊᓯ ᓯᕙᓪ ᒥᑦ ᐊᒻ ᒪ ᐊᑐᓕᕐᑖ ᑕᐅᔅ ᒧᑦ ᑕᒪᓐ ᓇ ᐊᑐᖅᑕᐅᔭᓇᐊᓖᑦ ᒪᖕᒋ ᓄᓚᒧᑦ ᐊᓯ ᓯᕙᓪ ᒧᑦ;
14. ᐊᒥᓯᕈᓇᐊᕐ ᓗᒋᑦ ᓴᓇᔭᓕᓇᔾ ᑯᑦ ᐃᖅᑲᓇᐃᔭᖅᑎᖏ ᐊᒻ ᒪ ᐊᑐᖅᑐᔅ ᓴᖏ ᐱᑦᑕᖅᑲᓇᐊᖅᑲᖅᑎᑕᐅᔭᓂ ᒪᑭᒪᑎᑦ ᑎᑎᐊᓂᕐ ᒥᑦ ᐊᓯ ᓯᕙᓪ ᒨᖕᖓᖅ ᓄᓖᖅ ᑎᓯᔪᓄᑦ ᐊᑦ ᑕᑯᓄᑦ ᐊᐅᓚᑦ ᑎᓂᕐ ᒥᑦ ᐊᓯ ᓯᕙᒃ;
15. ᐅᔾ ᔨᓇᑦ ᑎᐊᕐ ᓗᒋᑦ ᐱᓕᕆᐊᖑᕆᐊᓖᑦ ᐃᓂᖕᖏᑦ ᓗᒋᑦ ᓴᓐ ᓂᑦ ᓂᐊᖏ ᒪᑦ ᐊᑐᓇᐊᖅ ᐊᓯ ᓯᕙᓪ ᒨᖕᖓᖅ (ᓘᕐ ᓗ, ᐊᑦ ᑕᑯᐃᑦ ᐊᓯ ᓯᕙᓪ ᒨᖅᑕᐅᓂᖏ ᐊᑦ ᑕᓇᐃᖅᓯᒪᔭᓇᐊᖅᑲᖅᑎᑕᐅᓗᑎᑦ, ᓴᓗᓪ ᒪᖅᓴᖅᓯᑦ ᑕᕐ ᓗᒍ ᓴᓗᓪ ᒪᖅᓴᓇᐊᖅᑲᖅᓴᐃᑉ ᐸᑦ);
16. ᖁᒥᕐ ᕈᐊᕐ ᓗᑎᒃ ᐊᒻ ᒪᓗ ᖃᐅᔨᓴᕐ ᓗᑎᒃ ᐊᔾ ᔨᕇᓐ ᖑᐊᖅ ᑐᑦ ᐃᓗᓕᖕᒪ ᑎᓯᔪᓂᑦ ᓴᓂᓕᓇᐅᑎᑦ ᓴᓂᑦ ᐱᓕᕆᐊᑦ ᓴᐅᑉ ᓇᓗᓇᐃᔭᐃᓂᐊᕐ ᒪᑕ ᓇᓪ ᓕᐊ ᖃᓂᑦ ᓴᓛᖑᕆᐊᖅᑲᖅ ᒪᖕᒋᖅ ᓄᓖᖅ ᒥᑦ (ᐃᖕᒥ ᕿᔾ ᔨᑎᓂᑦ ᐊᑐᓗᐊᕐᓴᑦ ᖑᒍᑦ ᐊᒻ ᒪᓗ ᑭᒃ ᑯᑐᐃᓐ ᓇᕐ ᓄᑦ ᐅᐸᑦ ᑕᐅᔭᓐ ᓇᓂᖅ ᓴᐅᕐᑖ ᓗᒍ);
17. ᓇᓗᓇᐃᔭᐃᓗᑎᒃ ᐃᓂᑦ ᓴᕐ ᓯᐅᕙᐅᒐᔭᓐ ᖑᐊᖅᑐᓂᑦ ᖁᓂᑦ ᓴᓂᕐ ᓴᐅᔭᓐ ᓇᕐ ᓂᖏ ᓄᑦ ᐱᓕᕆᐊᑦ ᓴᐅᑉ ᐃᓚᖏ ᓄᑦ ᓄᓇᓖ ᒥᑦ ᑕᑯᓐ ᓇᕐ ᓗᑎᒃ ᐊᑐᕆᐊᑦ ᓴᖅ ᐊᑐᖅᑕᐅᓯᒪᔪᓂᑦ ᐃᓂᓂᑦ (ᓘᕐ ᓗᖅᑲᖅᑲᓕᐊᕆᐊᒥ, ᑰᓕᐊᕆᐊᒥ); ᐊᒻ ᒪᓗ,

18. ᖃᐅᔨᓴᕐ ᓂᖅᑯ ᓗᑎᑦ ᐊᐱᖅᑯ ᑕᕐ ᓂᖓᓂᑦ ᐊᒻᒪ ᐊᓄᓇᖓᓂᑦ ᐊᔅ ᓯᕙᒻ ᒥᑦ ᐊᒻᒪ ᐊᑐᕆᐊᖓᐊᔅ ᓯᕙᒻ ᔫᕆᐊᖅ ᑎᑎᕋᐅᔭᖅᓯᒪᓂᖓᐊᒻᒪ ᐊᐅᓚᓂᖓᓂᑦ ᒪᓕᑦ ᑕᐅᔭᕆᐊᓖᑦ ᐱᓕᕆᐊᖅᑯ ᑎᐊᕋᓗᐊᕐ ᒪᖕᖏᕐ ᐊᐱᖅᑯ ᑕᕐ ᓂᖓᓂᑦ ᐊᒻᒪ ᐊᓯᖏ ᐊᑐᕆᒧᑦ ᐊᑦ ᑐᐃᓂᖅᑯᑦ .

ᐃᑭᑦ ᑎᖅᑯ ᑕᕐ ᓂᐅᔪᖅ ᓈᒻ ᒪᕙᓯᕕᔭᐅᓚᐅᖏ ᑑᕙᓗᐊᖅ ᖄᓇᐅᔭᑐᕐ ᓂᖓᓂᑦ ᖅᒫᓐ ᓇᐅᔪᒥᑦ, ᐊᒥᓯᑦ ᐱᔪᒪᓂᖅᑯᑦ ᐊᑦ ᑕᑯᓗᕆᓂᕐ ᒥᑦ ᓄᓇᓕᐸᐅᔭᒃ ᑯᑦ ᑲᑎᒪᔨᖏ, ᓄᓇᓖ ᒥᐅᑕᐃᑦ ᐊᒻᒪ ᓇᓐ ᒥᓂᖅᑯᑦ ᐊᑯᓂᐅᑎᑦ ᑎᔪᓐ ᓇᑐᐃᓐ ᓇᕆᐊᖅᑯ ᓂᖓᓂᑦ ᑎᓯᔪᓂᑦ ᐊᑦ ᑕᑯᓂᑦ ᐊᐅᓚᑦ ᑎᓂᕐ ᒥᑦ ᐊᔅ ᓯᕙᒃ. ᓄᓇᓕᐸᐅᔭᒃ ᑯᑦ ᑲᑎᒪᔨᖏ ᖃᐅᔨᕆᐊᒃ ᑲᓐ ᓂᕈᒪᔪᑦ ᐊᑦ ᑕᑯᓂᑦ ᐃᑭᑦ ᑎᕙᓪ ᒥᑦ ᐃᓚᕆᔭᐅᕐᓯ ᓗᒍ ᐸᕐ ᓇᐅᑎᒧᑦ, ᑕᐃᒪᐃᓐ ᓂᖏᓄᑦ, ᓄᓇᓕᐸᐅᔭᒃ ᑯᑦ ᐊᑐᕐᖢᐅᔫᖓᓗᐊᑦ ᐅᑯᓂᖕᖑ

3. ᖃᐅᔨᓴᕐ ᓗᑎᑦ ᐊᒻᒪ ᕿᓂᕐ ᓗᑎᑦ ᖄᓇᐅᔭᖅᑲᖅᑎᑕᐅᓂᕐ ᒥᑦ ᓯᓚᑖᓃᖕᖏᓐ ᓇᖅᑐᓂᑦ ᐃᑲᔪᕐ ᓂᖅᑲᖅᓴᔭᖅᑐᑦ ᖄᓇᐅᔭᑎᒍᑦ ᐊᑦ ᑕᑯᓄᑦ ᐃᑭᑦ ᑎᕙᓪ ᒥᑦ ᓄᓇᓖ ᒧᑦ (Green Municipal Fund, etc.), ᐊᒻᒪ
4. ᐃᖅᑲᓇᐃᔭᖅᑎᑦ ᑎᒍᓂᓴᓇᓯᒪᔪᓕᕆᓂ ᐱᔭᕇᖅᓯ ᓗᑎᑦ ᓇᒧᓇᐃᔭᖅᓯᒪᔪᓂᑦ ᖃᐅᔨᓴᐃᓂᕐ ᒥᑦ ᓇᓖᖅᓴᕐᓴᔅ ᓴᓂᑦ ᐊᒻᒪ ᓴᖅᑭᑎᑦ ᑎᒍᑎᑦ ᓇᒧᓇᐃᔭᖅᓯᒪᔪᓂᑦ ᐸᕐ ᓇᐅᒻ ᒥᑦ ᐊᑐᓕᖅᑎᑕᐅᓂᖓᓂᑦ ᐊᑦ ᑕᑯᓄᑦ ᐃᑭᑦ ᑎᕙᒃ (ᐅᕝ ᕙᔫᓐ ᓅᑦ ᐊᓯᖏ ᐆᓇᖅᑐᔫᖅᑐᑦ) ᐃᖃᓗᓐ ᓂ. ᑖᓐ ᓇ ᐱᖅᑯᐅᔾ ᓴᓂᐊᖅᑐᖅ ᓇᒧᓇᐃᖅᓯᓂᕐ ᒥᑦ ᐱᔪᒪᓂᕐ ᒥᑦ ᓄᐊᑦ ᑎᓂᐊᕐ ᓗᑎᑦ ᐊᑦ ᑐᐊᓂᓪᓚᓐ ᓂᑦ ᐊᒻᒪ ᐊᑭᖏ ᓂᑦ ᑐᑭᓯᕆᐊᕈᑎᓂᑦ ᓯᓇᒃ ᑯᑖᖅᑲᖅᑎᑦ ᑎᓴᓂᑦ .

ᐊᑐᓕᖅᑎᑕᐅᓂᖓᓄᑖᑉ ᑕᖅᕋᓐ ᓂᑦ ᓴᓂᓕᕆᐅᑎᑦ ᓴᓂᑦ ᐸᕐ ᓇᐅᑎᑦ ᓴᖅ ᐱᓪ ᒪᕆᐅᓂᐊᖅᑐᖅ ᐱᓕᕆᐊᖑᔪᓂ ᓄᓇᓕᐸᐅᔭᒃ ᑯᓐ ᓄᑦ ᐊᐅᓚᑕᐅᓂᖓᓄᑦ ᐊᒻᒪ ᐱᓕᕆᖅᑲᑎᖅᑲᓐ ᒥᑦ ᐊᒥᓯᓂᑦ ᐱᓕᕆᕙᓐ ᓂᑦ ᐊᕐ ᖀᔪᓚᐅᔪᓂᑦ . ᐃᖅᑲᓇᐃᔭᖅᑏᖄᑦ ᐊᓯᔾ ᔨᖅᑯ ᑕᕐ ᓂᖏ ᓄᑦ ᑕᐃᒪᐃᓕᔪᑦ ᑐᓂᐅᑭᐅᑕᖅᑐᒥᑦ ᐊᒻᒪ ᐊᖕᖒᖕᖏ ᐊᑭᑐᔪ ᓄᑦ ᐱᓕᕆᐊᑦ ᓂᕆᐅᕆᔭᐅᔪᑦ ᐊᑐᓕᖅᑎᑕᐅᓪᓗᐊᓂᖓᓄᑦ, ᐊᒻᒪ ᑐᐊᕙᐊᖑᓛᕐ ᓂᖓᓄᑖᒥᑦ ᑕᖅᕋᓐ ᓂᑦ ᓴᓂᓕᕝ ᕙᑦ ᓴᐅᒃ ᐱᓪ ᓗᒍ, ᐊᑐᓕᕐᖢᐅᔪᖅ ᐱᓕᕆᐊᒧᑦ ᐊᐅᓚᑦ ᑎᓐ ᒧᑦ ᑎᒥᐅᔪᒥᑦ ᐃᖅᑲᓇᐃᔭᖅᑎᑕᐅᓗᑎᑦ ᐊᐅᓚᑦ ᑎᓗᑎᑦ ᑖᔅ ᓯᒥᖕᖑ ᐱᓕᕆᐊᒥᑦ ᐊᒻᒪ ᐱᔭᕇᕆᐊᓕᓕᓪᓖᑦ ᐱᔭᕇᖅᑕᐅᓯᒪᔭᕆᐊᖅᑯ ᓗᑎᑦ .

ᒫᓐ ᓇᐅᔪᒥᑦ ᒥᔅ ᓴᐅᓴᑦ ᑕᐅᓯᒪᔪᖅ ᐊᑭᖅᑯᖅᓴᔭᕐ ᓂᖓᓂᑦ ᐊᑐᓕᖅᑎᑕᐅᓂᖓᓂᑦ ᑖᓐ ᓇ ᐸᕐ ᓇᐅᑦ (ᐃᓚᓕᐅᑎᓗᒋᑦ ᒪᑐᓯᔾ ᔪᑎᑦ ᓴᑦ ᑑᓕᐊᕆᐊᒥ ᐊᑦ ᓯᕙᓪ ᒥᑦ) ᖃᓂᒋᔭᐸᓗᐊᓃᓐ ᓂᐊᖅᑐᑦ $13,980,000 ᐊᕐ ᕌᒎᓄᑦ ᑕᓪ ᓕᒪᓄᑦ . ᓄᓇᓕᐸᐅᔭᒃ ᑯᑦ ᐊᑭᑐᔪᓄᑦ ᖄᓇᐅᔭᓂᑦ ᐱᓕᕆᔾ ᔪᑎᖅᑲᐳᓐ ᓇᖅᑐᑦ ᐊᔾ ᔨᕆᓐ ᓐ ᒋ ᑐᓂᑦ ᐱᓕᕆᔾ ᔪᑎᑦ ᓴᓂᑦ (ᒎᓯᔫ ᓄᑦ ᑖᒃ ᔫᔭᐃᔭᐅᑎᒥᓂᖅ ᓂᒃ, ᓄᓈᑦ ᒐᕙᒪᒃ ᑯᓐ ᓂᑦ ᐊᖑᕈᑎᒍᑦ ᑐᓂᖅ ᐳᓯᐊᖑᕚᑦ ᑐᓂᑦ ᐃᓗᐃᒃ ᑲᐅᓪ ᓗᕆᑦ, ᓄᐊᑕᐅᕚ ᓚᐊᔪᓂᑦ ᓇᓪ ᓚᐅᒃ ᑯᓖᓂᑦ, ᓴᓂᓕᕆᐅᑎᓂᑦ, ᓱᓇᓕᒫᓂᑦ ᐊᐅᓚᑦ ᓯᔾ ᔪᑎᓂᑦ, ᐊᓯᖏ ᓂᓪ ᓗ). ᖄᓇᐅᔭᐃᑦ ᓇᑭᓐ ᖔᖑᐊᖅ ᓂᖏ ᐊᔾ ᔨᕆᓐ ᖏ ᑐᓄᑦ ᐊᒻᒪ ᐊᕐ ᕌᒎᓄᑦ ᐊᑐᕋᔭᖅᑐᑦ ᐱᓕᕆᐊᑦ ᓴᒧᑦ ᓇᒧᓇᐃᔭᕐ ᓯᒪᓖᖅᑐᑦ ᓄᓇᓕᐸᐅᔭᒃ ᑯᑦ ᓴᖅᑭᓖᖅᑕᖕᖏᓂᑦ ᐊᕐ ᕌᒎᓄᑦ ᑕᓪ ᓕᒪᓄᑦ ᐊᑭᑐᔪᓕᖅ ᔪᑎᓂᑦ ᐸᕐ ᓇᐅᑎᒥ (2014-2018).

ᓄᓇᓕᐸᐅᔭᒃ ᑯᑦ ᐊᕐ ᕌᒎᓕᓖᒧᑦ ᐊᐅᓚᑦ ᓯᔾ ᔪᑎᓄᑦ ᐊᒻᒪ ᑲᒪᕆᐊᕈᑎᓄᑦ ᐊᑭᓕᖅᑕᐅᕙᑦ ᑐᑦ ᖁᕝ ᕙᓇᐊᔾ ᔭᓐ ᖑᔫᓇᔭᑦ ᐱᔾ ᔪᑎᕆᓪ ᓗᒍ ᐸᕐ ᓇᐅᑎᐅᑉ ᐊᑐᓕᖅᑎᑕᐅᓂᖓ ᒪᓕᑦ ᑕᐅᓗᑎᒃ ᖁ ᓯᑦ ᖄᓇᐅᔭᐃᑦ ᐃᓯᖅᐸᑦ ᑐᑦ ᐊᑐᐃᓐ ᓇᐅᕙᔭᖅᑐᑦ ᐱᓕᕆᔾ ᔪᑎᑦ ᓴᖅ ᐊᑐᓕᖅᑎᑕᐅᑎᓪ ᓗᒍ, ᐊᑐᖅᐸᑦ ᑐᑦ ᐊᑭᓕᖅᐸᑦ ᑕᖅᑯ (ᓴᓂᕐ ᓄᑦ ᐊᒻᒪ ᐊᑦ ᓯᕙᓪ ᔫᕆᔾ ᔪᑎᑦ) ᖁᕝ ᕙᓇᐊᕆᐊᖅᑲᔭᖅᑐᑦ 63 ᐳᓴᓂᑦ ᐊᑭᓕᐅᑎᑦ ᓴᓂᑦ ᐊᑭᓕᕆᐊᓕᓐ ᓄᑦ ᓴᖅᑭᕋᔭᖅᑐᓂᑦ . ᓇᓚᐅᑦ ᑖᖅᑕᐅᓯᒪᔪᑦ ᐊᕝ ᕓᖅ ᖁᕝ ᕙᕆᐊᕈᑎᐅᕆᐊᖅᑲᔭᖅᑐᑦ ᐱᕙᔭᖅᑐᑦ ᐊᐅᓚᑕᐅᔪᑦ ᓴᑦ ᐃᓚᕆᐊᕐ ᓂᖏ ᓄᑦ ᐊᒻᒪ ᑲᒪᕆᐊᕈᑎᑦ ᓴᑦ ᐊᑦ ᑐᐊᔪᑦ ᐃᑭᑦ ᓯᕙᓕᕆᓂᕐ ᒧᑦ . ᓇᒧᓇᐃᔭᕐ ᓯᒪᓂᕐ ᓴᓂᑦ ᑐᑭᓯᕆᐊᕈᑎᓂᑦ ᐊᑭᑦ ᓴᐃᑦ ᐃᓚᕆᐊᕈᑎᑦ ᓴᖕᖏ ᓂᑦ ᐱᔾ ᔪᑎᖅᑲᖅᑐᑦ ᐱᔭᐅᓖᖅᑐᑦ ᑐᑦ ᓯᕋᓕᖅᑲᑕ ᑭᒃ ᑯᓐ ᓄᑦ ᐱᓕᕆᐊᖅᑲᒪᓚᕙᔭᓐ ᖑᐊᕐ ᒪᖅᑰᖅ ᓇᒧᓇᐃᕐ ᓯᔾ ᔪᑎᒥᑦ ᐅᖃᐅᓯᐅᓯᒪᔪᒥᑦ . ᐃᓚᖏ ᐊᑐᕆᐊᓕᕆᔾ ᔪᑎᑦ ᓴᓄᑦ ᐃᓚᒍᑕᐅᕆᐊᖅᑲᔭᖅᑐᑦ ᐊᑭᓕᖅᑕᐅᕙᔭᕐ ᒥᔪᑦ ᓯᐅᕋᓕᕆᔾ ᔪᑎᓂᑦ ᓅᒥᑦ, ᓯᕗᓂᑦ ᑎᓐ ᓂᐊᑦ ᑐᐃᔾ ᔪᑕᐅᑐᐃᓐ ᓇᕆᐊᓕᑦ ᓯᑎᒃ ᑯᓐ ᓄᑦ ᐊᑭᓕᖅᑕᐅᑎᐊᕐᖅᑲᑦ ᑐᓂᑦ ᓯᐅᕋᓂᑦ ᓂᐅᕕᖅᑲᑦ ᑐᓂᑦ .

ᓅᖅ ᐱᓕᕆᐊᖅ ᐊᑐᓕᖅᑎᑕᐅᒍᓂ, ᐱᓪ ᒪᕆᐅᓂᐊᖅᑐᖅ ᑖᒃ ᑯᐊ ᐃᓚᒍᑕᖕᖑ ᐊᐅᓚᓂᖕᖏ ᓄᑦ ᐊᑭᖕᖑ ᐸᕐ ᓇᑕᐅᓯᒪᔪᑦ ᐊᑐᖅᑐᔅ ᓴᓚᐅᖅᐸᑦ ᓚᐊᓂᖅ ᒧᑦ ᐊᒻᒪ ᖃᐅᔨᓴᖅᑕᐅᖅ ᑕᖅᑐᓂᐋᖅᑭᕆᐊᖅᑕᐅᖅ ᑕᕈᓐ ᓇᓂᐊᕐ ᒪᑦ ᐋᖅᑭᕆᐊᖅᑕᐅᔭᕆᐊᖅᑲᐃᒍᓂ. ᑖᓐ ᓇ ᖃᐅᔨᓴᕐ ᓂᐅᔪᖅ ᐱᓪ ᒪᕆᐅᓪ ᒥᔪᖅᑕᐅᖅ ᓄᓇᓕᐅᔪᖅ ᐊᒻᒪ ᐊᑦ ᑕᑯᖕᖑ ᐊᖕᖑ ᓕᕝᕙᓪ ᓕᐊᖕᖑ ᓇᖅᑐᑦ .

Table of Contents

1. Introduction

The City of Iqaluit (City) currently manages its waste at the West 40 Landfill. This facility is at capacity and a new facility is needed as soon as possible. Both the City's Water License and General Plan require that the City complete a new Solid Waste Management Plan to address the City's current and future solid waste management needs. The purpose of this plan is to select a new solid waste management site and program and identify the work that needs to be done to open the new site and implement the new program.

