



# The Silica Control Tool

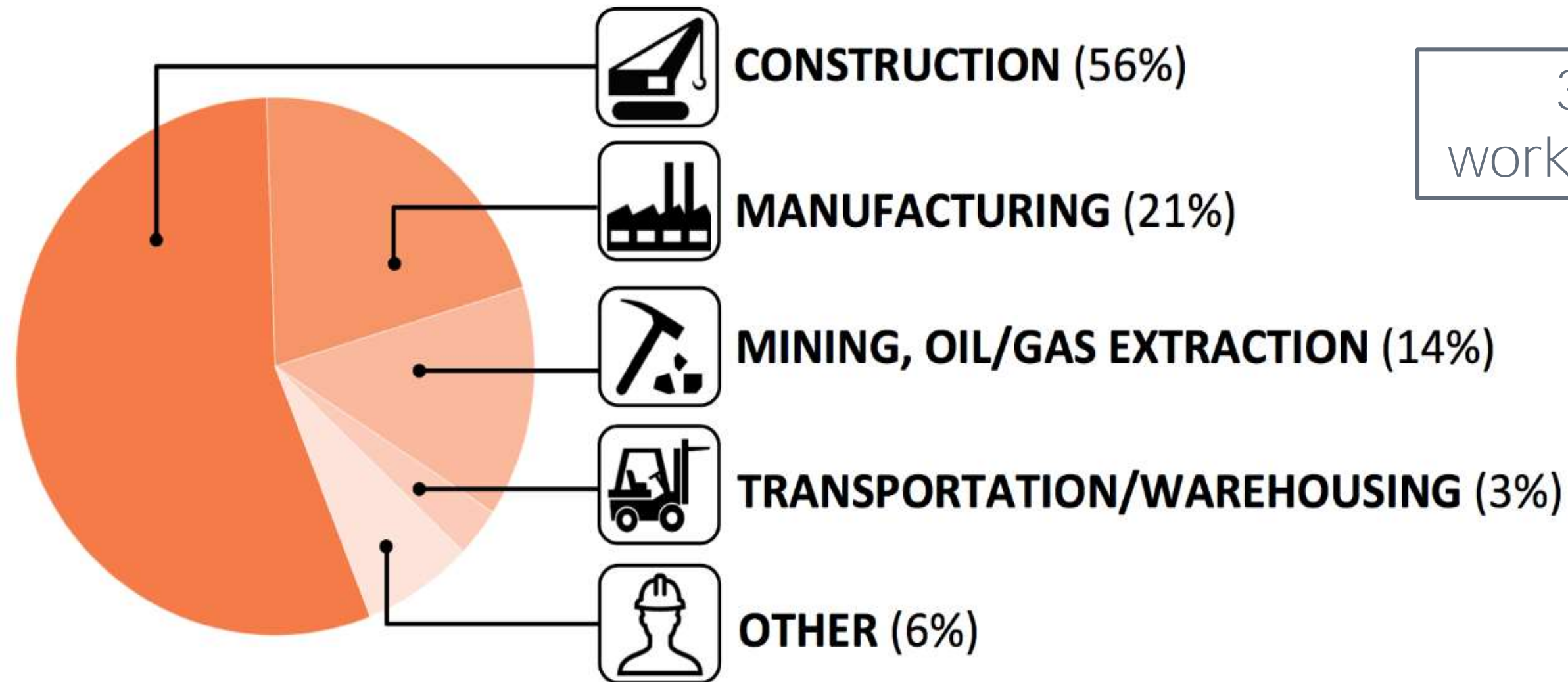
## A “living” risk assessment tool for the construction industry

*Presented by:*

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**Senior Research Scientist, BCCSA**



