

The recovery of an AMD-impacted stream treated by steel slag leach beds: A case study in the East Branch of Raccoon Creek

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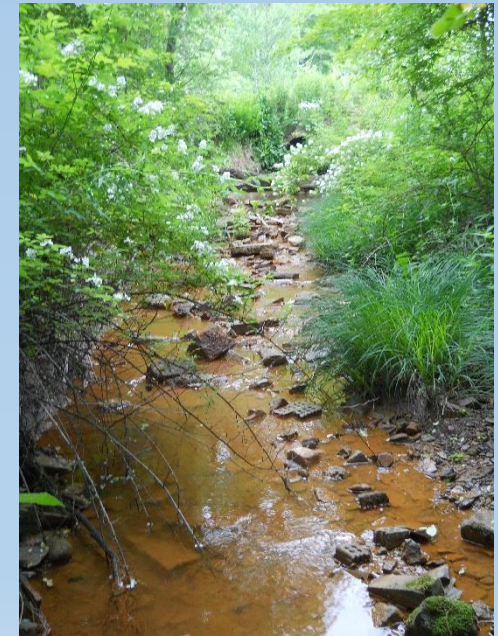
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East Branch

- Drainage Area 19.95 mi² (12,768 acres)
- Approximately 8 miles long, average elevation change per mile = 19.5ft
- 5% of land affected by underground mines (approx. 576 acres)
- 15% land affected by surface mine (approx. 1983 acres)
- *Pre-reclamation: largest contributor of acidity to headwaters of Raccoon Creek*



East Branch Characteristics

- Unglaciaded region of Allegheny plateau
- Mississippian and Pennsylvanian sedimentary rocks
- Sandstone, shale, conglomerate, with bituminous coal (high in S)
- Mined since the 1800's



Reclamation and Restoration

- Over \$2,000,000 in reclamation projects
 - Reclaimed gob piles
 - Three Phases of Steel Slag Bed Construction (11 SSLBs)
 - Limestone channels
- Phase I completed December 2008 (EB210)
 - Reduced acid load from 1175 lbs/day to 1 lb/day
 - Reduced metal load 186 lbs/day to 46 lbs/day
- Phase II and III (completed in Dec 2010 and Spring 2011)
 - Reduced acid load from 251 lbs/day to 36 lbs/day
 - EB190



Primary Research Questions

- Relationship between MAIS values (rapid bioassessments), sediment chemistry, and aqueous chemistry?
- Are there definable zones of recovery below steel slag leach beds?
- How does the alkalinity budget change from the treatments in the headwaters to the mouth of East Branch?



Methods

- Rapid bioassessment (MAIS)
 - 5 sites along mainstem
 - 150 m reach
 - 3 kick nets, 20 dips nets
 - Evaluated/scored by RCP
- Qualitative Habitat Evaluation Index
- Water quality samples
 - YSI sonde or Myron Ultrameter
 - Filtered and non-filtered samples

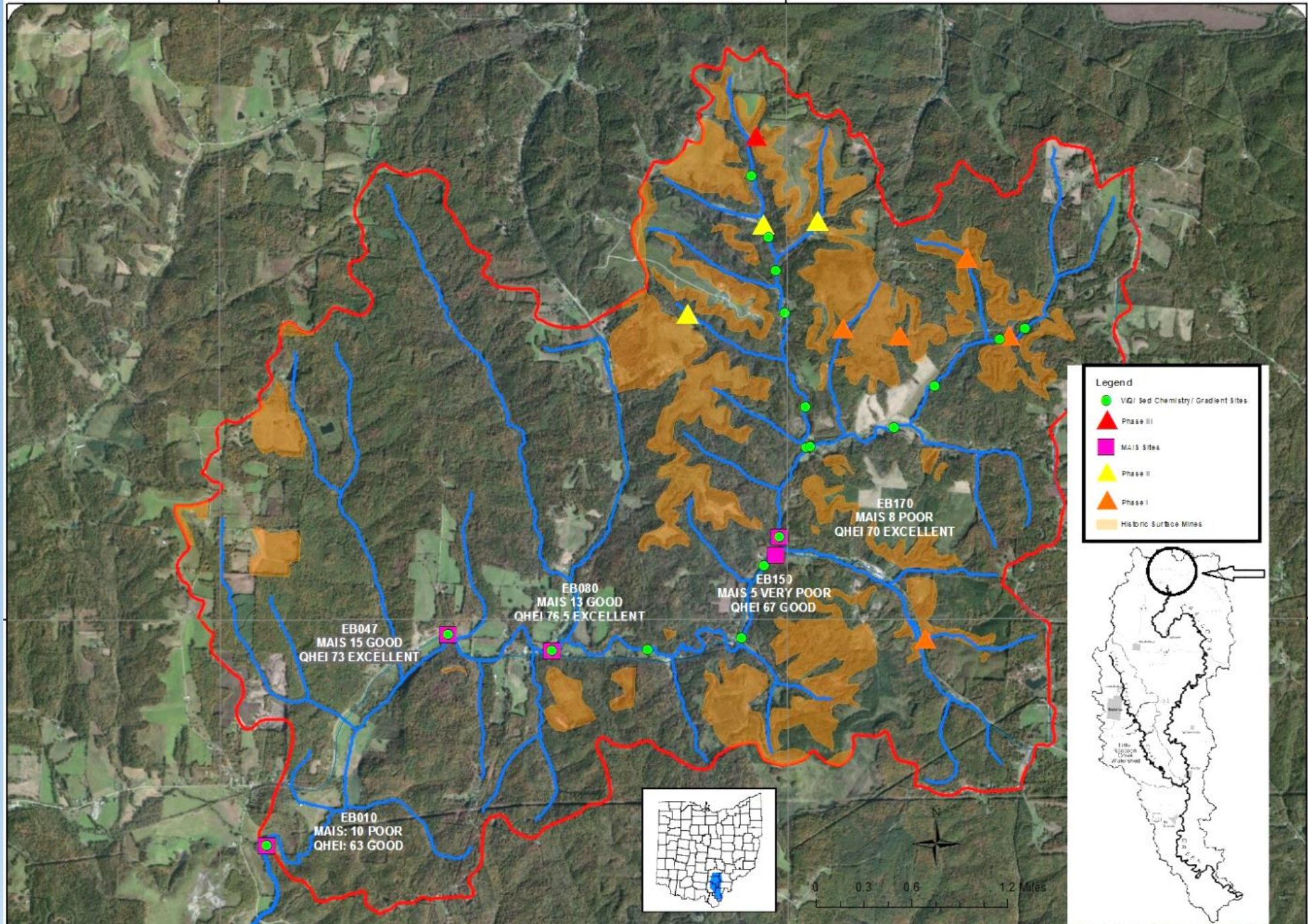
Discharge

- Baski Cutthroat flume
- Pygmy meter



Data Collection To Date:

- MAIS at 5 site in July 2013
- Low flow WQ samples and alkalinity budget in August 2013
- High flow WQ samples and acidity/alkalinity budgets in June 2014
- QHEI at MAIS sites in October 2013
- Gradient measured at 14 sites in January and February 2014



Legend

- VGI/ Sed Chemistry/ Gradient Sites
- ▲ Phase III
- MAIS Sites
- ▲ Phase II
- ▲ Phase I
- Historic Surface Mines



EB047
MAIS 15 GOOD
QHEI 73 EXCELLENT

EB080
MAIS 13 GOOD
QHEI 76.5 EXCELLENT

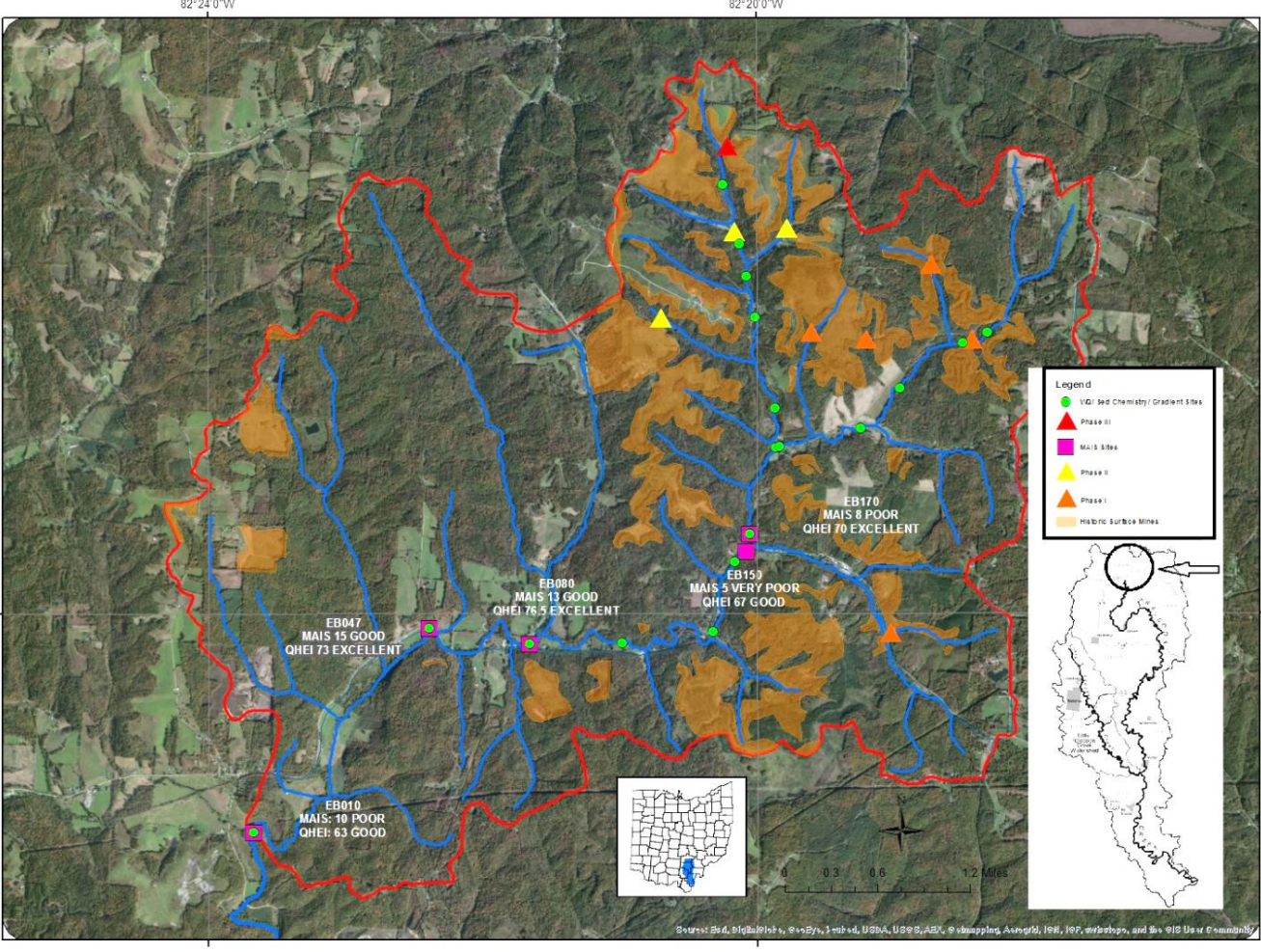
EB150
MAIS 5 VERY POOR
QHEI 67 GOOD

EB170
MAIS 8 POOR
QHEI 70 EXCELLENT

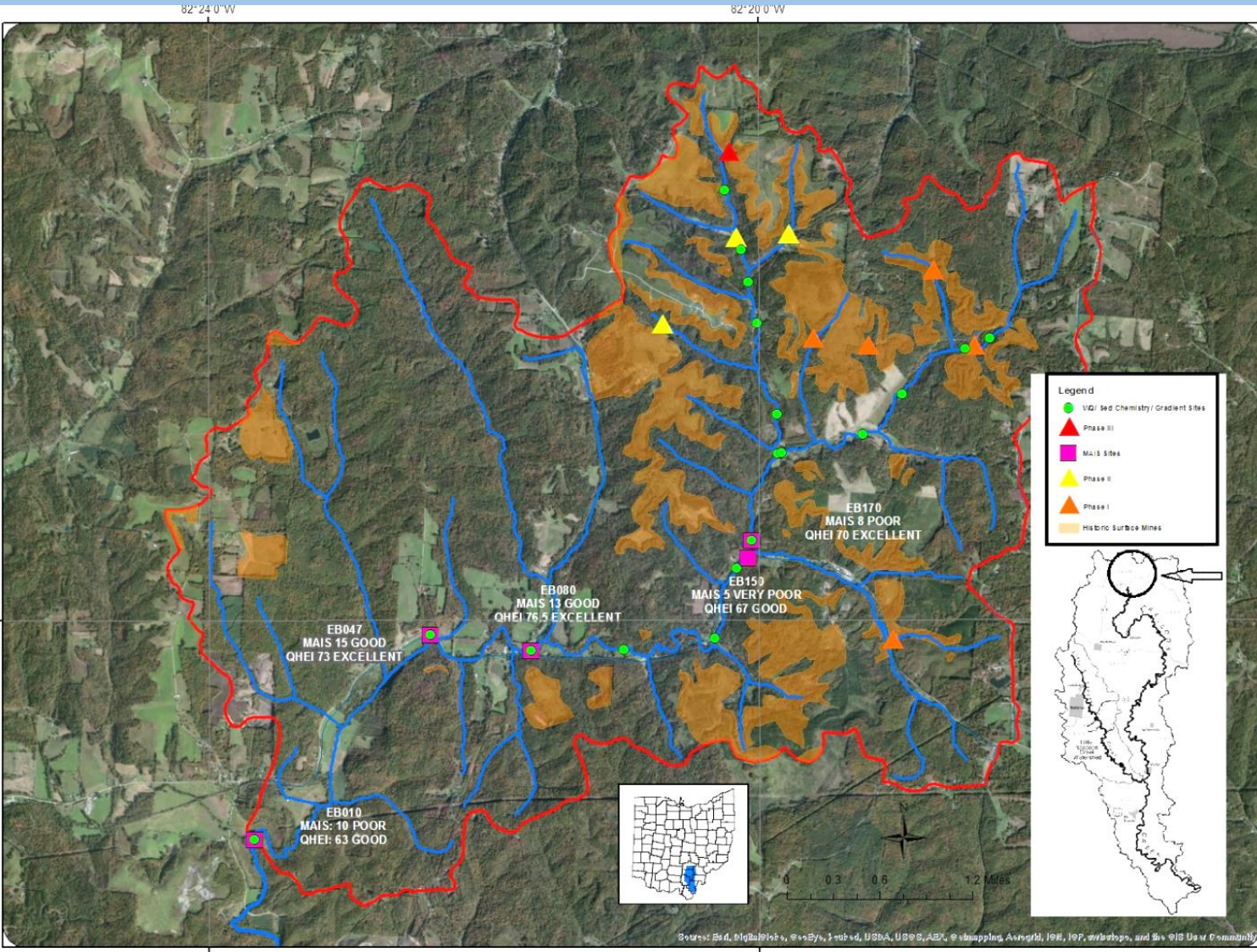
EB010
MAIS: 10 POOR
QHEI: 63 GOOD

MAIS values in East Branch and MSBC010

Year	MSBC010	EB010	EB047
2001	*	*	5
2002	*	*	3
2003	*	*	0
2005	8	*	*
2006	9	8	*
2007	12	12	*
2008	9	6	*
2009	10	12	11
2010	12	11	13
2011	13	9	8
2012	12	13	12

