



Maryland
Department of
the Environment

Maryland Biological Stressor Identification Process (2014)

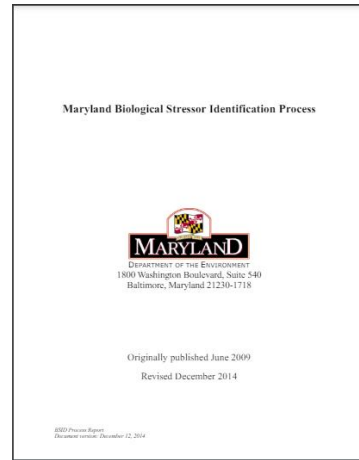
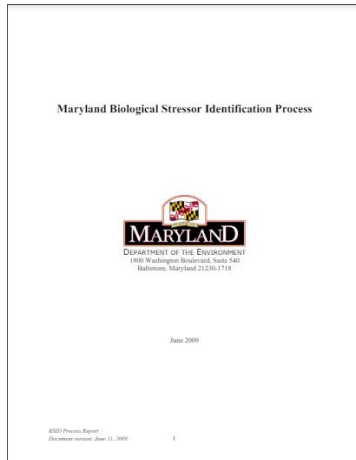
06/04/2024



MD BSID

History

- First developed in 2009
- Updated in 2014
 - [Studies published](#) around 2016

