Appendix E

Executive Summaries

E-1 Environmental Site Assessment

E-2 Underground Waste Disposal Plan

E-3 Human Health and Ecological Risk Assessment

Environmental Site Assessment

1.7 G.13, ᐊᕙᑎᖓᓂᒃ ᖃᐅᔨᓴᕐᓂᖅ

1.7.1 ᓇᐃᒡᓕᒋᐊᕐᓯᒪᔪᑦ ᐅᖃᐅᓯᒃᓴᐃᑦ

ᐱᒋᐊᕐᓂᖓ

ᓇᓂᓯᕕᒃ ᓄᓇᖓ ᑲᖏᕐᓗᒃᒥᑦᑐᖅ ᐊᕐᕙᕐᑐᑦ ᑲᖏᕐᓗᐊᓂ ᓄᓇᓕᖓᑕ ᐃᒃᐱᐊᕐᔪᑦ ᖃᓂᒋᔭᓂᑦᑐᖅ ᐅᐊᒃᓇᖓᓂ ᕿᑭᕐᑕᓗᑦ, ᐅᔭᕐᒃᑕᖃᑦᑕᕐᓯᒪᔪᖅ ᓴᕕᒃᓴᒥᒃ ᐊᒻᒪᓗ ᑯᓯᕐᓯᐊᒃᓴᒥᒃ 1976-ᒥᑦ 2002-ᒧᑦ. ᓇᓂᓯᕕᒃ ᐅᔭᕐᒃᓂᐊᕐᕕᒃ ᒪᑐᕕᓚᐅᕐᑐᖅ 2002-ᒥ ᐱᑕᖃᕐᑎᐊᕈᓐᓂᕐᓂᖓᓄᑦ ᐅᔭᕐᒃᑕᕐᑕᐅᔪᓐᓇᕐᑐᖅ ᐊᒻᒪᓗ ᐊᑭᑭᓗᐊᓕᕐᓂᖓᓄᑦ ᓴᕕᒃᓴᖅ.

ᒪᑐᔭᐅᓂᖓᓄᑦ ᓴᓗᒻᒪᖅᓴᕐᑕᐅᓂᖓᓄᓪᓗ ᐸᕐᓇᐅᑎᖃᕐᓗᑎᒃ, ᑲᓐᔮᓐᑯ-ᑯᑦ ᐅᔭᕐᒃᓯᐅᕐᑎᑦ ᐱᕐᑯᑎᓕᑦ ᖃᐅᔨᓴᕐᑎᑦᑎᓚᐅᕐᒪᑕ ᐊᕙᑎᖓᓂᒃ ᓇᓗᓇᐃᕐᓯᓇᓱᒃᓗᑎᒃ ᖃᓄᐃᑦᑐᑎᒋᒃᒪᖔᑕ ᖃᓄᑎᒋᕐᒪᖔᑕᓗ ᓱᕈᓐᓇᕐᑐᔪᑦ ᓄᓇᖓᓂᑦᑐᑦ. ᑮᓇᓕᐅᔪᖅ ᖃᐅᔨᓴᕐᓂᐅᔪᖅ ᐱᒋᐊᕐᑕᐅᓚᐅᕐᓯᒪᔪᖅ ᔪᓚᐃ 2002-ᒥ ᑲᒪᒋᔭᐅᓪᓗᓂ ᑲᓐᓄ ᓕ-ᑯᓐᓄᑦ, ᐊᖏᕐᑕᐅᓚᐅᑲᓚᐅᕐᑐᑦ ᐃᒥᓕᕆᔅᑯᓐᓄᑦ ᑭᓯᐊᓂ ᒪᓕᒃᓂᐊᐳᑎᒃ ᐅᖃᕐᓯᒪᔪᓂᒃ 15-ᖑᔪᓂᒃ ᐱᔭᕆᐊᖃᕐᑐᓂᒃ ᑐᓴᕐᑕᐅᔪᒪᔪᓂᒃᓗ ᑐᑭᓯᐊᒋᐊᕈᑕᐅᔪᓂᒃᓗ. ᐊᑐᓂ ᐱᔭᕆᐊᖃᕐᑐᑦ ᑕᕙᓂ ᑎᑎᕋᕐᓯᒪᔪᑦ.

ᐱᖓᓱᖓᑦ ᖃᐅᔨᓴᕐᓂᖅ ᐱᒋᐊᕐᑕᐅᓚᐅᕐᑐᖅ ᐊᒋᓯ 2003-ᒥ ᐅᖃᐅᓯᒃᓴᐅᔪᓪᓗ ᐱᖅᑯᓯᐅᔭᐅᓯᒪᓪᓗᑎᒃ ᑲᑎᑕᐅᓯᒪᔪᑦ ᐃᓚᐅᖃᑕᐅᔪᓄᑦ ᓄᓇᕗᒻᒥ ᐃᒥᓕᕆᔨᒃᑯᑦ ᑲᑎᒪᔨᖏᓐᓄᑦ ᐅᖃᕐᓯᒪᔪᑦ. ᐱᖓᔪᖓᓂᒃ ᖃᐅᔨᓴᕐᓂᐅᔪᑉ ᐃᓗᓕᖏᑦ ᑕᕙᓪᓚ ᑎᑎᕋᕐᓯᒪᔪᑦ.

ᑲᑎᓪᓗᒋᑦ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᔪᑦ 267 ᑐᐊᕙᖓᓂᒃ ᑲᑎᑕᐅᓯᒪᔪᑦ ᐊᒻᒪᓗ 90-ᓂᒃ ᖃᐅᔨᓴᕐᑕᐅᔭᕕᓂᕐᓂᒃ. ᐊᒻᒪᑦᑕᐅᖅ 15-ᖑᔪᑦ ᐃᒥᕐᒧᑦ ᖃᐅᔨᓴᐅᑕᐅᔭᕕᓂᑦ ᖃᖓᓂᑦᑐᒧᑦ ᐊᒻᒪᓗ ᐃᓗᐊᓂᑦᑐᑦ. ᓴᕕᒃᓴᖃᕐᓂᖓᓗ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᔪᑦ ᐅᕐᓱᐊᓗᒃᓴᖃᕐᓂᖓᓗ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᔪᑦ ᖃᐅᔨᓴᕐᕕᒃᒥ.

ᐱᓕᕆᐊᖑᓚᐅᕐᑐᑦ ᐱᖓᔪᖓᓂ ᖃᐅᔨᓴᕐᑕᐅᔪᑦ ᐱᔭᕆᕐᓂᕐᑕᐅᔪᑦ ᐸᕐᓇᐅᑎᐅᔪᓐᓇᕐᓯᓪᓗᑎᒃᓗ ᓴᓗᒻᒪᖅᓴᐃᓂᕐᒧᑦ ᐊᕙᑎᖓᓗ ᖃᐅᔨᓴᒃᑲᓂᕆᐊᖃᕈᓐᓂᕐᑎᑕᐅᓪᓗᓂ.

ᑭᖑᓕᕐᕙᖓ

ᑭᖑᓕᕐᕙᖓ ᑎᑎᕋᕐᓯᒪᔪᒥ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐱᖓᔪᖓᓂ ᐅᑯᐊᖑᔪᑦ:

ᑐᓚᒃᑕᕐᕕᒃ

- ᓱᕈᕐᓇᕐᑐᖃᕐᓂᖓ ᖃᓄᕐ ᐊᖏᑎᒋᒃᒪᖔᑦ ᖃᐅᔨᒪᔭᐅᓕᕐᓗᓂ ᑐᑭᓯᔭᐅᓪᓗᓂ ᐅᕐᓱᖃᐅᑎᑦ 40-ᒥᑕᒥᑦ ᐅᖓᑕᓄᐊᕐᓯᒪᖏᓐᓂᖓᓂᒃ ᑕᕙᖓᑦ ᖃᑎᒃᓯᓕᕐᓯᒪᔪᑦ ᐊᕙᓗᐊᓄᑦ ᑭᒃᓕᖃᕐᓗᓂ ᐅᕐᓱᖃᐅᑎᒥᑦᑐᖅ.
- ᓱᕈᕐᓇᕐᑐᖃᕐᓂᖓ ᑐᐊᕙᐅᑦ ᑐᓚᒃᑕᕐᕕᒃᒥᑦᑐᖅ ᐅᓯᓕᕐᓱᕐᕕᒃᒥᑦᑐᖅ ᐅᖓᑕᓂᓐᓂᕐᑕᐅᔪᖅ ᓴᓇᐅᑎᒃᑯᑦ ᖃᐅᔨᓴᐅᑕᐅᖃᑦᑐᒥᑦ ᐃᒪᕐᒥᐅᑕᐃᑦ ᓴᐳᑎᓯᒪᓇᓱᒃᓗᒋᑦ ᓴᓗᒻᒪᖅᓴᕐᑕᐅᓂᐊᕐᑐᖅ ᑐᐊᕙᖓ.
- ᑲᖓᓂᑦᑐᑦ ᓄᓇᐅᑦ ᓱᕈᕐᓇᕐᑐᖃᕐᑐᑦ ᐅᕐᓴᒃᓴᐃᕕᐅᑦ ᖃᓂᒋᔭᓂᑦᑐᑦ. ᑕᓐᓇ ᓱᕈᕐᓇᕐᑐᖃᕐᓂᖓ ᑕᒪᓂᑐᐊᕐ ᓱᕐᓗ ᐅᕐᓱᖃᐅᑎᑦ ᖃᓂᒋᔭᐃᓐᓇᖓᓂᑦᑐᖅ.
- ᓱᕈᕐᓇᕐᑐᖃᕐᓂᖓᓗ ᖃᐅᔨᓴᕐᑕᐅᓚᐅᕐᒥᔪᖅ ᓱᓪᓗᓕᑯᖓᔪᖅ ᐅᕐᓱᐊᓗᖃᐅᑎ ᑐᑭᓯᕙᐅᓚᐅᕐᑐᖅ ᓱᕈᕐᓇᕐᑐᓂᖓ ᖃᓂᒋᔭᐃᓐᓇᖓᓂᓐᓂᖓᓂᒃ ᓱᓗᓕᒃᒥᑦ ᐅᖓᓯᒃᓂᖃᕐᑐᖅ 40-ᓯᓐᑕᒥᑕᒥᒃ.
- ᓴᕕᒃᓴᕈᔪᓂᖓ ᐱᑕᖃᕐᓂᕋᕐᑕᐅᓪᓗᓂ ᑐᓚᒃᑕᕐᕕᒃᒥ ᐱᒋᕙᕐᓗᓂ ᐸᖓᓂᑦ ᐃᒃᓗᐊᓗᑦ ᐅᓯᓕᕐᓱᕐᕕᒃᒧᑦ ᐊᒻᒪᓗ ᐅᓱᕐᖃᐅᑎᒧᑦ. ᐊᑕᐅᓯᕐᒥᒃ ᓇᓗᓇᐃᕐᓯᓯᒪᓪᓗᑎᒃ ᐱᑕᖃᕐᓂᖓᓂᒃ ᓴᕕᒃᓴᖃᕐᓂᖓᓂᒃ. ᑯᓯᕐᓯᐊᒃᓴᕐ ᐱᑕᖃᕐᓂᕋᕐᑕᐅᒥᓪᓗᓂ ᐸᖓᓂᑦ ᐃᒃᓗᐊᓗᑦ ᐊᑭᓇᖓᓄᑦ ᑎᑭᓪᓗᖑ. ᖃᐅᔨᓴᐅᑎᒃᑯᑦ ᓇᓴᐅᑎᒃᑯᑦ ᑎᑭᐅᒪᔭᖓ ᐅᖓᑕᑲᓄᐊᕐᓯᒪᖏᑦᑐᖅ ᐃᓚᒃᓴᒃᑯᕕᐅᔪᒥ ᐃᓗᒻᒧᓪᓗ ᖃᐅᔨᓴᕐᑕᐅᒪᒥ ᑐᑭᓯᔭᐅᓚᐅᕐᑐᖅ ᐃᑎᓂᖃᕐᑐᒥᒃ 0.4 ᒥᑕᓂᒥᒃ ᐃᖅᓴᐅᑎᓯᒪᓂᖓᓂᒃ.
- ᓇᕕᒃᓴᒃ ᐅᖓᑕᓂᑦᑐᕐ ᓇᓴᐅᑎᒃᑯᑦ, ᑐᐊᕙᖓ ᓴᓗᒻᒪᖅᓴᕐᑕᐅᓂᐊᕐᑐᖅ, ᓴᕕᒃᓴᖃᕐᓂᖓ ᑕᒪᕐᒥᒃ ᓴᓗᒻᒪᖅᓴᕐᑕᐅᓂᐊᕐᑐᖅ ᑐᐊᕙᖓᓗ ᐃᔭᕐᑕᐅᓗ.

