VERMONT
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

INVESTIGATING AFFF USE AT A REGIONAL AIRPORT

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STATE OF VERMONT AGENCY OF NATURAL RESOURCES

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

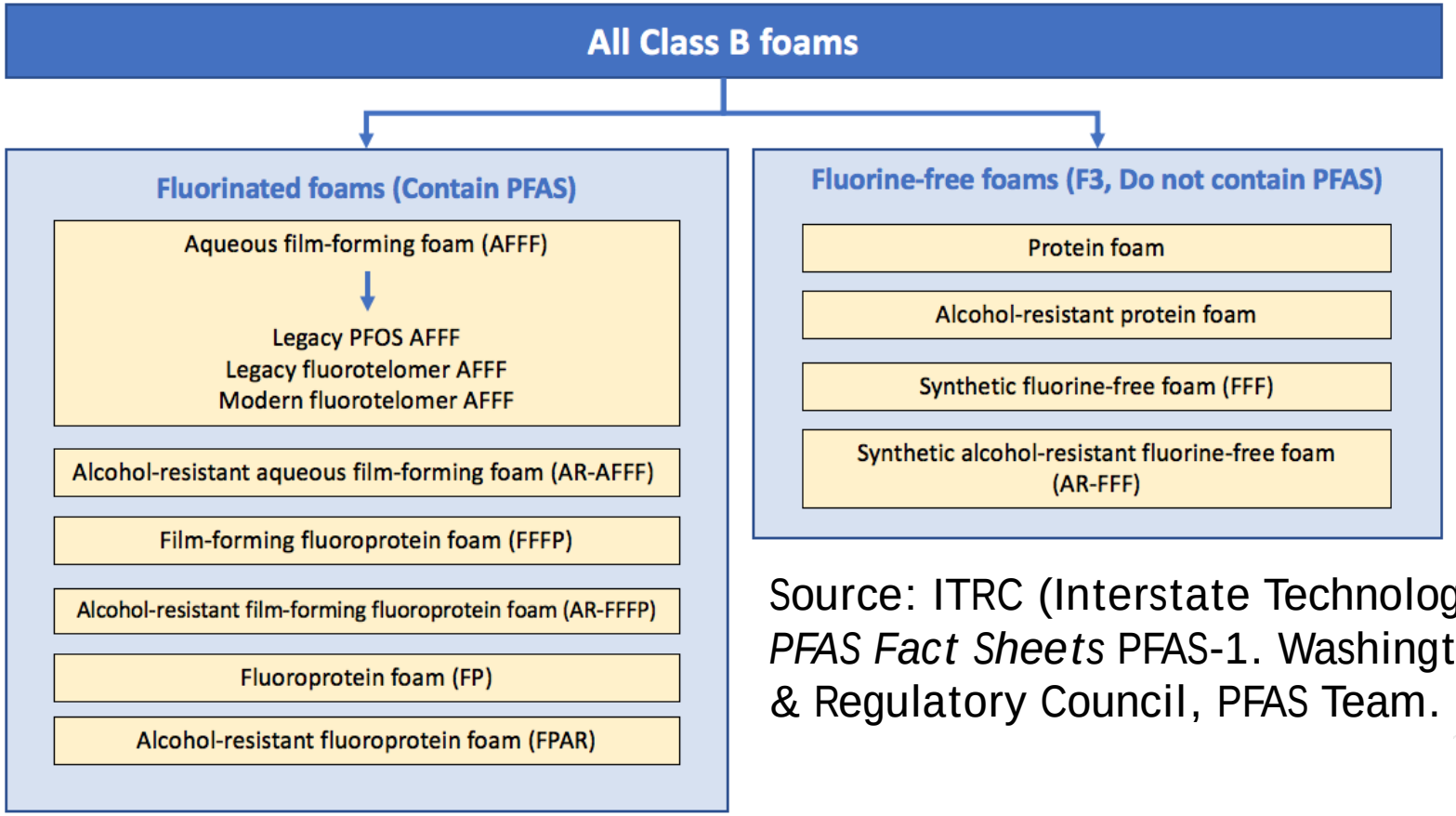
WASTE MANAGEMENT & PREVENTION DIVISION

SITES MANAGEMENT SECTION

DATE OF PRESENTATION:
MARCH 7, 2019

AQUEOUS FILM FORMING FOAMS (AFFF)

- AFFF is a concentrate that is blended with water to create a foam that is intended for fighting high-hazard liquid fires
- Of most concern are PFAS-containing **Class B AFFF**



Source: ITRC (Interstate Technology & Regulatory Council). 2018. *PFAS Fact Sheets* PFAS-1. Washington, D.C.: Interstate Technology & Regulatory Council, PFAS Team. www.itrcweb.org.

AQUEOUS FILM FORMING FOAM (AFFF)

- Only 3% of fluorochemical production is for AFFF
  - 75% of AFFF production used by military
  - 25% used by oil refineries, municipal airports, fire stations, tank farms
- **Complex, proprietary mixtures**
- PFASs a few % in mixture but still g/L levels
- Brief history
  - Mid 1960s – 1970: 3M sole source supplier of AFFF
  - 1973: National Foam
  - 1976: Ansul
  - 1994 to present: Angus, Chemguard, Fire Service Plus
- **Bottom line = multiple AFFFs used at most sites**

Slide courtesy of ITRC (Interstate Technology & Regulatory Council)

WHERE CLASS B AFFF IS IN SERVICE/DISCHARGED:

- ✓ Chemical Plants
- ✓ Flammable liquid storage and processing facilities
- ✓ Larger Airports (aircraft rescue and firefighting, hangars)*
- ✓ State HAZMAT Team
- ✓ Military Facilities*
- ✓ Fire Training Facilities
- ✓ Local Fire Departments
- ✓ Merchant Operations (oil tankers, offshore platforms)

* Currently required to use AFFF that meets the requirements of the U.S. Department of Defense (DoD) Military Specification (MILSPEC) "Fire Extinguishing Agent, Aqueous Film-Forming Foam"

Source: ITRC (Interstate Technology & Regulatory Council). 2018. *PFAS Fact Sheets* PFAS-1. Washington, D.C.: Interstate Technology & Regulatory Council, PFAS Team. www.itrcweb.org.

INVESTIGATING AFFF USE IN VERMONT

- Search the Vermont Spill Program's spill reports for hazardous material fires, tanker fires, and other rollovers and crashes
- Identify military bases that have fire fighting capabilities
  - Vermont Air National Guard
  - Camp Ethan Allen Training Site
- Identify **FAA Part 139** Airports in the State
  - Burlington International Airport (BTV)
  - Rutland Southern Vermont Regional Airport (RUT)
- Identify fire training centers in the State
- Monitor incoming spill reports for accidents with fires that may have had AFFF releases as part of the emergency response

FAA PART 139
AIRPORT OPERATING CERTIFICATE

- Part 139 Airports have operating certificates from the FAA that require certain safety and service requirements, including:
  - Fueling Facilities
  - Certain Terminal Requirements
  - Night Operations
  - **Aircraft Rescue and Fire Fighting (ARFF)**

AIRCRAFT RESCUE & FIRE FIGHTING (ARFF) REQUIREMENTS AT FAA PART 139 AIRPORTS

- Must have onsite ARFF capabilities including a pumper truck
- The pumper truck must be full of Class B AFFF at all times
- Required to use AFFF that meets the DoD MILSPEC for Aqueous Film-Forming Foam
- Airport must keep enough AFFF onsite to fill the truck **3 times** in the event of an emergency

FAA-MANDATED AFFF AND EMERGENCY RESPONSE TESTING

- Each year, the FAA requires testing of the ARFF equipment, the AFFF, and First Responders
- **ARFF Equipment Testing:**
  - The pumper truck has its turrets and hand valves opened to ensure they effectively spray foam
- **AFFF Testing:**
  - The AFFF is tested to ensure it has the appropriate surface tension, expansion ratio, and other criteria
- **Emergency Response Testing:**
  - First Responders are tasked with responding to a mock emergency on the airfield. When they arrive on the scene, they are timed as to how long it takes for them to set up on a scene and run the pumps

DOES YOUR AIRPORT HAVE ONE OF THESE?

H_2O Capacity: 300 gallons

AFFF Capacity: 40 gallons

…OR ONE OF THESE?

