



**Michigan
Technological
University**

Tire-Derived Aggregate (TDA) Products for Road Construction

Zhanping You, P.E., Ph.D., F.ASCE, F.EMI

Distinguished Professor and University Professor
Department of Civil, Environmental, and Geospatial Engineering
Director, Michigan Tech Transportation Institute
Michigan Technological University
Email: zyou@mtu.edu

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2. Field Application of TDA Shreds

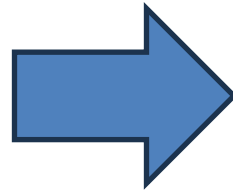
3. Field Application of Pre-compacted TDA Blocks

4. Environmental Effects and Benefits of Using TDA

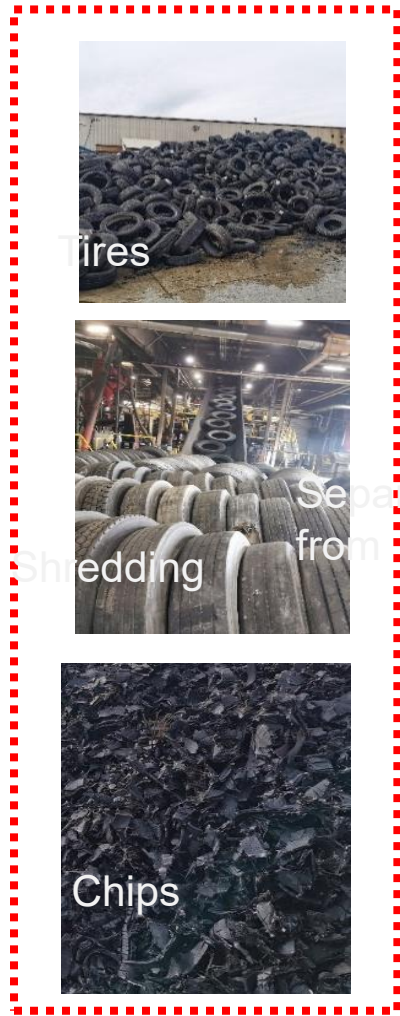
1. Introduction on Tire-Derived Aggregate (TDA)

1.1 TDA Production Process

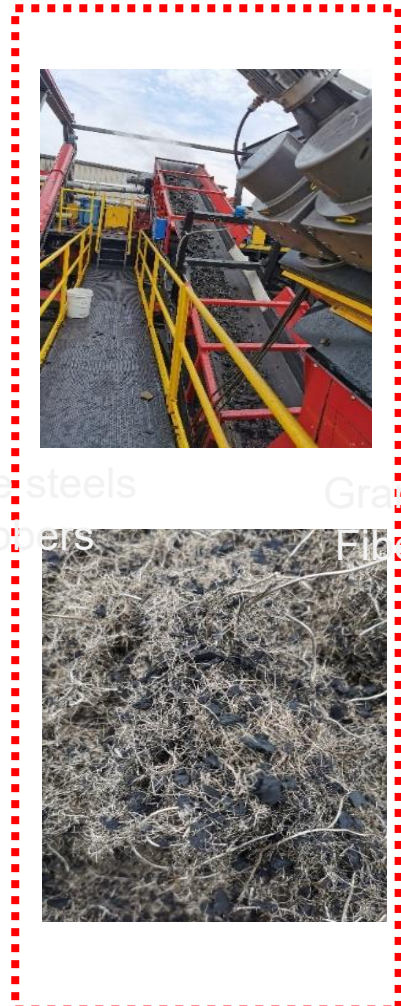
- TDA is made by processing waste tires with tire shredding machine;
- TDA can be used as an alternative to conventional civil engineering materials, such as stone, gravel, soil, sand, lightweight aggregate, or other fill materials.



