ABS Group

NDIA
International Explosives Safety Symposium & Exposition

West Fertilizer Explosion Source Energy and Structural Damage

Presented by

Ben Harrison, P.E.

Technical Director

ABS Group

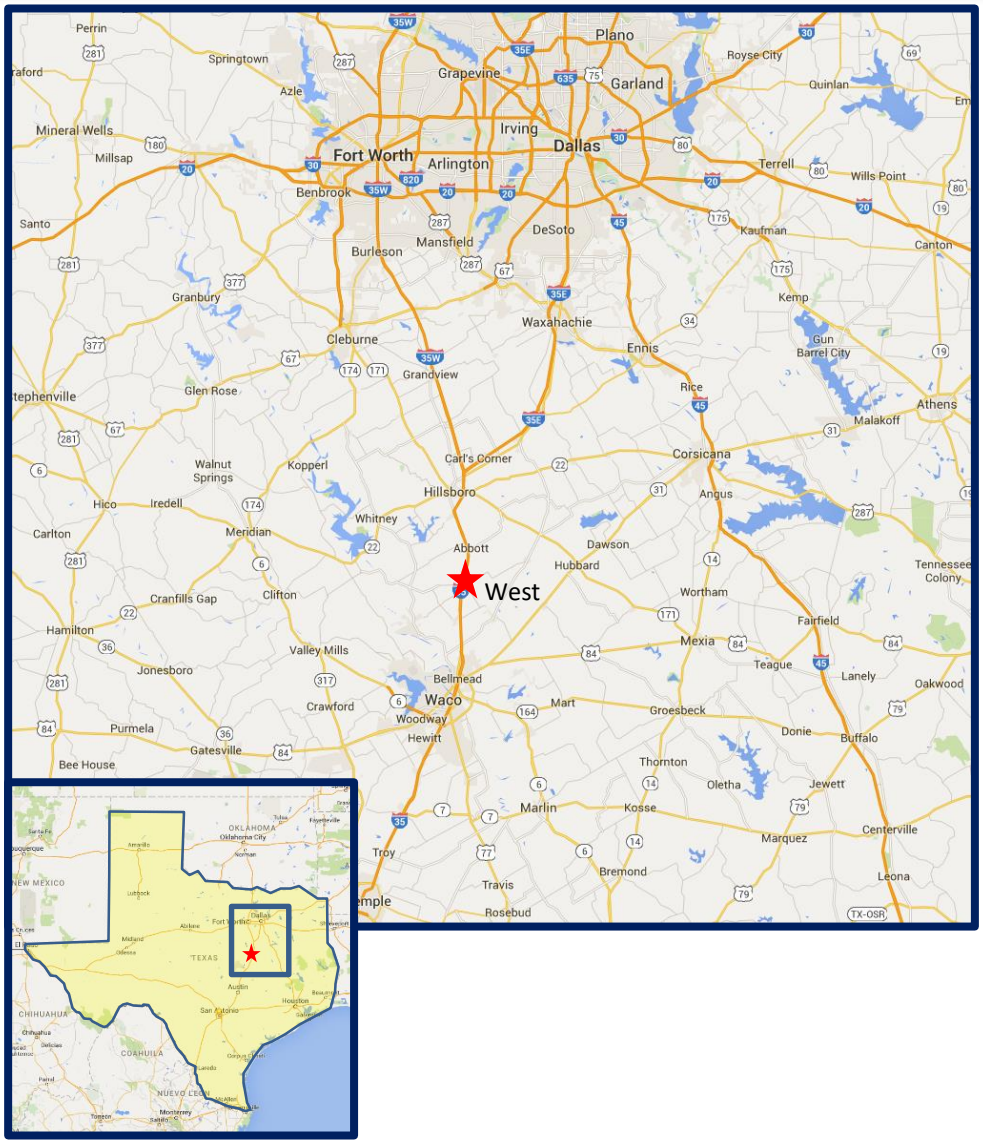
August 9, 2018

Acknowledgements

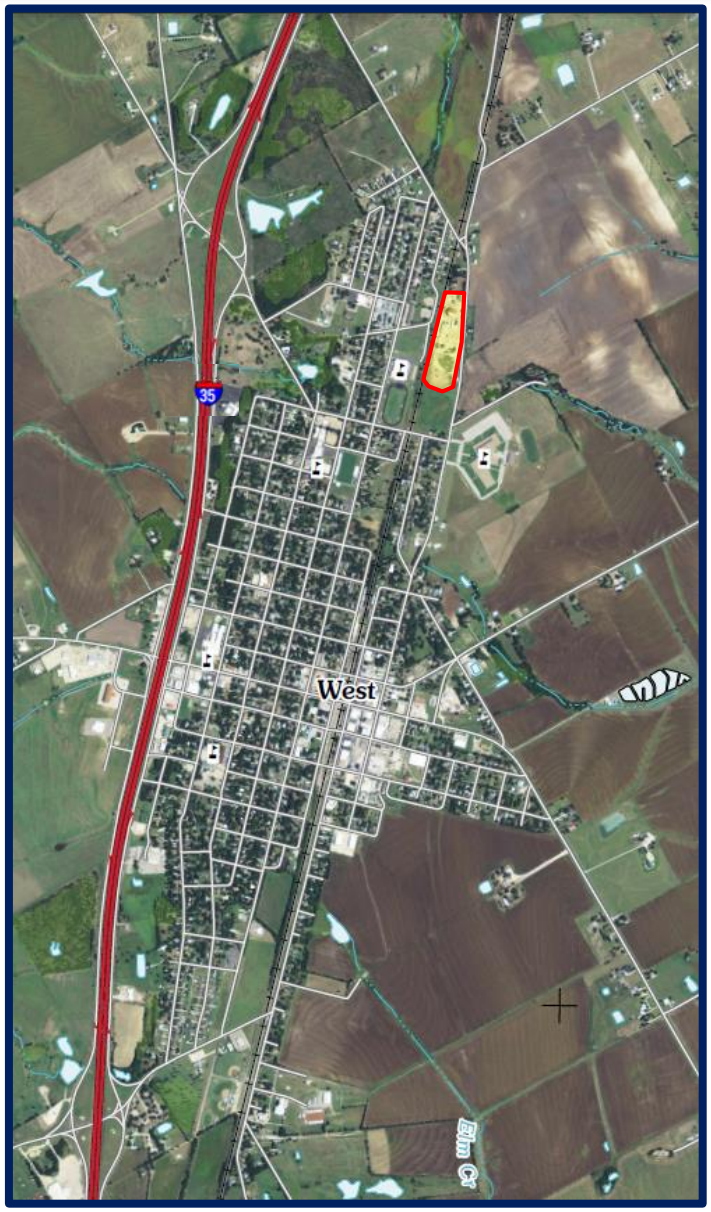
- **Victims of the West Fertilizer Explosion**
  - Fatalities
    - 12 First Responders
    - 3 Members of the Public
  - Injured
    - Over 260

