



Protecting the Common Waters of the Great Lakes Basin  
Through Public Trust Solutions

July 19, 2018

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**VIA ELECTRONIC SUBMISSION**

**FLOW (For Love of Water) Public Comments on the Joint Application of Enbridge Energy to Occupy Great Lakes Bottomlands for Anchoring Support Structures and Improvements For Line 5 Pipelines in the Straits of Mackinac and Lake Michigan [HNC-AR90-WAHM0 and Corps File No. LRE-2010-00463-56-N18]**

Dear U.S. Army Corps of Engineers Commander Sugrue, Chief Simon, Chief Kuhne, and Regulatory Project Manager Otanez:

For Love of Water (“FLOW”) is writing to request that the U.S. Army Corps of Engineers (“USACE” or “Corps”) conduct an environmental impact study (“EIS”) and public hearing pursuant to Section 102(c)(2) of the National Environmental Policy Act (“NEPA”) and applicable rules in connection with Enbridge Energy’s application for a Department of the Army permit under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 403) and Section 404(e) of the Clean Water Act (“CWA”) (33 U.S.C. § 1344).

Enbridge's present application to install an additional 48 new screw anchor and bracket design structures for the dual Line 5 pipelines in the Straits materially changes the [original design](#) authorized by the [state's 1953 easement](#)<sup>1</sup> and continues to pose an ongoing and unacceptable risk to human health, the Great Lakes, and over 400 water crossings in the State of Michigan. Enbridge has cleverly evaded comprehensive environmental review of its 65-year-old pipeline infrastructure by piecemealing/segmenting its ongoing construction activities since 2001 to brace against the strong currents in the Straits of Mackinac.

If this application for another 48 screw anchors to the original pipeline design is approved, the Michigan Department of Environmental Quality ("DEQ") and the Corps will have jointly authorized Enbridge to install a total of 198 anchor brackets to the Line 5 pipelines on public trust bottomlands and waters without the state or federal agencies ever demanding a comprehensive review of risks, impacts, or alternatives under the law. Structurally, this means that approximately three miles of pipeline are elevated in public trust waters above the bottomlands owned by the State of Michigan for the benefit of citizens for fishing, navigation, boating, swimming, drinking water, and other human and recreational needs.<sup>2</sup>

The Corps' decision to conduct the first environmental assessment ("EA") related to Enbridge's Line 5 screw anchors on the lakebed over the course of 15 years is a welcomed one. However, the law and facts in this decision compel the Corps to conduct a comprehensive EIS rather than an EA. The location of Line 5 in the heart of the open waters of the Great Lakes and the potential for a pipeline oil spill represents a significant and ongoing threat to human health, the environment, and the economy of the Great Lakes.

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<sup>1</sup> See Ed Timm, Technical Letter, July 18, 2018, Comments Regarding the Enbridge Application for a Permit to Install 48 New Screw Anchor Supports under Line 5 in the Straits of Mackinac, e.g., pp. 1-4 (See Appendix 1); see also previous public comments by FLOW and others on the change in pipeline design that has not previously been authorized or approved by any federal or state agency. FLOW, *Comments on the Joint Application of Enbridge Energy to Occupy Great Lakes Bottomlands for Anchoring Supports*, June 29, 2017 <http://flowforwater.org/wp-content/uploads/2017/06/FINAL-2017-06-29-17-Comments-to-DEQ-USCOE-Joint-App-Enbridge-for-Supports.pdf>; FLOW, *Supplemental Comments on the Joint Application of Enbridge Energy to Occupy Great Lakes Bottomlands for Anchoring Support*, Aug. 4, 2017, <http://flowforwater.org/wp-content/uploads/2016/04/FLOW-Supplemental-Comments-to-DEQ-USCOE-Joint-App-Enbridge-for-Supports-2017.08.04-with-Appendices.pdf>; FLOW, *Supplemental Comments on 2017 Anchor Permit Application*, Oct. 12, 2017, <http://flowforwater.org/wp-content/uploads/2018/02/FLOW-Supplemental-Comments-to-DEQ-USCOE-Joint-App-Enbridge-for-Supports.pdf>; FLOW, *Supplemental Public Comments on Enbridge's Joint Permit for 22 Screw Anchors*, Feb. 9, 2018, <http://flowforwater.org/wp-content/uploads/2018/02/FLOW-Supplemental-Comments-on-2017-Anchor-Permit-2018.02.09.pdf>; FLOW, *Public Comments on Enbridge's Joint Permit Application for 48 Screw Anchors*, May 11, 2018, <http://flowforwater.org/wp-content/uploads/2018/05/FINAL-FLOW-public-comments-on-Anchor-Permit-05-11-18.pdf>.

<sup>2</sup> The combined change in design of these dual lines under the Straits coupled with the public trust and servitude raise the level of the pending application to a major federal action significantly affecting the quality of human environment. (See Section I, below); See also, *Obrecht v. National Gypsum Co.*, 361 Mich. 399 (Mich. 1960); *Illinois Cent. R.R. Co. v. Illinois*, 146 U.S. 387 (1892) (holding that the public trust bottomlands are also subject to a paramount navigational servitude for passage of ships and maritime commerce and travel owed to every citizen of the U.S.).

A proposed federal permit to install 48 screw anchors on Enbridge’s Line 5 in the Straits of Mackinac constitutes a “major Federal action[ ] significantly affecting the quality of the human environment”<sup>3</sup> because such activity interferes with federal navigation and tribal fishing and treaty rights, and represents an unacceptable risk given the magnitude of harm to drinking water supplies, and unprecedented regional economic impact and natural resource damages. Based on the law and compelling evidentiary case, FLOW concludes and recommends that the Corps apply a broad scope of review of the EA and EIS to the entire dual pipelines in the Straits, not confined to the screw anchors.

**I. THE CORPS MUST PREPARE AN EIS UNDER NEPA BECAUSE ENBRIDGE’S PROPOSED ACTIVITY CONSTITUTES A “MAJOR FEDERAL ACTION[ ] SIGNIFICANTLY AFFECTING THE QUALITY OF THE HUMAN ENVIRONMENT”**

Under Section 404 of the CWA and Section 10 of the Rivers and Harbors Act, the Corps issues nationwide permits (“NWP”) to authorize any category of activities involving discharges of dredged or fill material in waters of the U.S. that will result in “no more than minimal individual and cumulative adverse environmental effects.”<sup>4</sup> NWP 12 specifically authorizes discharges of dredged or fill material into waters of the U.S. and structures or work in navigable waters of the U.S. in connection with the construction, maintenance, repair of utility lines and associated facilities provided the activity does not result in the loss of greater than 1/2-acre of waters of the United States for each single and complete project.<sup>5</sup> NWP 12 permits are subject to categorical exemptions from NEPA’s EA and EIS review so long as the proposed activity satisfies the nationwide permit general conditions.<sup>6</sup> In this instance, however, the Corps must perform an EIS on Enbridge’s application for 48 screw anchors because (1) the proposed action is a major federal action; and (2) the proposed action significantly affects the quality of the human environment.

As our “basic national charter” governing environmental protection, NEPA requires all federal agencies to prepare an EIS where (1) the proposed action is a “major Federal action;” and (2) the proposed action “significantly affects the quality of the human environment.”<sup>7</sup> A “major Federal action” includes those “with effects that may be major and which are potentially subject to Federal control and responsibility.”<sup>8</sup> In addition, private actions involving permitting for construction and management activities may constitute a “major Federal action” subject to EIS requirements.<sup>9</sup>

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<sup>3</sup> 42 U.S.C. § 4332(2)(C) (2018); 40 C.F.R. §§ 1508.27(a)-(b) (2018).

