MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY
ABANDONED MINE RECLAMATION BUREAU

ABANDONED HARDROCK MINE PRIORITY SITES

RECLAIMED ABANDONED AND INACTIVE MINES SCORING SYSTEM (RAIMSS)

Prepared For:

Montana Department of Environmental Quality
Abandoned Mine Reclamation Bureau
1520 East Sixth Avenue
Helena, Montana 59620

Prepared By:

Pioneer Technical Services, Inc.
P.O. Box 3445
Butte, Montana 59702

Engineering Services Agreement DEQ-AMRB No. 004

JUNE 1996

TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd.)

TABLE OF CONTENTS (cont'd.)

TABLE OF CONTENTS (cont'd.)

1.0 INTRODUCTION

This document describes the Reclaimed Abandoned and Inactive Mines Scoring System (RAIMSS) used by the Montana Department of Environmental Quality/Abandoned Mine Reclamation Bureau (MDEQ/AMRB) to rescore abandoned and inactive mining sites that have been reclaimed. The RAIMSS has been developed to provide a mechanism for MDEQ/AMRB to determine whether the reclamation activities performed at a site have satisfactorily mitigated the human health and environmental threats identified at the site. The RAIMSS provides a rationale for proposing that no further reclamation is necessary for a site and the site can be removed from the AMRB's priority list if the RAIMSS score is below a threshold value. The scoring system is very similar to the Abandoned and Inactive Mines Scoring System (AIMSS) developed by the AMRB (MDEQ/AMRB-Pioneer, 1994); however, it has been modified slightly to address reclaimed mine sites.

Standard reclamation goals have been developed by MDEQ/AMRB, based primarily on criteria generated by the U.S. Environmental Protection Agency's (EPA) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process, for mitigating releases or threatened releases of hazardous substances from abandoned and inactive mines. These goals are based on the relative reduction in risk to public health or the environment, taking into account the populations at risk (human and ecologic), the hazard potential of the substances, the potential for contamination of drinking water supplies, the potential for direct human contact, and the potential for detrimental effects to sensitive ecosystems.

The RAIMSS is not, and is not intended to be, equivalent to a detailed qualitative or quantitative human health or ecologic risk assessment, as might be performed as part of remedial actions. This system is used to score differing and disparate sites using a common basis - relative risks to human health or the environment. The RAIMSS attempts to estimate risks posed by reclaimed mine sites being evaluated relative to other mine sites. Since the scoring is intended as a screening mechanism, the effects of potential inaccuracies have been minimized by intervalizing those data with the greatest degree of uncertainty (e.g., population and waste quantities). It also maximizes the use of existing site data, especially the measured concentrations and volumes present in waste materials with respect to background concentrations.

Most of the evaluation factors and scores are the same as used in the AIMSS; the scoring algorithm is identical. The primary sources of information used to rescore a reclaimed mine site are the reclamation derived site information and laboratory data generated by those investigations. There are two major differences between the RAIMSS and the AIMSS: 1) in the RAIMSS, the observed release and exceedences components have been removed from each pathway, since it is difficult to determine immediate improvements in most of the media evaluated; and 2) an additional (lower score) category for waste source containment (accessibility in direct contact) has been added to the RAIMSS to reflect the additional protection afforded by a combination of several mitigation measures, which together meet the risk reduction goals for the site.

The scoring system's structure (algorithm) is identical to that used by the AIMSS. Four pathways or routes of exposure are evaluated:

1) groundwater pathway;

2) surface water pathway;

3) air pathway; and

4) direct contact pathway.

Within each of the four pathways, three primary factors are evaluated:

1) the likelihood of release of hazardous constituents to the pathway;

2) waste characteristics, including the concentrations of hazardous constituents corrected for background, the quantity of wastes (volumes, areas), and the relative toxicity of each constituent to humans and ecosystems; and

3) the potential receptors (targets) of exposure to hazardous constituents at the site, both human and ecologic.

The following is a discussion of each of the pathways, factors, and other site-specific criteria as they relate to the RAIMSS. Several factors are redundant between pathways; these factors will be fully discussed the first time they are identified, and referenced when used subsequently. Again, factors and scores are similar to those used in the AIMSS. Appendix A provides a detailed example of the Brooklyn Mine and Millsite that has been rescored using the RAIMSS after reclamation performed in 1995. Appendix B provides a detailed example of the calculation of the waste characteristics score for each of the sources at the Brooklyn site, post-reclamation. This example is provided to aid in understanding the RAIMSS.

2.0 GROUNDWATER PATHWAY

The groundwater pathway is evaluated using the following factors: the likelihood of release to groundwater; groundwater waste characteristics; and groundwater targets. The product of these three factors is the groundwater pathway score.

2.1 GROUNDWATER LIKELIHOOD OF RELEASE

The likelihood of release factor evaluates the potential to release constituents to groundwater using two criteria: the containment of the wastes at the site and the estimated depth to groundwater.

2.1.1 Containment After Reclamation

Containment is evaluated with respect to engineered reclamation designed to prevent releases from contaminant sources to groundwater, including:

1) amendments to the waste materials that reduce contaminant solubility or mobility;

2) slope reduction/stabilization with a vegetated topsoil cover (12 inches thick) over the waste;

3) surface water run-on diversions and run-off catchments;

4) installation of an impermeable cap system over the waste; and

5) installation of an impermeable liner beneath the waste materials (in-place or at a constructed repository) with a leachate collection system.

These engineered systems (3, 4, and 5) must be intact, functioning, and regularly monitored and maintained.

Using each waste source at the site, assign a value to the source as follows: none of the above containment systems = 20; presence of one of the above systems = 10; presence of two of the above systems = 5; presence of three of the above systems (excluding the impermeable cap and underliner) = 1; presence of four of the above systems (excluding only the underlier) = 0.1; or all five of the above, including an underliner, leachate collection, and a cap system = 0.05.

2.1.2 Depth to Groundwater

The depth to groundwater for each source is estimated using the existing well logs from the area, observation of springs, seeps or flowing adits at the site, and the relative topography of the site (stream valley or hilltop). Using this estimated depth (or actual depth, if available), assign a value for each source as follows: shallow (less than 25 feet to water) = 20; moderate (25 to 100 feet) = 10; or deep (greater than 100 feet) = 2. These values are the same as those used for the detailed (source specific) AIMSS, but will likely be different for different sources, or if additional data are available.

2.1.3 Groundwater Likelihood of Release Score for Reclaimed Site

Calculate the groundwater likelihood of release score by multiplying the containment value by the depth value (Maximum score is 400).

2.2 GROUNDWATER WASTE CHARACTERISTICS

Waste characteristics for the groundwater pathway are evaluated using the volume of waste materials (sources) at the site, the concentrations of constituents in samples of the waste material, the background concentrations, and the EPA HRS human toxicity value (SCDM, 1994). These values are the same as those used for the AIMSS, but are source specific. If sources have been combined, such as placed in a repository, the waste characteristics scores for each of those sources are summed.

2.2.1 Quantity

A quantity value is assigned according to measured volumes of waste materials in cubic yards (cy) for each solid matrix source(s) or portions of a source, for which analytical data exist. Each sample collected at a site is assigned a volume that the sample represents. This sample volume is derived based on the source volume(s) that the composite sample analyses represents.

Also, a value is assigned for each measured and sampled adit discharge in gallons per day (gpd = cubic feet per second [cfs] X 646,272 gpd/cfs). The conversion of cfs to gpd is used to equate adit discharges (highly mobile constituents) with other solid matrix sources (less mobile) at the site.