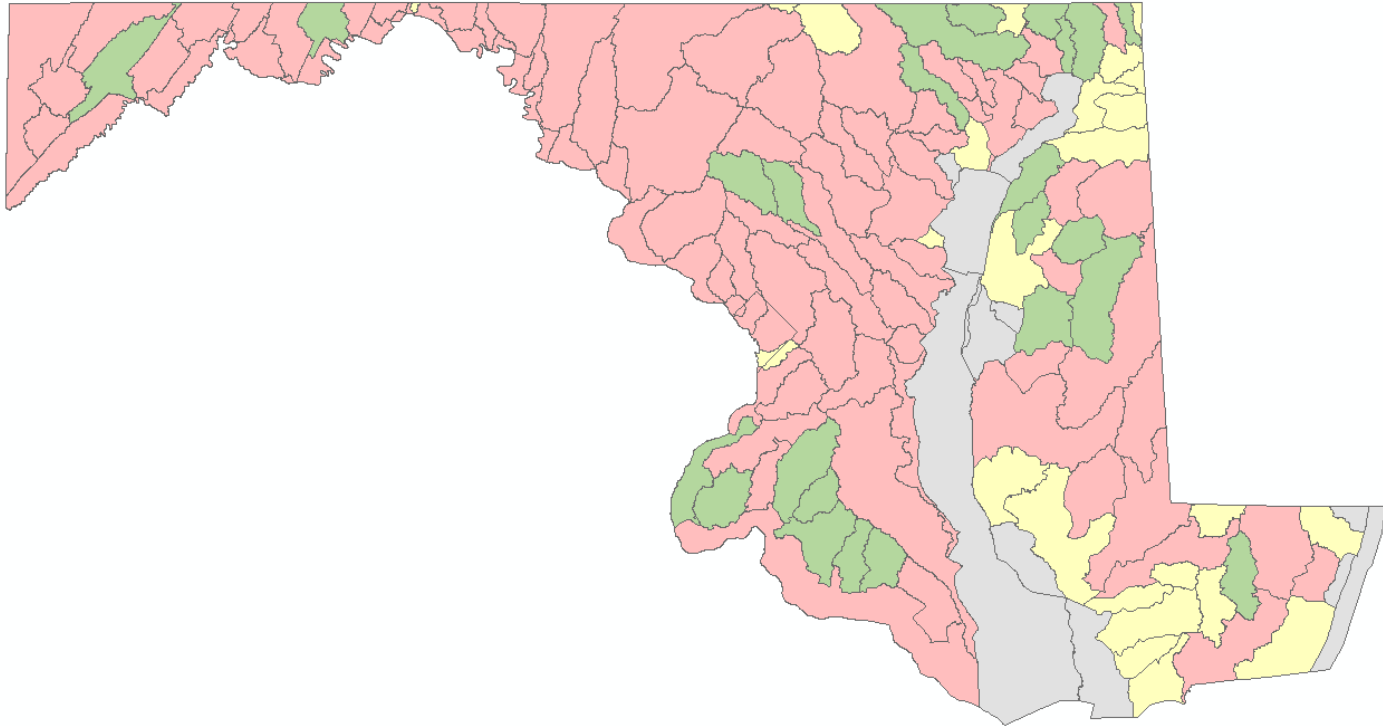


Data

- Maryland Biological Stream Survey:
 - 1st to 4th order non-tidal streams
 - Benthic macroinvertebrates
 - Fish
 - Water chemistry
 - Instream habitat
 - Riparian habitat
 - Altitude
 - Land use
 - Impervious surface
 - State Roads
- n = 1,284**



2014 Biological Assessment Results





MD BSID

Goal

- Compare biology to stressor levels
- Using case-control statistics: Mantel-Haenszel Odds Ratios
- Samples are categorized into groups, then numbers in each group are compared
- Sites are categorized by:
 - Biology: 😊 or ☹️
 - Stressor: ↑ or ↓
 - Physiographic region and stream order

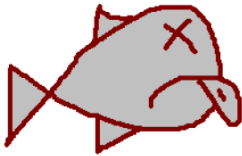
Data from R2 (2000-2004)
and R3 (2007-2009)



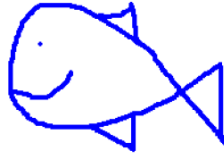
Biology Categories

Cases vs. Controls

FIBI < 3



FIBI ≥ 3



BIBI < 3



BIBI ≥ 3



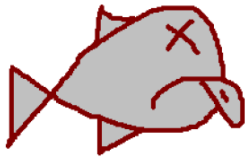
Narrative Rating	IBI Score Range
Good	4.0 – 5.0
Fair	3.0 – 3.9
Poor	2.0 – 2.9
Very Poor	1.0 – 1.9



