Location Restrictions Demonstrations

DTE Electric Company
Monroe Power Plant Fly Ash Basin
Coal Combustion Residual Unit

7955 East Dunbar Road
Monroe, Michigan

September 2018

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Prepared For
DTE Electric Company

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Certification

I, the undersigned Michigan Professional Engineer, hereby certify that I am familiar with the technical requirements of Title 40 Code of Federal Regulations Part 257 Subpart D (§257). I also certify that it is my professional opinion that, to the best of my knowledge, information, and belief, that the information in this demonstration is in accordance with current good and accepted engineering practice(s) and standard(s) and meets the requirements of §257.60 through §257.64.

For the purpose of this document, "certify" and "certification" shall be interpreted and construed to be a "statement of professional opinion." The certification is understood and intended to be an expression of my professional opinion as a Michigan Licensed Professional Engineer, based upon knowledge, information, and belief. The statement(s) of professional opinion are not and shall not be interpreted or construed to be a guarantee or a warranty of the analysis herein.

David B. McKenzie, P.E.

License No: 6201042332

Seal/Date

Section 1
Background

The purpose of this document is to demonstrate that the Coal Combustion Residual (CCR) Fly Ash Basin (FAB) at the Monroe Power Plant (MONPP) is in compliance with the location restrictions outlined in the Environmental Protection Agency's (EPA) final CCR rule [Title 40 Code of Federal Regulations Parts 257 and 261] Subpart D – "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments" (§257.60 through §257.64, federal rule). The FAB is considered a CCR impoundment and landfill.

This document includes information from a desktop study and well installation activities and also engineering calculations to demonstrate that the FAB is in compliance with placement above the uppermost aquifer criteria (§257.60), and location criteria with respect to wetlands (§257.61), fault areas (§257.62), seismic impact zones (§257.63), and unstable areas (§257.64).

Supporting documents are provided as appendices to this demonstration.

1.1 Facility and CCR Unit Information

The MONPP is located in Section 16, Township 7 South, Range 9 East, at 7955 East Dunbar Road, Monroe in Monroe County, Michigan. The MONPP FAB is located about one mile southwest of the MONPP at latitude 41° 53' 03" North and longitude 83° 22' 31" West. The MONPP FAB is bounded by Dunbar Road and Plum Creek to the north and northeast, Interstate 75 to the northwest, a 200-acre peninsula into Lake Erie to the east and southeast, Lake Erie to the south and a large open field to the southwest.

The property has been used continuously for the operation of the MONPP FAB since approximately 1975 and is constructed over a natural clay-rich soil base. The MONPP FAB and landfill is a Type III solid waste disposal facility owned by DTE Electric Company (DTE Electric), which currently accepts coal ash from DTE Electric's MONPP. The MONPP FAB is operated in accordance with Michigan Part 115 of the Natural Resources and Environmental Protection Act (NREPA), PA 451 of 1994, as amended, and the current operating license number is 9393.

The FAB base is keyed into the existing natural clay-rich soil ground surface at an elevation of 563.4 feet. This natural low permeability clay-rich soil base serves as an underlying hydraulic barrier, forming a natural liner of at least 23 feet of natural clay-rich soil below the base of the FAB. The constructed berm that follows the perimeter of the FAB reaches an elevation of 614 ft., approximately 5 ft above the operational water level of the FAB.

1.2 Site Setting

The MONPP FAB CCR unit is located approximately 200 feet southwest of Plum Creek and immediately north of Lake Erie. The uppermost aquifer at the MONPP FAB CCR consists of saturated limestone present beneath at least 37 feet and up to 53.5 feet of thick contiguous silty clay-rich soil that serves as a natural confining hydraulic barrier that isolates the underlying uppermost aquifer. The limestone bedrock aquifer is artesian in every location except MW-16-01, where the static water level was approximately 1 to 2 feet below ground surface (ft bgs).

A groundwater monitoring system has been established for the MONPP FAB CCR unit as detailed in the *Groundwater Monitoring System Summary Report – Monroe Power Plant Coal Combustion Residual Fly Ash Basin* (GWMS Report) (TRC, October 2017). The detection monitoring well network for the MONPP FAB CCR unit currently consists of seven monitoring wells that are screened in the uppermost aquifer. The monitoring well boring logs are included in Appendix A.

