UNITED STATES OF AMERICA
BEFORE THE FEDERAL ENERGY REGULATORY COMMISSION

	)	Docket No. CP16-22
In the Matter Of NEXUS Gas Transmission, LLC	)	February1, 2017
	)	

MOTION TO INTERVENE OF UNITED COMMUNITIES FOR PROTECTING OUR WATER AND ELEVATING RIGHTS (UC4POWER)

In accordance with the requirements of Rules 212 and 214 of the Rules of Practice and Procedure of the Federal Energy Regulatory Commission ("FERC" or the "Commission"), 18 C.F.R. §§ 385.212 and 385.214, and regulations under the Natural Gas Act ("NGA"), 18 C.F.R. § 157.10, the grassroots association United Communities for Protecting Our Water and Elevating Rights ("UC4POWER," "Intervenor"), Intervenor herein, hereby moves to intervene in the above-captioned proceeding on the terms set forth below.

Pursuant to Rules 212 and 213(a)(2) of the Commission's rules, 18 C.F.R. §§ 385.212, 385.213(a)(2), Intervenor respectfully requests permission to respond to any answer that may be filed in opposition to this Motion to Intervene.

This motion to intervene is timely filed. Intervenor UC4POWER's participation in this proceeding is in the public interest.

In support of its Motion, UC4POWER states as follows.

I. CONTACT INFORMATION FOR COMMUNICATIONS AND SERVICE

All communications, pleadings, and orders respecting this proceeding should be sent to:

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II. REQUEST FOR FORMAL ADJUDICATORY HEARING

Pursuant to NGA regulations, 18 C.F.R. § 157.10(a)(1), UC4POWER respectfully requests a formal hearing on the application of NEXUS Gas Transmission, LLC ("NEXUS" or the "Company") for a certificate of public convenience and necessity authorizing the construction and operation of the NEXUS pipeline, including the environmental impacts of and public need for the project.

III. IDENTITY OF INTERVENOR UC4POWER AND REPRESENTED MEMBERS

UC4POWER is a nonprofit, unincorporated grassroots association of persons with 10 members which opposes the planning, construction and development of the proposed NEXUS natural gas pipeline in Ohio and Michigan and particularly focuses on the seismic, hydrological and geological dangers to the environment, public health and safety posed by the pipeline within approximately one mile of the City of Waterville, Ohio, proximate to the water intake, filtration and treatment plant owned by the City of Bowling Green, Ohio on the banks of the Maumee River.

UC4POWER has no general headquarters office, but has members in the cities of Bowling Green, Ohio and Waterville, Ohio, in Wood and Lucas Counties, respectively.

UC4POWER's interests in this case involve preservation of the natural environment, public health and environmental safety from the proposed NEXUS natural gas megapipeline, which would transport enormous quantities of fracked natural gas from western Pennsylvania and eastern Ohio through Ohio and Michigan to a distribution hub in Ontario called the Dawn Hub, and thence for foreign export. UC4POWER opposes the chemical and radiological pollution and climate change-inducing effects from the transport of natural gas obtained via horizontal hydraulic fracturing ("fracking") through the NEXUS pipeline. The group opposes the threats posed by NEXUS to public water sources in the Northwestern Ohio region as further delineated below. UC4POWER's members support the rapid transition from fossil fuels to energy which is not carbon-based nor dependent upon exploitative corporations. Members of UC4POWER have in the past advocated for policies at the local, state and federal levels which would overcome barriers to energy efficiency and renewable energy as low-cost, low-risk alternatives to fossil fuels. They have done so through such means as commenting in opposition to fossil energy projects, intervening in regulatory proceedings to oppose permits or certificates for the same, initiating and assisting in referendum passage of community-based rights legislation, and proffering expert and lay testimony in local, state and federal proceedings, public hearings and workshops. UC4POWER members have undertaken these actions to ensure that fossil fuels are kept in the ground, and that clean energy solutions are adopted commonly and widely.

Five (5) members of UC4POWER claim an interest in this litigation.

UC4POWER member Daniel R. Myers lives at 707 East Merry Avenue, Bowling Green, Ohio 43402. He is president of the Bowling Green State University Environmental Action Group. He opposes construction of the NEXUS pipeline on a variety of environmental grounds, and is a residential customer of the City of Bowling Green water system. He depends on the safe and continuous functioning of the City's water intake and treatment plant on the Maumee River as his source of supply.

UC4POWER Member Kelly Jacobs resides at 516 Mechanic St., Waterville OH 43566. She opposes construction of the NEXUS pipeline on a variety of environmental grounds, and lives within approximately .75 mile of the intersection of the Bowling Green Fault, a crack in the Earth's crust which will be crossed by the NEXUS pipeline. The proposed NEXUS pipeline is planned for installation within 600' or so of the City of Bowling Green water intake and treatment plant on the Maumee River. Ms. Jacobs will become a residential customer of the City of Bowling Green water system when that system interconnects with the City of Waterville in mid-March 2017.

UC4POWER members Blaine Todd Childers and Jennifer Karches reside at 407 N. Main Street, Bowling Green, Ohio 43402. They oppose construction of the NEXUS pipeline on a variety of environmental grounds. They are residential customers of the City of Bowling Green water system and depend on the safe and continuous functioning of the City's water intake and treatment plant on the Maumee River as their source of supply.

UC4POWER member Neocles Leontis resides at 119 N. Summit St., Bowling Green, Ohio 43402. He opposes construction of the NEXUS pipeline on a variety of economic and environmental grounds. He is a residential customer of the City of Bowling Green water system and depends on the safe and continuous functioning of the City's water intake and treatment plant on the Maumee River as his source of supply.

UC4POWER member Lisa Kochheiser resides at 1045 Varsity West, Bowling Green, Ohio 43402. She opposes the construction of the NEXUS pipeline on a variety of environmental grounds. She is a residential customer of the City of Bowling Green water system and depends on the safe and continuous functioning of the City's water intake and treatment plant on the

Maumee River as her source of supply.

The NEXUS pipeline project directly and adversely threatens the City of Bowling Green's and City of Waterville's municipal water supplies. The Final Environmental Impact Statement ("FEIS") contains a flatly false statement of supposedly scientific fact that the Bowling Green Fault is not visible at the surface of the Earth, from which FERC concludes that the Fault will play no adverse role in the construction or operation of NEXUS. In fact, the Fault is visible at the surface and cannot be ruled out as a serious consideration since the pipeline is planned to be constructed to cross it perpendicularly just a few feet deep in the ground. Construction of the NEXUS pipeline across the Bowling Green Fault, some 600' from the Bowling Green water intake and treatment plant, coupled with installation of the pipeline nearby underneath the Maumee River riverbed via horizontal directional drilling ("HDD") in porous, unstable and saturated karst geology. The Fault is located near an active stone quarry with regular blasting, poses a multifaceted set of threats to the operability and integrity of the water system and the pipeline itself. There has been no identification of these various factors nor analysis and discussion of their potential interrelationships or synergistic effects in the NEXUS FEIS.

The interests that UC4POWER represents here are shared by the public at large. Therefore, UC4POWER's intervention on behalf of its directly-affected members is also warranted in the public interest under 18 C.F.R. § 385.214(b)(2)(iii).

IV. TIMELINESS OF MOTION TO INTERVENE

Intervenor UC4POWER states that this motion filing is timely. While it is being filed some 60 days after publication of the FEIS, Intervenor and its members discovered only on November 30, 2016, with the publication of the FEIS that the FERC Staff and NEXUS have conducted no investigation to determine the physical existence and location of, and the seismic implications of, the Bowling Green Fault, which runs from southeastern Michigan down through western Lucas County, Ohio and Wood County, Ohio. Contrary to the conclusion in the FEIS, the Bowling Green Fault is visible at the Earth's surface.

At p. 4-10 of the FEIS, FERC Staff states:

> The NGT Project would not intersect any known, mapped, or inferred active fault lines (USGS, 2006).
>
> Several comments were received regarding faults in the NGT Project area, specifically the Bowling Green Fault, which, in Ohio, extends from the Michigan state line in the area of Toledo, southward into Hardin County. The NGT Project crosses the Bowling Green Fault at MP 180.8 near the Maumee River. *The Bowling Green Fault is not visible in surficial geology and only identified in basement rock, which is approximately 2,200 to 2,300 feet below ground surface in the area* (Baranoski, 2013). The Bowling Green Fault was active between 443 to 416 million years ago (USGS, 2006). No other faults in proximity to the NGT Project exhibit evidence of activity within the last 1.6 million years, and there is no clear association between faults and small earthquakes that occur in the region (Hansen, 2015).

(Emphasis added). As explained below, it is completely false that the Fault is identifiable only in basement rock. The Fault is visible at the surface, identified in aerial photos and is memorialized by a permanent plaque located in Farnsworth Metropark on the northern bank of the Maumee River. The Fault runs through the park and is diagrammed on the plaque. It is visible from that location.

The false FEIS conclusion about the Bowling Green Fault has possibly caused FERC Staff and NEXUS to fail to serious scrutinize and analyze these considerations: proximity of the City of Bowling Green water intake and treatment plant some 600' away, which includes a large above-ground reservoir; an active blasting stone quarry a few hundred yards north of the treatment plant, alongside which the NEXUS pipeline would run on the northern bank of the Maumee River; the expected presence of shallow karst geological formations in the immediate vicinity of all of these locations, and as well underneath the Maumee riverbed where HDD would be undertaken for installation of the pipeline.

The public has a right to expect and to rely on its regulatory agency to fully investigate the veracity of statements given to it by a pipeline applicant. The fact that Intervenor UC4POWER can disprove the major falsehood in the FEIS that the Bowling Green Fault is buried deep underground has profound implications for the degree of completeness of the FEIS. FERC has an inherent legal responsibility to investigate this new information irrespective of when during the certificate proceeding it is first disclosed. There is a continuing obligation for the agency, even post-issuance of the certificate of public convenience and necessity, to supplement the EIS when significant new information is presented.

A. The Motion To Intervene Meets The Commission's Standards For Untimely Petitions

The Commission considers a motion to intervene after the deadline for submitting such motions a form of extraordinary relief, requiring the person seeking it to justify why the Commission should allow a departure from the orderly procedures its Regulations establish for deciding cases. What the Commission will consider in deciding whether the person seeking late intervention has justified that form of extraordinary relief is well-established and easily stated. It will consider:

> [W]hether the movant had good cause for not filing timely; any disruption of the proceeding that might result from permitting intervention; whether the movant's interest is adequately represented by other parties; and whether any prejudice to, or additional burden on, existing parties might result from permitting the intervention.

Erie Boulevard Hydropower, L.P., 117 FERC ¶ 61,189, at P 30 (2006) (citing 18 C.F.R. § 385.214(d) (2006)).