Each media (solid or water) and sampled source at the site will be scored separately. Assign the sample quantity value and the toxicity value as follows:

Range (cy or gpd)	Quantity Value
less than 10	0.003
10-30	0.01
30-100	0.03
100-300	0.1
300-1,000	0.3
1,000-3,000	1.
3,000-10,000	3.
10,000-30,000	10.
30,000-100,000	30.
100,000-300,000	100.
300,000-1,000,000	300.
more than 1,000,000	1,000.

Constituent	Human Toxicity Value
Antimony	10.
Arsenic	10.
Barium	10.
Cadmium	10.
Chromium	10.
Cobalt	0.001
Copper	0.
Iron	0.
Lead	10.
Mercury	10.
Nickel	0.1
Silver	0.1
Zinc	0.01
Thorium	10.
Uranium	10.
Cyanide	0.1
Asbestos	10.

2.2.2 Hazard

The hazard value is calculated for each constituent (note: asbestos is not included in the groundwater waste characteristics evaluation since it is immobile in groundwater and in subsurface soils) as the product of the sample concentration (solids in mg/Kg or water in μg/L) and toxicity values (derived from the EPA HRS human toxicity values divided by 1,000; SCDM, 1994). Solid sample concentrations are corrected by subtracting background concentrations, and using the difference in the calculation; adit discharge concentrations are used directly because background concentrations are not applicable. If adit discharges have been treated, use concentration data for the treated discharge.

A separate product is calculated for each element, the element-products are summed for each sample, and the sample values are summed for each source.

For sample #1:
Constituent 1: (Sample conc. - background conc.) x Human toxicity value = _____
Constituent 2: (Sample conc. - background conc.) x Human toxicity value = _____

Constituent n: (Sample conc. - background conc.) x Human toxicity value = _____

The sum of the element-products is the hazard value for sample #1 = _____

The hazard value procedure is repeated for each sample collected at the site.

For sample #n:
Constituent 1: (Sample conc. - background conc.) x Human toxicity value = _____
Constituent n: (Sample conc. - background conc.) x Human toxicity value = _____
Sum of element-products (hazard value) for sample #n = _____

2.2.3 Groundwater Waste Characteristics Score

The waste characteristics score is calculated by multiplying the sample quantity value and the hazard value (calculated above) for each sample, summing the values for all samples from the source, and then dividing by 10,000:

Sample #1: Sample quantity value x sample #1 hazard value = _____

Sample #n: Sample quantity value x sample #n hazard value = _____

The groundwater waste characteristics score for each source is the sum of the sample products divided by 10,000.

2.3 GROUNDWATER TARGETS

The groundwater targets score is evaluated by assessing those potential users of groundwater, giving a greater weight to those potential groundwater users that are closer to the site. This method differs slightly from the HRS in that the detailed wells/distance/dilution factoring is simplified reflecting the limited well information available. These values are the same as those used for the detailed (source specific) AIMSS, but will likely be different for different sources, or if additional information is available.

2.3.1 Number of Wells Within One Mile

This value is derived using the number of wells within one mile of the site, as reported in the MBMG well inventory database, multiplied by 2.5 persons per well. The assumption of 2.5 persons per well is based on the average number of persons per residence reported for Montana. If site specific information indicates more or fewer wells, use that value if it can be documented.

2.3.2 Number of Wells Between One and Four Miles

This value is derived using the number of wells within four miles of the site, as reported in the MBMG well inventory database, and subtracting the number of wells within one mile (above). These targets are also multiplied by 2.5 persons per well, and then divided by a distance/dilution factor of 2.5, to reflect the lessened risk due to greater distance from the sources and dilution. If site specific information indicates more or fewer wells, use that value if it can be documented.

2.3.3 Distance to Nearest Well

This value is an adjustment used to emphasize the greater risk to wells close to the site (per HRS). Only the nearest well is used (residential or recreational use), regardless of the number or frequency of persons using that well. Assign a value as follows: less than 1,000 feet = 10; between 1,000 feet and 1/2 mile = 5; and more than 1/2 mile = 0.

2.3.4 Groundwater Targets Score

The groundwater targets score is the sum of the above three values: wells within one mile, wells between one and four miles, and the nearest well value.

2.4 GROUNDWATER PATHWAY SCORE

The Groundwater Pathway Score is the product of the Groundwater Likelihood of Release Score (Section 2.1), the Groundwater Waste Characteristics Score (Section 2.2), and the Groundwater Targets Score (Section 2.3).

3.0 SURFACE WATER PATHWAY

The surface water pathway is evaluated using the following factors: the likelihood of release to surface water, surface water waste characteristics, and surface water targets. The product of these three factors is the surface water pathway score.

3.1 SURFACE WATER LIKELIHOOD OF RELEASE

The likelihood of release factor evaluates the potential to release constituents to surface water using two criteria: the containment of the wastes at the site and the distance from waste materials to surface water.

3.1.1 Containment After Reclamation

Containment is evaluated with respect to engineered reclamation designed to prevent releases from contaminant sources to surface water via flooding and run-off, including:

1) waste containment dams with erosion protection and surface water diversions designed to withstand the 100-year flood event or complete removal of wastes from the 100-year floodplain;

2) effective and functioning run-on/run-off control systems;

3) sediment collection basins;

4) waste slope reduction and stabilization with a vegetated topsoil cover with erosion control mats if required (slopes greater than 2.5:1); and

5) Treatment and/or diversion of discharging adits (if any) such that:

    a) flow is diverted around other wastes and does not discharge to a surface water body, or

    b) flow is treated before discharging to surface water.

These engineered systems must be intact, functioning, and regularly monitored and maintained.

Using each waste source at the site, assign a value to the source as follows: none of the above containment systems = 20; presence of one of the above systems = 10; presence of two of the above systems = 1; presence of three of the above systems = 0.1; or presence of four of the above five systems = 0.05.

3.1.2 Distance to Surface Water

The distance from the source material to the nearest surface water drainage (including intermittent drainages) is used for this factor. Use this distance to assign a value as follows: less than 25 feet = 20; between 25 and 100 feet = 10; and greater than 100 feet = 2.

3.1.3 Surface Water Likelihood of Release Score

Calculate the surface water likelihood of release score by multiplying the containment value by the distance value (Maximum score is 400).

3.2 SURFACE WATER WASTE CHARACTERISTICS

Waste characteristics for the surface water pathway are evaluated using the volume of waste materials at the site, the concentrations of constituents in samples of the waste material, the background concentrations, and the EPA HRS human toxicity and ecotoxicity values (SCDM, 1994). These values are the same as those used for the AIMSS, but are source specific. If sources have been combined, such as placed in a repository, the waste characteristics scores for those sources are summed.

3.2.1 Quantity

A quantity value is assigned in the same manner as the groundwater pathway (Section 2.2.1). A value is also assigned for adit discharges as in the groundwater pathway.

Each media (solid or water) and sampled source at the site will be scored separately. Assign the sample quantity value, the toxicity value, and the ecotoxicity value as follows:

Range (cy or gpd)	Quantity Value	Constituent	Human Toxicity Value	Ecotoxicity Value
less than 10	0.003	Antimony	10.	0.
10-30	0.01	Arsenic	10.	0.01
30-100	0.03	Barium	10.	0.001
100-300	0.1	Cadmium	10.	1.
300-1,000	0.3	Chromium	10.	10.
1,000-3,000	1.	Cobalt	0.001	0.
3,000-10,000	3.	Copper	0.	0.1
10,000-30,000	10.	Iron	0.	0.01
30,000-100,000	30.	Lead	10.	1.
100,000-300,000	100.	Mercury	10.	10.
300,000-1,000,000	300.	Nickel	0.1	0.01
more than 1,000,000	1,000.	Silver	0.1	10.
		Zinc	0.01	0.01
		Thorium	10.	10.
		Uranium	10.	10.
		Cyanide	0.1	1.
		Asbestos	10.	0.

