HUMAN HEALTH RISK ASSESSMENT FOR THE ROMIC SOUTHWEST FACILITY (CHANDLER, ARIZONA)

Prepared for:

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October 2006
03-13617B

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ACRONYM LIST

AAQGS	Ambient Air Quality Guidelines
ACGIH	American Conference of Governmental Industrial Hygienists
ADEQ	Arizona Department of Environmental Quality
AEGLs	Acute Exposure Guideline Levels
AEI	Average Exposed Individual
AT	Averaging Time
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
BPIP	Building Profile Input Program
BW	Body Weight
C	Chemical Concentration
CAG	Carcinogen Assessment Group
Cal/EPA	California Environmental Protection Agency
CDI	Chronic Daily Intake
CFR	Code of Federal Regulations
COPC	Chemical of Potential Concern
CR	Contact Rate
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
DCE	Dichloroethene
DEM	Digital Elevation Map
DEQ	Department of Environmental Quality
ED	Exposure Duration
EF	Exposure Frequency
ET	Exposure Time
ERPG	Emergency Response Planning Guidelines
FID	Flame Ionization Detection
GRIC	Gila River Indian Community
HEAST	Health Effects Summary Tables
HI	Hazard Index
HQ	Hazard Quotient
HRA	Health Risk Assessment
I	Intake of Chemical
IRIS	Integrated Risk Information System
ISCST3	Industrial Source Complex Short Term
LOAEL	Lowest-Observed-Adverse-Effect-Level
LOEL	Lowest-Observed-Effect-Level
MCL	Maximum Contaminant Level
MSDS	Material Data Safety Sheet
NCP	National Contingency Plan
NOAEL	No-Observed-Adverse-Effect-Level
NOEL	No-Observed-Effect-Level
ODEQ	Oregon Department of Environmental Quality
OEHHA	Office of Environmental Health Hazard Assessment

OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene or Perchloroethene
PEL	Permissible Exposure Limit
PPRTV	Provisional Peer Reviewed Toxicity Values
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
REL	Reference Exposure Level
RfC	Reference Concentration
RfD	Reference Dose
RME	Reasonable Maximum Exposure
SCRAM	Support Center for Regulatory Air Models
STEL	Short Term Exposure Limit
TCE	Trichloroethene
TCEQ	Texas Commission on Environmental Quality Effects Screening Levels
TEEL	Temporary Emergency Exposure Limits
TLV	Threshold Limit Value
TPH	Total Petroleum Hydrocarbons
TPHCWG	Total Petroleum Hydrocarbon Criteria Working Group
TSD	Treatment, Storage, and Disposal
TWA	Time-weighted Average
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

%	percent
atm	atmosphere
^{o}C	degrees Centigrade
^{o}F	degrees Fahrenheit
K	degrees Kelvin
g	gram
kg	kilograms
m	meter
m^2	square meters
m^3	cubic meters
mg	milligrams
mmHg	millimeter mercury
mol	mole
ppm	parts per million
psi	pounds per square inch
sec	second
µg/L	microgram per liter

EXECUTIVE SUMMARY

ES.1 Introduction

Romic Environmental Technologies, Inc. ("Romic") operates a commercial hazardous waste treatment, storage, and disposal (TSD) Facility ("Facility" or "Site") in Chandler, Arizona. The Facility is located in the Lone Butte Industrial Park in the Gila River Indian Community. The Site receives waste solvents, antifreeze, wastewater contaminated with solvents and metals (e.g., lead and nickel), and other wastes (e.g., discarded paints and used oil filters). The main operations at the Site consist of recycling waste solvents to produce reusable solvents, blending wastes to produce fuel-grade materials, recycling antifreeze, and treating industrial wastewater.

The United States Environmental Protection Agency (USEPA) will be evaluating the Resource Conservation and Recovery Act (RCRA) Part B permit application for the Site. In support of that permit evaluation, the USEPA has requested that Romic prepare a human health risk assessment (HRA). The purpose of the HRA is to evaluate potential adverse effects to human populations that are at or around the Facility and that could be exposed to chemical emissions from the Site. This report presents the methodology and results of the HRA.

Table ES.1 summarizes the estimated health risks calculated in this HRA. The results of the HRA show that the estimated lifetime incremental cancer risks are less than 2×10^{-5} for all populations evaluated. This estimated cancer risk is within the acceptable risk level used by the USEPA for hazardous waste sites (1×10^{-4} to 1×10^{-6}). The chronic noncancer hazard indices (HIs) calculated in this risk assessment were below one for all populations evaluated. According to USEPA, individual chemical exposures that yield a HI of less than 1 are not expected to result in adverse noncancer health effects (USEPA 1989). Although the calculated acute HI is slightly higher than one, based on the conservativeness in this evaluation, a HI of greater than one is unlikely to occur at the Site. Based on the results of the risk assessment, no significant chronic or acute health effects are expected for the off-site populations evaluated.

ES.2 Site Description

Romic is a hazardous waste management services company. Their TSD Facility in Chandler, Arizona is located at 6760 West Allison Road.

Industrial wastes are currently shipped to the Facility for recycling and treatment from various industries, including:

- Dry cleaning
- Printing
- Electronics
- Aerospace
- Paint
- Automotive

In addition, the Facility receives household hazardous waste (e.g., motor oil, paints, cleaners, etc.) from household waste collection events.
Potential sources of emissions associated with normal operations at the Facility can be divided into four main categories:

1. stack/exhaust point emissions,
2. storage emissions from tanks,
3. fugitive (not caught by a capture system) emissions related to transfer and storage operations, and
4. fugitive emissions from miscellaneous operations.

Each source of emissions was evaluated in the HRA.

ES.3 Human Health Risk Assessment

The Site is located in the Lone Butte Industrial Park in the Gila River Indian Community, in Maricopa County, Arizona. Adjacent to the Facility is Lumber Products, a manufacturer of wood products for the building industry. South of the Facility is a warehouse for a modular closets manufacturer, Classy Closets. Next to this is Stericycle; a medical waste autoclave operation. Southwest of the Facility is a tool manufacturing plant for Ryobi. The Lone Butte (Gila River Indian Community) Casino is approximately one kilometer west of the Facility.

The Gila River Indian Community has a population of approximately 14,000[1]. The nearest residences on the reservation are approximately two kilometers to the east of the Site. The nearest residences off the reservation are in the City of Chandler, approximately two kilometers north of the Facility.

Based on the land use surrounding the Site, this risk assessment evaluated off-site workers and off-site residents. Potential risks to off-site workers and off-site residents have been estimated at actual worker and residential locations. In addition to the above populations, the risk assessment also evaluates the risk at specific locations including schools, daycare centers, health care facilities, and senior homes in the vicinity of the Site.

The risk assessment analyzes the emissions from the Site from operations as described in the facility's Part B Permit application. Since emissions include only volatile chemicals, the only relevant exposure route would be inhalation. Because deposition of volatile chemicals will be insignificant, direct contact pathways (such as dermal contact and soil ingestion) and indirect contact pathways (ingestion of contaminated vegetables/meats/fish and mother's milk) are not quantitatively evaluated in the risk assessment.

For this HRA, exposure assumptions corresponding to both an average exposed individual (AEI) and a reasonable maximum exposure (RME) scenario were developed. Intake assumptions for the average exposure scenario are selected to represent the best estimate of exposure while the intake assumptions for the RME scenario represent "the highest exposure that is reasonably expected to occur at a site" (USEPA 1989). According to the USEPA, the intent of the RME

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[1] Inter Tribal Council of Arizona, Inc. http://www.itcaonline.com/tribes_gila.html

scenario is “to estimate a conservative exposure case (i.e., well above the average case) that is still within the range of possible exposures” (USEPA 1989). The RME is estimated by combining “upper-bound and mid-range exposure factors so that the result represents an exposure scenario that is both protective and reasonable; not the worst possible case” (USEPA 1991).

In order to estimate the ambient air concentrations, emissions of chemicals from the Site were estimated and the dispersion of the emissions in the air was modeled. The Industrial Source Complex Short Term Version 3 (ISCST3) dispersion model was used to estimate off-site ambient air concentrations at the selected receptors.

The estimated risks in this assessment are based primarily on a series of conservative assumptions related to predicted environmental concentrations, exposure, and chemical toxicity. The use of conservative assumptions tends to produce upper-bound estimates of risk. Although it is difficult to quantify the uncertainties associated with all the assumptions made in this risk assessment, the use of conservative assumptions is likely to result in substantial overestimates of exposure, and hence, risk.

ES.3.1 Chronic Health Effects

Estimating cancer risks and noncancer HIs requires information regarding the level of intake of the chemical and the relationship between intake of the chemical and its toxicity as a function of human exposure to the chemical. The methodology used to derive the cancer risks and noncancer HIs for the selected chemicals is based on guidance provided by USEPA. The potential risk associated with a chemical in air can be estimated using equations that describe the relationships among the estimated intake of Site-related chemicals, toxicity of the specific chemicals, and overall risk for carcinogenic and noncarcinogenic health effects. For carcinogenic effects, the relationship is given by the following equation (USEPA 1989):

$$\text{Risk} = I \times CSF$$

Where:

Risk = Cancer Risk; the probability of an individual developing cancer as a result of exposure to a particular cumulative dose of a potential carcinogen (unitless)

I = Intake of a chemical (mg chemical/kg body weight-day)

CSF = Cancer Slope Factor (mg chemical/kg body weight-day)

The relationship for noncarcinogenic effects is given by the following equation (USEPA 1989):

$$HI = \frac{I}{RfD}$$

Where:

HI = Hazard Index; an expression of the potential for noncarcinogenic effects, which relates the allowable amount of a chemical (RfD) to the estimated Site-specific intake (unitless)

I = Intake of chemical (mg chemical/kg body weight-day)

RfD = Reference Dose; the toxicity value indicating the threshold amount of chemical contacted below which no adverse health effects are expected (mg chemical/kg body weight-day).

The National Contingency Plan (NCP) (40 CFR 300) is commonly cited as the basis for acceptable incremental risk levels. According to the NCP, lifetime incremental cancer risks posed by a site should not exceed one hundred in a million (1×10^{-4}) to one in a million (1×10^{-6}). For noncancer health hazards, a target HI of one (1) is identified. Individual chemical exposures that yield HIs of less than 1 are not expected to result in adverse noncancer health effects (USEPA 1989).

A summary of the cumulative cancer risks and noncancer hazard indices calculated in this risk assessment are presented in Table ES.1. As shown in these tables, the estimated lifetime incremental cancer risks are less than 1×10^{-5} for all populations and the estimated HIs are less than one for all populations.

For off-site residents, the estimated AEI cancer risk is 4.1×10^{-8}. The estimated RME cancer risk is 1.8×10^{-7}. The estimated noncancer HIs are less than one for off-site residents. These estimated risks are well below the NCP target risk range. The estimated noncancer HI for the AEI residential scenario is 0.0012 and for the RME residential scenario is 0.00087. These estimated HIs are well below the target HI of one (1). As the maximum off-site sensitive receptor is the maximum off-site resident, the maximum estimated excess lifetime cancer risk and HI is the same for both populations.

The estimated excess lifetime risks for the AEI off-site worker scenarios are 2.8×10^{-6}, 1.6×10^{-6}, and 2.4×10^{-6} for Shift 1, Shift 2 and Shift 3, respectively. The estimated excess lifetime risks for the RME off-site worker scenarios are 1.8×10^{-5}, 1.0×10^{-5}, and 1.5×10^{-5} for Shift 1, Shift 2 and Shift 3, respectively. All risk estimates fall within the NCP target risk range. The estimated noncancer HIs for all AEI and RME workers scenarios are well below the target HI of one (1).

ES.3.2 Acute Health Effects

No individual chemical or source exceeded an acute HQ of one (1). The maximum HI, assuming all maximum one hour concentrations occurred at the same time would be 1.6, just slightly above the noncancer target level. The major chemical contributors to this HI are acetone (0.60 from lab packs), methylene chloride (0.32 from multiple sources), and alcohol (0.22 from lab packs). As a conservative assumption, it was assumed that all alcohol emissions from the Site were 2-propanol or isopropyl alcohol.

The individual source with the largest estimated acute HI is labpacks; with an acute HI of 0.86. Again, this is a very conservative estimate as it assumes all chemicals potentially present in lab packs are present at the same time and that the operation takes an entire hour, which is unlikely.

Based on the conservativeness in this evaluation, a HI of greater than one is unlikely to occur at the Site.

ES.3.3 Occupational Standards

Area and personal air sampling results were used to evaluate potential inhalation exposures to on-site workers. The sampling results were compared with the Permissible Exposure Limits (PELs) derived by the Occupational Safety and Health Administration (OSHA). A worker's exposure to a chemical in a workday, expressed as an eight-hour time weighted average concentration, must not exceed the PEL for that chemical. All sampling results were below the chemical-specific PELs.

ES.4 Conclusions

A summary of the cumulative cancer risks calculated in this risk assessment show that the estimated lifetime incremental cancer risks are less than 2×10^{-5} for all populations evaluated. This estimated cancer risk is well within the acceptable risk level used by the USEPA for hazardous waste sites (1×10^{-4} to 1×10^{-6}).

For noncancer health hazards, a target HI of one (1) is identified. Individual chemical exposures that yield HIs of less than 1 are not expected to result in adverse noncancer health effects (USEPA 1989). The chronic HIs calculated in this risk assessment are below one for all populations evaluated. Although the calculated acute HI is slightly higher than one, based on the conservativeness in this evaluation, a HI of greater than one is unlikely to occur at the Site.

Based on the results of the risk assessment, no significant chronic or acute health effects are expected for the off-site populations evaluated. In addition, based on previous on-site worker sampling results, no occupational standard exceedences are expected.

ES.5 References

United States Environmental Protection Agency (USEPA). 1989. *Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part A).* Interim Final. Office of Emergency and Remedial Response. EPA-540/1-89/002. Washington, D.C. December.

1.0 INTRODUCTION

1.1 Overview

Romic Environmental Technologies, Inc. ("Romic") operates a commercial hazardous waste treatment, storage, and disposal (TSD) Facility ("Facility" or "Site") in Chandler, Arizona. The Facility is located in the Lone Butte Industrial Park in the Gila River Indian Community. The Site receives waste solvents, antifreeze, wastewater contaminated with solvents and metals (e.g., lead and nickel), and other wastes (e.g., discarded paints and used oil filters). The waste arrives in five- to 30-gallon cans, 55-gallon drums, tri-wall containers, roll-off containers, or tank trucks. The main operations at the Site consist of recycling waste solvents to produce reusable solvents, blending wastes to produce fuel-grade materials, recycling antifreeze, and treating industrial wastewater.