A mean hydraulic conductivity of approximately 4.3 feet/day was measured from one of the CCR monitoring wells using single well hydraulic conductivity tests (e.g., slug tests) performed in 2016. This result is consistent with other sources (5 feet/day) for the hydraulic conductivity of the Bass Island Group.

Potentiometric groundwater elevation data collected in 2016 and 2017 suggest that there is horizontal groundwater flow potential within the upper aquifer unit generally to the northeast towards Plum Creek. The average hydraulic gradient to the northeast is on the order of 0.002 foot/foot along the eastern part of the MONPP FAB to 0.004 to 0.005 foot/foot in the center and northwestern part of the FAB, with an overall mean gradient of 0.004 foot/foot.

The surface water elevation within the FAB raised surface impoundment is at least 5 to more than 30 feet above the potentiometric surface elevations in the uppermost aquifer limestone, and more than 60 feet above the base of the underlying clay-rich confining unit that isolates groundwater within the limestone aquifer. Therefore, flow potential from the CCR unit to the surrounding area would be radially outward from the FAB. However, there is no hydraulic communication between the uppermost aquifer and the FAB due to the continuous silty clay-rich confining unit beneath the MONPP FAB. Based on the artesian conditions, the low permeability of the underlying natural soils, and the calculated time of travel for groundwater to flow vertically from the FAB to the uppermost aquifer, it is not possible for the uppermost aquifer to have been affected by CCR from FAB operations that began in 1975.

Section 2
Location Restrictions

The location restrictions designated in the federal CCR rule are presented below with a corresponding demonstration to show compliance with each restriction. The location restrictions include placement above the uppermost aquifer, within wetlands, near fault areas, within seismic impact zones, and unstable areas based on available geologic and geomorphological information. Supporting information for the demonstrations is included in the appendices to this report.

2.1 §257.60 – Placement Above the Uppermost Aquifer

The federal CCR rule requires that CCR units such as the MONPP FAB must be constructed with a base that is located no less than 1.52 meters (five feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in the groundwater elevations (including the seasonal high water table). As discussed in Section 1.1 (above), the FAB is keyed into the natural clay-rich soil ground surface at an elevation of 563.4 feet. THE FAB is underlain by at least 23 feet of the natural low permeability clay-rich soil. The uppermost aquifer, based on saturated soil observations during soil borings is located at the silty clay-weathered limestone interface, at an approximate elevation of 527 to 540 ft MSL. Cross-sections showing the installation top and bottom elevation of the approximate basin bottom and depth to the uppermost aquifer are included in Appendix B.

Based on this demonstration, the base of the MONPP FAB is located greater than 5 feet above the upper limit of the uppermost aquifer and there is not a hydraulic connection between the FAB and the underlying groundwater caused by normal fluctuations in groundwater level. Therefore, the FAB is in compliance with the requirements of §257.60.

2.2 §257.61 – Wetlands

The CCR location standards restrict existing and new CCR surface impoundments from being located in wetlands, as defined at 40 CFR 232.2 (40 CFR 257.61(a)). Wetlands are defined in 40 CFR 232.2 *Waters of the United States (3)(iv)* as, "…those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." TRC reviewed National Wetland Inventory (NWI) maps and Michigan Resource Information

System (MIRIS) Land Cover Maps archived and available through Michigan Department of Natural Resources (MDNR), Michigan Resource Inventory Program (MRIP) to ascertain whether or not the MONPP FAB located in wetlands.

As shown on the map in Appendix C, soils at and in the vicinity of the site are designated as wetland soils, most likely due to the proximity of the site to Plum Creek and Lake Erie. NWI (2005) recognizes areas to the southeast and northeast of the FAB as wetlands, and an area identified as wetlands on NWI and MIRIS maps that has wetland soils is located within the site. However, wetland delineations performed at the MONPP FAB by DTE Electric showed that all wetlands were located outside of the FAB berms (outside the CCR unit) in perimeter drainage channels.

Based on TRC's review of wetland inventory resources and current site conditions, TRC is of the opinion that the MONPP FAB is not located in an area exhibiting wetland characteristics, and that continued operations at the FAB will have no potential to impact any wetlands near the CCR unit. TRC also concludes that due to its use as an NPDES treatment unit, this basin is not wetlands as defined in 40 CFR 232.2.