UC4POWER had a right to expect correct seismic information to be provided by

NEXUS. It further had a right to expect the FERC Staff to properly investigate the veracity of that information. After learning that the FEIS did not correct the grossly incorrect assertions concerning the Bowling Green Fault, Intervenor has timely obtained an expert opinion and brought this serious matter to the attention of the Commission. This interest in the Fault is not adequately represented by other parties. The implications of a complete failure to examine the status and implications of a seismic fault at the surface of the Earth where the pipeline is proposed to cross is if such inherent importance that any disruption of the proceedings must be deemed secondary to proper NEPA scrutiny. Similarly, prejudice to a mere private pipeline applicant is inferior to the prejudice to the public interest which is at stake. Applying the Commission's criteria for acceptance of an untimely motion to intervene, Intervenor UC4POWER has demonstrated that it should be allowed intervention.

B. The Agency Has An Inherent Responsibility To Address NEPA Concerns Whenever They Are Raised

FERC's construction of its statutory authority, as distinct from an express prohibition by Congress, may not be used to limit the agency's obligations under NEPA. "NEPA's legislative history reflects Congress's concern that agencies might attempt to avoid any compliance with NEPA by narrowly construing other statutory directives to create a conflict with NEPA. *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin.*, 538 F.3d 1172, 1213 (9 Cir. 2008); *Sierra Club v. Mainella*, 459 F. Supp. 2d 76, 105 (D.D.C. 2006) (distinguishing agency NEPA responsibilities in situations where "an agency has 'no ability' because of lack of 'statutory authority' to address the impact" with situations where an agency "is only constrained by its own regulation from considering impacts").

NEPA does not permit the Commission to confine itself solely to consideration of environmental issues raised by the parties. *Calvert Cliffs' Coordinating Committee v. Atomic Energy Commission*, 146 U.S.App.D.C. 33, 449 F.2d 1109, 1118-1119 (1971). The Commission is required "to consider environmental values 'at every distinctive and comprehensive stage of the (agency's) process.' The primary and nondelegable responsibility for fulfilling that function lies with the Commission." *Greene County Planning Board v. Federal Power Commission*, 455 F.2d 412, 420 (2d Cir. 1972), quoting *Calvert Cliffs' Coordinating Committee v. Atomic Energy Commission, supra,* 449 F.2d at 1119.

Section 102(2) of NEPA therefore requires government agencies to comply "to the fullest extent possible." *Ctr. for Biological Diversity*, 538 F.3d at 1213 (quoting *Forelaws on Bd. v. Johnson*, 743 F.2d 677, 683 (9th Cir.1985)). *See also Flint Ridge Dev. Co. v. Scenic Rivers Ass'n of Okla*., 426 U.S. 776, 787 (1976) (quoting House and Senate Conferees, who inserted the "fullest extent possible" language into NEPA, to say that "no agency shall utilize an excessively narrow construction of its existing statutory authorizations to avoid compliance").

Similarly, NEPA regulations interpret the language "to the fullest extent possible" to mean that "each agency of the Federal Government shall comply with that section unless existing law . . . expressly prohibits or makes compliance impossible." 40 C.F.R. § 1500.6. The legislative history of § 1500.6 explains that this language "shall not be used by any Federal agency as a means of avoiding compliance with [NEPA's] directives. . . ." 115 Cong. Rec. (Part 29) 39702-39703 (1969); *see also Calvert Cliffs' Coordinating Comm. Inc. v. U.S. Atomic Energy Comm'n*, 449 F.2d 1109, 1114 (D.C. Cir. 1971) ("We must stress as forcefully as possible that this language does not provide an escape hatch for footdragging agencies; it does not make NEPA's procedural requirements somehow 'discretionary.' . . . Indeed, [the language] sets a high standard for the agencies, a standard which must be rigorously enforced by the reviewing courts.”).

In reviewing compliance with NEPA, courts must first determine whether the agency has complied with its “procedural” obligations under Section 102 of NEPA, to ensure that the environmental impact statement contains sufficient discussion of the relevant issues and opposing viewpoints to enable the decisionmaker to take a “hard look” at environmental factors, and to make a reasoned decision. *Kleppe v. Sierra Club*, 427 U.S. 390, 410 n. 21 (1976); *Sierra Club v. Adams*, 578 F.2d 389, 393-396 (D.C.Cir.1978). Second, reviewing courts must determine whether the agency has complied with its “substantive” obligations under Section 101 of NEPA; it must ensure that the agency's conclusions are not irrational or otherwise “arbitrary and capricious.” *See Calvert Cliffs' Coordinating Committee, Inc. v. AEC*, 449 F.2d 1109 (D.C.Cir.1971); *County of Suffolk v. Sec'y of Interior*, 562 F.2d 1368, 1383 (2d Cir. 1977), *cert. denied*, 434 U.S. 1064, 98 S.Ct. 1238, 55 L.Ed.2d 764 (1978)*; Strycker's Bay Neighborhood Council v. Karlen*, 444 U.S. 223, 226-228, 100 S.Ct. 497, 499-500, 62 L.Ed.2d 433 (1980). In making these determinations the courts must be governed by a “rule of reason.” *Concerned About Trident v. Rumsfeld*, 555 F.2d 817, 827 (D.C.Cir.1977); *Merck & Cie v. Gnosis S.p.A.*, 808 F.3d 829, 841 (Fed. Cir. 2015).

Finally, NEPA requires supplementation of an EIS even after project approval when “[t]he agency makes substantial changes in the proposed action that are relevant to environmental concerns” or “[t]here are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts.” 40 C.F.R. § 1502.9(c)(1)(I), (ii). *See also Marsh v. Or. Nat. Res. Council*, 490 U.S. 360, 361 (1989) (supplemental EIS required “if the new information will affect the quality of the human environment in a significant manner or to a significant extent not already considered"); *Davis III v. Latschar*, 202 F.3d 359, 369 (D.C. Cir. 2000) ("changes that cause effects which are significantly different from those already studied require supplementary consideration").

Clearly, the expert opinion proffered with this Motion enumerates "effects which are significantly different from those already studied." The implications of the Bowling Green Fault at the surface differ considerably from the present insignificance attributed to the Fault in the FEIS, according to the expert geological opinion letter proffered by Intervenor.

Unless this urgent seismic concern is properly scrutinized and publicly vetted under NEPA, reviewing courts will not be able to find that there has been proper, much less adequate, compliance with the statute. Because FERC has an inherent, nondelegable responsibility to follow the law, the Commission must grant the petition to intervene.

V. GROUNDS FOR INTERVENTION

FERC's approval of the NEXUS project will induce and promote a great deal of shale gas drilling in Ohio and will cause associated detrimental environmental effects on Ohio's forests and wildlife habitat, water, air, and recreation resources. FERC's approvals of greenfield, *ad hoc* pipeline projects such as NEXUS, will cause direct, indirect and cumulative environmental impacts to public resources. Approval of NEXUS is unjustifiable, but it is FERC that conducts the weighing of factors to grant a certificate of convenience and necessity. Without informed scientific analysis of the Bowling Green Fault as a surficial seismic feature, including its possible interrelated effects on the City of Bowling Green water intake and treatment plant, HDD installation of the pipeline under the Maumee River through expected karst geology and the implications of a nearby active blasting stone quarry, the NEPA determinations for NEXUS will be defective and incomplete.

The NEXUS pipeline is designed to deliver 1.5 billion cubic feet of gas per day (Bcf/d). According to FERC and Michigan Public Service Commission ("MPSC") filings, NEXUS plans to transport over half, (51%, .76 Bcf/d) of its 1.5 Bcf/d capacity to Canada. DTE will take up to 150,000 Dth/d or 10% of NEXUS-delivered gas as fuel for natural gas-fired electricity-generating plants and distribution of natural gas to residential, commercial and industrial customers.

The NEXUS pipeline is not needed, according to current economic predictors of redundant transportation capacity. The expected adverse impacts of the project on the exceptional resources of the Lake Erie Basin are unacceptable; NEXUS will cause the needless destruction of thousands of acres of farmland, woodland, wetlands and other aspects of the natural environment, and it will negatively affect hundreds of landowners. It will also cause undue risks by being constructed across the Bowling Green Fault.

Below are UC4POWER's specific grounds for intervention, as required by 18 C.F.R. § 385.214(b)(1):

A. Lack Of Evidence Of Public Convenience And Necessity

Under the Natural Gas Act, FERC must determine whether NEXUS "is or will be required by the present or future public convenience and necessity." 15 U.S.C. § 717f(e). Applying this standard, "the Commission will approve an application for a certificate only if the public benefits from the project outweigh any adverse effects." Certification of New Interstate Natural Gas Pipeline Facilities, 88 FERC ¶ 61,227 at 28 (1999), *clarified*, 90 FERC ¶ 61,128

(2000), *further clarified*, 92 FERC ¶ 61,094 (2000). Determination of genuine need for a proposed pipeline is a critical part of this balancing test, and the Commission has charged itself with considering “all relevant factors reflecting on the need for the project.” *Id.* at 23. The Commission must also weigh the adverse impacts of the project, specified as the interests of existing customers, the interests of competing pipelines, the interests of landowners and surrounding communities. *Id.*

“[I]n deciding whether to authorize the construction of major new pipeline facilities, the Commission balances the public benefits against the potential adverse consequences. The Commission’s goal is to give appropriate consideration to the enhancement of competitive transportation alternatives, the possibility of overbuilding, subsidization by existing customers, the applicant’s responsibility for unsubscribed capacity, the avoidance of unnecessary disruptions of the environment, and the unneeded exercise of eminent domain in evaluating new pipeline construction.” *Natural Gas Pipeline Company of America LLC*, Docket No. CP15-505-000, Order on Certificate at 3 (March 17, 2016); NEXUS FEIS 1-3.

As demonstrated below, the lack of identification and analysis of the Bowling Green Fault and its interactive effects with local phenomena suggests that the pipeline could cause unnecessary disruptions of the environment.

B. The FEIS Contains A Significant Omission As To Seismic Effects Which Violates NEPA And Poses Threats To Public Health And Environment

Under agency policy, the Commission is obligated to evaluate environmental considerations under the National Environmental Policy Act (“NEPA”). The Commission evaluates whether a project “can be constructed and operated in an environmentally acceptable manner” and it has discretion to reject a proposed project on these grounds. *Millennium Pipeline*

Co., L.L.C., 141 FERC ¶ 61,198 at 27 (Dec. 7, 2012). FERC must balance "public convenience and necessity" against potential adverse impacts.