The United States Environmental Protection Agency (USEPA) will be evaluating the Resource Conservation and Recovery Act (RCRA) Part B permit application for the Site. As a part of that permit evaluation, the USEPA has requested that Romic prepare a health risk assessment (HRA). The purpose of the HRA is to evaluate the potential for adverse effects to human populations that are at or around the Facility and that could be exposed to chemical emissions from the Site. Prior to the preparation of the HRA, a Health Risk Assessment Work Plan was submitted to the USEPA (ENVIRON 2005a). This work plan outlined the methodology and data to be used in preparing the HRA. Subsequently, detailed technical memoranda were submitted for review and approval by the USEPA as follows:

- Ecological Impacts Screening (ENVIRON 2005b),
- Identification of Off-Site Receptors ("Off-Site Receptor Technical Memorandum (ENVIRON 2005c),
- Selection of Chemicals of Potential Concern ("Chemical Selection Technical Memorandum") (ENVIRON 2005d), and
- Proposed Methodology for Estimating Operations Emissions and Exposure Concentrations ("Emissions/Exposure Concentrations Technical Memorandum") (ENVIRON 2005e).

These memoranda provided detailed discussions regarding the methodology, data and assumptions that would be used to select the receptors that would be evaluated, to select the chemicals of concern that would be evaluated, and to estimate the emissions from the on-Site Facility operations. The information presented in these memoranda is used in this HRA along with any changes in response to comments received from USEPA.

The methodology used in this HRA is consistent with USEPA risk assessment guidance including the following key guidance documents:

- *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A), Interim Final (RAGS)* (USEPA 1989),

- *Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"* (USEPA 1991), and

- *Exposure Factors Handbook* (USEPA 1997).

1.2 Report Organization

This HRA is divided into nine sections as follows:

Section 1.0 - Introduction: describes the purpose and scope of the HRA and outlines the report organization.

Section 2.0 - Site Description: presents an overview of the Site and surrounding area, provides a description of the Facility operations and anticipated emissions, and identifies features at the Site that are relevant to the risk assessment including local land use, topography, hydrological conditions, and meteorological conditions.

Section 3.0 - Hazard Identification: identifies the chemicals to be evaluated in the HRA and presents the chronic toxicity values, acute toxicity values, and occupational standards for the selected chemicals.

Section 4.0 – Identification of Potential Human Exposure Pathways and Exposed Populations: discusses both potential and complete exposure pathways and potentially exposed populations.

Section 5.0 – Estimated Emissions: identifies potential emission sources and summarizes the information used in the emission estimates for each source.

Section 6.0 – Estimation of Representative Exposure Concentrations: describes the information and data used to estimate the concentrations of chemicals in the ambient air near the Site.

Section 7.0 - Risk Characterization: presents estimated potential cancer risks and chronic and acute noncancer health effects potentially related to chemical emissions from the Site. In addition to quantifying risks, this section identifies and describes the uncertainties associated with the risk estimates and discusses how these uncertainties may affect the HRA conclusions.

Section 8.0 – Evaluation of Non-Routine Releases: summarizes the results of the evaluation of non-routine (accidental) releases at the Site. A more detailed discussion is presented as an appendix to this report.

Section 9.0 – Conclusion: summarizes the results of the HRA and provides conclusions regarding the potential for adverse health risks due to emissions from the Site.

Supporting documentation is presented in the appendices to this report. The screening processes for chemical selection are presented in Appendix A. Appendix B includes the supporting information and documentation for the estimation of air emissions from the Site. The air dispersion model files are presented in Appendix C. A detailed description of the evaluation of non-routine releases is included in Appendix D.

1.3 References

ENVIRON International Corporation (ENVIRON). 2005a. *Health Risk Assessment Workplan For Romic Environmental Technologies Corporation (Southwest). Chandler, Arizona.* February 11.

ENVIRON International Corporation (ENVIRON). 2005b. *Technical Memorandum - Ecological Impacts Screening, Romic Environmental Technologies Corporation (Southwest). June 2.*

ENVIRON International Corporation (ENVIRON). 2005c. *Technical Memorandum – Identification of Off-Site Receptors, Romic Environmental Technologies Corporation (Southwest). June 3.*

ENVIRON International Corporation (ENVIRON). 2005d. *Technical Memorandum - Selection of Chemicals of Potential Concern, Romic Environmental Technologies Corporation (Southwest). July 20.*

ENVIRON International Corporation (ENVIRON). 2005e. Technical Memorandum - *Proposed Methodology for Estimating Operational Emissions and Exposure Concentrations, Romic Environmental Technologies Corporation (Southwest). August 8.*

United States Environmental Protection Agency (USEPA). 1989. *Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part A).* Interim Final. Office of Emergency and Remedial Response. EPA-540/1-89/002. Washington, D.C. December.

United States Environmental Protection Agency (USEPA). 1991. *Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual. Supplemental Guidance. Standard Default Exposure Factors*. Office of Emergency and Remedial Response. March 25.

United States Environmental Protection Agency (USEPA). 1997. *Exposure Factors Handbook.* EPA/600/P-95/002Fa. August.

2.0 SITE DESCRIPTION

This section presents a description of the Site and its operations, as well as of the surrounding general land use, topography and meteorological conditions. The information summarized in this section provides background information or is used directly in evaluations described in later sections.

2.1 Overview of Site

Romic is a hazardous waste management services company. Their TSD Facility in Chandler, Arizona is located at 6760 West Allison Road. Figure 2.1 is a map depicting the location of the Facility.

The Facility is a full-service commercial hazardous waste treatment and storage facility that is primarily engaged in resource recovery. The Facility anticipates accepting a range of hazardous and certain non-hazardous wastes. The Facility’s current plant layout is depicted in Figure 2.3.

Trucks enter via the west entrance from Allison Road and exit via the east driveway onto Allison Road. Drums and other containers are stored in Drum Storage Building #1 (north end of Site) and Drum Storage Building #2 (east end of Site). Drum Storage Building #2 is currently used only to store non-hazardous wastes and non-waste materials; Romic has applied for authority to store hazardous wastes in this area. On the southwest corner of the Site is the laboratory where samples of incoming waste are verified. North of the laboratory is the distillation column, thin film evaporator and the vacuum pot. These are housed in an open sided roofed structure. The Facility’s emissions control unit is located adjacent to this structure. North of these units are Tank Farms A and B. Across the driveway to the west are located Tank Farms C and D. South of Tank Farms C and D are the east and west bay processing areas which include paint draining, aerosol depressurizing, and drum emptying. Consolidation of small quantity wastes is also conducted here. South of the east and west bay processing areas are nonhazardous waste and product tanks, and the locker room/lunch room buildings. East of Tank Farms C and D are Tank Farms E and F. South of Tank Farms E and F are Tank Farm G and Drum Storage Building #2.

The majority of the Facility is paved. Storm water that falls within each containment area in the active portion of the Site flows to the blind sump within that area. While the sumps are not separately lined, all of the containment areas are underlain with a 30 mil geoliner. The sumps in the containment areas are monolithic poured concrete constructions integral to the concrete pads that contain them. The storm water is collected from these sumps, pumped into rainwater storage tanks, and tested prior to discharge to the road.

Industrial wastewater is discharged under permit No. 24 to the City of Chandler. The Site is subject to categorical pretreatment standards as a Centralized Waste Treatment facility, but does not discharge process wastewater into the city sewer system at this time.

2.2 Facility Operations and Anticipated Emissions

Industrial wastes are currently shipped to the Facility for recycling and treatment from various industries, including:

- Dry cleaning
- Printing
- Electronics
- Aerospace
- Paint
- Automotive

In addition, the Facility receives household hazardous waste (e.g., motor oil, paints, cleaners, etc.) from household waste collection events.

The Facility can receive, store and process wastes in either bulk loads (e.g., tanker trucks, roll-off boxes, etc.) or containers (e.g., 55-gallon drums, totes, etc.). All containers manifested to the Facility are inspected and assigned a unique tracking number, which is marked on the container using a bar code label. The containers may be stored within a designated storage area prior to transfer to the assigned process area. The storage areas are equipped with secondary containment and designed so that incompatible wastes (e.g., strong acids and strong bases) are segregated. The Facility reclaims, recycles, treats, and stores hazardous waste using the following process options:

- Solvent Recycling
- Ethylene Glycol Recycling
- Fuel Blending
- Wastewater Treatment
- Neutralization
- Solids Consolidation
- Repackaging
- Off-Site Transfer

Romic does <u>not</u> accept the following types of hazardous waste for treatment or processing:

- Radioactive wastes
- Explosives
- Polychlorinated biphenyls (PCBs) with concentrations in excess of 50 parts per million (ppm)
- Etiological wastes
- Pathogenic wastes

Potential sources of emissions associated with normal operations at the Facility can be divided into four main categories:

1. stack/exhaust point emissions,
2. storage emissions from tanks,
3. fugitive (not caught by a capture system) emissions related to transfer and storage operations, and
4. fugitive emissions from miscellaneous operations.

Each of these categories is discussed in further detail in Section 5.0 of this HRA.

2.3 Local Land Use

Land use surrounding the Site, and potential off-site receptors, were identified in the Off-Site Receptor Technical Memorandum (ENVIRON 2005a). As discussed in Section 6.0, modeling receptors points were located for evaluation of these identified off-site receptors.

The Site is located in the Lone Butte Industrial Park in the Gila River Indian Community, in Maricopa County, Arizona. The industrial park, which is zoned for industrial and commercial land use, is at the north end of the reservation, and is located at approximately the intersection of Interstate Highway 10 and the Loop Highway 202.

Figure 2.3 depicts the layout and occupants of the industrial park. Adjacent to the Facility is Lumber Products, a manufacturer of wood products for the building industry. South of the Facility is a warehouse for a modular closets manufacturer, Classy Closets. Next to this is Stericycle; a medical waste autoclave operation. Southwest of the Facility is a tool manufacturing plant for Ryobi. The Lone Butte (Gila River Indian Community) Casino is approximately one kilometer west of the Facility.

The Gila River Indian Community has a population of approximately 14,000[2]. The nearest residences on the reservation are approximately two kilometers to the east of the Site. For the identification of residential areas on tribal lands, information from the Office of Land Use Planning for the Gila River Indian Community was relied upon.

The nearest residences off the reservation are in the City of Chandler, approximately two kilometers north of the Facility. Residential areas were identified from current aerial photographs of the region and street maps. The residential areas in the vicinity of the Facility are shown on Figure 2.4.

Sensitive receptors are those populations who may be more sensitive to chemical emissions than the general population. These receptors would include children (such as in daycares and schools), the elderly (such as in care facilities), and the sick (such as in health care facilities). The closest sensitive receptors off-reservation (including daycares, schools, hospitals, and other care facilities) were identified from databases that contain publicly available information regarding licensed social services, such as daycares, medical facilities, and elder health care facilities. These databases are available from the State of Arizona Department of Health Services[3]. The facilities included in these databases are:

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[2] Inter Tribal Council of Arizona, Inc. http://www.itcaonline.com/tribes_gila.html

[3] Arizona Department of Health Services: Division of Licensing Services:

- Assisted living facilities,
- Behavior health facilities,
- Child care facilities,
- Group homes,
- Long term care facilities, and
- Medical facilities.

Sensitive receptors located within the zip codes surrounding the Site were identified, and their location relative to the Site was determined based on address. The closest on-reservation sensitive receptors were identified from information provided by the Gila River Indian Community[4].

The Maricopa County School District website[5] was also reviewed. It was determined that the school districts closest to the Site are: the Tempe Union High School District (#213), the Chandler Unified School District (#80) and the Kyrene Elementary School District (#28).

Figure 2.5 depicts those sensitive receptors within five kilometers of the Site. Table 2.1 lists the sensitive receptors shown in the figure.

2.4 Topography

Based on a review of the United States Geological Survey (USGS) topographic map for the Guadalupe Arizona quadrangle, ground elevation at the Site is approximately 1,150 feet above mean sea level. The surrounding topography is relatively flat, with a slight downward slope to the southwest. There are no on-Site surface water bodies. The nearest surface water bodies are the Gila River, located approximately 10 miles to the south, and the Salt River, located approximately 10 miles to the north.

2.5 Geological and Hydrological Conditions

The Site is located in the Phoenix Sub-basin in the Sonoran Desert section of the Basin and Range province, which is characterized by alternating mountain ranges and broad sediment-filled valleys, most of which were formed by block faulting during the last part of the Cenozoic Era. The sediments, derived from the surrounding mountains, may be thousands of feet thick, thinning near the mountains. Based on a geologic map of Arizona prepared by Steve Reynolds (1988), surficial deposits at the Site are alluvium in present day valleys and piedmonts, eolian deposits, and local glacial deposits (Holocene to middle Pleistocene in age).

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http://www.azdhs/gov/als/databases/index.htm

[4] Information received from Mr. Larry Stevenson. Director of Land Use Planning for the Gila River Indian Community. May 24, 2005.

[5] Maricopa County School Districts. http://www.maricopa.gov/schools/Pdf/district_map.pdf

The Gila River Indian Community (GRIC) Department of Environmental Quality (DEQ), through ATC Associates, Inc., has been conducting a groundwater monitoring program in the vicinity of the Site. This investigation was summarized in the Phase I Remedial Investigation Report (ATC Associates Inc. 2004). The initial monitoring started in 2002, when a monitoring well was installed approximately one mile west of intersection 1-10 and Wild Horse Road (over a mile southwest of the Facility). The purpose of this well, which was screened from 70 to 100 feet below ground surface (bgs) was to monitor ambient background water quality in the subsurface beneath the Gila Floodway (ATC Associates Inc. 2004).

The investigation expanded when trichloroethene (TCE) was discovered in the groundwater at concentrations ranging from 8.4 to 25 micrograms per liter (µg/L). This is compared to the USEPA maximum contaminant level (MCL) for TCE in drinking water of 5 µg/L. Two additional monitoring wells were installed each in 2002 (LB-1 and LB02) and 2004 (LB-3 and LB-4) and the chemical list for analysis was expanded to include additional volatile organic compounds (VOCs) (benzene, 1,1-dichloroethene [1,1-DCE], tetrachloroethene [PCE] and TCE), and 1,4-dioxane and perchlorate.

Based on the Phase I Report (ATC Associates Inc. 2004), the maximum TCE concentration in groundwater has been detected in LB-2 (98 µg/L in 2004). The well closest to the Romic Facility is LB-4 (about 500 feet southwest of the Facility). In 2004, chemicals detected in this well included TCE (78 µg/L), 1,1-dichloroethene (1,1-DCE at 33 µg/L), and tetrachloroethene (PCE at 66 µg/L). The source of VOCs is unknown, but is thought to be due to multiple sources. According to the Phase I Report (ATC Associates Inc. 2004); the likely source of perchlorate is the former Aerodyne facility and the Pacific Scientific Energy Materials Company.

At the request of USEPA, the VOCs detected in LB-4 have been evaluated in this HRA for potential vapor migration from groundwater through soil and into an on-Site building. According to the Phase I Report (ATC Associates Inc. 2004); there are no other potentially complete exposure pathways at this time. Drinking water in the area has been evaluated for these VOCs, which were not detected above detection limits. As groundwater is the only possible source of exposure, DEQ concluded that no ecological receptors were impacted.