Based detailed analysis and community feedback, a new solid waste management site and program have been selected. There is also a set of recommendations that have been developed to address community feedback and ensure that the plan meets the needs of the community. Based on the outcomes of this work, Section 5 identifies the work that needs to be done over the next five years to implement the recommendations in this plan along with a high-level cost analysis.

2. Approach

2.1 Overview

The solid waste management program and site selection process involved a detailed technical analysis along with extensive stakeholder and public input. The process involved four phases:

1. Understand the Problem,
2. Identify Potential Waste Management Program and Site Options,
3. Evaluate Alternative Solid Waste Management Program and Site Options, and
4. Recommend Preferred Solid Waste Management Program and Site.

Over the course of the project, three Newsletters (see Appendix A) were mailed to all residents to provide information and request feedback on the different phases. In conjunction with the Newsletters, three public Open Houses were held to collect public feedback, and several meetings were held with City Council. In addition, an Options Brief (see Appendix A) was developed and distributed and a bilingual website (English and Inuktitut) was maintained to communicate project progress and share resources (www.iqaluitwasteproject.ca).

In the final Newsletter and Open House, the preferred site and program were presented for community input before the program was finalized and brought to Council for final approval. This plan was approved by Council on January 28, 2014 (Motion # 14-21).

2.2 Solid Waste Management Program Vision and Goals

Based on community feedback, the following vision and goals were developed to guide the development and implementation of the City's new Solid Waste Management Program.

VISION:

"The City of Iqaluit will be a leader in Northern waste management practices by identifying and implementing locally appropriate waste management solutions that maximize waste diversion and minimize environmental impacts."

GOALS:

1. EDUCATE the community on the reuse, diversion and disposal options available.
2. REDUCE the amount of waste produced and the amount of litter in our streets.
3. REUSE goods and materials that are not at the end of their useful life.
4. COMPOST organics for the benefit of the community.
5. MANAGE hazardous waste to protect the environment and people in our community.
6. RECYCLE using methods that are locally appropriate.
7. DISPOSE of remaining waste in a way that is environmentally, economically and socially sustainable.

2.3 Evaluation Criteria

Community input at Open House #1 and #2 also led to the development of a set of evaluation criteria for the project:

1. Minimize environmental impact,
2. Cost effective and affordable,
3. Aligns with solid waste management vision and goals,
4. Good track record/Appropriate technology for our remote Arctic community,
5. Acceptable to the community, and
6. Ease of Implementation.

These criteria were used in the evaluation of the different program options and the relevant criteria (#1,2,5) were used in the site selection process along with other more specific site selection criteria.

3. Selection of a New Solid Waste Management Program

3.1 Program Evaluation Process

In order to identify the most suitable program, four program options were generated based on community input received at Open House #2:

1. Open Windrow Compost,
2. In-vessel Compost,
3. Open Windrow Compost plus Incineration, and
4. Open Windrow Compost plus Household Recycling of Fibers and Metals.

Based on an analysis of regulatory requirements, technical and economic feasibility, and public and stakeholder feedback, all of the four options listed above include the following common components:

- Segregation, stockpiling and recycling of tires, bulky metals, appliances. The segregation of these materials is a solid waste operations best practice. The bulky nature of these materials make landfilling them problematic. In addition, the potential commodity value of steel makes the bulky metals and appliances good candidates for recycling.
- End of Life Vehicle program. Vehicles are bulky items that are also problematic to landfill. They also contain fluids that can be toxic to the environment if not removed and properly managed in an End of Life Vehicle program. As with the bulky metals and appliances above, the metal in these vehicles is a good candidate for recycling.
- Household hazardous waste and waste electronics program. The segregation of hazardous waste and waste electronics is a solid waste operations best practice and a requirement under the City's Water License. Although small amounts of this waste are generated compared to other wastes, it is important that these components of the waste stream are managed properly. If they aren't, the toxic material in hazardous waste and waste electronics can leach out and make the landfill and its runoff more toxic. Also, hazardous waste can impact health and safety at the site and increase the risk of landfill fires.
- Reuse center for larger items not at end of useful life. This program will allow the City to divert usable materials from disposal, and would be relatively inexpensive to run. In addition, residents have expressed a strong interest in this type of program.
- Composting of household organics and sewage sludge. Composting food waste and sewage sludge will help the City manage a key and somewhat problematic component of its waste stream. Composting this material will help to reduce odors, animal nuisances, and leachate at the landfill site while providing the City with a potential source of alternative landfill cover material.
- Use of shredded wood and compost as landfill cover material/supplement. The regular application of cover material is a solid waste operations best practice; however, the City does not have an easy supply of affordable landfill cover material. Using shredded wood and compost as an alternative daily cover can help

to reduce the requirement and associated cost of using more expensive options such as crushed gravel/pit run material.

To assist in the analysis of the different options against the evaluation criteria, diversion rates and estimated site lifespans were calculated for each option along with a detailed cost analysis. The cost analysis identified the total capital cost, the operation and maintenance cost and capital cost annualized over the identified lifespan. This cost analysis also identified the total annual cost (annualized capital cost plus annual operation and maintenance cost) in order to compare the impact of options with significantly different diversion rates and associated lifespans.

Table 1 summarizes the results of the cost analysis completed for each of the options and provides information on the status quo solid waste management program for comparison. See Appendix E for more detailed information on Iqaluit's waste composition and how the programs were applied in each option.

The estimated capital costs for the options were prepared as Class D estimates. These are preliminary estimates that indicate the approximate magnitude cost of the proposed options. Class D estimates are typically used to obtain preliminary approval and for discussion purposes.

The capital and operation and maintenance costs used for incineration were based on information gathered from the following five incineration companies:

1. Eco Waste Solutions
2. Waste to Energy Canada
3. WCS
4. Therm-Tec, and
5. EnerWaste.

For the purpose of this analysis, the operation and maintenance cost identified for Option 3 (incineration) assumes no cost savings from residual heat or electricity production. Due to the size of incinerator that would be required in Iqaluit, it is unlikely a waste-to-energy unit would be found to be more technically and economically feasible than an incinerator that does not recover energy.

Table 1. Program Option Cost Comparison

Program Options	Program Description **The following components are common to all options:** • Segregated, stockpiled, sent south for recycling/disposal when revenues allow: tires, bulky metals, appliances, End of Life Vehicles (ELV), electronics, hazardous waste • Cover material: compost and shredded wood waste • Reuse Center for all but Status Quo	Total Capital Cost (based on Northwest site) (millions)	Annual Capital Cost (capital cost divided by lifespan) (millions)	Annual O&M Cost (millions)	Total Annual Cost (annualized capital cost plus annual O&M cost) (millions)	Annual Diversion Rate [1]	Facility Lifespan (years)
Status Quo at new Solid Waste Management Site	• Composted (open windrow): all sewage sludge • Landfilled: glass, plastics, household metals, plastics, paper/cardboard, organics, remaining waste	8.50	0.20	0.82	1.02	8%	42
Option 1: Open Windrow Compost	• Composted (open windrow): food waste (70%), paper/cardboard (50%), wood (25%), all sewage sludge • Landfilled: glass, plastics, household metals, remaining waste	9.08	0.16	0.87	1.03	44%	56
Option 2: In-vessel Compost	• Composted (in-vessel): food waste (70%), paper/cardboard (70%)[2], wood (25%), all sewage sludge • Landfilled: glass, plastics, household metals, remaining waste	10.5	0.18	1.00	1.18	48%	58
Option 3: Open Windrow Compost Plus Incineration	• Composted (open windrow)[3]: food waste (70%), all sewage sludge • Incineration: wood (25%), remaining waste after composting and stockpiling (see common items above) • Landfilled: Glass, household metals, incinerator ash	13.58[4]	0.19	1.69	1.88	67%	71
Option 4: Open Windrow Compost Plus Household Recycling of Fibers and Metals	• Household Recycling: metals (70%), paper/cardboard (70%) • Composted (open windrow): food waste (70%), all sewage sludge • Landfilled: glass, plastics, remaining waste	9.53	0.16	1.56	1.72	50%	59

[1]Where applicable includes diversion through recycling/composting/reuse programs as well as reduction of waste through incineration (70%).
[2]In-vessel compost can take more paper/cardboard than open windrow due to ability to optimize conditions for composting process.
[3]Due to water content in food waste and sludge, it is more cost effective to compost them (instead of incineration)
[4]Capital cost does not include cost of pollution controls.

3.2 Evaluation Results

For each option, each evaluation criterion was given a score of 1 to 3, based on the following scoring system:

- Poor or worst performance – 1 point;
- Neutral effect, or mid-range performance – 2 points; and
- Strong or best performance – 3 points.

Table 2 below summarizes the scoring that was completed for each of the option and the rational for the scores is given in the sections below.

Table 2. Summary of Option Scoring Against Evaluation Criteria

Criteria	Option 1 (Open Windrow Compost)	Option 2 (In-vessel Compost)	Option 3 (Open Windrow Compost + Incineration)	Option 4 (Open Windrow Compost + Household Recycling)
Minimize Environmental Impact	2	2	3	2
Cost Effective / Affordable	3	2	1	1
Aligns with Vision and Goals	3	3	2	2
Good Track Record/ Appropriate Tech	3	2	1	1
Acceptable to Community	3	3	3	3
Ease of Implementation	3	1	1	1
TOTAL	**17**	**13**	**11**	**10**

3.2.1 Minimize Environmental Impact

All four options will manage organics, runoff, household hazardous waste, waste electronics, and end of life vehicles to reduce the environmental impact of the site. In terms of environmental impact, the main difference between the options is their diversion rates, which impact the lifespan of the solid waste management site. Using the site efficiently will reduce the environmental impact by extending its lifespan and delaying the need for a new site. Diversion can also minimize environmental impact by allowing materials to be recycled and reused. This can reduce the need for new materials, which can be energy intensive to produce and transport to the community. In Nunavut, some of

these energy savings will be reduced by the energy required to transport the goods to southern recycling facilities.

The scoring for this criterion was primarily based on the diversion rates that can be achieved by each option.

Incineration (Option #3) was given the highest score (3) due to its ability to provide the greatest reduction in the amount of waste being disposed (total diversion rate of 67%). It is assumed that the incinerator will follow environmental regulations for emissions and that effective air pollution control systems will be used on the system; therefore, no points were deducted on the basis on air pollution.

The remaining options were each given a score of 2 points as they have similar diversion rates. Their total diversion rates ranged from 44-50%, which is a significant increase from the Status Quo diversion rate of 8%, but was not as significant as the Incineration Option.

3.2.2 Cost Effective and Affordable

Open Windrow Compost was the most cost effective option as it had the lowest Total Annual Cost. This option also had the lowest capital and operation and maintenance costs of all the options. Open Windrow Compost plus Incineration was the least cost effective option (highest Total Annual Cost, Capital Cost and Operation and Maintenance Cost). It has the highest diversion rate and lifespan but still had the highest high Total Annual Cost due to its high Capital Cost ($4.5 million more than Open Windrow alone) and high annual operating costs ($820,000 more than Open Windrow alone). Open Windrow Compost plus Household Recycling of Fibers and Metals also had a high Total Annual Cost. This high Total Annual Cost is due to the fact that the addition of the recycling program results in significant increases in capital and operating costs with minimal diversion rate increases.

Based on these results, Option 1 was given a score of 3 points, Option 2 was given a score of 2 points and Options 3 and 4 were both given scores of 1 point.

3.2.3 Aligns with Solid Waste Management Vision and Goals

Options 1 and 2 aligned fully with the vision and goals and were awarded full marks (3) for this criterion. Option 3 (incineration) lost a mark for not aligning fully with Goal #7: Dispose of remaining waste in a way that is environmentally, economically and socially sustainable. The high operating costs and staffing requirements could impact the economic and social sustainability of an incinerator in Iqaluit. The City of Nuuk has had difficulties operating their incinerator due to its staffing requirements (see more information on the Nuuk Incinerator in Appendix B). The City of Iqaluit could also face similar challenges as it often suffers from high turnover and high vacancy rates typical of northern communities.

Option 4 (household recycling) lost a mark for not aligning fully with Goal #6: Recycle using methods that are locally appropriate. The high additional cost for a small increase in diversion, as well as the difficulties experienced by past programs in our community, suggests that the household recycling program included in this option is not locally appropriate in our current context. Furthermore, there are existing ways to deal with pop cans (Co-op recycling program) and paper (e.g. Government of Nunavut office paper recycling and NorthwesTel phonebook recycling programs) in the community. Also, with composting, the City has another option for managing a portion of its paper products.

Based on the above discussion, Options 1 and 2 received a score of 3 points, while Options 3 and 4 each received a score of 2 points.

3.2.4 Good Track Record and Appropriate Technology for the Arctic

While open windrow composting (Option 1) is a relatively new practice for arctic communities, the experiences of the Cities of Yellowknife and Whitehorse indicate that open windrow composting is a feasible solid waste management technique in an arctic environment. In addition, the Bill Mackenzie Humanitarian Society has conducted a successful composting project in Iqaluit, which collected household organics from approximately 100 homes. Also, the City has completed a successful pilot project, which demonstrated that a freeze-thaw compost process was an effective means of treating its sewage sludge.

The 'low-tech' nature of open windrow composting makes it all the more appropriate for Iqaluit's remote location, as it would be less susceptible to processing equipment malfunctions. As a result, Option 1 received a score of 3 points.

While in-vessel composting (Option 2) is relatively common across southern Canada and in the United States, it has not been proven in an arctic environment. In-vessel composting is a simple process with no moving parts and would allow for the composting process to accept more material and be completed in a much faster timeframe. Due to the fact this technology would be new to the Arctic, it was given a score of 2 points.

Incineration does not have a strong track-record in small Canadian municipalities. In fact, municipal solid waste incinerators (or waste combustion) facilities are not common in Canada. Currently, there are only six municipal solid waste thermal treatment facilities operating in Canada with a capacity greater than 9125 tonnes per year (tpy) (Environment Canada, MSW Thermal Treatment in Canada, 2006):

- Metro Vancouver Waste-to-Energy Facility, BC (approx. 273,000 tpy);
- Quebec City Incinerator, QC (approx 293,000 tpy);
- City of Lévis Incinerator, QC (approx 25,000 tpy);
- Algonquin Power Peel Energy From Waste Facility, Brampton, ON (approx. 148,000 tpy);
- PEI Energy Systems EFW Facility, Charlottetown, PEI (approx. 26,000 tpy); and,

- Wainwright Energy From Waste Facility, AB (approx. 3,700 tpy—not operating at full capacity).

The only facility that is of similar scale to that required in Iqaluit is the Wainwright facility; however, it should be noted that 72% of its waste stream is from medical waste, which is not comparable to Iqaluit's waste composition.

All of the above listed facilities have energy recovery systems and are privately operated, with the exception of the facility in Lévis, QC, which has no energy recovery and is operated by the municipal government. In the past, the small Municipality of Iles-de-Madeleine operated a thermal treatment facility, which handled approximately 2400 tpy (Environment Canada, MSW Thermal Treatment in Canada, 2006). In 2008, the municipality decided to close the facility due to cost of maintenance and issues with the proper disposal of the residual ash (CBC news, 2013).

The Hamlet of Pangnirtung had an incinerator in the 1980 that was briefly used before it ran into difficulties and was abandoned. In Greenland, the City of Nuuk has had an incinerator for over 20 years, but has struggled with its operation (see Appendix B for more information on the Nuuk incinerator). While incineration is used at hospitals, mining camps and on military bases in the Canadian arctic, it is noteworthy that the waste stream composition, volumes and staffing challenges in these situations are not comparable to those in Iqaluit.

Due to the lack of examples of successful small-scale municipal incinerators in Canada, the varied track record of incinerators in both southern and northern communities, Option 3 criterion was given a score of 1 point.

Recycling in Nunavut has a relatively poor track record in our community and other Nunavut communities, primarily due to the high cost of shipping and operations. Given the economic realities of recycling in Nunavut, recycling was not viewed to be an appropriate program at this time, particularly for fibres. As a result, Option 4 received a score of 1 point. It should be noted that this could change in the future if shipping costs or recycling revenues change significantly.

3.2.5 Acceptable to Community

Throughout the public consultation process, there was a strong expression of support for both composting and recycling programs in Iqaluit. Incineration also received a favourable response, although some community members were concerned with the municipality's ability to handle its technical complexity. There were no concerns specifically raised with in-vessel compost.

Given the high level of support for composting, recycling and incineration as options for managing Iqaluit's solid waste, all four options received a score of 3 points.

In addition to option specific feedback used in the scoring above, there was some public feedback that impacted all of the options:

- Residents were concerned that issues at the existing landfill site (unsightliness, blowing litter, odor, etc.) would continue at the new solid waste management site;
- Residents indicated that they want to be proud of the new facility and want to ensure that management practices protect the land and water surrounding the site;
- Residents were concerned with whether compost would be a suitable cover material and were concerned that it might blow away; and
- Residents wanted the City to look into bailing waste before it was disposed in the landfill. They felt that this approach could minimize blowing waste and cover material requirements and could also lead to a better-managed site.

These issues have been addressed in the Site Design and Operations Recommendations (see Section 3.3.2 below).

3.2.6 Ease of Implementation

This criterion examines ease of implementation by considering all aspects of implementing the option, including staffing, training, purchasing equipment, logistics, etc.

Option 1 would be the easiest to implement. The equipment and infrastructure requirements for the open windrow compost program are relatively simple to address. Staff training will be required, but procedures are not overly complex to learn. There is also room for some error and adjustment without significant financial or technical consequences. Also, this program can start small be built up over time as staff becomes familiar with the open windrow compost process. As a result, this option was given a score of 3 points.

Option 2 would be more complex to implement due to the increase in the complexity of the technology. The in-vessel compost infrastructure would require a more complex procurement process and more training than Option 1. Also, it would increase the requirements for water, sewer, and power at the solid waste management site. As a result, Option 2 was given a score of 1 point.

Options 3 would require a complex tendering process to purchase and install an incinerator. This process will need to be carefully implemented, monitored to ensure that the incinerator meets the City's needs. This option also requires hiring technical staff, training of existing staff and establishing how repair and maintenance work will be completed, which will likely require flying in a technician from the south. In addition, this technology might result in regulatory delays, as it would be the only municipal incinerator operating in the territory. As a result of the level of complexity associated with the implementation of this option, it was given a score of 1 point.

Option 4 was also given a score of one point due to the complexity of its implementation. The facility and equipment requirements for the recycling facility would be relatively straightforward but the logistics of the recycling program (collection, sorting, shipping, etc.) will require a lot of careful research, planning and implementation. In addition, this

option requires a lot of community education to ensure participation and proper separation of materials.

3.3 Solid Waste Management Program Recommendations

3.3.1 Recommended Program

In the options analysis, the Option 1 (Open Windrow Compost) had the highest total score of all the options. This program can achieve a diversion rate of 44%, a significant increase over the status quo, with a minimal increase in capital and operating costs compared to the status quo (see Table 1).

As a result, Option 1 (Open Windrow Compost) is recommended to be the new Solid Waste Management Program for the City of Iqaluit.

Table 3 provides a complete summary of the program components that are included in the recommended Solid Waste Management Program

Table 3. Summary of Recommended Program Components

Program Component	Description
Open Windrow Compost Program • Food waste • Paper/cardboard • Clean wood • Sewage Sludge	• Food waste will be collected though municipal curb-side collection, sewage sludge delivered from the Wastewater Treatment Plant, clean wood segregated at the solid waste management site, and paper/cardboard collected from high yield commercial/institutional establishments. • Collection of organics will be integrated into existing garbage pick-up schedule (e.g. replace a garbage collection day with an organics collection day). • Can accept about one quarter of our wood waste and about half of our paper/cardboard. • Composting will be completed by the Open Windrow method, which is a low cost, low-tech approach that has been successfully implemented in Iqaluit by the Bill Mackenzie Humanitarian Society. • Compost and shredded wood waste will be used as landfill cover material. • Program will be phased in over time. It will begin on a small scale to test and refine Iqaluit specific procedures prior to full implementation.
Household Hazardous Waste Program	• Corrosive, flammable, explosive or poisonous waste will be dropped off at a designated area at the waste management facility where it will be sorted and prepared for shipping to an accredited southern hazardous waste facility.
Bulky Recycling Program • Scrap metal • Appliances • Tires • Waste Electronics	• Bulky items (scrap metal, appliances, tires, waste electronics) will be dropped off at designated areas of the solid waste management site, prepared and stored for shipping to accredited southern recycling facility.
End of Life Vehicles Program	• Seasonal program (summer). • Trained municipal staff will drain fluids and safely remove hazardous materials and reusable parts. Unsalvageable metal will be compacted and shipped south with the scrap metal.
Reuse Center • Larger items that can be reused (e.g. construction materials, furniture, wood, etc.)	• Useable goods and materials will be dropped off at designated area, sorted and stored for re-use by the public. • If necessary, a sea can will be used to protect goods from the elements. • Will not include items that are accepted elsewhere in town (clothing, books, toys, etc.).
Landfill **Waste not diverted by the above programs**	• Waste not included in the above programs will be disposed of in an area designed to isolate it from ground and surface water. Precipitation that comes in contact with waste (runoff) will be managed on the site and will be treated before it is discharged into the environment. • Landfill waste will be compacted to reduce volume and covered to reduce blowing litter, odor and animal problems.
Public Education Program	• On-going public education and awareness programs will be run to promote effective waste management practices in the community.

3.3.2 Site Design and Operations Recommendations

In addition to the recommended program components described above, some design and operation recommendations have also been developed based on stakeholder and community feedback:

1. Allocate adequate resources and training to ensure that the new facility follows best management practices and protects the surrounding land and water;
2. Ensure that operating and maintenance procedures have specific measures to minimize blowing waste at the site and to ensure that litter does not accumulate outside of the site boundary (e.g. cover material procedures, wind screens at active disposal area, regularly scheduled off-site litter cleanups);
3. Ensure that the operation and maintenance manual includes cover material guidelines to ensure that the material used meets the requirements of the site; and,
4. Require that the Design Brief investigate the option of baling and stacking the municipal waste in the landfill and make a recommendation whether this approach should be used at the new site.

3.3.3 Incineration Recommendations

Although incineration received a low score in the analysis and was not deemed to be cost effective at this time, there remains a strong interest in this disposal technology from City Council, residents and stakeholders due to its potential to significantly increase the lifespan of the solid waste management site.

