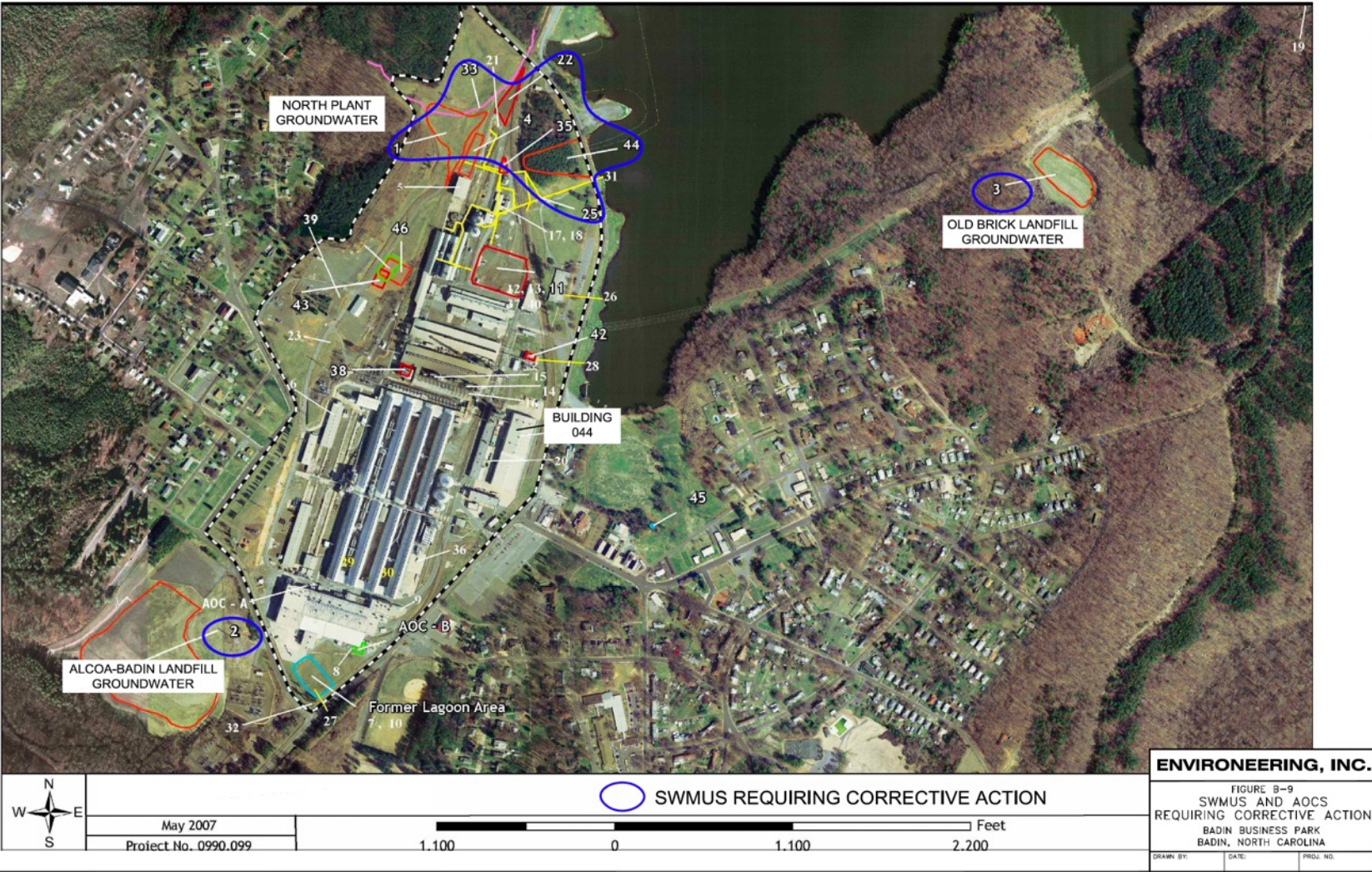


# Public Meeting on Remedial Activities at Badin Business Park

Tuesday November 19, 2019  
Stanly County Commissioners Meeting Room

Presentation by Anna Wade and Sam Olson, Duke  
Environmental Law & Policy Clinic

# Solid Waste Management Unit (SWMUs) Requiring Corrective Action



# Hazardous Waste Management

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CERCLA



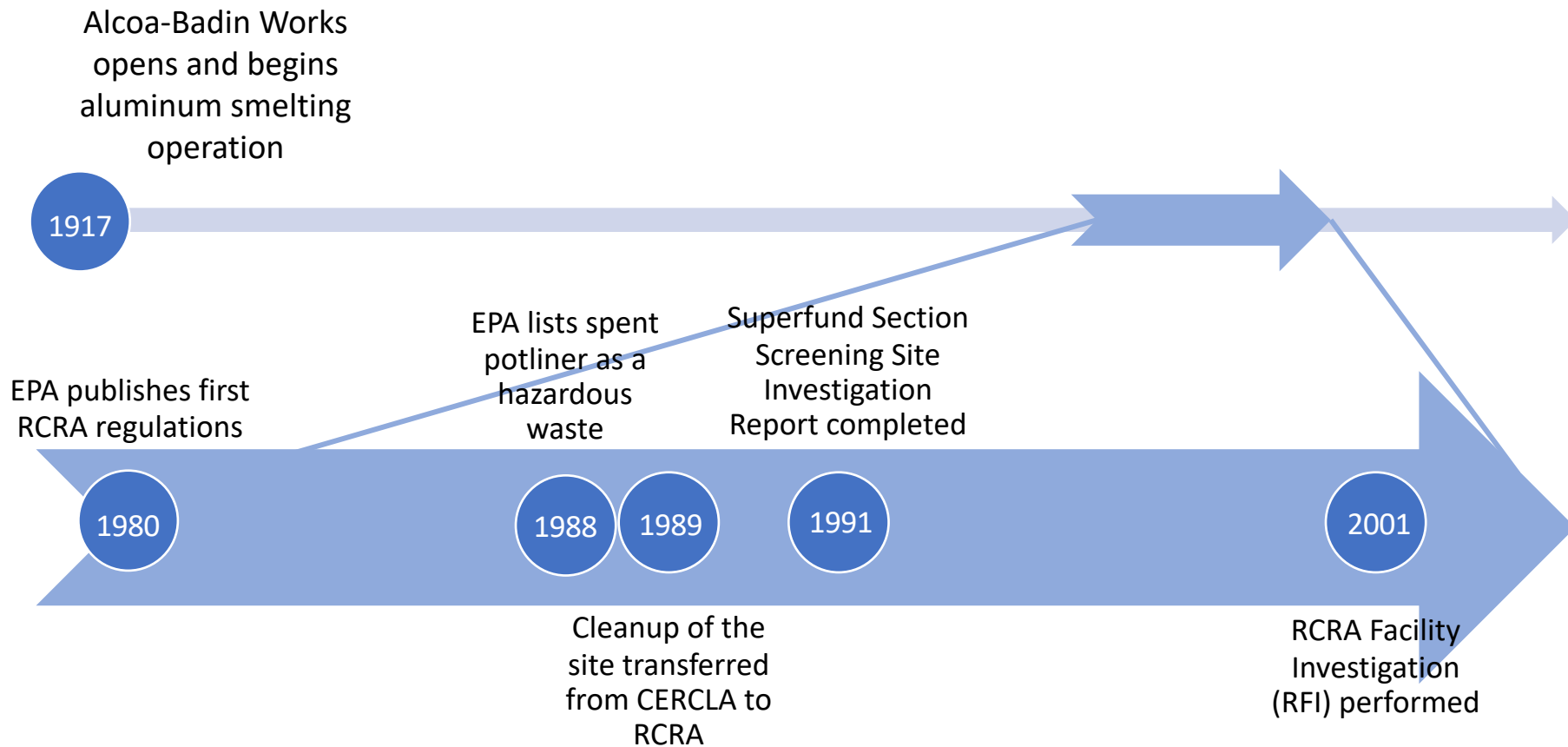
RCRA



State Laws  
&  
Regulations



# Timeline of Hazardous Waste Management in Badin



# Timeline of Hazardous Waste Management in Badin

Alcoa-Badin Works  
opens and begins  
aluminum smelting  
operation

1917

2001

RCRA Facility  
Investigation  
(RFI)  
performed

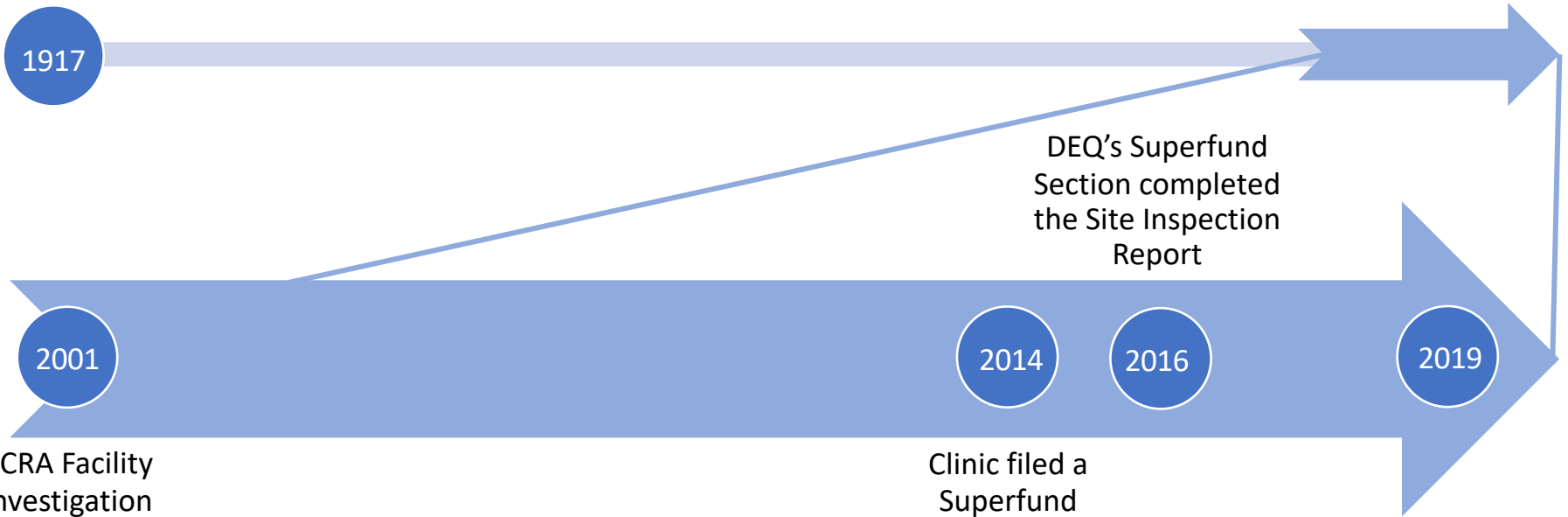
2014

Clinic filed a  
Superfund  
petition with  
EPA Region 4

2016

DEQ's Superfund  
Section completed  
the Site Inspection  
Report

2019



# Corrective Action Phases

RCRA Facility Investigation (RFI)  
performed in 2001

Phase 1: Update  
of site geological  
and hydrological  
model and  
establishment of  
remedial  
objectives

