CalARP
Offsite Consequence Analysis

Jack Becker
Compliance Services Manager,
Condor Earth

TH-A1
March 27, 2025

27th California Unified Program
Annual Training Conference
March 24-27, 2025

PSM / RMP / CalARP Components

Registration.....(RMP/CalARP)
Executive Summary.....(RMP/CalARP)
Management System.....(RMP/CalARP)
Hazard Assessment.....(RMP/CalARP)
Prevention Program Elements.....(PSM/RMP/CalARP)
Emergency Response Program.....(PSM/RMP/CalARP)

CalARP Hazard Assessment

- 5-Year Accident History
- Offsite Consequence Analysis (OCA)
  - Worst-case and alternative release scenarios
  - Offsite impacts to public and environment

CalARP Offsite Consequence Analysis

Agenda

- Applicability
- Parameters
- Worst-case and Alternative Scenarios
- Modeling Software and Examples
  - RMP*Comp, ALOHA and EJScreen
  - Toxic gases, liquids and solids
  - Flammable substances

Poll Question 1

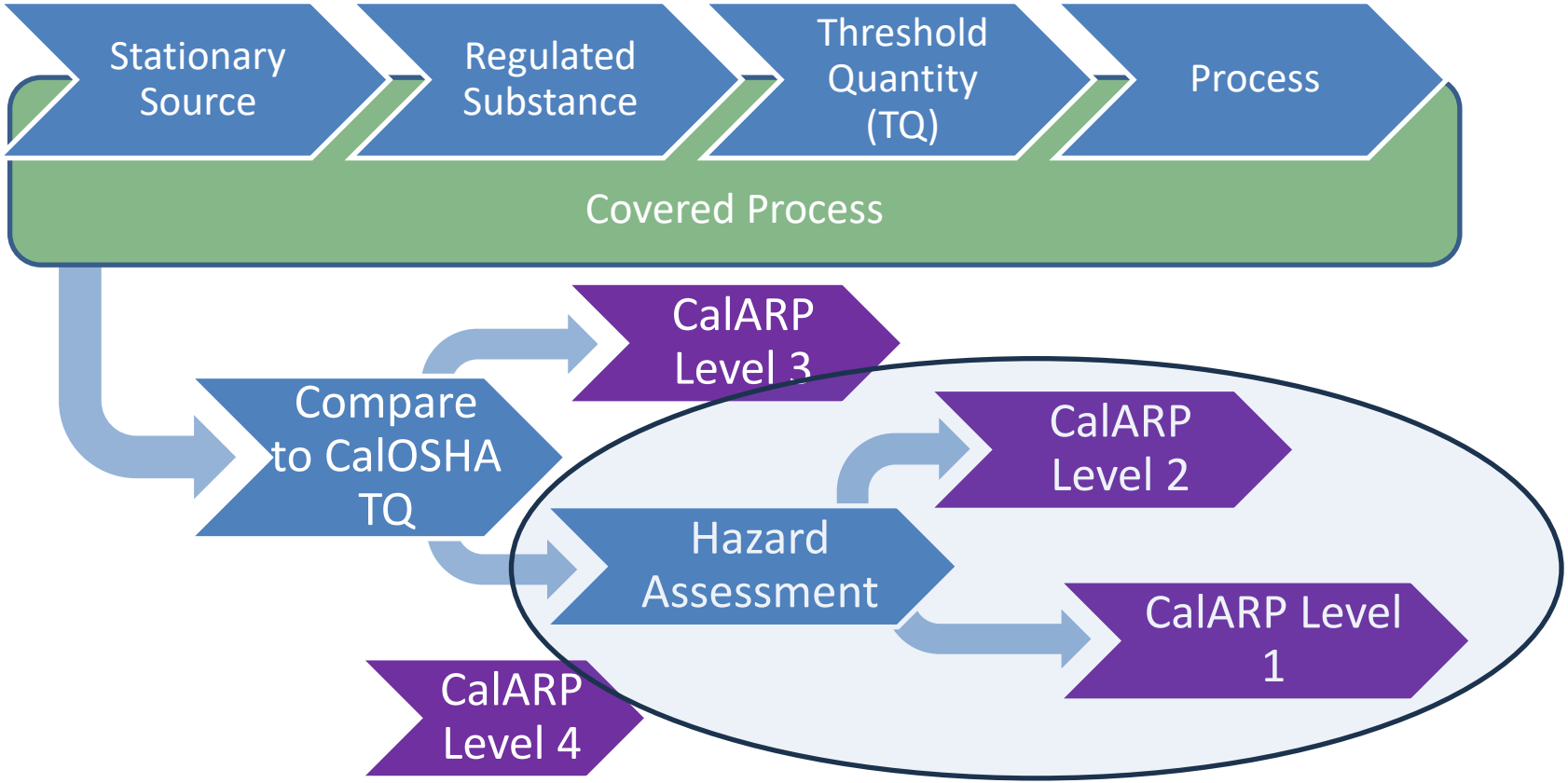
What would you like to learn most about in this session?

Right to Know

California Health and Safety Code, Division 20, Chapter 6.11, Section 25531.1.

The Legislature finds and declares that the public has a right to know about acutely hazardous materials accident risks that may affect their health and safety, and that this right includes full and timely access to hazard assessment information, including offsite consequence analysis for the most likely hazards, which identifies the offsite area which may be required to take protective action in the event of an acutely hazardous materials release.

Applicability



Applicability

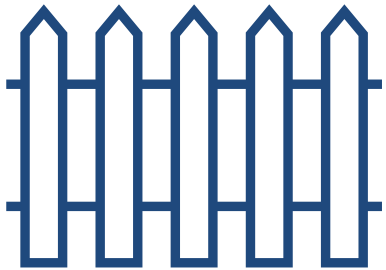
Program Level 1 (no offsite impacts)

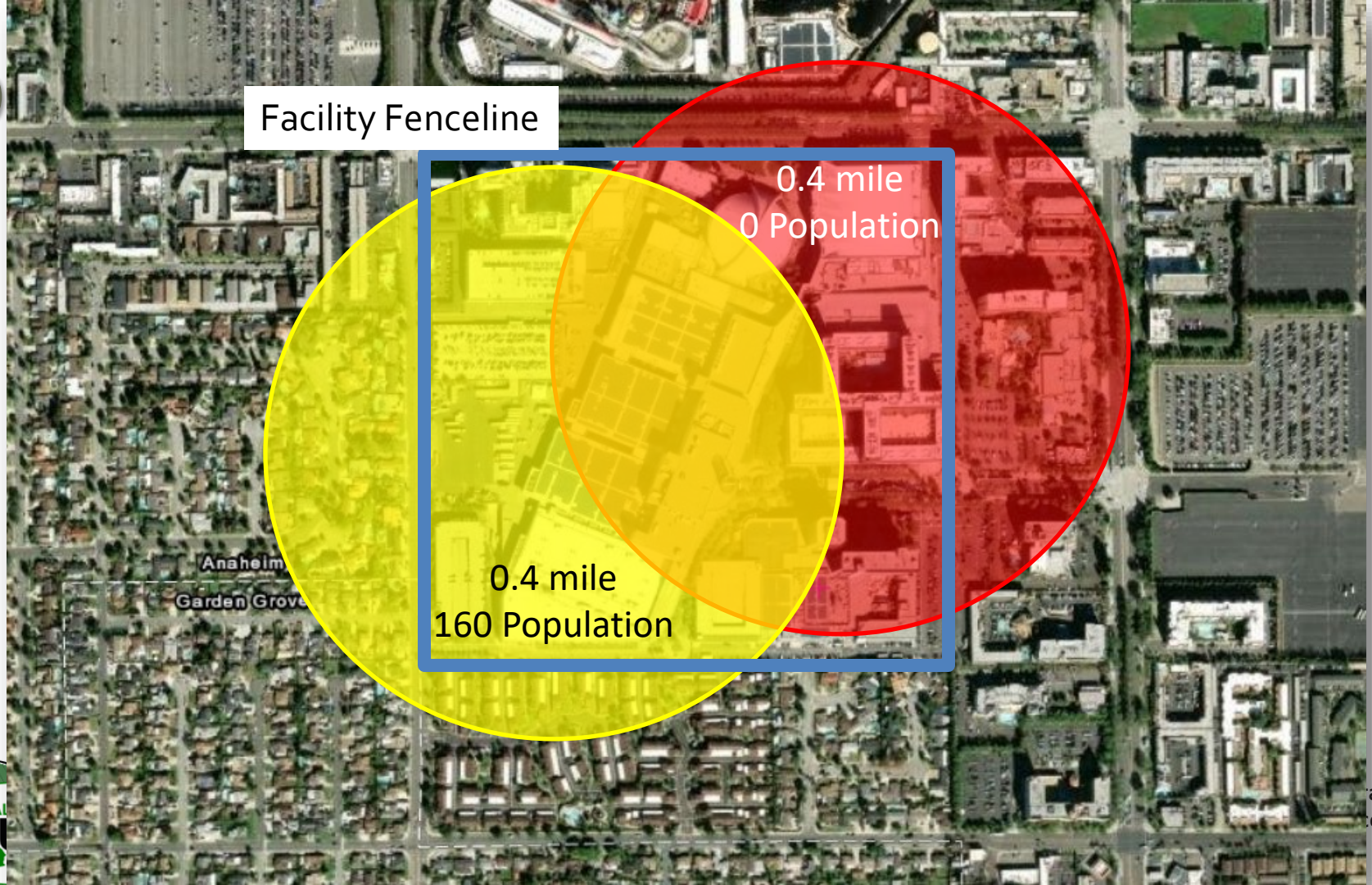
- Prepare one worst-case release scenario
- Report the 5-year accident history

Offsite Definition

19 CCR § 5050.3(rr)

"Offsite" means areas beyond the property boundary of the stationary source, and areas within the property boundary to which the public has routine and unrestricted access during or outside business hours.




Facility Fenceline
0.4 mile
0 Population
0.4 mile
160 Population
Anaheim
Garden Grove

Poll Question 2

Are there offsite impacts from the red worst-case release?

Reclassify Program Level

California Health and Safety Code, Division 20, Chapter 6.11, Section 25534

Reclassification of a process whether there is a significant likelihood that the use of regulated substances by a stationary source may pose a regulated substances accident risk:

- Higher program level
- Exempt
- Lower program level

Applicability

Program Level 2, 3 or 4

- Prepare at least one worst-case release scenario
  - Greatest distance to endpoint for substances
  - If different public receptors are affected for both flammable and toxic processes, report additional worst-case
- Prepare alternative release scenarios for each process for toxic substances
- Prepare one alternative release for flammables
- Report the 5-year accident history

Toxic Endpoints

Toxic Endpoints (listed in Appendix A of CCR, Title 19, Division 5, Chapter 2)

Ammonia: 0.14 mg/L

Chlorine: 0.0087 mg/L

Nitric Acid: 0.026 mg/L

Sulfur Dioxide: 0.0078 mg/L

Paraquat dichloride: 0.0005 mg/L

Acrolein [2-Propenal]: 0.0011 mg/L

Toxic Endpoints

Ammonia mg/L to PPM conversion

$$\text{Endpoint (ppm)} = \frac{[Endpoint\ (mg/L) x\ 1000\ x\ 24.5]}{[Molecular\ Weight]}$$

$$\text{200 ppm} = \frac{(0.14\ mg/L\ x\ 1000\ x\ 24.5)}{17.03}$$

Appendix A References for Consequence Analysis Methods
https://www.epa.gov/sites/default/files/2017-05/documents/oca-apds.pdf

Flammable Endpoints

- Overpressure of 1 pound per square inch (psi) for vapor cloud explosions.
- Radiant heat/exposure time. A radiant heat of 5 kw/m^2 for 40 seconds.
- Lower flammability limit. A lower flammability limit as provided in NFPA documents or other generally recognized sources.

Worst-case Release Parameters

Quantity released

- Greatest amount held in single vessel or pipe
- Administrative controls (procedures limiting quantity)

Weather conditions

- F atmospheric stability
- 1.5 meters/second wind speed
- Highest daily maximum temperature within 3 years (liquids)

Release height

- Ground level release (0 feet)

Worst-case Release Parameters

Duration of release

- 10 minutes for gases
- Instantaneous spill and volatilization for liquids and refrigerated gases handled as liquid
- One hour for toxic solids

Substance temperature

- Refrigerated liquids at boiling point
- Account for toxic liquid temperature in scenario

Worst-case Release Parameters

Passive mitigation must be able to withstand the release event and remain functional

- Building enclosure
- Containment dike

Surface Roughness

- Urban: Many obstacles in the immediate area
- Rural: Flat, unobstructed

W

am
e

Poll Question 3

Would you select urban or rural surface roughness?

Worst-case Release Selection

Stationary source with multiple processes or parameters:

- Assess worst-case scenario for the processes with the greatest quantity in a vessel or pipe
- Assess other scenarios with a higher pressure or temperature
- Assess additional scenarios closer the facility boundary.

Select the worst-case with the greatest distance to endpoint beyond the stationary source boundary.

