

Watershed-scale remediation of acid mine drainage in the Robinson Run Watershed

2026 West Virginia Mine Drainage
Task Force Symposium

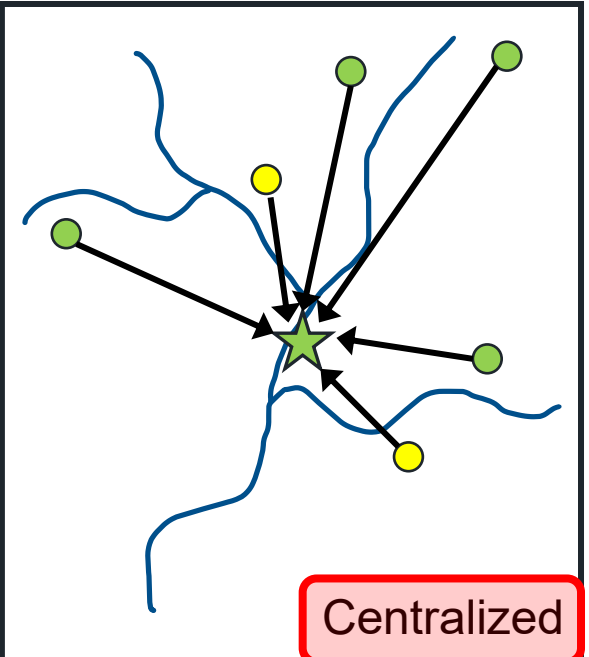
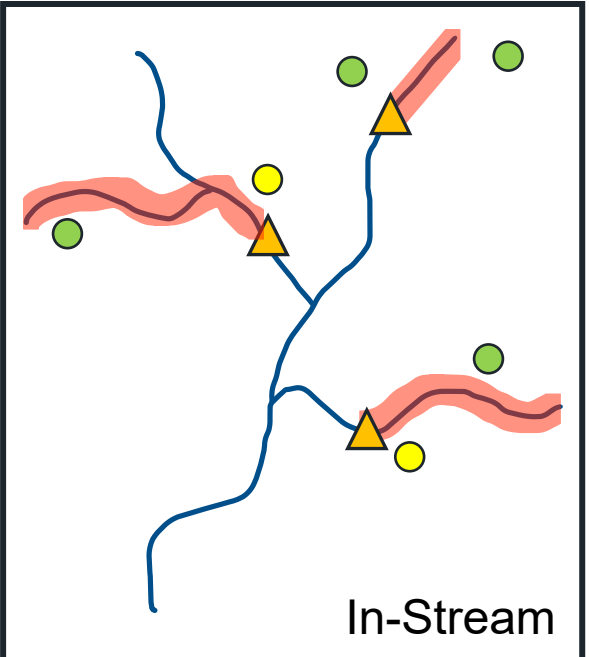
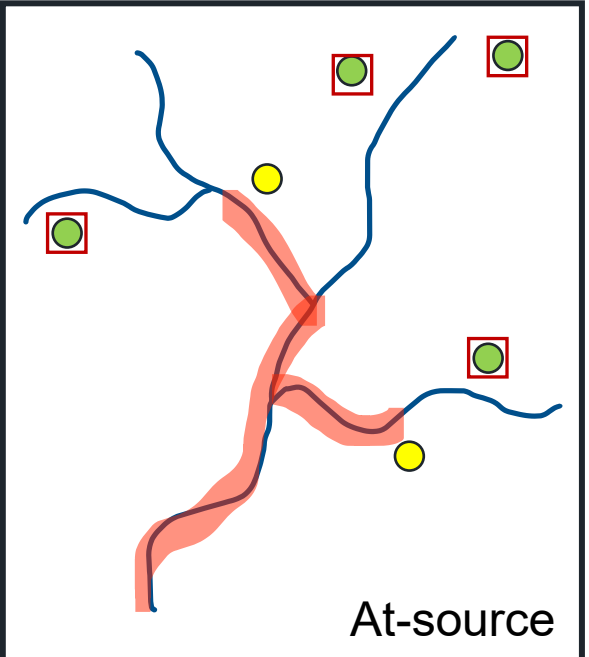
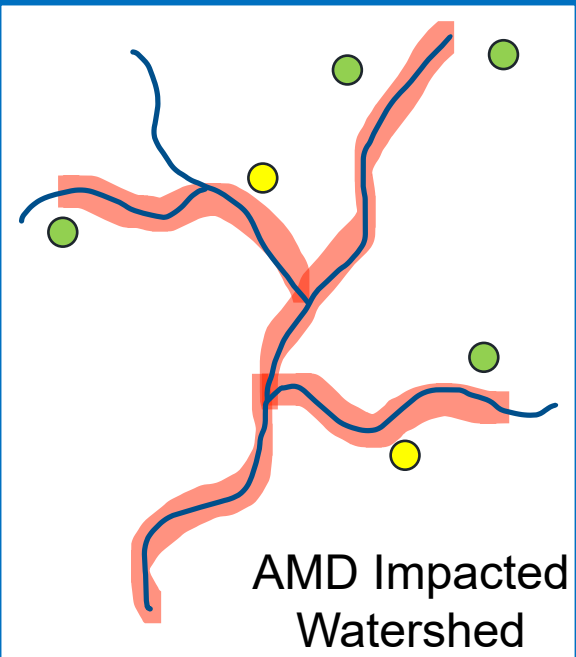
May 5, 2026

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Remediation Alternatives for AMD-impacted watersheds

- Streams
- Impairment
- AMD Sources
 - Bond Forfeiture (BF) (regulated)
 - Abandoned Mine Land (AML) (unregulated)
- Treatment
 - At-source treatment system
 - In-stream doser
 - Consolidation
 - Centralized treatment plant

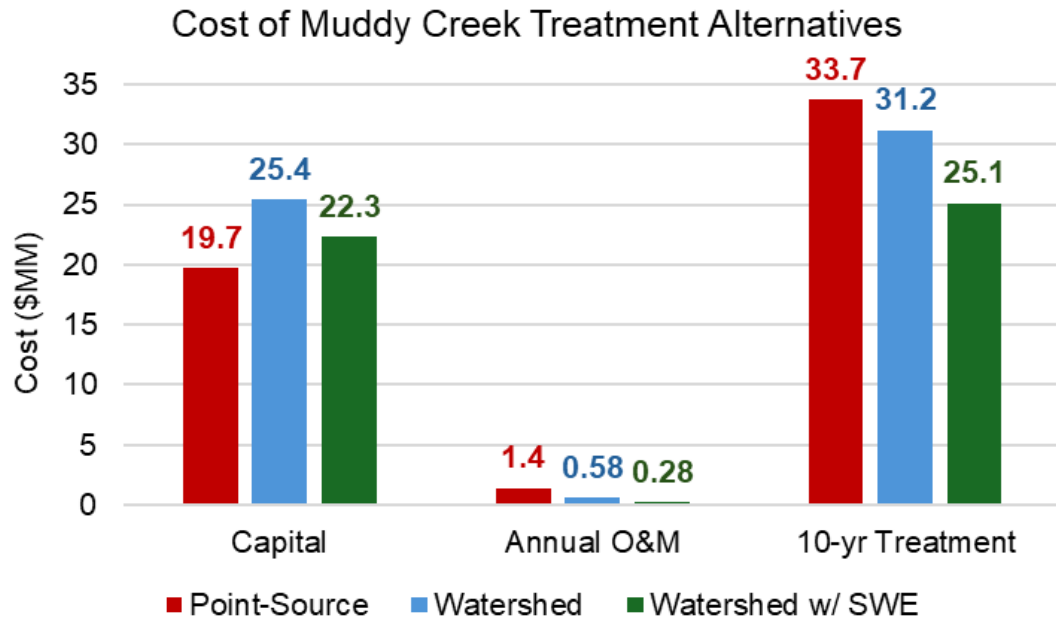


Point-Source Approach

Watershed Approach

Case Study – Muddy Creek Watershed, WV

Cost



Source: [Spirnak et al 2025](#)

Restoration



- pH increase: 4.3 to 7.3
- >80% reduction in iron/aluminum
- WVSCI score increase: 32 to 63
- Fish increase: 0 to 140 (mottled sculpin, trout)
- Improved stream length: 0 to 3.2 (Muddy) + 16 (Cheat)

Case Study – Muddy Creek Watershed

Lessons Learned

Recommendations

Jurisdictional challenges

Prioritize watersheds impacted by AML

Permitting challenges

Develop alternative watershed-based permitting structure

Sacrifice zones for dosers

Use centralized approach to highest degree possible

Maintenance challenges

Pre-treat ferrous iron
Limit hydraulic conveyance
Use mine pools as conveyance
Strategic plant placement

Sludge disposal challenges

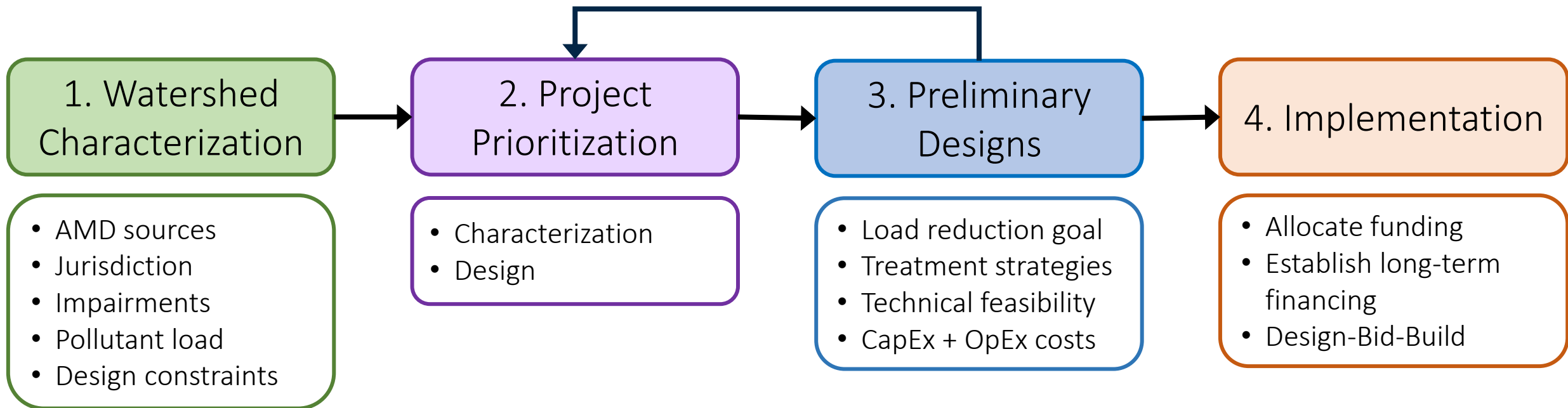
Prioritize sludge disposal

Limited baseline data

Collect robust data in characterization phase

Watershed-scale AMD remediation in WV

- **Agency:** WVDEP AML
- **Funding:** Bipartisan Infrastructure Law (BIL)
aka Infrastructure Investment and Jobs Act (IIJA)
- **Timeline:** Nov 2023 –Dec 2026
- **Objective:** Identify and develop watershed-scale AMD remediation projects

