Airport Technology R&D Team

Engineered Material Arresting Systems

Presented to: X ALACPA Seminar and VIII FAA Workshop, Mexico City

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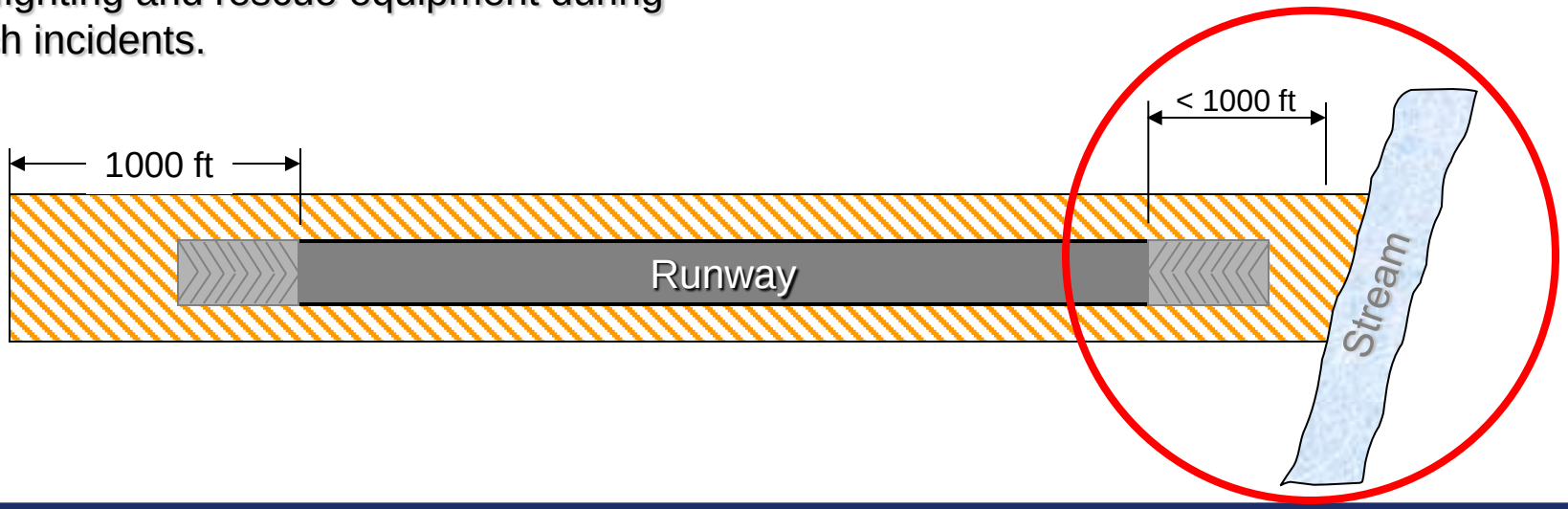
Date: 02 October, 2013

Federal Aviation Administration

Problem

Runway Safety Area

Concept: The Runway Safety Area (RSA) offers an additional level of safety to the airport in the event that an airplane undershoots, or overruns the end of the runway. RSA's are designed to reduce the risk of damage to airplanes and passengers as well as provide greater accessibility for firefighting and rescue equipment during such incidents.



Background

On February 28, 1984, a Scandinavian Airline System DC-10-30 aircraft overran after landing on runway 4R at John F. Kennedy (JFK) International Airport and plunged into Thurston Basin.

National Transportation Safety Board (NTSB) accident report DCA84AA018 indicated that the DC-10 departed the end of the runway at about 75 knots and entered Thurston Basin 600 feet later still moving at about 38 knots.

NTSB Safety Recommendation

In consideration of the potential for catastrophic overrun accidents, the NTSB issued the following Safety Recommendation A-84-37 to the FAA:

"Initiate research and development activities to establish the feasibility of soft ground aircraft arresting systems and promulgate a design standard, if the systems are found to be practical."