It is possible for incineration to be added to the recommended program. In fact, the components of this program are important building blocks for the operation of a safe and effective incineration program in Iqaluit. For example, organics have a high moisture content, which would take a lot of energy to evaporate off in the incineration process. Also, an incinerator would not accept the City's household hazardous waste (HHW); therefore, it is important that a strong HHW program is in place before incineration is introduced to ensure that explosive and toxic materials are not included in the incinerator's feed stream. Finally, an incinerator still requires a landfill to dispose of the residual ash; therefore, the new solid waste site also needs to be in place before incineration could begin.

City Council is interested in pursuing incineration as part of this plan. As a result, it is recommended that the City:

1. Investigate and pursue external funding opportunities that could help finance an incinerator for the community (Green Municipal Fund, etc.).
2. Hire a qualified engineering firm to complete a detailed analysis of the options and develop a detailed plan for implementing incineration (or other feasible thermal waste technology) in Iqaluit. This analysis should involve the following components:

a. Identify a suitable site for an incinerator (Solid Waste Management Site or alternate site),
b. Examine the current status of incinerator use in the Arctic (across sectors) and the status of incinerator use in similar sized municipalities,
c. Examine the feasibility of incinerating the existing waste pile at the West 40 Landfill,
d. Issue a Request for Expression of Interest (REOI) for thermal waste conversion technology for Iqaluit's municipal solid waste (see Appendix C for what should be included in the this request),
e. Evaluate the REOI submissions to identify the most appropriate technologies for Iqaluit,
f. Based on the results of the REOI assessment, conduct a detailed assessment of:
    i. Staffing and training requirements (should also consider City's staffing record for similar positions over last 3 years),
    ii. Capital costs (including shipping costs and any supporting infrastructure and equipment required),
    iii. Operating and Maintenance Costs (including fuel, labor, maintenance and repair),
    iv. Requirements for proper disposal of residue,
    v. Cost benefit analysis of energy recovery,
    vi. Regulatory requirements,
    vii. Changes that would be required in the City's Solid Waste Management Program,
    viii. Capital and operational funding options, and
    ix. Challenges and risks associated with implementing this technology in Iqaluit.

4. Site Selection

4.1 Site Overview

As the City's current solid waste management facility (West 40 Landfill) is at capacity, a new solid waste management site for waste diversion and disposal activities is required. This new site will include the following features:

- Landfill area with a minimum 20 year design capacity and the potential expansion for further 20 years (40 year planning horizon);
- Areas for equipment maintenance and storage;
- Office and garage;
- Operating areas for diversion programs, including:
    - Reuse center,
    - Bulky recycling,

- Hazardous waste management,
- Open windrow composting, and
- End-of–life vehicles;

- Infrastructure for required utilities (e.g. water, sewer, electricity)
- Water management system to divert clean water away from the site (e.g. berms) and collect and treat landfill runoff before it is discharged into the environment; and,
- Fencing around the site.

In order to ensure the longevity of the new solid waste management facility and its access road, it is important that all components are designed, built and operated to withstand projected climate change impacts over the lifespan of the site. Important impacts to be considered include:

- Increased average temperature,
- Increased precipitation,
- Changes in permafrost conditions, and
- Increased frequency and severity of storm events.

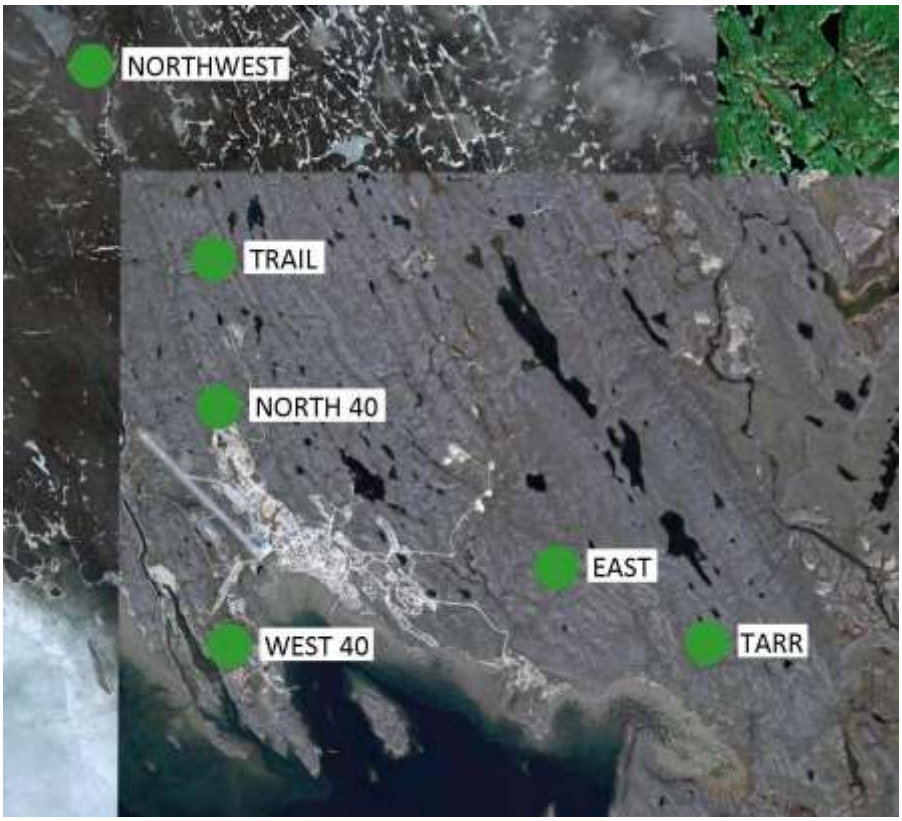
4.2 Site Evaluation Process

Six sites were included in the site selection process (see Figure 1). Three of these sites were included based on public feedback from Open House #1 (North 40, West 40, East). The remaining three were included based on a high-level landscape analysis, which identified additional sites located within the municipal boundary with suitable topography, area and setbacks from water bodies (Northwest, Trail, Tarr).

To assess their feasibility, all six sites were screened against the following site selection criteria:

1. Meets size requirement based on a 40 year capacity;
2. Meets regulatory and land-use constraint requirements;
3. Meets appropriate setbacks from lakes and rivers; and,
4. Suitable site base on the following criteria:
    a. Feasible access route and site slopes,
    b. Low potential for snow drifting issues,
    c. Minimal aesthetic issues (odor and visibility).

Figure 1: Landfill Siting Options



Of the six sites considered, only one (Northwest site) met all of the above criteria. This site was then analyzed against the project's relevant evaluation criteria (see Section 2.3 above). The analysis of the sites against these sets of criteria is detailed in Sections 4.3 below.

4.3 Site Evaluation Results

Table 4 summarizes the results of the site evaluation process and also provides information on the kilometers of new road that will be required to access the site.

Table 4: Site Evaluation Summary

Site selection criteria \ SITE	NORTH 40	WEST 40	TRAIL	EAST	TARR	NORTHWEST
Description	Area within former granular extraction area	Open area across street from current landfill	Adjacent to current granular source	North of Apex	North and inland from Tarr inlet	Adjacent to future granular supply
Meets size requirement (min 40 year capacity)	X	X	✓	✓	✓	✓
Meets regulatory requirements	X	X	X	✓	✓	✓
Meets required set backs from lakes and rivers				✓	✓	✓
Suitability • Feasible access route and site slopes* • Low potential for snow drifting issues • Minimal aesthetic issues (odor and visibility*) *based on 2011 site visit	SITES SCREENED OUT			X Steep slopes, limited wind protec-tion, and visibility from town	X Difficult topogra-phy along access route	✓ Reasonable site slopes, feasible access route, no odor or visibility con-cerns
New road required				1.7 km	3.5 km	3.6 km

4.3.1 Meets Size Requirements

The City of Iqaluit is looking for a new solid waste management site that has enough capacity for a minimum lifespan of 40 years. In order to meet this objective, based on waste generation rates and operational space requirements the new site needs to be approximately 60 hectares. This area was calculated based on waste generation rates of 10.95 m^3/person/year and population projections from the 2010 City of Iqaluit General Plan (Bylaw 703).

The Trail, East, Tarr and Northwest sites all met this requirement. The North 40 and West 40 sites both have less than 30 hectares available and do not meet this requirement.

4.3.2 Meets Regulatory and Land-Use Constraints

Figure 2 shows the major land-use and regulatory constraints that impact the siting of a new solid waste management site. In summary, the new site must be:

a. Within the Municipal Boundary (black dashed line) and outside of the Watershed Protection Area (blue shaded area), Park Reserve (green shaded area) (2010 General Plan and Zoning Bylaw),
b. Outside the 4000m radius "Outer Surface" from the Airport Terminal Building (Iqaluit Airport Zoning Regulations—shown as purple dashed line),
c. At least 90m from any public road allowance and 450m from any residential building (General Sanitation Regulations for Nunavut—shown as red dashed line)

The East, Tarr and Northwest sites all meet this set of requirements, but the remaining sites do not. The Trail, West 40 and North 40 sites all fall within the airport's 4000m "Outer Surface". The North 40 also falls within the setback required General Sanitation Regulations.

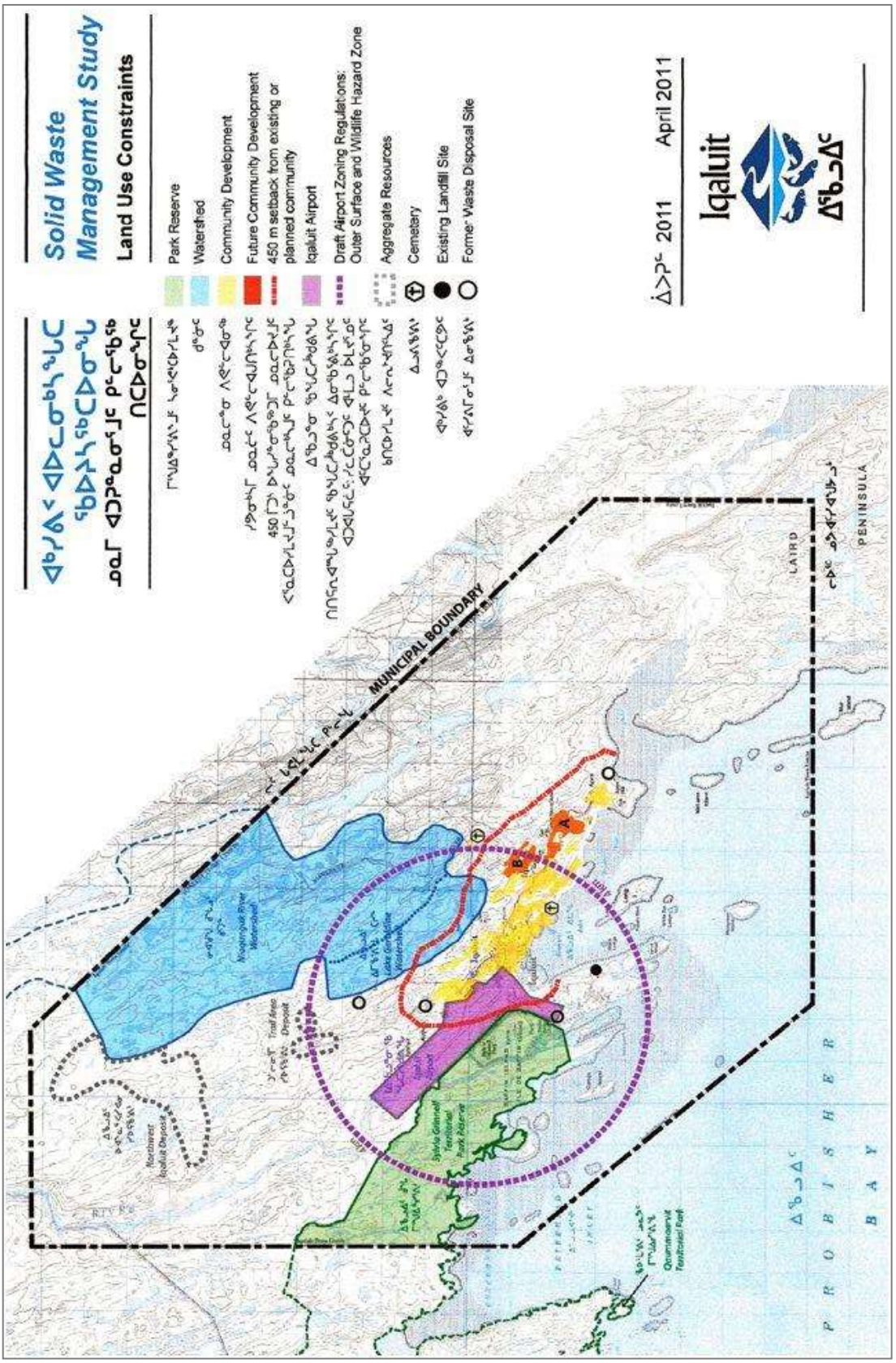
At this point, the North 40, West 40 and Trail sites were screened out of the site selection process because they did not meet the first two criteria. These sites also had other issues limiting their suitability, which were not captured in the analysis completed this far. The Trail site is located adjacent to an area with known geotechnical issues (massive ice has been discovered at the adjacent Trail Area Deposit). In addition, the Trail site would require that a bridge be constructed over Crazy Creek, which would add to the cost and complexity of the project. At the North 40 site, which is adjacent to an old military dump, outstanding land ownership and environmental liability issues could be a significant obstacle to proceeding with the project the required timeframe.

4.3.3 Meets appropriate setbacks from lakes and rivers

In order to provide protection to surface water, the new solid waste management site should be set back from surface water by at least 300m. While contaminated water will be contained on the site and treated before its release, this buffer area provides a physical barrier as well as the necessary space for intervention in the event of a spill or release. It also provides a buffer for windblown debris that might escape the site that will provide opportunity for cleanup/interception before it reaches the water

The remaining three sites (East, Tarr and Northwest) all meet this criteria and are located on the "height on land", which will help to avoid wet-areas and minimize the volume of ground and surface water that must be managed at the site. Avoiding low areas also helps to minimize potential snow drifting issues.

Figure 2: Solid Waste Management Site Land Use Constraint Map



4.3.4 Suitable Site

This criterion considered the following three factors:

- Feasible access route and site slopes,
- Low potential for snow drifting issues, and
- Minimal aesthetic issues (odor and visibility).

These factors were evaluated by examining the prevailing wind patterns and topography along with visual site and route inspections, which were conducted by exp Service Inc. in 2011.

The East site was found to be unsuitable due to steep slopes, limited wind protection and high visibility from current and future residential areas. The Tarr site was also found to be unsuitable due to difficult topography along the access route. The Northwest site was the only site that was found to be suitable. It had reasonable site slopes, a feasible access route and no odor or visibility concerns.

Figure 3 shows the specific location of the Northwest site on a topographic map.

4.3.5 Evaluation against Environmental, Economic, and Social Evaluation Criteria

In addition to meeting site selection criteria above, the Northwest site, also fared well against the project's relevant environmental, economic and social evaluation criteria.

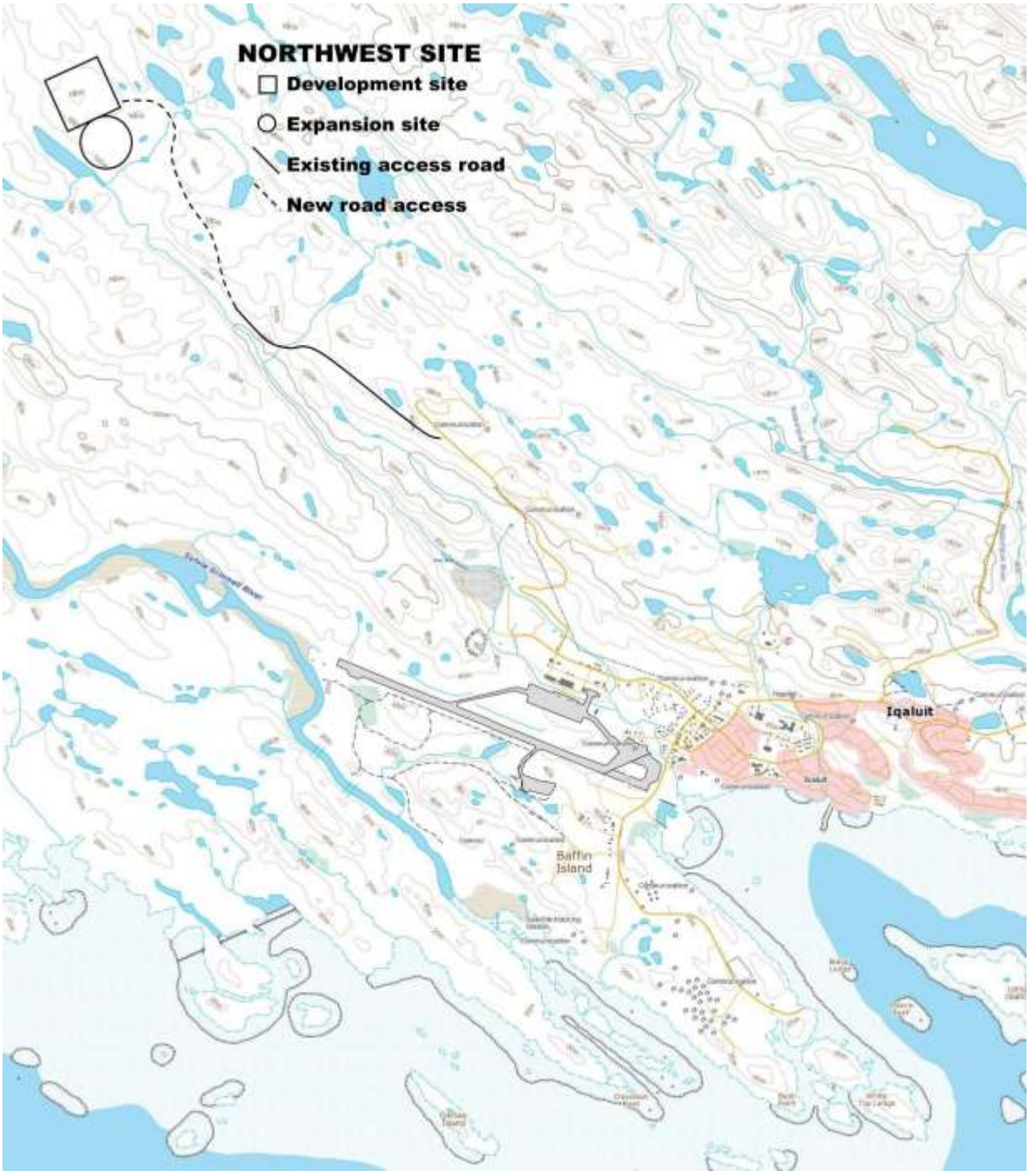
4.3.5.1 Minimize Environmental Impact

The Northwest site minimizes environmental impact by having the appropriate setbacks from water bodies and by using an access road that is already planned to be built for the new granular source. Other sites considered would require a new road to be built through undisturbed areas for the sole purpose of this project.

4.3.5.2 Cost Effective and Affordable

The Northwest site is cost effective due to its ability to share access road capital and maintenance (summer only) costs with the new granular source project, which is scheduled to be completed in a similar timeframe.

Figure 3. Location of Northwest Site



4.3.5.3 Acceptable to the Community

In Open House #2, the Northwest site was identified as the most favorable by participating members of the community. In the written and verbal feedback from Open House #3, although some members of the public indicated that they would prefer not to

disturb a new area, the site itself was not strongly objected to. Some concerns; however were raised due to the distance the site is located from town:

1. Will the Public Works department be able to handle the extra road maintenance?
2. Will garbage blow from vehicles driving to the site litter the lands along the access road?
3. Will the extra distance prohibit some residents from participating in the City's solid waste management programs?
4. Will drifting snow become a problem at the site or along the access route?
5. Could components of the new solid waste management program be located closer to town (e.g. reuse center, composting site, bulky recycling that will be shipped south, hazardous waste drop-off)?

Some residents and members of Council also expressed a strong interest in the possibility of using old solid waste sites (e.g. North 40) for components of the solid waste management program that could be relocated closer to town. This idea, along with the concerns listed above, has been addressed in the site selection recommendations below to ensure that public concerns are addressed in this plan.

4.4 Solid Waste Management Site Recommendations

Based on the site selection analysis completed above, it is recommended that the City:

1. Locate the new Solid Waste Management Site at the Northwest Site;
2. Increase Public Works staffing and budget as required to properly maintain the access road to the new solid waste management site;
3. Ensure that measures are put in place to prevent the accumulation of litter along the access road (e.g. require that waste being transported to the site is properly secured, regular clean-up of any litter that does occur)
4. Review and analyze the different components of the solid waste management program to identify which should be located closer to town (to reduce transportation costs and increase accessibility for the public);
5. Identify suitable sites for program components that can be relocated closer to town with a focus on using previously impacted sites (e.g. North 40, West 40);
6. Conduct a snow and wind study at the site and along the access route to ensure that the design and operating procedures adequately address snow drifting and other wind related impacts; and,
7. Design, build and operate the new solid waste management infrastructure with consideration for projected climate change impacts over its lifespan (e.g. permafrost changes, increased precipitation and temperature, increased frequency and severity of storm events).

5. Implementation

5.1 Overview

This section outlines the steps that must be taken in order to develop the new solid waste management site and implement the new solid waste management program. It also reviews the capital and operational costs associated with implementing this plan.

The following list outlines the major project activities that will need to occur over the next 5 years.

2014

- Complete necessary site studies (snow and wind, topographic, geotechnical, etc.)
- Complete Design Brief, Preliminary Design and Detailed Engineering Design
- Identify equipment to be purchased and the relevant specs
- Complete required regulatory submissions
- Update Solid Waste Bylaw to correspond with new Solid Waste Management Plan
- Complete required legal survey, land title transfer and Zoning Bylaw amendment
- Identify alternate sites for suitable components, which can be located closer to town
- Identify container system(s) to be used to collect residential and commercial organics
- Plan for required user fee increases
- Examine capital funding options in the upcoming 5-year Capital Plan
- Complete a detailed analysis of the incinerator options available and develop a detailed plan for implementing incineration (or other feasible thermal waste technology) in Iqaluit
- Investigate and pursue external funding opportunities that could help finance an incinerator for the community (Green Municipal Fund, etc.)

