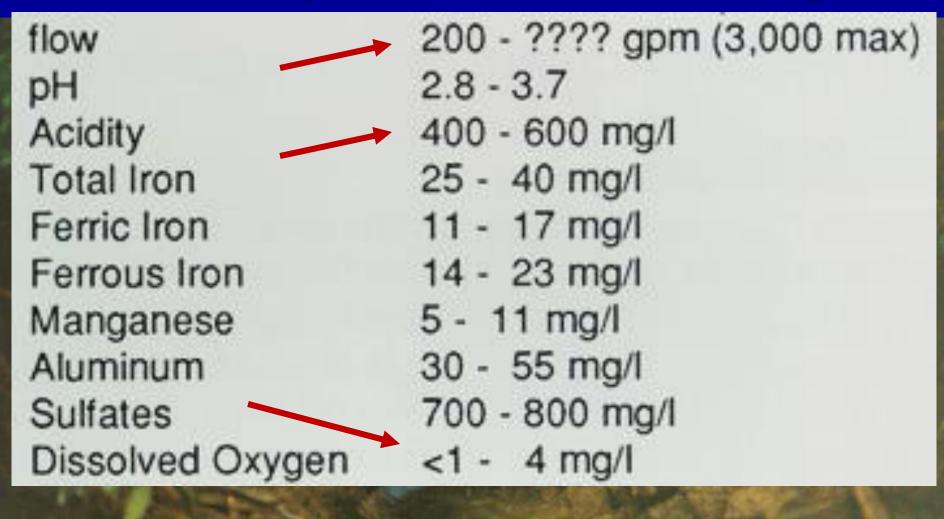


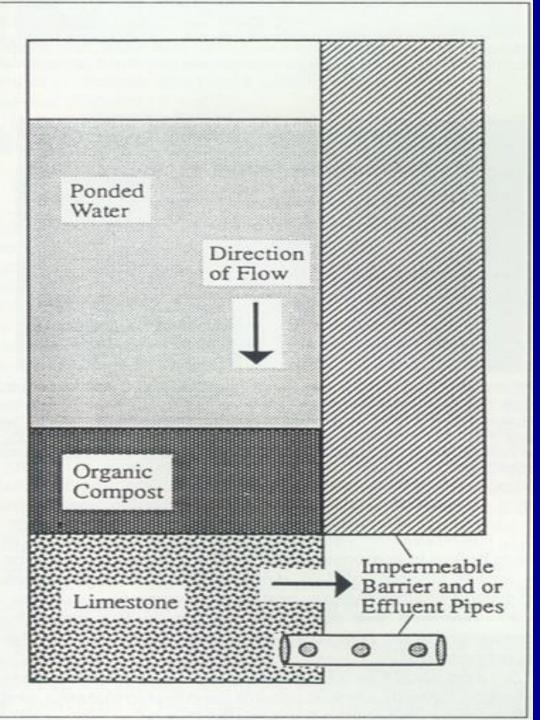
#29 Portal Water – 1990 Flow?



#29 Portal Water

Water Quality of #29 Portal at Douglas

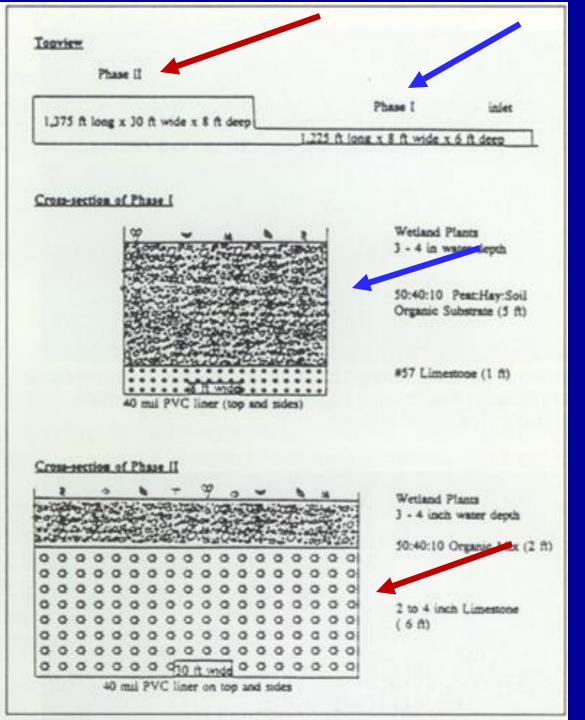




Side View

WALD –
Alkalinity-Producing
System

Idea to push the Water down through Organic compost then into Limestone.