- Smaller quantities handled at higher temperature or pressure
- Proximity to the boundary or fence line of the stationary source

Alternative Release Parameters

Toxic Substances

- Analyze at least one alternative release scenario for each regulated substance

Flammable Substances

- One alternative to represent flammable substance processes

Alternative Release Parameters

Scenario selection:

- More likely to occur than the worst-case scenario
- Reach an endpoint offsite, unless no such scenario exists
- Reach a public receptor, unless no such scenario exists

Factors in selecting the scenario:

- Five-year accident history
- Accidents / incidents in related industry
- Failure scenarios identified in the Hazard Review or Process Hazard Analysis

Alternative Release Parameters

Mitigation

- Active: Emergency shut down, transfer or deluge systems
- Passive: Building enclosure or containment berms

Weather conditions

- Typical conditions may be used

Surface Roughness

- Urban: Many obstacles in the immediate area
- Rural: Flat, unobstructed

Offsite Impacts

Public

- Estimate the population
  - Marplot uses 2010 census data
  - EJScreen uses 2020 census data
- 2 significant digits
- Note the presence of public institutions in the RMP

Public receptors:

Schools, childcare facilities, hospitals, long term health care facilities, prisons, parks, recreational areas and major commercial, office or industrial buildings.

Definitions

19 CCR § 5050.3(ww)

"Population" means the public

19 CCR § 5050.3(eee)

"Public" means any person except employees or contractors at the stationary source.

Offsite Impacts

There is no required methodology for population estimates

EPA RMP OCA Guidance

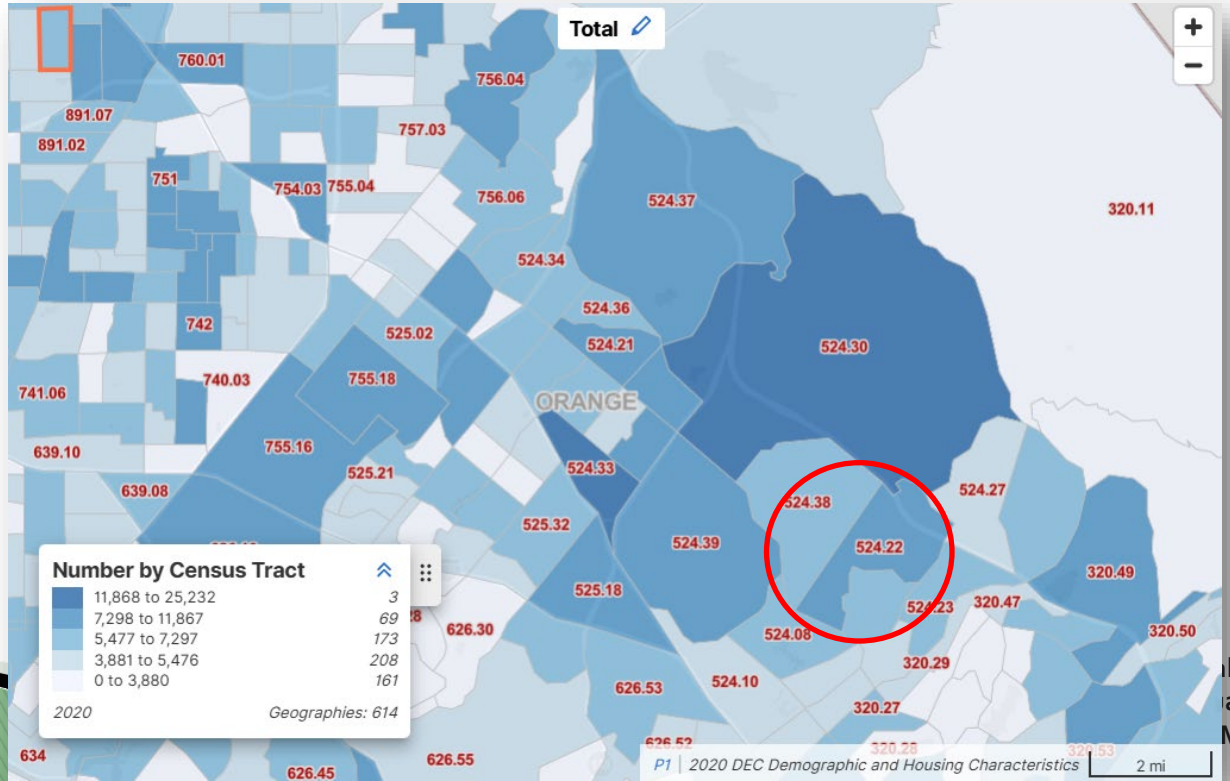
- May use the most recent Census data or other source you believe is more accurate
- You are not required to update Census data or conduct any surveys to develop your estimates

Marplot Population Estimate Methodology

- Average population per square mile of each Census tract
- Apply percentage of tract area within toxic endpoint
- Sum of total

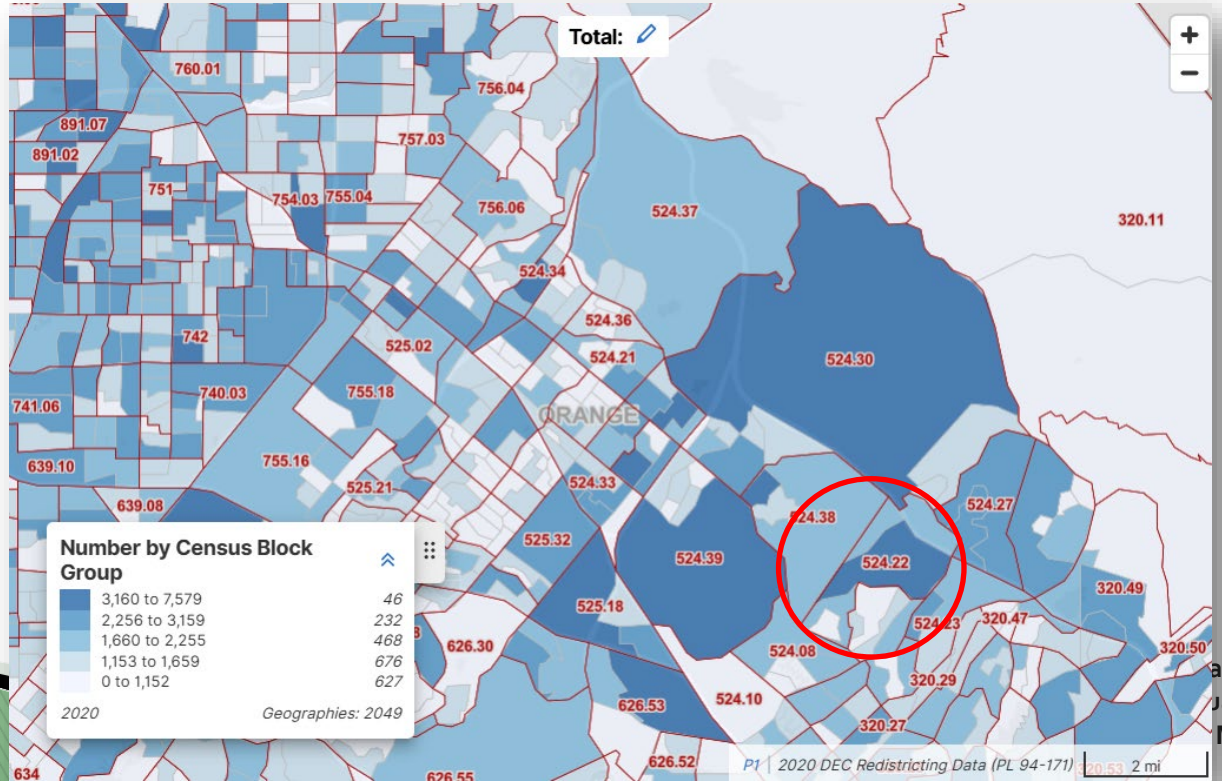
Offsite Impacts

Orange County Census Tract Population



Offsite Impacts

Orange County Census Block Group Population



Offsite Impacts

Environmental

- List environmental receptors within the distance to endpoint

Environmental receptors:

- National or state parks, forests, or monuments; officially designated wildlife sanctuaries, preserves, refuges, or areas; and Federal wilderness areas

Offsite Impacts

Environmental Justice Screening Tool (EJScreen)
https://www.epa.gov/ejscreen

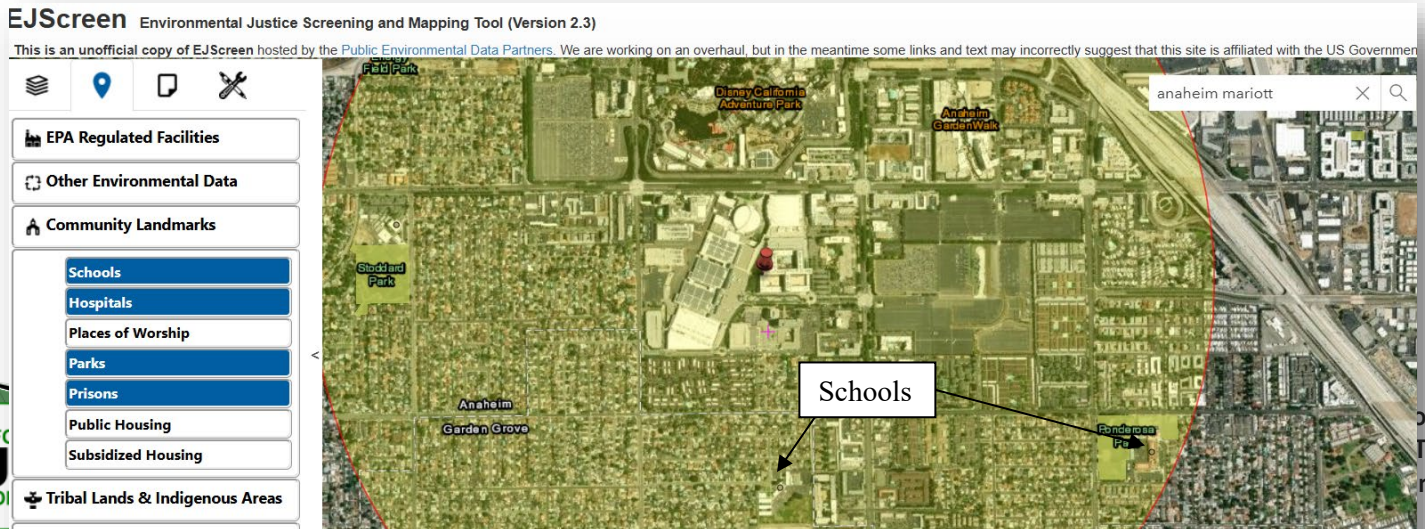
EJScreen suggested by NOAA for population estimates due to inability to update Marplot with 2020 Census data.

EJ Screen has been taken down by EPA

Offsite Impacts

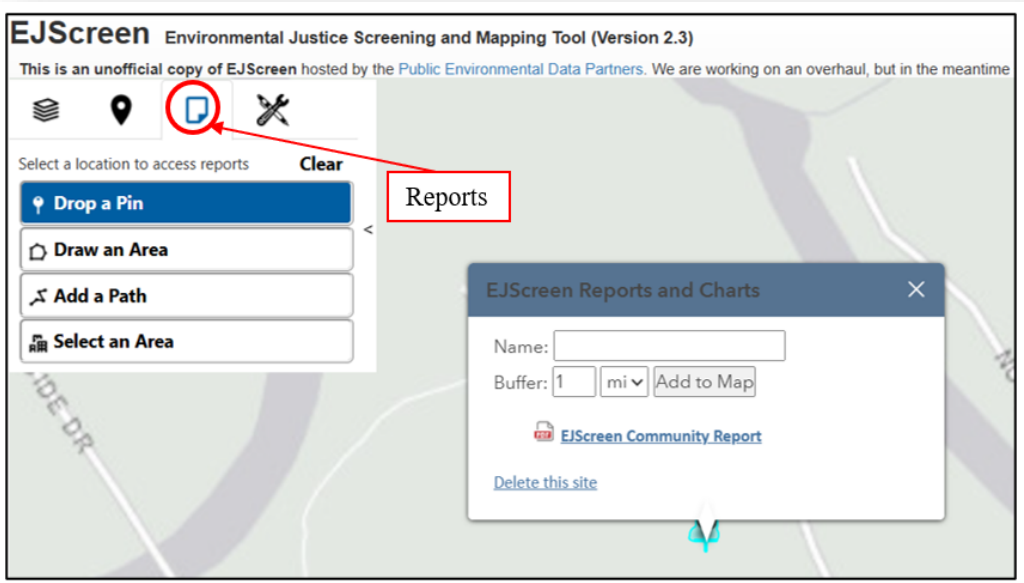
[Public Environmental Data Partners](#) created an unofficial copy of EJScreen [screening-tools.com/epa-ejscreen](#)

- The copy provides the same population estimate results as the original
- Population estimates use block groups instead of Census tracts
- Schools, hospitals, prisons and parks are included in the mapping tool



Offsite Impacts

Instructions for using EJScreen for CalARP and RMP and Offsite Consequence Analysis https://condorearth.com/wp-content/uploads/2025/03/EJScreen-Instructions.pdf



Offsite Consequence Analysis Updates

Update Requirements

- Every five years, or
- When a process change increases or decreases the distance to toxic endpoint by a factor of 2 or more

Poll Question 4

What else is required if the worst-case distance to endpoint decreases by a factor of two or more?

