Long Term Sustainable Plan
Solid Waste Management Facility
for the
Hamlet of Repulse Bay

Prepared for:

Hamlet of Repulse Bay

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OTCD00019713A
January 2009

ᐊᐅᓚᑦᓯᔨᓄᑦ ᓇᐃᓈᖅᓯᒪᓪᓗᒍ ᐅᓂᒃᑳᖅ

Trow Associates Inc. (Trow) ᐱᓕᕆᑎᑕᐅᑲᐃᓐᓇᖅᑐᑦ Hᐊᒪᓚᒃᑯᖏᓐᓄᑦ ᓇᐅᔮᕐᒥᐅᑦ ᐱᔭᕇᖅᑕᐅᕐᑯᓪᓗᒋᑦ ᐋᖅᑭᒡᓱᖅᓯᒪᓂᕆᓂᐊᖅᑕᖓ ᓯᕙᑐᔪᒧᑦ ᐸᕐᓇᐅᑎᐅᓂᐊᕐᓗᓂ ᐊᑐᖅᑕᐅᖏᓐᓇᑐᓐᓇᕐᓂᐊᕐᒪᑦ ᐊᑦᑕᕐᕕᐅᕐᑲᑦᑕᕐᓗᓂ Hᐊᒪᓚᒃᑯᑦ ᑕᕆᓕᖕᓄᑦ ᐃᒋᑕᖏᓐᓄᑦ.

ᐅᓂᒃᑳᓕᐊᖑᔪᖅ ᓴᖅᑭᔮᒪᔪᖅ ᑲᑎᒪᓚᐅᖅᑎᓪᓗᒋᑦ ᔫᓂ 2008-ᖑᑎᓪᓗᒍ, ᒪᐃᔭᓗ ᐊᒻᒪ ᑎᑎᕋᖅᑎᕆᑲᐃᓐᓇᖅᑕᖓᑦ, Hᐊᒪᓚᒃᑯᓪᓗ ᑲᑎᒪᔩᖏᑦ ᐊᒻᒪ ᓄᓇᓕᖕᓄᑦ ᒐᕙᒪᒃᑯᓐᓄᓪᓗ ᐱᔨᑦᓯᖅᑎᒃᑯᑦ ᐱᓕᕆᔩᖏᑦ ᑭᕙᓪᓕᕐᒥ. ᑕᐃᑲᓂ ᑲᑎᒪᓂᖃᖅᑎᓪᓗᒋᑦ, ᑲᔪᓯᔪᓂᒃ ᐊᐅᓚᑦᑎᔾᔪᑎᓂᒃ ᐱᔾᔪᑎᖃᓚᐅᖅᑐᑦ ᑕᕆᓕᕐᓂᒃ ᐊᒃᑕᕐᕕᖕᒥᒃ ᐃᓱᒫᓗᒍᑎᖃᓚᐅᖅᑐᑦ ᐊᒻᒪ ᑎᒃᑕᐅᖃᑦᑕᕐᓂᖏᓐᓂᒃ ᐊᒃᑕᐃᑦ ᑕᐃᑲᓐᖓᑦ ᐊᒃᑕᕐᕕᖕᒥᑦ ᓯᕿᖅᓯᑐᐃᓐᓇᓇᐊᖃᕐᒪᑕ ᓄᓇᓕᖕᓂᕐᒥᐅᑦ ᐃᒪᖃᕐᕕᖑᓐᓂᒃ ᐊᒻᒪ ᓄᓇᐅᑉ ᐱᐅᓂᖓ ᓱᕐᑦᑎᔭᐅᓪᓗᓂ. ᒪᕿᖕᓂᒃ ᓇᓕᕌᕿᑑᖕᓂᒃ ᓴᖅᑭᑦᑎᖃᓚᐅᖅᑐᖅ ᑕᒪᑐᒨᖓ ᑭᒡᒍᓯᐊᓂᐊᕐᓗᑎᒃ:

1. ᐋᖅᑭᒡᑕᐅᓗᓂ ᒫᓐᓇ ᐱᔾᔪᑎᐅᔪᑦ ᐱᓪᓗᒍ ᒫᓐᓇᐅᔪᖅ ᑕᕆᓕᖕᓄᑦ ᐊᒃᑕᕐᕕᐅᔪᑉ ᐃᓂᖓ; ᐊᒻᒪ

2. ᓇᓗᓇᐃᖅᓯᓗᑎᒃ ᓄᑖᓂᒃ ᐃᓂᒃᓴᐅᓂᐊᖅᑐᒥᒃ ᓯᕗᓂᒃᓴᒧᑦ ᓯᕙᑐᔪᒧᑦ ᑕᕆᓕᖕᓄᑦ ᐊᒃᑕᕐᕕᒃᓴᐅᓂᐊᖅᑐᒥᒃ.

ᐅᑯᐊ ᐅᓂᒃᑳᖅᓯᒪᔪᑦ ᓇᓗᓇᐃᖅᓯᓯᒪᓂᑦ ᖃᐅᔨᓴᕐᓂᐅᑉ ᐃᖕᕆᕋᓂᕆᓚᐅᖅᑕᖑᒐᓂᒃ ᕿᒥᕐᕈᓇᒃᑎᓪᓗᒋᑦ ᒪᕿᖕᓂᒃ ᓇᓕᕌᕿᑑᖕᓂᒃ ᐊᒻᒪ ᐊᑐᓕᕐᑯᔭᓕᐅᖅᓯᒪᓪᓗᑎᒃ ᓯᕙᑐᔪᒧᑦ ᐊᑐᖅᑕᐅᓂᐊᕐᓗᓂ ᐸᕐᓇᐅᑎᒃᓴᖑᓐᓂᒃ Hᐊᒪᓚᒃᑯᑦ ᑕᕆᓕᖕᓄᑦ ᐊᒃᑕᕐᕕᒃᓴᖑᓐᓄᑦ ᑭᓐᖑᒫᔭᕆᓐᓄᑦ.

ᑖᒃᑯᐊ ᐱᓕᕆᓂᐊᖅᑐᑦ ᓯᕗᓪᓕᖅᐹᒥ ᑎᓕᔭᐅᓯᒪᕗᑦ ᕿᒥᕐᕈᓇᖁᔭᐅᓪᓗᑎᒃ HᐊᒪᓚᒃᑯᑦC ᒫᓐᓇᐅᔪᖅ ᑕᕆᓕᖕᓄᑦ ᐊᒃᑕᕐᕕᕆᔭᖑᓂᒃ. HᐊᒪᓚᒃᑯᑦC ᑕᕆᓕᖕᓄᑦ ᐊᒃᑕᕐᕕᖓᑦ ᒫᓐᓇ ᐅᖓᓯᖕᓂᖃᖅᑐᖅ 2 ᕿᓚᒥᑐᓂᒃ ᐅᐊᖕᓇᖕᖓᓂ ᓄᓇᓕᐅᔪᑦ ᐊᒻᒪ ᓴᐅᓯᕝᕕᖃᕐᓗᓂ, ᓴᕕᕋᔾᔪᓄᓪᓗ ᐊᒃᑕᕐᕕᖃᕐᓗᓂ, ᐊᑦᑕᓇᖅᑐᓄᓪᓗ ᐃᒋᑕᐅᓂᑯᓄᑦ ᐃᓂᖃᕐᕕᖃᕐᓗᓂ ᐊᒻᒪ ᕿᔪᐃᑦ ᐃᒋᑕᐅᓯᒪᔪᑦ ᖃᓕᓃᓕᖅᑎᓯᒪᓪᓗᑎᒃ. ᓄᓇᓕᐅᔪᑦ ᐃᒥᖅᑕᕐᕕᖓ ᐅᖓᓯᖕᓂᖃᕐᓗᓂ 1.5 ᕿᓚᒥᑐᓂᒃ ᐅᐊᖕᓇᖕᖓᓂᑦ ᓄᓇᐅᑉ ᓴᐅᓯᕝᕕᐅᑉ. ᑖᓐᓇ ᐊᑦᑕᕐᕕᒃ ᓴᓇᔭᐅᓚᐅᖅᓯᒪᔪᖅ 2002-ᖑᑎᓪᓗᒍ ᐊᒻᒪ ᐱᖃᓯᐅᔾᔨᓯᒪᓪᓗᓂ ᓴᓇᔭᐅᓯᒪᔪᒥᒃ ᐅᖓᓗᓯᒪᓪᓗᓂ ᓄᓇᒥᒃ ᓴᐃᒨᖃᓗᓂ ᐃᓱᐊᓂ ᑕᐃᕙᑦᓯᒪ ᓇᖅᓴᑯᐸ. ᒫᓐᓇᐅᔪᖅ ᓴᐃᒨᓂᔭᖓᑦ 1.8 ᒥᑕᓂᒃ ᐳᖅᑐᓂᓕᒃ ᐊᒻᒪ ᑎᑭᓯᒪᕆᑦᑐᖅ ᐊᕙᓗᓕᐊᓇᓯᒪᔪᒧᑦ ᓄᓇᔪᑦ ᐊᑕᕆᖅᓗᒍᓗ ᐊᒃᑕᕐᕕᒃ ᐊᕙᓗᓯᒪᓇᓂ. ᐱᓕᕆᐅᕐᑐᑦ ᓇᓗᓇᐃᖅᓯᓚᐅᖅᑐᑦ ᐅᓄᑲᓪᒪᒃᑐᓂᒃ ᐊᑲᐅᙱᓕᐅᕈᑎᓂᒃ ᑕᐃᑲᓂ ᐊᑦᑕᕐᕕᕆᔭᐅᔪᖅ ᑲᒪᕆᔭᐅᒃᑲᓐᓂᓇᐊᖅᑲᖅᑐᖅ, ᑭᓯᐊᓂᓕ ᐱᔾᔪᑎᓪᓗᐊᑕᖓ ᓴᐃᒨᖅ ᐃᓚᒃᑮᓂᖓᓄᑦ ᑎᒃᑕᐅᖃᑦᑕᖅᐳᑦ ᓴᓂᑦ ᑕᐃᑲᓐᖓᑦ ᐊᒃᑕᕐᕕᖕᒥᑦ. ᐱᓕᕆᔨᐅᔪᑦ ᐊᑐᓕᕐᑯᔭᓕᐅᓚᐅᖅᑐᑦ ᓴᐃᒨᖓ ᐳᖅᑐᓯᕆᐊᖅᑕᐅᕐᑯᓪᓗᒍ ᐊᒻᒪ ᐊᕙᓗᓕᒫᖓ ᓴᐃᒨᓕᖅᑕᐅᓗᓂ.

ᐃᓚᕆᓪᓗᓂᐅᒃ ᑕᒪᑐᒪ ᖃᐅᔨᓴᕐᓂᐅᑉ ᐱᓕᕆᔨᐅᔪᑦ ᑎᓕᔭᐅᓚᐅᕐᒥᔪᑦ ᓴᓇᖃᑎᖃᕐᑯᓪᓗᑎᒃ ᓄᓇᓕᖕᓂ ᓇᓗᓇᐃᖅᓯᓇᓱᒃᑎᓪᓗᑎᒃ ᓄᑖᒥᒃ ᑕᕆᓕᖕᓄᑦ ᐊᒃᑕᕐᕕᒃᓴᐅᓂᐊᖅᑐᒥᒃ. ᐱᓕᕆᔨᐅᔪᑦ ᑐᓴᕐᓯᐊᕐᓯᒪᔪᑦ Hᐊᒪᓚᒃᑯᓐᓂᑦ, ᓇᓗᓇᐃᖅᓯᓚᐅᕐᕈᑎᒡᓗ 6-ᓂᒃ ᐃᓂᒃᓴᐅᕙᒃᑐᓂᒃ ᐃᓱᒪᒃᓴᖅᓯᐅᕈᑕᐅᓂᐊᕐᒪᑕ. ᒪᕐᕉᒃ ᐃᓂᒃᓴᐅᔪᑦ ᓇᓗᓇᐃᖅᑕᐅᓚᐅᖅᑐᑦ ᓇᓕᕌᕿᑦ A-ᖑᓂᖅᑕᐅᓪᓗᓂ ᐊᒻᒪ B, ᓇᓗᓇᐃᖅᑕᐅᓚᐅᖅᑐᑦ ᑕᑯᓇᒃᑕᐅᓚᐅᕋᖅᑖᖅᑎᓪᓗᒋᑦ. ᓇᓕᕌᕿᑦ A ᐊᑕᖅᑕᐅᕙᓚᐅᖅᑐᖅ ᒥᑦᑕᕐᕕᓕᕆᔨᒃᑯᓐᓂᑦ ᑐᐊᐸᓕᖅᓱᖅᑕᐅᓪᓗᓂ ᒥᑦᑕᕐᕕᒃ ᑕᐃᑲᓐᖓᑦ. ᓇᓕᕌᕿᑦ B ᐅᐊᖕᓇᖕᖓᑕ ᐱᖕᖓᓇᖅᐸᓯᖕᖓᓂᑦᑐᖅ ᓄᓇᓕᐅᔪᑦ, ᑕᐅᕙᓐᖓᑦ ᑐᐊᐸᑕᕐᕕᐅᕙᓚᐅᖅᑐᒥᑦ Hᐊᒪᓚᒃᑯᓐᓂᑦ. ᑖᒃᑯᐊ ᐃᓂᒃᓴᐅᔪᓐᓇᖅᑐᑦ ᑐᓂᔭᐅᓚᐅᖅᑐᑦ HᐊᒪᓚᒃᑯᑦC ᑲᑎᒪᔩᖏᓐᓄᑦ ᐊᒻᒪ ᐃᓂᐅᔪᑦ ᓈᒻᒪᒋᔭᐅᓚᐅᕆᒻᒪᑕ ᐃᓱᒪᒃᓴᖅᓯᐅᕈᑕᐅᒃᑲᓂᓚᐅᕆᑦᑐᑦ. ᑕᐃᑦᓱᒪᓂ ᑕᑯᔭᖅᑐᖅᑎᓪᓗᒋᑦ, ᑎᓴᒪᒃᑲᓂᖕᓂᒃ ᐃᓂᒃᓴᓂᒃ ᓇᓗᓇᐃᖅᓯᓚᐅᖅᑐᑦ ᑐᓴᕐᓯᐊᓚᐅᖅᑎᓪᓗᒋᑦ HᐊᒪᓚᒃᑯᑦC ᑲᑎᒪᔩᖏᓐᓂᑦ. ᐃᓂᒃᓴᐅᔪᖅ 1 ᑕᐅᕙᓂᑦᑐᖅ ᐃᒡᓗᖕᒋᖕᖓᓂ ᓂᕆᖅᐸᓯᐊᓂ ᐊᑦᑕᕐᕕᐅᑉ. ᐃᓂᒃᓴᐅᔪᓐᓇᖅᑐᖅ 2 ᑕᐅᕙᓂᑦᑐᖅ ᓂᕆᐊᓂ ᐃᓂᒃᓴᐅᔪᓐᓇᖅᑑᑉ 1. ᐃᓂᒃᓴᐅᔪᓐᓇᖅᑐᖅ 3 ᐊᒻᒪ 4 ᑕᐅᕙᓂᑦᑐᑦ ᐱᖕᖓᓇᖕᖓᓂ ᐃᑎᖅᓴᐅᑉ ᐊᒻᒪ ᑲᓇᖕᓇᖕᖓᓂᓪᓗᓂ ᓄᓇᓕᐅᑉ. ᐊᓯᖏᑦ ᐃᓂᒃᓴᐅᔪᓐᓇᖅᑐᑦ 1 ᐊᒻᒪ 3 ᐊᖅᑯᑎᖅᑕᖅᑐᑦ HᐊᒪᓚᒃᑯᑦC ᑕᐅᕗᖓ, ᐊᐃᑉᐸᖏᑦ ᐃᓂᒃᓴᐅᔪᓐᓇᖅᑐᑦ 3 ᐊᒻᒪ 4

ᐊᖅᑯᑎᖅᑕᑎᒃ ᐃᓱᓇᐅᔪᖅ ᑕᐅᕐᓱᓚᐅᔪᒥᒃ. ᐊᑐᓂ ᐃᓂᒃᓴᐅᔪᓱᓇᖅᑐᑦ ᐱᕕᖅᑕᓕᐊᖅᑐᑦ ᓕᕆᑐᑐᔪᑦ ᐊᑐᖅᑕᐅᔪᓱᓇᖏᑦᑐᒃ ᐊᐳᑕᕐᓂᔪᓂᑦ ᑕᖅᑕᓕᕆᔨᔪᑦ ᑕᖅᑕᓱᓄᑦ ᓄᓇᕗᓂᒡᓗᓂ. ᑎᓴᒪᐅᔪᑦ ᓇᒥᕋᐅᑎᑦ, ᓇᒥᕋᕐᑕᑦ 2 ᐱᐅᕈᓚᐅᓂᖅᓯᒪᔭᐅᖅᑐᑦ ᑕᖅᑕᓱᓄᑦ ᐊᐳᑕᕐᕕᕈᓚᐅᓂᖅᑐᑦ ᐃᓂᒃᓴᐅᓂᐊᖅᑐᑦ ᐃᓂᒃᓴᐅᓂᐊᖅᑐᑦ.