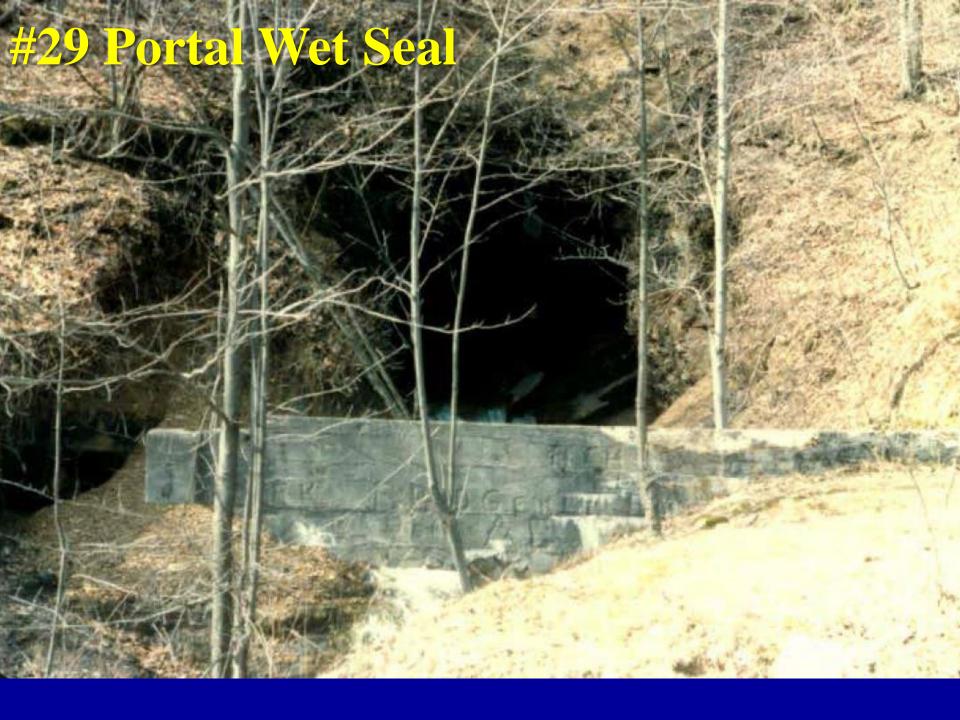
Construction Specs

Topview shows overall dimensions.

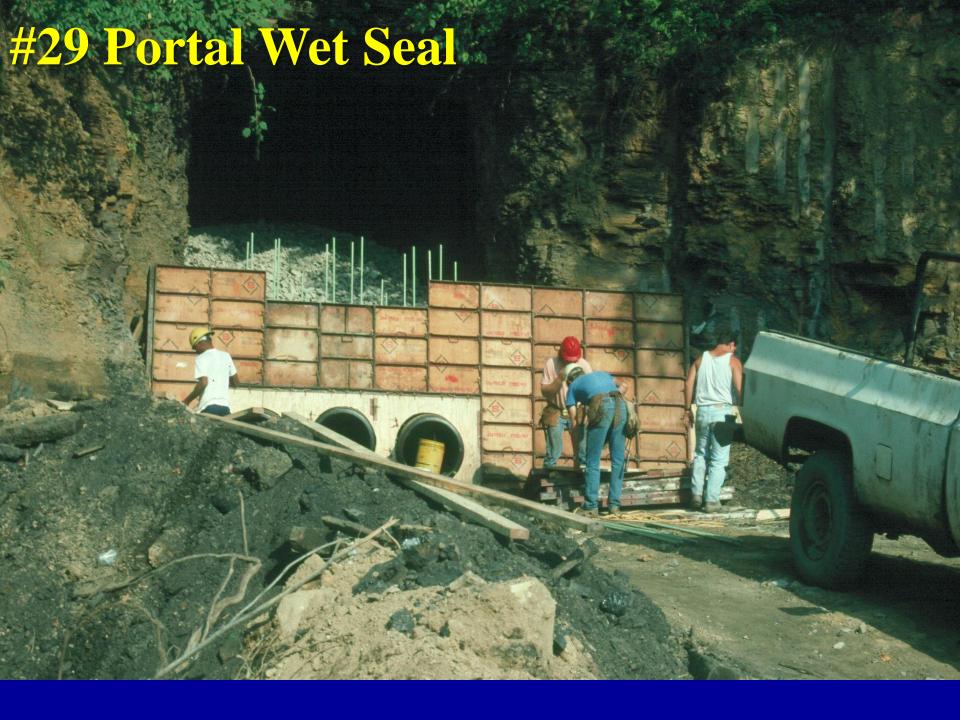
Cross-section of

Phase I (8-ft wide) (Organic)