Biology Categories

Cases vs. Controls

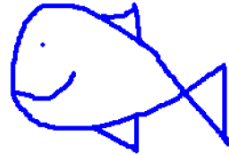
FIBI < 3



BIBI < 3



in 8-digit watershed

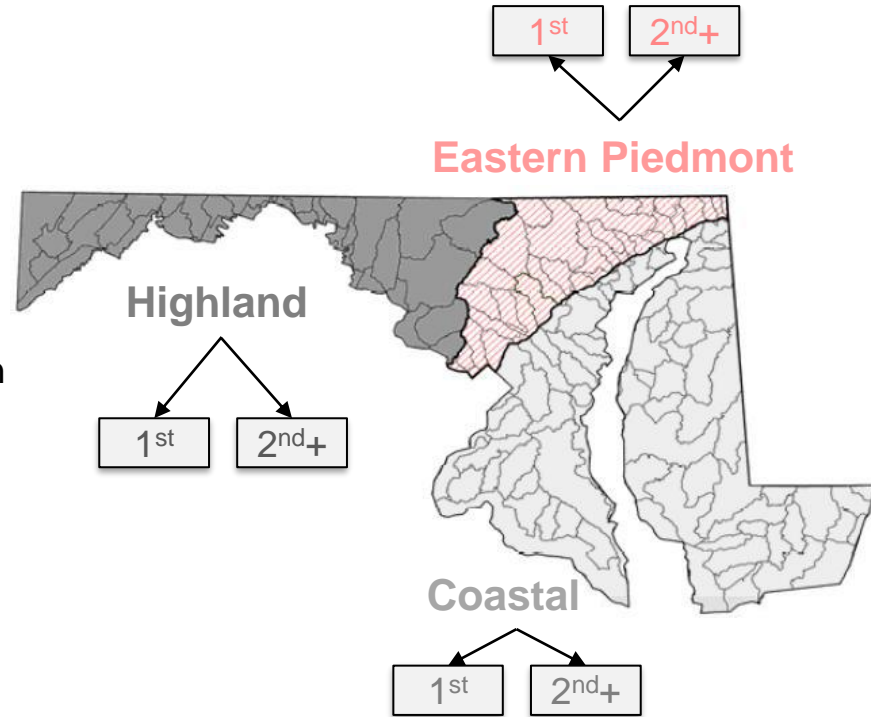


FIBI ≥ 3



BIBI ≥ 3

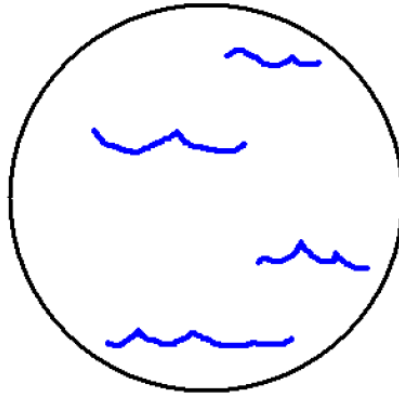
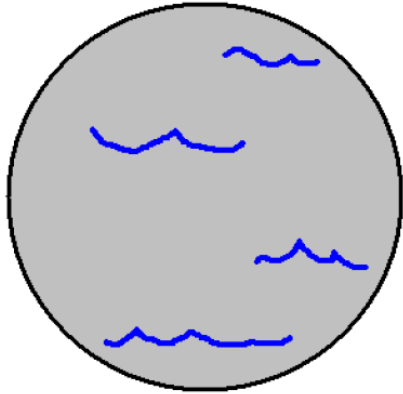
in physiographic region





Stressor Categories

Stressor above limit vs. Stressor below limit



- Source:
 - Acidity
 - Agricultural
 - Anthropogenic
 - Impervious
 - Urban
- Stressor:
 - Sediment
 - Habitat (instream & riparian)
 - Chemistry (inorganic, nutrients, and pH)



Parameter Thresholds

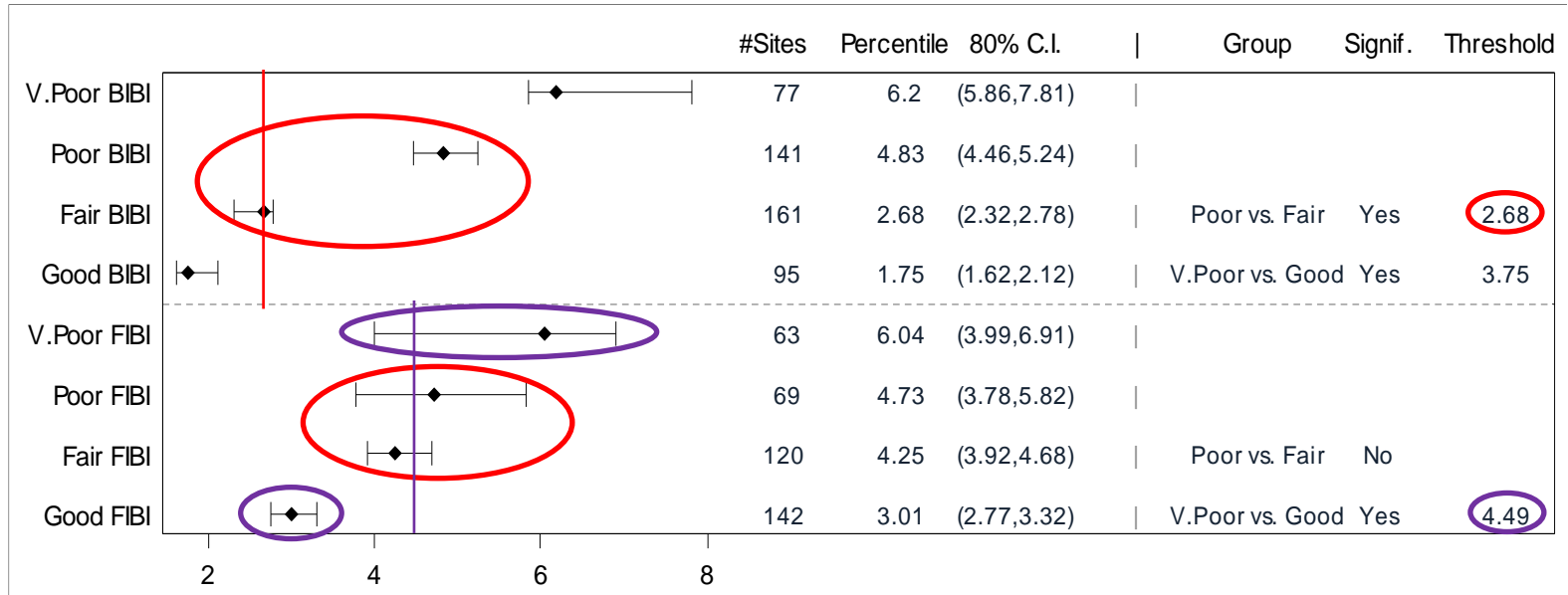
Each parameter was assigned a stressor threshold per eco-region, based on:

- Existing guidelines: COMAR, literature, MDDNR MBSS
- Statistical analysis on grouped responses → indicate levels above which degradation to biological communities is likely to occur
 - Compared stressor levels among different biological conditions: sites pooled into each narrative IBI category and stratified by ecoregion
 - Graphs displaying 80% confidence intervals of grouped percentile distributions and statistical significance tested







Parameter Thresholds

High Total Nitrogen, Highland





MD BSID – Contingency Tables

	Case	Control
Stressor above limit	a 	b 
Stressor below limit	c 	d 

Two-way contingency table for every:

- Stressor
- Watershed



MD BSID – Odds Ratio

$$\text{Odds Ratio} = \frac{ad}{bc} = \frac{\begin{array}{cc} \text{Red fish with X} & \text{Blue fish} \\ \text{Grey background} & \text{White background} \end{array}}{\begin{array}{cc} \text{Red fish with X} & \text{Blue fish} \\ \text{White background} & \text{Grey background} \end{array}}$$

If >1, the result is significant, and stressor is likely to be impacting biology



MD BSID – Attributable Risk

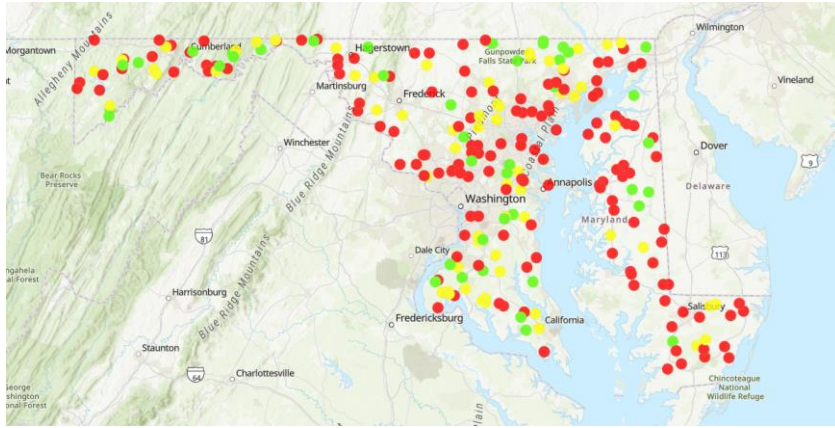
The portion of the sites with poor to very poor biological conditions as a result of the stressor

$$AR = \left(\frac{\text{Poor Biological Conditions}}{\text{Poor Biological Conditions}} \right) - \left(\frac{\text{Poor Biological Conditions}}{\text{Good Biological Conditions}} \right)$$

Also combined by categories of stressors and sources.



