Regulatory Perspective:
Solid Waste Management Program

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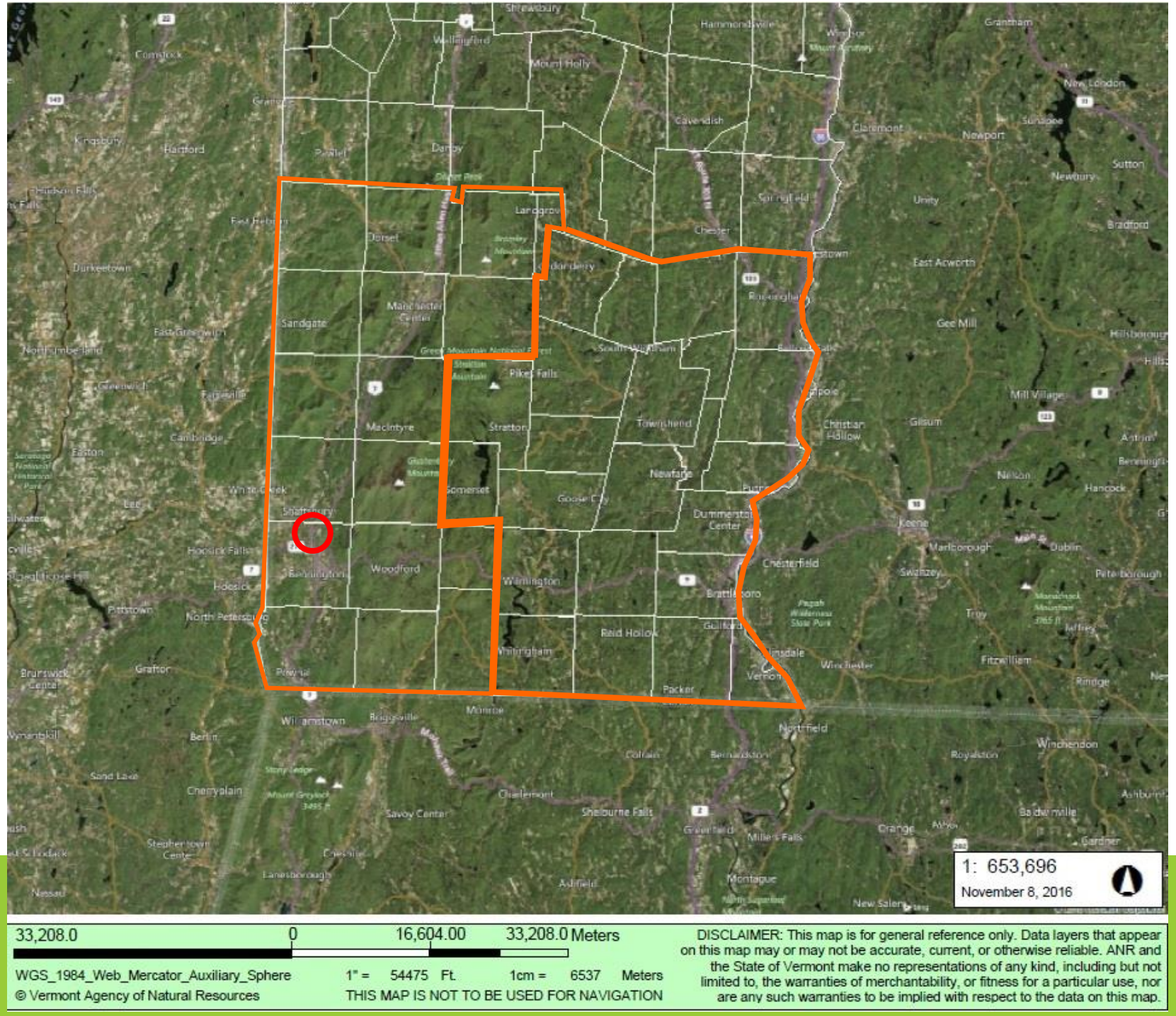


- N. Bennington
  - Former Chemfab facility
  - Bennington Landfill
  - Burgess Landfill