Phase II (30-ft wide) Limestone









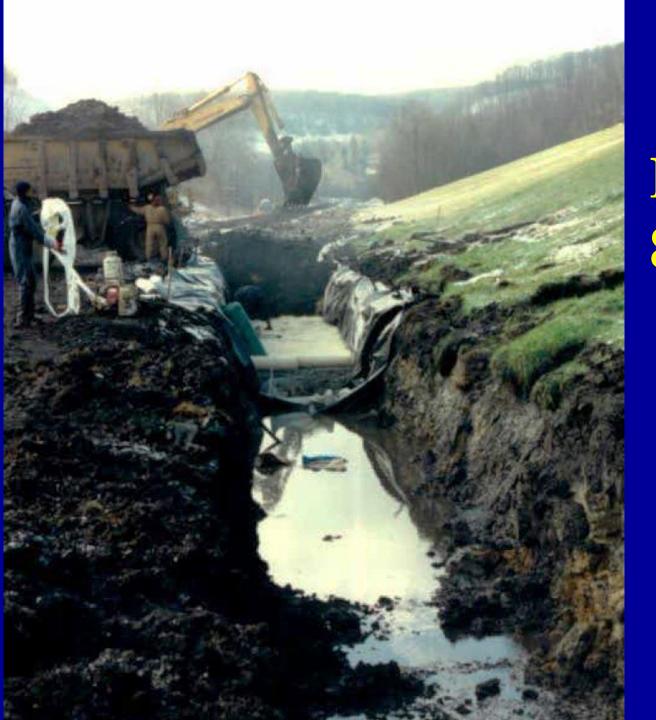




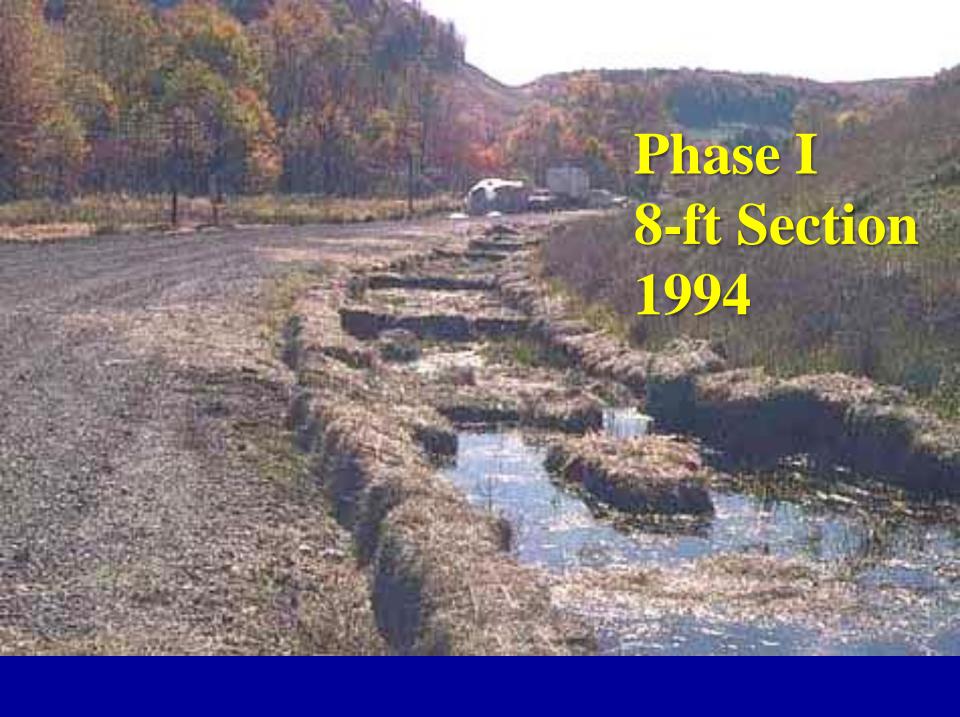
Phase I
8-ft Section

1,225 ft long

5 ft OM 1 ft LS



Phase I 8-ft Section













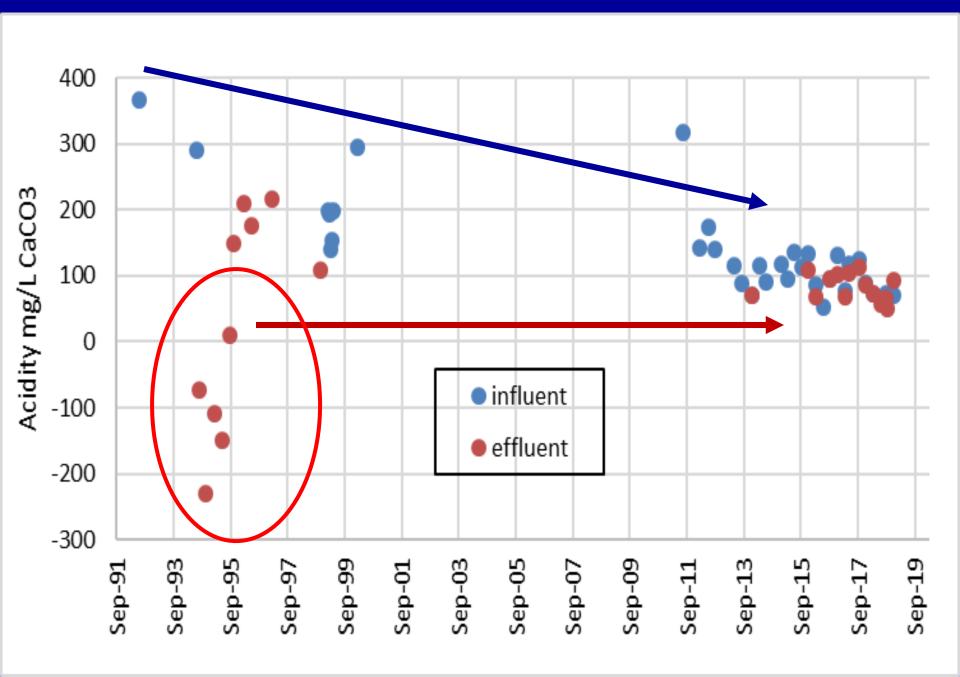








WALD Influent and Effluent – 1991–2019



Evaluation and Redesign of Wetland/ALD Passive System in North Fork of the Blackwater River, WV

Robert Hedin¹, Katherine Linnell², George Watzlaf¹, Naomi Anderson¹

