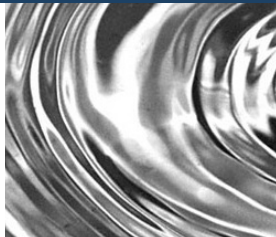


Explosive Results:
The Pressure Wave Effect





Frank H. Johnson, P.E., CSP
President & CEO



Gary L. Jackson, P.E., CSP, CFEI
Senior Consulting and
Forensic Engineer

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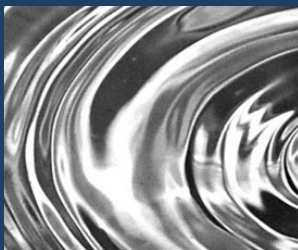
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(903) 566-4504 fax

12785 State Hwy 64 East

Tyler, Texas 75707-5333

www.sealcorp.com



What Happened in West, Texas?

West, Texas, a town of 2,700 people located about 20 miles north of Waco. On Wednesday, April 17th, 2013, West Volunteer Firefighters responded to a fire at the West Fertilizer Company around 6 pm. About 20 minutes into fighting the blaze the facility exploded with the destructive power of a 2.1 earthquake registering as far away as 400 miles. The blast destroyed 60 to 80 houses, reducing a 50-unit apartment complex to rubble.

Fertilizer did this? What is Ammonium Nitrate?

Ammonium nitrate is an odorless, colorless or white, crystal salt produced by the reaction of ammonia and nitric acid. Ammonium nitrate is in many ways one of the best (and certainly one of the cheapest) sources of crop-nourishing nitrogen



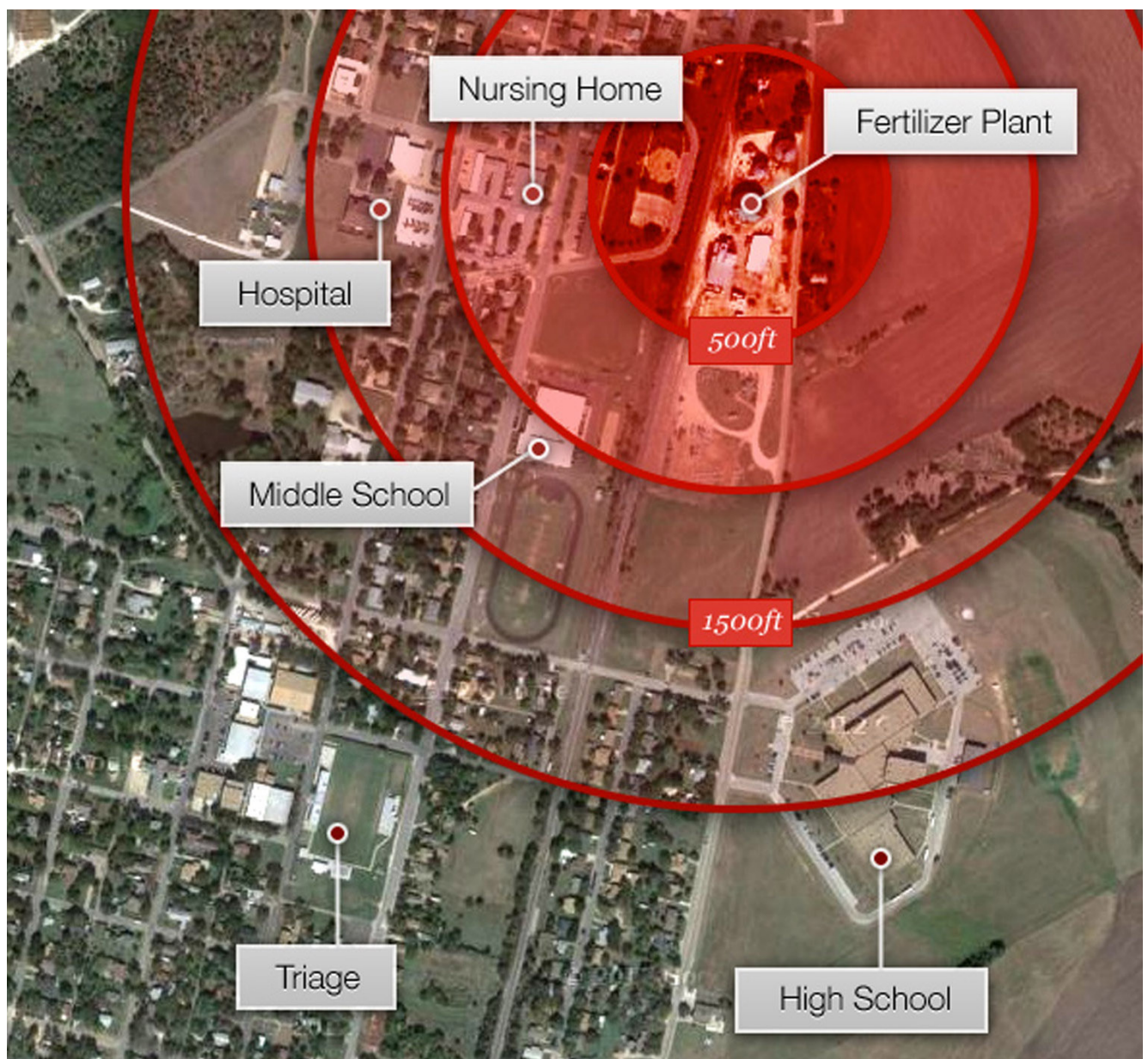
available. For starters, ammonium nitrate is inexpensive to manufacture. It provides a source of nitrogen to plants, which increases growth and crop yields. Ammonium nitrate is also well-suited to bolstering certain types of crops. It's quite effective with fruit trees. Small quantities of ammonium nitrate are also sold as an additive for mining explosives and other non-agricultural uses. But ammonium nitrate has a potentially lethal downside: If it comes into contact with an open flame or other ignition source, under certain conditions it explodes violently. The explosive force occurs when solid ammonium nitrate decomposes very rapidly into two gases, nitrous oxide and water vapor.