2015

- Obtain regulatory approvals
- Complete road and site construction
- Purchase equipment
- Develop Operation and Maintenance Manual
- Develop and implement Site and Program Transition Action Plan, which includes staff training, phasing in of new programs (e.g. open windrow compost), move from old site to new site, etc.
- Develop and implement Public Education Plan
- Commission and open new Northwest Solid Waste Management Site
- Close and begin decommissioning of West 40 Landfill
- Complete required data collection, monitoring and reporting at the new site

2016

- Complete decommissioning at the West 40 Landfill
- Continue to implement Site and Program Transition Plan
- Continue to implement Public Education Plan
- Complete required data collection, monitoring and reporting at the new site
- Based on outcome of REOI analysis, incineration implementation plan and 5-year capital plan, begin procurement process to purchase and install incinerator

2017

- Complete required monitoring at the decommissioned West 40 Landfill
- Complete implementation of new program at the new Solid Waste Management Site
- Implement Public Education Plan
- Complete required data collection, monitoring and reporting at the new site

2018

- Complete required monitoring at the decommissioned West 40 Landfill
- Implement Public Education Plan
- Complete required data collection, monitoring and reporting at the new site
- Complete 5-year program review to assess effectiveness of program and recommend next steps

As the above activities show, this is a significant undertaking for the City that will require the coordination and cooperation of multiple departments over multiple years. Due to the high turnover rates typical of the North and the volume of capital projects anticipated during this period, it is recommended that a project management firm be hired to coordinate this project and ensure that all tasks are completed when required.

5.2 Implementation Tasks by Department

The following table identifies the tasks that must be completed by each department over the next 5-year period.

Table 5. Summary of Implementation Tasks to be Completed by Different Departments

Department	Task	
	Year	Description
Engineering	2014	Hire Project Management Firm
	2014	Hire an engineering firm to complete a detailed analysis of incineration (or other thermal waste technology) options available and develop a detailed plan for implementing this technology in Iqaluit.

	2014	Investigate and pursue external funding opportunities that could help finance an incinerator for the community (Green Municipal Fund, etc.)
	2014	Examine capital funding options in the upcoming 5-year Capital Plan
	2014	Hire an Engineering Firm (RFP) to complete: • All necessary site studies (geotechnical, topographic, snow and wind analysis, etc.), • An assessment of which components can be moved closer to town (if suitable site is identified), • Design Brief for access road, site development and new equipment requirements, • Preliminary design, detailed design and required tender documents for access road and site construction, • Equipment specs and tender documents, • Construction administration, site inspection, commissioning, • Required regulatory approval process, • Site and Program Transition Plan development and implementation, • Operation and Maintenance Manual development (should address remote workplace issues), and • Training Program development and implementation • Program implementation support (for 2 years after opening on new site)
	2014	Based on stakeholder input and the experience of other northern cities and the Bill Mackenzie Humanitarian Society, identify container system to be used for curb-side collection of organics at residential and commercial establishments
	2015	Hire contractor(s) to construct the access road and new site (Tender)
	2015	Purchase new solid waste management equipment (Tender)
	2015	Work with Public Works to develop and implement a Public Education Plan
	2018	Work with Public Works to complete a 5 year program review to assess program effectiveness and make recommendations of next steps
Planning and Development	2014	Complete legal survey of the new Solid Waste Management Site and Transfer of Title to the City of Iqaluit
	2014	Complete rezoning of the site as per the requirements of the City's General Plan and Zoning Bylaw
	2014	Complete alternate site analysis to identify sites that could accommodate components closer to town as well as sites

		that could be suitable for an incinerator (focus on previously impacted sites)
Corporate Services/ Administration	2014	Work with Public Works to update Solid Waste Management Bylaw
	2014	Work with Public Works to identify additional Public Works staffing and budget requirements to properly maintain the access road to the new solid waste management facility
	2014	Develop a plan for fee increases required to cover new operating costs
	2015-2018	Monitor Sanitation Budget (income vs. expenditures) and work with Public Works to adjust tipping and/or collection fees if required. Note-some budget lines may need to be split out for better tracking.
Public Works	2015-2017	With support of engineering firm providing implementation support, implement Site and Program Transition Plan
	2015-2018	Collect data on waste generation and waste diversion rates and complete required monitoring and annual reporting
	2014-2018	Work with the Engineering Department to implement the Decommissioning Plan at the West 40 Landfill
Human Resources	2015	Work with Public Works to hire additional staff required for program implementation and road maintenance

5.3 Cost

5.3.1 Capital Costs

As discussed above, this project involves multiple components and will be completed over several years. As such, this project will have capital costs over several fiscal years. Table 6 below provides a high-level cash flow estimate for the major components of the project, not including operation and maintenance costs, which are discussed below. These cost estimates will be further refined as the design is further developed. Appendix D provides a more detailed breakdown of the capital infrastructure and equipment required to implement the new solid waste management program at the Northwest site. The total capital cost associated with implementing the recommended solid waste management program (including incineration and decommissioning of the West 40 Landfill) is estimated to be $13,980,000.

The City currently has access to capital funding through a variety of different sources (Gas Tax Funding, GN Capital Contribution Agreement, Reserves, Sanitation Fund, General Operating Fund, etc.). The source of funds for the various components and years of this project will be detailed in the City's upcoming 5-year Capital Plan (2014-2018).

Table 6. Cash flow estimate for major capital components (not including operating costs)

Cost	Year					Total
	2014	2015	2016	2017	2018	
Project Management Contract	$40,000	$40,000	$20,000			**$100,000**
Engineering Services Contract	$300,000	$150,000	$50,000			**$500,000**
Construction Contracts and Equipment Purchase[1]		$9,080,000				**$9,080,000**
Compost Collection Containers		$25,000	$25,000	$50,000		**$100,000**
Education/ Communication Program Development[2]		$30,000				**$30,000**
Alternate Site Review	$20,000					**$20,000**
Legal Survey	$50,000					**$50,000**
Decommissioning of West 40 Landfill	$100,000	$200,000	$700,000			**$1,000,000**
Solid Waste Bylaw Update		$50,000				**$50,000**
Technical Incineration Review	$50,000					**$50,000**
Incinerator Purchase and Installation			$3,000,000			$3,000,000
Total	**$560,000**	**$ 9,575,000**	**$3,795,000**	**$50,000**	**$0**	**$13,980,000**

[1]See Appendix D for a list of infrastructure and equipment required at the new facility.
[2]Implementation will be part of operational budget.

5.3.2 Incremental Operation and Maintenance Costs

As the new site is developed and the new program is implemented, it is expected that there will be increases in the City's operation and maintenance costs.

It should be noted that the operating costs presented in Table 1 focused solely on implementing the programs at the site and do not include several items that will impact other areas of the City's budget (e.g. increased road maintenance costs, increased fuel

costs for garbage trucks, West 40 decommissioning costs). These items did not impact the cost difference between the program options, but are important to consider for budgeting purposes. These additional items are outlined in Table 7 below.

As Table 7 shows, it is projected that the annual operating budget may need to increase by approximately $ 1,685,000 when the new solid waste management program (including incineration) is implemented at the new site and the current West 40 Landfill is decommissioned.

There are several sources of funds that can be used to address this increase:

- Gravel Fund (Gravel Royalties) for the portion of cost that can be allocated to the new granular supply (approximately $125,000),
- Sanitation Fund (User Fees), and
- General Operating Fund (Municipal Taxes).

Due to cost sharing of the access road with the new granular supply, $125,000 of this annual operating budget will be applied to The Gravel Fund. The Gravel Fund had excess revenues of only $25,000 in 2013. This suggests that gravel royalties may need to be adjusted to pay for portion of access road maintenance costs and asset depreciation costs that will be allocated to the future granular source, which is expected to open before the new solid waste management site opens.

After the $125,000 is allocated to the Gravel Fund, there remains $ 1,560,000 to be covered by the Sanitation Fund. The Sanitation Fund brings in revenues from user fees (landfill tipping fees and garbage collection fees). The audited financial statements from 2012 show that the Sanitation Fund had over $640,000 in excess revenues. It is currently expected that the Sanitation Fund will have a similar amount of excess revenues in 2013. Depending on the amount of excess revenues available when the program is implemented, user fees (both garbage collection and tipping fees) will need to increase by up to 63% to cover the additional costs. Table 8 shows the impact of a range of potential cost increases on residential and commercial sanitation fees. It should be noted that these increases only address operation and maintenance cost increases associated with implementing the plan; they do not address the capital cost requirements of the plan, which are outlined in Table 6.

The City will need to plan for these new revenue requirements and will need to decide if it will spread the required fee increases over time or apply them all at once. A possible scenario would be to apply an increase in sanitation fees in 2014 and 2015, prior to the opening of the new facility. This would help to spread the fee increases over time. Additional revenues generated prior to the opening of the new facility could be put in a reserve in order to act as a buffer when more increases are required when the facility opens (i.e. cover the shortfall from the reserve and increase rates the following year).

Table 7. Estimated Operation and Maintenance Cost Increases Associated with New Solid Waste Management Program and Site

Item	Estimated O&M cost increase for first year of operation at new facility *	Note
Increase in operation and maintenance costs associated implementing the new solid waste management program at the solid waste management site (not including garbage trucks transporting solid waste to the site)	$ 920,000/year	Option #1 costs adjusted to projected 2015 volumes. Includes $820,000 /year operation and maintenance cost estimate for incineration**.
The increased operation and maintenance costs (equipment and staffing) that will be incurred by the roads crews maintaining the access road (grading in the summer and snow plowing in the winter)	$100,000/year	$25,000 of this to be applied to the new granular supply budget, which will share ½ of the summer access road maintenance costs
Cover material for landfill	$60,000/year	Can be offset by compost once program is implemented. Assumes that 1:4 cover material requirement met by pit run material.
New accounting rules that require that annual depreciation be applied to the assets,	$300,000/year	$100,000 of this to be applied to the new granular supply budget, which will share ½ of the access road depreciation costs
Additional costs associated with additional distance traveled to the new site (additional staff time, gas, maintenance, etc.)	$200,000/year	New site is approximately three times further from town (4 corners) than current West 40 site
Implementation of the communication and public education plan	$5,000/year	
Costs associated with run-off treatment	$35,000/year	Based on the 2011 West 40 Landfill Drainage Management Review Report Recommendations
Required monitoring and reporting at the decommissioned West 40 site	$65,000/year	Based on the 2013 Implementation Plan cost estimates.
Total Additional Annual Costs	**$1,685,000/year**	**$125,000/year of this total will be applied to the new granular supply budget**

*Note that operating costs will grow was waste generation rates continue to grow with the increasing population; however, revenues from user fee will also increase as the population increases.

** More refined operation and maintenance costs will be determined during the Request for Expression of Interest process.

Table 8. Impact of operation and maintenance cost recovery scenarios on sanitation fees

		Residential Sanitation Fees		Commercial Sanitation Fees[2]	
	Current	$30/month	$360/year	$200/month	$2400/year
Scenarios for $1,560,000 cost recovery[1]	**Required one time rate increase**	**Increase in Monthly Rate**	**Increase in Annual Bill**	**Increase in Rate**	**Increase in Annual Bill**
No surplus applied	63%	$18.90	$226.80	$126.00	$1,512.00
Apply $300,000 surplus	51%	$15.30	$183.60	$102.00	$1,224.00
Apply $495,000 surplus	43%	$12.90	$154.80	$86.00	$1,032.00
Apply $600,000 surplus	39%	$11.70	$140.40	$78.00	$936.00

[1]Based on the sanitation and tipping fee revenues reported in the City's 2012 Audited Financial Statements
[2]Base commercial amount (increases with increased pick-up frequency)

As the new program is implemented, it will be important that these additional operational costs are planned for in the budgeting process and monitored over time so that fee adjustments can be made if required. This monitoring is also important as the community and its waste generation rates continue to grow.

Appendix A- Project Newsletters and Options Brief

Newsletter #1
Newsletter #2
Newsletter #3
Preliminary Brief on Diversion and Disposal Options

Iqaluit Waste Management Project: Designing the Future of Solid Waste Management in our Community

Newsletter #1 April 2011 www.iqaluitwasteproject.ca

Waste Management: Planning for Today and Tomorrow

The City of Iqaluit is in the process of developing a new Solid Waste Management Program that will meet our community's current and future needs. The City is facing a number of solid waste management challenges, including the City's rapid population growth (up 38% since 2001) and a landfill that has filled up. The September 2010 fire at the landfill underscores the importance of working together to find waste management solutions that meet both the short and long term needs of the community.

At the end of this process, the following questions will be answered:

1. What solid waste management options are viable for our remote Arctic community?
2. Considering all social, economic and environmental impacts, what is the best solid waste management program for our community?
3. How will we deal with special issues such as end-of-life vehicles, sewage-sludge and household hazardous waste?
4. What type of solid waste management facilities do we need to build? Where will they be located, and how big do they need to be?
5. How are we going to manage the challenges of our existing landfill, both before and after the new facilities are built?

Get Involved!

Solid waste management is an important municipal issue that touches all of us every day. What we do with our waste affects both the health of our community and the health of our environment. Get involved and have your say! Share your ideas on what we should do to better manage our waste, or better yet, on how to avoid creating it in the first place. Our first **Open House** will take place on **Wednesday, April 13, 2011** from **7:30-9:00 pm** in the **Inuksuk High School Cafeteria**.

Want more information? Have questions?
Visit us online at
www.iqaluitwasteproject.ca or e-mail us at
comments@iqaluitwasteproject.ca.

Process Overview

Phase 1: Understand the problem

- Review the current system
- Assess our waste management needs
- Identify key issues, challenges and opportunities

Phase 2: Identify potential waste management options

- Identify a long-list of potential solutions to Iqaluit's waste management needs
- Identify possible locations for a new waste management site

Phase 3: Evaluate alternative Solid Waste Management Program options

- Evaluate the program and site options using a Triple Bottom Line approach

Phase 4: Recommend preferred Solid Waste Management Program

- Recommend the preferred Solid Waste Management Program to Council (including a recommended site and technology)

Ongoing: Stakeholder and community consultation

On-going engagement with stakeholders and the community will be conducted using the project website, interviews, newsletters, public meetings, and Council meetings.

Printed on recycled paper

Iqaluit's Current Landfill: Background Information

Iqaluit's current landfill (see photo, below) has been operating since 1994. Initially, municipal waste was burned at the landfill; however, this practice stopped in 2002 with the purchase of a steel-wheeled compactor for use on the site.

Originally, the site was developed to manage surface water runoff and provide two distinct working areas for municipal and metal waste. It has since evolved to include designated areas for tires and household hazardous waste, such as waste oil, paint and batteries. Recently, landfill staff have also begun to separate electronics and appliances from the regular waste stream.

The current landfill is near capacity and new solid waste management facilities are required. These newsletters will be used to involve our community in the design of a new Solid Waste Management Program and selection of a new waste management site and facilities.

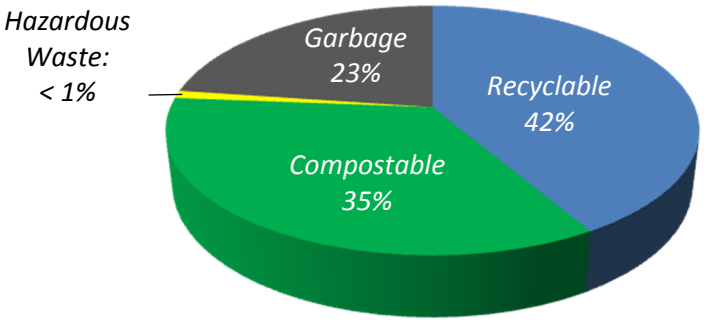
Spotlight on Sewage Sludge

The solids that are filtered out of Iqaluit's sewage at the waste-water treatment plant (sewage sludge) are disposed of in a designated area of the landfill. In 2006, a pilot project was funded by the Federation of Canadian Municipalities to determine if a freeze-thaw dewatering and composting process would be an effective treatment method for the sludge (see photo of composted pile, below).

The results of this project showed that this process was successful in reducing the microbiological content of the sludge, making the resulting compost suitable for use as landfill cover material. Space limitations in the current landfill have limited the full-scale application of this process, but it will be considered in the development of the new Solid Waste Management Plan.

What's in our Waste?

Data from a waste audit conducted in 2002 shows that recyclable and compostable materials make up 77% of Iqaluit's waste stream (see chart, below). Once the snow melts, a new waste audit will be completed to update Iqaluit's waste composition numbers.



Project Contact Information

Meagan Leach
Director of Engineering and Sustainability
City of Iqaluit
E-mail: m.leach@city.iqaluit.nu.ca
Phone: 867-979-6363 ext. 226

John Smith
Senior Waste Management Specialist
Trow Associates
E-mail: john.smith@trow.ca
Phone: 905-793-9800 ext. 2533

Iqaluit Waste Management Project: Designing the Future of Solid Waste Management in our Community

Newsletter #2 June 2011

www.iqaluitwasteproject.ca

Thank you for your input!

The City of Iqaluit would like to thank everyone who has provided input/feedback through interviews, the April Open House, a meeting at the Elders Qammaq and written comments.

What we heard

1. Residents are frustrated with how solid waste issues have been handled in the past and the lack of action on this important community issue.
2. Residents are interested in composting and recycling to reduce the amount of waste requiring disposal.
3. Hunters do not want waste/pollution in the rivers and sea and want the impact of the smell on the animals to be considered.
4. Residents want us to build on past work (don't reinvent the wheel!).

   Note: A list of past studies and references are available online or at building 2425.
5. Residents are unhappy with how the City currently deals with its wastewater (sewage).

   Note: While this is outside of the scope of this project, we heard that wastewater treatment is an important community concern and will take it into consideration in the development of our upcoming Capital Plan.
6. Residents want a cleaner community with less litter.
7. There are concerns about charging tipping/disposal fees to low-income households.
8. Residents are concerned about old dump sites that are not being addressed in this study.

   Note: This issue is discussed in the 2010 General Plan.
9. Residents want to understand the true cost of our waste disposal and want to be well informed about the options under consideration.

Get Involved: Open House #2!

Date: Monday June 27, 2011
Time: 6:30-8:00pm
Location: AWG Lobby

As requested, after a short presentation, we will use a roundtable format to evaluate and discuss the diversion, disposal and site options under consideration.

Draft Vision and Goals

Based on the feedback received, we have prepared a draft vision and goals for the new Solid Waste Management Program. Are we on the right track?

VISION:

The City of Iqaluit will be a leader in Northern waste management practices by identifying and implementing locally appropriate waste management solutions that maximize waste diversion and minimize environmental impacts.

GOALS:

1. REDUCE the amount of waste produced and the amount of litter in our streets.
2. REUSE goods and materials that are discarded before the end of their useful life.
3. RECYCLE using methods that are locally appropriate .
4. MANAGE hazardous waste to protect the environment and people in our community.
5. COMPOST household organics for the benefit of the community.
6. DISPOSE of remaining waste in a way that is environmentally, economically and socially sustainable.

Next Steps

We are currently in the process of evaluating different waste management and site options. Diversion and disposal options being considered are summarized in tables on pages 2-5 of this newsletter and a *preliminary* list of sites under consideration is shown on page 6. A more detailed Issues Analysis Brief can be downloaded at the project website(www.iqaluitwasteproject.ca) or picked up at Building 2425. Over the summer months, we will continue to research and evaluate the different options against the project evaluation criteria (see "Evaluation Criteria" text box below). In the fall, we will present a recommended Solid Waste Management Program and waste disposal site.

Evaluation Criteria

Based on your feedback, the following criteria will be used to evaluate the diversion and disposal options and design a new waste management program:

1. Environmental impact.
2. Appropriate technology for our remote Arctic community.
3. Alignment with project goals and objectives.
4. Track record of technology/program.
5. Cost effectiveness/affordability.
6. Social and cultural acceptability.
7. Ease of implementation.

Diversion/Disposal Options

Diversion Options	How it works	Things to consider
Re-use Centre	• Useable goods and materials are sorted and stored for reuse by the public (e.g., wood, furniture, etc).	• How would this program be managed? Would some items need to be protected from the elements to allow for re-use (could seacan containers be used)? • Could program be coordinated with local charitable organization(s)? Could available items be posted online?
End of Life Vehicles	• Trained staff members drain fluids and safely remove hazardous materials and reusable parts. • Unsalvageable metal is compacted and shipped south with the scrap	• What are the space requirements for processing and storage? (How many vehicles disposed of annually?) • Would an indoor service area be required? Would indoor servicing requirements be lower if program was seasonal (e.g. just in summer)? • Training/certification and health and safety requirements for staff.

Diversion options continued on next page...

Diversion Options (cont'd)		How it works	Things to consider
Recycling	**Residential/ Commercial** • Plastic containers • Steel cans • Pop cans • Paper & Cardboard • Glass	• Recyclable materials are diverted from the waste stream, sorted, bailed and shipped (sealift and then truck) to a southern recycling facility. • Recyclables are either collected: 1) at a depot, or 2) through municipal curb-side collection (e.g., blue bin).	• Paper and cardboard could be composted instead. • Glass diverted from the waste stream could be crushed and used locally as construction aggregate or as landfill cover. Will there be a local demand for the amount of glass aggregate produced? Compost can also be used for landfill cover material (amount of cover material required needs to be assessed). • Indoor sorting facility may be required to continue programs in winter months. How would these facilities be serviced (heat, electricity, water, sewer)? • What type of container would be most convenient for residents and workplaces to sort their recycling materials? (e.g., a bin, bag, etc.).
	Bulky • Waste electronics • Tires • Appliances • Scrap metal	• Bulky recyclable material is dropped off at the landfill/recycling depot.	• What pre-processing/sorting is required before shipping to ensure Iqaluit receives maximum value on the sale of recyclable materials? • Materials will need to be stored longer than in southern communities because we have to ship materials out on sealift (also applies to residential/ commercial recyclables).
	<u>Opportunities for partnership:</u> Arctic Coop (can recycling), NorthwesTel (phone book recycling), Southeast Nunavut Company (bottle return), Government of Nunavut (office paper recycling) <u>Policy options for consideration:</u> Deposit-return on beverage containers, mandatory recycling bylaw, municipal ban on hard-to-recycle materials, etc.		