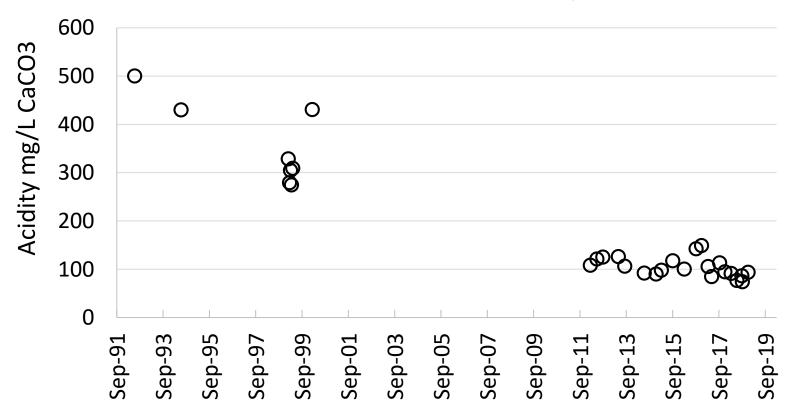
¹Hedin Environmental, Pittsburgh PA

² Langan Engineering and Environmental Services, Canonsburg, PA

WALD Passive Treatment Redesign

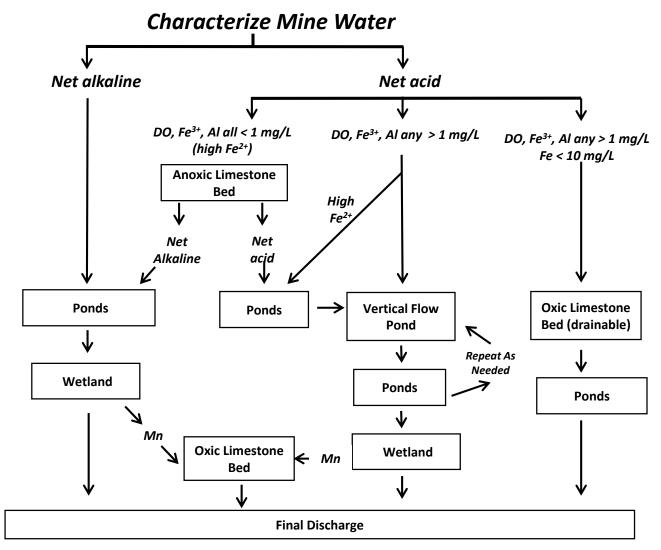
- Section 319 grant to Friends of Blackwater
- Contract with Langan Engineering (2018)
 - Treatment system design: Hedin Environmental
 - Permitting: FOB with Langan assistance
 - Construction package: Langan Engineering