To assess the potential for vapor migration from groundwater into ambient or indoor air on the Site, the USEPA version of the Johnson and Ettinger model was used with well specific soil properties and depth to groundwater. It was assumed that the concentrations present in LB-4 are present under the Site. Using the proposed USEPA cancer slope factor for TCE (a range of 0.02 to 0.4 $[\text{mg/kg-day}]^{-1}$), the estimated excess lifetime cancer risk for an on-site worker would range from 1×10^{-6} to 1×10^{-8}. As this is a conservative evaluation and the risks are well within the USEPA acceptable risk range, this is not considered a significant exposure pathway at the Site.

There are two main surface water features to the north of the Site: the Gila River Drain and a low-lying retention basin. According to Romic, the retention basin is owned by the Arizona Department of Transportation as a potential recharge basin. The embankments of both the Gila River Drain and the low-lying retention basin are higher in elevation than the Site. As there is no known perched groundwater in the DEQ study area, and the groundwater flow is from the west to southwest, there would be no impact from groundwater beneath the Facility on these water sources.

2.6 Meteorological Conditions

The Site is located in an arid region considered low desert. The annual average temperatures range from the high 30s ^{o}F to well over 100 ^{o}F. The average rainfall in the City of Chandler region is approximately 7.6 inches per year[6]. The rainy season is typically January through March, and during the monsoon season, typically from early July through mid-September. The wind in the region generally varies between three and five miles per hour. The predominant winds are from the easterly direction.

2.7 References

ATC Associates Inc. 2004. Phase I Remedial Investigation Report, prepared for the Gila River Indian Community Department of Environmental Quality, Water Quality Program. September 30.

ENVIRON International Corporation (ENVIRON). 2005a. *Technical Memorandum – Identification of Off-Site Receptors, Romic Environmental Technologies Corporation (Southwest). June 3.*

Reynolds, S.J. 1988. Geologic Map of Arizona. Arizona Geological Survey Map 26, scale 1:1,000,000.

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[6] Weatherbase: Historical Weather http://www.weatherbase.com/weather/weather.php3?s=687227&refer=

3.0 HAZARD IDENTIFICATION

The first part of this section identifies the chemicals included in the quantitative risk assessment. This methodology for selecting chemicals was described in the Chemical Selection Technical Memorandum (ENVIRON 2005). This same memorandum, incorporating comments received from USEPA, is included as Appendix A to this HRA. The second part of this section identifies the toxicity values for the chemicals to be evaluated and describes and discusses the basis of the selected toxicity values.

3.1 Identification of Chemicals from Operation Emissions

As discussed in Appendix A, to select the chemicals of potential concern (COPCs), chemical constituents of process streams (i.e., distillation recycling wastes and blending operations) were identified from a database maintained by Romic. This database contains information regarding the wastestreams accepted at the Site and the chemical composition of those wastestreams, based on waste manifests for the materials. The period of time selected as representative of current and future throughput was January 2004 through December 2004. A list of constituents (including compound groups and mixtures) was produced from this database.

The master list of chemicals was screened to identify the COPCs to be quantitatively evaluated in this HRA. In the first step, materials that were duplicates or obviously solids (and hence would result in insignificant vapor emissions) were removed from the list. Materials removed included soil, metals, sludge, salts, wipes, fabric and filters. Remaining compounds that were non-specific chemicals were grouped together under one compound "class" where appropriate.

In the second step, the following was determined:

- Chemicals listed on the Arizona Department of Environmental Quality (ADEQ) list of chemicals and chemical compounds for which the ADEQ has developed ambient air quality guidelines (AAQGS).[7]
- Chemicals that contributed greater than 0.1 percent to the wastestream.

All chemicals with either an AAQGS or a contribution of greater then 0.1 percent were selected as COPC. In the Chemical Selection Technical Memorandum (ENVIRON 2005), chemicals were also deleted from the COPC list based on vapor pressure. After discussions with USEPA, the 13 chemicals deleted based on vapor pressure were included as COPCs for this HRA. A total of 95 COPCs were identified. The COPCs are summarized on Table 3.1.

3.2 Toxicity Assessment

The purpose of the toxicity assessment is to present the weight-of-evidence regarding the potential for a chemical to cause adverse effects in exposed individuals, and to quantitatively characterize, where possible, the relationship between exposure to a chemical and the increased

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[7] http://www.azdeq.gov/environ/air/permits/download/ambient.pdf

likelihood and/or severity of adverse effects (dose-response assessment). Well conducted epidemiological studies that show a positive association between exposure to a chemical and health effects are the most convincing evidence for predicting potential hazards for humans. However, human data that would be adequate to serve as the basis for the dose-response assessment are available for only a few chemicals. In most cases, toxicity assessments for a chemical has to rely on information derived from experiments conducted on non-human mammals, such as the rat, mouse, rabbit, guinea pig, hamster, dog, or monkey.

When the dose-response assessment is based on animal studies, it usually requires two types of extrapolation: high-to-low dose extrapolation and interspecies extrapolation. High-to-low dose extrapolation involves predicting the incidence rate of an adverse effect at low exposure levels based on results obtained at high exposure levels. Interspecies extrapolation involves predicting the likelihood of an adverse effect in humans based on results obtained from animal studies. In the absence of evidence to the contrary, it is assumed that adverse effects observed in animals would also occur in humans.

The remainder of this section discusses chronic toxicity values, acute toxicity values, and occupational standards.

3.2.1 Chronic Toxicity

Chemicals are usually evaluated for their potential chronic health effects in two categories, carcinogenic and noncarcinogenic. Different methods are used to estimate the potential for carcinogenic and noncarcinogenic health effects to occur. Chemicals that produce noncarcinogenic effects may or may not also be associated with carcinogenic effects. USEPA considers carcinogens to pose a risk for cancer at all exposure levels (i.e., a "no-threshold" assumption); that is, any increase in dose is associated with an increase in the probability of developing cancer. In contrast, noncarcinogens generally are thought to produce adverse health effects only when some minimum exposure level is reached (i.e., a threshold dose).

The following sources, listed in order of preference, were used to obtain the cancer and chronic noncancer toxicity values for this assessment:

- USEPA's Integrated Risk Information System (IRIS) (USEPA 2005a). IRIS is an on-line database that contains USEPA-approved oral and inhalation toxicity values.

- USEPA's Provisional Peer Reviewed Toxicity Values (PPRTVs). PPRTVs are interim toxicity values developed by the Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center.

- The California Environmental Protection Agency (Cal/EPA) Office of Environmental Health Hazard Assessment (OEHHA) Toxicity Criteria Database (Cal/EPA 2005). The Toxicity Criteria Database is an online database that contains Cal/EPA-approved oral and inhalation toxicity values.

- USEPA's *Health Effects Assessment Summary Tables* (HEAST) (USEPA 1997). HEAST provides an older listing of provisional toxicity values.

The above hierarchy is consistent with the hierarchy specified in USEPA guidelines (USEPA 2003).

The following sections describe the methods used for the chronic toxicity assessment of carcinogens and noncarcinogens, respectively.

3.2.1.1 Carcinogenic Effects

As stated above, current risk assessment practice for carcinogens is based on the assumptions that there is no threshold dose for carcinogenic effects. This "no-threshold" assumption for carcinogenic effects is based on a current hypothesized mechanism about the carcinogenic processes and has generally been adopted by regulatory agencies as a conservative practice to protect public health. In the absence of compelling scientific evidence to the contrary, the "no-threshold" assumption is used in this risk assessment for evaluating carcinogenic effects. Although the magnitude of the risk declines with decreasing exposure, the risk is believed to be zero only at zero exposure.

There are two components to the evaluation of the carcinogenic effects of a chemical: a qualitative determination of the likelihood of it being a human carcinogen (weight-of-evidence), and a quantitative assessment of the relationship between exposure dose and response (i.e., cancer slope factor [CSF]). Using the weight-of-evidence approach, the USEPA's Carcinogen Assessment Group (CAG) categorizes chemicals into Groups A, B, C, D, and E carcinogens (USEPA 1989). CAG's classification of carcinogens is briefly described below:

- **Group A -- Human Carcinogen**

  This category indicates that there is sufficient evidence available from human epidemiological studies to support a causal association between exposure to the chemical and the development of human cancer.

- **Group B-- Probable Human Carcinogen**

  The category indicates that sufficient evidence exists from animal studies to support a causal relationship between exposure to the chemical and the development of cancer in animals. This category is divided into subgroups B1 and B2. Group B1 chemicals also have limited evidence for carcinogenicity from human epidemiological studies. Group B2 chemicals have inadequate or no evidence from epidemiological studies.

- **Group C -- Possible Human Carcinogen**

  This category is for chemicals that exhibit limited evidence of carcinogenicity in animals.

- **Group D -- Not Classifiable as to Human Carcinogenicity**

  This category is used for chemicals with inadequate human and animal evidence of carcinogenicity.

- **Group E -- Evidence of Noncarcinogenicity for Humans**

  This category is used for chemicals that show no evidence of carcinogenicity in at least two adequate animal tests in different species or in both adequate epidemiological and animal studies.

As described earlier, CSFs are used to quantify the response potency of a potential carcinogen. CSFs are typically calculated for carcinogens in group A, B1, and B2. The USEPA decides to derive CSFs for Group C chemicals on a case-by-case basis.

CSFs may be based on either human epidemiological or animal data and are calculated by applying a mathematical model to extrapolate from responses observed at relatively high exposure doses in the studies to responses expected at lower doses of human exposure to environmental contaminants. A number of mathematical models and procedures have been developed for the extrapolation. In the absence of adequate data to the contrary, the linearized multistage model is employed (USEPA 1989).

In general, the CSF is a plausible upper-bound estimate of the probability of a response per unit intake of a chemical, e.g., $(mg/kg/day)^{-1}$, over a lifetime. The CSF is used in risk assessments to estimate an upper-bound lifetime probability of an individual developing cancer, as a result of exposure to a particular level of a potential carcinogen. The true value of the risk is unknown, and may be as low as zero.

Table 3.2 presents the inhalation CSFs to be used in this HRA. Where available, the table presents the weight-of-evidence of carcinogen classification (developed by USEPA).

3.2.1.2 Noncarcinogenic Effects

The dose-response assessment for noncarcinogenic effects requires the derivation of an exposure level below which no adverse health effects in humans are expected to occur. USEPA refers to these levels as reference doses (RfDs) for oral exposure and reference concentrations (RfCs) for inhalation exposure

(USEPA 1989). RfDs and RfCs are calculated by dividing a quantitative toxicity index, derived from human or animal studies, by an appropriate safety or uncertainty factor. The quantitative toxicity indices that may be used for the derivation of RfDs or RfCs include the No-Observed-Effect-Level (NOEL), the No-Observed-Adverse-Effect-Level (NOAEL), Lowest-Observed-Effect-Level (LOEL), and the Lowest-Observed-Adverse-Effect Level (LOAEL) (USEPA 1989).

The basis for the application of different safety or uncertainty factors is outlined in the *Risk Assessment Guidance for Superfund* (USEPA 1989) and is briefly discussed here. A 10-fold factor (i.e., dividing the value by 10) is used to account for variation in sensitivity in the general human population. A 10-fold factor is used when extrapolating data from animal studies to human exposure to account for interspecies variation. A 10-fold factor is used when a toxicity index (e.g., NOAEL) derived from a subchronic (e.g., three months) rather than a chronic (lifetime) study is used as the basis for deriving a chronic RfD. A 10-fold factor is used when a LOAEL is used instead of a NOAEL. An additional uncertainty factor (also called a modifying factor) of between one and 10 may be used depending on the quality of the data and severity of the toxic effects. The default value for the modifying factor is one (1) (USEPA 1989).

The chronic inhalation RfC’s for chemicals evaluated in this HRA are shown in Table 3.2.

For certain chemicals, noncancer reference doses were not available. When possible, surrogate toxicity values were selected for these chemicals by using the toxicity criteria associated with a compound having a similar chemical structure. Based on the structural similarities, is assumed that the pharmacokinetics of the two chemicals will be similar and thus, the toxicity criteria of the surrogate compound can be used to provide a realistic estimate of the potential for adverse health effects for similar compounds lacking toxicity criteria. Surrogate chemicals are footnoted in Table 3.2.

Petroleum mixtures considered in this evaluation include: total petroleum hydrocarbons (TPH)-gasoline, naphtha, TPH-mineral spirits (Stoddard solvent), TPH-jet fuel (same as TPH-kerosene), paraffinic hydrocarbons, and TPH-diesel. No chronic toxicity criteria are available for these petroleum mixtures in the sources listed above. In the absence of published toxicity factors for these hydrocarbon mixtures, ENVIRON developed toxicity factors using an indicator/surrogate approach as recommended by the Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG 1997).

The TPHCWG approach is the product of a collaborative effort between industry, government, and academia and reflects the most current theories on evaluating complex mixtures. The basis for the TPHCWG methodology is the examination of a mixture as the product of several smaller subsets, which are defined by specific carbon ranges and are referred to as fractions. Within each fraction, toxicity surrogates are conservatively selected to be representative of the entire petroleum mixture in that range. One RfD is representative of the aliphatics (i.e., alkanes, alkenes, alkynes, and cycloalkanes) and one RfD is representative of the aromatics (i.e., polynuclear aromatics, diaromatics, and monoaromatics). This is based upon the TPHCWG assumption that within a given carbon range and structural class (i.e., aliphatic or aromatic), individual chemical components have similar toxic effects.

Toxicity values derived using the TPHCWG approach were obtained from the Oregon Department of Environmental Quality (ODEQ) Risk-Based Decision Making for Remediation of Petroleum-Contaminated Sites (ODEQ 2003). The RfDs derived for the petroleum mixtures in this evaluation are presented in Table 3.3.

3.2.2 Acute Toxicity

Acute health effects were also considered in this HRA. For acute toxicity values, the following sources were reviewed:

- U.S. Occupational Safety and Health Administration (OSHA) Permissible Exposure Levels (PELs) (29 CFR § 1910.1000)
- American Conference of Governmental Industrial Hygienists Threshold Limit Values (TLVs) (ACGIH 2005)
- California Acute Reference Exposure Levels (RELs) (Cal/EPA 2000)
- Texas Commission on Environmental Quality Effects Screening Levels (TCEQ 2003)
- National Advisory Council Acute Exposure Guideline Levels (AEGLs) (USEPA 2005b)
- U.S. Department of Energy Emergency Response Planning Guidelines (ERPGs) and Temporary Emergency Exposure Limits (TEELs) (United States Department of Energy [USDOE] 2005)
- Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRLs) (ATSDR 2004)

The acute toxicity values are summarized in Table 3.4.

For this risk assessment, acute health effects were evaluated for a maximum one-hour average concentration. This is a conservative assumption as the maximum one-hour average concentration will always be equal to or greater than a concentration for an averaging time greater than one hour. This is because concentrations not as large as the maximum one-hour concentration would be averaged in the concentration estimation.