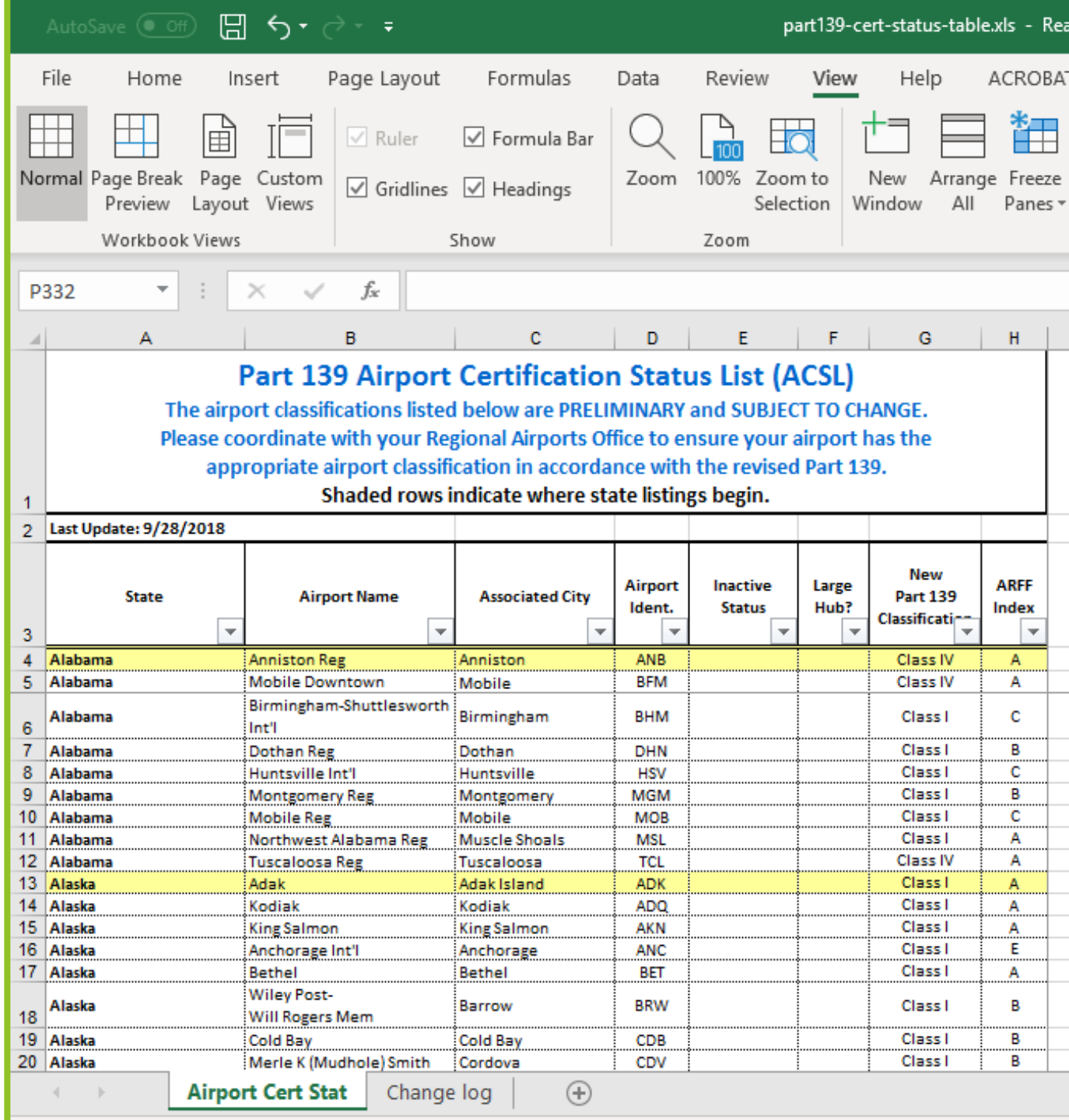
H_2O Capacity: 1,250 gallons

AFFF Capacity: 130 gallons

FAA LISTING OF PART 139 AIRPORTS

https://www.faa.gov/airports/airport_safety/part139_cert/

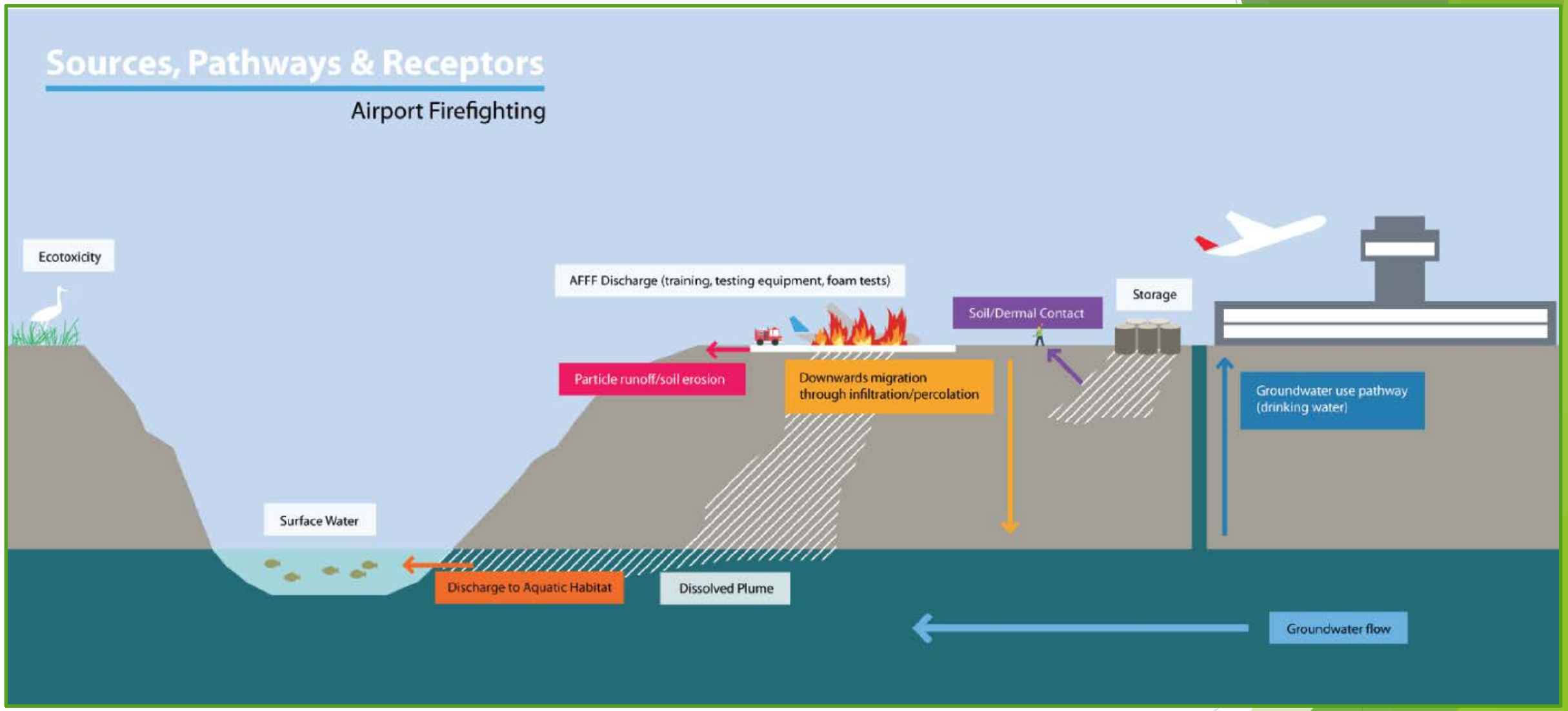
Part 139 Airports by State	
RI	1
VT	2
NH	2
ME	4
CT	4
MA	9
NY	24
FL	26
CA & TX	30



POTENTIAL AREAS OF CONCERN - AIRPORT

- AFFF Storage Areas
- Areas on the airfield where AFFF was applied as part of an emergency response (**ie. plane crashes**)
- Firefighting training areas, burn pits, or other areas where AFFF may have been discharged as part of training
- Areas where AFFF was discharged as part of FAA testing
- Areas where AFFF was loaded or removed from ARFF vehicles during maintenance
- Historical disposal areas
- Airport stormwater system discharge points
- Pipeline terminals/bulk storage areas
- Hangars with engineered fire suppression systems using AFFF

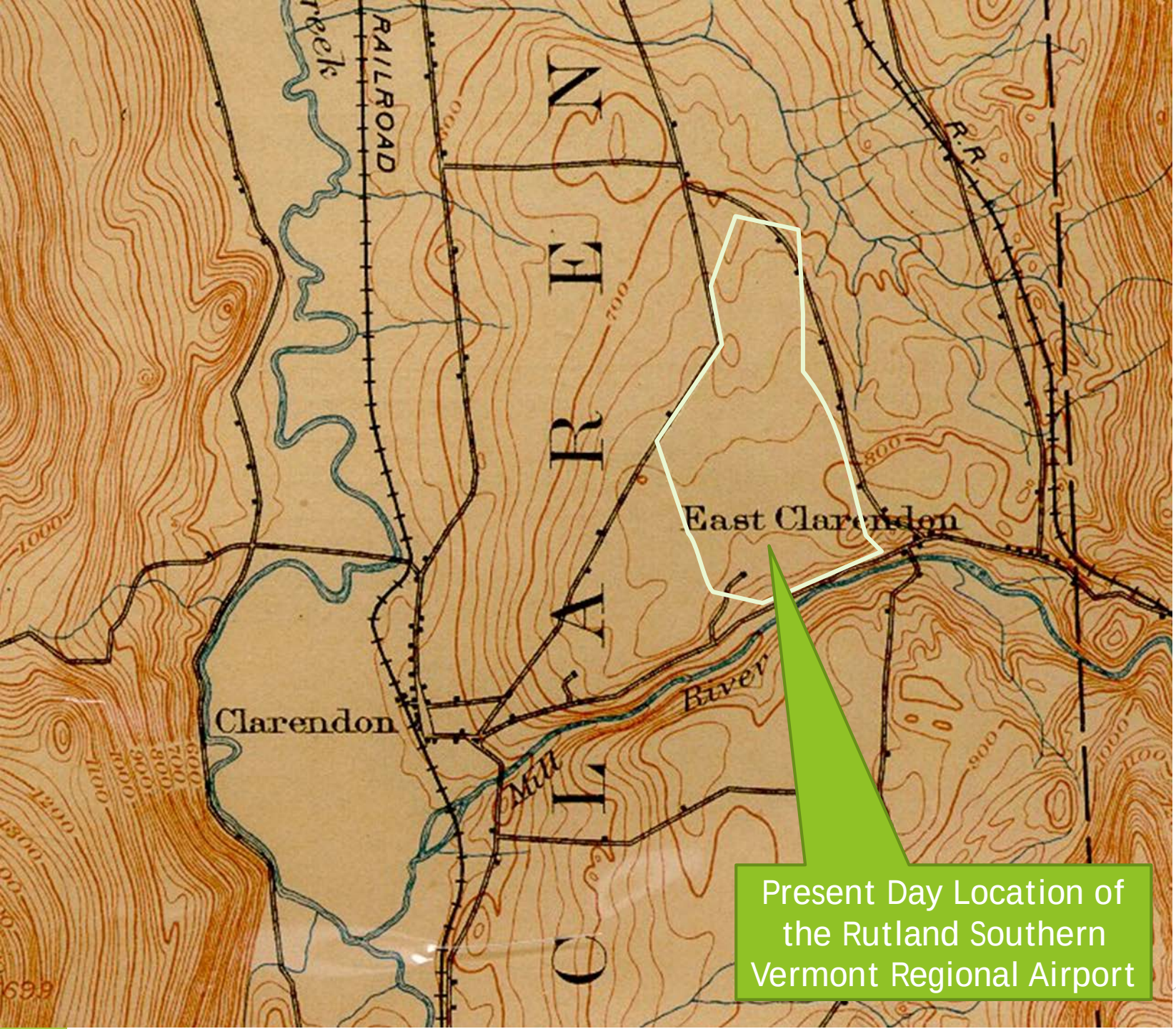
Source: ACRP (Airport Cooperative Research Program). 2017. ACRP Research Report 173. Use and Potential Impacts of AFFF Containing Per- and Polyfluoroalkyl Substances (PFASs) at Airports. National Academy of Sciences. http://www.trb.org/ACRP/Blurbs/175866.aspx



Source: ACRP (Airport Cooperative Research Program). 2017. ACRP Research Report 173. Use and Potential Impacts of AFFF Containing Per- and Polyfluoroalkyl Substances (PFASs) at Airports. National Academy of Sciences. http://www.trb.org/ACRP/Blurbs/175866.aspx