3.2.2 Human Hazard

The human hazard value is calculated for each constituent (note: manganese is excluded, asbestos is included) as the product of the sample concentration (corrected by subtracting background, solids in mg/Kg or water in μg/L) and human toxicity values (derived from the EPA HRS human toxicity values/1,000; SCDM. 1994). If adit discharges have been treated, use concentration data for the treated discharge. A separate product is calculated for each element, the element-products are summed for each sample, and the sample values are summed for each source.

For sample #1:
Constituent 1: (Sample conc. - background conc.) x Human toxicity value = _____
Constituent 2: (Sample conc. - background conc.) x Human toxicity value = _____

.
.

Constituent n: (Sample conc. - background conc.) x Human toxicity value = _____

The sum of the element-products is the human hazard value for sample #1 = _____

The human hazard value procedure is repeated for each sample collected at the site.

For sample #n:
Constituent 1: (Sample conc. - background conc.) x Human toxicity value = _____
Constituent n: (Sample conc. - background conc.) x Human toxicity value = _____
Sum of element-products (human hazard value) for sample #n = _____

The waste score (human) is calculated by multiplying the sample quantity value and the human hazard value (calculated above) for each sample, summing the values for all samples from the source, and then dividing by 10,000:

Sample #1: Sample quantity value x sample #1 human hazard value = _____

.

.

Sample #n: Sample quantity value x sample #n human hazard value = _____

The waste score (human) for each source is the sum of the sample products divided by 10,000.

3.2.3 Ecologic Hazard

The ecologic value is calculated for each constituent (note: manganese is excluded) as the product of the sample concentration (corrected by subtracting background, solids in mg/Kg or water in μg/L) and ecotoxicity values (derived from the EPA HRS ecotoxicity values/1,000; SCDM, 1994, see table in Section 3.2.1). If adit discharges have been treated, use concentration data for the treated discharge. A separate product is calculated for each element and the element-products are summed for each sample.

For sample #1:
Constituent 1: (Sample conc. - background conc.) x ecotoxicity value = _____
Constituent 2: (Sample conc. - background conc.) x ecotoxicity value = _____

.

.

Constituent n: (Sample conc. - background conc.) x ecotoxicity value = _____

The sum of element-products is the ecohazard value for sample #1 = _____

The ecohazard value procedure is repeated for each sample collected at the site.

For sample #n:
Constituent 1: (Sample conc. - background conc.) x ecotoxicity value = _____
Constituent n: (Sample conc. - background conc.) x ecotoxicity value = _____

Sum of element-products (ecohazard value) for sample #n = _____

The waste score (ecologic) is calculated by multiplying the sample quantity value and the ecohazard value (calculated above) for each sample from the source, summing the values for all samples, and then dividing by 10,000:

Sample #1: Sample quantity value x sample #1 ecohazard value = _____

.

.

Sample #n: Sample quantity value x sample #n ecohazard value = _____

The waste score (ecologic) for each source is the sum of the sample products divided by 10,000.

3.2.4 Surface Water Waste Characteristics Score

The total surface water waste characteristics score for each source is the sum the human waste score and the ecologic waste score.

3.3 SURFACE WATER TARGETS

The surface water targets score is evaluated by assessing those potential users of surface water within 15 miles downstream (same as HRS target distance limit), including environmental targets (wetlands, fisheries, etc.). The target scoring differs from the HRS in that it is simplified and includes a target that the HRS does not consider (impacted surface water drainages). These values are the same as those used for the detailed (source specific) AIMSS, but may be different for different sources, or updated information.

3.3.1 Number of Persons Using Surface Water for Drinking Water

The number of persons using surface water for drinking water was compiled from Water Quality Bureau records regarding stream designations for drinking water supplies and inventoried water systems. The total population served was adjusted for dilution of the receiving stream, per the HRS dilution factors. The potentially affected drinking water intakes that were used for sites evaluated by AMRB, and the appropriate dilution factors are listed below.

Water System - Location	Service Population	Flow	Dilution Factor*	Adjusted Population
Helena - Tenmile Creek intake	24,500	17 cfs	0.1	2,450
Butte - Basin Creek / Big Hole R.	33,744	19 cfs	0.1	3,374
Anaconda - Silver Lake pipeline	9,771	21 cfs	0.1	977

* The HRS dilution factor for receiving streams between 10 and 100 cfs = 0.1.

3.3.2 Impacted Drainage(s) Remaining After Reclamation

The distance of impacted stream/drainage downstream from the site with respect to sedimentation and acid mine drainage characteristics was recorded on the inventory form during the site visit. The value assigned is the distance in thousands of feet (observed impacted distance / 1,000). If drainages have been reclaimed or rebuilt, use only the unreclaimed distance.

3.3.3 Other Surface Water Uses

Other surface water resource uses within 15 miles downstream were determined from the site visit, inspection of the Montana Department of Fish, Wildlife and Parks (MDFWP) data base (fisheries, wetlands, threatened and endangered species), U.S. Geological Survey (USGS) topographic maps and U.S. Department of Agriculture/Forest Service (USFS) maps, and the Montana Department of Natural Resources and Conservation (MDNRC) water rights database. Assign these values as follows:

Wetlands (5 acre minimum) observed or in the MDFWP database = 10; otherwise = 0.

Fishery class in the MDFWP database: Class 1 = 20; Class 2 = 10; Class 3 = 5; Class 4 = 1; Class 5, Class 6, or not classified = 0.

Recreational use at downstream parks or recreation areas (maps, observation) = 5; otherwise = 0.

Irrigation/stock watering from the MDNRC database, observed at site, or on maps = 2; else = 0.

Threatened/endangered species habitat from the MDFWP database = 5; otherwise = 0.

3.3.4 Surface Water Targets Score

The surface water targets score is the sum of the above seven values: drinking water use, impacted drainages, wetlands, fishery, recreation use, irrigation/stock watering, and threatened/endangered species habitat.

3.4 SURFACE WATER PATHWAY SCORE

The Surface Water Pathway score is the product of the Surface Water Likelihood of Release Score (Section 3.1), the Surface Water Waste Characteristics Score (Section 3.2), and the Surface Water Targets Score (Section 3.3).

4.0 AIR PATHWAY

The air pathway is evaluated using the following factors: the likelihood of release to the atmosphere, air waste characteristics, and air targets. The product of these three factors is the air pathway score.

4.1 AIR LIKELIHOOD OF RELEASE

The likelihood of release factor evaluates the potential to release constituents to the air pathway using two criteria: the containment of the wastes at the site; and the distance to the nearest population.

4.1.1 Containment After Reclamation

Containment is evaluated with respect to dust emissions (topsoil, vegetative cover, or perennially wetted). Dust propagation potential for each source was evaluated during the initial site visit and recorded on the inventory form as high, moderate, low, or none. The dust potential was derived considering the percent of vegetative or other cover, available fines, topography, and moisture content.

Using the dust propagation potential noted on the form for each unreclaimed source, assign a value to the source as follows: high dust potential = 20; moderate dust potential = 15; low dust potential = 10; or no dust potential (on form) = 1. If the waste source has been reclaimed with at least 12 inches of continuous, uncontaminated cover soil, revegetated, and dust release has been effectively prevented, assign a value of 0.1.