<sup>4</sup> 33 U.S.C. § 1344(e)(1) (2018).

<sup>5</sup> Nationwide Permit 12 Department of the Army Corps of Engineers. Final Notice of Issuance and Modifications of Nationwide Permits, Federal Register Authorized March 19, 2017 <http://saw-reg.usace.army.mil/NWP2017/2017NWP12.pdf>.

<sup>6</sup> 40 C.F.R. § 1508.4 (2018).

<sup>7</sup> 42 U.S.C. § 4332 (2018); 40 C.F.R. § 1500.1 (2018).

<sup>8</sup> 40 C.F.R. § 1508.18 (2018).

<sup>9</sup> *Id.*

The EIS must describe: “(i) the environmental impact of the proposed action, (ii) any adverse environmental effects which cannot be avoided should the proposal be implemented, (iii) alternatives to the proposed action, (iv) the relationship between local short-term uses of man’s environment and the maintenance and enhancement of long-term productivity, and (v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action.”<sup>10</sup>

In performing an EA, the Corps must determine whether an EIS is required.<sup>11</sup> To make this threshold determination of whether to conduct an EIS, the lead federal agency first prepares an EA that takes a “hard look” at the proposal, a full range of reasonable alternatives, and the potential environmental impacts of the proposed action.<sup>12</sup> An EA must also inform the public and officials of consequences and alternatives before decisions are made. If the actions or related actions involve “any significant environmental impacts that might result from the action,” the EIS is required before any agency action on the permit application is taken.<sup>13</sup> In this instance, the preparation of an EIS is required because the likely environmental effects are both severe and uncertain.<sup>14</sup>

Pursuant to NEPA’s “hard look” requirement, the agency must ensure that “the adverse environmental effects of the proposed action are adequately identified and evaluated.”<sup>15</sup> An EIS must be prepared if “substantial questions are raised as to whether a project may cause significant degradation.”<sup>16</sup> “Significantly” has two components: “context” and “intensity.”<sup>17</sup> Context refers to the setting (e.g., the Great Lakes) in which the action takes place.<sup>18</sup> Intensity refers to “the severity of the impacts,”<sup>19</sup> which include, *inter alia*, the effect on “public health or safety”; “[u]nique characteristics of the geographic area such as proximity to historic or cultural resources”; the extent to which the environmental effects “are likely to be highly controversial” or “are highly uncertain or involve unique or unknown risks”; “[w]hether the action is related to other actions with individually insignificant but cumulatively significant impacts”; and the degree to which the action “may cause loss or destruction of significant . . . cultural[ ] or historical resources.”<sup>20</sup> The impact on the environment from incremental actions when added to other past, present, and reasonably foreseeable future actions must be considered.<sup>21</sup>

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<sup>10</sup> 42 U.S.C. § 4332(2)(C) (2018); 40 C.F.R. § 1500.1.

<sup>11</sup> 40 C.F.R. §§ 1501.4(b), 1508.9(a) (2018).

<sup>12</sup> 40 C.F.R. § 1508.9 (2018).

<sup>13</sup> *Sierra Club v. Peterson*, 717 F.2d 1409, 1414 (D.C. Cir. 1983).

<sup>14</sup> *See* 42 U.S.C. § 4332 (2018).

<sup>15</sup> *Standing Rock Sioux Tribe v. USACE*, 255 F. Supp. 3d 101 (2017); *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 350 (1989); *Ocean Advocates v. USACE*, 402 F.3d 846 (9th Cir. 2005).

<sup>16</sup> *Id.*; *Idaho Sporting Cong. v. Thomas*, 137 F.3d 1146, 1149 (9th Cir. 1998).

<sup>17</sup> 40 C.F.R. § 1508.27 (2018).

<sup>18</sup> 40 C.F.R. § 1508.27(a) (2018).

<sup>19</sup> *See id.* § 1508.27(b).

<sup>20</sup> 40 C.F.R. § 1508.27 (2018).

<sup>21</sup> *City of Carmel-by-the-Sea v. U.S. Dept. of Transp.*, 123 F.3d 1142 (9th Cir. 1997); *see e.g.* 40 C.F.R. § 1502.16 (2018).

As noted, impacts refer to “potential” or “may,” and where the context and intensity exist, uncertainty demands preparation of an EIS. Finally, the Corps must give a “convincing statement of reasons” to justify not preparing an EIS. For example, in a case involving an extension of harbor facilities for petroleum transport, the Corps was required to prepare an EIS, where the extension and the nature of potential consequences, as the changed or new pipeline line in the instant matter, were not previously evaluated by an agency.<sup>22</sup>

Both the context and intensity of the possible effects from Enbridge’s proposed action are particularly relevant, given that the Great Lakes are considered a high consequence area (“HCA”) under the 2016 PIPES Act<sup>23</sup> and the Straits of Mackinac are “the worst possible place” for an oil spill in the Great Lakes according to a 2014 University of Michigan study.<sup>24</sup> A Line 5 oil spill in this environmentally sensitive area could cause a \$6.3 billion dollar impact to the Great Lakes economy, significantly affecting the public’s use of the Great Lakes freshwater for drinking water, recreation, and navigation, as well as the sovereign tribal rights to fish in the Straits of Mackinac. Early on in evaluating the significant harm to the environment, health and the Great Lakes, the Michigan Petroleum Pipeline Task Force concluded that the consequences of a crude oil spill or release from Line 5 in the Straits of Mackinac would be “very significant.”<sup>25</sup>

The Corps has committed to preparing at least an EA. For the reasons stated below, the nature, extent, risks, and fundamental changed or new design of Line 5 above the bottomlands of the Straits, and given the substantial serious concerns or opposition by a large percentage of citizens, the Corps should prepare an EIS as required by NEPA. The significance of the Line 5 in the Straits of Mackinac is unprecedented in light of the applicant’s record, and the new pipeline design elevating the serious risks and the likelihood or potential for devastating and severe consequences to the Great Lakes, citizens, communities, paramount tribal and public fishing grounds, boating, drinking water, and public and private property.

Enbridge’s proposal to construct an additional 48 screw anchors on Line 5’s underwater pipelines located in the Straits of Mackinac constitutes a “major federal action” under NEPA, because it is a specific project affecting the waters of the U.S. that is subject to federal approval under Section 404(e) of the CWA and Section 10 of the Rivers and Harbors Act of 1899.<sup>26</sup> With Enbridge’s proposed construction of 48 new screw anchors along Line 5, the corporation will have cumulatively constructed 198 anchor support structures that lift approximately three miles of the dual pipelines off the lakebed owned and held in public trust by Michigan and protected by a federal navigational servitude. This matter constitutes a major federal action because of substantial paramount public trust navigational and tribal interests in fishing and threatened fishing grounds, as well as widespread community and citizen concern and opposition.

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<sup>22</sup> *Ocean Advocates v. USACE*, 402 F.3d 846 at 866-868.

<sup>23</sup> 49 U.S.C. § 60109 (2018).

<sup>24</sup> David J. Schwab, *Straits of Mackinac Contaminant Release Scenarios: Flow Visualization and Tracer Simulations*, University of Michigan Water Center, Spring 2014, <http://graham.umich.edu/media/files/mackinac-report.pdf>.

<sup>25</sup> Michigan Petroleum Pipeline Task Force, *Michigan Petroleum Pipeline Task Force Report*, July 2015, [https://www.michigan.gov/documents/deq/M\\_Petroleum\\_Pipeline\\_Report\\_2015-10\\_reducedsize\\_494297\\_7.pdf](https://www.michigan.gov/documents/deq/M_Petroleum_Pipeline_Report_2015-10_reducedsize_494297_7.pdf).