WALD influent acidity

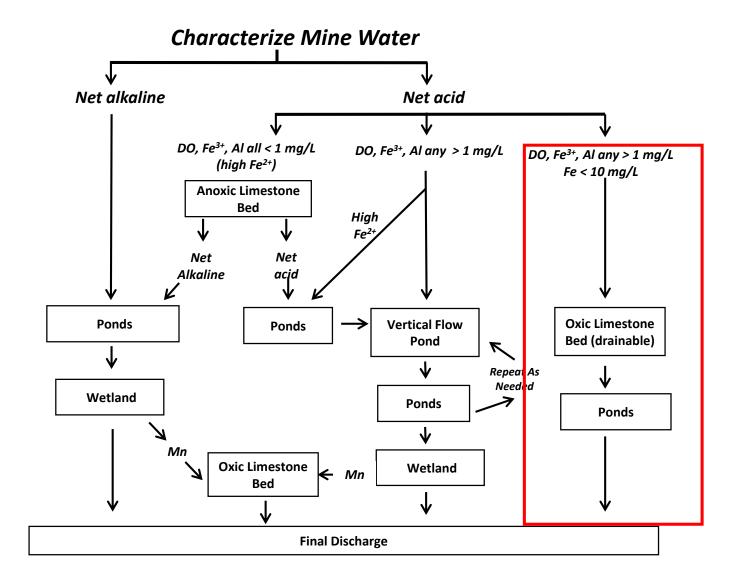


	Flow	рН	Acid	Al	Fe	Mn	SO4	Acid
	gpm	s.u.	mg/L	mg/L	mg/L	mg/L	mg/L	ppd
2011-18	169	3.3	105	10.7	2.2	2.9	340	208

	Flow	рН	Acid	Al	Fe	Mn	SO4	Acid
2011-18	169	3.3	105	10.7	2.2	2.9	340	208



Modified from, Hedin, R and Nairn, R. 1992 WV Task Force Meeting

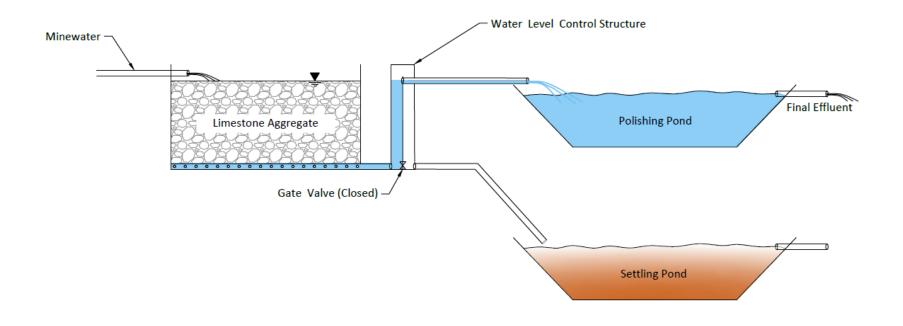


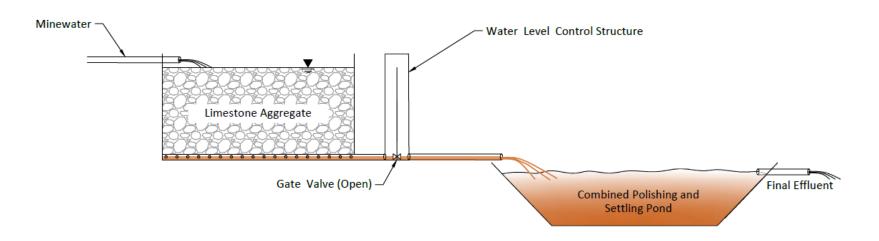
Modified from, Hedin, R and Nairn, R. 1992 WV Task Force Meeting