FAA Airport Technology Research

- Development of a mathematical model to represent the tire/material interface
- Prediction of stopping distance within the arrestor bed
- Verification of the mathematical model by field testing
- Demonstration full scale arrest of a Boeing 727 airplane from a speed of 55 knots.

Cooperative Research and Development Agreements

Engineered Systems Arresting Company (ESCO)

[Now…Division of Zodiac Aerospace Corporation]

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The Port Authority of New York & New Jersey

Research and Development

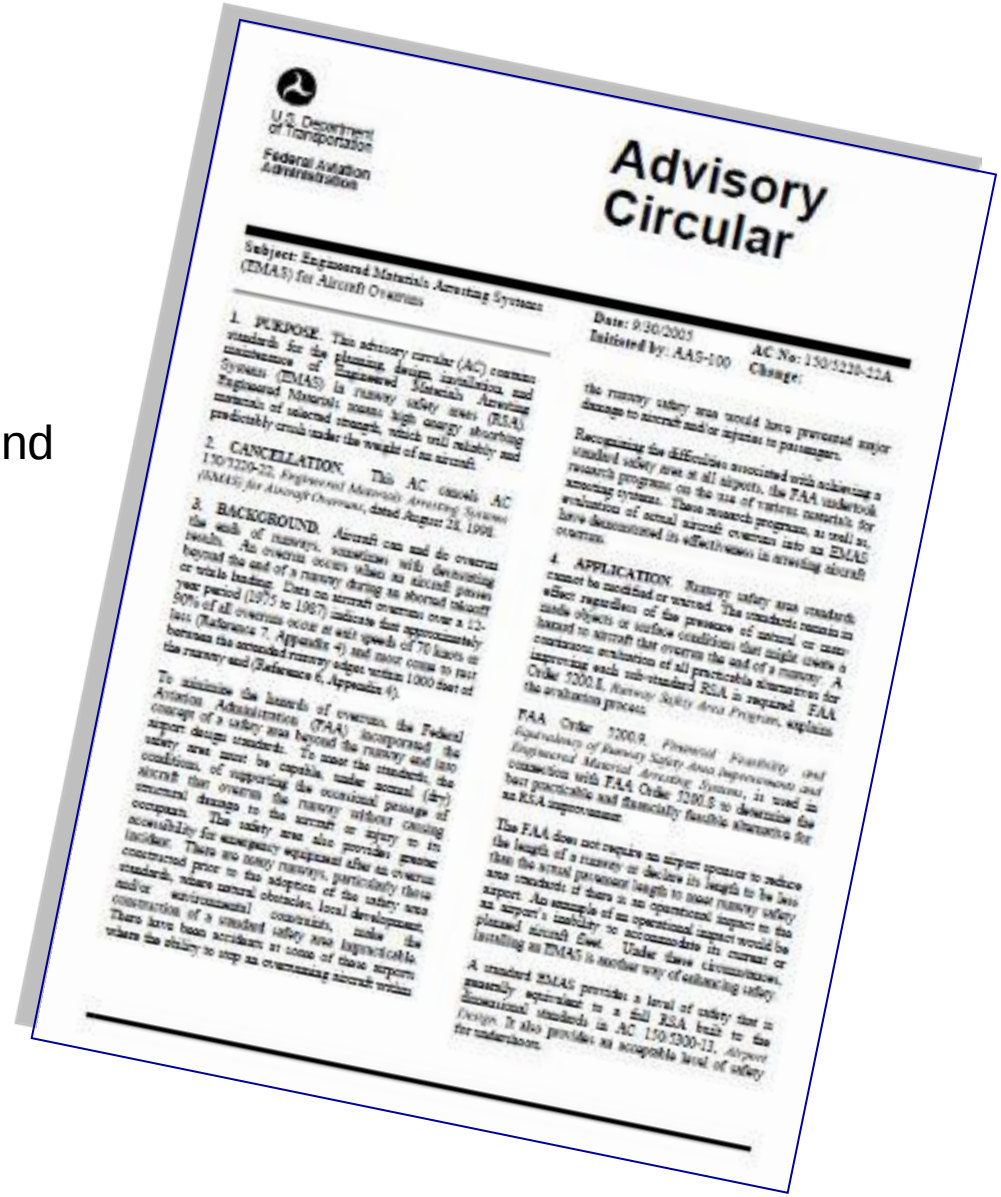
- Materials research and testing
- Several small and medium scale material tests
- Software created to determine aircraft response to soft ground materials
- Mathematical model and predicted stopping distance
- Full-scale aircraft arrest of FAA test aircraft
- Aircraft Rescue & Firefighting (ARFF) vehicle mobility tests
- Material fire tests
- Affects on navigation aides
- Moisture protection considerations
- Cold weather testing
- Prototype arrestor bed at JFK
- Jet blast resistance coatings

