Attachment 2 - Indoor Air Risk Assessment Parameters

For the Spring 2005 Scope of Work

A: Background

The following figure and tables provide the parameters that must be used by BNSF in future risk assessment work conducted under the Spring 2005 Statement of Work (SOW) at the BNSF Livingston facility. The figure and tables that comprise Attachment 2 cover the indoor air exposure pathway and potential contaminants of concern that may need to be evaluated at the facility. These tables provide the information that DEQ currently believes BNSF may need for indoor air risk assessment work at the Facility; however, inclusion of these exposure pathways and data in this Attachment does not automatically require that BNSF calculate site-specific cleanup levels for each of the contaminants of concern and exposure pathways. Section B of this document describes the conditions under which use of the attached tables would be required by DEQ. The Livingston SOW shall provide risk assessment information for future risk assessment of other media at the Facility.

Where a parameter value is provided in the following tables, BNSF shall use that value for the risk assessment amendment. During risk assessment work, BNSF may propose a revised parameter value(s) for DEQ approval. BNSF must provide the equations used to calculate the site-specific cleanup levels in the risk assessment amendment. If necessary, DEQ will apply the hierarchy described in OSWER Directive 9285.7-53 Human Health Toxicity Values in Superfund Risk Assessments (December 2003) to the process of updating to the toxicity values in the future. BNSF must add the cancer guideline, target organ, and uncertainty/modifying factor information to Tables 11 through 14.

The cumulative carcinogenic risk for any exposure pathway and exposure area shall not exceed 1×10^{-5}. The cumulative non-carcinogenic hazard index for any exposure pathway, primary target organ, and exposure area shall not exceed 1.

Once additional investigation results are available, BNSF will prepare tables 2.1 and 3.1 RME in the Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments) Final, December 2001. BNSF will prepare these tables for all media for inclusion in the risk assessment amendment.

Depending on VPH concentrations in groundwater near residential property, DEQ may require evaluation of residential exposure to contaminated groundwater while showering or bathing and VPH vapor migration to indoor air.

Additional tables may be required or additional information may need to be added to the existing tables based on future analytical results, particularly if new contaminants of concern are identified during supplemental investigations.

B: Exposure Assumptions

This section describes the conditions under which use of each of the attached tables would be required by DEQ.

VOCs in Indoor Air

BNSF must either use the screening levels provided in EPA's 2002 Draft Vapor Intrusion Guidance (Table 3-1 of the Spring SOW), or conduct risk assessment work to calculate site-specific cleanup levels for VOCs in indoor air. The following conditions apply for calculation of human health-based cleanup levels:

- If indoor air containing VOCs at concentrations exceeding screening levels is discovered on the railyard, then BNSF must calculate cleanup levels for the railyard property using either Table 6 or Table 2. Table 2 provides residential exposure assumptions, which would be conservative for the railyard workers. Table 6 provides commercial-industrial exposure assumptions, which would be appropriate for railyard workers on the condition that BNSF places institutional controls on the railyard that limit future use to industrial-commercial.
- If indoor air containing VOCs at concentrations exceeding screening levels is discovered off the railyard, then BNSF must calculate cleanup levels for the off-railyard property using Table 2. Table 2 provides residential exposure assumptions, including a 24-hour exposure time, which must be used for all off-railyard property regardless of its current use. This will ensure protectiveness for future use of off-railyard property.

C: List of Figure and Tables

Figure 1 – Site Conceptual Exposure Model

Table 1 – Selection of Exposure Pathways

Table 2 – Exposure Assumptions for Offsite Residents – Volatiles in Indoor Air

Table 3 - Exposure Assumptions for Commercial/Industrial Workers – Volatiles in Indoor Air