<sup>26</sup> 33 U.S.C. §§ 1344, 403 (2018).

FLOW urges that the Corps takes into consideration the following adverse impacts and effects when finalizing the agency's determination on whether Enbridge's proposed action significantly affects the quality of the human environment:

**Interference with Navigation of Waters of the U.S. and Navigational Servitude:** Enbridge's proposed project and new design interferes with the federal government's reserved right of a navigational servitude in the waters of the Great Lakes. With Line 5's new design elevated off the lakebed, the pipeline is now more susceptible to anchor strikes than it has ever been. This susceptibility was best exemplified on April 1, 2018 when a tug boat anchor dented the dual oil pipelines in three locations and spilled over 600 gallons of dielectric fluid from an adjacent transmission cable into the waters of Lake Michigan.<sup>27</sup> The new elevated design of Line 5 poses a significant risk to the indispensable Great Lakes shipping industry, which creates \$35 billion in economic activity and supports over 200,000 jobs.<sup>28</sup> In light of the elevated pipeline's interference with the federal government's navigational servitude, and the increased risk to the Great Lakes shipping industry, Enbridge's proposed application for an additional 48 screw anchors significantly affects the quality of the human environment.

**Interference with Sovereign Tribal Rights:** Categorical exclusions from NEPA are allowed only if the proposed activity or operation does not "impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights."<sup>29</sup> In this case, an EIS must examine the potential adverse effects on treaty rights in the Straits of Mackinac. Every day, Line 5 transports 23 million gallons of crude oil through the Straits of Mackinac in public trust and treaty protected waters and over 400 water crossings throughout the State of Michigan. Enbridge's continued operation of Line 5 threatens to destroy the off-reservation fishing rights of five Indian tribes who signed the March 28, 1836 Treaty of Washington (7 Stat. 491): they include Bay Mills Indian Community, Sault Ste. Marie Tribe of Chippewa Indians, Grand Traverse Band of Ottawa and Chippewa Indians, Little River Band of Ottawa Indians, and Little Traverse Bay Bands of Odawa Indians, and are collectively represented by the Chippewa Ottawa Resource Authority ("CORA"). In the 1836 Treaty, these Tribes reserved off-reservation fishing rights in the Great Lakes including the Straits of Mackinac that have been confirmed by the federal courts.<sup>30</sup> The Straits of Mackinac are the spawning and fishing grounds for 60 percent of the commercial tribal whitefish catch.

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<sup>27</sup> Emily Lawler, *Line 5 Damaged, Likely From Same Anchor Strike that Caused Spill*, MLive, April 11, 2018, [https://www.mlive.com/news/index.ssf/2018/04/anchor\\_strike\\_responsible\\_for.html](https://www.mlive.com/news/index.ssf/2018/04/anchor_strike_responsible_for.html).

<sup>28</sup> Great Lakes Seaway Partnership, *Great Lakes - St. Lawrence Seaway Economic Study*, July 18, 2018, <http://greatlakesseaway.org/great-lakes-st-lawrence-seaway-economic-impacts-study-results-released-seaway-system-shipping-supports-over-237000-jobs-35-billion-in-economic-activity/>.

<sup>29</sup> 40 C.F.R. § 1508.4 (2018).

<sup>30</sup> *United States v. Michigan*, 471 F. Supp. 192 (W.D. Mich. 1979), aff'd. 653 F.2d 277 (6th Cir. 1981), cert. denied, 454 U.S. 1124 (1981).

**Interference with Drinking Water Supplies:** A 2016 University of Michigan study concluded that a Line 5 pipeline rupture could potentially affect up to 720 miles of shoreline on Lakes Michigan and Huron.<sup>31</sup> Such a rupture would immediately contaminate the Great Lakes drinking water supply for Mackinac Island and the City of St. Ignace, and the oil spill could threaten shoreline communities and their water source from Traverse City to Alpena and beyond. Depending on the size of a catastrophic oil spill in the Great Lakes, more than 400,000 residents and other customers with their water supply are at direct risk or potentially threatened.<sup>32</sup>

**Interference with Regional Economy and Natural Resource Damage:** Michigan's economy could suffer an estimated \$6 billion blow from a Line 5 oil spill, damaging tourism, aquatic and terrestrial wildlife and natural resources, coastal property values, commercial fishing, and municipal water systems, according to a study by a Michigan State University economist commissioned by FLOW.<sup>33</sup> Specifically, this economic impact study estimates \$697.5 million in costs for natural resource damages and restoration and more than \$5.6 billion in total economic impacts, including: \$4.8 billion in economic impacts to the tourism economy; \$61 million in economic impacts to commercial fishing; \$233 million in economic impacts to municipal water systems; over \$485 million in economic impacts to coastal property values.<sup>34</sup>

**Significant Level of Unacceptable Risk:** Since 2001, the Corps and the DEQ have jointly permitted and authorized Enbridge to install a total of 150 screw anchors to the Line 5 pipeline on public trust bottomlands and waters without ever demanding a comprehensive review of risks, impacts, or alternatives as required under both state and federal law. In addition, Enbridge has never conducted a comprehensive engineering study to evaluate the water's currents, gravitational, and thermal expansion stresses on Line 5 with 198 anchors both bracing and elevating it off the lakebed floor.

Enbridge's new screw anchor and bracket design structures for the dual Line 5 pipelines in the Straits are material changes from the [original design](#) authorized by the [state's 1953 easement](#). In fact, a review of the historical documents reveals that Enbridge essentially neglected and allowed ongoing easement violations of the 75-foot maximum span provision from the time the line was constructed in 1953 until 2001, according to Dr. Timm's July 18, 2018 technical report.<sup>35</sup> For example, by 1980, Enbridge documented 17 span violations that exceeded the 75-foot requirement.<sup>36</sup> By 2003, the Kiefner report commissioned by Enbridge documented massive lakebed erosion from 1980 to 2003 that caused unsupported spans to grow as long as 286 feet on the east leg pipeline and 224 feet on the west leg pipeline.<sup>37</sup>

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<sup>31</sup> David J. Schwab, *Straits of Mackinac Contaminant Release Scenarios: Flow Visualization and Tracer Simulations*, University of Michigan Water Center, Spring 2014, <http://graham.umich.edu/media/files/mackinac-report.pdf>.

<sup>32</sup> FLOW, *Protecting the Heart of the Great Lakes from a Disastrous Oil Spill*, [http://flowforwater.org/wp-content/uploads/2017/01/FLOW\\_brochure\\_digital-2-2.pdf](http://flowforwater.org/wp-content/uploads/2017/01/FLOW_brochure_digital-2-2.pdf)

<sup>33</sup> FLOW, *Oil Spill Economics: Estimates of the Economic Damages of an Oil Spill in the Straits of Mackinac in Michigan*, May 2018 [http://flowforwater.org/wp-content/uploads/2018/05/FLOW\\_Report\\_Line-5\\_Final-release-1.pdf](http://flowforwater.org/wp-content/uploads/2018/05/FLOW_Report_Line-5_Final-release-1.pdf).

<sup>34</sup> *Id.*

<sup>35</sup> Dr. Edward Timm, "Comments Regarding the Enbridge Application for a Permit to Install 48 New Screw Anchor Supports under Line 5 in the Straits of Mackinac," Submitted to the U.S. Army Corps of Engineers, July 18, 2018 (See Appendix 1).