ᖃᓪᓕᖅᑎᓯᒪᓕᑦ ᒪᒥᑲᓂᔭᕐᓂᖅᑐᑦ ᐱᖅᓯᐅᖅᓴᓯᒪᓂᒃ ᐊᐸᑐᔪᓂᒃ ᐊᓯᐅᓂᓐᓇᖅᑐᒃ, ᐊᑯᓂᐅᓂᓐᓄᑦ ᐊᑐᖅᑕᐅᓂᓐᓄᒪᑦ ᐊᐸᖅᓯᒪᓂᒃ, ᐊᒻᒪ ᓄᓇᕗᓂᒡᓗᓂ ᐅᓪᒪᑎᐅᖅᓯᒪᓕᖅᑎᑦ ᐊᒻᒪ ᐊᑐᖅᑕᐅᔪᓱᓇᖅᑎᓂᒃ ᐅᑯᓄᖅ:

1. ᓴᓂᒪᖅᓴᖅᑕᐅᓂᓂᒃ ᐃᓱᓇᐅᔪᖅ ᐊᖅᑕᓕᕆᔨᐅᔪᖅ ᐃᑎᑦᓯᐊᐅᕐᓚᖅᑐᖅ;

2. ᓴᓂᒪᖅᓴᐃᓂᓂᒃ ᐊᒻᒪ ᐊᖏᑎᑕᑭᖅᑕᐅᓂᓂᒃ ᐃᓱᓇᐅᔪᖅ ᑕᖏᑦᓂᖏᓂ ᐊᖅᑕᓕᕆᔨᔪᑦ; ᐊᒻᒪ

3. ᓴᓇᓂᑎᒃ ᓄᑦᖃᑦᑐᒃ ᑕᖏᑦᓂᖏᓂ ᐊᖅᑕᓕᐅᓂᐊᖅᑐᑦᑐᒃ.

ᖃᓪᓕᖅᑐᓂᓴᐅᔪᖅᑐᖅ ᓇᒥᕋᕐᑕᑎᓂᒃ ᐋᖅᑭᒃᓯᒪᔭᐅᖅᑐᑦ ᓴᓂᒪᖅᓴᖅᑕᐅᔪᓴᓇᖅᑲᖅᓯᖏᓂᒃ ᐃᓱᓇᐅᔪᖅ ᑕᖏᑦᓂᖏᓂ ᐊᖅᑕᓕᕆᔨᔪᖅ ᐊᑐᖅᑕᐅᔪᒪᓂᖅᓴᐅᔭᓂᐅᓂ. ᑭᓯᐊᓂᑦ, ᓴᓂᒪᖅᓴᐃᓂᖅᑐᖅ ᐃᓱᓇᐅᔪᖅ ᐊᖅᑕᓕᖏᑦᑐᒃ ᓇᓂᓇᐃᖅᑕᐅᑕᐅᖅᑐᑦᖅ ᐊᑐᓪᓗᐊᓂᔪᑦ ᓇᒥᕋᕐᑎᑎᑐᒃ, ᓴᓇᐅᐅᓂᖏᓐᓄᒃ ᓄᑦᖃᑦᑐᒃ ᐊᖅᑕᓕᖏᑦᑐᒃ ᖃᓄᐃᓕᓴᕐᓯᓂᖅᑐᑦᑐᖅᓴᐅᑕᓇᖅᑐᑦ.

ᐊᑐᓪᓗᐊᓂᕆᔨᔪᑦ ᓄᓇᕗᓂᒡᓗᓂ ᐊᑐᖅᑕᐅᔪᓱᓇᖅᑐᓂ ᐸᖏᐅᑎ ᑕᖏᑦᓂᖏᓂ ᐊᖅᑕᓕᕆᒃ ᕼᐊᒪᓚᒃᑯᑦ ᓴᓂᒪᖅᓴᖅᑕᐅᓂᒃ ᐃᓱᓇᐅᔪᖅ ᐊᖅᑕᓕᖏᓐᓂᖅᓴᖅᑎᑦ ᐃᓄᐃᒧᐊᑐᐅᓂᑦ. ᑕᒃᑯᐊ ᐱᖅᓄᐅᖅᓴᓄᓪᓕᐅᔪᑦ ᓴᓇᓂᑎᒃ ᓄᑦᖃᑦᑐᒃ 3 ᒥᑕᓂᒃ ᐳᖅᑐᓂᖅᑲᖅᓱᓂᒃ ᐊᐅᔪᓚᐃᖏᓐ ᐊᖅᑕᓕᐅᔨᑦ ᐊᒻᒪ ᐊᑐᓚᖅᑎᑎᑐᓂᒃ ᐊᐅᓚᑎᑎᓴᐃᑎᓂᑦ ᐱᐅᓴᓗᐅᓂᐊᖅᑐᖅᑐᒃ, ᑕᒃᑯᐊ ᓴᓂᑦ ᑎᒃᑕᐅᔪᕐᓂᓂᖅᓴᐅᓂᐊᖅᓯᒪᓕᑦ.

ᐅᖅᑲᓄᔪᓴᐅᖅᑲᑲᐅᔪᖅ ᐅᐊᑎᑎᐊᖅ ᒪᓚᓐᓗᒍ, ᖃᓪᓕᖅᑐᓂᖅ ᓴᓇᓂᑎᖅᑲᖅᑕᐅᓂᓴᖅᓴᑦᑕ ᐃᓱᓇ ᐊᖅᑕᓕᕆᔨᑦ ᐊᒻᒪ ᖃᓪᓕᖅᑐᓂᖅ ᓄᑦᖃᑦᑐᒃ ᐊᖅᑕᓕᕆᓚᐅᓂᐊᖅᓯᒪᔪᑦ ᑕᐅᔭᓂ ᐃᓂᒃᓴᐅᓂᐊᖅᑐᑦ 2-ᒥ ᐊᔪᔨᑦᑎᐊᑐᐃᓇᓚᐅᖅᓴᑦ. ᐊᔪᔨᑲᓴᕐᓂᑐᓂᒃ ᐊᑐᔾᓂᖅᑐᒃ ᖃᓪᓕᖅᑐᓇᓴᑎᓂᒃ ᓴᓇᓂᑎᒃ ᐊᑐᔾᓂᓴᕐᓂᑐᓂᒃ ᐊᑐᓚᖅᑎᑎᑐᓂᖅᓴᖅᑐᐃᓐᓇᐅᔪᑦ.

Executive Summary

Trow Associates Inc. (Trow) was retained by the Hamlet of Repulse Bay (Hamlet) to complete a long term sustainable design plan for the disposal of the Hamlet's solid waste.

This report is the result of a meeting in June of 2008, between the Mayor, acting SAO, Council of the Hamlet and CGS (Kivalliq). At this meeting, ongoing operational issues of the existing solid waste disposal site was raised including the issue of windblown trash from the current waste facility with regards to the potential contamination of the community's potable water supply and the damaging effect on the aesthetic view of the land. Two options were brought forth to address this issue:

1. To resolve the immediate issues regarding the current waste disposal site; and

2. Identify new sites for the construction of a future long term solid waste disposal facility.

The following report describes the study process to assess these two options and it provides recommendations for a long term sustainable plan for the Hamlet's solid waste disposal requirements.

The project team's first task was to assess the Hamlet's current waste disposal facility. The Hamlet's existing solid waste facility is located approximately 2 kms to the north of the community and is comprised of a landfill area, a bulky metal waste disposal area, a hazardous waste storage area and a wood stockpile. The community's water supply is located approximately 1.5 kms north of the landfill. The existing facility was constructed in 2002 and includes the construction of an earth berm topped with a fence at the end of a small valley. The existing fence is approximately 1.8 m high and does not extend across the entire berm nor does in extend around the entire facility. The project team identified several deficiencies at the existing waste disposal site that required attention however, the main issue was that the existing fencing is insufficient to prevent windblown garbage escaping from the facility. The project team recommended that the fence should be increased in height and constructed to enclose the entire site.

As part of this study the project team was also tasked to work with the community to identify a new solid waste disposal facility. The project team in consultation with the Hamlet, identified a total of 6 alternate sites for consideration. The first two (2) sites referred to as Alternatives A and B, were identified during the initial site visit. Alternate A was the area previously used by the Airport Authority to excavate material for the existing airport runway. Alternate B was to the northwest of the community, an area previously used by the municipality for gravel extraction. These sites were presented to the Hamlet's Council and they were deemed unacceptable for further consideration. During a subsequent site visit, four (4) additional locations were identified through consultation with the Hamlet Council. Alternate site 1 is located on the opposite side (south edge) of the same gorge as the existing facility. Alternate site 2 is located to the south of alternate site 1. Alternate sites 3 and 4 are located on the west edge of a gorge that is located to the east of the community. Alternate sites 1 and 2 have existing access by Hamlet roads, while alternate sites 3 and 4 have no road access at the present time. Each of

the alternate locations provides an adequate configuration for the development of a long term solid waste facility for the community. Of the 4 alternatives options, alternative 2 was deemed to be the best potential site for a new solid waste disposal facility.

A set of evaluation criteria including Capital Cost, Life Cycle Cost, and Community Acceptance were weighted and applied against the following alternative options:

1. Remediation of the existing solid waste disposal facility;

2. Remediation and expansion of the existing solid waste disposal facility; and

3. Construction of a new solid waste disposal facility.

The evaluation of the alternative options concluded that the remediation of the existing solid waste facility waste is the preferred option. However, while the remediation of the existing site was determined to be recommended option, the construction of a new waste disposal facility scored equally as high.

The recommended long term sustainable plan for the solid waste facility for the Hamlet is to remediate the existing facility to address the ongoing operational issues. This includes the construction of a new 3 m high fence around the entire facility and adopting operational practices, which will also assist in eliminating the amount of windborne trash.

As previously mentioned, the evaluation of the remediation of the existing facility versus the construction of a new facility at alternate site 2 was a virtual tie. A different emphasis on the weight of the evaluation criteria may have resulted in a different recommendation.

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1.0 Introduction

Trow Associates Inc. (Trow) was retained by the Hamlet of Repulse Bay (Hamlet) to complete the Long Term Sustainable Design Plan solid waste facility for the Hamlet.

At a meeting held on June 5, 2008 between CGS (Kivalliq), the Mayor, acting SAO and Council of Repulse Bay, concerns were brought forward regarding the location of the existing solid waste facility in relationship to the Hamlet and their water supply. At present, prevailing winds blow trash outside the current facility's limits, potentially contaminating the community's potable water and damaging the aesthetic view of the land. There are also concerns regarding potential leaching from the hazardous wastes.

As a result of the meeting two options were brought forth: 1) fix the immediate problem regarding the escaping garbage; test the nearby water source; test leachate from solid waste in the water surrounding the existing solid waste site, and equip the existing facility to meet the needs of the Hamlet for the next 20 years; or 2) identify new site locations, and construct a new long term facility to accommodate the Hamlet's needs over the next 20 years. The following report will assess if rehabilitation of the existing facility or construction of a new facility provides the best Long Term Sustainable Plan for the Hamlet's solid waste disposal requirements.

As part of the evaluation a potential new site must be chosen. For this evaluation, a list of alternate sites was developed through consultation with the Hamlet, and a preferred site was selected. This site was then compared to the redevelopment of the existing site. It should be noted that if the decision to construct a new facility is made, a more comprehensive site selection process, including addition public consultation would be required.

2.0 Background

2.1. Location

The Hamlet of Repulse Bay is located on the south side of Rae Isthmus between the Gulf of Bootia and Southampton Island at the north shore of Repulse Bay as shown on Figure 1. It lies on the on the Arctic Circle and is in the Kivalliq Region of Nunavut.

2.2. Climate

Repulse Bay receives an annual total precipitation of 15.6 cm of rain and 130.7 cm of snowfall. The July average high and low temperatures are 16 and 6 °C and the January average high and low temperatures are -29.5 and -36.4 °C. The predominate winds are from the north at an average speed of 23 km/hr.

2.3. Topography, Geology and Morphology

Repulse Bay is located on a steeply cliffed coastline with hills and valleys carved from the bedrock. The area is dominated by bedrock ridges and glaciomarine deposits. The bedrock is mapped as Archean Granitoid and also includes Precambrian rocks. The soil cover is a mix of glacial and non glacial overburden, including deposits of sand and silt with mixed cobble and boulders.

2.4. Existing Solid Waste Facility

The Hamlet's existing solid waste facility is located approximately 2 km to the north of the community as shown on Figure 2. It is comprised of a landfill (also referred to as the Municipal Solid Waste Disposal Area), bulky metals disposal area, hazardous waste storage area; and a wood stockpile, as shown in Figure 3. The community water supply is located 1.5 km north of the existing facility.

The existing facility was constructed in 2004. The south-east end of the waste disposal area is enclosed with an earthen constructed berm topped with a fence. This fence does not span the full length of the berm leaving approximately 25 metres at either end of the berm unfenced.

The waste disposal area has been designed as a natural attenuation landfill and has no liner. Therefore, it is very important that hazardous wastes are removed from the general waste prior to disposal, thus preventing potential contamination of the groundwater.

The current operation of the waste management facility includes the placement of large metal items and wood in an area separated from the waste disposal area. Paper and cardboard material are sometimes separated from the general waste and burned.

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scale: N.T.S.	CLIENT: HAMLET OF REPULSE BAY	project no.: OTCD19713A
date: 09/01/09		
drawn by: M BERRIGAN	TITLE: LOCATION PLAN	FIG.1

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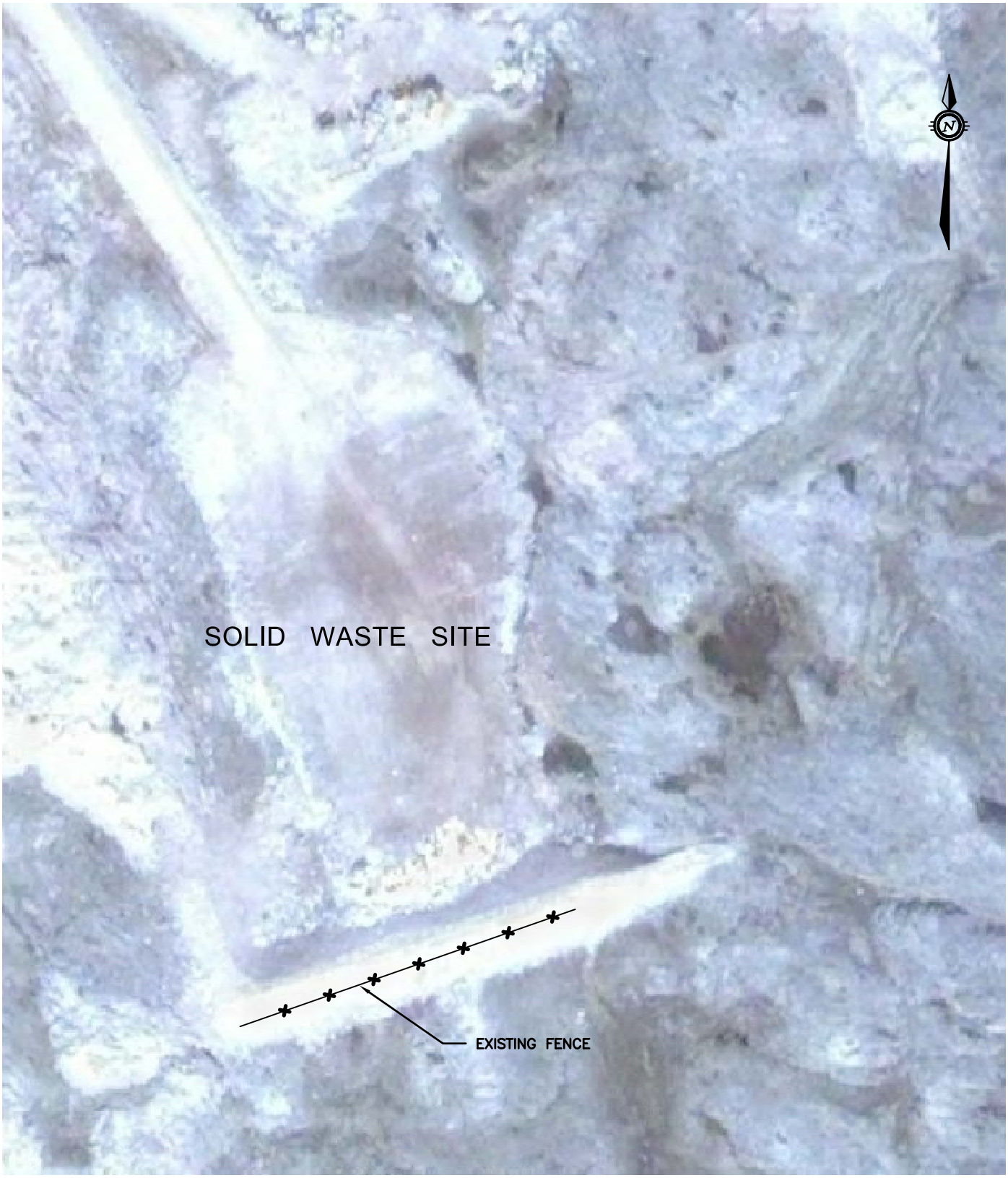
scale: N.T.S.	CLIENT: HAMLET OF REPULSE BAY	project no.: OTCD19713A
date: 09/01/09	TITLE: SITE PLAN	FIG.2
drawn by: M BERRIGAN		



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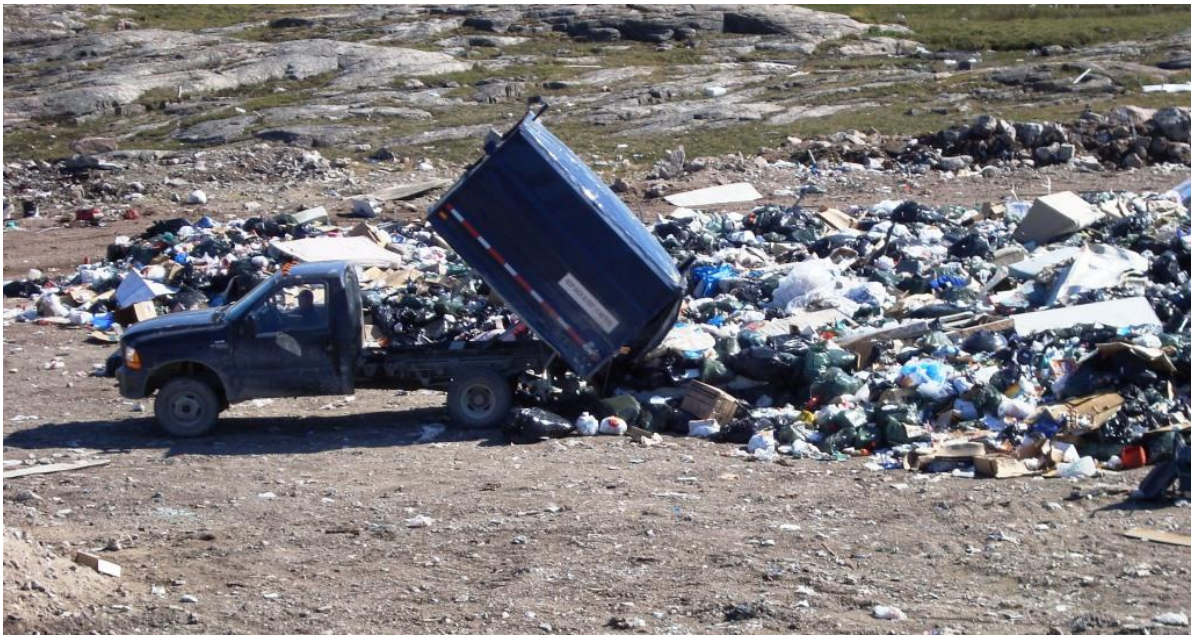
scale: N.T.S.	CLIENT: HAMLET OF REPULSE BAY	project no.: OTCD19713A
date: 09/01/09	TITLE: EXISTING CONDITIONS	FIG.3
drawn by: M.BERRIGAN		

Currently, there is a large pile of metal items located near the entrance of the Solid Waste Management facility. There is also a large pile of wood waste close to the leading edge of the existing waste disposal area. General waste is collected from the community in a side loading truck and deposited at the leading edge of the existing waste by the waste collection operator (Photograph 1). The waste material is not compacted or covered. Therefore, material tends to cause litter outside the waste management facility when it is blown around by the wind.