Completed  
2010

Phase 2:  
Identification of  
potential  
treatment  
technologies

Completed  
2009

Phase 3:  
Engineering Data  
Collection Work  
Plan

Completed  
2012

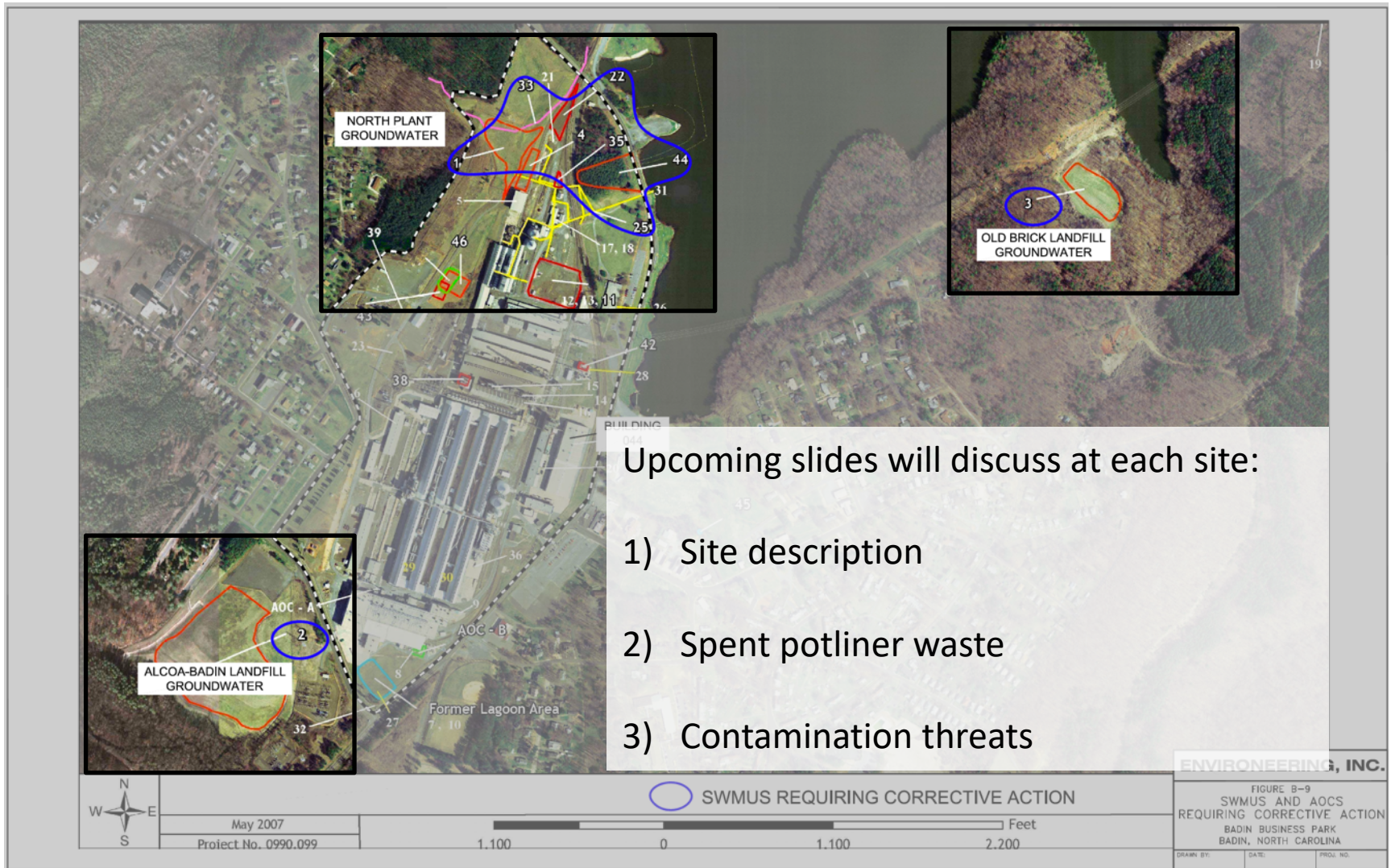
Phase 4: Refine  
Corrective  
Measures  
Alternatives

?

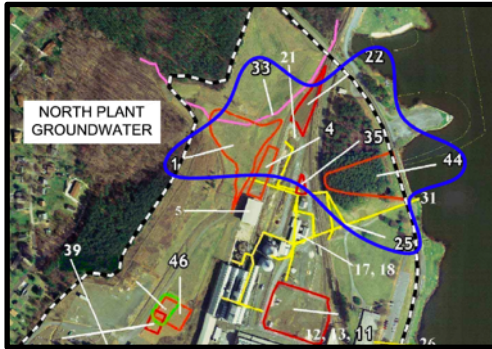
Phase 5:  
Justification and  
Recommendation  
of Selected  
Corrective  
Measure  
Alternative

?

# Largest SWMU areas with buried spent potliner

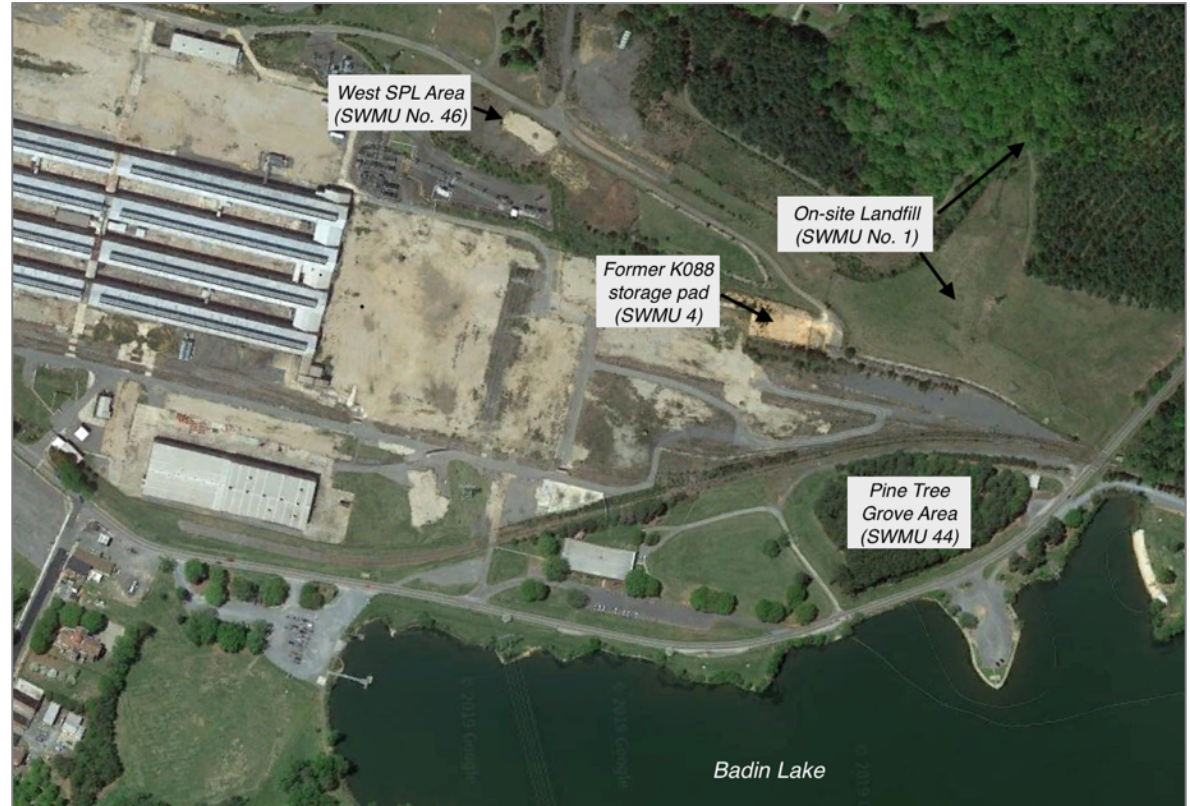


## North End SWMU Area



- Represents original active facility
- Highest number of monitoring stormwater outfalls
- Highest number of monitoring wells