4.1.2 Distance to Nearest Population

The distance from the source material to the nearest population (town) or individual residence is used for this factor. Use this distance to assign a value as follows: less than 1,000 feet = 20; between 1,000 feet and 1/2 mile = 10; and greater than 1/2 mile = 5.

4.1.3 Air Likelihood of Release Score

Calculate the air pathway likelihood of release score by multiplying the containment value by the distance value (Maximum score = 400).

4.2 AIR WASTE CHARACTERISTICS

Waste characteristics for the air pathway are evaluated using the exposed surface area of each source (post-reclamation) at the site, the concentrations of constituents in surficial samples of the waste material, the background concentrations, and the EPA HRS human toxicity and ecotoxicity values (SCDM, 1994).

4.2.1 Quantity

A quantity value is assigned according to measured estimates of exposed surface areas (in 100's of square feet) for each solid matrix source(s) or portions of a source, for which analytical data exist. If a discrete surface sample was collected, only those analyses are used. The surface area is derived based on the source surface area(s) that the sample analyses represents.

Each source at the site is scored separately. Assign the sample quantity value, the toxicity value, and the ecotoxicity value as follows:

Range (100's of sq. ft.)	Quantity Value
less than 10	0.001
10-100	0.01
100-1,000	0.1
1,000-10,000	1.
10,000-100,000	10.
100,000-1,000,000	100.
more than 1,000,000	1,000.

Constituent	Human Toxicity Value	Ecotoxicity Value
Antimony	10.	0.
Arsenic	10.	0.01
Barium	10.	0.001
Cadmium	10.	1.
Chromium	10.	10.
Cobalt	0.001	0.
Copper	0.	0.1
Iron	0.	0.01
Lead	10.	1.
Mercury	10.	10.
Nickel	0.1	0.01
Silver	0.1	10.
Zinc	0.01	0.01
Thorium	10.	10.
Uranium	10.	10.
Cyanide	0.1	1.
Asbestos	10.	0.

4.2.2 Human Hazard

The human hazard value is calculated for each constituent (note: manganese is excluded, asbestos is included) as the product of the sample concentration (in mg/Kg) and human toxicity values (derived from the EPA HRS human toxicity values/1,000; SCDM, 1994). Solid sample concentrations are corrected by subtracting background concentrations, and using the difference in the calculation. A separate product is calculated for each element and the element-products are summed for each sample, and the sample values are summed for each source.

For sample #1:
Constituent 1: (Sample conc. - background conc.) x Human toxicity value = _____
Constituent 2: (Sample conc. - background conc.) x Human toxicity value = _____

.
.

Constituent n: (Sample conc. - background conc.) x Human toxicity value = _____

The sum of the element-products is the human hazard value for sample #1 = _____

The human hazard value procedure is repeated for each sample collected at the site.

For sample #n:
Constituent 1: (Sample conc. - background conc.) x Human toxicity value = _____
Constituent n: (Sample conc. - background conc.) x Human toxicity value = _____
Sum of element-products (human hazard value) for sample #n = _____

The waste score (human) is calculated by multiplying the sample quantity value and the human hazard value (calculated above) for each sample, summing the values for all samples from that source, and then dividing by 10,000:

Sample #1: Sample quantity value x sample #1 human hazard value = _____

.
.

Sample #n: Sample quantity value x sample #n human hazard value = _____

The waste score (human) is the sum of the sample products divided by 10,000.

4.2.3 Ecologic Hazard

The ecologic value is calculated for each constituent (note: manganese is excluded) as the product of the sample concentration (corrected by subtracting background, in mg/Kg) and ecotoxicity values (derived from the EPA HRS ecotoxicity values/1,000; SCDM, 1994, see table in Section 4.2.1). A separate product is calculated for each element and the element-products are summed for each sample.

For sample #1:
Constituent 1: (Sample conc. - background conc.) x ecotoxicity value = _____
Constituent 2: (Sample conc. - background conc.) x ecotoxicity value = _____

.
.

Constituent n: (Sample conc. - background conc.) x ecotoxicity value = _____

The sum of element-products is the ecohazard value for sample #1 = _____

The ecohazard value procedure is repeated for each sample collected from the source.

For sample #n:
Constituent 1: (Sample conc. - background conc.) x ecotoxicity value = _____
Constituent n: (Sample conc. - background conc.) x ecotoxicity value = _____

Sum of element-products (ecohazard value) for sample #n = _____

The waste score (ecologic) is calculated by multiplying the sample quantity value and the ecohazard value (calculated above) for each sample, summing the values for all samples, and then dividing by 10,000:

Sample #1: Sample quantity value x sample #1 ecohazard value = _____

Sample #n: Sample quantity value x sample #n ecohazard value = _____

The waste score (ecologic) is the sum of the sample products divided by 10,000.

4.2.4 Air Pathway Waste Characteristics Score

The total air pathway waste characteristics score for the source is the sum the human waste score and the ecologic waste score.

4.3 AIR PATHWAY TARGETS

The air pathway targets score is evaluated by assessing population and environmental receptors near the site potentially affected by airborne releases of waste constituents from the site. These values are the same as those used for the detailed (source specific) AIMSS, but may be different for different sources. If site specific information indicates more or receptors, use that value if it can be documented.

4.3.1 Population Within Four Miles

Population within a 4-mile radius of the site was determined from available census information for larger municipalities, and from maps and field observations for smaller municipalities and rural populations. The four-mile distance is the same as the HRS target distance limit for the air pathway. To account for uncertainty in the population figures, population is intervalized into ranges (ranges are from the HRS) and recorded on the site inventory form: 0; 1-10; 10-30; 30-100; 100-300; 300-1,000; 1,000-3,000; 3,000-10,000; and >10,000. The lower value of the range is used to be conservative in assigning a population score. This value is assigned as the population within four miles.

4.3.2 Distance to Nearest Residence

The nearest residence score is an adjustment used to emphasize the greater risk to persons living close to the site (per the HRS). The distance to the nearest residence

was observed during the site visit and recorded on the inventory form. Only the nearest residence is used (full-time or recreational use), regardless of the number or frequency of persons living at the residence. Assign a value as follows: less than 1,000 feet = 10; between 1,000 feet and 1/2 mile = 5; and more than 1/2 mile = 0.

4.3.3 Sensitive Environments

Sensitive environments on or near the site (within the 4-mile target distance limit) are assigned air target scores, as in the HRS. Sensitive environments were determined from the site visit and inspection of the MDFWP data base (wetlands, threatened and endangered species). Assign these values as follows:

Wetlands (5 acre minimum) observed or MDFWP database = 10; otherwise =0.

National or State parks or wilderness areas = 10; otherwise = 0.

Threatened/endangered species habitat from the MDFWP database = 5; otherwise = 0.

4.3.4 Air Pathway Targets Score

The air pathway targets score is the sum of the above five values: population within four miles, nearest residence, wetlands, parks/wilderness, and threatened/endangered species habitat.

4.4 AIR PATHWAY SCORE

The Air Pathway Score is the product of the Air Likelihood of Release Score (Section 4.1), the Air Waste Characteristics Score (Section 4.2), and the Air Targets Score (Section 4.3).

5.0 DIRECT CONTACT

The direct contact exposure route is evaluated using the following factors: the likelihood of exposure, direct contact waste characteristics, and direct contact targets. The product of these three factors is the direct contact score.

5.1 DIRECT CONTACT LIKELIHOOD OF EXPOSURE

The direct contact likelihood of exposure factor evaluates the potential for direct contact with constituents at the site using two criteria: the accessibility of the wastes at the site and the distance to the nearest population or residence.