Scrap Tire Process



Stages I



Stages II



Stages III



Stages IV

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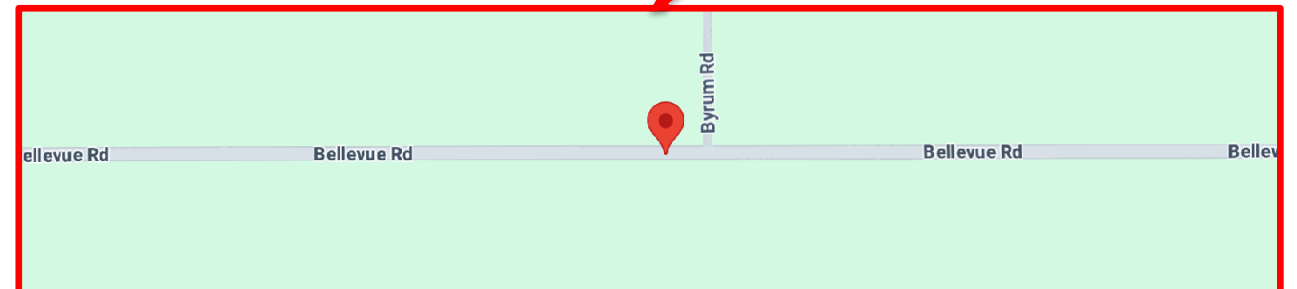
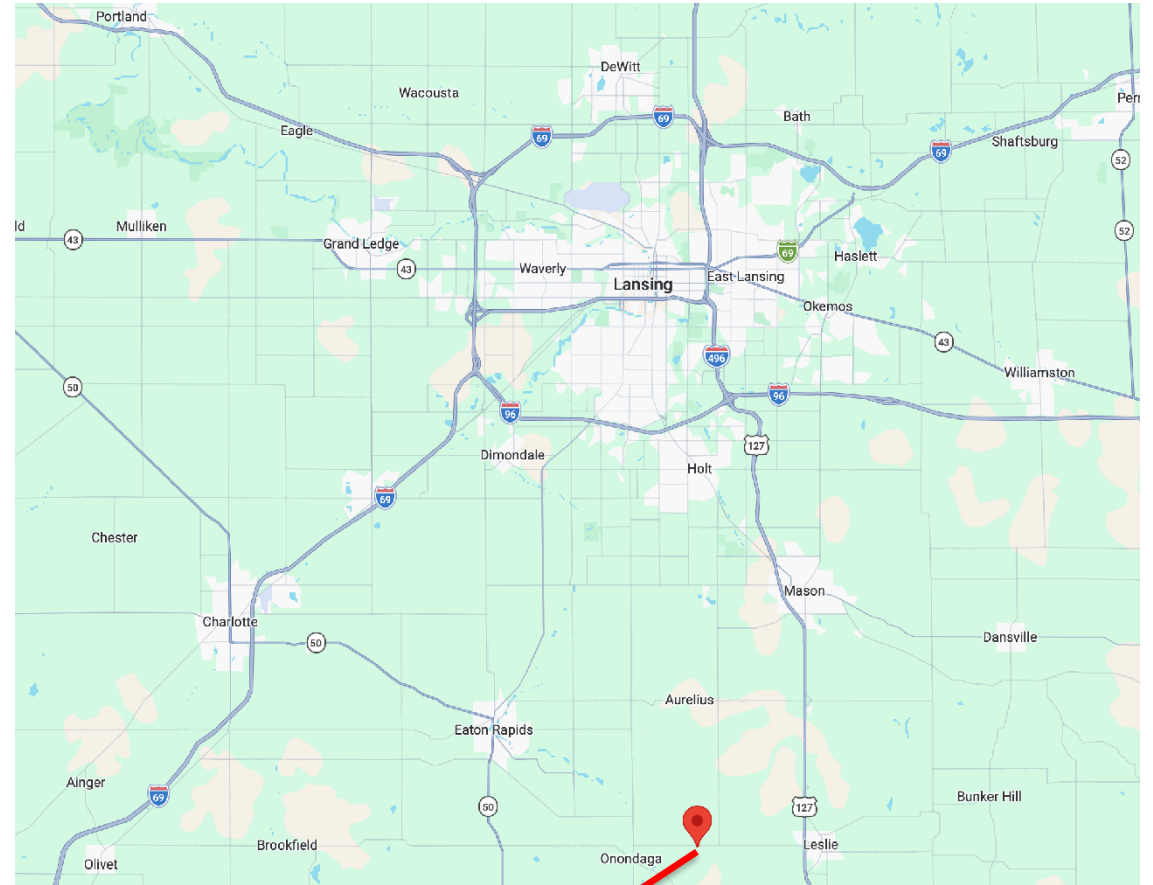
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2. Field Application of TDA Shreds

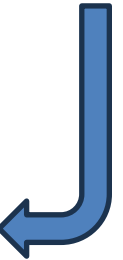
2.1 Project in Ingham County

- Constructed in August 2021
- Bellevue Road, Ingham County, Michigan



2. Field Application of TDA Shreds

2.1 Project in Ingham County



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2. Field Application of TDA Shreds

2.1 Project in Ingham County

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2. Field Application of TDA Shreds

2.1 Project in Ingham County

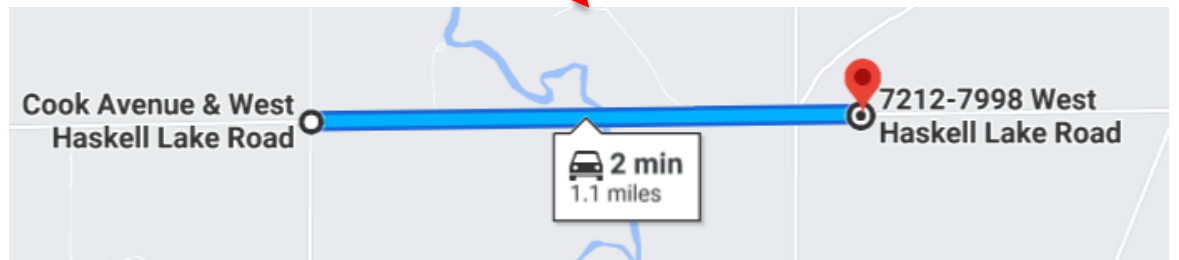
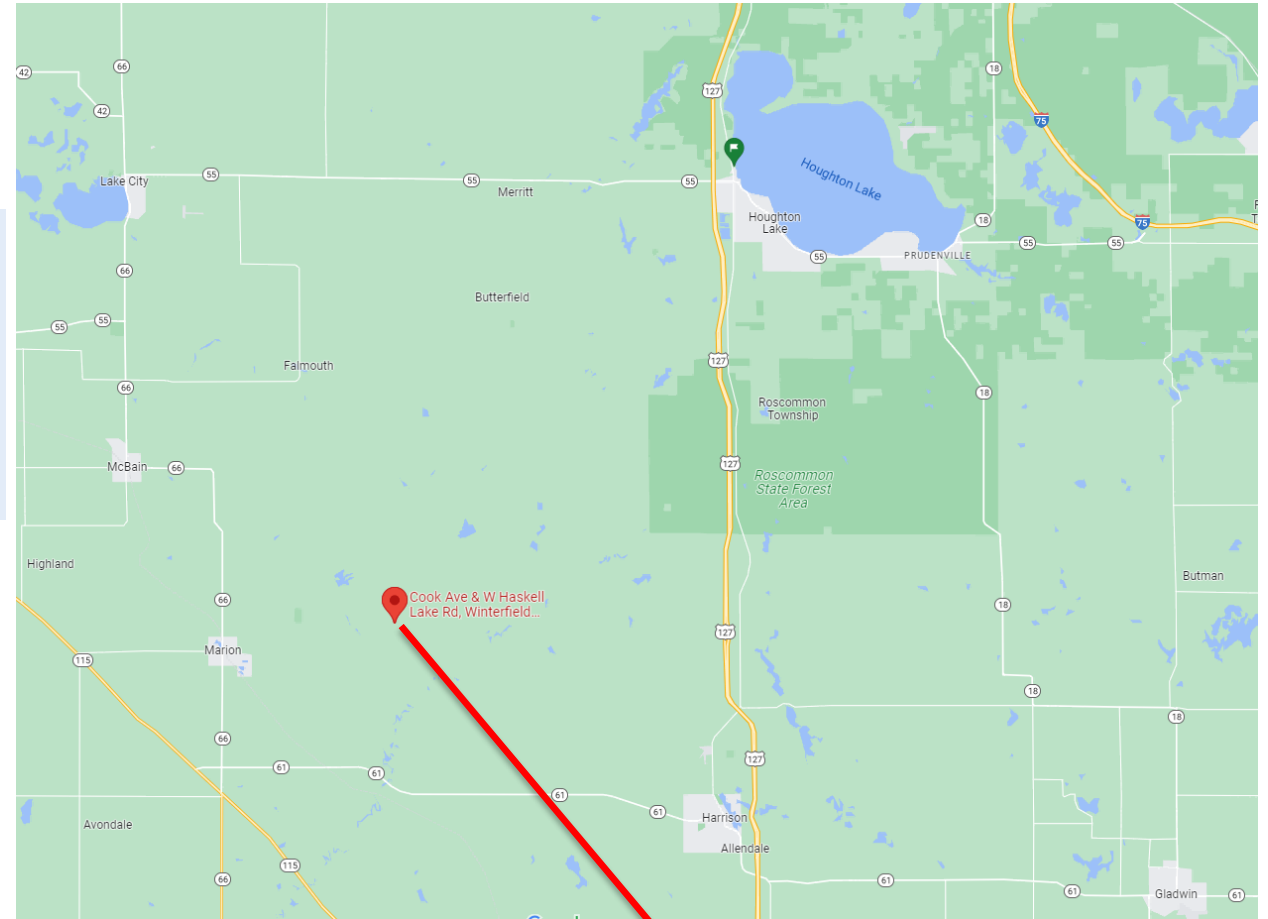
- 3 years after construction