Photograph 1: Unloading Waste at the Hamlet's Waste Disposal Site



Presently, the Hamlet's Public Works Department has received additional hands on training for the day to day operations to help address the wind blown debris issue. Additional temporary fencing has also been installed to extend the fencing in an effort to better capture any wind blown debris.

Nuna Burnside Engineering and Environmental Ltd. developed an Interim Operation and Maintenance Plan, October 2006, for the Hamlet's current disposal facility. The Plan set out a prescribed list of policies governing the operation of the current solid waste disposal area. A copy of the Interim Operation and Maintenance Plan is attached as Appendix A.

2.5. Previous Waste Management Facility

The previous waste management facility, located to the north of the Hamlet, still has large metal items located onsite. It also has waste material above ground which can cause a hazard to the public. The previous site should be properly closed. A minimum of 60 cm of earthen material (preferably clay based material) should be spread and compacted across the entire site.

3.0 System Requirements

3.1. General

The proposed solid waste facility for the Hamlet must meet the long term needs of the community and the regulatory requirements of the Hamlet's water licence. The design horizon for this project shall be 20 years, until the year 2029.

3.2. Site Evaluation Criteria

The evaluation of a waste disposal site as part of a long term waste management strategy for the area is based on a number of considerations:

- As landfilling is the ultimate destination of unwanted or unusable waste, a sanitary landfill must be the primary disposal option for consideration when determining suitability of a site;
- The site must have the capacity to accommodate the Hamlet's waste for 20 years based on forecasted population data and current waste generation rates;
- The site must minimize the aesthetic impact of waste management;
- Biophysical environmental impact should be minimized;
- Prescribed restriction areas are to be applied when choosing a new location site;
- Minimum distances between the facility and the Hamlet's hunting grounds must be considered, and
- Maximize distances to water supplies, water courses, wetlands, and fish habitats.

3.3. Population

The population projections for this project will be based on "Nunavut: Community Population Projections" as published by the Nunavut Bureau of Statistics. The Nunavut Bureau of Statistics population projections provide projected populations of the Nunavut communities to the year 2020. As the planning horizon for this project is past the population projections available from the Nunavut Bureau of Statistics, the population projections from 2020 to 2029 are estimated using the average growth rate for the Hamlet between the year 2000 and 2020 of 2.5%. Table 3.1 below summarizes the population projections to the year 2029.

Table 3.1 - Population Projections

Planning Year	Year	Population	Planning Year	Year	Population
	2000	**615**	6	2015	**903**
	2001	**630**	7	2016	**928**
	2002	**648**	8	2017	**949**
	2003	**664**	9	2018	**970**
	2004	**682**	10	2019	**990**
	2005	**702**	11	2020	**1,012**
	2006	**720**	12	2021	**1,037**
	2007	**738**	13	2022	**1,063**
	2008	**757**	14	2023	**1,090**
0	2009	**777**	15	2024	**1,117**
1	2010	**797**	16	2025	**1,145**
2	2011	**818**	17	2026	**1,174**
3	2012	**838**	18	2027	**1,203**
4	2013	**858**	19	2028	**1,233**
5	2014	**881**	20	2029	**1,264**

3.4. Solid Waste Generation

Solid waste generation rates are published by the Department of Municipal and Community Affairs (MACA) of the Government of the Northwest Territories to estimate average waste quantities generated in northern communities. Trow used this formula, developed by MACA, to generate the yearly residential waste generation for the Hamlet over the next 20 years, based on the above population projections.

The population of the projected 20 year operational life span of the facility never exceeds 2000 residents; therefore, the equation for populations 0-2000 will be used for all solid waste values from Table 3.2. These equations produce the solid waste generated by the community over the course of a year. The yearly volumes are then cumulatively calculated to produce the projected volume of solid waste to be contained within the facility.

Table 3.2 – Solid Waste Generation Rates (MACA)

Community Population	Produced Per Capita
0 – 2000	Residential Rate x (1.0 + 0.00023 x Population)
2000 – 10,000	Residential Rate x [-1.0 + {0.323 x Ln(Population)}]
Over 10,000	Residential Rate x 2.0

3.5. Solid Waste Volumes

The solid waste within the facility will undergo stratified layers of compaction by a front end loader in lifts of 250 mm to 300 mm, gradually building up the waste across the designated fill area. These layers will be accompanied by a 100 mm layer of soil once per month in the summer, when the ground surface is no longer frozen, preventing trash from blowing offsite.

MACA standards expect the cumulative volumes to be reduced by a 3:1 ratio, totaling storage volume to a third as seen in Table 3.3. At the end of the 20 year projected duration, there is an expected 31,635 m^3 of solid waste to be contained. For the purpose of this study, a 10 percent allowance was included for cover material resulting in a total volume of storage required to be approximately 35,000 m^3. For the purpose of developing new sites a depth of 3 m was assumed resulting in a footprint of the disposal site being approximately 11,600 m^2 or approximately 110 m by 110 m.

3.6. Regulatory Requirements

The proposed solid waste facility will have to meet the standards as set out in the Hamlet's water licence. The Hamlet is operating under a valid water licence issued by the Nunavut Water Board, as required under the Nunavut Lands Claim Agreement and the Nunavut Waters Act.

Table 3.3 - Cumulative Waste Volume

Planning Year	Year	Population	Annual Volume Solid Waste m^3	Cumulative Volume Solid Waste m^3	Compacted Cumulative Volume Solid Waste m^3
0	2009	777	3,343	3,343	1,114
1	2010	797	3,442	6,785	2,262
2	2011	818	3,547	10,333	3,444
3	2012	838	3,648	13,981	4,660
4	2013	858	3,750	17,731	5,910
5	2014	881	3,867	21,598	7,199
6	2015	903	3,980	25,578	8,526
7	2016	928	4,110	29,688	9,896
8	2017	949	4,220	33,908	11,303
9	2018	970	4,330	38,239	12,746
10	2019	990	4,436	42,675	14,225
11	2020	1,012	4,554	47,229	15,743
12	2021	1,037	4,689	51,918	17,306
13	2022	1,063	4,830	56,748	18,916
14	2023	1,090	4,975	61,723	20,574
15	2024	1,117	5,125	66,848	22,283
16	2025	1,145	5,280	72,127	24,042
17	2026	1,174	5,440	77,567	25,856
18	2027	1,203	5,606	83,173	27,724
19	2028	1,233	5,777	88,950	29,650
20	**2029**	**1,264**	**5,954**	**94,904**	**31,635**

4.0 Evaluation of Alternatives

4.1. Evaluation Process

The evaluation of the alternatives put forth will be undertaken utilizing a decision matrix. The decision matrix is a tool which evaluates each of the alternatives against a predetermined set of criteria, which are in turn are weighted due to importance in the decision process. The alternative which receives the highest total score is deemed to be the recommended or preferred alternative. A prescreen of alternatives is generally undertaken to eliminate any alternatives that do not meet the minimum requirements of the facility. These minimum requirements are referred to as "must" criteria. Any alternative that does not meet the minimum requirements of the "must" criteria will be eliminated from further consideration.

The second set of criteria that the alternatives are rated against is referred to as "want" criteria. The want criteria are weighted based on their importance to the decision-making process. Each alternative is then rated between 1 and 10 against these criteria. The product of the alternative's rating and the criteria's weight is the weighted score for the alternative against that criterion. The sum of the weighted scores is the total score for each alternative. The alternative with the highest total weighted score is deemed the preferred or recommended alternative.

4.1.1. "Must" Criteria

For the evaluation of the Solid Waste Facility the "must" criteria are listed below:

1. Residential Setback: The Site must be outside the 450 m residential setback.
2. Regulatory requirements: the alternative must be required to meet the regulatory requirements as set out in the Hamlet's water licence.

4.1.2. "Want" Criteria

The evaluation of the Solid Waste Facility is based on the following "want" criteria and weighting:

1. Capital Cost: Minimizing the capital cost of an alternative is an objective of the project. (criterion weight – 10)
2. Life Cycle Cost: Life cycle cost analysis is an evaluation method for alternatives which provides a common basis of evaluation by incorporating expenditures over the study period. (criterion weight – 8)
3. Community Acceptance: Acceptance of the facility is important for any operation as it will generally lead to a better operated facility. (criterion weight – 7)

5.0 Life Cycle Cost

5.1. Life Cycle Cost Analysis Methods

Life cycle cost analysis is an evaluation method for alternatives which provides a common basis of evaluation by incorporating expenditures over the study period. A life cycle cost analysis does not take into account factors such as social benefits, political desirability, quality or suitability of alternatives or levels of service. Used as part of a comparison process, which has considered other relevant factors, a life cycle cost analysis will determine the economic efficiency of the options and will assist in the comparison of alternatives.

An economic analysis of options must acknowledge all expenditures which occur during the life of the infrastructure. These costs include capital costs, future recapitalization and operational and maintenance costs. Life cycle cost analysis is typically expressed as a present value analysis in which future expenditures are converted into initial year investments using a discount rate. The option with the lowest present value is deemed to be the most cost effective.

The discount rate reflects the time value of money, and converts future costs to an equivalent present value. For Public Sector projects the rate reflects the "social opportunity cost rate".

To calculate the present value of expenditure the following formula is used:

$$PV = S_n \times (PVF)$$

$$= S_n \times \frac{1}{(1 + DR)^n}$$

$$PVF = \frac{1}{(1 + DR)^n}$$

Where, PV = Present Value of expenditure "S" ($)

S_n = Expenditure in Year n ($)

n = Number of years in the future the expenditure occurs

PVF = Present Value Factor

DR = Discount Rate (%)

In present value analysis the alternatives must be compared over a common time period. Equivalent uniform annual cost analysis must be used for capital investments with a life which extends beyond the analysis time period. This allows the analysis to account for the value of the investment at the end of the analysis period. The uniform annual cost analysis converts each capital expenditure into an equivalent uniform annual cost. These costs are then converted to a

present value for the portion of the alternatives designed life which is in the analysis. The equivalent uniform annual cost is calculated by the following formula:

$$EUAC = C \times CRF$$

$$CRF = \frac{DR\,(1 + DR)^{EL}}{(1 + DR)^{EL} - 1}$$

Where, EUAC = Equivalent uniform annual cost ($)

C = Capital expenditure ($)

CRF = Capital Recovery Factor

EL = Economic Life (years)

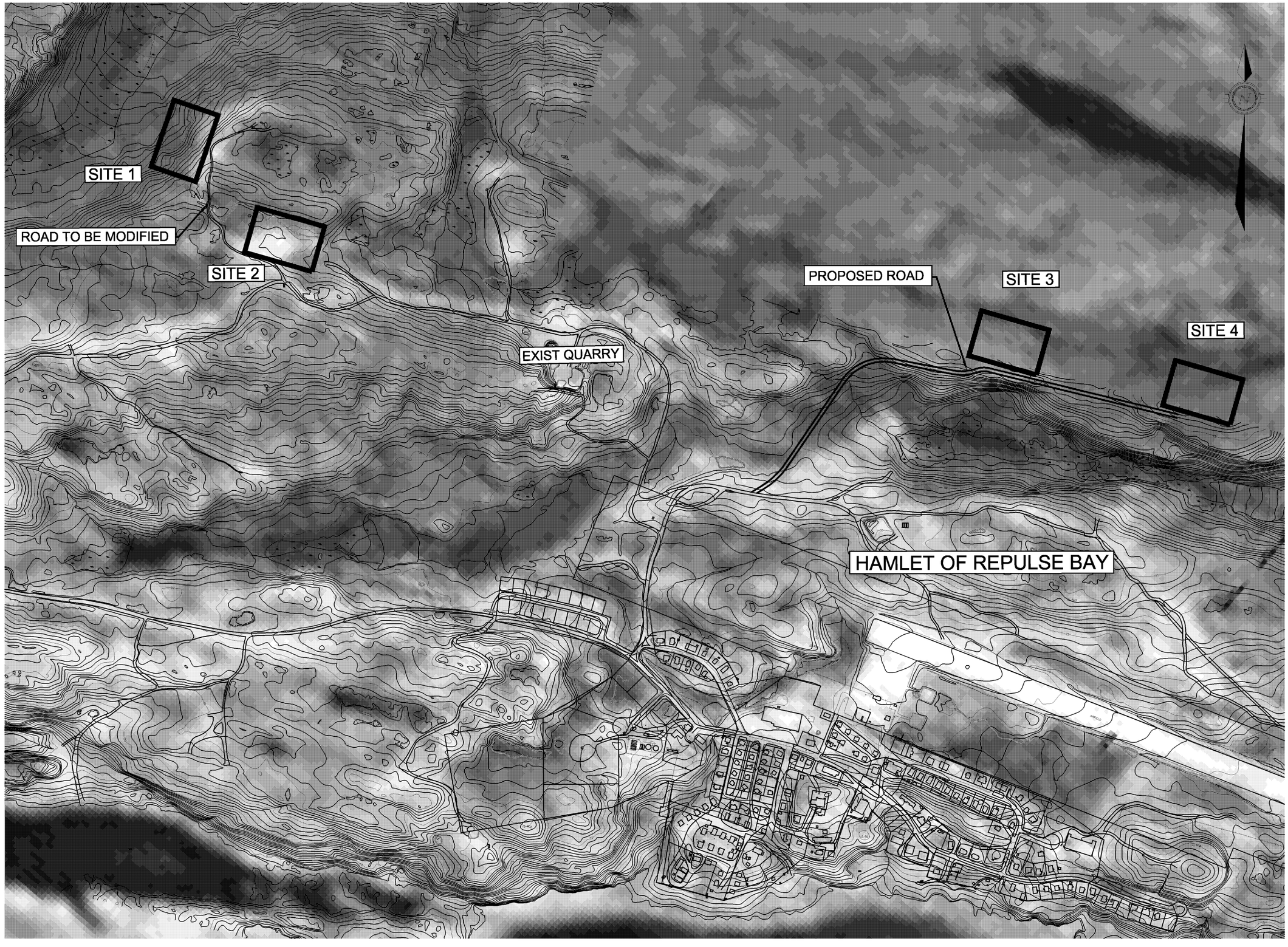
6.0 Alternative Waste Disposal Sites

A preliminary solid waste management site selection was conducted with the objective to identify potential sites for evaluation. Two potential locations were identified as suitable locations for a new site. One potential location for a solid waste disposal site is situated to the east of the community and was previously used by the Airport Authority to excavate material for the existing airport runway (Alternative A). A second site was identified to the northwest of the community that was previously used by the municipality for gravel extraction (Alternative B). However, when these sites were presented to the Hamlet Council several issues precluded them from being acceptable alternative solutions:

- The first alternative site is located in an area of the Hamlet that receives a large amount of snowfall and snow drifting in the winter months; and
- The second alternative site will be utilized in the near future for gravel extraction by the airport authority for additional runway material.

Based on these factors, Alternative A and Alternative B were considered unacceptable and were excluded from future consideration.