Diversion Options (cont'd)	How it works	Things to consider
Composting • Food waste • Paper • Cardboard • Wood chips 	• Organics are diverted from the waste stream and are either collected: 1) at a depot or, 2) through municipal curb -side collection (ex. green bin). • ***Option 1: Open Windrow*** Composting occurs in long piles that are turned regularly for aeration and mixing. • ***Option 2: In-vessel*** Composting occurs in controlled, enclosed reactors.	• Option 1 is a low cost, low-tech approach that has been successfully implemented in Iqaluit by The Bill Mackenzie Humanitarian Society. • Option 2 is more expensive but allows for greater control, which results in a shorter composting process and less odour problems. Can enough organics be diverted to make such a system feasible? • Could potentially produce energy through anaerobic biogas production. Would this energy be used on-site or in nearby facilities? • Can our sewage sludge management program also be included in either of the processes? • Composting system could accept approximately 1/3 of Iqaluit's wood waste. If wood shredding is to take place, an indoor facility may be required during winter months. Wood for shredding should be clean (no nails or screws, etc.). • Existing shredder may be of suitable size/type for shredding food waste and cardboard.
Household Hazardous Waste • Corrosive, flammable, explosive or poisonous waste	• Hazardous waste is dropped off at a designated area at the waste management facility where it is sorted and prepared for shipping to a southern hazardous waste facility.	• Should a more central drop-off location be considered? Could programs be run seasonally? • Education program important to ensure that hazardous waste is identified and separated out of the regular waste stream. • Would the City consider privatizing this part of its solid waste management?

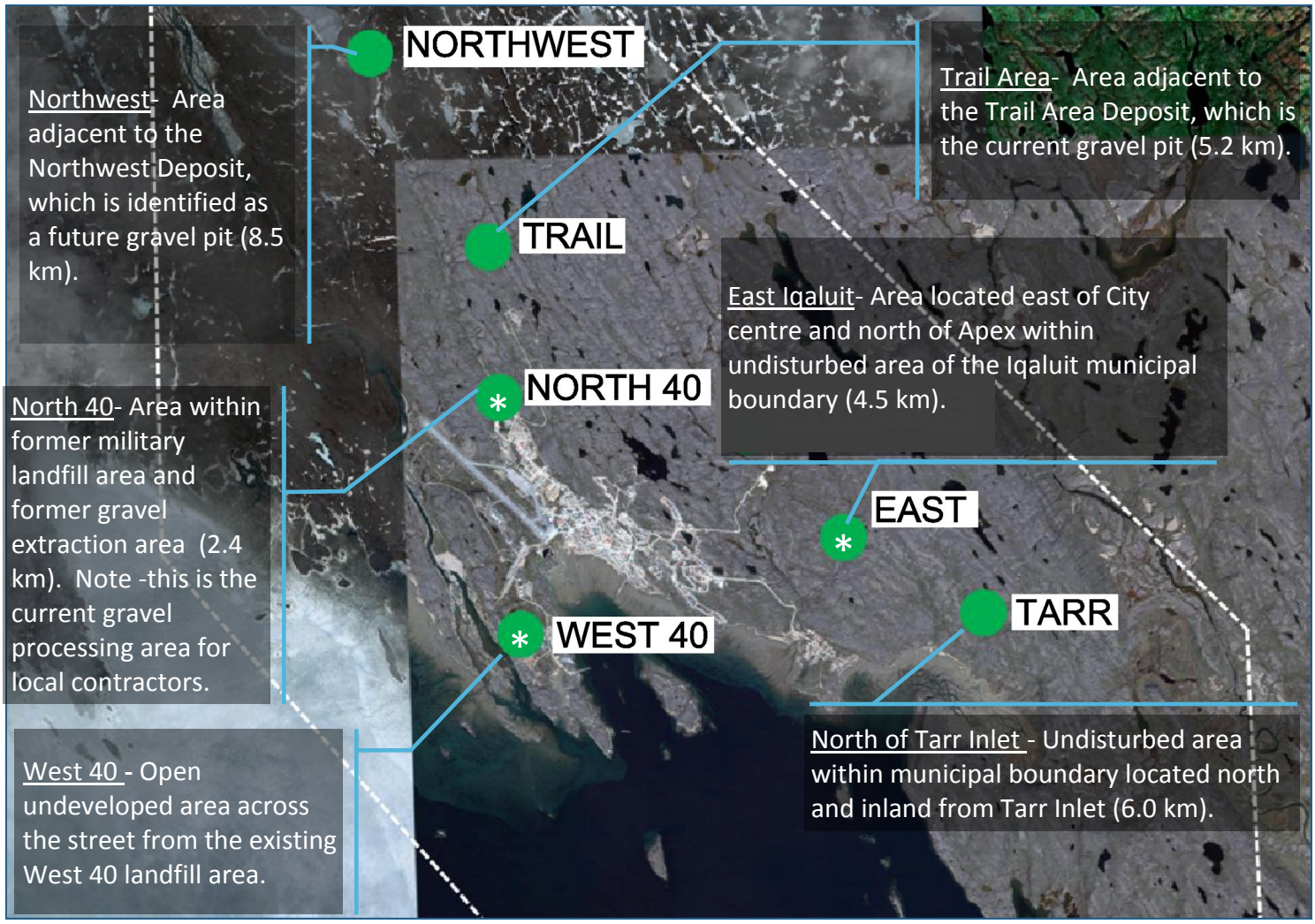
Disposal Options	Description	Pros	Cons	Discussion

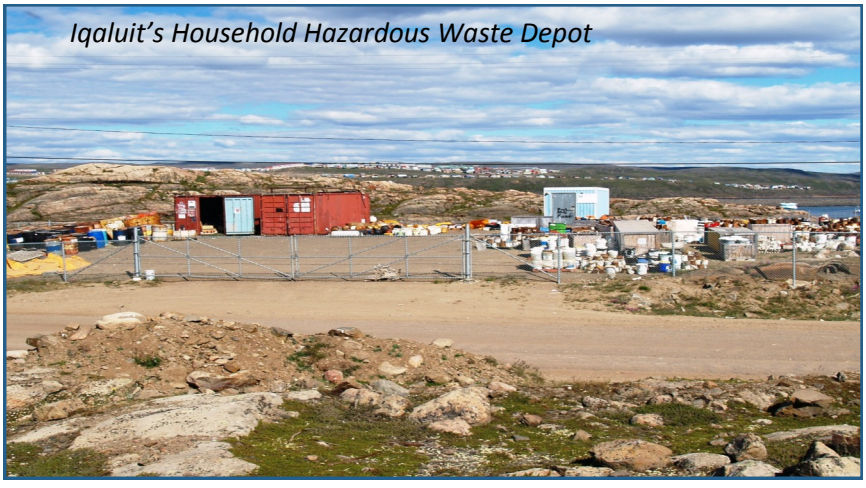
Waste to Energy	**INCINERATION**
	• "Burns" waste under carefully controlled conditions.
	• High temperatures (> 1000 deg C) and pollution control processes are used to reduce/ control air emissions.
	
	ADVANCED THERMAL TREATMENT
	• Uses an indirect source of heat to decompose carbon-based materials into a synthetic gas.
	• Pyrolysis is undertaken in the absence of oxygen, while gasification and plasma use a limited amount of oxygen. The limited use or absence of oxygen in these processes results in the production of fewer air emissions.
		• Reduces volume of waste that needs to be landfilled (maximize usable life of the landfill or minimize landfill footprint).
		• Potential for energy/heat recovery.
		• Minimizes animal issues.
			• More complex to operate/ maintain.
			• Technical training requirements.
			• More expensive to build and operate.
			• Not a proven technology in the arctic.
			• Emissions of pollutants, especially if run improperly .
				• Residual ash is landfilled but could also be used as aggregate substitute (depending on its chemistry).
				• Some materials may be better than others for incineration/thermal treatment (e.g., wood, papers and plastics combust better than glass or metals).
				• Might be possible to use up waste from the current West 40 landfill, but several issues must be carefully considered:
				  • Safety of "mining" the pile (risk of fire, stability of pile).
				  • Blowing litter when cover material is removed.
				  • Sorting out material that is not safe for incineration (health and safety issues, added labour expense).
				• Advanced thermal treatments generally require a significant amount of waste to efficiently run and to make them financially feasible. Availability of incinerator or advanced thermal treatment facility may reduce political/public will to fund diversion programs.
				• Alternate means of disposal required in case of equipment breakdown.

Landfill	• Waste that cannot be diverted by other programs (e.g., non-recyclable plastics) is disposed of in an area designed to separate the waste from groundwater and surface water. Precipitation that comes in contact with the waste (runoff) will be treated before it is discharged into the environment.
	• Waste is compacted to reduce volume and is covered to reduce blowing litter, odour and animal problems.
	• Landfill will be designed to meet the needs of Iqaluit for the next 40+ years.
		• Fewer emissions.
		• Less expensive.
		• Easier to operate and maintain.
		• Less technical training requirements.
			• More space required.
			• Odour from breakdown of organics (would minimized by compost program).
			• Less aesthetically pleasing.
			• Clustering of birds.
				• Site selection criteria will include :
				  • Size requirements.
				  • Setback from airport and residential areas.
				  • Development and servicing costs.
				  • Ecological impact.
				  • Groundwater and surface water protection.
				  • Geotechnical suitability.
				  • Visibility from town.
				  • Ability to access landfill site during winter months.
				  • Ability to house other waste management services (e.g., reuse centre, recycling depot).
				• Method of onsite runoff treatment needs to be determined.

Selection of New Waste Disposal Site

Iqaluit's future Solid Waste Management Program will need a new worksite for diversion and disposal. The figure below shows the sites that are currently under consideration. Sites marked with a star (*) were identified by residents at Open House #1. Distance from City centre is indicated in brackets. See landfill discussion on previous page for site selection criteria.





Iqaluit's Household Hazardous Waste Depot

Questions ?

Comments?

Email us:
comments@iqaluitwasteproject.ca
Call us:
979-6363 ext. 226
(Director of Engineering and Sustainability)

Iqaluit Waste Management Project: Designing the Future of Solid Waste Management in our Community

Newsletter #3 June 2013 www.iqaluitwasteproject.ca

Project Update

Based on a detailed options analysis process and community input from Open House #2, a new solid waste management site and program have been identified for the City of Iqaluit.

Site: Northwest site, adjacent to future granular source (see page 3).

Program: Landfill with compost program (curb-side pick-up), bulky recycling (scrap metal, appliances, etc.), and hazardous waste management (see page 5).

This final Newsletter presents the results of this project to allow for community input before the recommended site and program are presented to Council for approval.

Get Involved:

Open House #3

Date: July 17, 2013
Time: 6:00-8:00pm
Location: Abe Okpik Hall

In this project's final Open House, the City will present information on the recommended solid waste management site and program.

Iqaluit's Solid Waste Management Program Vision and Goals

VISION:

The City of Iqaluit will be a leader in Northern waste management practices by identifying and implementing locally appropriate waste management solutions that maximize waste diversion and minimize environmental impacts.

GOALS:

1. EDUCATE the community on the reuse, diversion and disposal options available.
2. REDUCE the amount of waste produced and the amount of litter in our streets.
3. REUSE goods and materials that are not at the end of their useful life.
4. COMPOST organics for the benefit of the community.
5. MANAGE hazardous waste to protect the environment and people in our community.
6. RECYCLE using methods that are locally appropriate .
7. DISPOSE of remaining waste in a way that is environmentally, economically and socially sustainable.

Evaluation of Recommended Site and Program

The following summarizes the analysis of the recommended site (Northwest site, see page 3) and program (landfill with open windrow compost program, see page 5) against the project's environmental, economic and social evaluation criteria (highlighted in **black** below).

Environmental Criteria

Minimize Environmental Impact

The diversion programs included in this option (see page 5) can divert up to 44% of the waste from the landfill and can extend the lifespan on the site by 14 years compared to the status quo. The recommended composting program provides environmental benefits by conserving landfill space, reducing odors, reducing leachate and providing a suitable cover material for the landfill. Environmental impact will be further limited through a run-off management program, hazardous waste management program and the recycling of scrap metal and bulky items. The recommended Northwest site minimizes environmental impact by being set back from rivers and lakes and by sharing an access road with one that is already planned for the future granular source development. Other sites would require a new road to be built through undisturbed areas for the sole purpose of this project.

Economic Criteria

Cost Effective and Affordable

As the Option Comparison Chart shows (see page 4), the recommended program is the most cost effective option over the lifespan of the site. It is also the most affordable program option for capital and operating costs. The recommended site is cost effective due to its ability to share access road capital and maintenance costs with the new granular source project, which is scheduled to be completed in a similar timeframe.

Social Criteria

Aligns with Solid Waste Management Vision and Goals

Good Track Record/ Appropriate Technology for our Remote Arctic Community

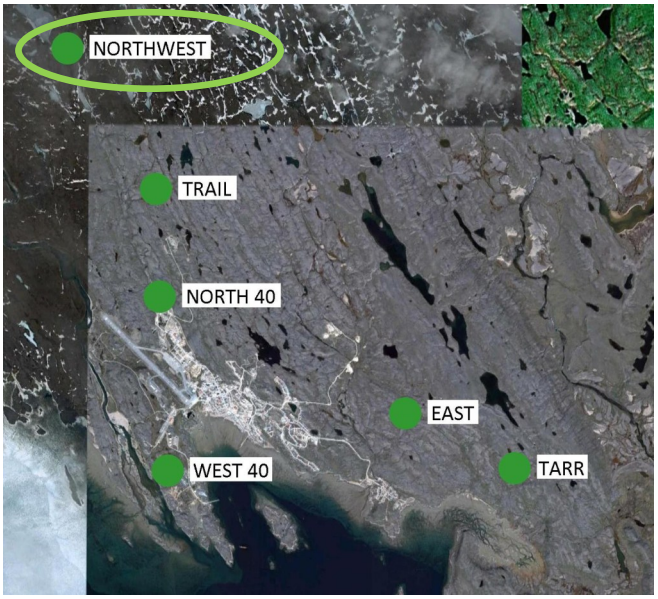
Acceptable to the Community

Ease of Implementation

Open windrow composting programs have been successfully implemented in our community (Bill Mackenzie Humanitarian Society) and in other northern communities. Community feedback during Open House #2 showed a large amount of support for a municipal compost program. The recommended program would be the easiest option to implement but it will still require staff training and the implementation and phasing in of new programs. The recommended Northwest site was identified as the most favorable during Open House #2, and was also found to be most suitable from a technical perspective (see page 3).

Recommended Solid Waste Management Site

The **Northwest site** has been identified as the preferred location for Iqaluit's new Solid Waste Management Facility based on the analysis of size and regulatory requirements, site suitability, access road feasibility and public support. The table below provides a summary of the site selection process. The North 40, West 40, and Trail sites were screened out for not meeting the airport zoning regulations. A site visit was completed to visually inspect the remaining sites and their access routes. East and Tarr sites were screened out due to site suitability and access route issues.



SITE / Description / Site selection criteria	NORTH 40 Area within former granular extraction area	WEST 40 Open area across street from current landfill	TRAIL Adjacent to current granular source	EAST North of Apex	TARR North and inland from Tarr inlet	NORTHWEST Adjacent to future granular supply
Meets size requirement (min 40 year capacity)	X	X	✓	✓	✓	✓
Meets regulatory requirements	X	X	X	✓	✓	✓
Meets required set backs from lakes and rivers				✓	✓	✓
Suitability • **Feasible access route and site slopes*** • **Low potential for snow drifting issues** • **Minimal aesthetic issues (odor and visibility*)** *based on 2011 site visit	SITES SCREENED OUT			X **Steep slopes, limited wind protection, and visibility from town**	X **Difficult topography along access route**	✓ **Reasonable site slopes, feasible access route, no odor or visibility concerns**
New road required				1.7 km	3.5 km	3.6 km

Program Options	Program Description **The following components are common to all options:** • Segregated, stockpiled, sent south for recycling/ disposal when revenues allow: tires, bulky metals, appliances, End of Life Vehicles (ELV), electronics, hazardous waste • Cover material: compost and shredded wood waste • Re-use Center for all but Status Quo	Total Capital Cost (based on North-west site) (millions)	Annual Capital Cost (capital cost divided by lifespan) (millions)	Annual O&M Cost (millions)	Total Annual Cost (annualized capital cost plus annual O&M cost) (millions)	Annual Diver-sion Rate [1]	Facility Lifespan (years)
Status Quo at new Solid Waste Management Site	• Composted (open windrow): all sewage sludge • Landfilled: glass, plastics, household metals, plastics, paper/cardboard, organics, remaining waste	8.50	0.20	0.82	1.02	8%	42
Option 1: Open Windrow Compost	• Composted (open windrow): food waste (70%), paper/ cardboard (50%), wood (25%), all sewage sludge • Landfilled: glass, plastics, household metals, remaining waste	9.08	0.16	0.87	1.03	44%	56
Option 2: In-vessel Compost	• Composted (in-vessel): food waste (70%), paper/ cardboard (70%)[2], wood (25%), all sewage sludge • Landfilled: glass, plastics, household metals, remaining waste	10.5	0.18	1.00	1.18	48%	58
Option 3: Open Windrow Compost Plus Incineration	• Composted (open windrow)[3]: food waste (70%), all sewage sludge • Incineration: wood (25%), remaining waste after composting and stockpiling (see common items above) • Landfilled: Glass, household metals, incinerator ash	13.58	0.19	1.69	1.88	67%	71
Option 4: Open Windrow Compost Plus Household Recycling of Fibres and Metals	• Household Recycling: metals (70%), paper/cardboard (70%) • Composted (open windrow): food waste (70%), all sewage sludge • Landfilled: glass, plastics, remaining waste	9.53	0.16	1.56	1.72	50%	59

[1] Where applicable, includes diversion through recycling/composting/reuse programs as well as reduction of waste through incineration (70%).
[2] In-vessel compost can take more paper/cardboard than open windrow due to ability to optimize conditions for composting process.
[3] Due to water content in food waste and sludge, it is more cost effective to compost them (instead of incineration.)

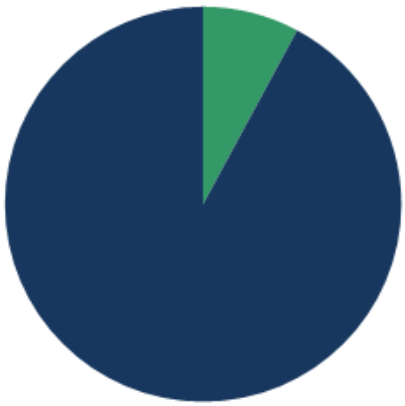
Recommended Solid Waste Management Program: New Landfill with Open Windrow Compost

Program Component	Description
Open Windrow Compost Program • Food waste • Paper/cardboard • Clean wood • Sewage Sludge	• Food waste will be collected though municipal curb-side collection, sewage sludge delivered from the Wastewater Treatment Plant, clean wood segregated at the solid waste management site, and paper/cardboard collected from high yield commercial/institutional establishments. • Collection of organics will be integrated into existing garbage pick-up schedule (e.g. replace a garbage collection day with an organics collection day). • Can accept about one quarter of our wood waste and about half of our paper/ cardboard. • Composting will be completed by the Open Windrow method, which is a low cost, low-tech approach that has been successfully implemented in Iqaluit by the Bill Mackenzie Humanitarian Society. • Compost and shredded wood waste will be used as landfill cover material.
Household Hazardous Waste Program	• Corrosive, flammable, explosive or poisonous waste will be dropped off at a designated area at the waste management facility where it will be sorted and prepared for shipping to an accredited southern hazardous waste facility.
Bulky Recycling Program • Scrap metal • Appliances • Tires • Waste Electronics	• Bulky items (scrap metal, appliances, tires, waste electronics) will be dropped off at designated areas of the solid waste management site, prepared and stored for shipping to accredited southern recycling facility.
End of Life Vehicles Program	• Seasonal program (summer) . • Trained municipal staff will drain fluids and safely remove hazardous materials and reusable parts. Unsalvageable metal will be compacted and shipped south with the scrap metal.
Re-use Center • Larger items that can be reused (e.g. construction materials, furniture, wood, etc.)	• Useable goods and materials will be dropped off at designated area, sorted and stored for re-use by the public. • If necessary, a sea can will be used to protect goods from the elements. • Will not include items that are accepted elsewhere in town (clothing, books, toys, etc.).
Landfill **Waste not diverted by the above programs**	• Waste not included in the above programs will be disposed of in an area designed to isolate it from ground and surface water. Precipitation that comes in contact with waste (runoff) will be managed on the site and will be treated before it is discharged into the environment. • Landfill waste will be compacted to reduce volume and covered to reduce blowing litter, odour and animal problems.
Public Education Program	• On-going public education and awareness programs will be run to promote effective waste management practices in the community.

Next Steps

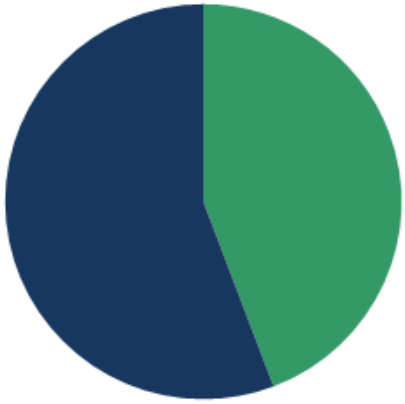
Following the July Open House, community feedback will be incorporated into the recommendation that is taken to Council for approval. After Council approves the site and program, next steps include:

- Regulatory approval process through the Nunavut Water Board
- Detailed site investigations to obtain geotechnical and topographic information for site design
- Design and tendering of site and access road
- Municipal staff training in preparation of new programs
- Construction and commissioning of the new Solid Waste Management Facility
- Phasing in of new programs
- Public education campaign to encourage participation in new programs
- Closure and Decommissioning of West 40 Landfill



Status Quo:

- **8% Diverted**
- **92% Landfilled**



Recommended Program:

- **44% Diverted**
- **56% Landfilled**

Questions ? Comments?

Email us:
comments@iqaluitwasteproject.ca
Call us:
979-6363 ext. 226
(Director of Engineering and Sustainability)

We want your feedback on the recommended site and program! Please share your thoughts in the space below and drop them off at City Hall by **July 19, 2013** or email your comments to comments@iqaluitwasteproject.ca:

City of Iqaluit

Preliminary Brief on Diversion and Disposal Options

Project Name
Iqaluit Waste Management Project

Project Number
OTT-00020728

Prepared By:

Jean-Louis Gaudet

John Smith

exp Services Inc.
1595 Clark Boulevard
Brampton, ON L6T 4V1
Canada

Date Submitted
17.06.11

City of Iqaluit

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Legal Notification

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Table of Contents

1 Introduction

As part of Phase 3 of its Solid Waste Management Project (see Figure 1 below), the City of Iqaluit is currently in the process of examining a wide range of disposal and diversion options. It is also investigating future waste management sites. This document provides an overview of the various options under consideration. As the Phase 3 work continues, these options will be further analyzed and evaluated against the following project criteria:

1. Environmental impact,
2. Appropriate technology for our remote Arctic community,
3. Alignment with project goals and objectives,
4. Track record of technology/program,
5. Cost effectiveness/affordability,
6. Social and cultural acceptability, and
7. Ease of implementation.