Offsite Consequence Analysis Updates

Update Requirements

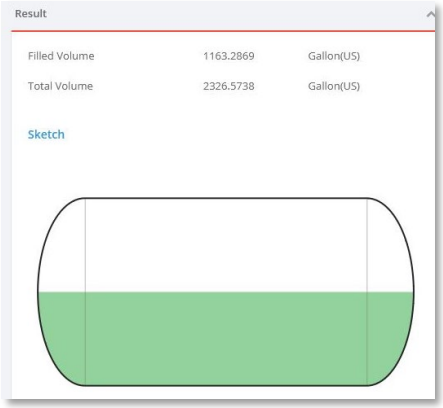
- Every five years, or
- When a process change increases or decreases the distance to toxic endpoint by a factor of 2 or more
  - Revise and update the RMP within 6 months

Documentation

Worst-case and Alternative

- Description of scenario (vessel, pipe and substance)
- Assumptions, parameters used and rationale
  - Administrative controls and any passive mitigation
  - Effect of the controls and mitigation on the release quantity and rate

Estimate quantity released, release rate and duration
Methodology and model used for distance to endpoint
Data used for estimating public and environmental receptors



Documentation

Review of 41 RMPs by Los Angeles County Fire CUPA

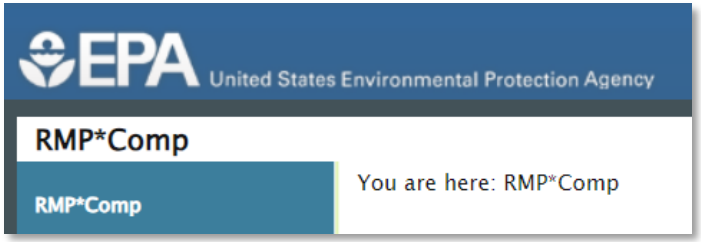
- Majority of the OCAs did not document a Census year
  - 1 included a statement that "most recently published census data" was used (7/30/24)
  - 1 other referenced data from "EPAs Marplot application software version 4.2.3" (5/3/24)
  - 2 documented that 2010 census data from MARPLOT Version 5.1.1 was used (March 2024 & 12/5/23)

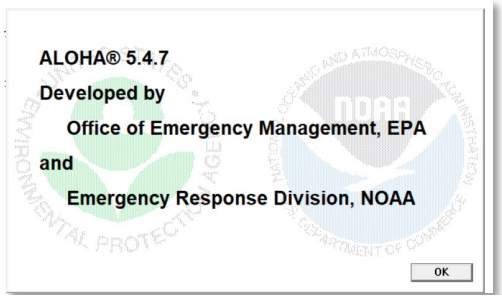
Examples

RMP*Comp

ALOHA

Marplot



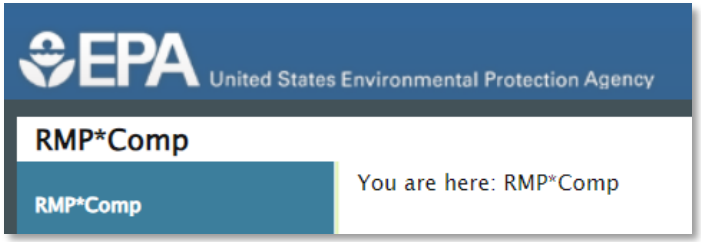


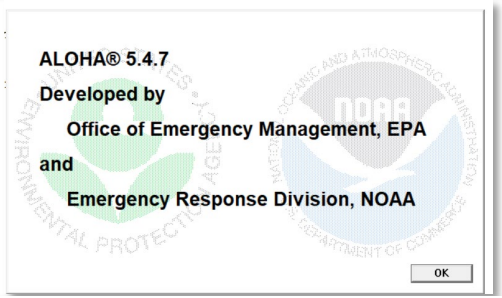
Examples

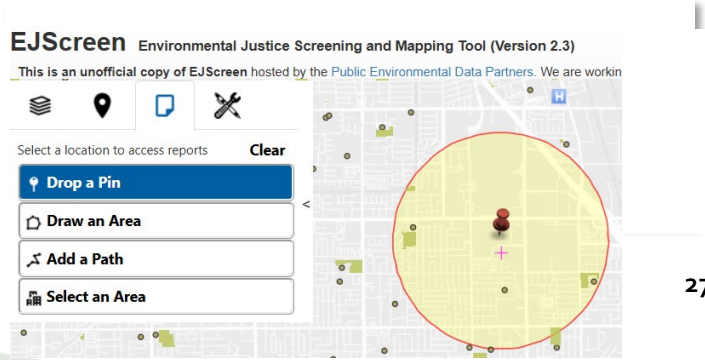
RMP*Comp

ALOHA

EJScreen

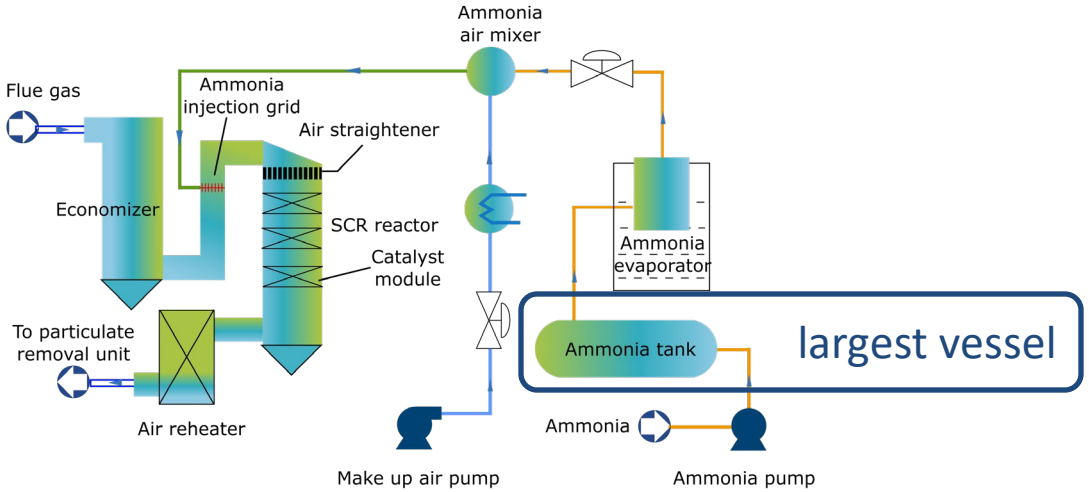






Example 1

Worst-case release from a biomass plant with a selective catalytic reduction process that contains up to 51,000 pounds of ammonia.



Example 1

Worst-case release scenario

Quantity: 51,000 pounds contained within one storage vessel

Physical state: Liquified under pressure

Terrain: Rural, open area with few obstructions

Mitigation: None, located outside

RMP*Comp

- Provides the distance to endpoint results from simple generalized calculations
- Follows Risk Management Program Guidance For Offsite Consequence Analysis
- Provides results in 0.1 mile increments up to 25 miles
- Weather conditions are not adjustable for toxic gases

Example 1

Acetylene [Ethyne]	74-86-2	Flammable Gas
Acrolein	107-02-8	Toxic Liquid
Acrylonitrile	107-13-1	Toxic Liquid
Acrylyl chloride	814-68-6	Toxic Liquid
Allyl alcohol	107-18-6	Toxic Liquid
Allylamine	107-11-9	Toxic Liquid
Ammonia (anhydrous)	7664-41-7	Toxic Gas
Ammonia (water solution)	7664-41-7	Toxic Liquid
Arsenous trichloride	7784-34-1	Toxic Liquid
Arsine	7784-42-1	Toxic Gas
Boron trichloride	10294-34-5	Toxic Gas
Boron trifluoride	7637-07-2	Toxic Gas
Boron trifluoride compound with methyl ether (1:1)	353-42-4	Toxic Liquid

Example 1

Errors Found

No errors found

Chemical Information

Chemical Name: Ammonia (anhydrous)

CAS Number: 7664-41-7

Chemical Type: Toxic Gas

Worst-case Analysis

Scenario type: (●) Worst-case ( ) Alternative

Physical state: ( ) Unliquefied ( ) Liquefied by refrigeration (●) Liquefied under pressure

Quantity released: 51,000 pounds

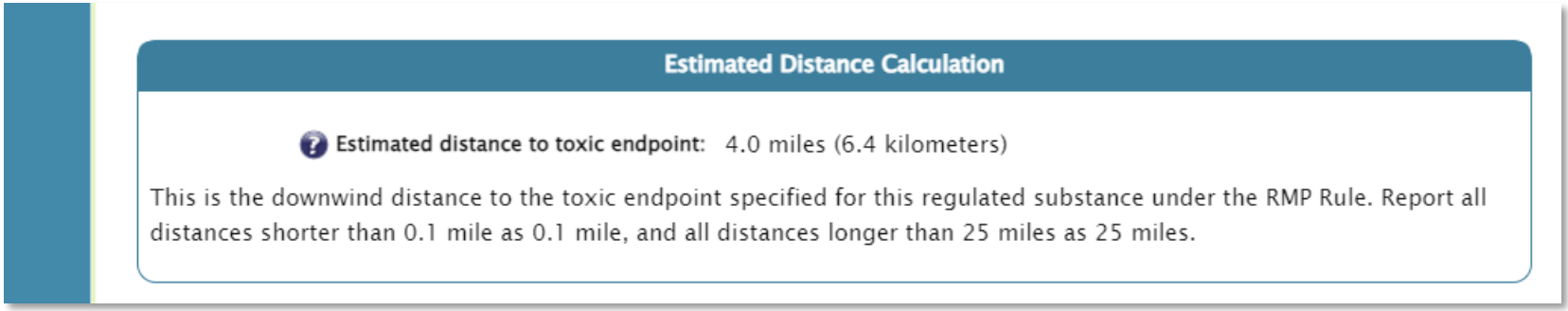
Surrounding terrain type: ( ) Urban (many obstacles in the immediate area) (●) Rural (terrain generally flat and unobstructed)

Mitigation measures

Check the checkbox below if the following mitigation measure is in place in your process.

Release in enclosed space, in direct contact with outside air: ☐

Example 1



Same scenario in ALOHA is greater than 6 miles

```
THREAT ZONE:
  Model Run: Gaussian
  Red    : greater than 6 miles --- (0.14 mg/liter)
```

Exan

Scenario Summary

Chemical:	Ammonia (anhydrous)
CAS number:	7664-41-7
Threat type:	Toxic Gas
Scenario type:	Worst-case
Physical state:	Liquefied under pressure
Quantity released:	51000 pounds
Release duration:	10 min
Release rate:	5100 pounds per minute
Mitigation measures:	NONE
Surrounding terrain type:	Rural surroundings (terrain generally flat and unobstructed)
Toxic endpoint:	0.14 mg/L; basis: ERPG-2

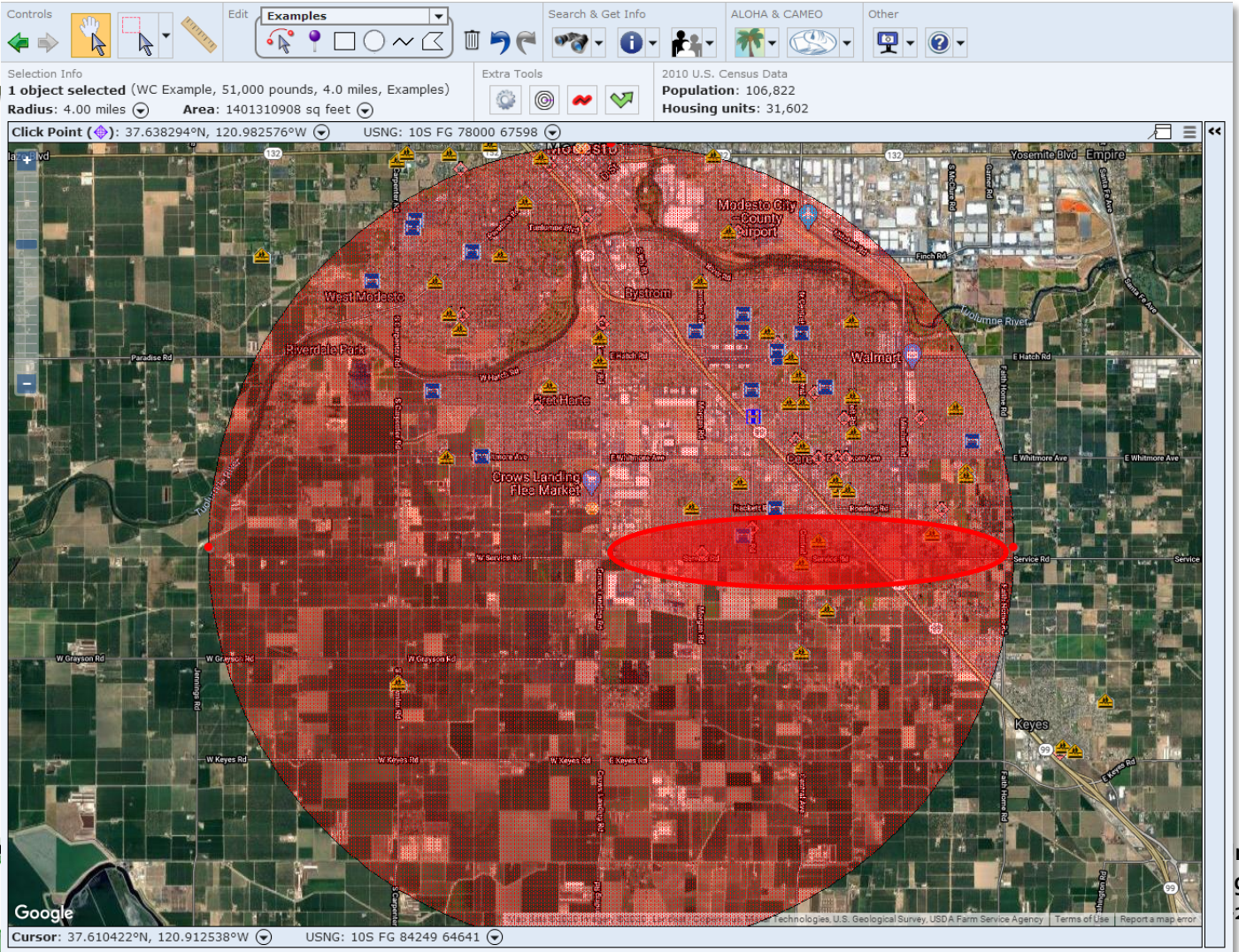
Assumptions about this scenario

Wind speed:	1.5 meters/second (3.4 miles/hour)
Stability class:	F
Air temperature:	77 degrees F (25 degrees C)