- **United States Chemical Safety and Hazard Investigation Board**
  - Donald Holmstrom, JD
    Director, Retired
  - Johnnie Banks, CFEI
    Supervisory Investigator, Retired

Background

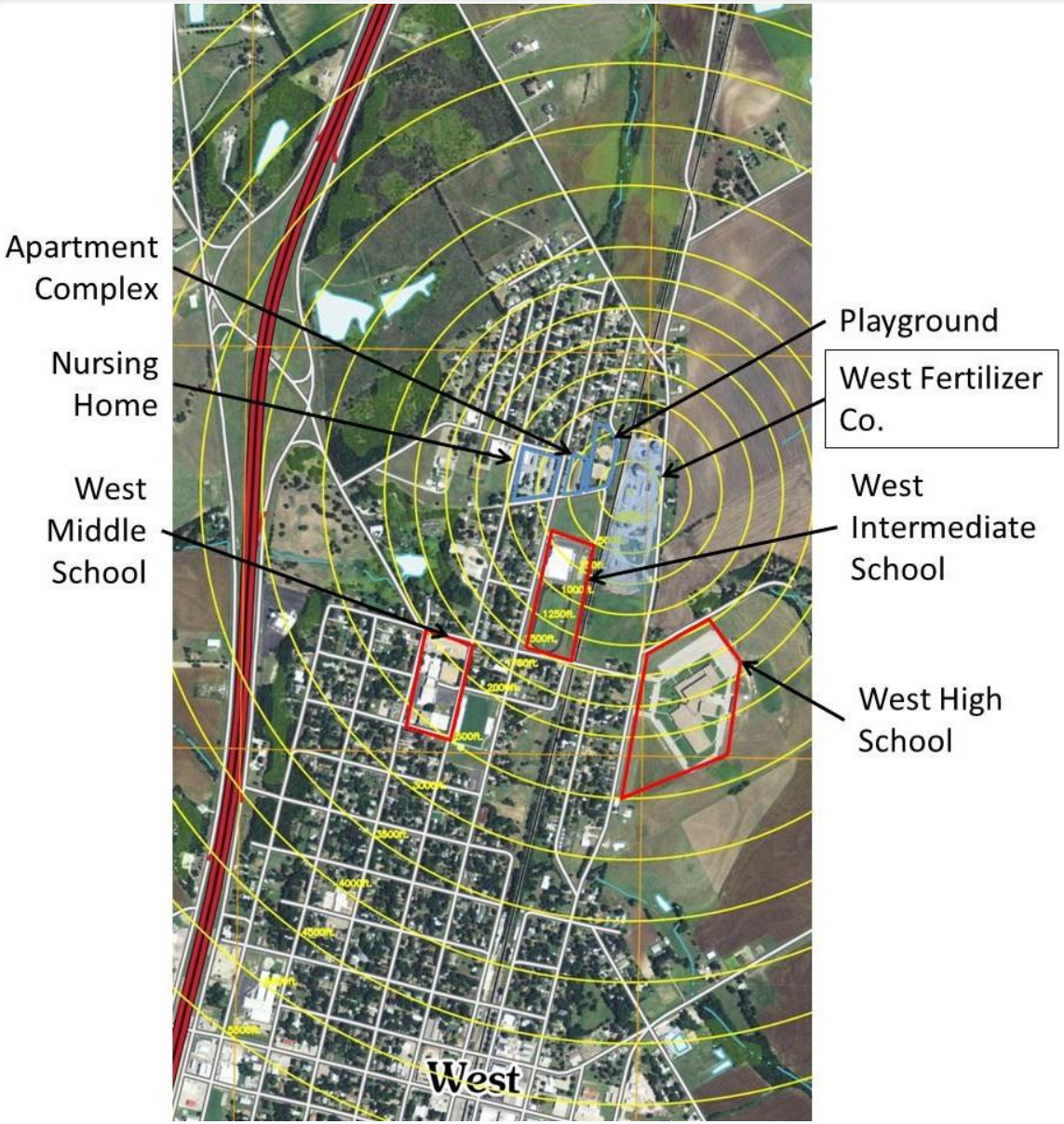

Perrin
Springtown
Plano
Royse City
Grapevine
Garland
Quinlan
Azle
Mineral Wells
Irving
Dallas
Millsap
Fort Worth
Arlington
Terrell
Wills Point
Benbrook
Santo
DeSoto
Kaufman
Mansfield
Burleson
Canton
Granbury
Kemp
Waxahachie
Cleburne
Ennis
Gun Barrel City
Grandview
Glen Rose
Rice
Athens
Malakoff
Walnut Springs
Kopperl
Carl's Corner
Corsicana
Hillsboro
Angus
Hico
Iredell
Whitney
Meridian
Carlton
Abbott
Dawson
Hubbard
West
Tennessee Colony
Cranfills Gap
Clifton
Wortham
Hamilton
Fairfield
Mexia
Valley Mills
Teague
Lanely
Jonesboro
Bellmead
Oakwood
Waco
Crawford
Mart
Groesbeck
Woodway
Purmela
Hewitt
Donie
Buffalo
Gatesville
Bee House
Thornton
Oletha
Jewett
Marlin
Kosse
Centerville
Troy
Marquez
Bremond
Leona
Travis
Rosebud
TX-OSR

