EPA
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Agency

Lead Risk Assessment Model Training

Disclaimer: The views expressed are those of the author(s) and do not necessarily reflect the views or policies of the U.S. EPA.

Day 2: July 24, 2025

Introductions and Training Overview

- **Training Leaders:**
  - EPA TRW Lead Committee Co-chairs
    - Dr. Michele Burgess (OSRTI), Dr. Charlie Partridge (R8), and Ms. Courtney Carroll (R1)
  - Dr. James Brown, EPA
  - Dr. Mark Follansbee, SRC
- **Training Goals:**
  - Overview of the 3 models used to evaluate risk from lead
    - IEUBK, ALM, and AALM
  - Exercises and demonstrations of these models

For any questions related to lead evaluation, please contact the Lead TRW by email (pbhelp@epa.gov) or visit the TRW website: https://www.epa.gov/superfund/lead-superfund-sites-technical-assistance

Agenda

Day 1:

- IEUBK and ALM in Lead Risk Assessment
- Overview of the AALM
- Discussion and Q&A
- IEUBK exercises (1-3): single runs, finding PRG, use of site-specific bioavailability information
- Discussion and Q&A

Day 2:

- IEUBK exercises (4&5): batch mode and time-weighted averaging for intermittent exposure scenarios
- Discussion and Q&A
- ALM exercise 6
- AALM demonstration and intermittent exposure example
- Discussion and Q&A

IEUBK- Practice Exercises

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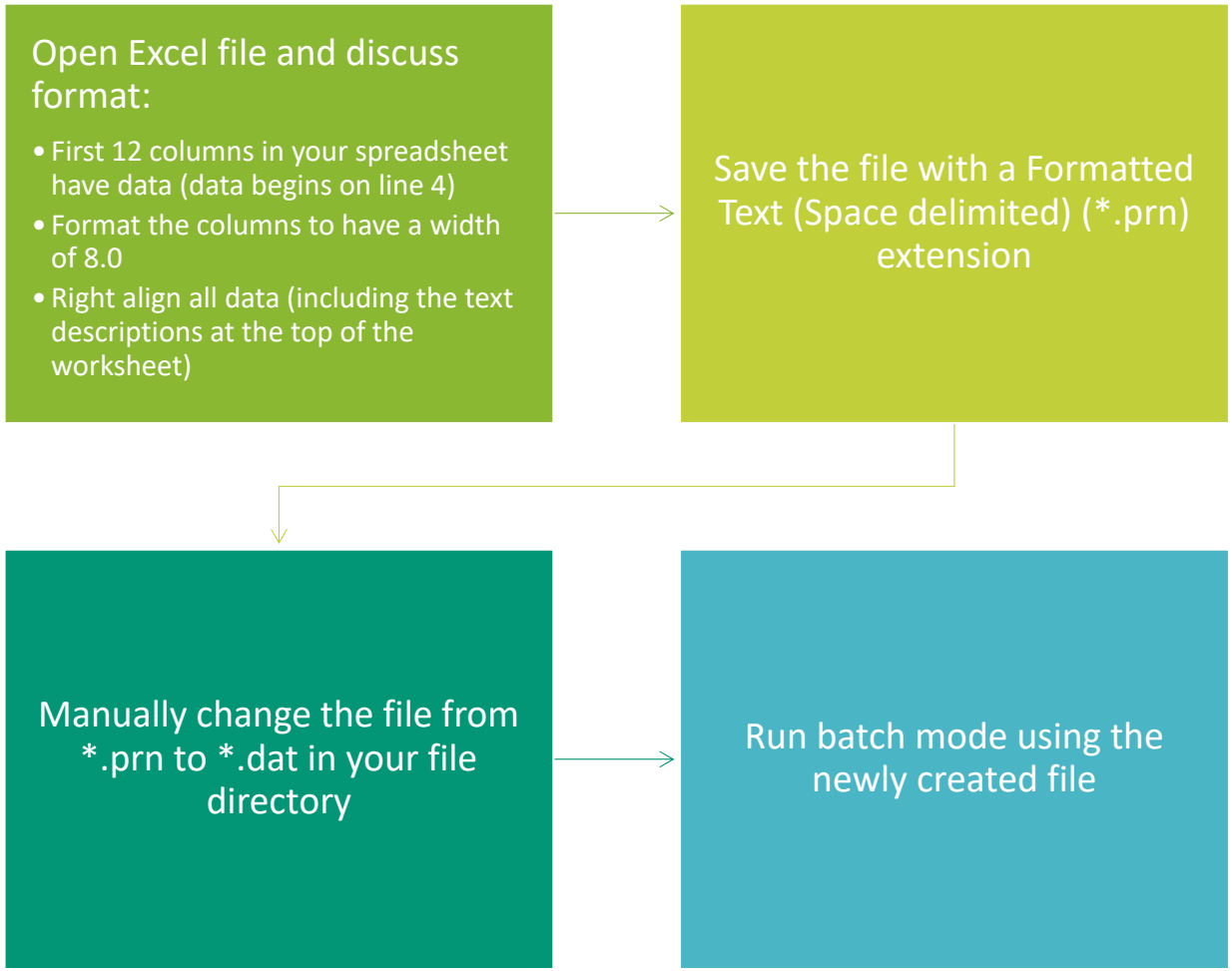
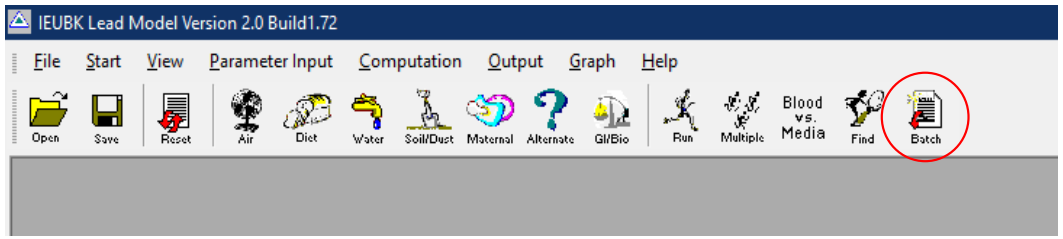
Exercise 4: Batch Mode

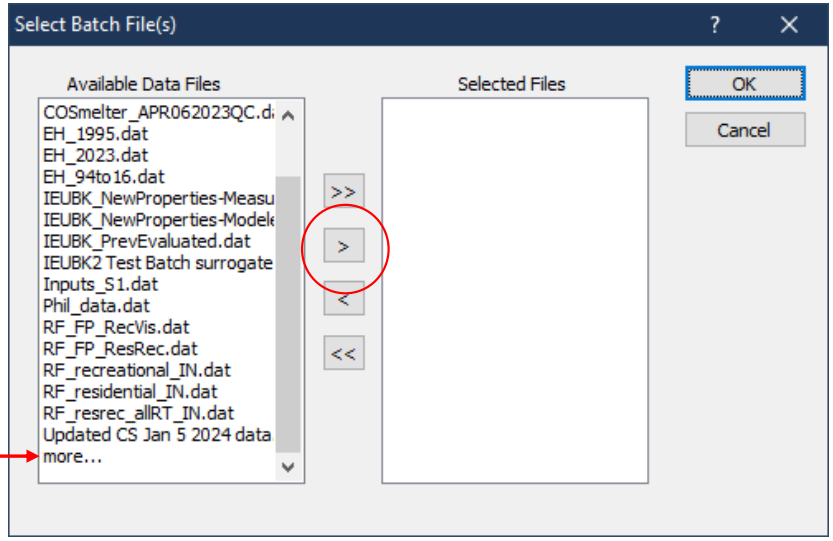
- Used to run multiple properties simultaneously
- Batch mode input file format is required
  - See IEUBK User Guide Appendix A3
- Any inputs not specified in the batch mode input file are set by the IEUBK model at time of the run
- For future scenarios, use 32-month age group. This age result approximates the 12- to 72-month average calculated in single run mode
  - Differences in the results are so small that they are not expected to impact site decisions

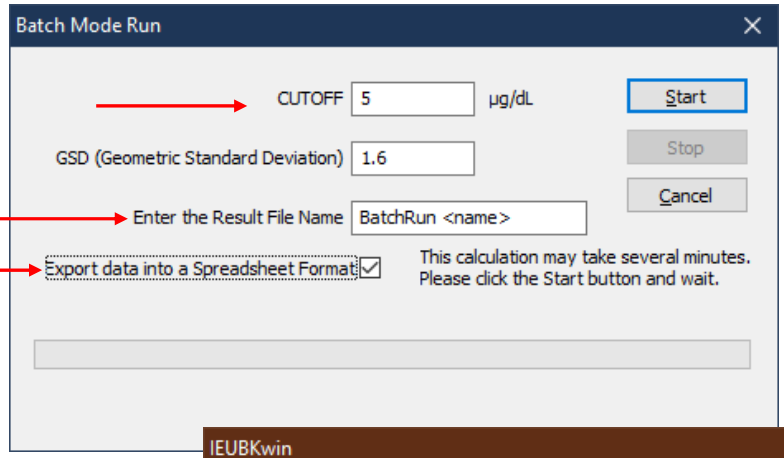
Batch mode run (Exercise Batch Mode file)