2. Field Application of TDA Shreds

2.2 Project in Clare County

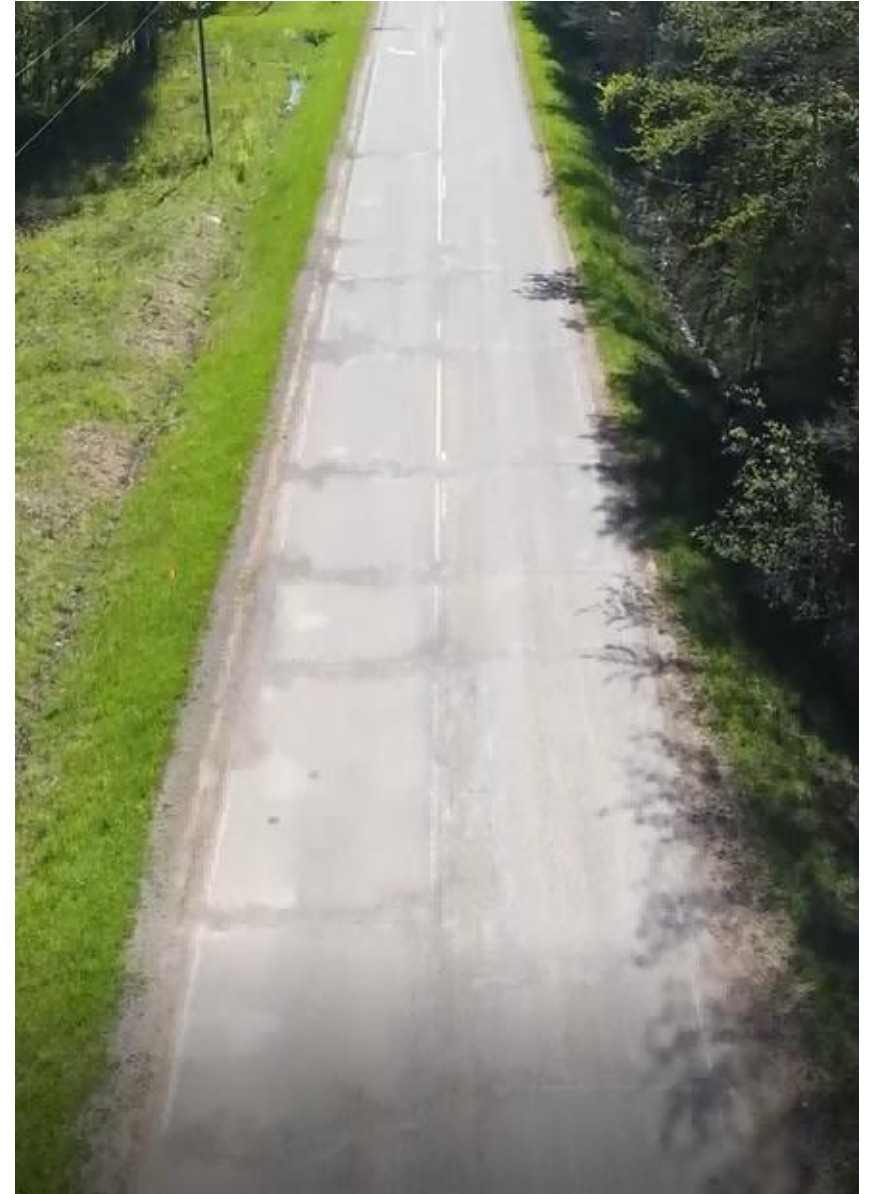
- Constructed in May 2022
- Haskell Lake Road, Clare County, Michigan
- Road section total length: ~1.15 miles



