

TECHNICAL MEMORANDUM

Morrow Reservoir – Preliminary Observations of Downstream Sedimentation

PREPARED FOR: David Fox Director, Licensing and Compliance
Eagle Creek Renewable Energy
PREPARED BY: Rob Myllyoja
Stantec
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INTRODUCTION

Eagle Creek Renewable Energy (ECRE) began the drawdown of the Morrow Lake for inspection and maintenance of the Morrow Lake Dam in November 2019. Following the drawdown, Michigan Department of Environment, Great Lakes, and Energy (EGLE) informed ECRE of reports of increased turbidity and some fine sediment deposits along the Kalamazoo River downstream of the dam. The sediment of concern is typically a dark-colored mixture of silt and clay similar to sediment that has deposited in the lake near the dam.

A sieve and hydrometer analysis of a composite sample of the sediment from approximately 100 yds upstream of the dam behind the containment on the left descending bank (LDB) indicates that the sediment is 23% sand and organic matter that is coarser than a #200 sieve, 52.1% silt, and 24.9% clay. Another sieve and hydrometer analysis of lake bed material (from the lake delta) is pending, but the sediment at this location appears to be much lighter in color and higher in sand and clay compared to the dark-colored fines closer to and downstream from the dam.

Silt is defined as particles from 0.004-0.0625 mm and clay particles are <0.004 mm based on the Wentworth scale. It is these silt and clay “fines” that tend to cause substrate embeddedness and impact water clarity and physical habitat. The physical characteristics of sediments determine their settling time and sediment transport by the river. Silt is highly erosive. Clay is less erosive, but once clay does erode, the particles tend to stay in suspension for a much longer period of time than other types of particles. The best control measures for fines are source control measures to prevent the material from eroding and mobilizing.

PURPOSE

Stantec conducted a reconnaissance downstream of the Morrow Lake Dam on August 20 and 21, 2020, to begin assessing potential sediment impacts in the Kalamazoo River downstream of the dam. The field observations also provide insights on how and where to conduct additional assessment.

METHODS

Stantec visited several road crossings in Kalamazoo on August 20, 2020, between Morrow Lake Dam and the crossing at D Avenue in Cooper Township located approximately 10.5 miles

downstream of the dam. We installed the turbidity monitoring equipment, recorded water depth measurements with a Raymarine depth finder, and probed sediment depths with an 8-ft long steel tile to determine depth to gravel or refusal (see attached Figures). The Figures show observed deposit areas. Note that all deposit areas may not be shown because:

- Some depositional side bars were submerged and there was only about 1 ft of visibility.
- Deposition in the back of oxbows could not be viewed from the river.
- The boat was often moving at moderate-to-high speeds to avoid getting stuck due to low flow conditions.

OBSERVATIONS

Note: Based on the Comstock USGS gage, the discharge was 622 cfs on August 21, 2020.

The characteristics of the fine sediment deposition in the observed reach:

- It appears that much of the material that may have deposited between the Morrow Lake Dam and the River Street in the winter/spring of 2020 have remobilized.
- Immediately downstream of the dam, there are significant deposits of fine sediment in the side channel on the left descending bank (LDB) to 6.5 ft deep. Deposits are >8 ft deep along the bank erosion area on the RDB and the channel center.
- Immediately downstream of Consumers Power Drive, there are deposits of fine sediment along both the RDB and LDB.
- Turbidity levels increase in Kalamazoo and then begin to decrease below Patterson Road; turbidity was visibly reduced at the D Avenue crossing in Cooper Township (Table 1).
- Based on observations by SWAT downstream of Plainwell during the week of August 24, 2020, turbidity levels may be higher than background levels further downstream (Plainwell, Otsego, etc.) and smaller 1"-2" muck deposition areas were noted. However, determining or quantifying the downstream extent of impacts will be difficult considering possible historic deposition, dredging, and dam removals in recent years.