5.1.1 Accessibility After Reclamation

Accessibility of wastes at the site is evaluated with respect to the presence of fences, signs, physical barriers, gates, or guards that restrict access to the site wastes by residents or recreational users. These access restrictions must be intact and at least partially effective at limiting access to waste sources by people.

Each source is assigned a value as follows: easily accessible - no fences, gates, or signs = 20; moderately accessible - barbed wire fences, road gated, and signs posted = 10; difficult access - chain link fence, road gated and locked = 5; and not accessible - site completely fenced, access road gated and locked, site guarded (does not include locked or manned access points more than 1/2 mile from the actual mine site) = 1. If the waste materials at the site have been reclaimed with at least 12 inches of continuous, uncontaminated cover soil, revegetated, and direct contact exposure by visitors and trespassers has been effectively prevented, assign a value of 0.1.

5.1.2 Distance to Nearest Population

The distance from the source material to the nearest population (town) or individual residence is used for this factor. Use this distance to assign a value as follows: less than 1,000 feet = 20; between 1,000 feet and 1/2 mile = 10; and greater than 1/2 mile = 5.

5.1.3 Direct Contact Likelihood of Exposure Score

Calculate the direct contact likelihood of exposure score by multiplying the accessibility value by the distance value (Maximum score = 400).

5.2 DIRECT CONTACT WASTE CHARACTERISTICS

Waste characteristics for direct contact are evaluated using the exposed surface area of each source (post reclamation) at the site, the concentrations of constituents in samples of the waste material, the background concentrations, and the EPA HRS human toxicity value (SCDM, 1994).

5.2.1 Quantity

A quantity value is assigned in the same manner as the air pathway (Section 4.2.1). Each source at the site is scored separately. Assign the sample quantity value and the toxicity value as follows:

Range (100's of sq. ft.)	Quantity Value
less than 10	0.001
10-100	0.01
100-1,000	0.1
1,000-10,000	1.
10,000-100,000	10.
100,000-1,000,000	100.
more than 1,000,000	1,000.

Element	Human Toxicity Value
Antimony	10.
Arsenic	10.
Barium	10.
Cadmium	10.
Chromium	10.
Cobalt	0.001
Copper	0.
Iron	0.
Lead	10.
Mercury	10.
Nickel	0.1
Silver	0.1
Zinc	0.01
Thorium	10.
Uranium	10.
Cyanide	0.1
Asbestos	10.

5.2.2 Hazard

The hazard value is calculated for each constituent (note: manganese is excluded, asbestos is included) as the product of the sample concentration (in mg/Kg, corrected by subtracting background) and human toxicity values (derived from the EPA HRS human toxicity values/1,000; SCDM, 1994). A separate product is calculated for each element, the element-products are summed for each sample, and the sample values are summed for each source.

For sample #1:
Constituent 1: (Sample conc. - background conc.) x Human toxicity value = _____
Constituent 2: (Sample conc. - background conc.) x Human toxicity value = _____

Constituent n: (Sample conc. - background conc.) x Human toxicity value = _____

The sum of the element-products is the hazard value for sample #1 = _____

The hazard value procedure is repeated for each sample collected at the site.

For sample #n:
Constituent 1: (Sample conc. - background conc.) x Human toxicity value = _____
Constituent n: (Sample conc. - background conc.) x Human toxicity value = _____

Sum of element-products (hazard value) for sample #n = _____

5.2.3 Direct Contact Waste Characteristics Score

The waste characteristics score is calculated by multiplying the sample quantity value and the hazard value (calculated above) for each sample, summing the values for all samples from the source, and then dividing by 10,000:

Sample #1: Sample quantity value x sample #1 hazard value = _____

.

.

Sample #n: Sample quantity value x sample #n hazard value = _____

The direct contact waste characteristics score for each source is the sum of the sample products divided by 10,000.

5.3 DIRECT CONTACT TARGETS

The direct contact targets score is evaluated by assessing nearby receptors potentially affected by direct contact with waste constituents at the site. These values are the same as those used for the detailed (source specific) AIMSS, but may be different for different sources. If site specific information indicates more or fewer receptors, use that value if it can be documented.

5.3.1 Population Within One Mile

Population within a 1-mile radius of the site was determined from available census information for larger municipalities and from maps and field observations for smaller municipalities and rural populations. The one-mile distance is the same as the HRS target distance limit for the direct contact (soil exposure pathway). To account for uncertainty in the population figures, population is intervalized into ranges (ranges are from the HRS) and recorded on the site inventory form: 0; 1-10; 10-30; 30-100; 100-300; 300-1,000; 1,000-3,000; 3,000-10,000; and >10,000. The lower value of the range is used to be conservative in assigning a population score. This value is assigned as the population within one mile.

5.3.2 Distance to Nearest Residence

The nearest residence score is an adjustment used to emphasize the relatively greater risk to persons living close to the site (per the HRS). The distance to the nearest residence was observed during the site visit and recorded on the inventory form. Only the nearest residence is used (full-time or recreational use), regardless of the number or frequency of persons living at the residence. Assign a value as follows: less than 1,000 feet = 10; between 1,000 feet and 1/2 mile = 5; and more than 1/2 mile = 0.

5.3.3 Recreational Use

Recreational use of the site is an adjustment to account for direct contact with site wastes by persons who use the site for recreation, but do not live within the one-mile radius around the site. The value is assigned based on an evaluation of several criteria, collectively referred to as "attractiveness" in the HRS: proximity to populated areas, heavily travelled roads, or other recreation areas; uncommon features of the site which may attract recreationists (e.g., motorcyclists); and the amount of physical evidence of recreational use observed at the site. Assign a value as follows: high recreational use = 10; moderate use = 5; low use = 2; and no use = 0.

5.3.4 Direct Contact Targets Score

The direct contact targets score is the sum of the above three values: population within one mile, nearest residence, and recreational use.

5.4 DIRECT CONTACT SCORE

The Direct Contact Score is the product of the Direct Contact Likelihood of Exposure Score (Section 5.1), the Direct Contact Waste Characteristics Score (Section 5.2), and the Direct Contact Targets Score (Section 5.3).

6.0 RECLAIMED MINE SITE SCORE

Sum the four pathway scores and divide by 100,000 to obtain the reclaimed score for each source at the site. [Groundwater Pathway Score (Section 2.4) + Surface Water Pathway Score (Section 3.4) + Air Pathway Score (Section 4.4) + Direct Contact Score (Section 5.4)] / 100,000 = Reclaimed Source Score. The sum of scores for each source at the site (reclaimed and unreclaimed) is the total Reclaimed Mine Site Score.

For de-listing purposes, the same cutoff value is used as the original AIMSS. If a reclaimed site scores less than 0.04, it has been effectively reclaimed as it relates to AMRB's resource allocation and can be removed from AMRB's priority list.

7.0 SITE SAFETY SCORE

The site safety score is evaluated using the following factors: the safety threat (accessibility), safety hazards, and safety targets. The product of these three factors divided by 1,000 is the site safety score.

7.1 SAFETY THREAT AFTER RECLAMATION

The potential threat of human contact with safety hazards at a site is evaluated using the relative accessibility to the safety hazard. Accessibility is evaluated with respect to

the presence of fences, signs, physical barriers, gates, or guards, that restrict access by residents or recreational users to the site hazards. These access restrictions must be intact and at least partially effective at limiting access by people. The most easily accessible hazard is scored as follows: easily accessible - no fences, gates, or signs = 20; moderately accessible - barbed wire fences, road gated, and signs posted = 10; difficult access - chain link fence, road gated and locked = 5; and not accessible - site completely fenced, access road gated and locked, site guarded (does not include locked or manned access points more than 1/2 mile from the actual abandoned mine site) = 1. The accessibility score is the same as the accessibility score in the Direct Contact Section (5.1.1).