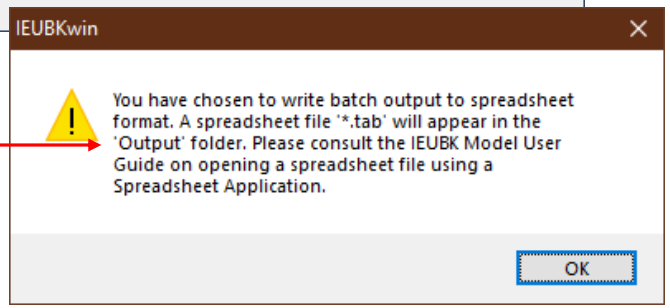


Run the batch mode input file

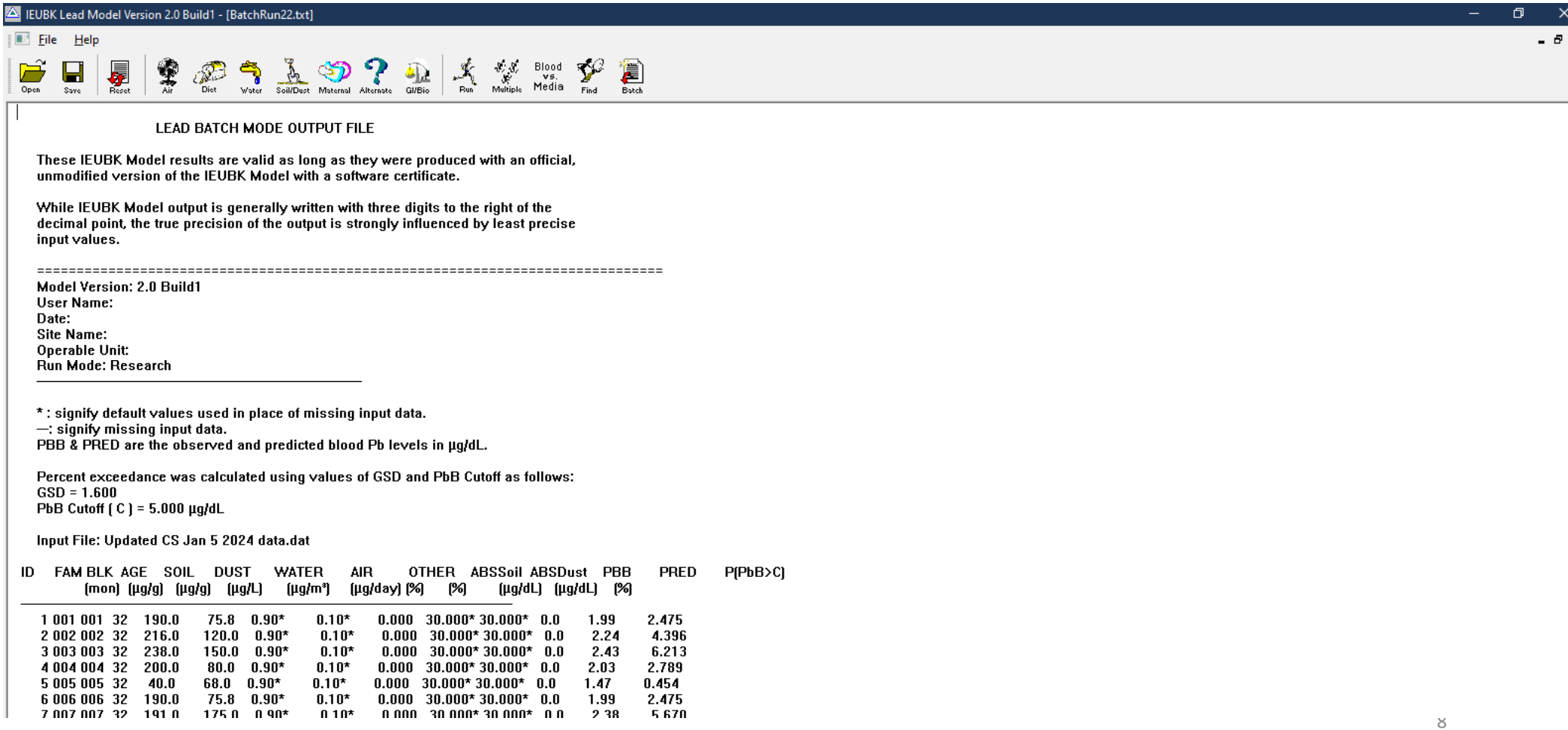








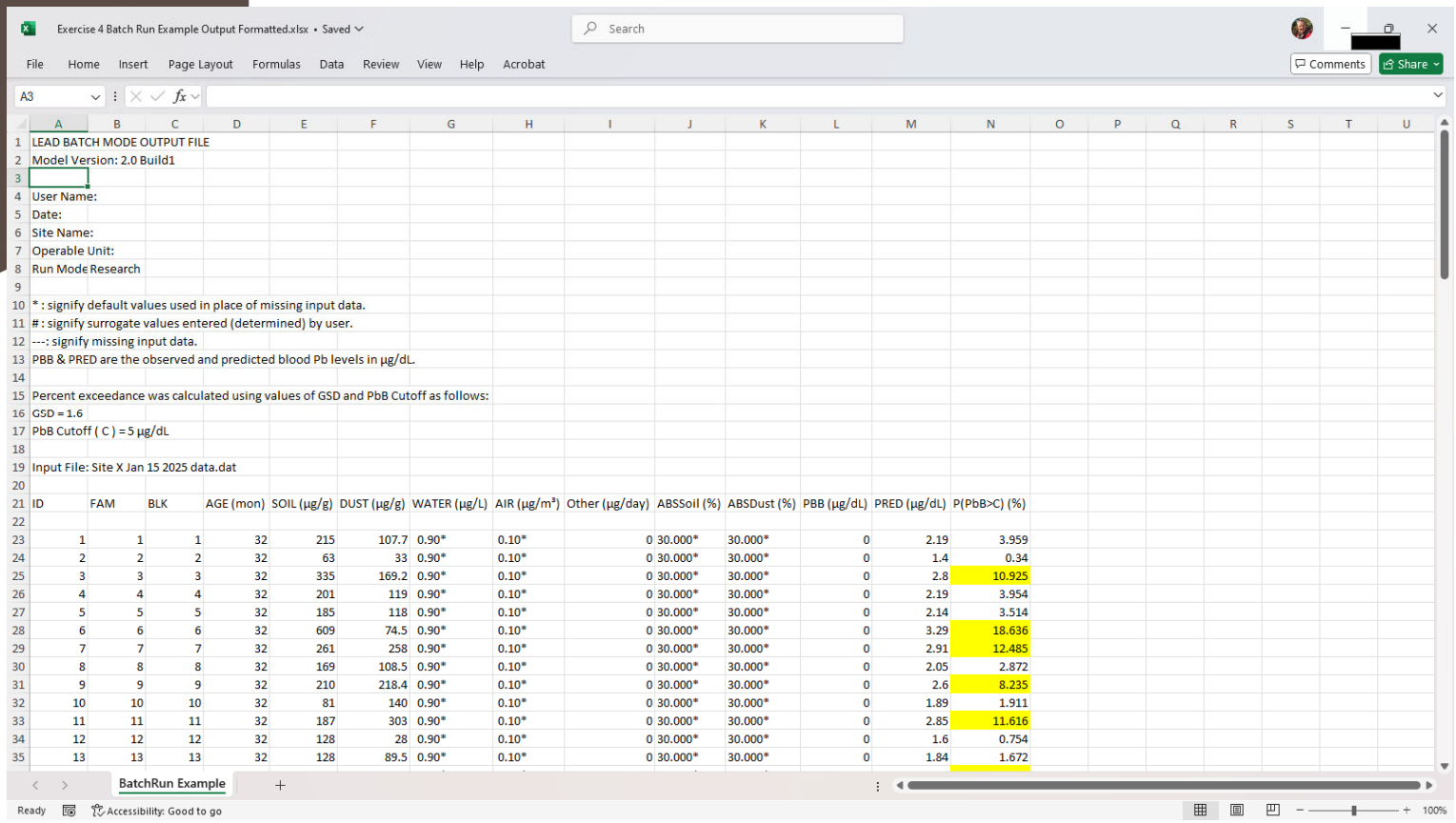
Batch mode results



Formatting Batch Mode Output

- Locate your batch mode results (TAB) file in the Output folder of your IEUBK V2 directory and import to Excel
- Adjust column width to read column headers
- Manipulate the data as desired
  - Use conditional formatting to highlight Pred (PbB) > 5%
  - Import to SAS or GIS software to map the results

Formatted results



Exercise 4 Batch Run Example Output Formatted.xlsx • Saved

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Comments Share

A3

LEAD BATCH MODE OUTPUT FILE
Model Version: 2.0 Build1

User Name:
Date:
Site Name:
Operable Unit:
Run Mode Research

* : signify default values used in place of missing input data.
# : signify surrogate values entered (determined) by user.
---: signify missing input data.
PBB & PRED are the observed and predicted blood Pb levels in µg/dL.

Percent exceedance was calculated using values of GSD and PbB Cutoff as follows:
GSD = 1.6
PbB Cutoff (C) = 5 µg/dL

Input File: Site X Jan 15 2025 data.dat

ID	FAM	BLK	AGE (mon)	SOIL (µg/g)	DUST (µg/g)	WATER (µg/L)	AIR (µg/m³)	Other (µg/day)	ABSSoil (%)	ABSDust (%)	PBB (µg/dL)	PRED (µg/dL)	P(PbB>C) (%)
1	1	1	32	215	107.7	0.90*	0.10*	0	30.000*	30.000*	0	2.19	3.959
2	2	2	32	63	33	0.90*	0.10*	0	30.000*	30.000*	0	1.4	0.34
3	3	3	32	335	169.2	0.90*	0.10*	0	30.000*	30.000*	0	2.8	10.925
4	4	4	32	201	119	0.90*	0.10*	0	30.000*	30.000*	0	2.19	3.954
5	5	5	32	185	118	0.90*	0.10*	0	30.000*	30.000*	0	2.14	3.514
6	6	6	32	609	74.5	0.90*	0.10*	0	30.000*	30.000*	0	3.29	18.636
7	7	7	32	261	258	0.90*	0.10*	0	30.000*	30.000*	0	2.91	12.485
8	8	8	32	169	108.5	0.90*	0.10*	0	30.000*	30.000*	0	2.05	2.872
9	9	9	32	210	218.4	0.90*	0.10*	0	30.000*	30.000*	0	2.6	8.235
10	10	10	32	81	140	0.90*	0.10*	0	30.000*	30.000*	0	1.89	1.911
11	11	11	32	187	303	0.90*	0.10*	0	30.000*	30.000*	0	2.85	11.616
12	12	12	32	128	28	0.90*	0.10*	0	30.000*	30.000*	0	1.6	0.754
13	13	13	32	128	89.5	0.90*	0.10*	0	30.000*	30.000*	0	1.84	1.672

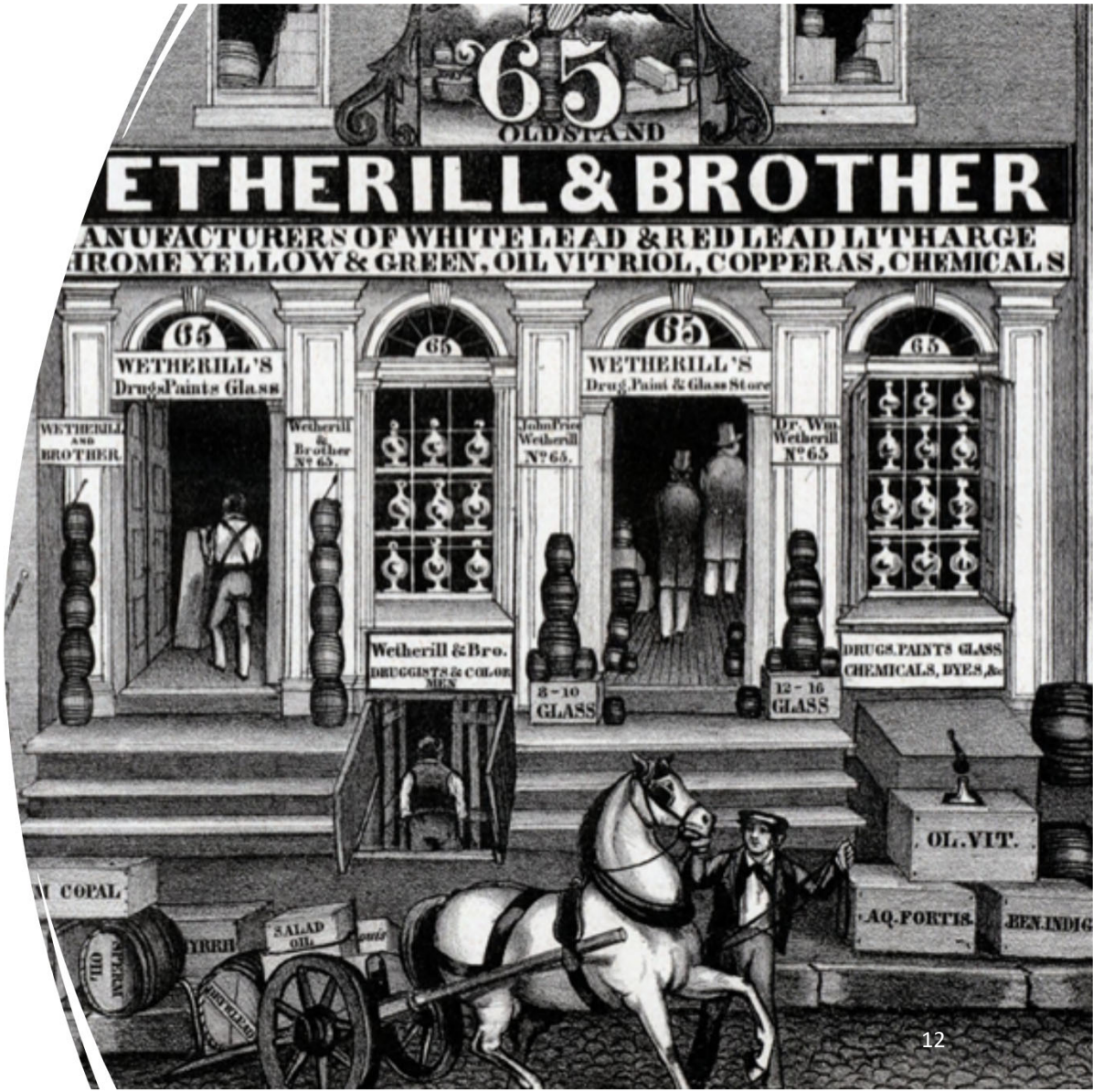
BatchRun Example

Ready Accessibility: Good to go 100%

Batch Mode Comments

- Change run conditions quickly in the IEUBK model
  - Alternate intake, intake rates for all media, bioavailability (if asterisks are used)
- Allows users to run very large data sets (under the same model conditions set by the user)
- Allows users to calculate a dust lead concentration from outdoor soil lead
- Can queue multiple files and run sequentially
  - Results will be stacked in output file with header identifiers

Please put questions in the Q&A chat



Exercise 5: Simple Time Weighting and Intermittent Exposure

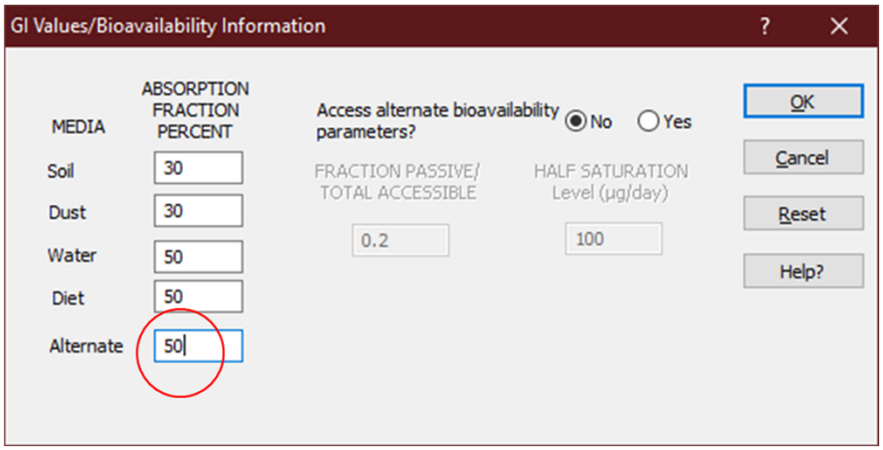
- Used for exposure scenarios when child receptors are splitting time between multiple locations
  - Day care, second residence
  - Parks, recreation areas
- See US EPA 2024 Intermittent Exposure Guidance
- Minimum exposure frequency and duration
  - No less than 1 day per week for 3 consecutive months

Risk Assessment for River Park

- Hypothetical site consists of a small community of homes abutting a river park downstream from an area with sediment contaminated with tailings. Site information indicates local resident children recreate at a local river park **2 days per week** (on average) and children of all ages wade and/or swim for **1 hour/day** from May-August
- Site information:
  - Seven local residences with soil lead concentrations of **50, 75, 100, 125, 150, 175, 200 mg/kg**
  - Beach sediment lead concentration is **310 mg/kg**
  - **No RBA** information for solid media at the site
  - River water lead concentration is 25 µg/L (**0.025 µg/mL**)
- Based on professional judgment (and informed by EFH Table 3-7), you have elected to use **40 mL/hour** as the incidental ingestion rate of surface water while swimming and wading. Intake is (0.025 µg/mL * 40 mL/hour) or **1 µg Pb/day.** Enter this as an alternate intake
- Assess P5 risk for the site, including site-specific media exposures to soil, sediment, and surface water