CALIFORNIA CUPA FORUM

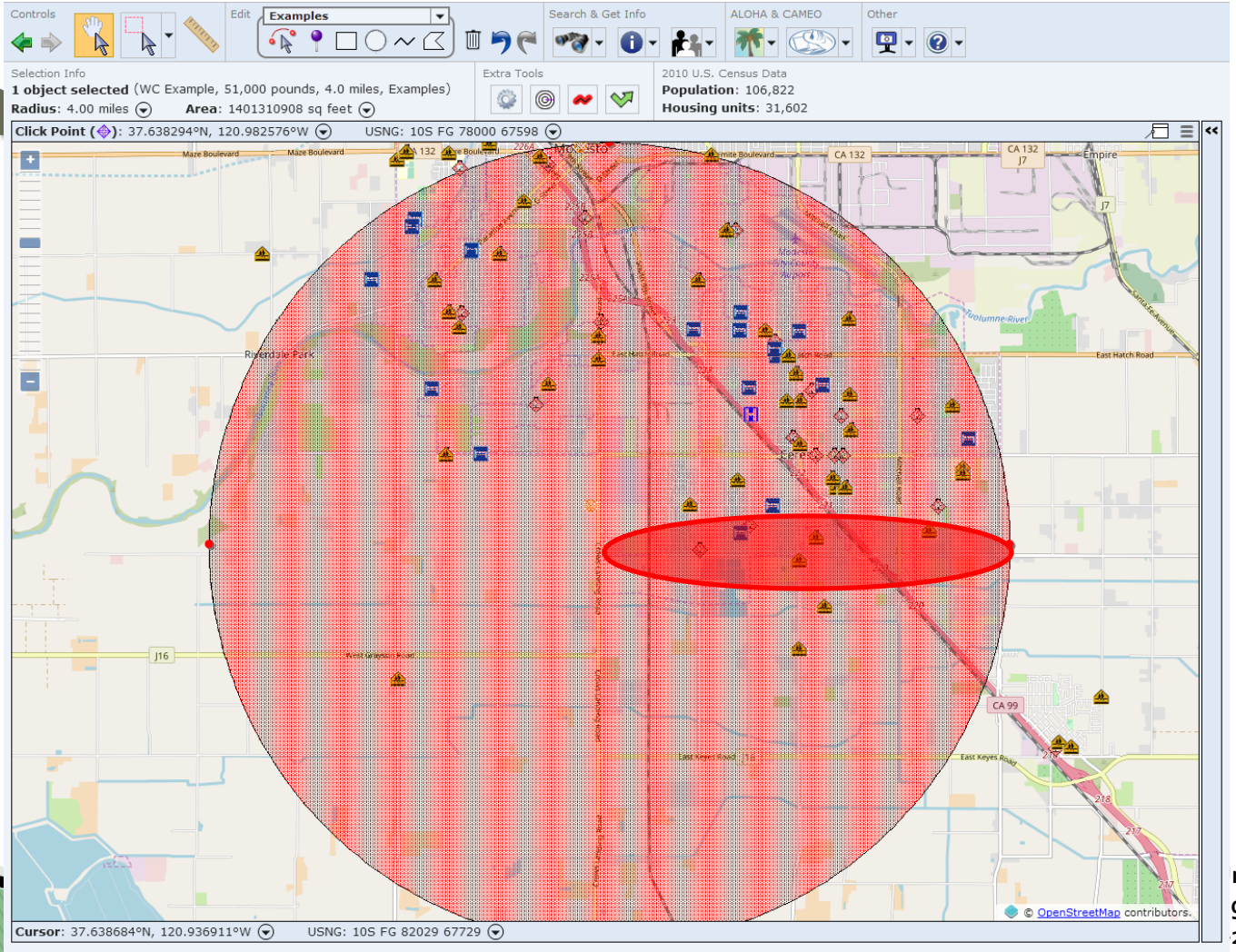
Exar

Wind →


Controls
Edit
Examples
Search & Get Info
ALOHA & CAMEO
Other
Selection Info
1 object selected (WC Example, 51,000 pounds, 4.0 miles, Examples)
Radius: 4.00 miles
Area: 1401310908 sq feet
Extra Tools
2010 U.S. Census Data
Population: 106,822
Housing units: 31,602
Click Point (): 37.638294°N, 120.982576°W
USNG: 10S FG 78000 67598
Modesto City-County Airport
West Modesto
Riverdale Park
Bystrom
Walmart
Crows Landing Flea Market
Keyes
Yosemite Blvd
Empire
Volume River
Cursor: 37.610422°N, 120.912538°W
USNG: 10S FG 84249 64641
Google

Exam

Wind →

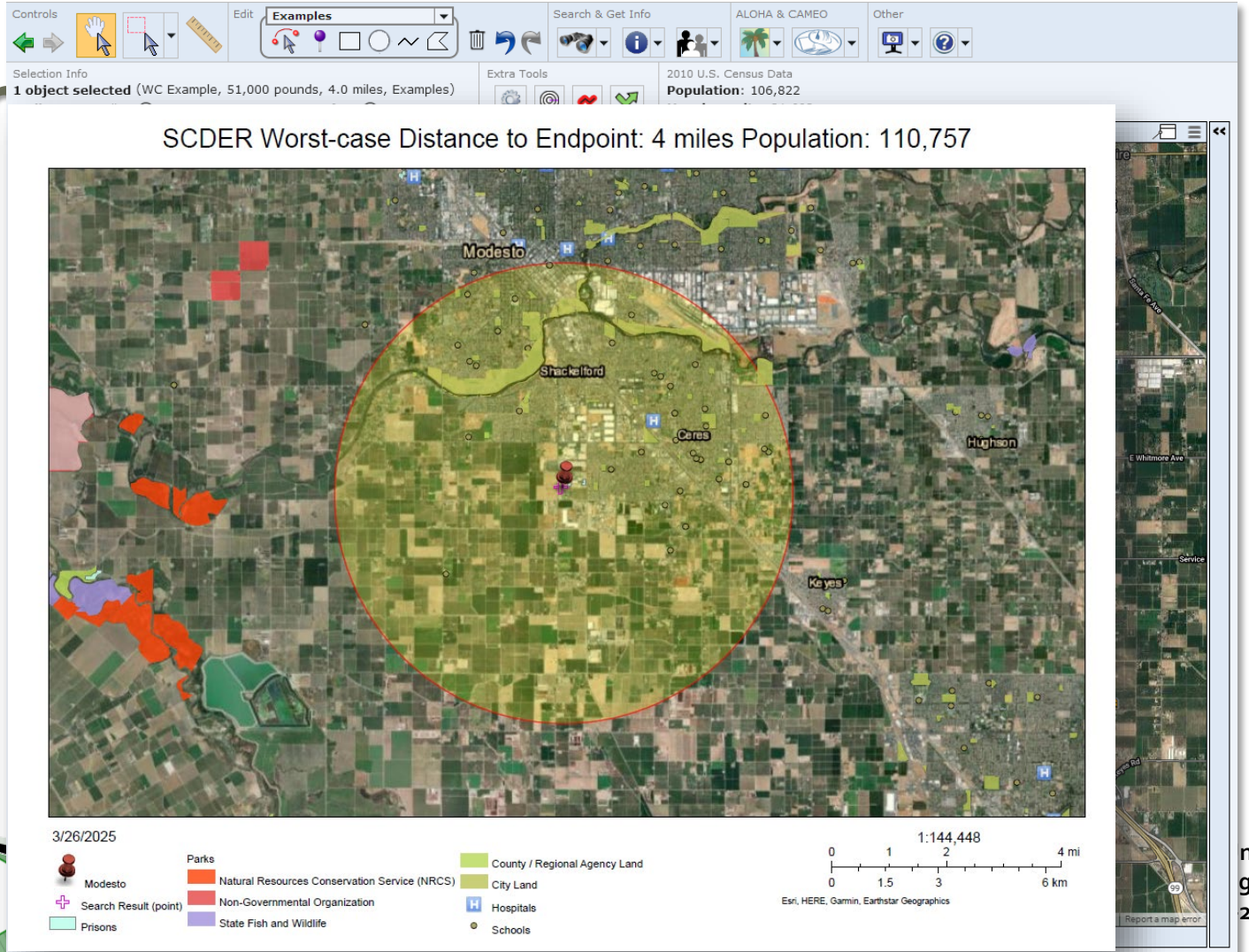


CALIFORNIA CUPA FORUM

nified Program
g Conference
27, 2025

Exar

Wind →



CALIFORNIA CUPA FORUM

nified Program
g Conference
27, 2025

Example 1

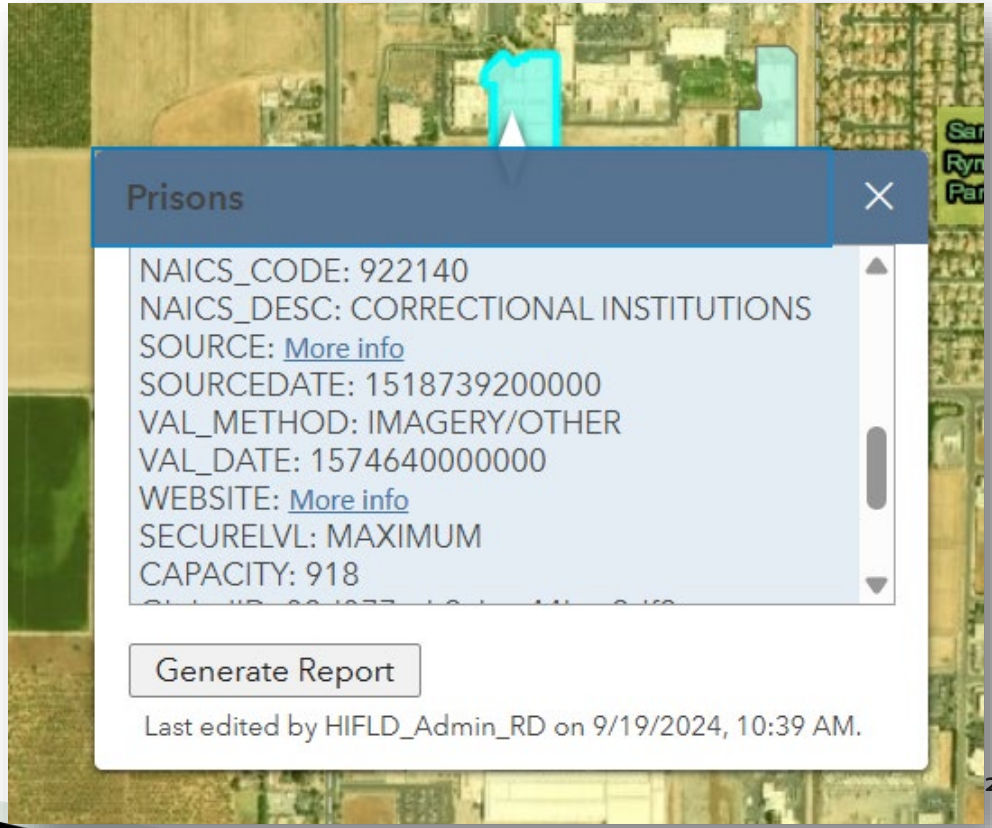
Report the public receptor types with the distance to toxic endpoint.

2.13 Public receptors within distance to endpoint	
2.13.a. Schools	Y
2.13.b. Residences	Y
2.13.c. Hospitals	Y
2.13.d. Prison/Correctional Facilities	Y
2.13.e. Recreational Areas	Y

A list of public receptors is not required.

