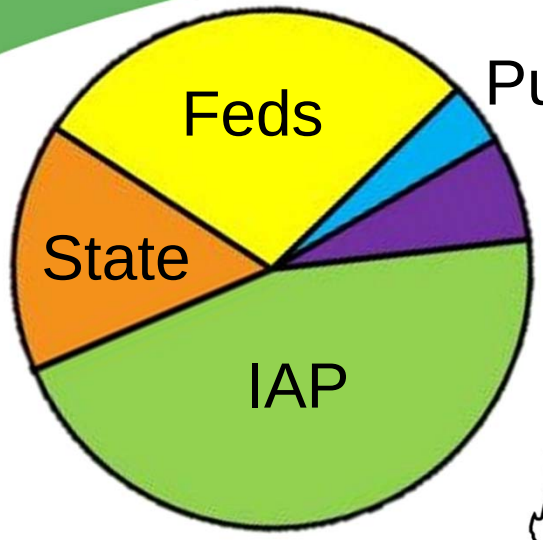
Evaluation of Bioavailability of Contaminants in Soil:
State-of-the-Art Guidance from ITRC

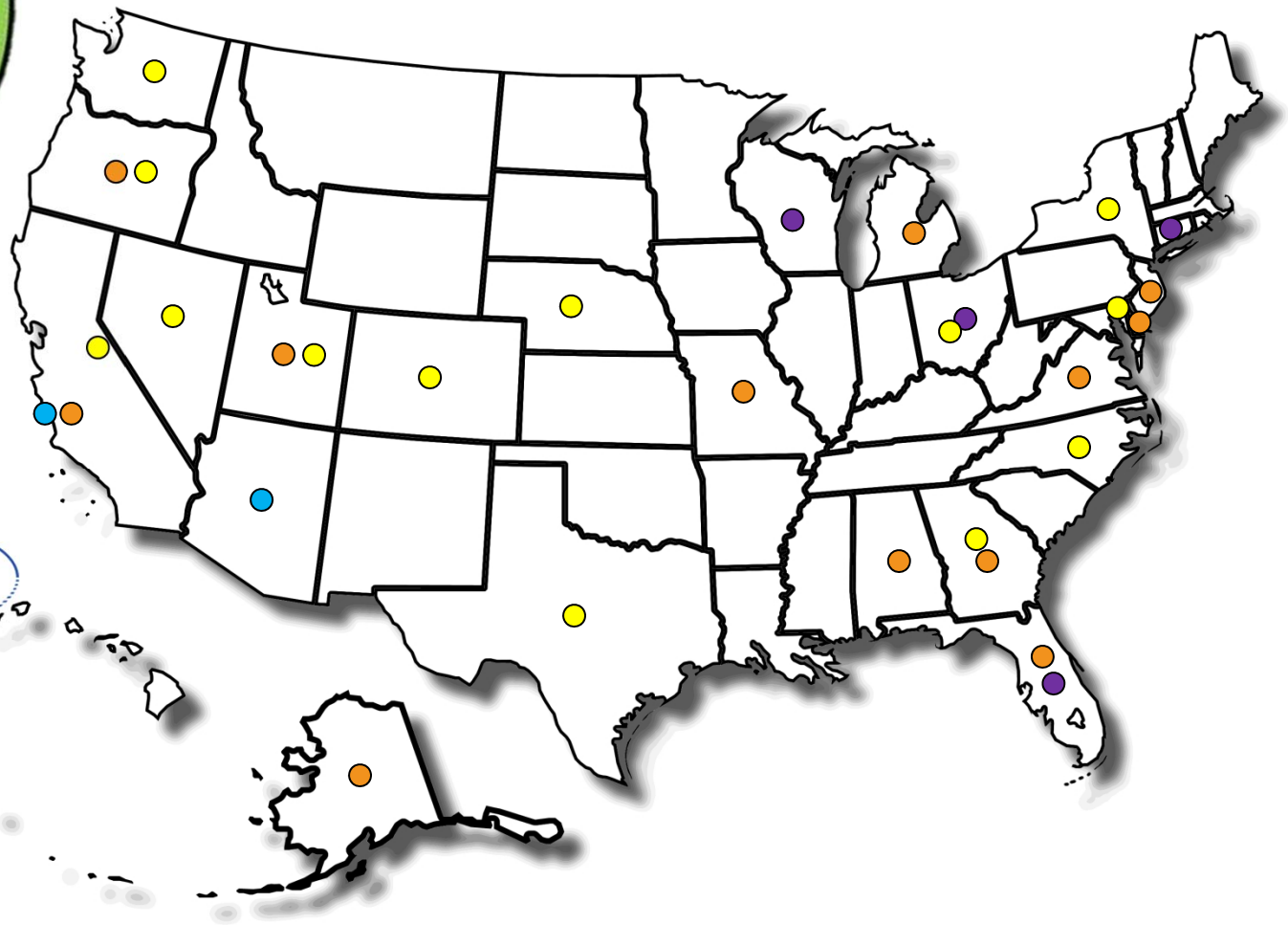
C. Sorrentino
K. Durant
L. Hay-Wilson

INTERSTATE TECHNOLOGY REGULATORY COUNCIL ITRC



3 yr ~ 150 people

average 75 on the team



If you need to leave now:

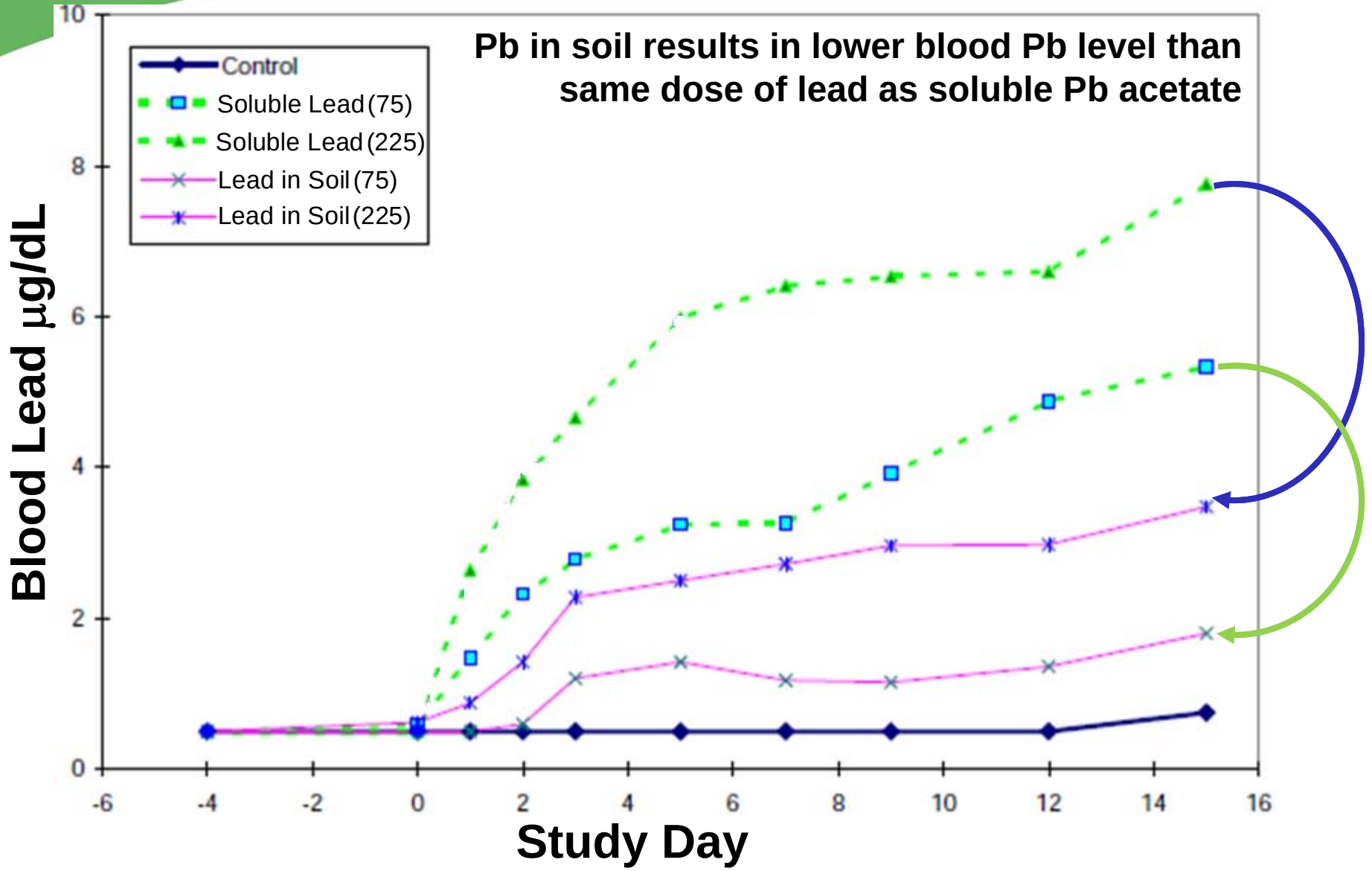
- **It works and it's a win-win**
  (*save **$** AND is protective*)
- **Not for all sites**
  (*but VERY useful when appropriate*)
- **Not a "one-size-fits-all" solution**
  (sorry)
- **Different strokes for different folks**
  (Check the Lead Agency)