<sup>36</sup> *Id.* at 2.

<sup>37</sup> *Id.*

Enbridge's new pipeline design -- which attempts to rigidly brace the lines to the lake bottom against the Straits' powerful currents -- is causing fundamental structural problems, including the loss of protective coating, bare metal spots, and anti-corrosion cathodic protection. Enbridge has known that the screw anchors are causing coating and raw metal loss and exposure to the pipeline since at least 2014,<sup>38</sup> yet they persist in advocating for this design as mere maintenance and repair—in part to avoid any material alterations to the pipeline from being labeled new construction, which would require a full EIS under federal law and a new occupancy application under the GLSLA. This pipeline damage to the coating and structural integrity to Line 5 underscores the significant risks that Line 5 and its screw anchors pose to the environment.

**New Evidence of Anchor Strike Risk:** Since Enbridge's March joint permit application for 22 screw anchors, new evidence of anchor damage to Line 5 and inspection violations demonstrate the significant safety risks Line 5 poses to the freshwater resources of the Great Lakes. This highly damaging information about the condition of Line 5 from an anchor strike must be seriously evaluated by the State of Michigan and the Corps under the GLSLA, the Michigan Environmental Protection Act ("MEPA"), CWA, and other relevant federal statutes.

On April 1, a tugboat [anchor struck](#) and ruptured two electric transmission cables owned and operated by American Transmission Company ("ATC") that are located adjacent to Enbridge's Line 5 pipelines in the Straits. This same anchor hit and dented Line 5 in three locations. Although it was crucial to quickly evaluate the damage to Line 5, Enbridge was unable to conduct underwater autonomous vehicle inspection of the dented sites for two weeks and a visual inspection for three weeks. Enbridge temporarily shut down the flow of oil on two occasions during the Coast Guard's emergency response to the ATC's dielectric fluid spill.

**Lack of Transparency and Untrustworthy Record of Applicant:** Enbridge's continuing lack of transparency and active effort to mislead both state and federal regulators and the public is simply unacceptable. In negotiating the Line 6B 2016 federal consent decree with Department Of Justice ("DOJ") and Environmental Protection Agency ("EPA"), Enbridge represented that the installation of screw anchors on the lakebed was a safety measure, even though the corporation had full knowledge as early as 2014 that this new engineering design was defective, caused pipeline coating loss, elevated Line 5 off the lakebed floor, and ultimately increased the overall risk of an anchor strike and pipeline rupture. In addition, Enbridge applied for three joint DEQ and Corps screw anchor permits in 2016, 2017, and 2018 with full knowledge of its defective design. When Enbridge finally disclosed this information in November 2017, the corporation stated that 48 out of 128 screw anchor locations inspected by divers had gaps, including three the size of dinner plates that were bare metal and 42 that had calcareous deposits.<sup>39</sup>

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<sup>38</sup> Garret Ellison, *Enbridge knew about Line 5 coating damage in 2014*, MLive, Oct. 27, 2017 [http://www.mlive.com/news/index.ssf/2017/10/enbridge\\_line\\_5\\_damage\\_2014\\_de.html](http://www.mlive.com/news/index.ssf/2017/10/enbridge_line_5_damage_2014_de.html).

<sup>39</sup> Mark Tower, *Enbridge finds issues at 42 of 48 sites along underwater oil pipeline*, MLive, Nov. 15, 2017 [http://www.mlive.com/news/grand-rapids/index.ssf/2017/11/enbridge\\_finds\\_issues\\_with\\_42.html](http://www.mlive.com/news/grand-rapids/index.ssf/2017/11/enbridge_finds_issues_with_42.html).

Most recently, in May 2018, Enbridge was fined \$1.9 million by the EPA as part of its Line 6B consent decree for failing to meet its pipeline safety inspection obligations (including two locations on land-based portions of Line 5).<sup>40</sup>

## II. THE SCOPE OF THE EIS AND/OR EA MUST COMPREHENSIVELY STUDY AND EVALUATE THE SIGNIFICANT IMPACTS TO ENVIRONMENT AND HEALTH AND RANGE OF REASONABLE ALTERNATIVES TO THE DUAL PIPELINES OF LINE 5 IN THE STRAITS

Whether an EA or EIS, the discussion and analysis of alternatives to actions that may significantly affect the environment is “at the heart” of the Corps’ duties under NEPA.<sup>41</sup> The discussion of the range of alternatives to a proposed action must be “reasonable;<sup>42</sup> and it must not unduly narrowed by limiting the project to the purpose stated in the application.<sup>43</sup> Typically, the EIS or assessment must evaluate a full range of reasonably possible alternatives to accomplish the basic purpose of the project under review<sup>44</sup> – that is, a detailed disclosure of alternative ways or methods that would avoid or reduce impact and accomplish the goal or purpose.<sup>45</sup> However, in doing so, the government body must conduct a thorough evaluation and provide detailed reasons for its conclusions.<sup>46</sup>

The consideration of alternatives and their comparative impacts must be in response to the basic “underlying purpose”<sup>47</sup> of the action proposed, and not simply the stated action in the application<sup>48</sup> (i.e., Enbridge’s description in the instant application for “repair” or “maintenance” by installation of more anchors cannot be used to limit discussion of alternatives to real purpose, seeking approval to continued use by changed or new pipeline design to transporting crude oil, increased in recent years from 300,000 bbls/day to 540,000 bbls/day). An agency may not define the objectives of its action in terms so unreasonably narrow that only one alternative from among the environmentally benign ones in the agency’s power would accomplish the goals of the agency’s action, and the EIS would become a foreordained formality.<sup>49</sup> Moreover, the approach to the alternative requirement cannot be drawn too

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<sup>40</sup> Jim Malewitz, *Enbridge Fined \$1.9 Million for Inspection Woes on Line 5, Other Pipelines*, Bridge, May 4, 2018 <https://www.bridgemi.com/michigan-environment-watch/enbridge-fined-19-million-inspection-woes-line-5-other-pipelines>.

<sup>41</sup> *Alaska v. Andrus*, 580 F.2d 465, 475 (D.C. Cir. 1978); 40 C.F.R. § 1502.14 (2018).

<sup>42</sup> 42 U.S.C. § 4332(2)(c)(iii) (2018).

<sup>43</sup> *Sierra Club v. Coleman*, 421 F. Supp. 63 (D.D.C. 1976).

<sup>44</sup> E.g., Council of Environmental Quality rules on NEPA impact and alternative studies and statements. 40 C.F.R. § 1501 (2018).

<sup>45</sup> *Id.* NEPA EIS, Alternatives requirement; 42 U.S.C. § 4332(C)(3) (2018) (“The purpose of an EIS is a “full and fair discussion [to] inform decision makers of environmental impacts... and reasonable alternatives which would avoid or minimize adverse impacts.”); 40 C.F.R. § 1502.1; *Stewart Park & Reserve Coal Inc. v. Slater*, 352 F.3d 545, 557 (2d Cir. 2003).

<sup>46</sup> *Sierra Club v. Coleman*, (“The purpose of an EIS is a “full and fair discussion [to] inform decision makers of environmental impacts... and reasonable alternatives which would avoid or minimize adverse impacts.”); 40 C.F.R. § 1502.1; *Stewart Park & Reserve Coal. Inc. v. Slater*, 352 F.3d 545, 557 (2d Cir. 2003).

<sup>47</sup> 40 C.F.R. § 1502.13 (2018).