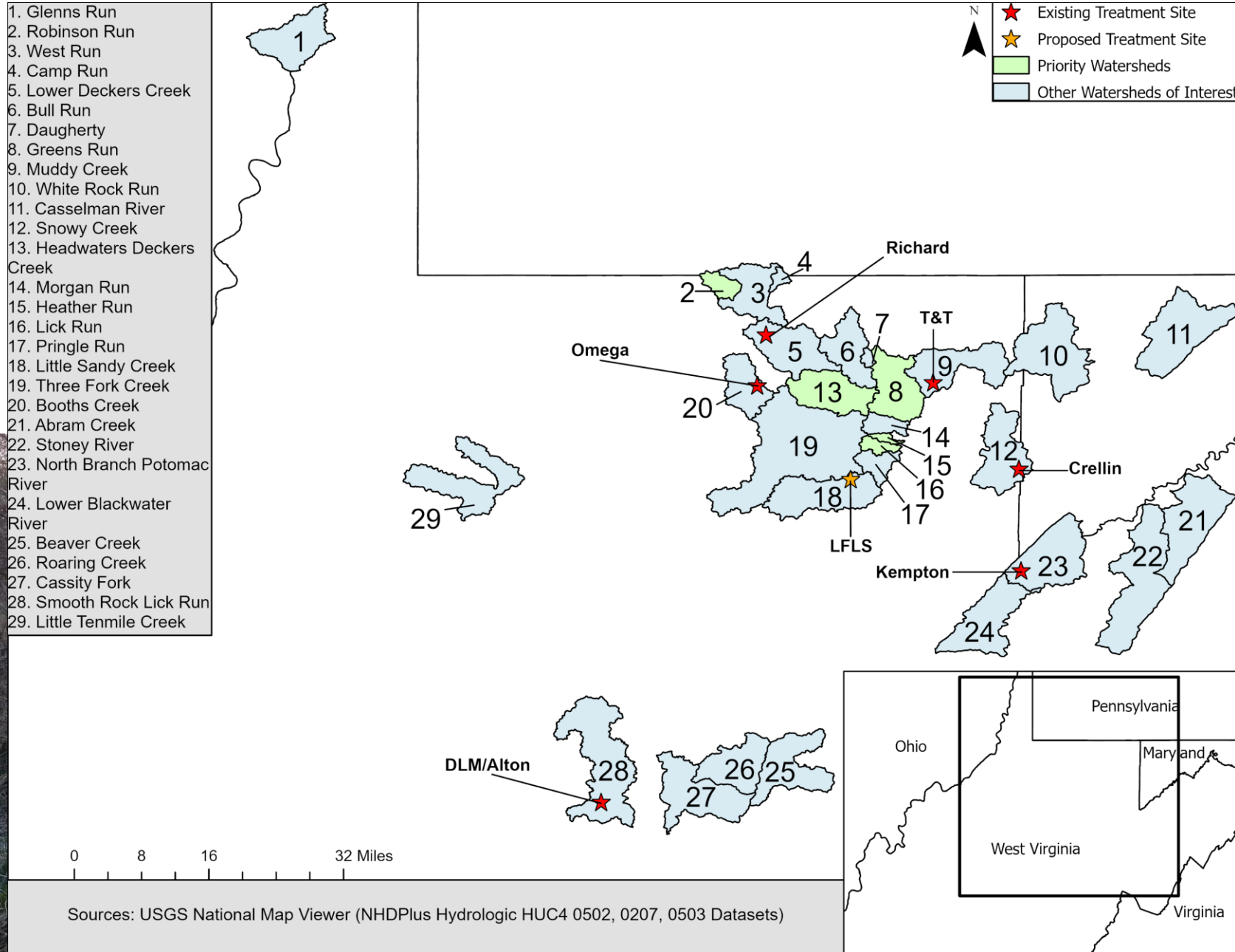


Watershed Characterization

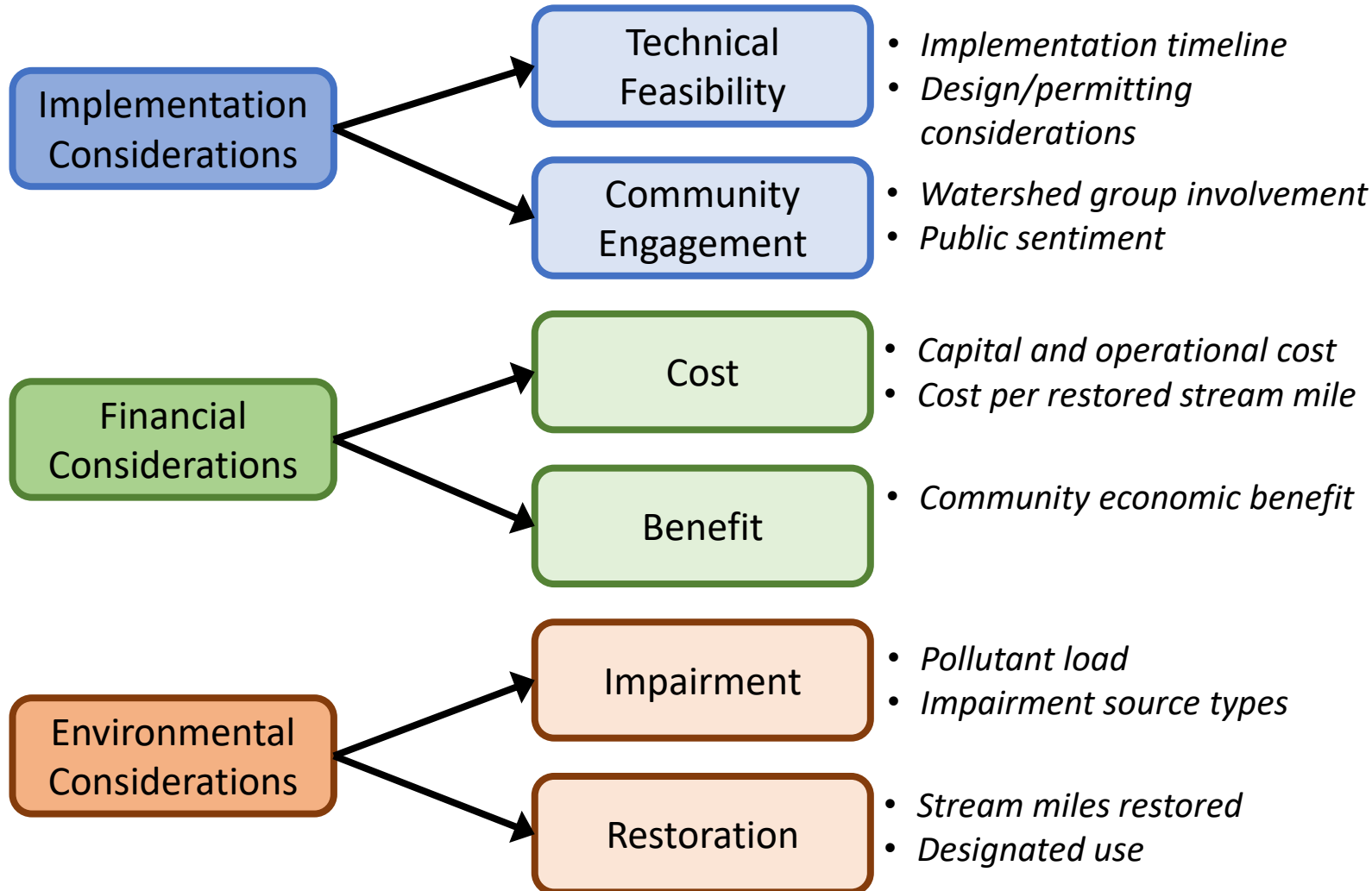
- >2,000 samples collected to date (in-stream, at-source, combined)
- 29 watersheds (and counting!) across Northern WV



1. Glens Run
2. Robinson Run
3. West Run
4. Camp Run
5. Lower Deckers Creek
6. Bull Run
7. Daugherty
8. Greens Run
9. Muddy Creek
10. White Rock Run
11. Casselman River
12. Snowy Creek
13. Headwaters Deckers Creek
14. Morgan Run
15. Heather Run
16. Lick Run
17. Pringle Run
18. Little Sandy Creek
19. Three Fork Creek
20. Booths Creek
21. Abram Creek
22. Stoney River
23. North Branch Potomac River
24. Lower Blackwater River
25. Beaver Creek
26. Roaring Creek
27. Cassity Fork
28. Smooth Rock Lick Run
29. Little Tenmile Creek



Project Prioritization



Objective: Rank/prioritize watershed-scale projects

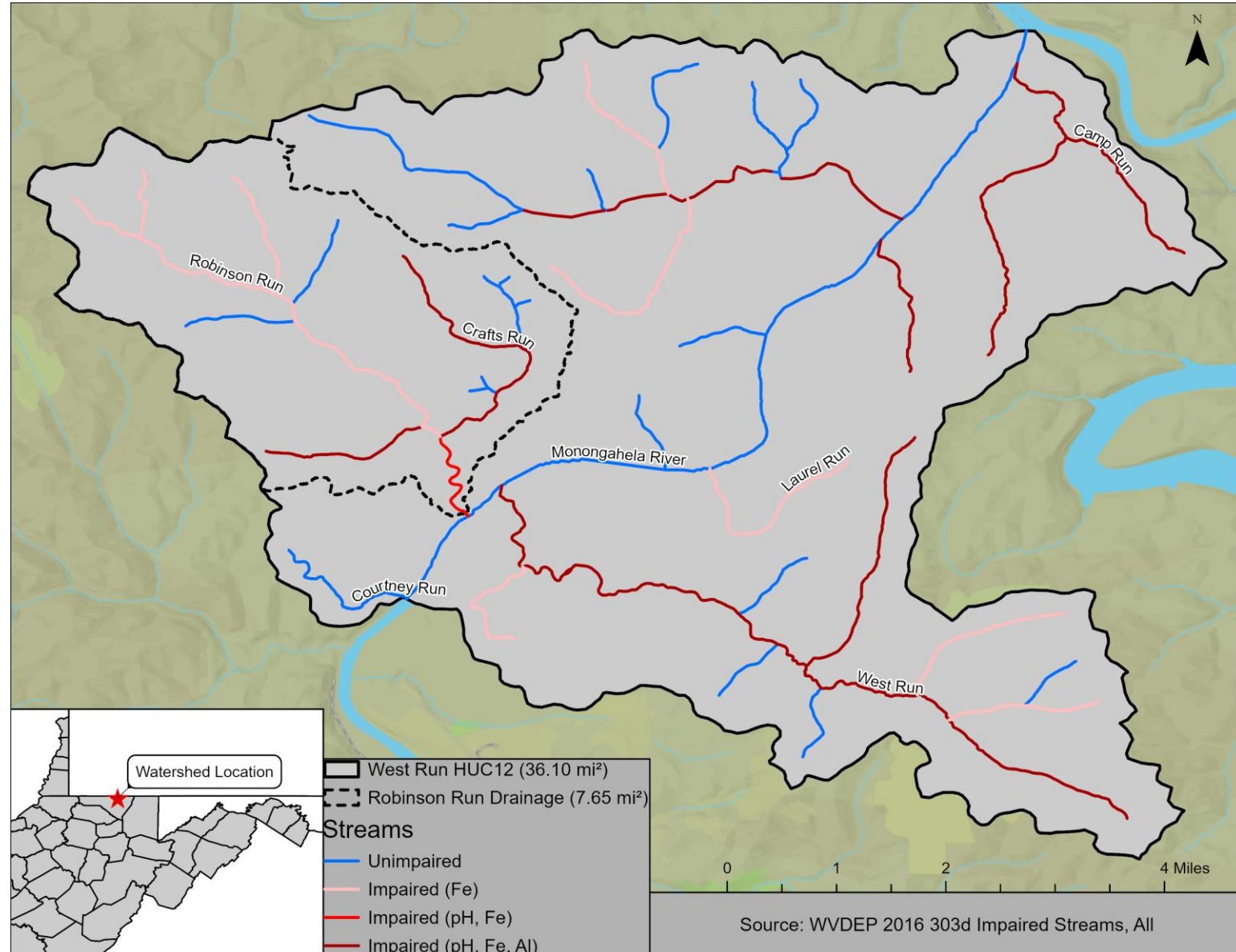
Priority Watersheds

1. Robinson Run (Mon)
2. Greens Run (Cheat)
3. Heather-Lick Run (Cheat)
4. Headwaters Deckers Creek (Mon)

[Source: Marino 2025](#)