RUTLAND SOUTHERN VERMONT REGIONAL AIRPORT

Located in Clarendon, VT

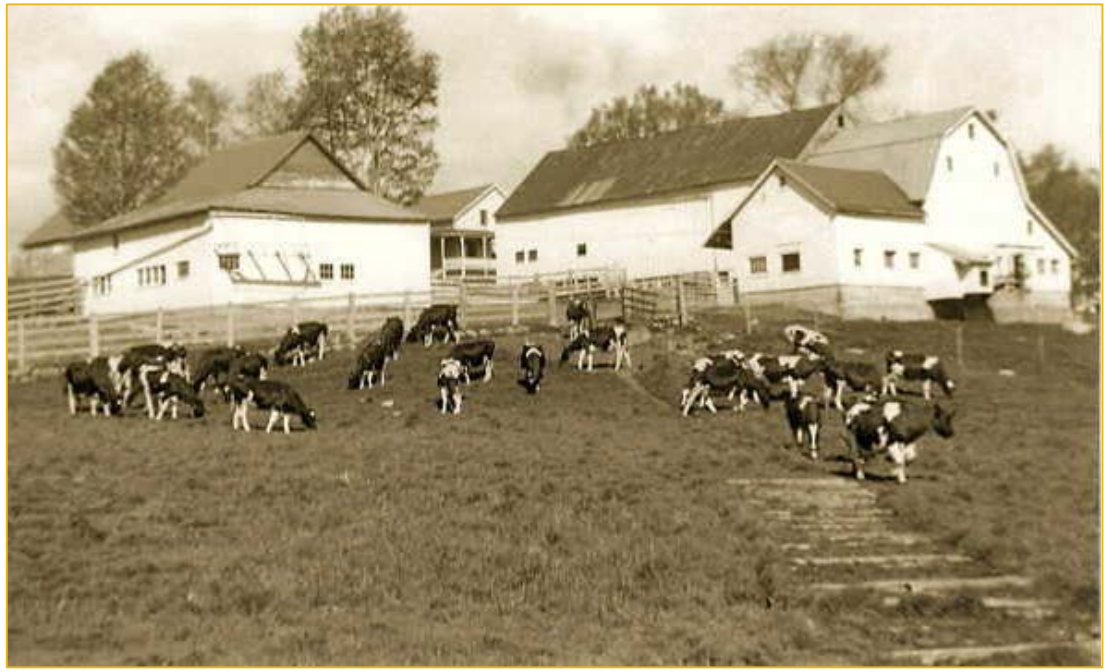


1893

Rutland, VT Quadrangle

USGS 15 Minute Series

BEFORE THE AIRPORT



Pictures are courtesy of the Historical Society of Clarendon Vermont

AIRPORT CONSTRUCTION

Begins in 1942

Pictures are courtesy of the Historical Society of Clarendon Vermont

RUTLAND AIRPORT - 1946

GEOLOGY

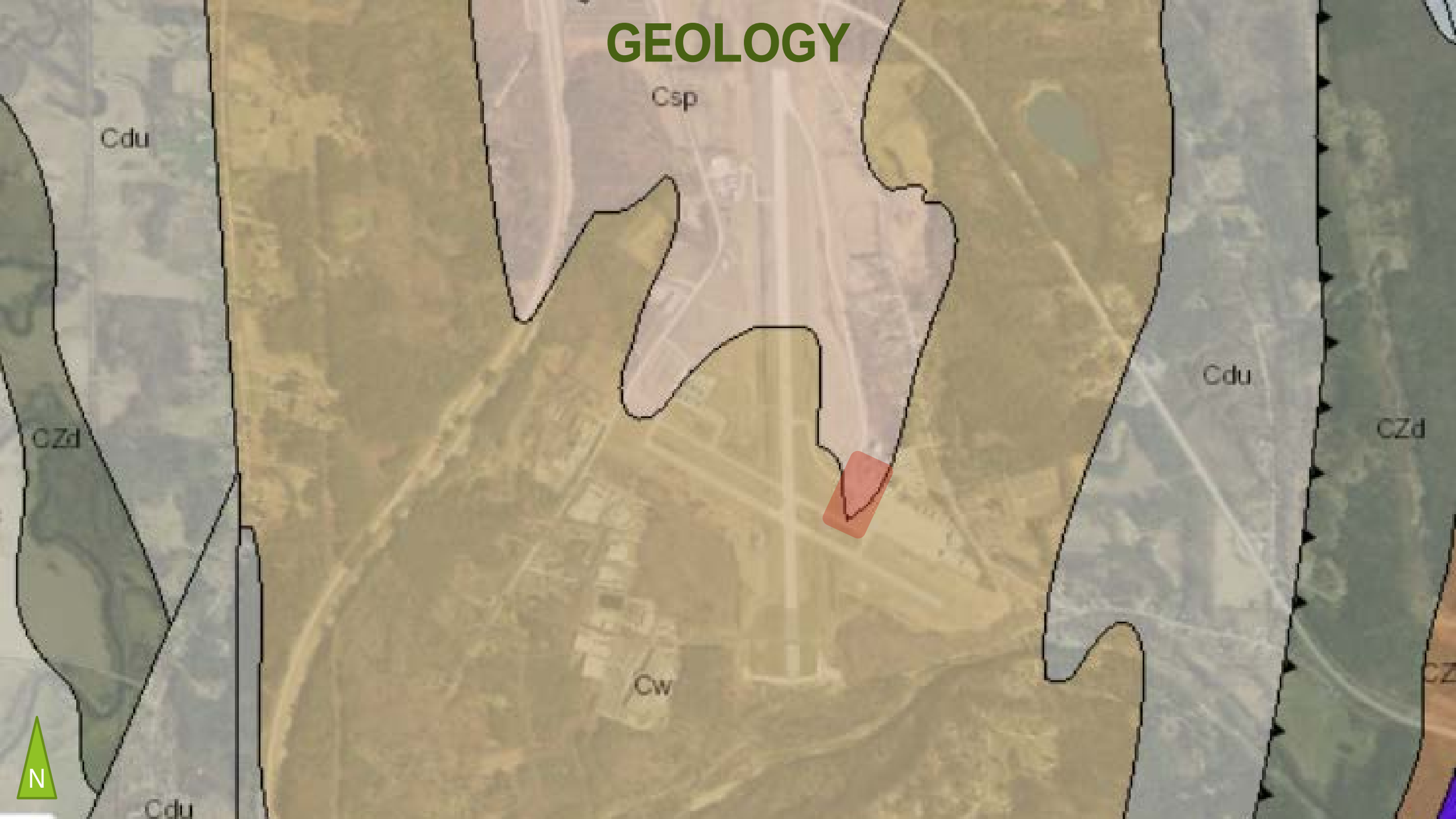
- Bedrock – Two Types:

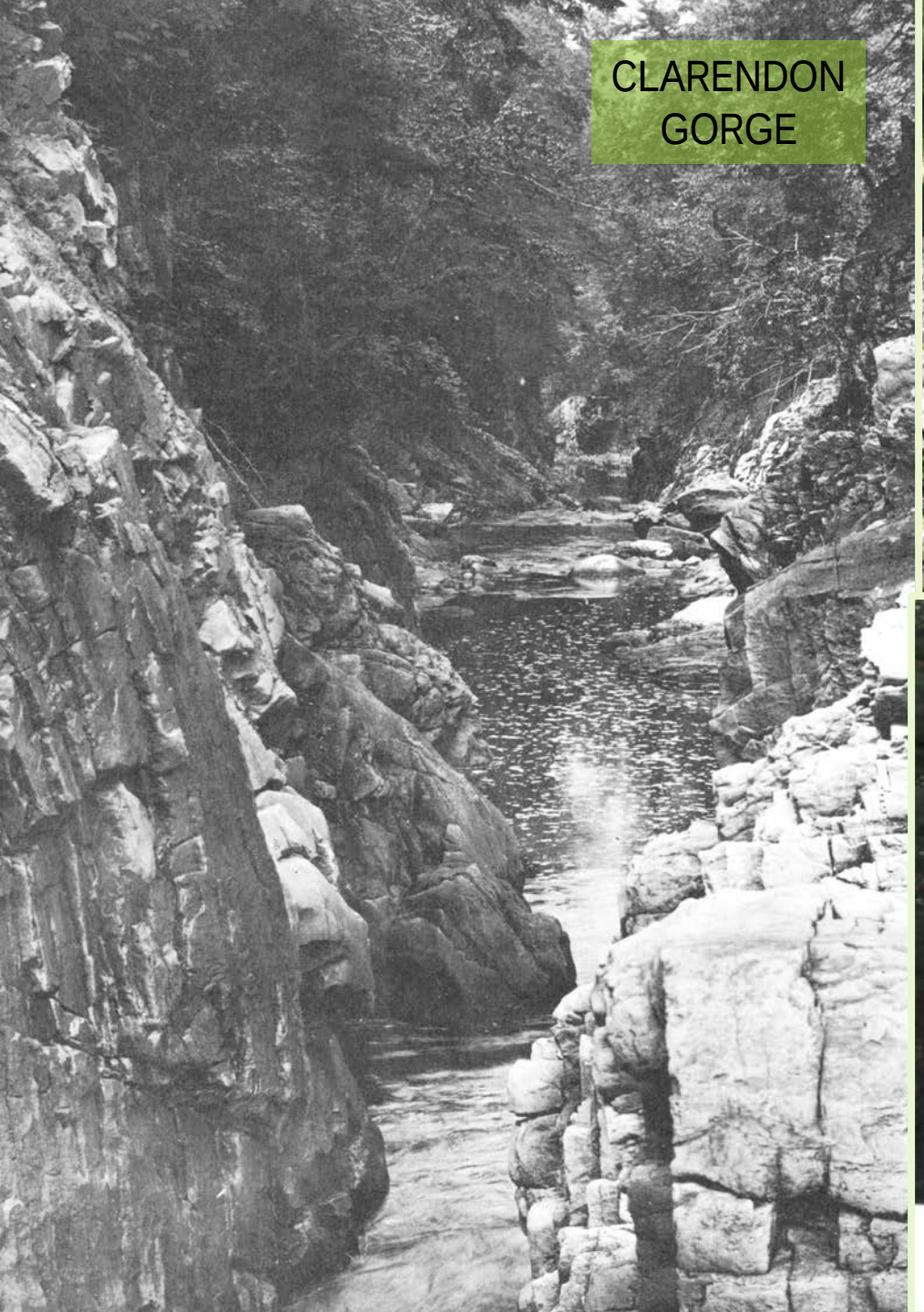
Clarendon Springs Formation (Upper Cambrian)—Steel-gray-weathering, light-gray, massive calcitic dolostone grading upward into darker, more fissile calcitic dolostone containing white quartz knots near top; unit locally brecciated. Locally contains light-bluish-gray to whitish-gray calcite marble (Cspl) within dolostone and beneath the calcitic marbles of the overlying Shelburne Marble

Winooski Dolostone (Middle Cambrian)—Well-bedded dolostone weathering beige, cream, and buff, with green, red, or gray phyllite, siliceous partings, and thin beds of blue-quartz-pebble conglomerate and quartzite

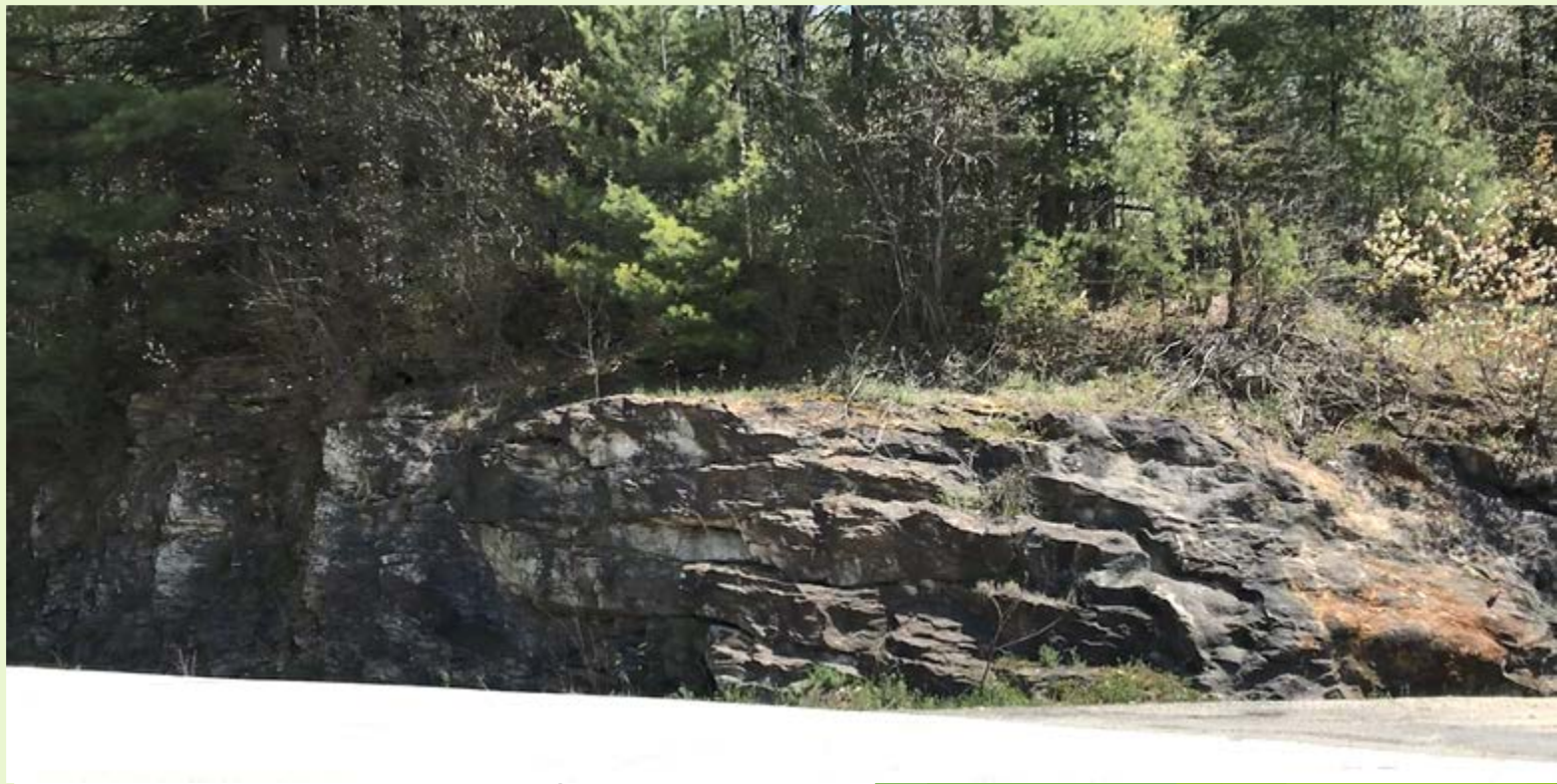
- Surficial Geology:
  - Recessional moraine deposits on most of the site
  - Kame moraine deposits with sand deposits and ice contact outwash gravel in the eastern part of the site