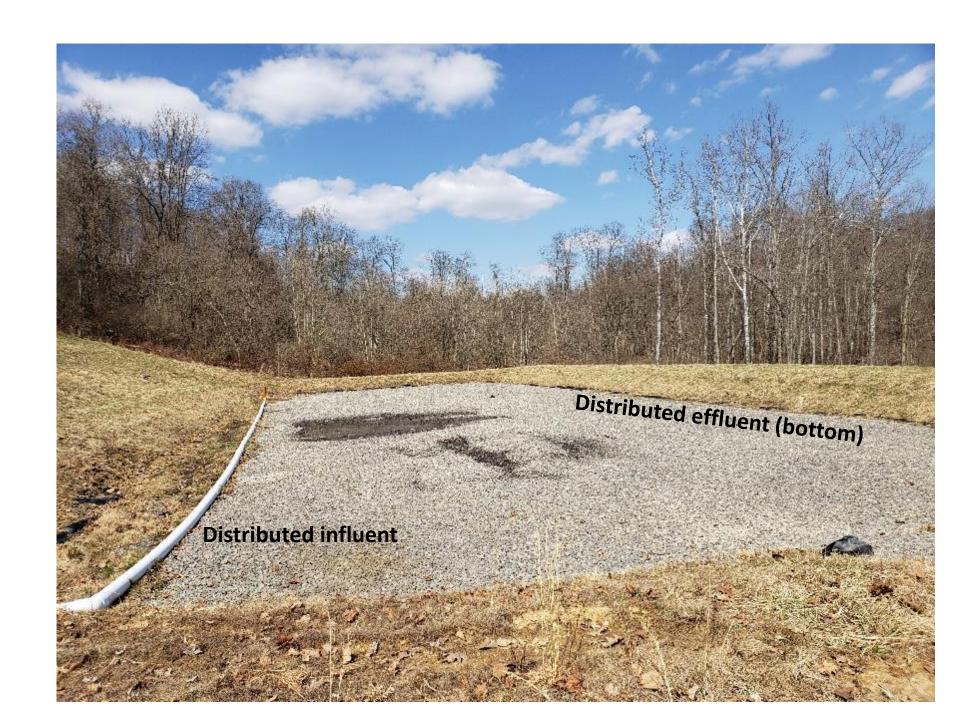
Drainable Limestone Bed Passive System

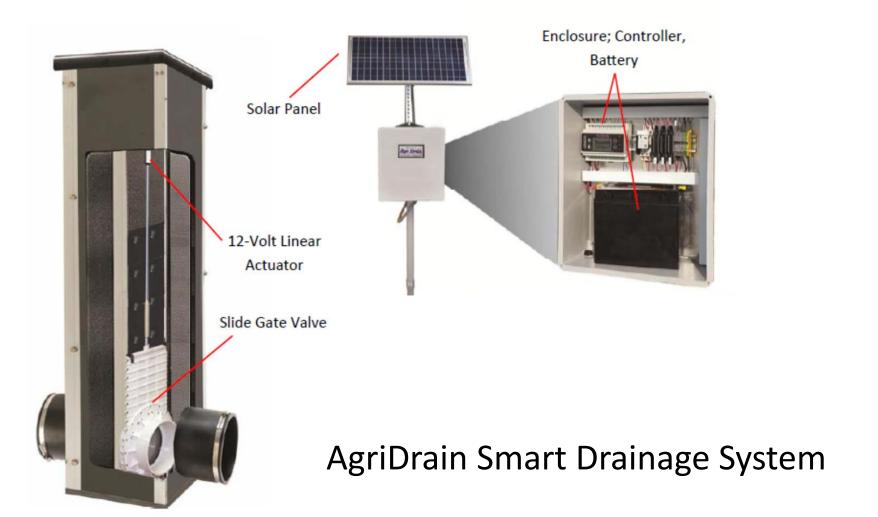
- Bed of limestone aggregate, open to atmosphere
- Formation of Al, Fe, and Mn oxyhydroxides is encouraged
- Bed is regularly drained empty which removes portion of solids
- Draining eliminates permeabilty issues and prolongs the reactivity of the limestone by years
- Eventually the limestone must be cleaned

Drainable Limestone Bed









Agri Drain Smart Drainage System (solar powered computer controlled gate valve)