School	Lodi Academy	1230 S. Central Avenue	Lodi	CA
School	Lodi Seventh-Day Adventist Elementary	1240 S. Central Avenue	Lodi	CA
School	Clyde Needham Elementary School	420 S. Pleasant Avenue	Lodi	CA
School	Heritage Primary Elementary School	509 E. Eden Street	Lodi	CA

Example 1

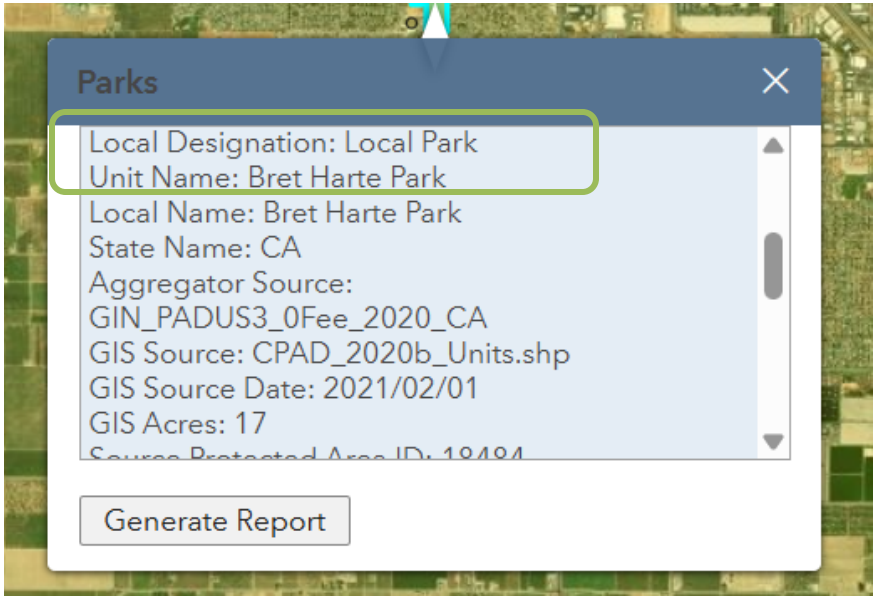

Prisons
NAICS_CODE: 922140
NAICS_DESC: CORRECTIONAL INSTITUTIONS
SOURCE: More info
SOURCEDATE: 1518739200000
VAL_METHOD: IMAGERY/OTHER
VAL_DATE: 1574640000000
WEBSITE: More info
SECURELVL: MAXIMUM
CAPACITY: 918
Generate Report
Last edited by HIFLD_Admin_RD on 9/19/2024, 10:39 AM.

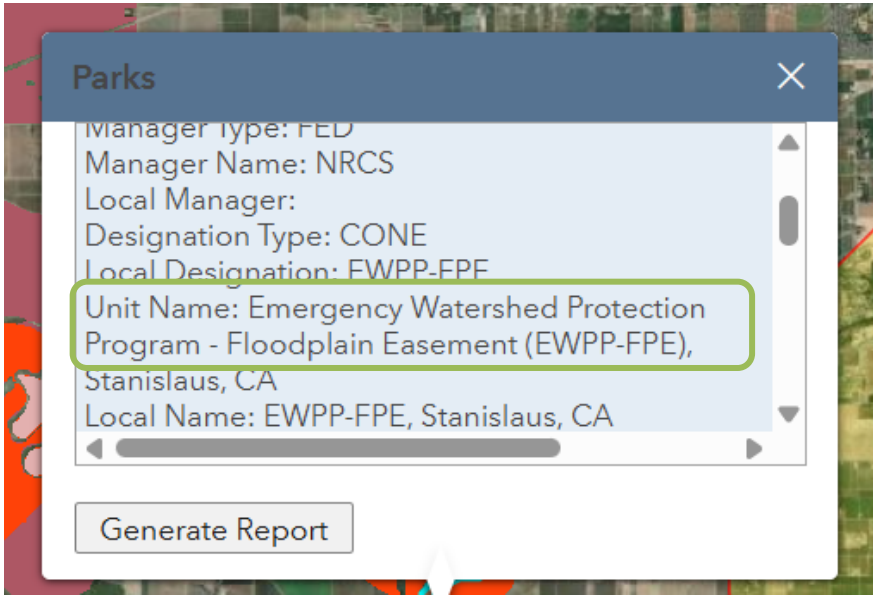
Example 1

Legend displays the features at extent of the map when printed, not only in the buffer

Easements are included in the parks layer

Example 1


Parks
Local Designation: Local Park
Unit Name: Bret Harte Park
Local Name: Bret Harte Park
State Name: CA
Aggregator Source:
GIN_PADUS3_0Fee_2020_CA
GIS Source: CPAD_2020b_Units.shp
GIS Source Date: 2021/02/01
GIS Acres: 17
Generate Report


Parks
Manager Name: NRCS
Local Manager:
Designation Type: CONE
Unit Name: Emergency Watershed Protection
Program - Floodplain Easement (EWPP-FPE),
Stanislaus, CA
Local Name: EWPP-FPE, Stanislaus, CA
Generate Report

Example 2

Worst-case release from a water treatment facility that stores up to 3,200 gallons of 19% aqueous ammonia. The storage tank is within a containment dike of 600 square feet.

The process contains approximately 4,700 pounds of ammonia. Model the instantaneous spill and volatilization.

Example 2 – RMP*Comp

Worst-case release scenario

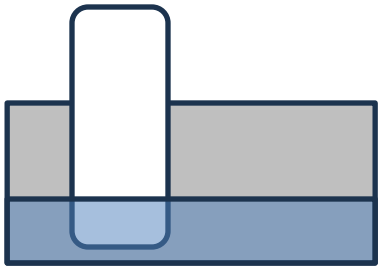
Quantity: 3,200 gallons of 20-percent aqueous ammonia in a storage tank.

Physical state: Liquid

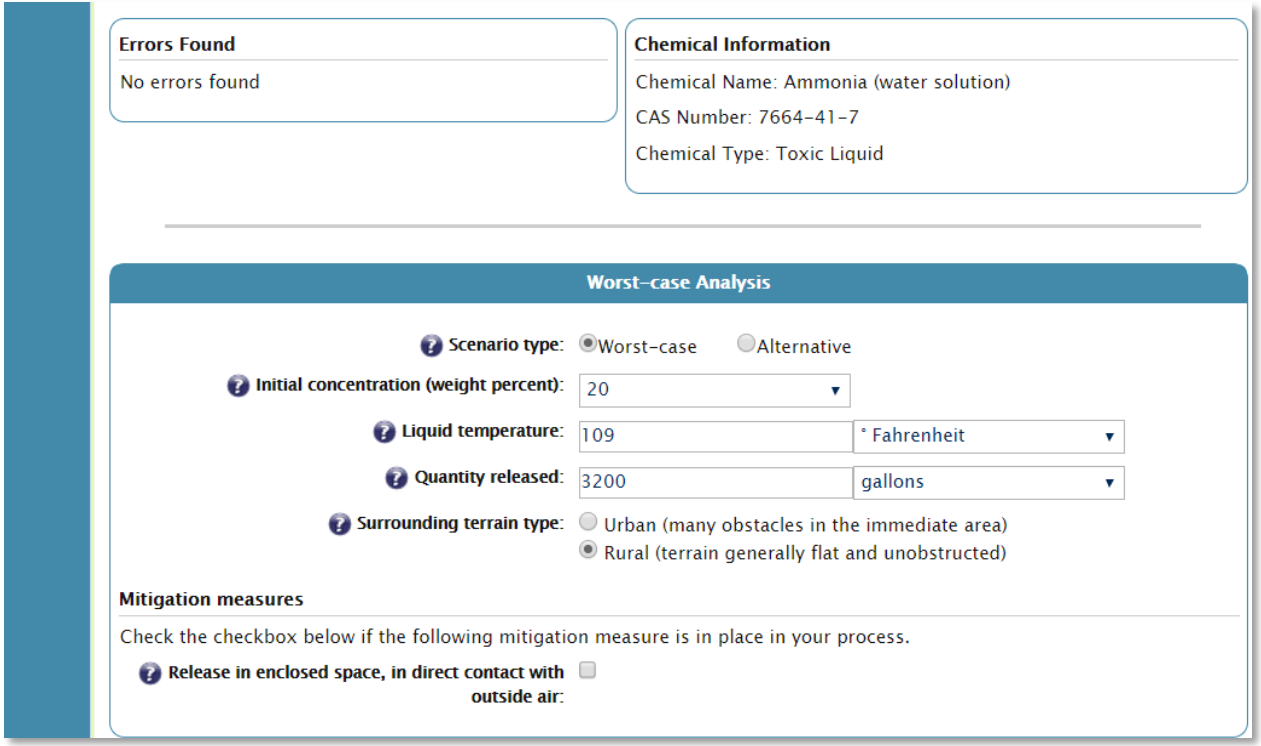
Temperature of liquid: 109 °F

Terrain: Rural, open area with few obstructions.

Mitigation: None, located outside.



Example 2 – RMP*Comp



Errors Found

No errors found

Chemical Information

Chemical Name: Ammonia (water solution)

CAS Number: 7664-41-7

Chemical Type: Toxic Liquid

Worst-case Analysis

Scenario type: (•) Worst-case ( ) Alternative

Initial concentration (weight percent): 20

Liquid temperature: 109 ° Fahrenheit

Quantity released: 3200 gallons

Surrounding terrain type: ( ) Urban (many obstacles in the immediate area) (•) Rural (terrain generally flat and unobstructed)

Mitigation measures

Check the checkbox below if the following mitigation measure is in place in your process.

Release in enclosed space, in direct contact with outside air: ☐

Exam[illegible] RMP*Comp

Estimated Distance Calculation

Estimated distance to toxic endpoint: 1.2 miles (1.9 kilometers)

This is the downwind distance to the toxic endpoint specified for this regulated substance under the RMP Rule. Report all distances shorter than 0.1 mile as 0.1 mile, and all distances longer than 25 miles as 25 miles.

Scenario Summary

Chemical:	Ammonia (water solution)
Initial concentration:	20 %
CAS number:	7664-41-7
Threat type:	Toxic Liquid
Scenario type:	Worst-case
Liquid temperature:	109 F
Quantity released:	3200 gallons
Release duration:	10 min
Release rate:	489 pounds per minute
Mitigation measures:	NONE
Surrounding terrain type:	Rural surroundings (terrain generally flat and unobstructed)
Toxic endpoint:	0.14 mg/L; basis: ERPG-2

Assumptions about this scenario

Wind speed:	1.5 meters/second (3.4 miles/hour)
Stability class:	F
Air temperature:	77 degrees F (25 degrees C)

Example 2 – ALOHA

Worst-case release scenario

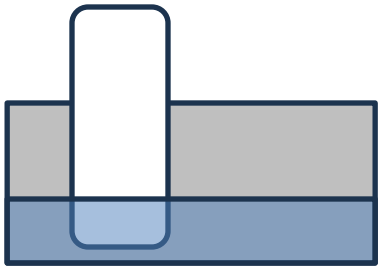
Quantity: 3,200 gallons of 19-percent aqueous ammonia in a storage tank

Physical state: Liquid

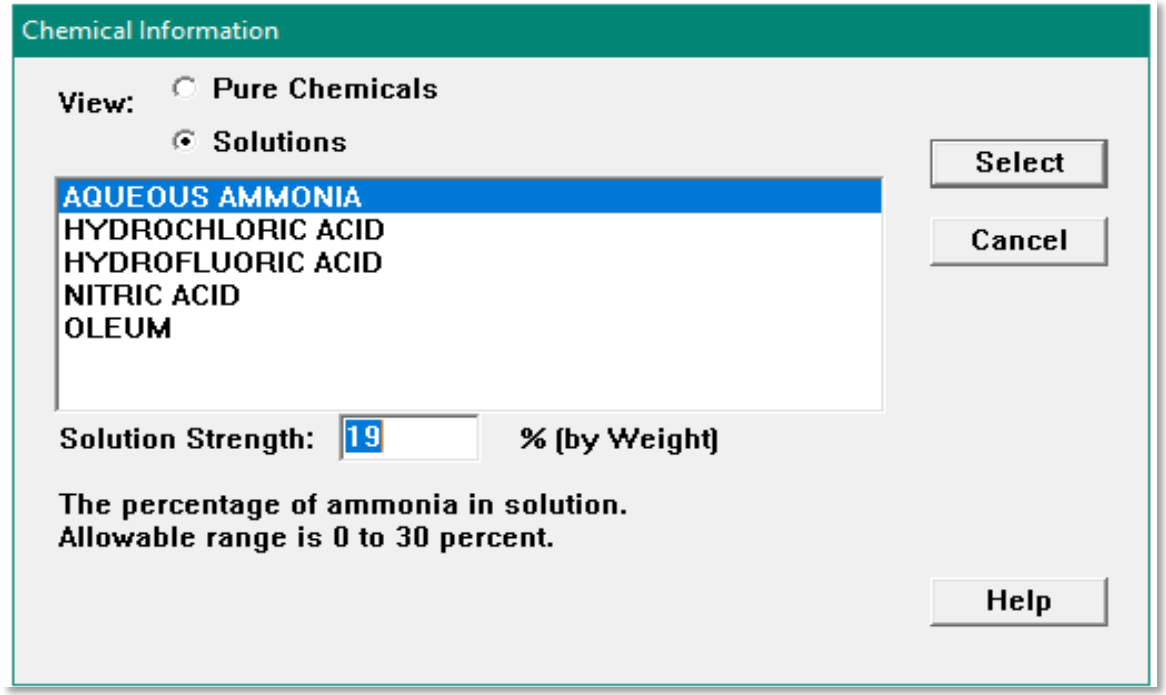
Air and liquid temperature: 109 °F

Terrain: Open country (Rural)