GEOLOGY




CLARENDON
GORGE


BEDROCK
OUTCROPS

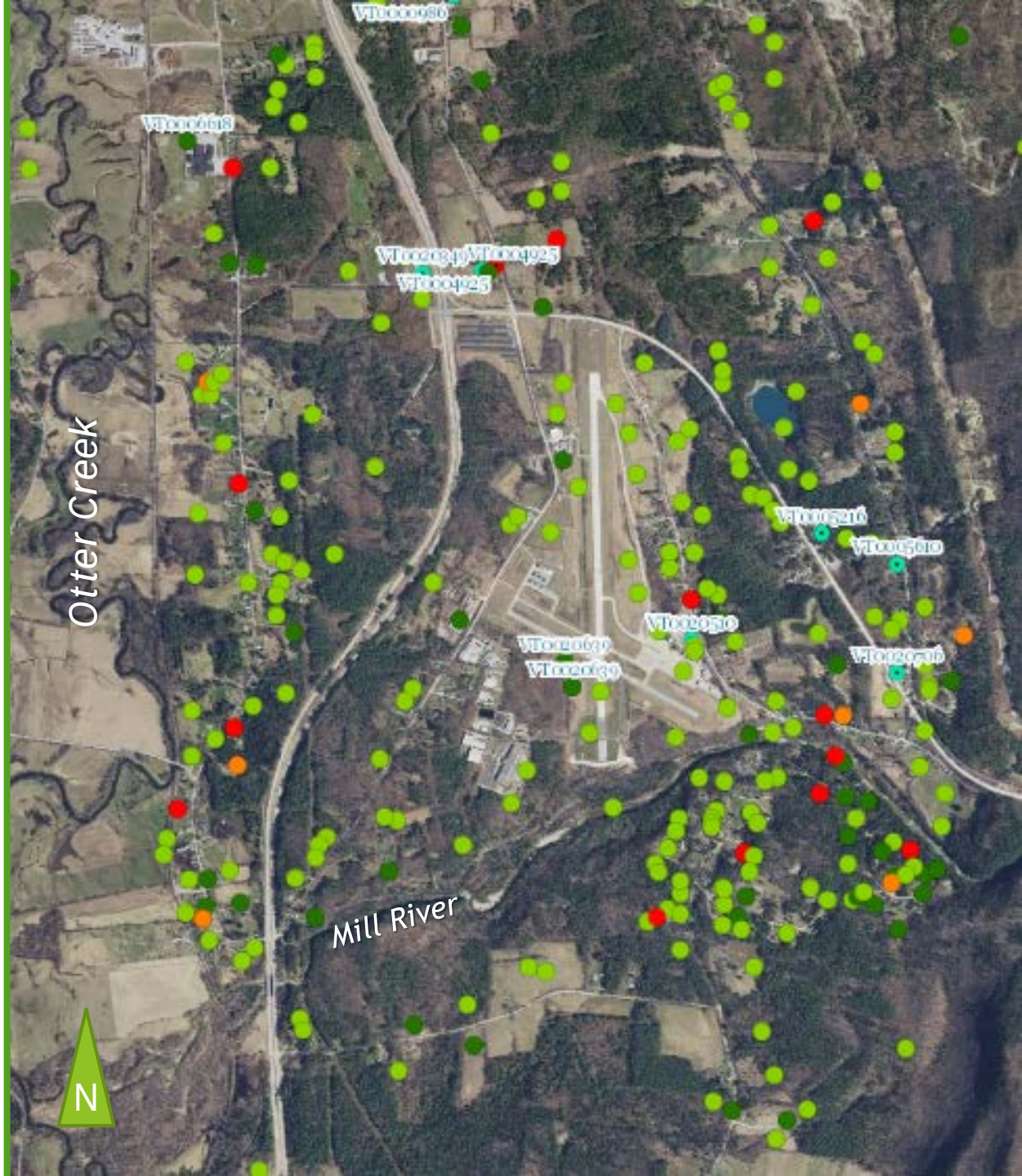


DRINKING WATER WELLS NEAR THE AIRPORT

- Within 1/4-mile of airport:
  - **83+ Private Wells**
  - 5 Public Wells (3 at airport)
  - 2 Source Protection Areas*

    *both located on airport property

- Within 1-mile of airport:
  - **253+ Private Wells**
  - 9 Public Wells
  - 3 Source Protection Areas



WHEN DID THE AIRPORT START USING AFFF?

Before the August 6, 1986 Crash & Fire

- Learjet took off from the wrong runway (too short)
- Plane went thru fence at end of the runway and came to rest in a field on the other side of Route 7B
- The plane was carrying 1,000lbs of Jet Fuel
- **Fire broke out and was extinguished with AFFF**
- According to fire officials the plane was covered in AFFF throughout the salvage operation as well

LEARJET 55

AUGUST 7, 1986
RUTLAND HERALD ARTICLE

The fuel tank in the right wing apparently burned, Lloyd said. Firefighters covered the plane with foam and water to prevent explosions and further fire from two remaining intact fuel tanks, he said. The plane was carrying about 1,000 pounds of aviation fuel, he said.

Foam covers all that remained of the Lear 55 jet that went off the runway at Rutland State Airport Wednesday. The plane came to rest in a field off old Route 7 and then burst into flames.

(Photos by Stephen Baumann)

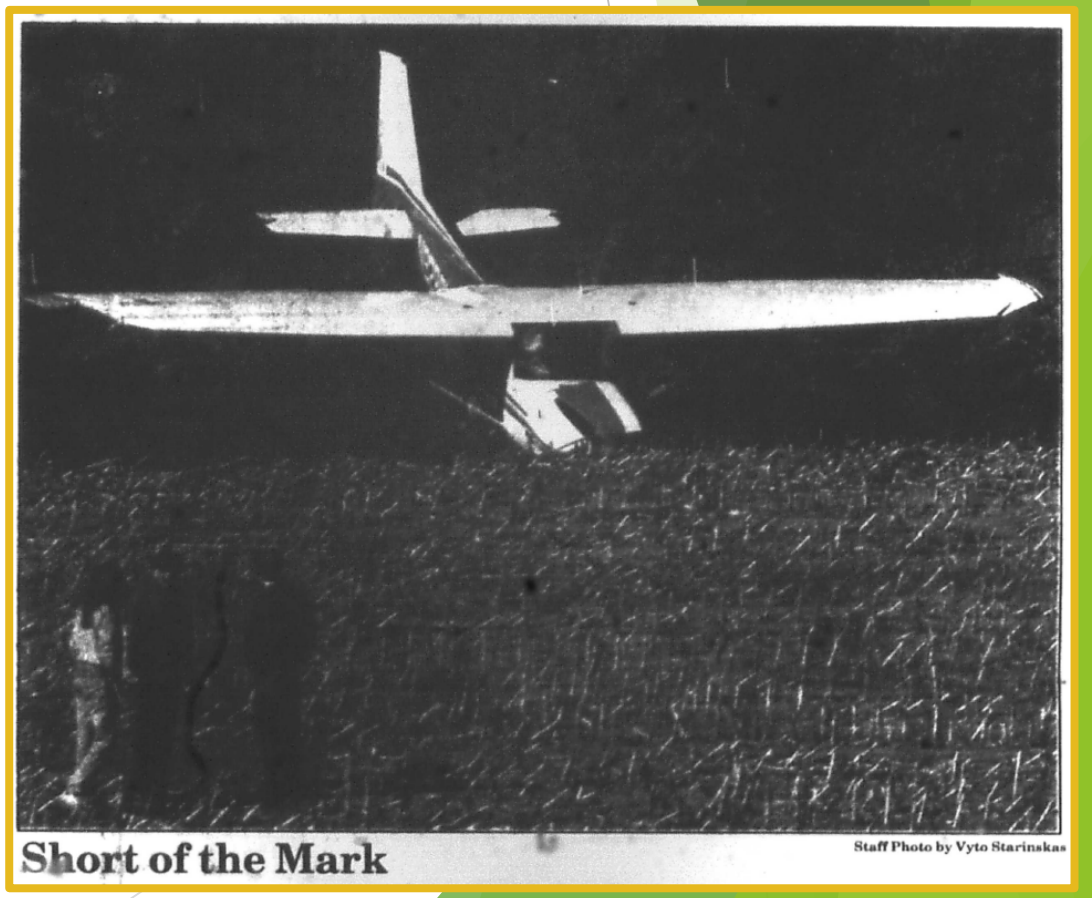
Rutland area firemen spray foam on a Lear 55 jet that burned at Rutland State Airport Wednesday after it went off the end of the wrong runway. The passengers in the jet, which is owned by Federal Paperboard, were able to escape the plane before it was engulfed in flames.