2. Field Application of TDA Shreds

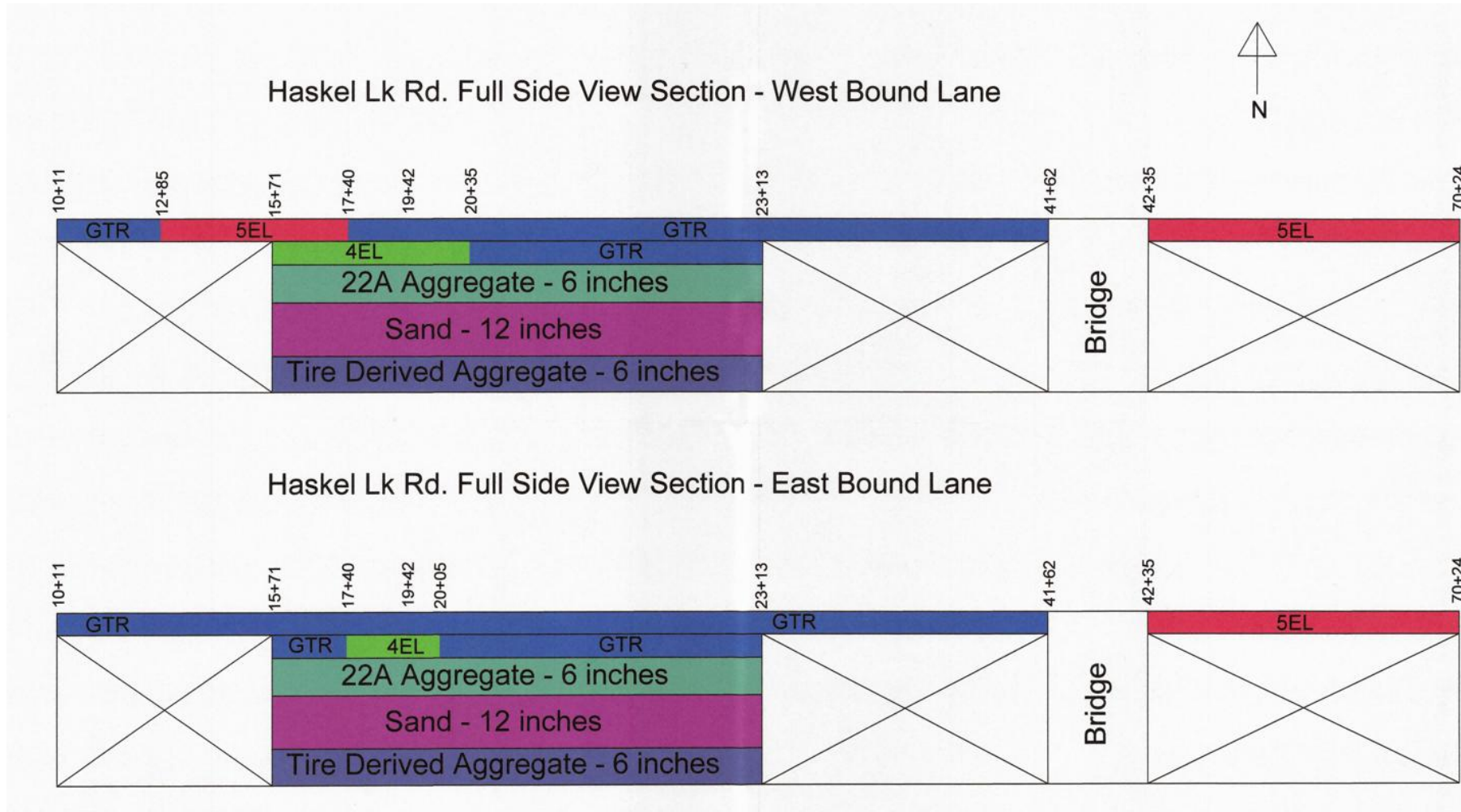
2.2 Project in Clare County

The original road condition was poor and required a major improvement.



2. Field Application of TDA Shreds

2.2 Project in Clare County



Construction Layout

2. Field Application of TDA Shreds

2.2 Project in Clare County

Subgrade excavation

- High moisture content in the subgrade soil, resulting in soft and unstable conditions