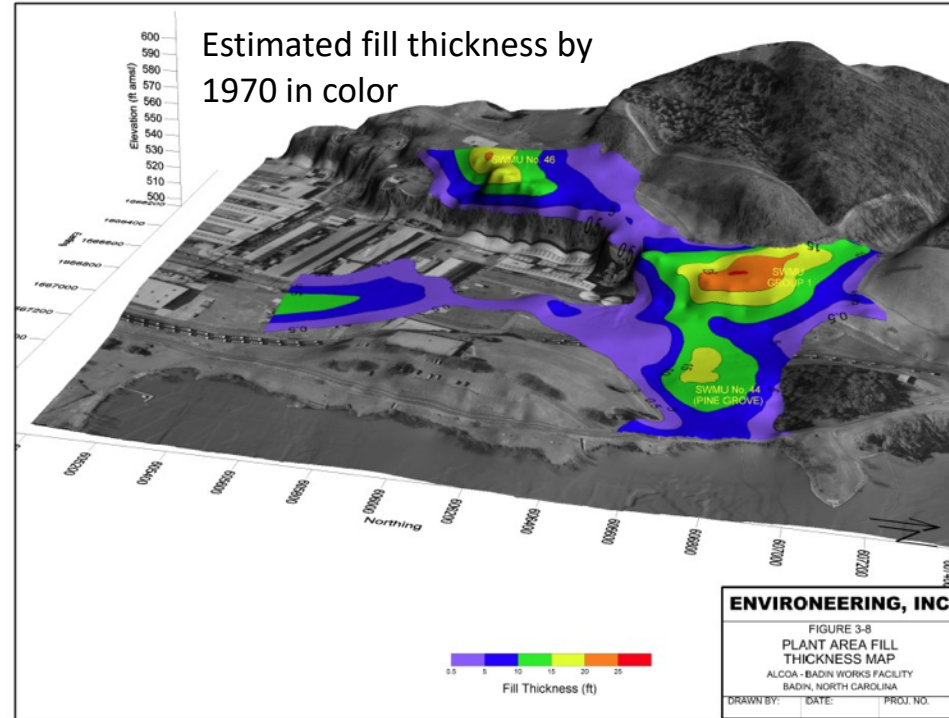
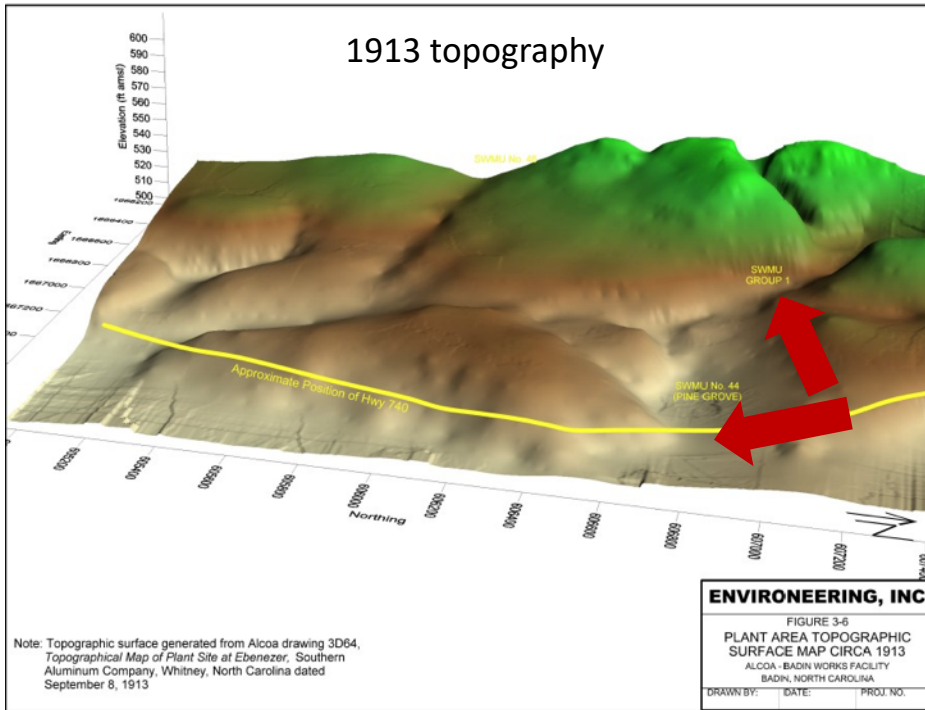
2019 aerial view from Google Earth






# Topography (shape of the land)

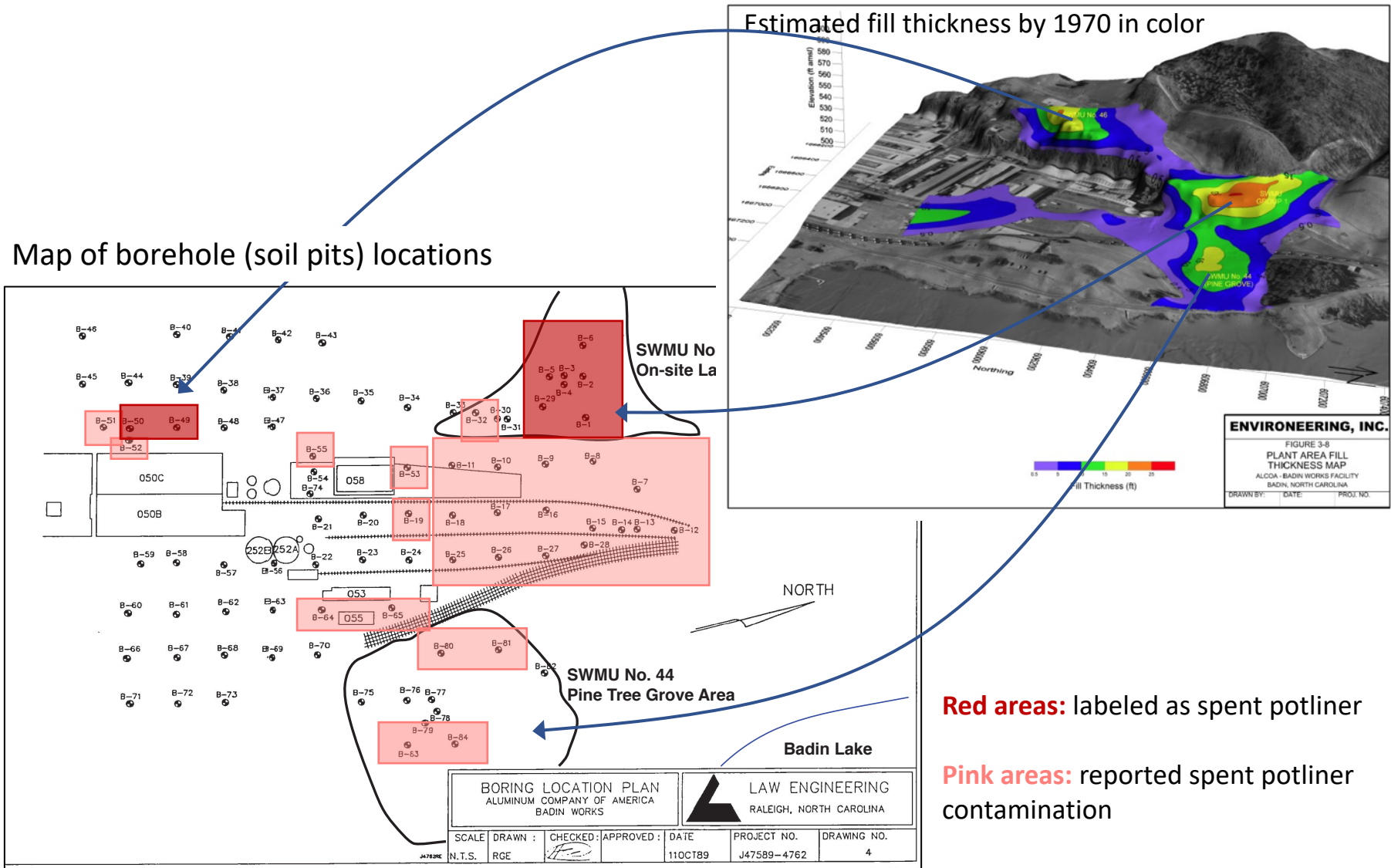
North End SWMU Area is a natural valley that was progressively filled in from 1916 to 1968



 Red arrows point to sites where spent potliner was dumped in a valley draining into Badin Lake, from 1910s to 1970s

By 1970s, cyanide and fluoride were leaching from **unlined** fill material (**in color**) into surface water and Badin Lake.

# Buried spent potliner found throughout fill material in 1989



Map source: Law Engineering, Aluminum Company of America: Report of Environmental Services North End Subsurface Exploration (1989).

# Buried spent potliner found throughout fill material in 1989, and still in 2001

1989 data

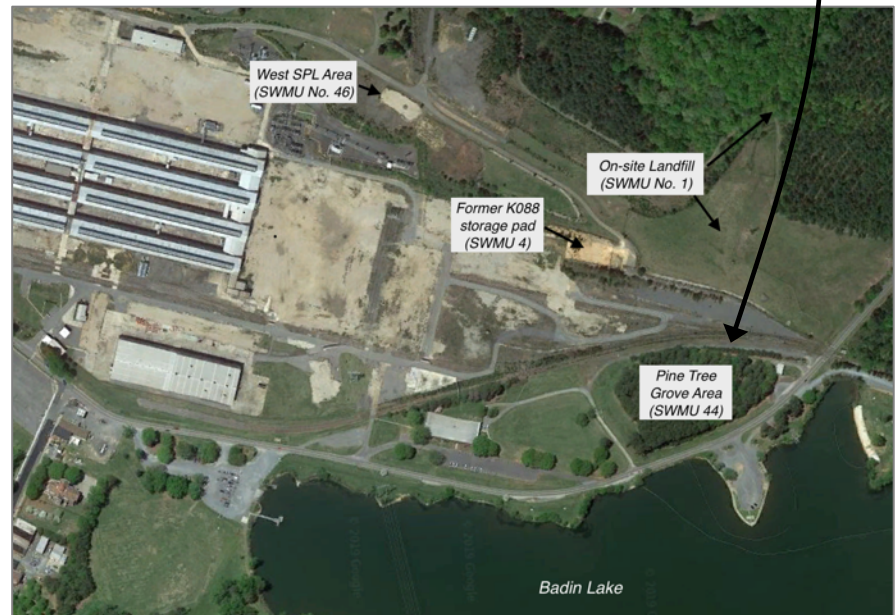
Boring ID	Depth, ft	Total CN <sup>1</sup>	Total F <sup>2</sup>	SPL depth, ft	Water table, ft
B-1	1 - 2.5	65	2,500	2.5 - 6.0	
B-2	6.5 - 8	39	1,500	2.0 - 7.5	
B-3	No boring sample			0.3 - 5.0	
B-4	15.5 - 17	0.7	49	0.3 - 16.0	13.5
B-5	15.5 - 17	3.9	180	5.0 - 16.0	15.0
B-6	No boring sample			5.0 - 10.0	
B-6"	3.5 - 5	11	1,400		
B-8	3.5 - 5	32	94		
B-9	1 - 2.5	1.6	530		6.0
B-10	6 - 7.5	2.5	310		
B-11	18.5 - 20	19	560		15.0
B-12	1 - 2.5	6.7	1,300		
B-13	3.5 - 5	4.2	570		
B-14	3.5 - 5	6	890		
B-15	8.5 - 10	16	1,300		
B-15	4	50	1,300		
B-16	8.5 - 10	2.7	1,100		7.0
B-17	12.5 - 14	6.3	430		7.0
B-25	18.5 - 20	1.8	930		11.0
B-26	17	8.4	1,100		
B-27	4	8.8	1,100		
B-28	13.5 - 15	20	180		11.8
B-29	3.5 - 5	67	2,200	5.0 - 12.0	11.5
B-32	3.5 - 5	2.4	210		
B-49	3.5 - 5	13	590	5.0 - 8.0	
B-50	8 - 9.5	18	3,900	5.0 - 8.5	
B-50	18.5 - 20	560	970	5.0 - 8.5	
B-51	3.5 - 5	58	2,300		
B-51	18.5 - 20	320	3,000		
B-52	13.5 - 15	43	770		
B-53	10 - 11.5	9.7	1,200		
B-53	18.5 - 20	58	50		
B-65	3.5 - 5	1.5	1,200		
B-79	3	1.2	110		
B-81	18.5 - 20	2	180		18.0