Robinson Run Watershed

- Monongalia County, WV
- West Run HUC12
050200030309
- Discharges directly to
Monongahela River
- Drainage area 7.65 mi²
- Total stream length 13.34 mi
- 10.37 mi (78%) impaired by
AMD



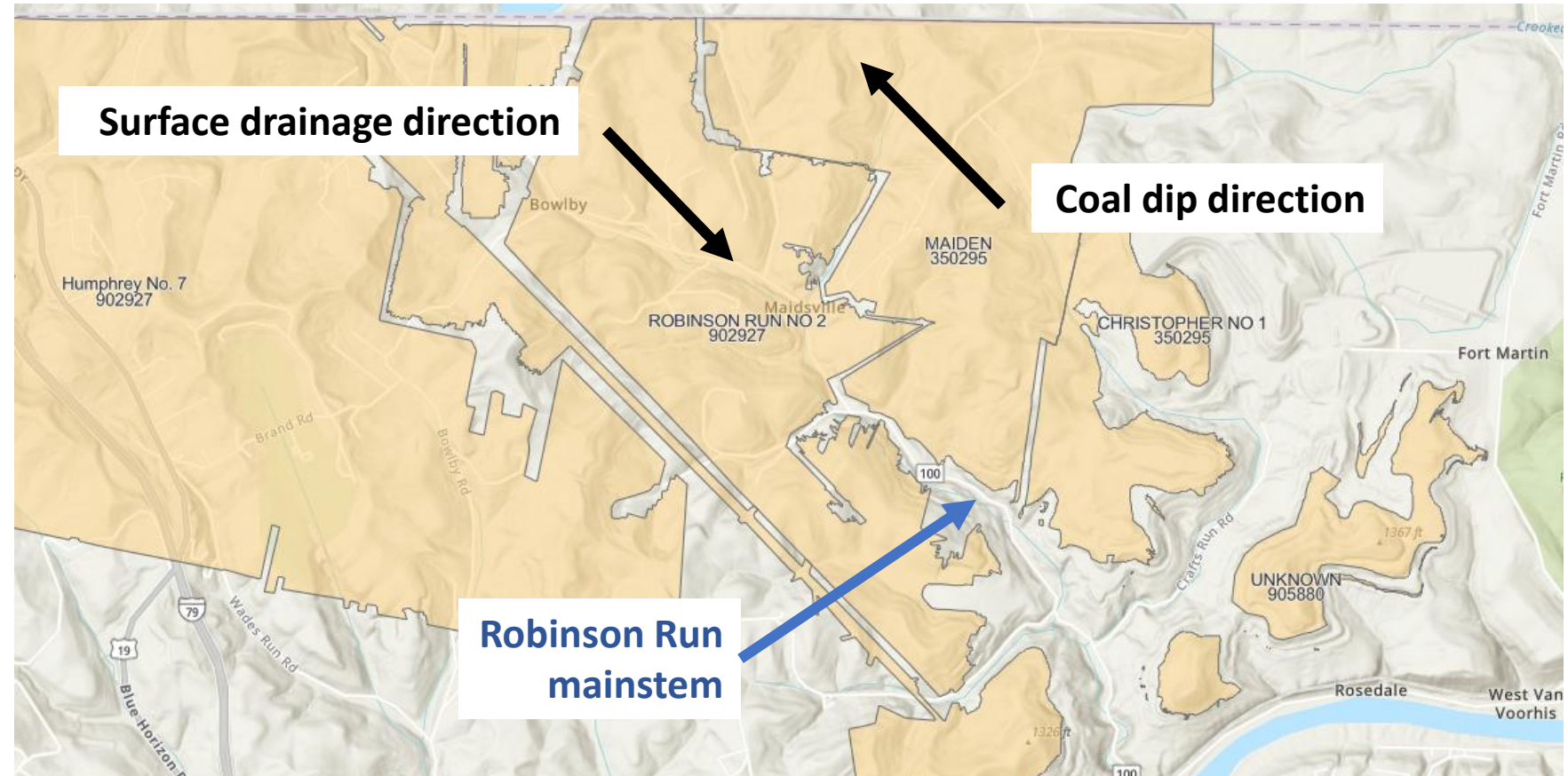
Why Robinson Run?

1. High restoration potential
2. Manageable scale
3. Good location
4. Long history of mining
5. Landowner support



Mining

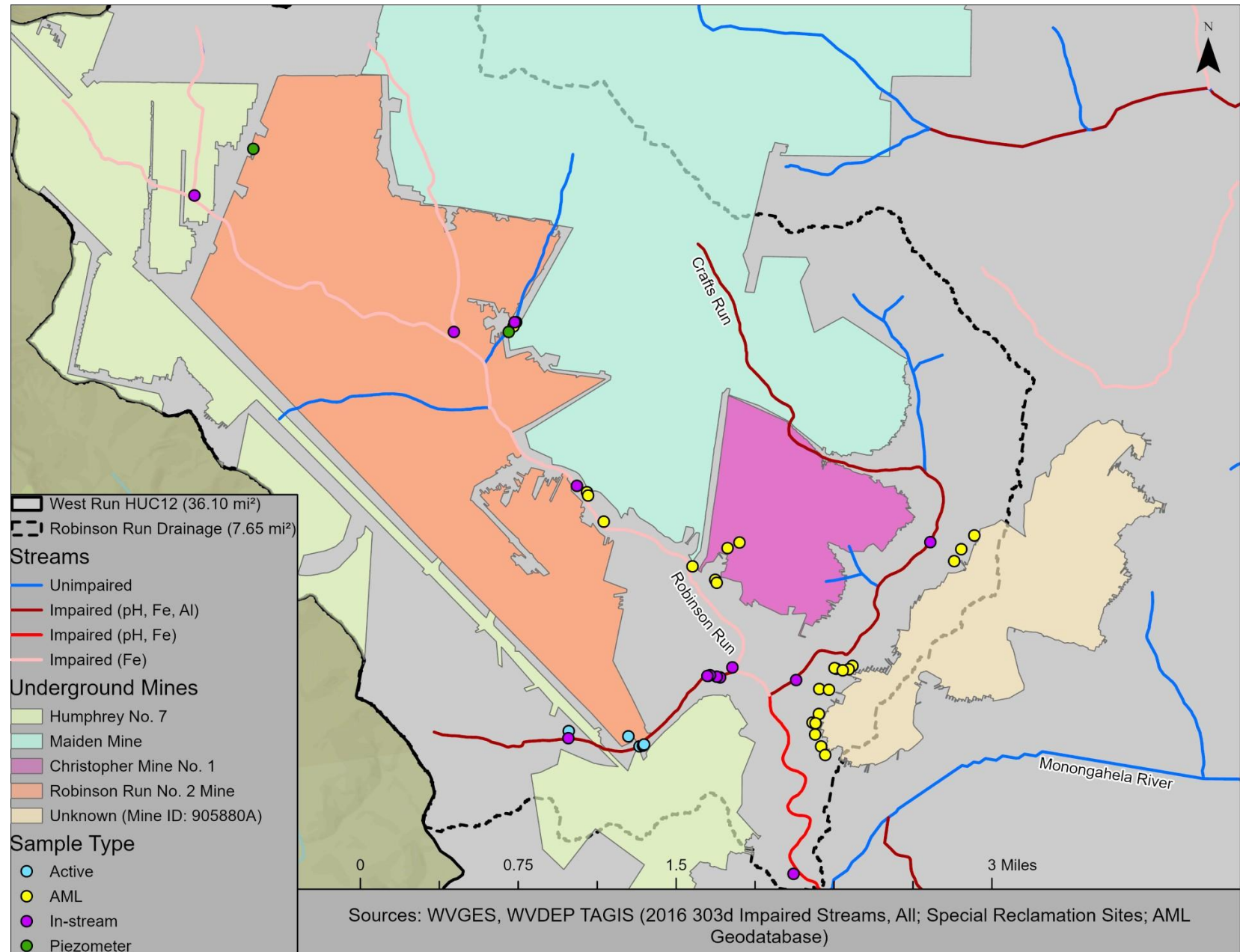
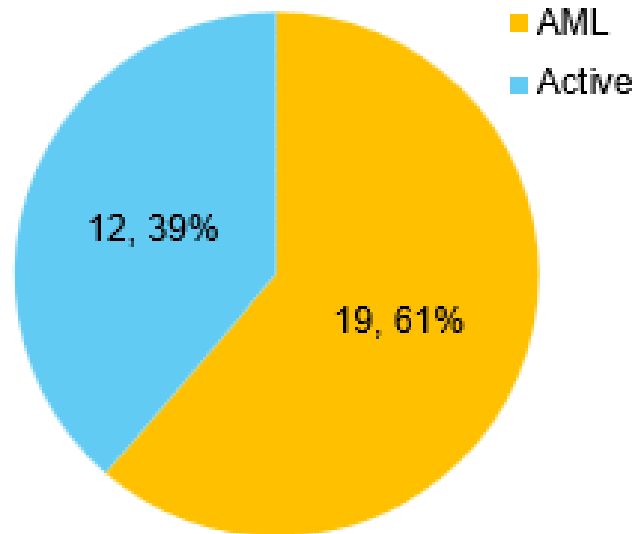
- Total underground mining 3,561 ac
- 5 primary mines of interest in Pittsburgh coal seam
- AML mining 2,514 ac (70%)
- Total AMD flow ~1,100 gpm



Mine name	Coal seam	Total area (ac)	Area within watershed (ac)	Year Mining Ended	Jurisdiction
Maiden Mine	Pittsburgh	986	765	1931	Title IV
Christopher Mine No. 1	Pittsburgh	316	316	1960	Title IV
Robinson Run No. 2	Pittsburgh	1,074	1,074	1941	Title IV
Humphrey No. 7	Pittsburgh	4,450	731	2014	Title V
Unknown (Mine ID: 905880A)	Pittsburgh	359	359	1956	Title IV
	Total	7,185	3,245		

AMD source identification

- 34 total ID'ed
 - 24 from public data
 - +10 from field reconnaissance
- **31** w/ documented AMD