3.2.3 Occupational Standards

In order to assess the on-Site worker, measured concentrations of airborne chemicals at the Site were compared with the PELs derived by the federal OSHA. PELs may be either a time-weighted-average (TWA) exposure limit (8 hour), a 15-minute short term exposure limit (STEL), or a ceiling. The PELs are listed in the Code of Federal Regulations (CFR), Title 29, Department of Labor, Part 1910, Occupational Safety and Health Standards, Subpart Z, Toxic and Hazardous Substances, Section 1910.1000, Air Contaminants. Table Z-1, Limits for Air Contaminants.[8] Table 3.5 presents the PELs for the chemicals evaluated in this HRA.

Romic's worker health & safety protection program includes employee training, management involvement, hazard identification and mitigation, process and procedure design to avoid exposure, and protective equipment. Employees are given extensive training in the properties and hazards of the materials they handle. All employees are trained in accordance with 29 CFR 1910.120, OSHA's hazardous waste operations and emergency response standard. They are trained in the use of and provided appropriate personal protective equipment such as gloves, clothing, and hearing and eye protection. The facility supplies uniforms to its employees through a uniform service; employees are not to take soiled uniforms home for laundering. The facility also has locker room and shower facilities.

Though Romic's employee exposure monitoring program has demonstrated that employees are not exposed to air contaminants above PELs, the facility has implemented an internal standard such that employees are required to wear air-purifying respirators, at a minimum, when performing any activity that could involve the handling of uncontained wastes. Such activities include pumping waste from drums, cleaning out of equipment, and sampling of waste-bearing containers or vehicles. This standard provides an additional level of protection beyond that required under regulation.

3.3 References

Agency for Toxic Substances and Disease Registry (ATSDR). 2005. *Minimal Risk Levels (MRLs) for Hazardous Substances.* Atlanta, GA. Available at: http://www.atsdr.cdc.gov/mrls.html

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California Environmental Protection Agency (Cal/EPA). 2005. *California Toxicity Criteria Database.* Office of Environmental Health Hazard Assessment. April.

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[8] http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992.

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Code of Federal Regulations (CFR). 2005. Title 29, *Department of Labor*. Part 1910, *Occupational Safety and Health Standards*. Subpart Z, *Toxic and Hazardous Substances*. Section 1910.1000, *Air Contaminants*. Table Z-1, *Limits for Air Contaminants*. (29 CFR § 1910.1000) Available at: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992

ENVIRON International Corporation (ENVIRON). 2005. *Technical Memorandum - Selection of Chemicals of Potential Concern, Romic Environmental Technologies Corporation (Southwest). July 20.*

Oregon Department of Environmental Quality (ODEQ). 2003. Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites. Land Quality Division. September 2002

Texas Commission on Environmental Quality (TCEQ). 2003. *Effects Screening Levels List.* Available at: http://www.tceq.state.tx.us/implementation/tox/esl/list_main.html#esl_1

Total Petroleum Hydrocarbon Criteria Working Group Series (TPHCWGS). 1997. Volume 4, *Development of Fraction Specific Reference Doses (RfDs) and Reference Concentrations (RfCs) for Total Petroleum Hydrocarbons (TPH).* Amherst Scientific Publishers. Amherst, Massachusetts.

United States Department of Energy (USDOE). 2005. Environment, Safety and Health. *ERPGs and TEELs*. Available at: http://www.eh.doe.gov/chem_safety/teel/TEELs_Rev20_Table3.pdf

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United States Environmental Protection Agency (USEPA). 1997. *Health Effects Assessment Summary Tables (HEAST). FY 1997 Update*. Office of Research and Development. EPA 540-R-97-36. July.

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United States Environmental Protection Agency (USEPA). 2005a. *Integrated Risk Information System (IRIS).* Online database maintained by the USEPA. http://www.epa.gov/iriswebp/iris/index.html. Cincinnati, OH. April.

United States Environmental Protection Agency (USEPA). 2005b. *Acute Exposure Guideline Levels (AEGLs).* Online database maintained by the USEPA. July. Available at: http://www.epa.gov/oppt/aegl/chemlist.htm

4.0 IDENTIFICATION OF POTENTIAL HUMAN EXPOSURE PATHWAYS AND EXPOSED POPULATIONS

The purpose of this section is to identify the populations who may be exposed to chemical emissions from the Site and to identify the pathways by which these populations may be exposed. In accordance with USEPA guidance (USEPA 1989), a Conceptual Site Model (CSM) has been prepared for the Site. The CSM is used to show the relationships between potential chemical sources, exposure pathways, exposure routes, and receptors. The CSM for this Site, which is shown in Figure 4.1, is discussed further below.

4.1 Potentially Exposed Populations

The Site is currently used as a TSD Facility. Under the Part B permit, the Site would continue to operate in this capacity. Therefore, potential current and future on-Site receptors would include on-Site workers and visitors. On-Site workers are expected to be on the Site with greater frequency and duration than visitors. Therefore, only the on-Site worker is quantitatively evaluated in this HRA. Any health risks to visitors would be lower than those estimated for on-Site workers.

As discussed in Section 2.0, the area immediately surrounding the Site is zoned for industrial operations. Beyond the industrial park, to the east and south is Gila River Indian reservation land, largely undeveloped and uninhabited. North of the Site is the Loop 202 Highway, north of which is the City of Chandler. This area is mixed residential and commercial land uses.

Based on the land use surrounding the Site, this HRA evaluated off-Site workers, off-Site residents, and sensitive receptors within the vicinity of the Site. Potential risks to off-Site workers have been estimated for any point off-Site, including along a railway spur that cut through the Facility. Off-Site residents and sensitive receptors have been estimated at actual receptor locations. This HRA analyzes the potential impact of emissions from the Site from both current operations and additional units proposed in the Part B Permit Application.

4.2 Relevant Exposure Pathways

An exposure pathway is defined as "the course a chemical or physical agent takes from the source to the exposed individual" (USEPA 1989). A complete exposure pathway consists of four elements:

- A source of chemical release,
- An environmental transport medium (e.g., air) for the release chemicals,
- An exposure point (a point of human contact), and
- An exposure route (e.g., inhalation) at the exposure or contact point.

An exposure pathway is considered complete only if all of these elements are present.

The potential sources of chemical releases from the Site were discussed in Section 3.0. These sources include volatile emissions from recycling and fuel blending operations, storage and sampling operations, and ancillary operations. Because no dust-generating operations occur at the Site, only volatile emissions are evaluated in this HRA.

The potential transport medium would be the ambient air. For on-Site workers, this is best estimated from personnel air monitoring results obtained on an ongoing basis for compliance with worker health and safety regulations. For off-Site populations, chemical concentrations in air have been estimated using agency-approved emission and dispersion modeling techniques. The determination of off-Site concentrations due to routine air emissions from the Facility is described in further detail in Section 5.0.

For off-Site workers and off-Site residents, the point of exposure is assumed to be the actual receptor location. In order to evaluate potential receptor points surrounding the Site, both gridded and discrete points have been modeled. In addition discrete receptor points have been added to include the Facility boundary, nearby residences, and the location of sensitive receptors (i.e., schools, daycare centers, health care facilities, and senior homes).

Since emissions include only volatile chemicals, the only relevant exposure route would be inhalation. Because deposition of volatile chemicals will be insignificant, direct contact pathways (such as dermal contact and soil ingestion) and indirect contact pathways (ingestion of contaminated vegetables/meats/fish and mother's milk) are not quantitatively evaluated in this HRA. All of the potentially exposed populations, pathways, and routes quantitatively evaluated in the risk assessment are summarized in Figure 4.1.

4.3 Estimation of Intake

The USEPA (1989) defines exposure as "the contact with a chemical or physical agent" and defines the magnitude of exposure as "the amount of an agent available at human exchange boundaries (i.e., lungs, gut, skin) during a specified time." Exposure assessments are designed to determine the degree of contact a person has with a chemical. Thus, estimating human exposure to a chemical requires information regarding the concentration of chemical with which a person will come into contact and the extent of the contact. The methods for estimating chemical concentrations in air are discussed in Section 5.0. This section presents the equations used to estimate inhalation pathway chemical exposures (or intakes). The estimates of intakes will be combined with toxicity values (Section 3.0) to estimate potential human risks (Section 7.0).

The chemical intake equation includes variables that characterize the exposure concentration, contact rate, exposure time, exposure frequency, exposure duration, body weight, and exposure averaging time. The result of the intake calculation is an estimation of the mass of the chemical absorbed by the body per unit body weight per unit time (e.g., milligram per kilogram per day or mg/kg/day). The inhalation intake or exposure is dependent on the exposure concentration and the contact rate and can be calculated using the following equation (USEPA 1989):

$$I = \frac{C \times CR \times ET \times EF \times ED}{BW \times AT}$$

Where:

I	=	Intake of a chemical (mg chemical/kg body weight-day)
C	=	Chemical concentration (mg chemical/cubic meter [m^3] air)
CR	=	Contact Rate; the amount of medium contacted per unit time (m^3 air/hour)
ET	=	Exposure Time (hours/day)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (years)
BW	=	Body Weight (kg)
AT	=	Averaging Time; period over which exposure is averaged (days)

Parameters used to estimate intakes for the potential populations of concern are discussed below.

4.4 Exposure Assumptions for Relevant Receptors and Pathways

The parameters used in the intake equation can be separated into four categories:

- Estimated representative exposure concentrations,
- Assumptions regarding human physiology (e.g., body weight),
- Assumptions specific to the exposed populations (e.g., years in which an individual resides or works in the same location), and
- Assumptions specific to the exposure route (e.g., the amount of air breathed per day).

The estimation of representative exposure concentrations is presented in Section 5.0. The following sections present the assumptions for physiological parameters, population-specific parameters, and route-specific parameters used to estimate exposure to chemicals potentially emitted from the Site.

For this risk assessment, exposure assumptions corresponding to both an average exposed individual (AEI) and a reasonable maximum exposure (RME) scenario were developed. Intake assumptions for the average exposure scenario are selected to represent the central tendency of exposure while the intake assumptions for the RME scenario represent “the highest exposure that is reasonably expected to occur at a site” (USEPA 1989).

According to the USEPA, the intent of the RME scenario is “to estimate a conservative exposure case (i.e., well above the average case) that is still within the range of possible exposures” (USEPA 1989). The RME is estimated by combining “upper-bound and mid-range exposure factors so that the result represents an exposure scenario that is both protective and reasonable; not the worst possible case” (USEPA 1991). Where available and appropriate, exposure parameter values recommended by the USEPA (USEPA 1989, 1991, 1997, 2004) were used. For some exposure parameters, the USEPA do not have recommended values or the default recommendations are not appropriate for the populations being evaluated. In such cases, best professional judgment was used to select parameter values corresponding to the individual pathways.

Tables 4.1 and 4.2 summarize the parameter values used in the intake equation for each receptor population for the AEI and RME scenarios, respectively. These parameters are further discussed below.

4.4.1 Human Physiology Assumptions

For estimating exposures to the potentially exposed off-Site adult worker and resident, the physiological assumptions for a male adult have been used as recommended by USEPA (1991). The physiological assumptions used in this HRA include an adult body weight of 70 (kg) for both adult off-Site populations.

For the adult worker, the RME breathing rate is 20 m^3 for an 8-hour workday or 2.5 m^3/hour (USEPA 1991) and the AEI breathing rate is 12 m^3/day or 1.5 m^3/hour (USEPA 1997). For adult residents, the RME breathing rate is 20 m^3/day or 0.83 m^3/hour (USEPA 1989, 1991) and the AEI breathing rate is 15.2 m^3/day or 0.63 m^3/hour (USEPA 1997).

For the child resident, physiological assumptions for the average child from infancy to six years (i.e., 0-6 years) have been used. The child is assumed to have a body weight of 15 kg (USEPA 1991). For the child resident, the RME breathing rate is 10 m^3/day, or 0.42 m^3/hour (USEPA 2004). For the child resident, the assumed AEI breathing rate is 7.2 m^3/day or 0.3 m^3/hour. This breathing rate is based on the age-weighted average for children from 0-6 years (USEPA 1997).

4.4.2 Population-Specific Assumptions

Assumptions regarding population-specific exposure time, exposure frequency, exposure duration, and exposure averaging time are used to estimate the chemical intakes for potentially exposed populations. The exposure time, frequency and duration determine the total time of exposure for each potentially exposed population. Exposure time assumptions have been determined for each of the populations as discussed below. Standard default assumptions recommended by the USEPA (1989, 1991) regarding exposure frequency and duration are used in this risk assessment when applicable.

For both the RME and AEI off-Site worker, it is assumed that exposure occurs for 8 hours/day, 250 days/year (USEPA 1991). The duration of exposure is assumed to be 25 years for the RME off-Site worker (USEPA 1991) and 6.6 years for the AEI worker (USEPA 1997).

For the RME and AEI off-Site residents, it is assumed that exposure occurs for 24 hours/day (USEPA 1991). Consistent with USEPA (1991) guidance, an exposure frequency of 350 days per year is assumed for both the adult and child residents for the RME and AEI scenario. This assumes that residents are present in their home seven days a week for 50 weeks a year (or approximately 96% of the time). Approximately two weeks (or 15 days) are spent away from home on vacation.

The exposure duration for the resident under the RME scenario is assumed to be 30 years (USEPA 1991, 1997). According to USEPA (1997), this is the 95th percentile for time spent at one residence. For the AEI scenario, a value of nine years is used. This corresponds to the 50th percentile for time spent at one residence (USEPA 1997).

The exposure averaging time for estimating chemical intake depends on the type of toxic effect being assessed. In accordance with regulatory guidance (USEPA 1989), intakes for carcinogens are calculated by averaging the dose received over a lifetime (i.e., 70 years or 25,550 days). As indicated in regulatory guidance for noncarcinogens, the averaging time for chronic long-term exposure is the period of potential exposure (USEPA 1989). The basis for the use of different averaging times for carcinogens and noncarcinogens is related to the currently held scientific opinion that the mechanisms of action for the two categories of chemicals are different.

For carcinogenic effects, an age-adjusted intake factor is calculated which takes into account the difference in route-specific intake rates, body weights, and exposure duration for children and adults. The 30-year residential exposure duration for carcinogenic effects is a composite of exposure assumptions for six years as a child and 24 years as an adult. These assumptions allow for the possibility that the 30 years one individual is assumed to live in the area may cover from the period from childhood to adulthood. Regulatory guidance recommends this age-adjusted approach (USEPA 1991). The nine-year residential exposure duration for carcinogenic effects is a composite of exposure assumptions for two years as a child and seven years as an adult.

For noncarcinogenic exposures, the RME adult resident is exposed for 24 years and the child for six years (USEPA 1991). For the AEI scenario, an adult exposure of seven years and child exposure of two years is assumed.

4.4.3 Route-Specific Assumptions

Since only volatile chemicals are emitted from the Site, inhalation is the only pathway evaluated in this risk assessment. All breathing rate assumptions are discussed in Section 4.3.1.