At p. 4-10 of the FEIS, FERC Staff states:

> The NGT Project would not intersect any known, mapped, or inferred active fault lines (USGS, 2006).
>
> Several comments were received regarding faults in the NGT Project area, specifically the Bowling Green Fault, which, in Ohio, extends from the Michigan state line in the area of Toledo, southward into Hardin County. The NGT Project crosses the Bowling Green Fault at MP 180.8 near the Maumee River. *The Bowling Green Fault is not visible in surficial geology and only identified in basement rock, which is approximately 2,200 to 2,300 feet below ground surface in the area* (Baranoski, 2013). The Bowling Green Fault was active between 443 to 416 million years ago (USGS, 2006). No other faults in proximity to the NGT Project exhibit evidence of activity within the last 1.6 million years, and there is no clear association between faults and small earthquakes that occur in the region (Hansen, 2015).

(Emphasis added). The above passage comprises the entire discussion of the Bowling Green Fault in the FEIS. The conclusion that there is no probability of earthquake activity near-term, and no association between the Fault and any seismic activity in the region, is predicated on the completely incorrect assertion that the Bowling Green Fault is buried 2,300 feet deep and is not a surface seismic feature.

Andrew Kear, Ph.D. has provided an expert opinion on the significance of this serious omission from the FEIS.[1] Dr. Kear has a Bachelor's and Master's degree in Geology, six years' experience as an environmental consultant, and a Doctorate in Environmental Policy with natural gas policy and politics as his primary research field. He presently serves as an assistant professor with a dual appointment in the School of Earth, Environment and Society and Department of Political Science at Bowling Green State University. With his experience, education, background

[1] Dr. Kear's expert opinion is marked as Exhibit A hereto.

in geology and public policy, and understanding of the National Environmental Policy Act and requisite Environmental Impact Statement for a major pipeline approval, Dr. Kear is highly qualified to assess the scientific validity and regulatory implementation of the NEPA-EIS for the proposed Nexus Pipeline.

Dr. Kear's expert conclusions, as expressed in his attached report, address the threats to public health and safety and potential risks associated with the proposed location of the Nexus pipeline where it transects both the Bowling Green Fault and the Maumee River. For the convenience of the Commission and parties, a map of the Waterville, Ohio region is attached as Exhibit C, and it shows the relative locations of the Bowling Green Fault, City of Bowling Green water intake and treatment plant, Maumee River crossing and the Hanson Stone Quarry on the western edge of the City of Waterville, Ohio.

Dr. Kear concludes:

"1) Given the inadequate characterization of the BG Fault System in the FEIS (2016), further geophysical and geotechnical investigation is warranted to characterize the risk potential from the pipeline.

2) Poor quality bedrock, extreme fracturing, the BG Fault, and potential karst features all conspire against the proposed pipeline installation beneath the Maumee River.

3) Geotechnical data and reporting of the subsurface conditions (FEIS, 2016) clearly indicate the high risk, operational problems, time and increased costs that will be encountered during pipeline installation beneath the Maumee River.

4) Due to its close proximity to the Bowling Green Municipal Water supply the potential contamination by drilling fluids, earthquakes due to fault lubrication, and leaks during operation,

the pipeline poses a serious public health threat. It could contaminate a regional drinking water supply, the Maumee River, and Lake Erie.

5) A completed karst survey, as mandated by the FEIS but not yet conducted, and a hydrogeological investigation should precede any final pipeline siting decision.

6) The ongoing blasting activity at the Hanson Aggregates Quarry and its impacts on pipeline stability and integrity is not addressed in the Given the inadequate characterization of the BG Fault System in the FEIS (2016), further geophysical and geotechnical investigation is warranted to adequately characterize the risk potential from the pipeline as it crosses both the Maumee River and the fault system.

Regarding the FEIS conclusion that the Bowling Green Fault is not visible at the surface, Dr. Kear finds:

> This statement is clearly refuted by satellite imagery, on-the-ground observation, and a 1984 U.S. Geologic Survey photograph of the Bowling Green Fault Zone at nearby Hanson Aggregates Quarry (see Attachment 1). Notably, the BG Fault is even marked by a Metroparks Toledo sign at Farnsworth Park showing exactly where the fault crosses the Maumee River. *Due to the inaccurate and inadequate characterization of the BG Fault System in the FEIS, further geophysical and geotechnical investigation is warranted to characterize the risk potential from the pipeline as it crosses both the Maumee River and the fault system. Faults are planar rock fractures that show evidence of relative movement, and placing a pipeline under a river and transecting a fault that has clear surficial expression requires greater justification.*

(Emphasis added).

Regarding earthquake risk, Dr. Kear concludes:

> Because the BG Fault has not been active within the last 1.6 million years (Onasch, 1995) does not mean that it could not be reactivated, especially if natural gas drilling, hydraulic fracturing, deep-well injection, and horizontal directional drilling (HDD) pipeline installation activities take place over and/or near the fault zone in Wood and Lucas Counties. Despite the lack of recent evidence of perceptible movement along the BG Fault and the unpredictability of earthquake forecasting, Wood County has experienced four earthquakes (2-2.5 magnitude) since 1992 and a magnitude 3 earthquake

on September 29, 1974 (Dart and Hansen, 2008; Hansen, 2015).

> ***** ***** ***** *****
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> Given the structural geologic features of western and northwestern Ohio, relatively recent earthquake activity in Wood County, and the inadequate characterization of the BG Fault System, further geophysical and geotechnical investigation is warranted to adequately characterize the risk potential from the pipeline.

Respecting geotechnical risks, Dr. Kear analyzed a report which appears in the Appendix to the FEIS (Appendix E1-4, copy attached hereto as Exhibit B) by Fluor Enterprises, Inc. and Fugro Consultants, Inc. He notes that the report determines that the proposed pipeline crossing underneath the Maumee River is characterized by "very poor quality bedrock." Further the report states that, "in this case it is not possible to maintain sufficient depth of cover beneath the river while staying above the bedrock surface. Therefore, the design is based on penetrating bedrock, which achieves 75 feet of cover beneath the Maumee River." Further and "according to preliminary field logs, the bedrock is characterized by extreme fracturing, which in some cases can be problematic for installation by HDD. Although the feasibility of the Maumee River cannot be ruled out, subsurface conditions are present that increase the risk of HDD operational problems" (FEIS, 2016, p. E4-134).

The Fluor study, with which Dr. Kear concurs, concludes that "Due to subsurface conditions, the risk level associated with the proposed crossing of the Maumee River is high." (p. E4-135). Fluor further determined that reaming and pullback operations in the fractured bedrock can be problematic; loss of drilling fluid circulation could be an issue; and "inadvertent drilling fluid returns due to hydrofracture do not typically occur on rock crossings, but instead occur by flowing through existing fractures, joints, or solution cavities (p. E4-139). The horizontal drilling and hydrofracturing plan to install the pipeline underneath the Maumee River (which would span

3,999 feet) is estimated to take 81 days but could be increased by 50 to 100 percent if operational problems are encountered (FEIS, 2016, p. E4-140). From the Fluor study, Dr. Kear extrapolated and determined that

> Poor quality bedrock, extreme fracturing, the BG fault, and potential karst features all conspire against this proposed pipeline installation underneath the Maumee River. The proposed location and drilling and installation methods are problematic from a geotechnical, risk, and cost perspective. During horizontal drilling operations, drilling fluids will likely enter the fractures, lubricate the fault, and could potentially induce earthquakes. Even if earthquakes do not occur, the loss of drilling fluids to the fractures and potential karst features in the subsurface poses a significant operational problem costing time, resources, and money. The potential contamination of near surface aquifers and even the Maumee River with drilling fluids has not been adequately considered in the FEIS. Finally, the potential cost and time overruns for installing a pipeline here, including any environmental contamination mitigation, also auger against this Maumee River crossing location.

As to the risks from karst, Dr. Kear states that "Given the historic presence of oil and gas in the region, the potential for hydrogen sulfide migration along the fault, and dissolution of bedrock from sulfuric acid (related to the hydrogen sulfide), the probability of karst features is highly likely. A pipeline placed over such karst features poses a risk to groundwater that serves as both rural and municipal drinking water supplies." He continues, "Arguably, a completed karst survey of the potential pipeline route through Lucas and Wood County should precede any final FERC decision-making."

Respecting the risks to the City of Bowling Green water supply, the expert says that "From a risk assessment perspective, one would be hard pressed to pick a location that threatens public health and safety more than this location does:"

Not only could a pipeline leak contaminate a regional drinking water supply, but it could also contaminate the Maumee River and Lake Erie. As noted previously, the probability of drilling fluid losses to the BG Fault and associated fractures during installation activities also poses an unnecessary threat to local and regional water quality that could negatively impact not only public health but also the agricultural community. Additionally, the hydrogeology of Lucas and Wood County is not adequately addressed in the FEIS. Specifically, the water table is very shallow in the Great Black Swamp (within Lucas and Wood County) and the potential impacts on this near surface aquifer from a pipeline leak are not considered. *From a risk assessment perspective, one would be hard pressed to pick a location that threatens public health and safety more than this location does.*

Of the planned passage of the pipeline parallel to the property boundary of the Hanson Aggregates Quarry, Dr. Kear observes that "[t]he anthropogenically induced seismic risk posed by this quarry and other related activities along the pipeline route require greater attention. At minimum, a geophysical (seismic) investigation is needed to delineate the potential risks created by placing a pipeline in close proximity to an active quarry."

VI. CONCLUSION

Intervenor UC4POWER has, via expert analysis, exposed a major mistake of scientific fact in the Final Environmental Impact Statement which (1) is the fault of NEXUS and the FERC Staff, not the public; (2) As a mistake of scientific fact, the error de-emphasized the interrelationship of the Bowling Green Fault with other local features: an active blasting quarry, poor quality karst geology for HDD drilling underneath the Maumee River, proximity of the City of Bowling Green major water supply facility; and (3) induced a gross underestimation of risks caused by adding the NEXUS pipeline to the pre-existing circumstances in the Waterville, Ohio region. The misidentification of the location of the Bowling Green Fault has caused a gross misunderstanding of the implications for earthquake risks, unforeseen stresses to the NEXUS pipeline, lubrication and worsening of adverse consequences from the proximity of the fault, even defective installation of the pipeline under the Maumee River, which is a major regional water source.

FERC has a nondelegable obligation to comply as fully as possible with the National Environmental Policy Act. A FEIS which contains the stunning misinformation about the Bowling Green Fault will not only be legally insufficient, but as Dr. Kear asserts, pose a credible threat to public health and safety by threatening the stability of the physical environment.

UC4POWER should be granted leave to intervene and to litigate its NEPA claims.

WHEREFORE, United Communities for Protecting Our Water and Elevating Rights prays the Federal Energy Regulatory Commission grant it leave to participate as a full party in this certificate proceeding.