ᒥᑕᖅᕕᐱᓂᖅ

- ᐅᖅᓱᐊᓗᒃᑕᖃᖅᓂᖓᓂᒃ ᓇᓗᓇᐃᖅᓯᓚᐅᖅᑐᑦ ᑭᖑᓕᖅᒥᒃ ᖃᐅᔨᓴᖅᑎᓪᓗᒋᑦ ᐊᕙᑎᖓᓂᒃ ᐊᑭᓐᓴᖓᓂ ᒥᑦᑕᖅᕕᐱᓂᐅᑦ. ᐅᖅᓱᐊᓗᖃᖅᓂᖓ ᐅᖓᑕᓂᖕᒋᑦᑐᖅ 45-ᒥᑕ ᐱᑕᖃᖅᓂᕆᔭᖓᑕ. ᐳᖅᓱᐊᓗᒃᑕᖃᖅᓂᖓᓂᒃ ᐃᓗᑦᑐᖅᓯᒪᔪᒥ ᖃᐅᔨᒪᔪᑎᖃᓚᐅᖅᒥᒍᑦ ᑭᓯᐊᓂ ᖃᐅᔨᕆᐊᖅᑕᐅᒐᒥ ᓇᓴᐅᑎᒃᑯᑦ ᑐᖓᓂᓚᐅᖅᑐᖅ ᑭᒃᓕᒋᔭᕆᐊᖃᖅᑕᖓᑕ. Hᓐᓇᓗ ᖃᐅᔨᓴᐅᑎ ᐅᖓᓯᒃᓂᖃᓚᐅᖅᑐᖅ 45-ᒥᑕᒥᒃ ᐱᑕᖃᖅᓂᖓᓂᑦ.
- ᑯᓯᖅᓯᐊᒃᓴᖅ ᓇᓴᐅᑎᒃᑯᑦ ᐅᖓᑕᓂᓚᐅᖅᑐᖅ ᑭᖑᓕᖅᒥᒃ ᖃᐅᔨᓴᖅᑎᓪᓗᒋᑦ ᐊᕙᑎᖓᓂᒃ ᓂᒋᖓᓂ ᒥᑦᑕᖅᕕᐱᓂᐅᑦ. ᖃᐅᔨᓴᖅᑕᐅᓚᐅᖅᑐᖅ ᖃᓄᑎᒋ ᐱᑕᖃᖅᑎᒋᒃᒪᖓᑦ ᐃᓗᑐᔪᒧᑦ ᐊᒻᒪᓗ ᓴᓂᒧᑦ ᖃᖓᓂᑐᐃᓐᓇᖅᓂᕿᖅᑕᐅᔪᖅ ᓄᓇᐅᑦ ᑐᐊᐸᖓᓂ.

ᓄᓇᓕᖓ, ᕿᔪᓕᓇᕕᒃ

- ᐅᖅᓱᐊᓗᒃᑕᖃᖅᓂᖓᓂᒃ ᕿᔪᓕᓇᕕᒃᒥ ᖃᐅᔨᔭᐅᓯᒪᓪᓗᓂ ᑐᐊᐸᖓᓂ ᐅᖓᑕᓂᖕᒋᑦᑐᖅ 50-ᒥᑕ ᐃᒃᓗᒥᑦ. ᑯᖓᓂ ᖃᓂᒋᔭᓂᑦᑐᖅ ᖃᐅᔨᓴᖅᑕᐅᒍᓗᐊᕐᒥ ᐅᖅᓱᐊᓗᒃᓯᐊᖅᕕᐅᓚᐅᖕᒋᑦᑐᖅ ᐃᒪᖓᓂ.

ᓴᓇᕕᐊᓗᒃ ᐃᒃᓗᐊᓗᒃ

- ᑐᐊᐸᖓ ᖃᓂᒋᔭᖓ ᐅᖅᓱᐊᓗᒃᑕᖃᐅᖅᑐᖅ ᐅᖅᓱᖃᐅᑎᐅᑦ ᖃᓂᒋᔭᖓᓂ. ᐳᖅᓱᐊᓗᖃᖅᓂᖓ ᐅᖓᑕᓂᓚᐅᖕᒋᑦᑐᖅ 0.95-ᒥᑕᒥᒃ ᐊᑕᓂᑦ ᑭᓯᐊᓂᓗ ᐱᑕᖃᓚᐅᖅᑐᖅ 15-ᒥᑕᒥ ᐃᓗᑐᓂᓕᒃᒥ.
- ᐅᖅᓱᐊᓗᒃᑕᖃᖅᓂᖓᓂᒃ ᓇᓗᓇᐃᖅᓯᓚᐅᖅᑐᑦ ᑭᓂᖅᑐᖃᐅᑎᒥᑦ, ᑯᖓᑕ ᐊᒻᒪᓗ ᐃᒃᓗᐊᓗᑦ ᐊᑯᓐᓂᖓᓂᑦᑐᖅ ᑭᓂᖅᑐᒃᑯᕕᒃ. ᖃᐅᔨᓚᐅᖅᑐᑦ ᖃᓂᒋᔭᐃᓐᓇᖓ ᑭᓂᖅᑐᖅᑕᖃᐅᖅᓂᖓᓂᒃ ᑯᒃᒧᐊᖅᓯᒪᖕᒋᑦᑐᖅ ᑭᓂᖅᑐᓂᖓ
- ᐅᖅᓱᐊᓗᒃ ᖃᐅᔨᔭᐅᓯᒪᔪᖅ ᑐᐊᐸᖓᓂ ᓴᓗᒻᒪᖅᓴᐃᕕᒃᒥ ᖃᓂᒋᔭᖓᓂ ᑭᓯᐊᓂ ᐅᖓᑕᓂᖕᒋᑦᑐᖅ 50-ᒥᑕ.
- ᓴᕕᒃᓴᖃᖅᓂᖕᒋᑦ ᑐᐊᐸᒃ ᖃᓂᒋᔭᓂᑦᑐᑦ. ᖃᐅᔨᓴᖅᓗᑎᒃ ᑐᑭᓯᓚᐅᖅᑐᑦ ᐱᑕᖃᖅᓗᐊᖅᑎᓪᓗᒋᑦ ᓴᕕᒃᓴᐃᑦ ᑯᓯᖅᓯᐊᒃᓴᐃᓪᓗ ᑭᓯᐊᓂᓕ ᖃᖓᓂᑦ ᐅᖓᑕᓄᐊᖃᑦᑕᖕᒋᑦᑐᖅ 0.4-ᒥᑕ ᐊᒻᒧᑦ.

ᐱᖅᑯᑎᒃᑯᕕᒃ

- ᐅᖅᓱᐊᓗᖃᖅᓂᖓ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᖅ ᐊᖓᓂ ᑐᐊᐸᖓᑕ, ᑕᑯᒃᓴᐅᓪᓗᓂᓗ ᐅᖅᓱᐊᓗᖃᖅᓂᖓ, ᐅᖅᓱᐊᓗᖃᓚᓇᒃᓂᖓ (ᖃᐅᔨᓴᖅᑕᐅᓗᓂ ᕿᖑᓕᖅᒥᒃ ᐊᕙᑎᖓ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᖅ ᐱᑕᖃᖅᓂᖓᓂᒃ ᐅᓱᐊᓗᒃᑕᖃᖅᓂᖓᓂᒃ) ᐅᖓᑕᓄᐊᖓᓪᓗᓂᓗ ᖃᐃᖅᓱᕋᖑᓂᖓᓄᑦ ᑕᐅᓄᖓ ᐃᓗᒻᒧᑦ ᐃᑎᓂᖃᖅᑐᒥᒃ 0.8-ᒥᑕᒥᒃ ᐅᖓᑕᓄᐊᖕᒋᑐᒐᓗᐊᖅ ᖃᐃᖅᓱᓚᖑᓂᖓᑕ ᕿᒃᓕᖓᓄᑦ ᐃᑎᓂᖃᖅᑐᒥ 0.4-ᒥᑕᒥᒃ ᐊᑕᓂ ᑐᐊᐸᖓᑕ.

ᐱᖅᑯᑎᒃᑯᕕᐅᔪᖅ ᐃᓂᓕᐅᖅᓯᒪᔪᖅ

- ᖃᐅᔨᓴᖅᑕᐅᓪᓗᓂ ᐅᖅᓱᐊᓗᖃᖅᓂᖓ ᑐᐊᐸᒃᒥ 25-ᐳᓴᖓ ᑐᐊᐸᐅᑦ ᐃᔭᖅᑕᐅᓂᐊᖅᑐᖅ ᐅᖓᑕᓂᖕᒋᓐᓂᖓᓂᒃ ᓇᓴᐅᑎᒃᑯᑦ ᖃᐅᔨᒪᔪᑕᐅᔪᒧᑦ.

Appendix E-1

ᐊᒃᑕᕐᕕᒃ

- ᐅᕐᓱᐊᓗᒃᑕᖃᕐᒪᖔᑦ ᖃᐅᔨᓴᐅᑎᖏᑦ ᑐᐊᐸᖓᓂ ᐊᒻᒪᓗ ᐃᒥᕈᔭᓂᖓᓂ ᐊᑕᓂ ᐊᒻᒪᓗ ᓇᓚᓂ ᐊᒻᒪᓗ ᐱᑕᖃᕆᓗᐊᕆᖓᑦ ᑐᖓᓂᓗᐊᕐᓗᑎᒃ ᓇᓴᐅᑎᒃᑯᑦ ᑮᓕᒥᔭᕆᐊᖃᕐᑕᖓᑕ
- ᓴᕕᒃᓴᖃᓚᐅᖏᑦᑐᑦ ᑐᐊᐸᖓᓂ

ᓴᓇᕕᒃ *K-Baseline*

- ᐅᕐᓱᐊᓗᒃᑕᖃᕐᓂᖓᓂᒃ ᖃᐅᔨᓚᐅᕐᑐᑦ ᑐᐊᐸᖓᓂᒃ. ᐊᐅᓚᐅᓯᕙᕕᐅᑦ ᖃᓂᒥᔭᖓ. ᐃᓗᑦᑐᕐᓯᓪᓗᑎᒃᓗ ᖃᐅᔨᓴᕐᓂᖓ ᖃᐅᔨᓚᐅᕐᑐᑦ ᐅᖓᑕᓄᐊᕐᓯᒪᖏᓐᓂᖓᓂᒃ ᑯᖓᑕ ᖃᓂᒥᔭᓄᑦ ᑮᓕᖃᕐᓗᓂ
- ᖃᐅᔨᓴᕐᓂᒃᑯᑦ ᐱᖓᔪᖓᓐᓂ ᖃᐅᔨᓚᐅᕐᑐᑦ ᓄᓇᐅᑦ ᖃᖏᓐᓇᖓ ᐅᕐᓱᐊᓗᒃᑕᖃᕐᓂᖓᓂᒃ ᐃᓗᓪᓗᒃᓯᒪᖏᓐᓂᖓᓂᒃ.

ᐊᕐᖁᑎᑦ

- ᐅᕐᓱᐊᓗᒃᑕᖃᕐᓂᖏᑦ ᖃᐅᔨᓴᐅᓚᐅᕐᑐᑦ ᐊᕐᖁᑎᑦ ᑮᓕᖏᑦ ᐱᕐᖁᑎᖃᕐᕕᕕᓂᕐ, ᑕᓱᒪᓗ ᖃᓂᒥᔭᐃᓐᓇᖓ ᐅᕐᓱᐊᓗᖃᐅᕐᓗᓂ.
- ᓴᕕᒃᓴᖃᕐᓂᖓ ᖃᐅᔨᓴᐅᓚᐅᕐᑐᖅ ᐅᔭᕋᒃᑕᕐᕕᐅᓯᒪᔪᑦ ᖃᓂᒥᔭᓂᑦᑐᖅ ᐊᕐᖁᑎ ᑕᓇᐅᕐᓘᑦ ᐅᔭᐅᒪᔪᖅ ᐸᓚᑕᕐᕕᒃ.
- ᓴᕕᒃᓴᖃᕐᑐᕐ ᐃᓚᖓ ᐊᕐᖁᑎ ᓄᓇᓕᖓᓂᑦ ᓴᓇᕕᐊᓗᒃᓘᐊᖓᔪᖅ ᐊᑭᓐᓇᖓᓂ ᐃᑲᕈᑎᐅᑦ ᑯᕕᕐᓗᑯᓘᑦ ᓴᓗᒻᒪᕐᓴᐃᕕᐅᑦ ᖃᓂᒥᔭᓂ.. ᐱᑕᖃᓚᐅᖏᑦᑐᖅ 0.4 ᒥᑕ ᐅᖓᑕᓂ ᐊᒻᒨᑦ.
- ᓇᕕᒃᓴᖃᕐᓂᖓ ᐱᑕᖃᐅᕐᑐᖅ ᖃᖓᓂ ᓄᓇᐅᑦ ᐊᕐᖁᑎᒥ ᓴᓇᕕᐊᓗᑦ ᐊᒻᒪᓗ ᓴᓗᒻᒪᕐᓴᐃᕕᐅᑦ ᐊᑯᓐᓂᖓᓂ, ᐃᓂᖃᕐᑐᖅ ᐅᖓᓯᒃᓂᖃᕐᑐᒥᒃ 1.5 ᑭᓇᒥᑕ ᐅᐊᒃᓇᖓᓂ. ᓱᕋᕐᓇᕐᑐᖃᕐᓂᖓ ᐅᖓᑕᓄᐊᓚᐅᖏᑦᑐᖅ 0.4 ᒥᑕ ᐊᒻᒨᑦ.

Executive Summary (Environmental Site Assessment)

Introduction

The Nanisivik Mine, located on the south shore of Strathcona Sound near the community of Arctic Bay in the North Baffin region, produced lead and zinc mineral concentrates from 1976 to 2002. The mine was permanently shut down in 2002 due to depleted ore reserves and poor economic forecasts.

As part of the closure and reclamation planning process, CanZinco Ltd., the mine owner, commissioned an Environmental Site Assessment ("ESA") to identify the nature and distribution of contaminants in soil. A Phase 2 ESA was undertaken in July 2002 by Gartner Lee Limited ("Gartner Lee"). Conditional approval was given by the NWB for the Phase 2 ESA Report based on fulfillment of 15 specified conditions regarding information requests and requests for clarifications. Each of those conditions is addressed herein.

A Phase 3 ESA investigation was conducted in August 2003 that incorporated as many of the comments that were brought forward through the NWB review of the Phase 2 ESA Report as allowed by timelines and practicalities. The Phase 3 ESA investigations are reported on herein.