Figure 1: Process for Iqaluit's Solid Waste Management Project.

2 Current Cost of Waste Collection and Disposal

Based on an estimated waste generation of 82,805 m^3 per year, and a population of 7405[1], it currently costs the City of Iqaluit $8.07 per m^3 per year and $90.22 per capita per year to collect and dispose of its waste. These numbers do not include capital projects, reserves for the purchase of capital equipment associated with waste management, or revenue from tipping or collection fees (i.e. only operation and maintenance).

Table 1. Summary of current cost of disposal

	Estimated Cost	Estimated Cost Per Tonne[2]
Collection (trucks, staff)	$348,595	$48.89
Landfill Operations and Maintenance	$319,460	$39.40
Total	**$668,055**	**$82.39**

3 Diversion Options

3.1 Recycling Program

3.1.1 Residential/Commercial Recycling

What is it?

The separation of recyclables (such as paper, cardboard and food/beverage containers) from regular waste for recycling.

How would it work?

Instead of placing recyclables into regular garbage, residents would place them in a separate bin or bag inside their home. Residents would then drop off these materials at a recycling depot or set them outside for municipal collection. The collected materials would then either be processed locally or shipped south (sealift and truck) and sold to a southern recycling facility. Items with potential to be processed locally include paper and cardboard (if used in a composting program) and glass.

Marketplace revenues for glass are typically low per tonne (refer to Table 4) and glass could potentially be collected, crushed and used locally; therefore, while glass is a recyclable material, it is

[1] Medium 2010 population projection presented in Iqaluit's General Plan (2010).
[2] Estimated tonnage based on Trow 2002 Waste Audit

not recommended that the City send the material south for recycling. Items to consider when planning for including glass in a recycling program include:

- Glass is an inert material made of sand and can be landfilled with no negative environmental issues.
- Crushing recovered glass and using it locally would be consistent with the philosophy of sustainability and would reduce shipping costs associated with sending recyclable material other than glass south for processing and marketing.
- Special equipment may be required for the crushing of glass (see examples of typical equipment in Figure 2 below).
- Whether there is a local demand for glass aggregate within the City.
- Whether glass crushing could take place within an indoor sorting building or whether glass crushing could occur seasonally in an outdoor location (with equipment stored inside over the winter).
- Applicable health and safety controls that are required to protect employees against glass dust in the facility.
- Whether the glass could be collected with other recyclables, or if should it be collected separately to avoid broken glass getting mixed in with the other recyclables.
- Opportunities to partner with the Liquor Commission bottle return program.

Figure 2: Examples of Glass Crushers

Diversion Potential

Based on the 2002 waste audit completed by Trow Associates[3], approximately 3,400 tonnes of Iqaluit's waste stream is made up of recyclable materials. Assuming a recovery rate of 70% and participation from Iqaluit's residential and the commercial sector, a recycling program could potentially divert 29% (or 2,384 tonnes) of the City's solid waste from disposal. This would include:

[3] A new waste audit will be completed in July 2011 as part of this study.

- 1,287 tonnes of paper and cardboard;
- 596 tonnes of PET and HDPE plastic containers;
- 263 tonnes of glass; and
- 238 tonnes of metal containers (125 tonnes of steel cans and 107 tonnes of aluminum cans).

Estimated Cost

The preliminary shipping costs are based on the NEAS shipping rates[4], plus container rental and road transport costs as described in Dillon Consulting's evaluation of the Government of Nunavut's recycling pilot project[5]. Table 2 below presents the estimated tonnage of recyclables collected, estimated costs and potential revenue.

Table 2: Recycling Program Shipping Costs

	Estimated Tonnes	Estimated Shipping Cost (baled*)	Container rental cost	Container road transport cost	Sorting and Baling [+, *]	Total Cost	Est. Revenue	Net Cost (total cost - revenue)	% of Total Net Cost
Paper/ Cardboard	1,287	$618,712	$97,812	$61,132	$25,746	$803,402	$132,592	$670,810	62%
PET and HDPE plastic containers	596	$377,446	$69,518	$43,449	$11,914	$502,327	$264,640	$237,687	22%
Glass	263	$175,867	$33,173	$20,733	$5,250	$235,023	-$4,397	$239,420	22%
Steel	125	$35,471	$2,933	$1,833	$2,506	$42,743	$29,539	$13,203	1%
Aluminum	107	$71,754	$13,535	$8,459	$2,142	$95,890	$176,180	-$80,290	-7%
Total	***2,378***	***$1,279,249***	***$216,971***	***$135,607***	***$47,558***	***$1,679,385***	***$602,951***	***$1,080,831***	

[+] Additional sorting and bailing required in the south. Estimated at $20 per tonne.
* Exception would be glass, which would be shipped loose.

Assuming all of the recyclable materials noted in the table above are sent south for recycling, the total estimated annual sorting and shipping costs for a recycling program in Iqaluit is about $1.1 Million, or $455 per tonne. Recycling of paper and cardboard contributes the greatest portion of the overall cost (62%), while glass is the most expensive per tonne to sort and ship ($912 per tonne).

Finding alternative and local diversion opportunities for some of the materials may help to reduce the overall costs of a recycling program. For example, glass could be crushed and used locally, possibly as a construction aggregate or as landfill cover. Little revenue would be expected from using crushed glass as an aggregate – while aggregate stone is currently valued at $6.50 per m^3 in Iqaluit, concrete is not a commonly used product and mixers may need to alter their mix to accommodate the crushed

[4] Nunavut Eastern Arctic Shipping Inc. *Freight Rates for the 2011Arctice Navigation Season*. April 11, 2011.
[5] Dillon Consulting Limited. *Evaluation of Recycling Pilot Projects Final Report*. March 2, 2010.

glass. Paper and cardboard could also be managed locally by composting it (see Section 3.2) or by thermal treatment (e.g., incineration or waste-to-energy; see Section 4.1).

Additionally, some materials may be diverted through other initiatives. For example, all or a portion of the City's aluminum cans could be collected and recycled through the Arctic Co-op recycling program. Table 3 below compares the estimated recycling program shipping costs noted above against various program scenarios.

Table 3: Recycling Program Shipping Costs for Various Scenarios

	Estimated Tonnes	Total Cost	Est. Revenue	Net Cost (total cost - revenue)	Net Cost per Tonne
Scenario 1: All materials shipped south for recycling	2,378	$1,679,385	$602,951	$1,080,831	$455
Scenario 2: Paper, Plastic, Steel Aluminum (glass used locally)	2,378	$1,449,611	$607,348	$842,263	$354
Scenario 3: Plastic, Steel and Aluminum (glass used locally, paper/cardboard composted or thermally treated)	1,091	$646,209	$474,756	$171,453	$157
Scenario 4: Plastic, Steel and 50% of Aluminum (glass used locally, paper/cardboard composted or thermally treated; 50% of aluminum cans handled through other programs)	1037	$598,264	$386,666	$211,598	$204
Scenario 5: Plastic and Steel (glass used locally, paper/cardboard composted or thermally treated; all aluminum cans handled through other programs)	984	$550,320	$298,576	$251,743	$256

The per tonne revenue for the recyclable materials discussed above are based on the yearly average recyclable commodity prices in Ontario for 2008 to 2011. As Table 4 illustrates below, the market value for recyclable materials fluctuates over time. Aluminum traditionally has held the most value, while mixed glass has a negative market value (clear glass has fared better than mixed glass and has had an average value of $25 and $27 per tonne). Municipalities typically deal with this uncertainty by using rolling 3 to 5 year averages in their planning estimates.

Table 4: Yearly Average Recyclable Commodity Prices (2008-2011)[6]

Commodity	2008	2009	2010	2011	Average
Paper	$121	$72	$90	$129	**$103**
PET and HDPE plastic containers (combined)	$462	$253	$427	$633	**$444**
Glass (mixed)	-$24	-$18	-$15	-$10	**-$17**
Steel	$245	$89	263	346	**236**
Aluminum	$1,904	$1,215	1,591	1,870	**1,645**

Issues to Consider

There are a number of operational and infrastructure considerations that would need to be discussed if Iqaluit were to implement a recycling program. These are noted below.

Partnership opportunities with existing non-municipal recycling programs:

There are a number of other recycling programs currently operating in Iqaluit that the City needs to be aware of as it develops its own municipal recycling program:

- Bottle return program run by Southeast Nunavut Company – collects and bales liquor bottles and beer cans returned through the Iqaluit Liquor Commission deposit/refund program. Beer cans are shipped south for recycling.
- Arctic Co-operatives Ltd. aluminum can recycling initiative – a new program that will allow residents to drop off aluminum cans at member co-ops (estimated start date: June 2011). Other partners include The Co-operators, Nunavut Sealink and Supply Inc., Arctic Beverages, Canadian North Airlines, and the Government of Nunavut. Program funded in part through 10-cent charge on disposable plastic grocery bags.
- NorthwesTel phone book recycling program – Program uses an incentive program in schools to encourage children to return telephone books for recycling. Schools receive a donation based on the number of telephone books received per student. The telephone books are sent to Bell Canada in Montreal for recycling.
- Government of Nunavut Community and Government Services (CGS) office paper recycling program – Shredded paper is picked up from CGS by young offenders (provided by the Department of Justice, Young Offenders Division), which is baled and shipped south for recycling. The Government of Nunavut has a contract with Canadian North, who uses the paper as ballast. The City of Iqaluit, NorthwestTel, and Akhaliak each participate in the program, which sends approximately 1 tonne of paper for recycling each week.

  The City intends to study these programs to understand current opportunities and constraints and to identify potential synergies.

[6] *Source: StewardEdge Price Sheet. April 2011. www.stewardedge.ca/pdf/pricesheet/2011/04_2011.pdf*

Program Scope

- Which materials should be included in a residential/commercial recycling program?
    - Low cost of glass and potential for local reuse/repurposing make it less feasible to ship it south for recycling.
    - Potential to compost or incinerate paper rather than ship south for recycling.
    - Materials may be diverted through other existing local recycling programs.
    - Other considerations will include impact on diversion, economic value and processing requirements.
- Whether paper and cardboard is composted or incinerated rather than shipped south for recycling should be assessed.
- Challenges and opportunities for effectively extending the recycling program to commercial, government and non-profit organizations in Iqaluit (e.g., how this portion of the recycling program would be funded and what their source separation and collection needs are).

Operations

- Materials may need to be stored longer than is typical in southern communities, as shipping is only available seasonally through sea lift.
- Materials will require some degree of preparation prior to shipping.
- Whether a depot or curb side pickup is more appropriate for Iqaluit. A benefit of curbside is that it is more convenient, which could result in more material being collected. However, curbside programs are typically more expensive than depot systems.
- Challenges and opportunities for greater source separation during collection (whether through curbside collection or at depots) to minimize processing requirements
- The amount of staff required for collection and operations is to be assessed.
- An appropriate data monitoring/recording/reporting program would be required to track the amount of material being diverted from disposal.
- What type of process would be used to sort recyclables during processing (e.g. manual or mechanical sorting or a combination of both).
- The amount of pre-processing/sorting required before shipping to ensure Iqaluit receives maximum value on the sale of recyclable materials.
- The potential for odour/cleaning issues associated with residual food and drink in food and beverage containers (can be mitigated by asking residents to ensure materials are empty and/or to rinse containers before recycling).
- Implementation of program could be phased in over time to allow for program testing, refinement and gradual purchase of required equipment.

Equipment

- Whether an indoor sorting facility is required to continue programs in winter months, and how the facilities would be serviced (heat, electricity, water, sewer).
- The type of container that would be most convenient for residents and workplaces to sort their recycling materials (for example, a plastic blue bag, reusable bag, or a blue box, as shown in Figure 3 below).
- To manage collection costs at existing levels, the same truck could be used to collect recyclables, whereby a garbage collection day is replaced with a recycling collection day.
- Potential for existing or future depots to accommodate/support non-municipal recycling or reuse initiatives.

Figure 3: Examples of plastic blue bag (left), cloth recycling bag (middle) and blue box (right)

3.1.2 Bulky Materials Recycling

What is it?

The separation of bulky recyclable material (such as electronics, tires, appliances, scrap metal and mattresses[7]) from regular waste for recycling.

How would it work?

Residents with bulky recyclables would be able to drop off their materials at the landfill site or recycling depot. These materials would then be prepared for shipping south to be recycled.

Diversion Potential

Scrap metal recycling initiatives in Iqaluit have recycled approximately 6,500 m^3 of metal. These programs have been joint initiatives between the Government of Nunavut, the Federal Government and the City of Iqaluit. These initiatives focused on historic metal waste and are not permanent programs to address future metal waste generation. Continuing these types of initiatives in the new municipal waste management program would allow for scrap metal recycling to continue. The majority of the scrap metal in Iqaluit is comprised of end-of-life vehicles (see Section 3.3), with some amounts of appliances and construction debris.

No data is currently available on the quantity of waste electronics, tires or mattresses available for recycling in Iqaluit.

Estimated Cost/Revenue

The Dillon recycling pilot study report[8] describes the results of a scrap metal pilot study conducted in the communities of Rankin Inlet NU, Churchill MB, and Gillam MB. The Dillon report estimates that the program removed 0.025 tonnes of scrap metal/person/year at a cost of $585/tonne. Based on the costs described in this report it is estimated that the annual cost of such a program in Iqaluit could be around $90,000. A cost estimate more specific to Iqaluit is currently being developed based on current shipping rates, material value and past program costs, but this number is provided for initial discussion purposes.

Cost estimates for the recycling of the other bulky items are currently being researched and developed.

Issues to Consider

Issues to consider during the implementation of a bulky material recycling program in Iqaluit include:

- An accurate assessment of the quantities of bulky recyclables generated annually;
- How materials would be made ready for shipping (e.g., stacking and wrapping electronic waste on a pallet, etc)

[7] Mattresses are shredded and the recyclable materials are separated out.
[8] Dillon Consulting Limited. *Evaluation of Recycling Pilot Projects Final Report*. March 2, 2010.

- Will likely be storing materials longer than in southern communities in order to accommodate issues related to shipping.
- Opportunities for reusing and/or recycling used tires locally .
- Availability of sorting/storage space at existing or future waste management sites;
- Whether the service would be available year-long, seasonally, or at a set number of days or events per year.
- Would the City provide any kind of pick-up service for larger items (for a fee?)?

3.2 Composting Program

What is it?

Composting is the process of converting organic materials such as food waste, paper, cardboard and /or woodchips into a soil-like substance called compost.

Figure 4: Organics Green Cart and Mini Bin

How does it work?

Residents and businesses would separate organics from their regular waste. In other communities with an organics diversion program, organic waste is placed in a mini-bin, which is emptied daily into a green cart (see Figure 4). Residents would either drop the organics off at a depot location or place the materials outside for municipal collection[9].

Paper, cardboard and wood waste collected separately could be composted along with the food waste. These materials would have to be shredded before being mixed with the food waste. Any wood waste used would have to be clean (e.g. no nails or screws).

A compost program may also be able to deal with the sewage sludge produced at the Waste Water Treatment Plant.

During the composting process, the organic materials breakdown and turn into a crumbly, earthy-type material. The composting process stabilizes the organic material, thereby reducing the risk of

[9] While depot locations for household organics are less common than curbside collection, other communities have used them in the past or continue to do so. For example, a neighbourhood in the community of Centre & South Hastings, Ontario used a depot system to collect organics between 2001 and 2006. No significant issues were reported, although the depot was closed due to lack of processing facility to accept the material. Also in Ontario, the County of Peterborough successfully operated a pilot organics depot in 2006, while the Township of Assiginack has recently implemented a depot to collect its municipal household organics.

leachate and the generation of methane (a potent greenhouse gas), kills pathogens, and destroys seeds. The composting process decreases the volume of organic matter by about 40% to 50%.

The City will also need to consider how the compost will be used. The Canadian Council of Ministers of the Environment (CCME) have established guidelines for compost quality to help ensure a consistent, high quality product that is safe for all uses[10]. The guidelines are based on four criteria for product safety and quality, including:

- Foreign matter;
- Maturity;
- Pathogens; and
- Trace elements.

Using these criteria, the CCME has established two grades of compost:

- Category A – unrestricted: can be used for any application, such as agricultural lands, residential gardens, etc.
- Category B – restricted: has restricted use due to presence of sharp foreign matter or higher trace element content.

For these categories, the CCME has also established criteria concerning the presence of pathogens. For mixed municipal waste, the compost pile must achieve a temperature of 55 ^{o}C for a certain length of time (depending on the process used), have a fecal coliforms count of less than 1000 most probable number (MPN)/g of total solids calculated on a dry weight basis, and have no Salmonella sp. with a detection level more than 3 MPN/4g total solids calculated on a dry weight basis.

If compost does not achieve either category A or B, then it must be disposed (it can also be used as landfill cover material).

Two common methods that could be used for composting the organic material are open windrow composting and in-vessel composting, which are described in more detail below.

Open Windrow Composting

Open windrow composting occurs in long piles that are turned regularly for aeration and mixing. This method is currently used by the City of Yellowknife (see case study below) and by the Bill MacKenzie Humanitarian Society (BMHS) to compost material from about 100 Iqaluit households.

In windrow composting, organic waste is composted in long piles or rows, often on a concrete or paved pad. To improved odour and moisture control, windrows can be covered with a removable fabric-like membrane or built under a roof. Heavy equipment is used to regularly mix or turn the pile in order to aerate and blend the material. Turning frequency depends on the size of the pile and feedstock and can range from several times daily to once a month. Generally, the composting process takes about 13 weeks, but would likely take longer in Iqaluit's arctic environment. For example, it took approximately two years for the City of Yellowknife to completely compost their material.

[10] Canadian Council of Ministers of the Environment. *Guidelines for Compost Quality.* 2005.

A key benefit of windrow composting is its low cost and low-tech approach. Another is its flexibility, as windrow systems can handle volumes ranging from 5 tonnes/day to 100 tonnes/day. As observed with the Yellowknife project, a key challenge with windrow composting in Iqaluit would be that its processing would slow considerably during the winter in sub-zero temperatures. Other challenges with windrow composting include odour issues from food waste, managing liquid runoff, and land requirements.

Case Study: City of Yellowknife Composting Program

The City of Yellowknife is currently running a composting pilot project. The project collected organic material from 10 to 15 local businesses, with each business given a 4 yard, overhead tipping bin for collecting the materials. Collection was once every two weeks in the winter months and weekly during summer months. Approximately 400-700 tonnes of organic materials were collected over a two year period. The organic material was piled in long, open trapezoid piles and were periodically turned to provide aeration, control temperatures and blend organic material.

Three separate piles were created at the waste facility. The first was for mixing and storing incoming organic waste, the second was an active composting pile, and the third was a curing pile (i.e., a pile where organics complete the last part of the composting process). The whole process, from collecting organic material to producing usable compost, took two years. During the first year, organic materials were allowed to actively compost, while the second year was used for curing the composted material.

There were a number of issues pertaining to local climate and geography that Yellowknife had to address that may provide lessons for composting in Iqaluit.

Timeframe: The prolonged winters and short summers typical of a northern climate caused the composting to take a relatively long time. Under conditions found in southern Canada or in the United States, composting takes between 13 to 15 weeks (from organics collection to marketable compost). In Yellowknife, the composting process took two years from start to finish. Between November and April, no activity was evident in the windrows, as the piles were almost completely frozen. During the remaining months, crews were able to turn and monitor the piles and active composting was evident.

Animal Issues: Another issue was the attraction of animals and birds. An electric fence was constructed around the perimeter of the designated compost area in order to deter bears from entering the open facility. In addition, covers were installed on top of every windrow in order to prevent birds (mostly gulls and ravens) from landing and foraging on the windrows. Special geotextile material was used, as regular tarp material was easily punctured by some types of bird.

Collection Issues: Winter conditions also created issues during collection, as organic material often froze to the inside of bins during winter months and thus made it difficult to empty.

Figure 5: Example of In Vessel System (CV Composter, Engineered Compost Systems, Seattle, WA)

In-vessel Composting

An alternative to windrow composting is in-vessel composting. During this process, organic material is composted within large or small enclosed structures. The enclosures may be a series of chambers within a larger sealed building or individual containers located outdoors (see Figure 5 above). The containers/chambers help to better manage temperature and aeration in the compost pile, which can result in a shorter composting process. This system provides some flexibility over tonnage amounts, as this type of system can be outfitted for 180 tonnes/year to 30,000 tonnes/year or more. Once the material has finished primary composting in the vessels, the material can then be finished in a turned windrow system.

Benefits of the in-vessel approach include the ability to compost organics material during the winter months. Other advantages include composting speed and better control over odour and other composting issues. It also provides an opportunity for biogas production and collection, which can be used to generate energy (the organics would need to be processed aerobically, which means “without oxygen”. See process diagram in Figure 6). However, these systems are more technically complex and have higher capital and operational costs.

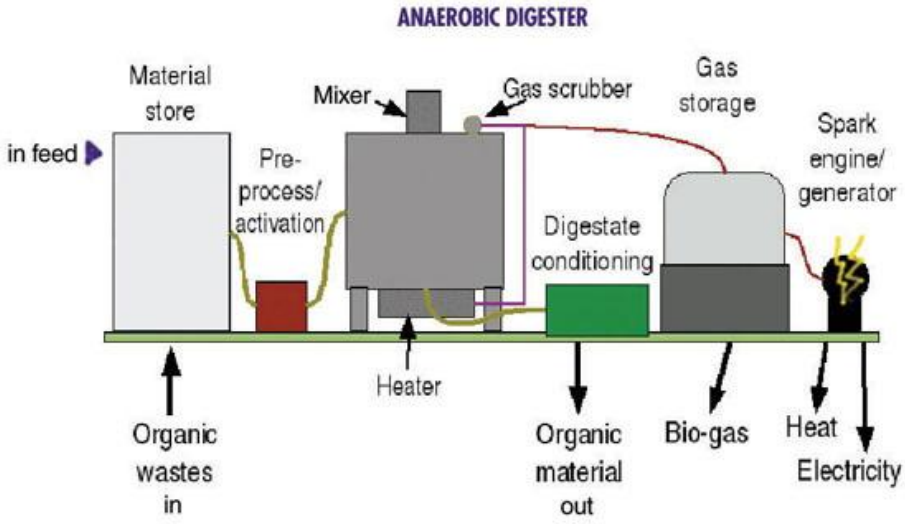

Figure 6: Anaerobic Composting Process[11]

Diversion Potential

A composting program could divert approximately 1,987 tonnes of organics from disposal (not including paper/cardboard, wood), assuming that the program recovered 70% of organics from the waste stream. Assuming that the composting process reduces raw organic matter by about 40% to 50%, this could result in up to 890 tonnes of compost being produced annually.