Upon the rejection of the first two alternative sites, four additional locations for alternative solid waste disposal sites were identified to the west of the community as shown on Figure 4. Alternative Sites 1, 3 and 4 have similar characteristics, with each site located along a rock face that is approximately 4-5 m high. Alternative Site 2 is situated adjacent to a 3-4 m high rock outcrop. Alternative Site 1 is located on the opposite side (the south edge) of the same gorge as the existing facility. Alternative Site 2 is located to the south of Alternative Site 1. Alternative Sites 3 and 4 are located on the west edge of a gorge that lies north to south. The gorge extends from the existing solid waste disposal site at the west end to a Hudson Bay Inlet at the east end of the gorge. Alternative sites 1 and 2 can be accessed by the existing Hamlet road. Alternative sites 3 and 4 have no road access at the present time. Each of the alternative locations provides an adequate configuration for the development of a long term solid waste disposal site for the community. Alternative sites 3 and 4 would provide a slightly deeper structure than alternative sites 1 and 2 which would help to alleviate the potential for litter to be blown out of the site. The base of all 4 alternative locations is mostly soil and loose rock which can be excavated to provide a good foundation for which the solid waste can be placed. The rock face at each of the alternative locations will provide a good structure to deposit and build up the solid waste to an appropriate elevation to meet its 20 year life span. All four alternative sites will require the development of an earth berm along the perimeter to enclose the site. Furthermore a properly constructed fence will need to be erected along the site perimeter for public safety, to keep out wildlife, and reduce wind blown litter. Alternative sites 3 and 4 would also require the construction of approximately 700 and 1000 metres of access road respectively.



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CLIENT:

HAMLET OF REPULSE BAY

TITLE:

POTENTIAL SITES

scale	1:8000
date	09/01/09
drawn by	M ROULEAU
project no.	OTCD19713A

FIG. 4

6.1. Capital Cost Estimates

The estimated capital cost for the development of the four alternate sites includes all the cost to develop an operational solid waste disposal site. The capital cost estimates provided are Class D estimates, and therefore are meant for planning and budgetary use only. All the estimates include a 20% contingency and a 15% allowance for engineering cost.

As described above, the four alternates have similar site features. The capital cost of developing the four sites includes the creation of a waste disposal area through the construction of a berm. For alternatives 1, 3 and 4 this will include excavating into the side of the escarpment and utilizing the excavated material for berm construction. The sites will be fenced, and an allowance has been provided for site drainage and preparation of a bulky metal disposal area, and general site preparation. For sites 3 and 4 the construction of an access road 700m or 1000m respectively, will be required.

The estimated capital cost for the four new sites are summarize in Table 6.1 – Capital costs. Breakdowns of the estimated capital costs are included in Appendix B.

Table 6.1 – Capital Cost

Alternative	Capital Cost
Alternative Site 1	$1,460,000
Alternative Site 2	$850,000
Alternative Site 3	$1,870,000
Alternative Site 4	$2,140,000

6.2. Life Cycle Costs

The four alternatives put forth have similar operating and maintenance costs, and therefore these costs are not to be included in the life cycle cost. As the sites all have a 20 year service life there is also no need for recapitalization of the facility. Therefore the life cycle cost will be equivalent to the capital cost. As such, for the evaluation of the alternative sites, life cycle costs will not be included in the evaluation as it would over emphasis the capital cost.

6.3. Evaluation of Alternative Sites

6.3.1. "Must" Criteria

The two criteria that the solid waste facility must meet are the ability to meet the Hamlet's requirements, i.e. to meet the needs of the projected population of the Hamlet and meet the regulatory requirements of the Hamlet's water licence as set out by the Nunavut Water Board.

All four alternatives meet the "must" criteria put forth for the evaluation of alternatives.

6.3.2. Assessment of Alternatives

The four alternatives for the Solid Waste Facility for the Hamlet were assessed against the "want" criteria presented in Section 4.1.2. The results of the assessment are summarized in the following sections.

6.3.2.1. Capital Costs (Weight 10)

Class D cost estimates were prepared for the four alternatives and are presented in detail in Appendix B. The capital cost, as well as score for each alternative and the weighted score are summarized in Table 6.2.

Table 6.2 – Capital Costs

Alternative	Capital Cost	Score
Alternative 1	$1,460,000	6
Alternative 2	$850,000	8
Alternative 3	$1,870,000	4
Alternative 4	$2,140,000	3

6.3.2.2. Life Cycle Costs (Weight 8)

As describe above, Life Cycle Costing is not included in the evaluation of these alternatives.

6.3.2.3. Community Acceptance (Weight 7)

A meeting with the Hamlet Council reiterated the community's concerns regarding the current solid waste disposal site. Hamlet Council preferred the alternative sites identified to the east of the community particularly alternative sites 2 through 4 identified in figure 4. They felt that these locations were:

- In an area that can be accessed during the winter period;
- An acceptable distance from the community;
- Does not interfere with the Hamlet airport;
- Does not interfere with potential expansion of the community; and
- Does not interfere with the community's primary hunting grounds.

Alternative 1 was acceptable to the community, however, during the site visit the community representatives indicated that it was the least acceptable site of the four alternatives.

Alternative 2 was acceptable to the community, however, during the site visit the community representatives indicated that alternatives 3 and 4 were preferred.

Alternatives 3 and 4 were acceptable to the community. During the site visit the community representatives indicated that they were the preferred locations.

A summary of the score for Community Acceptance for the four alternatives is summarized on table 6.3.

Table 6.3 – Community Acceptance

Alternative	Score
Alternative 1	5
Alternative 2	7
Alternative 3	9
Alternative 4	9

6.4. Analysis Summary

The evaluation of the four alternative sites, based on the above mentioned scoring, is shown on Table 6.4. Based on the scoring described above and the weighing of the options, Alternative 2 is recommended as the preferred site if a new facility is to be constructed.

Table 6.4 – Evaluation of Alternatives

Criteria	Weight	Alternative 1		Alternative 2		Alternative 3		Alternative 4	
		Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Capital Cost	10	6	60	8	80	4	40	3	30
Life cycle cost	NA								
Community Acceptance	7	5	35	7	49	9	63	9	63
Total Score									
Ranking			**95**		**129**		**103**		**93**

7.0 Existing Solid Waste Disposal Site

7.1. Existing Solid Waste Disposal Site

The existing solid waste disposal site consists of the following components:

- Large metal item storage area;
- Wood storage area;
- Hazardous waste storage area; and
- Waste disposal area.

The waste disposal area has been designed as a natural attenuation landfill and has no liner. The south-east end of the waste disposal area is enclosed with an earthen constructed berm. A 2 m fence has been constructed on top of the berm but the fence does not run along the full length of the berm. Approximately 25 m at either end of the bermed area remains unfenced.

Photograph 2: Waste Disposal Area Earth Berm and Fence

Photograph 3: Waste Disposal Area Earth Berm and Fence

The current operation of the waste management facility includes the placement of large metal items and wood in an area separate from the waste disposal area. Paper and cardboard material is sometimes separated from the general waste and burned. Currently, there is a large pile of metal items located near the entrance of the Solid Waste Management facility. There is also a large pile of wood waste close to the leading edge of the existing waste disposal area. General waste is collected from the community using a side loading waste collection vehicle and deposited at the leading edge of the existing waste by the waste collection operator. The waste material is not compacted or covered, therefore prevailing winds tend to blow material out of the disposal site, causing litter throughout the community.

7.2. Remediation Measures

Presently, the main social and environmental issues regarding the waste management site is the significant amount of wind blown material that leaves the site and litters the community. There are several remedial measures that have been recommended to alleviate this problem as follows:

1. The material deposited in the waste disposal area should be compacted regularly using a front end loader.
2. The materials should be covered with a minimum of 10 cm of soil at least once per month.
3. The existing fence situated along the berm needs to be continued at either end, to fully enclose the south end of the waste disposal area. It should also be increased in height to a minimum of 3 m.

Photograph 4: Waste Wood Pile at Existing Solid Waste Disposal Site

Photograph 5: Scrap Metal Area at Existing Solid Waste Disposal Site

4. The bulky steel items that have been stockpiled at the waste management facility should be transferred to a metal recovery facility for recycling. Currently, scrap metal has a very high value.
5. The stockpiled wood waste should be burned.
6. Hazardous waste should be transferred to a hazardous waste recovery facility.

These remedial measures will significantly reduce the amount of material presently located at the site and decrease the amount of material blown from the waste disposal area which is littering the surrounding area.

7.3. Service Life of Existing Facility

The interim Operations and Maintenance Manual prepared by Nuna Burnside reports that the as-built facility does not match the design drawing for the facility, and no as-built drawings were available. Based on the site visit and the information available, it appears that the berm at the end of the disposal cell would have to be raised approximately 1 m and extended around the site, to achieve the twenty year design life of the original design. It is estimated that the current facility has only 75% of the original design capacity or a 15 year life. As the facility was constructed in 2003, 5 years of the service life has been used, leaving an estimated 10 years for the current facility. It is estimated that if the existing facility is rehabilitated and expanded to match the original design the remaining service life would be approximately 15 years.

7.4. Capital Cost Estimates

The capital cost for the two alternates for the remediation of the existing facility was estimated based on the following. The first alternative was the remediation of the existing site to address the operational issues identified. This would allow the site to be used for an estimated 10 years before a new site would have to be developed. The second alternative was to raise and extend the existing berm to match the original design and install a new fence to address the operational issues identified. This would allow the site to be used for an estimated 15 years before a new site would have to be developed. The estimated capital cost for each alternative includes all the costs to develop an operational solid waste disposal site. The capital cost estimates provided are Class D estimates, and therefore are meant for planning and budgetary use only. All the estimates include a 20% contingency and a 15% allowance for engineering costs.

The estimated capital cost for the two alternate redevelopment alternatives are summarize in Table 7.1 – Capital costs. Breakdowns of the estimated capital costs are included in Appendix B.

Table 7.1 – Capital Cost Estimates

Alternative	Capital Cost
Alternative 5 - Remediate Existing Site	$290,000
Alternative 6 –Expand Existing Site	$510,000

7.5. Life Cycle Costs

As discussed with the development of the new alternatives, the operation and maintenance costs of all the sites are comparable and therefore have similar effect on the life cycle costs, and can therefore be excluded from consideration. As the redevelopment of the existing site will not meet the Hamlet's needs for the 20 year service life, these alternatives will include a recapitalization cost at the end of the useful life of the existing facility (estimated at 10 years for remediation and 15 years for expansion and remediation). For the purpose of this study, the recapitalization costs will be based on the development of the preferred alternative from Section 6. As discussed in Section 5, capital costs which do not match the 20 year design life must be calculated as Equivalent Uniform Annual costs which are subsequently converted to present Values for inclusion in the life cycle cost analysis. Details of the calculation of Equivalent Uniform Annual Costs and the Present Value for the two alternatives for rehabilitation of the existing site are included in Appendix C, and are summarized in Table 7.2.

Table 7.2 – Present Value of Rehabilitation Estimates

Alternative	Present Value
Alternative 5 - Remediate Existing Site	$559,079
Alternative 6 – Expand Existing Site	$618,968

7.6. Evaluation of Redevelopment Alternatives

7.6.1. "Must" Criteria

The two criteria that the Solid Waste Facility must meet are the ability to meet the Hamlet's requirements, i.e. to meet the needs of the projected population of the Hamlet and meet the regulatory requirements of the Hamlet's water licence as set out by the Nunavut Water Board.

Both alternatives for the redevelopment of the existing site meet the "must" criteria put forth for the evaluation of alternatives.

7.6.2. Assessment of Alternatives

The two alternatives for the redevelopment of the existing solid waste facility were assessed against the "want" criteria presented in Section 6.1.2. The results of the assessment are summarized in the following sections.

7.6.2.1. Capital Costs (Weight 10)

Class D cost estimates were prepared for the two alternatives and presented above, as well as the score for each alternative which are summarized in Table 7.3.

Table 7.3 – Capital Costs

Alternative	Capital Cost	Score
Alternative 5 - Remediate Existing Site	$290,000	10
Alternative 6 – Expand Existing Site	$510,000	9

7.6.2.2. Life Cycle Costs (Weight 8)

Life cycle costs include the estimated capital and recapitalization cost as presented above and score for each alternative are summarized below in Table 7.4.

Table 7.4 – Life Cycle Costs

Alternative	Life Cycle Cost	Score
Alternative 5 - Remediate Existing Site	$559,079	10
Alternative 6 – Expand Existing Site	$618,968	9

7.6.2.3. Community Acceptance (Weight 7)

A public meeting was held with the community to discuss the current solid waste disposal site and potential alternative locations for a new site. Results of the public consultation process indicated that the community was dissatisfied with the current solid waste disposal site due to the following issues:

- The site does not prevent the prevailing winds from causing litter site to be deposited throughout the community which causes aesthetic and nuisance problems; and
- The current site is located to close to the community's current potable water source.

Although the two options being considered are for the same site, it is believed from consultation with the Hamlet Council that the longer the current site is operational, the more dissatisfied the community will be. A summary of the scores for community acceptance is summarized in Table 7.5

Table 7.5 – Community Acceptance

Alternative	Score
Alternative 5 - Remediate Existing Site	2
Alternative 6 – Expand Existing Site	1

7.7. Analysis Summary

The evaluation of the two alternatives for redevelopment, based on the above mentioned scoring is shown on Table 7.6

Table 7.6 – Evaluation of Alternatives

Criteria	Weight	Alternative 5		Alternative 6	
		Score	Weighted Score	Score	Weighted Score
Capital Cost	10	10	100	9	90
Life cycle cost	8	10	80	9	72
Community Acceptance	7	2	14	1	7
Total Score					
Ranking			**194**		**169**

Based on the evaluation above Alternative 5 the remediation of the existing facility is preferred over the remediation and expansions.

8.0 Evaluation of Redevelopment of Existing Site vs New Site

The evaluation of the remediation of the existing site compared to the development of a new facility will be based on the scores in Sections 6 and 7. For the evaluation of the development of the new facility, Life Cycle costs were not consider as the alternatives all had similar operational and maintenance costs. However when compared to the remediation of the existing facility it must be considered as the remediation alternative includes a recapitalization during the 20 year study horizon. The life cycle cost of Alternative 2 will be based on the Equivalent Uniform annual cost spread over the 20 year life of the facility and a present day value to the yearly costs calculated. Details of the calculation of the Life Cycle Cost for Alternative 2 are included in Appendix C.

8.1. Evaluation

The following tables summarize the evaluation as per Sections 6 and 7.

Table 8.1 – Capital Costs

Alternative	Capital Cost	Score
Alternative 2	$850,000	8
Alternative 5 - Remediate Existing Site	$290,000	10

Table 8.2 – Life Cycle Costs

Alternative	Life Cycle Cost	Score
Alternative 2	$850,000	8
Alternative 5 - Remediate Existing Site	$559,079	10

Table 8.3 – Community Acceptance

Alternative	Score
Alternative 2	7
Alternative 5 - Remediate Existing Site	2

The evaluation of the two alternatives for redevelopment based on the above mentioned scoring is shown on Table 8.4

Table 8.4 – Evaluation of Alternatives

Criteria	Weight	Alternative 2		Alternative 5	
		Score	Weighted Score	Score	Weighted Score
Capital Cost	10	8	80	10	100
Life Cycle Cost	8	8	64	10	80
Community Acceptance	7	7	49	2	14
Total Score					
Ranking			**193**		**194**

Based on the evaluation above, Alternative 5 is recommended as the alternative for the Long Term Sustainable Plan for the Hamlet of Repulse Bay's Solid Waste Management Facility. However, it should be noted that Alternative 5 is in a virtual tie according to the evaluation.

9.0 Conclusions and Recommendations

This report has been prepared in response to the GN's commitment to the Hamlet to review the options of remediating the existing solid waste facility or constructing a new facility. The goal of the project was to determine which option would be best serve the Hamlet as the base for their Long Term Sustainable Plan for Solid Waste Management. The following conclusions and recommendations are based on the information within this report.

1. The Hamlet of Repulse Bay is unhappy with the current solid waste disposal site.

2. The Government of Nunavut agreed to review the options of remediating the existing site and the construction of a new facility.

3. The existing facility was not constructed as per the design drawings.

4. The estimated service life for the existing facility is approximately 10 years.

5. It is estimated that the existing facility's service life could be extended to 15 years if it was expanded to match the original design drawings.

6. The two alternate sites originally proposed by Trow were deemed to be unacceptable by the Hamlet.

7. The Hamlet and Trow identified four new alternate sites which were feasible and acceptable to the Hamlet.

8. Of the four alternate sites it was determined that Alternative Site 2 was the preferred location for a new solid waste disposal facility.

9. It was determined that remediating the existing site to address the current issues was preferable over the option to expand and remediate the site.

10. When the option of remediating the existing site was compared to the option of constructing a new site, the remediation of the existing site was determined to be the preferred option.

11. Although the remediation of the existing site was determined to be the preferred option, the construction of the new site was a very close second in a virtual tie.

12. The decision making process was based on economic and social criteria, with the emphasis on economic criteria.

13. Remediation of the existing facility is the most economic option both as a capital expenses as well as he life cycle costs.

14. Construction of a new facility is the most attractive alternative from the community's acceptance (social) standpoint.

15. Different weighting of the options could lead to a reversal of the recommendation, however due to the closeness of the evaluation either options should be deemed acceptable.

Trow Associates Inc.

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Appendix A

Interim Operations and Maintenance Manual

ᓄᓇᕗᑦ BURNSIDE

Interim Operation and Maintenance (O&M) Plan
Solid Waste Management Facility
Hamlet of Repulse Bay

Prepared by

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October 2006

File No: N-0 11463

Interim Operation and Maintenance (O&M) Plan
Solid Waste Management Facility
Hamlet of Repulse Bay

October 2006

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1.0 Introduction

This Interim Operation and Maintenance Plan has been prepared to assist the Community of Repulse Bay in the operation of their Solid Waste Disposal Facility. It provides a description of the regular operating procedures as well as monitoring requirements.