Math Model Validation


Federal Aviation Administration

Research Results

- **Satisfied NTSB Recommendations**
  - Feasibility of using a soft ground material to arrest aircraft
  - Promulgating a standard


U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns

Date: 9/30/2005 AC No: 150/5220-22A
Initiated by: AAS-100 Change:

1. PURPOSE. This advisory circular (AC) contains standards for the planning, design, installation, and maintenance of Engineered Materials Arresting Systems (EMAS) in runway safety areas (RSA). Engineered Materials means high energy absorbing materials of selected strength which will reliably and predictably crush under the weight of an aircraft.

2. CANCELLATION. This AC cancels AC 150/5220-22, *Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns*, dated August 28, 1998.

3. BACKGROUND. Aircraft can and do overrun the ends of runways, sometimes with devastating results. An overrun occurs when an aircraft passes beyond the end of a runway during an aborted takeoff or while landing. Data on aircraft overruns over a 12-year period (1975 to 1987) indicate that approximately 80% of all overruns occur at exit speeds of 70 knots or less (Reference 7, Appendix 4) and most come to rest between the extended runway object areas within 1000 feet of the runway end (Reference 6, Appendix 4).

To minimize the hazards of overruns, the Federal Aviation Administration (FAA) incorporated the concept of a safety area beyond the runway and into airport design standards. To meet the standards, the safety area must be capable, under normal (dry) conditions, of supporting the occasional passage of aircraft that overrun the runway without causing structural damage to the aircraft or injury to its occupants. The safety area also provides greater accessibility for emergency equipment after an overrun incident. There are many runways, particularly those constructed prior to the adoption of the safety area standards, where natural obstacles, local development, and/or environmental constraints, make the construction of a standard safety area impracticable. There have been accidents at some of these airports where the ability to stop an overrunning aircraft within the runway safety area would have prevented major damage to aircraft and/or injuries to passengers.

Recognizing the difficulties associated with achieving a standard safety area at all airports, the FAA undertook research programs on the use of various materials for arresting systems. These research programs, as well as evaluation of actual aircraft overruns into an EMAS have demonstrated its effectiveness in arresting aircraft overruns.

4. APPLICATION. Runway safety area standards cannot be considered or waived. The standards remain in effect regardless of the presence of natural or man-made objects or surface conditions that might create a hazard to aircraft that overrun the end of a runway. A comparative evaluation of all practicable alternatives for improving each sub-standard RSA is required. FAA Order 5200.8, *Runway Safety Area Program*, explains the evaluation process.

FAA Order 5200.9, *Financial Feasibility and Equivalency of Runway Safety Area Improvements and Engineered Material Arresting Systems*, is used in connection with FAA Order 5200.8 to determine the best practicable and financially feasible alternative for an RSA improvement.

The FAA does not require an airport sponsor to reduce the length of a runway or declare its length to be less than the actual pavement length to meet runway safety area standards if there is an operational impact to the airport. An example of an operational impact would be an airport's inability to accommodate its current or planned aircraft fleet. Under these circumstances, installing an EMAS is another way of enhancing safety.