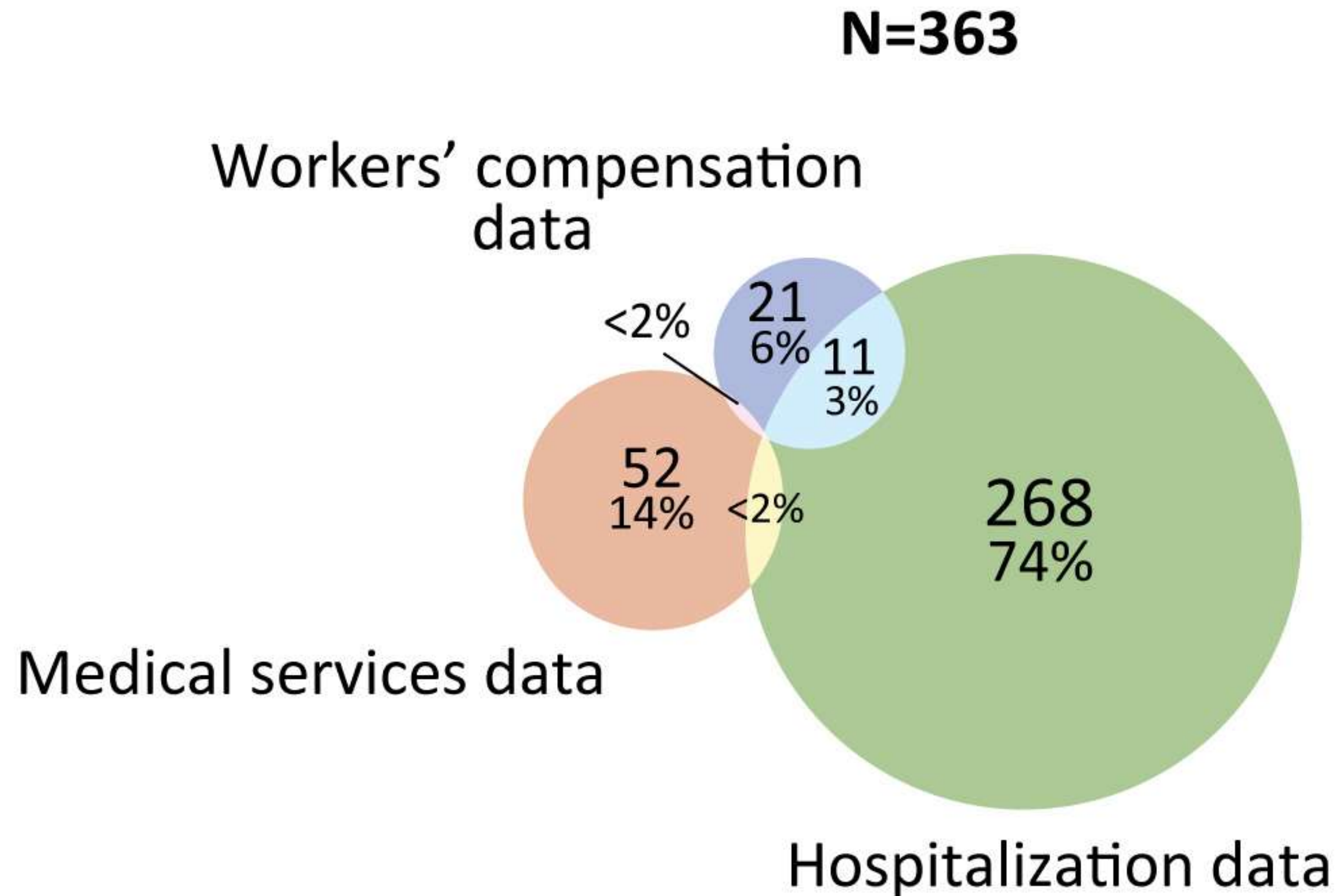
# CAREX Estimates



380 000  
workers exposed

573  
lung cancers

# Silicosis 1992 - 2007



# WorkSafeBC OHS Regulation

- *Substance specific* requirements for RCS implemented 2017
- 8-Hour Occupational Exposure Limit:  $0.025 \text{ mg/m}^3$
- Requirement to monitor exposure for any work activity that **generates RCS dust” and create Exposure Control Plan (ECP)**

# Construction Challenges

- Work sites change rapidly
- Workers and companies move between sites
- Tasks vary within and between work shifts
- Lack of available in-house exposure measurements and industrial hygiene expertise
- 92 % of BC employers have <10 employees
- 85% have <5

# Objective Monitoring Data



- Monitoring can be based on “objective air monitoring data, that was collected during **equivalent work operations through industry surveys or peer reviewed or scientific studies...**”





# The Silica Control Tool

- Help employers use existing data
- Educate employers and workers
- Produce effective Exposure Control Plans (ECPs)
- Reduce effort and cost
- Improve quality of exposure data used in risk assessment



# The Silica Control Tool

- Based on database of >4000 personal RCS measurements
- Predicts exposure level with and without controls
- Compares to exposure limit
- Creates Electronic and Paper ECP





Exposure Control Planning

Jobsite at  
**Example**

November 14th, 2017 to November 8th, 2017

✓ INTRODUCTION

📍 SILICA PROCESS

✓ Get prepared

✓ Jobsite details

● **Work activity**

● Work area & duration

● Silica process summary

🔒 SILICA EXPOSURE (NO CONTROLS)

🔒 EXPOSURE CONTROL

🔒 SILICA EXPOSURE (WITH CONTROLS)

🔒 RESIDUAL EXPOSURE CONTROL

🔒 DOCUMENTATION

🔒 CONCLUSION

# Work Activity

The **work activity** is the combination of *material*, *task* and *tool* that will be performed. Basically, (1) the *material* determines how much **crystalline silica** is present and how easily dust can be created when disturbed; and (2) the *task/tool* determines how much energy is exerted into the material. The combination of (1) and (2) determines how much airborne RCS dust is predicted as a result of the nature of the work activity.

**Identify** the planned work activity to be performed at this jobsite. In some cases, note that the combination of *material* and *task* (without further identifying the *tool*) is enough to make a determination of how much energy is expected to be exerted into the material.

1. Select Material:

Concrete

2. Select Task:

Drilling

3. Select Tool:

Electric Hammer Drill

Can't find your Material, Task or Tool? [Click here.](#)

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Exposure Control Planning

# Drilling Concrete with a Hammer Drill

Inside for less than 4 hours

Jobsite at  
**Example**

November 14th, 2017 to November 8th, 2017

✓ INTRODUCTION

✓ SILICA PROCESS

📍 SILICA EXPOSURE (NO CONTROLS)

✓ Get prepared

● Exposure analysis (No Controls)

🔒 EXPOSURE CONTROL

🔒 SILICA EXPOSURE (WITH CONTROLS)

🔒 RESIDUAL EXPOSURE CONTROL

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## Exposure Analysis (No Controls)

RESULTS

DETAILS

SAVE



### EXPOSURE MONITORING DATA EQUIVALENT

Est. Exposure Level  
(No Controls)

Exposure Limit

Action Level

**0.066 mg/m<sup>3</sup>**

**0.025 mg/m<sup>3</sup>**

Est. Exposure Level  
exceeds by **264%**

**0.0125 mg/m<sup>3</sup>**

Est. Exposure Level  
exceeds by **528%**

Risk Classification

**HAZARDOUS LEVEL**

We recommend to proceed as HAZARDOUS exposure level or perform an air sampling test.



**WARNING**

This exposure risk must be controlled:

## Exposure Control Planning

## Drilling Concrete with a an Electric Hammer Drill

Inside for less than 4 hours

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✓ INTRODUCTION

✓ SILICA PROCESS

✓ SILICA EXPOSURE (NO CONTROLS)

## 📍 EXPOSURE CONTROL

✓ Get prepared

✓ Risk elimination &amp; substitution

● Engineering controls

● Administrative controls

● Exposure control summary

🔒 SILICA EXPOSURE (WITH CONTROLS)

🔒 RESIDUAL EXPOSURE CONTROL

# Engineering Controls

Engineering controls are engineered methods that are built into the design of equipment, process, or plant to minimize a hazardous exposure.