OKLAHOMA
NEW MEXICO
TEXAS
CHIHUAHUA
COAHUILA


35
West

Background

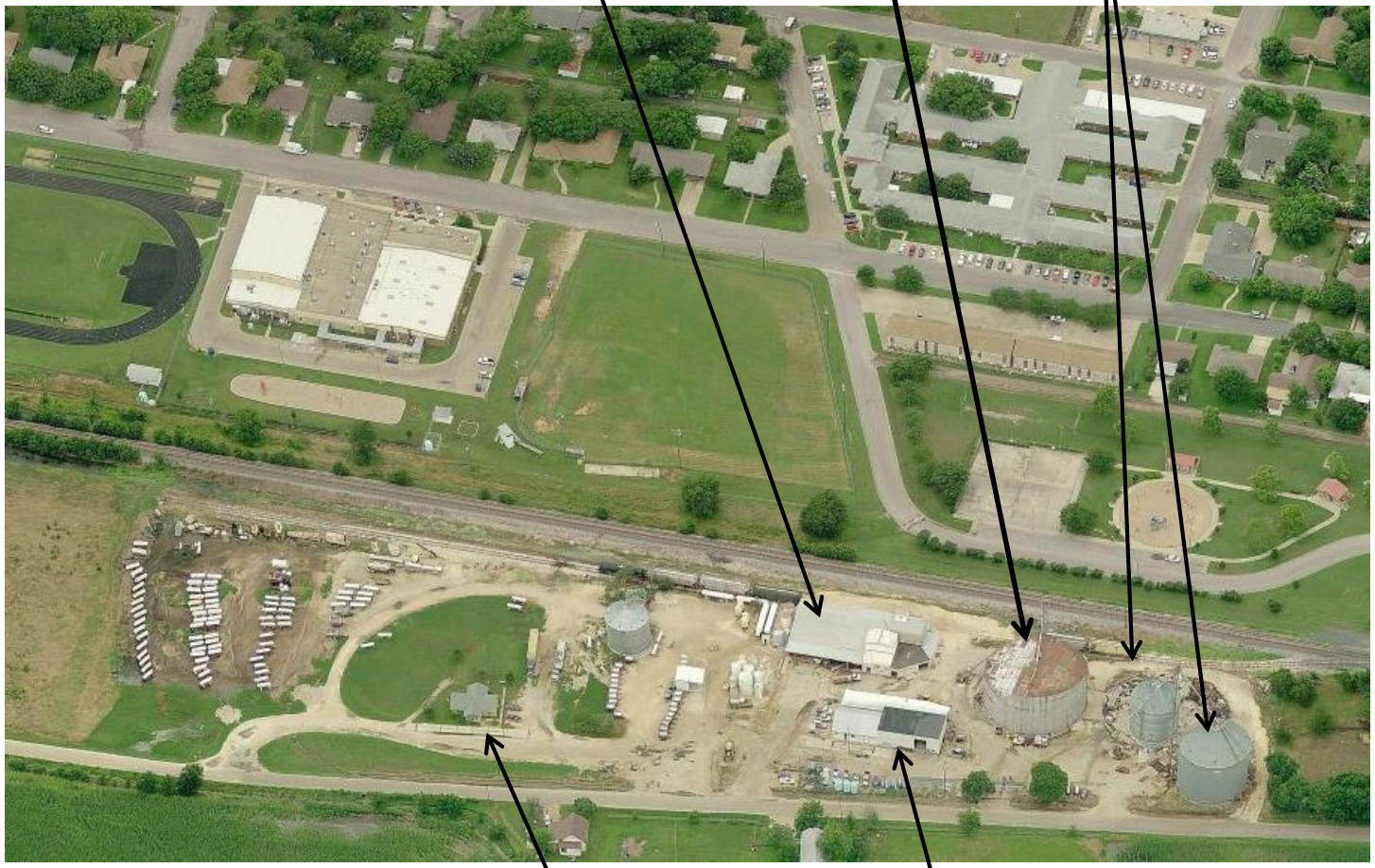
- **April 17, 2013**
  - Fire reported at 7:29 pm
  - Explosion involving bulk storage of ammonium nitrate at 7:51 pm
  - 15 Deceased and over 260 injured
  - Crater measured 90 ft in diameter