We Focused on ARSENIC, LEAD, and PAHs

Site-Specific Bioavailability

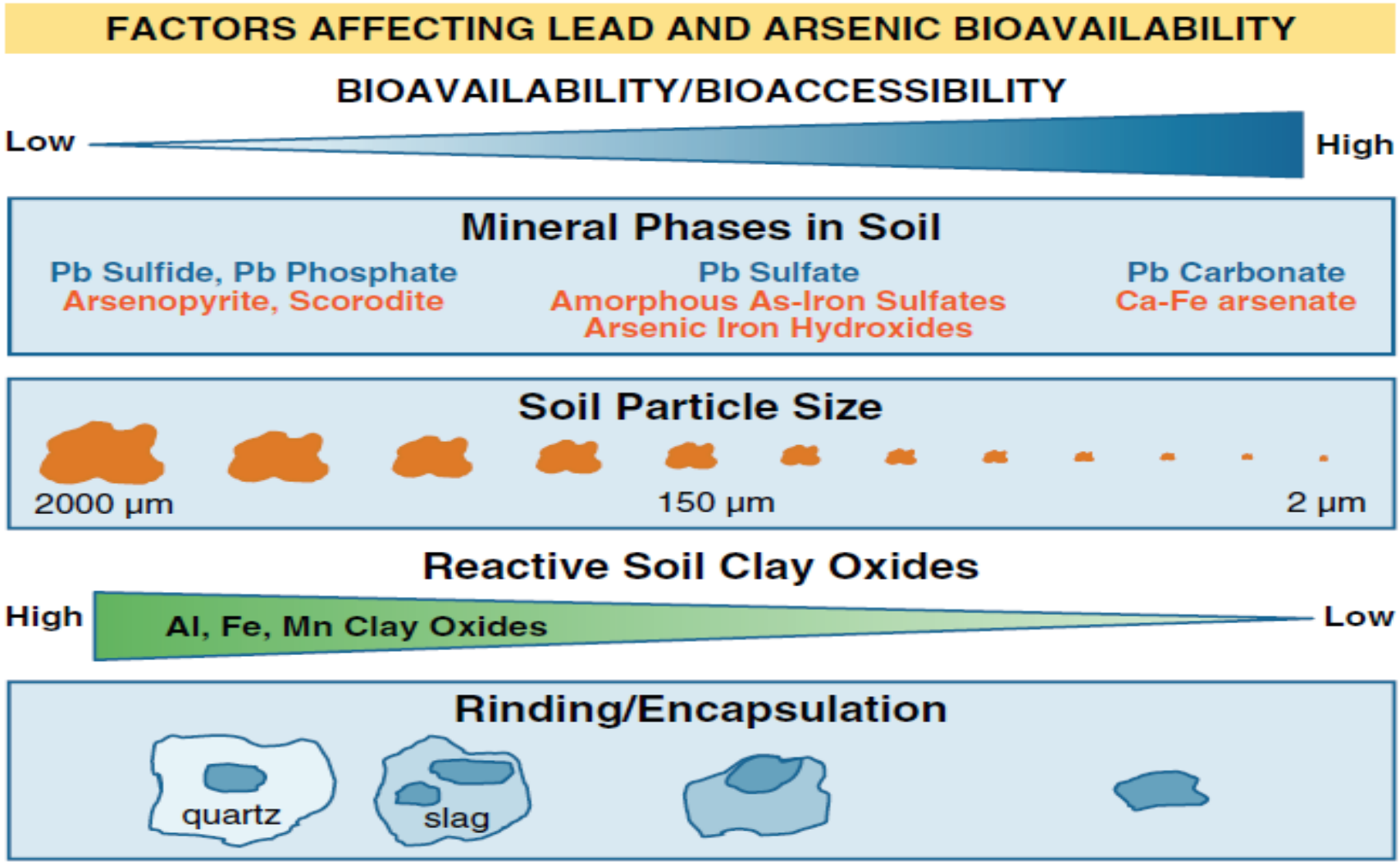
- Reduce Uncertainty in Exposure Assessment
- Improve Human Health Risk Assessment
- Better Risk Management Decisions
- More Rational Use of Resources **Same Protection**

RBA – Relative Oral Bioavailability



ITRC BCS-1 Section 6.3

Source: U.S. EPA OSWER 9285.7-77 2007



ITRC BCS-1 Figure 3-1

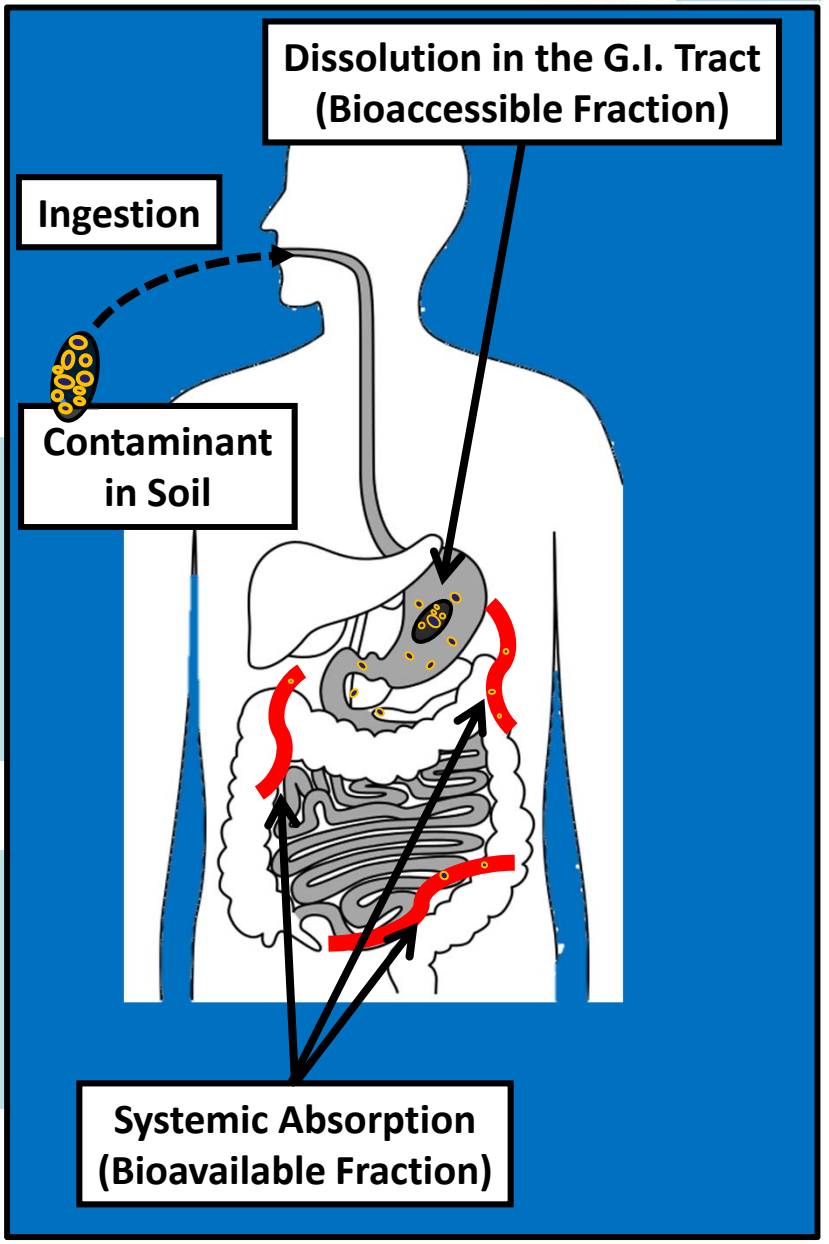
Bioavailability vs Bioaccessibility

Bioavailability:

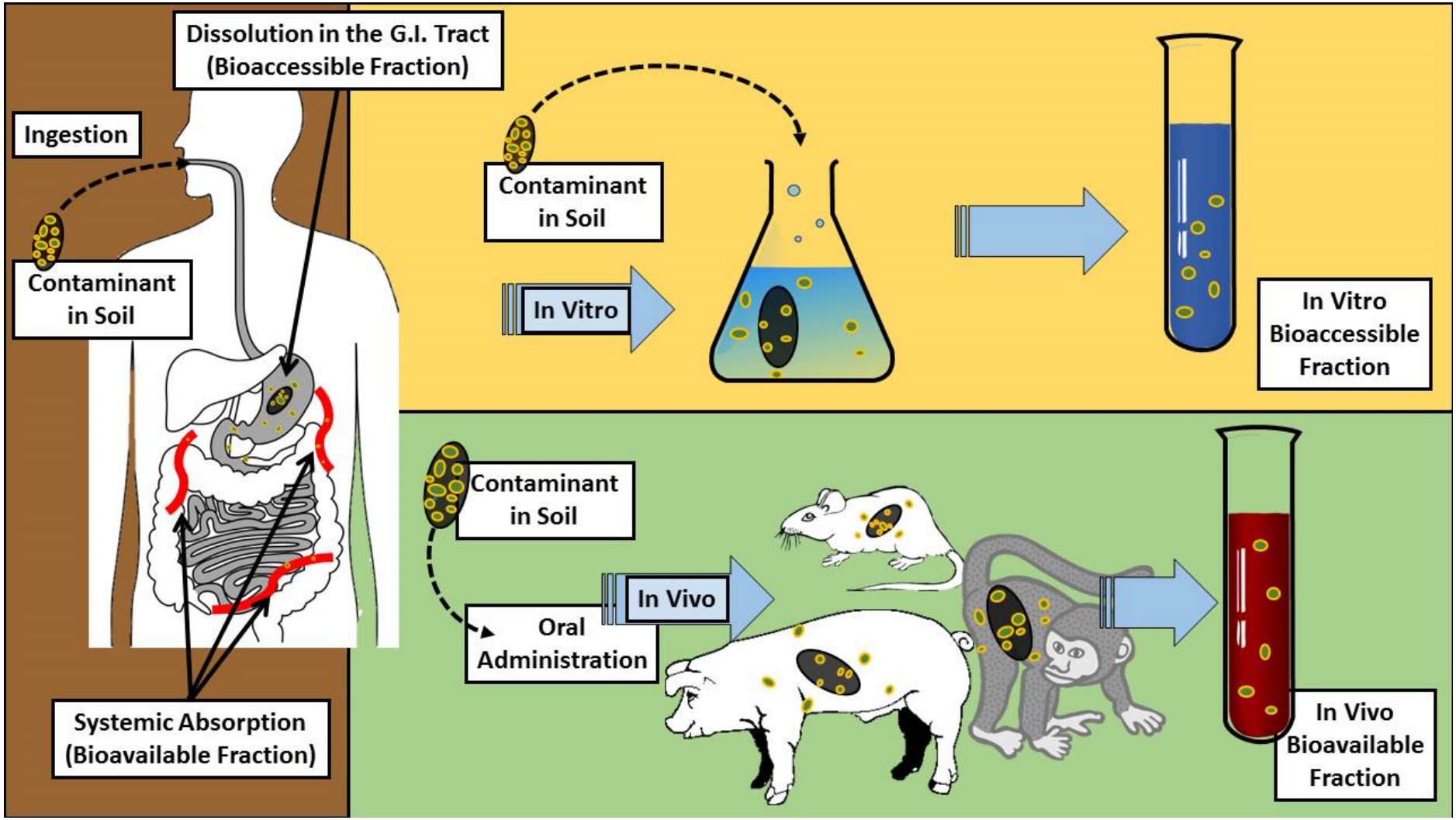
The portion of a chemical that is absorbed by a living organism and reaches the central compartment (blood)

Bioaccessibility:

The fraction of a chemical that **<u>may</u>** be available for uptake by an organism.

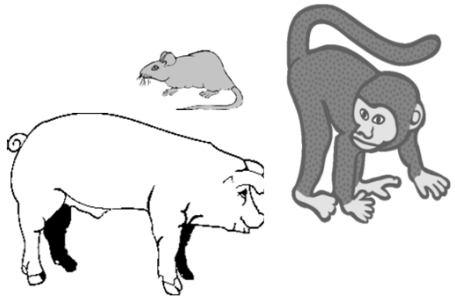


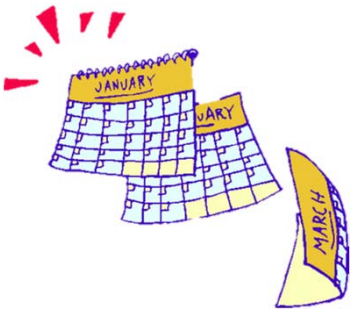
Bioavailability vs Bioaccessibility

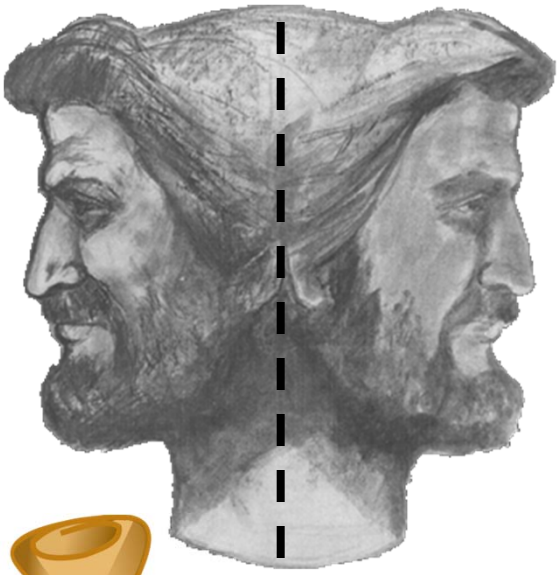


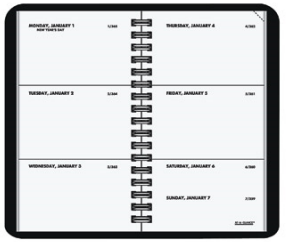
BIOAVAILABILITY | **BIOACCESSIBILITY**

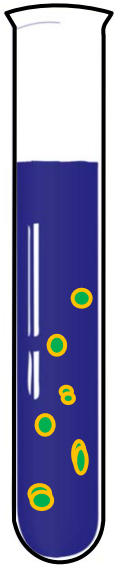
In Vivo | *In Vitro*











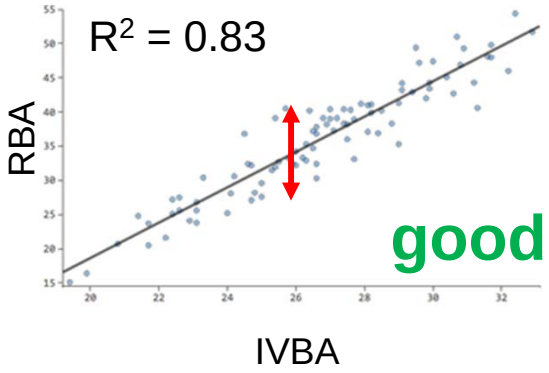
Tens of Thousands

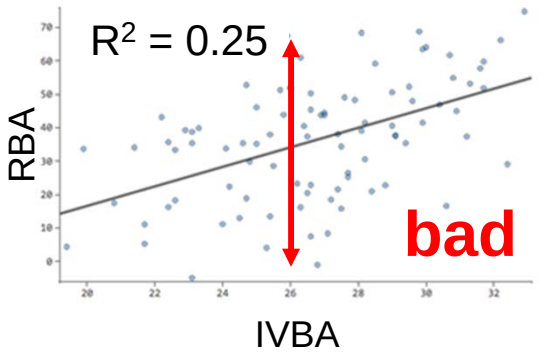
Hundreds

Can Bioaccessibility Predict Bioavailability?