Select the engineering control option you will be implementing for *Drilling concrete using a hammer drill* at this jobsite.

If you're not sure which option to select, click DETAILS for (1) CRITERIA to see what the researchers envision for the control; (2) PROPER PRACTICES to see how the control is expected to be used; and (3) INFORMATION for control guidelines & tips.

☐ Wetting integrated to tool [Details](#)☒ LEV integrated to tool [Details](#)

✚ LEV integrated to tool will be added to your ECP.

☐ Engineering control not listed [Details](#)☐ You have indicated you DO NOT intend to use an engineering control. [Details](#)

We'll now ask questions about the administrative controls you plan to implement.



Exposure Control Planning

Drilling Concrete with a an Electric Hammer Drill

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- SILICA EXPOSURE (NO CONTROLS)
- EXPOSURE CONTROL

SILICA EXPOSURE (WITH CONTROLS)

- Get prepared
- Exposure Analysis (With Controls)

RESIDUAL EXPOSURE CONTROL

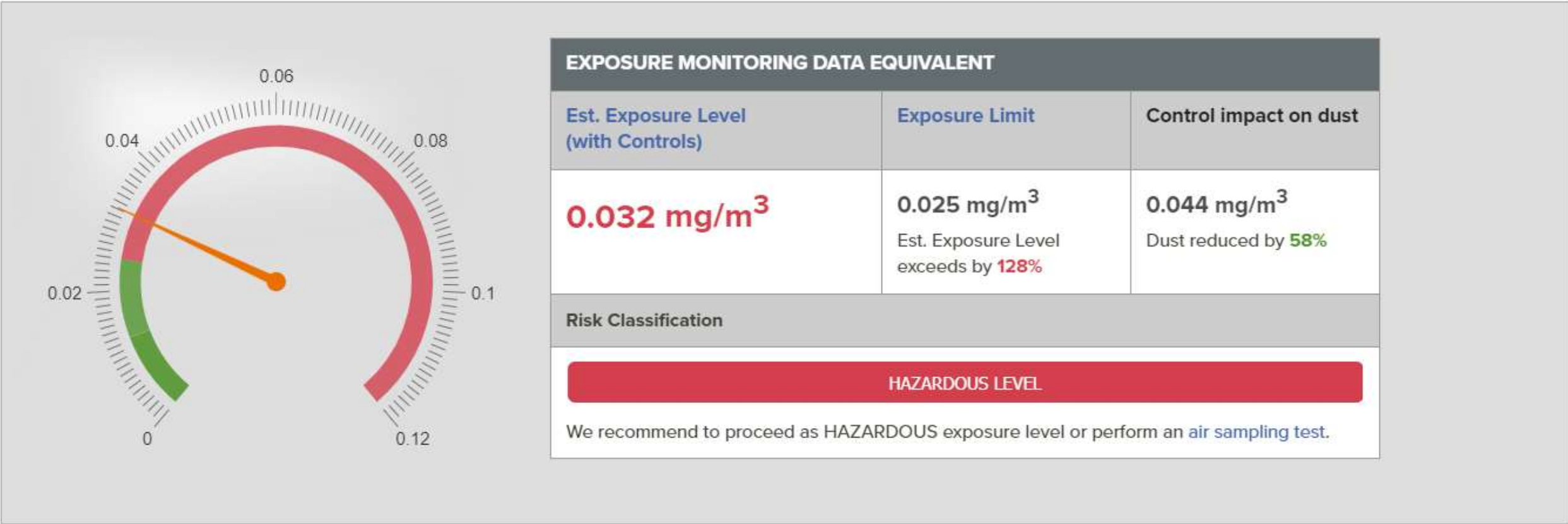
DOCUMENTATION

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Exposure Analysis (with Controls)

RESULTS

DETAILS



WARNING

This exposure risk must be further controlled:

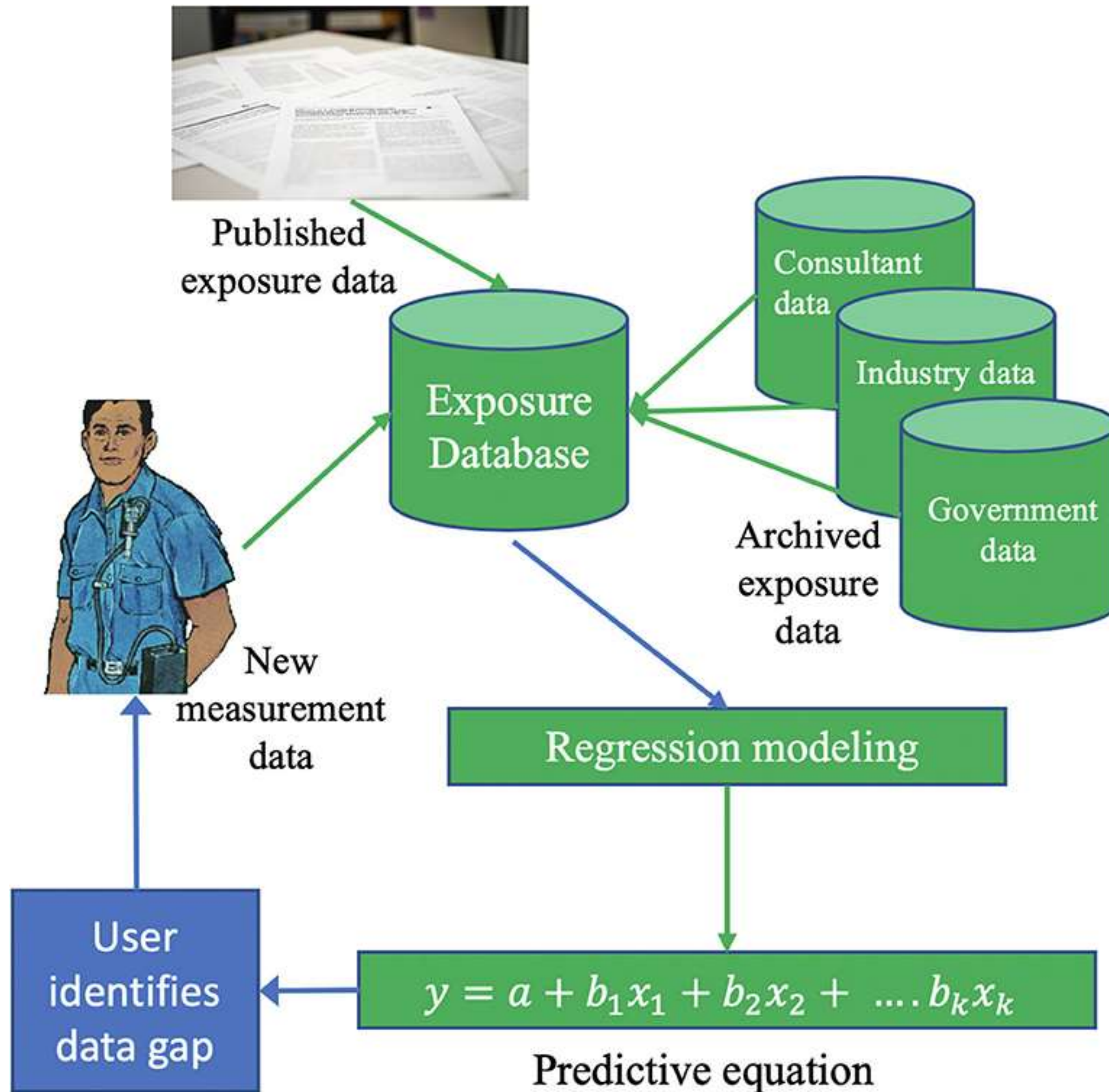
# Silica Control Tool Support

- BCCSA provides support for users
- Continual data collection
- Tool updated in response to user requests and new data



# Ongoing Silica Sampling

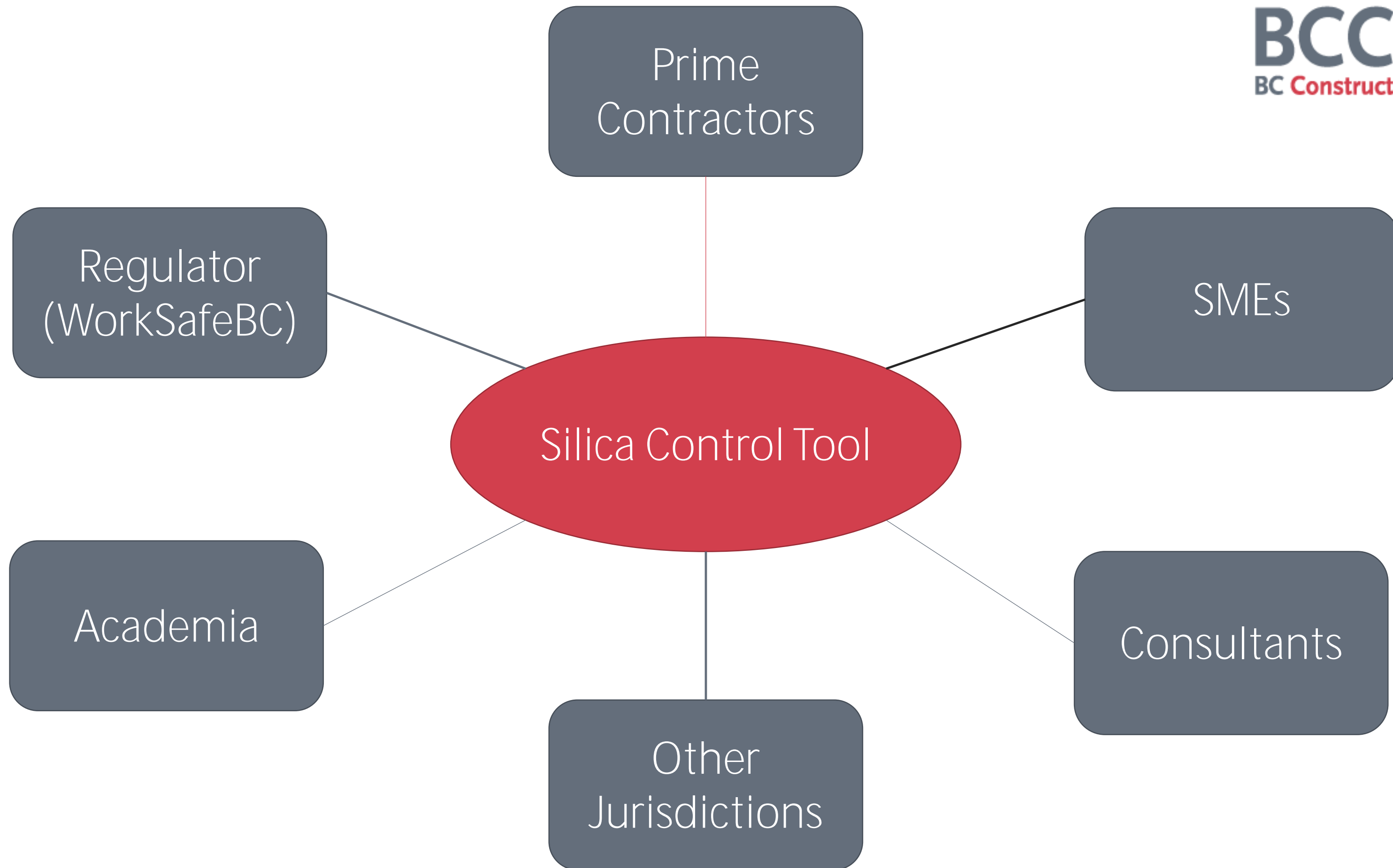
- Add recent/local data
- Literature review
- Add new activities to the Silica Control Tool
- Add new controls (e.g. dustbane)
- Fill in gaps (e.g. unavailable controls)