2.3 §257.62 – Fault areas

The federal CCR rule requires that CCR units not be located within 60 meters (200 feet) of the outermost damage zone of a fault that has had displacement in Holocene time (within the most recent 11,700 years) unless the owner or operator demonstrates that an alternative setback distance of less than 60 meters (200 feet) will not cause damage to the structural integrity of the CCR unit. USGS-recognized Quaternary faults in the U.S. are shown on the map in Appendix D.

The lower peninsula of Michigan is covered by a mantle of glacial deposits obscuring any surficial evidence of faulting (Bricker, 1977). In these areas of glacial deposition, fault zones are considered to be stable, and any recent recorded earth movement in Michigan has been noted to originate from source depths of 95 to 110 kilometers into the subsurface (Brinker, 1977). Historical records indicate that nearly all seismic events that have occurred in Michigan have been relatively minor in intensity (I to VI on the Modified Mercalli Intensity Scale).

Evidence of active faulting during the Holocene in the MONPP FAB area is not supported by this determination; therefore, the FAB is in compliance with the requirements of §257.62.

2.4 §257.63 – Seismic Impact Zones

The federal CCR rule requires that CCR units not be located in seismic impact zones unless the owner or operator demonstrates that all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the

maximum horizontal acceleration in lithified earth material for the site. The federal CCR rule defines a seismic impact zone as "an area having a 2% or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitation pull (g), will exceed 0.10 g in 50 years."

To determine whether the MONPP FAB is located in a seismic impact zone, the USGS Earthquake Hazards Program was consulted to determine the earthquake hazard for the FAB. The Earthquake Hazards Program uses the 2015 NEHRP Provisions as a reference document; the following factors were used to calculate the peak ground acceleration:

- The site class is Class C: firm to very stiff surficial clay soils underlain by very stiff to hard clay beginning at approximately 20 ft bgs. The clay is underlain by weathered and competent limestone bedrock beginning approximately 30 to 50 ft bgs. This determination was made based on the first 100 ft of soil and rock encountered. The first 50 feet are comprised of very stiff to hard clay, and the remainder is limestone bedrock.
- The site falls under the Risk Category III, due to its primary function as a power-generating station.

The 2015 National Earthquake Hazards Reduction Program U.S. seismic design maps website (USGS 2015; Appendix E) indicates a mapped peak ground acceleration of 0.063 g for the FAB area. Using the Class C site determination results in a design peak ground acceleration of 0.082 g. This calculated design peak ground acceleration value is less than 0.10 g in 50 years.

Evidence of a seismic impact zone is not supported by this determination; therefore, TRC concludes that the MONPP FAB is not located in a seismic impact zone. The FAB is in compliance with the requirements of §257.63.

2.5 §257.64 – Unstable Areas

The federal CCR rule requires that CCR units not be located in an unstable area unless the owner or operator demonstrates that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted. Factors associated with soil conditions resulting in significant differential settlement, geologic or geomorphologic features, and human-made features or events must be evaluated to determine compliance.

This demonstration was performed by evaluating the results of geotechnical explorations at the MONPP (Geosyntec Consultants, 2010), the Round 7 Dam Assessment-Final Report (GZA GeoEnvironmental, Inc., 2011), reviewing local geology and topography, and evaluating human-made features or events at the MONPP area.

The geotechnical exploration performed at the MONPP identified silty clay, with traces of sand and gravel. The clay exhibits a very stiff to hard consistency and high shear strengths, with harder and stronger soils noted with depth. The unconsolidated soils occur above weathered and competent limestone bedrock. Based on these geotechnical records, there is no evidence of unstable soil or underlying bedrock conditions proximal to the FAB.

Based on information maintained by the Michigan Natural Features Inventory and Michigan State University Extension, Monroe County topography, due to the presence of underlying limestone bedrock, is subject to the potential but infrequent occurrence of sinkholes and caves. However, no evidence of sinkholes or caves have been discovered or noted at the MONPP property and therefore are not expected to contribute to the development of unstable site soil conditions.

Based on DTE Electric records, the perimeter berm for the FAB was constructed in the 1970s. In 2016, Geosystec Consultants performed a slope stability safety factor assessment for the FAB berms (Geosyntec, 2016). The assessment concluded that the Ash Basin meets the safety factor requirements with the maximum water level maintained at 609 ft MSL or less.