Water Quality Monitoring

Per AMD source

Site Code	Sample Type	Receiving Stream	No. samples	Flow (gpm) Min	Flow (gpm) Max	Flow (gpm) Avg	pH Avg	Net acidity (mg/L)	Sulfate (mg/L)	Iron, total (mg/L)	Iron, dissolved (mg/L)	Aluminum, total (mg/L)	Aluminum, dissolved (mg/L)	Acidity load (tpy)	Iron load (tpy)	Aluminum load (tpy)
Maiden - AS - RO - 1	AML	Robinson Run	1	165	165	165	4.4	446.85	1735.17	155.68	149.21	8.50	8.10	162.21	56.51	3.09
RR MAIDEN WS	AML	Robinson Run	23	0	1152	141	4.0	546.16	2063.26	193.12	176.83	10.36	11.01	174.17	56.94	3.33
RR MAIDEN BH	AML	Robinson Run	25	10	1133	163	3.2	928.76	2702.48	238.92	233.42	49.21	48.21	368.47	92.21	19.54
RR LU Seep	AML	Robinson Run	13	8	30	17	2.6	465.12	2342.90	57.48	58.25	39.36	39.29	18.51	2.39	1.55
RR Crafts AML 1	AML	Crafts Run	7	4	33	15	2.7	757.48	1855.43	115.59	111.82	70.41	69.31	25.60	3.86	2.43
RR Crafts AML 2	AML	Crafts Run	7	5	39	23	2.7	622.54	1773.02	98.09	97.19	54.18	53.79	31.99	4.93	2.88
RR Crafts AML 3	AML	Crafts Run	7	5	39	23	2.8	416.37	1568.09	61.42	57.80	37.46	36.93	21.58	2.94	2.02
RR CR Seep SRC South	AML	Crafts Run	12	0	12	7	2.7	920.96	2368.46	118.12	113.70	97.98	94.74	12.68	1.41	1.30
RR CR Seep SRC EAST	AML	Crafts Run	12	5	31	12	2.6	1002.01	2153.34	114.84	106.15	106.85	103.09	27.19	2.88	2.61
RR LU SEEP 2 Source R	AML	Robinson Run	14	6	30	13	2.6	585.93	1947.83	57.95	56.32	64.42	63.17	16.44	1.54	1.80
RR LU SEEP 2 Source L	AML	Robinson Run	14	4	44	14	2.7	687.00	2377.03	98.82	102.38	60.93	62.37	19.72	2.55	1.73
RR LP RECON 1	AML	Robinson Run	3	1	2	2	2.8	582.53	1846.23	127.44	101.43	42.51	39.05	1.44	0.20	0.15
RR CR SEEP New	AML	Crafts Run	12	5	14	9	2.6	1314.88	2540.88	174.11	164.54	140.33	133.37	23.44	2.30	1.73
RR LU Seep 2 Channel	AML	Robinson Run	11	3	330	40	8.0	-212.51	1380.63	0.66	0.47	0.11	0.31	-2.21	0.03	0.13
RR LP RECON 2	AML	Robinson Run	2	1	8	4	2.7	-	2511.27	-	-	-	-	-	-	-
RR WS 2	AML	Robinson Run	1	2	2	2	3.3	199.60	1108.93	5.90	10.40	27.31	27.15	0.92	0.03	0.13
RR LP RECON	AML	Robinson Run	3	1	2	1	2.8	148.44	1487.78	13.01	9.70	16.33	-	-	-	-
RR LU SEEP 2 Channel Mid Fork	AML	Robinson Run	1	0	0	-	6.9	-	-	-	-	-	-	-	-	-
RR LU SEEP 2 Channel L Fork	AML	Robinson Run	1	0	0	-	7.1	-	-	-	-	-	-	-	-	-
RR LU SEEP 2 Channel R Fork	AML	Robinson Run	1	0	0	-	7.6	-	-	-	-	-	-	-	-	-
RR DANA PORTAL	AML	UNT/Robinson Run RM 2.75	8	4	20	10	6.7	-241.45	599.38	17.93	2.49	0.10	-	-	-	-
RR DANA PORTAL 2	AML	UNT/Robinson Run RM 2.75	8	0	6	3	6.7	-220.74	710.04	52.78	0.58	0.36	-	-	-	-
RR LP Recon 4	AML	Robinson Run	3	0	1	1	2.8	398.56	1644.04	53.43	45.34	39.75	-	-	-	-
RR LP Recon Pond	AML	Robinson Run	3	0	0	-	2.8	-	3070.82	-	-	-	-	-	-	-
RR LP Recon 1.5	AML	Robinson Run	2	5	5	5	2.5	537.91	1716.38	53.64	48.95	52.86	-	-	-	-
RR Beth 1	Active	UNT/Robinson Run RM 1.09	9	0	4	2	3.2	1650.38	4143.11	132.66	45.23	275.85	-	-	-	-
RR Beth 2	Active	UNT/Robinson Run RM 1.09	2	3	3	3	2.5	1203.17	2018.43	220.58	216.40	76.65	-	-	-	-
RR-U-119-83	Active	UNT/ Robinson Run RM 1.09	1	9	9	9	2.7	1536.95	2950.25	308.57	287.58	134.02	-	-	-	-
RR-U-119-83 LEFT SEEP	Active	UNT/ Robinson Run RM 1.09	1	15	15	15	2.5	1370.58	2595.83	282.16	260.21	115.52	-	-	-	-
RR-U-119-83 EFFLUENT	Active	UNT/ Robinson Run RM 1.09	1	2	2	2	7.8	-211.17	450.96	0.10	0.42	0.07	-	-	-	-
RR U-119-83 POND	Active	UNT/ Robinson Run RM 1.09	12	100	100	100	2.7	786.96	1964.54	118.34	113.55	75.04	-	-	-	-
RR-Chris-P	Piezometer	NA	6	0	0	-	8.0	-1440.58	54.11	21.80	0.15	0.10	-	-	-	-
RR Maid P	Piezometer	NA	9	0	0	-	6.8	-423.36	575.21	1861.30	0.51	0.07	-	-	-	-

- Monthly sampling since April 2023
- 339 samples to date

Watershed totals/averages

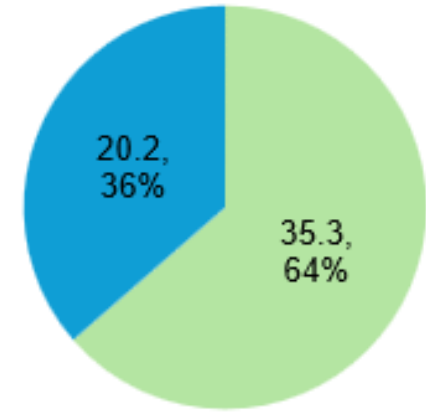
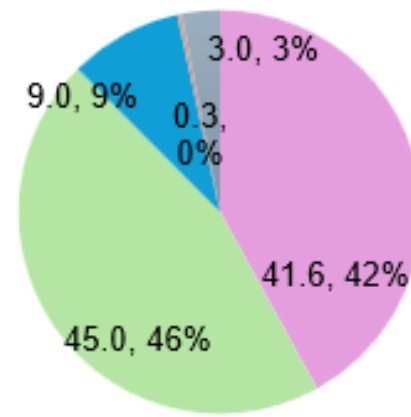
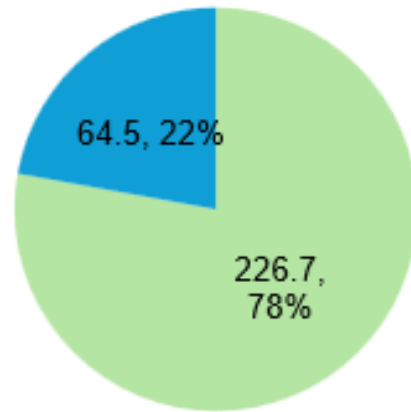
Flow (gpm), total	815
pH, avg	4.0
Net acidity (mg/L), avg	494
Total iron (mg/L), avg	164
Total aluminum (mg/L), avg	55
Acidity load (tpy), total	1143
Iron load (tpy), total	276
Aluminum load (tpy), total	70

Pollutant loads

Source	Pollutant loads (tpy)		
	Acidity	Iron	Aluminum
TMDL (2014)	291	362	183
Source sampling (2024-2026)	1,143	276	70

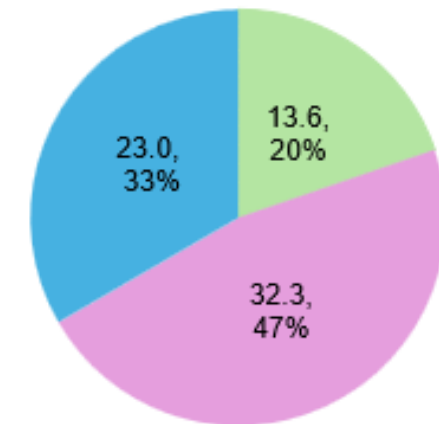
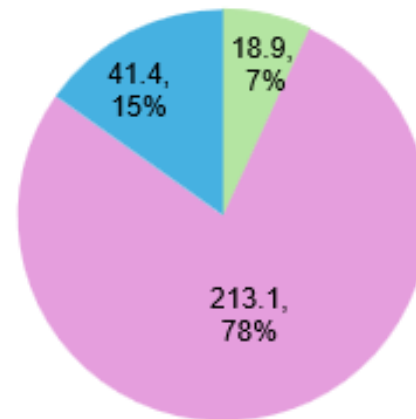
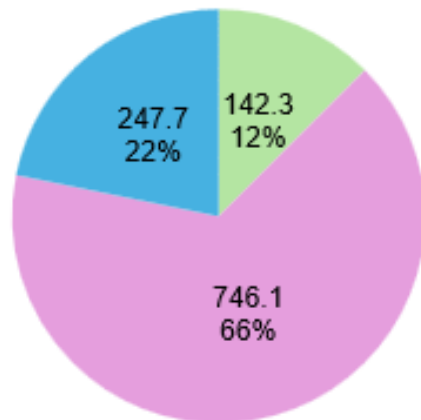
TMDL
(2014)

- Robinson Run
- Crafts Run
- UNT/Robinson Run RM 1.09
- UNT/Robinson Run RM 2.91
- UNT/Robinson Run RM 4.09



Source
Sampling
(2024-2026)