Davies HW and Gorman Ng M (2020)  
Development of a Web-Based Tool for  
Risk Assessment and Exposure Control  
Planning of Silica-Producing Tasks in the  
Construction Sector. *Front Public Health*  
8:371

# Benefits of using measurements

- Can calibrate to other jurisdictions
- See evidence of exposure and control effectiveness
- Measurements can be used more than once
- Monitor trends in exposure
- Can update with new measurements
- Encourages industry engagement



# Tool Updates

- Silica Control Tool Launched Spring 2017
- 400 + measurements added since launch
- Version 3 launching winter 2020:
  - New work activities (e.g. sanding drywall)
  - New control (sweeping compounds)
  - More flexible user interface



# Research

- Alberta OHS Futures (completed October 2018)
- Manitoba Research and Workplace Innovation (ongoing)

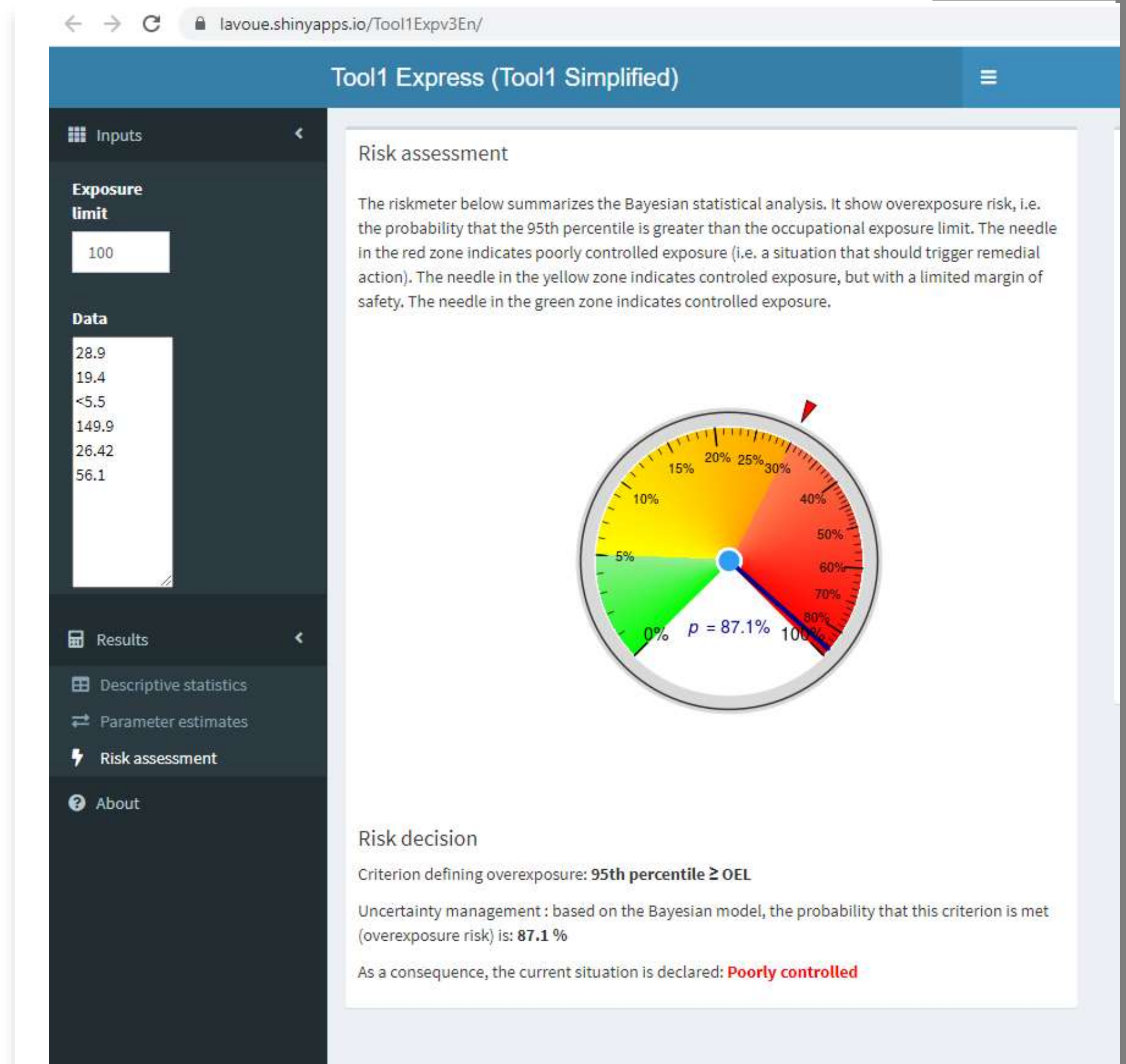
## *Extension to other jurisdictions*

- Industry Survey (identify common silica processes)
- RCS Sampling

## *Refinement of statistical approach (Bayesian modelling)*

# Bayesian Version

- Probability based risk assessment
- May allow user to incorporate their own data as prior
- Example: [expostats.ca](http://expostats.ca)



# Conclusions

- Data can be used beyond one-time compliance measure
- Good uptake by industry and partnership with WorkSafeBC
- Encourages exposure measurement and sharing by employers
- Continuing research supports ongoing development
- Model and tool are updated as new data become available
- Adaptable to other jurisdictions



Thank you



# Silica in Construction Database

- Database of silica in construction measurements, Beaudry et al. (2013)\*: N = 11 800
- Updated literature review in 2015: N = 3600
- Canadian companies and govt.: N = 300
- BCCSA/UBC Monitoring, 2015 to present: N = 610+

\*Beaudry C, Lavoué J, Suavé J-F *et al* (2013). Occupational Exposure to Silica in Construction Workers: A Literature-Based Exposure Database. *J Occup Environ Hyg*; 10(2):71-77.