IVIVC: In Vivo In Vitro Correlation

- wide range of soil types (including yours)
- goodness of fit
- magnitude of prediction error



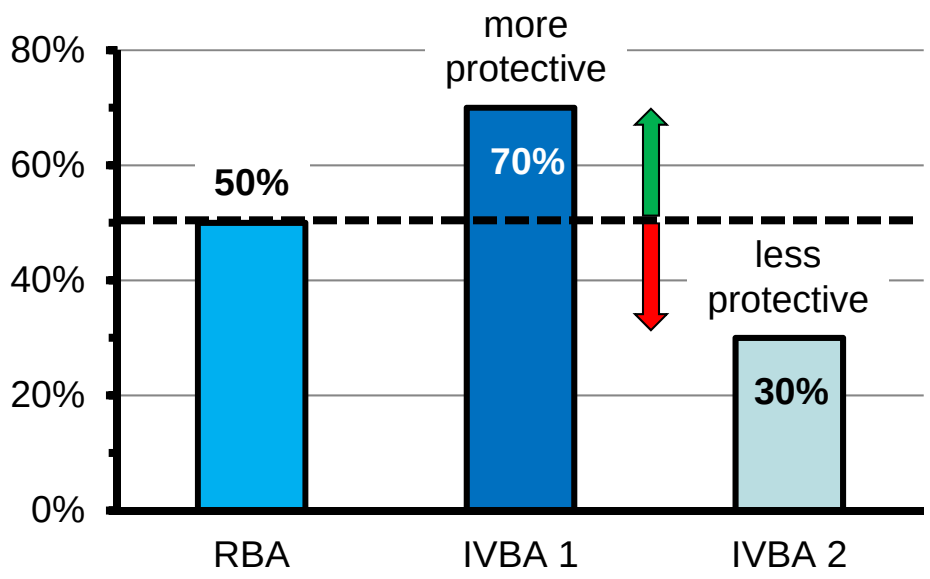


Can Bioaccessibility Predict Bioavailability?

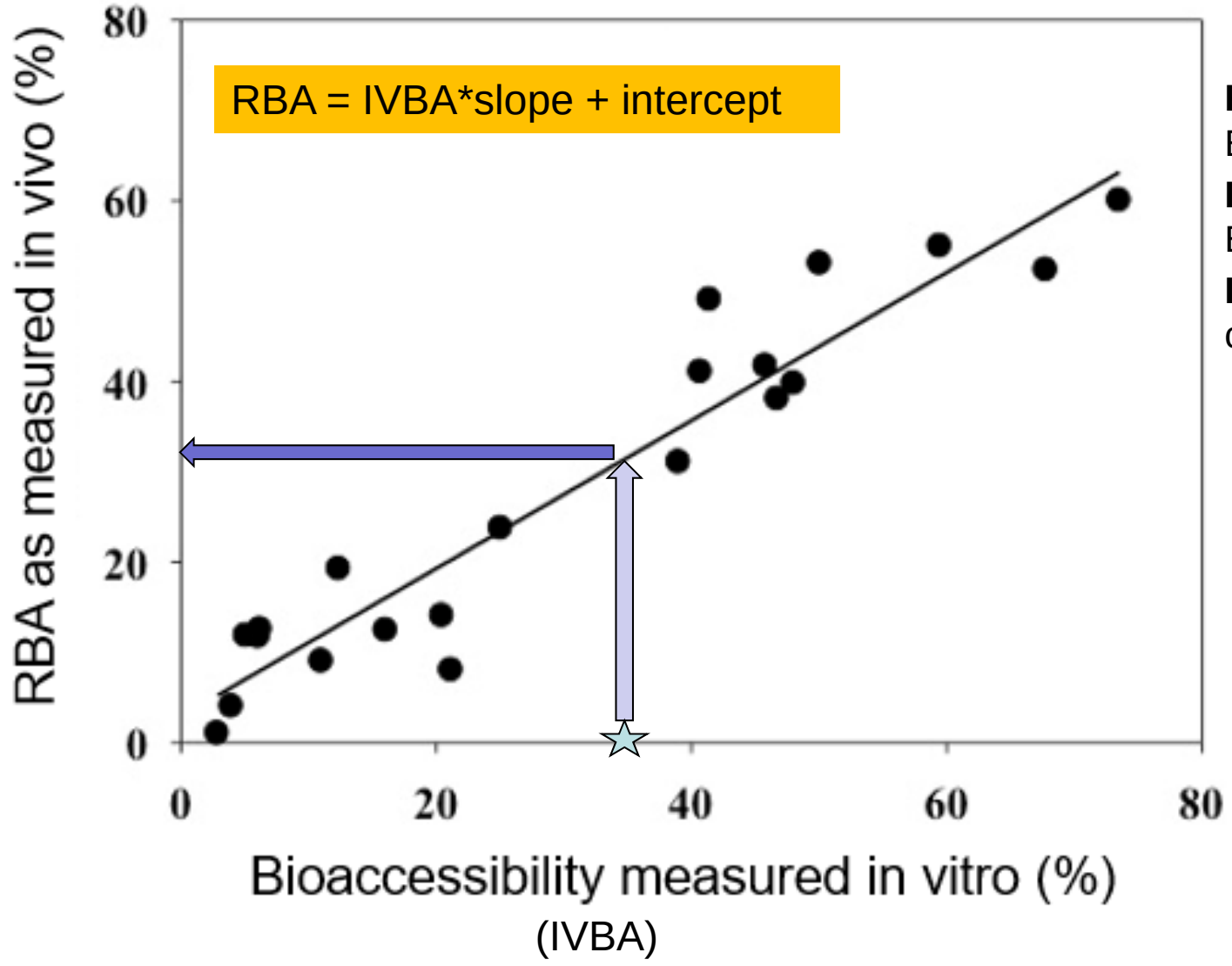
IVIVC: In Vitro-In Vivo Correlation

- results repeatable within and among labs
- over- or under-prediction

$$\text{RISK} = \frac{C_s \times \text{RBA} \times IR \times EF \times ED}{1/CSF \times BW \times AT}$$