- Crafts Run
- Robinson Run
- UNT/Robinson Run RM 1.09



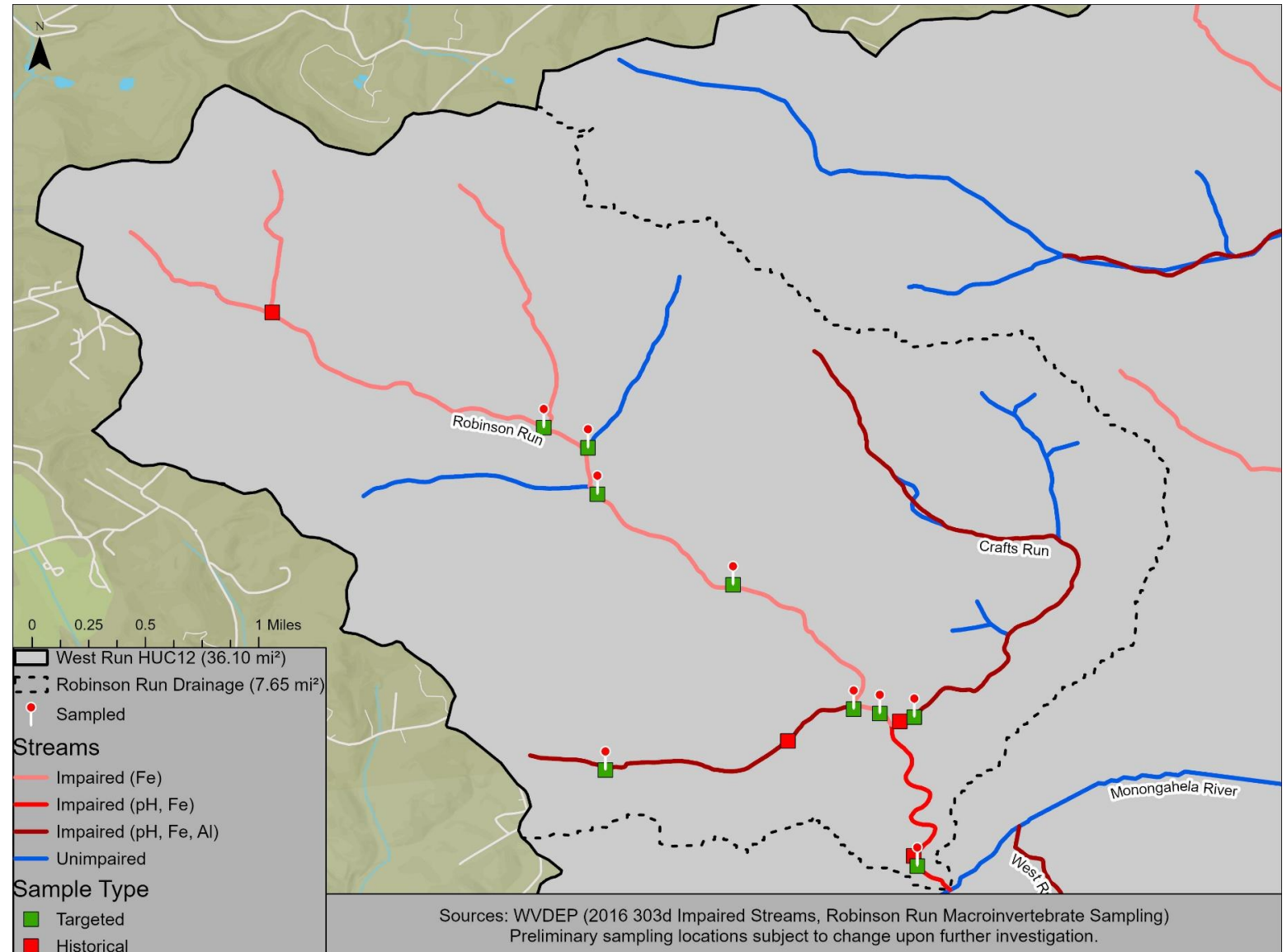
Acidity

Iron

Aluminum

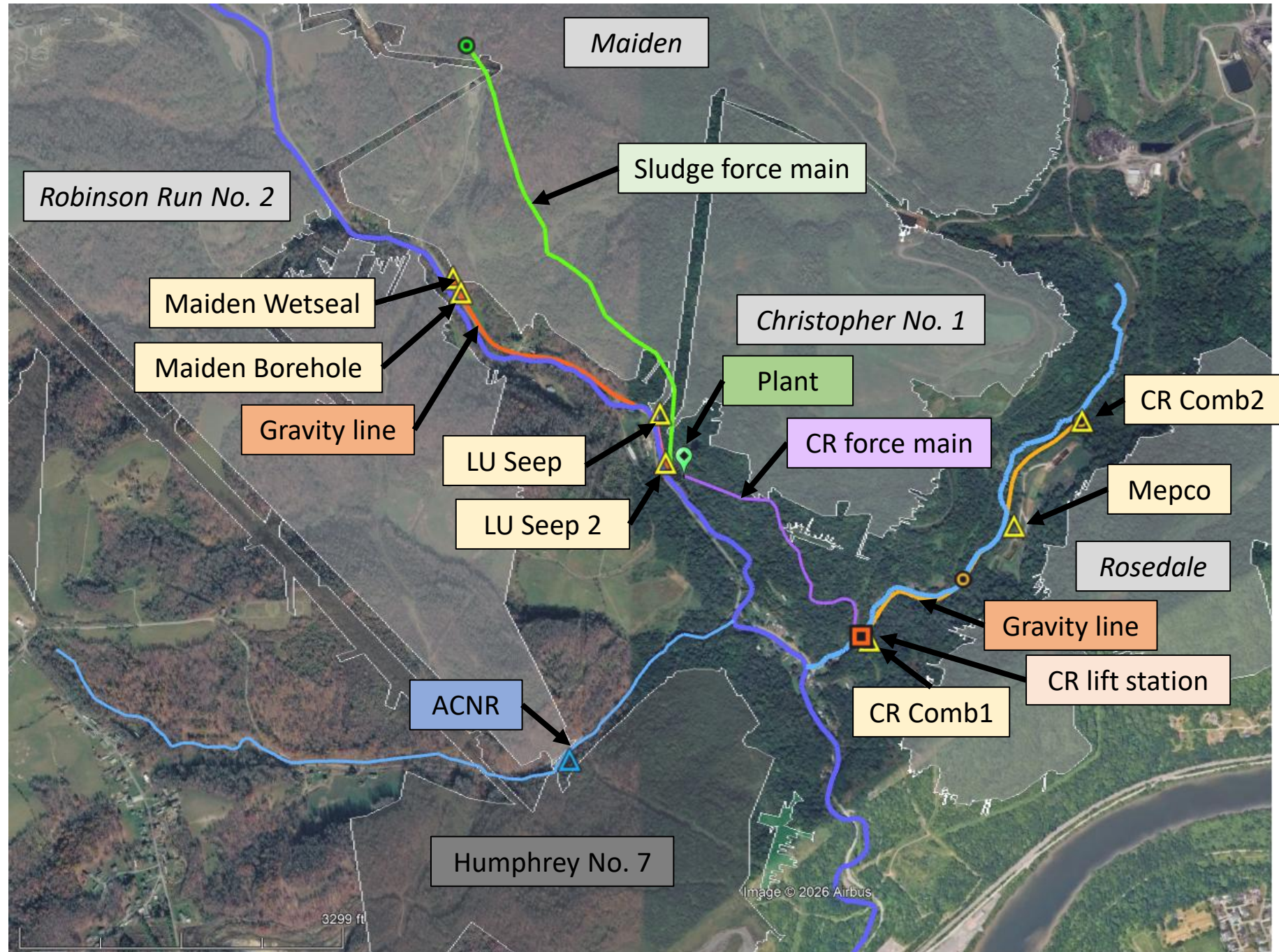
Biological Monitoring

- Murry Lab, WVU Davis College
- Macroinvertebrate samples and fish surveys
- Conducted for pre-treatment baseline
- Classification in progress



Conceptual Plan for Treatment

- ~\$11.3MM
- Collection and gravity convey or RR sources
- Collection and pumping of CR sources
- Sludge disposal in Maiden Mine



Restoration potential

Robinson has good WQ and aquatic life upstream of Maiden Mine discharges!