MD BSID- Challenges



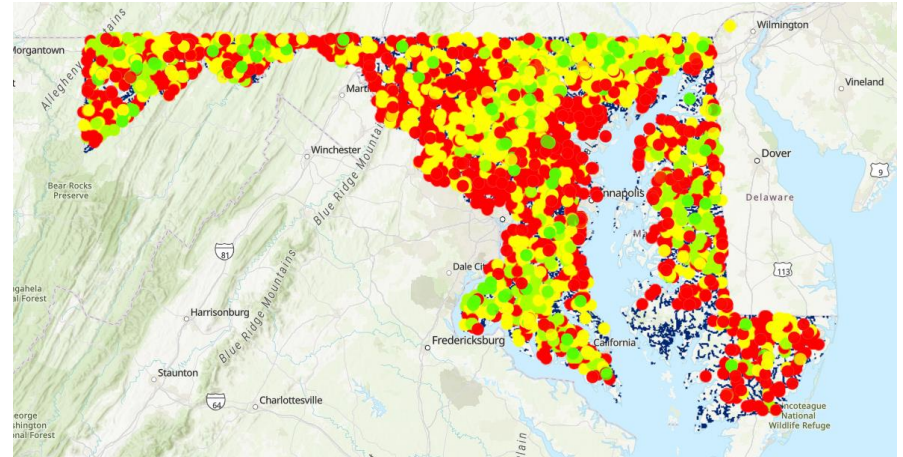
- Sampling efforts have not remained the same over time
- Sampling methodology has changed

Images:

MBSS- Biological Stream Survey Random Sites (2021-2023)- Top

MBSS- Biological Stream Survey Sites (1995-2023)- Right

<https://maryland.maps.arcgis.com/apps/webappviewer/index.html?id=30ee9336f8d54e4ebf971c3a1a7576ed>





MD BSID- Challenges

MBSS SUMMER HABITAT DATA SHEET Page: of

Watershed Code: Segment: Type: Year: Reviewer: First / Second
SITE CODE:
Habitat Assessor:

BANK EROSION		HABITAT ASSESSMENT		FLOW		
Left Bank	Right Bank			Lat. Loc. (m)	Depth (cm)	Velocity (m/s)
Extent (m)	<input type="text"/>	1. Instream Habitat (0-20)	<input type="text"/>	0	0	0
Severity	<input type="text"/>	2. Epifaunal Substrate (0-20)	<input type="text"/>	0	0	0
0 = none		3. Velocity/Depth Diversity (0-20)	<input type="text"/>			
1 = min		4. Pool/Glide/Eddy Quality (0-20)	<input type="text"/>			
2 = med		Extent (m)	<input type="text"/>			
3 = severe		5. Riffle/Run Quality (0-20)	<input type="text"/>			
Average		Extent (m)	<input type="text"/>			
Height (m)		6. Embeddedness (%)	<input type="text"/>			
		7. Shading (%)	<input type="text"/>			

BAR FORMATION & SUBSTRATE

Severity:
0 = none
1 = min
2 = med
3 = severe

Cobble
Gravel
Sand
Silt/Clay

STREAM CHARACTER

Braided Gravel Boulder >2m
Riffle Sand Boulder <2m
Run/Glide Silt/Clay Beaver Pond
Deep Pool (>= 0.5m) Cobble Overhead Cover
Shallow Pool (< 0.5m) Bedrock Undercut Bank
Filamentous algae

A = Absent P = Present E = Extensive

Woody Debris

No. of Instream Woody Debris:
No. of De-watered Woody Debris:
No. of Instream Rootwads:
No. of De-watered Rootwads:

Maximum Depth (cm)

Wetted Width (m):
Thalweg Depth (cm):
0 m:
25 m:
50 m:
75 m:

Alternative Flow Measurements

Distance (cm):
Depth (cm):
Width (cm):
Time (sec): 1.
2.
3.