Process for the Intermittent Exposure Assessment

1. Do TWA calculations
2. Batch run file input calculations
3. Create batch input file
   1. Save as PRN
   2. Change to DAT
4. Open IEUBK
5. Set RBA for alternate source (or load from SVD)
   - This is because exposure to water while swimming is being evaluated as an alternate intake in the model (the alternate AF is 50% because water's AF is 50%)
6. Run batch mode and format results



Weighting Soil Lead Concentration Term

Site information

- Residential soil lead concentrations: (A) 50, (B) 75, (C) 100 , (D) 125, (E) 150, (F) 175, (G) 200 mg/kg
- Beach sediment lead concentration is 310 mg/kg

Soil lead concentration is time weighted according to US EPA (2024):

$$PbS_w = (PbS_{home} * time_{home}) + (PbS_{site} * time_{site})$$

Where:

PbS_w = time weighted soil lead concentration; mg/kg

PbS_{home} = residential soil lead concentration; mg/kg

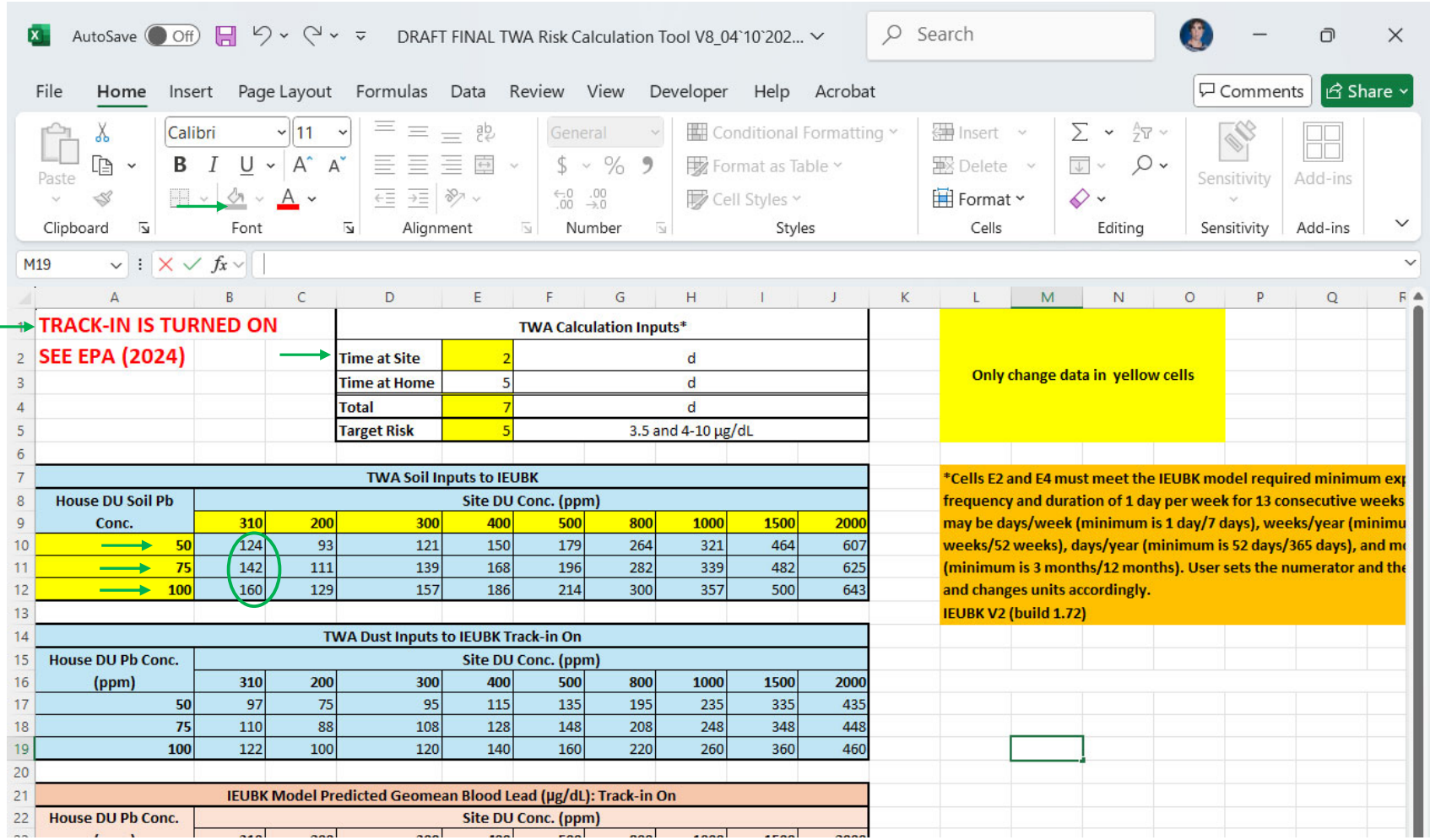
$time_{home}$ = fraction of time at home (e.g., 5 days out of 7 days or 5/7); unitless

PbS_{site} = site soil lead concentration; mg/kg

$time_{site}$ = fraction of time at site (e.g., 2 days out of 7 days or 2/7); unitless

Calculate PbS_w using the **TWA calculator tool** or your own spreadsheet

Weighted Soil Lead Concentrations



AutoSave Off | DRAFT FINAL TWA Risk Calculation Tool V8_04`10`202... | Search

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Clipboard | Font | Alignment | Number | Styles | Cells | Editing | Sensitivity | Add-ins

M19

TRACK-IN IS TURNED ON

SEE EPA (2024)

TWA Calculation Inputs*		
Time at Site	2	d
Time at Home	5	d
Total	7	d
Target Risk	5	3.5 and 4-10 µg/dL

Only change data in yellow cells

*Cells E2 and E4 must meet the IEUBK model required minimum exp
frequency and duration of 1 day per week for 13 consecutive weeks
may be days/week (minimum is 1 day/7 days), weeks/year (minimu
weeks/52 weeks), days/year (minimum is 52 days/365 days), and m
(minimum is 3 months/12 months). User sets the numerator and the
and changes units accordingly.
IEUBK V2 (build 1.72)

TWA Soil Inputs to IEUBK									
House DU Soil Pb Conc.	Site DU Conc. (ppm)								
	310	200	300	400	500	800	1000	1500	2000
50	124	93	121	150	179	264	321	464	607
75	142	111	139	168	196	282	339	482	625
100	160	129	157	186	214	300	357	500	643

TWA Dust Inputs to IEUBK Track-in On									
House DU Pb Conc. (ppm)	Site DU Conc. (ppm)								
	310	200	300	400	500	800	1000	1500	2000
50	97	75	95	115	135	195	235	335	435
75	110	88	108	128	148	208	248	348	448
100	122	100	120	140	160	220	260	360	460

IEUBK Model Predicted Geomean Blood Lead (µg/dL): Track-in On	
House DU Pb Conc.	Site DU Conc. (ppm)

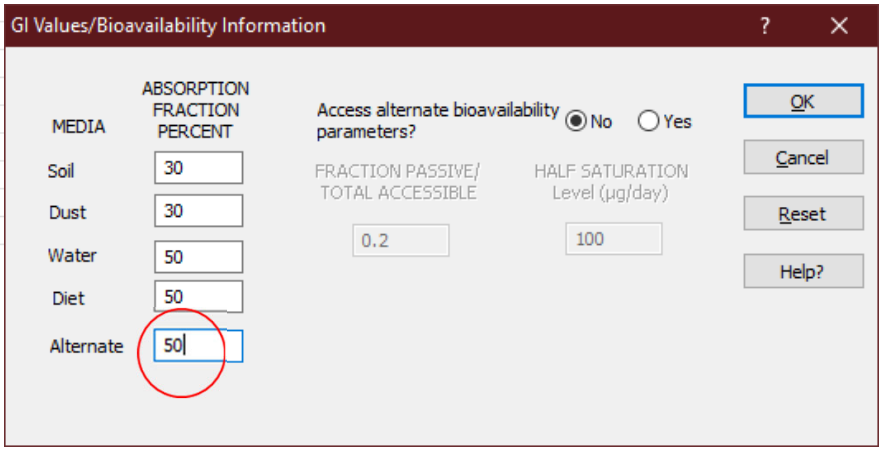
Preparing to Run Batch Mode

- Create a batch mode input file
  - Do calculations in one tab and copy this tab as numbers (no formulae) into the batch input file

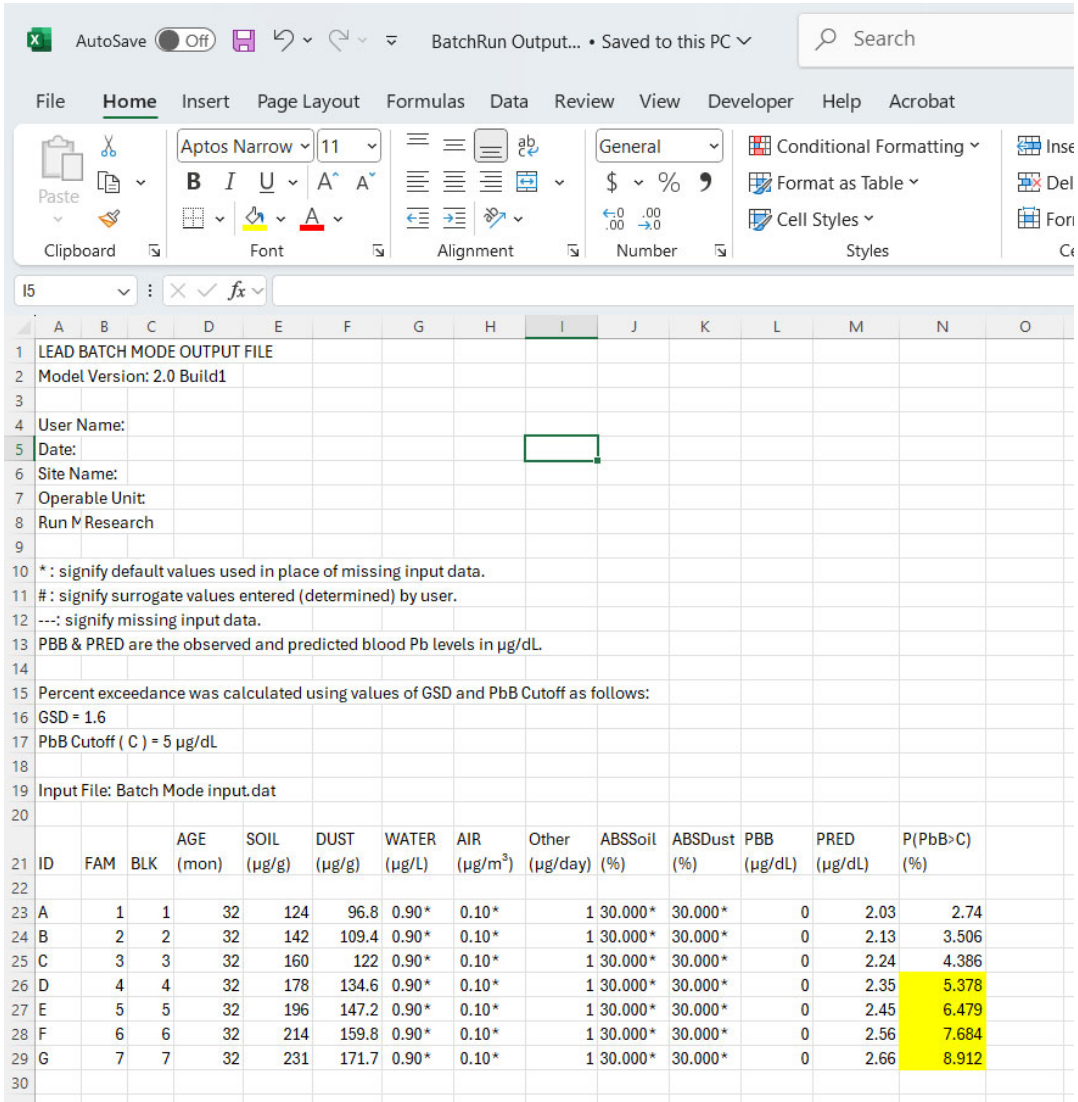
F16

	A	B	C	D	E	F	G	H	I	J	K	L
1	IEUBK input data file example											
2	NOTE: actual data begins on line 4!!											
3	ID	FAM	BLOCK	AGE	SOIL	DUST	WATER	AIR	OTHER	PbB	ABSSoil	ABSDust
4	A	1	1	32	124	96.8	*	*	1	0	*	*
5	B	2	2	32	142	109.4	*	*	1	0	*	*
6	C	3	3	32	160	122	*	*	1	0	*	*
7	D	4	4	32	178	134.6	*	*	1	0	*	*
8	E	5	5	32	196	147.2	*	*	1	0	*	*
9	F	6	6	32	214	159.8	*	*	1	0	*	*
10	G	7	7	32	231	171.7	*	*	1	0	*	*
11												
12												

- Batch file has PbSw concentrations from TWA calculator, calculated MSA dust (where PbDw = [PbSw*0.7] + [PbA *100]), and surface water
- Remember to change the Alt Source AF=50%



Results



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Aptos Narrow 11 | General | Conditional Formatting | Format as Table | Cell Styles