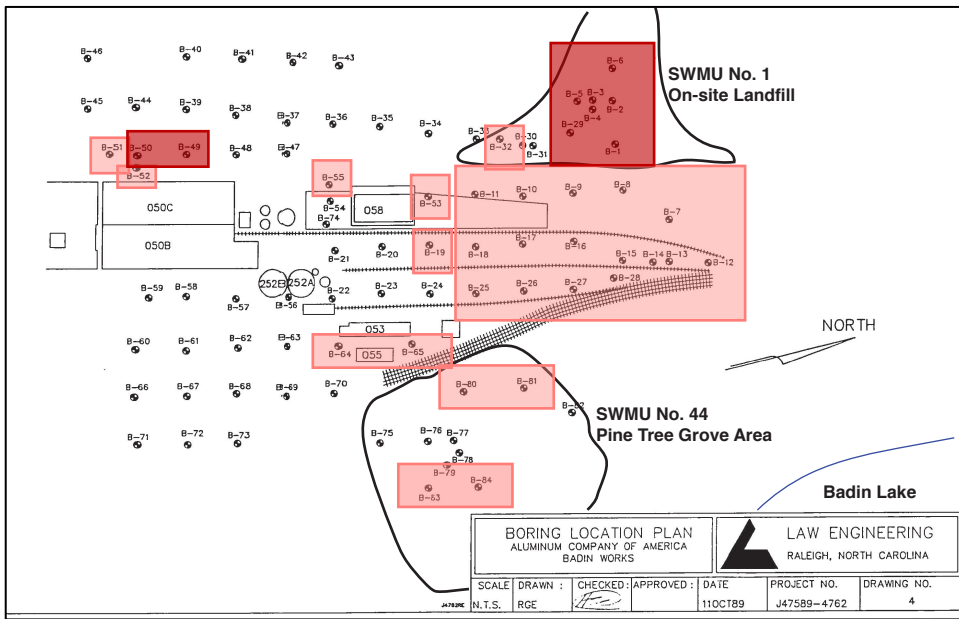
2001 soil sample from Pine Tree Grove Area (PTG)

Soil Sample ID	Depth, ft	Amenable CN <sup>1</sup>	Total CN <sup>1</sup>	Total F <sup>2</sup>	Water table depth, ft
PTG-SB-1	18.0	0.2	0.52	7,400	4 to 10
PTG-SB-2	15.0	< 0.25	1.1	670	4 to 10
PTG-SB-3	15.0	10.7	10.9	14,600	4 to 10
PTG-SB-4	28.0	< 0.25	1.5	570	4 to 10
PTG-SB-5	5.0	< 0.25	0.57	6,900	4 to 10
PTG-SB-6	20.0	< 0.25	6	2,000	4 to 10
PTG-SB-7	15.0	< 0.25	2.6	3,300	4 to 10

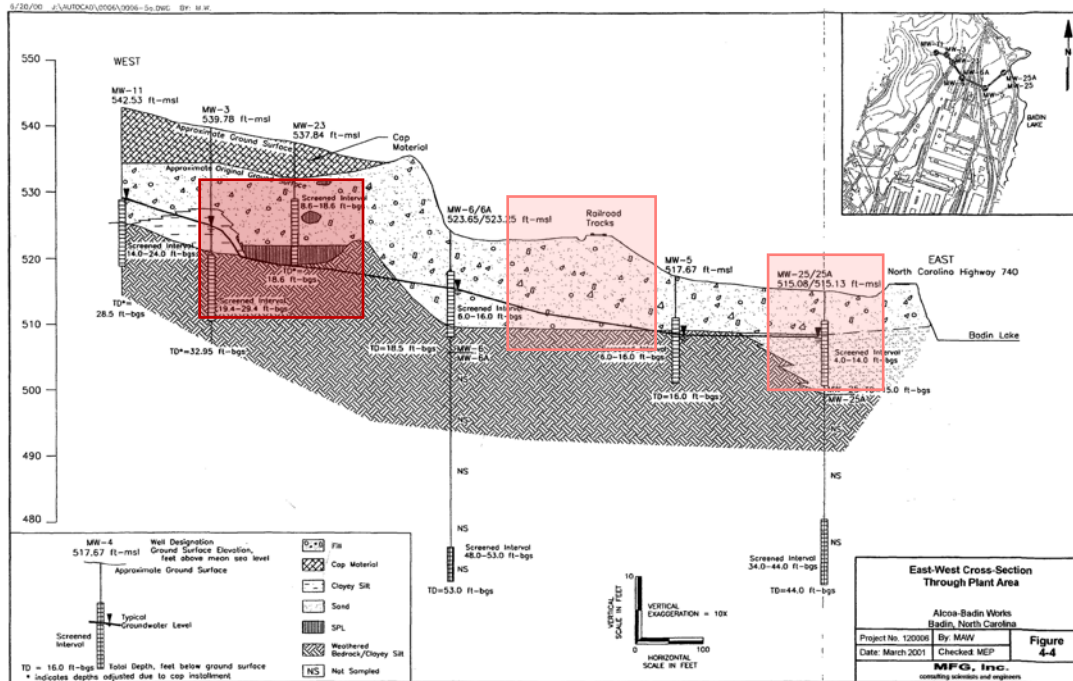
CN and F in mg/kg in both tables

Soil samples below water table at PTG





Map of borehole (soil pits) locations.



Known locations of buried spent potliner are not shown in Alcoa's cross sections of the North End SWMU area.

**Red areas:** labeled as spent potliner  
**Pink areas:** spent potliner contamination but not labeled

# North End SMWU Area: Contamination threats in groundwater

	Available Cyanide (mg/L)		Fluoride (mg/L)	
	2001	2012	2001	2012
MW-1	1.2	< 0.0018	< 0.1	0.020 J
MW-2	3.9	NS	216	NS
MW-3	< 0.01	NS	1	NS
MW-4	0.48	0.22	81.5	49
MW-5	0.054	< 0.0018	2.6	6
MW-6	2.7	0.58	3700	1800
MW-7	< 0.01	< 0.0018	< 0.1	0.03 J
MW-8	0.24	0.011	15.7	14
MW-9	0.494	0.039	45	23
MW-10	x	< 0.0018	1.6	1.2
MW-11	< 0.01	< 0.0018	0.84	0.51
MW-12	0.14	NS	20	NS
MW-13	< 0.01	NS	< 0.01	NS
MW-14		< 0.0018		6.4
MW-14(D)		< 0.0018		7.3
MW-15		< 0.0018		0.29
MW-16	0.42	0.034	15.5	13
MW-17	< 0.01	< 0.0018	< 0.1	0.03 J
MW-18	< 0.01	< 0.0018	0.1	0.040 J
MW-19	< 0.01	< 0.0018	< 0.01	0.06
MW-20	0.078	NS	0.58	NS
MW-21	0.14	NS	1710	NS
MW-22	0.93	NS	2340	NS
MW-23	Dry	1.4	Dry	4500
MW-24	0.76	NS	1250	NS
MW-25	0.091	NS	88.3	NS
MW-25A	0.13	NS	6.5	NS
MW-26	0.024	NS	12.5	NS
MW-27	0.11	0.095	439	300
MW-28	< 0.01	< 0.0018	< 0.2	0.030 J
MW-29	0.25	0.70	18	52