Respectfully,

February 1, 2017

Terry J. Lodge

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CERTIFICATE OF SERVICE

In accordance with the requirements of Section 385.2010 of the Commission's Rules of Practice and Procedures, I hereby certify that I have this 1st day of February, 2017, caused a copy of the foregoing document to be served upon each person designated on the official service list compiled by the Commission's Secretary in this proceeding.

Terry J. Lodge

Terry J. Lodge, Esq.
Counsel for UC4POWER

Exhibit A

Public Health and Safety Risks of the Proposed Nexus Pipeline in Wood and Lucas Counties, Ohio

Andrew R. Kear, PhD

January 31, 2017

Public Health and Safety Risks of the Proposed Nexus Pipeline in Wood and Lucas Counties, Ohio

Andrew R. Kear, PhD

Introduction

This report expresses my concerns regarding the proposed siting of the Nexus Pipeline in Wood and Lucas Counties, Ohio. Specifically, the Final Environmental Impact Statement (FERC-FEIS-270F) for the NEXUS Gas Transmission Project promulgated by the Federal Energy Regulatory Commission (FERC) in November 2016 does not adequately assess the public health and safety risk potential of the proposed location of the Nexus Pipeline where it transects both the Bowling Green Fault and the Maumee River in Wood and Lucas Counties. The primary objective of this report is to highlight these risks by identifying scientific data gaps including inaccurate and incomplete geological characterization, potential drinking and surface water contamination, geotechnical issues, and seismic risks.

Executive Summary

The proposed location of the Nexus Pipeline as it crosses the Maumee River between Lucas and Wood Counties poses a serious threat to public health and safety that requires further scientific investigation and justification. Alternative routes that minimize these risks should be considered.

- Given the inadequate characterization of the BG Fault System in the FEIS (2016), further geophysical and geotechnical investigation is warranted to characterize the risk potential from the pipeline.
- Poor quality bedrock, extreme fracturing, the BG Fault, and potential karst features all conspire against the proposed pipeline installation beneath the Maumee River.
- Geotechnical data and reporting of the subsurface conditions (FEIS, 2016) clearly indicate the high risk, operational problems, time and increased costs that will be encountered during pipeline installation beneath the Maumee River.
- Due to its close proximity to the Bowling Green Municipal Water supply the potential contamination by drilling fluids, earthquakes due to fault lubrication, and leaks during operation, the pipeline poses a serious public health threat. It could contaminate a regional drinking water supply, the Maumee River, and Lake Erie.
- A completed karst survey, as mandated by the FEIS but not yet conducted, and a hydrogeological investigation should precede any final pipeline siting decision.
- The ongoing blasting activity at the Hanson Aggregates Quarry and its impacts on pipeline stability and integrity is not addressed in the FEIS.

From a geologic, geotechnical, cost, and public health risk perspective, I ask FERC, the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and Spectra Energy to re-evaluate the proposed Nexus Pipeline route through Lucas and Wood Counties. Alternative routes should be considered for the Maumee River pipeline crossing to minimize risks to public health and safety. Although the FEIS considered a Waterville Route Alternative, ultimately it was not recommended because it would "represent merely a shift of impacts from one area, group of landowners, and set of resources to another area, group of landowners and set of resources" (FEIS, 2016: p. 3-64). A number of specific reasons were given in the FEIS as to why the Waterville Route Alternative was not chosen, but the most significant reason appears to be that the alternative would add over 41 miles of extra length to the pipeline at considerable expense. Regardless of the rationale for rejecting the Waterville Route Alternative, the risks associated with the preferred route have not been adequately taken into consideration. This report identifies those risks and calls for further scientific investigation, justification, and consideration of alternative routes.

Bowling Green Fault Surficial Expression and Risk

> **The inaccurate and inadequate scientific analysis of the BG Fault and its surficial expression within the FEIS (2016) warrants further investigation and analysis of the potential risks.**

The FEIS (2016) acknowledges the Nexus Gas Transmission (NGT) Project crosses the Bowling Green (BG) Fault at MP 180.8 near the Maumee River and it "is not visible in surficial geology and only identified in basement rock, which is approximately 2,200 to 2,300 feet below ground surface in the area" (FEIS, 2016: p. 4-10; Baranoski, 2013). This statement is clearly refuted by satellite imagery, on-the-ground observation, and a 1984 U.S. Geologic Survey photograph of the Bowling Green Fault Zone at nearby Hanson Aggregates Quarry (see Attachment 1). Notably, the BG Fault is even marked by a Metroparks Toledo sign at Farnsworth Park showing exactly where the fault crosses the Maumee River. Due to the inaccurate and inadequate characterization of the BG Fault System in the FEIS, further geophysical and geotechnical investigation is warranted to characterize the risk potential from the pipeline as it crosses both the Maumee River and the fault system. Faults are planar rock fractures that show evidence of relative movement, and placing a pipeline under a river and transecting a fault that has clear surficial expression requires greater justification.

Earthquake Potential and Risk

Because the BG Fault has not been active within the last 1.6 million years (Onasch, 1995) does not mean that it could not be reactivated, especially if natural gas drilling, hydraulic fracturing, deep-well injection, and horizontal directional drilling (HDD) pipeline installation activities take place over and/or near the fault zone in Wood and Lucas Counties. Despite the lack of recent evidence of perceptible movement along the BG Fault and the unpredictability of earthquake forecasting, Wood

County has experienced four earthquakes (2-2.5 magnitude) since 1992 and a magnitude 3 earthquake on Septmber 29, 1974 (Dart and Hansen, 2008; Hansen, 2015). Dart and Hansen (2008) assert:

> *"The origins of Ohio earthquakes are poorly understood. However, Ohio earthquakes appear to be associated with ancient zones of weakness within the North American continental crust. These zones of weakness are characterized by deeply buried and poorly documented faults. Some of these weak zones periodically release accumulated strain in the form of earthquakes."*

Western and northwestern Ohio contains several of these zones of weakness. For example, northwestern Ohio is transected by the Bowling Green Fault System including the Maumee Fault, Outlet Fault, and other unidentified (but likely present) faults; western Ohio is on the periphery of the New Madrid Seismic zone, site of the 1811-12 earthquake sequence (8.0 magnitude range); and the Anna and Fort Wayne failed Rifts (site where crust initially split in response to continental collision which resulted in the Grenville Mountains 800 million -1 billion years ago) that "appear to be the source of many earthquakes in Shelby and Auglaize Counties" (Hansen 2015, p. 4 for quote) to the south of Wood County. Given the structural geologic features of western and northwestern Ohio, relatively recent earthquake activity in Wood County, and the inadequate characterization of the BG Fault System, further geophysical and geotechnical investigation is warranted to adequately characterize the risk potential from the pipeline.

Given the structural geologic features of western and northwestern Ohio, relatively recent earthquake activity in Wood County, and the inadequate characterization of the BG Fault System, further geophysical and geotechnical investigation is warranted to adequately characterize the risk potential from the pipeline.

Geotechnical Risk and Cost

The FEIS (2016) contained numerous appendices including a geotechnical investigation (Appendix E1-4) and report by Fluor Enterprises, Inc. and Fugro Consultants, Inc. As part of this geotechnical investigation, four borings were drilled (two on either side of the Maumee River) in order to characterize the geology at the proposed Nexus Pipeline Maumee River crossing location. According to field logs and geotechnical data from the Fluor Enterprises, Inc. HDD Design Report (Rev. 2) included within the FEIS (2016) as Appendix E4:

> *"Rock quality designation (RQD) ranged from 0 to 66, with the average value being 12, indicating very poor quality bedrock." Further the report states that, "in this case it is not possible to maintain sufficient depth of cover beneath the river while staying above the bedrock surface. Therefore, the design is based on penetrating bedrock,*

which achieves 75 feet of cover beneath the Maumee River." Further and "according to preliminary field logs, the bedrock is characterized by extreme fracturing, which in some cases can be problematic for installation by HDD. Although the feasibility of the Maumee River cannot be ruled out, subsurface conditions are present that increase the risk of HDD operational problems" (FEIS, 2016, p. E4-134).

The report also notes the risk level associated with the propose crossing of the Maumee River is high (p. E4-135); reaming and pullback operations in the fractured bedrock can be problematic; loss of drilling fluid circulation could be an issue; and "inadvertent drilling fluid returns due to hydrofracture do not typically occur on rock crossings, but instead occur by flowing through existing fractures, joints, or solution cavities (p. E4-139). The horizontal directional drilling (HDD) and hydrofracturing plan to install the pipeline underneath the Maumee River (which would span 3,999 feet) is estimated to take 81 days but could be increased by 50 to 100 percent if operational problems are encountered (FEIS, 2016, p. E4-140). Based on the existing geotechnical information, the likelihood of encountering operational problems is high.

Poor quality bedrock, extreme fracturing, the BG fault, and potential karst features all conspire against this proposed pipeline installation underneath the Maumee River.

Poor quality bedrock, extreme fracturing, the BG fault, and potential karst features all conspire against this proposed pipeline installation underneath the Maumee River. The proposed location and drilling and installation methods are problematic from a geotechnical, risk, and cost perspective. During horizontal drilling operations, drilling fluids will likely enter the fractures, lubricate the fault, and could potentially induce earthquakes. Even if earthquakes do not occur, the loss of drilling fluids to the fractures and potential karst features in the subsurface poses a significant operational problem costing time, resources, and money. The potential contamination of near surface aquifers and even the Maumee River with drilling fluids has not been adequately considered in the FEIS. Finally, the potential cost and time overruns for installing a pipeline here, including any environmental contamination mitigation, also auger against this Maumee River crossing location.

Karst Potential and Risk

The geophysical investigation of potential karst areas within Wood and Lucas Counties has not been completed or submitted to FERC by Spectra Energy/NEXUS. Karst areas result from the dissolution of soluble bedrock (e.g. limestone, dolomite, etc.) by slightly acidic groundwater, and karst features include sinkholes, caverns, irregular bedrock topography and springs. Given the presence and development of oil and gas in the region, the potential for hydrogen sulfide migration along the fault, and dissolution of bedrock from sulfuric acid (related to the hydrogen sulfide), the probability of karst features is highly likely. A pipeline placed over such karst features poses a risk to ground and surface water that serves as both rural and municipal drinking water supplies. As clearly spelled out in the FEIS (2016, p. 4-19), "prior to construction, NEXUS should file with the Secretary, the results of geophysical surveys to detect previously unidentified karst features. If previously unidentified karst features are found, NEXUS should also file for review and written approval of the Director of the OEP its plans to avoid or mitigate the features prior to construction in the vicinity of the feature." Arguably, a completed karst survey of the potential pipeline route through Lucas and Wood County should precede any final FERC decision-making.