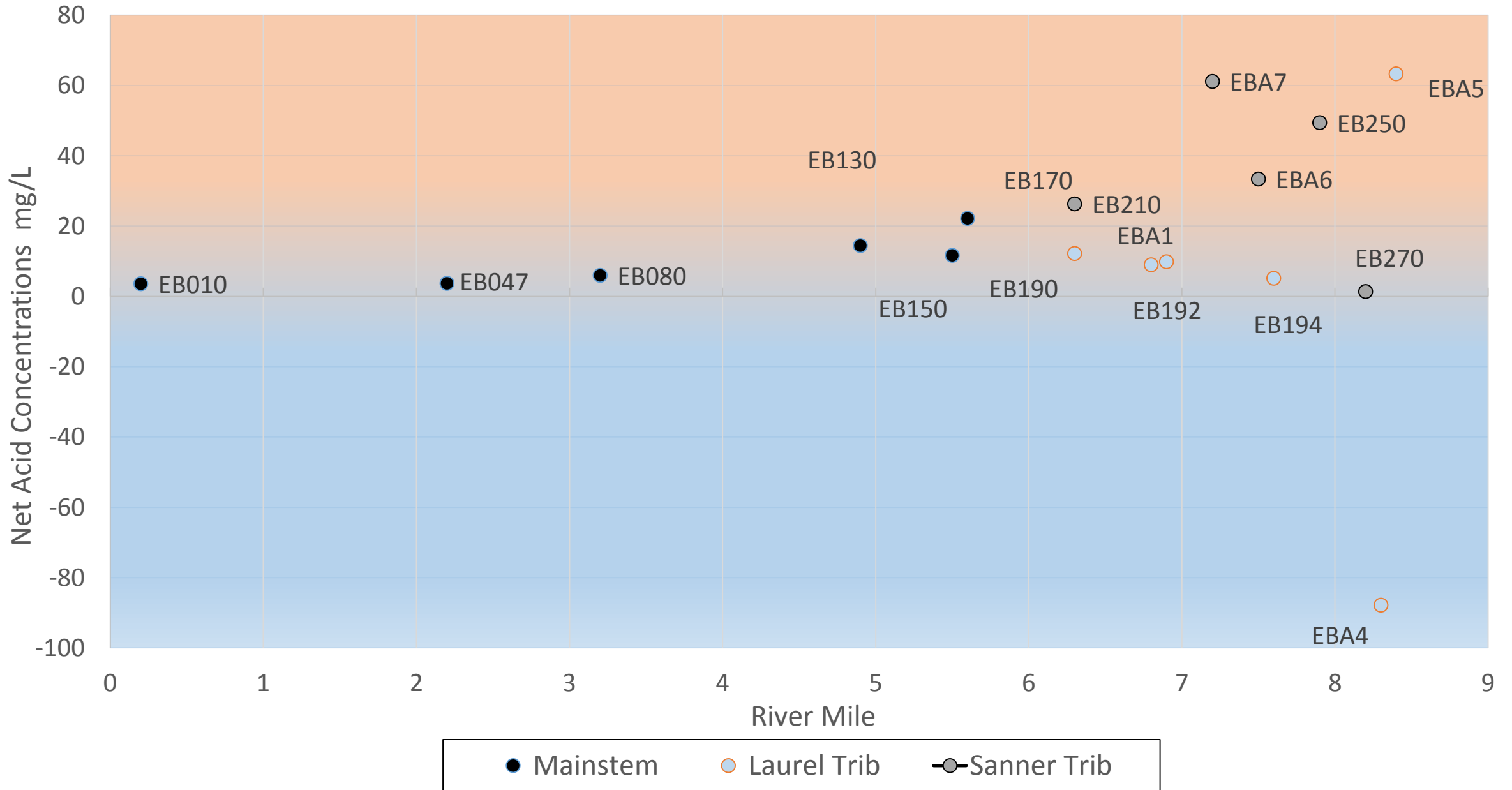


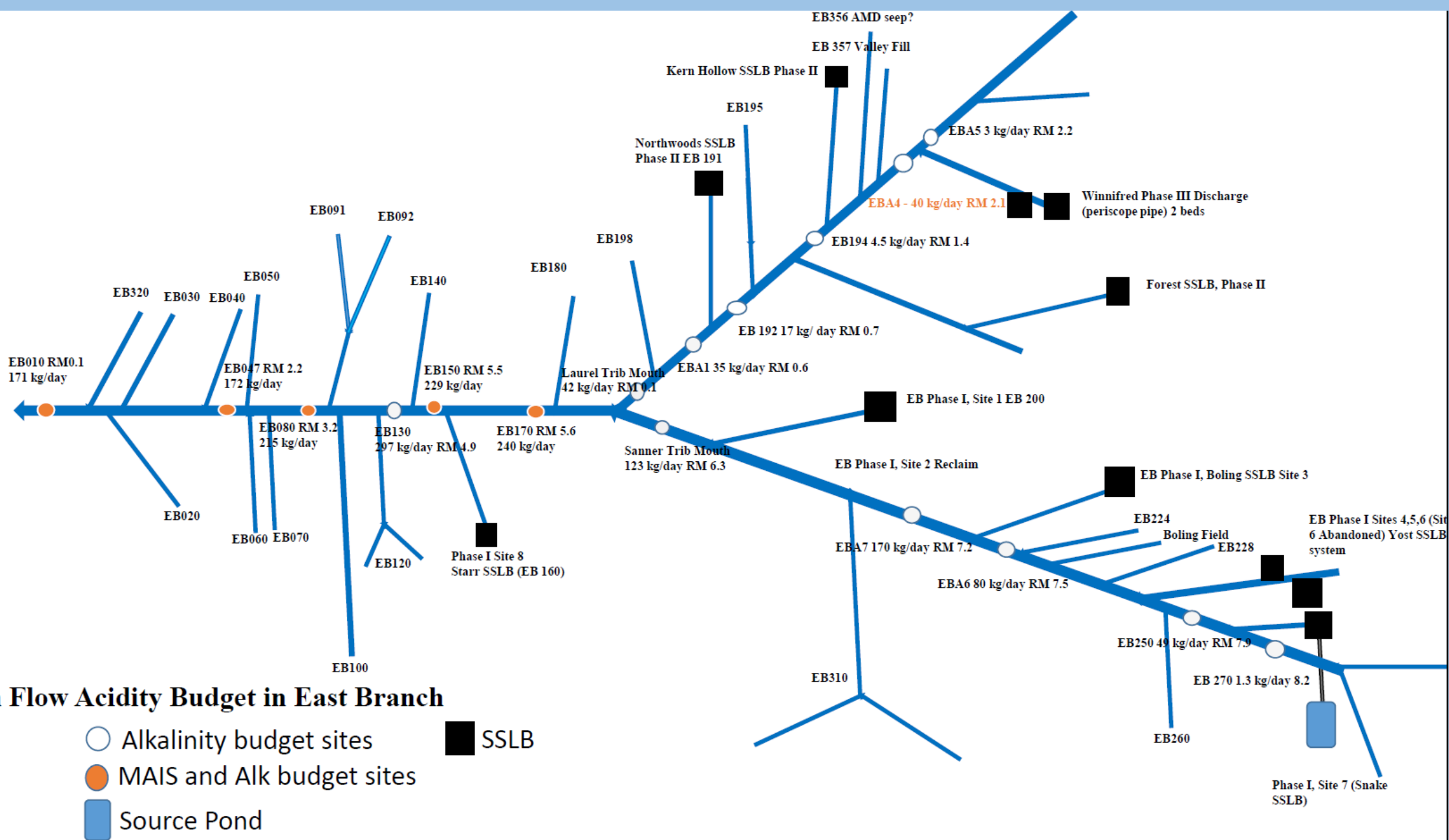
MSBC010 has improved status. $R^2 = 0.60$ $P = 0.043$
(NPS Report, 2012)