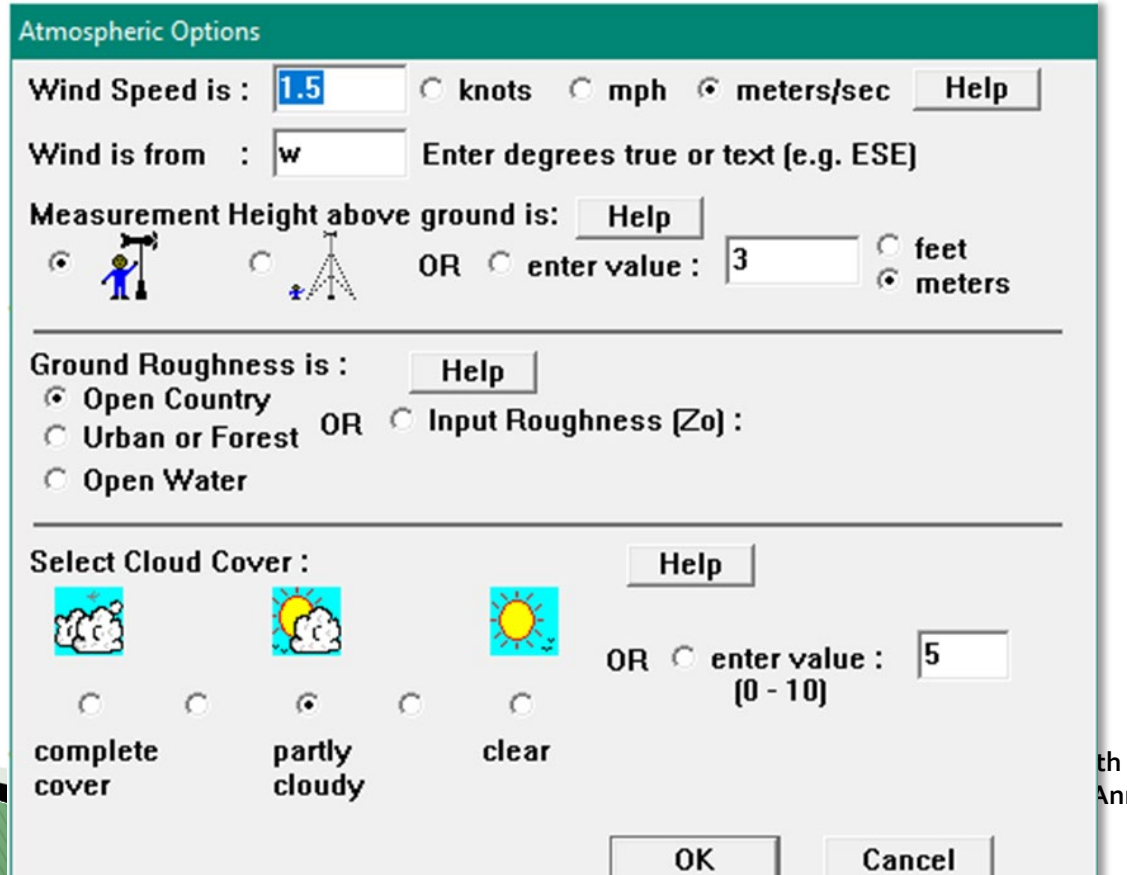
Mitigation: 600 square foot containment



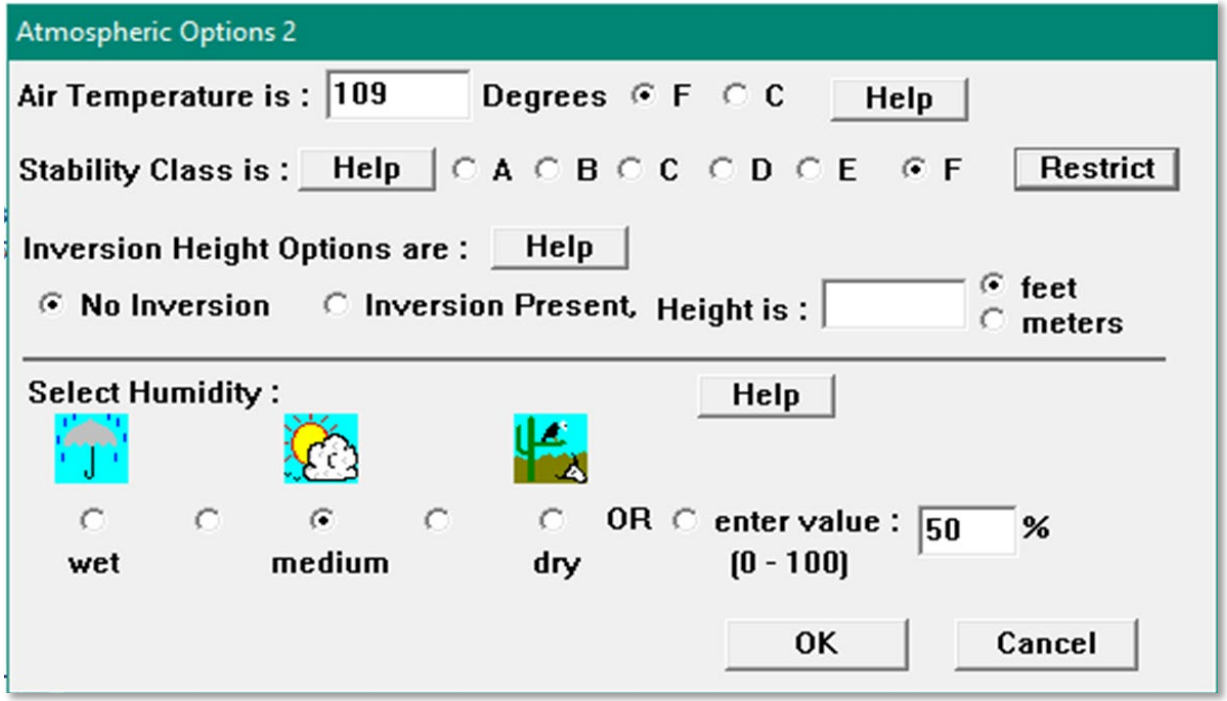
Example 2 - ALOHA



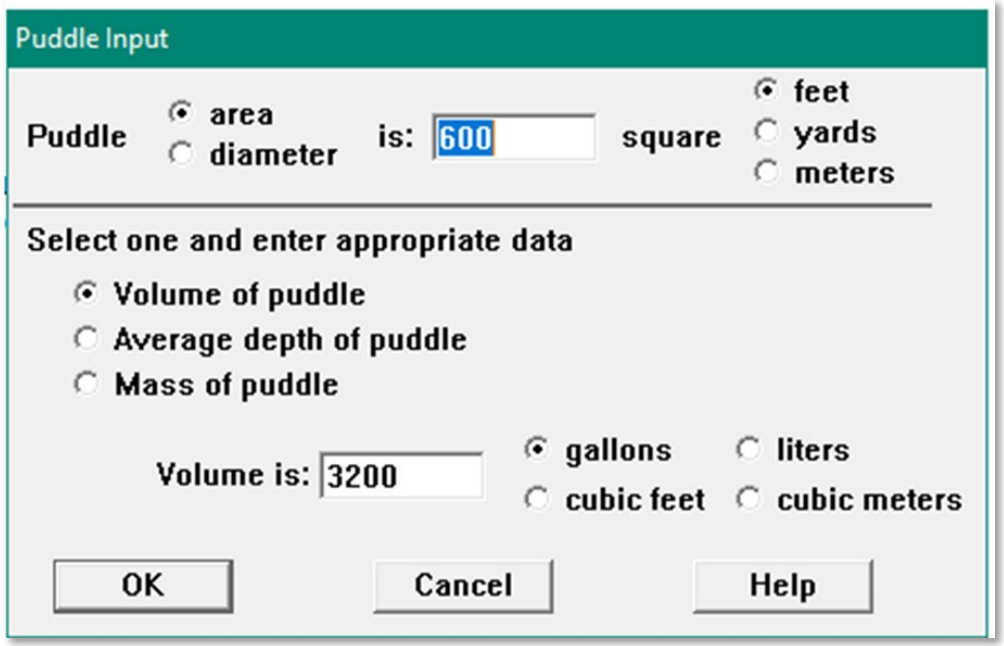
Example 2 - ALOHA



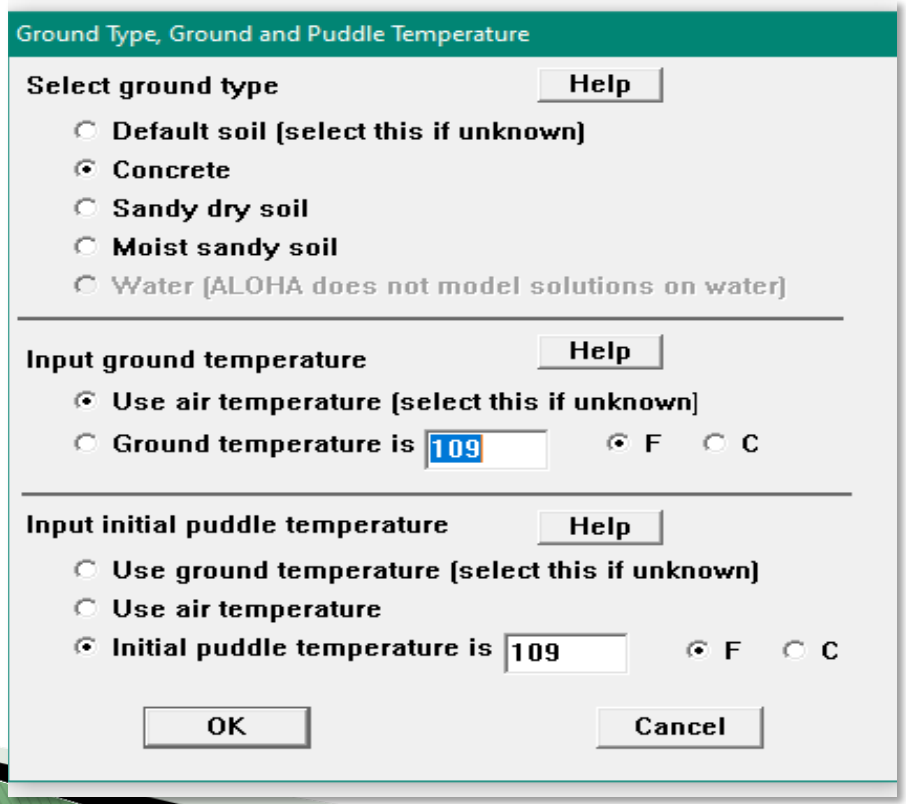
Example 2 - ALOHA



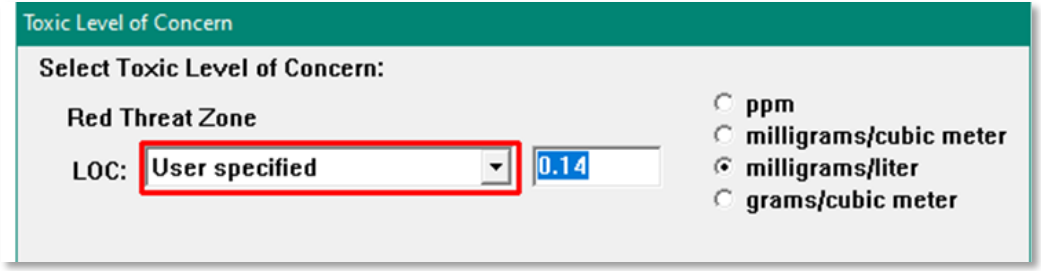
Example 2 - ALOHA



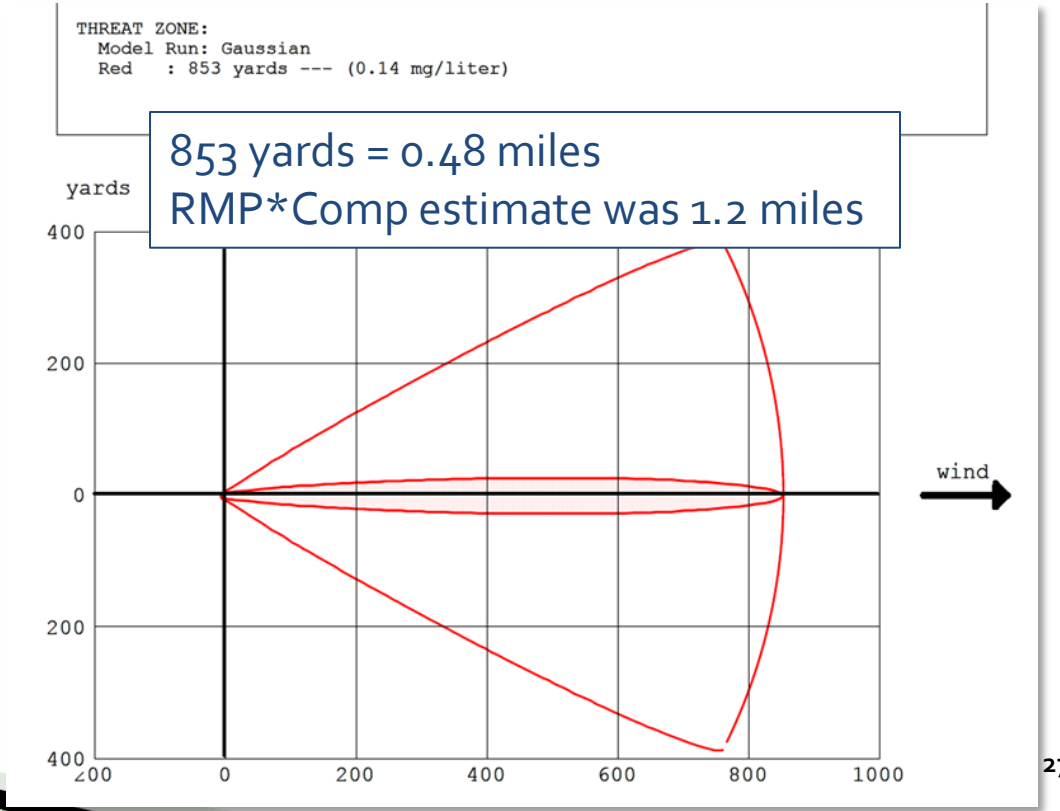
Example 2 - ALOHA



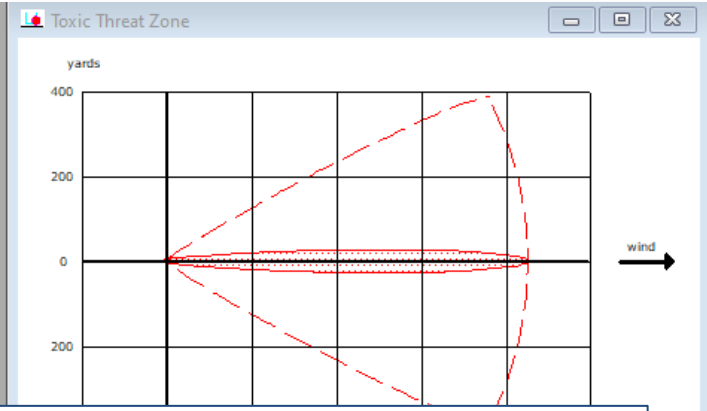
Example 2 - ALOHA



Example 2 - ALOHA



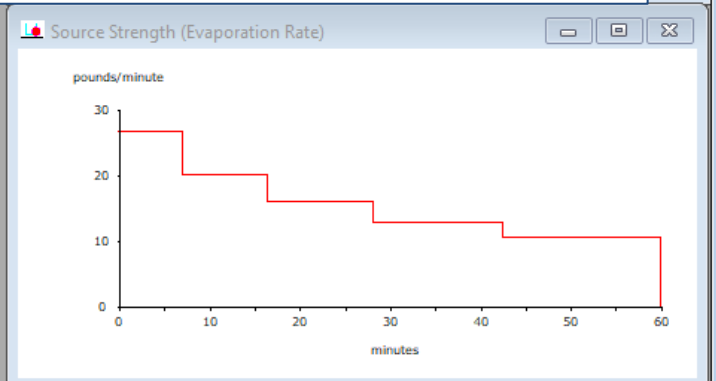
Ex



Release rate:

ALOHA 26.7 pounds/minute

RMP*Comp 489 pounds/minute



Text Summary

```
SITE DATA:
  Location: MOUNTAIN HOUSE, CALIFORNIA
  Building Air Exchanges Per Hour: 0.57 (unsheltered single storied)
  Time: August 28, 2018  1410 hours PDT (user specified)

CHEMICAL DATA:
  Chemical Name: AQUEOUS AMMONIA
  Solution Strength: 19% (by weight)
  Ambient Boiling Point: 121.2° F
  Partial Pressure at Ambient Temperature: 0.70 atm
  Ambient Saturation Concentration: 704,180 ppm or 70.4%
  Hazardous Component: AMMONIA
  CAS Number: 7664-41-7                  Molecular Weight: 17.03 g/mol
  AEGL-1 (60 min): 30 ppm   AEGL-2 (60 min): 160 ppm   AEGL-3 (60 min): 1]
  IDLH: 300 ppm      LEL: 150000 ppm     UEL: 280000 ppm

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
  Wind: 1.5 meters/second from w at 3 meters
  Ground Roughness: open country         Cloud Cover: 5 tenths
  Air Temperature: 109° F
  Stability Class: F (user override)
  No Inversion Height                    Relative Humidity: 50%

SOURCE STRENGTH:
  Evaporating Puddle (Note: chemical is flammable)
  Puddle Area: 600 square feet           Puddle Volume: 3200 gallons
  Ground Type: Concrete                  Ground Temperature: 109° F
  Initial Puddle Temperature: 104° F
  Release Duration: ALOHA limited the duration to 1 hour
  Max Average Sustained Release Rate: 26.7 pounds/min
     (averaged over a minute or more)
  Total Amount Hazardous Component Released: 941 pounds

THREAT ZONE:
  Model Run: Gaussian
  Red    : 853 yards --- (0.14 mg/liter)
```

ALOHA

Allows for greater scenario details than RMP*Comp

- Weather conditions are editable
- Substance and containment release details
- Models a changing release rate over time
- Maximum distance is 6 miles

Example 3