Clipboard Font Alignment Number Styles

I5

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	LEAD BATCH MODE OUTPUT FILE														
2	Model Version: 2.0 Build1														
3															
4	User Name:														
5	Date:														
6	Site Name:														
7	Operable Unit:														
8	Run M Research														
9															
10	* : signify default values used in place of missing input data.														
11	# : signify surrogate values entered (determined) by user.														
12	---: signify missing input data.														
13	PBB & PRED are the observed and predicted blood Pb levels in µg/dL.														
14															
15	Percent exceedance was calculated using values of GSD and PbB Cutoff as follows:														
16	GSD = 1.6														
17	PbB Cutoff (C) = 5 µg/dL														
18															
19	Input File: Batch Mode input.dat														
20															
21	ID	FAM	BLK	AGE (mon)	SOIL (µg/g)	DUST (µg/g)	WATER (µg/L)	AIR (µg/m^3)	Other (µg/day)	ABSSoil (%)	ABSDust (%)	PBB (µg/dL)	PRED (µg/dL)	P(PbB>C) (%)	
22															
23	A	1	1	32	124	96.8	0.90*	0.10*	1	30.000*	30.000*	0	2.03	2.74	
24	B	2	2	32	142	109.4	0.90*	0.10*	1	30.000*	30.000*	0	2.13	3.506	
25	C	3	3	32	160	122	0.90*	0.10*	1	30.000*	30.000*	0	2.24	4.386	
26	D	4	4	32	178	134.6	0.90*	0.10*	1	30.000*	30.000*	0	2.35	5.378	
27	E	5	5	32	196	147.2	0.90*	0.10*	1	30.000*	30.000*	0	2.45	6.479	
28	F	6	6	32	214	159.8	0.90*	0.10*	1	30.000*	30.000*	0	2.56	7.684	
29	G	7	7	32	231	171.7	0.90*	0.10*	1	30.000*	30.000*	0	2.66	8.912	
30															

RBA-adjusted Exposure Point Concentration (EPC)

- What if this exercise (#5) had different bioavailability information for lead in the soil and sediment?
- The recommended approach is to incorporate the bioavailability adjustment in the exposure point concentration (EPC) by calculating RBA-adjusted EPCs.
- RBA-adjusted EPC approach is discussed in EPA (2021), "*Guidance for Sample Collection for In Vitro Bioaccessibility Assay for Arsenic and Lead in Soil and Applications of Relative Bioavailability Data in Human Health Risk Assessment.*"
  - See Attachment C Case Study of EPA (2021) for further detail

Site-specific Bioavailability Information is Incorporated into the Soil Concentration Term

- Instead of updating the bioavailability information in the IEUBK "GI Values/ Bioavailability" window, users can adjust the soil concentration (EPC):

$$RBA_{adjusted}\ EPC = EPC * RBA_{fraction}$$

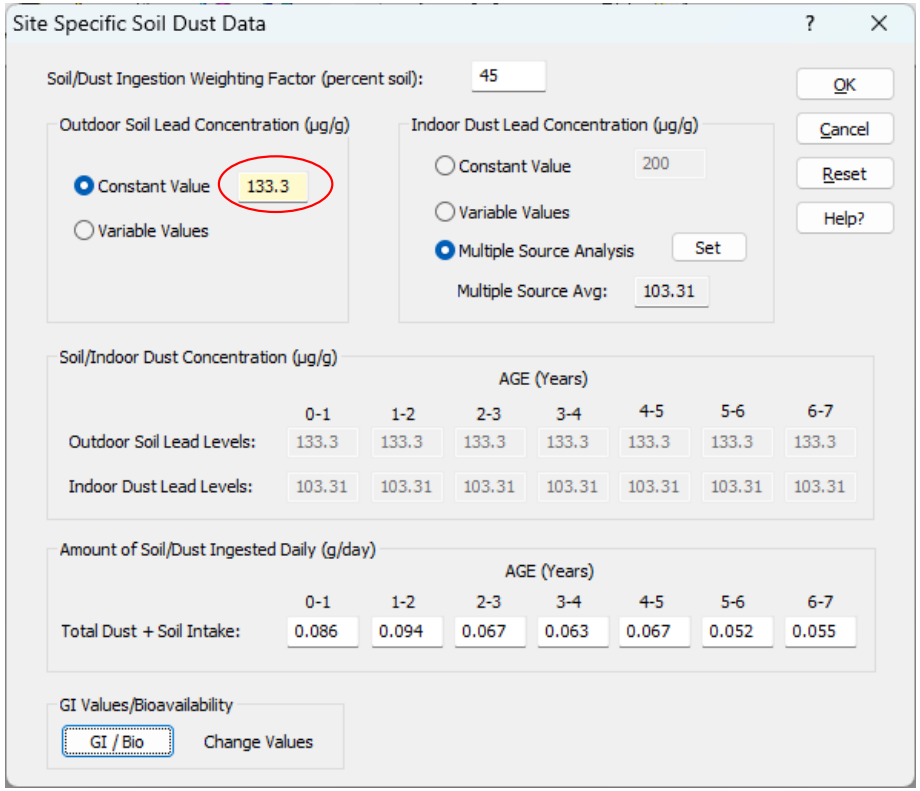
Where:

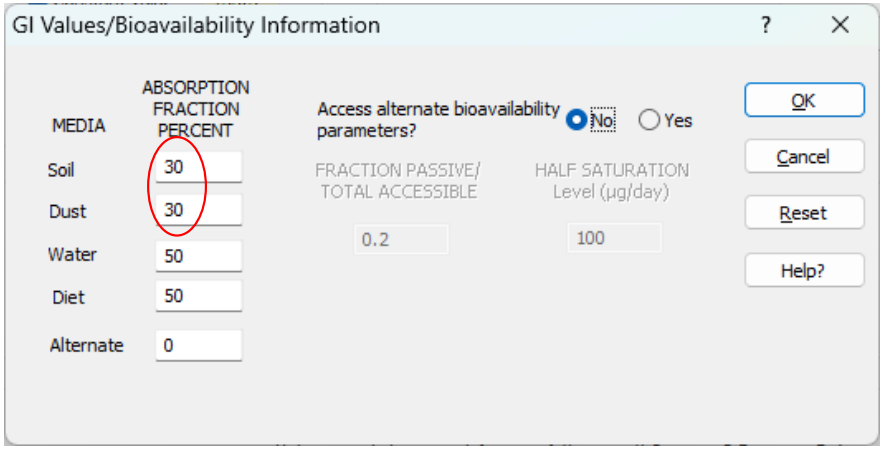
$$RBA_{fraction} = \text{observed } RBA_{media} \div \text{default } RBA_{media}$$

For example, $RBA_{adjusted}$ EPC for 200 mg/kg and observed RBA= 40% (default RBA= 60%)

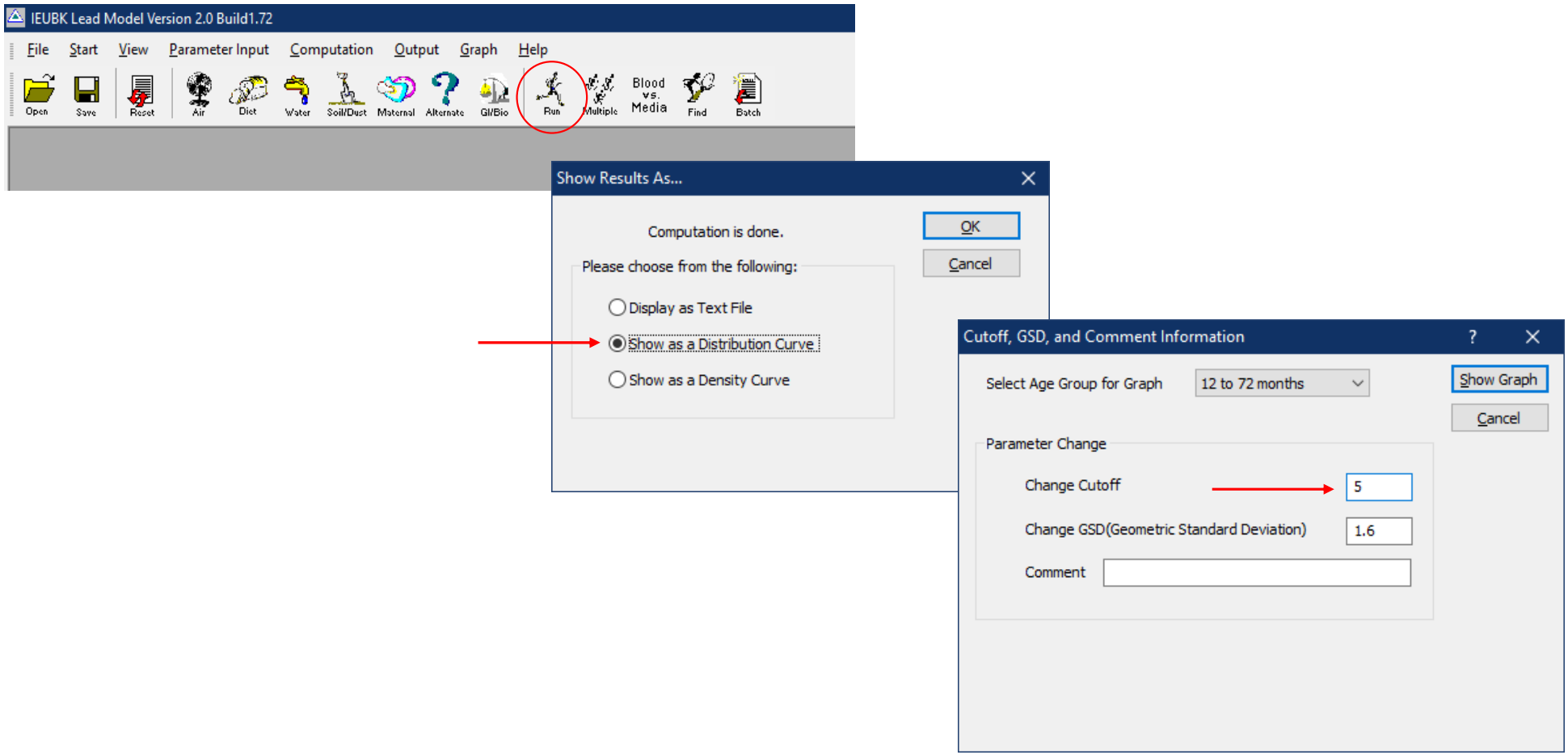
$RBA_{adjusted}$ EPC= 200 * (40/60) = 133.3 mg/kg

Use RBA-adjusted Soil EPC and Keep Default Bioavailability Values

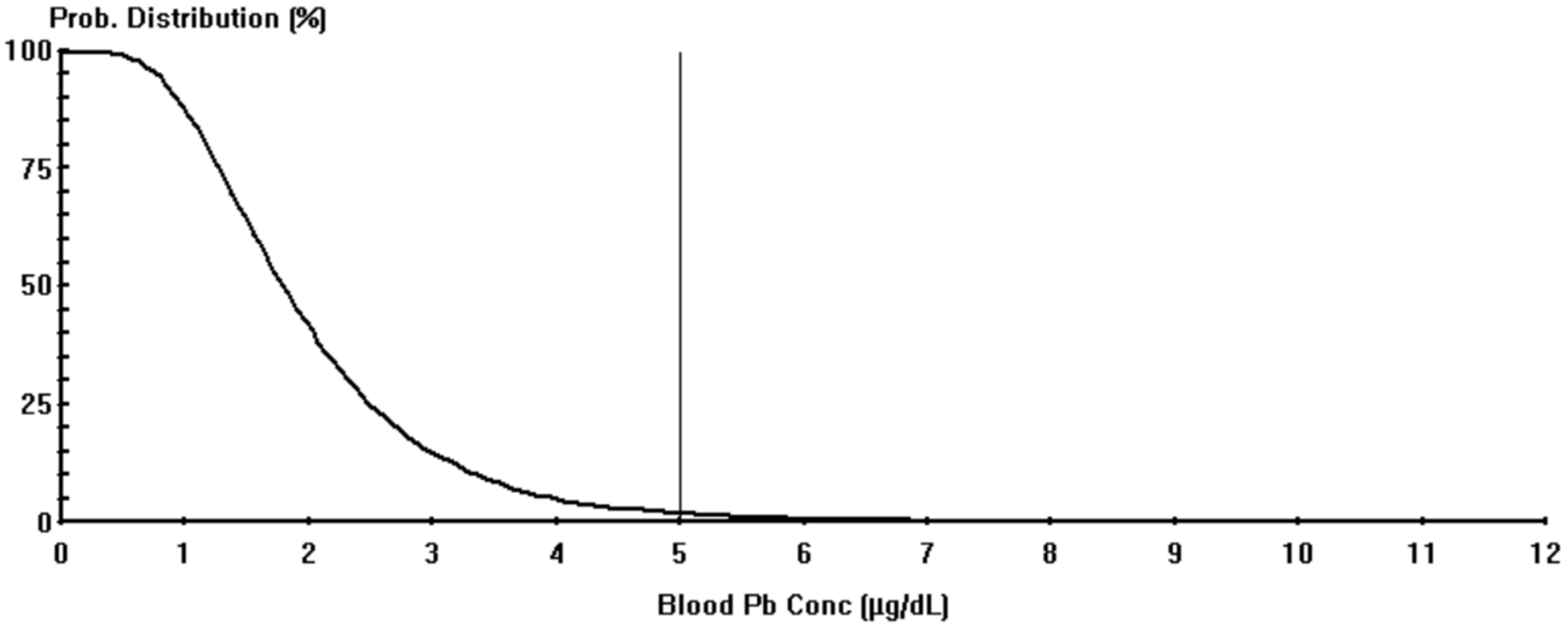




Run the Model



Using RBA = 40% as a $RBA_{adjusted}$ EPC



Cutoff = 5.000 µg/dl
Geo Mean = 1.893
GSD = 1.600
% Above = 1.938

Age Range = 12 to 72 months

Run Mode = Research

Discussion and Q&A

ALM–Practice Exercise

Disclaimer: The views expressed are those of the author(s) and do not necessarily reflect the views or policies of the U.S. EPA.