2. Field Application of TDA Shreds

2.2 Project in Clare County

Geotextile placement over subgrade

- Separation layer installed to isolate wet subgrade



6-inch tire-derived aggregate (TDA) layer

- Placed to provide drainage and structural support



2. Field Application of TDA Shreds

2.2 Project in Clare County

**Geotextile placement over TDA to create
a level surface**

12-inch sand layer



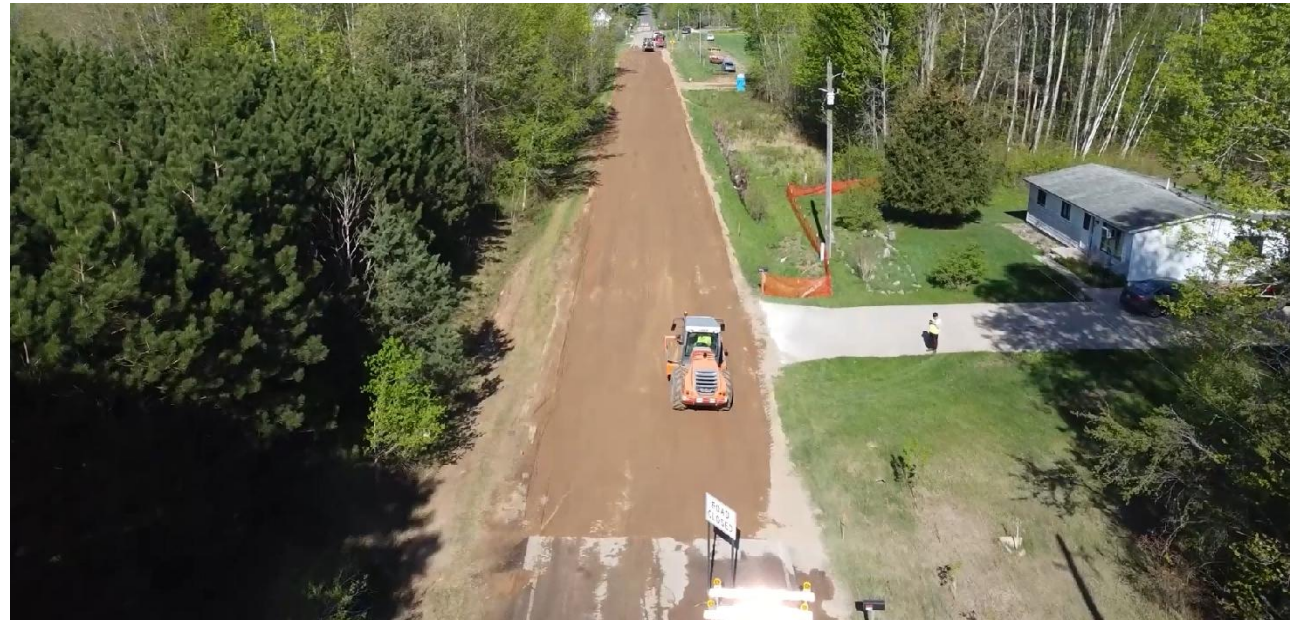
2. Field Application of TDA Shreds

2.2 Project in Clare County

6-inch gravel layer



Base compaction



2. Field Application of TDA Shreds

2.2 Project in Clare County

2-inch asphalt leveling layer



2-inch asphalt surface layer



2. Field Application of TDA Shreds

2.2 Project in Clare County

Asphalt surface compaction



Asphalt surface compaction complete



2. Field Application of TDA Shreds

2.2 Project in Clare County



**Original pavement surface
(before reconstruction)**



**Reconstructed pavement surface
(after construction)**

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3. Field Application of Pre-compacted TDA Blocks

3.1 Introduction on TDA Block

TDA Blocks using 100% recycled scrap tires

30*30*60 inch, about 1,200 lbs. each



3. Field Application of Pre-compacted TDA Blocks

3.2 TDA Block Production Process

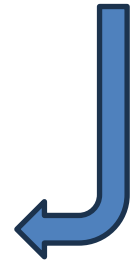
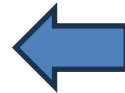


- The production involves multiple cycles of:
Adding tire chips → compression → filling → (repeated multiple times) → final compression and wrapping, resulting in a pre-stressed, confined block.
- The final TDA blocks contain pre-stress, which can reduce or eliminate the need for additional field compaction of tire chips.

3. Field Application of Pre-compacted TDA Blocks

3.3 Application of TDA Blocks in Walkway Construction

MN, 2025



3. Field Application of Pre-compacted TDA Blocks

3.4 Application of TDA Blocks in Embankment Construction

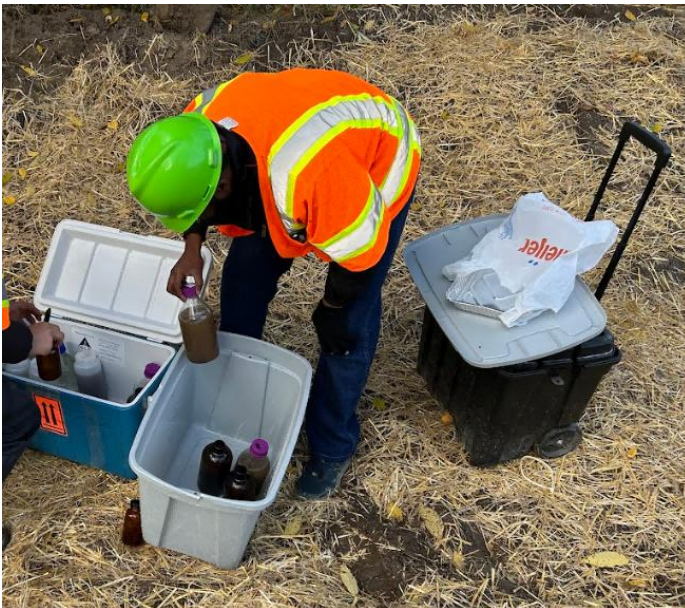
Clare County, MI, October 2025



3. Field Application of Pre-compacted TDA Blocks

3.4 Application of TDA Blocks in Embankment Construction

Clare County, MI, October 2025



In-situ modulus was evaluated using a lightweight deflectometer (LWD).

- Over the TDA area with stones covered: 3.47-3.76 MPa
- Control section – on the area (No TDA) with straw covered: 2.68-4.09 MPa

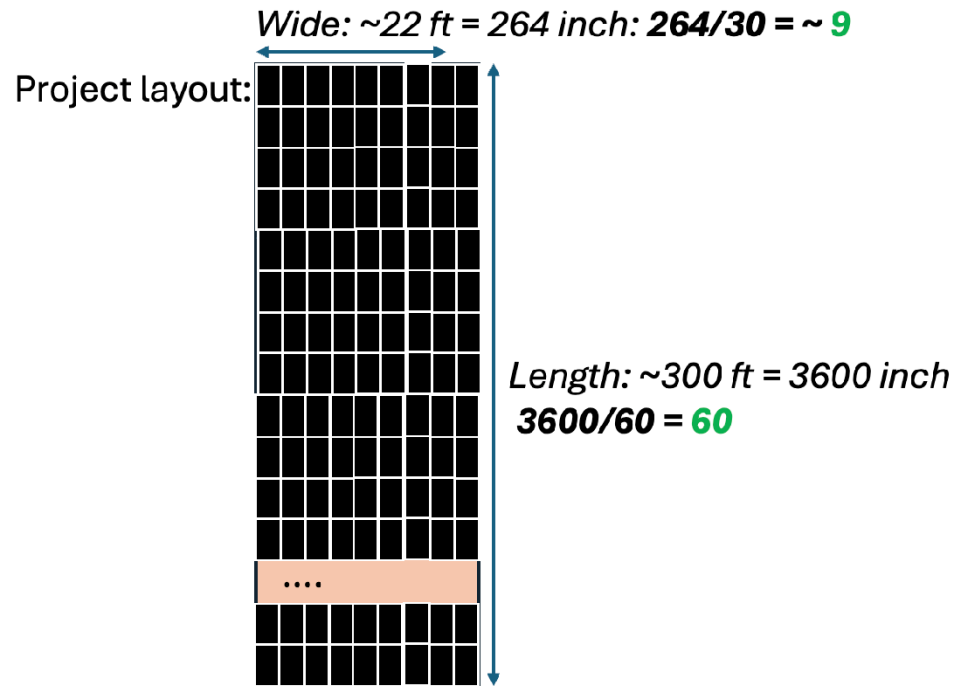
Soil and water samples (road surface runoff, upstream surface water, and downstream surface water) were collected for laboratory analysis.