PFAS Sampling

Adopted: December 2016

20 ppt for the sum of PFOA and PFOS

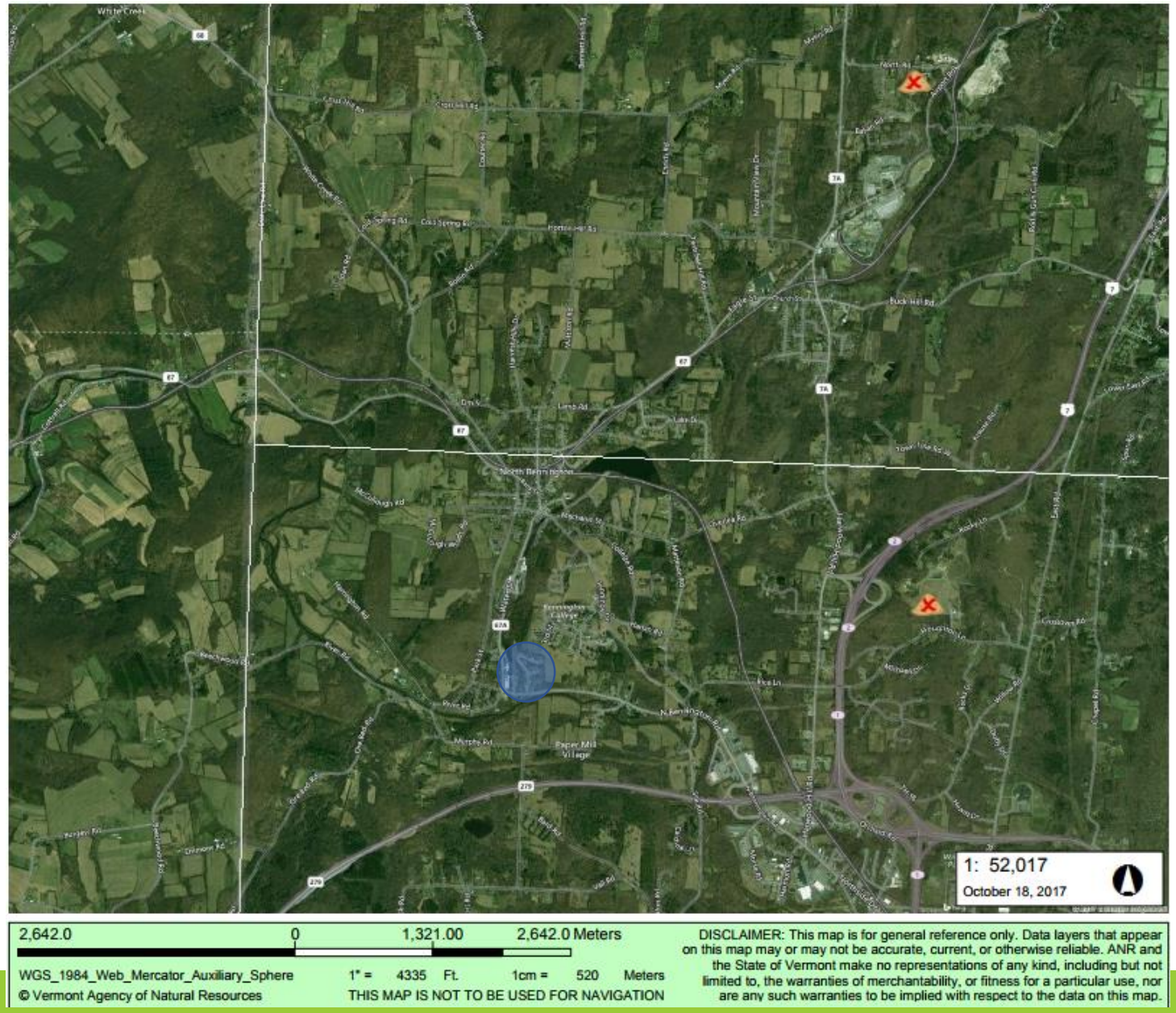
TABLE 1
Primary Groundwater Quality Standards