Evidence of unstable areas due to soil conditions resulting in significant differential settling, geologic or geomorphologic features, or human-made features or events is not supported by this determination; therefore, it is TRC's opinion that MONPP FAB is not located in an unstable geological area and that the FAB berm meets safety factor requirements at current FAB operating conditions and berm structural conditions. The FAB, therefore, is in compliance with the requirements of §257.64.

Section 3
Conclusions

Based on the evaluation provided in this demonstration, the MONPP FAB is in compliance with the location restrictions provided in §257.60 through §257.64 of the CCR rule. No additional action, justification, or demonstration is required to document compliance with the location restrictions provided in the CCR rule after this demonstration has been placed into the operating record, posted to the publicly-accessible website, and government notifications provided.

Section 4
References

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Appendix A
Monitoring Well Boring Logs

WELL CONSTRUCTION LOG

WELL NO. MW-16-01

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	2/17/16	2/17/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	578.91	581.74	60.0	6

Boring Location: SW of fly ash basin.	Personnel	Drilling Equipment:
N: 143121.86 E: 13394675.84	Logged By - Jennifer Reed Driller - Austin Goldsmith	TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations:		
Monroe, MI	Monroe	Michigan	While Drilling:	Date/Time	Depth (ft bgs)
			After Drilling:	Date/Time 3/17/16 08:45	Depth (ft bgs) 2.00

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
1 CS	65		0	**SILTY CLAY** mostly clay, some silt, low plasticity, very dark gray (7.5YR 3/1), no odor, moist, medium stiff, high organic content, roots and grass.				
				Change to no roots at 3.5 feet.				
				Change to hard at 5.0 feet.				
				Change to medium stiff at 5.5 feet.				
				Change to trace to few gravel at 6.0 feet.				
2 CS	95		10	Change to medium plasticity, dark gray (10YR 4/1) mottled with yellowish brown (10YR 5/6), at 12.5 feet.				
				Change to dark gray (10YR 4/1), very stiff at 17.5 feet.				
3 ST	60		20					
4 CS	100				CL-ML			
5 CS	100		30	Change to weathered limestone appearance, light gray (10YR 7/1), slight odor, stiff at 32.5 feet.				
6 CS	95		40	Change to not cohesive at 42.5 feet. Change to little silt, few coarse sand at 43.5 feet. Change to some silt, trace coarse sand at 45.0 feet.				
				Grades to wet from 40 to 48 feet. Change to bedrock fragments encountered, wet at 48.0 feet.				
7 CS	100		50	**LIMESTONE** very weathered, light gray (10YR 7/1), moist, medium dense, similar to silt.				
				End of boring at 55.0 feet below ground surface.				

SOIL BORING WELL CONSTRUCTION LOG 231828.0001.GPJ TRC_CORP.GDT 231828.0001.0000 5/16/16

Signature: Jreed

Firm: TRC Environmental Corporation
1540 Eisenhower Place Ann Arbor, Michigan
734-971-7080
Fax 734-971-9022

WELL CONSTRUCTION LOG

WELL NO. MW-16-02

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	2/18/16	2/18/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	579.44	581.81	55.0	6

Boring Location: S of fly ash basin. N: 140938.78 E: 13396986.03	Personnel: Logged By - Jennifer Reed; Driller - Austin Goldsmith	Drilling Equipment: TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations:
Monroe, MI	Monroe	Michigan	While Drilling: Date/Time — Depth (ft bgs); After Drilling: Date/Time 3/17/16 09:30 — Depth (ft bgs) -4.82

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
1 CS	90		0	**SILTY CLAY** mostly clay, some silt, trace to few sand, trace to few gravel, low plasticity, dark brown (10YR 3/3), no odor, moist, hard. Change to dry at 3.25 feet. Change to dark gray (10YR 4/1) at 5.0 feet.				Artesian well conditions present.
2 CS	95		10	Change to moist at 9.5 feet Change to very stiff at 10.5 feet. Change to dark gray (10YR 4/1), mottled with light reddish brown (5YR 6/3) at 12.0 feet.				
3 ST	65		20		CL-ML			
4 CS	100			Change to no mottling at 25.0 feet.				
5 ST	95		30					
6 CS	100							
7 CS	100		40	**SILTY CLAY WITH SAND** mostly clay, some silt, little fine to coarse sand, low plasticity, dark gray (10YR 4/1), no odor, moist, very stiff. Change to light gray (10YR 7/1), slight odor at 42.5 feet.	CL-ML			
8 CS	100		50	**SILTY CLAY** mostly clay, some silt, few gravel, very low plasticity, light gray (10YR 7/1), slight odor, moist, hard. Change to dry, not cohesive at 51.5 feet.	CL-ML			
				LIMESTONE weathered, slight odor, saturated.				
			60	End of boring at 60.0 feet below ground surface.				