- pH 8
- Total Fe 1.4 mg/L
- Total Al 1.3 mg/L
- Acidity -133.7 mg/L



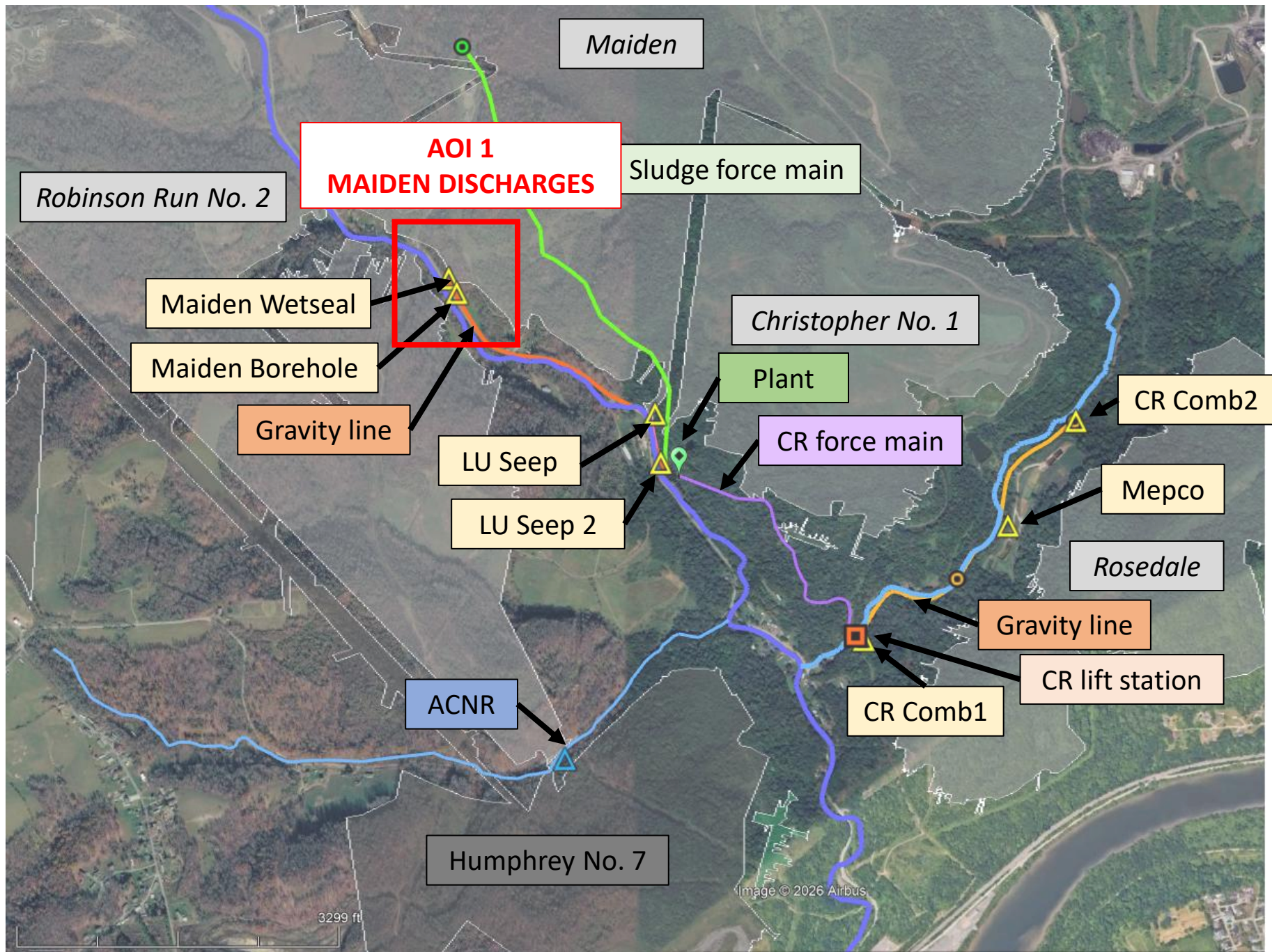
mixing w/ Maiden
at low flow

upstream of Maiden

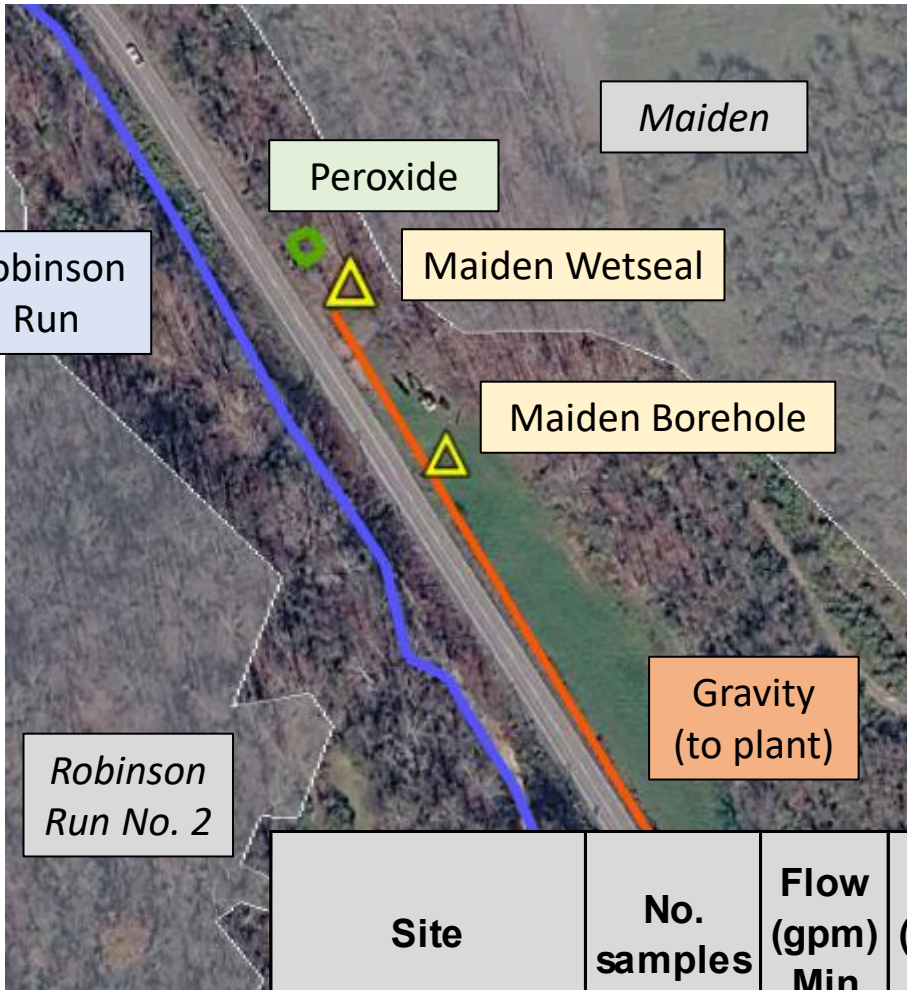


downstream of Maiden



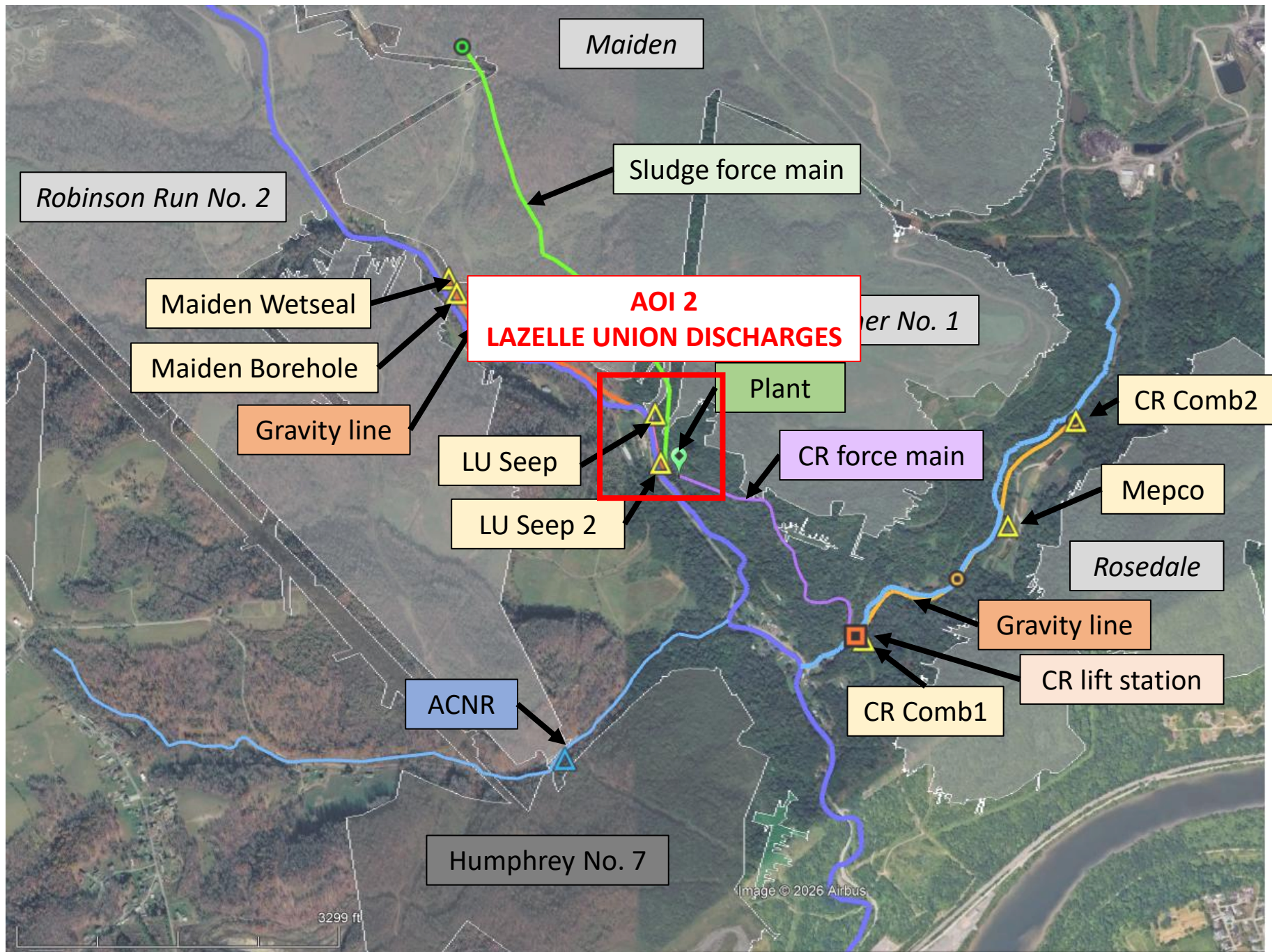


AOI 1 – Maiden discharges



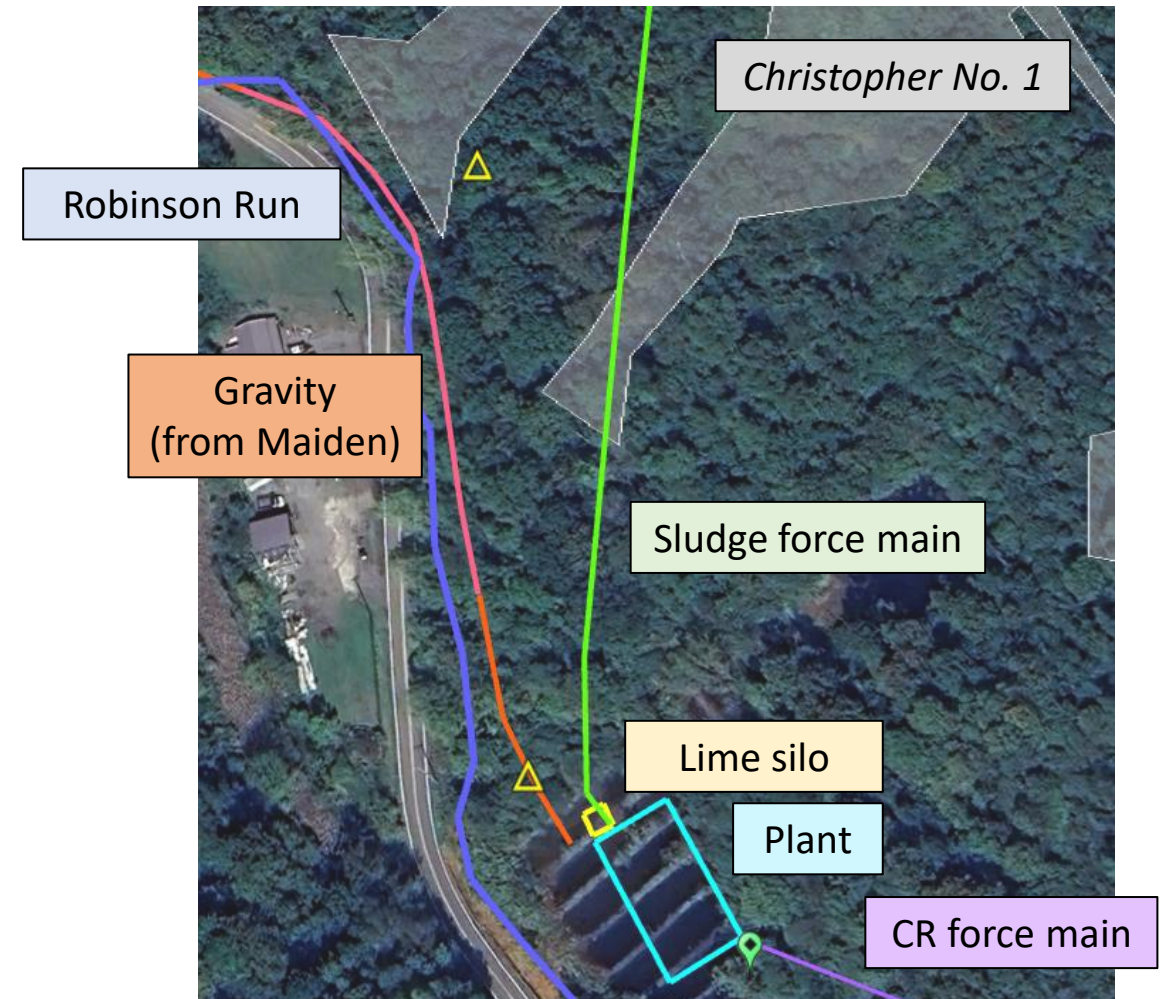
- Prior AML project (land reclamation, wetseal) after [prior blowout](#)
- Collection and gravity conveyance to plant
- Ferrous iron (peroxide for pre-treatment)
- Flow anomalies
 - Installed flow loggers
 - Monitoring piezometers in Maiden and Robinson Run No.2

Site	No. samples	Flow (gpm) Min	Flow (gpm) Max	Flow (gpm) Avg	pH Avg	Net acidity (mg/L)	Iron, total (mg/L)	Iron, dissolved (mg/L)	Aluminum, total (mg/L)	Acidity load (tpy)	Iron load (tpy)	Aluminum load (tpy)
Maiden Wetseal	23	0	1152	141	4.0	546.2	193.1	176.8	10.4	174.2	56.9	3.3
Maiden Borehole	25	10	1133	163	3.2	928.8	238.9	233.4	49.2	368.5	92.2	19.5

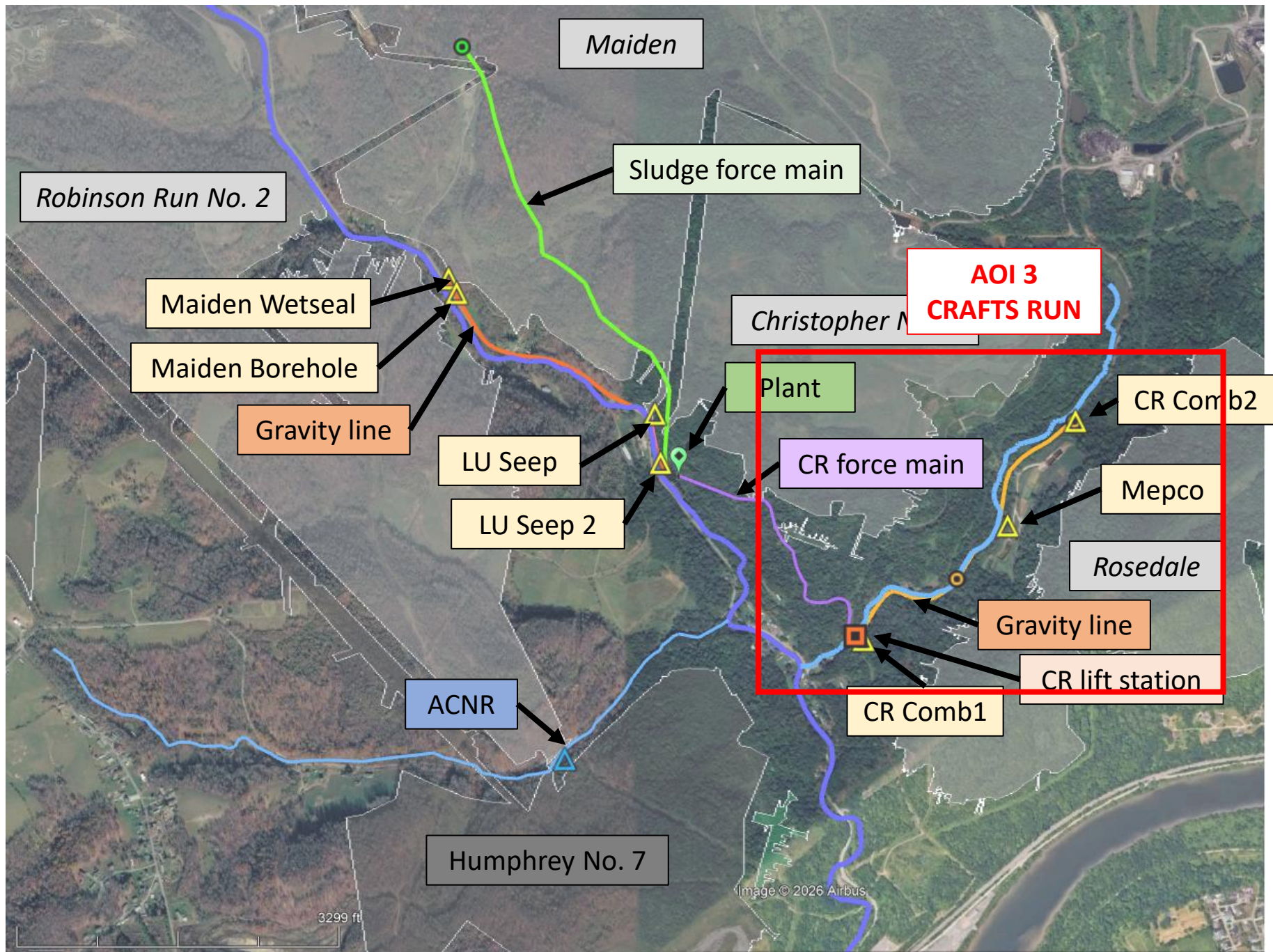


AOI 2 – Lazelle Union discharges

- Proposed plant site location
- Collection and gravity conveyance to plant
- Reclamation of “11 Ponds” site