Bowling Green City Water Supply Risk

From a risk assessment perspective, one would be hard pressed to pick a location that threatens public health and safety more than this location does.

The proposed pipeline is in close proximity (within 600 feet) just north of the Bowling Green Municipal Water Reservoir and slightly downstream of the municipal water intake on the Maumee River. This poses a serious public health threat to not only the city of Bowling Green but also to other surrounding communities who rely on this water supply. Not only could a pipeline leak contaminate a regional drinking water supply, but it could also contaminate the Maumee River and Lake Erie. As noted previously, the probability of drilling fluid losses to the BG Fault and associated fractures during installation activities also poses an unnecessary threat to local and regional water quality that could negatively impact not only public health but also the agricultural community. Additionally, the hydrogeology of Lucas and Wood County is not adequately addressed in the FEIS. Specifically, the water table is very shallow in the Great Black Swamp (within Lucas and Wood County) and the potential impacts on this near surface aquifer from a pipeline leak are not considered. From a risk assessment perspective, one would be hard pressed to pick a location that threatens public health and safety more than this location does.

Hanson Aggregate Quarry Risk

The proposed pipeline location would be ½ mile from the active Hanson Aggregates Quarry (Wood County) where blasting activities are on going. The FEIS makes no mention of Hanson Quarry, its blasting schedule, and its potential impacts on pipeline stability and integrity. The anthropogenically induced seismic risk posed by this quarry and other related activities along the pipeline route require greater attention. At minimum, a geophysical (seismic) investigation is needed to delineate the potential risks created by placing a pipeline in close proximity to an active quarry.

Conclusion

In sum, from a risk assessment perspective the proposed Nexus Pipeline location as it crosses the Maumee River in Lucas and Wood County (as identified in the FEIS, 2016) poses a credible threat to public health and safety. The surficial expression of the Bowling Green Fault; uncharacterized regional and local seismic potential; geotechnical problems and risk; poor subsurface geology conditions for successful pipeline installation; close proximity of the Bowling Green Municipal Water Supply Reservoir and intake; active blasting at the Hanson Aggregates Quarry; and the absence of karst geology and hydrogeologic characterization necessitate not only greater investigation of the risks but also more scientific justification for the proposed pipeline location in this area. The proposed location of the Nexus Pipeline as it crosses the Maumee River between Lucas and Wood Counties poses a serious threat to public health and safety and alternative routes that minimize these risks should be considered.

"Sworn to by me under penalty of perjury this 31st day of January, 2017 at Bowling Green, Ohio.

Andrew R. Kear, PhD

Author Background

The author of this report, Andrew Kear, has a Bachelor's and Master's degree in Geology, six years experience as an environmental consultant, and a Doctorate in Political Science (Colorado State University) with natural gas policy and politics as his primary research field. He is an assistant professor with a dual appointment in the School of Earth, Environment and Society and Department of Political Science at Bowling Green State University. Given his experience, education, background in geology and public policy, and understanding of the National Environmental Policy Act and requisite Environmental Impact Statement for a major pipeline approval, he is uniquely qualified to assess the scientific validity and regulatory implementation of the NEPA-EIS for the proposed Nexus Pipeline.

I, Dr. Andrew R. Kear, am solely responsible for the content of this report, and it does not reflect or represent in any way the thoughts, opinions, or perspectives of Bowling Green State University.

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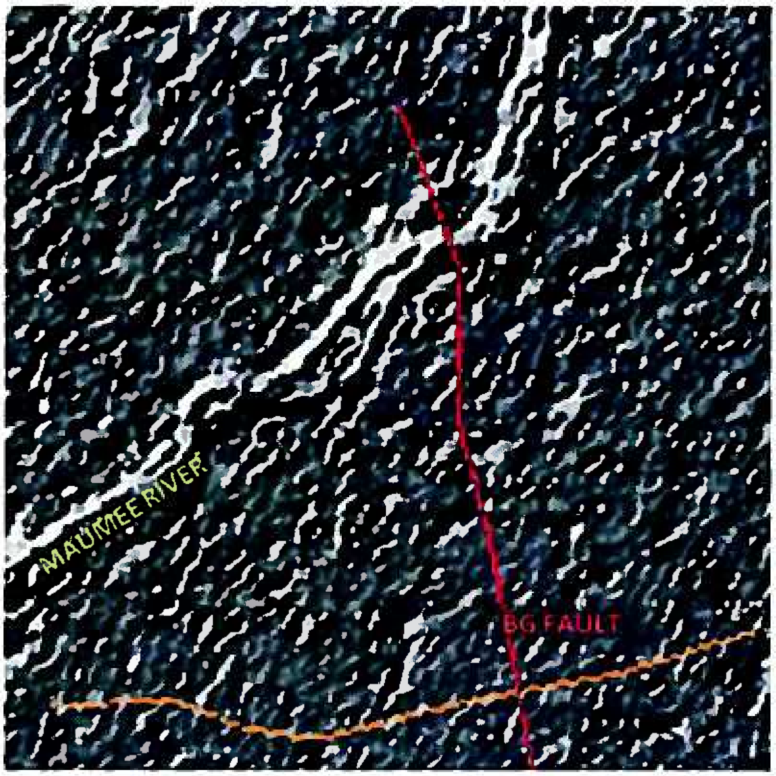
Attachment 1



MP 181.2 Maumee River

Base Data

In performing the HDD design and engineering analysis presented in this report, we have relied upon the following information:

- A combination of LiDAR, hydrographic, and traditional survey data covering the proposed crossing location
- A geotechnical data report prepared by Fugro Consultants, Inc. titled "Geotechnical and Geophysical Data Report, Maumee River HDD Crossing, Nexus Gas Transmission Project, Lucas County, Ohio" and dated September 11, 2015
- A reconnaissance of the proposed crossing location conducted in July of 2015 by a representative of JDH&A

General Site Description

The 36-inch Maumee River Crossing is located just south of Waterville, Ohio near the north edge of Missionary Island. The crossing involves passing beneath the Maumee River as well as US Highway 24 (Anthony Wayne Trail) on the west side of the West River Road on the east side of the river. The width of the river at the proposed crossing location is approximately 2,000 feet. The area is mostly comprised of agricultural land with a mix of woods. The terrain is relatively flat, but drops off near the Maumee River. From the plateaus on each side of the river, the elevation drops off about 40 to 50 feet from the upland farm fields on each side to the edge of water. An overview of the proposed crossing location is provided in Figures 1. Photos taken at the time of the site reconnaissance are included in Figures 2 and 3.

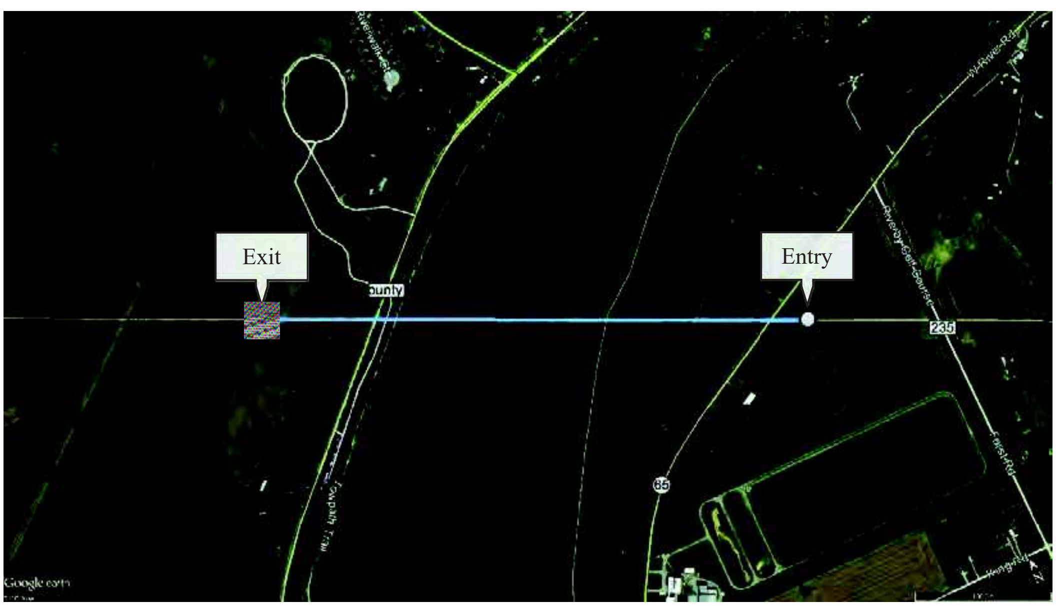


Figure 1: Overview of the Maumee River Crossing

Figure 2: View from West River Road toward entry location

Figure 3: Maumee River (west channel)

Subsurface Conditions

Four geotechnical borings have been taken as part of the site investigation conducted by Fugro Consultants, Inc. Two borings were taken on the west side of the river, both of which were drilled to a depth of 105 feet. Both borings encountered primarily lean clay to lean clay with sand overlying sedimentary bedrock. The top of bedrock was encountered at 85 feet in boring MAU-05 and 98 feet boring MAU-06. Borings MAU-01 and MAU-02 were drilled on the east side of the river. MAU-01 was drilled to 67 feet below the ground surface and encountered fat clay with occasional gravel and gravelly fat clay. Boring MAU-02 encountered mostly sandy lean clay with gravel to a depth of 78 feet. Sand with silt and gravel was encountered at 79 feet with sedimentary bedrock in the form of limestone and siltstone at a depth of 82 feet. The field logs indicate extensive fracturing in the limestone and siltstone. Rock quality designation (RQD) ranged from 0 to 66, with the average value being 12, indicating very poor quality bedrock. Unconfined compressive strength (UCS) of the bedrock averaged 5,988 psi.

Refer to the geotechnical data report prepared by Fugro Consultants, Inc. titled "Geotechnical and Geophysical Data Report, Maumee River HDD Crossing, Nexus Gas Transmission Project, Lucas County, Ohio" and dated September 11, 2015 for additional information.

Design Geometry & Layout

The Maumee River HDD design involves a horizontal length of 3,999 feet. The design length results from an entry angle of 12-degrees, an exit angle of 8-degrees, and a radius of curvature equal to 3,600 feet. In this case, it was not possible to maintain sufficient depth of cover beneath the river while staying above the bedrock surface. Therefore, the design is based on penetrating bedrock, which achieves 75 feet of cover beneath the Maumee River.

The west side of the crossing was chosen for the proposed exit point due to the open farm fields which are free of obstructions, which allow the pipeline pull section to be fabricated in a single segment and thus avoid tie-in welds during pullback.

The preliminary HDD plan and profile design drawing for the Maumee River Crossing is attached to this report for reference.