Substance	Enforcement Standard (micrograms per liter (=ppb), except as noted)	Preventive Action Level** (micrograms per liter (=ppb), except as noted)
Nitrites	1000.0	500.0
Ortho-phenylphenol	18.0	9.0
Oxamyl	200.0	100.0
Paclobtrazol	455.0	45.5
Paraquat	30.0	3.0
Perfluorooctanesulfonic acid (PFOS) ***	0.02	0.01
Perfluorooctanoic acid (PFOA)***	0.02	0.01
Pendimethalin	280.0	140.0

Groundwater Protection Rule and Strategy

§7-203

(cc) Sludges from wastewater treatment facilities, collected leachate from solid waste management facilities, and residuals from the treatment of drinking water that contain perfluorooctanoic acid, perfluorooctanesulfonic acid or a material containing perfluorooctanoic acid or perfluorooctanesulfonic acid and when those remediation wastes are disposed in accordance with a corrective action plan or disposal plan approved by the Secretary.

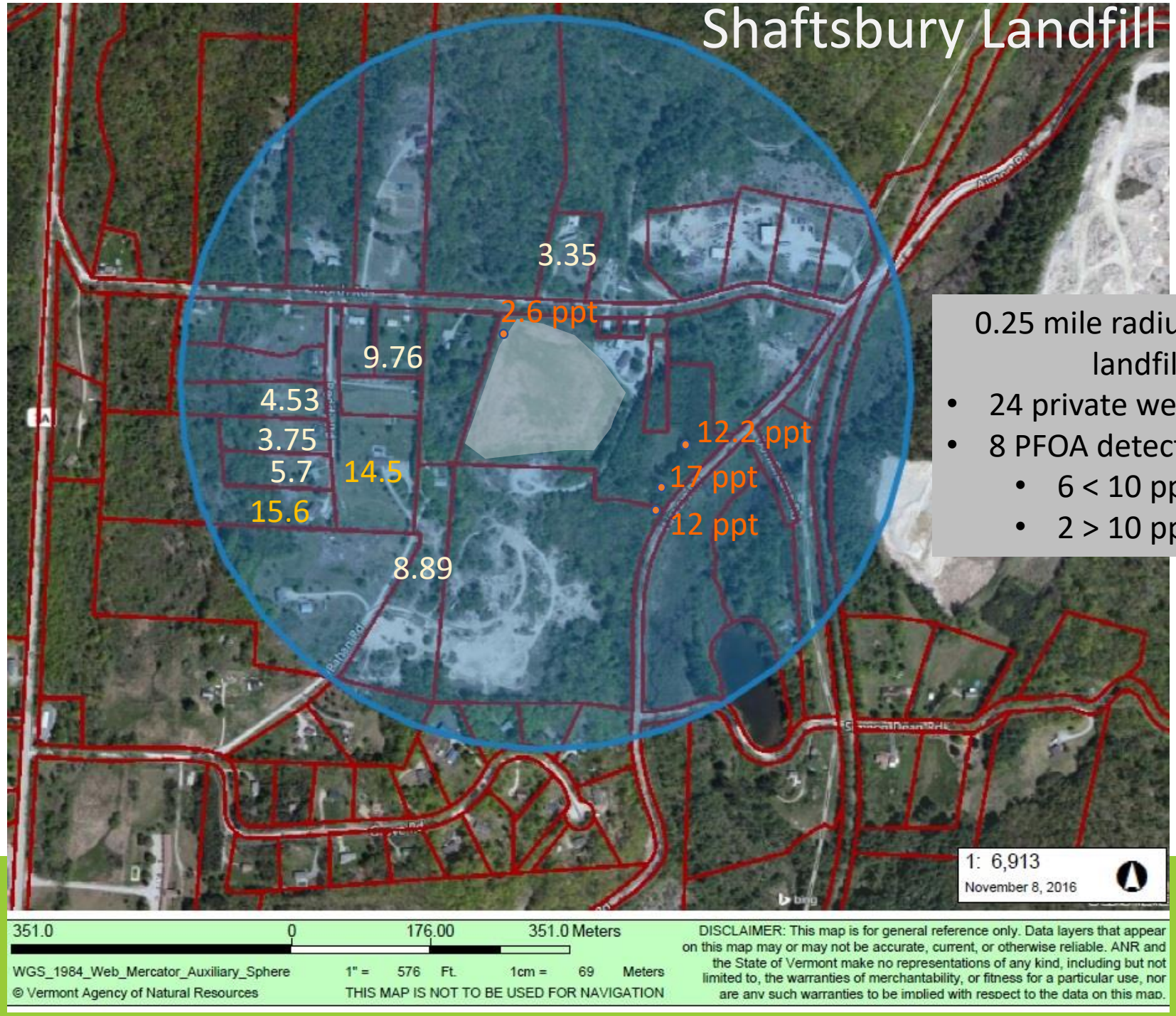


Shaftsbury Landfill

- In operation 1967 – 2006
- Historic gas issues, and some groundwater contamination concerns
- Three downgradient monitoring wells
- Initial detection of 25 ppt PFOA