Using an IVIVC to Predict RBA



RBA: Relative Oral Bioavailability

IVBA: In Vitro Bioaccessibility

IVIVC: In Vivo - In Vitro correlation

ITRC BCS-1 Figure 7-2

Source: DTSC 2016

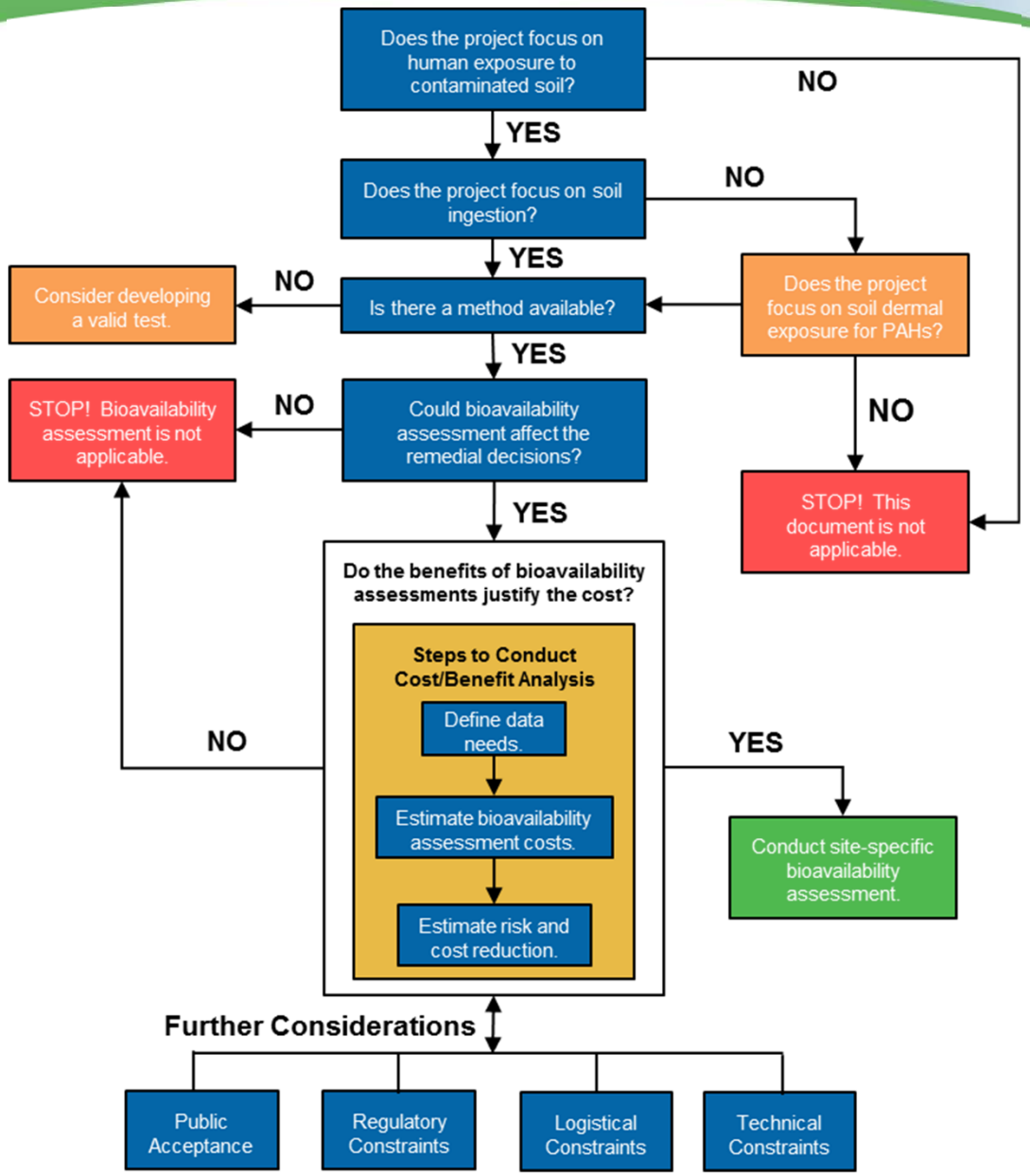
RBA Results into HHRA

$$\text{Exposure} = \frac{C_s \times RBA \times IR \times EF \times ED}{BW \times AT}$$

C_s	(Concentration in soil)	=	site-specific, mg/kg
RBA	(Relative bioavailability)	=	site-specific, unitless
IR	(Ingestion rate)	=	mg soil / day
EF	(Exposure Frequency)	=	days / year
ED	(Exposure Duration)	=	years
AT	(Averaging time)	=	days
BW	(Body weight)	=	kg

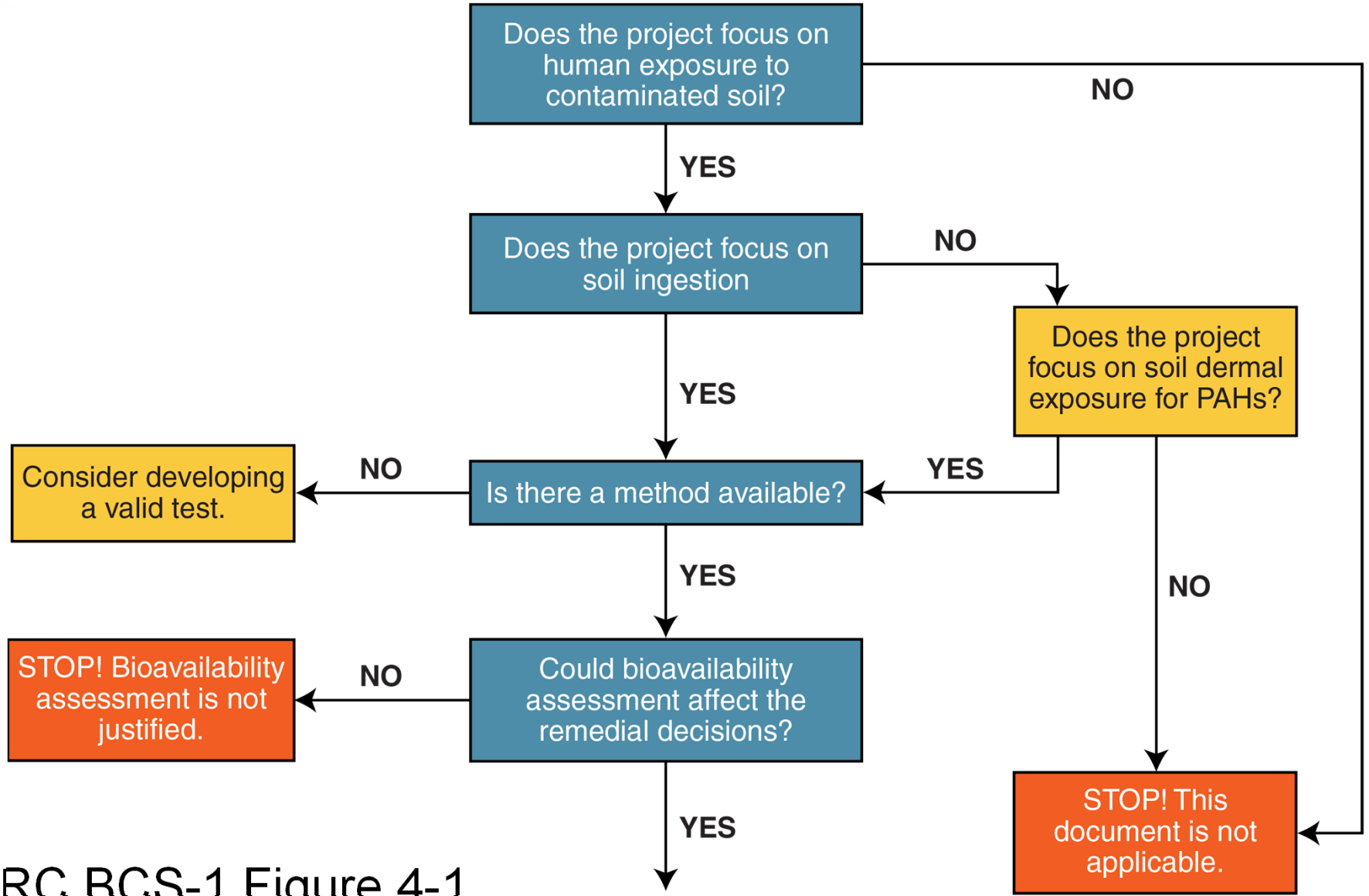
ITRC BCS-1 Section 9.1.3.2

It's NOT for All Sites (How to Decide)