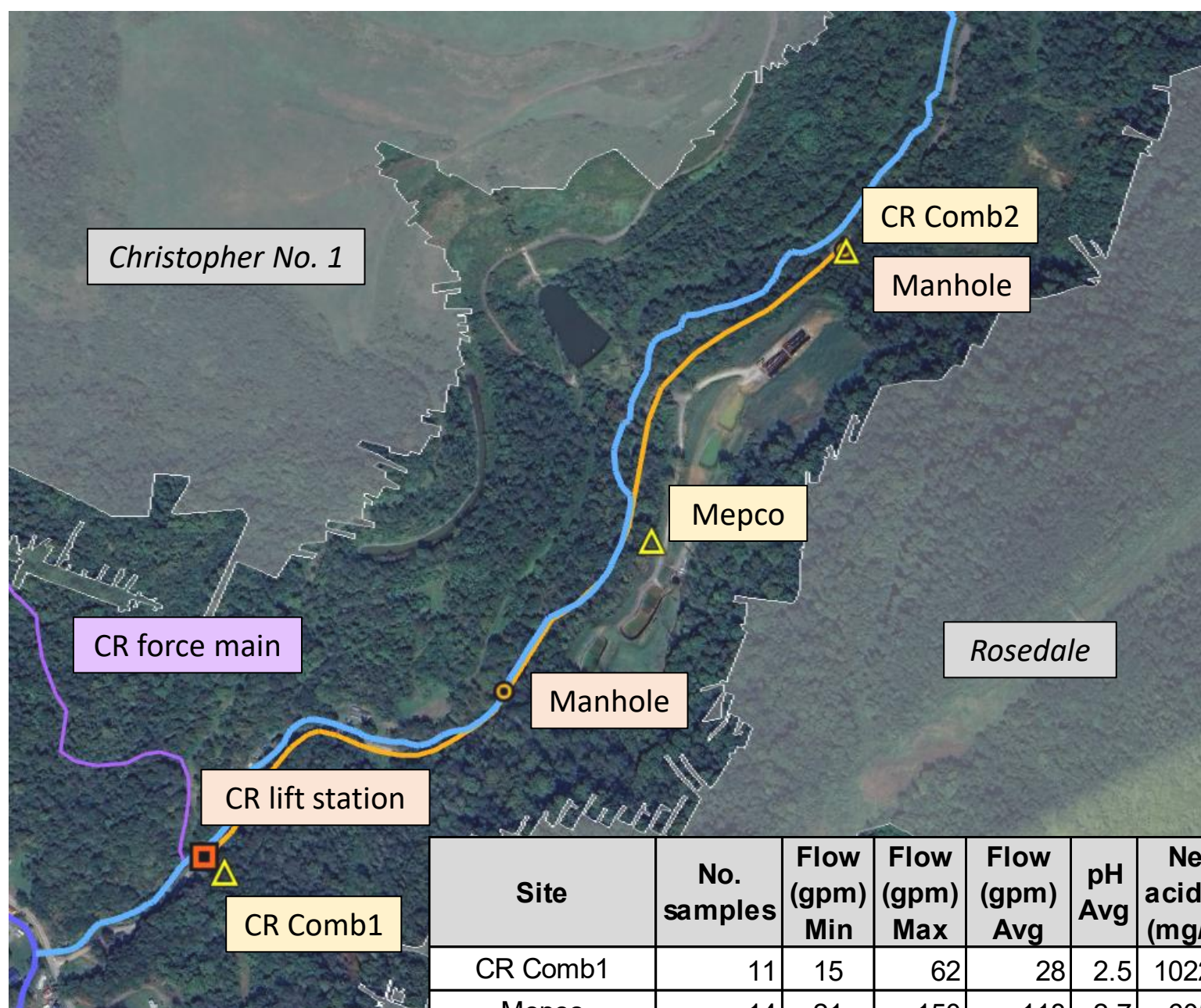


Site	No. samples	Flow (gpm) Min	Flow (gpm) Max	Flow (gpm) Avg	pH Avg	Net acidity (mg/L)	Iron, total (mg/L)	Iron, dissolved (mg/L)	Aluminum, total (mg/L)	Acidity load (tpy)	Iron load (tpy)	Aluminum load (tpy)
LU Seep	13	8	30	17	2.6	465.1	57.5	58.2	39.4	18.5	2.4	1.6
LU Seep 2 (right)	14	6	30	13	2.6	585.9	57.9	56.3	64.4	16.4	1.5	1.8
LU Seep 2 (left)	14	4	44	14	2.7	687.0	98.8	102.4	60.9	19.7	2.6	1.7

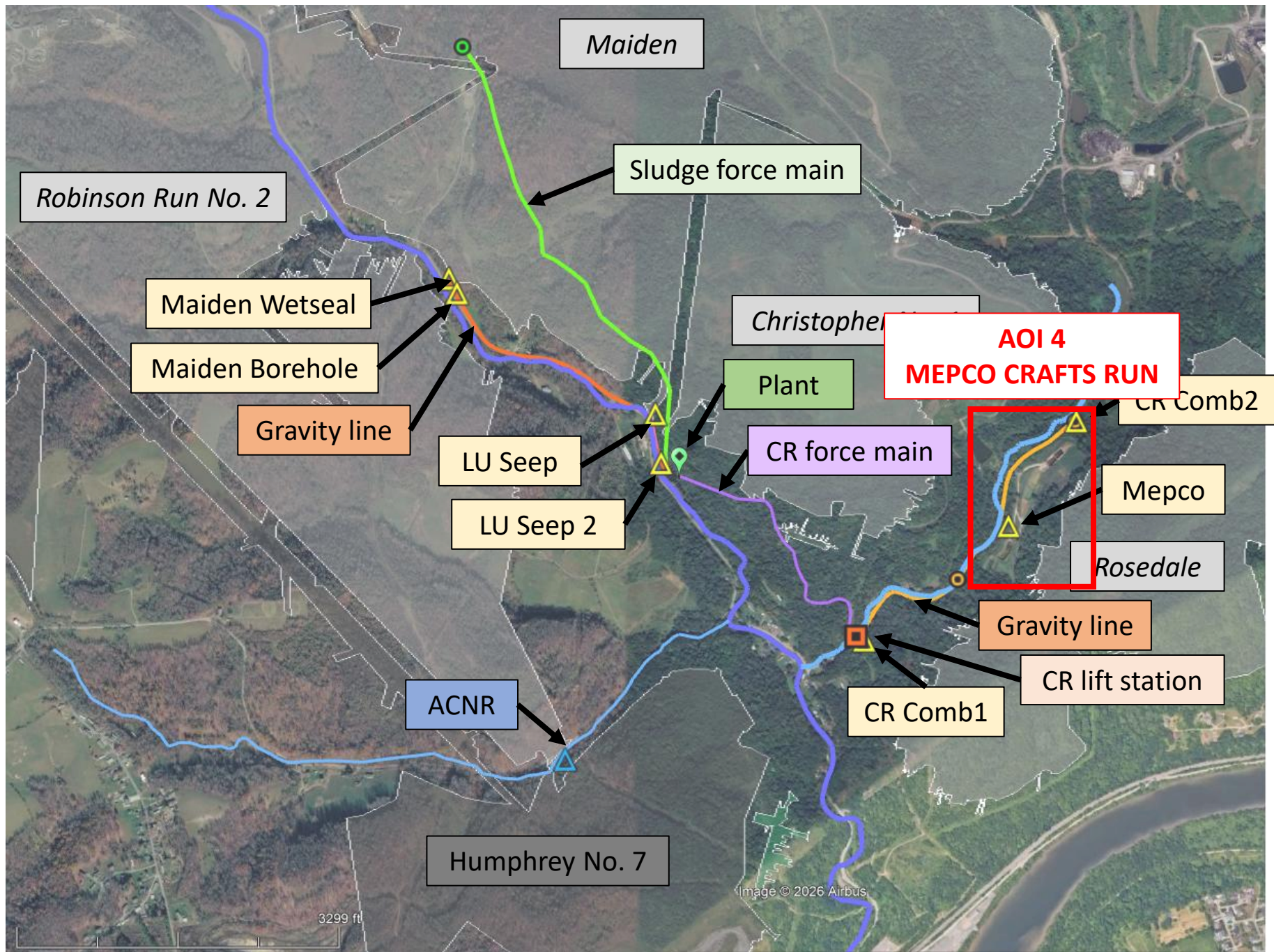


AOI 3 – Crafts Run

- Several AML discharges from Rosedale Mine
 - Treated by Mepco OR
 - Discharge as combined sources into CR
- Lift station to plant at DS collection point



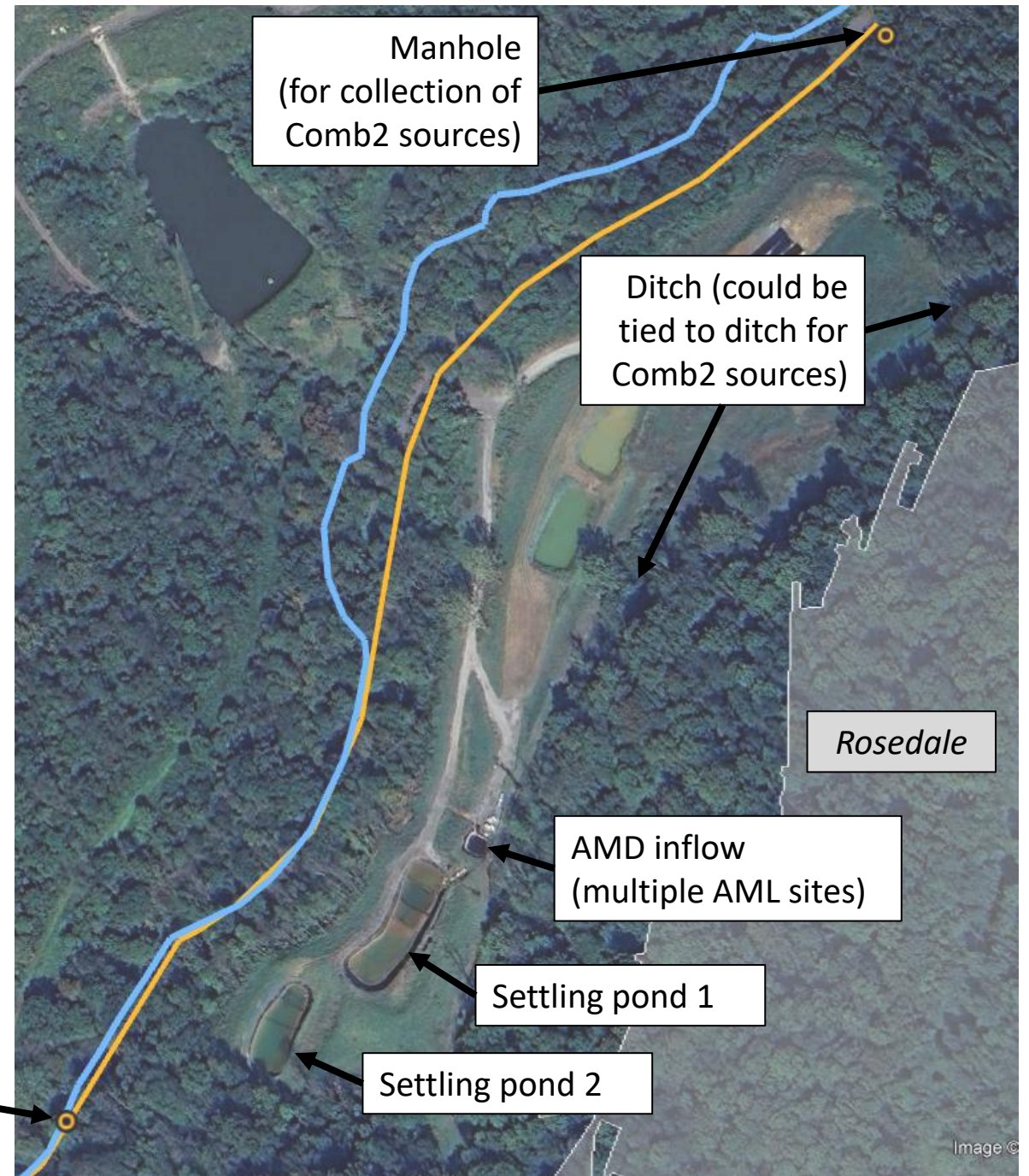
Site	No. samples	Flow (gpm) Min	Flow (gpm) Max	Flow (gpm) Avg	pH Avg	Net acidity (mg/L)	Iron, total (mg/L)	Iron, dissolved (mg/L)	Aluminum, total (mg/L)	Acidity load (tpy)	Iron load (tpy)	Aluminum load (tpy)
CR Comb1	11	15	62	28	2.5	1022.9	114.2	113.5	107.3	56.7	6.1	6.1
Mepco	14	21	150	118	2.7	605.7	87.7	73.9	61.2	173.3	26.2	17.4
CR Comb2	13	7	59	27	3.1	446.6	56.2	52.6	44.5	22.3	3.0	2.3