A standard EMAS provides a level of safety that is generally equivalent to a full RSA built to the dimensional standards in AC 150/5300-13, *Airport Design*. It also provides an acceptable level of safety for runways

FAA AC 150/5220-22A
FAA Order 5200.9

EMAS

Engineered Material Arresting System

Concept: An EMAS is designed to stop an overrunning aircraft by exerting predictable deceleration forces on its landing gear as the EMAS material crushes. It must be designed to minimize the potential for structural damage to aircraft, since such damage could result in injuries to passengers and/or affect the predictability of deceleration forces.

Engineered Materials means high energy absorbing materials of selected strength, which will reliably and predictably crush under the weight of an aircraft.


ESCO's EMAS product is currently installed at 72 runway ends at 47 United States airports.
EMASMAX®
Boston Logan International Airport

100% Aircraft Arrestment Success

Date	Crew and Passengers	Incident
May 1999	30	A Saab 340 commuter aircraft overran the runway at JFK
May 2003	3	A Gemini Cargo MD-11 overran the runway at JFK
January 2005	3	A Boeing 747 overran the runway at JFK
July 2006	5	A Mystere Falcon 900 overran the runway at Greenville Downtown Airport in South Carolina
July 2008	145	An Airbus A320 overran the runway at ORD
January 2010	34	A Bombardier CRJ-200 regional jet overran the runway at Yeager Airport in Charleston, WVA
October 2010	10	A G-4 Gulfstream overran the runway at Teterboro Airport in Teterboro, NJ
November 2011	5	A Cessna Citation II overran the runway at Key West International Airport in Key West, FL

JFK – 1999
Saab 340 Arrested at the end of Runway 4R after overrun.

JFK – May 30, 2003
Cargo MD-11 Arrested at the end of Runway 4R after overrun.

JFK – January 22, 2005
Cargo B-747 Arrested at the end of Runway 4R after overrunning during landing in snow storm

Charles Yeager Airport, WV

Completed installation

As applied

CRW – January 19, 2010
PSA Airlines CRJ-200 arrested at the end of runway at Yeager Airport, Charleston, WV

A Cessna Citation II overran the runway at Key West International Airport in Key West, FL

There were 5 passengers/crew on board. No injuries.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R&D Current Status

- **FAA maintains open CRDA's with two EMAS manufacturers**
  - ESCO/Zodiac Aerospace
  - Norsk Glasgjenvinning (NGG)

- **ESCO**
  - continues to pursue product enhancement through improved protective materials
  - several new FAA/ESCO R&D projects
- **NGG**
  - NGG is seeking operational deployments in Norway and pursuing North American options

Seam Seal Damage - Wildlife

ESCO/Zodiac continually conducts research to identify materials and methods to improve their product