The Hamlet of Repulse Bay Solid Waste Disposal Facility consists of the following components:

- Landfill (also referred to as the Municipal Solid Waste Disposal Area)
- The Bulky Metals Disposal Area
- The Hazardous Waste Storage Area.

The facility has been in use for approximately 3 years. The facility does not have a Nunavut Water Board (NWB) license and no license application has been made to date.

The current design does not appear to meet Nunavut Water Board requirements, and as a result, this Operation and Maintenance Plan can only be considered "interim" until the site design meets NWB approval.

The current NWB license Number NWB3REP0409 allows for the use of water and disposal of waste for the Hamlet of Repulse Bay. The current landfill site is not included in the license.

A design for a new landfill in the location to the current site was prepared by Dillon Consulting in May 2002. No supporting documentation other than four design drawings were provided for review.

The site was constructed in 2003, and the constructed facility differs significantly from the Dillon design. No as-built drawings or any other documentation was available for review. No information was provided by the designer or contractor on how the site was to operate.

This Interim Operation and Maintenance Plan has been prepared as a temporary plan to assist Hamlet of Repulse Bay staff in operating the site until as built drawings are prepared, the design is reviewed, and modified (if required) and an application made to amend the Water Board license.

This operation and maintenance plan emphasizes the health and safety of site workers and the public as the item of foremost priority.

1.1 Background

The Hamlet of Repulse Bay is located in the Kavalliq Region of Nunavut as shown on Figure 1.

The community has a population of approximately 738, with an approximate 3.5 percent projected growth rate. Community infrastructure includes:

- A water truck fill station, which draws water from Nuviq Luktujuq
- Trucked water to holding tanks in each building
- A sewage lagoon which receives trucked sewage collected from holding tanks in each building
- Sewage treatment via an exfiltration lagoon to a wetland
- A Solid Waste Disposal Facility, which includes a Municipal Solid Waste Disposal Area, a Bulky Materials Disposal Area, and a Hazardous Waste Storage Area
- Several rock and sand quarries
- Diesel powered generators.

The Hamlet is predominately residential with a few small commercial establishments including a hotel, several construction contracting businesses, grocery store, and a variety of other small businesses. Hunting and fishing in the traditional manner is still a prime occupation for many of the inhabitants. Community buildings include an elementary school, Hamlet office, public works yard, GN offices, and police station.

1.1.1 Climate

The average rain fall at Repulse Bay is 15.6 cm and the average snow fall is 130.7 cm per year. The near high and low temperatures in July is 16.0 and 6.0 °C. In January the near high and low temperatures are -29.5 and -36.4 °C. Winds are generally from the north averaging 23.0 km/hr.

1.1.2 Geology and Morphology

The area of the solid waste disposal facility is dominated by bedrock ridges and glaciomarine deposits. Bedrock is mapped as Archean Granitoid, which also includes a variety of Precambrian rocks. Glacial and non-glacial over burden, including blanket deposits of sand and silt with mixed cobble and boulder, occour between outcrop ridges. Borrow areas with suitable material for use as landfill cover are located just north and east of the site.

2.0 Operation and Maintenance

2.1 Overview

The Hamlet of Repulse Bay Solid Waste Management facility consists of two main components:

- Diversion consisting of
  - Wood pile
  - Bulk metals disposal area
  - Hazardous waste storage area
- Landfill.

The site was deigned and constructed as a natural attenuation landfill. It does not have a liner, so contaminants are able to reach from the water and enter the natural environment.

In order to protect the environment, the facility is designed to divert as much waste as possible from landfilling. This is especially important for hazardous wastes such as batteries, waste oil, waste antifreeze, and other materials that could harm the environment if landfilled.

Figure 2 displays the layout of the solid waste disposal facility and surrounding area. Figures 3 and 4 show the site in cross-section.

Site operations must comply with the Nunavut Safety Act, and with the health and safety of workers and the public as the first priority.

2.2 Material Arrival

Material will arrive at the facility mainly by a small dump garbage truck owned by the Hamlet or by private residential drop-off.

After Hamlet staff collect waste, the collection vehicles will progress to the landfill, where wastes will be tipped into the burn pile. After being tipped (or during collection), staff will perform an inspection of the waste to ensure that it does not contain visible hazardous waste or bulky metals. If such waste is noted, it will be segregated in the appropriate locations of the approved Hazardous Waste storage area or the Bulky Metals Disposal Area.

Members of the community may drop off materials directly at the facility (mainly bulky metals) or hazardous wastes. The public should be encouraged to place materials in the appropriate location; generally bulky metals within the Bulky Metals Disposal Area, and hazardous waste in the Hazardous Waste Storage Area. Wood in the wood pile, etc.

The layout of the site and waste diversion process is displayed on Figure 5.

The staff will record the number of trips to the Solid Waste Disposal Facility per day and estimate the approximate quantity in cubic metres on the Waste Placement Forms included as Appendix A. If waste is present on site that has been tipped by others, an estimate of the quantity shall be made and recorded. Records are to be delivered to the Hamlet office once per week, were they will be retained on file for inclusion in the Annual Report.

2.3 Wood

Burnable and wood materials that may have reusable value are placed in the wood pile in the waste diversion area (Figure 5). The wood pile should be burned on occasion when quantities build up. Burning should take place when wind and climate conditions are favourable.

2.4 Bulky Metals Disposal Area

2.4.1 Regular Operation

Staff should inspect the bulky metals disposal area on a regular basis to check for new materials. Fluids (oil, antifreeze) should be drained from vehicles, and if possible, batteries should be removed and transferred to the Hazardous Waste Storage Area. Bulky metals should then be tagged to indicate that they have been inspected and cleaned.

Bulky metals should be moved to the appropriate location to maximize segregation of the materials. These groupings can be developed by the operation staff based on needs and materials, but are anticipated to consist of tires, appliances, bicycles, ATV's, snowmobiles and miscellaneous debris.

2.4.2 Regular Maintenance

Although reuse of the material is possible, there are materials that will have no potential future life. It is recommended that periodically, (i.e., every 3 to 5 years), bulky metals with no further recyclable value be removed out and buried in a dedicated burial pit, developed to the east of the existing Bulky Metals Disposal Area. The location of the burial area is shown on Figure 2.

2.5 Hazardous Waste Storage Area

2.5.1 Operations

During regular operations work on the facility, any hazardous materials placed on site should be transferred to the storage area. Batteries must be stored upright. Oils, lubricants and antifreeze may be bulked together in common drums, preferably remaining

in their original packaging. Unknown substances should remain in their package and placed into drums.

Only persons with the appropriate skills and training are permitted to handle hazardous wastes.

2.5.2 Maintenance

The area should be inspected on a regular basis for signs of spillage or leaks. Degraded containers (i.e., rusted drums) should be replaced as required.

When materials within the facility have accumulated to quantities that constitute a load, the Hamlet should arrange for them to be removed from site by a licensed hauler and who will remove them from the community and dispose of them in a licensed facility.

The area is currently unlined and has no spill control measures. Design upgrades are needed to meet NWB requirements.

2.6 Landfill

The layout of the landfill is displayed on Figure 2. No documentation was provided indicating how the designer of the site or the constructor of the site intended the site to operate. The operation of the site has been interpreted based on field findings. These operational procedures for the landfill are presented below:

2.6.1 Operation

Site operations include potentially hazardous practices such as burning and operation of heavy equipment. All work is to be conducted only by staff with the appropriate training to conduct the work safely. The health and safety of workers and the public takes precedence.

It has been indicated that the burning of waste is a necessity to prevent odour, eliminate flies, and to reduce potential problems with scavengers, such as bears and foxes (since the ability to cover waste is limited due to the short operational season). In order to minimize the potential for impacts from fires the following rules are to be followed:

- Burn only in the established burn area
- If possible, materials should not to be tipped directly onto burning or smoldering waste; it is preferable to not ignite the waste until it has all been collected for the day
- Ensure that the weather is acceptable for burning. The following guidelines are recommended:
  - Wind speed should be checked. If loose paper or debris can be lifted and carried off site (moderate breezes or greater), burning shall be avoided

- The wind direction should be checked, to ensure that smoke does not drift towards the Hamlet, or workers in the vicinity
- If heavy rain is present, burning should be avoided (as it may result in poor combustion and greater potential to generate by-products).

The site operators shall stay upwind of the fire at all times.

Prior to waste handling, the equipment operator will confirm that the waste is no longer hot or burning. As required, using a dozer or a loader, the ash and unburnt general municipal wastes will be pushed away from the burn pit and along the active face, observing the following operating principles:

- All waste shall be removed from the tipping and burn areas

- The waste shall be pushed and spread along the disposal area at a maximum 3:1 grade (shallower grades result in the need for too much cover, steeper grades are typically not stable).

The operational procedures are as follows:

- Drop off of waste at the designated area at the end of the access road – Figure 6
- Conduct burning on a regular basis when climate conditions are favourable – Figure 6
- Scrape the burned waste off the drop off area and move it into the fill area – Figure 7
- Compact and layer the waste 250 mm to 300 mm thick – Figure 7
- Gradually build up waste layers across the fill area – Figure 8
- Construct an additional berm once waste levels reach the height of the existing berm – Figure 8
- Continue filling to achieve final site grades over the designed waste footprint – Figure 9
- Close the fill area once final grades (maximum 3:1) are achieved – Figure 9
- Apply final 600 mm of cover and stabilize surface with cobbles – Figure 9.

2.6.2 Maintenance

Operations staff will perform weekly site inspection and maintenance. During these inspections, weekly site inspection forms (Appendix A) will be completed. These forms are designed to note the standard items requiring inspection and maintenance at the site, as well as other relevant information, such as weather. Health and safety concerns will also be noted. They are also used to document the response to any incidents that affect site operations such as accidents, injuries, fires, flooding, or chemical spills.

- The tipping area and necessary roadways shall be maintained by snow clearing in the winter and grading in the summer, and repaired as necessary
- Ditches and drainage channels shall be inspected for erosion, and repaired as necessary

- Site warning signage, which identifies the boundaries of the Solid Waste Disposal Facility (which includes the landfill, Hazardous Waste Storage Area, and the Bulky Metals Disposal Area) shall be inspected, and repaired or replaced as necessary
- Any airborne litter outside of the litter-control fences (which are located on top of the berm at the Facility) shall be removed, and deposited in the landfill
- Litter that has accumulated against the fences shall be removed and placed into the landfill
- After rain events and following the spring thaw, the site shall be inspected for leachate breakout. Cover the face if possible and ensure that leachate is being contained
- The berms and final cover at the Solid Waste Disposal Facility shall be inspected for erosion and settlement
- The fences at the Solid Waste Disposal Facility shall be inspected for damage, and repaired as necessary.

All details of any repairs shall be reported in the Annual Report.

Staff will place hazardous materials, such as oil or solvents into drums located in the Household Hazardous Waste Area. Materials should be left in the original container and placed into the drums, sorted according to what is in the containers (i.e., waste oils stored with oils, solvents with solvents, cleaners with cleaners). Drums will remained sealed within the compound.

2.6.3 Health and Safety

Health and safety of the public and site staff is to be considered the first priority all the times.

Site staff should be trained to conduct their jobs on site safely and in accordance with the Nunavut Safety Act.

Close attention should be given to the unique hazards of this site including:

- Scavenging bears and other wildlife
- Open burning
- Moving equipment
- Obscuring weather conditions
- Hazardous materials (in the waste and in the storage area).

Staff must be aware of these issues and operate the site in a manner to protect other staff and the public.

3.0 Facility Monitoring Procedures

Although the site does not have an Nunavut Water Board (NWB) license, regular monitoring of runoff from the Solid Waste Disposal Facility is required. The Monitoring Program is to include effluent samples collected from the water that naturally ponds below the face of the berm during the months on June to September, inclusive.

Currently it is recommended samples be collected from surface water locations as follows:

- Discharge from culvert
- Discharge from boulder seepage
- Selected locations down gradient.

Effluent samples collected shall be analyzed for the following parameters:

BOD	Faecal Coliforms
pH	Conductivity
Total Suspended Solids	Ammonia Nitrogen
Nitrate-Nitrite	Oil and Grease
Total Phenols	Sulphate
Sodium	Potassium
Magnesium	Calcium
Total Arsenic	Total Cadmium
Total Copper	Total Chromium
Total Iron	Total Lead
Total Mercury	Total Nickel
Total Zinc	

In addition, any analytical parameters which are normally identified in the NWB water license, or by an Inspector (as defined in the *Nunavut Waters and Nunavut Surface Rights Tribunal Act)* shall be included.

A site log will be used to identify the locations of sampling and condition at the time of sampling. Samples will be submitted to a CAEAL accredited laboratory following laboratory directions for shipping handling, and sampling.

Results of analytical testing and monitoring are to be recorded on a regular basis by the staff. Copies of the analytical certificates and Chain of Custody forms are to be kept for future reference.

Monthly and annual quantities of solid waste offloaded will be estimated and recorded on the Waste Placement Form (Appendix A).

It is expected that at some point in the future the monitoring procedures will be amended when the site is issued a NWB license.

3.1 Annual Report

An annual report shall be prepared for the site and submitted to the NWB. The report shall include:

- An overall description of the activities that occurred at the facility throughout the year, including both regular waste acceptance and annual shaping
- An estimate of the quantity of material received at the site
- A description of any maintenance or improvements that were completed at the site throughout the year
- A list of any complaints and actions taken to address them
- Analytical testing results.

Reporting should be conducted as outlined herein until a NWB license is achieved, at which time the license requirements will dictate the reporting requirements.

4.0 Contingency Measures

Contingency plans are designed so that site operators are prepared in the event of an accident or occurrence. The contingency measures described below are generic in nature since they must address a wide variety of issues.

4.1 Injuries

In the event of an injury to workers or members of the public:

- Apply first aid
- Seek medical assistance, if necessary
- Report the injury to the supervisor
- Document the incident and all response measures on the Weekly Site Inspection Form and Supplementary Site Inspection Form (Appendix A).

All health and safety related issues must be addressed in accordance with the Nunavut Safety Act.

4.2 Spills

Activities to be completed in the event of a spill would be outlined in the Hamlets Environmental Emergency Contingency Plan.

4.3 Fires

In the event of a fire, assess the situation. Do not attempt to fight a fire if it cannot be done safely. Call the Hamlet fire department. Alternatively, cover soils can be thrown onto the fire either by hand, or by using available equipment (i.e., bulldozer). Obtain help as necessary. Document the incident and all response measures on the Weekly Site Inspection Form and Supplementary Site Inspection Form (Appendix A).

4.4 Erosion

Erosion may become a problem if runoff rates exceed expectations or cover soils and vegetation is not well established for any reason. The preferred contingency measure for this is to repair the area of erosion with available materials.

5.0 Reference Documents

The following documents provide a resource of information to deal with specific issues:

- *Guidelines for the Planning, Design, Operations, and Maintenance of Modified Solid Waste Sites in the Northwest Territories*, prepared by Northwest Territories, Municipal and Community Affairs
- *Consolidation of General Sanitation Regulations* under the Public Health Act
- *Nunavut Safety Act*
- *Nunavut Waters and Nunavut Rights Tribunal Act*
- The following guidelines prepared by the Department of Sustainable Development:
  - *General Management of Hazardous Waste*
  - *Environmental Guidelines for Waste Antifreeze*
  - *Environmental Guidelines for Dust Suppression*
  - *General Management of Hazardous Wastes*
  - *Environmental Guidelines for Ozone Depleting Substances*
  - *Environmental Guidelines for Waste Asbestos*
  - *Environmental Guidelines for Waste Batteries*
  - *Environmental Guidelines for Waste Paint*
  - *Environmental Guidelines for Waste Solvent*
- The following polices prepared by the Government of Nunavut:
  - *Waste Lead (Draft)*
  - *Policies Regarding Open Burning*
  - *Management of Fluorescent Lamp Tubes.*

The Nunavut Water Board License will have specific requirements once one has been obtained for the site.