7.1.1 Safety Threat Score

The safety threat score is the accessibility of site hazards (Maximum = 20).

7.2 SAFETY HAZARDS AFTER RECLAMATION

Safety hazards at the site are scored using the product of the quantity of various hazards and the relative hazard value assigned for each type of hazard remaining after reclamation at the site.

Sum the number of remaining open, hazardous, near-vertical stopes and shafts. Open means an opening that is large enough for a child to fall into, hazardous means that the sides of the opening are steep enough that the opening could not be exited easily (i.e., by a child).

Sum the number of remaining open adits or near-horizontal openings, that are large enough and open enough for a curious child to enter.

Sum the number of remaining unstable highwalls or open pits. Unstable refers to slopes, cuts, undercut banks, or piles that are at a slope that is greater than the angle of repose.

Sum the number of remaining hazardous structures at the site. Hazardous refers to structurally unstable buildings, not all old buildings at the site.

Note whether explosives (includes blasting caps and decomposed explosives) remain on the site.

Note whether other hazardous materials (asbestos, chemicals, not including petroleum products) remain on the site.

Each hazard is scored separately by multiplying the quantity of each hazard by a hazard score to determine a hazard value. Assign hazard values as follows:

Hazard and quantity	Score	Hazard Value
Number of shafts and stopes	x 100	= ____
Number of adits and tunnels	x 50	= ____
Number of pits and unstable highwalls	x 75	= ____
Number of hazardous structures	x 40	= ____
Explosives present on site	= 50	____
Other hazardous materials present	= 100	____

7.2.1 Safety Hazards Score

The safety hazards score is the sum of all of the above hazard values.

7.3 SAFETY TARGETS

The safety targets score is evaluated in the same manner as the direct contact targets.

7.3.1 Population Within One Mile

Population within a 1-mile radius of the site is the same as in the direct contact targets section.

7.3.2 Distance to Nearest Residence

The nearest residence score is the same as in the direct contact targets section.

7.3.3 Recreational Use

The recreational use score is the same as in the direct contact targets section.

7.3.4 Safety Targets Score

The safety targets score is the sum of the above three values: population within one mile, nearest residence, and recreational use.

7.4 SITE SAFETY SCORE

The Site Safety Score is the product of the Safety Threat Score (Section 7.1), the Safety Hazards Score (Section 7.2), and the Safety Targets Score (Section 7.3) divided by 1,000.

8.0 REFERENCES

Federal Register, 1990. 40 CFR Part 300, Appendix A, 1990. Hazard Ranking System; Final Rule. Federal Register, Vol. 55, No. 241, Pages 51532-51667. Friday, December 14, 1990; Effective Date: March 14, 1991.

MDEQ/AMRB-Pioneer, 1994. Abandoned and Inactive Mine Scoring System. Prepared for MDEQ/AMRB by Pioneer Technical Services, Inc., June 1994.

SCDM, 1994. Superfund Chemical Database Matrix (SCDM), Hazardous Substance Factor Values (333 Substances), June 1994 version.

APPENDIX A

EXAMPLE RECLAIMED SITE SCORING, BROOKLYN MINE AND MILLSITE

The Brooklyn Mine and Millsite was reclaimed in 1995 as a joint effort by the AMRB and the USFS. The reclamation included the following treatments for the wastes at the site.

Waste rock dumps WR-1, WR-2, and WR-3 were not in the 100-year floodplain and were reclaimed similarly, including:

1) grading out the waste rock dumps, reducing and stabilizing the slopes;

2) amending the upper 12-18 inches of the graded dumps with lime to neutralize acid-generation potential;

3) placing a one- foot deep organic-amended soil cover on the wastes, erosion control blankets where slopes were greater than 2.5 to 1, and applying a seed mix for revegetation;

4) constructing run-on control measures and run-off collection ditches and basins; and

5) fencing reclaimed sources.

For each of these three waste sources, these measures constitute three of the five requirements for groundwater protection (containment value of 1), three of the five requirements for surface water protection (containment value of 0.1), and meet the requirement for air and direct contact protection (containment values of 0.1 for both).

An on-site repository was constructed to contain waste materials that were in the 100-year floodplain (WR-5 and WR-6) and the mill tailings (TP-1) which were eroding directly into surface water. Additionally, mill tailings from the Nonpareil Millsite located west of the Brooklyn site (TP-1, -2, -3, and -4) were removed and placed in the repository. The repository was constructed with the following parameters:

1) applying an impermeable underliner beneath the waste materials with an integral leachate collection system;

2) applying an impermeable cap over the waste materials with a drainage layer above the cap;

3) placing a two-feet deep organic-amended soil cover over the cap system and applying a seed mix for revegetation;

4) constructing run-on control measures and run-off collection ditches and basins; and

5) constructing fence and repository.

For each of these four waste sources, these measures constitute four of the five requirements for groundwater protection (containment value of 0.1), three of the five requirements for surface water protection (containment value of 0.1), and meet the requirement for air and direct contact protection (containment values of 0.1 for both).