<sup>48</sup> *Id.*

<sup>49</sup> *City of New York v. Dept. of Transp.*, 715 F.2d 732, 743 (2d Cir. 1983).

narrowly where it would result in the impacts or significant risks that are to be disclosed or avoided.<sup>50</sup> In sum, an agency is forbidden to limit the range of reasonably possible alternatives.

Further, where there is a relationship between new risk and safety concerns, the alternative analysis to an existing action or proposed action must treat the proposed action as new, and not previously authorized. An alternative analysis and related potential environmental impacts cannot be limited to an already authorized project or conduct, where new and additional circumstances, changes, and safety concerns have occurred or become known after the authorized project.<sup>51</sup>

In Section I, these comments outlined the significant existing severe and intense of the significant threats to the quality of the human environment. FLOW has on numerous occasions submitted technical reports and comments regarding the existence of alternatives that would avoid the severe threat of catastrophic harm and effects to Lake Huron and Lake Michigan and shoreline communities, property owners, and the many protected public trust uses and tribal fishing in these waters.<sup>52</sup> There is a reasonable, practical, feasible, and affordable alternative: the transport of crude oil carried by Line 5 to Canada, Detroit, and Toledo can be handled, with some minor or reasonable adjustments, by Line 6B (renamed by Enbridge as Line 78).<sup>53</sup> Practical solutions exist for both continued service of propane to the U.S. and transport of smaller volumes of crude oil out of northern Michigan. Enbridge has doubled the design capacity of Line 6B/78 with a 36-inch diameter pipeline from Griffith, IL to Stockbridge, MI; there, the line forks, with a 30-inch line to Sarnia and another equally large line to Detroit and Toledo. Moreover, Marathon in Detroit and Toledo refineries have access to 50,000 bbls/day of light crude oil from fields in Ohio and Pennsylvania, and from other pipelines from the south.<sup>54</sup>

It is clear that a “hard look” is necessary for any meaningful decision by the Corps regarding the continuous addition of anchor supports to redesign and shore up a failing design of Line 5 in the Straits. A reasonable analysis of alternatives must include the avoidance of severe, intense, and unacceptable harm threatened by Line 5 in the Straits. Thorough analysis, with clearly stated and supported reasons, not assumptions, is required based on the current conditions, failures, and circumstances surrounding Line 5. Enbridge and the State of Michigan, through its DEQ and Attorney General, can no longer pass off nearly three miles of elevated pipelines as “repair” or “maintenance.” The Corps, given its obligations under

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<sup>50</sup> 40 C.F.R. § 1502.14 (“[A]gencies shall: (a) Rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated. (b) Devote substantial treatment to each alternative considered in detail including the proposed action so that reviewers may evaluate their comparative merits. (c) Include reasonable alternatives not within the jurisdiction of the lead agency.”) This is similar to Michigan wetlands law, which discourages alternative analysis that draws the purpose or conduct in question so narrowly as to preclude consideration of alternatives that would eliminate or significantly reduce the loss of wetlands or natural resources that are threatened. MCL 303011(b)(4); R281. DEQ WPA rules prohibit “unduly narrowing” the basic project purpose to avoid considering alternatives, as did the respondent in this case. Applicant cannot narrow the purpose and must prove it has considered and established least damaging or wetland loss alternatives are not feasible and prudent. R281.922a(4).

<sup>51</sup> *Northern Plains Resource Council Inc. v Surface Transp. Bd.*, 668 F. 3d 1067, 1099 (9th Cir. 2011). (Holding a board’s decision to limit impact analysis to authorized railroad location or route was arbitrary and capricious).

<sup>52</sup> See FLOW, *Eliminating the Line 5 Oil Pipelines’ Unacceptable Risk to the Great Lakes through a Comprehensive Alternatives Analysis and Systems Approach*, Dec. 14, 2015, <http://flowforwater.org/wp-content/uploads/2015/12/FLOW-Composite-Report-12-14-15-FINAL-1.pdf> .

<sup>53</sup> *Id.*

<sup>54</sup> *Id.*

NEPA and the CWA, including protection of paramount navigational servitude and rights of citizens, can and should reject this narrow, untenable position; it is a misrepresentation of the reality that this is about substantially altering or establishing a new design in place of the failed design for the pipelines, and trying to continue a pipeline that is dangerous and no longer permissible. The proposed action underlying the application is to continue operating the dual lines in the Straits indefinitely.<sup>55</sup> To do so requires a full and complete analysis and discussion of alternatives to a pipeline the Straits. The substantial, unique, rare, sensitive, and public trust and tribal fishing and other uses of these waters and bottomlands demand an EIS and full analysis of a reasonable range of alternatives.

### **III. CONCLUSION AND REQUEST FOR ACTION**

FLOW appreciates the opportunity to comment on the framework and actions to be taken by the Corps pursuant to NEPA, rules, and applicable law to the Enbridge application for permits under CWA and Section 10 of the Rivers and Harbors Act. FLOW also appreciates the decision by the Corps to perform the EA and extend the time period for public comment. Further, FLOW requests that the USACE District Office incorporate this and all previous written comments submitted by FLOW into the record of these proceedings.

Based on the above report and comments, other public comments, and the record in this matter, FLOW submits that the unique facts, circumstances, and applicable laws compel the following actions:

- A.** The application purpose in conjunction with the 150 authorized anchors constitutes a substantially changed and new design for the dual pipelines under the Straits;
- B.** The addition of more supports as part of this continuing change in design involves the evaluation and determination regarding the dual pipelines in the Straits, and is not a mere “repair” or “maintenance” matter;
- C.** The past, continuing, and future use and operation of Line 5 in the Straits (together with the public trust, tribal, navigational, and fishing, recreation, ecosystem, health, drinking water, public and private property, and unacceptable harms and risk associated with these dual lines) constitute a “major federal action” that “significantly affects the quality of the human environment”;
- D.** The application concerns a continuing proposed action that involves far more than “minimal individual and cumulative adverse environmental, effects,” and, therefore falls outside the promulgated categorical exemptions of NEPA;

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<sup>55</sup> Garret Ellison, "Enbridge VP: Mackinac pipeline can operate indefinitely," MLive, June 10, 2016 [https://www.mlive.com/news/index.ssf/2016/06/enbridge\\_line\\_5\\_inspection.html](https://www.mlive.com/news/index.ssf/2016/06/enbridge_line_5_inspection.html)

- E.** The potential severity and context of Line 5's unacceptable risks and harms, and the unique nature of the water, lands, resources, public trust, tribal treaty rights, and navigational interests demand an immediate decision by the Corps District Office to direct the preparation of a comprehensive EIS and other related analyses and reviews before any decision or action is taken on the application; this EIS should include the following, but not limited to:
- An independent review of the structural integrity and safety of Line 5 in the Straits of Mackinac that evaluates the currents, gravitational and thermal stresses on this 65-year-old pipeline infrastructure with 150 anchor screws elevating the pipelines off the lakebed floor;
  - An independent analysis of feasible and prudent alternatives to operating Line 5 on sovereign public trust waters that examines existing pipeline capacity to transport light crude oil from Superior Wisconsin to Sarnia, Canada, including Enbridge's Line 6B; and
  - An independent analysis of risks and impacts of a pipeline rupture and impacts to public health and drinking water supplies, regional economy, tourism, property valuation, commercial and tribal fishing, shipping and navigation, and natural resource damages.
- F.** In the alternative, in preparing and reviewing an EA, the Corps and Detroit District should determine that an EIS is required, including but not limited to the elements listed above;
- G.** That in both the EA and/or EIS, the Corps should require a thorough analysis and discussion of the full range of alternatives to the proposed action regarding the substantially changed or new design of Line 5 in the Straits, not previously authorized; the range of alternatives should include the capacity, and adjustments to pipelines other than Line 5 in the Straits, including the pipeline system for crude oil transport in Michigan;
- H.** The Corps District Office should schedule and hold public hearings on the EA and/or the EIS in accord with the interests at stake and NEPA and its rules;
- I.** Based on the record and other matters identified in the EIS and/or EA process, the Corps District Commander and Regulatory Officers should deny Enbridge's current application for 48 new screw anchors on Line 5 in the Straits under the CWA, Section 10 of the Rivers and Harbors Act, and other applicable laws and regulations; and
- J.** The Corps should take any additional action necessary to prevent any risk of release from the dual lines in the Straits pending further review and before any final decision is made, including the temporary suspension of the transport of crude oil to prevent serious harm to the waters of the US, environment, fishing, navigation, drinking water and other uses, and the related ecosystem.