Pittsburgh Botanic Garden DLB solids basin

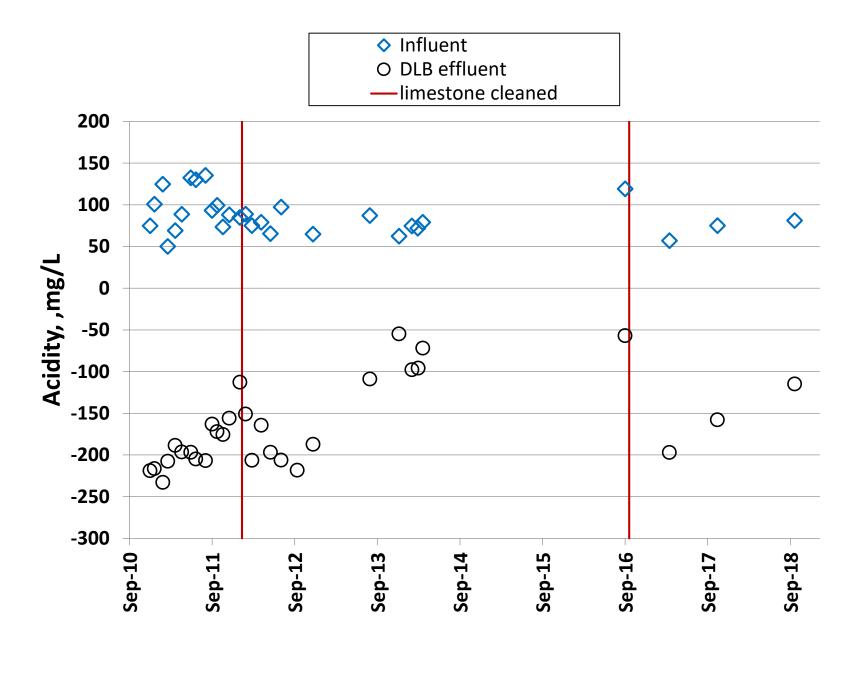


Performance of Existing DLB systems

	Flow	рН	Alk	Acid	Fe	Al	Mn
WALD							
Raw water	250	3.3	0	105	2.2	10.7	2.9
2	Scootac #1: 1,000 tons limestone, one DLB, installed 2010						
DLB in	na	4.0	0	88	0.2	10.7	24.4
DLB out	43	6.9	192	-164	0.1	0.2	1.8
PBG Lotus Pond: 450 tons limestone, one DLB, installed 2013							
DLB in		3.3	0	144	0.6	17.9	0.9
DLB out		6.7	208	-193	0.1	0.6	0.2
Greene: 4,700 tons limestone, four DLBs, installed 2015							
DLB in		3.4	0	105	3.4	3.9	31.7
DLB out	134	7.2	88	-74	0.2	0.1	1.6
Final		7.8	111	-59	0.7	0.1	0.8
Sterrett: 3,500 tons limestone, two DLBs, installed 2015							
DLB in	109	3.4	0	99	9.7	9.1	18.5
DLB out	107	6.9	146	-120	0.3	0.6	4.1
Final		7.4	125	-75	0.4	0.7	4.8