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Signature: Jreed

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WELL CONSTRUCTION LOG

WELL NO. MW-16-03

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	2/16/16	2/16/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	577.29	579.95	50.0	6

Boring Location: E of fly ash basin. N: 139040.68 E: 13395136.56	Personnel: Logged By - Chris Scieszka; Driller - Austin Goldsmith	Drilling Equipment: TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations: While Drilling: Date/Time; After Drilling: Date/Time 3/17/16 09:25	Depth (ft bgs); Depth (ft bgs) -13.95
Monroe, MI	Monroe	Michigan		

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
1 CS	70		0	**SILTY CLAY** mostly clay, some silt, low plasticity, very dark brown (10YR 2/2), no odor, moist, medium stiff (2.0 tsf), high organics, roots. Change to no roots, trace fine gravel at 2.5 feet.				Artesian well conditions present.
				Change to wood fragments present at 8.0 feet.				
2 CS	60		10	Change to medium to high plasticity, dark gray (10YR 4/1), mottled with yellowish brown (10YR 5/6) and light reddish brown (5YR 6/3), no organics at 10.0 feet. Change to trace to few fine to coarse sand, trace to few fine gravel low plasticity, yellowish brown (10YR 5/4), at 12.0 feet.				
				Change to dark gray (10YR 4/1), very stiff (3.0 tsf) at 17.0 feet.	CL-ML			
3 ST	100		20					
4 CS	100							
			30	Change to hard (>4.0 tsf) at 30.0 feet.				
5 CS	100							
				SAND mostly fine to coarse sand, trace to few silt, very dark gray (10YR 3/1), no odor, moist, loose.	SP			
			40	**SILTY CLAY** mostly clay, some silt, low plasticity, dark gray (10YR 4/1), no odor, moist, very stiff (3.0 tsf).	CL-ML			
6 CS	100			**LIMESTONE** light gray (10YR 7/1), slight odor, weathered, saturated. Change to very weathered, moist at 41.0 feet. Change to competent, dry.				
			50	End of boring at 50.0 feet below ground surface.				

SOIL BORING WELL CONSTRUCTION LOG 231828.0001.GPJ TRC_CORP.GDT 231828.0001.0000 5/16/16

Signature:

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WELL CONSTRUCTION LOG

TRC

WELL NO. MW-16-04

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	2/15/16	2/15/16	231828.0001.0000

Drilling Firm.	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	582.64	585.54	50.0	6

Boring Location: N of fly ash basin.	Personnel	Drilling Equipment:
N: 140704.67 E: 13390758.97	Logged By - Chris Scieszka Driller - Austin Goldsmith	TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations:		
Monroe, MI	Monroe	Michigan	While Drilling:	Date/Time	Depth (ft bgs)
			After Drilling:	Date/Time 3/17/16 10:15	Depth (ft bgs) -19.40

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
1 CS	20		0	**SILTY CLAY** mostly clay, little to some silt, trace to few fine to coarse sand, trace to few fine to coarse gravel, low plasticity, dark brown (10YR 3/3), no odor, dry, hard (>4.0 tsf).				Artesian well conditions present.
2 CS	100		10	Change to soft (0.5 tsf) at 10.0 feet. Change to very stiff (3 to 4 tsf) at 15.0 feet.				
3 ST	80		20	Change to dark gray (10YR 4/1) at 19.0 feet. Change to very stiff to hard (3 to >4 tsf) at 22.0 feet.	CL-ML			
4 CS	100		30	Change to cobble present at 29.5 feet. Change to hard (>4.0 tsf) at 31.0 feet.				
5 CS	100		40	**SILTY GRAVEL** mostly fine to coarse gravel, little to some silt, few fine to coarse sand, gray (10YR 5/1), no odor, saturated, medium dense to dense.	GM			
6 CS	80			**SILTY SAND** mostly fine to medium sand, little to some silt, gray (10YR 5/1), no odor, moist to saturated, dense to very dense.	SM			
			50	**SILT** mostly silt, trace to few fine sand, no plasticity, dark grayish brown (10YR 4/2), no odor, dry, very dense.	ML			
				LIMESTONE gray (10YR 5/1) to dark gray (10 R 4/1), dry, competent but fractured. End of boring at 50.0 feet below ground surface.				