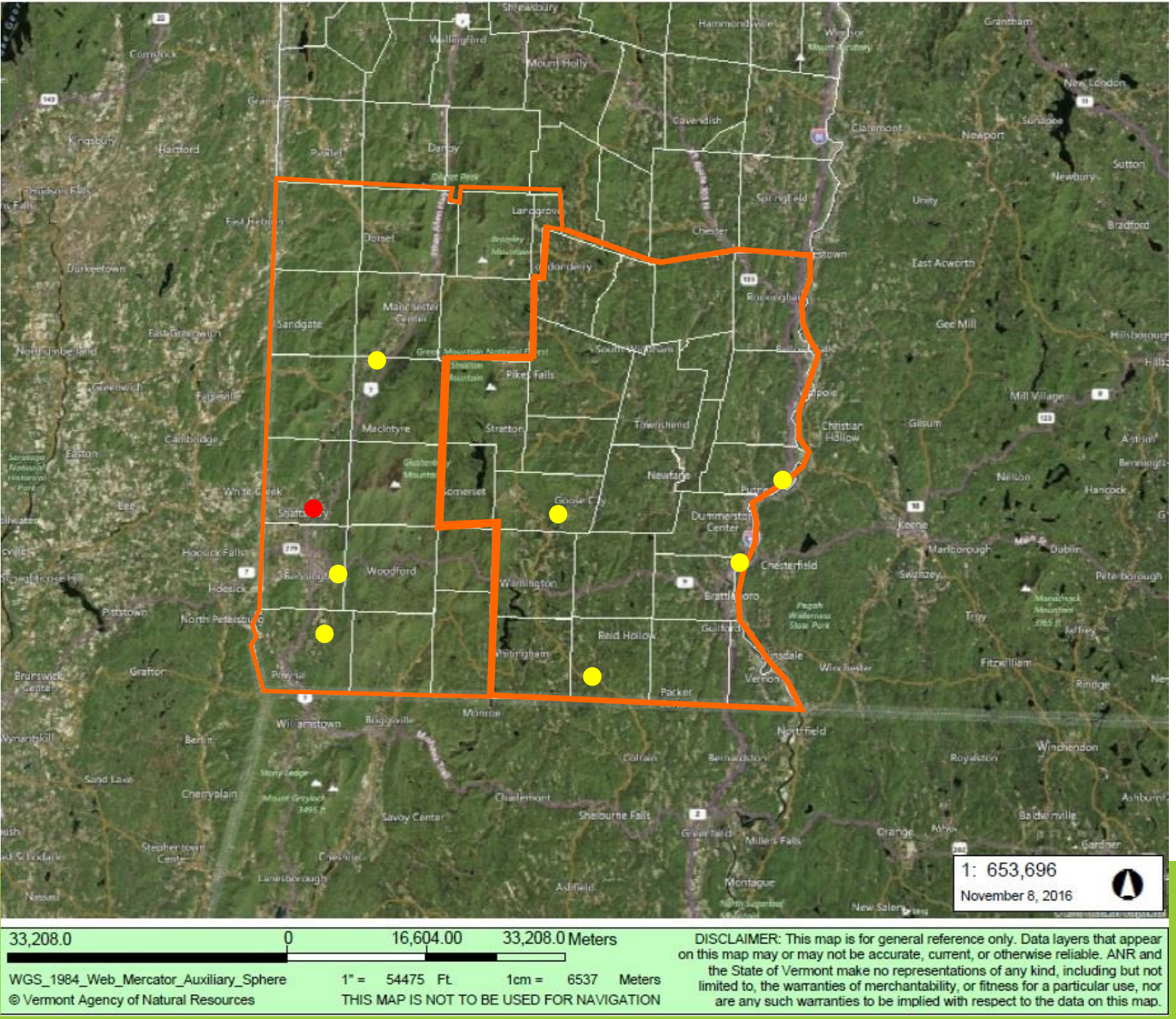
Closed Landfill Sampling

Shaftsbury Landfill



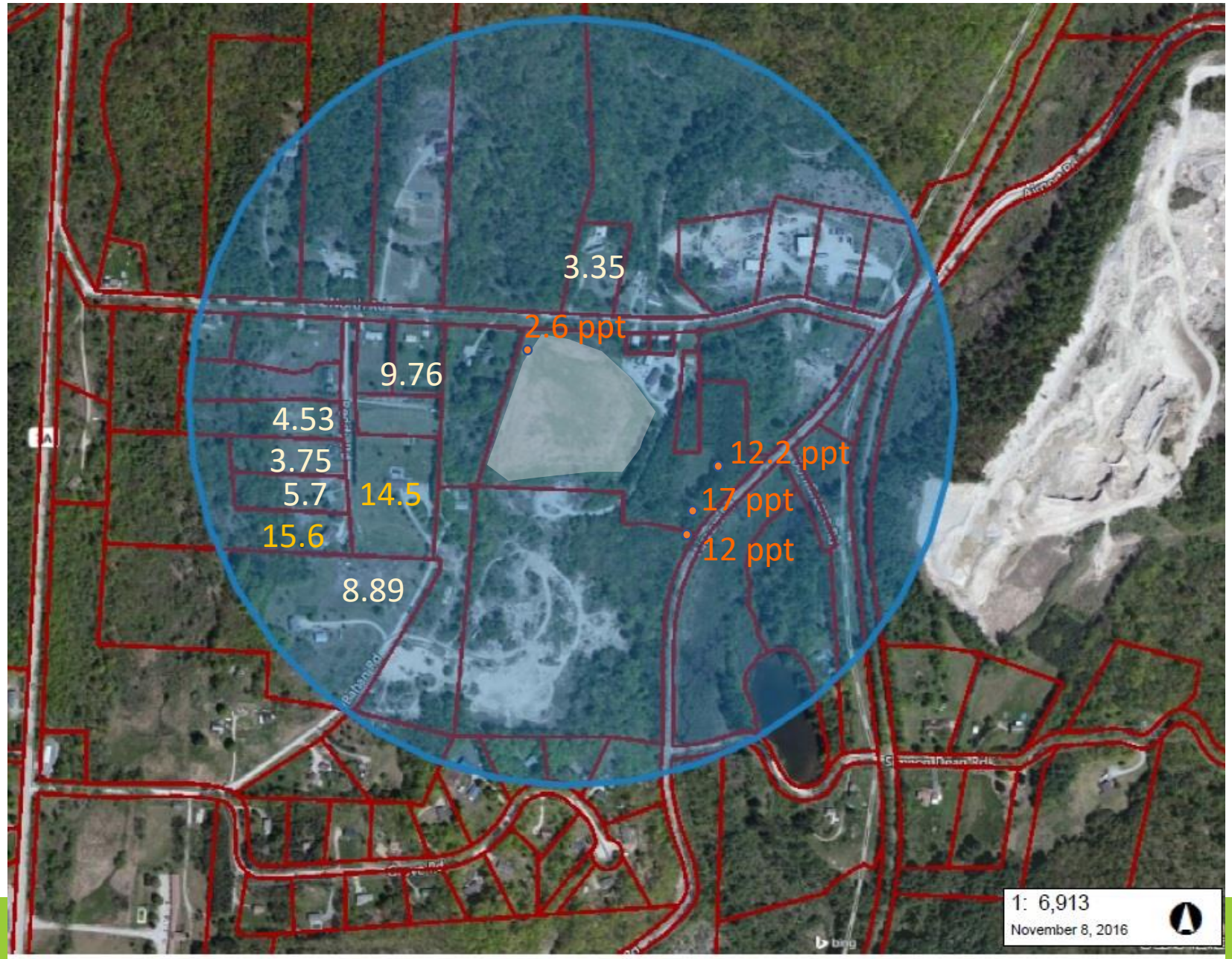
0.25 mile radius around landfill

- 24 private wells sampled
- 8 PFOA detections
  - 6 < 10 ppt
  - 2 > 10 ppt



- Bennington and Windham Counties
- 8 closed landfills