RMSS SCORESHEET

SITE NAME: BROOKLYN MINE AND MILL
PA NUMBER: 20-025

LINE NO.			SOURCE:	Total Site	Repository TP1, WR5&6 Nonpareil tails	Reclaimed WR1	Reclaimed WR2	Reclaimed WR3
		GROUNDWATER PATHWAY						
1	GW - LIKELIHOOD	CONTAINMENT	0/5=20; 1/5=10; 2/5=5; 3/5=1; 4/5=0.1; All=0.05		0.1	1.0	1.0	1.0
2	OF RELEASE	GW DEPTH	<25'=20; 25-100'=10; >100'=2		10	2	2	10
3		LIKELIHOOD SCORE	LINES 1 x 2		1.0	2.0	2.0	10.0
4	GW - WASTE CHAR.	RECALCULATED SCORE	(SEE APPENDIX B)		37.106	6.396	21.721	16.766
5		WELLS - 1 MI. x 2.5	#Wells <1 mi. (MBMG) x 2.5		0.0	0.0	0.0	0.0
6	GW - TARGETS	WELLS - 1 TO 4 MI	#Wells 1-4 mi. (MBMG)		11	11	11	11
7		NEAREST WELL	<1000'=20; 1000-2640'=10; >2640'=2		0	0	0	0
8		TARGETS SCORE	LINES 5 + 6 + 7		11.0	11.0	11.0	11.0
9		**GROUNDWATER SCORE**	LINES 3 x 4 x 8	2871	408	141	478	1844
		SURFACE WATER PATHWAY						
10	SW - LIKELIHOOD	CONTAINMENT	None=20; One=10; Two=1; All=0.1		0.1	0.1	0.1	0.1
11	OF RELEASE	DISTANCE TO SW	<25'=20; 25-100'=10; >100'=2		2	2	2	2
12		LIKELIHOOD SCORE	LINES 10 x 11		0.2	0.2	0.2	0.2
13	SW - WASTE CHAR.	RECALCULATED SCORE	(SEE APPENDIX B)		39.909	6.890	23.553	18.088
14		DRINKING WATER POP'N	#Served (WQB) x Dilution Factor		0	0	0	0
15		IMPACTED DRAINAGE	Impacted Distance in feet / 1,000		0	0	0	0
16		WETLANDS	MDFWP - No=0 ; Yes=10		10	10	10	10
17	SW - TARGETS	FISHERY	Class: 1=20 ; 2=10; 3=5; 4=1; else=0		5	5	5	5
18		RECREATION	Use? No=0 ; Yes=2		0	0	0	0
19		IRRIGATION/STOCK	Use? No=0 ; Yes=2		0	0	0	0
20		T & E SPECIES HABITAT	MDNRC - No=0 ; Yes=5		5	5	5	5
21		TARGETS SCORE	SUM LINES 14 - 20		20	20	20	20
22		**SURFACE WATER SCORE**	LINES 12 x 13 x 21	354	160	28	94	72
		AIR PATHWAY						
23	AIR - LIKELIHOOD	CONTAINMENT	Cover=0.1; No=1; Low=10; Mod=15; High=20		0.1	0.1	0.1	0.1
24	OF RELEASE	DISTANCE TO POP'N	<1000'=20; 1000-2640'=10; >2640'=5		5	5	5	5
25		LIKELIHOOD SCORE	LINES 23 x 24		0.5	0.5	0.5	0.5
26	AIR - WASTE CHAR.	RECALCULATED SCORE	(SEE APPENDIX B)		0.011	0.002	0.008	0.006
27		POPULATION - 4 MILES	0; 1; 10; 30; 100; 300; 1K; 3K; 10K		1	1	1	1
28		NEAREST RESIDENCE	<1000'=10; 1000-2640'=5; >2640'=0		0	0	0	0
29	AIR - TARGETS	WETLANDS	MDFWP - No=0 ; Yes=10		10	10	10	10
30		PARKS / WILDERNESS	No=0 ; Yes=10		0	0	0	0
31		T & E SPECIES HABITAT	MDNRC - No=0 ; Yes=5		5	5	5	5
32		TARGETS SCORE	SUM LINES 27 - 31		16	16	16	16
33		**AIR PATHWAY SCORE**	LINES 25 x 26 x 32	0	0	0	0	0
		DIRECT CONTACT PATHWAY						
34	LIKELIHOOD OF	ACCESSIBILITY	Easy=20; Mod=10; Diff=5; None=1; Cover=0.1		0.1	0.1	0.1	0.1
35	EXPOSURE	DISTANCE TO POP'N	<1000'=20; 1000-2640'=10; >2640'=5		5	5	5	5
36		LIKELIHOOD SCORE	LINES 34 x 35		0.5	0.5	0.5	0.5
37	D. C. WASTE CHAR.	RECALCULATED SCORE	(SEE APPENDIX B)		0.010	0.002	0.007	0.006
38	DIRECT CONTACT	POPULATION - 1 MILE	0; 1; 10; 30; 100; 300; 1K; 3K; 10K		0	0	0	0
39	TARGETS	NEAREST RESIDENCE	<1000'=10; 1000-2640'=5; >2640'=0		0	0	0	0
40		RECREATIONAL USE	None=0; Low=2; Mod=5; High=10		2	2	2	2
41		TARGETS SCORE	SUM LINES 38 - 40		2	2	2	2
42		**DIRECT CONTACT SCORE**	LINES 36 x 37 x 41	0	0	0	0	0
43	**RECLAIMED MINE SITE SCORE**							
		(LINES 9 + 22 + 33 + 42) / 100,000		**0.0322**	0.0057	0.0017	0.0057	0.0192

		SITE SAFETY		Total Site
1	THREAT REMAINING	ACCESSIBILITY	Easy=20; Mod=10; Diff=5; None=1; Fixed=0.1	0.1
2		OPEN SHAFTS	100 EA.	0
3		OPEN ADITS	50 EA.	0
4	HAZARDS	UNSTAB. HIWALLS / PITS	75 EA.	0
5	REMAINING	HAZ. STRUCTURES	40 EA.	120
6		EXPLOSIVES		0
7		HAZ. MATERIALS		0
8		HAZARDS SCORE	SUM LINES 2 - 7	120
9		POPULATION - 1 MILE		0
10	TARGETS	NEAREST RESIDENCE		0
11		RECREATIONAL USE		2
12		TARGETS SCORE	SUM LINES 9 - 11	2
13		SITE SAFETY SCORE	(LINES 1 x 8 x 12) / 1,000	0.02

APPENDIX B

EXAMPLE RECLAIMED SITE WASTE CHARACTERISTICS SCORING, BROOKLYN MINE AND MILLSITE

Waste characteristics scores were derived for the initial AIMSS scoring for the Brooklyn site in 1993. These scores were refined for each of the sources at the site in the preliminary risk analysis section of the Reclamation Work Plan prepared in 1994. Refining these scores after reclamation may be necessary because additional concentration data were collected during the reclamation investigation and more accurate volume and area determinations are available from both the investigation and the reclamation activity. Most reclamation activities do not change the volume or composition of the waste materials; hence, for scoring purposes, the waste characteristics are the same as before the reclamation occurred.

The following pages demonstrate the derivation of the waste characteristics scores for each of the waste sources at the Brooklyn site (WR-1, -2, -3, -5, -6, TP-1, and the Nonpareil tailings). At the end of the calculations, the scores for all the wastes that were placed in the repository were combined for calculating the RAIMSS score in Appendix A.