Background

April 17, 2013
7:51 pm

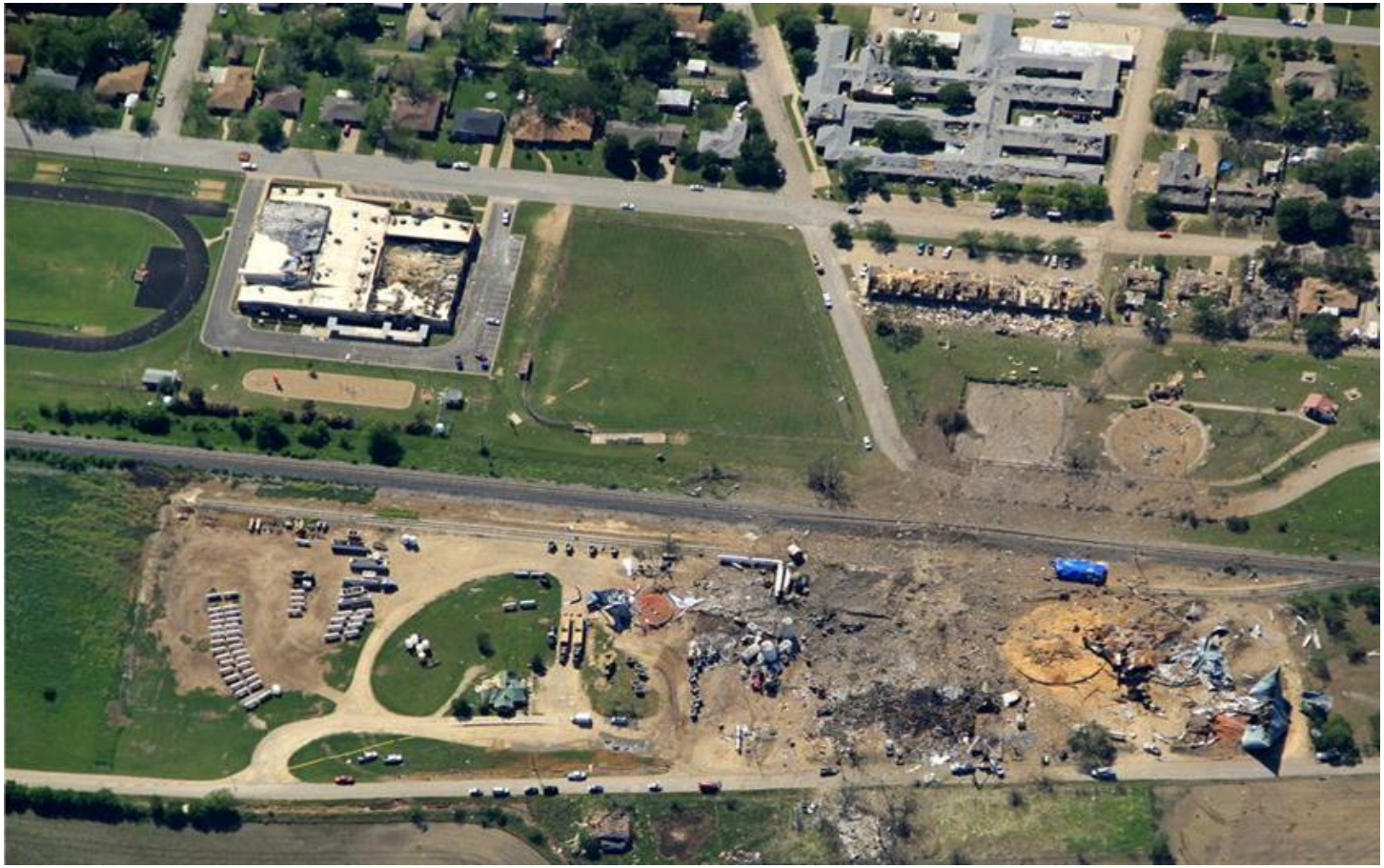
Background


Production Building
Corn Silo
Misc. Grain Silos
Scale House
Office / Chemical Storage

Background


Production Building
Corn Silo
Misc. Grain Silos
Scale House
Office / Chemical Storage