4.5 References

ENVIRON International Corporation (ENVIRON). 2005a. *Technical Memorandum – Identification of Off-Site Receptors, Romic Environmental Technologies Corporation (Southwest). June 3.*

United States Environmental Protection Agency (USEPA). 1989. *Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part A).* Interim Final. Office of Emergency and Remedial Response. EPA-540/1-89/002. Washington, D.C. December.

United States Environmental Protection Agency (USEPA). 1991. *Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual. Supplemental Guidance. Standard Default Exposure Factors.* Office of Emergency and Remedial Response. hMarch 25.

United States Environmental Protection Agency (USEPA). 1997. *Exposure Factors Handbook.* EPA/600/P-95/002Fa. August.

United States Environmental Protection Agency (USEPA). 2004. Region 9 Preliminary Goals (PRGs). October 20.

5.0 ESTIMATED EMISSIONS

5.1 Identification of Sources

The sources of emissions associated with normal operations at the Facility can be divided into four main categories: (1) stack/exhaust point emissions, (2) storage emissions from tanks, (3) fugitive emissions related to transfer and storage operations, and (4) fugitive emissions from miscellaneous operations. For each category, different types of information and methodologies were used to estimate emissions in this HRA. Data regarding emissions analyses or testing, material throughput (composition and quantity), and physical parameters of the sources (height of release, area of release, exhaust velocity and temperature) were requested from the Facility. The information used in the emission estimates is summarized in this section.

The operations at the Facility were identified and briefly described in the Emissions/Exposure Concentrations Technical Memorandum (ENVIRON 2005a). These sources are:

- Aerosol can crushing emissions (exhausted through the abatement systems)
- Drum emptying ("mucking") area
- Tanker truck washout area
- Rail loading area
- On-Site material transfer using tanker trucks
- Lab pack consolidation area
- Waste paint consolidation (exhausted through the abatement systems)
- Fugitive emissions from transfer point troughs
- Tank storage breathing and working losses
- Drum storage breathing losses
- Fugitive emissions from valves, pumps and flanges
- Drum sampling
- Truck sampling
- Railcar sampling
- Exhaust emissions from laboratory fume hoods
- Exhaust emissions from distillation processes
- Exhaust emissions from natural-gas fired boiler

Since that memorandum was submitted, the Facility has elected to install an enclosed and controlled waste paint consolidation/aerosol can emptying unit. This unit empties paint vessels and aerosol cans. Exhaust fumes are passed through the abatement system and carbon bed system, currently controlling emissions from the distillation units. This unit and its emissions are described more fully in Section 5.3.1. Hence, reference in earlier memoranda to aerosol can depressurization and to waste paint consolidation have been superceded by this new proposed process unit.

5.2 Composition of Emissions

The speciation of emissions (i.e., the division of total VOC emissions into emissions of the selected COPCs) is based on information regarding the nature of the material handled in each source. The methodology which was used to select the COPCs and the methodology used to develop the compositional profile for each main material stream was presented in the Chemical Selection Technical Memorandum (ENVIRON 2005b). The compositional profiles were updated as a result of comments from the USEPA. The revised profiles are provided in Appendix A. In some cases, profiles for other material streams were taken from published sources, as described below. The VOC composition for emissions from sources at the Facility can be categorized as one or more of the following:

1. Organic liquid waste stream
2. Blended fuel (product stream)
3. Wastewater stream
4. Lab pack processing
5. Refined product (lacquer thinner, Stoddard solvent)
6. Natural gas combustion

As discussed in the Chemical Selection Technical Memorandum (ENVIRON 2005b), the Facility provided information regarding the waste that is accepted throughout a year (the year 2004 was selected as the representative year). This information was in the form of an "inbound report". This report presented the total quantity of each individual chemical that was accepted at the Facility and its disposition (i.e., whether the material went to fuel blending, distillation processing, sent off-Site, etc.). Based on the planned disposition and the relative quantities of each chemical, a representative compositional profile for the organic liquid waste stream, the blended fuel product, and the wastewater stream was developed. The profile of each stream was based on the selected COPCs. As a result of comments received from the USEPA on the Emissions Estimation Technical Memorandum, several additional COPCs were added to the master list, and hence to the compositional profile for the three main mixture streams. These additional chemicals are noted in Appendix A, in which the updated compositional profiles are provided.

In reviewing the compositional data and the Facility's material handling receipts, it was found that two compounds, previously identified as COPCs, are in fact not handled in a method making them available for release to the atmosphere. Formaldehyde had been identified in the initial chemical selection process as a COPC. Further investigation into how the Facility receives and handles this chemical indicated that it is formalin (an aqueous solution of formaldehyde, typically 37% by volume) that is typically received by the Facility. It was also found that any formalin received by the Facility was typically in a closed lab pack. The Facility does not typically consolidate this material with the Facility's general wastestreams. Rather, it repacks the containers with other lab containers for off-site disposal. Hence, formaldehyde has been removed from the representative wastestreams. It was also determined that the second compound, mercury, is not included in the Facility's general wastestreams. Mercury is typically received as either part of lab pack materials, in which case it is combined with other lab materials and shipped to off-Site disposal, or it is received in salt form which is not volatile. No process at the Facility would generate mercury fumes or dust for release to the environment; hence mercury was removed from the representative wastestream compositional profiles.

5.3 Estimation of Emissions

The methodology used to estimate the emissions from the sources at the Site is described in this subsection. These methodologies were also described in the Emissions/Exposure Concentrations Technical Memorandum. Any refinements or changes in the methodology used from those proposed in the memorandum are noted and discussed.

Annual emission estimates are based on the Facility's information regarding maximum or expected maximum annual throughput for a particular source. Modeled emissions (grams per second) are based on the annual emission rate spread over 8,760 hours (total hours in a year). The modeling emission rate used for assessing the potential annual exposure for off-Site workers is three times the annual emission rate for each hour during the worker's shift. An off-Site worker would be exposed to any emissions from Romic operations for only a portion of each day, typically eight hours. There are three shifts in a day. Because operations at the Facility can occur during any part of the day but do not typically occur 24 hours per day[9], it was conservatively assumed that all operations could (but were unlikely to) occur during any one shift, hence an off-Site worker could be exposed to emissions during any one shift.

Short term (hourly) emission estimates are based on the Facility's information regarding short term (daily or hourly) maximum or expected maximum throughput for a particular source. The averaging period varies from source to source, depending on each source's typical operating schedule. The averaging time used in calculating the maximum short-term emission rate for modeling is described for each source.

5.3.1 Aerosol Can Crushing

The aerosol can crushing operation will take place in the enclosed waste paint consolidation/aerosol can crushing unit. This unit is exhausted to the Facility's abatement system/carbon bed system. This unit will take in aerosol cans, puncture the cans, and vacuum the contents into a closed receiving vessel. In the original Emissions Estimation Technical Memorandum submitted to the USEPA, it was proposed to omit this source from quantitative evaluation because its emissions were likely to be insignificant. At the request of the USEPA, a quantitative evaluation of the emissions that would result from this operation has been included in this HRA[10]. The estimation of VOC emissions from this operation to the abatement system is summarized in Table 5.1.

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[9] Tank storage, drum storage, fugitive emissions from tank/tank farm components, and troughs occur 24 hours per day; hence for modeling the exposure to off-site workers, the unadjusted average annual emission rates from these source were used. The other sources considered in this HRA were adjusted by a factor of three if they typically operated eight hours or less per day and by a factor of two if they typically operated approximately 12 hours per day to conservatively reflect the fact that these operations could occur during any shift.

[10] The controlled emissions from this operation are included in the abatement unit's total emissions since these emissions are vented to the air via the abatement system/carbon bed system.

In 2004, approximately 1,690 pounds of material was evacuated from aerosol cans[11].

The aerosol cans typically accepted at the Facility contain spray paints, household sprays, and lubricants. The Facility randomly selected four representative material safety data sheets (MSDSs) for each of the main types of aerosol cans processed (i.e., two spray paints, furniture polish, penetrating oil, and a spray degreaser). It was assumed that all aerosol material is evenly distributed among these five types of aerosol products. There may be a small quantity of other types of aerosol cans accepted, but these will vary in composition widely. The typical compositions of these representative products are summarized in Table 5.1.

Components of the material in the cans that are liquids at ambient temperatures (i.e., those materials whose vapor pressures are less than atmospheric pressure at ambient temperatures) would be captured and collected.

5.3.2 Drum "Mucking"

According to Romic, drums are occasionally received that contain material that cannot be pumped out. This material needs to be cleaned or "mucked" out of the drum before the drum can be deemed empty. The drum "mucking" operation at the facility is located in the northwest corner of the West Side Processing Area. As part of this process, the drums are typically scraped by hand. Material in the drum is typically solid or semi-solid and unlikely to aerosolize or evaporate during this process. Hence, no quantification of emissions from this source was conducted.

5.3.3 Tanker Truck Washout

Tanker trucks can be washed out at the Facility using high pressure water or steam. Wastewater is collected in a tub and pumped into a wastewater tank. Trucks must be cleaned out between loads to prevent cross-contamination. Fugitive emissions could be released from the opening on top of the truck during washing. Approximately 30 trucks per month are washed. Approximately 2/3 of the trucks held organic waste or blended fuel components. Approximately 1/3 of the trucks held low vapor pressure solvents (e.g., Stoddard solvent). VOC emissions resulting from truck washing were estimated using emission factors for tank truck cleaning, and represent the emissions from washing out tankers previously carrying different cargoes. Emission factors for different truck rinsing chemicals from Table 4.8-2 of AP-42 Section 4.8 "Tank and Drum Cleaning" (USEPA 1995a) were reviewed.

Table 5.2 summarizes the VOC emission estimates for this source. The short-term emission rate was estimated by assuming one truck washed per hour.

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[11] Please note that this value is corrected from the mass of the aerosol cans process in 2004 as noted in the raw materials table (Table 1a) of the chemical selection technical memorandum. This table contained the entire mass of this wastestream, including the can.

Table 5.3 presents the emissions of individual COPCs from this source. The VOC emissions released during the washing of a truck that held organic waste were speciated using the representative organic waste profile. The VOC emissions released during the washing of a truck that held blended fuel components were speciated using the representative blended fuel profile. The VOC emissions released during the washing of a truck that held solvent was assumed to be Stoddard solvent.

5.3.4 Rail Loading

Rail loading is performed on-Site at a spur that comes onto the Facility property. Approximately 60 railcars a year are filled on-Site. Railcars are received on-Site empty and clean. On-Site tanker trucks or “yard trucks” are used to transfer material from tanks to the railcar. During material transfer, the access hatchway at the top of the railcar is opened and a hose is fed into the railcar for submerged filling. A railcar can take up to approximately two hours to fill. Any fugitive emissions generated during material transfer would be emitted via the access hatchway.

Because this activity is similar to a tank’s working loss (emissions resulting from the displacement of vapor inside a tank during material transfer), the TANKS software was used to estimate a working loss emission rate for railcar loading/unloading, using the composition of the blended fuel composition. Water is also sometimes transported off-Site by rail; however, in order to be conservative, it was assumed that 100% of the throughput would be represented by blended fuel. Vapor displaced during filling operations will be piped to the facility’s abatement system/carbon bed system. Table 5.4 summarizes the estimated emission rates of individual COPCs from this operation. Table 5.12b presents the data that were used in the TANKS software for the estimation of the uncontrolled emission rates.

5.3.5 On-Site Tanker Trucks

An on-Site tanker truck is used to transfer material from product tanks (typically Tanks 108, 109, 137 and 138 in Tank Farm D1) to railcars. Approximately one railcar a week is filled with product in this manner. During filling of a tanker truck with material from a tank, displaced vapors are emitted via a vent on top of the tanker truck. There are three yard trucks, with a volume of up to 5,000 gallons. In order to be conservative, it was assumed that this throughput is entirely blended fuel.

Because this activity is similar to a tank’s working loss (emissions resulting from the displacement of vapor inside a tank during material transfer), the TANKS software was used to estimate a working loss emission rate for railcar loading. Vapor displaced during filling operations will be piped at the fill point to the facility’s abatement system/carbon bed system.

Table 5.5 summarizes the estimated controlled emission rates of individual COPCs (as represented by the blended fuel representative compositional profile) from this source.

Table 5.12b presents the data that were used in the TANKS software for the estimation of the individual chemical emission rates.

5.3.6 Lab Pack Consolidation

The Facility can receive small quantity vessels, called "lab packs". The Facility typically receives 2,200 gallons of lab pack materials per month. Of this material, approximately 10% is composed of inorganic materials, and 10% is composed of non-volatile or semi-volatile materials (such as herbicides, resins). Approximately 1,333 gallons of this material are organic solvents. The organic solvent material consolidated during the month includes acetone, ethyl acetate, isopropanol and mineral spirits[12]. These materials can be consolidated into one large vessel (without being unsealed and with no transfer of liquid material) and sent for off-Site disposal (lab pack vessel consolidation) or the liquid within the lab packs can be consolidated with other similar materials and either recycled on-Site or sent off-Site for disposal (lab pack material consolidation). Lab pack vessel consolidation is conducted in the drum storage building #1.

In lieu of any known published emissions estimation methodology appropriate for this process, a 1.5% material loss[13] as the estimated fugitive emission rate was conservatively assumed.

The short-term emission rate was estimated using the average hourly throughput, assuming up to eight hours per day, six days per week, four weeks per year of operation. Table 5.6 summarizes the data to be used in estimating the VOC emission rate from this source. Table 5.7 summarizes the data used to speciate the VOC emissions and presents the estimated emission rates for individual COPCs.

5.3.7 Waste Paint Consolidation

Waste paint from paint cans is consolidated at the Facility. The Facility will be using a self-contained closed consolidation unit which will exhaust to the Facility's VOC abatement system/carbon bed system. The Facility estimates that approximately 400 gallons of waste paint are collected per day or approximately 4,125 gallons of waste paint are collected per month. Most of the paint is oil-based architectural paint or primer, and comes from Texas or Nevada. As discussed in the Emissions Estimation Technical Memorandum, ENVIRON identified an appropriate representative MSDS for the waste put through this process[14]. The MSDS for these two products were used to represent the wastestream through waste paint collection. Based on the MSDS for these two paint products, it appears that Stoddard solvent is the solvent used as the basis for the mixture, with a trace quantity of ethyl benzene (0.1% in both cases).

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[12] Based on throughput for May 2005, a representative month.

[13] Similar to the USEPA loss fraction for the paint and varnish industry (USEPA AP-42 Section 6.4).

[14] ENVIRON spoke with a technical representative of Benjamin Moore, a major manufacturer of architectural paints and primers. They indicated that, in general, they sold five times more paint than primer (five to one ratio). They also identified their most popular solvent-based primer and paint: O24 and Satin Impervo 235 (respectively). The MSDSs for these two products were found on the Benjamin Moore website.