AVIATION ACCIDENT RESEARCH

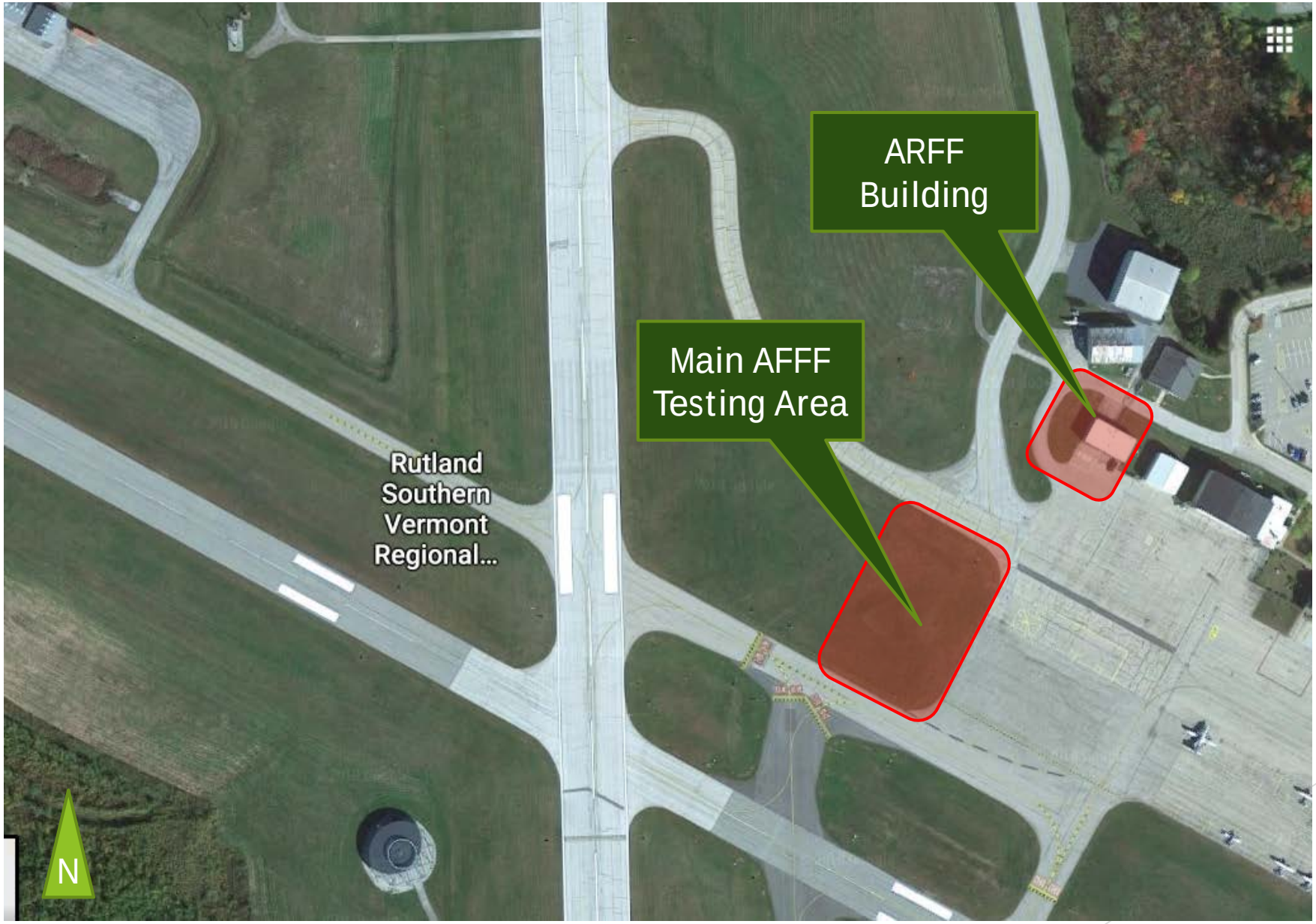
- Review NTSB Aviation Accident Database

  https://www.ntsb.gov/_layouts/ntsb.aviation/index.aspx

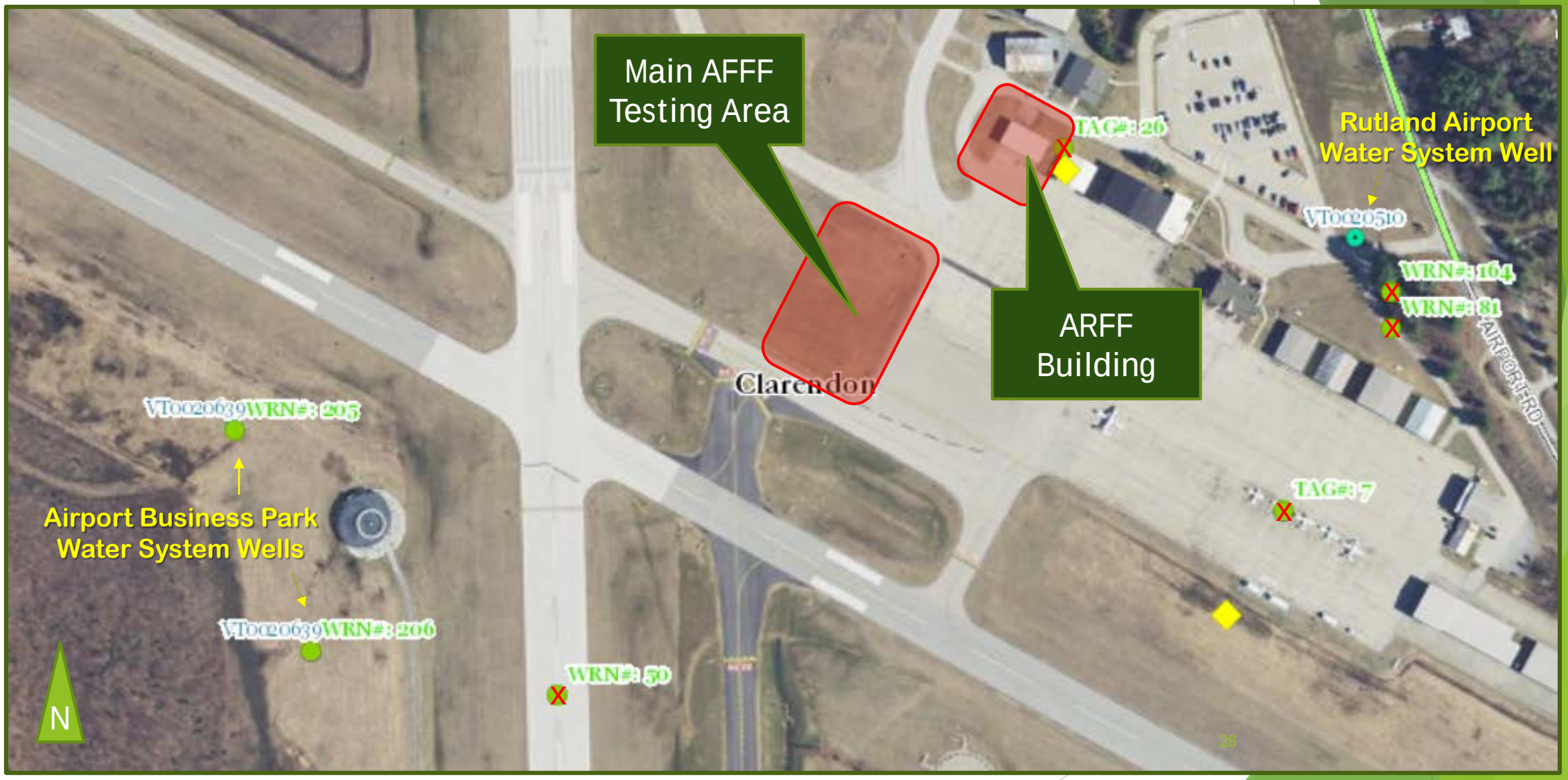
  - Doesn't always pinpoint the exact location of the crash
  - Doesn't specifically indicate if AFFF was applied
- Interview First Responders
- Talk to Airport Employees
- Talk to Residents & Town Officials
- Review Historic Newspapers
- State Police Reports are also available