Table 4– Cancer Toxicity Data – Inhalation

Table 5 – Non-Cancer Toxicity Data – Inhalation

Table 6 – Age-adjusted Factors

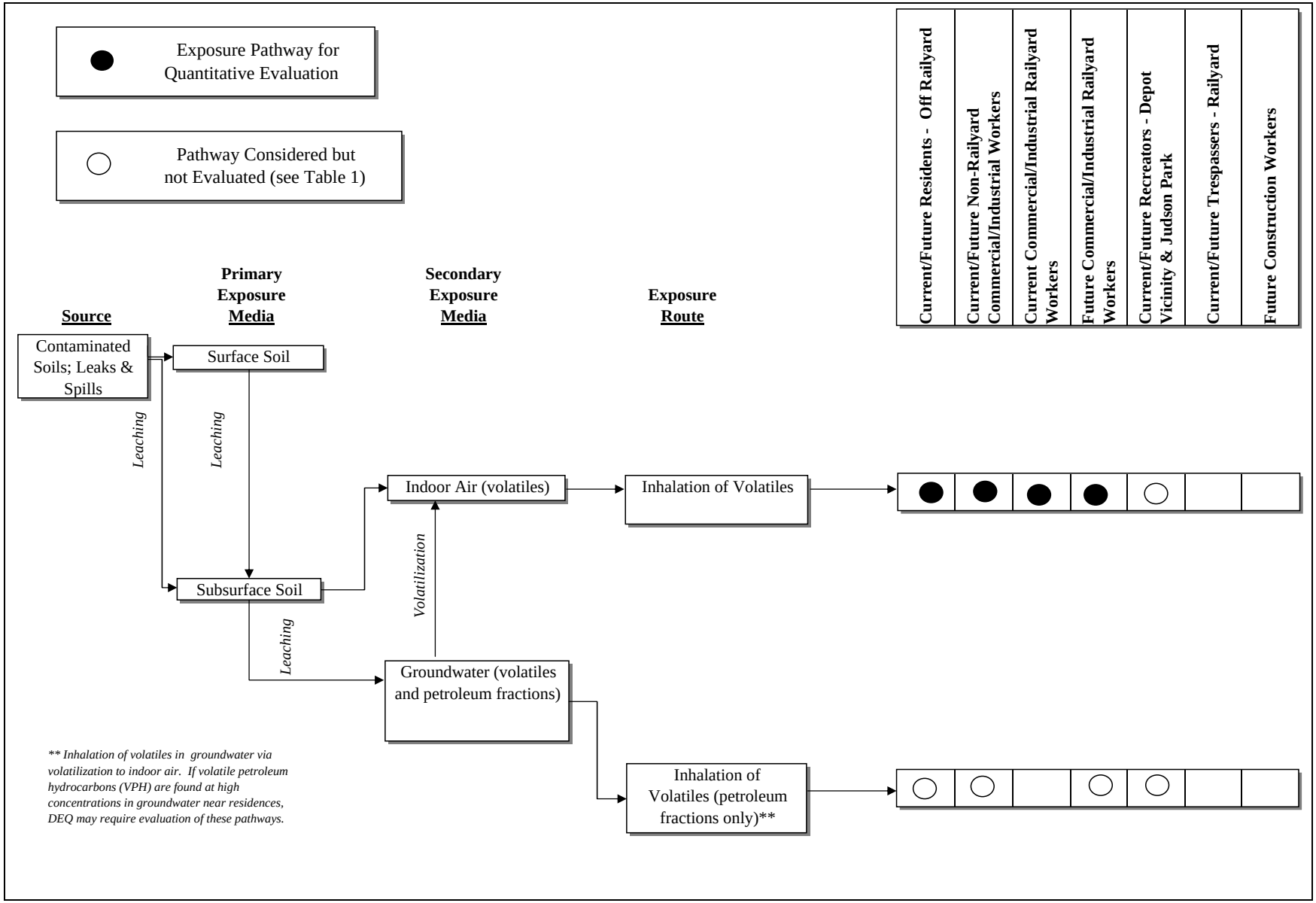

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Figure 1
Site Conceptual Exposure Model for Indoor Air- BN Livingston Shop Complex Facility

TABLE 1
SELECTION OF EXPOSURE PATHWAYS FOR INDOOR AIR
BNSF Livingston Shop Complex Facility