Adult Lead Methodology

Calculation of Preliminary Remediation Goals (PRGs) for Soil in Nonresidential Areas			
U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee			
Version date 06/14/2017			**EDIT RED CELLS**
Variable	**Description of Variable**	**Units**	**GSDi and PbBo from Analysis of NHANES 2009-2014**
$PbB_{fetal,\ 0.95}$	Target PbB in fetus (e.g., 2-8 µg/dL)	µg/dL	5
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	µg/dL	0.6
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050
$AF_{S,\ D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S,\ D}$	Exposure frequency (same for soil and dust)	days/yr	219
$AT_{S,\ D}$	Averaging time (same for soil and dust)	days/yr	365
PRG in Soil for no more than 5% probability that fetal PbB exceeds target PbB		**ppm**	**1,050**

Overview of the Adult Lead Methodology (ALM)

- ALM is a lead risk spreadsheet tool for Superfund site assessment
- Site-specific conceptual model shows complete exposure pathway for non-residential area
- Soil or sediment exposure to children older than 7 years, adolescents, or adults

Common Exposure Scenarios for the ALM

- Utility work
- Construction work
- Youth trespassers (>7 years old)
- Office work
- Landscaping

Application of the ALM

- In the forward direction, ALM can assess risk
  - Probability (%) of exceeding a user defined target blood lead concentration
- In the backward direction, ALM can derive preliminary remediation goals (PRGs)
  - Maximum soil lead concentration for the exposure scenario that meets the risk goal (no more than 5% probability of exceeding the user-defined target blood lead concentration)

Minimum Exposure for the ALM

- Exposure frequency (EF) ≥1 day/week
- Exposure duration ≥13 consecutive weeks

ALM Information Needed to Calculate Risk

- Required
  - Average soil lead concentration
  - Exposure frequency (average)
  - Exposure duration (average)
  - Typical (50 mg soil/day) or contact intensive (100 mg soil/day) exposure to soil (average soil dust ingestion rate)
  - Target blood lead concentration
- Encouraged
  - Bioavailability information

- ALM output is the probability (%) that fetal blood lead concentration will exceed the user-defined target blood lead concentration.

ALM Information Needed to Calculate PRG

- Required
  - Exposure frequency
  - Exposure duration
  - Typical or contact intensive exposure to soil (soil dust ingestion rate)
  - Target blood lead concentration
- Encouraged
  - Bioavailability information

- ALM output is the maximum soil lead concentration that does not exceed 5% probability that fetal blood lead concentration will exceed the user-defined target blood lead concentration

Hypothetical Example: Utility Corridor Scenario

Available site information

- Adult workers exposed to contaminated soil at depth 5 d/wk for 20 consecutive weeks
- Soil lead contamination at depth differs for 3 portions of the site
  - Area A = 1500 ppm
  - Area B = 800 ppm
  - Area C = 108 ppm

Hypothetical Example: Utility Corridor Scenario

Use the ALM to

1. Calculate risk for the 3 areas
2. Calculate a site-specific PRG

Risk target for this site is no more than 5% probability of exceeding 5 µg/dL (P5)

Risk Calculation Steps

Calculations of Blood Lead Concentrations (PbBs) and Risk in Nonresidential A as
U.S. EPA Technical Review Workgroup for Lead
Version date 06/14/2017

Edit Red Cells

CURRENT

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 2009-2014	GSDi and PbBo from Analysis of NHANES 2007-2010	GSDi and PbBo from Analysis of NHANES 2004-2007	GSDi and PbBo from Analysis of NHANES III (Phases 1&2)
PbS	Soil lead concentration	µg/g or ppm	1054		776	100
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4	0.4	0.4	0.4
GSD_i	Geometric standard deviation PbB	--	1.8	1.7	1.8	2.1
PbB_0	Baseline PbB	µg/dL	0.6	0.7	1.0	1.5
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050		0.050	0.050
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--	--	--	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--	--	--	--
K_{SD}	Mass fraction of soil in dust	--	--	--	--	--
$AF_{S,D}$	Absorption fraction (same for soil and dust)	--	0.12	0.12	0.12	0.12
$EF_{S,D}$	Exposure frequency (same for soil and dust)	days/yr	219	219	219	219
$AT_{S,D}$	Averaging time (same for soil and dust)	days/yr	365		365	365
PbB_{adult}	PbB of adult worker, geometric mean	µg/dL	2.1	2.3	2.1	1.6
$PbB_{fetal,0.95}$	95th percentile PbB among fetuses of adult workers	µg/dL	5.0	5.0	5.0	5.0
PbB_t	Target PbB level of concern (e.g., 2-8 ug/dL)	µg/dL	**5.0**		**5.0**	**5.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB exceeds target PbB, assuming lognormal distribution**	**%**	**5.0%**	**5.0%**	**5.0%**	**5.0%**

Risk Calculation: Area A

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 2009-2014
PbS	Soil lead concentration	µg/g or ppm	1500
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	µg/dL	0.6
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S,D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S,D}$	Exposure frequency (same for soil and dust)	days/yr	100
$AT_{S,D}$	Averaging time (same for soil and dust)	days/yr	140
PbB_{adult}	PbB of adult worker, geometric mean	µg/dL	5.7
$PbB_{fetal,\ 0.95}$	95th percentile PbB among fetuses of adult workers	µg/dL	13.6
PbB_t	Target PbB level of concern (e.g., 2-8 ug/dL)	µg/dL	**5.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB exceeds target PbB, assuming lognormal distribution**	**%**	**52.2%**

Risk Calculation: Area B

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 2009-2014
PbS	Soil lead concentration	µg/g or ppm	800
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	µg/dL	0.6
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S,D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S,D}$	Exposure frequency (same for soil and dust)	days/yr	100
$AT_{S,D}$	Averaging time (same for soil and dust)	days/yr	140
PbB_{adult}	PbB of adult worker, geometric mean	µg/dL	3.3
$PbB_{fetal,\ 0.95}$	95th percentile PbB among fetuses of adult workers	µg/dL	7.9
PbB_t	Target PbB level of concern (e.g., 2-8 ug/dL)	µg/dL	**5.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB exceeds target PbB, assuming lognormal distribution**	**%**	**19.4%**

Risk Calculation: Area C

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 2009-2014
PbS	Soil lead concentration	µg/g or ppm	108
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	µg/dL	0.6
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S,D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S,D}$	Exposure frequency (same for soil and dust)	days/yr	100
$AT_{S,D}$	Averaging time (same for soil and dust)	days/yr	140
PbB_{adult}	PbB of adult worker, geometric mean	µg/dL	1.0
$PbB_{fetal,\ 0.95}$	95th percentile PbB among fetuses of adult workers	µg/dL	2.3
PbB_t	Target PbB level of concern (e.g., 2-8 ug/dL)	µg/dL	**5.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB exceeds target PbB, assuming lognormal distribution**	**%**	**0.1%**

PRG Calculation Steps

Calculations of Preliminary Remediation Goals (PRGs) for Soil in Nonresidential eas

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 06/14/2017

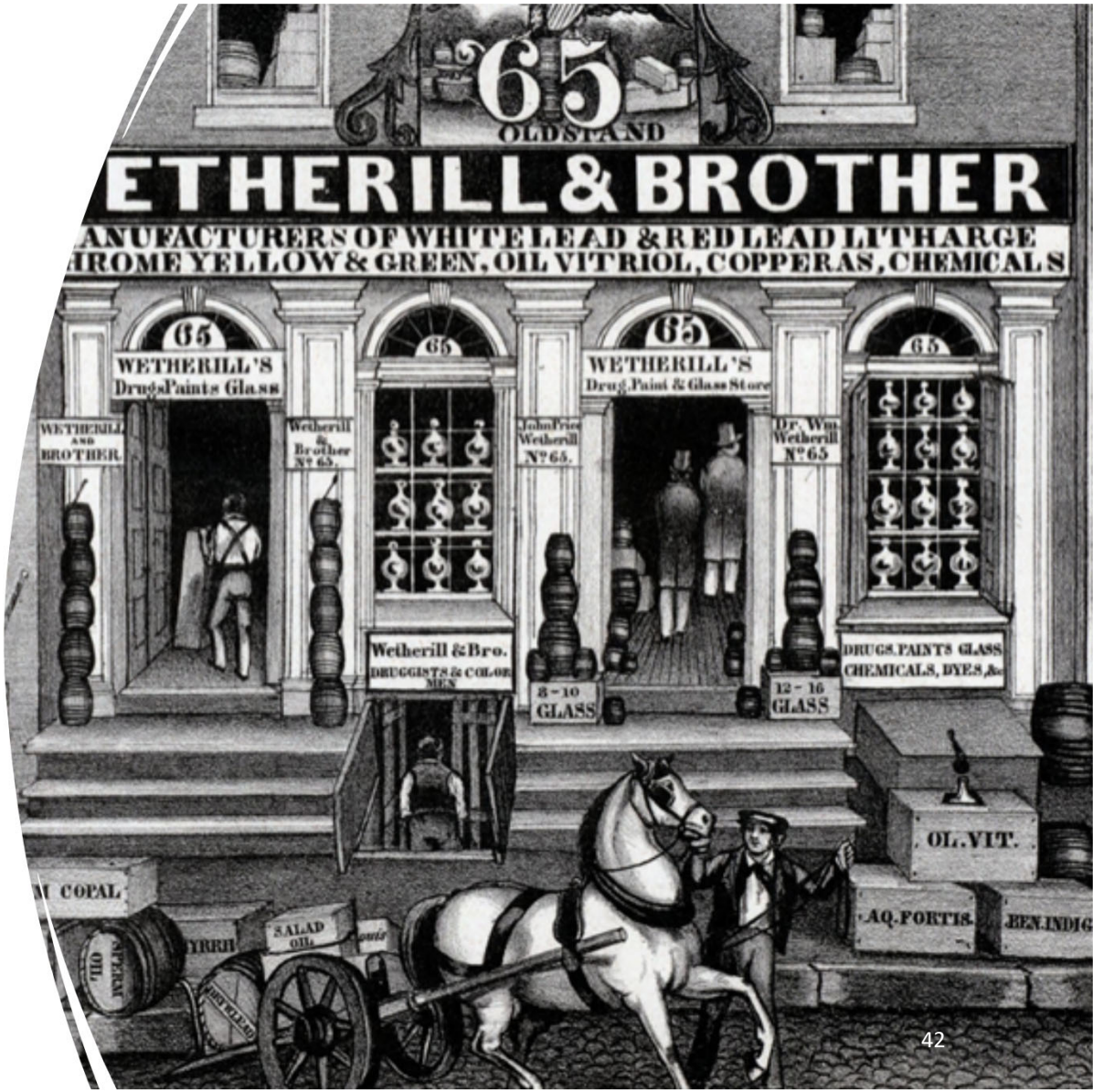
EDIT RED CELLS

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 2009-2014	GSDi and PbBo from Analysis of NHANES 2007-2010	GSDi and PbBo from Analysis of NHANES 1999-2004	GSDi and PbBo from Analysis of NHANES III (Phases 1&2)
$PbB_{fetal,\ 0.95}$	Target PbB in fetus (e.g., 2-8 µg/dL)	µg/dL	5	5	5	5
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4	0.4	0.4	0.4
GSD_i	Geometric standard deviation PbB	--	1.8	1.7	1.8	2.1
PbB_0	Baseline PbB	µg/dL	0.6	0.7	1.0	1.5
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050	0.050	0.050	0.050
$AF_{S,\ D}$	Absorption fraction (same for soil and dust)	--	0.12	0.12	0.12	0.12
$EF_{S,\ D}$	Exposure frequency (same for soil and dust)	days/yr	219	219	219	219
$AT_{S,\ D}$	Averaging time (same for soil and dust)	days/yr	365	365	365	365
PRG in Soil for no more than 5% probability that fetal PbB exceeds target PbB		**ppm**	**1,050**	**1,126**	**773**	**97**

PRG Calculation for Site

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 2009-2014
$PbB_{fetal,\ 0.95}$	Target PbB in fetus (e.g., 2-8 µg/dL)	µg/dL	5
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	µg/dL	0.6
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100
$AF_{S,\ D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S,\ D}$	Exposure frequency (same for soil and dust)	days/yr	100
$AT_{S,\ D}$	Averaging time (same for soil and dust)	days/yr	140
PRG in Soil for no more than 5% probability that fetal PbB exceeds target PbB		**ppm**	**441**