- 4 of 8 resulted in >20 ppt detections

Expanded Sampling



351.0 0 176.00 351.0 Meters

WGS_1984_Web_Mercator_Auxiliary_Sphere 1" = 576 Ft. 1cm = 69 Meters

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Shaftsbury Landfill

MW: 25 → 17 → 11.7 ppt
Supply Well: 15.6 → 15.1 ppt

2017 Results

Halifax Landfill

MW-3

October 2016	11.5 PFOA 16.7 PFOS
May 2017	78.2 PFOA 32.1 PFOS

MW-4

October 2016	4.8 PFOA

2017 Results

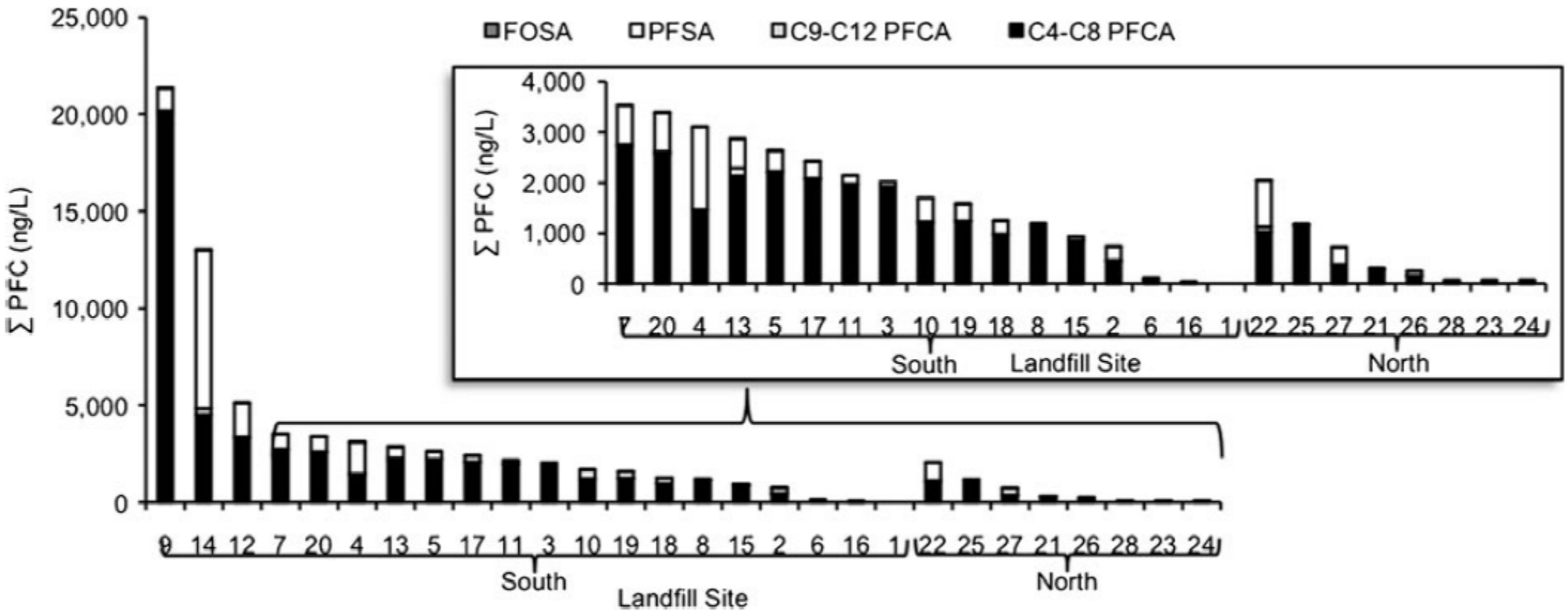


Fig. 2 Total PFC concentrations in landfill leachate across Canada. The *bars* represent the sum of the four sub-groups of PFCs