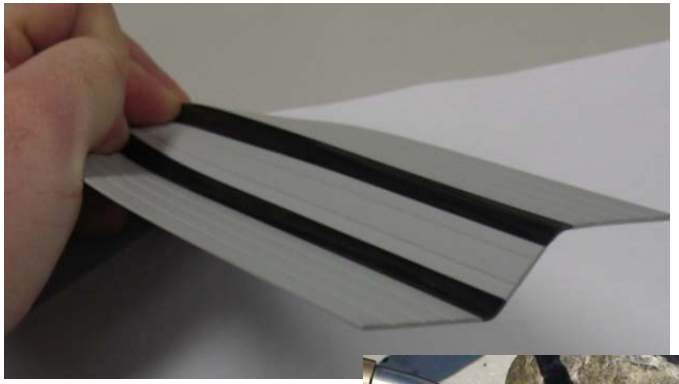
Wildlife Monitoring

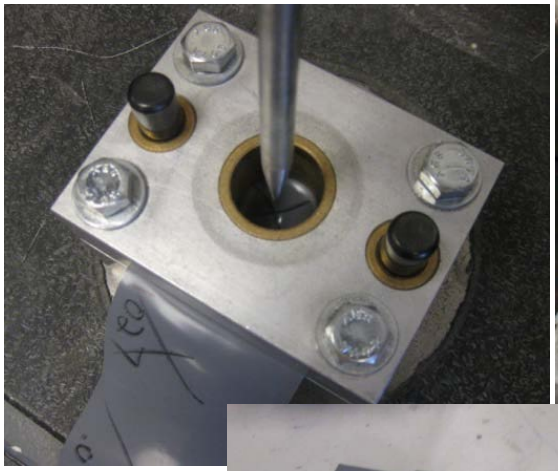


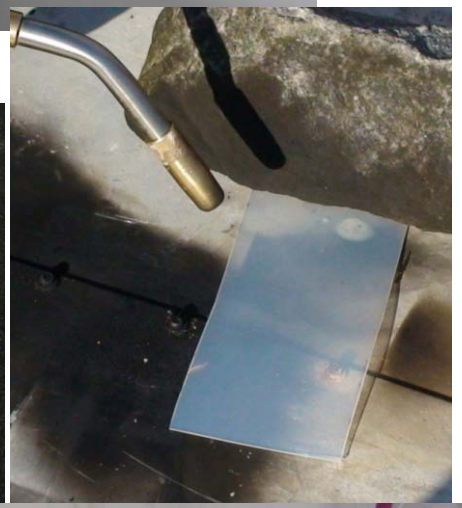



Testing Seam Seal

- **Flame Testing**
- **Accelerated weathering**
- **Outdoor weathering**
- **Mechanical properties**
  - Tensile
  - Tear
  - Puncture
  - Extreme Temperature
- **Chemical Resistance**
- **Static Testing**
- **Adhesion**