Scenario Time Frame	*Medium*	*Receptor Population*	*Exposure Medium*	*Receptor Age*	*Exposure Route*	*Type of Analysis*	*Rationale for Elimination of Exposure Pathway*
Current and Future	Subsurface Soil						
		Depot Recreators	Indoor Air (VOCs from Subsurface)	Child/Adolescent	Inhalation	None	Exposures expected to be minimal
		Off Railyard Resident	Indoor Air (VOCs from Subsurface)	Adult Child	Inhalation Inhalation	Quant. Quant.	NE NE
		Non-Railyard Commercial/Industrial Worker	Indoor Air (VOCs from Subsurface)	Adult	Inhalation	Quant.	NE
		Commercial/Industrial Railyard Worker	Indoor Air (VOCs from Subsurface)	Adult	Inhalation	Quant	NE
Potential Current and Future	Groundwater	Off Railyard Resident					
			Irrigation Well	Adult	Inhalation of Volatiles	None	Screened in the BRA - exposures ranges from 10^{-7} to 10^{-8}
				Child	Inhalation of Volatiles	None	Screened in the BRA - exposures ranges from 10^{-7} to 10^{-8}
			Indoor Air (VOCs from Subsurface)	Adult Child	Inhalation Inhalation	Quant. Quant	NE NE
		Non-Railyard Commercial/ Industrial Worker					
				Adult	Inhalation of Volatiles	None	Exposures expected to be minimal and difficult to quantify
			Irrigation Well	Adult	Inhalation of Volatiles	None	Exposures expected to be less than residential
			Indoor Air (VOCs from Subsurface)	Adult	Inhalation	Quant.	NE
		Judson Park Recreators	Irrigation Well				
				Child/Adolescent	Inhalation of Volatiles	None	Exposures expected to be less than residential
		Depot Recreators	Indoor Air (VOCs from Subsurface)	Child/Adolescent	Inhalation	None	Exposures expected to be minimal
		Commercial/Industrial Railyard Worker	Indoor Air (VOCs from Subsurface)	Adult	Inhalation	Quant	NE
Future	Groundwater	Commercial/Industrial Railyard Worker	Tap				
				Adult	Inhalation of Volatiles	None	Exposures expected to be minimal and difficult to quantify
			Irrigation Well	Adult	Inhalation of Volatiles	None	Exposures expected to be less than residential

NE = Not Eliminated
VOC = Volatile Organic Compound
VPH = Volatile Petroleum Hydrocarbon
BRA = CDM 1993, Final Report Baseline Risk Assessment Livingston Rail Yard, May 1993.
EPH = Extractable Petroleum Hydrocarbon

TABLE 3
EXPOSURE ASSUMPTIONS FOR COMMERCIAL/INDUSTRIAL WORKER - VOLATILES IN INDOOR AIR
BNSF Livingston Shop Complex Facility

Scenario Timeframe: Current & Future
Medium: Indoor Air
Exposure Medium: Indoor Air
Receptor Population: Commercial/Industrial Worker
Receptor Age: Adults

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
All	EF	Exposure Frequency	days/year	250	EPA 1991	To be included in a separate table in the
	ED	Exposure Duration	years	30	CDM 1993	risk assessment amendment
	BW-A	Body Weight - Adult	kg	70	EPA 2002, CDM 1993	
	AT-C	Averaging Time (Cancer)	days	27,375	EPA 1997	
	AT-N	Averaging Time (Non-Cancer)	days	10,950	EPA 1989	
Inhalation of VOCs Migrating to Indoor Air from Subsurface	IRA-A	Inhalation Rate (Adult)	m^3/day	10.4	EPA 1997	

Sources:

CDM 1993. Final Report Baseline Risk Assessment Livingston Rail Yard, May.

EPA 1989. Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual (Part A) Interim Final, December. EPA/540/1-89/002.

EPA 1991. Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals) Interim, December. EPA/540/1-92/003.

EPA 1997. Exposure Factors Handbook, August. EPA /600/P-95/002 Fa.