AOI 4 – Mepco CR Treatment System

- Passive treatment system (caustic drip, ponds) operated by Mepco
- Multiple AMD discharges from Rosedale
- Potential pre-treatment infrastructure for centralized system

Manhole
(future collection)



Manhole
(for collection of
Comb2 sources)

Ditch (could be
tied to ditch for
Comb2 sources)

Rosedale

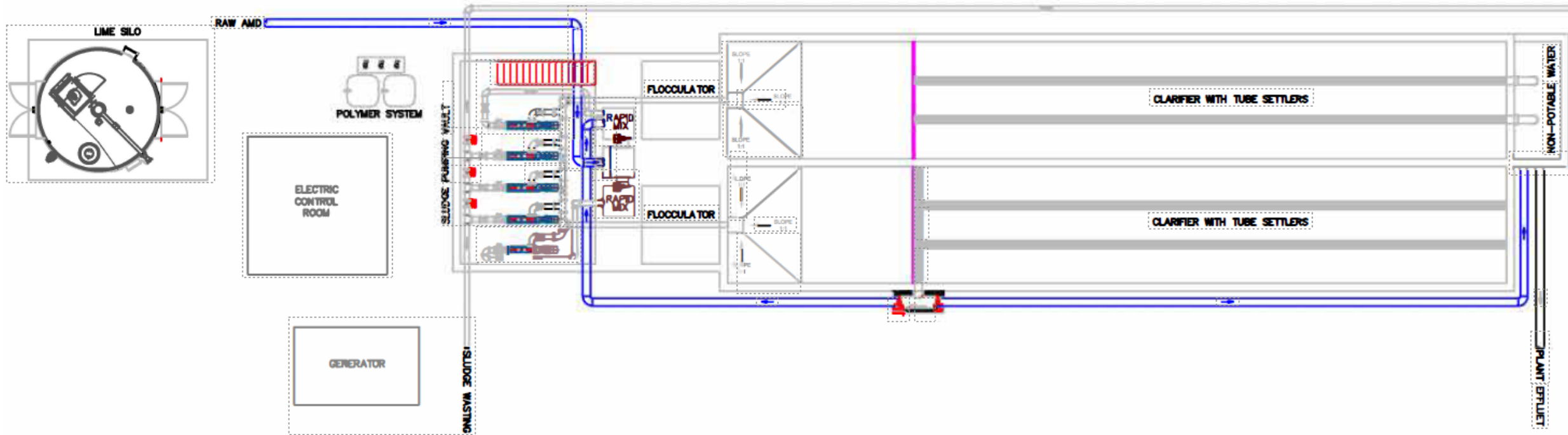
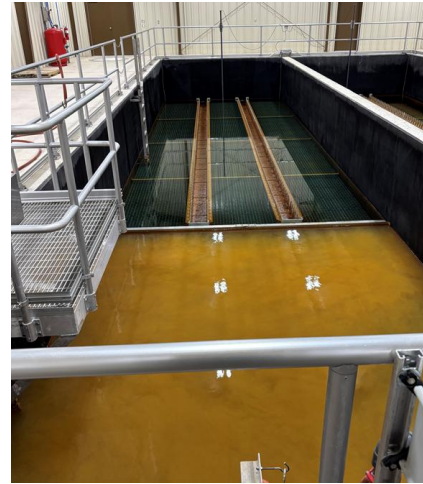
AMD inflow
(multiple AML sites)

Settling pond 1

Settling pond 2

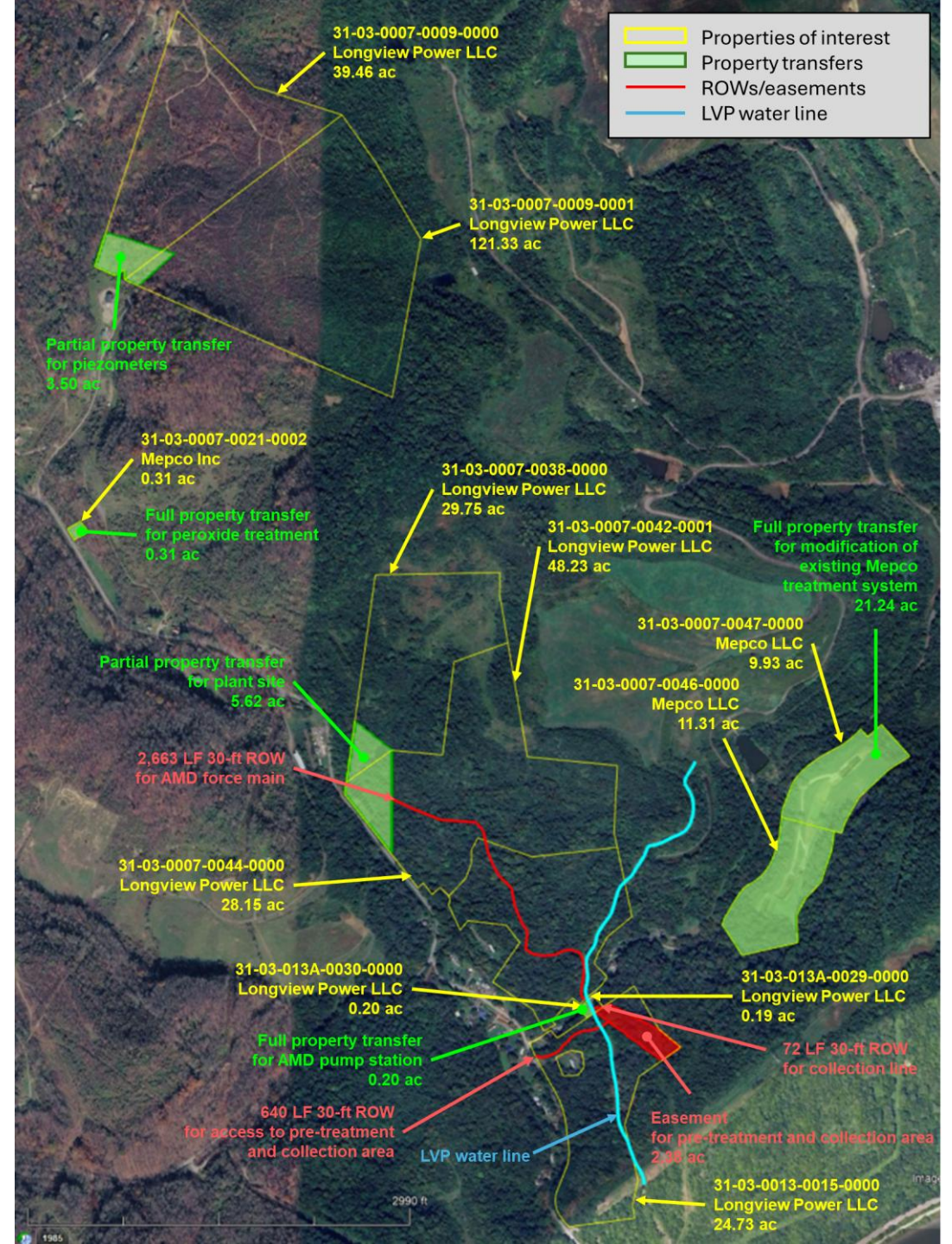
Centralized Treatment Plant

- Follows model of modern WVDEP plants
 - A34, C1, Richard
 - Rectangular clarifiers
 - Hydrated lime
- Max flow 2,500 gpm



Landowner Support

- 11 properties owned by Mepco and Longview Power
- Easements, ROWs, and property transfers (including proposed Plant site)



Next steps

- **Robinson Run**
 - **Complete preliminary (30%) plans (75% complete), provide to DEP AML for implementation**
 - **Updated WBP for West Run (319 program)**
- **WVDEP AML Project**
 - **Preliminary plans for current “priority projects”**
 - **Next round of “priority projects” in 2027**
 - **Expand into watersheds beyond the Cheat/Mon**

Rank	Project	Benefits	Challenges
1	Robinson Run	<ul style="list-style-type: none"> • High restoration impact • Manageable scale 	<ul style="list-style-type: none"> • High proportion of active discharges • Singular property for plant location • Requires pumping of sources
2	Greens Run	<ul style="list-style-type: none"> • High restoration impact • Manageable scale • High proportion of AML discharges • Landowner support 	<ul style="list-style-type: none"> • Limited properties for plant location
3	Heather/Lick Run	<ul style="list-style-type: none"> • High restoration impact • Could be completed in two phases. 	<ul style="list-style-type: none"> • Large scale • Complex design • Limited properties for plant location • Morgan Run and Pringle Run remaining impact on Cheat River
4	Headwaters Deckers Creek	<ul style="list-style-type: none"> • Moderate restoration impact • High proportion of AML discharges • Strong watershed group interest • Existing passive systems somewhat effective. 	<ul style="list-style-type: none"> • Sources spatially dispersed • Requires multiple individual treatment systems. • Landowner sentiment at existing treatment systems (i.e., Satcher Portals)
5	Pringle Run	<ul style="list-style-type: none"> • High restoration impact • Stream is good physical condition 	<ul style="list-style-type: none"> • Limited data • Multiple sources in headwaters
6	Morgan Run	<ul style="list-style-type: none"> • High restoration impact • Potential plant location identified 	<ul style="list-style-type: none"> • Sources spatially dispersed • Limited data
7	Bennetts Run (Little Tenmile Creek)	<ul style="list-style-type: none"> • Sources in proximity 	<ul style="list-style-type: none"> • Topographic constraints will limit potential plant sites
8	Roaring Creek/Grassy Run	<ul style="list-style-type: none"> • TBD 	<ul style="list-style-type: none"> • TBD

Acknowledgements



Friends of the Cheat



Questions?

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