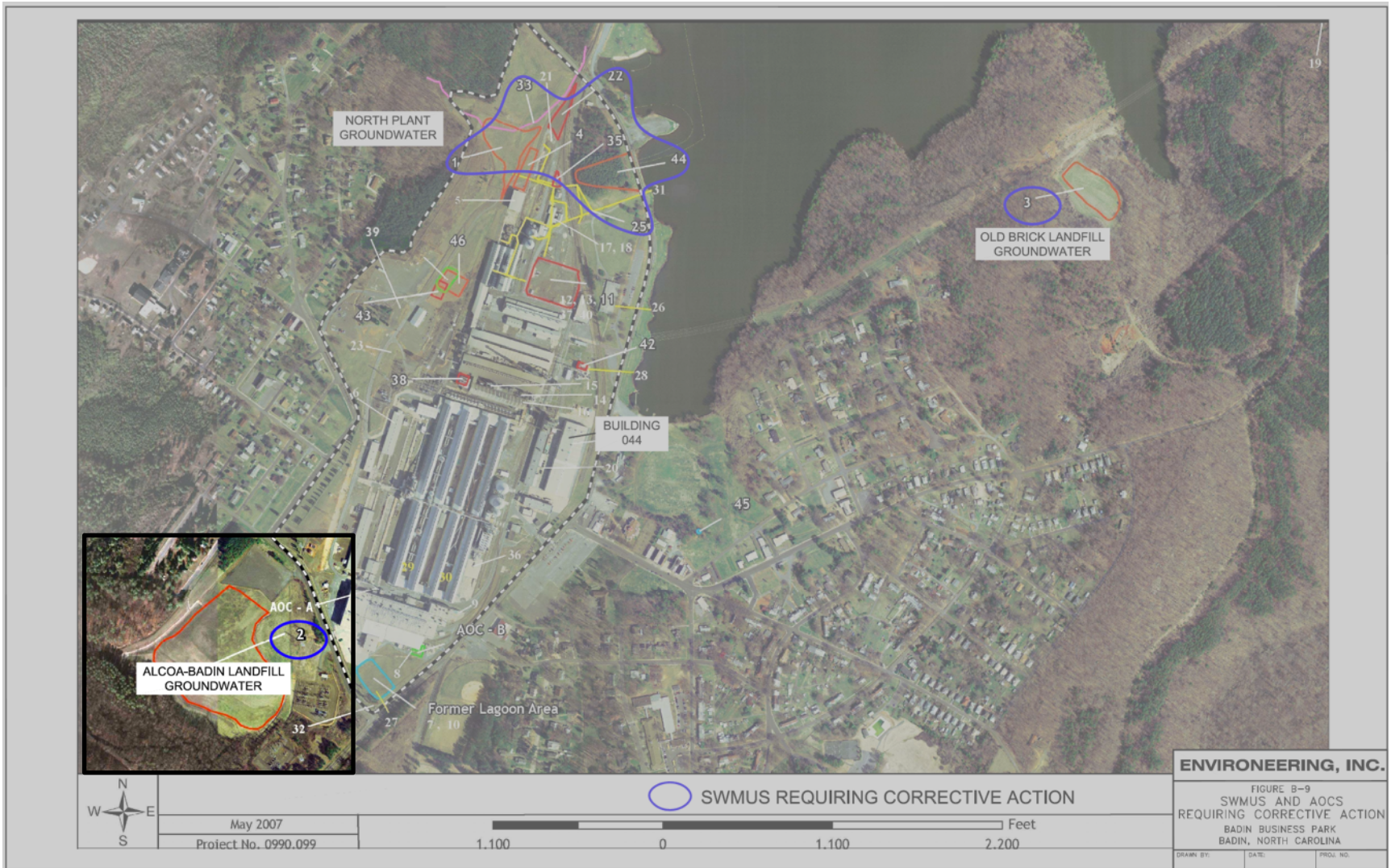
**Red:** Contamination exceeds NC 2L groundwater standards

**Gray:** contaminated well in 2001 not resampled in 2012

← Wells in spent potliner **not dry** despite cap installment in 1997

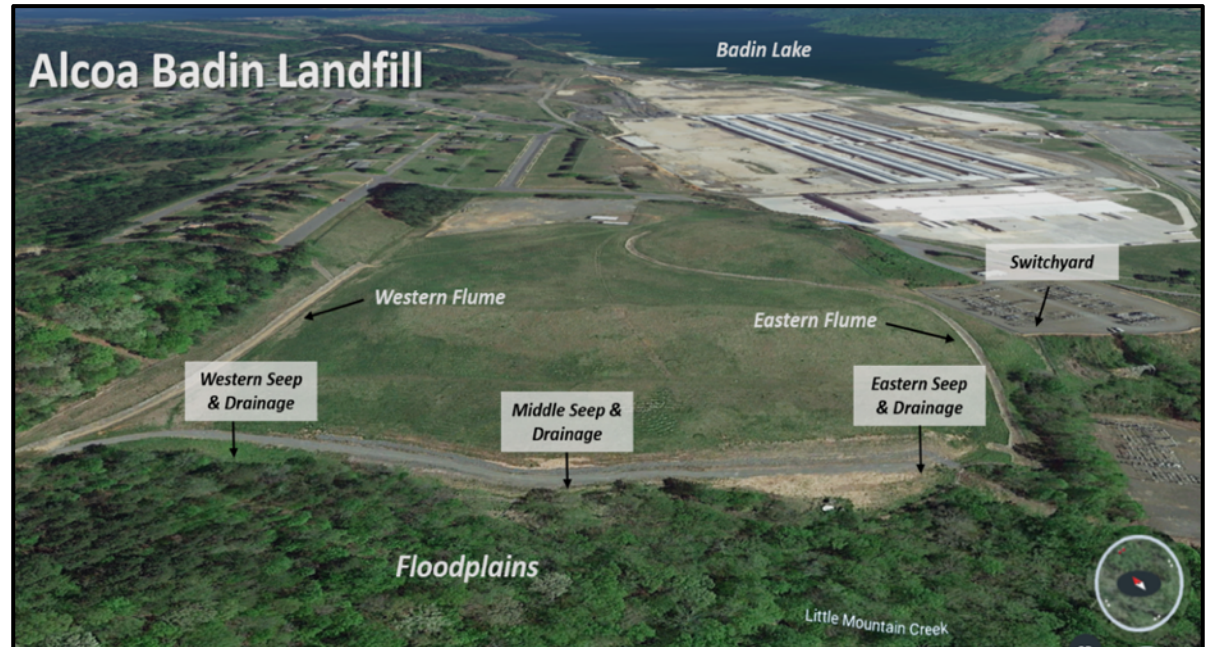
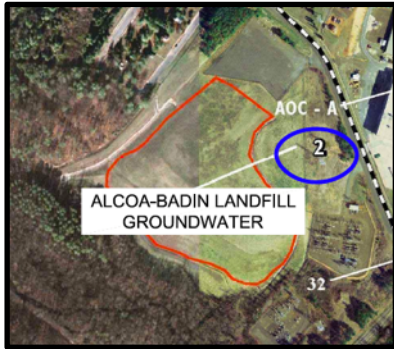
← Increase in cyanide and fluoride between 2001 and 2012

# SMWU No. 2: Alcoa-Badin Landfill



## SMWU No. 2: Alcoa-Badin Landfill

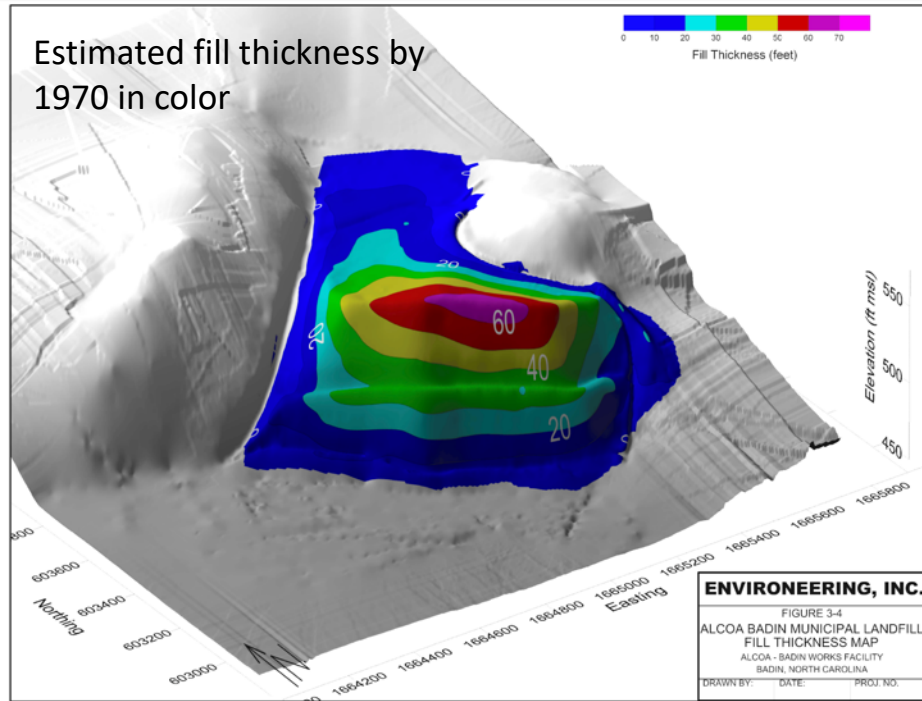
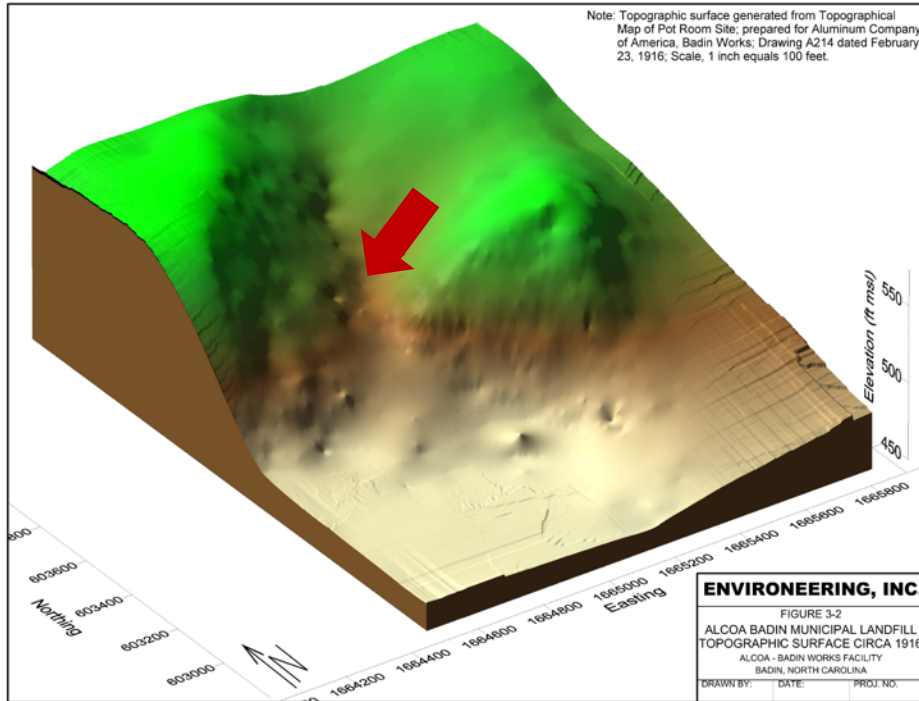
2019 aerial view from Google Earth