Li et al., Water, Air and Soil Pollution 223 (2012) 3365-3372

Landfill Leachate

Table 4
Ranges and mean concentration of individual PFCs in landfill leachate in this study compared with literature data in ng/L[a]

	(3M, 2001) ($n = 3$)	(Woldegiorgis et al., 2008) ($n = 4$)	(Kallenborn et al., 2004) ($n = 6$)	(Bossi et al., 2008) ($n = 2$)	This study ($n = 20$)
PFBS	NA	<0.5–110 (37.3)	5.64–112 (51.5)	NA	<0.39–1356 (220)
PFHxS	NA	12–1800 (518)	12.4–143 (77.0)	<0.2–3.1 (0.8)	<0.24–178 (22.2)
PFOS	<25–52.7 (17.7)	32–1500 (565)	32.8–187 (82.5)	<1.5–3.8 (1.1)	0.01–235 (30.9)
PFDS	NA	<1–0.28 (0.07)	NA	NA	ND
PFBA	NA	<12–30 (7.5)	NA	NA	<3.36–2968 (458)
PFHxA	NA	<7–310 (77.5)	26.4–697 (228)	NA	<0.37–2509 (234)
PFHpA	NA	<20–260 (197.5)	NA	NA	<0.12–280 (48.1)
PFOA	ND–48.1 (16.9)	38–1000 (537)	92.4–516 (293)	<2–5.8 (2.9)	<0.40–926 (145)
PFNA	NA	<18–100 (43.5)	4.7–61.5 (34.8)	<0.8	<3.63–80.1 (7.29)
PFDA	NA	<20–220 (82.5)	NA	<1.6	<0.21–55.1 (5.98)
PFUnA	NA	<59	NA	<2.2	<0.11–2.98 (0.36)
PFOSA	NA	<2–7 (2.75)	NQ–3.28 (1.17)	<0.3	<0.15–14.0 (2.77)

[a] NA = not analysed. ND = not detected. <x = below the respective method quantification limit (MQL).

Busch et al., Environmental Pollution 158 (2010) 1467-1471

Landfill Leachate

PFAS analyte:	Column 2:	Column 3:	Column 4:
	Landfill Leachate concentration requiring no restrictions	Landfill Leachate concentration which may require restrictions	Landfill Leachate concentration requiring pretreatment
PFOA	0.120 mg/L	0.120 mg/L to 1.2 mg/L	>1.2 mg/L
PFOS	0.001 mg/L	0.001 mg/L to 0.010 mg/L	>0.010 mg/L