In estimating the total volatile components throughput, it was assumed that all waste paint collected has a VOC content of 340 grams per liter. This is conservative since many types of household paint and paint products have a lower VOC content. In lieu of any known emissions estimation methodology for this type of source, a 1.5% material loss via evaporation was assumed. This is consistent with the USEPA emission factor (USEPA 1995) given for paint manufacturing (1% - 2% solvent loss)[15]. The short-term emission rate was based on the maximum daily throughput and eight hours per day of operation. The data that were used to estimate the VOC emissions from this source are presented in Table 5.8. Table 5.9 summarizes the data used to speciate the VOC emissions and presents the estimated emission rates for individual COPCs.

5.3.8 Transfer-Point Troughs

Fugitive evaporative emissions may occur from transfer-point troughs. The Facility manually transfers liquids to and from tanks. During these transfers, hoses are connected to the appropriate connector points in the troughs. Transfer pumps are located in the troughs as well. The Facility has protocols followed by their personnel to ensure that overfilling and spillage do not occur. If a spill does occur, Facility personnel have a response plan in place in which spills are immediately cleaned up, however it is possible that small quantities (“drips”) may be released to the troughs.

The emissions were estimated by estimated the total number of tank turnovers each tank farm associated with each trough. This was assumed to be an estimate of the typical maximum number of “drip” events. It was assumed that, on average, 10% of the trough’s surface area would be wetted during a drip event. It was assumed that 100% of “dripped” material would be evaporated and released as fugitive emissions to the atmosphere. Any spilled wastewater is, on average, 20% organic and hence, the VOC emission rate resulting from the evaporation of “dripped” material was accordingly adjusted to remove the water from the total estimated mass of material evaporated. Table 5.10 summarizes the estimation of the fugitive VOC emissions from the troughs following this methodology. This methodology is revised from that originally proposed in the Emission Exposure Concentration Technical Memorandum. The methodology was revised because it was overly conservative. The original proposed methodology was based on the assumption of a limitless reservoir of material for evaporation. The troughs rarely contain pooled material, and are more likely to be only wetted a fraction of the time.

To speciate the VOC fugitive emissions from the trough, the total emission rate for each COPC from the tank farm associated with each trough was used. The ratio of total VOC emissions from the troughs to the total VOC (as represented by the total COPC emissions) emissions was calculated for each trough. This ratio was applied to the individual COPC emission rate from the tank farm. Because material “dripped” into the trough (and thus evaporates) is material transferred in and out of the tanks in the tank farm, it was assumed that the overall composition of material evaporated from a trough

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[15] USEPA. 1983. *Compilation of Air Pollutant Emission Factors AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources*. Section 6.4, Paint and Varnish Manufacturing. May (incorporated in 1995 edition)

would be similar to the overall composition of material stored in the tanks. Because TANKS used this information, as well as the relative quantities transferred in and out of the tanks, the relative emission rates of the individual COPCs from the tanks in the tank farm would be representative of the total material through the troughs, and hence representative of the material evaporated from the troughs. Table 5.11 summarizes the individual COPC emission estimates.

5.3.9 Material Storage In Tanks

The tanks all have a conservation vent, which limits the evaporative losses during storage ("breathing losses") due to changes in ambient temperature. These vents have a pressure/vacuum setting, beyond which they allow the venting of vapors from the tank. The USEPA-approved TANKS model (version 4.09b) accounts for both working losses (evaporative losses resulting from filling and emptying) and breathing losses.

The storage vessel parameters used in estimating emissions using the TANKS model are summarized in Tables 12a and 12b. Storage vessel information used in TANKS, including vessel height, working volume, tank diameter, color, type, average and maximum filled volume, and composition of material throughput, was provided by the Facility.

The chemical composition of the material stored within each tank is a required input to the TANKS model. The TANKS model uses the chemical composition to estimate emissions of individual chemicals along with total emissions.

The calculation of emissions from the tanks also takes into account the fraction of time that each tank stores each type of waste. For example, if a tank is typically used to store wastewater 40% of the time and organic waste 60% of the time, then the emissions will represent emissions from storage of wastewater 40% of the time and storage of organic waste 60% of the time. The Facility provided ENVIRON with information that describes the fraction of time each tank holds liquid or aqueous organic material solutions. This characterization was based on 12 months of daily tank information, from January to December 2004. Table 5.13 summarizes the typical use each tank sees during the year. That is, for each tank, the table shows the fraction of time the tank will typically be used for storage of organic waste, aqueous waste, blended fuel, pure product, or is empty.

The meteorological data that was used in TANKS is part of the TANKS database of information for Phoenix, Arizona.

The estimated emission rates for each individual COPC for each tank at the Facility is summarized in Table 5.14.

5.3.10 Material Storage In Drums

Material is also stored on-Site in drums and totes. The drums at the Facility are located in two different storage areas (Storage Buildings #1 and #2) as well as sampling areas around the Facility. In Storage Building #1, the Facility can store up to 2,208 drums or 347 350-gallon totes or a combination of these containers for a total storage capacity of 121,440 gallons of containerized waste. The Facility can store up to 55,000 gallons of containerized waste in Storage Building #2. This may comprise 1,000 55-gallon drums or 157 350-gallon totes or a combination of containers. Small amounts of fugitive emissions from storage drums can result from the leaking of volatile chemicals from closed bungs. The small gaps in the seal made by the drum bung on each drum were evaluated similarly to a vapor leak from flanges. Therefore, an emission factor from USEPA guidance for leaks from flanges (based on data from chemical industry facilities) was used to estimate total VOC emissions from drums during closed storage (USEPA 1995b). This emission rate was speciated using the representative organic wastestream profile. Table 5.15 summarizes the number of drums stored in the various storage areas within the Facility. Table 5.16 presents emission estimates from drum storage.

5.3.11 Tank Connectors, Pumps, and Valves

Fugitive emissions from all component leaks from pumps, valves, and connectors associated with the tanks were estimated following guidelines in the USEPA Protocol for Equipment Leak Emission Estimates (USEPA 1995b). The Facility complies with the RCRA requirement that component leaks be monitored if the component contacts hazardous waste with organic chemical concentrations of at least 10 percent by weight (40 CFR Part 264 Subpart BB – Air Emission Standards for Equipment Leaks). At the Facility, this standard is applicable to 11 tanks on-Site which are permitted to store RCRA-hazardous waste. The monitoring logs for this monthly monitoring program revealed that there are very few readings above the acceptable levels. According to Facility personnel, any reading above background prompts immediate maintenance to inspect and repair the connector so that the monitor reads background.

The USEPA protocol for estimating fugitive emission rates from equipment leaks lists default emission rates (mass per unit time per source) for valves, pumps, and connectors in light liquid service that can be used. Since there are very few times that a component reads above background, and given the fact that when this occurs the connector is immediately serviced, it was assumed that the connectors typically will read only background concentrations. The USEPA protocol discusses the use of a "default-zero" leak rate (USEPA 1995b)[16] emission factors for estimating emissions from a connector whose emission reading does not read above background with a measuring unit that has a detection limit of 1 part per million by volume (ppmv) or less. The Facility uses a flame ionization detection (FID) device that has a detection limit of less than 1 ppmv. Table 5.17 summarizes these "default-zero" emission factors.

As there are no readings for the components associated with the unpermitted tanks, the average chemical industry component leak emission factors presented in the guidelines (USEPA 1995b)[17] were used. These factors are summarized in Table 5.17. The number of pumps/valves/connectors per tank farm is summarized in Table 5.18. The emissions

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[16] Page 2-32 and Table 2-1.

[17] Table 2-1 SOCMI Average Emission Factors.

from each tank farm were estimated using these emission factors. For those tanks that exclusively store chemicals not selected (non-COPCs) or for tanks exclusively storing wastewater for neutralization, emissions were not estimated for components associated with these tanks. Table 5.19 summarizes the total VOC emission rate estimated for each tank farm's associated components.

The VOC emissions estimated from tank components were speciated based on the individual emission rates of COPCs from the tank farm associated with the components. The total emission rate for each COPC from the tank farm was used. The ratio of total VOC emissions from the tank farm components to the total VOC (as represented by the total COPC emissions) emissions was calculated for each set of tank farm components. This ratio was applied to the individual COPC emission rate from the tank farm. It was assumed that the overall composition of material evaporated from tank farm components would be similar to the overall composition of material stored in the tanks. The material through these components is the same material stored in and transferred in/out of the tanks within each tank farm. Because TANKS used this information, as well as the relative quantities transferred in and out of the tanks, the relative emission rates of the individual COPCs from the tanks in the tank farm would be representative of the total material through the tank farm components, and hence representative of the material evaporated from the tank farm components. Table 5.20 summarizes the individual COPC emission estimates.

5.3.12 Drum, Tanker Truck, and Railcar Sampling

To estimate the emissions resulting from evaporation of sample material on the outside of the sampling tubes, the coating thickness of the material adhering to the outside of the sampling tube was estimated. It was assumed that all the organic liquid material adhering to the outside of the sampling tube evaporates. This is likely an overestimate. The following equation from Perry's Chemical Engineer's Handbook for film thickness of fluid from dip coating was used to estimate the film thickness of the material adhering to the sampling tube (Perry 1999):

$$h(\rho g/\sigma)^{1/2} = (0.944 * Ca^{2/3})/(1 - \cos\varphi)^{1/2}$$

Where:

h = film thickness, m
ρ = density, kg/m^3
g = acceleration due to gravity, m/s^2
σ = surface tension, kg/s^2
Ca = $\mu V/\sigma$, (i.e., capillary number)
φ = angle of inclination (from horizontal), degrees
μ = viscosity, kg-m/s
V = speed of withdrawal, m/s

The physical parameters (such as viscosity, density, and surface tension) of gasoline were used to represent the material that will adhere to the sampling tube. The volume of material adhering to the sampling tube and, hence, evaporating, was calculated as the product of the film thickness, the circumference of the sample tube, and the length of the sample tube.

On average, 116 drums are sampled per day, 365 days per year, although more than one drum may be sampled using a single sample tube. On average, approximately 1,000 tanker trucks are sampled per year. Typically up to 60 railcars are sampled per year. Approximately 1/3 of these contain wastewater and 2/3 of these contain blended fuel. The emissions estimation methodology for sampling of material in drums, tanker trucks, and railcars is further detailed in Table 5.21. Short-term average emission rates were estimated based on the typical maximum daily sample rate.

The estimated VOC emissions from tanker truck sampling were speciated using the maximum partial pressure of a COPC in any of the three representative material streams. This conservatively ensures that the maximum emission rate for each COPC, regardless of which type of stream it is present in, is estimated. Table 5.22 summarizes the emissions rates for each COPC from tanker truck sampling. The estimated VOC emissions from railcar sampling were speciated using the blended fuel representative composition. Rail is used to transport either blended fuel or wastewater. Using the blended fuel composition is conservative for estimating all the emissions from sampling. Table 5.23 summarizes the emission rates for each COPC from railcar sampling. The estimated VOC emissions from drum sampling were speciated using the organic wastestream representative composition. Table 5.24 summarizes the emission rates for each COPC from drum sampling.

5.3.13 Laboratory Fume Hoods

Fugitive emissions also occur during sample handling and analysis in the Facility's laboratory. Fugitive laboratory emissions are released into the environment through four fume hood vents. Currently, regulatory guidance is unavailable for estimating emissions from laboratory operations. It was assumed that 1% of the material handled under the fume hoods is lost via evaporation[18]. The Facility typically analyzes 42 samples a day, 80% of which are evaluated under fume hoods. Each sample is approximately 20 milliliters. It was assumed that the material handled in the laboratory was evenly handled between the four fume hood vents; each fume hood pulls approximately 100 cubic feet per minute. The laboratory operates 16 hours per day, five days per week. The short-term emission rates were estimated based on the typical maximum daily number of samples analyzed. Table 5.18 summarizes this information. Table 5.25 summarizes the estimation of the VOC emissions from this source. To speciate the VOC emissions from this operation, the maximum partial pressure of a COPC in any of the three representative material streams was used. This conservatively ensures that the maximum emission rate

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[18] The USEPA provides an emission factor of 1% to 2% of solvent for agitated mixing tanks (Page 6.4-1 of AP-42 Section 6.4 "Paint and Varnish"). We considered this to be an appropriate surrogate emission factor. The lower bound emission factor was used since the material in the laboratory is not agitated.

for a COPC is estimated from this source. Table 5.26 summarizes the estimated COPC emission rates from the laboratory exhaust.

5.3.14 Distillation Processes

Vapor emissions from the distillation processing units (thin film evaporator, vacuum pot, and distillation column) are vented to the ambient air via a process vent. Distillation processes are used to recycle either fairly pure liquids (more than 95% pure) or wastewater. The RCRA hazardous waste streams processed in these units are as follows:

(1) Vacuum Pot – acetone, lacquer thinner, isopropanol, methylene chloride

(2) Thin Film Evaporator – acetone, lacquer thinner, perchloroethylene, xylenes

(3) Distillation Column - methylene chloride, wastewater, perchloroethylene

Table 5.27 summarizes the typical annual (based on 2004) throughput of each stream through each distillation unit, as well as the average number of hours of processing per unit volume and the recovery fraction (i.e., the purity of the processed stream).

The Facility has presented conservative estimated emission factors and emission rates for each of these units in an earlier report submitted to the USEPA (Romic 2003). Although this earlier analysis showed that these process units are not subject to additional controls because the estimated emissions from these sources, combined, would be less than the triggering threshold, the Facility has elected to keep the current emissions abatement system and carbon bed system in place. Hence, this HRA incorporates the use of both the emissions abatement system and the carbon beds. The methodology used to estimate the individual emission factors for each unit presented in the 2003 engineering analysis was used in this evaluation.

The Facility has estimated that the abatement system achieves a control efficiency of over 95%. A control of efficiency of 95% was used in estimating emissions from this source. The Facility has estimated that the carbon beds downstream of the abatement system achieve a control efficiency of over 99%. A control efficiency of 99% was used in estimating emissions from this source. These two VOC control systems are in series; that is, their control efficiencies were combined (95% x 99%) to estimate the controlled emissions.

This methodology is based on the assumption that liquid in the reservoir is in equilibrium with the vapor in the reservoir. It was concluded in the (Romic 2003) report that the condenser of the distillation processes is oversized and hence any vapors that may be emitted by the distillation units (or sent to a control system) would only arise from the displacement of vapor in the receiving vessel. It was assumed that the vapor in the receiving vessel would be in equilibrium with the processed fluid. The emission factors developed are based on the displaced vapor in the reservoir. Raoult's law or Henry's Law was used to estimate the gas molar fractions of each of the main constituents of the mixture's emissions. The mass flowrate of each component from the distillation processes would be calculated based on the ideal gas law:

$$M_i = P_i * V * MW_i/(R*T)$$

Where:

M_i = mass of i in vapor displaced (mass per unit volume displaced)
P_i = partial pressure of i in displaced vapor
V = volume of displaced vapor (assumed to be equal to the volume throughput of liquid)
MW_i = molecular weight of i
R = universal gas constant
T = temperature of receiver (assumed to be 30^oC)

The partial pressure of 11 compounds in the aqueous stream was estimated using Raoult's Law. Because they are relatively immiscible in water and have a relatively high vapor pressure, the Henry's Law Constant for these 11 compounds (cyclohexane, gasoline, diesel, jet fuel, kerosene, isoparaffinic hydrocarbons, heptane, naptha, Stoddard solvent tetrahydrothiopene and general petroleum oil products) is very high and yields partial pressure estimates that are greater than one atmosphere. The partial pressures for these compounds have been estimated assuming that they are a mixture within themselves using Raoult's Law. Table 5.28 summarizes the estimation of the partial pressures of these compounds. These partial pressures were used to represent these compounds in the equilibrium vapor phase. Table 5.29 summarizes the emission factors from each distillation process (vacuum pot, distillation column, and thin film evaporator). The composition of the representative wastewater stream was presented in the Chemical Selection Technical Memorandum (ENVIRON 2005b).