Background



Investigation Goals

- **Summary of the damage**

- **Source energy of the explosion that best explains the observed damage**

West Fertilizer - Damage

Production Building - Crater

Railway Damage at 100 ft. – K3.4

West Fertilizer - Damage

Office / Chemical Storage Building at 85 ft. – K3

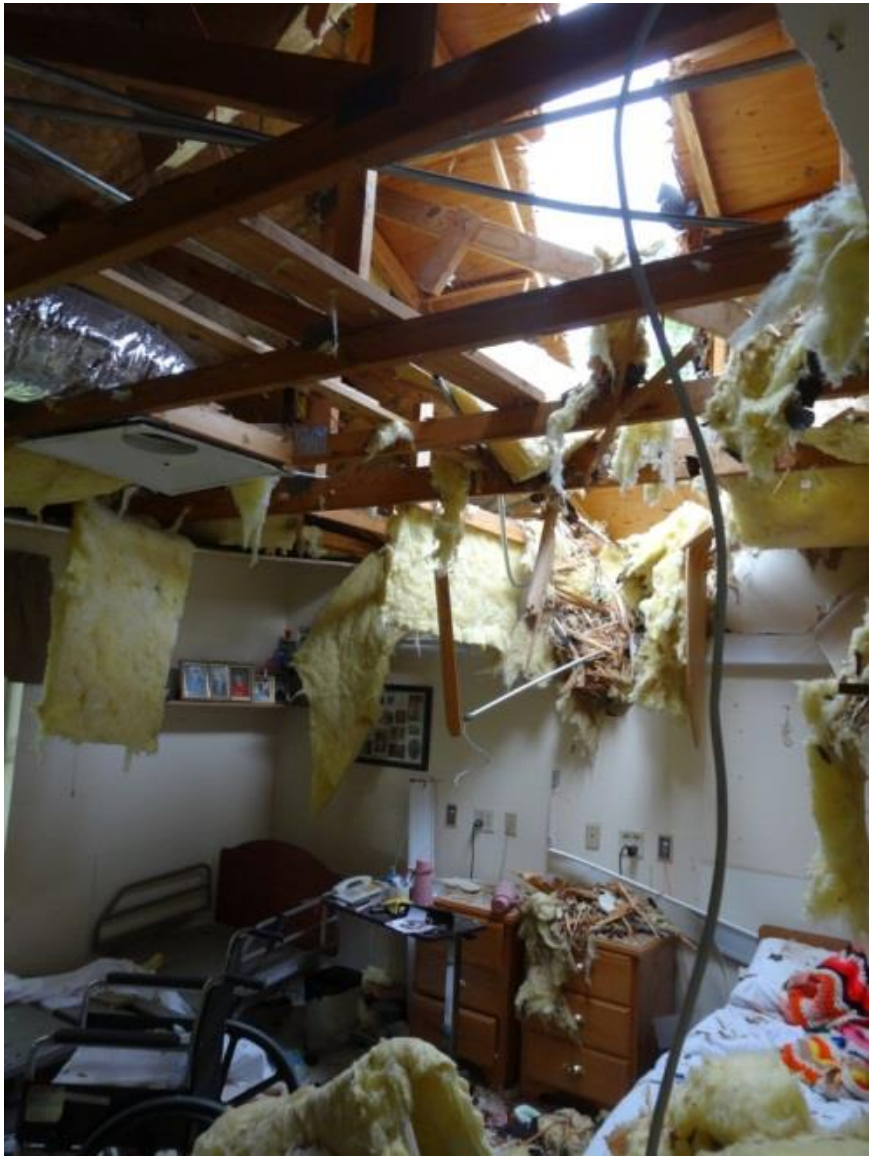
Scale House at 445 ft. – K15

Apartment Complex at 450 ft. – K15

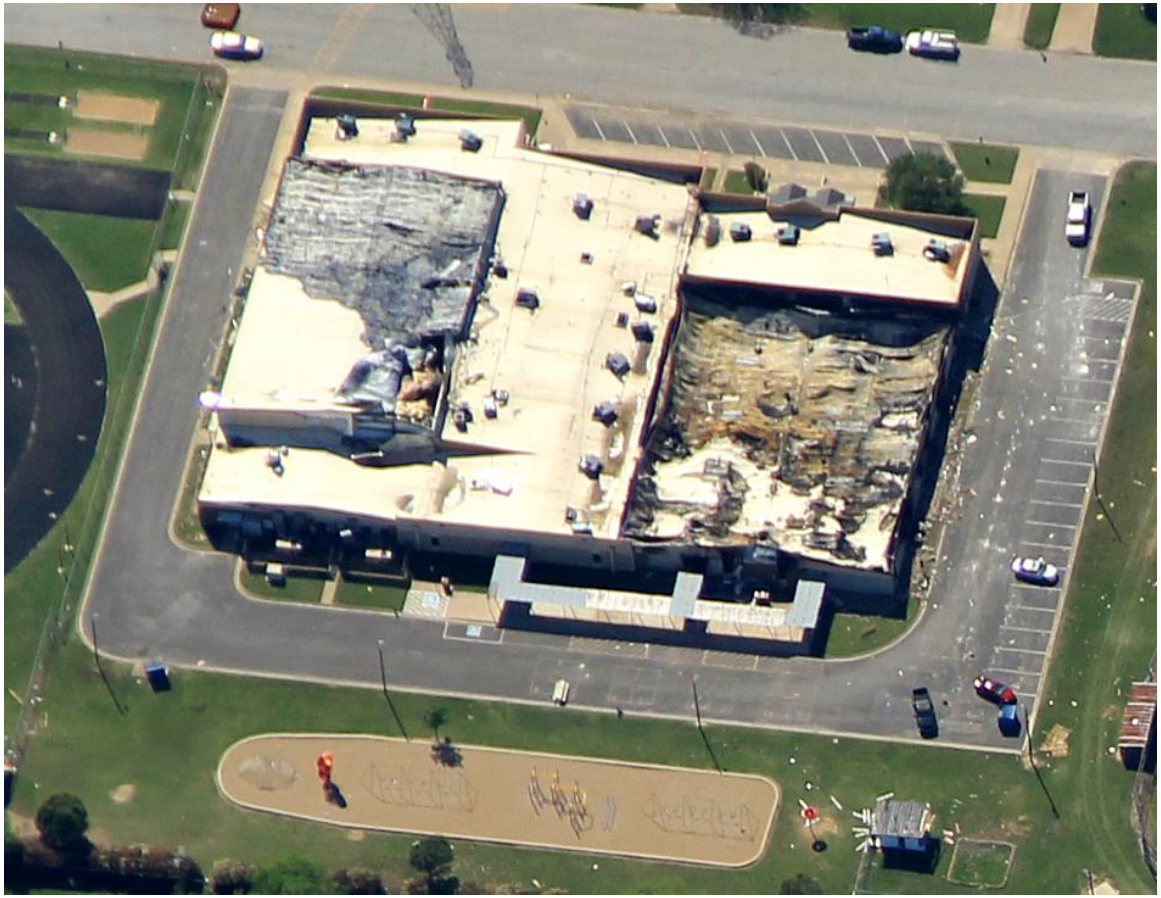
Rest Haven Nursing Home at 650 ft. – K22

Nursing Home Damage at 650 ft. – K22

Nursing Home Crater Ejecta at 910 ft. – K30



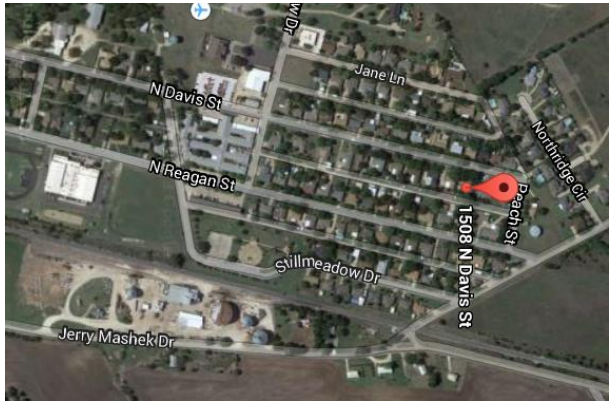
West Intermediate School at 700 ft. – K24



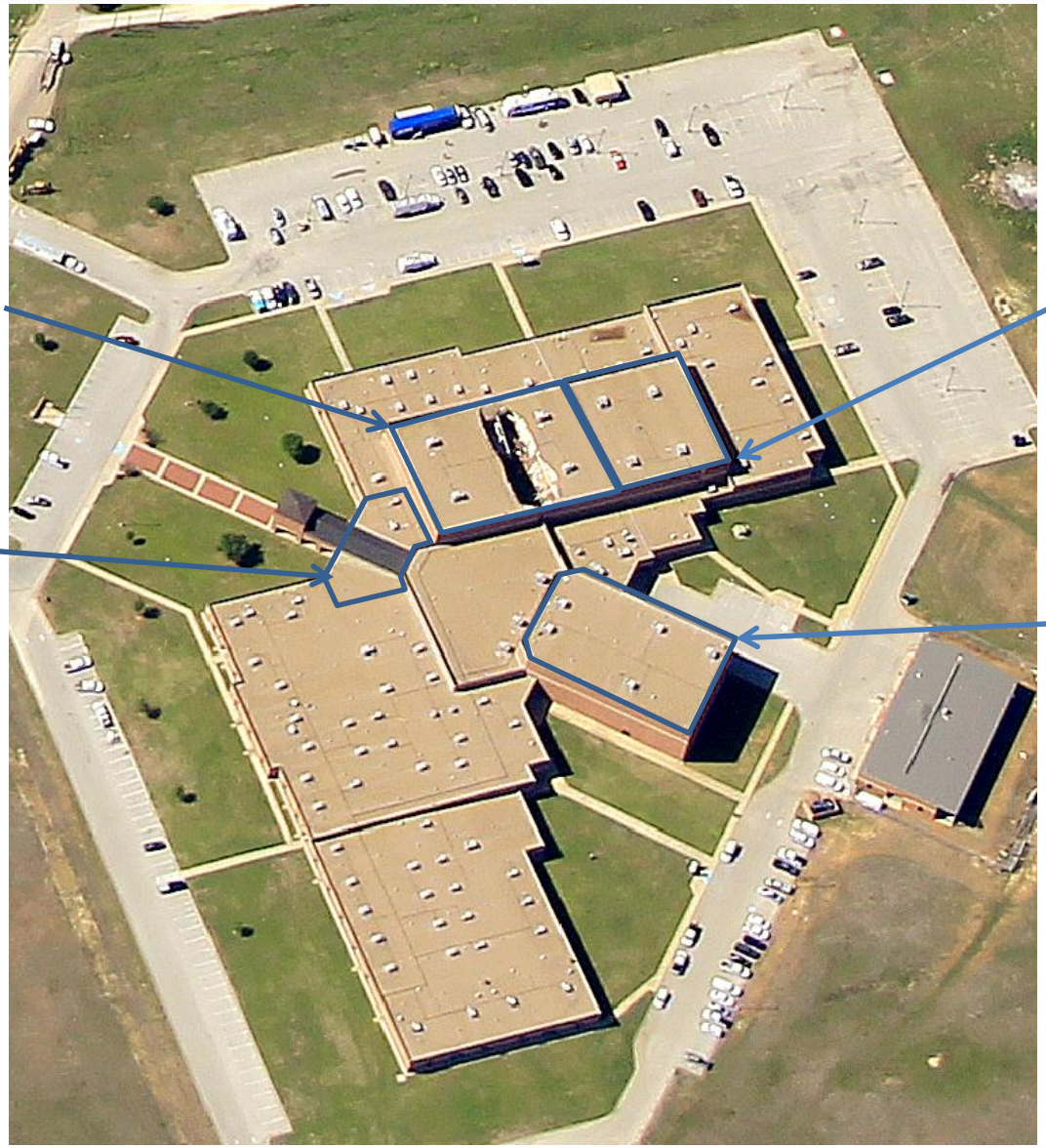
West Intermediate School at 700 ft. – K24