- Accumulated waste from 1916 to 1980
- Caught fire in 1991 and burned for 3+ months
- Deepest deposits of fill material, > 42 feet deep

# SMWU No. 2: Alcoa-Badin Landfill topography

SWMU No. 2 was a natural valley used as a dump (right), graded between mid-1970s and 1990s (left)

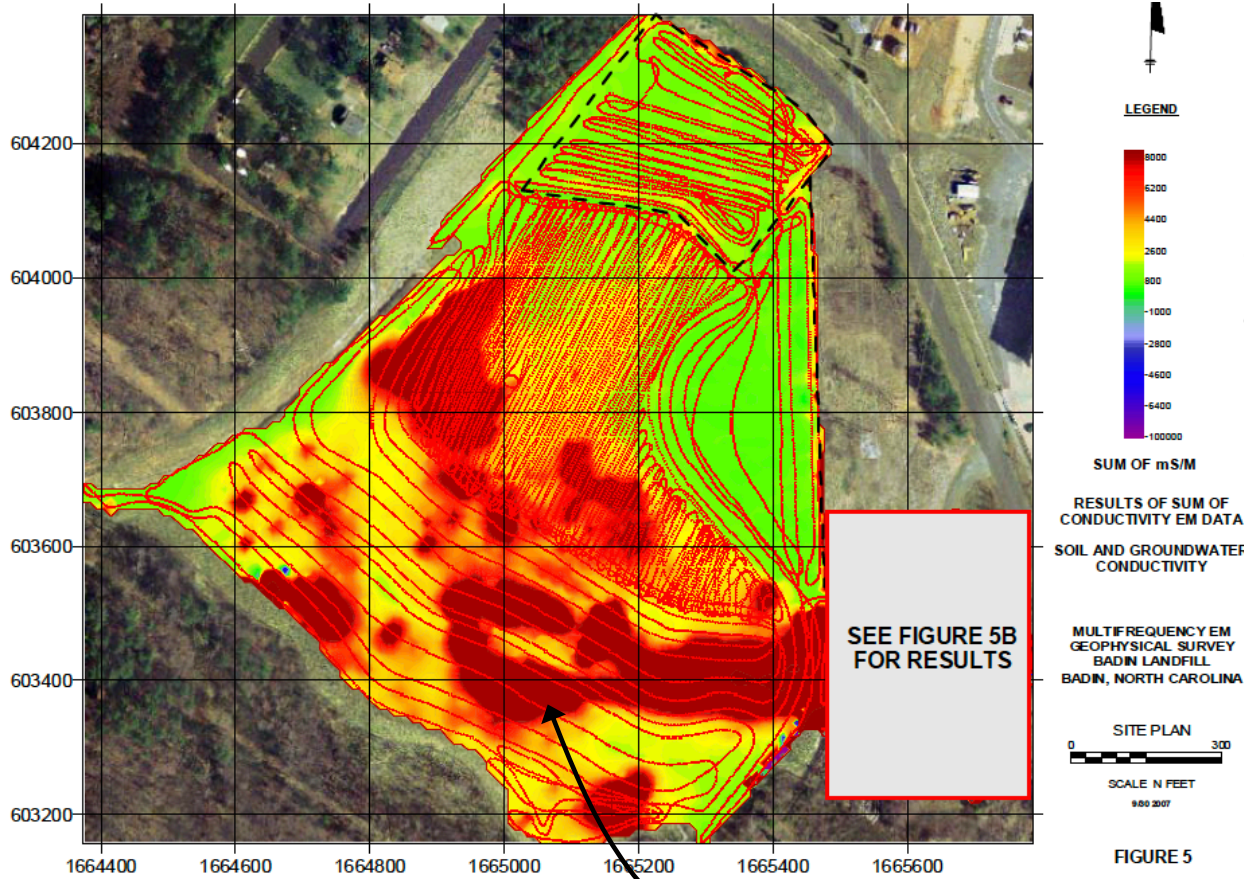


Red arrow points to natural valley draining into Little Mountain Creek



# SMWU No. 2 has unknown quantities of contaminants, including spent potliner

## Geophysical survey of electromagnetic conductivity in 2012



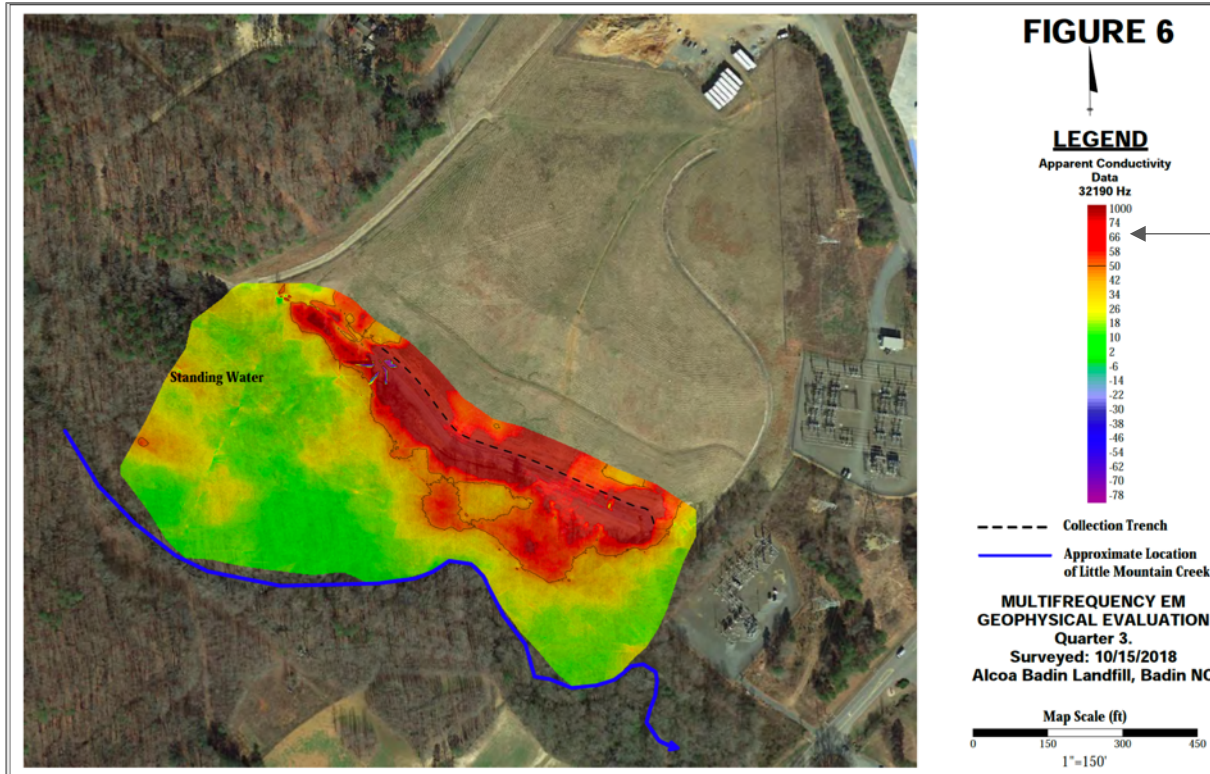
**Red** represents high levels of buried carbon-rich waste, including spent potliner

6.5 acres (out of 14) identified as having hazardous waste

Contamination hotspot in deepest area of fill, from 1970s plant renovations

# SMWU No. 2 is still leaching contaminants into Little Mountain Creek floodplain

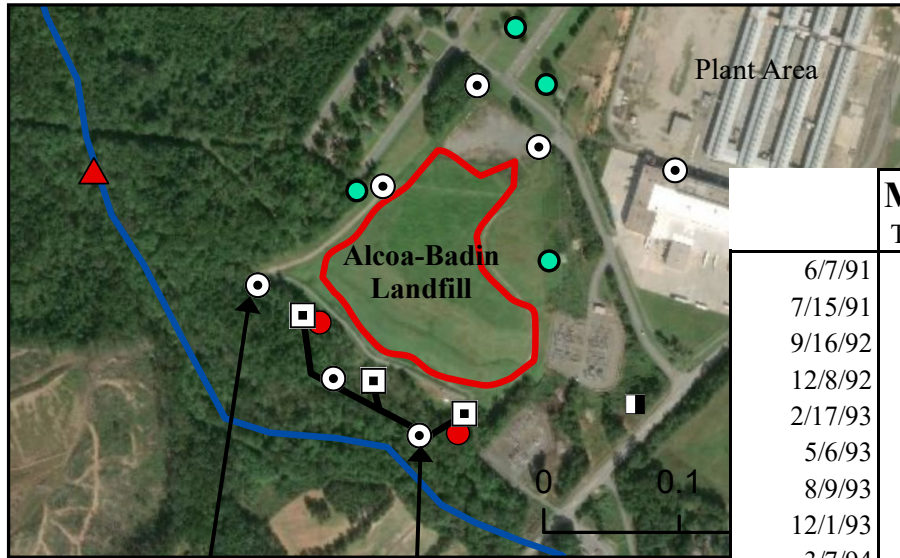
Geophysical survey of electromagnetic conductivity in Little Mountain Creek floodplain, 2019



Improper scaling may distort level of contamination in floodplain

Contaminant plumes (red) in groundwater going past collection trench (dotted line).