To estimate the total emission rate of each COPC from each distillation unit, the emission factors were applied to the 2004 annual throughput rates of each type of stream. The total emission rate for each COPC is the sum of the emission rate of each COPC from each unit. This assumes the concurrent operation of each distillation unit. This is rarely done, thus the estimated emission rates are conservative. In addition, as discussed earlier, the control efficiencies of both the emissions abatement system and the carbon beds have been incorporated into the emission estimates used in evaluating potential off-Site health impacts from this source. The short-term emission rates were estimated based on the typical number of hours per run per processed stream. Table 5.30 summarizes the individual COPC emission rates from each unit and from the total emission rate from the distillation exhaust stack.

5.3.15 Natural Gas-Fired Boiler

The Facility has a small boiler that produces plant steam. The boiler has a power rating of 400 horsepower and is fueled only with natural gas. The emissions from the boiler are vented from a small stack directly above the boiler. The emission factors that were used to estimate the emissions from this source are from the USEPA AP-42 Section 1.4.

Those organic species for which the AP-42 section has emission factors and that appear on the COPCs list were evaluated in this HRA. The short-term emission rates were based on the maximum typical hours of operation for this unit (12 hours per day). Table 5.31 summarizes the boiler's specifications. Table 5.32 summarizes the estimated COPC emissions from the boiler.

5.4 References

ENVIRON International Corporation (ENVIRON). 2005b. *Technical Memorandum - Selection of Chemicals of Potential Concern, Romic Environmental Technologies Corporation (Southwest). July 20.*

ENVIRON International Corporation (ENVIRON). 2005a. Technical Memorandum - *Proposed Methodology for Estimating Operational Emissions and Exposure Concentrations, Romic Environmental Technologies Corporation (Southwest). July 20.*

Perry, Robert H. and Green, Don W. *Perry's Chemical Engineers' Handbook*. Mc-Graw-Hill. 1999.

Romic Environmental Technologies Corp. 2003. *Engineering Analysis in Support of Air Emissions Standards Compliance Program (Title 40, CFR Part 265, Subparts AA and CC).* November 15.

United States Environmental Protection Agency (USEPA). 1995a. *Compilation of Air Pollutant Emission Factors AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources*. Section 6.4, Paint and Varnish Manufacturing. May 1983 (incorporated in 1995 edition).

United States Environmental Protection Agency (USEPA). 1995b. *Protocol for Equipment Leak Emission Estimates.* EPA-453/R-95-017. November.

6.0 ESTIMATION OF REPRESENTATIVE EXPOSURE CONCENTRATIONS

This section describes the information and data used to estimate the concentration of COPCs in the ambient air near the Site. This methodology was presented in the Emissions/Exposure Concentrations Technical Memorandum submitted to the USEPA (ENVIRON 2005a). In order to estimate the off-Site ambient air concentrations to which nearby residents and workers could be exposed, emissions of chemicals from the Site were estimated and the dispersion of the emissions in the air was modeled. In addition, in order to assess potential on-Site worker exposures, area and personal sampling data collected at the Site were evaluated.

As part of Romic's RCRA Part B permit application, the Site has proposed to change the designation at existing, but currently unregulated storage tanks and units to a designation of regulated under the permit, add tanks for organic liquid and wastewater storage, add tanks for fuel-blending operations, and add wastewater treatment units.

The sources considered in this HRA were described in Section 5.0. As described in that section, the identified sources were characterized on the basis of Site information and data regarding the nature of the material throughput for each source, the quantity and schedule for the operation, and the operating parameters for the sources.

The dispersion modeling methodology used to evaluate the resulting ambient concentrations of COPCs emitted to the air is discussed in Section 6.1. Air concentrations of chemicals emitted by the Site were estimated using a USEPA-approved air dispersion model. This model incorporates data and information regarding local meteorology and terrain. Local meteorological data was used to characterize the dispersive characteristics of the atmosphere for long-term and short-term exposures. Operational parameters such as the type of material handled in the unit and hours of operation were considered. Physical parameters of each source, such as height of release, exit gas temperature and exit gas flow rate, were also used.

Section 6.2 summarizes the data from area and personal sampling used to evaluate potential exposure to on-Site workers.

6.1 Estimation of Off-Site Exposure Concentrations

6.1.1 Air Dispersion Model

To estimate off-Site exposure concentrations, a Gaussian air dispersion model approved by the USEPA was used. This model is appropriate for use in estimating ground-level short-term ambient air concentrations resulting from non-reactive buoyant emissions from sources located in a relatively flat region. The Industrial Source Complex Short Term (ISCST3) model is a steady-state Gaussian plume model and assumes a linear relationship between emission rate and ambient air concentration at a given receptor. The aerodynamic downwash effect on emissions released near structures was incorporated where appropriate into the model. The ISCST3 model uses local hourly meteorological data, including wind speed, wind direction, ambient temperature and atmospheric stability to define the conditions for plume rise, transport and diffusion. Since only volatile emissions were modeled in this HRA, deposition of emitted chemicals was not included in the dispersion modeling (USEPA 1995). The model was executed using default control options:

- stack heights adjusted for stack-tip downwash,
- buoyancy-induced dispersion,
- concentration based on final plume rise,
- calm winds processing algorithm for calculating ground-level concentrations during "calm" conditions, and
- default values for wind profile exponents and vertical potential temperature gradients.

The model incorporates emission source information, such as height of release, type of release (point source, volume source, or area source), temperature of exiting emissions, source parameters, and location of source.

The model also incorporates information regarding the terrain, land use of the region surrounding the emissions sources and the effect of nearby structures on the dispersion of the emissions. The following sections discuss the determination and incorporation of this information. The air dispersion model files are included in Appendix B.

6.1.2 Modeled Sources

The sources of emissions included in the dispersion modeling are either point sources (distillation units exhaust stack, boiler stack, and laboratory stacks), elevated area sources (tank farms, drum storage, fugitive components for tank farms), ground level area sources (troughs), or volume sources (labpack consolidation, drum sampling, railcar sampling, truck sampling, on-Site truck transfers and truck washout). Table 6.1 summarizes the source parameters for point sources and Table 6.2 summarizes the source parameters for area sources. Table 6.3 summarizes source parameters for sources represented by volume sources. Figure 6.1 depicts the location and representation of each source evaluated in the refined dispersion modeling.

6.1.2 Emission Rates

Both annual average and short-term average maximum emission rates were estimated for all sources. Modeled emission rates are summarized in Table 6.4. For off-Site residents and sensitive receptors, annual exposures were estimated using the average annual emission rates, and short-term exposures were estimated using the average daily or hourly emission rates (as appropriate for each source). For off-Site workers, annual average exposures were estimated.

6.1.3 Meteorological Data

Meteorological data for the dispersion modeling was obtained from the USEPA SCRAM website for the Phoenix Sky Harbor International Airport. The airport is located 15.5 miles northwest of the Facility. Figure 6.2 depicts the region's topography and the relative location of the Phoenix Sky Harbor Airport and the Facility. The Emissions/Exposure Concentrations Technical Memorandum (ENVIRON 2005a) had originally proposed using data from the Chandler Airport. However, upon review of the available data, it is apparent that it is not sufficiently complete for use in regulatory dispersion modeling. Appendix C presents windroses for the Chandler Airport and the Phoenix Airport, as well as completeness statistics for the Chandler meteorological data. From the windroses, it can be seen that the general wind direction and wind speed categories trends observed at the two airports are similar. The Chandler data does not meet the USEPA modeling meteorological data completeness criteria. This is further described in the appendix.

Five years of hourly surface meteorological data (1994 to 1998) collected at the Phoenix Sky Harbor International Airport were used in the dispersion modeling. These data were combined with twice-daily upper air data collected at the Tucson International Airport. The meteorological data processing software, PCRAMMET, was used to combine surface and upper air data. Any missing data in the surface meteorological data were filled in as prescribed in "Procedures for Substituting Values for Missing NWS Meteorological Data for Use in Regulatory Air Quality Models"[19]. Figures 6.3 through 6.7 depict the surface windroses of the Phoenix meteorological data.

6.1.4 Building Downwash

Building downwash algorithms incorporated into the ISCST3 model account for the effects of the aerodynamic wakes and eddies produced by Facility buildings and structures on plume dispersion. Building downwash is the effect of nearby structures on the flow of emissions from their respective sources. The USEPA-approved Building Profile Input Program (BPIP) was used to determine the direction-specific building downwash parameters (USEPA 1993). When the stack height is less than the building height plus half the lesser of the building height or width, the methods of Schulman and Scire are followed. Otherwise, the methods of Huber and Snyder are followed. The selection between these two methodologies is determined by BPIP based on the information given to the model regarding building parameters, including building location, length, width, and height, as well as the height and location of the point source. The dimensions and locations of structures which could influence the dispersion characteristics of emissions from point sources on-Site were ascertained from Facility documents, including plot plans and visual estimates. Figure 6.8 depicts the representation of structures on-Site in the model. Table 6.5 lists the parameters of the on-Site structures.

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[19] http://www.epa.gov/scram001/surface/missdata.txt

6.1.5 Terrain Data

Digital elevation maps (DEMs) were incorporated into the model in order to take into account terrain effects. The DEMs are an array of regularly spaced points on a horizontal plane for which an elevation is specified. The DEMs used in this analysis were developed by the USGS. They are 7.5-minute quadrangles, spaced at 30 meters by 30 meters and were downloaded from the WebGIS website[20]. The DEM quadrants that cover the region in the vicinity of the Facility are the Guadalupe, Lone Butte, Chandler, Gila Butte NW, Tempe, Mesa, and Phoenix quadrangles. Other quadrangles can be imported as required by the extent of the domain in the dispersion modeling.

6.1.6 Receptors

Off-Site receptors were presented in the Off-Site Receptor Technical Memorandum (ENVIRON 2005b) and discussed in Section 2.0 of this HRA. Off-Site workers, residents, and sensitive receptors in the surrounding community, including the Gila River Indian Community, have been identified and were incorporated into the modeling. In addition, receptors were placed on the Facility boundary. Figure 6.9 depicts the gridded and discrete receptors that were used to represent off-Site workers. Figure 6.10 depicts the discrete receptors placed at actual off-Site residences and sensitive receptors.

6.1.7 Land Use Analysis

Auer's method of classifying land-use as either rural or urban was used to analyze the surrounding region (Auer 1978). This method calls for analysis of a three-kilometer radius around a site to determine if the majority of the land can be classified as either rural or urban. ENVIRON's analysis shows that well over 50% of the land is rural, therefore, it is appropriate to use rural dispersion coefficients in the ISCST3 model. Figure 6.11 shows the three-kilometer radius around the Facility and the categorization of land as either rural or urban.

6.1.8 Averaging Periods

Annual and one-hour exposure concentrations were estimated using dispersion modeling. The annual exposure concentrations were used to estimate the potential cancer and noncancer chronic risks. The one-hour exposure concentrations were used to estimate the noncancer acute risks.

6.2 On-Site Worker Monitoring Data

The most recent on-Site worker monitoring data were collected on March 2/3, 2006 (Robert Brown & Associates 2006). In total, 16 air samples were taken over two days. Most of these samples were personal samples. Table 6.1 summarizes the sample type (area or personal) and the worker task description. Table 6.2 summarizes the monitoring results. Chemicals detected

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[20] http://www.webgis.com/terraindata.html

include: acetone, isopropyl alcohol, methanol, methylene chloride, methyl ethyl ketone, toluene, and total hydrocarbons (as n-hexane).

6.3 References

Auer, Jr., A.H. "Correlation of Land Use and Cover with Meteorological Anomalies". *Journal of Applied Meteorology*, 17:636-643, 1978.

ENVIRON International Corporation (ENVIRON). 2005a. Technical Memorandum - *Proposed Methodology for Estimating Operational Emissions and Exposure Concentrations, Romic Environmental Technologies Corporation (Southwest). July 20.*

ENVIRON International Corporation (ENVIRON). 2005b. *Technical Memorandum – Identification of Off-Site Receptors, Romic Environmental Technologies Corporation (Southwest). June 3.*

Robert Brown & Associates. 2006. Letter to Romic Environmental Technologies Corp. from Robert E. Brown. March 23.

United States Environmental Protection Agency (USEPA). 1993. *User's Guide to the Building Profile Input Program*. EPA-454/R-93-038. October.

United States Environmental Protection Agency (USEPA). 1995. *User's Guide for the Industrial Source Complex (ISC) Dispersion Models. Volume I – User Instructions*. September.

7.0 RISK CHARACTERIZATION

Risk characterization is the final step of the risk assessment. It is defined as the combination of the exposure assessment and toxicity assessment to produce an estimate of risk and a characterization of uncertainties in the estimated risk (NRC 1983). This section presents the results of the risk assessment for the Site. In Section 7.1, the methods for estimating risk are discussed. Sections 7.2 and 7.3 present the estimated cancer risks and chronic noncancer hazard indices for off-Site residents and off-Site workers, respectively. Section 7.4 presents the cancer risk isopleths for the Site and the estimated risks for the maximum sensitive receptors. Peak air concentrations at the Site boundary are compared to the acute toxicity values in Section 7.5 and the on-Site worker monitoring data is compared to occupational standards in Section 7.6. Uncertainties in the risk estimates that may result from various assumptions used in the risk assessment are discussed in Section 7.7.

7.1 Method for Estimating Risk

Estimating cancer risks and noncancer (HIs) requires information regarding the level of intake of the chemical and the relationship between intake of the chemical and its toxicity as a function of human exposure to the chemical. The methodology used to derive the cancer risks and noncancer HIs for the selected chemicals is based on guidance provided by USEPA.

One can estimate the potential risk associated with a chemical in air using equations that describe the relationships among the estimated intake of Site-related chemicals, toxicity of the specific chemicals, and overall risk for carcinogenic and noncarcinogenic health effects. For carcinogenic effects, the relationship is given by the following equation (USEPA 1989):

$$\text{Risk} = I \times CSF$$

Where:

Risk = Cancer Risk; the probability of an individual developing cancer as a result of exposure to a particular cumulative dose of a potential carcinogen (unitless)

I = Intake of a chemical (mg chemical/kg body weight-day)

CSF = Cancer Slope Factor (mg chemical/kg body weight-day)$^{-1}$

The relationship for noncarcinogenic effects is given by the following equation (USEPA 1989):

$$HI = \frac{I}{RfD}$$

Where:

HI = Hazard Index; an expression of the potential for noncarcinogenic effects, which relates the allowable amount of a chemical (RfD) to the estimated Site-specific intake (unitless)

I = Intake of chemical (mg chemical/kg body weight-day)

RfD = Reference Dose; the toxicity value indicating the threshold amount of chemical contacted below which no adverse health effects are expected (mg chemical/kg body weight-day).