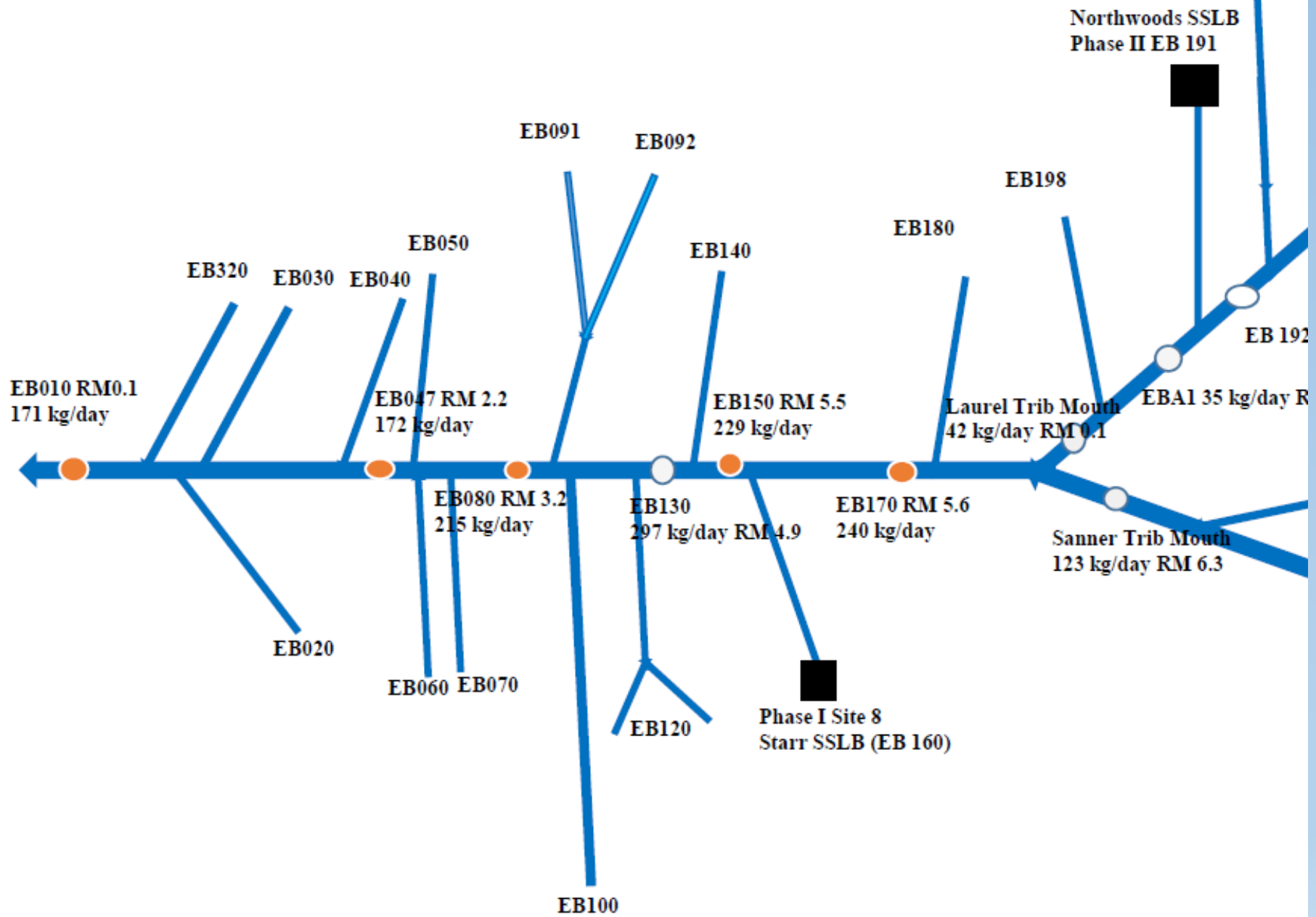


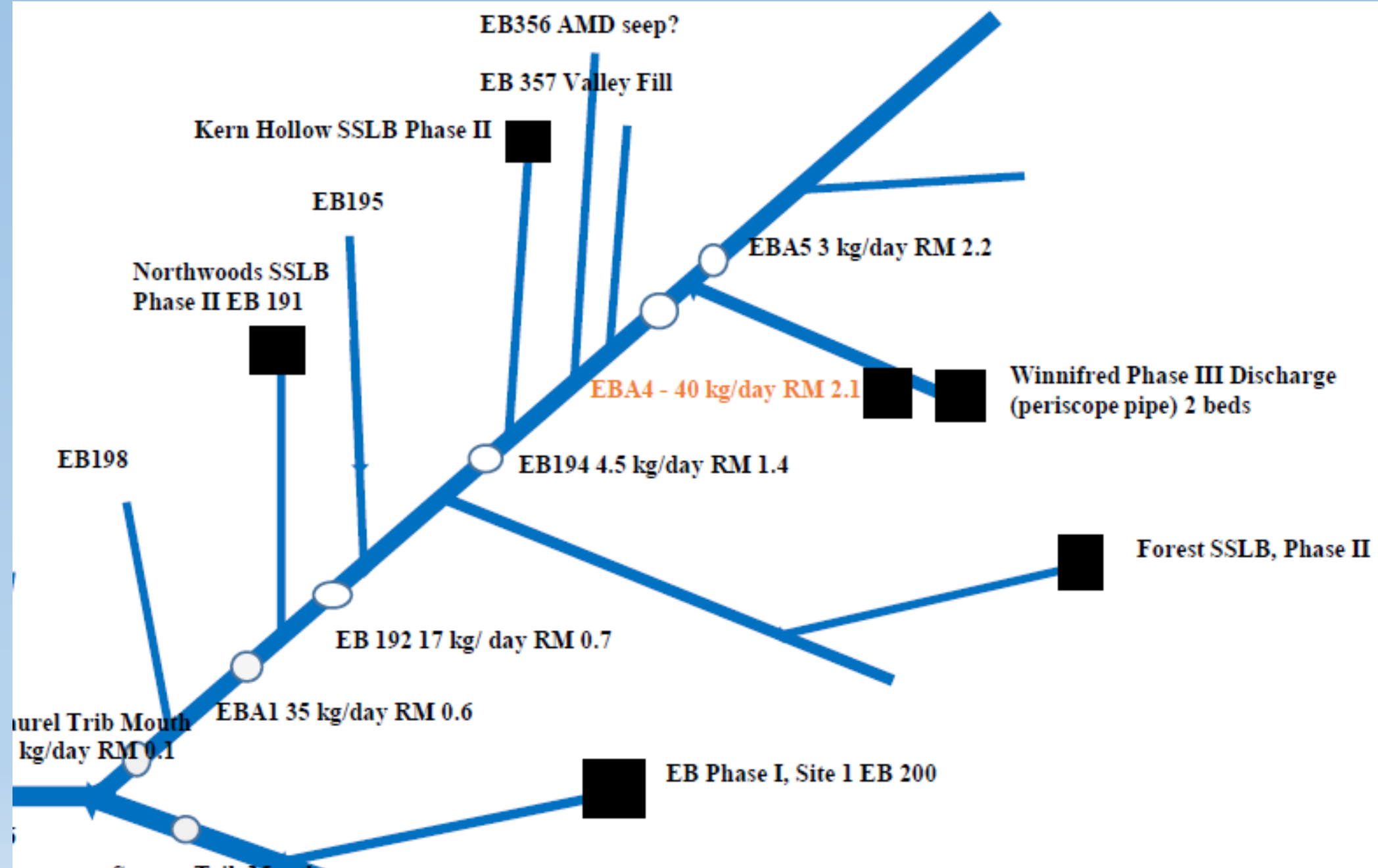
Site	Drainage Area mi ²	MAIS Score	QHEI
EB010	19.9	10 Poor	63 Good
EB047	15.4	15 Good	73 Excellent
EB080	13.9	13 Good	76.5 Excellent
EB150	8.43	5 Very Poor	67 Good
EB170	6.49	8 Poor	70 Excellent