Table 1 Turbidity Levels from the Morrow Lake Delta to Below Patterson Road on 8/21/2020

Location	Latitude, Longitude	Turbidity (Range) NTUs
upstream of riffle - dog park	42.277664, -85.443068	1.20
downstream of riffle at concrete pad	42.277515, -85.444280	1.25
downstream of delta	42.277490, -85.449335	1.00
below dam	42.282797, -85.492780	21.5 (18-25)
River Street	42.285900, -85.514260	22.6 (16-30)
Sprinkle Road	42.285700, -85.531485	47.8 (39-69)
King Hwy	42.285645, -85.552718	60.75 (48-75)
Pedestrian Bridge	42.290456, -85.558411	58.5 (45-73)
Mills Street	42.293330, -85.567265	52.8 (41-62)
Above Portage Creek	42.295200, -85.572410	43.75 (25-66)
Railroad Crossing	42.296409, -85.572654	33.5 (19-46)
Gull Street	42.299410, -85.572730	59 (48-72)
Patterson Road	42.303854, -85.571098	41.6 (30-51)
Below Patterson Road	42.307338, -85.571850	17.5 (15-20)

Fine sediment deposits have occurred in predictable ways:

- Historic aerials show numerous sand/gravel bar deposits along the river prior to 2020 in typical, naturally-occurring locations such as where the river is overly-wide, along point bars on inside bends, below islands, in backwater areas, and in side channels. Since the Morrow Lake drawdown (November 2019), the deposition of fine sediment has occurred in and on these same areas. As a result, the fine sediment deposits may appear to be more extensive than they actually are in some areas. For example:
 - Fine sediment extended the downstream end of existing sand/gravel bars,
 - Some fine sediment is present as a thin 1-2 inch deposit in interstitial areas between existing gravel deposits, contributing to an embedded appearance, and
 - Fine sediment deposited a 1-2 ft layer of fines on top of existing depositional features.
- Fines have deposited near the stream banks and in several oxbow meander cut-off areas.
- Large woody material and riparian trees create roughness that caused fine sediment to settle out on the lower stream banks (nearline the flowline) in many areas. Some of this material appears to now be eroding and becoming re-suspended.

The typical, predictable nature of these fine sediment deposit mechanisms/locations may allow for the planning of strategic containment areas.