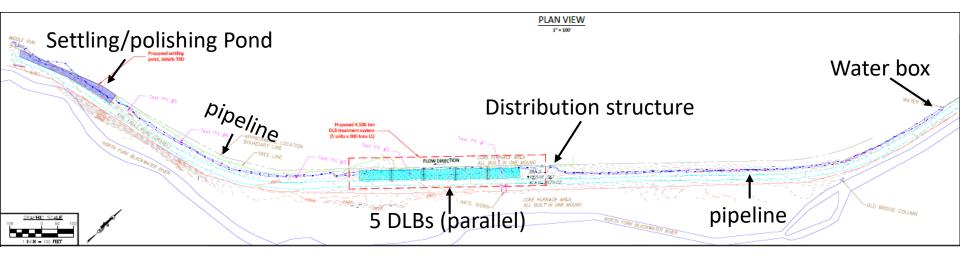
Scootac #1



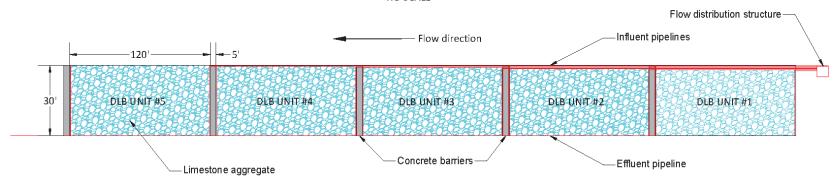




WALD Rehabilitation Design

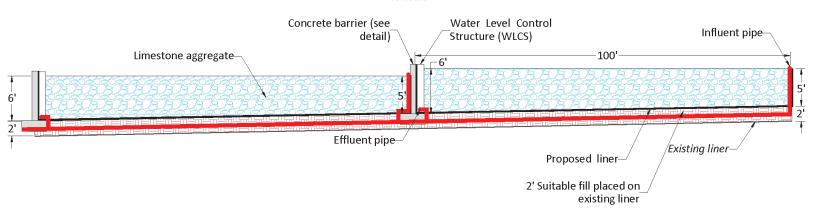






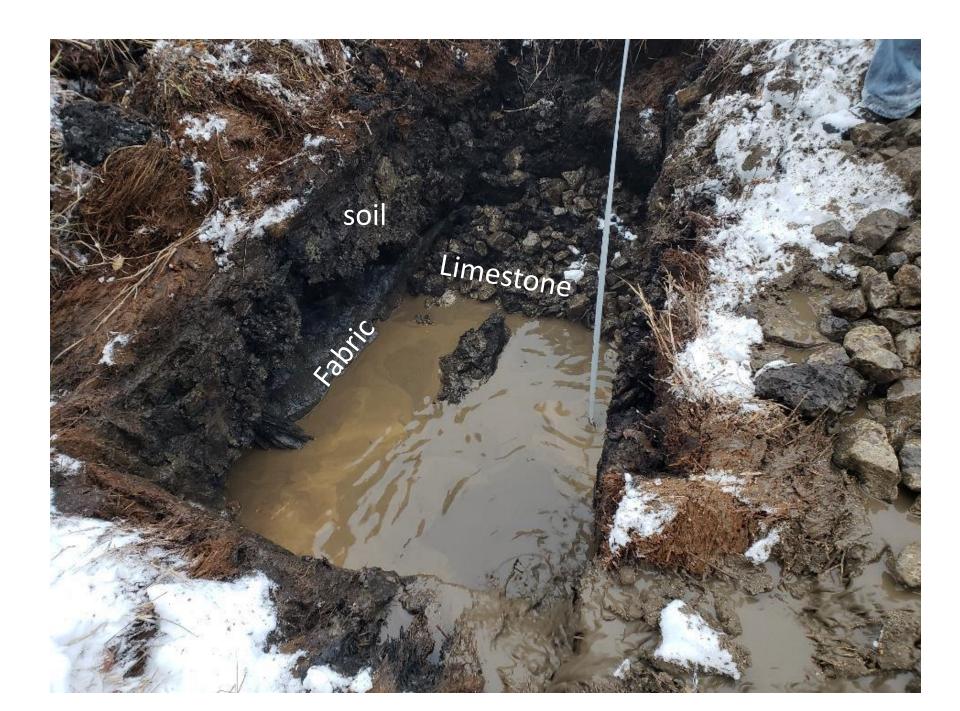
DLB Unit Profile

No Scale



WALD Limestone Investigation Jan 15, 2019







Limestone collected from WALD (Jan 2019)

CaCO ₃	90.5%
MgCO ₃	3.2%
Fe ₂ O ₃	0.3%
MnO ₂	<0.1%
SiO ₂	0.4%
Al ₂ O ₃	0.1%

Limestone particle size is important

Site	Classification	Size range
Scootac #1 and Greene DLBs	AASHTO 5	0.5 – 1.0 inch
PBG and Sterrett DLBs	AASHTO 3	1.0 – 2.0 inch
Existing WALD	AASHTO 1?	2 – 4 inch

Limestone choices

Proposed system needs 5,000 tons

WALD contains ~12,000 tons limestone

Remove and Clean limestone

- a) Use in DLB as-is (larger particle size)
- b) Use on other projects in area, purchase new stone
- c) Crush stone
 - a) Create AASHTO 3 or 5 stone
 - b) Use fines produced for trail maintenance

What's Next?

- Determine permitting requirements: spring 2019
- Deliver construction plans: spring 2019
- Obtain permits: spring/summer 2019
- Phase I: bid, install settling pond, limestone removal, install several VFPs: summer/fall 2019(?)
- Phase II: install remaining VFPs: 2020(?)
- Present results to WVMDTF: 2021

Questions or Comments?

White Ash site (Sullivan County PA)

- Three ALDs installed in 1999 that contained 4,500 ton LS; ALDs lined
- Failed within 2 years due to plugging (inadequate plumbing; input of dirty surface water; poor quality limestone)
- 2017 the system was opened and ~2,000 tons limestone was cleaned; new collection system installed; new influents/effluents
- System is treating 600 gpm flow.



The limestone in Cell C was severely fouled but it was all cleaned. Moving all of the solids out of the bed was a challenge.



Limestone cleaning. The mini excavator on the left directed flow as the 315 on the right mixed the stone. Water flowed out of the bed through the flush pipes on the bottom.

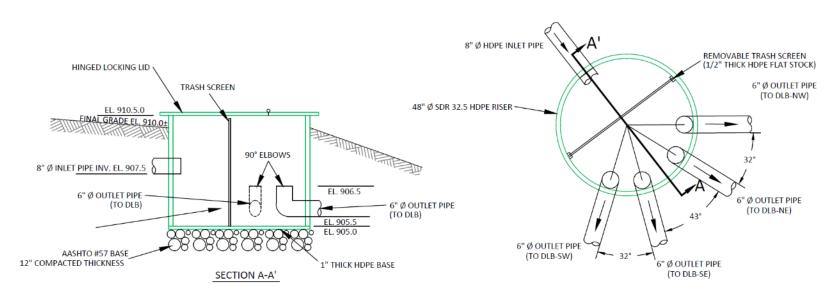
	WALD	Pond 4 in	Pond 4 out
Period	2011-2018	2015-	2015-2018
		2018	
Flow, average	169		106
Flow, max	413		300
рН	3.3	3.4	7.6
Alkalinity	0	0	112
Acidity	119	96	-57
Fe	2	3	0.7
Al	12	4	0.1
Mn	3	31	0.8
Number DLBs	five	four	
DLB arrangement	parallel	parallel	
Ton LS per DLB	1,000	1,500	
Ton LS, total	5,000	4,700	
Stone size		AASHTO 5	
Stone CaCO ₃	94% @ CaCO ₃	92% @ CaCO ₃	
Settling	Single pond	Single pond	







Flow distribution structure



Inlet Distribution Structure

NOT TO SCALE