Residential Damage at 700 ft. – K24

Residential Damage at 1,470 ft. – K50

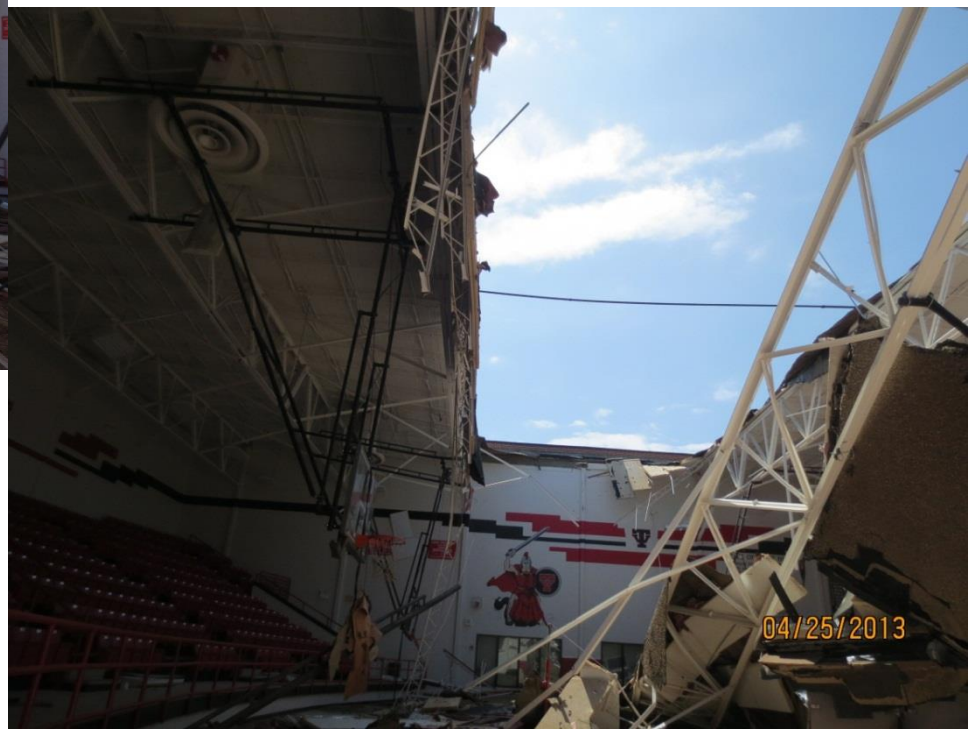


West High School at 1,500 ft. – K50



West High School at 1,500 ft. – K50

Spectator Gym



Determine the Source Energy

- **Damaged metal buildings**
- **Evaluate additional structures using ETL 1110-3-495**
- **Survey and evaluate drag loaded damage indicators**
- **Develop a possible range of charge weights**
- **Reconstruct West, TX in a 3D model to make final determination of the net explosive weight by evaluating**
  - Residential damage
  - Damage to the High School
  - Damage of the Intermediate School

Damaged Metal Buildings

Surveyed Metal Buildings

Approximate Crater Location

Damage Assessments Utilizing ETL 1110-3-495

Table A-1. Building Damage Categories. Use Figures A-1 through A-9.

Damage Category	Percent Total Building Damage	Damage Description	Repairable and Reusable
Severe	60 to 100	Frame collapse and massive destruction. Little left standing. Majority of personnel will suffer fatalities.	No
Heavy	40 to 60	Large deformation of structural members and major nonstructural component damage. Majority of personnel will suffer serious injuries with 10 to 40 percent suffering fatalities.	Very unlikely
Moderate	20 to 40	Some deformation of structural members and extensive nonstructural damage. Majority of personnel will suffer lacerations and blunt trauma from window glazing fragments or other nonstructural member debris. Zero to 10 percent of personnel suffer fatalities.	Possible
Minor	10 to 20	Little or no damage to major structural members and some damage to nonstructural. Personnel will suffer mostly minor and some serious lacerations and blunt trauma from window glazing fragments or nonstructural member debris.	Most probably
Minimal	0 to 10	Window damage extensive and light or local damage to nonstructural members. Personnel will suffer minor lacerations from window glazing fragments or other nonstructural member debris.	Yes