Assessment of Feasibility

Based on a review of available geotechnical information, the HDD segment must pass through approximately 325 feet of overburden soil containing occasional coarse granular material on the east side of the crossing, before penetrating sedimentary bedrock at a depth of approximately 75 feet. According to preliminary field logs, the bedrock is characterized by extreme fracturing, which in some cases can be problematic for installation by HDD. Although the feasibility of the Maumee River cannot be ruled out, subsurface conditions are present that increase the risk of HDD operational problems.

Risk Identification and Assessment

Potential construction impacts resulting from installation by HDD include possible damage to U.S. Highway 24 and West River Road due to heaving or settlement. In addition, there is risk that inadvertent drilling fluid returns will surface within the Maumee River.

HDD construction and operational risks associated with the crossing involve penetrating bedrock at depths in excess of 75 feet on the east side and almost 100 feet on the west side. Penetrating a deep bedrock surface during pilot hole drilling can sometimes be difficult due to bit deflection. The bit may deflect and skip across the top of the bedrock instead of penetrating it, resulting in unacceptable radius of curvature. A deep bedrock surface can be problematic during reaming and pullback operations due to misalignment at the soil/rock interface. Downhole reaming tools or the pull section may also hang up on the rock interface. Additional risks include failure of large diameter rock reaming tools downhole and operational problems associated with fractured bedrock, including loss of drilling fluid circulation.

Due to subsurface conditions, the risk level associated with the proposed crossing of the Maumee River is high.

Installation Loading Analysis

Two installation scenarios were evaluated for the proposed crossing. The first scenario assumed the pilot hole would be drilled to the exact design centerline shown on the plan and profile drawing. The second scenario assumed a worse-case model in which the pilot hole is drilled 25 feet deeper than the design profile with a radius of curvature reduced to 50 percent of the design radius. A summary of the assumptions used in each loading scenario is provided in Table 1.

Table 1: Loading Scenarios

Loading Scenario	Path Geometry	Drilling Fluid Weight	Buoyancy Condition	Above Ground Load
Number 1 As-Designed	Length: As designed Depth: As designed Radius: 3,600’	12 ppg	Empty	Assumed Negligible
Number 2 Worse-Case	Length: Increased by 50’ Depth: Increased by 25’ Radius: 1,800’	12 ppg	Empty	Assumed Negligible

Based on the loading scenarios described above, the estimated pulling load for the “as-designed” crossing, without ballast, is 632,344 pounds. In the “worse-case” installation scenario, the anticipated pulling load without ballast is 662,330 pounds. In both cases, loads and stresses fall within acceptable limits as defined by the PRCI method. Pipe parameters and other installation properties are provided in Figure 4. Detailed calculations for each scenario are summarized in Figures 5 and 6.

Line Pipe Properties		
Pipe Outside Diameter =	36.000	in
Wall Thickness =	0.741	in
Specified Minimum Yield Strength =	70,000	psi
Young's Modulus =	2.9E+07	psi
Moment of Inertia =	12755.22	in^4
Pipe Face Surface Area =	82.08	in^2
Diameter to Wall Thickness Ratio, D/t =	49	
Poisson's Ratio =	0.3	
Coefficient of Thermal Expansion =	6.5E-06	in/in/°F
Pipe Weight in Air =	279.04	lb/ft
Pipe Interior Volume =	6.50	ft^3/ft
Pipe Exterior Volume =	7.07	ft^3/ft
HDD Installation Properties		
Drilling Mud Density =	12.0	ppg
=	89.8	lb/ft^3
Ballast Density =	62.4	lb/ft^3
Coefficient of Soil Friction =	0.30	
Fluid Drag Coefficient =	0.025	psi
Ballast Weight =	405.51	lb/ft
Displaced Mud Weight =	634.48	lb/ft

Figure 4: Pipe and Installation Properties

Figure 5: Installation Loading and Stress Analysis (As-Designed)

Pipe and Installation Properties

Pipe Diameter, D =	36.000 in	Fluid Drag Coefficient, C_d =	0.025 psi	
PIpe Weight, W =	279.0 lb/ft	Ballast Weight / ft Pipe, W_b =	405.5 lb	(If Ballasted)
Coefficient of Soil Friction, μ =	0.30	Drilling Mud Displaced / ft Pipe, W_m =	634.5 lb	(If Submerged)
		Above Ground Load =	0 lb	

Exit Tangent - Summary of Pulling Load Calculations

Segment Length, L =	362.6 ft	Effective Weight, $W_e = W + W_b - W_m$ =	-355.4 lb/ft
Exit Angle, θ =	8.0 °		

Frictional Drag = $W_e\, L\, \mu \cos\theta$ =	38,289 lb
Fluidic Drag = $12\, \pi\, D\, L\, C_d$ =	12,303 lb
Axial Segment Weight = $W_e\, L \sin\theta$ =	17,937 lb
Pulling Load on Exit Tangent =	**68,529 lb**

Exit Sag Bend - Summary of Pulling Load Calculations

Segment Length, L =	502.7 ft	Average Tension, T =	121,693 lb
Segment Angle with Horizontal, θ =	-8.0 °	Radius of Curvature, R =	3,600 ft
Deflection Angle, α =	-4.0 °	Effective Weight, $W_e = W + W_b - W_m$ =	-355.4 lb/ft

$h = R\,[1 - \cos(\alpha/2)]$ =	8.77 ft	$j = [(E\, I) / T]^{1/2}$ =	1,743
$Y = [18\,(L)^2] - [(j)^2\,(1 - \cosh(U/2)^{-1}]$ =	2.6E+06	$X = (3\,L) - [\,(j / 2) \tanh(U/2)\,]$ =	689.38
$U = (12\,L) / j$ =	3.46	$N = [(T\,h) - W_e \cos\theta\,(Y/144)] / (X / 12)$ =	128,017 lb
Bending Frictional Drag = $2\,\mu\,N$ =	76,810 lb		
Fluidic Drag = $12\,\pi\,D\,L\,C_d$ =	17,055 lb		
Axial Segment Weight = $W_e\,L \sin\theta$ =	12,463 lb		
Pulling Load on Exit Sag Bend =	**106,328 lb**		
Total Pulling Load =	**174,857 lb**		

Bottom Tangent - Summary of Pulling Load Calculations

Segment Length, L =	2316.0 ft	Effective Weight, $W_e = W + W_b - W_m$ =	-355.4 lb/ft

Frictional Drag = $W_e\,L\,\mu$ =	246,962 lb
Fluidic Drag = $12\,\pi\,D\,L\,C_d$ =	78,581 lb
Axial Segment Weight = $W_e\,L \sin\theta$ =	0 lb
Pulling Load on Bottom Tangent =	**325,543 lb**
Total Pulling Load =	**500,400 lb**

Entry Sag Bend - Summary of Pulling Load Calculations

Segment Length, L =	628.3 ft	Average Tension, T =	558,632 lb
Segment Angle with Horizontal, θ =	10.0 °	Radius of Curvature, R =	3,600 ft
Deflection Angle, α =	5.0 °	Effective Weight, $W_e = W + W_b - W_m$ =	-355.4 lb/ft

$h = R\,[1 - \cos(\alpha/2)]$ =	13.70 ft	$j = [(E\,I) / T]^{1/2}$ =	814
$Y = [18\,(L)^2] - [(j)^2\,(1 - \cosh(U/2)^{-1}]$ =	6.5E+06	$X = (3\,L) - [\,(j / 2) \tanh(U/2)\,]$ =	1478.17
$U = (12\,L) / j$ =	9.27	$N = [(T\,h) - W_e \cos\theta\,(Y/144)] / (X / 12)$ =	191,018 lb
Bending Frictional Drag = $2\,\mu\,N$ =	114,611 lb		
Fluidic Drag = $12\,\pi\,D\,L\,C_d$ =	21,318 lb		
Axial Segment Weight = $W_e\,L \sin\theta$ =	-19,464 lb	Negative value indicates axial weight applied in direction of installation	
Pulling Load on Entry Sag Bend =	**116,465 lb**		
Total Pulling Load =	**616,865 lb**		

Entry Tangent - Summary of Pulling Load Calculations

Segment Length, L =	200.5 ft	Effective Weight, $W_e = W + W_b - W_m$ =	-355.4 lb/ft
Entry Angle, θ =	10.0 °		

Frictional Drag = $W_e\,L\,\mu \cos\theta$ =	21,050 lb	
Fluidic Drag = $12\,\pi\,D\,L\,C_d$ =	6,801 lb	
Axial Segment Weight = $W_e\,L \sin\theta$ =	-12,372 lb	Negative value indicates axial weight applied in direction of installation
Pulling Load on Entry Tangent =	**15,479 lb**	
Total Pulling Load =	**632,344 lb**	

Summary of Calculated Stress vs. Allowable Stress

	Tensile Stress		Bending Stress		External Hoop Stress		Combined Tensile & Bending		Combined Tensile, Bending & Ext. Hoop	
Entry Point	7,704	ok	0	ok	0	ok	0.12	ok	0.02	ok
	7,515	ok	0	ok	466	ok	0.12	ok	0.03	ok
PC										
	7,515	ok	12,083	ok	466	ok	0.38	ok	0.14	ok
	6,096	ok	12,083	ok	1295	ok	0.36	ok	0.16	ok
PT										
	6,096	ok	0	ok	1295	ok	0.10	ok	0.05	ok
	2,130	ok	0	ok	1295	ok	0.03	ok	0.04	ok
PC										
	2,130	ok	12,083	ok	1295	ok	0.30	ok	0.12	ok
	835	ok	12,083	ok	764	ok	0.28	ok	0.08	ok
PT										
	835	ok	0	ok	764	ok	0.01	ok	0.01	ok
Exit Point	0	ok	0	ok	0	ok	0.00	ok	0.00	ok

Figure 6: Installation Loading and Stress Analysis (Worse-Case)

Pipe and Installation Properties

Pipe Diameter, D = 36.000 in
Plpe Weight, W = 279.0 lb/ft
Coefficient of Soil Friction, μ = 0.30

Fluid Drag Coefficient, C_d = 0.025 psi
Ballast Weight / ft Pipe, W_b = 405.5 lb (If Ballasted)
Drilling Mud Displaced / ft Pipe, W_m = 634.5 lb (If Submerged)
Above Ground Load = 0 lb

Exit Tangent - Summary of Pulling Load Calculations

Segment Length, L = 668.1 ft
Exit Angle, θ = 8.0 °
Effective Weight, $W_e = W + W_b - W_m$ = -355.4 lb/ft

Frictional Drag = W_e L μ cosθ = 70,548 lb
Fluidic Drag = 12 π D L C_d = 22,668 lb
Axial Segment Weight = W_e L sinθ = 33,050 lb
Pulling Load on Exit Tangent = 126,266 lb