Alternative release of chlorine from a 5/16" (0.3125) diameter hole at 150 psig assumed 25 °C temperature

Example 3

Alternative release of chlorine from a 5/16" (0.3125) diameter hole at 150 psig assumed 25 °C temperature

$$QR = HA\ x\ Pt\ x \frac{1}{\sqrt{T}_t}\ x\ GF$$

where:	QR	=	Release rate (pounds per minute)
	HA	=	Hole or puncture area (square inches) (from hazard evaluation or best estimate)
	P_t	=	Tank pressure (pounds per square inch absolute (psia)) (from process information; for liquefied gases, equilibrium vapor pressure at 25 °C is included in Exhibit B-1, Appendix B)
	T_t	=	Tank temperature (K), where K is absolute temperature in kelvins; 25 °C (77 °F) is 298 K
	GF	=	Gas Factor, incorporating discharge coefficient, ratio of specific heats, molecular weight, and conversion factors (listed for each regulated toxic gas in Exhibit B-1, Appendix B)

Example 3

Alternative release of chlorine from a 5/16" (0.3125) diameter hole at 150 psig assumed 25 °C temperature

$$QR = HA\ x\ Pt\ x \frac{1}{\sqrt{T}_t}\ x\ GF$$

$$6.64\ \frac{lbs}{minute} = 0.024\ x\ 164.7\ x \frac{1}{\sqrt{298}}\ x\ 29$$

399 pounds = 6.65 lbs./minute x 60 minutes

Example 3

Exhibit 5
Chemical-Specific Reference Tables of Distances for Alternative Scenarios

Substance	Conditions of Release			Reference Table Number
	Gas or Vapor Density	Release Duration (minutes)	Topography	
Chlorine	Dense	10-60	Rural, urban	24

Reference Table 24
Distances to Toxic Endpoint for Chlorine
D Stability, Wind Speed 3.0 Meters per Second

Release Rate (lbs/min)	Distance to Endpoint (miles)	
	Rural	Urban
1	<0.1*	<0.1*
2	0.1	
5	0.1	
10	0.2	0.1

Poll Question 5

Have you reviewed or prepared worst-case releases for toxic solids?

Example 4

Worst-case scenario for toxic solids

5-pound bag of 70-percent phosmet pesticide (Imidan 70-W)

EPA emission factor 20 pounds/ton (1-percent) for industrial pigment mixing from weighing, mixing, grinding, tinting, thinning, and packaging.

Bag falls off a shelf and forms a 0.2672 ft^3 pile.

Example 4

Release from largest container based on emission factor

QR = EF x (LC x CS) x M

QR = Quantity Released

EF = Emission Factor

LC = Largest Container

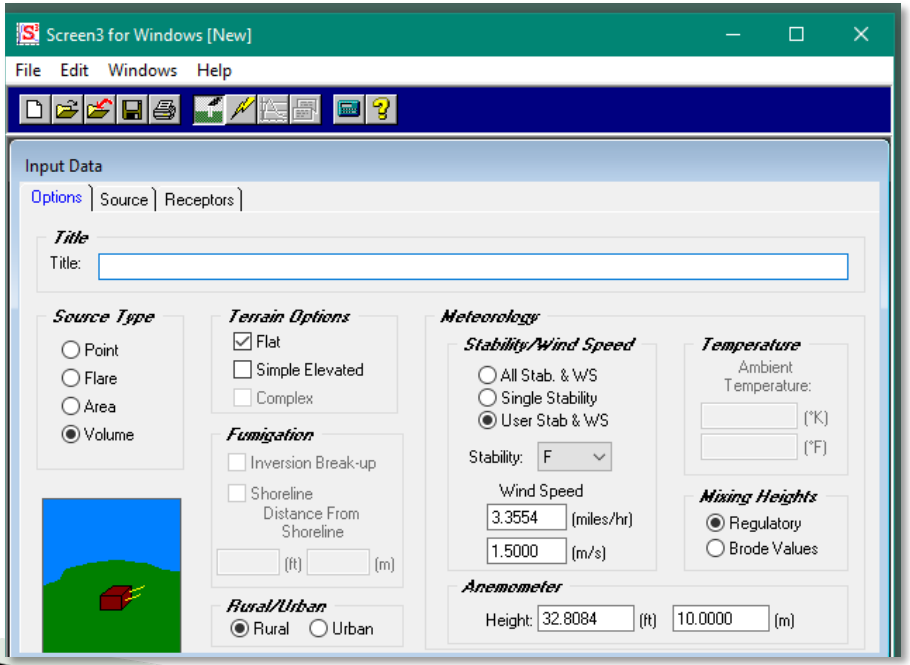
CS = Concentration of Substance

M = Mitigation Release Inside Building

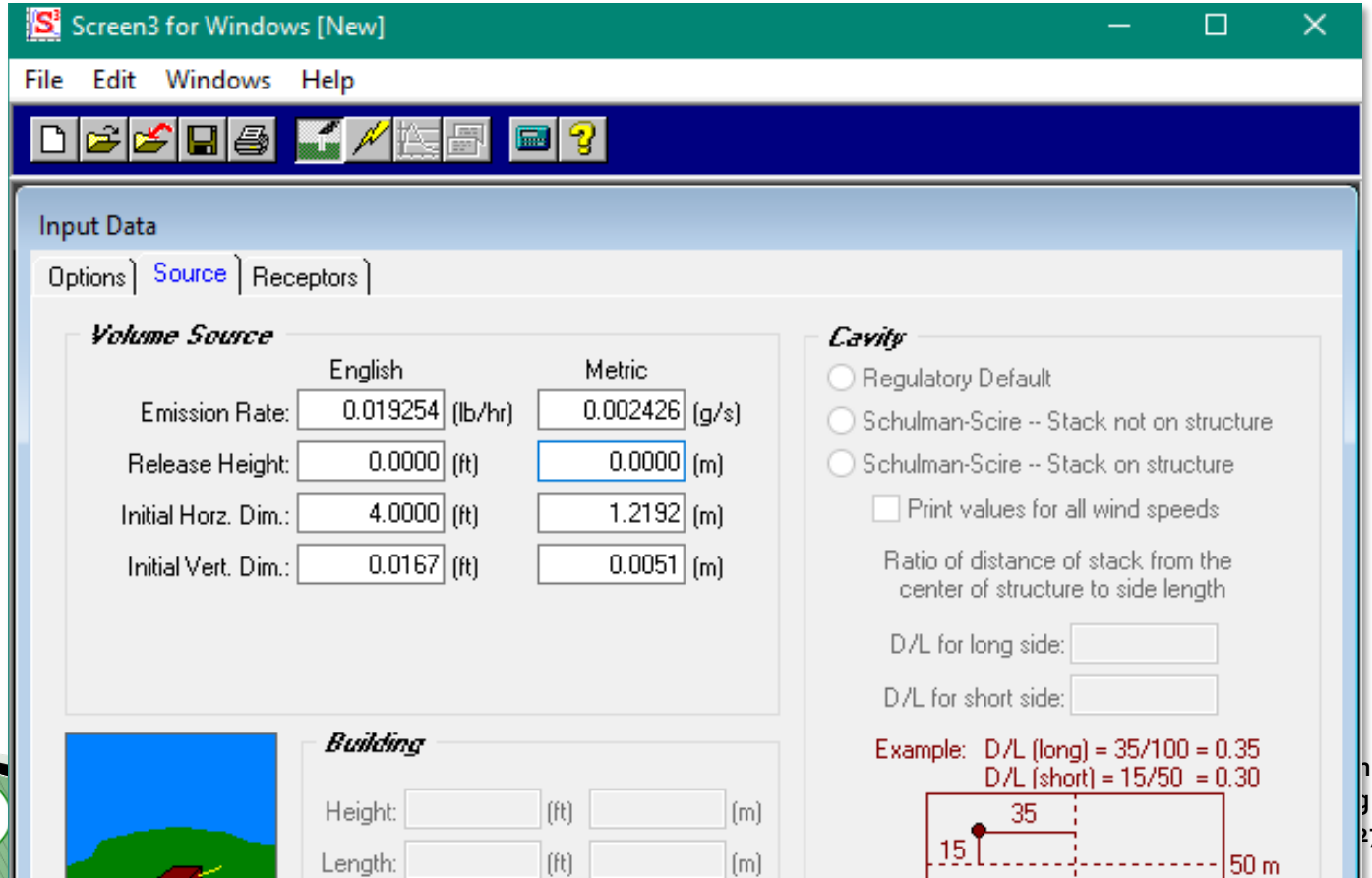
0.01925 pounds = 0.01 x (5 pounds x 0.70-percent) x 0.55