Please put questions in the Q&A chat

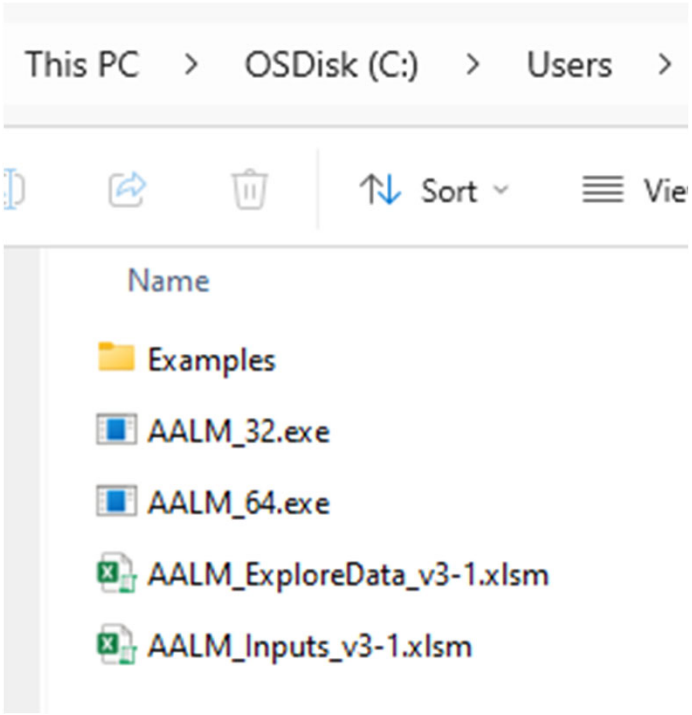


AALM Demonstration IEUBK Simulation and Intermittent Exposure Example

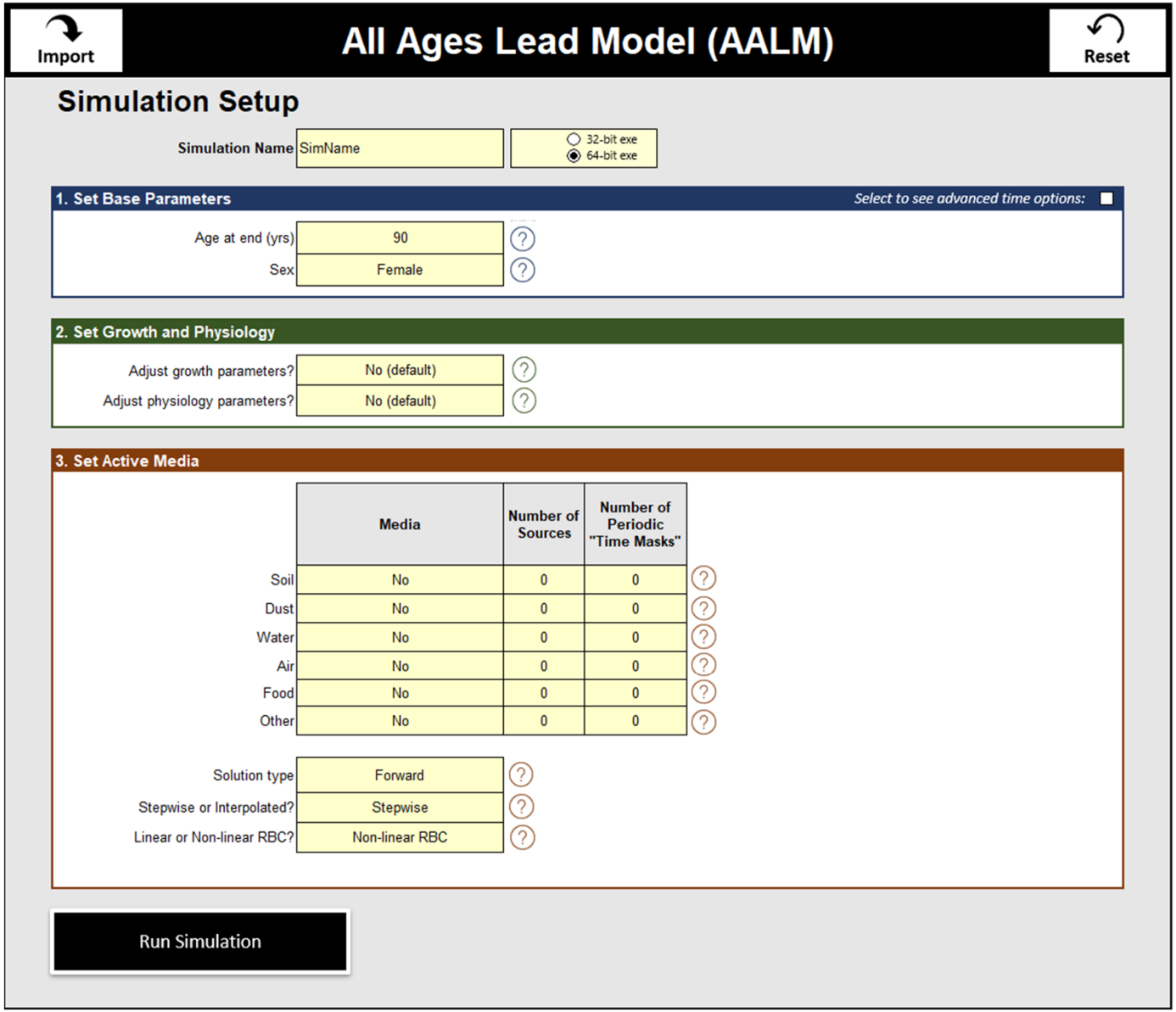
Disclaimer: The views expressed are those of the author(s) and do not necessarily reflect the views or policies of the U.S. EPA.

AALM Installation

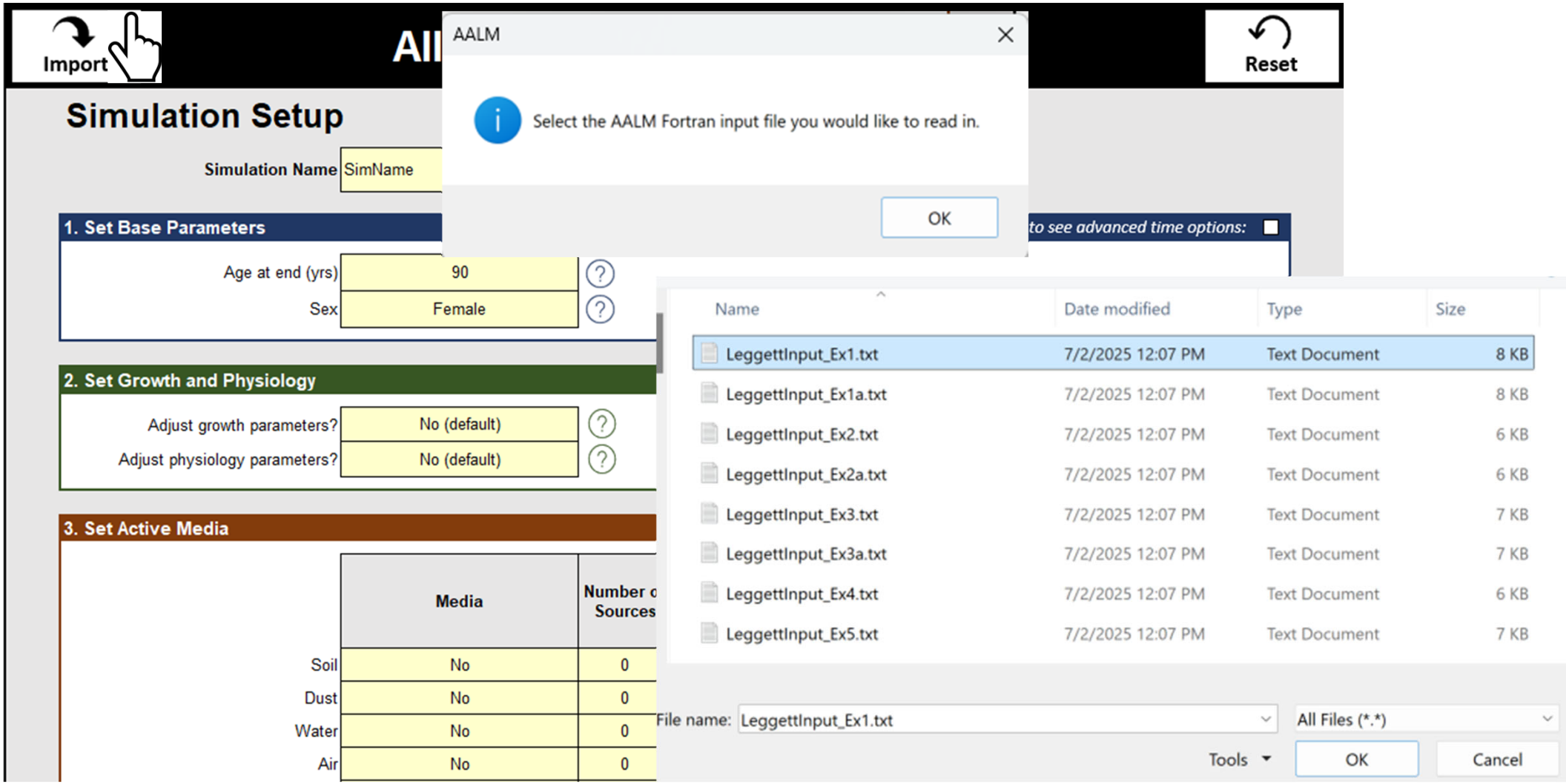
- Run from c: drive area where users have read & write access
- Three primary files
  - AALM_Inputs_v3-1.xlsm
    - Setup and run simulations
  - AALM_ExploreData_v3-1.xlsm
    - View simulation results
  - AALM_64.exe
    - Executable that performs calculations
- Examples folder
  - Eight files that can be imported to run AALM simulations discussed in the User's Guide

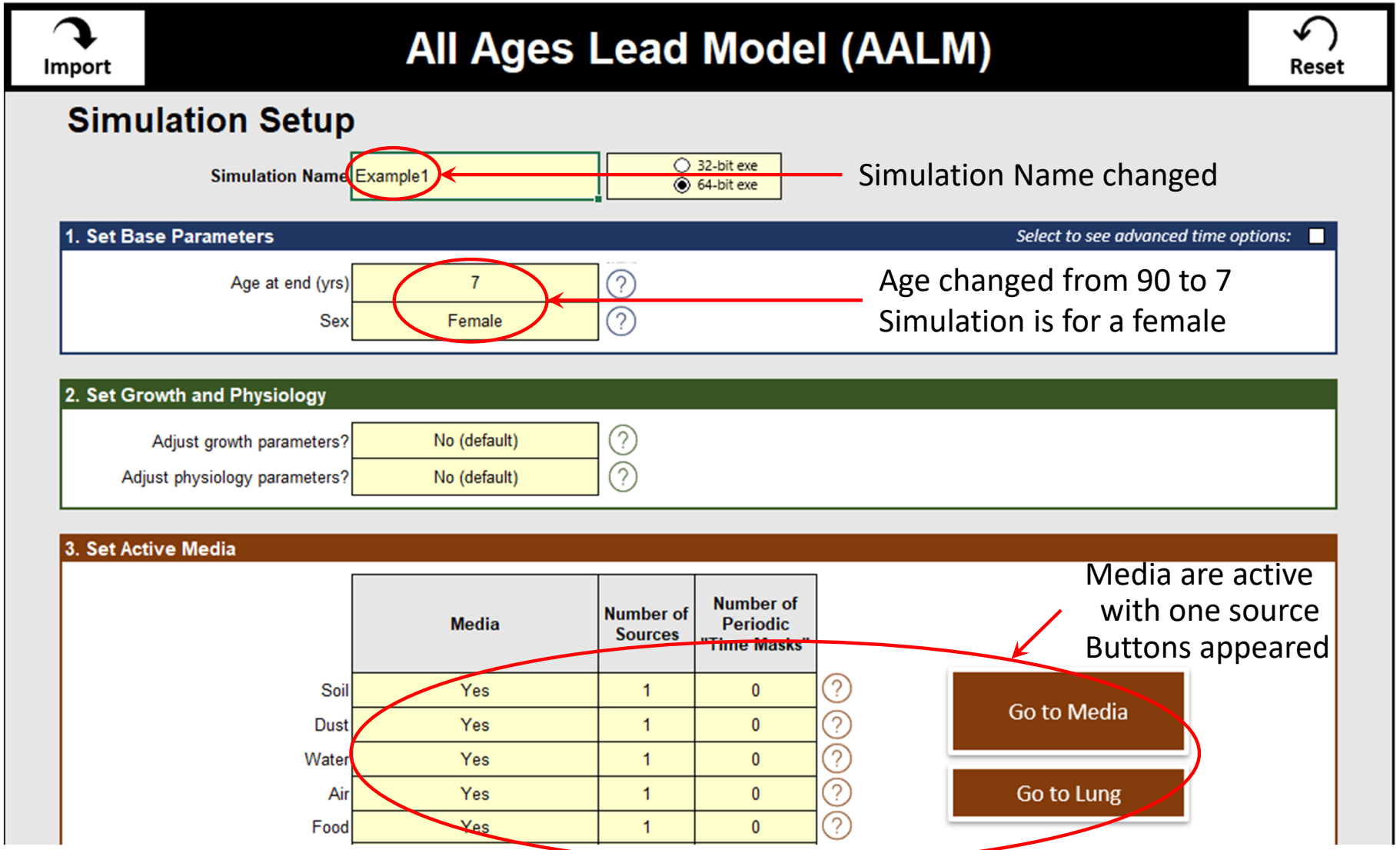


- AALM_Inputs_v3-1.xlsm
  - Setup and run simulations
- Setup
  - Base Parameters
    - Age and Sex
  - Growth and Physiology
    - Should not need to alter
  - Active Media
- Run Simulation



AALM – IEUBK Simulation




Import
All Ages Lead Model (AALM)
Reset
Simulation Setup
Simulation Name
Example1
32-bit exe
64-bit exe
Simulation Name changed
1. Set Base Parameters
Select to see advanced time options:
Age at end (yrs)
7
Sex
Female
Age changed from 90 to 7
Simulation is for a female
2. Set Growth and Physiology
Adjust growth parameters?
No (default)
Adjust physiology parameters?
No (default)
3. Set Active Media
Media
Number of Sources
Number of Periodic "Time Masks"
Soil
Yes
1
0
Dust
Yes
1
0
Water
Yes
1
0
Air
Yes
1
0
Food
Yes
1
0
Media are active with one source
Buttons appeared
Go to Media
Go to Lung