3. Field Application of Pre-compacted TDA Blocks

3.5 Application of TDA Blocks for Road Settlement Mitigation

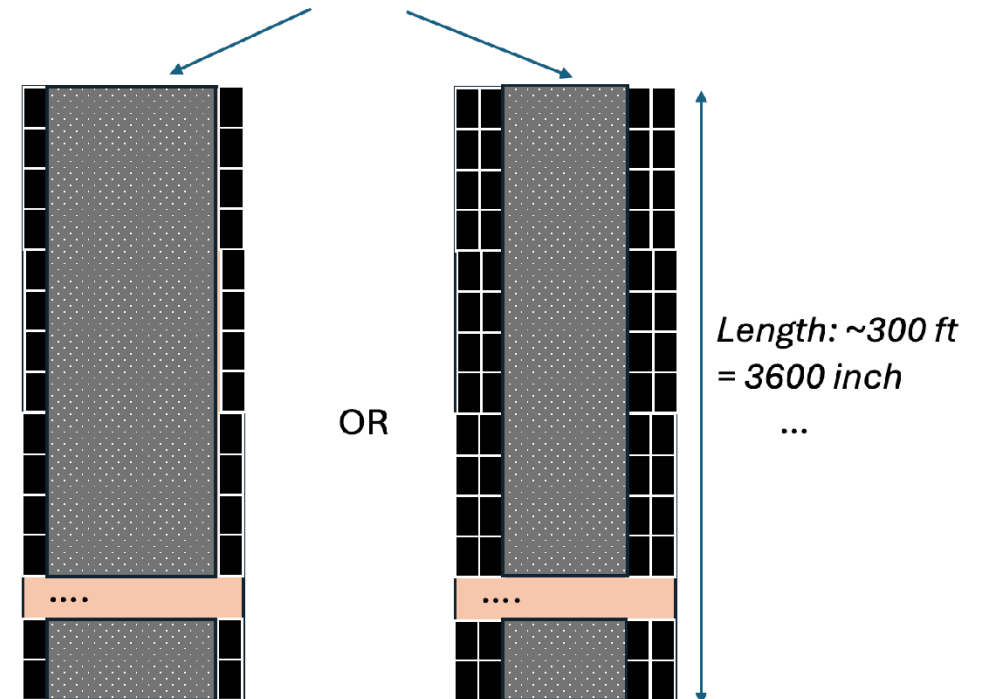
Ongoing project in Washtenaw County, MI, Planned for 2026

- TDA block size: 30 * 30 * 60 inch



TDA blocks needed: $9 * 60 = 540$;

Compacted TDA shreds, ~ 30 inch in thickness (after compaction)



TDA blocks needed: 120

TDA blocks needed: 240

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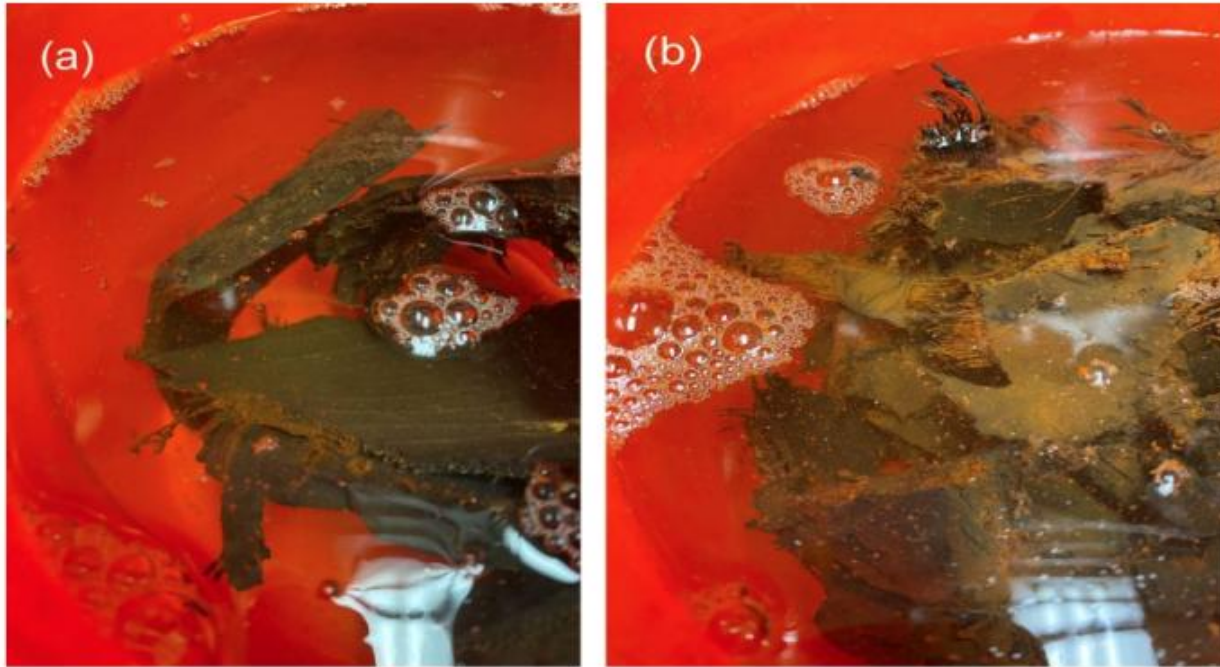
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4.1 Biofilm Growth on TDA