		Reclaimed Brooklyn WR1	Reclaimed Brooklyn WR2	Reclaimed Brooklyn WR3	Repository Brooklyn WR5,6	Repository Brooklyn TP1	Repository Nonpareil TP1,2,3,4	
Antimony	Source Concentration	97.80	331.00	529.00	35.00	347.00	282.00	Weighted Average
	Background Conc.	8.90	8.90	8.90	8.90	8.90	10.50	Sample(s)
	Corrected Concentratio	88.90	322.10	520.10	26.10	338.10	271.50	Source Conc. - Background Conc.
	Human Toxicity Value	10.00	10.00	10.00	10.00	10.00	10.00	From table, after EPA HRS (SCDM)
	Human Hazard	889.00	3221.00	5201.00	261.00	3381.00	2715.00	Corrected Conc. X Human Toxicity Value
	Ecotoxicity Value	0.00	0.00	0.00	0.00	0.00	0.00	From table, after EPA HRS (SCDM)
	Ecologic Hazard	0.00	0.00	0.00	0.00	0.00	0.00	Corrected Conc. X Ecotoxicity Value
Arsenic	Source Concentration	618.00	793.00	430.00	186.00	507.00	360.00	
	Background Conc.	25.60	25.60	25.60	25.60	25.60	39.20	
	Corrected Concentratio	592.40	767.40	404.40	160.40	481.40	320.80	
	Human Toxicity Value	10.00	10.00	10.00	10.00	10.00	10.00	
	Human Hazard	5924.00	7674.00	4044.00	1604.00	4814.00	3208.00	
	Ecotoxicity Value	0.01	0.01	0.01	0.01	0.01	0.01	
	Ecologic Hazard	5.92	7.67	4.04	1.60	4.81	3.21	
Barium	Source Concentration	293.00	455.00	481.00	249.00	968.00	433.00	
	Background Conc.	74.00	74.00	74.00	74.00	74.00	157.00	
	Corrected Concentratio	219.00	381.00	407.00	175.00	894.00	276.00	
	Human Toxicity Value	10.00	10.00	10.00	10.00	10.00	10.00	
	Human Hazard	2190.00	3810.00	4070.00	1750.00	8940.00	2760.00	
	Ecotoxicity Value	0.001	0.001	0.001	0.001	0.001	0.001	
	Ecologic Hazard	0.22	0.38	0.41	0.18	0.89	0.28	
Cadmium	Source Concentration	7.900	34.000	11.500	9.700	48.300	23.100	
	Background Conc.	0.900	0.900	0.900	0.900	0.900	1.700	
	Corrected Concentratio	7.000	33.100	10.600	8.800	47.400	21.400	
	Human Toxicity Value	10.00	10.00	10.00	10.00	10.00	10.00	
	Human Hazard	70.00	331.00	106.00	88.00	474.00	214.00	
	Ecotoxicity Value	1.00	1.00	1.00	1.00	1.00	1.00	
	Ecologic Hazard	7.00	33.10	10.60	8.80	47.40	21.40	
Chromium	Source Concentration	8.10	8.50	4.60	4.60	3.80	2.16	
	Background Conc.	9.80	9.80	9.80	9.80	9.80	12.10	
	Corrected Concentratio	0.00	0.00	0.00	0.00	0.00	0.00	
	Human Toxicity Value	10.00	10.00	10.00	10.00	10.00	10.00	
	Human Hazard	0.00	0.00	0.00	0.00	0.00	0.00	
	Ecotoxicity Value	10.00	10.00	10.00	10.00	10.00	10.00	
	Ecologic Hazard	0.00	0.00	0.00	0.00	0.00	0.00	
Cobalt	Source Concentration	14.40	7.10	4.30	3.30	3.30	1.64	
	Background Conc.	7.40	7.40	7.40	7.40	7.40	7.70	
	Corrected Concentratio	7.00	0.00	0.00	0.00	0.00	0.00	
	Human Toxicity Value	0.001	0.001	0.001	0.001	0.001	0.001	
	Human Hazard	0.01	0.00	0.00	0.00	0.00	0.00	
	Ecotoxicity Value	0.00	0.00	0.00	0.00	0.00	0.00	
	Ecologic Hazard	0.00	0.00	0.00	0.00	0.00	0.00	
Copper	Source Concentration	1483.00	394.00	218.00	124.00	630.00	159.00	
	Background Conc.	19.80	19.80	19.80	19.80	19.80	16.50	
	Corrected Concentratio	1463.20	374.20	198.20	104.20	610.20	142.50	
	Human Toxicity Value	0.00	0.00	0.00	0.00	0.00	0.00	
	Human Hazard	0.00	0.00	0.00	0.00	0.00	0.00	
	Ecotoxicity Value	0.10	0.10	0.10	0.10	0.10	0.10	
	Ecologic Hazard	146.32	37.42	19.82	10.42	61.02	14.25	
Iron	Source Concentration	36900.0	25147.0	14693.0	11543.0	17567.0	14900.0	
	Background Conc.	16050.0	16050.0	16050.0	16050.0	16050.0	14200.0	
	Corrected Concentratio	20850.0	9097.0	0.0	0.0	1517.0	700.0	
	Human Toxicity Value	0.00	0.00	0.00	0.00	0.00	0.00	
	Human Hazard	0.00	0.00	0.00	0.00	0.00	0.00	
	Ecotoxicity Value	0.01	0.01	0.01	0.01	0.01	0.01	
	Ecologic Hazard	208.50	90.97	0.00	0.00	15.17	7.00	
Lead	Source Concentration	1250.00	5746.00	4264.00	506.00	3807.00	3110.00	
	Background Conc.	31.80	31.80	31.80	31.80	31.80	51.00	
	Corrected Concentratio	1218.20	5714.20	4232.20	474.20	3775.20	3059.00	
	Human Toxicity Value	10.00	10.00	10.00	10.00	10.00	10.00	
	Human Hazard	12182.00	57142.00	42322.00	4742.00	37752.00	30590.00	
	Ecotoxicity Value	1.00	1.00	1.00	1.00	1.00	1.00	
	Ecologic Hazard	1218.20	5714.20	4232.20	474.20	3775.20	3059.00	

		Reclaimed Brooklyn WR1	Reclaimed Brooklyn WR2	Reclaimed Brooklyn WR3	Repository Brooklyn WR5,6	Repository Brooklyn TP1	Repository Nonpareil TP1,2,3,4	
Mercury	Source Concentration	5.6100	15.9000	9.6100	12.7000	8.9400	1.2200	Weighted Average
	Background Conc.	0.0900	0.0900	0.0900	0.0900	0.0900	0.1400	Sample(s)
	Corrected Concentratio	5.5200	15.8100	9.5200	12.6100	8.8500	1.0800	Source Conc. - Background Conc.
	Human Toxicity Value	10.00	10.00	10.00	10.00	10.00	10.00	From table, after EPA HRS (SCDM)
	Human Hazard	55.20	158.10	95.20	126.10	88.50	10.80	Corrected Conc. X Human Toxicity Value
	Ecotoxicity Value	10.00	10.00	10.00	10.00	10.00	10.00	From table, after EPA HRS (SCDM)
	Ecologic Hazard	55.20	158.10	95.20	126.10	88.50	10.80	Corrected Conc. X Ecotoxicity Value
Nickel	Source Concentration	22.60	27.80	18.60	31.70	11.30	2.13	
	Background Conc.	11.40	11.40	11.40	11.40	11.40	9.10	
	Corrected Concentratio	11.20	16.40	7.20	20.30	0.00	0.00	
	Human Toxicity Value	0.10	0.10	0.10	0.10	0.10	0.10	
	Human Hazard	1.12	1.64	0.72	2.03	0.00	0.00	
	Ecotoxicity Value	0.01	0.01	0.01	0.01	0.01	0.01	
	Ecologic Hazard	0.11	0.16	0.07	0.20	0.00	0.00	
Zinc	Source Concentration	802.00	6640.00	4725.00	2064.00	6517.00	3260.00	
	Background Conc.	68.30	68.30	68.30	68.30	68.30	116.00	
	Corrected Concentratio	733.70	6571.70	4656.70	1995.70	6448.70	3144.00	
	Human Toxicity Value	0.01	0.01	0.01	0.01	0.01	0.01	
	Human Hazard	7.34	65.72	46.57	19.96	64.49	31.44	
	Ecotoxicity Value	0.01	0.01	0.01	0.01	0.01	0.01	
	Ecologic Hazard	7.34	65.72	46.57	19.96	64.49	31.44	
Source Human Hazard		21318.66	72403.46	55885.49	8593.09	55513.99	39529.24	
	Sum of human hazard values for each contaminant							
Source Ecologic Hazard		1648.81	6107.73	4408.91	841.46	4057.49	3147.37	
	Sum of ecohazard values for each contaminant							
Source Volume (cu.yd.; corrected)		5750	4000	7200	13400	4900	4500	Measured at site
Quantity Value (volume - GW & SW		3	3	3	10	3	3	Assigned from range on table
Exposed Source Area (sq.ft./100)		0	0	0	0	0	0	Measured at site
Quantity Value (area - Air & DC)		0.001	0.001	0.001	0.001	0.001	0.001	Assigned from range on table

	Brooklyn WR1	Brooklyn WR2	Brooklyn WR3	Brooklyn WR5,6	Brooklyn TP1	Nonpareil TP1,2,3,4	Total Repository
Groundwater Waste Char. Score	6.3956	21.7210	16.7656	8.5931	16.6542	11.8588	37.1061
Source human hazard X quantity value / 10,000							
Suface Water Waste Char. Score	6.8902	23.5534	18.0883	9.2345	17.8714	12.8030	39.9090
[Source human hazard + source ecologic hazard] X quantity value / 10,000							
Air Waste Char. Score	0.0023	0.0079	0.0060	0.0009	0.0060	0.0043	0.0111
[Source human hazard + source ecologic hazard] X quantity value / 10,000							
Direct Contact Waste Char. Score	0.0021	0.0072	0.0056	0.0009	0.0056	0.0040	0.0104
Source human hazard X quantity value / 10,000							