Exit Sag Bend - Summary of Pulling Load Calculations

Segment Length, L = 251.3 ft
Segment Angle with Horizontal, θ = -8.0 °
Deflection Angle, α = -4.0 °
Average Tension, T = 164,579 lb
Radius of Curvature, R = 1,800 ft
Effective Weight, $W_e = W + W_b - W_m$ = -355.4 lb/ft

h = R [1 - cos(α/2)] = 4.38 ft
j = [(E I) / T]$^{1/2}$ = 1,499
Y = [18 (L)^2] - [(j)^2 (1 - cosh(U/2)$^{-1}$] = 3.4E+05
X = (3 L) - [(j / 2) tanh(U/2)] = 181.26
U = (12 L) / j = 2.01
N = [(T h) - W_e cosθ (Y/144)] / (X / 12) = 103,112 lb
Bending Frictional Drag = 2 μ N = 61,867 lb
Fluidic Drag = 12 π D L C_d = 8,527 lb
Axial Segment Weight = W_e L sinθ = 6,231 lb
Pulling Load on Exit Sag Bend = 76,626 lb
Total Pulling Load = 202,892 lb

Bottom Tangent - Summary of Pulling Load Calculations

Segment Length, L = 2329.7 ft
Effective Weight, $W_e = W + W_b - W_m$ = -355.4 lb/ft

Frictional Drag = W_e L μ = 248,421 lb
Fluidic Drag = 12 π D L C_d = 79,045 lb
Axial Segment Weight = W_e L sinθ = 0 lb
Pulling Load on Bottom Tangent = 327,466 lb
Total Pulling Load = 530,358 lb

Entry Sag Bend - Summary of Pulling Load Calculations

Segment Length, L = 314.2 ft
Segment Angle with Horizontal, θ = 10.0 °
Deflection Angle, α = 5.0 °
Average Tension, T = 576,966 lb
Radius of Curvature, R = 1,800 ft
Effective Weight, $W_e = W + W_b - W_m$ = -355.4 lb/ft

h = R [1 - cos(α/2)] = 6.85 ft
j = [(E I) / T]$^{1/2}$ = 801
Y = [18 (L)^2] - [(j)^2 (1 - cosh(U/2)$^{-1}$] = 1.3E+06
X = (3 L) - [(j / 2) tanh(U/2)] = 549.29
U = (12 L) / j = 4.71
N = [(T h) - W_e cosθ (Y/144)] / (X / 12) = 153,813 lb
Bending Frictional Drag = 2 μ N = 92,288 lb
Fluidic Drag = 12 π D L C_d = 10,659 lb
Axial Segment Weight = W_e L sinθ = -9,732 lb — Negative value indicates axial weight applied in direction of installation
Pulling Load on Entry Sag Bend = 93,215 lb
Total Pulling Load = 623,573 lb

Entry Tangent - Summary of Pulling Load Calculations

Segment Length, L = 501.9 ft
Entry Angle, θ = 10.0 °
Effective Weight, $W_e = W + W_b - W_m$ = -355.4 lb/ft

Frictional Drag = W_e L μ cosθ = 52,706 lb
Fluidic Drag = 12 π D L C_d = 17,029 lb
Axial Segment Weight = W_e L sinθ = -30,978 lb — Negative value indicates axial weight applied in direction of installation
Pulling Load on Entry Tangent = 38,757 lb
Total Pulling Load = 662,330 lb

Summary of Calculated Stress vs. Allowable Stress

	Tensile Stress		Bending Stress		External Hoop Stress		Combined Tensile & Bending		Combined Tensile, Bending & Ext. Hoop	
Entry Point	8,069	ok	0	ok	0	ok	0.13	ok	0.02	ok
	7,597	ok	0	ok	1259	ok	0.12	ok	0.06	ok
PC										
	7,597	ok	24,167	ok	1259	ok	0.65	ok	0.40	ok
	6,461	ok	24,167	ok	1673	ok	0.63	ok	0.41	ok
PT										
	6,461	ok	0	ok	1673	ok	0.10	ok	0.08	ok
	2,472	ok	0	ok	1673	ok	0.04	ok	0.06	ok
PC										
	2,472	ok	24,167	ok	1673	ok	0.57	ok	0.33	ok
	1,538	ok	24,167	ok	1408	ok	0.55	ok	0.29	ok
PT										
	1,538	ok	0	ok	1408	ok	0.02	ok	0.04	ok
Exit Point	0	ok	0	ok	0	ok	0.00	ok	0.00	ok

Hydrofracture Evaluation

The majority of the Maumee River Crossing will be installed through bedrock. Since the Delft Method discussed in Section 5 of the report is only applicable to uncemented subsurface materials, a hydrofracture evaluation was not completed. In general, inadvertent drilling fluid returns due to hydrofracture do not typically occur on rock crossings, but instead occur by flowing through existing fractures, joints, or solution cavities.

Construction Duration

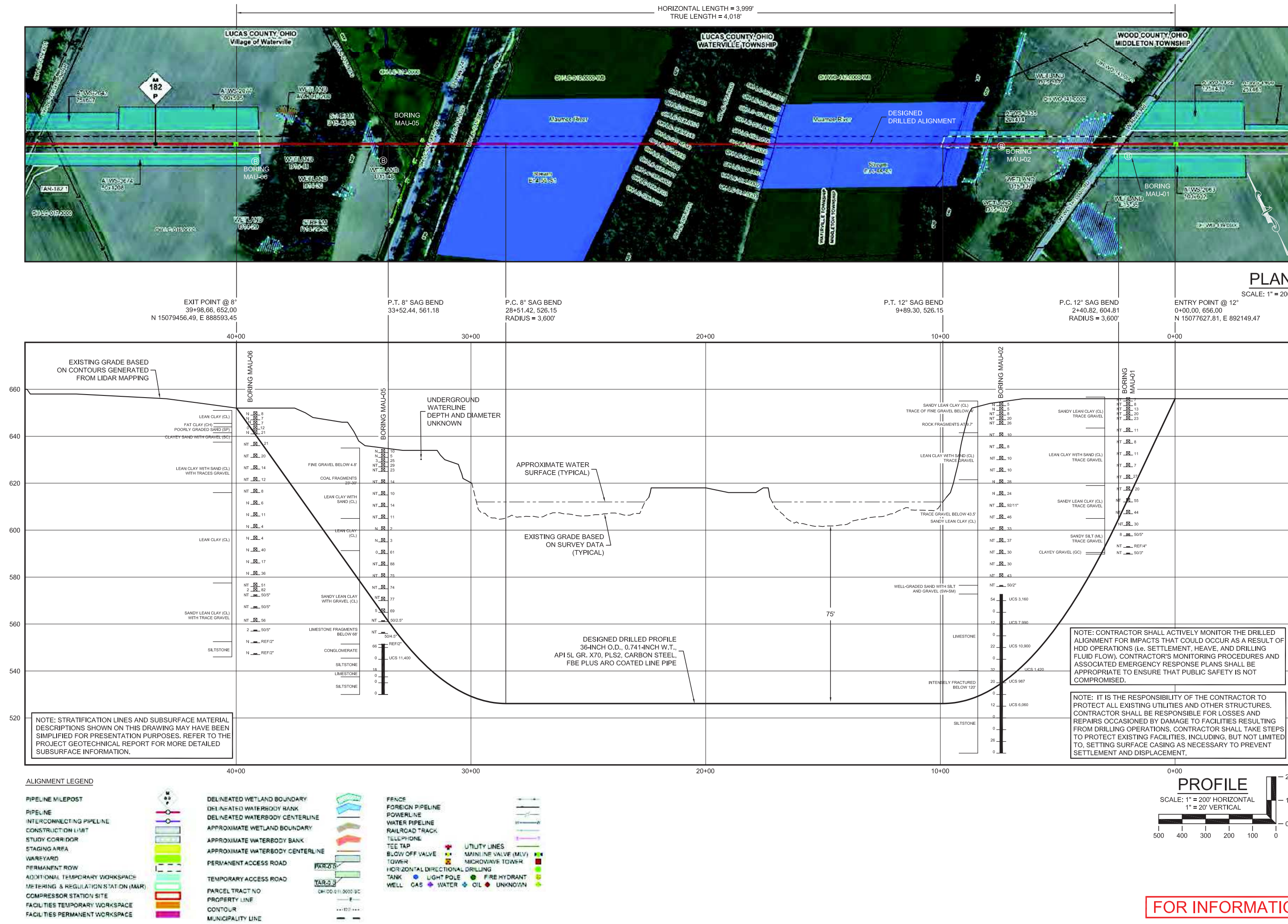
The estimated duration of construction for the Maumee River Crossing is 81 days. The estimate assumes single 12-hour shifts during pilot hole, reaming, and pullback operations. The pilot hole production rate and reaming travel speed were estimated by JDH&A based on information contained within the Pipeline Research Council International's "*Installation of Pipelines by Horizontal Directional Drilling*"[1], as well as past experience in similar subsurface conditions. Details relative to the estimate are provided in Figure 7.

Please note that the estimated duration is based on operations proceeding according to plan and does not include contingency. The occurrence of unanticipated operational problems could increase the duration of operations by 50 to 100 percent.

General Data		Comments						
Work Schedule, hours/shift =	12.0	36" Maumee River Crossing						
days/week =	7.0							
Drilled Length, feet =	4,018							
Pilot Hole								
Production Rate, feet/hour =	20							
shifts/day =	1							
Drilling Duration, hours =	200.9							
shifts =	16.7							
Trips to change tools, shifts =	2.0							
Pilot Hole Duration, days =	18.7							
Ream and Pull Back								
Pass Description =	24-inch	36-inch	48-inch			Swab	Pull Back	Total
Travel Speed, feet/minute =	0.4	0.4	0.4			8.0	6.0	
Mud Flow Rate, barrels/minute =	15.0	15.0	15.0			15.0	15.0	
shifts/day =	1	1	1			1	1	
Reaming Duration, hours =	195.7	195.7	195.7			12.7	15.5	615.1
shifts =	16.3	16.3	16.3			1.1	1.3	51.3
Rig up, shifts =	0.5	0.5	0.5			0.5	0.5	2.5
Trips to change tools, shifts =	2.0	2.0	2.0			0.0		6.0
Pass Duration, days =	18.8	18.8	18.8			1.6	1.8	59.8
Summary								
HDD Duration at Site, days =	80.5							
Site Establishment	Move in	Rig Up	Rig Down	Move Out				
shifts/day =	1	1	1	1				
shifts =	0.5	1.0	1.0	0.5				
days =	0.5	1.0	1.0	0.5				

Figure 7: Estimated Construction Duration

[1] *Installation of Pipelines by Horizontal Directional Drilling, An Engineering Design Guide*, prepared under the sponsorship of the Pipeline Research Committee at the American Gas Association, April 15, 1995, Revised under the sponsorship of the Pipeline Research Council International, Inc., 2008.