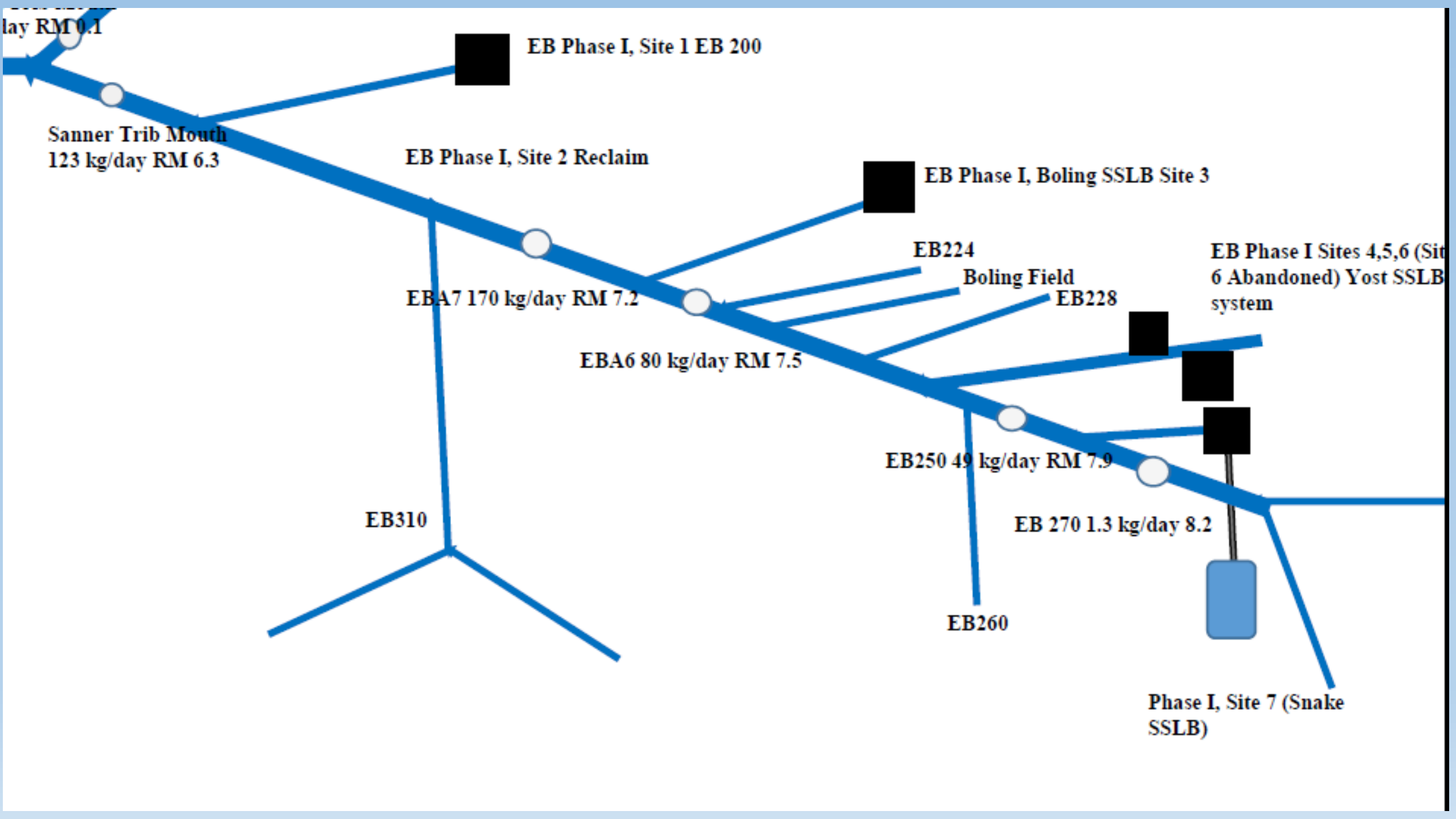
High Flow Acidity Concentrations (mg/L) by River Mile