While office paper and cardboard can be included in the City's recycling program, composting provides another option for the material. Including paper and cardboard in the composting program instead of the recycling program could increase the amount of material managed through composting to 3,274 tonnes annually. An in-vessel anaerobic system could potentially manage all of the City's paper, while a windrow system would be much more sensitive to the mix of material being composted.

Composting system could also accept approximately one-third of Iqaluit's wood waste. If wood shredding is to take place, an indoor facility may be required during winter months. Wood for shredding should be clean, containing no nails, screws or other materials.

Estimated cost

The estimated capital and operating costs for a windrow and an in-vessel system are presented in the table below. These costs are based on typical North American compost facility costs adjusted for Iqaluit's northern location and anticipated tonnage.

[11] Source: Emispec 2010. http://emispec.ca/en/biogas-generation.php

Table 5: Estimated Composting Costs

	Open Windrow[12]	In-Vessel[13]
Capital Cost	$500,000 - $650,000	$1M - $3M
Operating Cost[14][15]	$50,000 - $70,000 /year	$100,000 - $150,000 /year
	$ 25-35/tonne/year	$ 30-46/tonne/year

Issues to Consider

Operational and infrastructure considerations to be further assessed during the implementation of a composting program include:

Infrastructure

- Composting method must be selected:
  - The Bill Mackenzie Humanitarian Society successfully implemented a composting program using the Open Windrow method.
  - Alternatively, an in-vessel system may be able to produce energy and/or biofuel through bio-gas production. This would use an anaerobic approach, which means no oxygen is used in the composting process. Energy could be useful on-site or in nearby facilities.
- Iqaluit's existing shredder may be of suitable size/type for shredding food waste and cardboard. If shredding is to take place, an indoor facility maybe required during winter months.

Operations

- Current sewage sludge management could be included in the process. However, this process would require more rigorous management, testing and health and safety requirements, especially if a windrow process is used. If an anaerobic system was implemented, the material requirements would not be as sensitive.
- A composting process could be used to manage a portion (up to one-third) of the City's wood waste.
- Techniques for maximizing the composting process (e.g., using aerated windrow, gore-tech cover, tension fabric structures, or buildings – see Figure 7)).

12 Assuming windrow would include all food waste and sewage sludge.
13 Assuming in-vessel would include food waste, sewage sludge and paper.
14 Assuming 1,987 - 3247 tonnes could be composted/ year (70% capture rate)
15 Does not include collection costs.

- The type of container system residents/organizations would use to collect organic waste, for example a green bin or a compostable bag (see Figure 8).
- The type of vehicle to collect the food waste and the number of crew members needed per truck (can an existing City vehicle be used, or does a new one need to be purchased?).

Figure 7: Covered Windrow (left); tension fabric structure (right).

Figure 8: Paper composting bag (left); green cart (middle); green cart and automatic lift (right).

3.3 End-of-Life Vehicle Program

What is it?

An end-of-life vehicle is one that has reached the end of its useful life. End-of-life vehicles can be recycled or reused. The vehicles can be stripped of all salvageable parts and scrap metal can be recycled.

How does it work?

Residents would be able to drop off their end-of-life vehicles at a worksite near the landfill, and trained professionals would safely remove hazardous materials (batteries etc), drain fluids and remove reusable parts from the vehicles. The unsalvageable metal could be compacted and shipped down south as scrap metal. In 2008, an end-of-life vehicles initiative run jointed by the City and the Government of Nunavut collected about 700 cars, snowmobiles and four-wheelers for recycling. This material (approximately 5,000 tonnes) was processed on an industrial site in the West 40 and stored until it could be shipped south as scrap metal.

Diversion Potential

No annual disposal rate data is available for end-of-life vehicles, but the success of past programs shows that this is an important program for the community.

Estimated Cost

Safely dismantling the vehicles and preparing for recycling is estimated to cost $25,000 annually in staff time (assumes 2 staff members, working part-time between May and September). The estimated cost of shipping end-of-life vehicles would be similar to that of scrap metal (approximately $585/tonne). The cost of safely disposing of fluids and batteries will be part of the household hazardous waste program (see Section 3.4).

Issues to Consider

Dismantling, storing and recycling end-of-life vehicles requires proper training, safety considerations and the proper infrastructure to implement. Before implementation, the following considerations should be addressed:

- Confirmation of shipping costs.
- Availability of space for dismantling and storing vehicles.
- Whether an indoor service area would be required, and whether indoor servicing requirements would be lower if program was seasonal (e.g., just in summer).
- Type of training/certification required for staff dismantling the vehicles.
- Accurate estimates of quantities of vehicles stockpiled or requiring disposal annually.
- Health and safety issues to be considered.

- Whether the City would help to pick-up end of life vehicles.
- How do local garages deal with fluid disposal? Are there opportunities for partnership?

The New Hampshire Department of Environmental Services identified a number of best practices with respect to dismantling end-of-life vehicles, including[16]:

- Prior to removing parts and dismantling vehicle components, completely drain all vehicle fluids, including antifreeze, brake fluids, engine oils, transmission fluids, windshield washer fluid, power steering fluid, rear axle housing fluids, etc. Do this over an impervious surface.
- Do not mix the fluids. Recycle, reuse, or dispose of fluids in an appropriate manner.
- Dismantle and drain vehicles, parts, scrap, and cores in one centralized location that is under a roof and over an impervious surface (for example, concrete). Make sure there are no open drains or cracks in the surface.
- Use drip pans when unclipping hoses, unscrewing filters and removing parts.
- Replace drain plugs when done draining.
- Fully drain parts and cores on a drain table or drip rack before moving them to a storage area.
- Keep spill control equipment nearby. Clean up spills immediately.
- Seal all fluid lines after draining to prevent leaks. Metal lines can be crimped or bent; rubber hoses can be plugged with clamps, balls, or golf tees.
- Remove and separate recyclable and potentially hazardous components, including the fuel tank, radiator, tires, battery, catalytic converter, air bag units, and mercury switches.
- Remove and capture air conditioning refrigerants (R-12 and R-134a). Qualified persons, using certified equipment, must perform this work.
- Remove engines through the hood. Do not tip vehicles on their sides, because this allows fluids to run out and spill on the ground.
- Establish a good routine for dismantling vehicles and stick with it.
- At “you-pull-it” facilities (where customers are allowed to remove parts), make sure the flu-ids are drained from vehicles before customers are allowed to remove parts. Instruct customers on proper procedures to prevent leaks during removal of parts, and provide spill control supplies for convenient customer use.
- Store engines, transmissions, and other oily, greasy parts off the ground, over an impervious surface, and under cover to prevent soil, groundwater, and storm water contamination. Have spill controls, including drip pans and absorbents handy.
- Keep an inventory of the vehicles and parts stored at the facility

[16] New Hampshire Department of Environmental Services. *N.H. Green Yards BMP Guide Sheet #11*. May 2003.

In Canada, the Automotive Recyclers of Canada recently prepared the *National Code of Practice for Automotive Recyclers Participating in the National Vehicle Recycling Program* for Environment Canada[17]. The document describes the environmental considerations of related to managing end-of-life vehicles and reviews the national code of practice for reuse and resale, administration, spills, dealing with hazardous materials, automotive recycler processing areas, and equipment and infrastructure. The document is available for download at http://www.certifiedautorecycler.ca/Downloads/RYR_AB%20Code%20v2%20eng.pdf.

3.4 Household Hazardous Waste Program

What is it?

Diverting corrosive, flammable, explosive or poisonous waste from landfill by using designated drop-off sites or special collection days and events.

How does it work?

Household hazardous waste would be dropped off at a designated area of the waste management facility. Where feasible, some of the waste material could be reused (e.g., paint or stain), with the remainder being sorted and shipped to a southern hazardous waste facility for recycling and/or safe disposal. Household hazardous waste materials could include the following materials (among others):

- Cleaning products
- Batteries
- Light bulbs
- Automotive fluids
- Paint
- Stain removers
- Propane tanks
- Thermometers with mercury
- Wood varnish
- Needles
- Medication
- Drain openers
- Fire extinguishers
- Shoe care products
- Lighter fluid
- Fluorescent light tubes
- Abrasive powders
- Rust remover

Diversion Potential

Approximately 25 to 35 tonnes of household hazardous waste could be diverted annually by this type of program.

Estimated Cost

The estimated cost to manage and ship this material to a hazardous waste management location could range from $10,000 to $20,000 annually, which would be approximately $400 to $570/tonne/year.

Issues to Consider

[17] Automotive Recyclers of Canada. *National Code of Practice for Automotive Recyclers Participating in the National Vehicle Recycling Program*. March 2010.

As mentioned, initiating this type of option requires proper training, storage containers, shipping containers and education and promotion. The following are considerations to be reviewed further if this option is developed:

- The advantages and disadvantages of privatizing this part of Iqaluit's solid waste management program, even if government subsidies are available.
- Whether a specialized indoor facility would be required for this option during the winter months, and what kind of specialized ventilation and explosion proofing is required for such a facility.
- Whether the program could be operated during the summer months only.
- The territory and federal regulatory controls that would govern this program, including the shipment of household hazardous to another province.
- Staff training. It should be noted that training opportunities are available through the Nunavut Municipal Training Organization (NMTO). In 2001, the organization received the Canadian Association of Municipal Administrators 2011 Environment Award for its Household Hazardous Waste Management Training Program for Operators. [18]
- The Government of Nunavut has prepared the document *Environmental Guideline for the General Management of Hazardous Waste* (October 2010). This document should be consulted during the development of a municipal household hazardous waste recycling program. It provides additional considerations on:
    - Disposal of hazardous waste;
    - General requirements on storage, containers, facilities; and
    - How to ensure generators, carriers and receivers of hazardous waste are registered before undertaking activities involving these wastes.

3.5 Re-use Centre

What is it?

A dedicated location where re-usable materials can be dropped off, exchanged, bought or sold.

How does it work?

Anytime a resident has an item that they no longer need, but is still functioning, they could bring it to the re-use centre. Based on the condition of the item, the re-use centre would accept items as a donation (no money is given in return by the re-use centre) and they sell the items to recover costs for running the centre.

Items that could potentially be reused include:

- Wood

[18] Canadian Association of Municipal Administrators. *Ten Canadian Communities Recognized for Municipal Excellence.* June 1, 2011. www.civicinfo.bc.ca/cama/news_item.asp?newsid=122

- Building Materials
- Glassware
- Arts and Crafts
- Packaged Toys
- Electronics
- Books and other publishing
- Bicycles
- Furniture
- Appliances

Estimated Cost

Depending on the scope of this program, its implementation could require a large capital cost for a dedicated building with a large floor space if no building is available. Capital cost of such a building may range from $100,000 to $300,000, plus ongoing maintenance and utilities. Approximately one full time staff would be required to run and operate the re-use centre, depending on hours of operation.

Issues to Consider

Issues to consider with respect to establishing a re-use centre include:

- Whether some items would need to be protected from the elements to allow for re-use (and if Seacan containers could be used for this)
- Whether a new building is required to house and display the materials received, or if there is existing municipal or private sector space (e.g. second hand store).
- The potential for coordinating such a program with local charitable organizations.
- The types of items that would be acceptable.
- Methods for ensuring residents do not drop off unusable goods or waste.
- Hours of operation and staffing requirements.
- Whether the focus should be on wood and larger items rather than clothing and small household items, which could go to second hand store or local charities instead of being accepted at the re-use centre.
- The potential for coordinating the program with local charitable organization(s).
- The feasibility of posting available items online (e.g. Iqaluit sell/swap Facebook page).

3.6 Promotion and Education Programs

What is it?

All of the information and encouragement residents require to participate in the City's diversion programs.

How does it work?

A promotion and education program is key to the success of any waste management program. It raises awareness about the program's availability and helps ensure the program is used correctly. It educates residents about the environmental and social benefits of diverting waste, and inspires them to participate and take action. It also helps to educate the public on household hazardous waste items so they can be identified and properly disposed of.

A promotion and education program can change over time to respond to the needs of the municipality/ community. Typical components of an education program may include:

- Print materials, such as a brochure or posters
- Face-to-face contact to promote specific programs, possibly at community events or by going door-to-door;
- Using neighbourhood champions or community leaders to teach others or to lead by example;
- Give-aways or discounts to help overcome physical barriers to participation;
- Youth/school programs
- Interactive on-line waste forums and feedback forms; and
- Community-based social marketing approaches.

An education program should also include a monitoring and reporting plan to track its effectiveness and provide recommendations for improvement.

Estimated Cost

According to the *Blue Box Program Enhancement and Best Practice Assessment Project Final Report* by KPMG (prepared for Stewardship Ontario), on-going promotion and education programs can cost between $0.83 to $1.18 per household, while costs of $3 to $4 per household can occur when implementing a new program or system[19]. The costs are expected to be higher in Iqaluit due to higher printing and material costs.

[19] KPMG. *Blue Box Program Enhancement and Best Practice Assessment Project Final Report.* 2007. Prepared for Stewardship Ontario.

Figure 9: Composting brochure from City of Hamilton (left); `Oops` sticker (City of Hamilton), (middle); Mandatory recycling door hanger (right).

3.7 Policy Options

In addition to the programs listed above, there are a number of policy options that the City could use to encourage diversion, which are described below. It is important to note that the policy options would require material diversion programs in place in order to have an effect. The policy options would help support the other diversion programs and encourage their use by residents and businesses.

- **Deposit-return:** residents pay a deposit for each beverage container, and receive a refund when it is returned for recycling.
- **Mandatory recycling bylaw:** the City could explore developing a by-law that makes recycling mandatory for materials that have a diversion program in place.
- **Disposal ban:** materials that have a diversion program in place (e.g., wood waste) could be banned from the landfill.
- **Ban on materials:** some hard-to-recycle materials could be banned from Iqaluit, such as plastic bags (or certain types of plastic bags).
- **Greater enforcement of waste management programs:** Currently, the City has programs in place requesting the separation of some waste materials (such as wood, household hazardous waste) from regular garbage. The City can increase enforcement of these existing programs to help ensure the divertible materials do not enter the landfill.

In addition to the policy options listed above, the City could also lobby the Government of Nunavut to pursue Extended Producer Responsibility (EPR) or product stewardship opportunities. EPR or product stewardship involves the producers of products taking some or all of the responsibility for managing products at the end of their useful life. There are several examples of product stewardship across Canada, including for used oil, beverage containers, electronics, pharmaceuticals, tires, and other materials. In many of these cases, distributers and manufactures administer the collection and processing of their respective waste products. These costs are often recovered through the application of a recycling fee at the point of purchase. In Nova Scotia's paint recovery program, paint brand owners must register with Resource Recovery Fund Board Inc. (RRFB Nova Scotia), which administers the provinces waste diversion programs. Registered brand owners are able to sell their product within the province, and unused paint is returned by the public through a depot system.

There are no external costs associated with these policy options other than staff time (e.g. Municipal Enforcement Officers).

Issues to Consider

Implementing policy options often requires hiring and/or training existing enforcement officers to properly enforce by-laws and regulations. Up-front educational material and public awareness is typically required to educate residents before by-laws come into effect. The following are points of consideration for the above policy options:

- Whether current staff levels are sufficient to monitor/enforce policy directions.
- Additional training for staff to deal with enforcement issues (e.g., approaches to enforcement, how to address issues).
- The kinds and size of penalties given to first time and repeat offenders.
- Whether current enforcement programs meet a set standard or if they can be improved.
- Potential impact policies may have on current supply contracts and local businesses (especially policies banning certain materials).
- Whether enforcement take place at curbside, at landfill site or both.
- Added benefit of combining policies (e.g. a clear bag policy would make enforcing disposal bans easier).
- Whether the City have the authority to implement the policies or if they would have to be regulated at the territorial level (for example, some of the policies the City could lobby for, but it may be up to the territorial or federal government to implement).

4 Disposal Options

After the City and its residents have reduced, reused, recycled and composted as much waste as possible, some waste will still require disposal.

There are two main options being considered for disposal: waste-to-energy and a new landfill. These are described below.

4.1 Waste-to-Energy Treatment Processes

One option for dealing with the City's remaining waste is to convert it to energy (i.e. waste-to-energy). The two main methods of doing this is through incineration or through more advanced techniques collectively referred to as Advanced Thermal Treatment. These are described in greater detail in the following sections.

There are a number of advantages of incineration and waste-to-energy technologies over landfill, including that they significantly reduce the volume of waste that needs to be landfilled, that there is the potential for energy or heat generation, and that they do not attract animals as a landfill would.

Alternatively, there are drawbacks compared to landfilling. For example, the process of incineration and (in particular) waste-to-energy is technically much more complex. This generally means that the process is more expensive than landfilling and that advanced technical training is required to operate and maintain the machinery. Furthermore, many of these technologies require a considerable amount of energy (e.g. external supply of electricity or fuel) for start up and operation, which can outweigh any energy output benefit. There is also the concern of emissions of pollutants, especially if the facility is not run properly.

The capital cost of these technologies range from an estimated capital cost of $2M to $10M. Operation of an incineration facility sized for Iqaluit could require a staff of two to three general operators and at least one skilled technician.

4.1.1 Advanced Thermal Treatment

There are various forms of advanced thermal treatment that converts solid waste into forms of energy. These involve the decomposition of carbon-based materials using an indirect source of heat and result in a synthetic, combustible gas. Three common types of waste to energy technologies include gasification, pyrolysis, and plasma-arc. Pyrolsis is undertaken in the absence of oxygen, while gasification and plasma-arc use a limited amount of oxygen. The limited use or absence of oxygen results in the production of fewer air emissions at the thermal treatment source compared to combustion type thermal treatment technologies.

4.1.2 Incineration

In general, incineration involves converting residual waste into fuel or directly into energy. This conversion greatly reduces the quantity of waste for disposal while in most applications, providing a source of energy. The technologies required for incineration can vary in complexity, cost and

economies of scale. Based on the application, wastes can be fed into an incinerator on a continuous basis, or the material can be burned in batches.

Incineration can reduce the amount of waste requiring landfill by up to 90 percent by volume, or 70 percent by weight. While incineration can handle most wastes, its efficiency depends on the heat value (BTU) of the materials being processed. For example, glass and metals have little heat value, while plastics and fibres have more. While these types of processes can reduce the volume of waste, a waste disposal site or landfill is still required to manage the remaining waste residue known as ash.

The process for incineration typically consists of five key steps:

1. **Pre-processing** – waste is sorted to remove unsuitable materials, such as recyclables, hazardous waste, or over-sized items. Cleared waste may then be shredded and screened before being processed.
2. **Incineration** – waste is treated or destroyed under carefully controlled conditions. Heat is applied and concentrations of oxygen are adjusted to reduce the waste into simpler elements more suitable for use as a fuel or for landfill disposal.
3. **Energy recovery** – heat energy can be recovered from the process. This may involve boilers, which helps to convert the heat energy into steam, which is in turn converted to energy using turbines or generators. The steam can also be used for district heating. In some thermal treatment processes, the waste is converted into a solid, liquid or gaseous fuel that can be sold and used at other facilities (e.g., kilns or energy generations stations).
4. **Air pollution control** – air pollution control systems are used to reduce emissions from the incineration processes. These may include chemical or physical capture and removal technologies, neutralizing acid gases with lime, and capturing heavy metals, trace gases, and particulates.
5. **Ash management** – incineration results in an ash that will go to landfill for disposal or, depending on its chemical composition, may be used as an aggregate substitute.

A key issue related to incineration of waste is the release of pollutants into the atmosphere. Waste must be burned at a high temperature (in excess of 1,000 ^{o}C) in order to safely destroy wastes. Open burning does not provide sufficient temperatures to safely burn waste.

Air Emission Standards

Solid waste incinerators in Nunavut are required to meet the Canadian Council of Ministers of the Environment Canada-Wide Standards for dioxins/furans and mercury. Dioxins/furans are considered persistent organic pollutants (POPs), which, along with mercury, bio-accumulate in the environment and may cause adverse effects to human health and other organisms. Dioxins/furans can be generated when waste is incinerated improperly or at too low a temperature. Mercury is not created during the incineration process, so therefore it is very important that waste materials (such as thermostats) are not fed into an energy from waste system.

Source: Nunavut Department of Environment. Environmental *Guidelines for the Burning and Incineration of Solid Waste*. October 2010.

4.1.3 Issues to Consider

Issues to consider with respect to incineration and waste-to-energy include:

- Some materials may be better than others for incineration/thermal treatment (e.g., wood, papers and plastics combust better than glass or metals)
- Some of the waste materials from the current West 40 landfill may also be incinerated, but several issues must be carefully considered, such as:
    - Safety of "mining" the pile (risk of fire, stability of pile);
    - Blowing litter when cover material is exposed; and
    - Sorting out material that is not safe for incineration (health and safety issues, cost of disposal).
- While the residual ash typically would be landfilled, it might potentially be used as an aggregate substitute, depending on its chemistry.
- Heat energy could be recovered from this process and used for energy production (steam) or district/onsite heating.
- The availability of an incinerator or advanced thermal treatment facility may reduce the political/public will to fund diversion programs.
- Advanced thermal treatments generally require a significant amount of waste to efficiently run and to make them financially feasible.
- An alternate means of waste disposal and the ability to repair the facility is required in case of equipment breakdown.
- The Government of Nunavut is currently finalizing a desktop study on incineration and thermal treatment solid waste management facilities. Discussions with the GN indicate that no such facilities currently operate in Nunavut.

4.2 Landfill

Waste that cannot be diverted by other programs (e.g. non-recyclable plastics) is disposed of in an area designed to separate the waste from groundwater and surface water. Precipitation that comes in contact with the waste (runoff) will be managed and treated before it is discharged into the environment.

Landfills generally form one of three types: an open dump, a modified landfill and a sanitary landfill. An open dump has little to no site management, operations procedures or engineering design to safely manage the waste disposed. A modified landfill site will have some site management and operations procedures in place with some engineered design (e.g., leacahte control). Modified landfills are the most common in the arctic. Sanitary landfills are heavily engineered, with geotextile material lining the bottom of landfill areas and leachate collection and treatment systems.

To help maximize available space in the landfill and minimize nuisance issues such as pests and blowing litter, waste is often compacted in landfills using equipment such as a bulldozer or other large machinery.