Landfill Leachate Discharge Guideline Levels

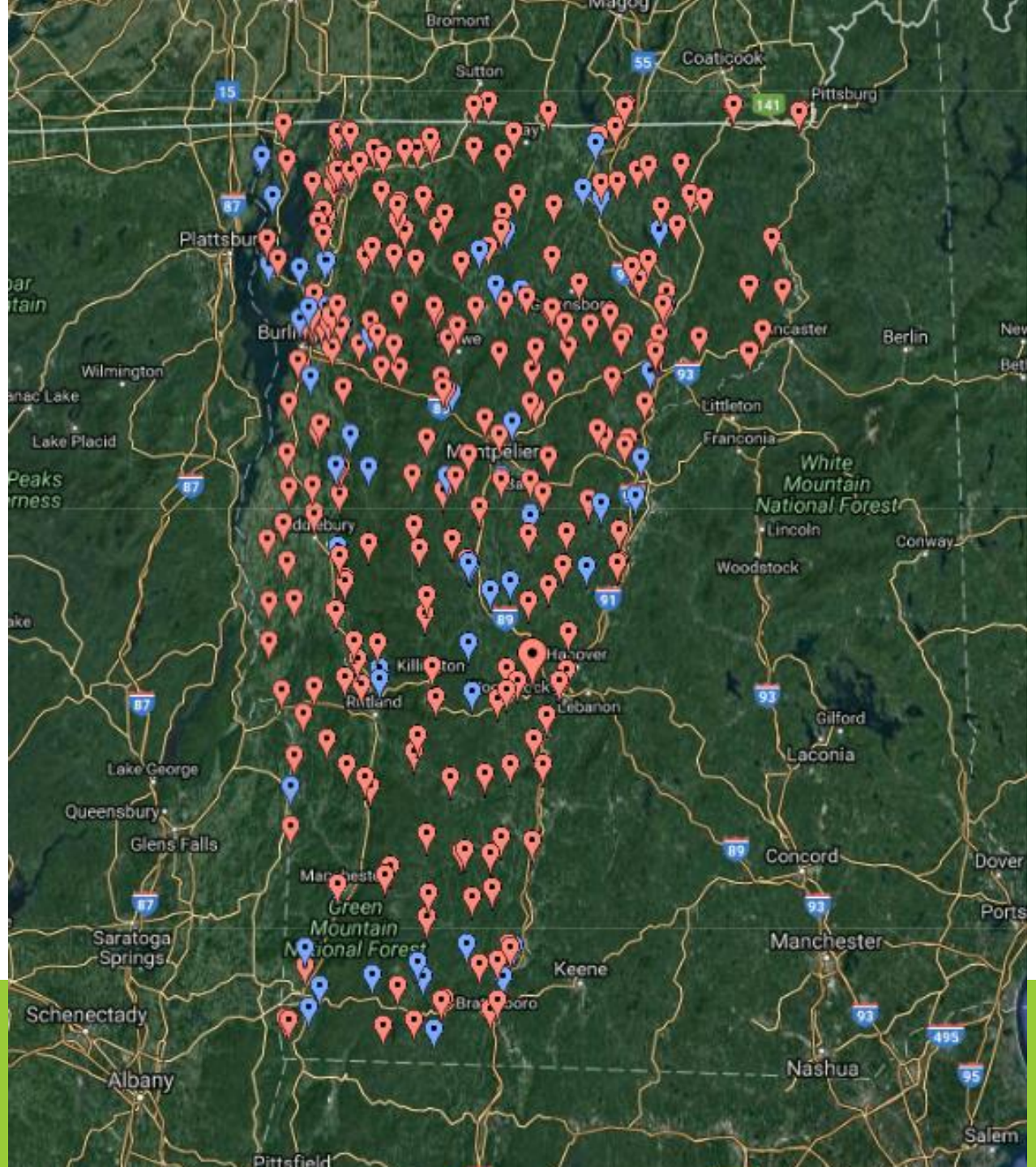
Table 3. Calculated RWC for PFOS and PFOA at Five WWTFs Using the "No Restrictions" Guideline Concentrations of 120,000 ng/L-PFOA and 1,000 ng/L-PFOS.

WWTF	Daily Max. Leachate (GPD)	Receiving Water	LMM CFS	Calculated RWC from leachate meeting the 'no restrictions' guideline concentrations	
				PFOA 0.12 mg/L	PFOS 0.001 mg/L
Montpelier	23,000	Winooski R.	190	24 ng/L	0.2 ng/L
Burlington North	23,000	Winooski R.	494	9.6 ng/L	0.08 ng/L
Essex Junction	30,000	Winooski R.	470	12 ng/L	0.1 ng/L
Barre	7,000	Stevens Branch	37	24 ng/L	0.2 ng/L
Newport City	15,000	Clyde River	101	22.8 ng/L	0.19 ng/L
Human Health Criteria				720 ng/L	6 ng/L

- 5 landfills actively collect and manage leachate at a wastewater treatment plant

- Disposal plans will need to be established in the advent of PFOA/PFOS concentrations exceeding the leachate guideline values requiring no restrictions

Landfill Leachate



- Landfill leachate analysis and management
- Expansion of closed landfill sampling and analysis

Continuing Work

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Questions?