A total of 267 soil samples were collected from 90 test pits during the Phase 3 ESA. Additionally, 15 water samples were collected from groundwater monitors and surface seeps. Analyses for metals and petroleum hydrocarbon concentrations were conducted at an accredited laboratory for a select subset of the soil samples and all of the water samples.

The work performed for the Phase 3 investigations is considered to complete the needs for preparation of a remedial plan for the Nanisivik site and no further ESA investigations are deemed necessary.

Conclusions

The conclusions drawn from Phase 3 program, as presented herein in Section 5, are provided below.

Dock Area

The downgradient extent of hydrocarbon contaminated soil at the fuel tank farm has been delineated. Testing has shown that it does not extend beyond 40 m from the berm of the tank farm.

Concentrations of hydrocarbons in the soil within the dock cell containing the ship loader facility exceed the generic PHC CWS IL for the protection of aquatic life, the site soil quality remediation objective.

Surficial hydrocarbon contamination is present at the AST adjacent the refuge station. The contamination appears to be isolated to the immediate area surrounding the AST.

Hydrocarbon contamination was detected in a test pit which exposed the fuel line from the dock to the tank farm. Results indicate that contamination is localized and has migrated less than 40 cm from the line.

Zinc concentrations greater than the SQRO for the dock area have been identified on surface adjacent the door to the concentrate shed on the west side, at the load out dock and adjacent the refuge station. One isolated incidence is documented on the east side of the concentrate shed. Lead concentrations also exceed the SQRO adjacent the door of the concentrate shed on the west side. No lead or zinc contamination greater than the SQROs is indicated in the reagent storage area. Analytical results indicate that the metal contaminated soil does not extend to 0.4 m below surface.

Silver exceeds the generic CEQG IL, the site soil quality remediation objective. Elevated silver results were returned in samples with zinc concentrations that were indicative of zinc concentrate and several times greater than the SQRO and therefore silver is contamination would be remediated during the remediation of the zinc contaminated soils.

STOL Airstrip

- Hydrocarbon contaminated soil detected during the Phase 2 ESA at the east end of the airstrip has been delineated. The contaminated soil does not extend 45 m from the point of origin as indicated by surface staining. Hydrocarbon contaminated seepage water was encountered in test pit TP03-373, however soil quality results from this test pit met the PHC CWS RL criteria. Test pit TP03-373 was excavated approximately 45 m from the point of origin.
- Lead concentrations greater than the SQRO detected during the Phase 2 ESA on the apron on the south side of the airstrip were investigated. The lead contamination has been delineated vertically and laterally and it is confined to the soils on surface at the apron.

Town, Carpenter Shop

- The downgradient extent of hydrocarbon contaminated soil at the Carpenter Shop has been delineated. It does not extend 50 m downgradient of the building. No impact of hydrocarbon contamination on the surface water was detected in the water flowing in a ditch adjacent to the Carpenter Shop.

Industrial complex

Soils beneath the surface water runoff pathway, downgradient of the fuel day tanks, are contaminated with hydrocarbons. Contamination did not extend to 0.95 m beneath surface at test pit TP03-331, but was present at 1.5 m below surface at the upgradient test pit TP02-88.

Hydrocarbon contaminated soil has been delineated at the waste oil tank, located between Twin Lakes Creek and the industrial complex. Results indicate that it is isolated to the downhill side of the tank and does not extend to the creek.

Hydrocarbon contaminated soil is present at the oil water separator. Analytical results obtained from test pit TP03-330 indicated that the contaminated soil does not extend 50 m downgradient of the oil water separator.

Metal contaminated soil is present in the soil surrounding the industrial complex. Analytical results to date indicate that concentrations of cadmium, lead and zinc greater than the SQROs do not generally extend to 0.4 m below surface.

Warehouse Yard

Hydrocarbon contamination is present in surficial soils with patchy, visible staining. Hydrocarbon contamination at an area of heavy staining (initially identified and sampled during the Phase 2 ESA) extends into the fractured bedrock to at least 0.8 m depth. It does not extend into the weathered, fractured bedrock, encountered 0.4 m, beneath lightly stained surface soils.

Landfarm Cell

Based on analytical results obtained to date, it is estimated that approximately 25% of the hydrocarbon contaminated soil being remediated in the landfarm cell at the landfill currently meets the generic PHC CWS RL criteria.

Landfill

No hydrocarbon contamination was detected in soil or water samples down gradient or cross gradient of the landfill and all analyses were less than the method detection limits.

No elevated metals were encountered in the soils.

K-Baseline

Hydrocarbon contamination of soil has been detected at the former AST and maintenance shop at K-Baseline. Analytical results from test pits excavated northwest of the former AST and maintenance shop indicated that the contaminated soil does not extent to intermittent tributary of Chris Creek.

Analytical results from the Phase 3 ESA illustrate that the hydrocarbon contaminated soil is isolated to the top of the active layer.

Roads

Surficial hydrocarbon contamination is present at the ASTs adjacent the refuge stations at the side of the roadways. The contamination appears to be isolated to the immediate area surrounding the ASTs.

Metal contamination of soil is present adjacent the former Oceanview mine workings.

Iron contaminated soil is present on the surface of the roadway between the townsite and the industrial complex at the west side of bridge near the sewage treatment plant. The contamination did not extent to 0.4 m below surface.

Metal contaminated soil is present on the surface of the roadway between the industrial complex and the screening plant, located approximately 1.5 km to the north. The contamination did not extend to 0.4 m below surface and was not detected in soils adjacent to the roadway.

Underground Mine Waste Disposal Plan

1.8 G.16, ᓄᓇᐅᑦ ᐃᓗᐊᓄᑦ ᐃᓗᐊᓄᐊᕐᖃᐃᓂᖅ ᐊᑐᕐᑕᐅᔮᐊᖏᑦᑐᓂᒃ

1.8.1 ᓇᐃᒃᓕᒋᐊᕐᓯᒪᔪᑦ ᐅᖃᐅᓯᒃᓴᐃᑦ

ᓇᓂᓯᕕᐅᑦ ᒪᑐᓂᖓ, ᐊᓯᖏᑦᑕᐅᕐ ᐅᔭᕋᒃᓂᐊᕐᕖᑦ ᒪᑐᖃᑦᑕᕐᒥᒃᒪᑕ, ᓴᕿᑎᑦᑎᓯᒪᒃᒪᑕ ᐅᔭᕋᒃᓂᐊᕐᑎᓪᓗᒋᑦ ᐱᔭᐅᖃᑦᑕᕐᓯᒪᔪᓂᒃ ᐃᒋᑕᐅᔪᓇᐊᓪᓚᒃᓂᒃ ᓴᓗᒻᒪᕐᓴᕐᑕᐅᔪᓇᐊᓪᓚᒃᓂᒃᓗ. ᐱᒍᑎᖓᓕ ᓄᓇᐅᑦ ᐃᓗᐊᓄᐊᕐᖃᐃᓂᕐᒧᑦ ᐸᕐᓇᐅᑎᖓ ᓇᓗᓇᐃᕐᓯᔪᑕᐅᓗᓪᓂ ᖃᓄᐃᑦᑐᑦ ᐃᒋᑕᐅᓂᐊᕐᒪᖓᑕ ᖁᔭᓇᕐᑕᐅᓂᐊᕐᒪᖓᑕᓗ, ᐱᖃᓯᐅᑎᒐᔭᕐᓗᑎᒃ ᓄᓇᓯᐅᑎᕖᓂᑦ, ᐊᐅᓚᐅᑎᕖᓂᑦ, ᐅᔭᕋᐃᓐᓇᐃᑦ, ᑐᐊᐸᐃᑦ ᓱᕈᕐᓇᕐᑐᖃᕐᑐᑦ ᓴᓂᑦ ᐊᓯᖏᓪᓗ ᐊᑐᕐᑕᐅᔮᐊᖏᑦᑐᑦ ᖁᔭᓇᕐᑕᐅᔪᑦ.
ᐸᕐᓇᐅᑎᒥ ᐅᓂᑲᕐᓯᒪᔪᑦ ᖃᓄᕐ ᐃᓗᐊᓄᐊᕐᖄᕐᑕᐅᓂᐊᕐᒪᖓᑕ ᐊᒻᒪᓗ ᓇᒧᖓᕐᖄᕐᓂᐊᕐᒪᖓᑕᓗ.

ᑐᕋᒐᓇᔭᖓᓕ ᐸᕐᓇᐅᑎᐅᑦ ᐃᒋᑕᐅᔪᑦ ᖁᔭᓇᕐᑕᐅᔪᓪᓗ ᐃᓕᐅᖄᕐᑕᐅᓗᑎᒃ ᓄᓇᐅᑦ ᐃᓗᐊᓄᑦ ᐃᓄᒃᓄᑦ ᐊᕙᑎᑦᑎᓐᓄᓪᓗ ᐊᑦᑕᕐᓇᕐᑯᓂᕐᓂᐊᕐᒪᑕ. ᑕᐃᒪᓐᓇ ᒪᕈᓕᖓᓗᓂ ᐱᓕᕆᐊᖑᓂᐊᕐᑐᖅ ᐃᒪᓐᓇ:

1. ᓄᓇᐅᑦ ᐃᓗᐊᓄᑦ ᐃᓗᑐᓂᖓᓄᑦ ᐃᓕᐅᖄᕐᑕᐅᓗᑎᒃ ᐃᒋᑕᐅᔪᑦ ᓄᓇᐅᑦ ᖃᖓᓄᑦ ᐃᓴᐅᑎᔪᓐᓇᐃᓕᑎᒋᐊᕐᓗᒋᑦ ᐸᖏᓪᓗ ᒪᑐᔭᐅᓗᑎᒃ ᐃᓯᕐᑕᐅᔪᓐᓇᐃᓕᓗᑎᒃ.

2. ᐳᔭᕋᒃᑦᕐᕖᕖᓂᕐᓄᑦ ᐃᓗᑦᑐᕐᓯᒪᔪᓄᑦ ᓴᐅᔭᐅᓗᑎᒃ ᖃᖓᓗ ᖃᐃᕐᖃᒃᑕᐅᓗᓂ ᐃᒥᕈᔪᓂᖓ ᖃᖓᓄᐊᖃᑦᑕᔮᐊᖏᓪᒪᑦ ᐊᒻᒪᓗ ᖁᐊᖑᓂᖓᓄᐊᕈᓂ ᖁᐊᖑᐃᓐᓇᓕᕋᔭᕐᒪᑦ.

ᑭᓱᓂᖏᑦ ᓇᓗᓇᐃᕐᑕᐅᓚᐅᕐᓗᑎᒃ ᖁᔭᓇᕐᑕᐅᔪᑦ, ᐸᕐᓇᐅᑎᖓᓂᒃ ᖃᓄᐃᑕᐅᔪᑎᒥᓂᐊᕐᑕᖓᓂᒃᓗ ᑎᑎᕋᕐᑕᐅᓗᑎᒃ ᓇᒧᓪᓗ ᐃᓕᔭᐅᓂᐊᕐᒪᖓᑦ. ᐃᓂᒋᓂᐊᕐᑕᖓ ᒪᓕᒃᓯᒪᓂᐊᕐᑐᖅ ᐊᑦᑕᕐᓇᕐᓂᖓ ᐱᕐᑯᑎᐅᑦ ᒪᓕᒃᓗᒍ ᐊᒻᒪᓗ ᐊᖏᓂᖓ ᐃᓗᐊᓄᐊᓇᐊᓕᒃ ᒪᓕᒃᓗᒍ.

ᓴᓂᓪᓗ ᑲᒪᒋᔭᐅᓂᖏᑦ ᑎᑎᕋᕐᑕᐅᔭᓪᓕᐊᓗᑎᒃ ᕿᒥᕈᔭᐅᔪᓐᓇᕐᓂᐊᕐᒪᑕ ᖃᐅᔨᓴᕐᑕᐅᓕᕈᑎᒃ. ᑎᑎᕋᕐᑕᐅᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᖃᓄᐃᑦᑐᓂᖏᑦ ᐃᒋᑕᐅᔪᑦᒪ, ᑭᓱᓂᖏᓪᓗ, ᓴᓗᒻᒪᓇᐊᖄᕐᓂᖓᓗ, ᐃᓂᒋᓂᐊᕐᑕᖓᓗ ᐊᒻᒪᓗ ᖃᓄᑎᒥ ᐊᖏᑎᒋᒃᒪᖓᑦ.

ᓇᓗᓇᐃᕐᓯᒪᔪᒥᒃ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᖅ ᐅᓇ ᑎᑎᕋᕐᓯᒪᔪᖅ ᖃᐅᔨᒪᔪᑕᐅᓂᐊᕐᑐᖅ ᖃᓄᐃᑦᑐᒃᒪᖓᑦ ᐃᒋᑕᐅᓂᐊᕐᑐᖅ.