Thank you for your serious consideration of our comments. Please advise if you have any questions or desire further information.

Sincerely yours,

A handwritten signature in blue ink, appearing to read "James Olson". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

James Olson  
President

A handwritten signature in blue ink, appearing to read "Liz Kirkwood". The signature is cursive and elegant, with a large initial "L".

Elizabeth R. Kirkwood  
Executive Director

For Love of Water  
153 ½ E Front Street, Suite 203C  
Traverse City, MI 49684

cc: Michigan Governor Rick Snyder  
Michigan Attorney General Bill Schuette  
MDNR Director Keith Creagh  
U.S. Senator and Hon. Gary Peters  
U.S. Senator and Hon. Debbie Stabenow

July 18, 2018 Technical Letter

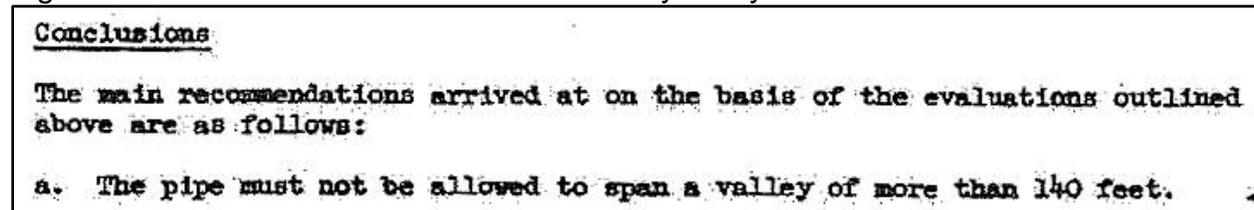
Comments Regarding the Enbridge Application for a Permit to Install  
48 New Screw Anchor Supports under Line 5 in the Straits of Mackinac

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Before the State of Michigan granted the easement required to construct Enbridge Line 5 across the bottomlands of the Straits of Mackinac, the State carefully reviewed the design calculations made by Bechtel, Inc., the design and construction firm that had overall responsibility for building a safe and reliable structure. Most important of the documents submitted for the State's review was an outside review of Bechtel's calculations by famed Columbia University Professor Mario Salvadori, the father of forensic structural engineering.

In a summary document<sup>1</sup>, Salvadori discusses the calculations necessary to insure the structural stability of the pipe and the results of these calculations regarding the exposed, submerged sections of Line 5. The foremost of these conclusions is shown in Figure 1 and it is this conclusion that led the State of Michigan to mandate that there should be no unsupported span greater than 75' anywhere along the exposed sections when granting the easement required for construction.

Figure 1 Main Conclusion of Salvadori Stability Analysis



As has been documented in numerous previous documents by Timm that have been submitted to both the MIDEQ and the MIPSAB, the original construction of the line did not comply with either the 1953 easement requirements or Salvadori's simple mandate for long term structural stability. While the full history of non-compliance has not been revealed, three documents<sup>2,3,4</sup> have shown the degree of non-compliance at two points in time, 1980 and 2003. Tables 1 and 2 tabulate data taken from these documents.

<sup>1</sup> "Engineering and Construction Considerations for the Mackinac Pipeline Company's Crossing of the Straits of Mackinac" and "Report on the Structural Analysis of the Subaqueous Crossing of the Mackinac Straits," submitted by Mackinac Pipeline Company/Lakehead Pipeline Company to the Michigan Department of Conservation, January, 1953

<sup>2</sup> "East Leg Profile Drawing", Michigan Pipeline Task Force, AG Attachment B, Parts A-E, Section A2, Document 164-00-1\_700-10483-01\_523921\_7.pdf

<sup>3</sup> "West Leg Profile Drawing", Michigan Pipeline Task Force, AG Attachment B, Parts A-E, Section A2, Document 164-00-1\_700-10483-01\_523922\_7, 1979

Table 1 along with notes found on the reference drawings reveals that the pipeline did not meet the easement requirements for unsupported span length at the time of construction and, by 1980, had three spans that violated Salvadori's stability limit.

Table 1 Tabulation of Unsupported Spans in 1980

<u>Summary of non-Compliant Unsupported Spans as of 1980</u>		
<u>Location</u>	<u>Spans &gt; 75 feet</u>	<u>Spans &gt; 140 feet</u>
West Leg	10	3
East Leg	7	0

Table 2 tabulates data taken from the Kiefner report. This report, commissioned by Enbridge and released to Enbridge in draft form in 2003 revealed that the unsupported spans had multiplied and grown very significantly over the time period from 1980 to 2003.

Table 2 Tabulation of Unsupported Spans in 2003

<u>Summary of non-Compliant Unsupported Spans as of 2003</u>		
<u>Location</u>	<u>Spans &gt; 140 feet</u>	<u>Maximum Span, feet</u>
West Leg	7	224
East Leg	9	286

Table 3 is an annotated table taken from Enbridge reports that details the results of underwater ROV inspections of Line 5 and the subsequent actions taken by Enbridge. The table provided to the SOM by Enbridge includes actions through the year 2012 and has been annotated by adding information about current and future support installations.

Table 3 reveals a pattern of neglect by Enbridge regarding the unsupported spans that developed under Line 5 because of bottomland erosion due to current action. Early efforts to support the line involved placing canvas bags under the pipe that were then filled with grout. These bags proved ineffective as supports and the failure of one of these supports led to the unstable 286' span shown in Table 2. It was not until 2001 that Enbridge started adding mechanical supports that supposedly ensure the stability of the line. From the time the line was constructed until 2001 Line 5 was essentially neglected and allowed to develop unstable spans. During this 48 year period of

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<sup>4</sup> "Assessment of Span Exposures on the 20-inch Petroleum Pipelines Crossing the Straits of Mackinac", Rosenfeld, M., Kiefner and Associates, Columbus, OH, Released October 2016

deferred maintenance there is reason to believe<sup>5</sup> the pipe was damaged by gravitational, current and expansion induced stresses.

Table 3 History of ROV Inspections and Support Actions on Line 5

Year of ROV Inspection	Supports Installed	Total Supports	Type of Support
1963	None	0	
1972	None	0	
1975	3	3	Grout Bags
1979	None	3	
1982	None	3	
1987	7	10	Grout Bags
1989	None	10	
1990	None	10	
1992	6	16	Grout Bags
1997	None	16	
2001	8	24	Grout Bags and Mechanical Supports
2003	16	40	Mechanical Screw Anchors
2004	16	56	Mechanical Screw Anchors
2005	14	70	Mechanical Screw Anchors
2006	12	82	Mechanical Screw Anchors
2007	None	82	
2010	7	89	Mechanical Screw Anchors
2012	17	106	Mechanical Screw Anchors
2014	22	128	Mechanical Screw Anchors
2016	22	150	Mechanical Screw Anchors
2018	48	198	Mechanical Screw Anchors

Table 3 includes the 48 supports that are the subject of the permit request from Enbridge that is the subject of this document. If this permit request is approved, Line 5 under the Straits will be supported by 198 discrete support structures. The rationale for the permit to install these supports can be found in conditions attached to the Federal Consent Decree<sup>6</sup> that resulted from settlement with the Federal Government of the negligent rupture of Enbridge Line 6b in 2010. Apparently, the need for the additional 48 supports is discussed in an unreleased Enbridge document that bases this need on bottomland erosion predictions that show many spans will exceed the 75' unsupported span condition of the original easement with the State of Michigan in the near future.