The National Contingency Plan (NCP) (40 CFR 300) is commonly cited as the basis for acceptable incremental risk levels. According to the NCP, lifetime incremental cancer risks posed by a site should not exceed one hundred in a million (1×10^{-4}) to one in a million (1×10^{-6}). For noncancer health hazards, a target HI of one (1) is identified. Individual chemical exposures that yield HIs of less than 1 are not expected to result in adverse noncancer health effects (USEPA 1989).

As discussed previously, cancer risks and chronic noncancer HIs were calculated in this risk assessment for off-Site residential, off-Site worker, and off-Site sensitive receptors as the result of potential exposures to the chemicals identified in Section 3.0. These calculations were conducted for an AEI and a RME scenario.

In the discussion below, estimated cancer risks are expressed using scientific notation (e.g., 1×10^{-6}) and estimated HIs are expressed using decimal notation (e.g., 0.001). Results presented in the text are expressed using one significant figure. The use of one significant figure when reporting risk results is recommended by USEPA (1989). Results prior to rounding are shown in the tables of results. Presentation of results prior to rounding is intended to facilitate the checking of the calculations by reviewers and to show the minor differences between the current and future emissions scenarios for most populations prior to rounding.

7.2 Cancer Risks and Chronic Noncancer Hazard Indices for Off-Site Residents and Sensitive Populations and Sensitive Populations

As shown in Table 7.1, the estimated excess cancer risk for the AEI residential scenario is 4.1×10^{-8} and for the RME residential scenario 1.8×10^{-7}. These estimated risks are well below the NCP target risk range. The estimated noncancer HI for the AEI residential scenario is 0.0012 and for the RME residential scenario is 0.00087. These estimated HIs are well below the target HI of one (1). The estimated excess cancer risk for the RME residential scenario is shown by emission source in Table 7.2. The estimated chronic HI for the RME residential scenario is shown by emission source in Table 7.3.

As the maximum off-site sensitive receptor is the maximum off-site resident, the maximum estimated excess lifetime cancer risk and HI is the same for both populations.

7.3 Cancer Risks and Chronic Noncancer Hazard Indices for Off-Site Workers

As shown in Table 7.1, the estimated excess lifetime risks for the AEI off-site worker scenarios are 2.8×10^{-6}, 1.6×10^{-6}, and 2.4×10^{-6} for Shift 1, Shift 2 and Shift 3, respectively. The estimated excess lifetime risks for the RME off-site worker scenarios are 1.8×10^{-5}, 1.0×10^{-5}, and 1.5×10^{-5} for Shift 1, Shift 2 and Shift 3, respectively. All risk estimates fall within the NCP target risk range. The estimated noncancer HIs for all AEI and RME workers scenarios are well below the target HI of one (1).

The estimated excess cancer risk for the RME off-site worker scenario is shown by emission source in Table 7.4. The estimated chronic HI for the RME off-site worker scenario is shown by emission source in Table 7.5.

7.4 Risk Isopleths

As there are no estimated excess lifetime cancer risks above 1×10^{-6} for residents and sensitive receptors, risk isopleths have not been developed for these populations. Figure 7.1 shows the risk isopleth for the AEI off-site worker scenario and Figure 7.2 shows the risk isopleth for the RME off-site worker scenario.

7.5 Acute Hazard Indices for an Individual at the Site Boundary

In order to evaluate the potential for acute health effects, the maximum one hour concentration estimated at the Site boundary was compared with the acute toxicity values presented in Section 3. As discussed in Section 3.2.2, the maximum one-hour concentration was conservatively used for comparison even for chemicals with longer averaging periods than one hour. The acute HIs are shown in Table 7.6 by receptor; the HQs are shown in Table 7.7 by chemical and source for the maximum receptor (includes all chemicals with a cumulative HI of greater than 0.1 from all sources).

As shown in Table 7.7, no individual chemical or source exceeded an HQ of one (1). The maximum HI, assuming all maximum one hour concentrations occurred at the same time would be 1.6, just slightly above the noncancer target level. The major chemical contributors to this HI are acetone (0.60 from lab packs), methylene chloride (0.32 from multiple sources), and alcohol (0.22 from lab packs). As a conservative assumption, it was assumed that all alcohol emissions from the Site were 2-propanol or isopropyl alcohol.

The individual source with the largest estimated acute HI is labpacks; with an acute HI of 0.86. The three major chemical contributors to this source are acetone (0.56), alcohol (0.2) and stoddard solvent (0.008). These three chemicals contribute 0.77 to the total HI from this source. Again, this is a very conservative estimate as it assumes all chemicals potentially present in lab packs are present at the same time and that the operation takes an entire hour, which is unlikely.

Based on the conservativeness in this evaluation, a HI of greater than one is unlikely to occur at the Site.

7.6 On-Site Worker Monitoring Data Compared to Occupational Standards

As discussed in Section 5.4, area and personal sampling results were used to evaluate potential exposure to on-Site workers. The sampling results are compared to PELs and STELs in Table 7.8. As shown in the table, none of the measurements exceeded their applicable limits.

7.7 Uncertainties

The estimated cancer risks and noncancer HIs presented in this HRA are based on numerous assumptions, most of which are considered conservative. Both generic and Site-specific assumptions are used to estimate the air concentrations, human exposures, chemical toxicity, and associated cancer and noncancer health risks. As a result of the cumulative effects of these conservative assumptions, the calculated risks are likely to overestimate actual risks.

Some of the assumptions used in this HRA are particularly uncertain or have a particularly strong influence on the estimated risks. The following section summarizes some of the uncertainties resulting from various assumptions used in this HRA.

7.7.1 Characterization of Waste Composition

The characterization of the liquid organic and aqueous organic waste stream was based on one representative year of data. The characterization of the lab pack waste stream was based on one representative two-week sample of data. Although these characterizations are based on discrete time periods, results from longer or more recent time periods are unlikely to be substantially different as both time periods represent receipts from numerous waste generators. Estimated health risks would likely decrease as the trend is to switch from more toxic to less toxic chemicals.

7.7.2 Selection of Chemicals for Risk Assessment

In order to select chemicals for the risk assessment, chemicals were evaluated on several criteria (amount contributed to the overall waste stream, vapor pressure, listing on the ADEQ AAAQGS). Although the risk assessment did not evaluate all chemicals identified on the master facility chemical list, the selected chemicals account for the vast majority of volatile chemicals at the Site (see Appendix A). Therefore, risks from additional chemicals should contribute only minimally to the total risks presented here.

7.7.3 Estimation of Representative Exposure Concentrations

In order to estimate representative exposure concentrations, emissions were estimated and air dispersion modeling was performed. A number of conservative assumptions were used in the emissions estimation.

In performing emissions estimations, data is gathered from available sources (e.g., Facility documents, Facility personnel, source tests, etc.) and research is done to determine emission factors (e.g., reviewing local and/or USEPA guidance). When particular information is unavailable for a specific source or a standard emissions estimation methodology/emission factor is not available, assumptions are made to estimate emissions. In this analysis, a number of conservative assumptions were used. These conservative assumptions are noted in Section 5.0 and include the following:

- Where different chemical streams passed through a process, the highest calculated partial pressure for a particular chemical in each of the streams was selected (that would result in the maximum evaporative emissions rate),
- It was assumed that mixtures of chemicals conforming to one of the three representative chemical mixtures were stored year-round in the storage tanks, resulting in maximum emissions. This is conservative, because in many cases, a particular chemical may only be present at the facility for a fraction of the year,
- Conservative control efficiencies for the facility's VOC abatement system and carbon bed system were assumed. The control efficiencies may be higher than those assumed in the emission estimates, and
- In estimating acute exposures to off-site receptors, it was assumed that all operations took place during all three shifts. This is very conservative because the greatest concentrations occur most often during the night under calm wind conditions. During this time of the day, very few, if any, operations take place at the facility.

7.7.4 Estimation of Human Exposure to Chemicals

Numerous assumptions are made in the estimation of human exposure to chemicals. These assumptions include parameters such as daily breathing rates and human activity patterns. Most of the exposure assumptions used in the calculation of risks and HIs are default assumptions recommended by USEPA, and are often the upper 90th or 95th percentile values. The combination of several upper-bound estimates used as exposure parameters to calculate chemical intake may substantially overestimate chemical intake. The risk and HIs calculated in this HRA are therefore likely to be greater than levels to which the evaluated populations would be exposed.

7.7.5 Toxicity Assessment

There are a number of uncertainties in conducting a toxicity assessment. The primary areas of uncertainty include the assumption that adverse effects observed in animal experiments would also be observed in humans (animal-to-human extrapolation), and that the toxic effects observed after exposure by one route would occur following exposure by a different route (route-to-route extrapolation (e.g., ingestion vs. inhalation)). Uncertainties in the toxicological assessments for carcinogens and noncarcinogens are discussed below.

Carcinogens

First, the use of animal data presents an uncertainty in predicting carcinogenicity in humans. While many substances are carcinogenic in one or more animal species, only a small number of substances are known to be human carcinogens, raising the possibility that not all animal carcinogens are human carcinogens and that not all human carcinogens are animal carcinogens. To prevent the underestimation of carcinogenic risk, regulatory agencies generally assume that humans are at least as sensitive to carcinogens as the most sensitive animal species.

Because most CSFs are an upper 95th percentile estimate of potency, and because upper 95th percentiles of probability distributions are not strictly additive, the total estimated cancer risk for an exposure pathway may become artificially more conservative as risks from a number of different carcinogens are summed. Similarly, substances with different weights of evidence for human carcinogenicity are summed equally, giving as much weight to group B or C carcinogens as to group A carcinogens. This too may contribute to an artificially conservative estimate of cancer risk.

Finally, the development of CSFs for carcinogens is predicated on the assumption generally made by regulatory agencies that no threshold exists for carcinogens (i.e., that there is some risk of cancer at all exposure levels above zero). The no-threshold hypothesis for carcinogens, however, has not been proven and may not be valid for substances that have been shown to be carcinogenic via other mechanisms (e.g., mechanisms that do not appear to act directly on genetic material).

Noncarcinogens

In order to adjust for uncertainties that arise from the use of animal data, regulatory agencies often base the RfD and RfC for noncarcinogenic effects on the most sensitive animal species (i.e., the species that experiences adverse effects at the lowest dose). The doses are then adjusted via the use of safety or uncertainty factors. The adjustment compensates for the lack of knowledge regarding interspecies extrapolation and guards against the possibility that humans are more sensitive than the most sensitive experimental animal species tested. The use of uncertainty factors is considered to be health protective. In addition, when route-specific toxicity data were lacking, one route was extrapolated to another (i.e., oral to inhalation). Due to the absence of contrary data, equal absorption rates are assumed for both routes.

7.7.6 Calculation of Risks

As discussed in Section 3.0, most CSFs are an upper 95th percentile estimate of potency. Because upper 95th percentiles of probability distributions are not strictly additive, the total estimated cancer risk may become artificially more conservative as risks from a number of different carcinogens are summed. Similarly, we summed the chronic HI of chemicals not expected to induce the same type of effects or that do not act by the same mechanism. This tends to overestimate the total estimated chronic HI.

The USEPA (1989) notes that the conservative assumptions used in a risk assessment are intended to assure that the estimated risks do not underestimate the actual risks posed by a site and that the estimated risks do not necessarily represent actual risks experienced by populations at or near a site. By using standardized conservative assumptions in a risk assessment, USEPA further states that:

> *"These values [risk estimates] are upperbound estimates of excess cancer risk potentially arising from lifetime exposure to the chemical in question. A number of assumptions have been made in the derivation of these values, many of which are likely to overestimate exposure and toxicity. The actual incidence of cancer is likely to be lower than these estimates and may be zero."*

The estimated risks in this risk assessment are based primarily on a series of conservative assumptions related to predicted environmental concentrations, exposure, and chemical toxicity. The use of conservative assumptions tends to produce upper-bound estimates of risk. Although it is difficult to quantify the uncertainties associated with all the assumptions made in this risk assessment, the use of conservative assumptions is likely to result in substantial overestimates of exposure, and hence, risk.

7.8 References

United States Environmental Protection Agency (USEPA). 1989. *Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part A)*. Interim Final. Office of Emergency and Remedial Response. EPA-540/1-89/002. Washington, D.C. December.

8.0 EVALUATION OF NON-ROUTINE RELEASES

In order to evaluate the potential on-site and off-site effects of non-routine releases, the facility prepared an assessment of the likelihood of accidents, process upsets, and non-routine releases, as well as the potential severity of such occurrences. This assessment includes an evaluation of potential types of accidental releases (on-site spills, off-site spills, explosions, and fire) and a discussion of Romic's recent history in terms of these releases. Although there have been minor on-site spills and fires, there has there has never been an off-site spill or explosion. The assessment also discusses the current processes and systems in place at the facility to prevent these non-routine releases. The Evaluation of Non-Routine Releases is included as Appendix D.

9.0 CONCLUSION

The purpose of this HRA is to evaluate potential adverse effects to human populations that are at or around the Facility and that could be exposed to chemical emissions from the Site. Based on the land use surrounding the Site, this risk assessment evaluated off-site workers and off-site residents. Potential risks to off-site workers and off-site residents have been estimated at actual worker and residential locations. In addition to the above populations, the risk assessment also evaluates the risk at specific locations including schools, daycare centers, health care facilities, and senior homes in the vicinity of the Site.

For this HRA, exposure assumptions corresponding to both an average exposed individual (AEI) and a reasonable maximum exposure (RME) scenario were developed. The results of the HRA show that the estimated lifetime incremental cancer risks are less than 2×10^{-5} for all populations evaluated. This estimated cancer risk is within the acceptable risk level used by the USEPA for hazardous waste sites (1×10^{-4} to 1×10^{-6}). The chronic noncancer hazard indices (HIs) calculated in this risk assessment were below one for all populations evaluated. According to USEPA, individual chemical exposures that yield a HI of less than 1 are not expected to result in adverse noncancer health effects (USEPA 1989). Although the calculated acute HI is slightly higher than one, based on the conservativeness in this evaluation, a HI of greater than one is unlikely to occur at the Site. Based on the results of the risk assessment, no significant chronic or acute health effects are expected for the off-site populations evaluated.

The estimated risks in this assessment are based primarily on a series of conservative assumptions related to predicted environmental concentrations, exposure, and chemical toxicity. The use of conservative assumptions tends to produce upper-bound estimates of risk. Although it is difficult to quantify the uncertainties associated with all the assumptions made in this risk assessment, the use of conservative assumptions is likely to result in substantial overestimates of exposure, and hence, risk.