Landfills do have a number of advantages and disadvantages compared to waste-to-energy systems. For example, landfills generate fewer dioxins and furans, can be less expensive to build, operate and maintain than incineration or thermal systems and require less technical training and maintenance. However, landfills require more space, give off odours (this can be minimized by diverting organics into a composting program), and are viewed as ruining the landscape.

5 Site Selection

Iqaluit's future Solid Waste Management Program will need a new waste management worksite for waste diversion and disposal activities. A new waste management site will include the following features:

- Landfill area[20]
- Areas for diversion programs:
    - Re-use
    - Household/commercial recycling
    - Bulky recycling
    - Household hazardous waste
    - Composting
    - End-of–life vehicles
    - Sewage sludge management (if not included in the compost program)
- Water management for clean water flowing toward the site and contaminated water within the site; and
- Litter management.

In addition to the project evaluation criteria listed in Section 1, the site selection process will consider:

- Regulatory requirements and land use constraints,
- Space requirements for both diversion and disposal programs,
- Setbacks from airports and residential areas,
- Development and servicing costs,
- Operation and maintenance costs,
- Ecological impacts,
- Groundwater and surface water protection,
- Geotechnical suitability,

[20] Even if an incinerator is chosen, the City will still require a landfill area to dispose of incinerator waste ash.

- Visibility from town, and
- Ability to access landfill site during winter months.

Figure 10 shows a map of the land use constraints affecting this project (e.g. municipal boundary, park lands, watershed protection zones, setbacks from current and future community development areas, proposed airport zoning regulations, etc.).

To date, six sites (shown in Figure 11 below) are being assessed in the site selection process:

1. Northwest,
2. Trail Area,
3. North 40,
4. West 40,
5. East Iqaluit, and
6. North of Tarr Inlet.

The North 40, West 40 and East Iqaluit sites were all identified by residents at Open House #1 and considered viable for inclusion in the site selection process by the consulting team. A preliminary inventory of these sites can be found in Appendix A.

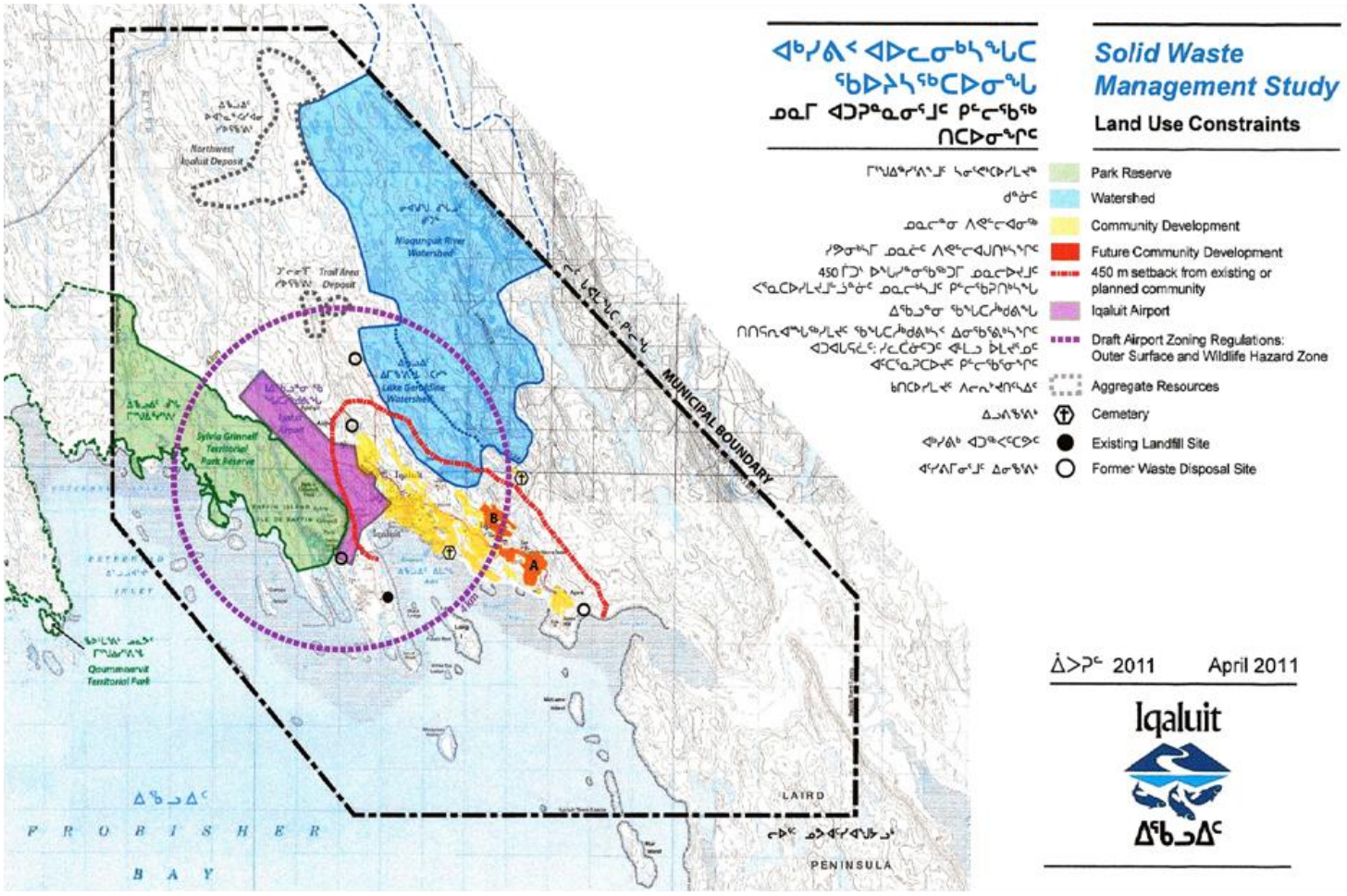

Figure 10. Solid waste management site land use constraints map.

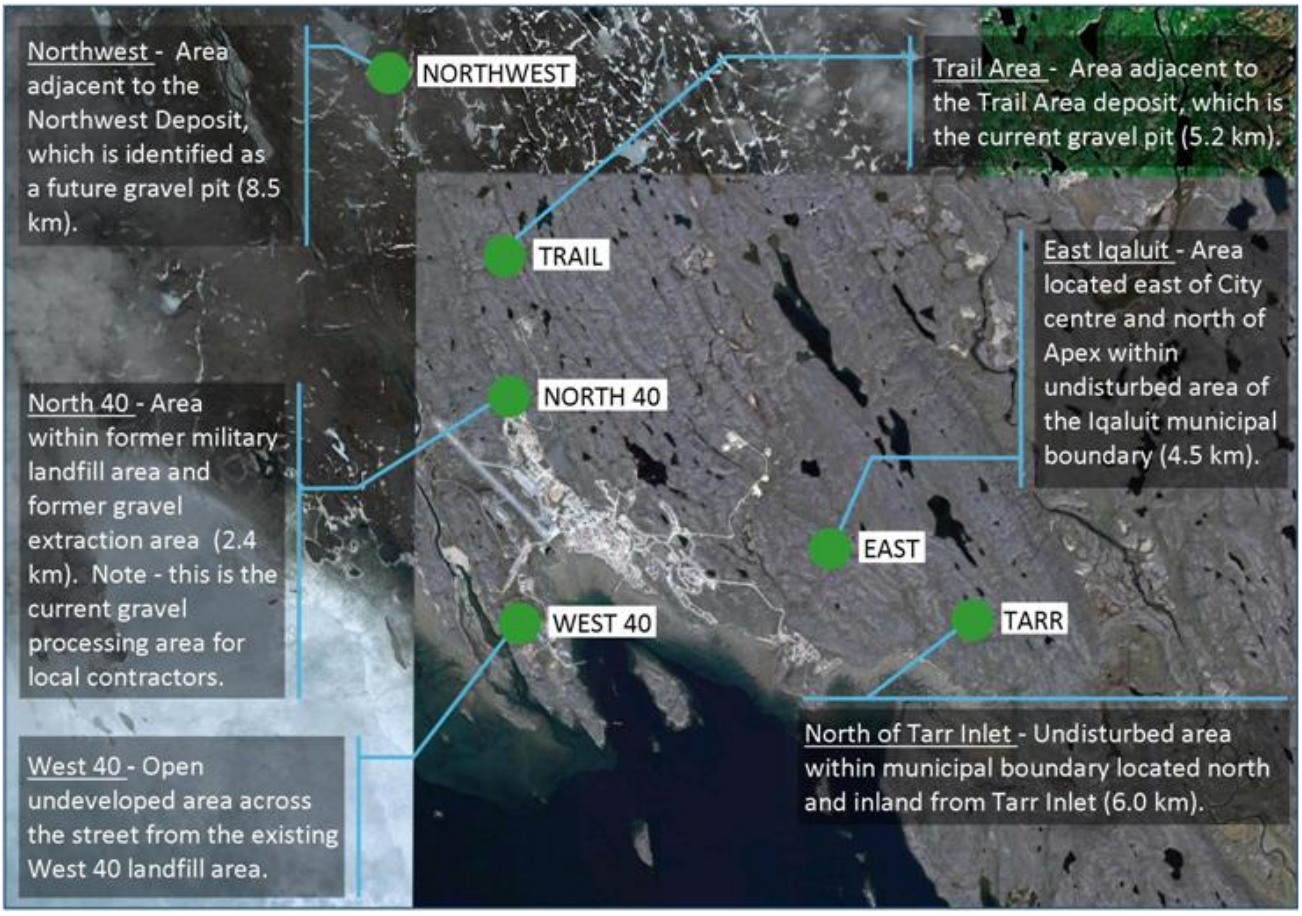

Figure 11. Six sites currently being assessed in the site selection process.

Appendix A- Preliminary Site Inventory

1. West 40

- The site is located 1.8 km southwest of the City center (Azimuth 222 degrees) adjacent to the existing West 40 landfill area.
- Access road: use the existing road to the Causeway
- Development: The northerly section of this site is the location of the DND receiver/transmitter site for the FOL operation at the airport. These lands are designated 'Transportation Facility' in the General Plan.
- Setback from airport (1.6 km) may pose a significant limitation.
- Geology: rock and gravel
- Surface water body: Frobisher Bay and Sylvia Grinneu River nearby
- Topography is relatively flat with drainage toward the river.
- Land ownership: City
- Community involvement: this site was identified by a resident at the first open house.
- Capacity: equal or less than 20 years

2. North 40

- The site is located 2.4 km northwest of the City centre (Azimuth 326 degrees), within the North 40 gravel pit.
- Access road: use the existing Federal Road.
- Development: within the former military landfill area and gravel extraction area. Current Gravel processing area for local contractors.
- Setback from airport (1.1 km) may pose a significant limitation.
- Geology: rock and sandy
- Surface water body: adjacent to a river/stream
- Topography is relatively flat
- Land ownership: not City owned
- Community involvement: this site was identified by a resident at the first open house.
- Capacity: equal or less than 20 years

3. East Iqaluit

- The site is located 4.5 km east of the City centre (Azimuth 103 degrees), north of Apex.
- Access road: would be developed with a new road beyond the Road to Nowhere, and an upgrade of a portion of the road to the Sandpits.
- Development: within an undisturbed area of the Iqaluit municipal boundary. Located approximately 600 m from planned residential uses (Future Development Areas A & B as shown on Figure B of General Plan).
- Setback from airport (4.9 km) is not a limitation.
- Geology is bedrock.
- Surface water body: 850 m from a river
- Site slopes northeast and southwest

- Land ownership: City
- Community involvement: this site was identified by a resident at the first open house.
- Capacity: more than 20 years

4. North of Tarr Inlet

- The site is located 6.0 km southeast of the City centre (Azimuth 102 degrees), north and inland from Tarr Inlet.
- Access road: would be developed with a new road beyond the Road to Nowhere, and an upgrade of a portion of the road to the Sandpits.
- Development: within an undisturbed area of the Iqaluit municipal boundary
- Setback from airport (8.5 km) is not a limitation.
- Geology is bedrock.
- Surface water body: 2300 m from a river
- Site is sloping northeast and southwest
- Land ownership: City
- Community involvement: this site was selected for consideration by consulting team NOT by the community resident.
- Capacity: more than 20 years

5. Trail Area

- The site is located 5.2 km northwest of the City Centre (Azimuth 341 degrees), adjacent to the site of the City's current gravel pit.
- Access road: would be developed as an upgrade to road leading to the Trail gravel extraction area.
- Development: within an undisturbed area of the Iqaluit municipal boundary
- Setback from airport (3.5 km) is not a limitation.
- Geology is bedrock.
- Surface water body: adjacent to ponds/lakes
- Site is sloping east and west
- Land ownership: City
- Community involvement: this site was selected for consideration by consulting team.
- Capacity: more than 20 years

6. **Northwest**

- The site is located 8.5 km northwest of the City centre (Azimuth 334 degrees), adjacent to a site identified as a future gravel pit for the City.
- Access road: to be developed with a new road beyond the Trail Area Deposit and an upgraded road to the Trail Area Deposit.
- Development: within a disturbed area of the Iqaluit municipal boundary
- Setback from airport (6.3 km) is not a limitation.
- Geology is bedrock.
- Surface water body: adjacent to ponds/lakes
- Topography is near height of land and sloping west
- Land ownership: City
- Community involvement: this site was selected for consideration by consulting team.
- Capacity: more than 20 years

Appendix B- Nuuk Incineration Information

General Information

- Built in 1987, now at capacity (population of Nuuk approximately 16,000)
- Processes approximately 40 tons/day
- Down for approximately 5 weeks/year for regular maintenance work
- Does not accept:
    - Hazardous waste
    - Waste oils
    - Impregnated wood
    - Usable items
    - Mattresses and sofas
    - Tires
- Annual operation and maintenance budget for entire solid waste management program $14.5 million Danish Kroner (approximately $2.7 million CND)
    - Incineration costs make up majority of this budget, but it also includes costs associated with all other solid waste management programs (hazardous waste management, landfill, recycling and reuse programs)
    - Financed through municipal taxes and user fees
- Uses electricity from hydroelectric dam to power the facility
- Provides residual heat to nearby aquatic center

Operational Information

- Have found that their system requires a dedicated management and technical team and very careful management
    - Used to be under the Director of Public Works, but found that they needed a dedicated manager who manages a team of technical staff and floor staff
    - Staffing and training has been a challenge
        - Difficult to attract skilled operators due to municipal wage level constraints
        - Feel that a community should not consider proceeding with incineration if there isn't a high level of certainty that they will be able to attract and retain at least one highly skilled incinerator operator, preferably a qualified machinist or alike, without gaps
    - For annual maintenance and more complex technical adjustments and repairs, an operator/technician is brought in from Denmark, which can be quite costly
- For years, thought that their incinerator didn't work properly
    - A few years ago, realized that it was an operational issue
    - Facility needs to be managed very carefully
    - Garbage must be downsized, mixed and fed with great care to maintain proper operations
        - Waste feed must be properly managed to even out energy content and maintain proper temperatures

        - Requires a great deal of dedication and commitment from staff (from floor staff to management)
            - They print out the temperature and throughput on each shift to allow workers to review their own performance and compare and compete with each other
- Based on their experience, they advised us to proceed with incineration with caution and to be sure to look at other diversion alternatives first

Appendix C – Information to be Included in the Request for Expression of Interest for Thermal Waste Conversion Technology

The Request for Expression of Interest (REOI) should include the following information:

- A description of Iqaluit's climate and geographic-related constraints that could potentially affect the performance of the technology (e.g., weather conditions, winter temperatures, remoteness of location, etc.).
- Projected waste tonnages, including total waste generation and projected diversion.
- A request for information on:
    - Recommended thermal waste conversion technology options (may be more than one option per company) based on total waste generated and on waste requiring disposal after diversion;
    - Approximate capital and operating cost for the technologies (understanding that this is not a full proposal);
    - Relevant technical specifications, including life span, typical maintenance or refurbishment periods, environmental controls, residue output, etc.;
    - Equipment and infrastructure required to support the operations of the technology (e.g., a building to house the technology, loading equipment, etc.);
    - Anticipated labor/training requirements for the technology;
    - Application of the technology in other jurisdictions of similar size and climate;
    - Potential and application for energy recovery (and any extra associated costs);
    - Feasibility and cost of incinerating the existing waste at the West 40 Landfill;
    - Available support options (e.g., in case equipment breaks down or malfunctions, etc.); and,
    - Lead time required from procurement to operation.

Appendix D- List of Capital Equipment and Infrastructure Requirements for Program Implementation at New Site

It is estimated that construction contracts and equipment purchases for implementing the recommended program (Option 1) at the new site (Northwest) will cost approximately $9,080,000 (Table 6). It is estimated that the capital cost for incineration will be an additional $3,000,000. This estimate includes the following items:

- Solid Waste Management Site
  - Access road
  - Office and garage
  - Fence around site
  - Work and storage areas for different program components
  - Water management and treatment infrastructure
  - Existing steel wheeled compactor
  - Mobile litter screens

- Compost Program
  - Temperature probe, moisture probe
  - Part-time front end loader (approx. 5-10hrs/week, existing equipment)
  - Concrete or gravel pad
  - The compost will likely have to have water added 2-3 times during the summer. If Iqaluit does not have an available water truck then a portable water tank/sprayer will be required

- Household Hazardous Waste Program
  - 2-3 sea cans for storage
  - A supply of 45 gallon steel or plastic drums for lab packing material
  - Absorbent granular material for lab packing
  - Wood pallets to stack full lab packed drums
  - Industrial plastic wrap to secure full drums on wooden pallets

- Bulky Recycling Program
  - Bailer capable of compacting appliances
  - Coolant extraction equipment

- End of Life Vehicle Program
  - Part-time loader to move vehicles (existing equipment)
  - Steel frame to set vehicles on for fluid evacuation
  - Steel or plastic drums to store and ship recovered fluids (i.e. oil, coolant, and transmission fluid)
  - Bailer capable of handling vehicles

- Reuse Center
  - 2-3 sea cans for storage

- Incinerator
    - Incinerator
    - Building to house the incinerator
    - Skid steer loader

Appendix E- Waste Composition and Program Option Details

Material	% of Waste Stream[1]	Program Applied (% captured in program)				
		Status Quo	Option 1	Option 2	Option 3	Option 4
1. PAPER	**26.18**	**Landfill**			**Incineration**	**Household Recycling (70%)**
Fiber, Magazine, Glossy	2.83		Open Windrow (70%)	In-Vessel Compost (70%)		
Cardboard and Boxboard	17.63		Open Windrow (70%)	In-Vessel Compost (70%)		
Polycoat (Tetra paks)	0.66		Landfill	Landfill		
Other Paper	5.06		Landfill	Landfill		
2. METALS	**3.09**	**Landfill**	**Landfill**	**Landfill**	**Landfill**	**Household Recycling (70%)**
Aluminum Food and Bev, Foil and Other	1.99					
Steel Food and Beverage	1.01					
Other Steel	0.10					
3. GLASS	**6.07**	**Landfill**	**Landfill**	**Landfill**	**Landfill**	**Landfill**
Glass Food and Bev.	1.22					
Glass Alcohol	4.41					
Glass Other	0.44					
4. PLASTICS	**7.57**	**Landfill**	**Landfill**	**Landfill**	**Incineration**	**Landfill**
PETE #1 containers	0.89					
HDPE #2 containers	0.58					
Polystyrene packaging	0.72					
Plastic Film	4.00					
Other Plastics	1.38					
5. ORGANICS (food waste)	**30.10**	**Landfill**	**Open Windrow (70%)**	**In-Vessel Compost (70%)**	**Open Windrow (70%)**	**Open Windrow (70%)**
6. OTHER METALS	**0.08**	**Landfill**	**Landfill**	**Landfill**	**Landfill**	**Landfill**
7. RUBBLE FROM CONSTRUCTION	**0.23**	**Landfill**	**Landfill**	**Landfill**	**Landfill**	**Landfill**
8. WOOD FROM CONSTRUCTION	**0.23**	**Landfill**	**Landfill**	**Landfill**	**Incineration**	**Landfill**
9. REUSE	**1.66**	**Reuse Center (70%)**	**Reuse Center (70%)**	**Reuse Center (70%)**	**Reuse Center (70%)**	**Reuse Center (70%)**
10. ELECTRONICS	**0.18**	**Hazardous Waste (100%)**	**Hazardous Waste (100%)**	**Hazardous Waste (100%)**	**Hazardous Waste (100%)**	**Hazardous Waste (100%)**
11. HHW	**0.07**	**Hazardous Waste (50%)**	**Hazardous Waste (50%)**	**Hazardous Waste (50%)**	**Hazardous Waste (50%)**	**Hazardous Waste (50%)**
12. OTHER UNCLASSIFIED	**12.99**	**Landfill**	**Landfill**	**Landfill**	**Incineration**	**Landfill**
13. BULKY MATERIAL SEPARATED AT LANDILL	**8.23**					
Freezers	0.09	Bulky Recycling (100%)	Bulky Recycling (100%)	Bulky Recycling (100%)	Bulky Recycling (100%)	Bulky Recycling (100%)
Appliances	0.15	Bulky Recycling (100%)	Bulky Recycling (100%)	Bulky Recycling (100%)	Bulky Recycling (100%)	Bulky Recycling (100%)
Oil Tanks	0.07	Bulky Recycling (100%)	Bulky Recycling (100%)	Bulky Recycling (100%)	Bulky Recycling (100%)	Bulky Recycling (100%)
Car Batteries	0.03	Hazardous Waste (100%)	Hazardous Waste (100%)	Hazardous Waste (100%)	Hazardous Waste (100%)	Hazardous Waste (100%)

Tires	0.06	Bulky Recycling (100%)	Bulky Recycling (100%)	Bulky Recycling (100%)	Bulky Recycling (100%)	Bulky Recycling (100%)
Wood [2]	7.83	50% shred/50% landfill	25% Open Windrow Compost/75% Shred	25% In-Vessel Compost/75% Shred	25% Incinerate/75% Shred	25% Incinerate/75% Shred
14. SEWAGE SLUDGE FROM WWTP	**2.60**	**Landfill**	**Open Windrow (100%)**	**In-Vessel Compost (100%)**	**Open Windrow (100%)**	**Open Windrow (100%)**
15. END OF LIFE VEHICLES	**0.74**	**End of Life Vehicle (100%)**	**End of Life Vehicle (100%)**	**End of Life Vehicle (100%)**	**End of Life Vehicle (100%)**	**End of Life Vehicle (100%)**

[1] From updated 2011 Waste Audit

[2] Shredded wood used as cover material