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WELL CONSTRUCTION LOG

TRC

WELL NO. MW-16-05

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	4/12/16	4/13/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	580.51	583.25	50.0	6

Boring Location: S edge of fly ash basin, along farm field edge. N: 139537.14 E: 13392810.51	Personnel: Logged By - Jennifer Reed; Driller - Austin Goldsmith	Drilling Equipment: TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations: While Drilling: Date/Time; After Drilling: Date/Time 5/5/16 12:47	Depth (ft bgs); Depth (ft bgs) -16.70
Monroe, MI	Monroe	Michigan		

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
1 CS	75		0	**SILTY CLAY** mostly clay, little to some silt, low plasticity, very dark brown (10YR 2/2), no odor, moist, medium stiff, organic material present, roots and grass. Change to few to little fine to coarse sand at 2.5 feet. Change to brown (10YR 5/3), very stiff, no organic material at 5.0 feet. Change to trace to few gravel, gray (10YR 5/1) at 7.5 feet.	CL-ML			Artesian well conditions present.
2 CS	100		10					
3 CS	100		20					
4 CS	100		30	Change to no to trace fine to medium sand, no gravel, dark gray (10YR 4/1), hard at 30 feet.				
5 CS	100		40	**LIMESTONE** weathered, light gray (10YR 7/1), slight odor, moist to dry. Change to competent at 46.5 feet.				
			50	End of boring at 50.0 feet below ground surface.				

SOIL BORING WELL CONSTRUCTION LOG 231828.0001.GPJ TRC_CORP.GDT 231828.0001.0000 5/16/16

Signature:

Firm: TRC Environmental Corporation
1540 Eisenhower Place Ann Arbor, Michigan
734-971-7080
Fax 734-971-9022

WELL CONSTRUCTION LOG

WELL NO. MW-16-06

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	4/13/16	4/13/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	579.20	581.94	50.0	6

Boring Location: NE of fly ash basin, along the river's edge. N: 142566.72 E: 13396398.37	Personnel: Logged By - Jennifer Reed; Driller - Austin Goldsmith	Drilling Equipment: TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations: While Drilling: Date/Time; After Drilling: Date/Time 5/5/16 09:30	Depth (ft bgs); Depth (ft bgs) -3.45
Monroe, MI	Monroe	Michigan		

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
1 CS	98		0	**CLAYEY SILT WITH SAND** mostly silt, few to little fine to coarse sand, few to little clay, black (10YR 2/1), no odor, moist, medium stiff, high organic content, roots and grass. Change to very dark gray (10YR 3/1) at 2.5 feet.	ML-CL			Artesian well conditions present.
				SILTY CLAY mostly clay, some silt, few to little fine to coarse sand, light yellowish brown (10YR 6/4), moist, medium stiff. Change to brown (10YR 5/3), very stiff to hard at 7.0 feet.				
2 CS	100		10	Change to dark gray (10YR 4/1), hard at 11.5 feet. Change to no to trace sand at 15.0 feet.	CL-ML			
3 CS	100		20	**SILTY CLAY WITH SAND** mostly clay, some silt, little fine to coarse sand, dark gray (10YR 4/1), moist, hard.				
4 CS	100		30		CL-ML			
5 CS	100		40					
				GRAVEL AND COBBLES large broken limestone boulders, and cobbles, saturated.	GP			
			50	End of boring at 50.0 feet below ground surface.				