# Model Built from Database

- Restricted data to:
  - Personal samples
  - Chemical analysis for RCS (quartz and/or cristobalite)
  - Standardized sampling/analytical methods

N = 4800

# Model built from Database

N total = 4800

75% from North America

17% from Canada

N = 235 from BC

N = 305 from Alberta

N = 102 from Manitoba

N = 29 from Ontario

N = 151 from Quebec

# Model Built from Database

- Linear regression model estimates exposure level based on:
  - Process (e.g. cutting concrete with powered saw)
  - Engineered controls (e.g. wetting, local exhaust ventilation)
  - Industry Sector
  - Project type (new, renovation, demolition)
  - Work environment (indoor or outdoor)
  - Region
  - Duration

# Data Variability

- Tool presents 95<sup>th</sup> percentile exposure estimate
  - Uncontrolled
  - Controlled
- Conservative estimate of exposure level
- Uses 8-hour exposure limit for comparison to task-based scenarios



Exposure Control Planning

Jobsite at  
**Example**  
November 14th, 2017 to November 8th, 2017

INTRODUCTION

SILICA PROCESS

Get prepared

Jobsite details

Work activity

Work area & duration

Silica process summary

SILICA EXPOSURE (NO CONTROLS)

EXPOSURE CONTROL

SILICA EXPOSURE (WITH CONTROLS)

RESIDUAL EXPOSURE CONTROL

DOCUMENTATION

CONCLUSION

# Now, we'll identify the silica process



A **silica process** is a process (in this case, a work activity under certain conditions) that results in the release of RCS dust in concentrations likely to exceed the **exposure limit**.

In addition to the nature of the work activity itself, the scope and circumstances of the work activity (such as the jobsite characteristics, work area environment and average work shift duration) can also play a role in determining the amount of airborne RCS dust likely to be present.

We'll now gather the information needed to identify the potential risk, starting with your jobsite details.

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Exposure Control Planning

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- Work area & duration
- Silica process summary

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Exposure Control Planning

Drilling Concrete with a Hammer Drill

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Work Area & Duration

Where and how long the work activity takes place can amplify the exposure risk.

Identify the work area and work activity duration for **Drilling Concrete with a Hammer Drill** at **Example**.

1. Select Work Area:

Inside

**Note:** For a work activity that moves between inside and outside, select *Inside* when at least 25% of the time is spent inside.

2. Select Work Activity Duration (avg. per shift):

- ✓ Please select less than 4 hours
- 4 to 8 hours
- more than 8 hours
- 0 hours

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Exposure Control Planning

**Drilling Concrete with a Hammer Drill**

Inside for less than 4 hours

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✓ INTRODUCTION

✓ SILICA PROCESS

📍 **SILICA EXPOSURE (NO CONTROLS)**

✓ Get prepared

● **Exposure analysis (No Controls)**

🔒 EXPOSURE CONTROL

🔒 SILICA EXPOSURE (WITH CONTROLS)

🔒 RESIDUAL EXPOSURE CONTROL

🔒 DOCUMENTATION

🔒 CONCLUSION

# Exposure Analysis (No Controls)

RESULTS

DETAILS

SAVE



## EXPOSURE MONITORING DATA EQUIVALENT

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(No Controls)

Exposure Limit

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**0.066 mg/m<sup>3</sup>**

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Exposure Control Planning

## Drilling Concrete with a Hammer Drill

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✓ SILICA EXPOSURE (NO CONTROLS)

📍 EXPOSURE CONTROL

● Get prepared

● Risk elimination & substitution

● Engineering controls

● Administrative controls

● Exposure control summary

🔒 SILICA EXPOSURE (WITH CONTROLS)

🔒 RESIDUAL EXPOSURE CONTROL

🔒 DOCUMENTATION

## Now, we'll control the risk



Get Prepared

Practice Considerations

**The next step** is to identify the appropriate controls required to eliminate or minimize the RCS dust exposure. The OHSR requires employers to select silica dust controls based on the following [Hierarchy of Controls](#):

- [Elimination & substitution](#)
- [Engineering controls](#)
- [Administrative controls](#)
- [Personal Protective Equipment \(PPE\)](#)

We will now identify which of these controls you have available.

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EXPOSURE CONTROL

✓ Get prepared

✓ Risk elimination & substitution

● Engineering controls

● Administrative controls

● Exposure control summary

🔒 SILICA EXPOSURE (WITH CONTROLS)

🔒 RESIDUAL EXPOSURE CONTROL

🔒 DOCUMENTATION

🔒 CONCLUSION

# 1. Water Spray and/or LEV Systems

Will you be using a water spray and/or a LEV system to reduce dust generated by Drilling Concrete with a Hammer Drill?

ANSWER

CRITERIA

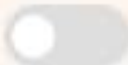
SAFE WORK PROCEDURES

INFORMATION

☒ Yes ☐ No

✚ A Water Spray and/or LEV System will be added as a control.

Next, select which type of water spray and/or LEV system you will be implementing:



**Option #1: Water Spray System (Tool Attachment)**

Select this option if only using a water spray tool attachment on your hammer drill.



**Option #3: LEV System (Tool Attachment)**

Select this option if *only* using a LEV system tool attachment on your hammer drill.