AIRPORT AFFF OPERATIONS

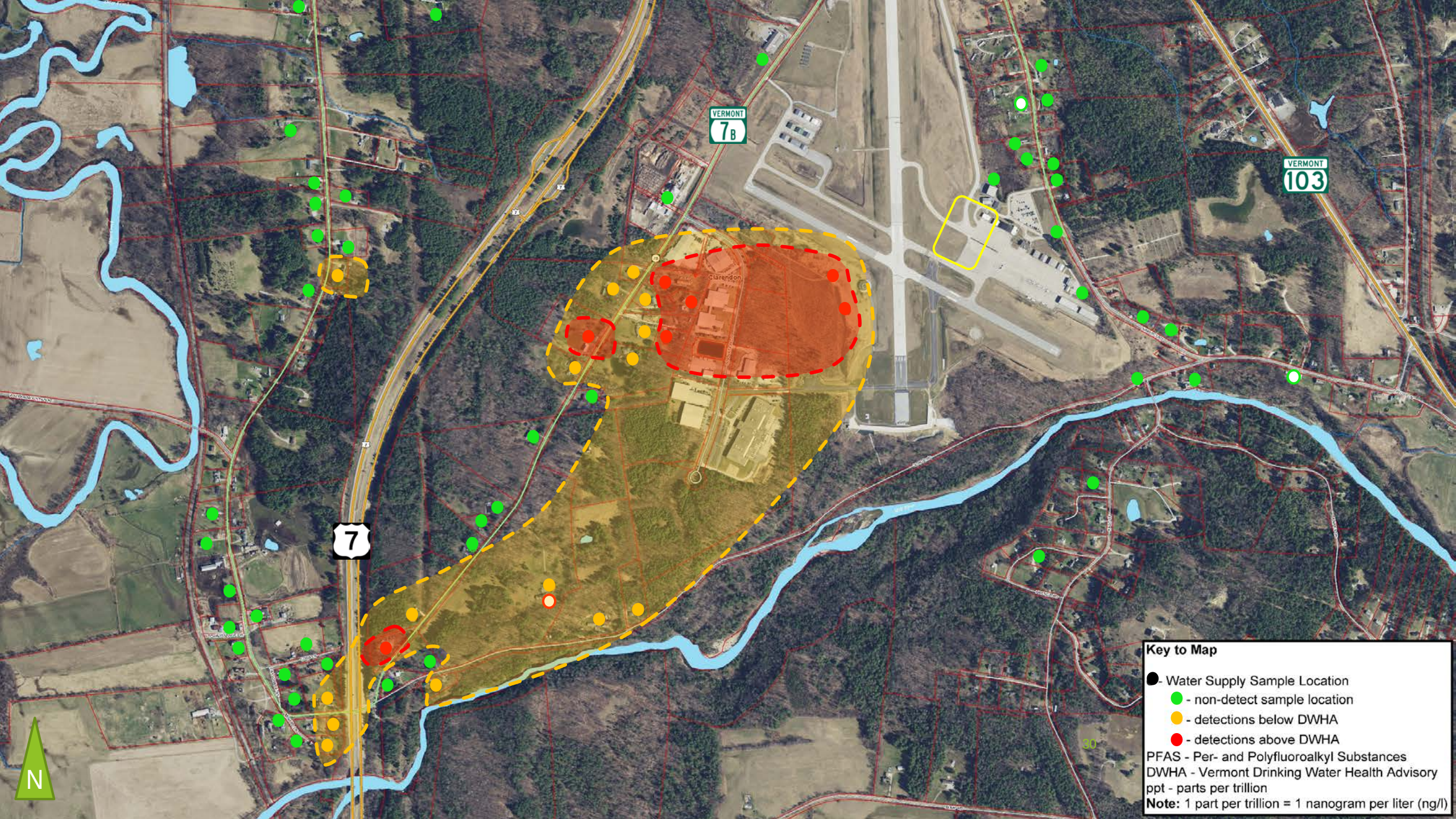


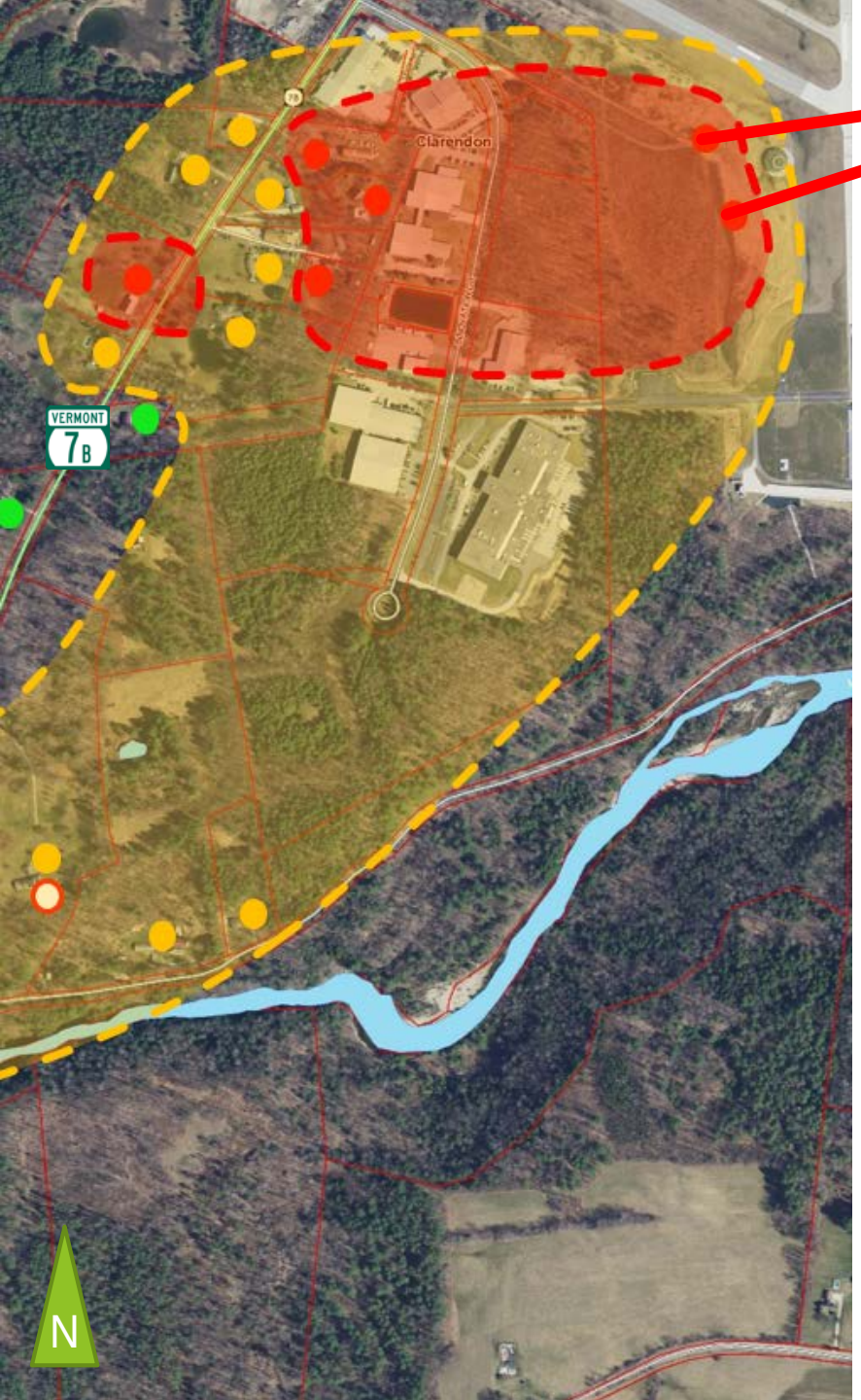
AIRPORT AFFF OPERATIONS



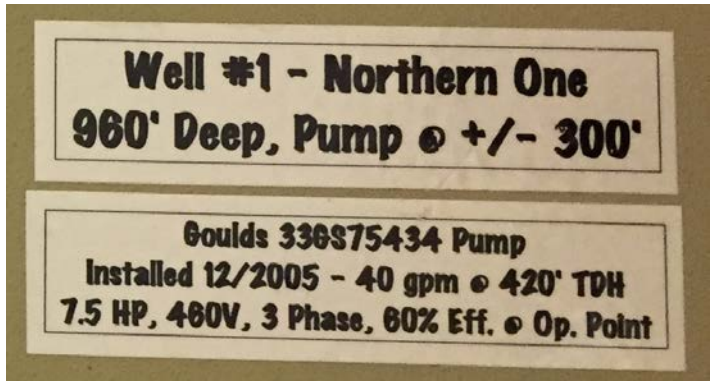
WATER SUPPLY TESTING SUMMARY

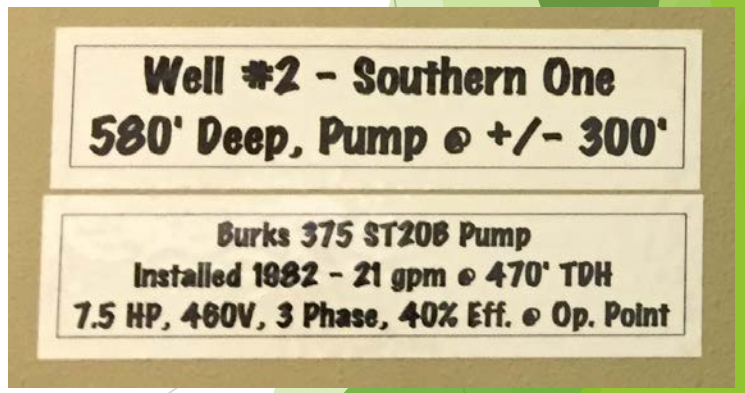
- 77 Bedrock supply wells sampled
- PFAS detections in 25 wells
- 4 Springs sampled; 2 with PFAS > VGES
- Treatment systems installed on 8 bedrock supply wells
  - 5 Residential Point of Entry Treatment (POET) Systems
  - 1 Agricultural POET
  - Airport Business Park Water Treatment System (2 wells)
- Furthest wells with detections are 1-½ miles southwest of the Airport


VERMONT
7B
VERMONT
103
7
Clarendon
N
Key to Map
- Water Supply Sample Location
- non-detect sample location
- detections below DWHA
- detections above DWHA
PFAS - Per- and Polyfluoroalkyl Substances
DWHA - Vermont Drinking Water Health Advisory
ppt - parts per trillion
Note: 1 part per trillion = 1 nanogram per liter (ng/l)



Business Park Water System Wells March 2018	Well #1 (ng/L)	Well #2 (ng/L)
Perfluoroheptanoic Acid (PFHpA)	**19**	**28**
Perfluorooctanoic Acid (PFOA)	**16**	**17**
Perfluorononanoic Acid (PFNA)	**1.8**	**2.7**
Perfluorobutanesulfonic Acid (PFBS)	14	ND<1.8
Perfluorohexane Sulfonic Acid (PFHxS)	**140**	**4.5**
Perfluorooctane Sulfonic Acid (PFOS)	**26**	**6.1**
Perfluorohexanoic Acid (PFHxA)	45	83
TOTAL PFAS INCLUDED IN DWHA *	**202.8**	**46.8**





* **NOTE:** As of the date of this presentation (March 7, 2019), the Vermont Drinking Water Health Advisory (DWHA) is 20 parts per trillion (ppt) for the sum of PFHpA, PFOA, PFNA, PFHxS, and PFOS.

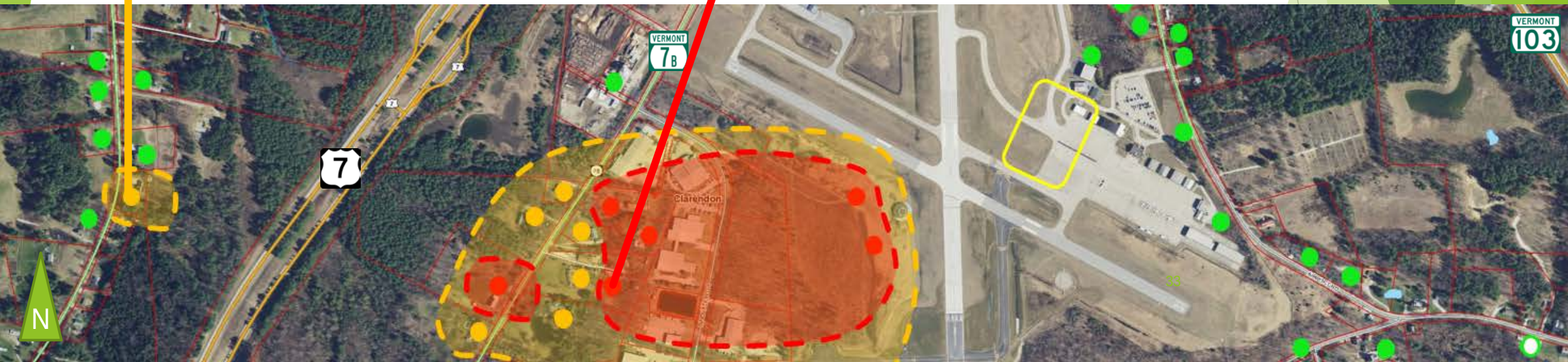
AIRPORT BUSINESS PARK WATER SYSTEM

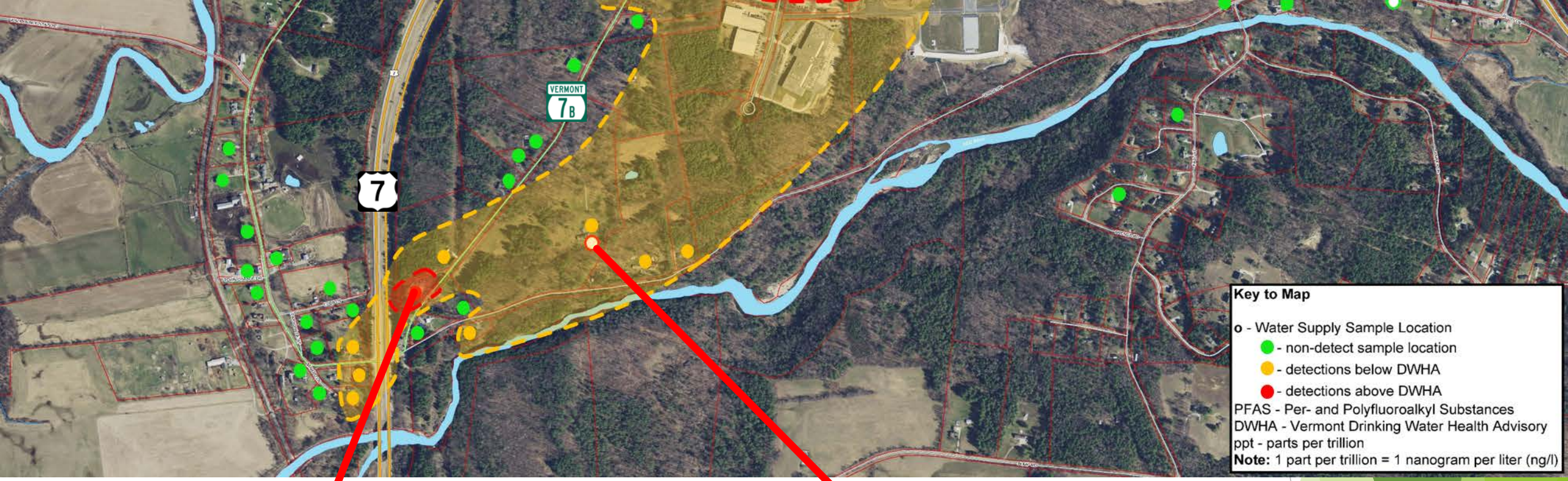
- PFAS Contamination Discovered in March 2018
- Bottled water and water totes provided to businesses and industries in the park
- Engineered treatment system constructed
  - Average Daily Demand = approx. 3,000 gal/day
  - Granulated Activated Carbon-based system
  - 4-48”x72” vessels that contain 54ft^3 of GAC
- ‘Do Not Drink’ Order lifted on **Sept. 1, 2018**