ᖃᓄᐃᑦᑐᓂᖓ ᓴᓂᖅ	ᖃᓄᐃᓕᖓᓂᖓ	ᐱᔭᕆᐊᖄᕐᓂᖓ ᓇᓴᐅᑎᒃᑯᑦ
ᓄᓇᓯᐅᑎᕖᓂᑦ ᐊᐅᓚᐅᑎᕈᔪᐃᓪᓗ	1- ᐱᑕᖃᐅᕐᑐᖅ ᐱᕐᑯᔭᑎᒍᑦ ᑲᒪᒋᔭᕆᐊᓕᒃᓂᒃ ᓱᕐᓗ ᕿᑐᓕᖓ ᐃᒪᖓ ᐊᐅᓚᑎᖓᑕᓗ ᐃᒪᖏᑦ 2- ᐃᓗᐊᓄᐊᕐᑕᐅᔪᓐᓇᕐᑐᖅ	ᐊᐃ1 ᐊᐃ2
ᐃᒃᓗᕕᓂᑦ ᓴᓂᖏᑦ	1- ᐃᓗᐊᓄᐊᕐᑕᐅᔪᓐᓇᕐᑐᖅ ᐅᕿᓗᓂᑦ ᐃᑭᑕᐅᓗᓂ	ᑎᑎ1
ᑐᐊᐸᒃ	1-ᓴᕕᒃᓴᖃᕐᑐᖅ 2- ᐅᕐᓱᐊᓗᖃᕐᑐᖅ	ᓴ1 ᓴ2

ᐸᕐᓇᐅᑎᑦ ᐃᒋᑕᐅᓂᐊᕐᑐᓄᑦ ᐊᖏᓂᖓᓂᒃ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᒃᒪᑕ ᐅᑯᐊᖑᔪᑦ:

1. ᑐᓚᒃᑕᕐᕕᒃ: ᐊᖏᓂᖃᕐᑐᖅ 3,750 ᑭᐸᓇᒃᓯᓗᒍ ᒥᑕ
2. ᐱᕐᑯᑎᒃᑯᕕᒃ: ᐊᖏᓂᖃᕐᑐᖅ 1,500 ᑭᐸᓇᒃᓯᓗᒍ ᒥᑕ
3. ᓇᓇᕕᐊᓗᒃ ᐃᒃᓗᐊᓗᒃ: ᐊᖏᓂᖃᕐᑐᖅ 3,700 ᑭᐸᓇᒃᓯᓗᒍ ᒥᑕ
4. ᓄᓇᓕᖓ: ᐊᖏᓂᖃᕐᑐᖅ 4,600 ᒥᑕ
5. ᓴᓗᒻᒪᕐᓴᐃᕕᒃ: ᐊᖏᓂᖃᕐᑐᖅ 1,000
6. ᓄᓇᓯᐅᑎᕈᔪᐃᑦ: ᐊᖏᓂᖃᕐᑐᑦ 4,150 ᑭᐸᓇᒃᓯᓗᒍ ᒥᑕ

Appendix E-2

ᑲᑎᓕᒪᕐᓗᒋᑦ ᐃᒋᑕᐅᓂᐊᕐᑐᑦ ᐃᓚᒃᑲᓐᓂᕐᓗᒍ 25-ᐳᓴᓐᒥᒃ ᐊᖏᓂᖃᕐᑐᑦ 23,500 ᑭᑉᐸᓇᒃᓯᓗᒍ ᒥᑕ.

ᓴᓂᑦ ᐃᒃᓗᓂᖕᒐᕐᑐᑦ ᐱᕐᑯᑎᕕᓂᓪᓗ ᒥᑭᒃᓕᑎᑕᐅᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᐊᔪᕐᓇᖏᑦᑐᐊᕐᖓᑦ ᐃᓗᐊᓄᐊᕐᑕᐅᖏᓐᓂᖏᓐᓂ. Hᐃᒪᓐᓇᒃᐸᓪᓗ ᐅᑎᕐᑕᑲᑕᓗᐊᖏᓐᓂᕐᓴᐅᒐᔭᕐᒪᑕ ᐅᓯᓪᓕᕐᓱᒐᓴᐅᓂᕐᓴᐅᒐᔭᕐᓗᑎᒃᓗ. ᐱᕕᖃᕐᓂᖓᓄᑦ ᓄᓇᐅᑦ ᐃᓗᐊᓂ ᐊᑕᐅᓯᐊᑐᐃᓐᓇᕐᓗᓂ ᐃᓗᐊᓄᐊᕐᑕᐅᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᐅᓯᔭᐅᒃᑲᓐᓂᖏᓪᓗᑎᒃ. ᓄᓇᓯᐅᑎᕐᔭᐸᑦ ᐊᑐᕐᑕᐅᓗᑎᒃ ᐃᓗᐊᓄᐊᖃᐃᖃᑦᑕᕐᓂᐊᕐᑐᑦ. ᐱᕕᖃᖏᓐᓂᕐᓴᒍᐊᕐᑕᐅᔭᑦ ᐊᔭᒃᑕᐅᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᐃᓗᐊᓄᑦ ᐱᕕᖃᕐᓂᖓ ᐊᑐᕐᑕᐅᔭᐃᓐᓇᐅᓇᓱᒃᓗᓂ.

ᐊᐳᒋᖏᑦᑐᑦ ᓇᓗᓇᐃᕐᑕᐅᓯᒪᔭᑦ ᐃᓂᒋᔭᐅᔭᓐᓇᕐᓂᖏᓐᓂᒃ. ᑕᒃᑯᐊ ᐃᓂᒋᔭᐅᔪᒪᔭᑦ ᖃᓂᒋᔭᓂᓪᓗᑎᒃ ᐃᓚᐅᖃᓇᐊᓚᒃᓄᑦ. ᑲᑎᓕᒪᕐᓗᒋᑦ 315,000 ᑭᑉᐸᓇᕐᓯᓗᒍ ᓯᑕᒥᒃ ᐃᓂᒃᓴᖃᕐᑐᑦ ᐃᓗᐊᓄᐊᓇᐊᓚᓪᓗ ᐊᖏᓂᖃᕐᓗᑎᒃ 23, 500-ᒥᒃ.

Appendix E-2

Executive Summary (waste disposal plan)

The closure of Nanisivik Mine as with any mine creates a considerable amount of material that requires disposal. The purpose of the waste disposal plan is to identify and classify the waste, which may include derelict equipment, contaminated soil, waste rock, demolition debris, and regulated or hazardous material. The plan will also provide information on how and where the waste will be disposed of.

The objective of the plan is to dispose of all waste in such a manner as to eliminate the pathway by which exposure to humans or the environment is possible. This will be done in two ways:

1. Deposit the material underground, in locations where gravity will prohibit migration of contaminants to surface openings and permafrost aggradation will effectively seal the waste in place.

2. Deposit the material into pits, cover with rock fill and contour to allow for surface drainage and the prevention of pooling. The natural aggradation of permafrost will then effectively isolate the waste.

A simple classification system is used to differentiate the types of waste.

Type of Waste	Criteria	Classification
Abandoned Equipment	1 – Purged of regulated materials prior to storage (free phase liquids, batteries, etc.)	AE1
	2 – Can be stored directly	AE2
Demolition Debris (inert solids)	1 – Can be stored directly or burned (wood debris)	DD1
Soil	1 – Contains Metals above the SQRO[1]	S1
	2 – Contains Hydrocarbons above the SQRO	S2

[1]SQRO = Soil Quality Remediation Objective

After the material is classified, an action plan for that particular material is followed and a storage location is selected. The storage location depends on the associated risk with the particular material as well as the volume required to facilitate the disposal.

Waste handling procedures will be recorded and documentation will be kept on site for review during the reclamation and post-closure monitoring periods. Records will include a description of the waste, classification, any decontamination required, storage location and estimated storage volume.

Disposal plans and waste volume estimates for the major component areas of the site are included in the Plan. These include:

- Dock Area: Total volume of 3,750 m^3.
- Warehouse Yard: Total volume of 1,500 m^3.
- Industrial Complex Area: Total volume of 3,700 m^3.
- Town Site: Total volume of 4,600 m^3
- WTDA: Total volume of 1,000 m^3
- Mobile Equipment: Total volume of 4,150 m^3.

The grand total of all waste with a 25% contingency added is 23,500 m^3.

Demolition debris and abandoned equipment volume will be reduced as much as possible prior to being placed in a storage location. This will minimize the number of trips and will better facilitate the loading of haulage trucks. The large amount of space available underground will make it possible to avoid handling the material more than once. In most cases trucks will dump directly into the allotted storage area and no further handling will be required. In areas where the height is limited, the material will be pushed up so that 60 to 75 percent of the space is utilized.

Several areas in the mine have been identified as potential storage areas. The areas selected for storage are in close proximity to the main haulage roads. A total of 345,000 m^3 of space is available for the storage of waste underground. There is clearly far more capacity than is required for the identified solid waste (23,500 m^3).

There are three areas available on surface, totaling 120,000 m^3, for the deposition of waste material. The East Open Pit and East trench will be filled with waste rock and metal contaminated soil, and the West Open Pit will be filled with a combination of Waste Rock, metal contaminated soil and inert demolition debris.

Demolition debris or abandoned equipment that is scheduled to be deposited in the West Open pit will be cut into pieces of size and shape that will minimize void spaces as fill material is layered over top.

Appendix E-3

ᓇᐃᒃᓕᕆᐊᕐᓯᒪᔪᑦ ᐅᖃᐅᓯᒃᓴᐅᔪᓂᑦ

ᐅᑯᓐᓂᙵᓂ ᓯᑎᐱᕆ 10 ᐊᒻᒪ ᓄᕕᐱᕆ 29, 2002 ᐊᑎᖅᑐᖅ ᔭᒃᓴ ᕗᐃᑦᕗᑦ ᐊᕙᑎᓕᕆᓂᕐᒧᑦ ᖃᐅᔨᓴᑕᐅᕐᒪᑦ ᑎᒥᖓᑦ ᐊᒻᒪ ᐊᕙᑎᑦᑎᓐᓄᑦ ᐊᑦᑕᕐᓇᖅᑐᕐᑐᑦ ᖃᐅᔨᓴᑕᐅᕐᑐᖅ ᐱᔪᑎᒋᓪᓗᓂᐅᒃ ᓇᓂᓯᕕᒃ ᐅᔾᔨᕆᓂᐊᕐᕕᐅᓪᓚᐅᖅᓯᒪᔪᖅ ᕿᑭᖅᑕᓗᒃᒥᑦᑐᖅ, ᓄᓇᕗᒻᒥ. ᐱᔪᑎᖃᓗᐊᓪᓚᐅᖅᑐᖅ ᖃᐅᔨᓴᕐᓗᑎᒃ ᑐᑭᓯᓇᓱᒃᓗᑎᒃ ᖃᐅᔨᒪᔭᐅᔪᑦ ᓴᕕᒃᓴᐃᑦ ᓴᕕᒃᓴᕈᔪᐃᑦᓗ ᒪᓂᕿᒥᑦᑐᑦ ᐅᔾᔨᕐᓯᐅᕕᐅᔪᒥ ᐊᑦᑕᕐᓇᖅᓯᒪᙳᑦ ᑎᒥᑦᑎᓐᓄᑦ ᐅᕕᑦᓗᓐᓂᑦ ᐊᕙᑎᑦᑎᓐᓄᑦ ᓯᕗᓂᒃᓴᒥ ᐃᓂᒋᔭᐅᒐᔭᕐᓂᖓ ᐅᔾᔨᕐᓂᐊᕈᓐᓂᕐᓯᒪᓕᕐᑎᓪᓗᒋᑦ. ᓯᕗᓂᒃᓴᒥ ᐊᑐᕐᑕᐅᒃᑲᓐᓂᕈᑎᒃᓴᖏᑦ ᐱᔭᕆᕐᓯᒪᓪᓚᐅᖏᑦᑐᑦ ᐅᖅᑳᓯᐅᓯᒪᓪᓚᐅᖏᑦᑐᑦ ᐊᒻᒪ ᑕᓐᓇ ᖃᐅᔨᓴᕐᓂᐅᔪᖅ ᑕᑯᓇᕐᓪᓚᐅᖅᑐᖅ ᐱᙳᕐᓕᕐᓯᒪᔪᓂᒃ ᐊᕿᒋᖏᑦᑐᓂᒃ ᑭᓱᒧᑦ ᐊᑐᕐᑕᐅᒐᔭᕐᓂᖓ ᒪᓕᒃᓗᒍ ᓯᕗᓂᒃᓴᒥ; ᑮᓇᐅᔭᒃᓴᕐᕕᐅᓗᓂ, ᐊᖏᕐᕋᕆᔭᐅᓗᓂ ᓄᓇᓕᐅᓗᓂ, ᐊᒻᒪ ᐱᖑᐊᕐᕕᐅᓗᓂ ᐊᖑᓇᓱᒃᑐᓄᓪᓗ.