Biofilm growth on TDA in the (a) Traditional TDA and (b) wire-exposed TDA. *

- According to the report, biofilms developed on TDA can capture most of the leached metals (**e.g., zinc, copper, and iron**), leading to very low metal concentrations in the effluent that meet U.S. EPA acute toxicity standards.

* Reference: Natarajan, Poornima; Gulliver, John S.; Cai, Meijun; McCollor, Mara; Singh, Rajneesh. (2025). Sustainable Application of TDA in Stormwater Infiltration and Treatment. Retrieved from the University Digital Conservancy, <https://hdl.handle.net/11299/276411>.

4. Environmental Effects and Benefits of Using TDA

4.1 Biofilm Growth on TDA



Microorganism Growth on Rock Aggregate *



Microorganism Growth on TDA *

- TDA exhibits **adsorption capacity** for both organic and inorganic contaminants, particularly under high concentration conditions.
- The high carbon content of rubber (~80%) enhances its affinity toward organic compounds.
- Adsorbed chemicals can be **biodegraded by microorganisms** after an acclimation period, which leads to a **natural regeneration of sorption capacity**.

* Reference: Usage Guide -- TDA (Tire-Derived Aggregate) (DRRR-2016-1545), <https://www2.calrecycle.ca.gov/Docs/Publications/Details/1545>.

4. Environmental Effects and Benefits of Using TDA

4.2 Leaching Test Results on Project in Clare County

Table. Leaching test results compared with the EPA standards *

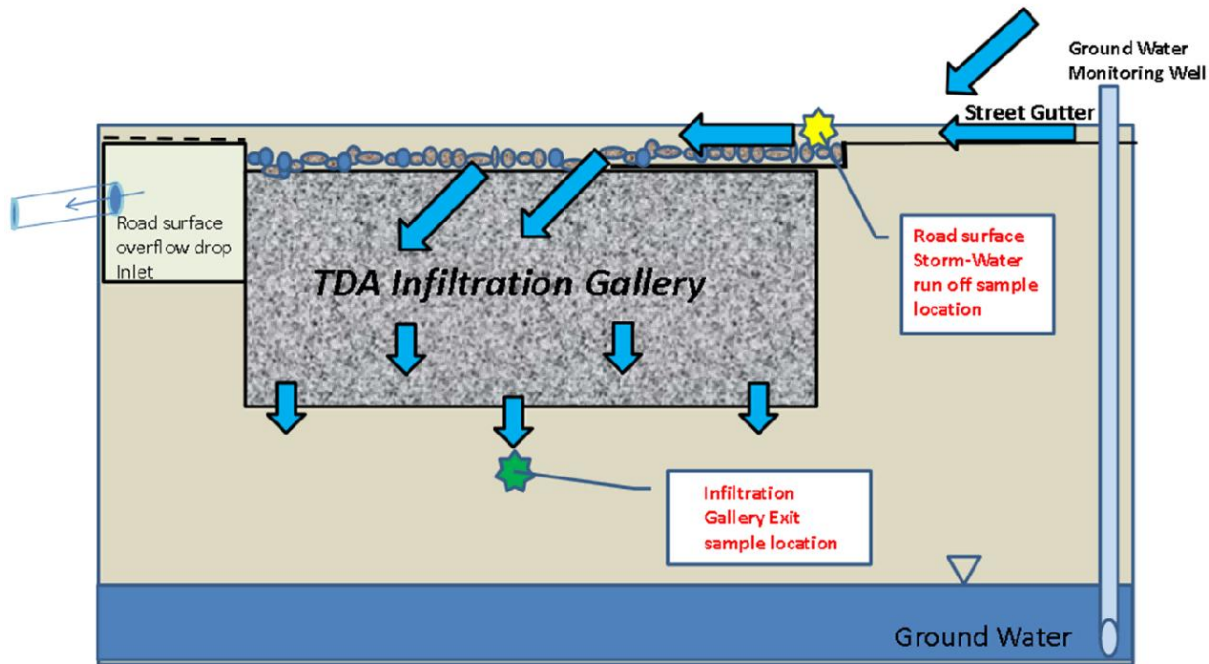
Leaching material	Contaminant content (mg/L)	Secondary Standard Level
Zinc	0.086	5
Iron	0.002	0.3
Manganese	0.178	0.05
Copper	0.008	1

* Note: The comparison is based on the U.S. Environmental Protection Agency National Secondary Drinking Water Standards.

4. Environmental Effects and Benefits of Using TDA

4.3 Using TDA Blocks to Capture Pollutants

Ongoing research: Using TDA blocks to intercept pollutants in stormwater runoff



The research team will assess the capacity of TDA blocks to retain the pollutants listed below using both field-collected samples and controlled laboratory experiments.

- Microplastics
- PFAS
- 6PPD-Q
- Heavy metals

4. Environmental Effects and Benefits of Using TDA

4.4 Benefits of Using TDA Block



Public roadway stormwater collectors can be constructed on road shoulders as water catch basins made with TDA blocks.



The goal is to capture rainwater coming off roadways and retain both the water and contaminants washed away within underground TDA blocks.



TDA blocks are designed to be easier to deliver and install, and they provide approximately 14 cubic feet of water storage per cubic yard of TDA.