SELECT RESIDENTIAL SUPPLY WELL RESULTS

Bedrock Supply Well	Concentration
Perfluorobutanoic Acid (PFBA)	3.2 ng/L

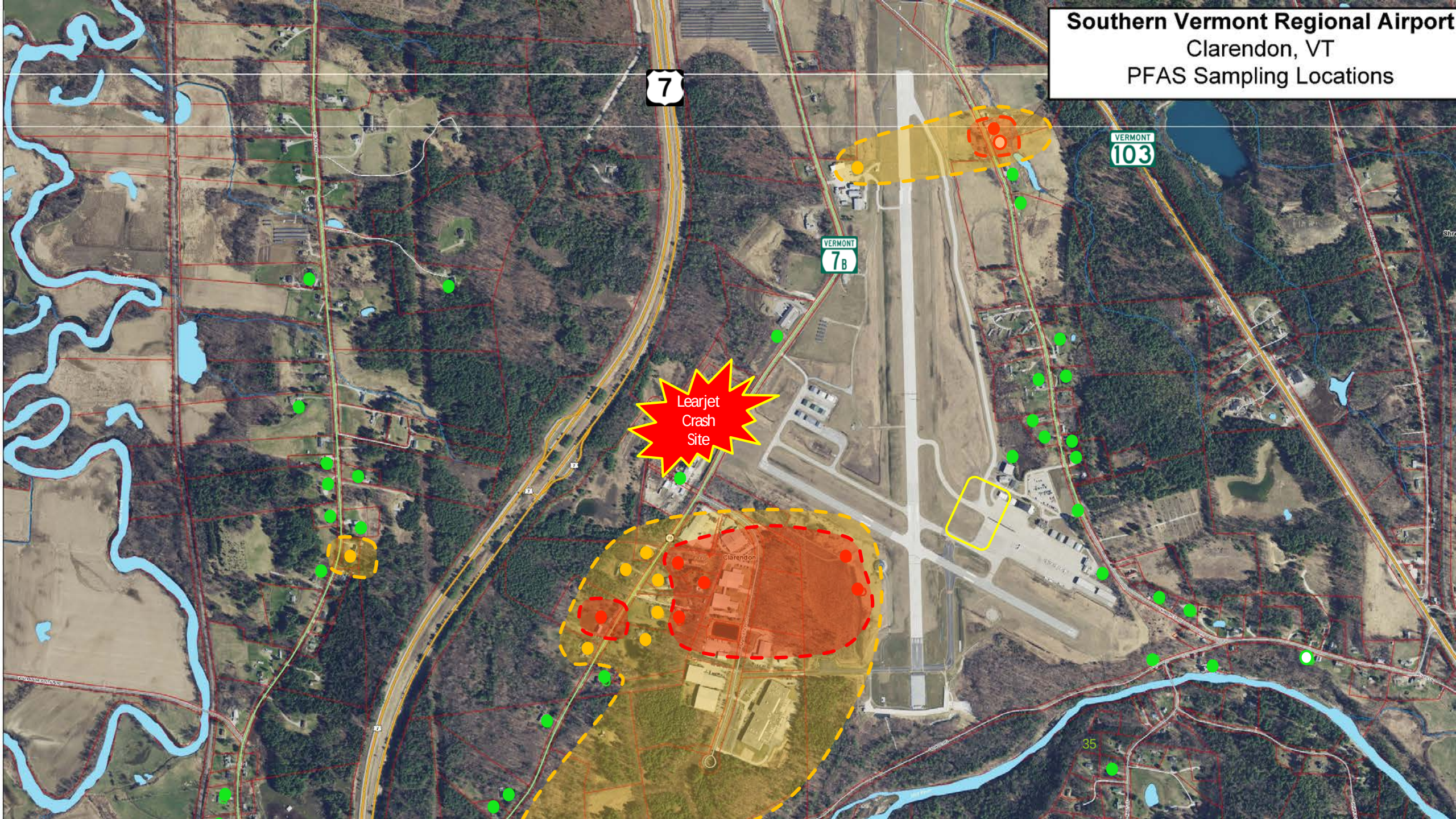
Bedrock Supply Well – 165ft Deep	Concentration
Perfluorobutanoic Acid (PFBA)	22 ng/L
Perfluorooctanoic Acid (PFOA)	16 ng/L
Perfluoropentanoic Acid (PFPeA)	79 ng/L
Perfluorohexane Sulfonic Acid (PFHxS)	3.6 ng/L
Perfluorohexanoic Acid (PFHxA)	45 ng/L
Perfluorooctane Sulfonic Acid (PFOS)	7.1 ng/L
Perfluorononanoic Acid (PFNA)	4.5 ng/L
Perfluoroheptanoic Acid (PFHpA)	28 ng/L
TOTAL PFAS INCLUDED IN DWHA	59.2 ng/L





Bedrock Supply Well – Depth Unknown	Concentration
Perfluoroheptanoic Acid (PFHpA)	2.4 ng/L
Perfluorooctanoic Acid (PFOA)	6.3 ng/L
Perfluoropentanoic Acid (PFPeA)	4.4 ng/L
Perfluorohexane Sulfonic Acid (PFHxS)	2.4 ng/L
Perfluorohexanoic Acid (PFHxA)	3.7 ng/L
Perfluorooctane Sulfonic Acid (PFOS)	12 ng/L
TOTAL PFAS INCLUDED IN DWHA	24.4 ng/L

Spring	Concentration
Perfluoroheptanoic Acid (PFHpA)	19 ng/L
Perfluorooctanoic Acid (PFOA)	3.8 ng/L
Perfluorohexane Sulfonic Acid (PFHxS)	4.5 ng/L
Perfluorohexanoic Acid (PFHxA)	61 ng/L
Perfluorooctane Sulfonic Acid (PFOS)	2.5 ng/L
TOTAL PFAS INCLUDED IN DWHA	29.8 ng/L


Southern Vermont Regional Airport
Clarendon, VT
PFAS Sampling Locations
7
VERMONT
103
VERMONT
7B
Learjet
Crash
Site
Clarendon
35

JUNE 2002: TWO PLANE CRASHES IN ONE MONTH!

Plane crash in Clarendon

Photo by Albert J. Marro

Clarendon firefighters spray foam on the wings of an airplane that went off the runway while landing Saturday at Rutland State Airport in North Clarendon. The plane went down an embankment and flipped onto its roof. The pilot, a Charlotte woman, said gusting winds caused her trouble as she was landing. She was shaken up, but not injured. *Story, Page D1.*

Crash: Plane destroyed

Continued from Page B1

The $65,000 plane was destroyed in the crash and leaked "considerable fuel," police said. Clarendon and Wallingford firefighters sprayed foam to minimize the chance of the fuel igniting.

On June 1, a Charlotte woman's plane went off the runway and down an embankment while landing at the airport. It flipped onto its roof. The woman, who was shaken up but not hurt, told authorities that high winds were a factor in that accident.

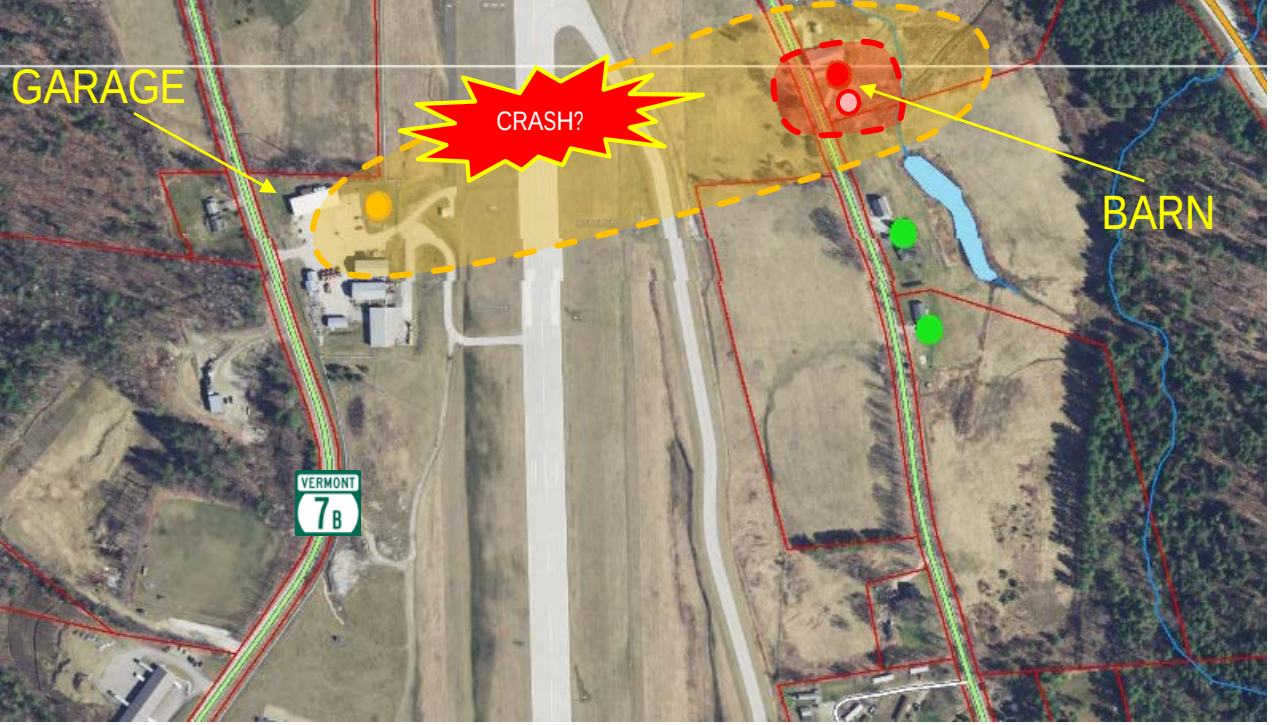
Both of these crashes did not have fires as a result of the crash