Example 4

Use Screen3 for dispersion modeling to find distance to endpoint



Example 4


Screen3 for Windows [New]
File Edit Windows Help
Input Data
Options Source Receptors
Volume Source
English Metric
Emission Rate: 0.019254 (lb/hr) 0.002426 (g/s)
Release Height: 0.0000 (ft) 0.0000 (m)
Initial Horz. Dim.: 4.0000 (ft) 1.2192 (m)
Initial Vert. Dim.: 0.0167 (ft) 0.0051 (m)
Building
Height: (ft) (m)
Length: (ft) (m)
Cavity
Regulatory Default
Schulman-Scire -- Stack not on structure
Schulman-Scire -- Stack on structure
Print values for all wind speeds
Ratio of distance of stack from the center of structure to side length
D/L for long side:
D/L for short side:
Example: D/L (long) = 35/100 = 0.35
D/L (short) = 15/50 = 0.30
35
15
50 m

Example 4

Use Screen3 for dispersion modeling to find distance to endpoint

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
1.	0.000	0	0.0	0.0	0.0	0.00	0.00	0.00	
10.	901.0	6	1.5	1.5	10000.0	0.00	1.61	0.36	NO
11.	813.0	6	1.5	1.5	10000.0	0.00	1.65	0.38	NO
12.	739.1	6	1.5	1.5	10000.0	0.00	1.69	0.41	NO
13.	676.2	6	1.5	1.5	10000.0	0.00	1.73	0.44	NO
14.	622.0	6	1.5	1.5	10000.0	0.00	1.77	0.47	NO
15.	574.9	6	1.5	1.5	10000.0	0.00	1.81	0.49	NO
16.	533.5	6	1.5	1.5	10000.0	0.00	1.85	0.52	NO
					10000.0	0.00	1.89	0.55	NO
					10000.0	0.00	1.93	0.57	NO
19.	435.4	6	1.5	1.5	10000.0	0.00	1.97	0.60	NO
20.	409.2	6	1.5	1.5	10000.0	0.00	2.01	0.63	NO
30.	245.5	6	1.5	1.5	10000.0	0.00	2.41	0.87	NO
40.	167.0	6	1.5	1.5	10000.0	0.00	2.80	1.10	NO
50.	122.3	6	1.5	1.5	10000.0	0.00	3.19	1.32	NO
60.	94.09	6	1.5	1.5	10000.0	0.00	3.57	1.53	NO
70.	74.99	6	1.5	1.5	10000.0	0.00	3.95	1.74	NO
80.	61.39	6	1.5	1.5	10000.0	0.00	4.33	1.94	NO
90.	51.33	6	1.5	1.5	10000.0	0.00	4.70	2.13	NO
100.	43.65	6	1.5	1.5	10000.0	0.00	5.07	2.33	NO

Phosmet toxic endpoint 0.00054 mg/l

Example 4

Worst-case release without known emission factor.

$$ARF = \frac{0.1064 \times (M_O^{0.125}) \times (H^{2.37})}{P_{BP}}$$

ARF = airborne release fraction

M_O = mass of powder spilled (kg)

H = Spill height (m)

P_{BP} = bulk density of powder (kg/m^3)

Source:
DOE-HDBK-3010-94
4.4.3.1.3 Free-Fall Spill of Powder Model 4-81

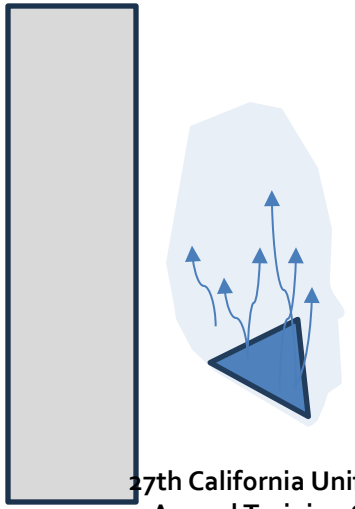
Example 4

5-pound bag of Imidan 70-W with a density of 240 kg/m^3 falls from a 1.5-meter-high shelf.

$$ARF = 0.1064 \times \frac{(M_O^{0.125} \times H^{2.37})}{P_{BP}^{1.02}}$$

$$0.001151 = 0.1064 \frac{(2.27^{0.125} \times 1.5^{2.37})}{240^{1.02}}$$

$$0.001151 = 0.1064 \frac{(1.17 \times 2.61)}{267.8}$$



Example 4

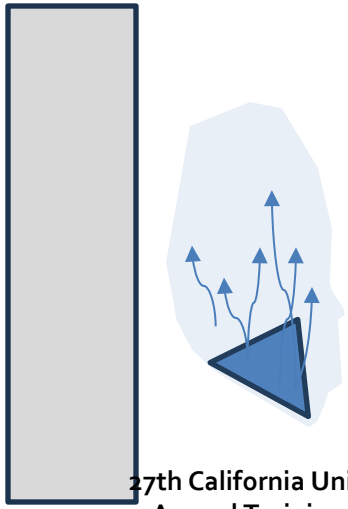
Release based on calculated airborne release fraction

QR = ARF x (LC x CS) x M

0.002215 = 0.001151 x (5-pounds x 0.70) x 0.55

0.002215 pounds/60 minutes

= 3.69×10^{-5} pounds/minute



Example 4

Toxic endpoint of 0.00054 mg/l

Release rate 3.69×10^{-5} pounds/minute

Exhibit 3-1
VULNERABLE ZONE DISTANCES FOR RATES OF RELEASE AND LEVEL OF CONCERN

SCREENING - Rural, F Atmospheric Stability, Low Wind Speed (3.4 miles per hour), Distances are Given in Miles

For Quantities of Release up to 10,000 pounds/minute

QR Rate of Release (#/min)	Levels of Concern (grams per cubic meter) (For LOC less than this, assume 10 mile distance)																				
	0.0001	0.0004	0.0007	0.001	0.002	0.0035	0.005	0.0075	0.01	0.02	0.035	0.05	0.075	0.1	0.25	0.5	0.75	1.0	2.0	5.0	10.0
1	9.0	2.5	1.7	1.3	0.9	0.6	0.5	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	**	**	**	**	**	**
2	*	4.5	2.8	2.1	1.3	0.9	0.8	0.6	0.5	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	**	**	**	**
3	*	6.7	3.9	2.9	1.7	1.2	1.0	0.8	0.6	0.4	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	**	**	**
4	*	9.0	5.1	3.7	2.1	1.5	1.2	0.9	0.8	0.5	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	**	**	**
5	*	*	6.3	4.5	2.5	1.7	1.3	1.0	0.9	0.6	0.4	0.3	0.3	0.2	0.1	0.1	0.1	0.1	**	**	**
8	*	*	*	7.1	3.7	2.4	1.8	1.4	1.2	0.8	0.5	0.4	0.4	0.3	0.2	0.1	0.1	0.1	0.1	**	**
10	*	*	*	9.0	4.5	2.8	2.1	1.6	1.3	0.9	0.6	0.5	0.4	0.3	0.2	0.1	0.1	0.1	0.1	**	**
15	*	*	*	*	6.7	3.9	2.9	2.1	1.7	1.1	0.8	0.6	0.5	0.4	0.3	0.2	0.1	0.1	0.1	0.1	**
20	*	*	*	*	9.0	5.1	3.7	2.7	2.1	1.3	0.9	0.8	0.6	0.5	0.3	0.2	0.2	0.1	0.1	0.1	**
25	*	*	*	*	*	6.3	4.5	3.2	2.5	1.5	1.1	0.9	0.7	0.6	0.3	0.2	0.2	0.2	0.1	0.1	**
30	*	*	*	*	*	7.6	5.3	3.7	2.9	1.7	1.2	1.0	0.8	0.6	0.4	0.3	0.2	0.2	0.1	0.1	0.1
35	*	*	*	*	*	9.0	6.2	4.2	3.3	2.0	1.3	1.1	0.8	0.7	0.4	0.3	0.2	0.2	0.1	0.1	0.1
40	*	*	*	*	*	*	7.1	4.8	3.7	2.1	1.5	1.2	0.9	0.8	0.4	0.3	0.2	0.2	0.1	0.1	0.1
45	*	*	*	*	*	*	8.0	5.3	4.1	2.3	1.6	1.2	1.0	0.8	0.5	0.3	0.3	0.2	0.2	0.1	0.1
50	*	*	*	*	*	*	9.0	5.9	4.5	2.5	1.7	1.3	1.0	0.9	0.5	0.3	0.3	0.2	0.2	0.1	0.1
60	*	*	*	*	*	*	*	7.1	5.3	2.9	1.9	1.5	1.2	1.0	0.6	0.4	0.3	0.3	0.2	0.1	0.1

Example 4

2.5-mile distance to toxic endpoint at 1 pound/minute from Exhibit 3-1

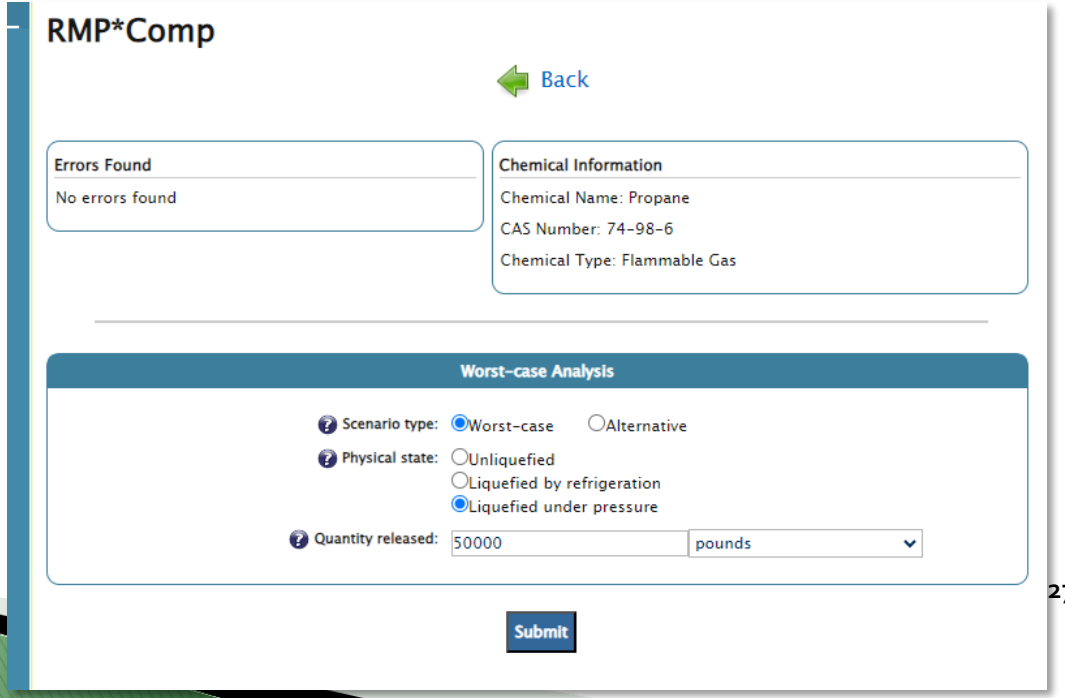
Vast overestimate of with release rate increased to 1 pound/minute from 3.69×10^{-5} pounds/minute.

Air modeling for solids takes more effort than other substance types. Worst-case releases of solids typically don't result in offsite impacts.

Example 5

Worst-case flammable release

50,000 pounds of propane liquefied under pressure



Example 5

50,000 pounds of propane liquefied under pressure

Estimated Distance Calculation

Estimated distance to 1 psi overpressure: 0.3 miles (0.5 kilometers)

This is the distance to the overpressure endpoint of 1 pound per square inch specified for this regulated substance under the RMP Rule.

Scenario Summary

Chemical:	Propane
CAS number:	74-98-6
Threat type:	Flammable Gas
Scenario type:	Worst-case
Physical state:	Liquefied under pressure
Quantity released:	50000 pounds

Questions?

Thank you

Contact Information:

Jack Becker

Compliance Services Manager,

Condor Earth

(209) 454-7394

jbecker@condorearth.com