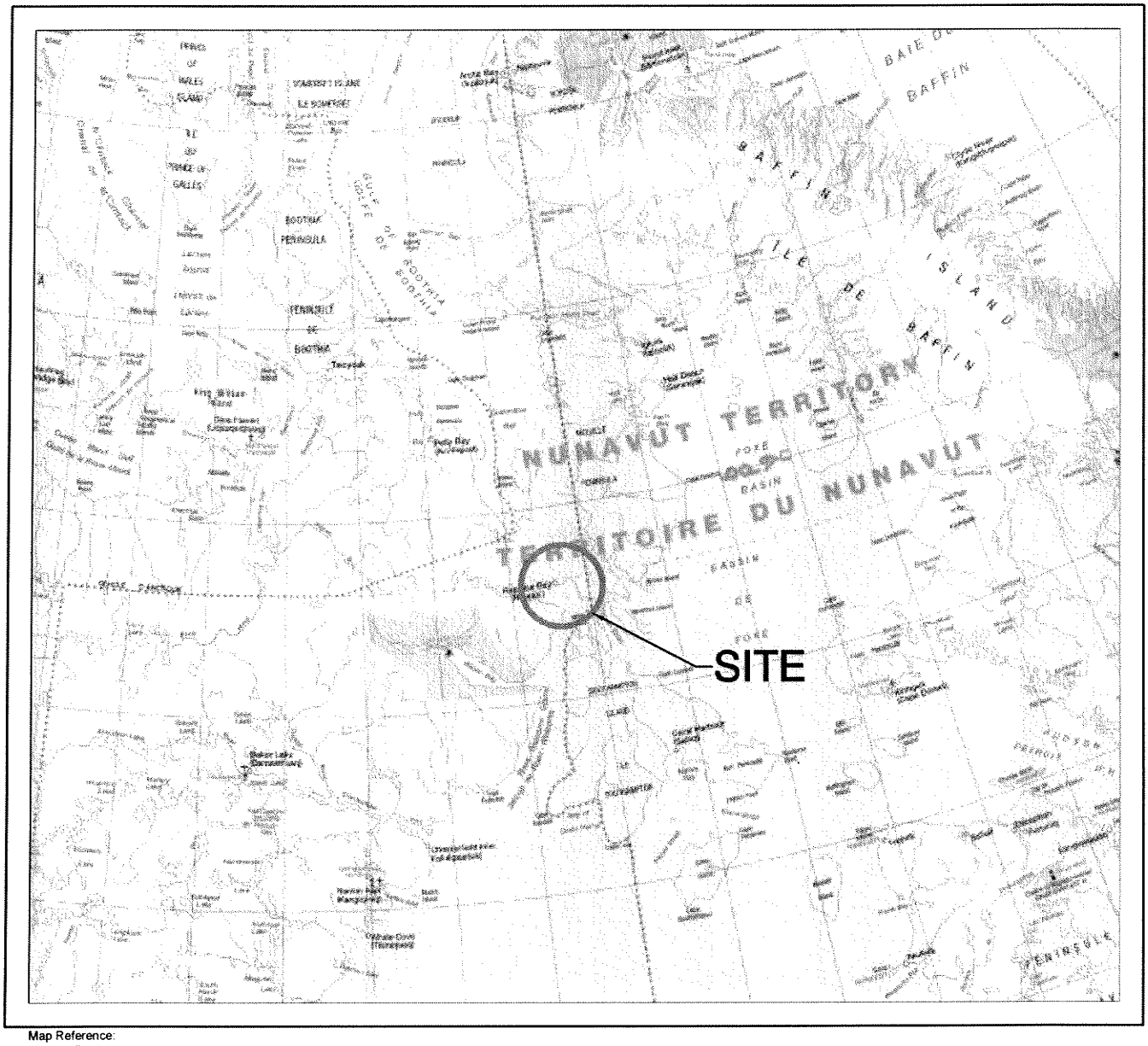
6.0 Summary

This Interim Operation and Maintenance Plan have been prepared for the Hamlet of Repulse Bay, to assist Hamlet staff to operate the Solid Waste Disposal Facility as effectively as possible, based on the existing design and construction layout. The site is not licensed by the Nunavut Water Board, and therefore operates in contravention to the Nunavut Waters and Nunavut Surface Rights Tribunal Act. There is also no documentation available outlining how the original designers and the contractor (which significantly modified the design) intended the site to operate.

The Hamlet of Repulse Bay must address design deficiencies, and obtain a Nunavut Water Board license for the site as soon as possible.

Training of site staff is an important component to solid waste management facility operations and maintenance. Site staff must receive job specific training in the operation and maintenance of the facility.

Figures



Map Reference:
Map Art Publishing
Ontario Road Atlas

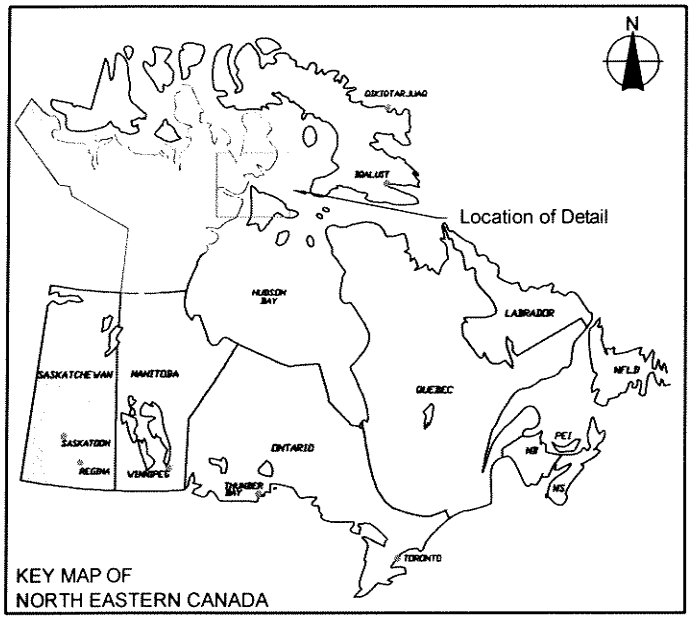


FIGURE 1 - SITE LOCATION MAP

HAMLET OF REPULSE BAY
SOLID WASTE DISPOSAL FACILITY

January 2007
Project Number: FEY11462

Prepared by: J. Amsen

Verified by: J. Walls

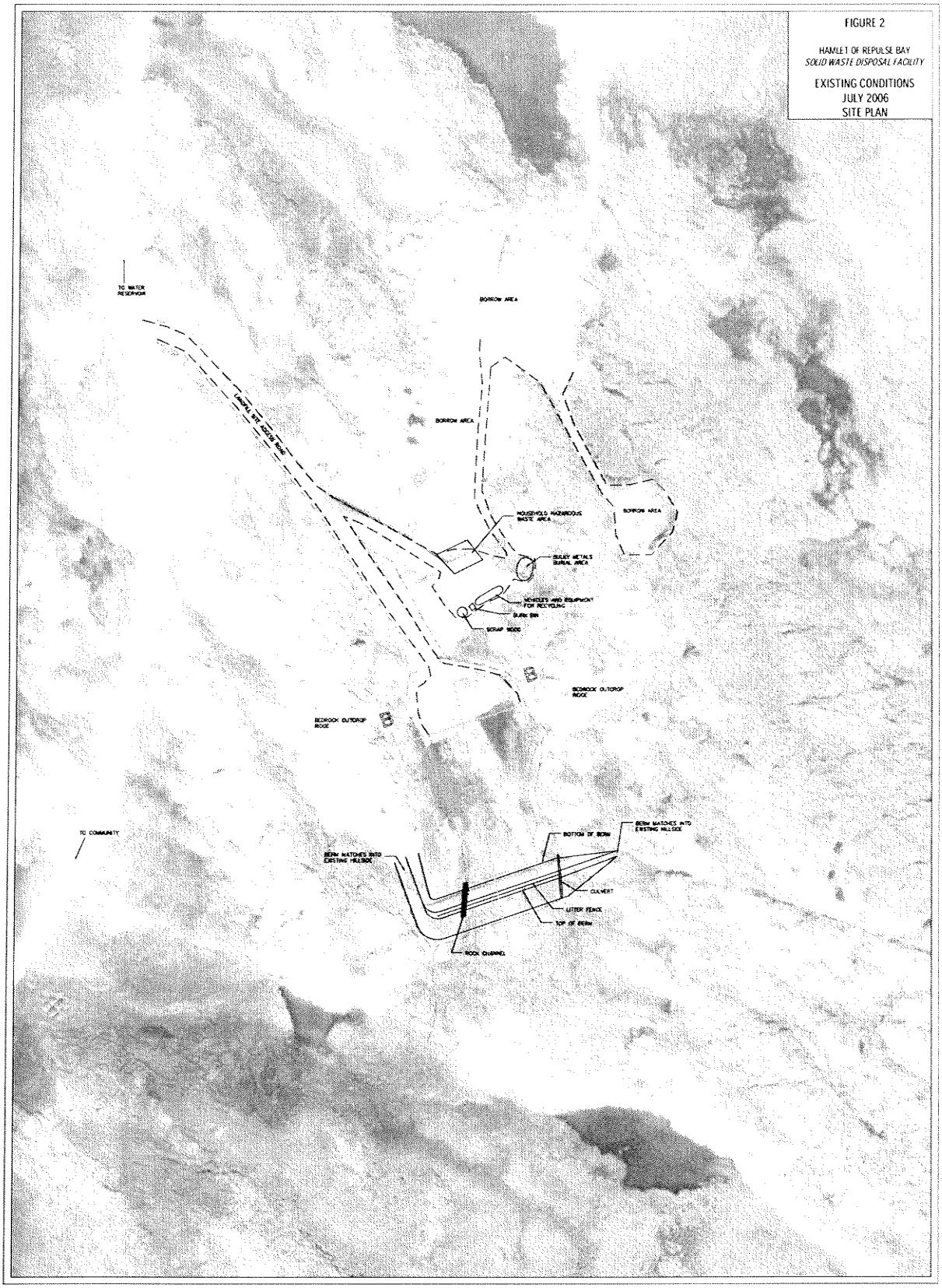
Revision #: 1

FEY11462 LF-REHAB EXIST CONDITIONS SL.DWG

FIGURE 2

HAMLET OF REPULSE BAY
SOLID WASTE DISPOSAL FACILITY

EXISTING CONDITIONS
JULY 2006
SITE PLAN



Legend

A A — CROSS SECTION LOCATION

SURFACE DRAINAGE FLOW DIRECTION

DITCH LINE AND FLOW DIRECTION

PROPOSED FINAL WASTE FOOTPRINT
(20 Year Capacity)

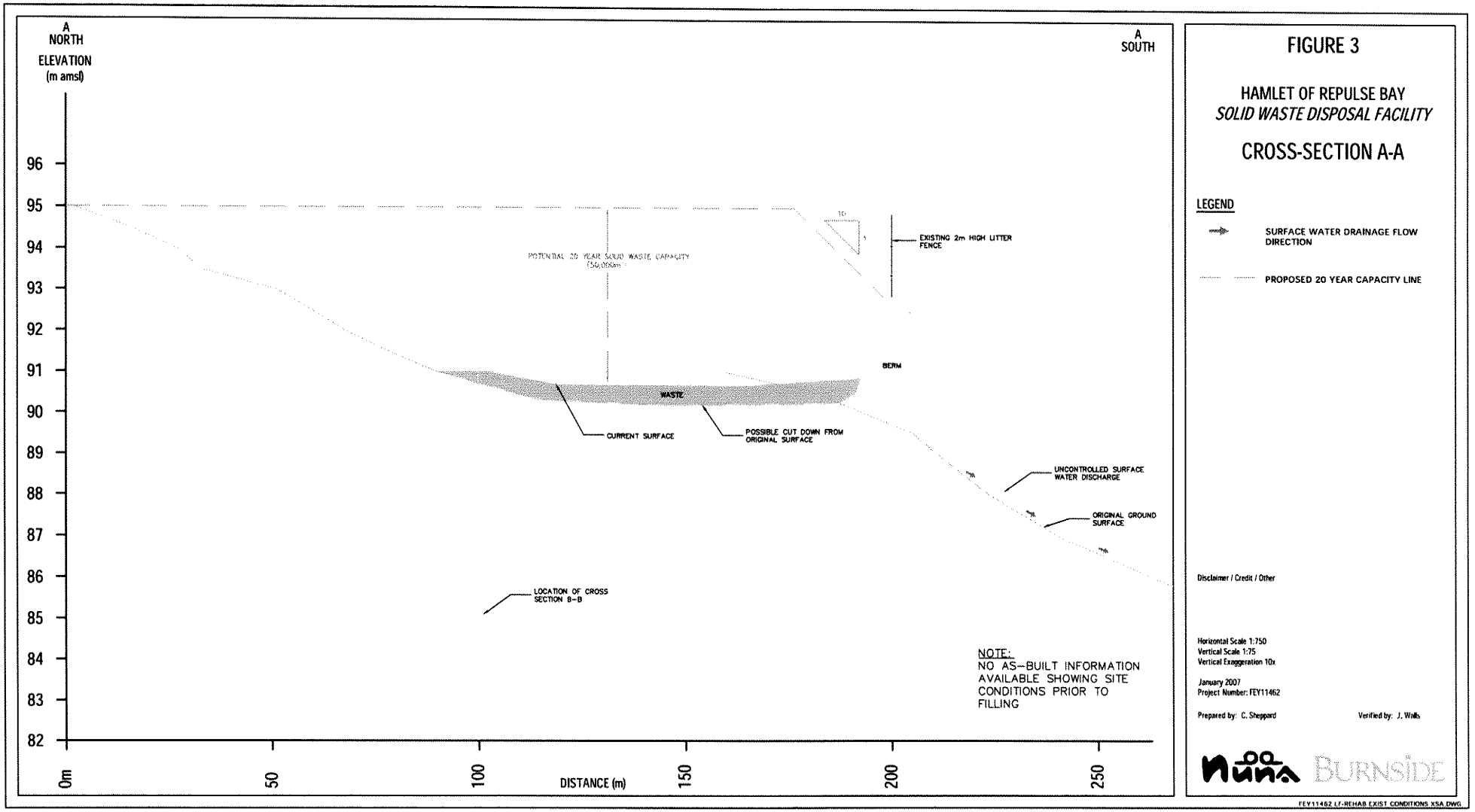


FIGURE 3

HAMLET OF REPULSE BAY
SOLID WASTE DISPOSAL FACILITY

CROSS-SECTION A-A

LEGEND

SURFACE WATER DRAINAGE FLOW DIRECTION

PROPOSED 20 YEAR CAPACITY LINE

Disclaimer / Credit / Other

Horizontal Scale 1:750
Vertical Scale 1:75
Vertical Exaggeration 10x

January 2007
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Prepared by: C. Sheppard

Verified by: J. Wells

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FEY11462 LF-REHAB EXIST CONDITIONS XSA.DWG

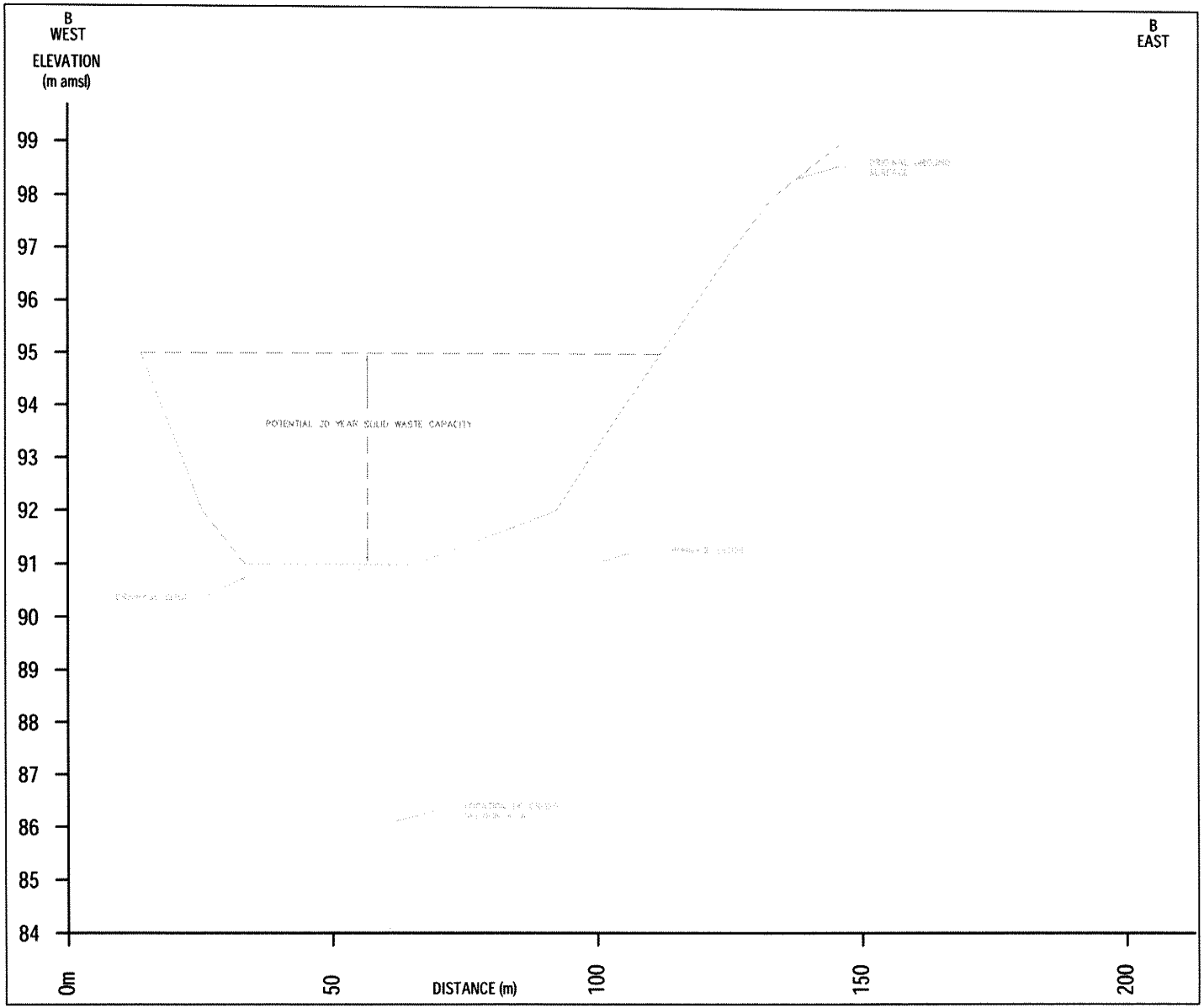

FIGURE 4

HAMLET OF REPULSE BAY
SOLID WASTE DISPOSAL FACILITY

CROSS-SECTION B-B

LEGEND

PROPOSED 20 YEAR CAPACITY LINE

Disclaimer / Credit / Other

Horiztonal Scale 1:750
Vertical Scale 1:75
Vertical Exaggeration 10x

October 2006
Project Number:

Prepared by: C. Sheppard

Verified by: J. Walls

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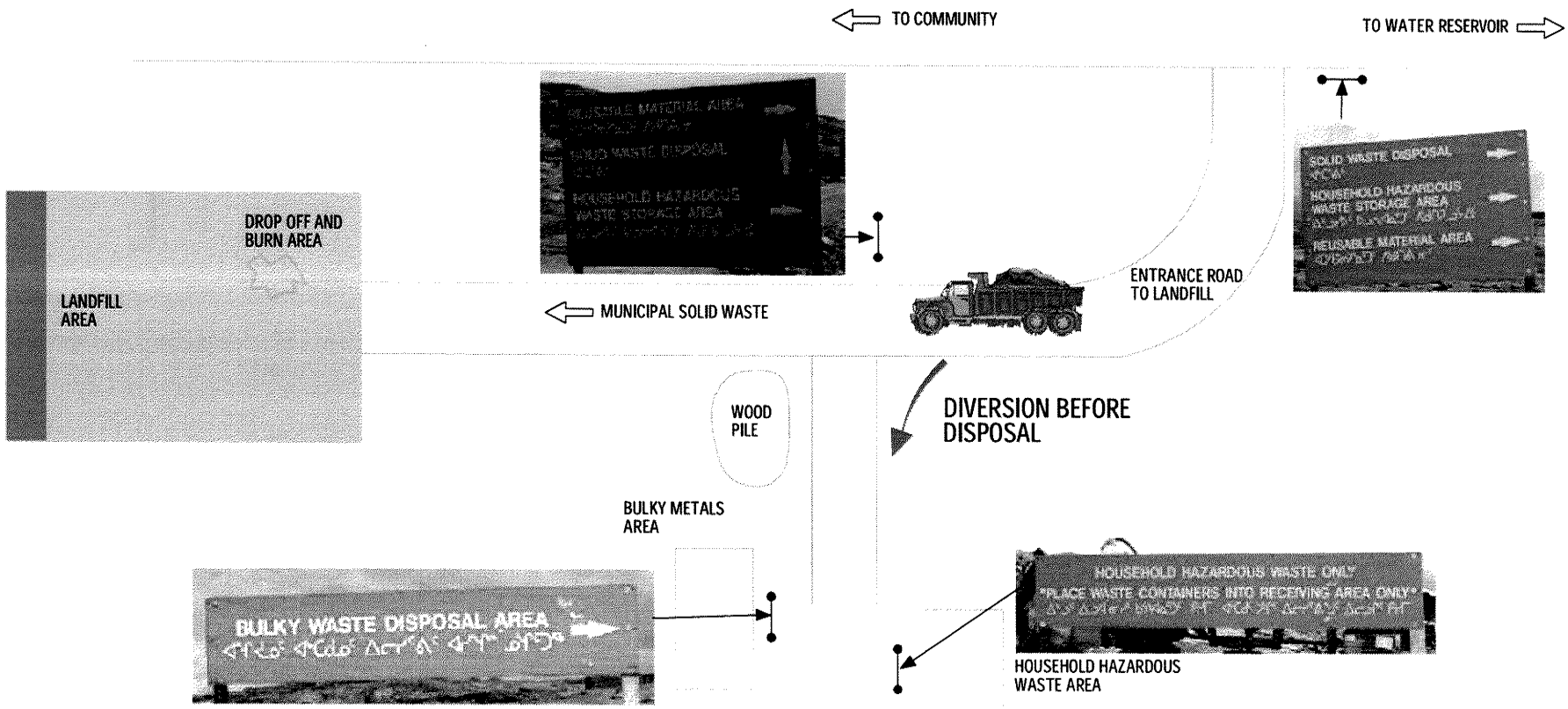
FIGURE 5

HAMLET OF REPULSE BAY
SOLID WASTE DISPOSAL FACILITY
WASTE DIVERSION



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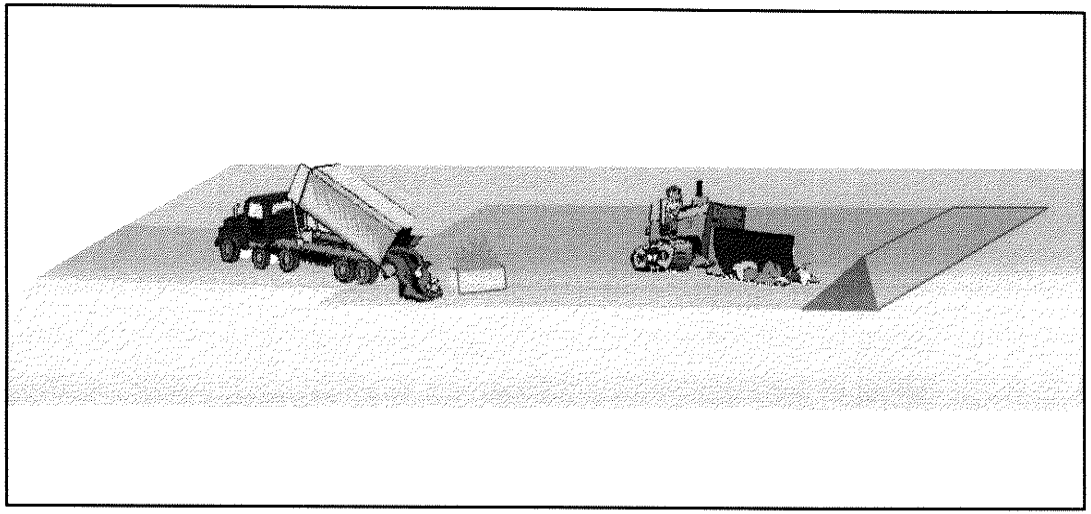
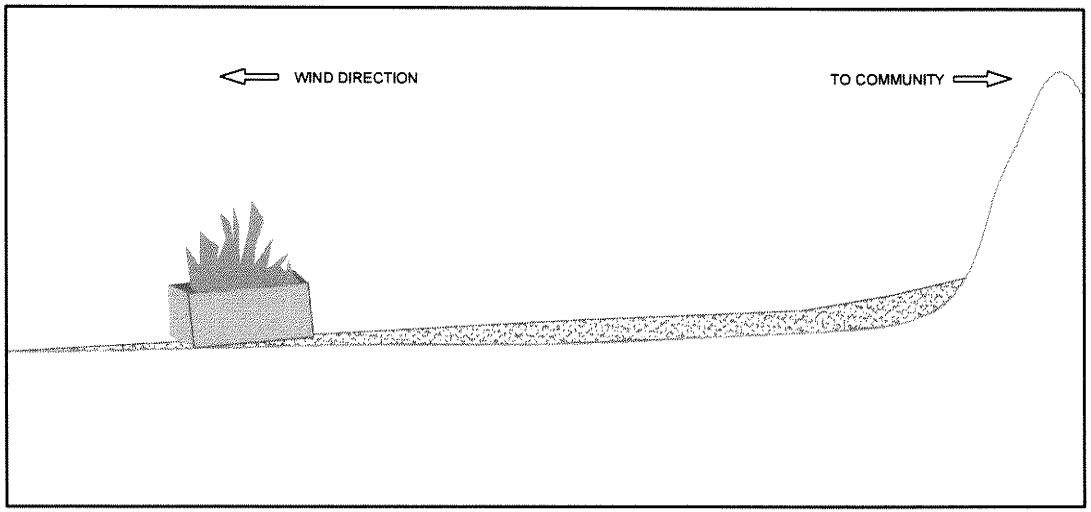
FEY11462 OPERATION AND MAINTENANCE_5.DWG

FIGURE 6

HAMLET OF REPULSE BAY
SOLID WASTE DISPOSAL FACILITY
DROP OFF AND BURNING



MUNICIPAL WASTE IS DUMPED IN THE DROP OFF AREA. THE GARBAGE TRUCK SHOULD NOT DRIVE ONTO AREAS WITH EXPOSED WASTE THAT COULD DAMAGE THE TIRES.



WASTE IS BURNED IN AN OPEN PILE OR WITHIN A BURN BIN. BURNING SHOULD TAKE PLACE WHEN THE WIND IS NOT BLOWING TOWARDS THE COMMUNITY.

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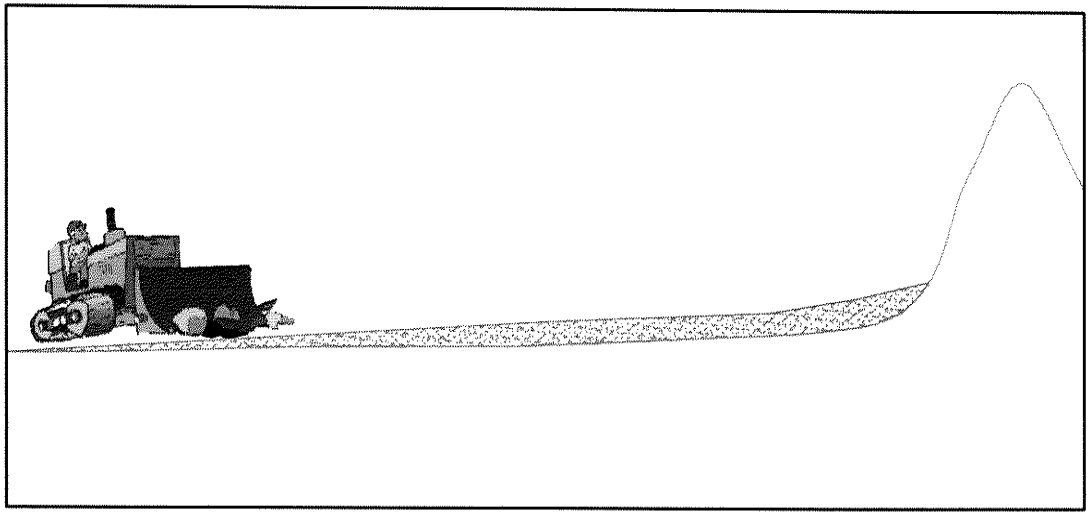
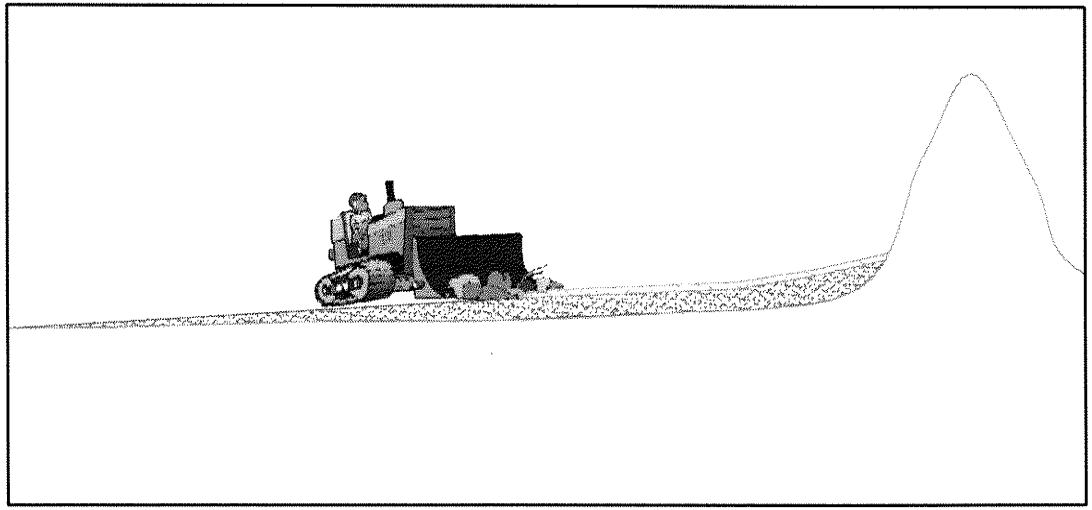
FIGURE 7

HAMLET OF REPULSE BAY
OPERATION AND MAINTAINENCE PLAN
COMPACTION



BURNED WASTE IS PUSHED ONTO THE FILL AREA.



WASTE IS SPREAD OVER A SMALL AREA AND COMPACTED BY MAKING SEVERAL PASSES WITH THE EQUIPTMENT. LAYERS SHOULD BE 250mm TO 300mm (10 TO 12 inches) FOR OPTIMAL WASTE COMPACTION. 50mm TO 100mm (2 TO 4 inches) OF COVER SOIL IS ADDED WHEN AN AREA (cellular layer) HAS BEEN FILLED.

January 2007
Project Number: FEY11462

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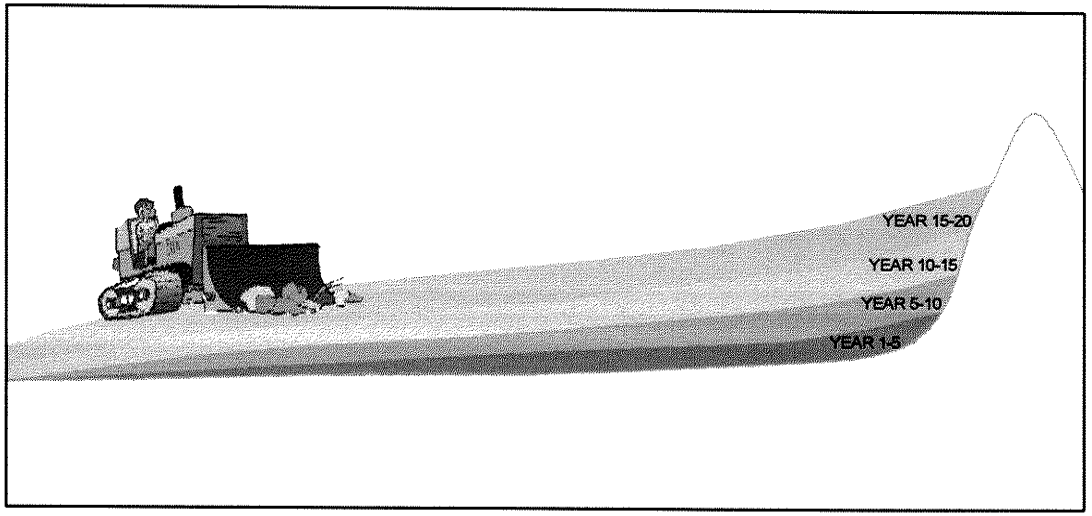
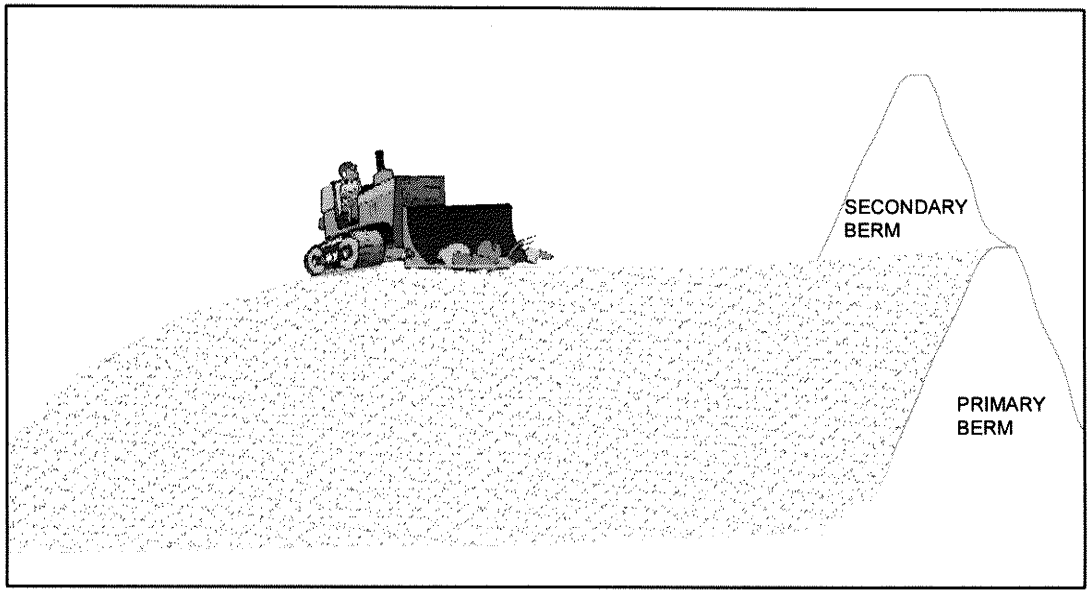
FIGURE 8

HAMLET OF REPULSE BAY
OPERATION AND MAINTENCE PLAN
PROGRESSIVE WASTE DEPOSITIVE



WASTE IS BUILT UP PROGRESSIVELY ACROSS THE SITE IN COMPACTED LAYERS MAINTAINING AN EVEN WORKABLE SLOPE NEVER EXCEEDING 3:1



TO EXTEND SITE LIFE BEYOND THE HEIGHT OF THE INITIAL BERM ANOTHER BERM CAN BE CONSTRUCTED AND FILLING CAN CONTINUE.