Explosive Damage

The Pressure Wave Effect

Assessing structural damage caused by over pressures due to nearby explosions require numerous considerations. Whenever a structure is exposed to a blast-wave there is an overpressure followed immediately by an under pressure.

The type of damage caused by various levels of overpressure can be found within various pieces of literature including Federal Emergency Management Agency





(FEMA) and National Fire Protection Association (NFPA).

The weakest part of the structure generally are the windows, resulting in cracked plate glass windows being the first damage caused by overpressure.

Damage similar to high wind damage also can occur to a structure; but, the racking of the structure due to horizontal forces caused by the over pressure and under pressure can result in more significant structural damage.

When assessing the damage to a structure exposed to a nearby blast we look for broken windows, racked structure, and missing or displaced boards similar to wind damage.

Unless the structure is a pier and beam structure, the foundation will likely not be affected.

In the event that the structure is racked, a more detailed inspection of any hidden damage must be conducted.

Engineers from SEAL have conducted structural damage assessments related to explosion damage claims on many occasions over our 30+ year history.

Damage	Incident Overpressure (psi)
Typical window glass breakage	0.15 – 0.22
Minor damage to some buildings	0.5 – 1.1
Panels of sheet metal buckled	1.1 – 1.8
Failure of concrete block walls	1.8 – 2.9
Collapse of wood framed buildings	Over 5.0
Serious damage to steel framed buildings	4 – 7
Severe damage to reinforced concrete structures	6 – 9
Probable total destruction of most buildings	10 – 12

SOURCES: *EXPLOSIVE SHOCKS IN AIR*, KINNEY & GRAHM, 1985; *FACILITY DAMAGE AND PERSONNEL INJURY FROM EXPLOSIVE BLAST*, MONTGOMERY & WARD, 1993; AND *THE EFFECTS OF NUCLEAR WEAPONS*, 3RD EDITION, GLASSTONE & DOLAN, 1977.



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