# SWMU No.2: Contamination threats in groundwater



MW-3, upstream  
MW-5, downstream

**Red:** Contamination exceeds NC 2L groundwater standards

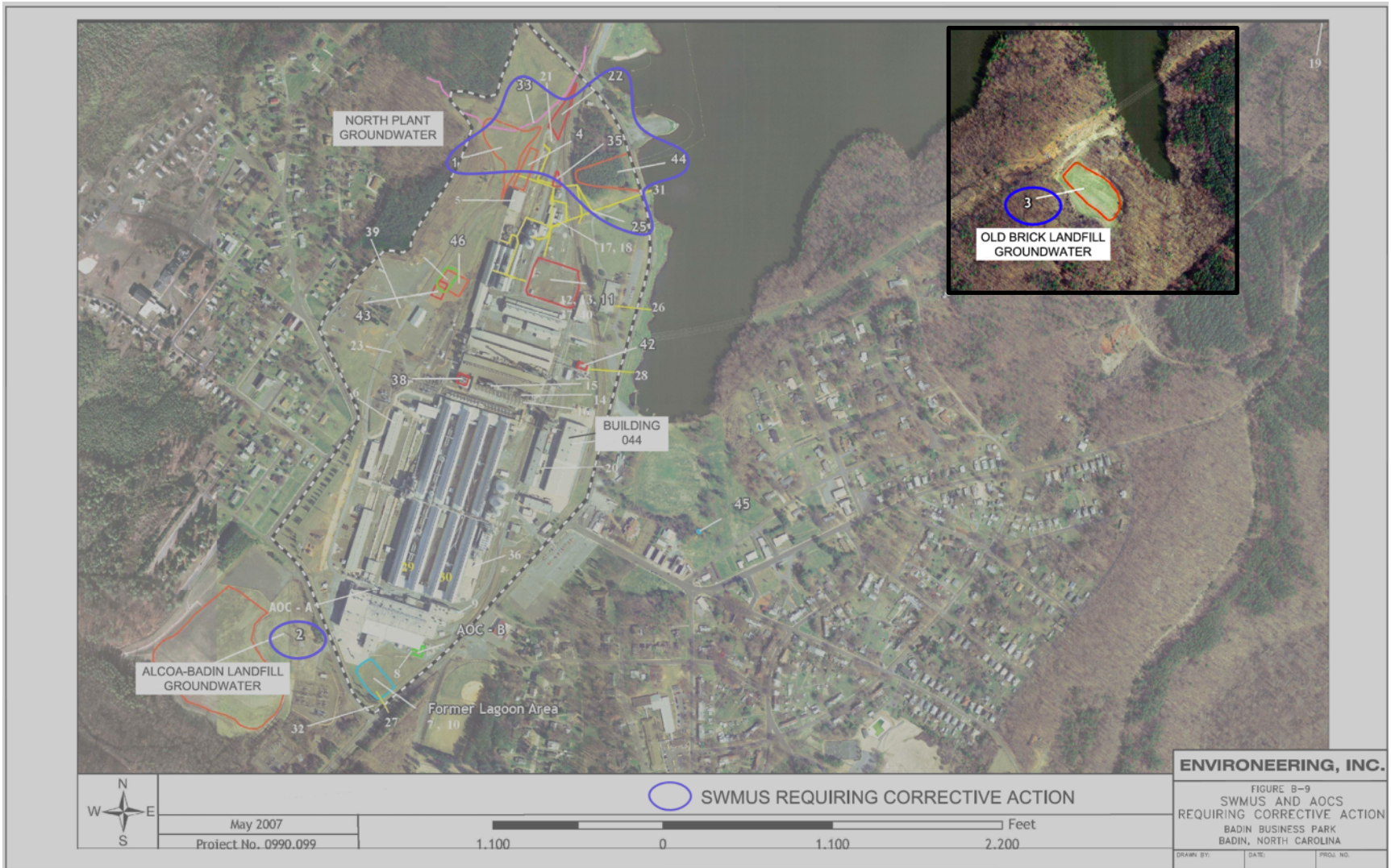
**Pink:** Values above detection limit

Cyanide and fluoride increases in Little Mountain Creek due to ongoing leaching from landfill

	Monitoring Well 3		
	Total Cyanide	Free Cyanide	Fluoride
6/7/91	< 0.005	< 0.05	0.111
7/15/91	< 0.005	< 0.05	0.2
9/16/92	< 0.01	< 0.01	0.2
12/8/92	< 0.01	< 0.01	0.209
2/17/93	< 0.01	< 0.01	< 0.2
5/6/93	< 0.01	< 0.01	0.18
8/9/93	< 0.01	< 0.01	0.2
12/1/93	< 0.01	0.013	< 0.2
3/7/94	< 0.01	< 0.01	< 0.2
5/11/94	< 0.01	< 0.01	0.51
8/30/94	< 0.01	< 0.01	< 0.2
12/15/94	< 0.01	< 0.01	< 0.2
6/26/96	< 0.005	< 0.005	0.2
9/25/96	< 0.01	< 0.01	0.17
12/5/96	< 0.01	< 0.01	0.21
4/22/98	< 0.01	< 0.01	0.23
10/21/98	< 0.005	NS	< 0.2
9/24/99	0.011	< 0.005	< 0.2
1/5/00	< 0.01	< 0.005	< 0.1
<b>10-year sampling gap</b>			
8/1/11	NS	NS	0.1
11/14/11	NS	< 0.002	FB
5/8/12	NS	< 0.002	< 1.0
8/3/12	NS	< 0.002	< 1.0

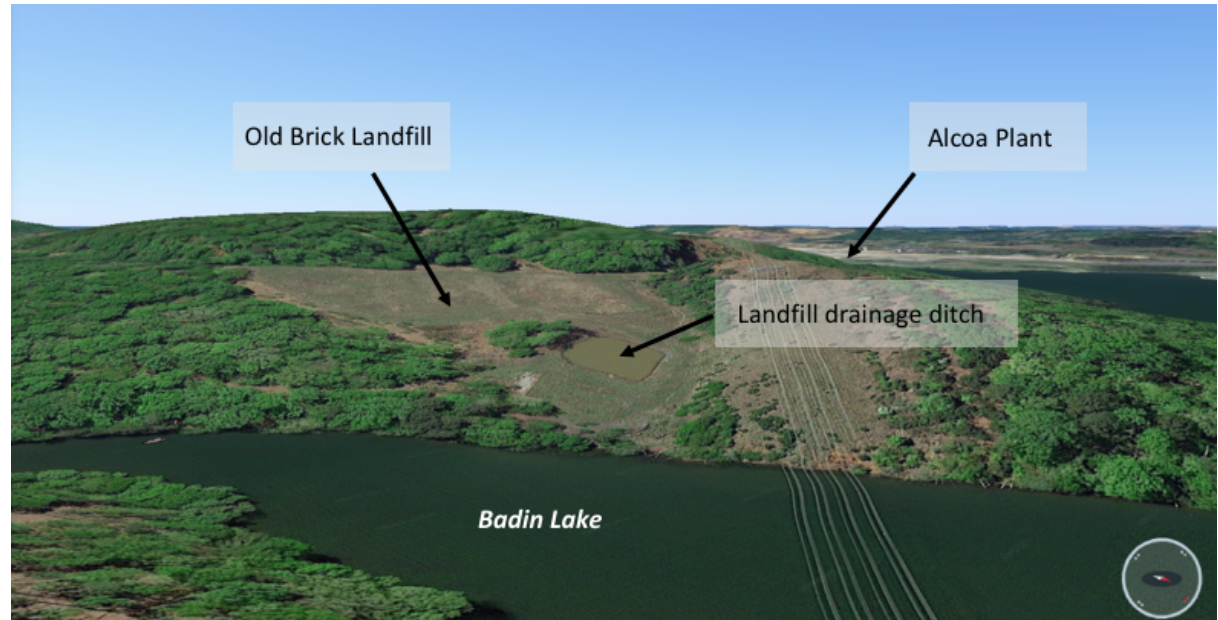
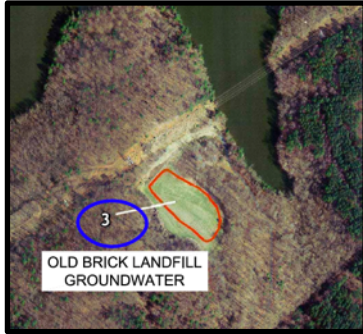
	Monitoring Well 5		
	Total Cyanide	Free Cyanide	Fluoride
6/7/91	0.068	< 0.05	0.136
7/15/91	0.19	< 0.05	0.1
9/16/92	0.22	0.029	0.1
12/8/92	0.242	0.288	< 0.2
2/17/93	0.14	0.032	< 0.2
5/6/93	0.24	0.068	< 0.1
8/9/93	0.031	0.031	0.1
12/1/93	0.282	0.019	< 0.2
3/7/94	0.113	0.024	< 0.2
5/11/94	< 0.01	< 0.01	0.51
8/30/94	0.188	0.017	0.3
12/15/94	0.021	< 0.01	< 0.2
6/26/96	0.239	0.131	1.2
9/25/96	0.25	0.11	0.28
12/5/96	< 0.01	0.13	< 0.2
4/22/98	0.13	0.013	0.25
10/21/98	0.31	NS	0.28
9/24/99	0.042	0.0059	< 0.2
1/5/00	0.25	0.0579	0.15
<b>10-year sampling gap</b>			
8/1/11	NS	NS	0.26
11/14/11	NS	0.027	FB
5/8/12	NS	0.024	< 1.0
8/3/12	NS	0.016	< 1.0

# SMWU No. 3: Old Brick Landfill



## SMWU No. 3: Old Brick Landfill

2019 aerial view from Google Earth

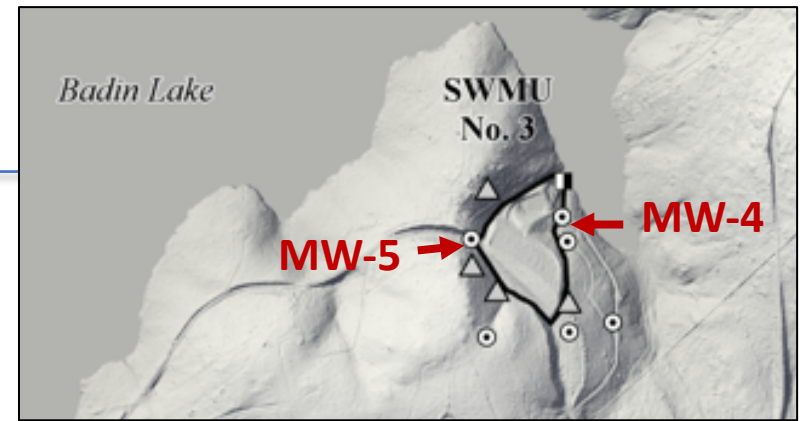


- Disposal site for spent potlining from 1915 to 1960
- Approximately 22,000 cubic yards of hazardous waste
- Hillside adjacent to Badin Lake
- Missing estimates of fill material and cross-section diagrams