January 2007
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Prepared by: J. Amsen

Verified by: J. Walls

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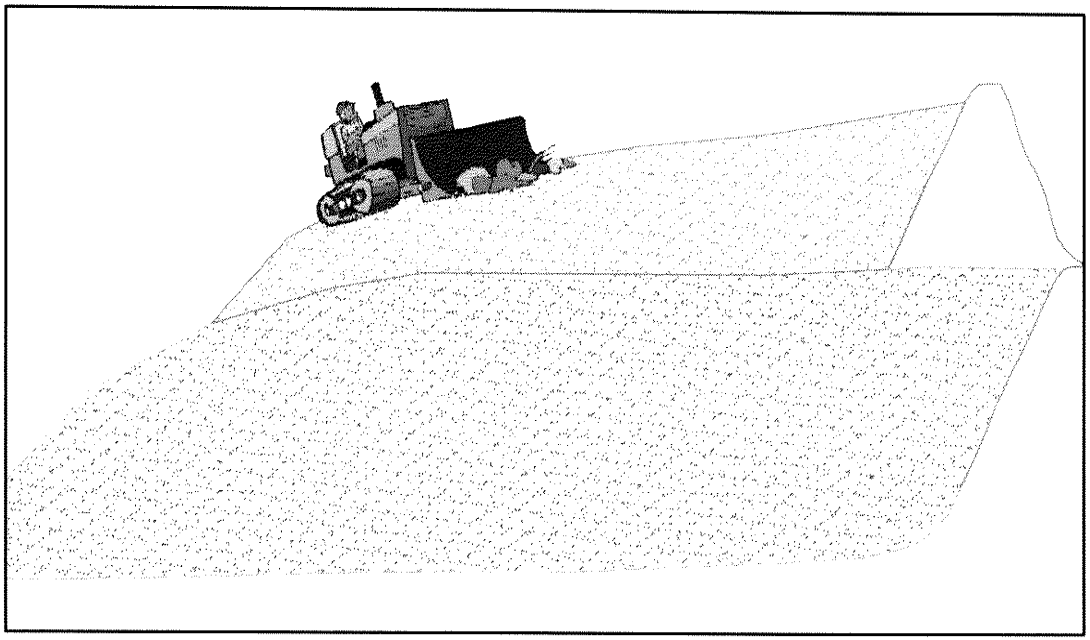
FEY11462 OPERATION AND MAINTENANCE_3.DWG



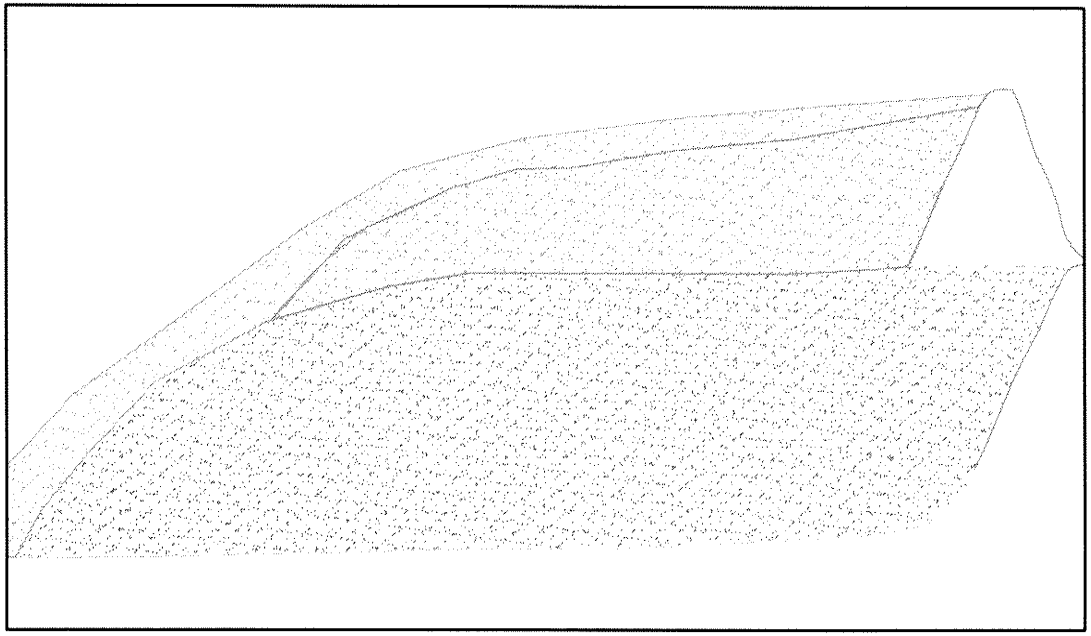


FIGURE 9

HAMLET OF REPULSE BAY
OPERATION AND MAINTENCE PLAN
FINAL GRADING AND CLOSURE

THIS PROCESS CAN CONTINUE PROVIDED ENGINEERING REVIEWS ARE DONE TO CONFIRM STABILITY AND ENVIRONMENTEAL CONDITIONS.

SITE CLOSURE WILL CONSIST OF 600mm OF THE MOST IMPERMIABLE COVER SOIL LOCALLY AVALIBLE . MAXIMUM SLOPE 3:1. THE SURFACE CAN BE STABILIZED WITH COBBLES AND ROCK TO RESEMBLE THE APPERANCE AND CONDITION OF THE SURROUNDING TUNDRA.

January 2007
Project Number: FEY11462

Prepared by: J. Amsen

Verified by: J. Walls

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REVISION #: 1

FEY11462 OPERATION AND MAINTENANCE_4.DWG

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Appendix A
Site Forms

Hamlet of Repulse Bay
Weekly Landfill Inspection Form

Inspected by: _____ Date: _____
Wind direction: _____ Temperature: _____
Precipitation: _____ Ground cover: _____

		YES	NO
1.	Is roadway and truck pad clear of snow?	_____	_____
2.	Does roadway require grading?	_____	_____
3.	Is there visible erosion on the berms?	_____	_____
4.	Is all signage visible and in tact?	_____	_____
5.	Is there litter on the fences?	_____	_____
6.	Is there evidence of leachate break-out from the face of the landfill?	_____	_____
7.	Are fences in good condition?	_____	_____
8.	Has there been any evidence of scavenging?	_____	_____
9.	Is there water accumulating in the Water Retention Area	_____	_____
10.	Has any hazardous material been incorporated into the waste pile?	_____	_____
11.	Does the waste require placement into the landfill?	_____	_____
12.	Are there any problems on the site?		
13.	Other Issues and Notes		

_____

_____

_____

Hamlet of Repulse Bay
Waste Placement Form

Date	Quantity Present upon arrival (m^3)	Quantity Delivered (m^3)	Number of Trips	Additional Activities (i.e., burning, tipping over edge, maintenance)	Initials

Appendix B

Capital Cost Estimates

Item	Description	Unit	Quantity	Unit Price	Amount
	Proposed Site 1				
1	Mobilization & Demobilization	L.S.	1	$ 25,000.00	$ 25,000.00
2	Supply , deliver and place material for New Berms	m^3	7500	$ 40.00	$ 300,000.00
3	Excavated material on site for Berms	m^3	5000	$ 100.00	$ 500,000.00
4	Improving existing road access to Site	m	420	$ 100.00	$ 42,000.00
5	Supply deliver and install Chain Link Fences	m	600	$ 270.00	$ 162,000.00
6	Site Works	L.S.	1	$ 40,000.00	$ 40,000.00
7	Drainage Works	L.S.	1	$ 10,000.00	$ 10,000.00
				Subtotal	**$ 1,079,000.00**
				15% Engineering	**$ 161,850.00**
				20% Contingency	**$ 215,800.00**
				Total	**$ 1,456,650.00**
	Proposed Site 2				
1	Mobilization & Demobilization	L.S.	1	$ 25,000.00	$ 25,000.00
2	Supply , deliver and place material for New Berms	m^3	1000	$ 40.00	$ 40,000.00
3	Excavated material on site for Berms	m^3	5500	$ 60.00	$ 330,000.00
4	Improving existing road access to Site	m	150	$ 100.00	$ 15,000.00
5	Supply deliver and install Chain Link Fences	m	600	$ 270.00	$ 162,000.00
6	Site works	L.S.	1	$ 40,000.00	$ 40,000.00
7	Ditching and Drainage Works	L.S.	1	$ 20,000.00	$ 20,000.00
				Subtotal	**$ 632,000.00**
				15% Engineering	**$ 94,800.00**
				20% Contingency	**$ 126,400.00**
				Total	**$ 853,200.00**

Item	Description	Unit	Quantity	Unit Price	Amount
	Proposed Site 3				
1	Mobilization & Demobilization	L.S.	1	$ 25,000.00	$ 25,000.00
2	Supply , deliver and place material for New Berms	m^3	7500	$ 40.00	$ 300,000.00
3	Excavated material on site for berms	m^3	5000	$ 100.00	$ 500,000.00
4	New road access to Site	m^3	7000	$ 50.00	$ 350,000.00
5	Supply deliver and install Chain Link Fences	m	600	$ 270.00	$ 162,000.00
6	Site Works	L.S.	1	$ 40,000.00	$ 40,000.00
7	Drainage Works	L.S.	1	$ 10,000.00	$ 10,000.00
				Subtotal	**$ 1,387,000.00**
				15%Engineering	**$ 208,050.00**
				20% Contingency	**$ 277,400.00**
				Total	**$ 1,872,450.00**
	Proposed Site 4				
1	Mobilization & Demobilization	L.S.	1	$ 25,000.00	$ 25,000.00
2	Supply , deliver and place material for New Berms	m^3	7500	$ 40.00	$ 300,000.00
3	Excavated material on site for berms	m^3	5000	$ 100.00	$ 500,000.00
4	New road access to Site	m^3	11000	$ 50.00	$ 550,000.00
5	Supply deliver and install Chain Link Fences	m	600	$ 270.00	$ 162,000.00
6	Site Works	L.S.	1	$ 40,000.00	$ 40,000.00
7	Drainage Works	L.S.	1	$ 10,000.00	$ 10,000.00
				Subtotal	**$ 1,587,000.00**
				15%Engineering	**$ 238,050.00**
				20% Contingency	**$ 317,400.00**
				Total	**$ 2,142,450.00**

Item	Description	Unit	Quantity	Unit Price	Amount
	Existing Site - Remediated				
1	Mobilization & Demobilization	L.S.	1	$ 25,000.00	$ 25,000.00
2	Supply , deliver and installation of new Chain Link Fences	m	600	$ 270.00	$ 162,000.00
3	Demolition and Disposal of Existing Fences	L.S.	1	$ 5,000.00	$ 5,000.00
4	Site Works	L.S.	1	$ 10,000.00	$ 10,000.00
5	Drainage Works	L.S.	1	$ 10,000.00	$ 10,000.00
				Subtotal	**$ 212,000.00**
				15% Engineering	**$ 31,800.00**
				20% Contingency	**$ 42,400.00**
				Total	**$ 286,200.00**

Item	Description	Unit	Quantity	Unit Price	Amount
	Existing Site - Expanded				
1	Mobilization & Demobilization	L.S.	1	$ 25,000.00	$ 25,000.00
2	Supply , deliver and place material for New Berms	m^3	4000	$ 40.00	$ 160,000.00
3	Supply , deliver and installation of new Chain Link Fences	m	600	$ 270.00	$ 162,000.00
4	Demolition and Disposal of Existing Fences	L.S.	1	$ 5,000.00	$ 5,000.00
5	Site Works	L.S.	1	$ 10,000.00	$ 10,000.00
6	Drainage Works	L.S.	1	$ 15,000.00	$ 15,000.00
				Subtotal	**$ 377,000.00**
				15% Engineering	**$ 56,550.00**
				20% Contingency	**$ 75,400.00**
				Total	**$ 508,950.00**

Appendix C

Life Cycle Cost Breakdowns

Equivalent uniform annual cost ($) (EUAC)

$$EUAC = C \times CRF$$

$$CRF = \frac{DR\,(1 + DR)^{EL}}{(1 + DR)^{EL} - 1}$$

Where C = Capital expenditure ($)
CRF = Capital Recovery Factor
EL = Economic Life (years)

Alternative 5 - Remediation of Existing Site

Capital Expenditure = $290,000

Economic Life (years) = 10

Discount Rate: = 0.08

$$CRF = \frac{0.08 \times (1 + 0.08)^{10}}{(1 + 0.08)^{10} - 1} = 0.14903$$

$$EUAC = \$290{,}000 \times 0.14903 = \$43{,}219$$

Alternative 6 - Remediation and Expand Existing Site

Capital Expenditure = $510,000

Economic Life (years) = 15

Discount Rate: = 0.08

$$CRF = \frac{0.08 \times (1 + 0.08)^{10}}{(1 + 0.08)^{10} - 1} = 0.11683$$

$$EUAC = \$510{,}000 \times 0.11683 = \$59{,}583$$

Development of Alternate Site 2

Capital Expenditure = $850,000

Economic Life (years) = 20

Discount Rate: = 0.08

$$CRF = \frac{0.08 \times (1 + 0.08)^{10}}{(1 + 0.08)^{10} - 1} = 0.10185$$

$$EUAC = \$850{,}000 \times 0.10185 = \$86{,}574$$

Present Value Calculation

Alternative 5 - Remediation of Existing Site

PV = Present Value of expenditure "S" ($)

$PV = S_n \times (PVF)$

$$= S_n \times \frac{1}{(1 + DR)^n}$$

Where; S_n = n ($)

n = Number of years

PVF = Present Value

DR = Discount Rate = 0.08

and $PVF = \frac{1}{(1 + DR)^n}$

Year	Capital Cost	EUAC	O&M Annual	Total Yearly	Present Value
1	$290,000.00	$43,218.55	N/A	$43,218.55	$40,017.18
2		$43,218.55	N/A	$43,218.55	$37,052.94
3		$43,218.55	N/A	$43,218.55	$34,308.28
4		$43,218.55	N/A	$43,218.55	$31,766.93
5		$43,218.55	N/A	$43,218.55	$29,413.82
6		$43,218.55	N/A	$43,218.55	$27,235.02
7		$43,218.55	N/A	$43,218.55	$25,217.61
8		$43,218.55	N/A	$43,218.55	$23,349.64
9		$43,218.55	N/A	$43,218.55	$21,620.04
10		$43,218.55	N/A	$43,218.55	$20,018.55
11	$850,000.00	$86,574.38	N/A	$86,574.38	$37,130.27
12		$86,574.38	N/A	$86,574.38	$34,379.88
13		$86,574.38	N/A	$86,574.38	$31,833.22
14		$86,574.38	N/A	$86,574.38	$29,475.20
15		$86,574.38	N/A	$86,574.38	$27,291.85
16		$86,574.38	N/A	$86,574.38	$25,270.24
17		$86,574.38	N/A	$86,574.38	$23,398.37
18		$86,574.38	N/A	$86,574.38	$21,665.15
19		$86,574.38	N/A	$86,574.38	$20,060.33
20		$86,574.38	N/A	$86,574.38	$18,574.38
				Total Present Value =	$559,078.88

Present Value Calculation

Alternative 6 - Remediation & Expansion of Existing Site

PV = Present Value of expenditure "S" ($)

$PV = S_n \times (PVF)$

$$= S_n \times \frac{1}{(1 + DR)^n}$$

Where; S_n = n ($)

n = Number of years

PVF = Present Value

DR = Discount Rate = 0.08

and $PVF = \frac{1}{(1 + DR)^n}$

Year	Capital Cost	EUAC	O&M Annual	Total Yearly	Present Value
1	$510,000.00	$59,583.07	N/A	$59,583.07	$55,169.51
2		$59,583.07	N/A	$59,583.07	$51,082.88
3		$59,583.07	N/A	$59,583.07	$47,298.96
4		$59,583.07	N/A	$59,583.07	$43,795.33
5		$59,583.07	N/A	$59,583.07	$40,551.23
6		$59,583.07	N/A	$59,583.07	$37,547.44
7		$59,583.07	N/A	$59,583.07	$34,766.15
8		$59,583.07	N/A	$59,583.07	$32,190.88
9		$59,583.07	N/A	$59,583.07	$29,806.37
10		$59,583.07	N/A	$59,583.07	$27,598.49
11		$59,583.07	N/A	$59,583.07	$25,554.16
12		$59,583.07	N/A	$59,583.07	$23,661.26
13		$59,583.07	N/A	$59,583.07	$21,908.57
14		$59,583.07	N/A	$59,583.07	$20,285.71
15		$59,583.07	N/A	$59,583.07	$18,783.07
16	$850,000.00	$86,574.38	N/A	$86,574.38	$25,270.24
17		$86,574.38	N/A	$86,574.38	$23,398.37
18		$86,574.38	N/A	$86,574.38	$21,665.15
19		$86,574.38	N/A	$86,574.38	$20,060.33
20		$86,574.38	N/A	$86,574.38	$18,574.38
Total Present Value =					$618,968.46

Present Value Calculation

Alternative Site 2

PV = Present Value of expenditure "S" ($)

$PV = S_n \times (PVF)$

$$= S_n \times \frac{1}{(1 + DR)^n}$$

Where S_n = n ($)

n = Number of years

PVF = Present Value

DR = Discount Rate = 0.08

and $$PVF = \frac{1}{(1 + DR)^n}$$

Year	Capital Cost	EUAC	O&M Annual	Total Yearly	Present Value
1	$850,000.00	$86,574.38	N/A	$86,574.38	$80,161.46
2		$86,574.38	N/A	$86,574.38	$74,223.57
3		$86,574.38	N/A	$86,574.38	$68,725.53
4		$86,574.38	N/A	$86,574.38	$63,634.75
5		$86,574.38	N/A	$86,574.38	$58,921.07
6		$86,574.38	N/A	$86,574.38	$54,556.54
7		$86,574.38	N/A	$86,574.38	$50,515.32
8		$86,574.38	N/A	$86,574.38	$46,773.44
9		$86,574.38	N/A	$86,574.38	$43,308.74
10		$86,574.38	N/A	$86,574.38	$40,100.69
11		$86,574.38	N/A	$86,574.38	$37,130.27
12		$86,574.38	N/A	$86,574.38	$34,379.88
13		$86,574.38	N/A	$86,574.38	$31,833.22
14		$86,574.38	N/A	$86,574.38	$29,475.20
15		$86,574.38	N/A	$86,574.38	$27,291.85
16		$86,574.38	N/A	$86,574.38	$25,270.24
17		$86,574.38	N/A	$86,574.38	$23,398.37
18		$86,574.38	N/A	$86,574.38	$21,665.15
19		$86,574.38	N/A	$86,574.38	$20,060.33
20		$86,574.38	N/A	$86,574.38	$18,574.38
Total Present Value =					$850,000.00