Norsk Glasgjenvinning (NGG) - Glasopor

Typical Layout

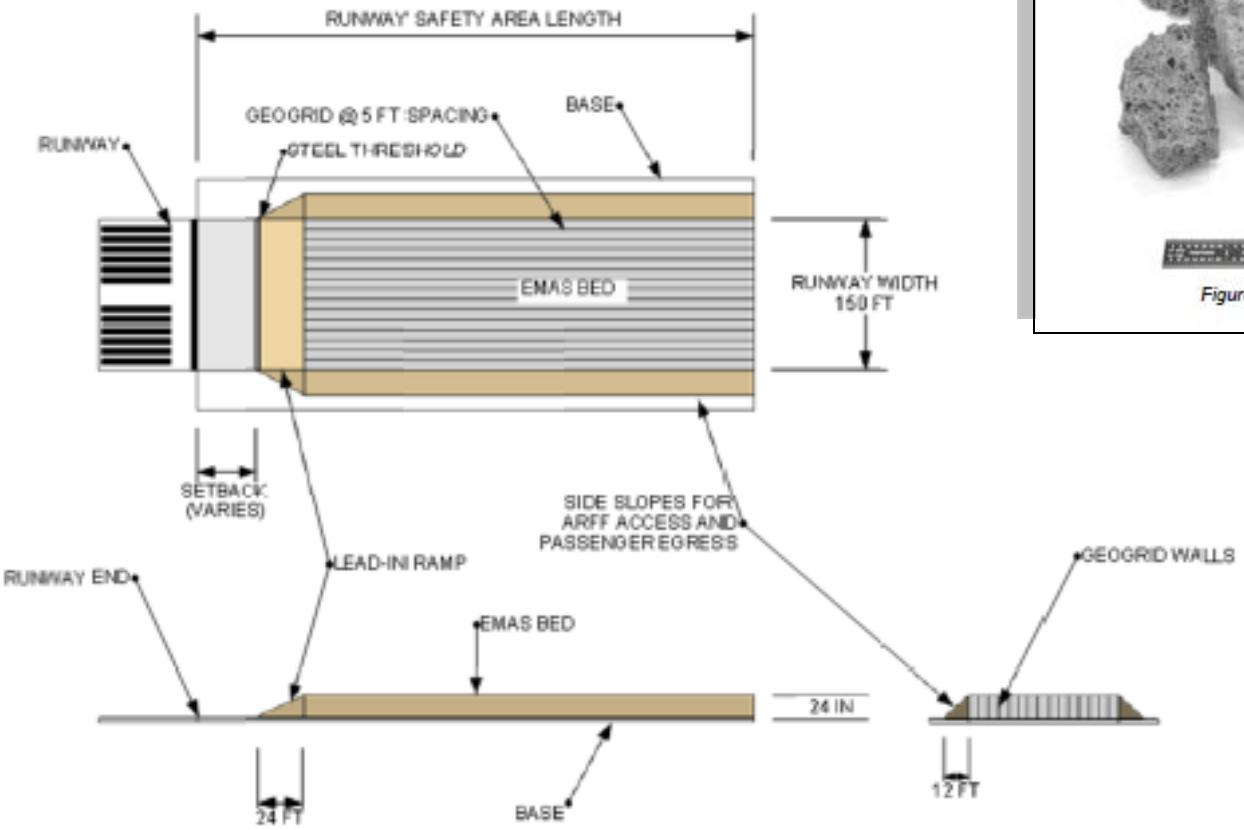


Figure 2. Glasopor EMAS Typical Layout and Dimensions

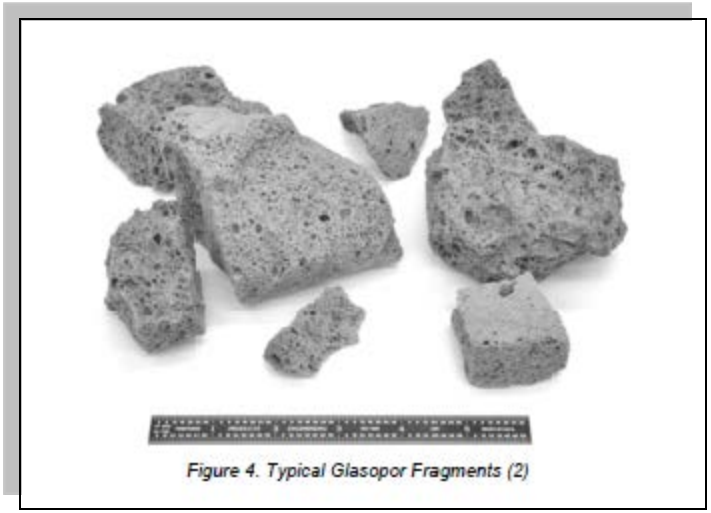
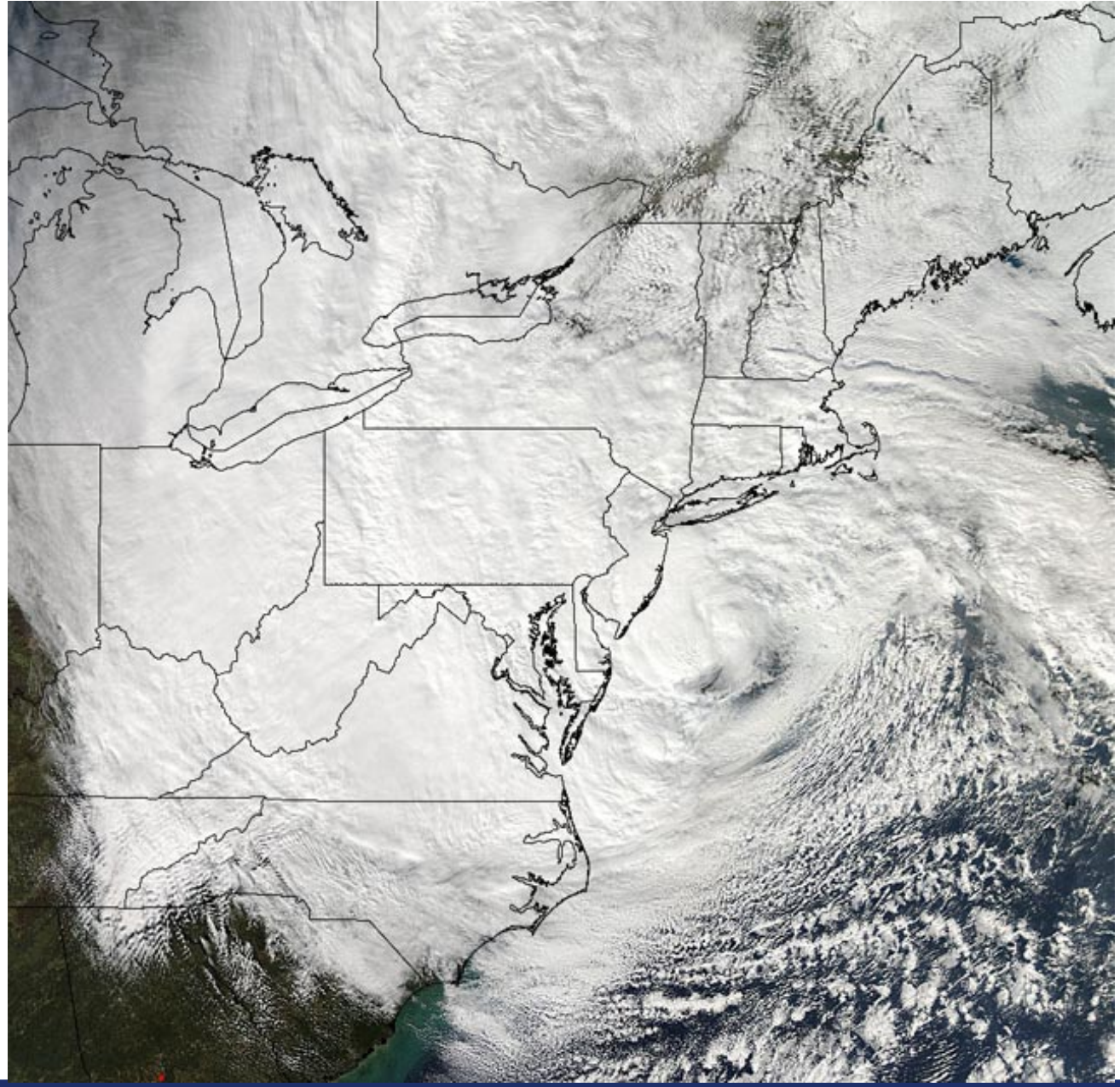
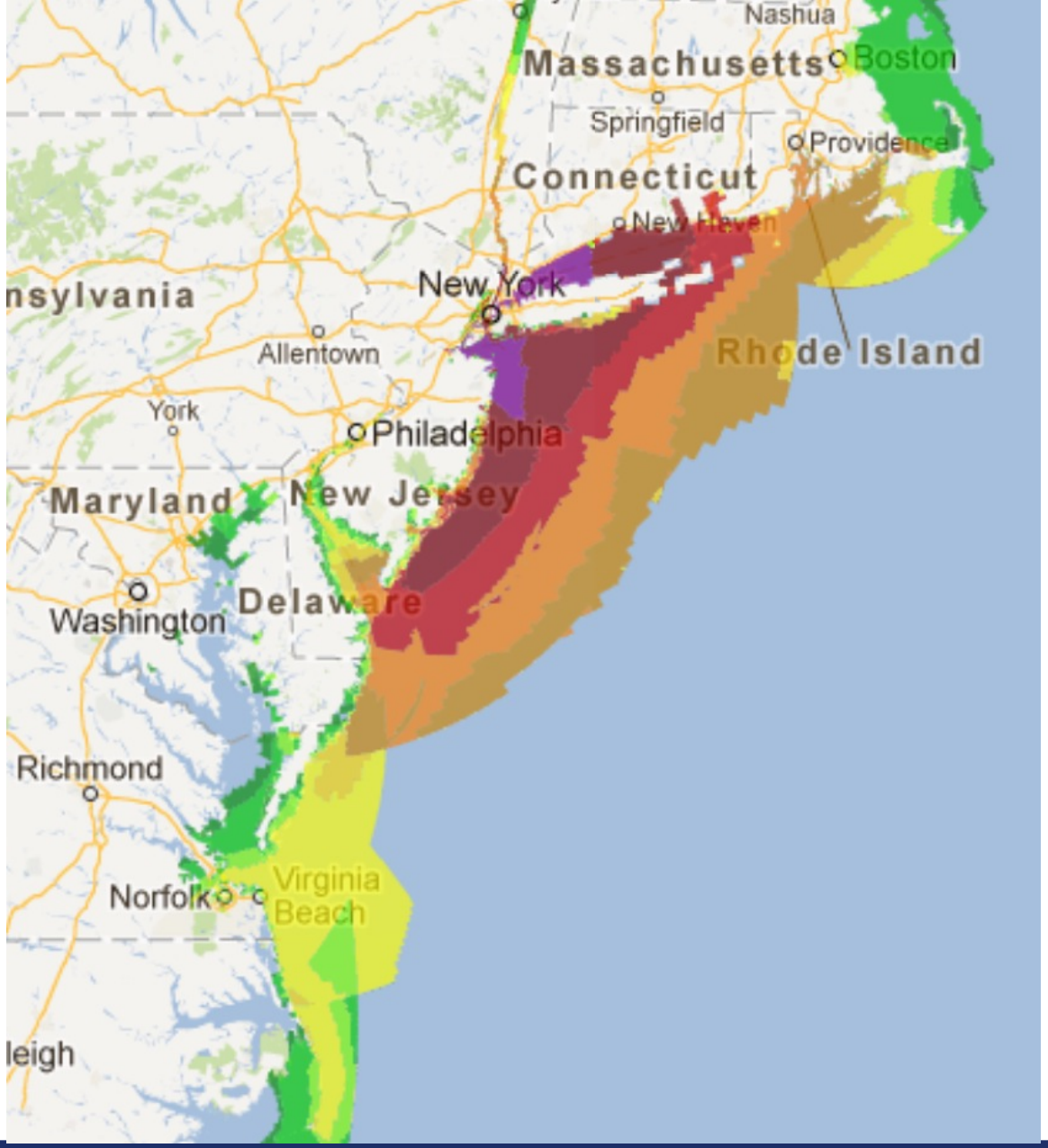


Figure 4. Typical Glasopor Fragments (2)

Super storm sandy emas damage

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EMAS
October 2, 2013

Federal Aviation Administration

EMAS Field Inspections of Storm Affected EMAS

Scrim Inspection - Borescope

Inspection – Moisture Content

Inspection – Field Strength Test

Storm Affected EMAS

- **Results from inspections were shared with each airport**
- **Recommendations were made for either continued inspection, replacement of damaged blocks, or entire EMAS bed replacement**
- **Potential FEMA aide for repairs or replacement**

Future EMAS R&D Work

- **Improve testing capabilities of**
  - Field Strength Tool (FST)
  - Moisture Content
- **Determine field performance and longevity of EMAS systems at airports**
  - Help airports plan for replacement
- **Testing of new snow removal device from EMAS**

FAA Information on EMAS

- U.S. Department of Transportation Federal Aviation Administration– ORDER 5200.9
- Advisory Circular 150/5220-22A - Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns
- FAA Fact Sheet - http://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=11961
- Airport Technology R&D Branch - http://www.airporttech.tc.faa.gov/
  - Download R&D Technical Reports

Questions ?

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