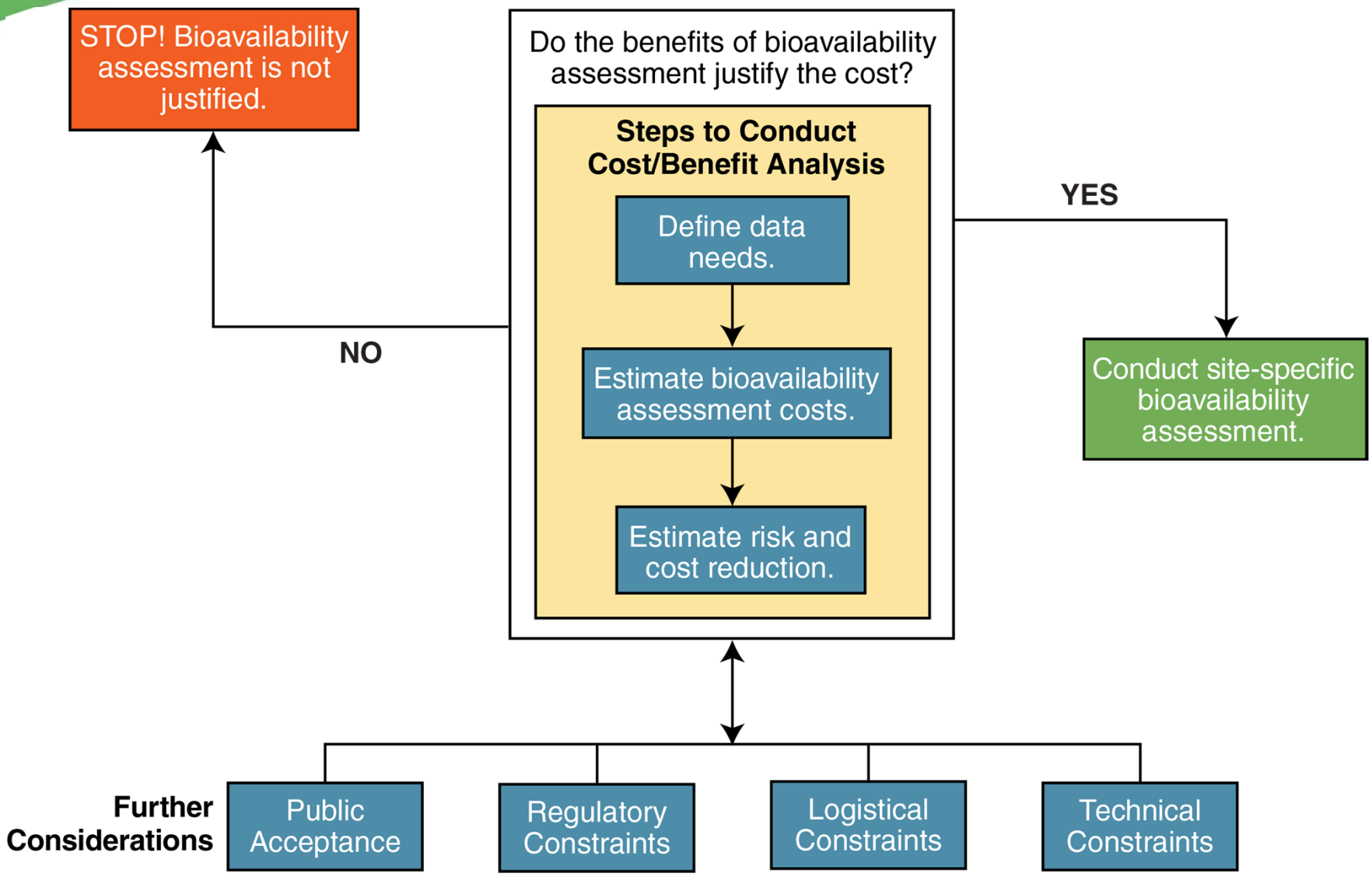
ITRC BCS-1 Figure 4-1

It's NOT for All Sites (How to Decide)



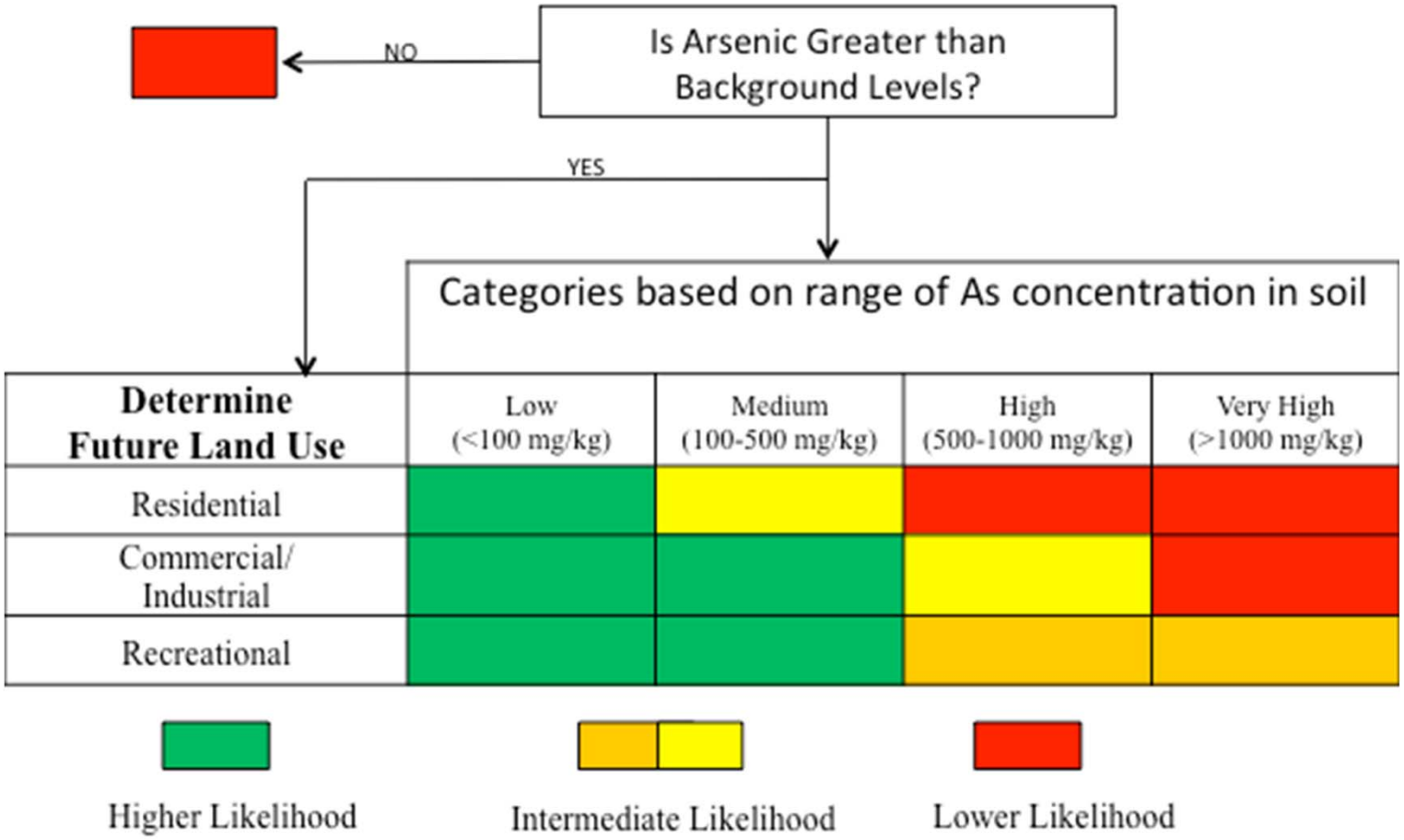
ITRC BCS-1 Figure 4-1

It's NOT for All Sites (How to Decide)