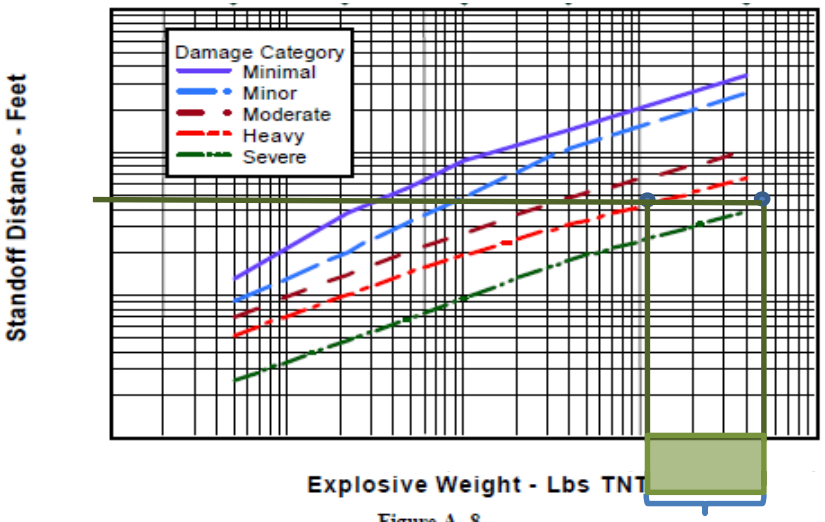


Figure A- 8.
A-12

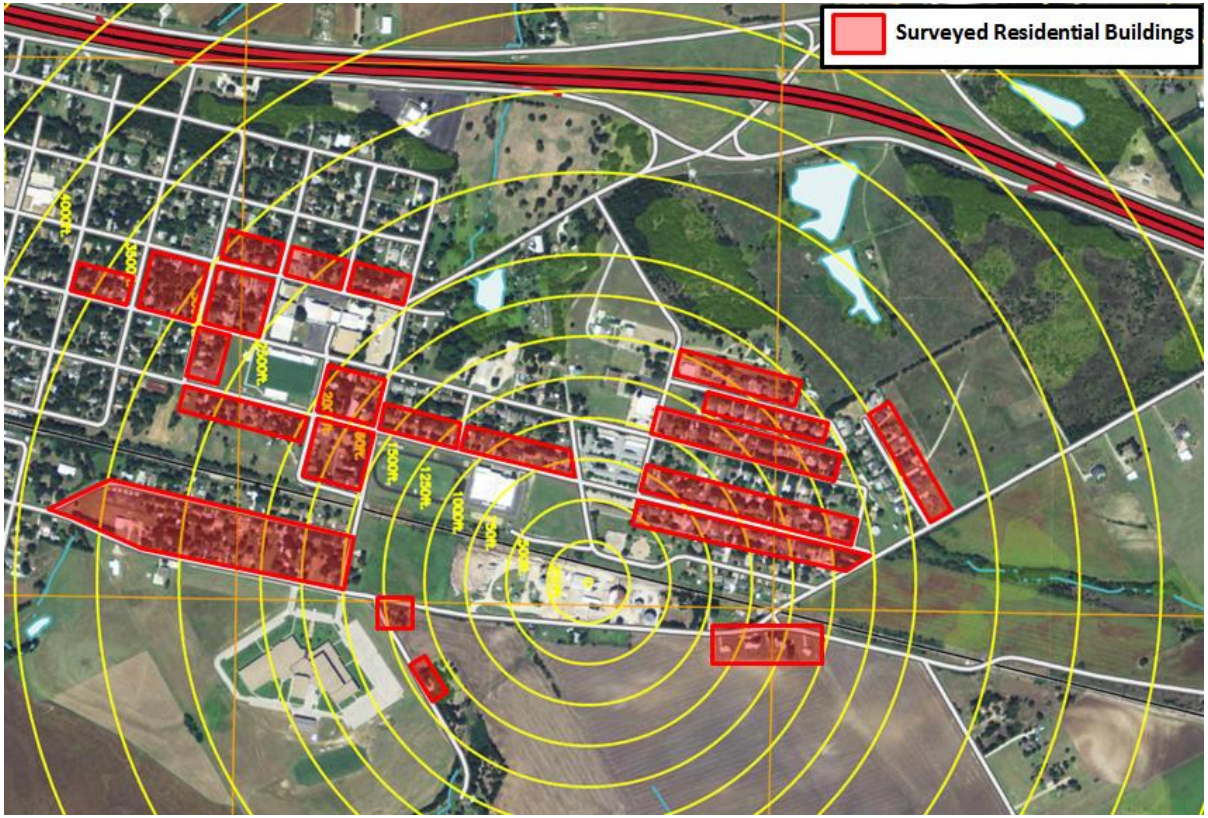
Potential Range of Charge Weights

Range of Potential Charge Weights

- **Preliminary Assessment Results**
  - Metal Building Assessment
    - Average Charge Weight of data
    - 20,000 lb_{TNT}
  - Apartment Complex and Nursing Home
    - Range of potential Charge Weights
    - 10,000 lb_{TNT} to 40,000 lb_{TNT}
- **Detailed Assessment of Community Damage**
  - Residences
  - High School
  - Intermediate School

Evaluate Range of Explosion Energies
20,000 lb_{TNT}
to
30,000 lb_{TNT}

Single Family Residence Damage



Residential Damage from FACET3D & CFD

BDL 5: Reflected wall has collapsed. Other walls and roof have substantial plastic deformation that may be approaching incipient collapse.

TNT_{Eq}	CDL1	CDL2	CDL3	CDL4	CDL5	Total
20,000-lb	6%	20%	22%	16%	36%	100%
22,500-lb	6%	12%	20%	19%	43%	100%
25,000-lb	6%	8%	18%	13%	55%	100%
27,500-lb	6%	2%	11%	16%	64%	100%
30,000-lb	5%	2%	10%	12%	72%	100%

BDL 4: Reflected wall components are collapsed or very severely damaged. Other walls and roof have permanent damage requiring replacement.

TNT_{Eq}	CDL1	CDL2	CDL3	CDL4	CDL5	Total
20,000-lb	8%	66%	20%	5%	0%	100%
22,500-lb	5%	59%	23%	11%	2%	100%
25,000-lb	3%	51%	27%	14%	6%	100%
27,500-lb	2%	38%	28%	14%	17%	100%
30,000-lb	2%	28%	30%	18%	22%	100%

BDL 3: Reflected wall components sustain permanent damage requiring replacement, other walls and roof have visible damage that is generally repairable.