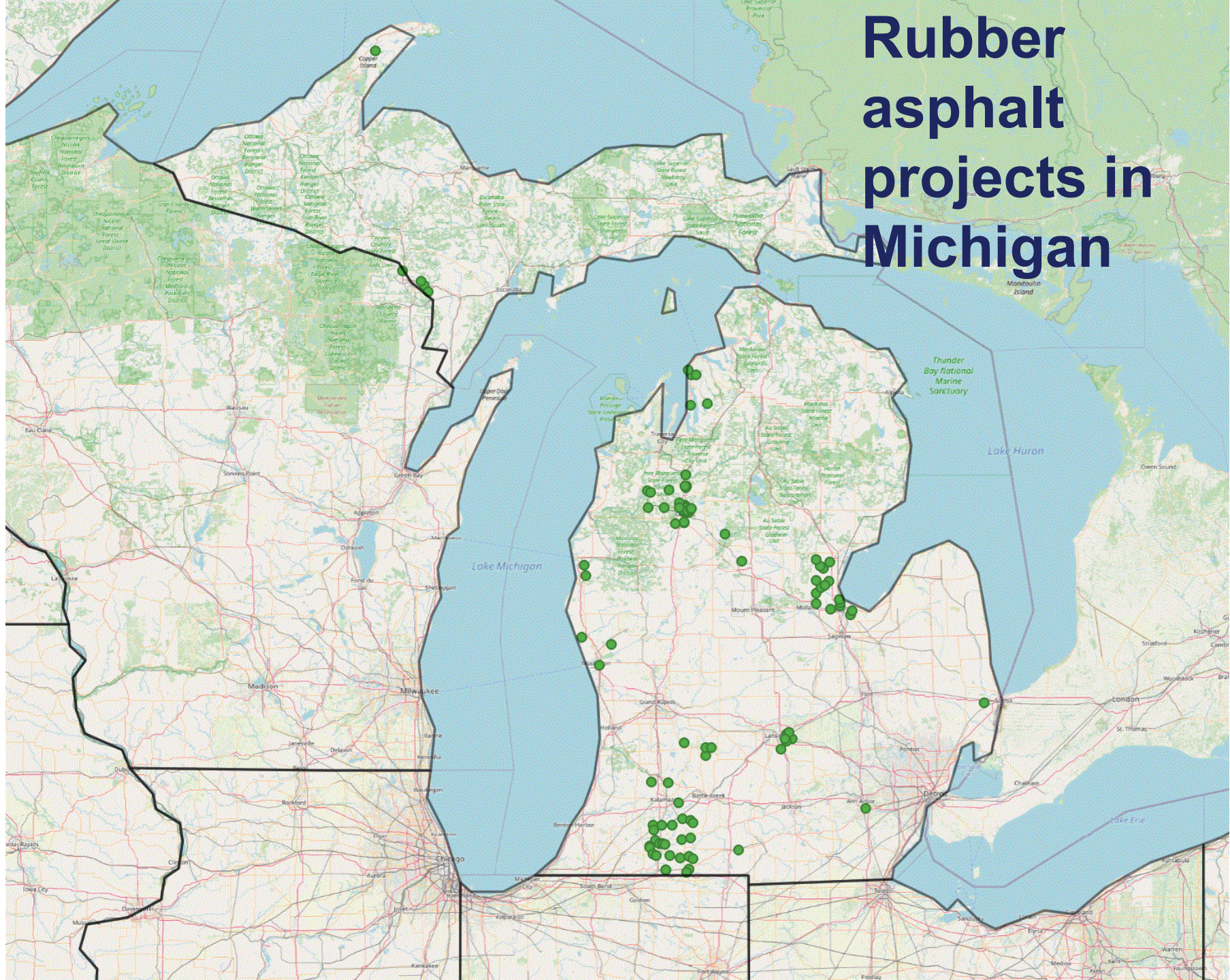


TDA can remove phosphorus and other organics and allows contaminants like 6PPD-Q to be kept out of open waterways and away from fish and other aquatic organisms.



Initial tests show that once 6PPD-Q is captured underground, the chemical becomes bound within the TDA and the surrounding soil.

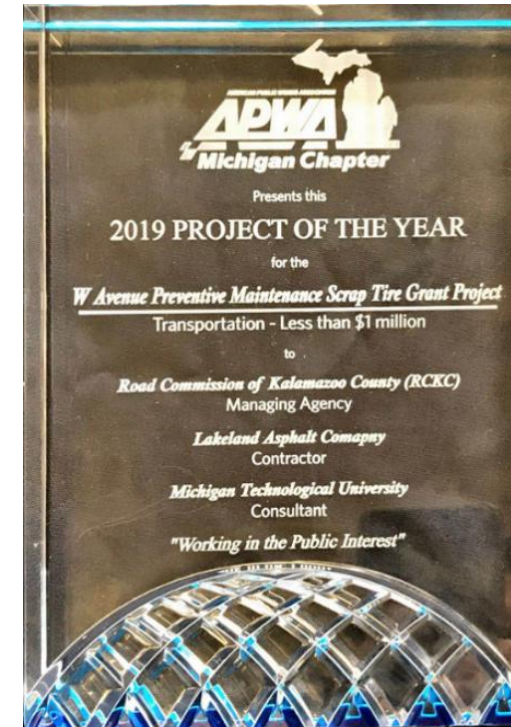
Rubber asphalt projects in Michigan



R&D Team with local and state partners in 2019



R&D Team with local and state partners in 2018





County Road Association OF MICHIGAN



Michigan
Technological
University



MICHIGAN DEPARTMENT OF
ENVIRONMENT, GREAT LAKES, AND ENERGY



Federal Highway
Administration

FHWA + EGLE funded project

MU Research Team:

**Zhanping You
Kobe Jin
Sepehr Mohammadi
Lei Yin
Kwadwo Boateng**