<sup>5</sup> "Technical Note: Evidence of Damage to Line 5 under the Straits of Mackinac", an excerpt from "An Analysis of Errors and Omissions in the Dynamic Risk, Inc. Line 5 Alternatives Analysis, Option 5", E. E. Timm, 2017, Filed with the MIPSAB

<sup>6</sup> Federal Consent Decree, Case 1:16-cv-00914, ECF No. 3 filed 7/20/16, condition 68.

Assuming a 75' spacing, 2.81 miles out of a total exposed length of 4.2 miles of the non-buried sections of Line 5 under the Straits will be supported off the bottom. This means about 67% of the pipe that was originally designed to be continuously supported will be transformed into a discretely supported structure through incremental maintenance. It appears the sole rationale for installing additional supports under Line 5 is to comply with the 75' easement limitation even though this 75' figure was the result of calculations that assume the pipeline is a continuously supported structure with a small number of unsupported spans. Line 5 has been transformed from a continuously supported structure to a discretely supported structure through incremental maintenance operations without any engineering stress analysis of the transformed structure.

As previously mentioned, Salvadori did an extensive engineering stress analysis of the proposed design for Line 5 under the Straits in 1953. Table 4 is a list, taken from Salvadori's report, of the possible failure modes and analyses conducted to assure the structural stability of the continuously supported design for the pipe. Over nineteen different failure modes for the continuously supported pipe were analyzed resulting in recommendations that were incorporated into the 1953 easement.

To date, the record does not indicate that any similar holistic stability analysis has been conducted for the new, discretely supported structure that is the result of Enbridge's incremental repairs. The stresses in a discretely supported pipeline are calculated using different mathematical approaches from those used for a continuously supported pipeline. Additionally, a discretely supported pipeline has failure modes not contemplated by Salvadori and is much more subject to vibrational issues due to the lack of damping compared to the very damp structure that results from continuous support. Vibrations excited by turbulent currents are much more likely in the supported structure because it is off the bottom and further into the current flow field with resultant increased current forces. Clearly, a supported structure is more vulnerable to being hooked by an errant anchor than a structure resting half buried on the bottom and is also far less able to withstand the forces caused by such an anchor hooking event compared to a continuously supported structure.

For the State of Michigan to grant a permit to transform Line 5 under the Straits from a continuously supported structure into a discretely supported structure without a complete analysis of the stability of the new structure cannot be justified as responsible engineering practice. There is a large body of engineering literature that documents how the transformation of a structure by maintenance without regard to the overall effect on the structure has resulted in disaster.

There are indications that the screw anchor supports being used by Enbridge to prop up Line 5 are either ill-conceived or inadequate for the job. Figures 2 and 3 are frames clipped from Enbridge underwater inspection videos that appear to show deformation of the supports caused by pipe movement. The cause of this deformation is not known but may involve either thermal expansion stresses or stresses caused by pipe motion due to currents and gravitational action. It is apparent that the screw anchor supports used

by Enbridge may be inadequate to provide suitable support in the vertical, transverse and longitudinal directions.

Table 4 Salvadori Stability Calculations

The following conditions have been considered in detail in order to specify the limitations recommended at the end of this report and to set up specifications for the materials and the construction of the pipe.

1. Forces due to the Current

Under the action of a recorded current of 1.96 knots, the pipe bends laterally. It is assumed that the pipe will rest on the bottom of the river on two points and will span a valley. The pipe span is assumed simply supported to magnify the existing stresses. The maximum permissible span due to current stresses is thus determined.

2. Stresses due to Vertical Loads

Under the action of its own weight (negative buoyancy) the pipe will bend in the vertical direction when spanning a valley. The pipe is considered full of water or empty and the corresponding maximum valley span is determined under the assumption of simple supports. The favorable influence of continuity of spans is ignored.

3. Combination of Horizontal and Vertical Forces

The stresses due to the current and to the vertical loads are combined to obtain the maximum safe span under both forces, both when the pipe is empty and when it is full.

4. Stresses due to Pressure

The stresses (hoop and longitudinal) due to internal operating and testing pressure were investigated, assuming the pipe to be a thin cylinder and a thick cylinder. The longitudinal stresses were obtained under the assumption of a pipe closed at both ends.

5. Combination of Bending Stresses and Pressure Stresses

The stresses under (3) and (4) were combined in such a way as to obtain the worst possible condition of stress in both tension and compression. The maximum shear stress due to these principal stresses was also determined.

6. Longitudinal Temperature Stresses

A maximum temperature differential of 40° F. was assumed as the basis for the determination of longitudinal stresses due to the prevented expansion of the pipe. This type of stresses is relieved by extension of the pipe due to bending.

7. Critical Length for Thermal Buckling

A temperature increase of 30° F. was assumed to determine the buckling length of pipe under fixed ends and simply supported ends conditions. These spans are longer than the minimum recommended spans.

8. Friction Required to keep Pipe in place during Thermal Expansion

The available friction on the bottom of the river is not capable of preventing the lateral displacement of the pipe due to thermal buckling. Hence the pipe will be displaced laterally and thermal longitudinal stresses will be relieved.

9. Ring Thermal Stresses

The stresses due to a temperature differential at 30° F. between the oil and the water were investigated under the assumption of a thick pipe. The pipe being thin, these stresses will not be reached.

10. Temperature Increase in Curvature

The increase in curvature due to temperature differentials of the order considered were found negligible. Thus, the corresponding bending stresses may be neglected.
11. Limitations on Curvature

In order to limit the bending stresses in the pipe due to the curvature of the bottom of the river, the minimum allowable curvature is determined and recommended.
12. Collapse of Empty Pipe

Under the assumption of an abnormal condition (due to implosion) which will suddenly empty the pipe, the external pressure is found not to be capable of buckling the pipe. The pipe, hence, will not collapse, due to external pressure, even if empty.
13. Local Buckling Stress

The maximum longitudinal compressive stress is much smaller than the buckling compressive stress for the pipe. Hence, no danger of local buckling is present.
14. Torsional Stresses Due to Slanted Approaches

The pipe does not follow the line of maximum slope on the banks of the river. This condition produces torsional moments and torsional shear stresses. The determination of these stresses under wide conditions proves that they are far from dangerous.
15. Rolling Tendency

The pipe has a tendency to roll under the action of the current pressure and of the lateral component of its weight on the slanted banks of the river. The available friction is proved to be sufficient to prevent such motion.
16. Lateral Motion of Pipe

Available friction on the full pipe is proved sufficient to prevent the lateral motion of the pipe under the pressure of the current at the bottom of the river. The friction available on the empty pipe may possibly not be sufficient to prevent its lateral motion and a minimum additional negative buoyancy is recommended for the pipe.
17. Knife Edge Cradle Stresses

The possibility of the pipe resting on a sharp edge is considered and the stresses due to this condition, assimilated to a line pressure all around the perimeter of the pipe, are determined. The angle subtended by the knife edge support is varied between  $30^\circ$  and  $180^\circ$ .
18. Catenary Action

The reduction of lateral displacement due to catenary action, under the assumption that the ends of a pipe span be prevented to move one towards the other by friction or other obstacles, is found to be of the order of 20%.
19. Miscellaneous Stresses

Other conditions of load and support have been considered and found to be unimportant. For example, the possibility of a concentrated load acting on the pipe is excluded due to the slats and wrapping.