ᖃᓄᐃᓕᖓᓕᕐᓂᐊᕐᕕᖓ ᖃᐅᔨᓴᕐᑕᐅᔪᑦ

ᓇᓂᓯᕕᒃ ᐅᔭᕐᓂᐊᕐᕕᒃ ᐅᑯᓂᙶᖅ ᕿᑭᖅᑕᓗᒃ ᐃᓚᖓᓂ ᐅᐊᒃᓇᖓᓂ ᐅᑭᐅᕐᑕᑐᒥ ᐅᑯᓂᙶᖅ ᓄᓇᕘᑎᒍᑦ 73-02 ᐅᐊᒃᓇᖅ, 84-31 ᐊᑭᓐᓇᖅ. ᐅᔭᕐᓂᐊᕐᔪᐊᖅ ᓯᒃᔭᖅᐸᓯᒃᒥᑦᑐᖅ ᖄᓗᓇᑎᑦ (ᓯᑐᓪᓚᒃᑯᓇ ᓴᐅᓐ) ᐃᓄᒃᑎᑐᑦ ᐊᖅᑰᑦ ᑲᖏᕐᓗᐊᓂ. ᖃᓂᓪᓚᖑᔭᖅ ᓄᓇᓕᐅᔭᖅ ᐃᒃᐱᐊᕐᔪᒃ (ᑐᓄᓂᕈᓯᖅ) (ᐊᑎᒃᐸᐃ) ᐅᖓᓯᒃᑐᓂᖅᑐᖅ 25 ᑭᓚᒥᑕ ᐊᑭᓐᓇᖑᓂᑦᑐᖅ ᓇᓂᓯᕕᐅᑦ ᐊᒻᒪ ᐅᐸᒃᑕᐅᔭᓐᓇᕐᓗᓂ 33ᑭᓚᒥᑕᒥᒃ ᑕᑭᓂᖅᑐᖅ ᐊᕐᑯᑎᒃᑯᑦ. ᒥᑦᑕᕕᖓ ᐅᖓᓯᒃᓂᖅᑐᖅ 9ᑭᓚᒥᑕᒥᒃ ᖃᓇᒃᓇᖑᓂ ᓇᓂᓯᕕᐅᑉ ᐊᒻᒪ ᐅᐸᒃᑕᐅᖃᑦᑕᕐᓗᓂ ᖃᖓᑕᓲᑎᒃ ᐅᖓᒻᒧᑦ ᐅᑎᒧᓪᓗ ᐊᑐᕆᒧᑦ, ᐃᖃᓗᒃᓄᑦ, ᖃᐅᔨᐃᑦᑐᒧᓪᓗ. ᓇᓂᓯᕕᒃ ᐅᔭᕐᓂᐊᕐᕕᒃ ᓄᓇᐅᑦ ᐊᑕᓂᑦ ᐅᔭᕐᑕᖃᑦᑕᕐᑐᖅ ᓴᐱᒃᓴᒥᒃ ᕿᓂᕐᑕᒥᒃ ᐅᔭᕐᓯᐅᕐᕕᒋᔭᐅᓗᓂᓗ ᐅᑯᓄᖓ ᐱᕐᑯᑎᒋᔭᐅᓚᐅᖅᑐᖅ ᑲᓐᔪᑯ ᓕᒥᑦᑯᓂ, ᐱᕐᑯᑎᒋᔭᐅᒃᒥᔭᖅ ᐸᓚᒃ ᕗᐊᑐᒃᑯᓐᓄᑦ . ᐅᔭᕐᑕᐃᓐᓇᕐᓯᒪᔪᑦ ᑕᐃᒪᙵᑦ 1976-ᒥᑦ. ᐱᑕᖅᑭᓗᐊᓕᕐᓂᖓᓄᑦ ᑮᓇᐅᔭᒃᓴᐅᑕᐅᔭᓐᓇᕐᑐᑦ ᓴᕕᒃᓴᖅ, ᐅᔭᕐᓂᐊᕈᓐᓂᓚᐅᕐᑐᑦ ᓴᕕᒃᓴᒥᒃ ᓯᑎᐱᕆ 2002ᒥ.

ᑕᓐᓇ ᐅᓂᒃᑳᕐᓯᒪᔭᖅ ᐊᕐᕌᒍᕐᑕᐅᓚᐅᕐᑐᑦ ᒪᓕᒃᓗᑎᒃ ᐃᓚᖓᓂᒃ ᐱᔭᕆᐊᖅᑎᑕᐅᔭᒥᒃ ᒪᑐᔭᐅᓂᖓᓄᑦ ᓴᓗᒻᒪᖅᓴᕐᑕᐅᓂᖓᓄᓪᓗ ᐸᕐᓇᐅᑎᒥ, ᐊᕐᕌᒃᑕᐅᓚᐅᕐᑐᖅ ᒪᓕᒃᓗᑎᒃ ᐊᑐᐊᒐᓂᒃ ᕿᒪᒃᑕᐅᓂᖏᓐᓄᑦ ᓴᓗᒻᒪᖅᓴᕐᑕᐅᓂᖏᓐᓄᓪᓗ ᐅᔭᕐᓂᐊᕐᔪᐊᓂ ᓄᓇᕐᔪᐊᒥ (ᓯᑎᐱᕆ 1990). ᑕᓐᓇ ᐊᑦᑕᕐᓇᕐᑐᓂᒃ ᑎᒥᖓᑦ ᖃᐅᔨᓴᕐᓂᐅᔭᖅ ᒪᓕᒃᓯᒪᓪᓚᐅᕐᑐᖅ ᐊᖏᕐᑕᐅᓯᒪᔪᓂᒃ ᖃᐅᔨᓴᐅᑕᐅᔪᓂᒃ ᐊᑦᑕᕐᓇᕐᓂᖏᓐᓂᒃ ᐊᑐᐊᒐᐃᑦ ᐱᖁᓯᐅᑎᓪᓗᑎᒃᓗ ᑎᑎᕋᕐᑕᐅᓯᒪᔪᑦ ᐊᓐᓂᐊᖅᑲᕐᓇᖏᑦᑐᓕᕆᓃᒃᑯᓐᓂᑦ ᒐᕙᒪᒃᑯᒃᑯᓐᓂᑦ, ᑲᓇᑕᒥ ᑲᑎᒪᔩᑦ ᒥᓂᓯᑕᐅᔪᑦ ᐊᕙᑎᓕᕆᓂᕐᒧᑦ, ᐊᒻᒪ ᐊᒥᐊᓕᒃᑲᒃᑯᑦ ᐊᕙᑎᓕᕆᓂᕐᒧᑦ ᐱᓕᕆᕖᖓᓂᑦ.

ᑎᑎᕋᕐᑕᐅᔪᑦ ᐊᕐᕌᒃᓯᒪᓂᖏᑦ

ᑐᐊᐸᒃᒥᑦ ᒪᓂᕿᒥᑦ ᑲᑎᑦᑎᓪᓗᑐᑦ ᖃᐅᔨᓴᕐᑕᐅᓪᓗᑎᒃ ᑎᑎᕋᕐᑕᐅᓪᓗᑎᒃᓗ ᐱᙳᕐᓂᖑᕐᑐᓂᒃ; ᐊᕙᑎᖓᓂᒃ ᖃᐅᔨᓴᕐᓂᕐᒥᑦ ᒪᕐᕉᔪᖓᓂᒃ ᑲᒪᒋᔭᐅᓪᓗᑐᑦ ᐊᑎᖅᑐᓄᑦ ᑳᓐᓄ ᓕ ᓕᒥᑦ, ᑭᒡᒍᐃᓪᓗᑎᒃ ᑳᕝᑯᒃᑯᓂᒃ ᔪᓚᐃ 2002ᒥ, ᓄᓇᐅᑉ ᖃᖓᓂᑦ ᑲᑎᑦᑎᕙᓪᓕᐊᓪᓗᑐᑦ ᖃᐅᔨᓴᓗᑎᒃᓗ ᐊᑎᖅᑐᑦ ᐃᐱᐊᐃ ᖃᐅᔨᓴᕐᑎᑦ ᑭᒡᒍᐃᓪᓗᑎᒃ ᓚᕙᓪᒃᑯᓂᒃ ᓄᓇᕗᒻᒥ ᔪᓂ 2002ᒥ; ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓯᒪᔪᑦ ᓴᕕᒃᓴᐅᓂᖏᑦ (ᑲᔪᐃᑦ,ᕿᕐᓂᕐᑕᑦ ᐊᒻᒪ ᓴᕕᒃᓴᐃᑦ) ᐱᑕᖃᐅᕐᓂᖏᑦ ᓄᓇᐅᑦ ᖃᖓᓂᑦᑐᑦ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓯᒪᔪᑦ ᓇᓂᓯᕕᒃᑯᓂᑦ ᕿᓂᕐᑎᓗᒋᑦ ᐅᔭᕐᑕᓚᒃᓴᓂᒃ 1985ᒥ. ᑕᐃᑲᓂ ᖃᐅᔨᓴᕐᑎᓗᒋᑦ 1985ᒥ, ᑯᕕᑦᑕᕐᓂᖏᑦ ᑯᕕᔨᖃᑦᑕᓪᓚᐅᕐᑐᑦ ᐃᒪᐅᑉ ᐊᑕᓄᑦ ᑕᔨᓕᐊᕆᓯᒪᔪᒧᑦ ᑕᐃᒪᐃᓂᖑᓄᑦ ᐃᒃᐱᒃᓇᐅᑎᓪᓗᑐᑦ ᐊᓄᕆᒧᑦ ᑎᒃᑐᖃᑦᑕᕐᓂᖏᑦ ᓴᕕᒃᓴᕈᔾᔪᒃ (ᐱᒋᐊᓪᓚᐅᕐᓯᒪᔪᑦ ᓄᓇᐅᑦ ᖃᖓᓄᑦ ᑯᕕᔭᖃᑦᑕᓕᕐᓗᑎᒃ 1991ᐸᓗᒃᒥ) ᖃᐅᔨᔭᐅᖏᓐᓄᑦ ᐊᓯᐅᓕᐅᑎᓪᓗᑐᑦ.

ᖃᐅᔨᓴᕐᑕᐅᔪᑦ ᑎᑎᕋᕐᓯᒪᓂᖏᑦ ᒪᓕᒃᓯᒪᓗᐅᕐᑐᑦ ᒫᓇᐅᔪᖅ ᑎᑎᕋᕐᑕᐅᔪᕕᓂᕐᓂᒃ ᐊᒻᒪᓗ ᑎᑎᕋᕐᑕᐅᖃᑦᑕᕐᓯᒪᔪᓂᑦ (1985ᒥ) ᑭᒃᓕᕆᔭᐅᓪᓗᓂ 95 ᐳᓴᒥᑦ ᑕᒪᖏᓐᓂᖃᕐᓗᓂ ᐊᑐᓂ ᖃᓄᑎᒋᓕᕐᓂᖓ ᑎᑎᕋᕐᑕᐅᓯᒪᔪᖅ ᖃᐅᔨᓴᕐᕕᐅᔪᓂ. ᐱᔪᑎᖃᓗᐅᕐᑐᑦ ᖃᐅᔨᓇᓱᒃᓗᑎᒃ ᖃᓄᑎᒋ ᐱᑕᖃᕐᑎᕆᒃᒪᖓᑦ ᐊᒻᒪᓗ ᑭᖑᓂᖓᑦᑎᓐᓂ ᖃᓄᐃᓕᖓᓂᓇᓚᐅᕐᑕᖏᑦ ᑐᐊᐸᐅᑦ. ᐱᑕᖃᕐᓂᖏᑦ ᐊᖏᓂᖏᑦ ᓇᓄᓇᐃᒃᑯᑕᐅᔪᖅ ᐱᑕᖃᖏᕕᑎᓚᐅᑕᖓ ᑭᒃᓕᕆᔭᐅᓪᓗᓂ ᓴᕕᒃᓴᖃᓕᕐᓂᖓ ᓇᓄᓇᐃᕐᑕᐅᔪᖅ ᓄᓇᐅᑦ ᖃᖓᓂᑦᑐᖅ ᑐᐊᐸᒃᒥ.

ᓇᓄᓇᐃᕐᑕᐅᓂᖏᑦ ᓱᕈᕐᓇᕐᑐᑦ ᐃᓱᒪᓗᒃᓇᕋᔭᕐᑐᑦ

ᓴᕕᒃᓴᐃᑦ ᖃᐅᔨᓴᕐᑕᐅᔪᑦ ᑕᒪᕐᒥᒃ ᓇᓄᓇᐃᕐᑕᐅᓯᒪᔪᑦ ᖃᐅᔨᓴᕐᑎᐅᔪᓂᑦ ᐅᖓᑕᓂᑦᑐᑦ ᐊᑐᐊᓘᑉ ᐅᖃᕐᓯᒪᓂᖓ ᐊᖏᑎᒋᔪᒥᒃ ᐱᑕᖃᕐᓗᓂ ᐱᕐᑯᖏᓂᕋᕐᑕᐅᓗᔪᕐᓂᖓ, (ᐊᕐᕿᒃᑕᐅᓯᒪᔪᖅ 1999ᒥ). ᐊᑐᐊᓘᐃᑦ ᐊᕐᕿᒃᓯᒪᔪᑦ ᐊᑐᕐᑕᐅᔪᓐᓇᕐᑐᑦ ᐊᕙᑎᑦᑎᓐᓄᑦ ᐅᕙᓗᓐᓂᑦ ᑎᒥᑦᑎᓐᓄᑦ ᐊᑦᑕᕐᓇᕋᔭᕐᑐᑦ ᖃᐅᔨᓴᕐᑕᐅᓂᖏᑦ ᑐᑭᓯᑭᐊᕐᕋᓱᑕᐅᓗᑎᒃ ᓄᓇᖓ ᖃᓄᐃᑦᑐᑎᕆᒃᒪᖓᑦ. ᑎᒥᒧᑦ ᐊᑦᑕᕐᓇᕐᑐᑦ ᖃᐅᔨᓴᕐᑕᐅᓂᖓ, ᓴᕕᒃᓴᐃᑦ ᓇᓄᓇᐃᕐᑕᓗᐅᕐᑐᑦ ᐊᒻᒪᓗ ᐊᕙᑎᑦᑎᓐᓄᑦ ᑐᕋᖓᔪᑦ ᖃᐅᔨᓴᕐᑕᓗᐅᕐᒥᔪᑦ. ᖃᐅᔨᒪᔭᐅᓂᐊᕐᒪᑦ ᑳᒍᐊ ᐊᑐᐊᓘᐃᑦ ᒪᓕᒃᑕᐅᔪᑦ ᐊᕐᕿᒃᑕᐅᓯᒪᔪᑦ ᐊᓐᑎᐅᓕᐅᒥᑦ ᐊᒥᐊᓕᒃᑯᓐᓕᓪᓗ.