TABLE 5
NONCANCER TOXICITY DATA -- INHALATION
BNSF Livingston Shop Complex Facility

Chemical of Potential Concern	Value Inhalation RfC	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD	Dates
TPH Ranges						
Aliphatic						
C5 - C8	5.70E-02	mg/kg-d	Neurotoxicity	NA	MADEP	2004
C9 - C18	5.70E-02	mg/kg-d	Neurotoxicity	NA	MADEP	2004
C19 - C32	NA	NA	NA	NA	MADEP	2004
Aromatic						
C9 - C18	1.40E-02	mg/kg-d	(a)	NA	MADEP	2004
C9 - C32	NA	NA	NA	NA	MADEP	2004
Chlorobenzene	1.70E-02	mg/kg-d			NCEA	2004
1,2-Dichlorobenzene	5.70E-02	mg/kg-d			HEAST	1997
1,4-Dichlorobenzene	2.30E-01	mg/kg-d			IRIS	2004
cis-1,2-Dichloroethene	NA	NA	NA	NA	IRIS	2004
trans-1,2-Dichloroethene	NA	NA	NA	NA	IRIS	2004
Methylene chloride	8.60E-01	mg/kg-d			HEAST	1997
Tetrachloroethylene	1.00E-02	mg/kg-d			CA EPA	2004
Trichloroethylene	1.00E-02	mg/kg-d			NCEA	2004
Vinyl Chloride (adult/child)	2.90E-02	mg/kg-d			IRIS	2004
Vinyl Chloride (adult)	2.90E-02	mg/kg-d			IRIS	2004
Anthracene	NA	NA	NA	NA	IRIS	2004
Acenaphthalene	NA	NA	NA	NA	IRIS	2004
Benzo(a)anthracene	NA	NA	NA	NA	IRIS	2004
Benzo(a)pyrene	NA	NA	NA	NA	IRIS	2004
Benzo(b)fluoranthene	NA	NA	NA	NA	IRIS	2004
Benzo(k)fluoranthene	NA	NA	NA	NA	IRIS	2004
Chrysene	NA	NA	NA	NA	IRIS	2004
Dibenzo(a,h)anthracene	NA	NA	NA	NA	IRIS	2004
Fluoranthene	NA	NA	NA	NA	IRIS	2004
Fluorene	NA	NA	NA	NA	IRIS	2004
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	IRIS	2004
Napthalene	8.60E-04	mg/kg-d			IRIS	2004
Pyrene	NA	NA	NA	NA	IRIS	2004
Lead*	NA	NA	NA	NA	NA	NA

*Lead is evaluated separately using lead-specific models.

(a) Body weight reduction, hepatic, renal, and developmental effects

NA = Not Applicable or Not Available

References

CA EPA = California EPA as referenced in the Region 9 PRG Table

IRIS = EPA Integrated Risk Information System

HEAST = EPA Health Effects Assessment Summary Tables, 1997.

MADEP = Massachusetts Department of Environmental Protection Updated Petroleum Hydrocarbon Fraction Toxicity Values for the VPH/EPH/APH Methodology, 2003.

NCEA = EPA National Center for Environmental Assessment as referenced in the Region 9 PRG Table

Air Inhalation Factor

IFAadj = EDc*IRAc/BWc + (EDtot-EDc)*IRAa/BWa

Parameters	Values
IFAadj (Age-adjusted inhalation factor - m^3*yr/kg*day)	8
EDc (Child exposure duration - yr; EPA, December 1991)	6
IRAc (Child inhalation rate - m^3/day; EPA, August 1997)	7.5
BWc (Child body weight - kg; EPA, August 1997)	15
EDtot (Total exposure duration - yr; EPA, December 1991)	30
IRAa (Adult inhalation rate - m^3/day; EPA, August 1997)	15.2
BWa (Adult body weight - kg; EPA, August 1997)	70

Air Inhalation Factor - Recreator

IFAadj = EDc*IRAc/BWc + (EDtot-EDc)*IRAa/BWa

Parameters	Values
IFAadj (Age-adjusted inhalation factor - m^3*yr/kg*day)	2
EDc (Child exposure duration - yr; EPA, December 1991)	6
IRAc (Child inhalation rate - m^3/day; EPA, August 1997)	2.4
BWc (Child body weight - kg; EPA, August 1997)	15
EDtot (Total exposure duration - yr; EPA, December 1991)	30
IRAa (Adult inhalation rate - m^3/day; EPA, August 1997)	3.2
BWa (Adult body weight - kg; EPA, August 1997)	70

EPA 1991. Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals) Interim, December. EPA/540/1-92/003.
EPA 1997. Exposure Factors Handbook, August. EPA /600/P-95/002 Fa.