Figures 2 and 3 show screw anchor supports that are tilted substantially from plumb. Since the apparatus used to screw these supports into the bottomland assures their plumb vertical placement, it is likely that these supports have been bent sideways by the longitudinal motion of the pipeline to which they are clamped.



Figure 2 Frame Clipped from 2012 Enbridge West Leg Inspection Video



Figure 3 Frame Clipped from Enbridge 2016 West Leg Inspection Video

The support legs of the screw anchor supports are made from 5", Schedule 40 pipe which may have adequate compressional strength to support the weight of the pipeline but is not adequate to accommodate the transverse and longitudinal forces imposed on them by a very rigid 20", Schedule 60 pipeline.

In 2001, Table 3 shows that Enbridge began transitioning from using grout filled canvas bags in their attempts to shore up the seriously undermined and sagging pipe. Following the discontinuance of the use of grout filled bag supports, Table 3 describes the supports installed in 2001 as "Grout Bags and Mechanical Supports." This is the first mention of mechanical supports and it is unclear exactly what kind of mechanical supports were installed in 2001. Concurrently, Enbridge contracted with the well-known offshore firm J. P. Kenny, to provide guidance on how best to support Line 5 under the Straits. Enbridge has not released whatever report(s) were produced by Kenny<sup>7</sup> but there is a reference to this subject in the Kiefner report. It is probable that the "mechanical" anchor(s) installed in 2001 derive their design from this report and differ from the "mechanical screw anchors" installed at later dates. Careful examination of Enbridge's underwater inspection videos reveals a mechanical anchor structure that is unlike all the other mechanical anchors installed under Line 4. Figure 5 shows this unique anchor structure which is differentiated from later anchors by the heavy X-bracing that provides substantial additional transverse stiffness as compared to the design adopted for all supports installed in 2003 and later.



Figure 4 Frame Clipped from Enbridge 2012 East Leg Inspection Video

<sup>7</sup> "Analysis of Spans" J. P. Kenny Report, Released to Enbridge in 2003, Documented as Reference 12 in the Kiefner Report, Reference 4

It is not known why Enbridge chose to simplify the design of the mechanical supports that are used under Line 5 but the later design is obviously cheaper to manufacture, easier to install and less able to resist transverse forces. It is possible that Enbridge has conducted analyses that conclude transverse stiffness is not an issue for the supports used under Line 5 but, if that analysis has been conducted, it should be examined to assure the design change made to the mechanical support structures provides adequate transverse stiffness to resist current induced loadings.

It should be apparent from the preceding discussion that for the State of Michigan to allow Enbridge to convert Line 5 under the Straits into a discretely supported pipeline from a continuously supported pipeline under the guise of maintenance is unsound engineering practice. A qualified structural analysis consultant should be retained to provide a complete, Salvadori style analysis of the structural stability of Line 5 as a discretely supported structure. Furthermore, as has been shown with the issues surrounding the Revised Alternatives Analysis by Dynamic Risk, Inc., this consultant should not be one whose source of income is the oil and gas industry. Hiring a consultant from the Mechanical Engineering Department of a major university, as was done with Salvadori, provides assurance of freedom from conflict of interest.

It is also my professional opinion that there are three issues remaining from the past work of the MIDEQ and the MIPSAB regarding structural stability of Line 5 under the Straits. These issues should be resolved before attempting a new study.

1. There is near total disagreement between the works of Timm and the Revised Alternatives Analysis regarding the stresses and stability of Line 5. These disagreements are clearly outlined in the rebuttal of the Revised Alternatives Analysis by Timm<sup>8</sup>. A qualified, non-industry consultant should be hired to thoroughly investigate the sources of these differences and form an opinion regarding the technical robustness of the differing approaches.
2. Stresses on the pipeline from currents occur instantaneously while all of the data taken regarding current velocities is long term averaged data. Current velocities estimated from hydrodynamic models suffer both from the lack of adequate data to calibrate these models and the fact that the models cannot determine instantaneous peak velocity. From my early reports to the State of Michigan regarding the stability of Line 5, I have recommended that a multi-point, cable powered ADCP be installed in the vicinity of the pipeline. Current and past ADCP measurements have tended to miss the peak storm season when the highest current velocities could be expected because they have to be removed from the Straits before icing occurs. It is unacceptable engineering practice to base calculations regarding the stability of Line 5 on incomplete data that is not suited to the purpose of determining the peak stresses on the pipe.
3. Much of the content of the Kiefner<sup>4</sup> report is devoted to the subject of how best to remove stress from sagged sections of the pipeline when placing supports. This is a

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<sup>8</sup> "Technical Note: Rebuttal of Revised Alternatives Analysis Attachment 6 and Related Sections of the Dynamic Risk Revised Alternatives Assessment", E. E. Timm, 12/6/2017

critical subject because merely placing a support without lifting the pipe into a lower stress condition merely stabilizes the pipe in its sagged, high stress state. The Kiefner report analyzes different strategies for destressing the pipe including filling it with low density NGL's, filling it with gas and lifting the pipe mechanically. All of these options have tradeoffs regarding their ability to destress a plastically deformed pipe and the impact of the destressing operation on the ability of the pipe to withstand thermal expansion. This is a complicated subject matter but the first step in any stress analysis of this vintage, neglected, discretely supported pipeline is to understand its stress history and current stress state. Any changes to the stress state of the pipeline caused by Enbridge's destressing operations during support placement are material to the understanding of the current condition of the pipeline. Figure 5 is a frame clipped from Enbridge inspection video that appears to show a broken lifting strap around the pipe. It is not known when and why this strap was utilized and broken but, if this strap broke violently during a lifting operation, it is possible that the pipe was damaged by the event. An inquiry into this subject to reveal Enbridge's methods for destressing the pipe during support placement is necessary to understand the effectiveness of this critical operation.



Figure 5 Broken Lifting Strap around West Leg from 2012 Enbridge Inspection Video

In a recent publication<sup>9</sup>, Henry Petroski<sup>10</sup> made the following comment about the structural failure of the newly constructed bridge on the campus of Florida International University on March 15, 2018: “Any time a structural design is altered, even in the seemingly smallest detail, the ways in which it can fail can be altered. That potential outcome is why it is essential for a modified design to be reanalyzed, with a complete set of new mathematical calculations. What may have been a perfectly safe structure can become a vulnerable one even when seemingly beneficial changes are introduced.”

This advice applies completely to Enbridge’s transformation of Line 5 under the Straits from a continuously supported structure to a discretely supported structure under the guise of beneficial maintenance. It would be the height of folly for the MIDEQ to grant further permits for Enbridge’s unanalyzed transformation of Line 5 into a new structure in light of what is known about past negligence and ongoing “maintenance” of this structure which has the potential to inflict catastrophic losses on an entire region in the event of rupture.

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<sup>9</sup> “Miami Bridge Collapse”, Petroski, H., American Scientist, v. 106, n. 4, July-August 2018, p. 206

<sup>10</sup> Henry Petroski is the Alexander S. Vesic Professor of Civil Engineering and Professor of History at Duke University