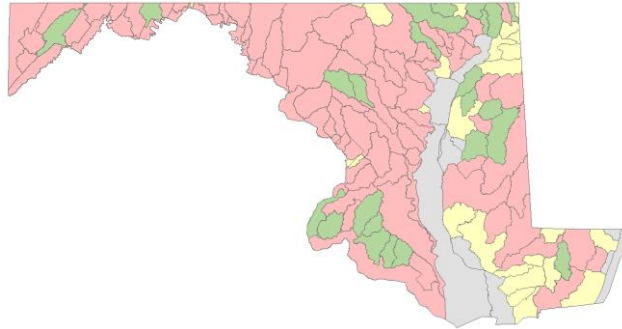
- Subjective parameters
- Additional stressors that are not currently being collected



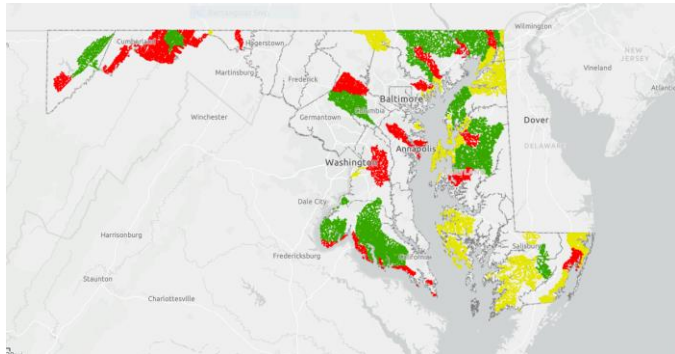


MD BSID- Challenges

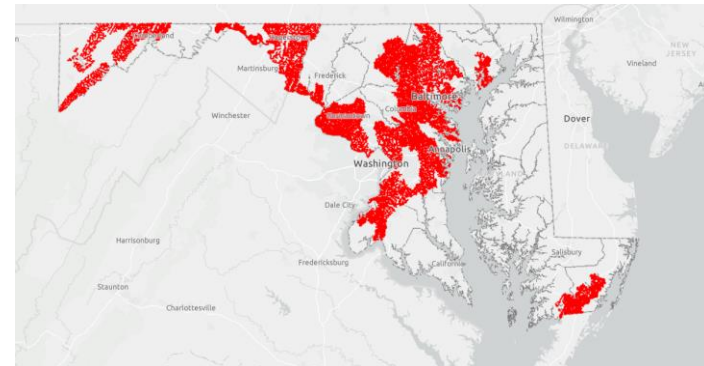
- Scale of the assessment does not help with targeting more degraded areas