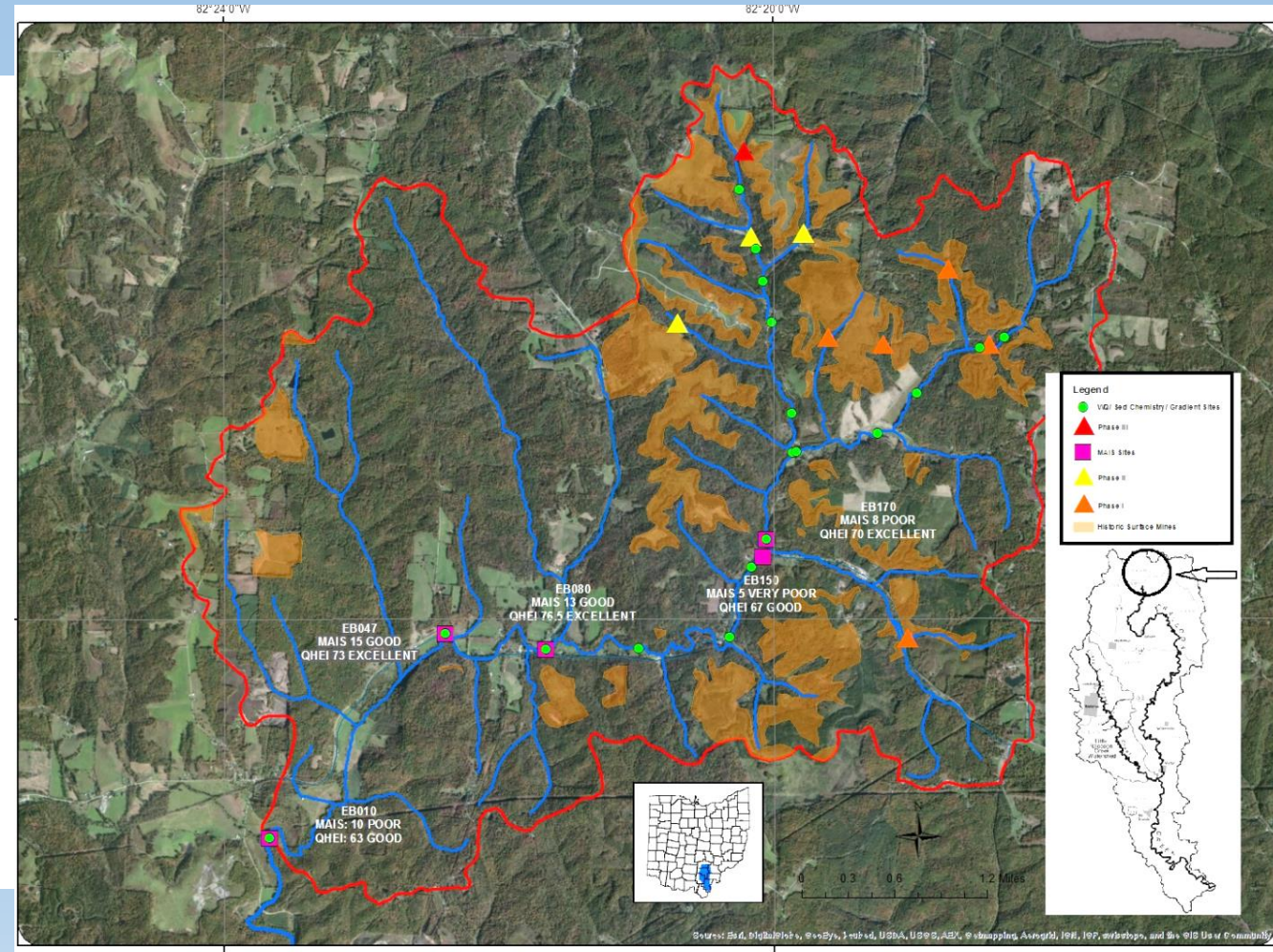
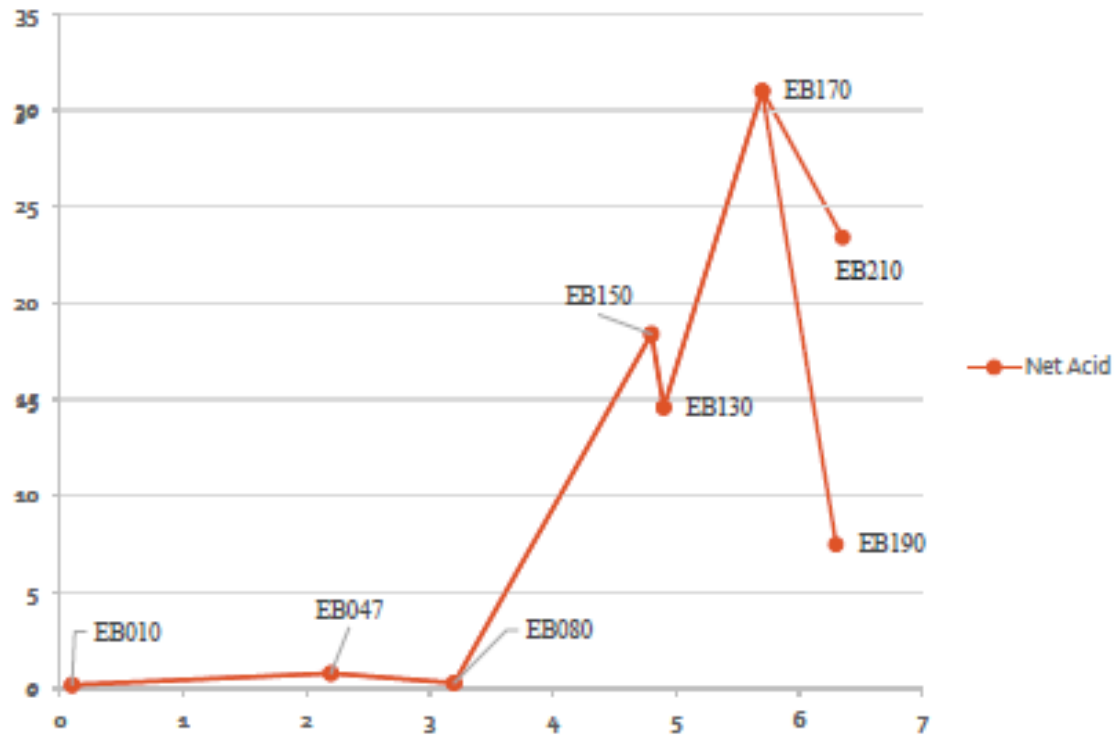




