



The Straits of Mackinac is a special place, and that's why we take extraordinary precautions to continue the safe and reliable operation of Line 5 as it crosses under the Straits. We're keeping a close watch on mussel populations along the Line 5 Straits crossing to ensure the system's safety is not compromised.

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### What has Enbridge done about mussel concerns at the Line 5 Straits crossing?

In 2014, we retained GEI Consultants Inc. to assess the mussels found along our parallel, 20-inch-diameter Line 5 pipelines crossing under the Straits of Mackinac. GEI's study concluded that mussel populations in the Straits pose no threat to Line 5.

### What qualifications do these consultants have?

GEI is a consulting firm founded by Harvard and MIT geotechnical engineers. GEI has 45 years of experience in monitoring and analyzing ecological and environmental habitats, and has experience with underwater structures in the Great Lakes.

### What did they discover?

GEI examined mussel samples from nine locations along the Line 5 Straits crossing. No zebra mussels were found in these samples, only quagga mussels. The consultants examined several factors – including mussel weight, mussel secretions, and potential corrosive properties, based on extensive research – and determined that mussels accumulated on Line 5 in the Straits of Mackinac had no impact on the pipeline.

### Are you keeping an eye on the issue?

We regularly inspect the exterior of the Line 5 pipe with expert divers and/or remote operated vehicles (ROVs). External inspections regularly examine the fiber-reinforced enamel coating, which is widely acknowledged as one of the most robust pipeline protection materials. We're also looking at additional opportunities to study mussels on the pipeline.



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## No pressure, no corrosion

The 2014 study by GEI Consultants Inc. found that mussels have not accumulated in such depths to cause pressure on the parallel, 20-inch-diameter lines – nor has the mussels’ attachment to the pipeline’s external coating caused any corrosion.

The mussel shells are thinner and more fragile than normal, due to the pipe depth and the low concentration of calcium in the Great Lakes – and, as a result, are not able to accumulate in more than a single layer. At an average weight of 1.34 grams per mussel, there is no reason to believe the mussels are putting undue weight on the carbon-steel pipe, which is a minimum of 0.812 inches thick. GEI believes this single layer of mussels may actually serve as a protective barrier for Line 5 against natural underwater elements.

The mussels attach to the line through filaments or strands made of protein secretions. A 2013 study found these proteins do not have a corrosive effect – and they have, in fact, been studied as an anti-corrosive for underwater pipes. In any event, the mussels’ attachments had not penetrated Line 5’s fiber-reinforced enamel coating, which is widely held as one of the most robust and durable pipeline protection materials.

Existing studies have found cases where zebra mussels have had a corrosive impact on metal under specific anoxic environmental conditions (meaning oxygen is depleted by restricted water movement caused by mud or other physical barriers); these conditions are not present at the Line 5 Straits crossing.

## Mussel study details and samples

Zebra and quagga mussels have been studied extensively as an invasive species, creating a wealth of scientific data that GEI researchers were able to draw upon to understand the mussels’ potential impact on Line 5.

GEI examined mussel samples from nine locations along the 4.5-mile Line 5 Straits crossing – finding no zebra mussels among any of the nine samples, and finding quagga mussels in each sample.

## Monitoring for mussel impact

Line 5 is inspected regularly using state-of-the-art inline inspection tools that work like MRI machines, checking for dents, buckles, cracks, or other signs of corrosion. We’ve completed a total of 25 high-resolution metal loss inspections since the mid-1990s, and no corrosion has been observed along the Line 5 Straits crossing.

## Keeping the Straits safe

Enbridge understands how important the Straits of Mackinac are to Michigan residents. The health and the protection of this waterway, and the Great Lakes, are essential to the vitality, sustainability, and economic prosperity of the region – and the state of Michigan.

## What is Line 5?

Enbridge’s Line 5 is a 645-mile, 30-inch-diameter pipeline that travels through Michigan’s Upper and Lower Peninsulas, originating in Superior, Wisconsin, and terminating in Sarnia, Ontario, Canada.

Products moved on Line 5 heat homes and businesses, fuel vehicles, and power industry in the state of Michigan.

Built in 1953 by the Bechtel Corporation to meet extraordinary design and construction standards, the Line 5 Straits of Mackinac crossing remains in excellent condition, and has never experienced a leak in more than 60 years of operation. We’re working hard to keep it that way.