GENERAL LEGEND

DRILLED PATH ENTRY/EXIT POINT

TOPOGRAPHIC SURVEY NOTES

1. LIDAR, SURVEY, AND HYDROGRAPHIC DATA PROVIDED BY FLUOR ENTERPRISES, INC., SUGARLAND, TEXAS.

2. NORTHINGS AND EASTINGS ARE IN U.S. SURVEY FEET REFERENCED TO UTM ZONE 17N, NAD83.

DRILLED PATH NOTES

1. DRILLED PATH STATIONING IS IN FEET BY HORIZONTAL MEASUREMENT AND IS REFERENCED TO CONTROL ESTABLISHED FOR THE DRILLED SEGMENT.

2. DRILLED PATH COORDINATES REFER TO CENTERLINE OF PIPE.

GEOTECHNICAL LEGEND

BORING LOCATION

SPLIT SPOON SAMPLE

PENETRATION RESISTANCE IN BLOWS PER FOOT FOR A 140 POUND HAMMER FALLING 30 INCHES

PERCENTAGE OF GRAVEL BY WEIGHT FOR SAMPLES CONTAINING GRAVEL

PUSH SAMPLE

CORE BARREL SAMPLE

UNCONFINED COMPRESSIVE STRENGTH (PSI)

TENSILE SPLITTING STRENGTH (PSI)

MOHS HARDNESS

ROCK QUALITY DESIGNATION (PERCENT)

GEOTECHNICAL NOTES

1. GEOTECHNICAL DATA PROVIDED BY FUGRO CONSULTANTS, INC. BATON ROUGE, LOUISIANA. REFER TO THE PROJECT GEOTECHNICAL REPORT DATED SEPTEMBER 11, 2015 FOR ADDITIONAL INFORMATION.

2. THE LETTER "N" TO THE LEFT OF A SPLIT SPOON SAMPLE INDICATES THAT NO GRAVEL WAS OBSERVED IN THE SAMPLE. THE LETTERS "NT" INDICATE THAT GRAVEL WAS OBSERVED BUT NO GRADATION TESTS WERE PERFORMED.

3. THE GEOTECHNICAL DATA IS ONLY DESCRIPTIVE OF THE LOCATIONS ACTUALLY SAMPLED. EXTENSION OF THIS DATA OUTSIDE OF THE ORIGINAL BORINGS MAY BE DONE TO CHARACTERIZE THE SOIL CONDITIONS, HOWEVER, COMPANY DOES NOT GUARANTEE THESE CHARACTERIZATIONS TO BE ACCURATE. CONTRACTOR MUST USE HIS OWN EXPERIENCE AND JUDGEMENT IN INTERPRETING THIS DATA.

PILOT HOLE TOLERANCES

THE PILOT HOLE SHALL BE DRILLED TO THE TOLERANCES LISTED BELOW. HOWEVER, IN ALL CASES, RIGHT-OF-WAY RESTRICTIONS AND CONCERN FOR ADJACENT FACILITIES SHALL TAKE PRECEDENCE OVER THESE TOLERANCES.

1. ENTRY POINT: UP TO 5 FEET FORWARD OR BACK FROM THE DESIGNED ENTRY POINT; UP TO 1 FOOT RIGHT OR LEFT OF THE DESIGNED ALIGNMENT.

2. EXIT POINT: UP TO 5 FEET SHORT OR 20 FEET LONG RELATIVE TO THE DESIGNED EXIT POINT; UP TO 5 FEET RIGHT OR LEFT OF THE DESIGNED ALIGNMENT.

3. ELEVATION: UP TO 5 FEET ABOVE AND 15 FEET BELOW THE DESIGNED PROFILE.

4. ALIGNMENT: UP TO 10 FEET RIGHT OR LEFT OF THE DESIGNED ALIGNMENT.

5. CURVE RADIUS: NO LESS THAN 1,800 FEET BASED ON A 3-JOINT AVERAGE

PROTECTION OF UNDERGROUND FACILITIES

CONTRACTOR SHALL UNDERTAKE THE FOLLOWING STEPS PRIOR TO COMMENCING DRILLING OPERATIONS:

1. CONTACT THE UTILITY LOCATION/NOTIFICATION SERVICE FOR THE CONSTRUCTION AREA.

2. POSITIVELY LOCATE AND STAKE ALL EXISTING UNDERGROUND FACILITIES. ANY FACILITIES LOCATED WITHIN 10 FEET OF THE DESIGNED DRILLED PATH SHALL BE EXPOSED.

3. MODIFY DRILLING PRACTICES AND DOWNHOLE ASSEMBLIES AS NECESSARY TO PREVENT DAMAGE TO EXISTING FACILITIES.

FOR INFORMATION ONLY - NOT FOR CONSTRUCTION

DWG. NO.	REFERENCE DWG.	REV	DSN	CK	DESCRIPTION
		2	ACM	JMS	RE-ISSUED FOR FERC
CLYD-A-1199	ALIGNMENT SHEET M.P. 181.26 TO M.P. 182.21	1	LKB	JMS	ISSUED FOR BID
CLYD-A-1198	ALIGNMENT SHEET M.P. 180.32 TO M.P. 181.26	0	LKB	ACM	ISSUED FOR FERC

John D. Hair, P.E.
Consulting Engineer
2424 East 21st Street
Suite 510
Tulsa, Oklahoma 74114

ENGINEERING APPROVALS

TITLE	PRELIMINARY SIGNATURE	DATE	CONSTRUCTION SIGNATURE	DATE
DRAWN BY:	DMP	08/07		
PROJECT MANAGER	JMS	08/07		
DESIGN ENGINEER	LKB	08/26		
DESIGN CHECKER	AM	08/26		

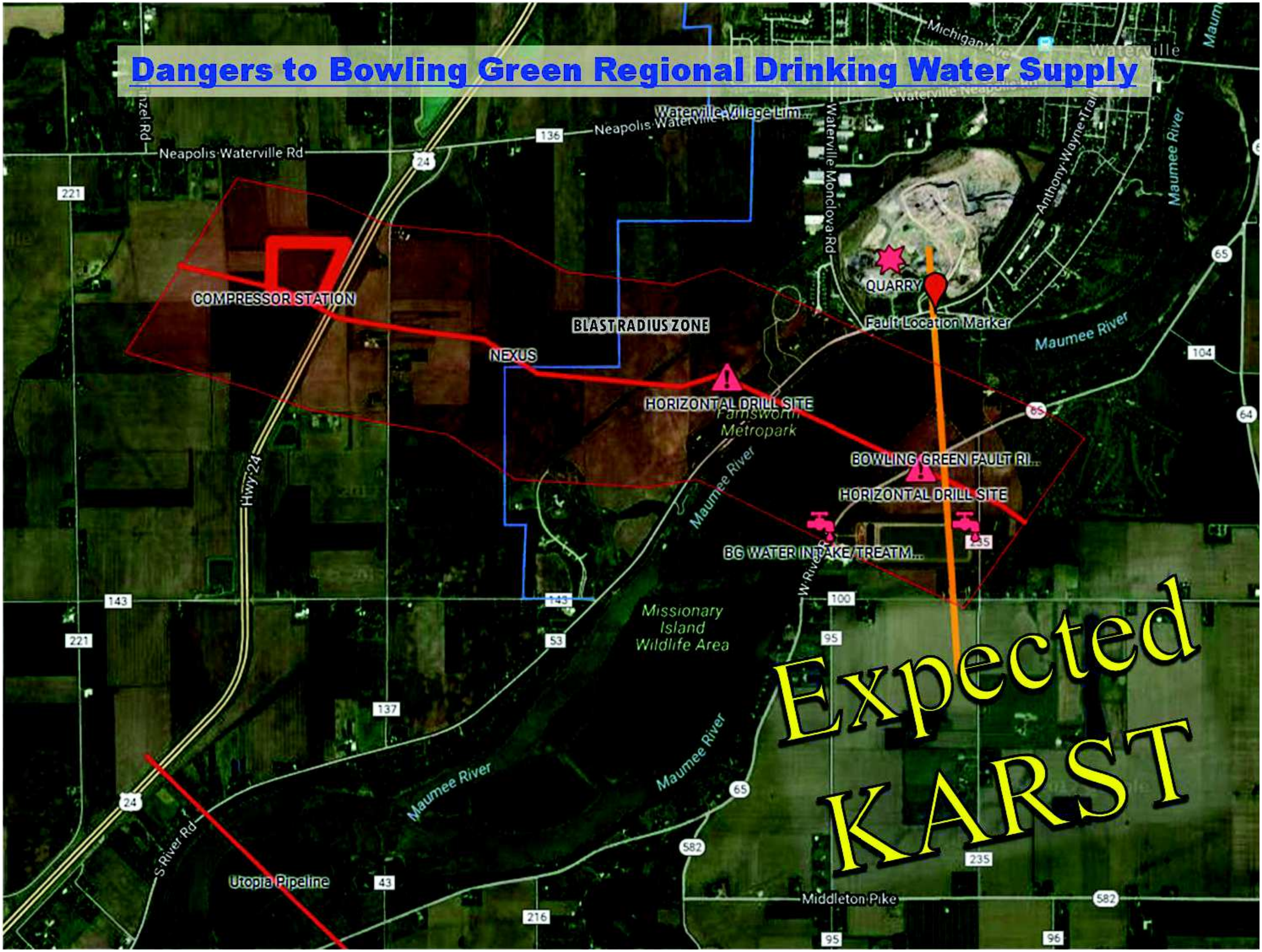
PLAN AND PROFILE
NEXUS PROPOSED MAINLINE PIPELINE
36-INCH MAUMEE RIVER CROSSING
BY HORIZONTAL DIRECTIONAL DRILLING

WOOD AND LUCAS COUNTIES, OHIO

NEXUS GAS TRANSMISSION

M.P. 181.2 | W.O. | SCALE: AS SHOWN | DWG. CLYD-H-1013 | REV. 2

Exhibit C



Dangers to Bowling Green Regional Drinking Water Supply
COMPRESSOR STATION
BLAST RADIUS ZONE
NEXUS
HORIZONTAL DRILL SITE
QUARRY
Fault Location Marker
BOWLING GREEN FAULT RI...
HORIZONTAL DRILL SITE
BG WATER INTAKE/TREATM...
Farnsworth Metropark
Missionary Island Wildlife Area
Maumee River
Utopia Pipeline
Neapolis Waterville Rd
Hwy 24
S River Rd
Middleton Pike
Waterville Monclova Rd
Anthony Wayne Trail
Michigan Ave
Waterville
Expected KARST