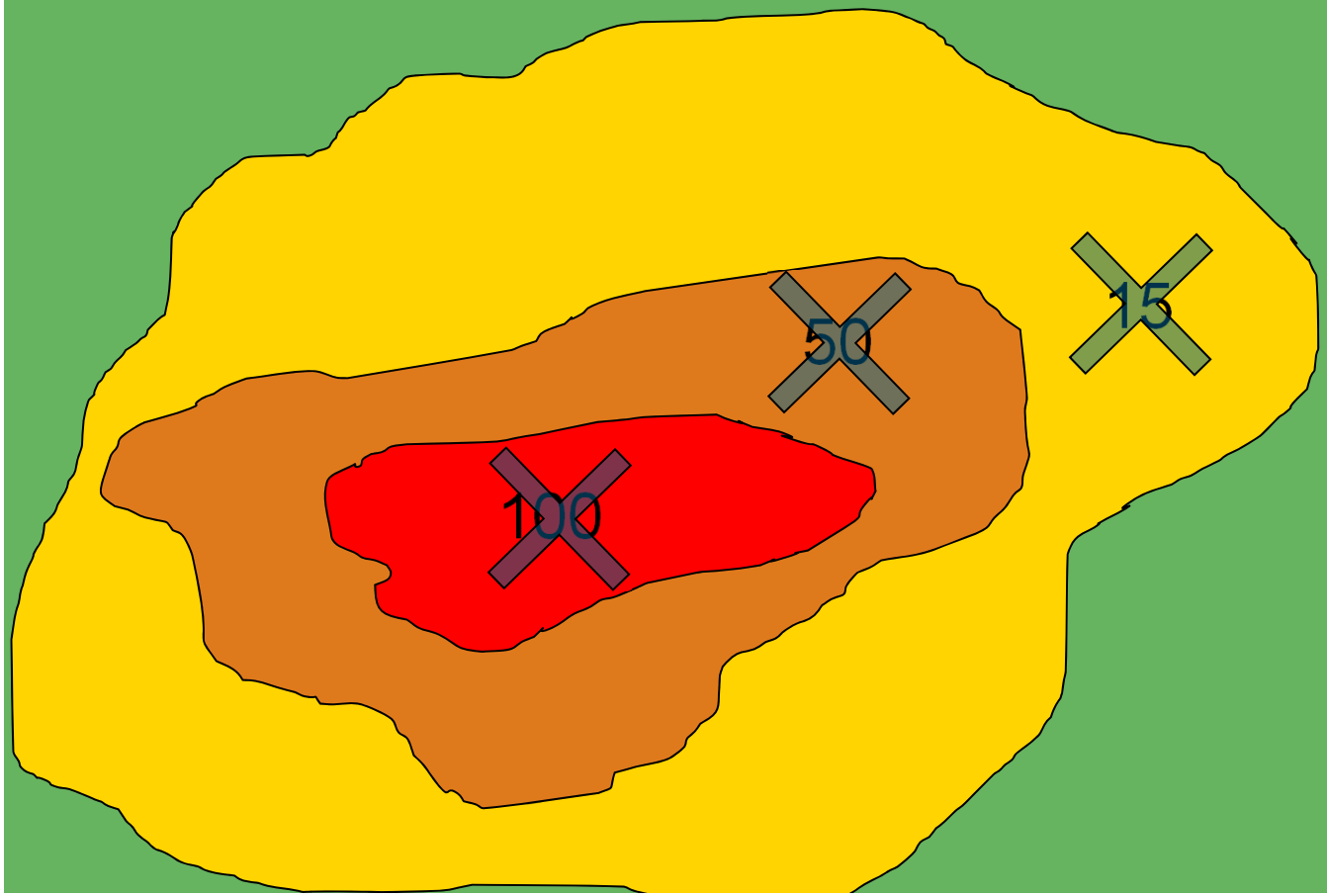
ITRC BCS-1 Figure 4-1

Use Site-Specific Bioavailability When It Can Make a Difference



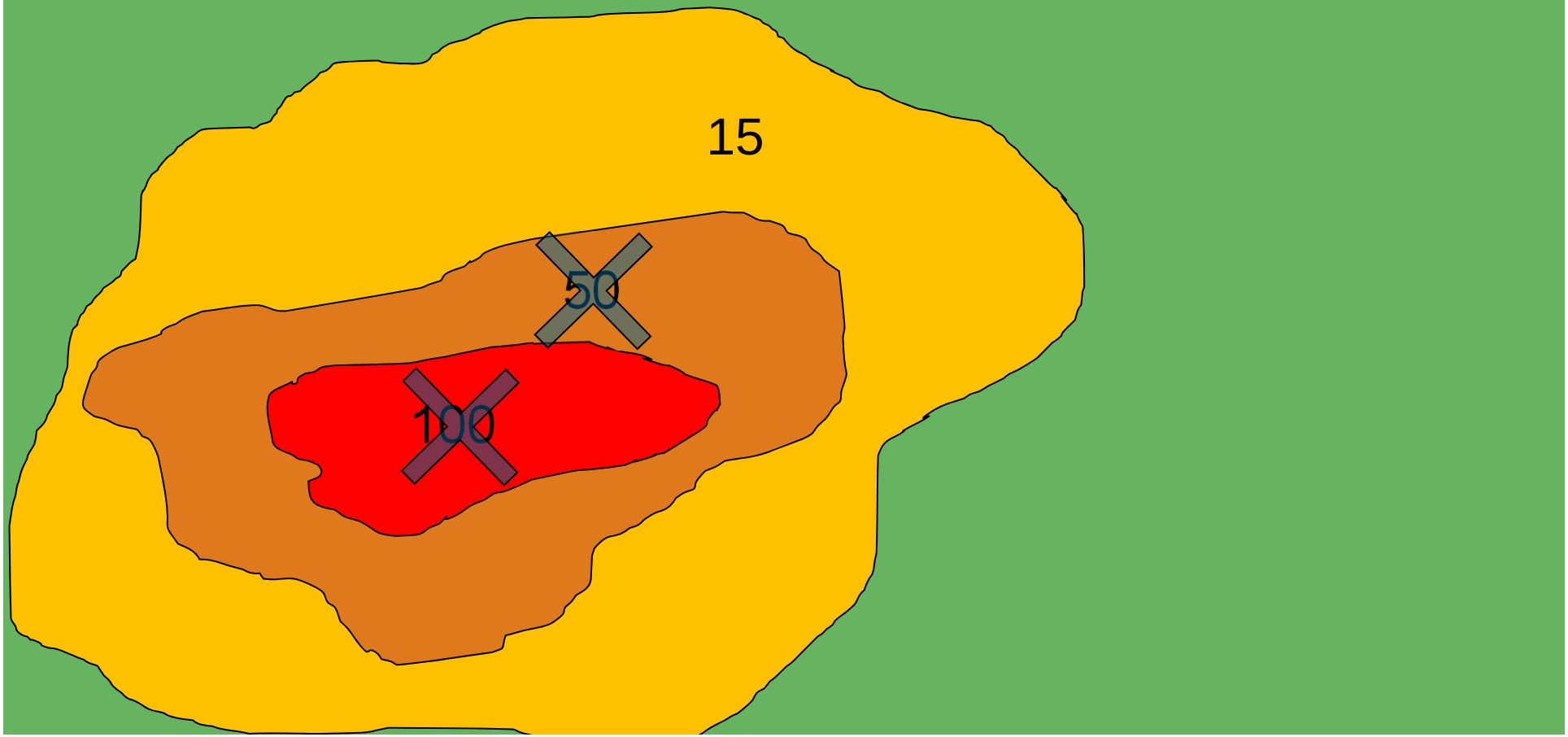
Bioavailability: 100%

Cleanup Goal 10^{-6} risk = 10 mg/kg



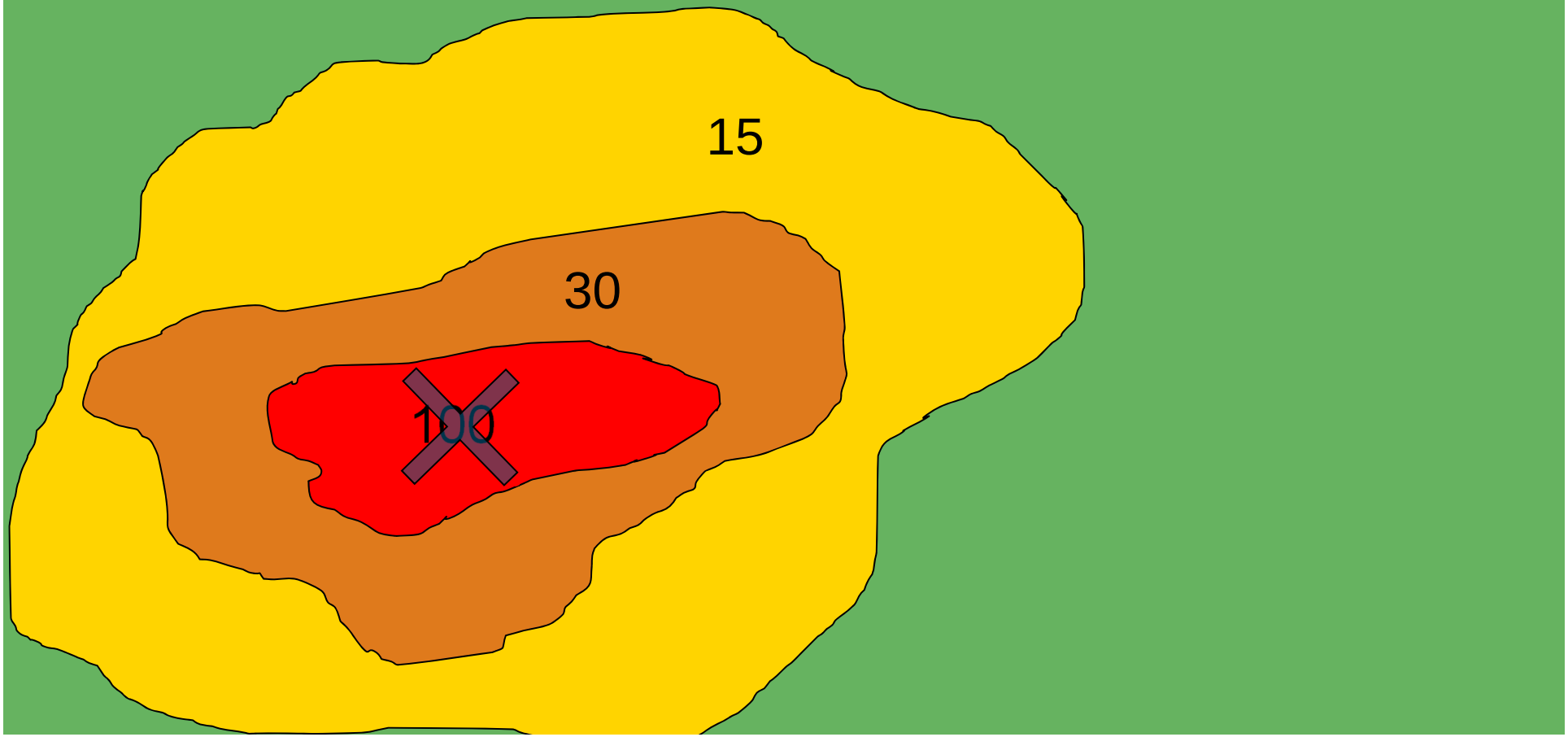
Default Bioavailability: 60%

Cleanup Goal 10^{-6} risk = 17 mg/kg



Site-Specific Bioavailability: 25%

Cleanup Goal 10^{-6} risk = 40 mg/kg



Engage Stakeholders Early During Planning

- Can be controversial for stakeholders
- Perception that it is in favor of the polluters
- Need buy-in from the regulators
- Not well known/established
- Be transparent and earn trust

What You Should Remember:

- **It works and it's a win-win**
  (*save **$** AND is protective*)
- **Not for all sites**
  (*but VERY useful when appropriate*)
- **Not a "one-size-fits-all" solution**
  (sorry)
- **Different strokes for different folks**
  (Check the Lead Agency)

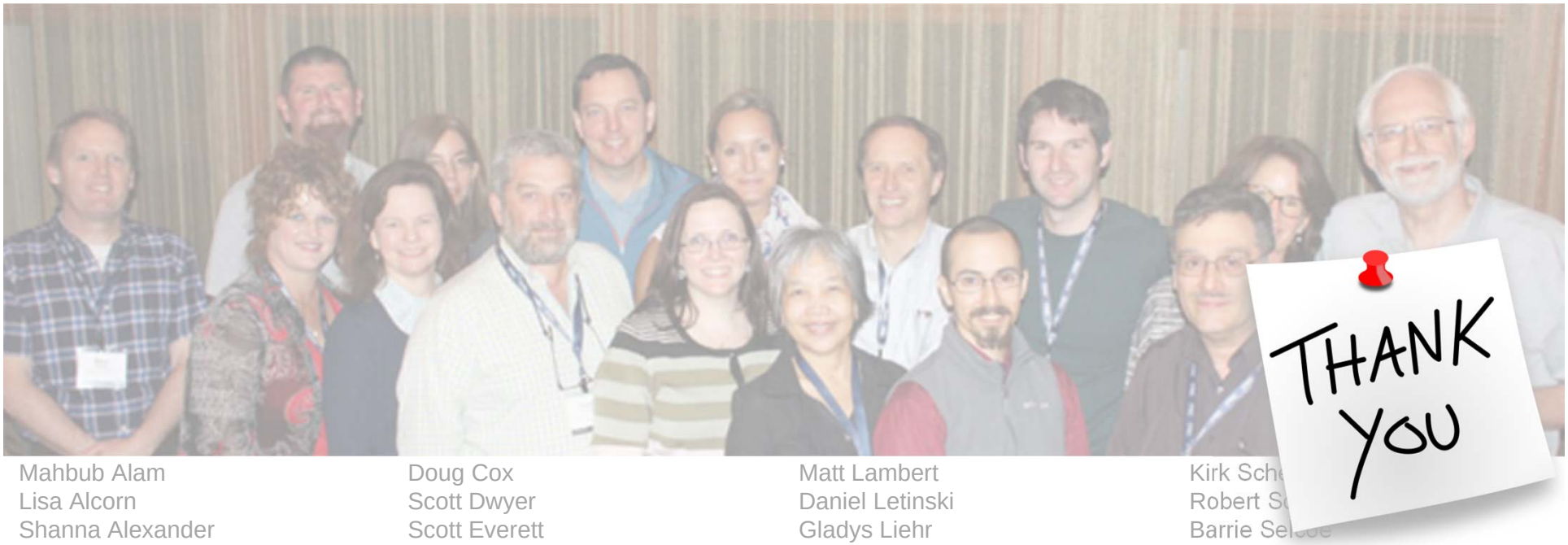
We focused on ARSENIC, LEAD, and PAHs