ᖃᐅᔨᓴᕐᑕᐅᔪᑦ ᓇᓄᓇᐃᕐᓯᓗᐅᕐᑐᖅ ᓴᕕᕋᔭᐅᓂᖏᓐᓂᒃ ᖃᓄᑎᒋᓕᕐᓯᒪᒃᒪᖓᑕ ᐅᑯᐊᖑᔪᑦ ᑲᑦᒥᐊᓪ, ᕿᕐᓂᕐᑕᖅ, ᕿᓪᓕᕐᑕᖅ ᓴᕕᒃᓴᐃᓪᓗ. ᑲᔪᖅ ᓴᕕᕋᔭᒃᓴᖅ ᐊᒻᒪᓗ ᕿᓪᓕᕐᑕᖅ ᕿᓂᕐᑕᐅᓗᐅᕐᑐᑦ ᐊᕙᑎᑦᑎᓐᓄᑦ ᖃᐅᔨᓴᕐᑎᓪᓗᒥᑦ ᐅᖓᑕᓄᕐᕕᕆᔪᓐᓴᕐᑕᖓ ᐊᖏᓂᖓ ᑐᐊᕙᕐᓂᖓ ᓴᕕᒃᓴᐅᔪᒥᒃ ᑐᖓᓂᓗᐅᕐᑐᑦ ᑎᒥᒧᑦ ᐊᑦᑕᕐᓇᕋᔭᕐᑐᒥᑦ ᐊᑐᐊᓘᖏᓐᓂᑦ.

ᓴᕿᔭᕐᓂᖏᑦ ᐃᓱᒪᒋᔭᐅᔪᑦ

ᖃᐅᔨᓴᕐᑕᐅᔪᒪᓗᐅᕐᑐᑦ ᓇᑭᖓᕐᓂᐊᕐᒪᖓᑕ ᒪᓕᒃᓯᒪᓗᐅᕐᑐᑦ ᓇᓂᓯᕕᐅᑉ ᓄᓇᖁᑎᑦ ᐊᑐᕐᓯᒪᔭᖏᓐᓂᒃ. ᑖᓇ ᓄᓇᐅᓂᖓ ᐊᕕᒃᑐᕐᓯᒪᒪᒪᐅᕐᑐᖅ ᐱᖓᓱᓕᖃᖓᓪᓗᓂ ᖃᐅᔨᓴᕐᕕᐅᔪᑦ ᓯᕗᓂᒃᓴᒥ ᐊᑐᕐᑕᐅᒐᔭᕐᓂᖓ ᒪᓕᒃᑕᐅᓪᓗᓂ. ᐊᔾᔨᖏᑦᑐᑦ ᖃᓄᐃᓕᖓᒐᔭᕐᓂᖏᑦ ᐃᓱᒪᒋᔭᐅᓪᓗᑎᒃ ᐊᑐᓂ ᓴᕿᔭᕋᔭᕐᓂᖓ ᓄᓇᐅᓪᓗ ᐊᑐᕐᑕᐅᓂᖓᓄᑦ ᐃᓱᒪᒋᔭᐅᓪᓗᑎᒃ. ᓄᓇ ᓇᓂᓯᕕᐅᑉ ᐃᓗᐊᓂᑦᑐᖅ ᖃᐅᔨᓴᕐᑕᐅᔪᖅ ᐊᖏᓂᖃᕐᑐᖅ 29Hᐃᒃᑎᐊ ᐊᒻᒪᓗ ᑕᐃᔭᐅᓪᓗᓂ ᓄᓇᓕᕆᔭᖓᓂᒃ. ᓄᓇᖓ ᐊᖏᓂᖓ ᖃᐅᔨᓴᕐᑕᐅᔪᖅ ᑐᓚᒃᑕᕐᕕᒃᒥ ᐊᖏᓂᖃᕐᑐᖅ 24 Hᐃᒃᑎᐊ ᑕᐃᔭᐅᓪᓗᓂ ᑐᓚᒃᑕᕐᕕᒃᒥᒃ ᐊᒻᒪᓗ ᓄᓇ (ᐱᖁᓯᐅᑎᖏᓪᓗᓂ ᓄᓇᓕᖓ ᐊᒻᒪᓗ ᑐᓚᒃᑕᕐᕕᒃ) ᐊᖏᓂᖃᕐᑐᖅ 4400Hᐃᒃᑎᐊ ᑕᐃᔭᐅᓪᓗᓂ ᐅᔭᕋᒃᑕᕐᕕᐅᔪᑦ. ᐊᑐᓂ ᖃᐅᔨᓴᕐᑕᐅᓗᐅᕐᑐᑦ ᖃᓄᑎᒋᓕᕐᓯᒪᒃᒪᖓᑕ.

ᓄᓇᓕᖓ ᐃᓱᒪᒋᔭᐅᓗᐅᕐᑐᖅ ᐃᓅᒃᓂᒃ ᓄᓇᒋᔭᐅᖏᓐᓇᕐᓂᐊᕐᒪᖓᑦ, ᑐᓚᒃᑕᕐᕕᒃ ᑭᓇᐅᔭᒃᓴᕐᑐᓄᑦ ᐊᑐᕐᑕᐅᓕᕐᓗᓂ, ᐊᒻᒪᓗ ᐅᔭᕋᒃᓯᐅᕐᓂᕕᓂᑦ ᐱᖑᐊᓗᒃᕕᐅᓕᕐᓗᑎᒃ ᐊᖑᓇᓱᒃᕕᐅᓗᑎᒃᓗ. ᑕᐃᒪᓐᓇ ᓄᓇᖓ ᐊᑐᕐᑕᐅᖑᐊᕐᑎᑕᐅᓪᓗᓂ ᐃᓱᒪᒋᔭᐅᓪᓗᓂ ᖃᐅᔨᓴᐅᑎᖃᓗᐅᕐᑐᑦ ᐃᒪᓐᓇ:

ᑎᒥᒧᑦ

ᑭᒃᓕᕆᔭᐅᔪᑦ ᐱᑕᖃᓐᓇᐊᖃᕐᓂᖓ ᐅᖓᑕᓄᐊᓇᐊᖃᖏᓐᓂᖓ ᑎᒥᒧᑦ ᑐᐊᐸᒃᒥᑦᑐᖅ ᐱᑕᖃᓐᓇᐊᖃᕐᓂᖓᑕ ᑭᒃᓕᕆᓗᔭᕐᑕᖓ ᐊᕐᕿᒃᑕᐅᓯᒪᔪᖅ ᐅᑯᓂᖓ ᒪᓕᒃᓗᑎᒃ:

- ᓄᑦᑕᓚᖅ ᑕᕿᖃᕐᑐᒥᑦ 6ᒥᑦ ᑎᑭᓪᓗᒍ ᑎᓴᒪᓂᒃ ᐊᕋᒍᖃᕐᑐᒧᑦ ᓂᕆᓐᓂᕈᓂ ᐊᒻᒪᓗ ᐅᕝᕙᓂᖓᓄᑦ ᐊᒃᑐᐃᓐᓂᕈᓂ ᓄᓇᐅᑦ ᖃᖓᓂᑦᑐᒥᒃ ᓴᕕᒃᓴᒥᒃ ᓱᕈᕐᓇᕐᑐᖃᕐᑐᒥᒃ.

- ᓄᑕᕋᓚᖅ ᑕᕿᖃᕐᑐᖅ 6ᒥᒃ ᑎᑭᓪᓗᒍ ᑎᓴᒪᓂᒃ ᐊᕋᒍᖃᕐᑐᒧᑦ ᓂᕆᓐᓂᕈᓂ ᓂᕿᓪᓚᑦᑕᕐᒥᒃ ᐊᖑᓇᓱᒃᑕᐅᔪᕕᓂᕐᓂᒃ. ᑖᓇ ᐊᖑᓇᓱᒃᑕᐅᔪᕕᓂᖅ ᓂᕆᔪᕕᓂᐅᒍᓂ ᐊᒻᒪ/ᐅᕙᓗᓐᓂᑦ ᐃᒥᕐᓂᕈᓂ ᓴᐱᒃᓴᕈᔪᒃᒥᒃ ᓱᕈᕐᓇᖅᑐᖅᑐᒥᒃ.

- ᑭᓇᑐᐃᓐᓇᖅ ᓇᓂᓯᕕᒃᒥ ᓄᓇᖃᕐᓗᓂ ᐃᓄᓂᕐᒥᓂᑦ 75ᓄᑦ ᑎᑭᓪᓗᒍ ᐊᒻᒪᓗ ᓱᕈᕐᓇᕐᑐᐃᑦ ᓇᔪᐃᓐᓇᕐᖑᐊᕐᓗᓂᒋᑦ.

ᐊᕙᑎᑦᑎᓐᓄᑦ

ᖃᐅᔨᓴᕐᑕᐅᔪᑦ ᑐᕋᖓᓂᕐᓴᐅᒍᓗᐊᕐᑎᓪᓗᒍ ᐊᕙᑎᑦᑎᓐᓄᑦ ᑭᓱᐊᓂ ᐅᒪᔪᐃᑦ ᐃᓱᒪᒋᔭᐅᖃᓯᐅᔭᐅᓯᒪᔪᑦ ᐃᒥᑐᐃᓐᓇᓇᐊᖅᓂᖏᓐᓄᑦ ᓄᓇᖓᓂᑦ. ᐃᓱᒪᒋᔭᐅᔪᖅ ᐃᒥᕐᕕᐅᒐᔭᕐᒪᖔᑦ ᑕᓯᕐ ᑯᕕᕐᑕᕐᕕᐅᔪᖅ ᑰᖓᓗ.

ᓴᓯᒃᓴᒥᒃ ᑎᒥᖓᓄᐊᕐᕋᔭᕐᑐᖅ ᓂᕆᔭᐅᒍᓂ ᐃᒥᕐᒥᖓᕐᑐᖅ ᑐᐊᐸᒃᒥᖓᕐᑐᕐᓗ ᐊᒻᒪᑦᑕᐅᖅ ᓴᐱᒃᓴᖅᓂᖏᑦ ᐱᕈᕐᑐᒥᖓᕐᑐᒥᑦ ᐅᒪᔪᖅᑎᖏᓐᓄᑦ ᓂᕿᒋᔭᐅᒍᓂ. ᐃᓱᒪᒋᔭᐅᓗᐊᓚᐅᕐᑐᕐᓕ ᓂᕆᔭᐅᒍᓂ ᖃᓄᐃᔪᑕᐅᒐᔭᕐᒪᖔᑦ. ᓂᐅᕐᓯᑕᐅᓗᓂ ᐊᒻᒪᓗ ᐅᐱᓂᒃᒧᐊᕐᓂᖓ ᐃᒃᐱᒃᓴᐅᑎᒐᔭᕐᑎᓪᓗᒋᑦᑕᐅᖅ ᑭᓱᐊᓂ ᒥᑭᓐᓂᕐᓴᐅᒃᒪᑦ ᐊᕐᑕᓇᕐᓂᖓᑕ ᓂᕆᔭᐅᔭᒥᑦ, ᖃᐅᔨᓴᕐᑕᐅᔭᑕᐅᖏᑦᑐᕐᓕ. ᑐᐊᐸᒃᒥᖓᕐᑐᑦ ᓂᐱᖃᑦᑕᕐᑐᑦ ᒥᕐᖁᒧᑦ, ᐊᒥᕐᒧᓪᓗ ᐃᓱᒪᒋᔭᐅᔭᖅ ᐊᓗᒃᑕᐅᓗᓂ ᓂᕆᔭᐅᖃᑦᑕᕋᔭᕐᒪᖔᑦ.

ᓂᕆᑐᐃᓐᓇᓇᐊᖅᑐᑦ ᓴᐱᒃᓴᕈᔪᒃᒥᒃ ᐅᒪᔪᐃᑦ ᐅᑯᐊᖑᔪᑦ, ᑭᒐᕕᐊᕐᔪᐃᑦ, ᑎᓇᑲᓂᐊᑦ, ᐊᕿᒋᑦ, ᐊᕕᖓᐃᓪ. ᑖᒃᑯᐊ ᓂᕆᑐᐃᓐᓇᓇᐊᓕᑦ ᐅᒪᔪᐃᑦ ᐱᑕᖃᕐᓂᖏᓐᓄᑦ ᓇᓂᓯᕕᒃᒥ.

ᐊᑦᑕᕐᓇᕐᓂᖓᑕ ᓇᓗᓇᐃᒃᑯᑕᖏᑦ

ᖁᓚᓂ ᐅᖃᕐᓯᒪᔪᑦ ᐃᓱᒪᒋᔭᐅᓪᓗᑎᒃ ᖃᐅᔨᓴᐅᑕᐅᓚᐅᕐᑐᑦ ᖃᓄᕐ ᑎᒥᑦᑎᓐᓄᑦ ᐊᒻᒪᓗ ᐊᕙᑎᑦᑎᓐᓄᑦ ᐃᒃᐱᒃᓴᐅᑎᒐᔭᕐᒪᖔᑦ ᐊᑦᑕᕐᓇᕐᑎᑭᒐᔭᕐᒪᖔᓪᓗ ᐃᒪᐃᓕᖓᔪᒥᒃ ᓇᓗᓇᐃᕐᓯᔪᑦ:

- ᓄᓇᐅᑉ ᖃᖓ ᑐᐊᐸᖓ ᓴᐱᒃᓴᐅᓂᖓ ᓴᐱᒃᓴᖃᕐᓂᖓᓗ ᐃᓱᒪᒋᔭᐅᔪᖅ ᐃᒃᐱᒃᓴᐅᑎᓗᐊᔭᐊᕐᒋᓐᓂᖓᓂᒃ ᐊᕙᑎᑦᑎᓐᓄᑦ ᐊᒻᒪᓗ ᐱᔭᐅᒐᔭᕐᓂᕐᒋᑦ ᐃᓱᒪᒋᔭᐅᓪᓗᑎᒃ.