Kalamazoo River Sediment Reconnaissance 8/21/2020

= Feet of Water/Feet of Sediment; E. Gr. = embedded gravel

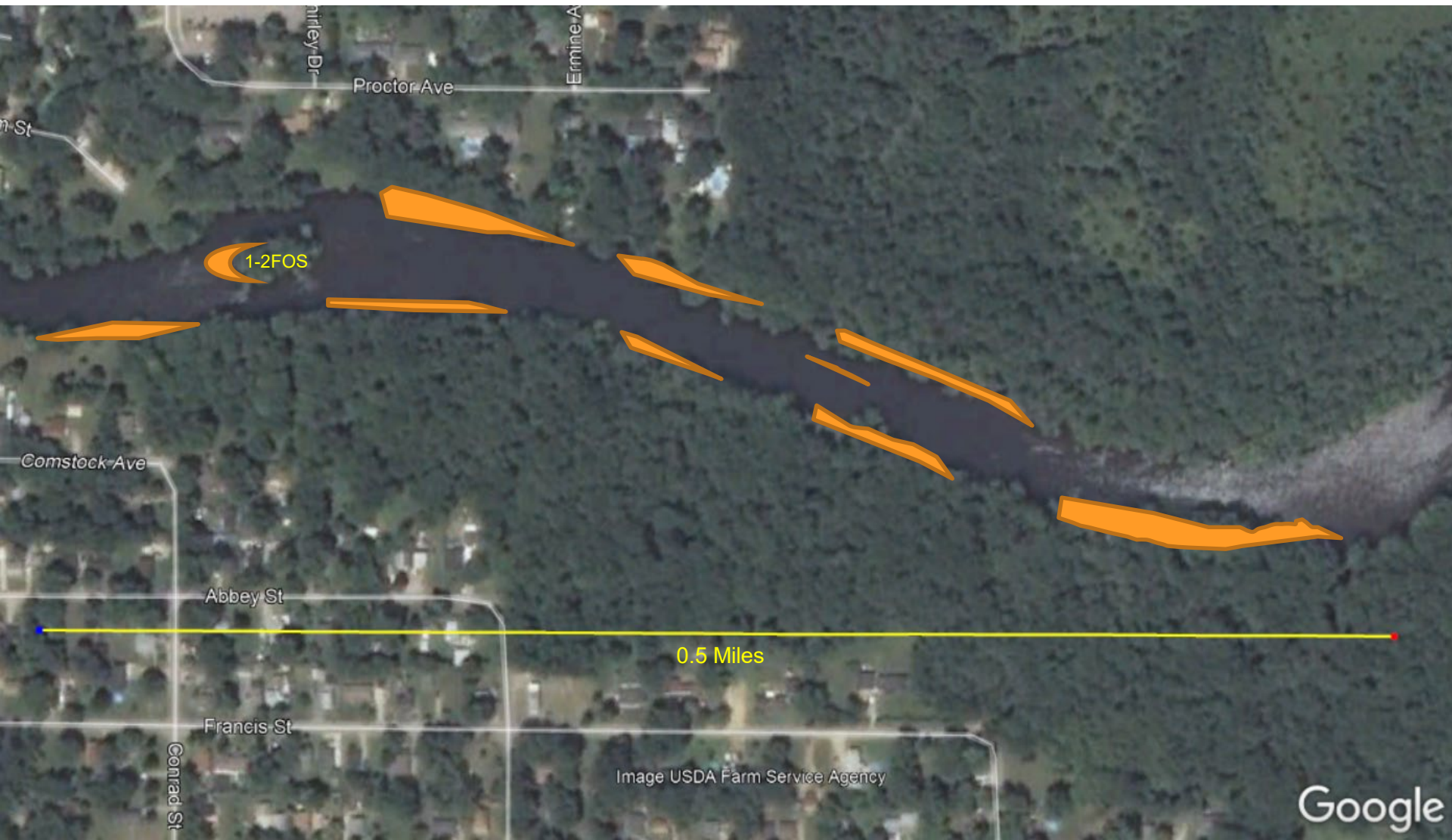
Sheet 1



Kalamazoo River Sediment Reconnaissance 8/21/2020

FOS = Feet of Sediment

Sheet 2



Kalamazoo River Sediment Reconnaissance 8/21/2020

Sheet 3



Kalamazoo River Sediment Reconnaissance 8/21/2020

FOS = Feet of Sediment

Sheet 4



Kalamazoo River Sediment Reconnaissance 8/21/2020

FOS = Feet of Sediment; E.Gr. = embedded gravel

Sheet 5



Kalamazoo River Sediment Reconnaissance 8/21/2020

FOS = Feet of Sediment; E.Gr. = embedded gravel

Sheet 6



Kalamazoo River Sediment Reconnaissance 8/21/2020