## SMWU No. 3: Old Brick Landfill

- Wells downgradient of landfill (MW-4) exceeded NC 2L groundwater standards during 1990s in comparison to upgradient (MW-5)



### Monitoring Well 4

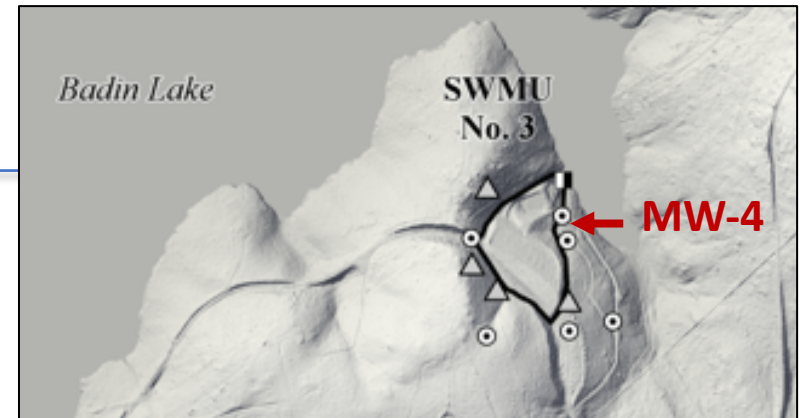
	Total Cyanide	Available Cyanide	Free Cyanide	Fluoride
6/8/91	0.49	NS	< 0.05	0.495
7/15/91	0.32	NS	< 0.05	0.9
9/16/92	0.62	NS	0.011	0.669
12/8/92	0.95	NS	0.011	<0.2
2/17/93	0.96	NS	< 0.01	0.95
5/6/93	0.42	NS	< 0.01	0.6
8/9/93	0.44	NS	0.012	0.8
12/1/93	0.64	NS	0.015	0.31
3/7/94	0.85	NS	0.012	1.13
5/11/94	0.46	NS	0.019	1.19
8/30/94	0.2	NS	0.031	0.95
12/15/94	0.4	NS	0.017	0.9
6/26/96	0.35	NS	0.113	1.03
9/25/96	0.35	NS	0.1	0.79
12/5/96	0.38	NS	0.12	1
4/23/98	0.27	NS	0.034	0.87
10/1/98	0.36	NS	NS	<0.2
9/25/99	0.38	0.034	0.022	0.93
1/7/00	0.16	0.11	0.095	NS
9/6/00	NS	NS	NS	NS
<b>10-year sampling gap</b>				
11/17/11	NS	0.016	NS	1.2
5/7/11	NS	0.018	NS	0.8
8/3/12	NS	0.022	NS	0.56

### Monitoring Well 5

	Total Cyanide	Available Cyanide	Free Cyanide	Fluoride
	< 0.005	NS	< 0.05	<0.1
	0.01	NS	< 0.05	<0.1
	< 0.01	NS	< 0.01	<0.2
	< 0.01	NS	< 0.01	<0.2
	< 0.01	NS	< 0.01	<0.1
	< 0.01	NS	< 0.01	<0.1
	< 0.01	NS	< 0.01	<0.2
	NS	NS	< 0.01	0.4
	< 0.01	NS	< 0.01	<0.2
	< 0.01	NS	< 0.01	<0.2
	< 0.01	NS	< 0.01	<0.2
	< 0.01	NS	< 0.01	<0.2
	< 0.01	NS	< 0.01	<0.2
	< 0.01	NS	< 0.01	<0.2
	< 0.01	NS	< 0.01	<0.2
	NS	NS	NS	NS
	< 0.01	< 0.01	< 0.005	<0.10
	< 0.01	< 0.01	< 0.005	NS
	NS	NS	NS	NS
<b>10-year sampling gap</b>				
	NS	< 0.002	NS	0.09
	NS	< 0.002	NS	<1
	NS	1.0	NS	<1

## SMWU No. 3: Old Brick Landfill

- 2004 and 2005 study concluded cap on landfill installed in 1990s not sufficient to prevent infiltration into the landfill

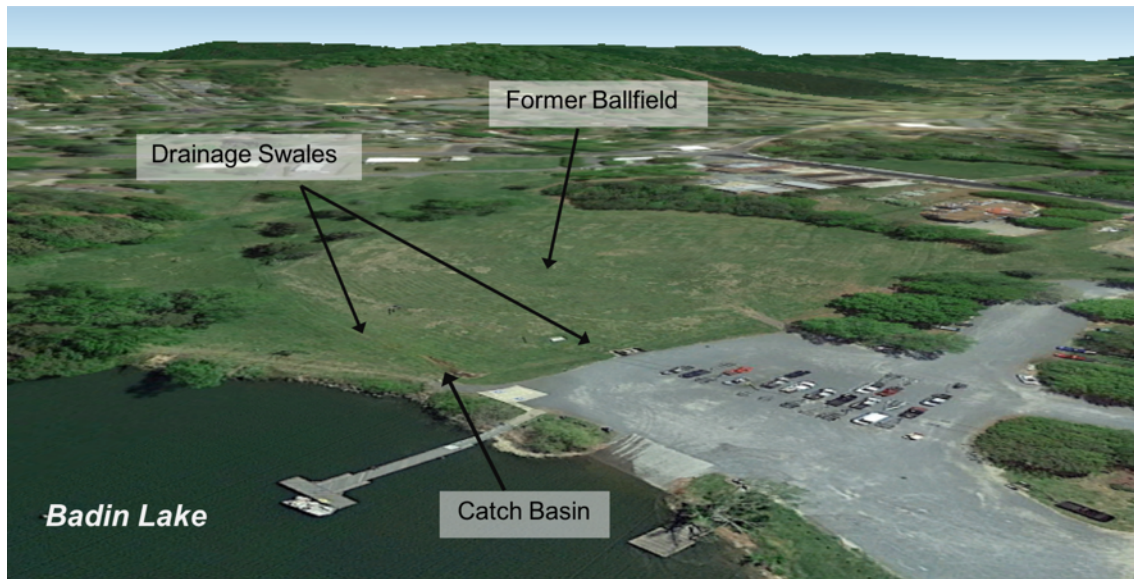


### Monitoring Well 4

	Total Cyanide	Available Cyanide	Free Cyanide	Fluoride
6/8/91	0.49	NS	< 0.05	0.495
7/15/91	0.32	NS	< 0.05	0.9
9/16/92	0.62	NS	0.011	0.669
12/8/92	0.95	NS	0.011	<0.2
2/17/93	0.96	NS	< 0.01	0.95
5/6/93	0.42	NS	< 0.01	0.6
8/9/93	0.44	NS	0.012	0.8
12/1/93	0.64	NS	0.015	0.31
3/7/94	0.85	NS	0.012	1.13
5/11/94	0.46	NS	0.019	1.19
8/30/94	0.2	NS	0.031	0.95
12/15/94	0.4	NS	0.017	0.9
6/26/96	0.35	NS	0.113	1.03
9/25/96	0.35	NS	0.1	0.79
12/5/96	0.38	NS	0.12	1
4/23/98	0.27	NS	0.034	0.87
10/1/98	0.36	NS	NS	<0.2
9/25/99	0.38	0.034	0.022	0.93
1/7/00	0.16	0.11	0.095	NS
9/6/00	NS	NS	NS	NS
<b>10-year sampling gap</b>				
11/17/11	NS	0.016	NS	1.2
5/7/11	NS	0.018	NS	0.8
8/3/12	NS	0.022	NS	0.56

← Samples taken in 2011 and 2012 within range of 1990s samples

## Investigations of additional sites of possible buried spent potliner are ongoing



Former Ballfield Area on shore of Badin Lake

Stop:	Address:	Alleged Disposal
1	Yadkin Brick Road, New London, NC	Pot liner buried in former clay mining pits (burial depth: 10-15 feet) across Yadkin Brick Road from former Yadkin Brick Plant.
3	Wood Street, Badin, NC	Alcoa Badin Landfill (SWMU #2).
4	Jackson, Sherman and Lincoln Streets, Badin, NC	Pot liner buried for several years on property currently forested and owned by Alcoa. *
5	34474 Kirk Ave, Albemarle, NC	Pot liner disposed on property parcel by former property owner (local waste hauler; deceased). Property is now residential.
6	Jackson Street, Badin, NC	Pot liner disposed at former wastewater treatment plant property, owned by Alcoa.
8	Falls Road, East of Badin, NC	Road-side disposal of pot liner.
9	End of Ash Street, Badin, NC	Pot liner disposed within 1000 feet of road on Alcoa property.
11	"Ball Field", Hwy 740 at Badin Lake, Badin NC	Pot liner disposed on Alcoa property subsequently used as a Baseball Field. Property is currently used as open space and as a boat launch to the lake.

Additional sites possibly contained buried spent potliner.

Table source: US EPA, Hazardous Waste Section, *Expanded Pre-CERCLIS Screening Assessment for SPL Disposal Area 1 and SPL Disposal Area 2* (2015).



# DEQ's Corrective Action Authority

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DEQ can require corrective actions for all releases of hazardous waste from a SWMU

**Regardless of the  
time at which  
waste was placed  
there**

**Outside the  
boundaries of the  
site “where  
necessary to  
protect human  
health and the  
environment”**

# RCRA Corrective Action remedies must . . .

1. Protect human health and the environment;
2. Attain media clean up objectives; and
3. Control the sources.

In 1984, Congress noted that  
“classes of land disposal facilities are not capable  
of assuring long-term containment of  
certain hazardous wastes, and to avoid  
substantial risk to human health and the  
environment, reliance on land disposal should be  
minimized or eliminated, and land disposal,  
particularly landfill and surface impoundment,  
should be the least favored method for  
managing hazardous wastes”

42 U.S.C. § 6901