Exposure Control Planning

# Drilling Concrete with a Hammer Drill

Inside for less than 4 hours

Jobsite at  
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✔ INTRODUCTION

✔ SILICA PROCESS

✔ SILICA EXPOSURE (NO CONTROLS)

📍 EXPOSURE CONTROL

✔ Get prepared

✔ Risk elimination & substitution

✔ Engineering controls

✔ Administrative controls

● Exposure control summary

🔒 SILICA EXPOSURE (WITH CONTROLS)

🔒 RESIDUAL EXPOSURE CONTROL

🔒 DOCUMENTATION

## Exposure Control Summary

ENGINEERING CONTROLS	
Control	Type
LEV System (Tool Attachment)	Water Spray and/or LEV Systems
ADMINISTRATIVE CONTROLS	
Control	Type
Inspections & Maintenance	Correct use & maintenance
Housekeeping	Removal & cleanup
Hygiene	Removal & cleanup
Silica Safety Instruction & Training	Instruction & training
Exposure Emergency Preparedness	Medical & emergency procedures
Work Shift Scheduling	Project management
Barriers	Separation from Source

Are there any controls to add or delete?

Edit Engineering Controls

Edit Administrative Controls

Exposure Control Planning

**Drilling Concrete with a Hammer Drill**

Inside for less than 4 hours

Jobsite at  
**Example**

November 14th, 2017 to November 8th, 2017

- ✓ INTRODUCTION
- ✓ SILICA PROCESS
- ✓ SILICA EXPOSURE (NO CONTROLS)
- ✓ EXPOSURE CONTROL

📍 **SILICA EXPOSURE (WITH CONTROLS)**

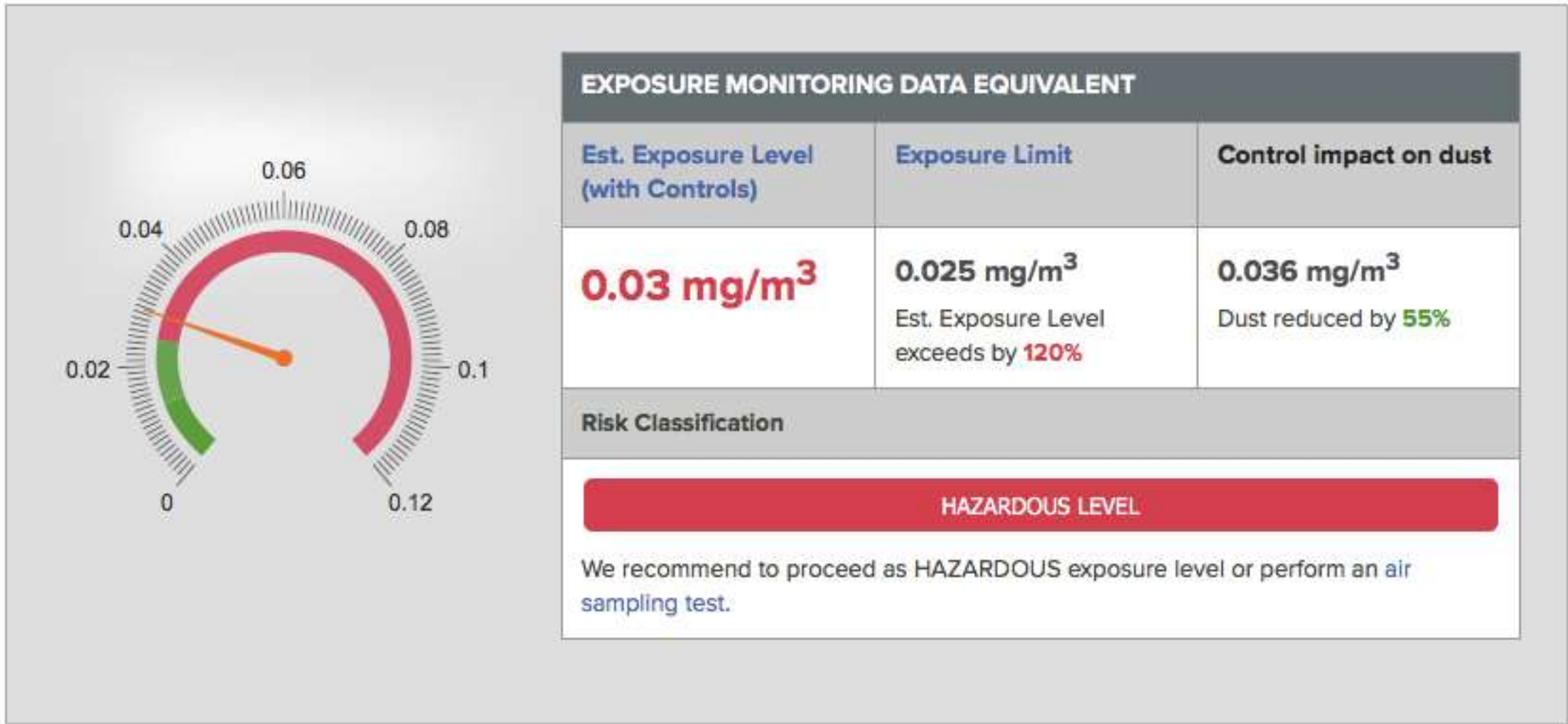
- ✓ Get prepared
- **Exposure Analysis (With Controls)**

- 🔒 RESIDUAL EXPOSURE CONTROL
- 🔒 DOCUMENTATION
- 🔒 CONCLUSION

# Exposure Analysis (with Controls)

RESULTS

DETAILS



**WARNING**  
This exposure risk must be further controlled:





Exposure Control Planning

Drilling Concrete with a Hammer Drill

Inside for less than 4 hours

Jobsite at  
Example

November 14th, 2017 to November 8th, 2017

- ✓ INTRODUCTION
- ✓ SILICA PROCESS
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- ✓ EXPOSURE CONTROL
- ✓ SILICA EXPOSURE (WITH CONTROLS)

RESIDUAL EXPOSURE CONTROL

✓ Get prepared

● Respirators & other PPE

🔒 DOCUMENTATION

🔒 CONCLUSION

# Respirators & Other PPE

Personal Protective Equipment (PPE) is equipment worn by workers to reduce exposure.

Answer these questions below about the PPE controls you have available for this jobsite.