Sheet 7



Kalamazoo River Sediment Reconnaissance 8/21/2020

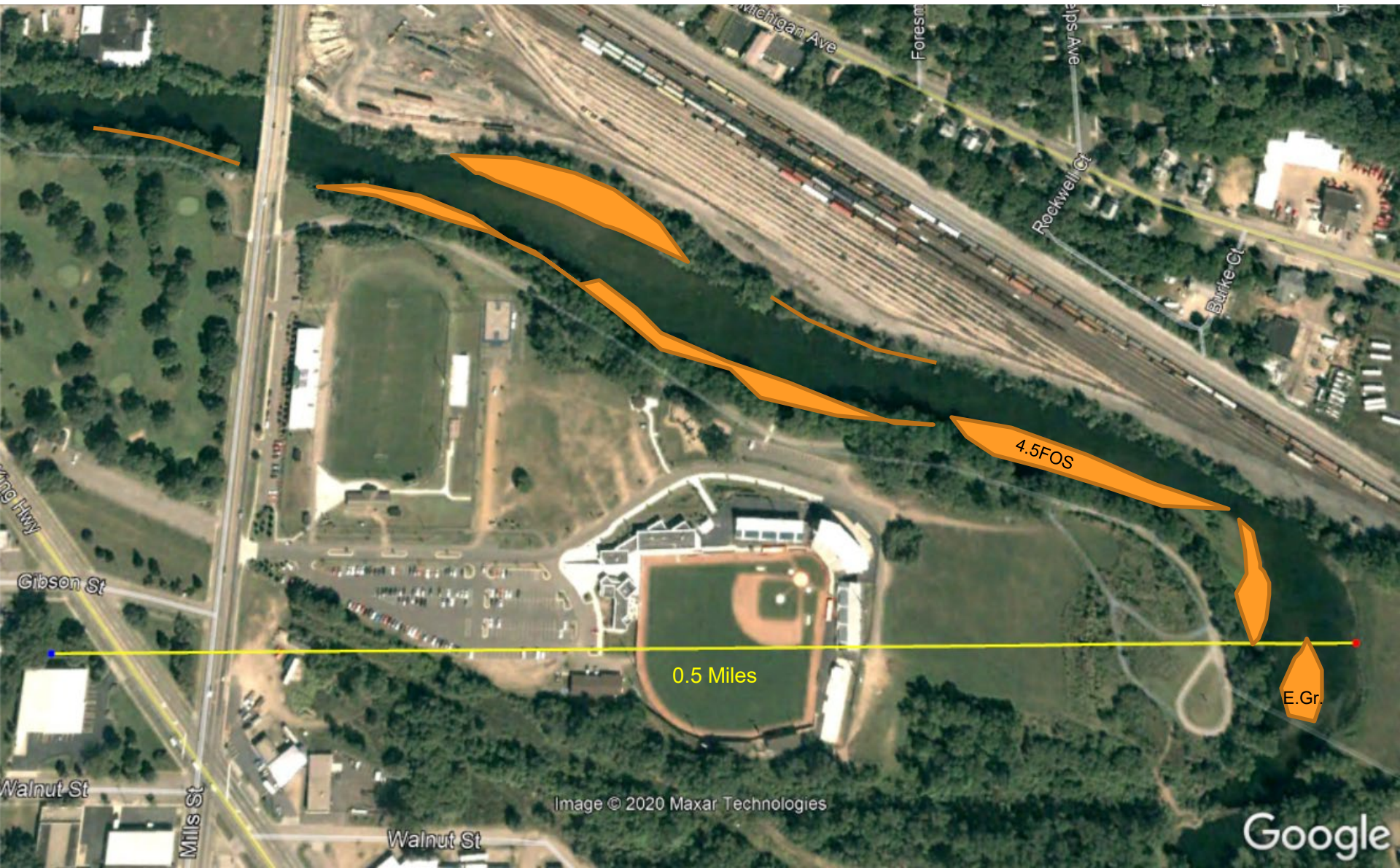
Sheet 8



Kalamazoo River Sediment Reconnaissance 8/21/2020

FOS = feet of sediment; E.Gr. = embedded gravel

Sheet 9



Kalamazoo River Sediment Reconnaissance 8/21/2020

Sheet 10



Kalamazoo River Sediment Reconnaissance 8/21/2020

- Turbidity levels are visibly higher in Kalamazoo, possibly due to re-suspension
- Approx. 10.5 miles downstream of Morrow Dam at East D Ave. in Cooper Twp, turbidity is visibly lower and there appears to be fewer lateral bars along the river banks.

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