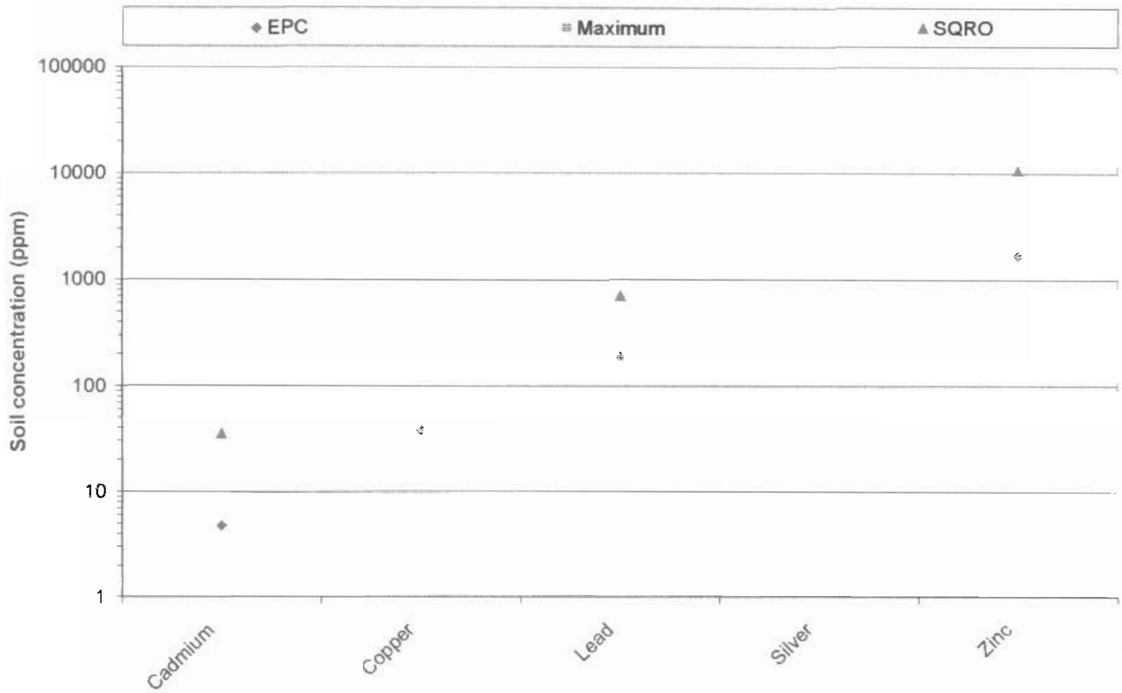
- ᓄᓇᐅᑉ ᖃᖓ ᑐᐊᐸᖓ ᓴᐱᒃᓴᖃᕐᓂᖓ ᓴᐱᕋᔭᒃᓴᖃᕐᓂᖓ ᐃᓱᒪᒋᔭᐅᔪᖅ ᑎᒥᑦᑎᓐᓄᑦ ᐃᒃᐱᒃᓴᐅᑎᓗᐊᔭᐊᕐᒋᓐᓂᖓᓂᒃ.

ᓄᓇᐅᑦ ᖃᖓᓂ ᑐᐊᐸᒃ ᓴᓗᒪᕐᑕᐅᔭᓇᐊᖃᕐᓂᖓ ᐊᕿᒃᑕᐅᓚᐅᕐᒥᔪᖅ ᐊᑐᓂ ᓴᐱᕋᔭᐅᓂᕐᒋᑦ ᒪᓕᒃᑕᐅᓪᓗᑎᒃ ᑎᒥᑦᑎᓐᓄᑦ ᐊᒻᒪᓗ ᐊᕙᑎᑦᑎᓐᓄᑦ ᖃᓄᑎᒋᕐᓗᑎᒃ ᐃᒃᐱᒃᓴᐅᑎᒐᔭᕐᒪᖔᑦ. ᖃᓄᐃᑕᐅᔪᑎᒃᓴᕐᒋᑦ ᐃᓱᒪᒋᔭᐅᓪᓗᓂ.

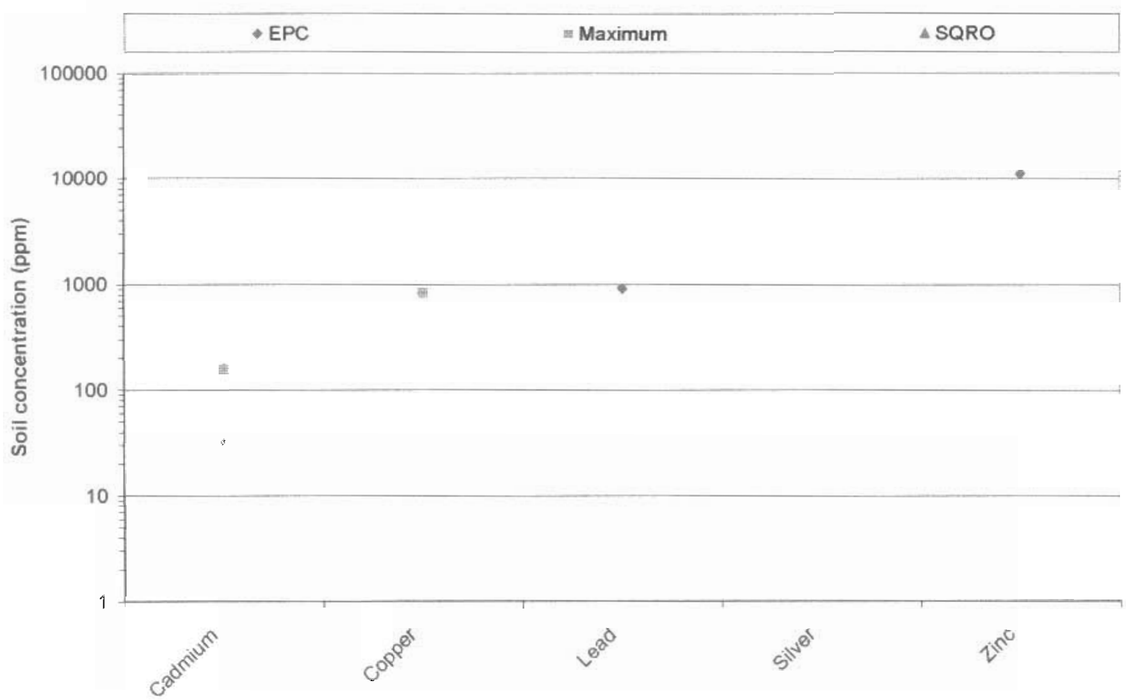
Appendix E-3

ᖃᓄᐃᓕᖓᓂᖏᑦ ᓇᐃᒃᓕᒋᐊᕐᓯᒪᓪᓗᑎᒃ ᓇᓗᓇᐃᕐᓯᒪᔪᑦ ᑎᑎᕋᐅᔭᕐᓯᒪᔪᒥ ᐊᑕᓂᑦᑐᒥ ᓄᓇᓕᖓᓄᑦ, ᑐᓚᒃᑕᕐᕕᒃᒧᑦ ᐊᒻᒪᓗ ᐅᔭᖅᑕᕐᕕᐅᖃᑦᑕᕐᓯᒪᔪᑦ.

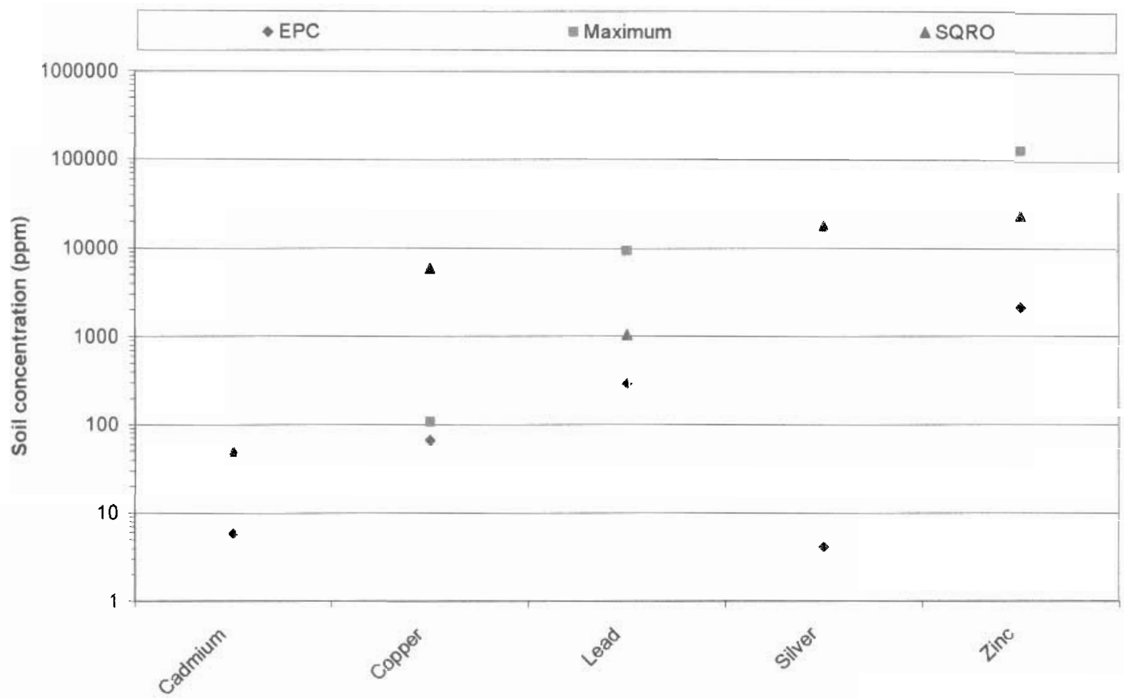
Comparison of SQROs and Site Data: Town Area



Comparison of SQROs and Site Data: Dock Area



Comparison of SQROs and Site Data: General Mine Area



ᐊᖏᓚᒥᒃ ᐱᑕᖃᓇᐊᖅᑲᕐᓂᖓ ᓱᕈᕐᓇᕐᑐᖅ, ᑲᔪᖅ ᓴᕕᕐᔪᒃ ᐊᒻᒪᓗ ᕿᓪᓕᕐᑕᖅ ᓴᕕᕐᔪᒃᓴᖅ ᑐᐊᐸᒃᒥᓐᓂᖓ ᐊᖏᓂᖓ ᒥᑭᓐᓂᕐᓴᐅᓚᐅᕐᑐᖅ ᑐᐊᐸᑦᑎᐊᕙᐅᓂᕋᕐᓯᒪᔪᑦ, ᑐᑭᓯᓇᕐᓯᓪᓗᓂ ᓴᓗᒪᕐᓴᕐᑕᐅᖏᒃᑲᓗᐊᕐᓗᑎᒃ ᑕᒃᑯᐊ ᓴᕕᒃᓴᐃᑦ ᐱᑕᖃᖏᓗᐊᕐᓂᖏᓐᓄᑦ.

ᓴᕕᒃᓴᖅ ᕿᕐᓂᕐᑕᖅ ᑐᐊᐸᖓ ᐱᑕᖃᕐᓂᖓ ᓄᓇᓕᖓᓂ ᐊᒻᒪᓗ ᐅᔭᕐᕿᑦᑕᕐᕕᐅᖃᕐᑕᕐᓯᒪᔪᓂ ᐊᖏᓂᕐᓴᐅᔪᖅ ᐱᑕᖃᓇᐊᖅᑲᕐᓂᖓᑕ ᑭᒃᓕᖓᓂᑦ, ᓇᓗᓇᐃᕐᓯᓪᓗᓂ ᑕᒪᕐᒥᐊᓗᒃ ᓴᕕᒃᓴᖅᑐᐃᓐᓇᐅᖏᑦᑐᖅ ᑭᓯᐊᓂᓕ ᐊᖏᓇᕐᑎᖅᓯᒪᓂᖏᑦ ᑲᒪᒋᔭᐅᔪᓇᐊᓕᑦ. ᑐᓚᒃᑕᕐᕕᒃ ᓴᓗᒪᕐᓴᕐᑕᐅᔪᓇᐊᖅᖏᑦᑐᖅ.

EXECUTIVE SUMMARY

Jacques Whitford Environment Limited (JWEL) has performed a human health and ecological risk assessment (HHERA) of the Nanisivik Mine site on Baffin Island, Nunavut. The primary objective of this study was to evaluate whether known concentrations of elements in surface soil at the site would present a significant risk to human or ecological health based on future use of the property after mine closing. Despite protracted discussions and numerous exchanges of proposals and ideas, future site re-development plans have not been finalized and the risk assessment considers three alternate scenarios for future land use: commercial, residential, and recreational/hunting.

Study background

Nanisivik Mine was an underground zinc-lead mine that was owned and operated by CanZinco Ltd. (CanZinco), a division of Breakwater Resources Ltd. The mine is located on the Borden Peninsula on northern Baffin Island in the Canadian Arctic at 73° 02' N, 84° 31' W. The mine site is located on the south shore of Strathcona Sound approximately 30 km from Admiralty Inlet. The nearest community is Arctic Bay, located approximately 25 km west of Nanisivik and linked by a 33 km all-weather road. The airport is located approximately 9 km south of Nanisivik and accommodates commercial flights to and from Ottawa, Iqaluit and Resolute, as well as charter and other unscheduled aircraft. Mining and milling at the site has been ongoing since 1976. Due to depleted levels of economically recoverable reserves, the mine stopped producing zinc and lead concentrates in September 2002.

This report was prepared in partial fulfillment of the requirements of the Site Closure and Reclamation Plan, which was developed in accordance with the "Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories" (NWTWB 1990). This HHERA was based on accepted risk assessment standards including those published by Health Canada, the Canadian Council of Ministers of the Environment (CCME), and the United States Environmental Protection Agency (US EPA).