## Respiratory Protective Equipment (RPE)

### RESPIRATOR SELECTION

Respirator Usage	Required Protection Factor	Respirator Type & Filter
PROTECTION REQUIRED	10	Half facepiece, non powered with N100 filter

## Respirators

QUESTION   CRITERIA   PROPER PRACTICES   INFORMATION

Will your workers in the work area have respirators available?

☒ YES   ☐ NO

➕ Respirators will be added as a control.





Exposure Control Planning

# Drilling Concrete with a Hammer Drill

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- ✔ INTRODUCTION
- ✔ SILICA PROCESS
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- ✔ EXPOSURE CONTROL
- ✔ SILICA EXPOSURE (WITH CONTROLS)
- ✔ RESIDUAL EXPOSURE CONTROL

📍 DOCUMENTATION

✔ Get prepared

● ECP Summary

● Generate ECP

🔒 CONCLUSION

SUMMARY

[SAVE PDF](#)

## EXPOSURE CONTROL PLAN (ECP) SUMMARY

A summary of your exposure control planning is below. Please review the summary carefully for omissions or errors. If all looks correct, you may decide to [Save a PDF version](#) of this summary.

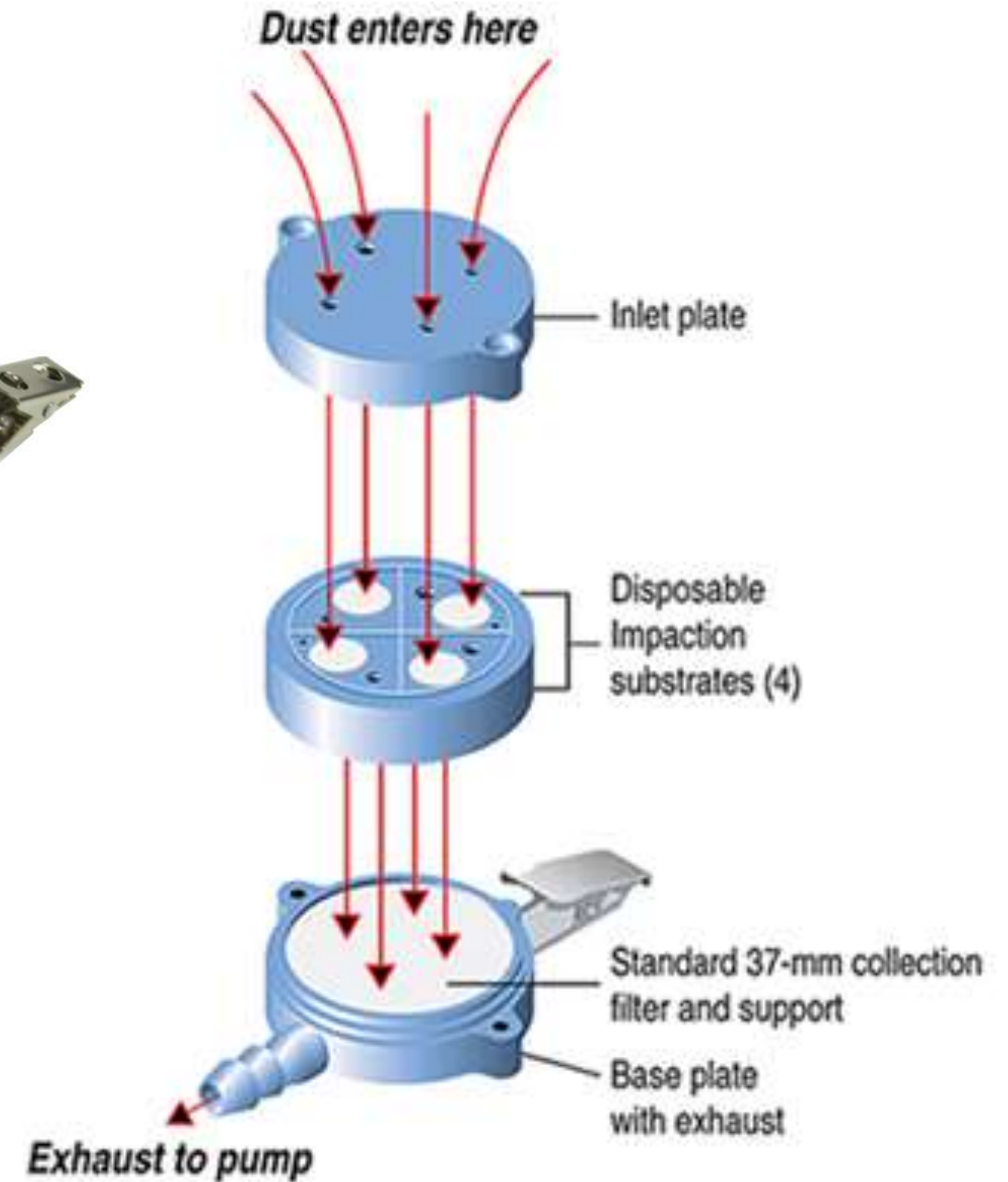
EMPLOYER DETAILS			ECP CONTACT
	<b>DJs Construction Ltd.</b> 1584 Taralawn Court Burnaby, BC V5B 3H3	(604) 253-7904 <a href="mailto:dinfo@djs-construction.ca">dinfo@djs-construction.ca</a> <a href="http://www.djs-construction.ca">www.djs-construction.ca</a>	<b>Melanie Gorman Ng</b>  <a href="mailto:mgorman.ng@gmail.com">mgorman.ng@gmail.com</a>
<i>Any details to edit?</i> <a href="#">Edit Employer Details</a>			

SILICA PROCESS		
Work Activity	Work Area	Duration per shift (avg.)
Drilling Concrete with a Hammer Drill	Inside	less than 4 hours
Jobsite Location	Jobsite Sector	Project Type

# Sampling



Zefon International



SKC Inc.