Bioavailability in Contaminated Soil

2016 ITRC Team of the Year

Team Leaders: C. Sorrentino & K. Durant
(CA DTSC) (DE DNREC)

L. Hay Wilson
Program Advisor



Mahbub Alam
Lisa Alcorn
Shanna Alexander
Hunter Anderson
Nicholas Basta
Paul Beam
Marlena Brewer
Mark Bruce
Ahmet Bulbulkaya
Michele Burgess
Teresa Caputi
Sandip Chattopadhyay
Jeremy Clark
Jeffrey A. Clock
Otakuye Conroy-Ben
Doug Cox
Scott Dwyer
Scott Everett
Brendlyn Faison
Norman Forsberg
Jessica Goin
Jose Gomez-Eyles
Valerie Hanley
Sonal Iyer
Walsta Jean-Baptiste
Deborah Johnston
Lawrence Kellum
Karen Kinsella
Ronald Kotun
Kate Kucharzyk
Matt Lambert
Daniel Letinski
Gladys Liehr
Kevin Long
Yvette Lowney
Diana Marquez
Morgan McGee-Solomon
Ameesha Mehta-Sampath
Anita Meyer
Marjorie Norman
Gbekeloluwa Oguntimein
Divinia Ries
Stephen Roberts
Pamela Rodgers
Chad Roper
Kirk Sch
Robert S
Barrie Sel
Elizabeth Semkiw
Geoff Siemering
James Smith
Peter Strauss
Hans Stroo
Alex Teimouri
MRutheyi Thompson
Bryn Thoms
Usha Vedagiri
Justice Williams
Lynn Woodbury
Stephen Zemba