AFFF was applied as a precaution

Exact locations of these crashes were difficult to find through research*

Local fire departments could apply non-military spec foam on crashes

Articles from the Rutland Herald



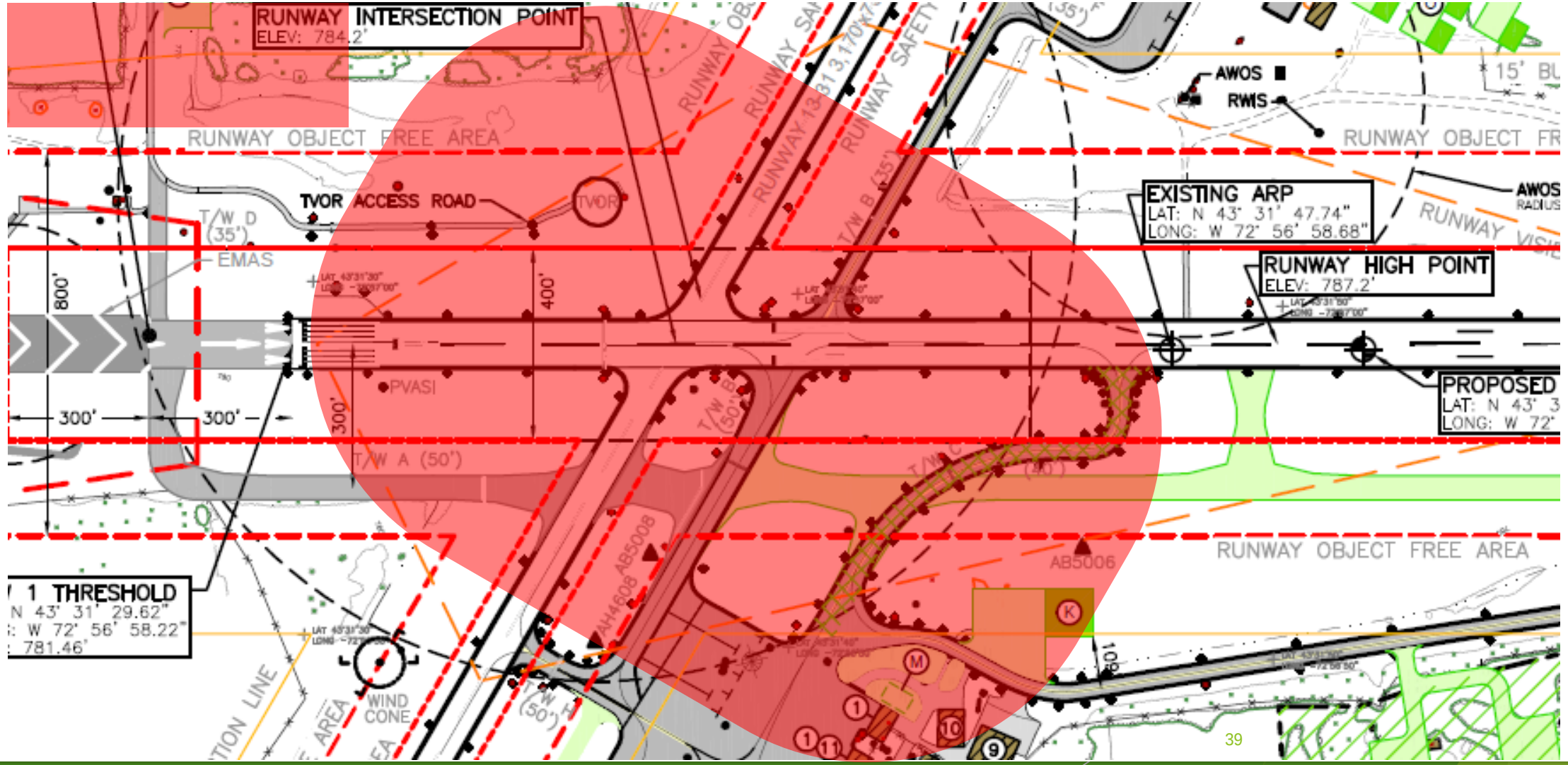
Garage Bedrock Supply Well (445ft)	Concentration
Perfluorobutanoic Acid (PFBA)	6.0 ng/L
Perfluorooctanoic Acid (PFOA)	**3.0 ng/L**
Perfluoropentanoic Acid (PFPeA)	2.1 ng/L
Perfluorohexane Sulfonic Acid (PFHxS)	**4.3 ng/L**
Perfluorohexanoic Acid (PFHxA)	1.9 ng/L
Perfluorooctane Sulfonic Acid (PFOS)	**2.0 ng/L**
TOTAL PFAS INCLUDED IN DWHA	**9.3 ng/L**

Spring at Barn	Concentration
Perfluoroheptanoic Acid (PFHpA)	**120 ng/L**
Perfluorooctanoic Acid (PFOA)	**70 ng/L**
Perfluorohexane Sulfonic Acid (PFHxS)	**3.8 ng/L**
Perfluorohexanoic Acid (PFHxA)	140 ng/L
Perfluorononanoic Acid (PFNA)	**8.6 ng/L**
Perfluorobutane Sulfonic Acid (PFBS)	1.7 ng/L
TOTAL PFAS INCLUDED IN DWHA	**202.4 ng/L**

Barn Bedrock Supply Well (480ft)	Concentration
Perfluoroheptanoic Acid (PFHpA)	**30 ng/L**
Perfluorooctanoic Acid (PFOA)	**13 ng/L**
Perfluorohexane Sulfonic Acid (PFHxS)	**3.8 ng/L**
Perfluorohexanoic Acid (PFHxA)	38 ng/L
TOTAL PFAS INCLUDED IN DWHA	**46.8 ng/L**

AVIATION ACCIDENT HISTORY MAP

SITE INVESTIGATION CHALLENGES

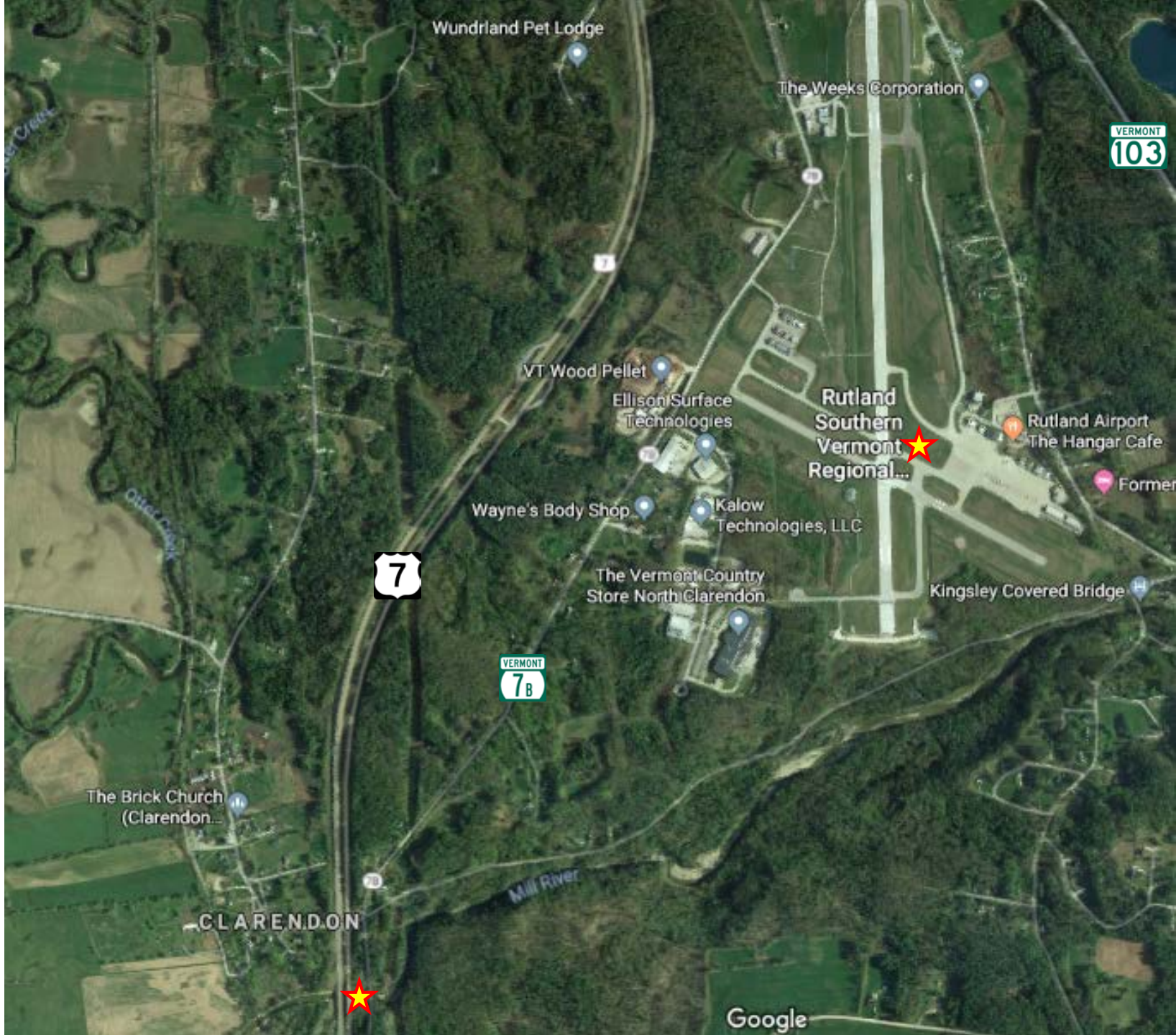


SITE INVESTIGATION CHALLENGES...

OFFSITE SOURCES?

BACKGROUND CONDITIONS?

★ - Soil Sample Location



CONCENTRATIONS OF PFAS IN SURFACE SOILS

Concentrations reported as nanograms per kilogram – ng/kg	Airport Taxiway	Lower Clarendon Gorge State Forest
Perfluorobutanoic acid (PFBA)	ND<270	ND<103.64
Perfluorobutane sulfonic acid (PFBS)	ND<270	ND<6.82
Perfluoropentanoic acid (PFPeA)	ND<210	ND<69.53
Perfluorohexanoic acid (PFHxA)	ND<210	ND<7.81
Perfluorohexane sulfonic acid (PFHxS)	ND<270	**740.54**
Perfluoroheptanoic acid (PFHpA)	ND<270	**197.23**
Perfluoroheptane sulfonic acid (PFHpS)	ND<270	Not Analyzed
Perfluorooctanoic acid (PFOA)	ND<270	**375.02**
Perfluorooctane sulfonic acid (PFOS)	ND<270	**475.84**
Perfluorononanoic acid (PFNA)	ND<270	**105.94**
Perfluorodecanoic acid (PFDA)	ND<270	**37.07**
Perfluorodecanesulfonic acid (PFDS)	ND<270	**28.93**
Perfluoroundecanoic acid (PFUnA)	ND<270	**69.61**
Perfluorododecanoic acid (PFDoA)	ND<270	ND<10.83
Perfluorotridecanoic acid (PFTrDA)	ND<270	ND<13.01
Perfluorooctadecanoic acid (PFODA)	Not Analyzed	**49.37**

ARFF BUILDING GROUNDWATER
MONITORING WELL MW-1S

Analyte	Concentration
Perfluorobutanoic acid (PFBA)	740 ng/L
Perfluorobutane sulfonic acid (PFBS)	9.9 ng/L
Perfluoropentanoic acid (PFPeA)	2,900 ng/L
Perfluoropentane sulfonic acid (PFPeS)	*Not Analyzed*
Perfluorohexanoic acid (PFHxA)	1,700 ng/L
Perfluorohexane sulfonic acid (PFHxS)	460 ng/L
Perfluoroheptanoic acid (PFHpA)	1,100 ng/L
Perfluoroheptane sulfonic acid (PFHpS)	69 ng/L
Perfluorooctanoic acid (PFOA)	340 ng/L
Perfluorooctane sulfonic acid (PFOS)	760 ng/L
Perfluorononanoic acid (PFNA)	6.1 ng/L
Perfluorodecanoic acid (PFDA)	ND
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	1,200 ng/L

MAIN FIRE TESTING AREA

MONITORING WELL MW-3S

Analyte	Concentration
Perfluorobutanoic acid (PFBA)	1,200 ng/L
Perfluorobutane sulfonic acid (PFBS)	3.3 ng/L
Perfluoropentanoic acid (PFPeA)	4,300 ng/L
Perfluoropentane sulfonic acid (PFPeS)	*Not Analyzed*
Perfluorohexanoic acid (PFHxA)	2,500 ng/L
Perfluorohexane sulfonic acid (PFHxS)	41 ng/L
Perfluoroheptanoic acid (PFHpA)	1,200 ng/L
Perfluoroheptane sulfonic acid (PFHpS)	2.3 ng/L
Perfluorooctanoic acid (PFOA)	500 ng/L
Perfluorooctane sulfonic acid (PFOS)	6.6 ng/L
Perfluorononanoic acid (PFNA)	73 ng/L
Perfluorodecanoic acid (PFDA)	ND
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	1,100 ng/L

NEXT STEPS

- Assess the potential for additional contributing sources
- Investigate stormwater discharge areas
- Investigate additional foam testing area
- Install additional groundwater monitoring wells
- Surface water sampling
- Bedrock Geologic Mapping
- Surficial Geologic Mapping
- Geophysical Logging of Bedrock Wells
- Groundwater and Surface Water Chemistry Studies

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Photo courtesy of the Vermont Department of Fish & Wildlife