MDE Biological Assessment 2014



MDE Biological (Cause Unknown) Assessments

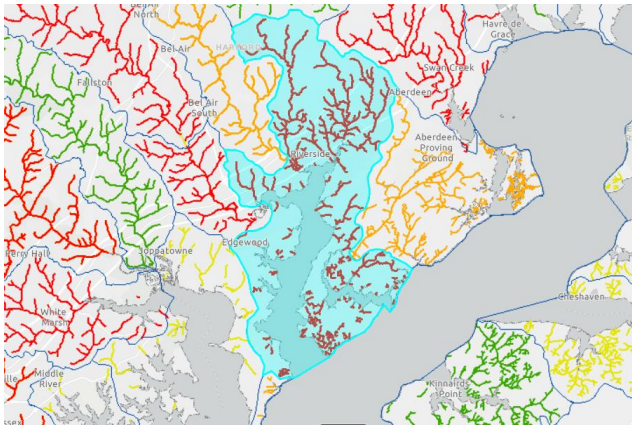


MDE Chloride and Sulfate Impairments



MD BSID- Challenges

- Updating the Biological Assessment
- Stressors vs. Biology



AU ID	Basin Name	AU Size	Designated Use	Listing Category	Cause	Percent Attributable Risk
MD-02130701	Bush River	102.81	Aquatic Life and Wildlife	4c	Habitat Alterations	59.00%
MD-02130701	Bush River	102.81	Aquatic Life and Wildlife	4c	Riparian Buffer, Lack of	75.00%
MD-02130701	Bush River	102.81	Aquatic Life and Wildlife	5	Total Suspended Solids (TSS)	31.00%
MD-02130701	Bush River	102.81	Aquatic Life and Wildlife	5s	Chloride	95.00%
MD-02130701	Bush River	102.81	Aquatic Life and Wildlife	2	Sulfate	



MD BSID- Next Steps

Work with ICPRB to update current process:

- Incorporate toxics into methodology
- Evaluate changing the scale

MS4 and DNR work

- Update the Biological Assessment
- Standardize sampling method
- Vet jurisdiction data to incorporate into the assessment



Image from MDE, 2008

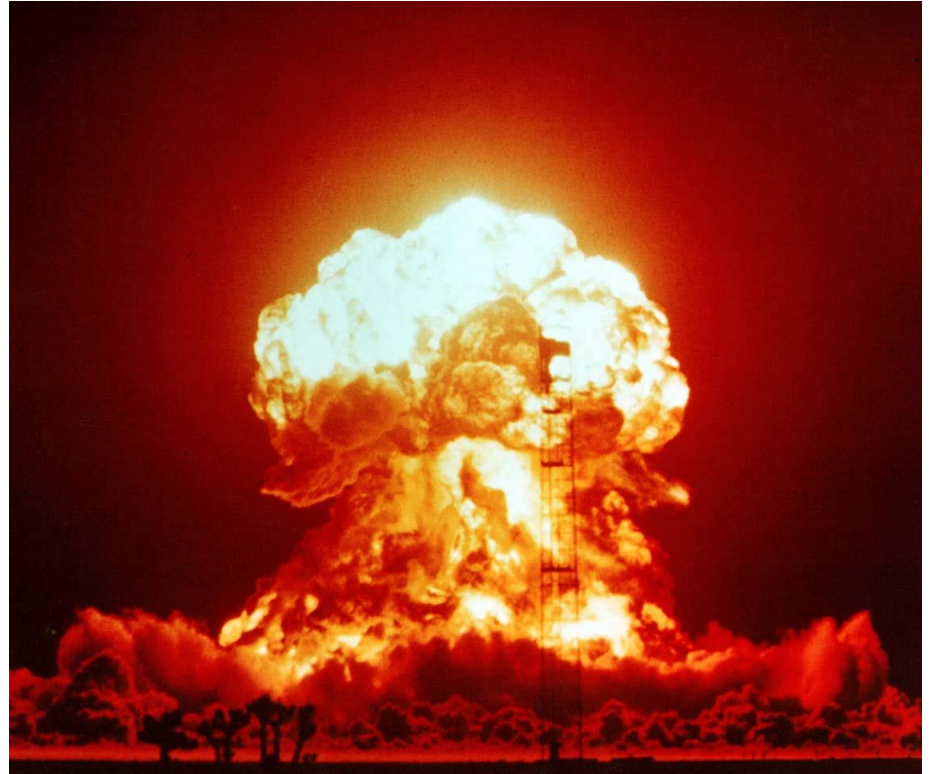


Remaining Questions

We could use your help!

If we change- does it blow up the process?

- Scale
- Assessment Units
- Updating Assessments
- Delisting
- Random vs. Targeted Sampling
- BSID Threshold Updates
- BSID Changes Over Time





Questions?

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