Media tab

Imported file applied IEUBK v2.0 default media concentrations, bioavailabilities, and intake rates

- Soil/Dust ingestion
  - 45% from soil
  - 55% from dust
- Air intake is average of IEUBK function (not user accessible) for each year

Soil

Reset Soil | Clear Soil

Concentration (ug/g)	Number of Ages	Ages (years)	0
	1	Source 1	200

Intake	Number of Ages	Ages (years)	0	1	2	3	4	5	6
	7	Intake (g/day)	0.0387	0.0423	0.03015	0.02835	0.03015	0.0234	0.02475
		Fraction, Source 1	1	1	1	1	1	1	1

RBA	RBA, Source 1	0.6

Dust

LTC | Clear Dust | Reset Dust

Concentration (ug/g)	Number of Ages	Ages (years)	0
	1	Source 1	150

Intake	Number of Ages	Ages (years)	0	1	2	3	4	5	6
	7	Intake (g/day)	0.0473	0.0517	0.03685	0.03465	0.03685	0.0286	0.03025
		Fraction, Source 1	1	1	1	1	1	1	1

RBA	RBA, Source 1	0.6

Water

Clear Water | Reset Water

Concentration (ug/L)	Number of Ages	Ages (years)	0
	1	Source 1	0.9

Intake	Number of Ages	Ages (years)	0	1	2	3	4	5	6
	7	Intake (L/day)	0.4	0.43	0.51	0.54	0.57	0.6	0.63
		Fraction, Source 1	1	1	1	1	1	1	1

RBA	RBA, Source 1	1

Air

Clear Air | Reset Air

Concentration (ug/m^3)	Number of Ages	Ages (years)	0
	1	Source 1	0.1

Intake	Number of Ages	Ages (years)	0	1	2	3	4	5	6
	7	Intake (m^3/day)	3.22	4.97	6.09	6.95	7.68	8.32	8.89
		Fraction, Source 1	1	1	1	1	1	1	1

RBA	RBA, Source 1	1

Food

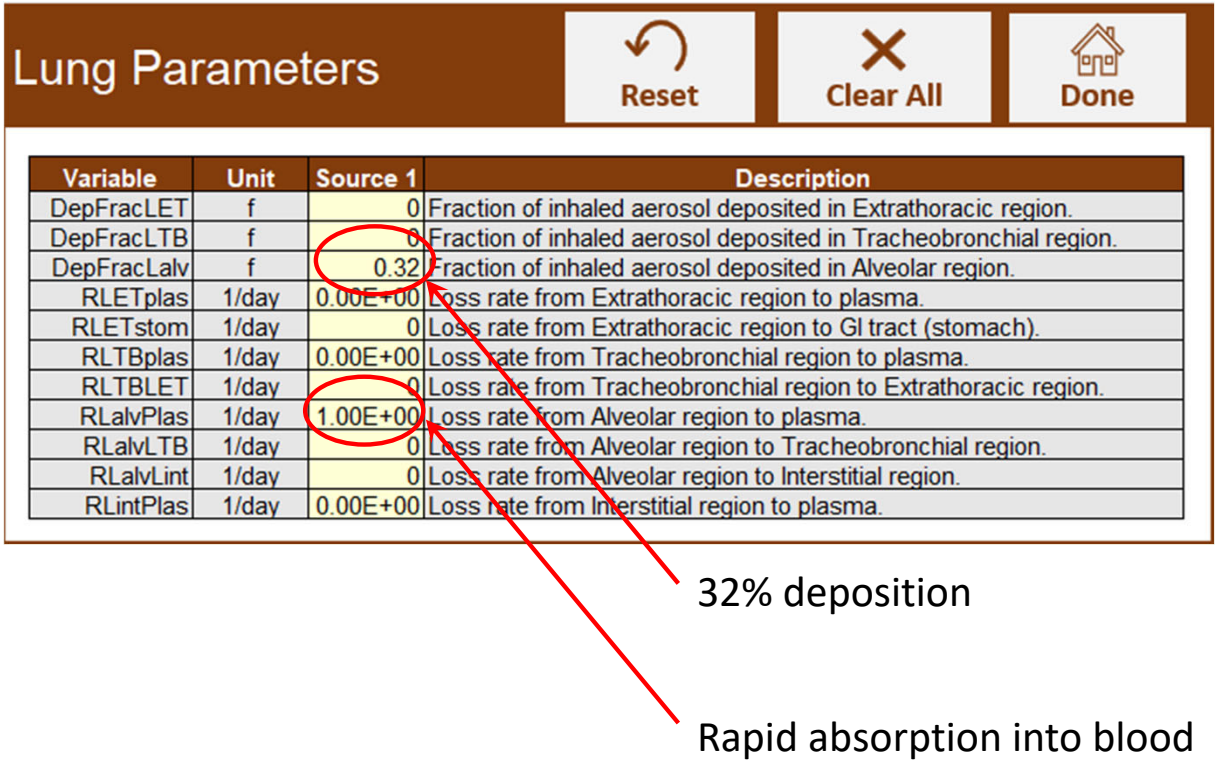
Clear Food | Reset Food

Intake (ug/day)	Number of Ages	Ages (years)	0	1	2	3	4	5	6
	7	Source 1	2.66	5.03	5.21	5.38	5.64	6.04	5.95

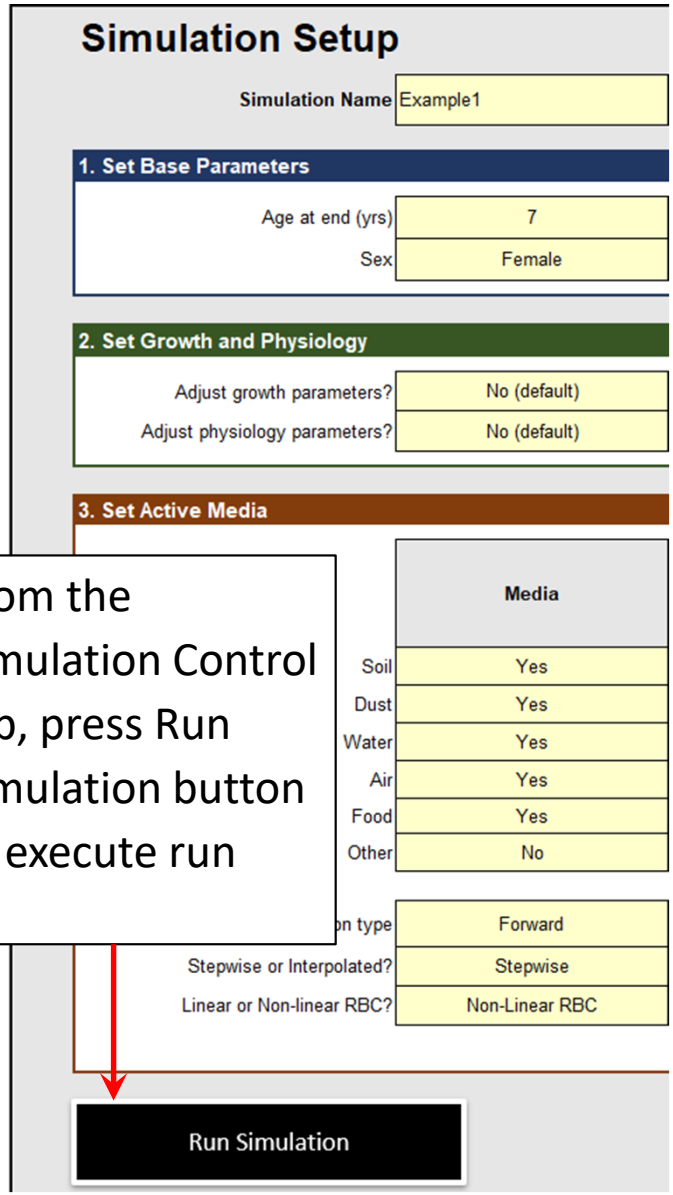
RBA	RBA, Source 1	1

Lung tab

Imported file applied 32% deposition and complete absorption of deposited particles consistent with the IEUBK v2.0



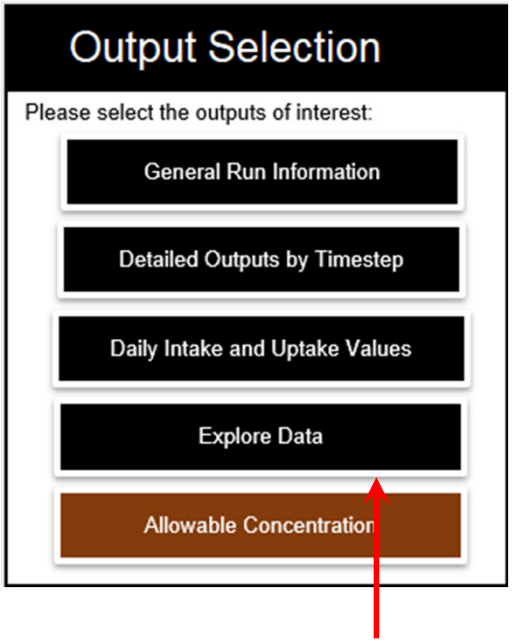
Variable	Unit	Source 1	Description
DepFracLET	f	0	Fraction of inhaled aerosol deposited in Extrathoracic region.
DepFracLTB	f	0	Fraction of inhaled aerosol deposited in Tracheobronchial region.
DepFracLalv	f	0.32	Fraction of inhaled aerosol deposited in Alveolar region.
RLETplas	1/day	0.00E+00	Loss rate from Extrathoracic region to plasma.
RLETstom	1/day	0	Loss rate from Extrathoracic region to GI tract (stomach).
RLTBplas	1/day	0.00E+00	Loss rate from Tracheobronchial region to plasma.
RLTBLET	1/day	0	Loss rate from Tracheobronchial region to Extrathoracic region.
RLalvPlas	1/day	1.00E+00	Loss rate from Alveolar region to plasma.
RLalvLTB	1/day	0	Loss rate from Alveolar region to Tracheobronchial region.
RLalvLint	1/day	0	Loss rate from Alveolar region to Interstitial region.
RLintPlas	1/day	0.00E+00	Loss rate from Interstitial region to plasma.



From the Simulation Control tab, press Run Simulation button to execute run

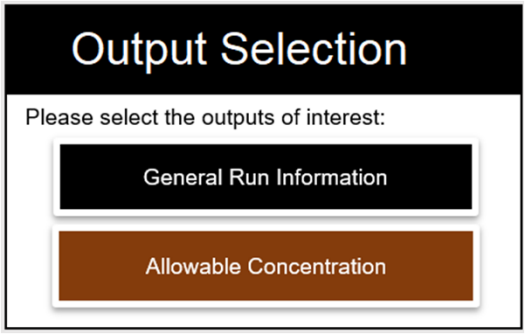
Output Selection box indicates the run is complete.

AALM v3.0



Next, press Explore Data button to view results.

AALM v3.1

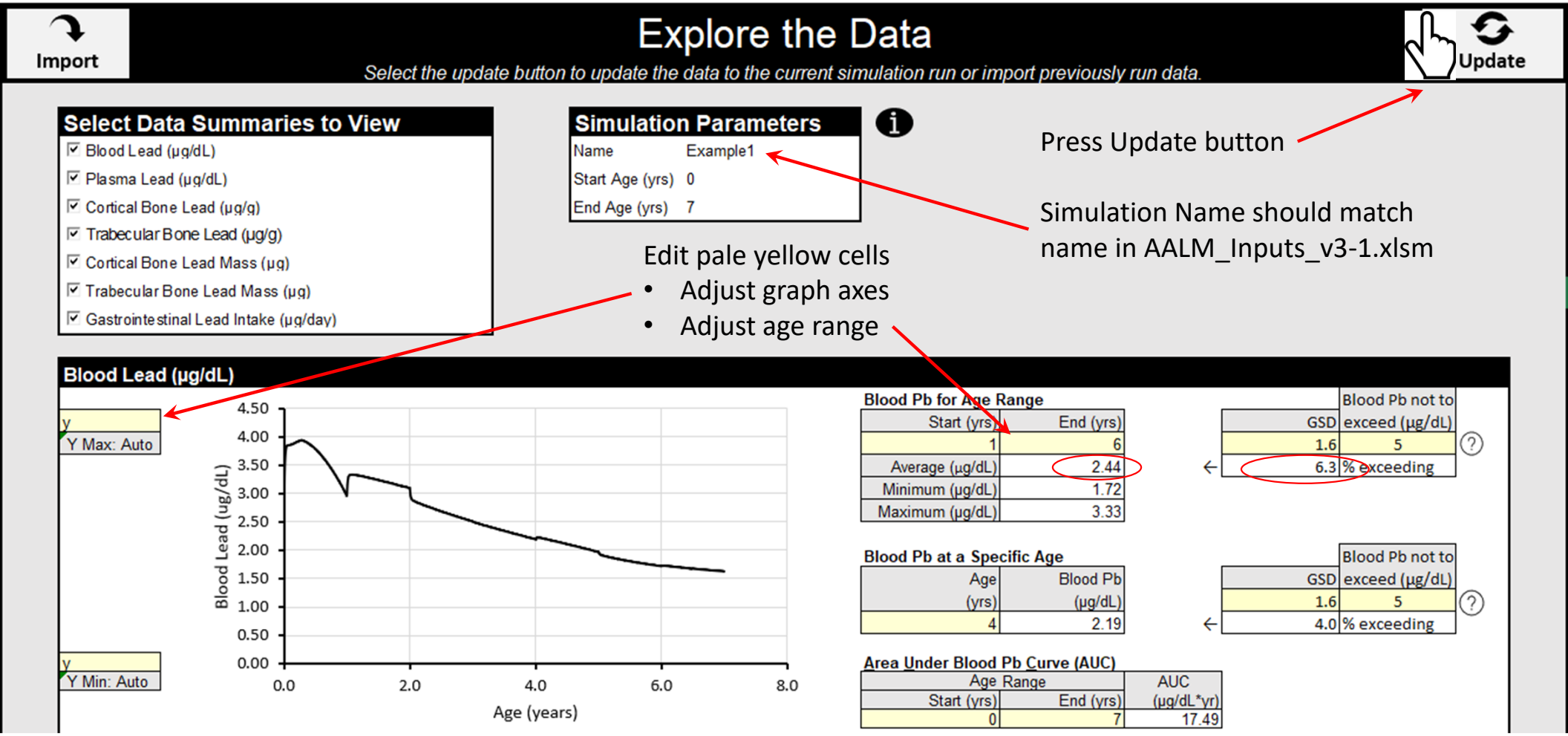


Next, open Explore Data file "AALM_ExploreData_v3-1.xlsm" to view results.