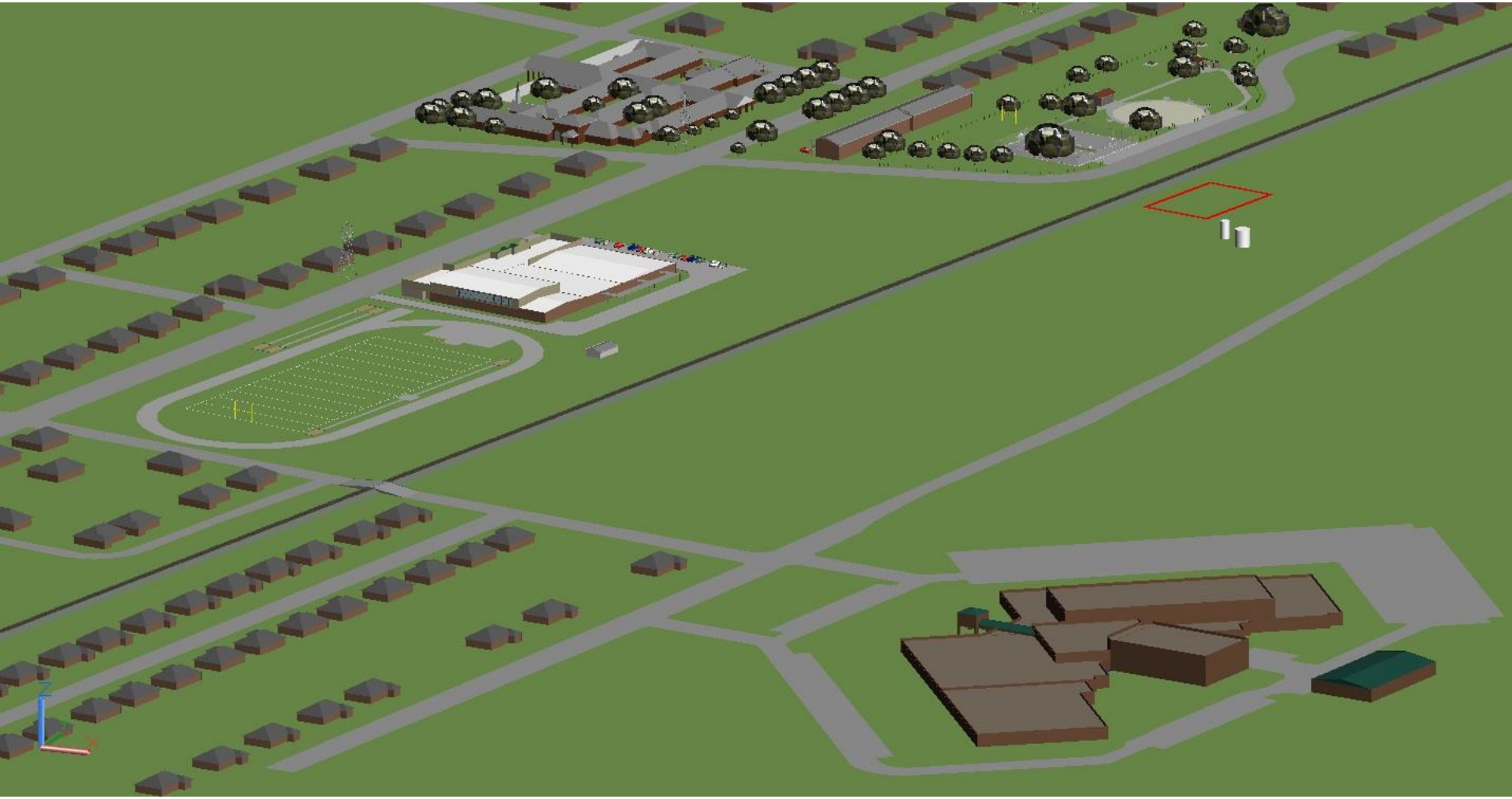
TNT_{Eq}	CDL1	CDL2	CDL3	CDL4	CDL5	Total
20,000-lb	30%	69%	1%	0%	0%	100%
22,500-lb	20%	78%	2%	0%	0%	100%
25,000-lb	10%	84%	6%	0%	0%	100%
27,500-lb	2%	86%	10%	1%	0%	100%
30,000-lb	0%	81%	16%	3%	0%	100%

Residential Damage from FACET3D & CFD

- **Charge Weights Consistent with Residential Damage on Reagan St.**

1100 - 1200 Block of N. Reagan St.					
BDL	20,000-lb	22,500-lb	25,000-lb	27,500-lb	30,000-lb
2	•	•	•		
3		•	•		
4		•	•		
1400 - 1500 Block of N. Reagan St.					
3			•	•	•
4			•	•	
5		•	•	•	

Construct 3-D CFD and FACET3D Model of West



CFD Simulation – from West

Full Report to the U.S. CSB

http://www.csb.gov/west-fertilizer-explosion-and-fire-/

West Fertilizer Explosion and Fire

Accident Description

Accident: West Fertilizer Explosion and Fire

Location: Location: West, TX

Accident Occured On: 04/17/2013 | **Final Report Released On:** 01/28/2016

Accident Type: Chemical Distribution - Fire and Explosion

Investigation Status: The CSB's investigation was approved by a unanimous board vote at a public meeting in Waco, TX, on January 28, 2016.

A massive explosion at a fertilizer storage and distribution facility fatally injured twelve volunteer firefighters, two members of the public and caused hundreds of injuries.

Final Reports

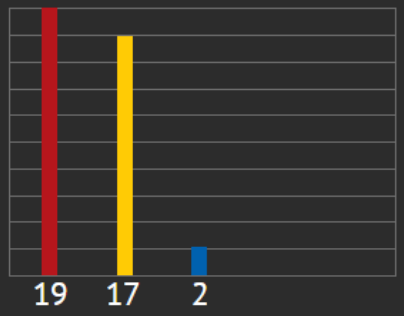
FINAL REPORT: West Fertilizer Final Investigation Report

Full Report to the U.S. CSB Available Online

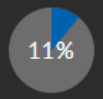
http://www.csb.gov/west-fertilizer-explosion-and-fire-/

Recent Photos View All

Statistics



- TOTAL RECOMMENDATIONS # 19
- OPEN RECOMMENDATIONS # 17
- CLOSED RECOMMENDATIONS # 2



89 vs 11
TOTAL % OPEN VS. CLOSED

Related News

CSB board approves the West Fertilizer Company report and recommendations with a unanimous vote
1/29/2016

Chemical Safety Board Releases New Safety Video, Dangerously Close:

View All

Related Events

JAN 28 Public Meeting in Waco, Texas

VIEW ALL EVENTS

Related Documents

- West Fertilizer Incident Support Services Final Report
- Rafael Moure-Eraso Written Senate Testimony 3.6.14
- Written Testimony Envrionment and Public Works Committee Thursday June 27, 2013

View All

Related Documents

- West Fertilizer Incident Support Services Final Report
- Rafael Moure-Eraso Written Senate Testimony 3.6.14
- Written Testimony Envrionment and Public Works Committee Thursday June 27, 2013
- May 17, 2013 Letter from Chairperson Rafael Moure-Eraso to Chairman Boxer
- April 30, 2013, Letter from Chairman Boxer
- Summary of CSB Explosive and Toxic Incident Recommendations 1998 - 2013
- West Fertilizer Final Investigation Report
- Preliminary Findings into the West Fertilizer Explosion and Fire
- Public Meeting Presentation (1-28-2016)
- Transcript of April 22, 2014, West Public Meeting

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