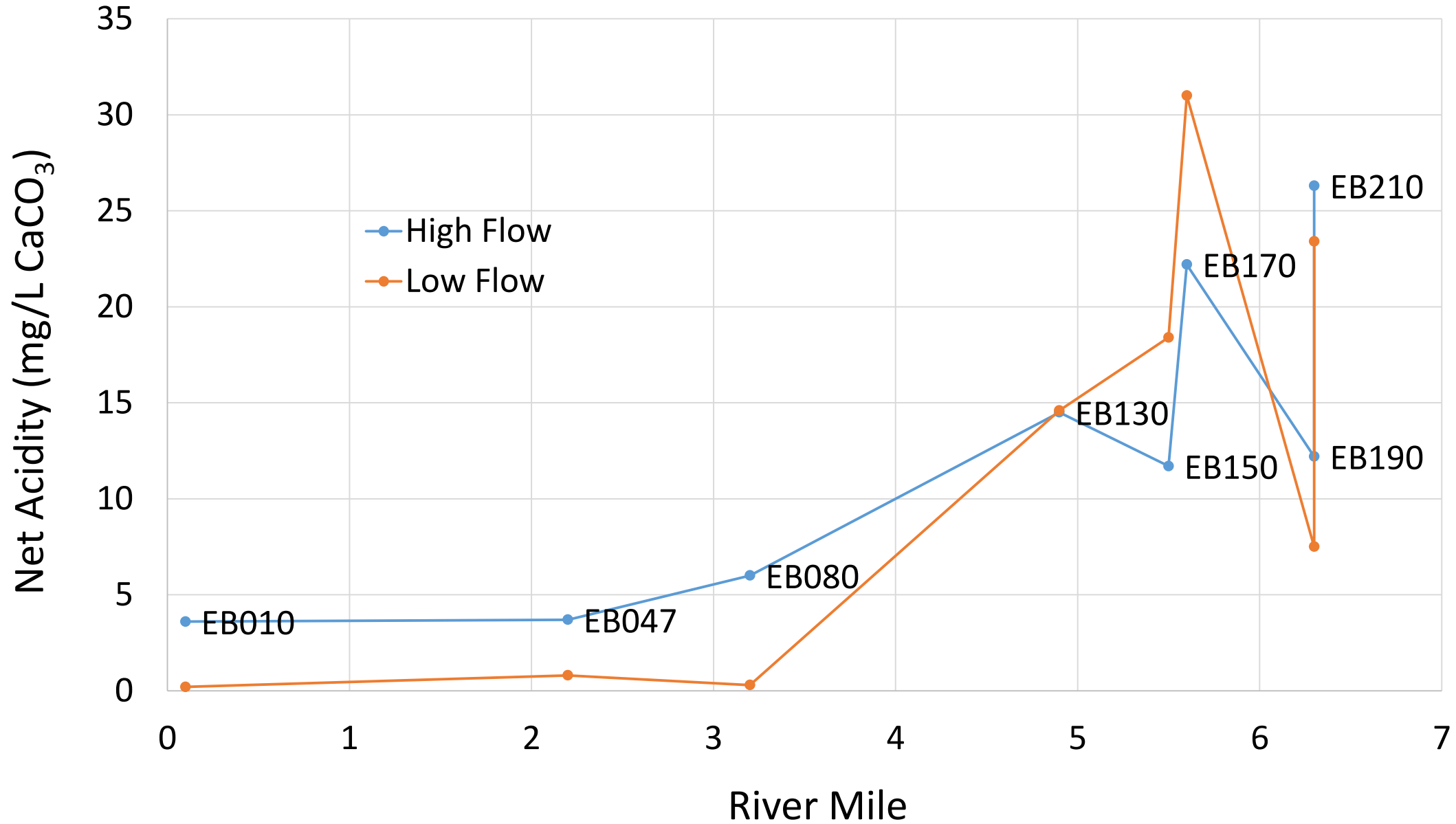




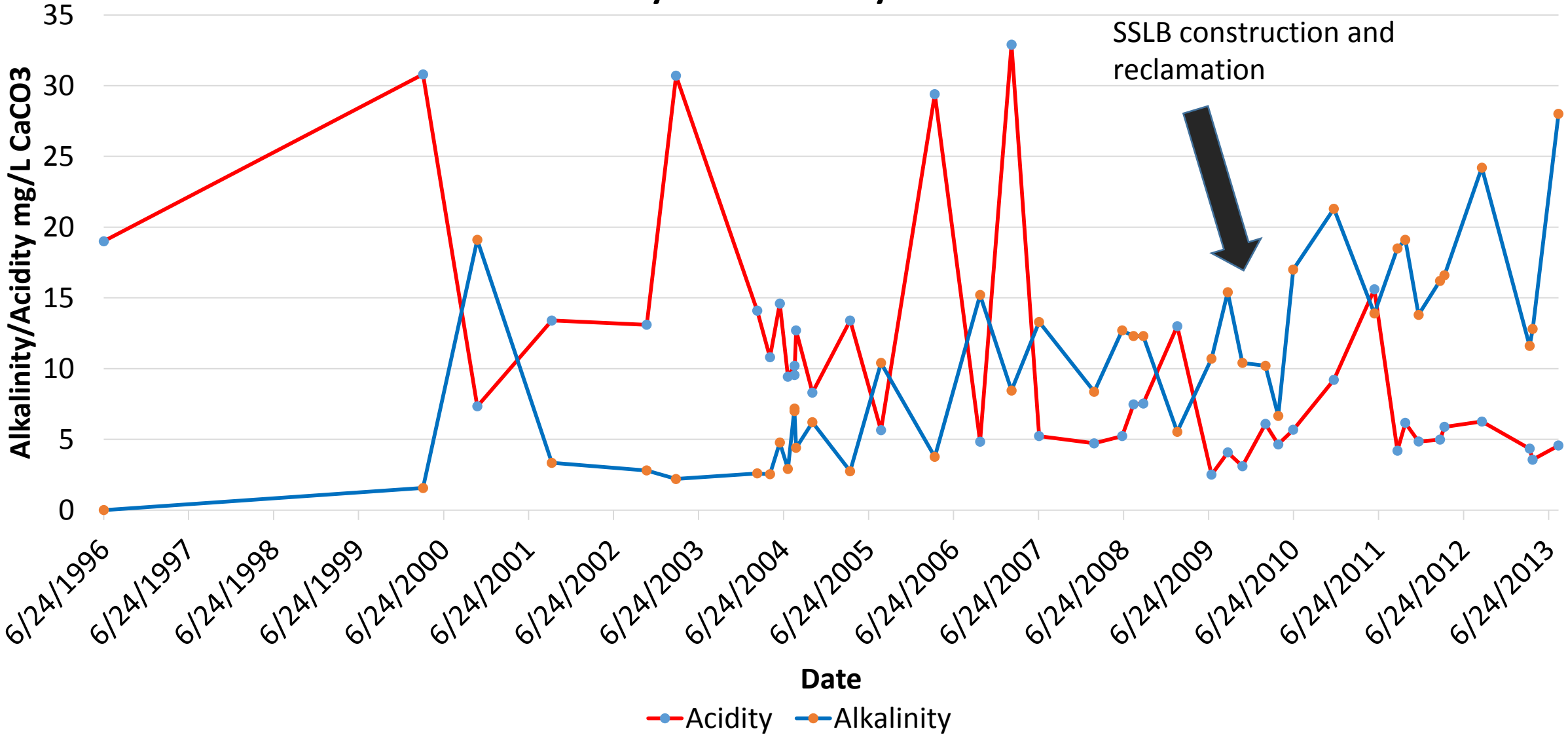
Net Acidity by RM (mg/L CaCO₃) Low-flow August 2013



High-flow and Low-flow net acidity concentrations



Acidity and Alkalinity at EB010



Future Research

- Sediment sampling July 2014
- Sediment analysis July 2014
- MAIS July 2014
- WQ Sampling/Alkalinity Budget August 2014
- Finish gradient sampling August 2014
- QHEI October 2014



Questions?



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