Data Compilation

The soil data selected for use in the risk assessment were compiled from three sources: a Phase II Environmental Site Assessment conducted by Gartner Lee Limited (GLL), on behalf of CanZinco in July 2002; a surface soil sampling program conducted by EBA Engineering Consultants Ltd. (EBA), on behalf of the Government of Nunavut in June 2002; and an extensive survey of metal (copper, lead, and zinc) concentrations in surficial soils throughout the mine area conducted by Nanisivik Mine Limited (Nanisivik) as part of their mineral exploration activities in 1985.

Statistical analyses were run on both the current and background (1985) data sets to determine 95% upper confidence limits (UCLs) for each element in each study area. The primary purpose of these analyses was to determine representative exposure point concentrations (EPCs) for each area and background soil concentrations (BSCs), for deriving potential risks associated with the identified soil concentrations. The EPC is considered to be a reasonable estimate of area-wide exposure of receptors to metals in surface soil.

Screening of Potential Chemicals of Concern

Elements included for consideration were all elements identified in the review of the GLL and EBA data at concentrations exceeding the generic CCME soil quality guidelines (CCME 1999). Generic CCME guidelines may be based on either ecological or human health protection and provide a protective initial screening of the site data. For the human health risk assessment, these elements were screened specifically against human health based generic guidelines and for the ecological risk assessment, they were screened specifically against ecologically based generic guidelines. In order of preference, these guidelines are taken from CCME (CCME 1999), Ontario Ministry of the Environment (OMOE 1996a), or the United States Environmental Protection Agency (US EPA).

Based on this screening, the elements carried forward to the quantitative risk assessments were the metals cadmium, copper, lead, silver, and zinc. Silver (general mine area only) and copper were only carried forward for the ecological risk assessment because maximum soil concentrations for these metals were less than human health based generic guidelines.

Exposure Scenarios

The area of interest for the risk assessment was governed by the Nanisivik inferred lease and claim boundaries, which largely coincide with topographical features and the shoreline of Strathcona Sound to the north. This area (approximately 4,500 ha) was subdivided into three smaller study areas based on probable future land use. This was done to allow for separate receptor, exposure, and land use scenarios. The area encompassing the town of Nanisivik covered approximately 29 ha and was referred to as the 'town area'. The area encompassing the dock covered approximately 24 ha and was referred to as the 'dock area'. The remaining land (not including the town area and dock area) covered an area of approximately 4400 ha and was referred to as the 'general mine area'. Separate EPCs and exposure estimates were calculated for each area independently.

Local consultation was conducted in Nanisivik and Arctic Bay to accurately depic the traditional, current and expected future use of the lands. For the purposes of this risk assessment the town area was assumed to continue as residential land use, the dock area as commercial/light industrial land use, and the general mine area as recreational/hunting land use. Based on these land uses, the following conceptual models were developed:

Human Health

The conceptual model that forms the basis for the derivation of the human health soil quality site-specific threshold limits is as follows:

- A toddler aged six months to four years ingests and comes into dermal contact with surface soil contaminated with cadmium, lead, and zinc;
- A toddler aged six months to four years ingests drinking water from the Nanisivik town water supply;
- A toddler aged six months to four years ingests wild game from hunting in the area. The wild game may have ingested or come into contact with surface soil and/or water contaminated with cadmium, lead, and zinc; and
- A person lives in Nanisivik from birth to 70 years of age and is exposed to cadmium by inhalation of soil-derived dust throughout their lifetime.

Ecological Health

Although risks of exposure to contaminated soils are the focus of this ERA, wildlife on the site may also take in metals when they drink surface water from the site. The main sources of drinking water to wildlife were assumed to include the Twin Lakes, Twin Creek and Chris Creek.

The potential exposure media for intake of metals include direct ingestion of surface water and soils, as well as metal uptake from eating plant material and animal (bird/mammal) prey at the mine site. The major exposure pathway considered was ingestion. Inhalation and dermal absorption are also possible exposure pathways, but these are considered to be relatively minor by comparison to ingestion, and are not included as direct pathways in this ERA. Soil that adheres to fur or feathers is, for the most part, ingested by preening/licking activity and is included in the estimate of direct soil ingestion.

The selected receptors in the model are Gyrfalcon, Arctic fox, Ptarmigan and lemming. These receptors are considered to be representative of indigenous wildlife for Nanisivik.

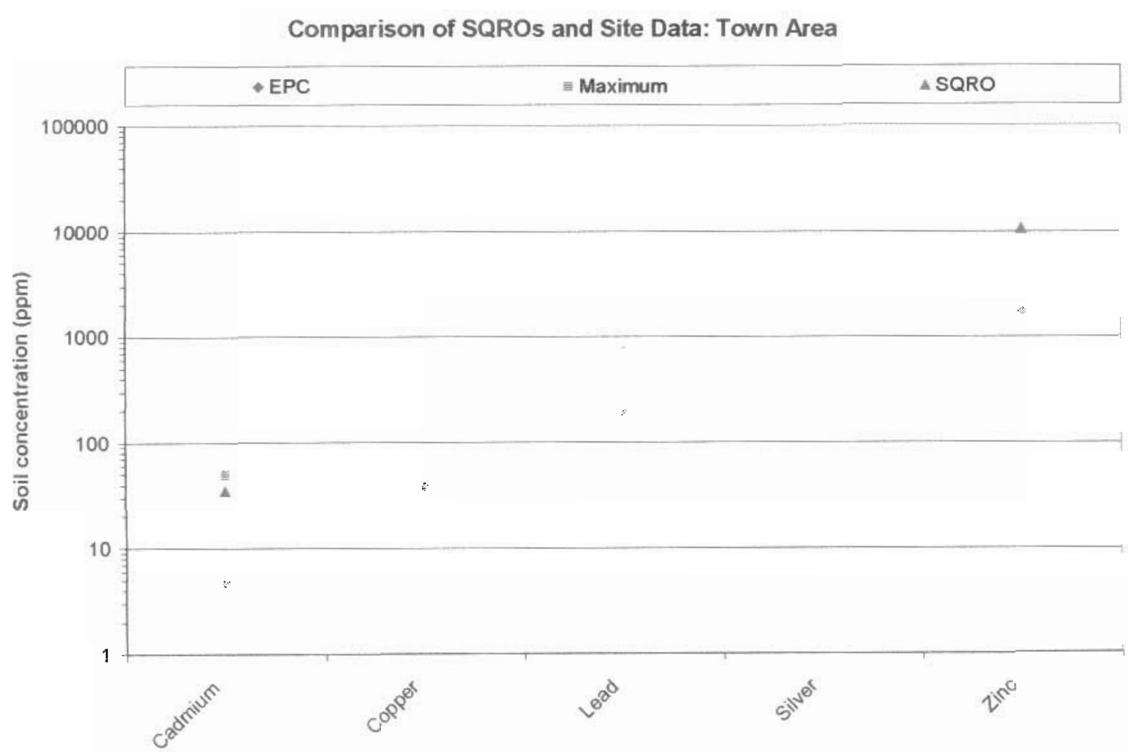
Risk Characterization

The above noted exposure scenarios were evaluated to identify the potential for adverse effects to human or ecological receptors, with the following outcomes:

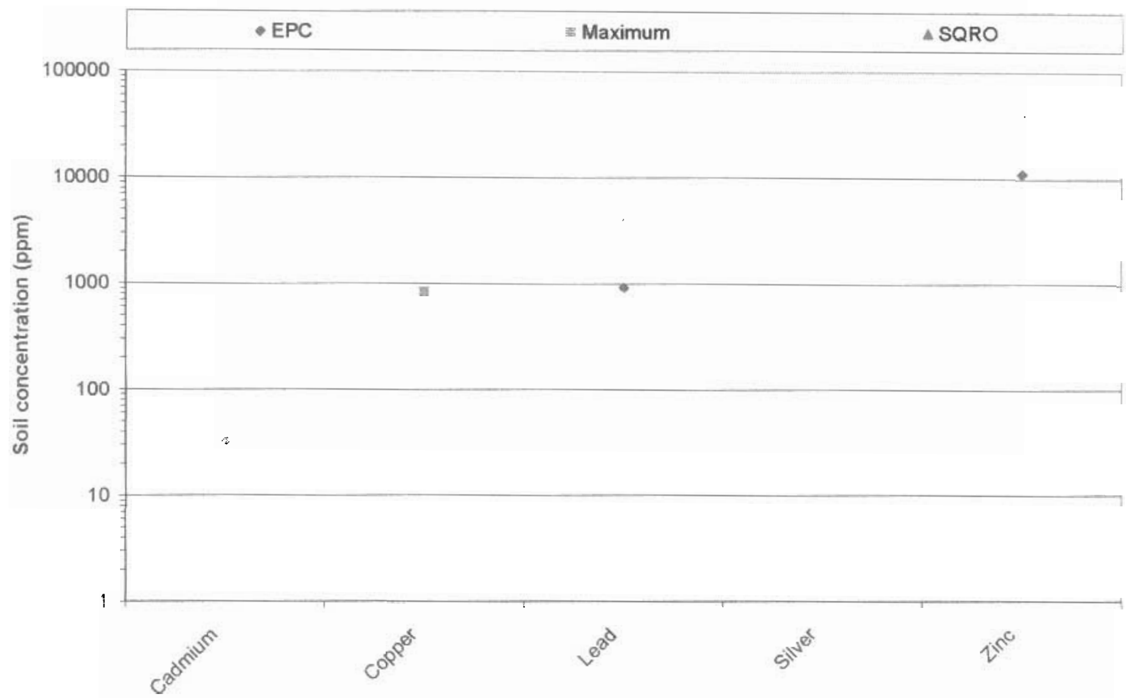
- Surface soil EPCs of the identified elements are not anticipated to produce any adverse effects in the ecological receptors and exposure scenarios included in this risk assessment.

- Surface soil EPCs of the identified elements are not anticipated to produce any adverse effects in the human receptors and exposure scenarios included in this risk assessment.

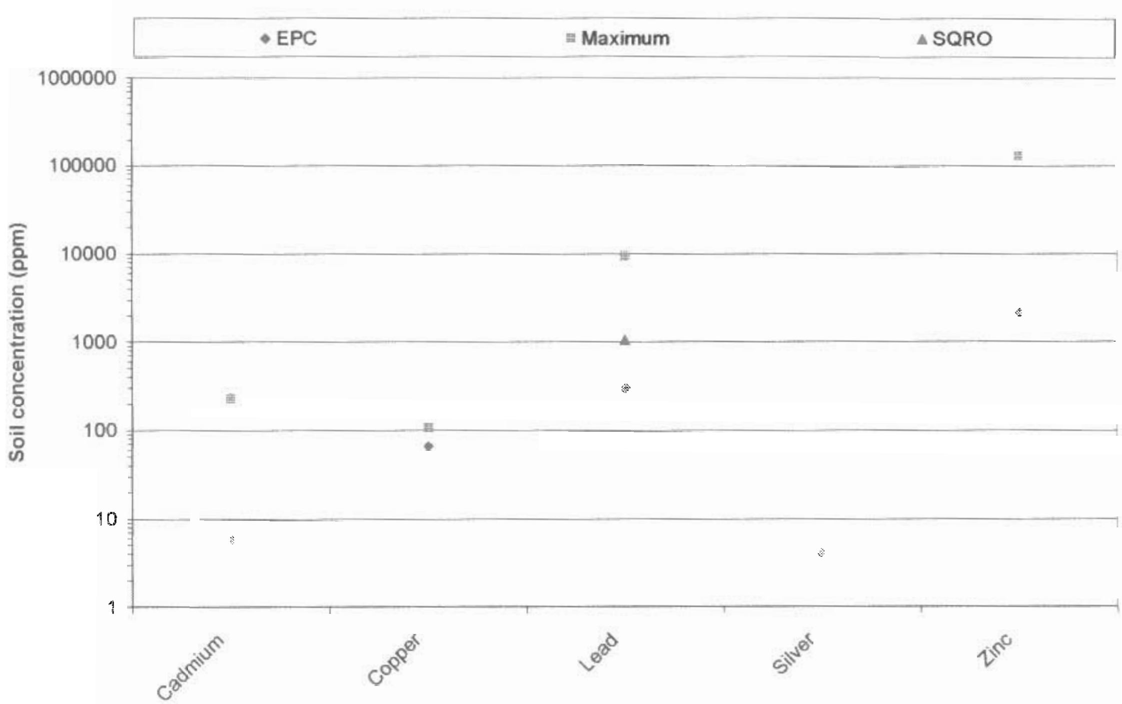
Soil Quality Remedial Objectives (SQROs) were then developed for each metal in each exposure area as the lowest of the ecological or human health site-specific threshold limits developed in this risk assessment. The SQROs were compared to current site conditions (EPCs, BSCs, and maximum concentrations). Results are summarized in graphs below for the town area, the dock area, and the general mine area.



Comparison of SQROs and Site Data: Dock Area



Comparison of SQROs and Site Data: General Mine Area



Maximum copper and silver surface soil concentrations were less than their SQROs, indicating that no remedial action is required for these metals

Cadmium, lead and zinc EPCs in the town area and general mine area are less than their SQROs, indicating that there is no unacceptable area-wide impact. However, a limited number of sample concentrations exceeded the SQROs, indicating that isolated "hot spots" may require risk management. JWEL's consultations with CanZinco indicate that isolated "hot spots" that are not natural mineralized areas will be targeted for remediation.

In the dock area, the EPCs for Cd, Pb and Zn for the dock area are less than their SQROs. Therefore, no remedial action is required for this area. However, it should be noted that CanZinco has publicly committed to remediation in the dock area.