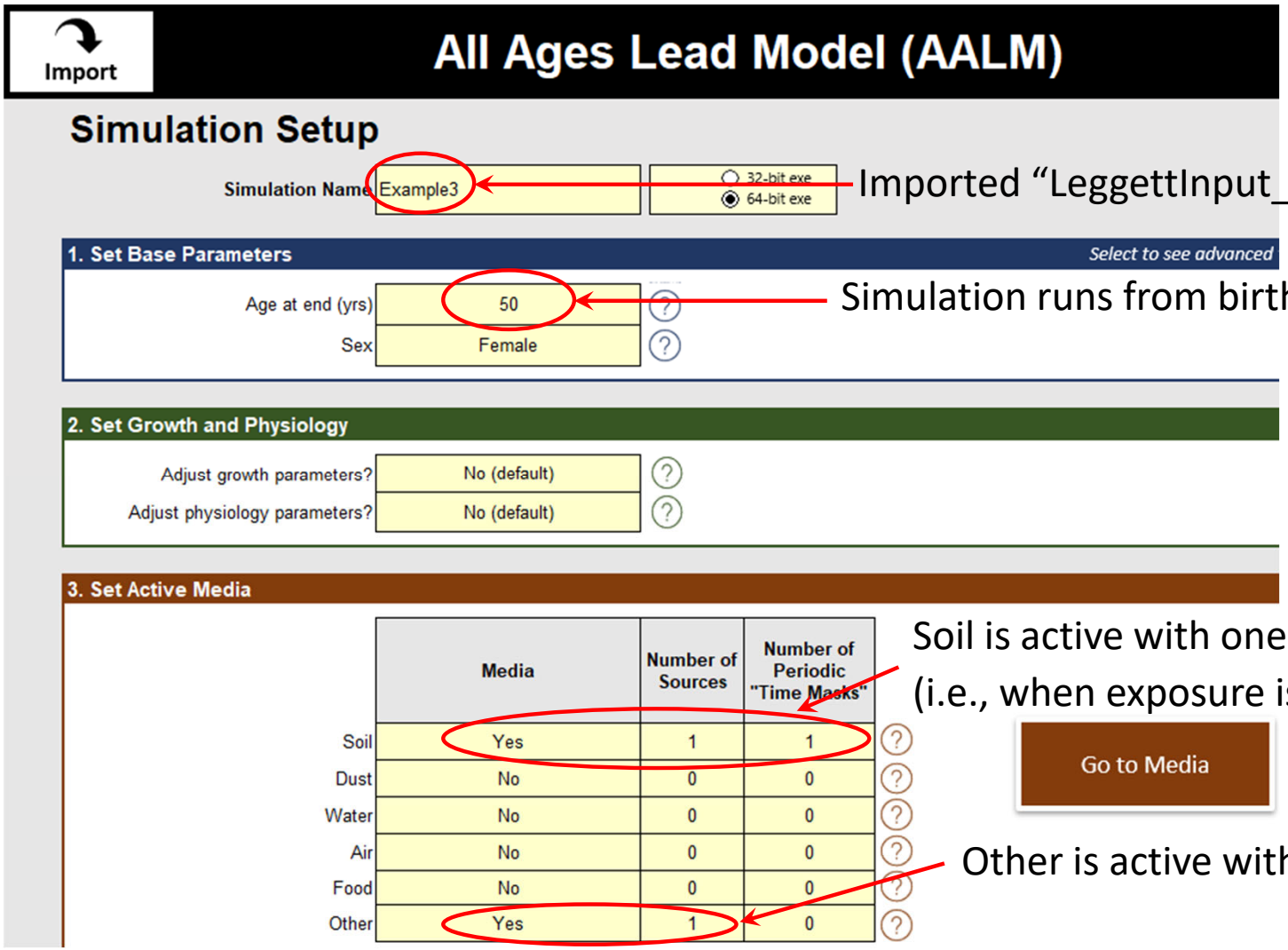
AALM v3.1 has been separated into two workbooks to improve model performance.

AALM – IEUBK Simulation Results

(viewing "AALM_ExploreData_v3-1.xlsm" below)



AALM – Intermittent Exposure Example



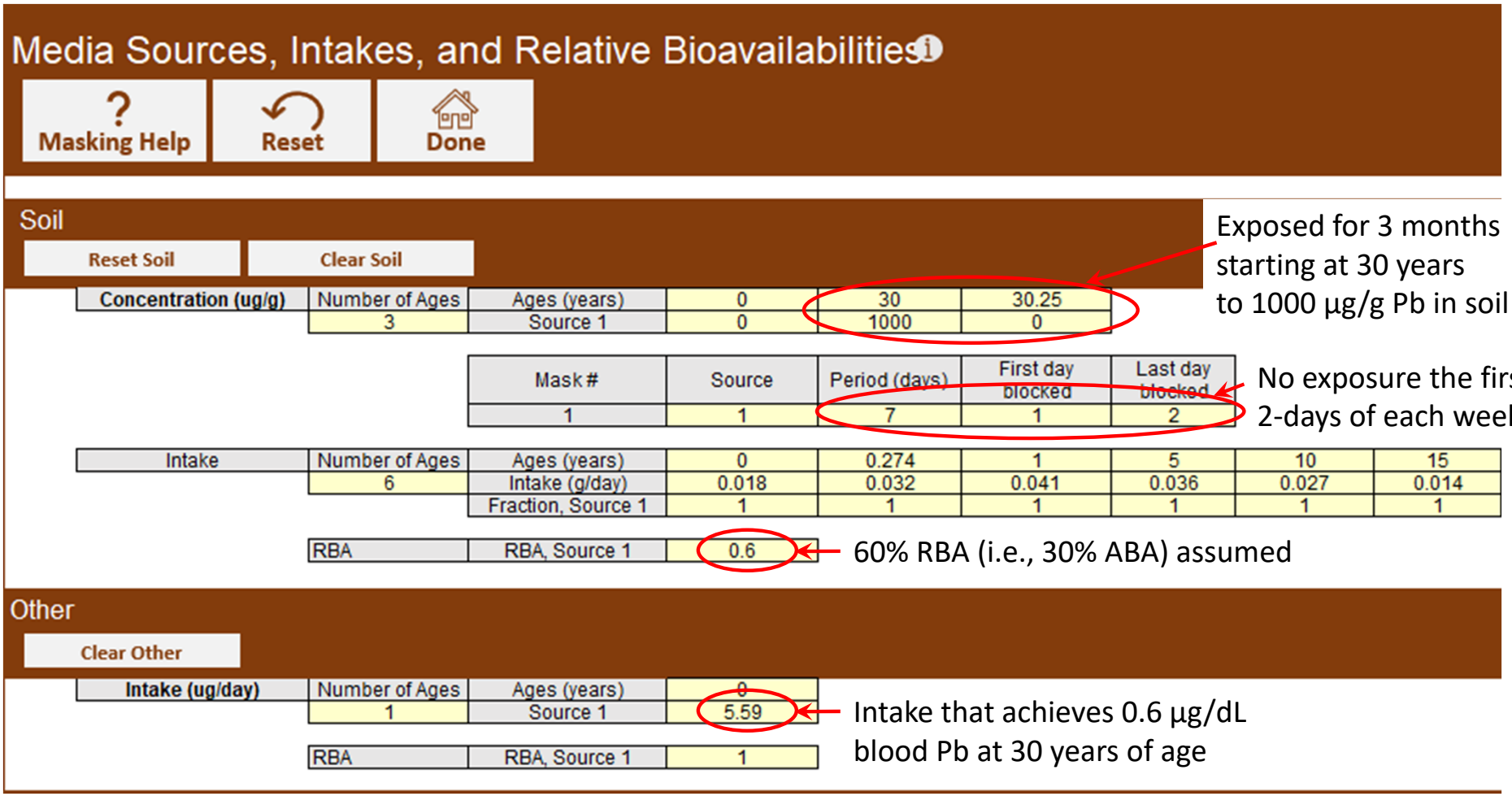
Imported "LeggettInput_Ex3.txt" for Example 3

Simulation runs from birth to 50 years of age

Soil is active with one source and one mask (i.e., when exposure is turned off or blocked)

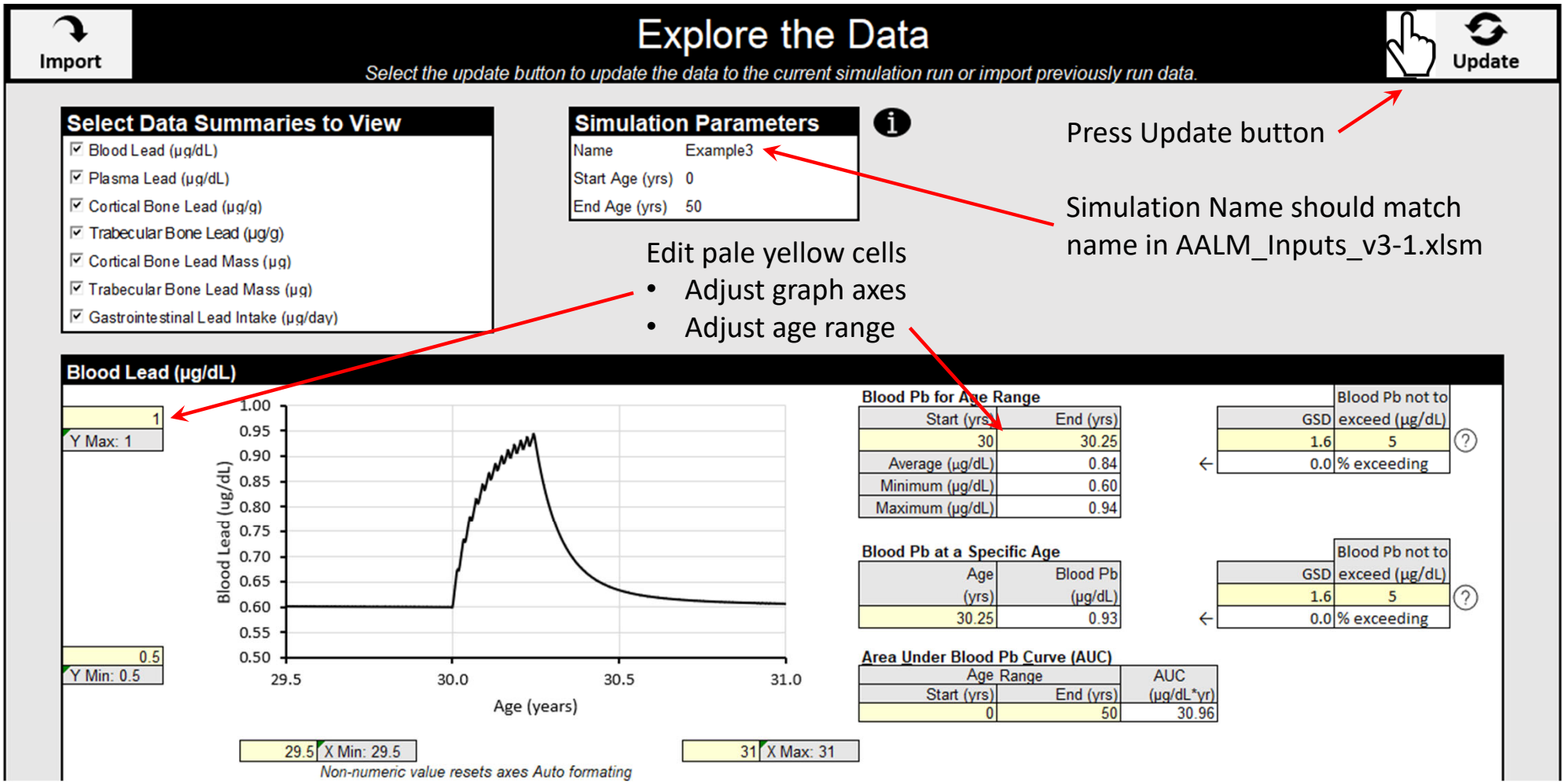
Other is active with one source

AALM – Intermittent Exposure Example



AALM – Intermittent Exposure Example

(viewing "AALM_ExploreData_v3-1.xlsm" below)



Discussion and Q&A