SOIL BORING WELL CONSTRUCTION LOG 231828.0001.GPJ TRC_CORP.GDT 231828.0001.0000 5/19/16

Signature: Reed

Firm: TRC Environmental Corporation
1540 Eisenhower Place Ann Arbor, Michigan
734-971-7080
Fax 734-971-9022

WELL CONSTRUCTION LOG

TRC

WELL NO. MW-16-07

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	4/14/16	4/14/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	575.41	578.40	40.0	6

Boring Location: N of fly ash basin, S of E Dunbar Road, W of main gate.	Personnel	Drilling Equipment:
N: 143408.82 E: 13392311.01	Logged By - Jennifer Reed Driller - Austin Goldsmith	TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations:		
Monroe, MI	Monroe	Michigan	While Drilling:	Date/Time	Depth (ft bgs)
			After Drilling:	Date/Time 5/5/16 10:44	Depth (ft bgs)

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
			0	**TOPSOIL**				Artesian well conditions present.
1 CS	95			**SILTY CLAY** mostly clay, some silt, few to little sand, brown (10YR 5/3) to gray (10YR 5/1), no odor, moist, medium stiff.				
			10	Change to dark gray (10YR 4/1) at 9.5 feet.	CL-ML			
2 CS	100							
			20					
3 CS	100			**SANDY SILT WITH CLAY** mostly silt, little sand, little clay, dark gray (10YR 4/1), moist, medium to very stiff. Change to little to some sand at 25.0 feet.				
			30	Change to gray (GLEY1 5/N), crumbly at 28.5 feet.	ML-CL			
4 CS	100			Change to wet at 35.0 feet.				
				LIMESTONE weathered, light gray (10YR 7/1), slight odor, wet.				
			40	Change to saturated at 39.5 feet.				
				End of boring at 40.0 feet below ground surface.				
			50					

SOIL BORING WELL CONSTRUCTION LOG 231828.0001.GPJ TRC_CORP.GDT 231828.0001.0000 6/6/16

Signature: Austin Smith for J Reed

Firm: TRC Environmental Corporation
1540 Eisenhower Place Ann Arbor, Michigan
734-971-7080
Fax 734-971-9022

Appendix B
Cross Sections

LEGEND

- MONITORING WELLS
- APPROXIMATE BOUNDARY OF FLY ASH BASIN
- CROSS SECTIONS

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.

N

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:

WORKING COPY

CROSS SECTION LOCATOR MAP

DRAWN BY:	J. PAPEZ	PROJ NO.:	265996.0001
CHECKED BY:			
APPROVED BY:			**FIGURE B-1**
DATE:	SEPTEMBER 2017		

TRC
1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
www.trcsolutions.com

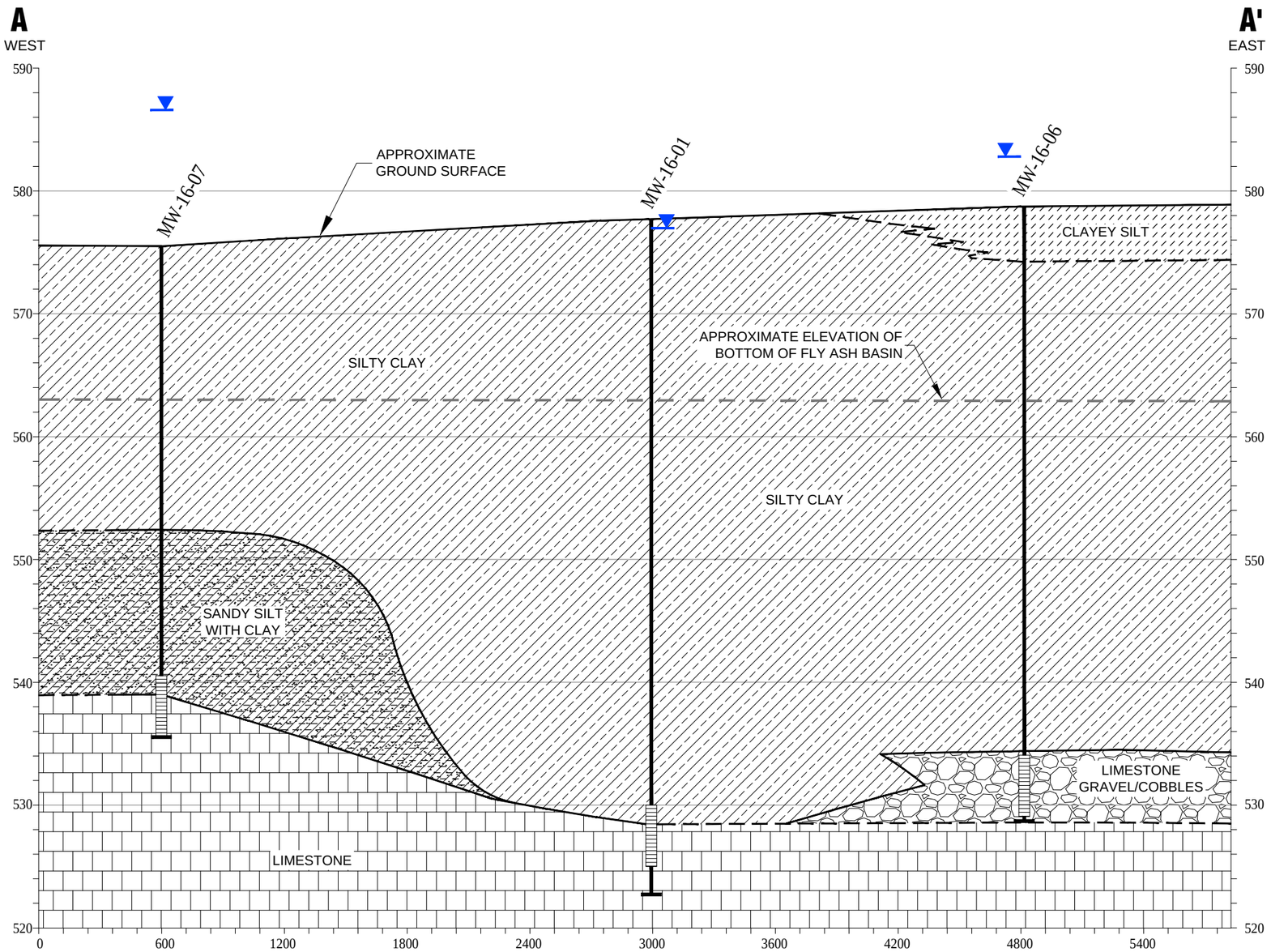
FILE NO.: 265996-0001-008.mxd

Plot Date: 9/6/2017, 13:35:02 PM by JPAPEZ -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-008.mxd

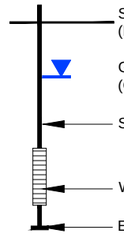
Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

TRC - GIS

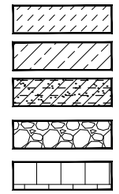
GENERALIZED GEOLOGIC CROSS-SECTION A-A'

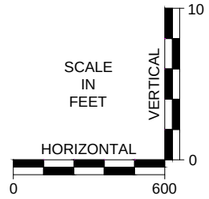


LEGEND



Lithology Key





PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT - FLY ASH BASIN
MONROE, MICHIGAN

TITLE:
GENERALIZED
GEOLOGIC CROSS-SECTION A-A'

DRAWN BY:	D.STEHLE	PROJ NO.:	265996.0001.01
CHECKED BY:	S.HOLMSTROM		
APPROVED BY:	V.BUENING		**FIGURE B-2**
DATE:	SEPTEMBER 2017		

TRC
1540 Eisenhower Place
Ann Arbor, MI 48108
Phone: 734.971.7080
www.trcsolutions.com

FILE NO.: 265996.0001.01.01.04-05.dwg

GENERALIZED GEOLOGIC CROSS-SECTION B-B'

B SOUTH — **B'** NORTH

ACCESS ROAD

APPROXIMATE GROUND SURFACE

FLY ASH BASIN OPEN WATER

OPERATION WATER LEVEL ~609'

DEEPEST ASH ~570.2'

MINIMUM ASH THICKNESS ~7'

BOTTOM OF BASIN ~563'

MW-16-05

MW-16-01

Plum Creek

SILTY CLAY

LIMESTONE

620 610 600 590 580 570 560 550 540 530 520

0 600 1200 1800 2400 3000 3600 4200 4800 5400

LEGEND

- STRATEGRAPHIC BOUNDARY (DASHED WHERE INFERRED)
- GROUNDWATER ELEVATION (COLLECTED 03/06/2017)
- SOIL BORING
- WELL SCREEN INTERVAL
- END OF BORING

Lithology Key

- SILTY CLAY
- LIMESTONE BEDROCK

SCALE IN FEET — VERTICAL 10 0 — HORIZONTAL 0 600

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT - FLY ASH BASIN
MONROE, MICHIGAN

TITLE:
GENERALIZED GEOLOGIC CROSS-SECTION B-B'

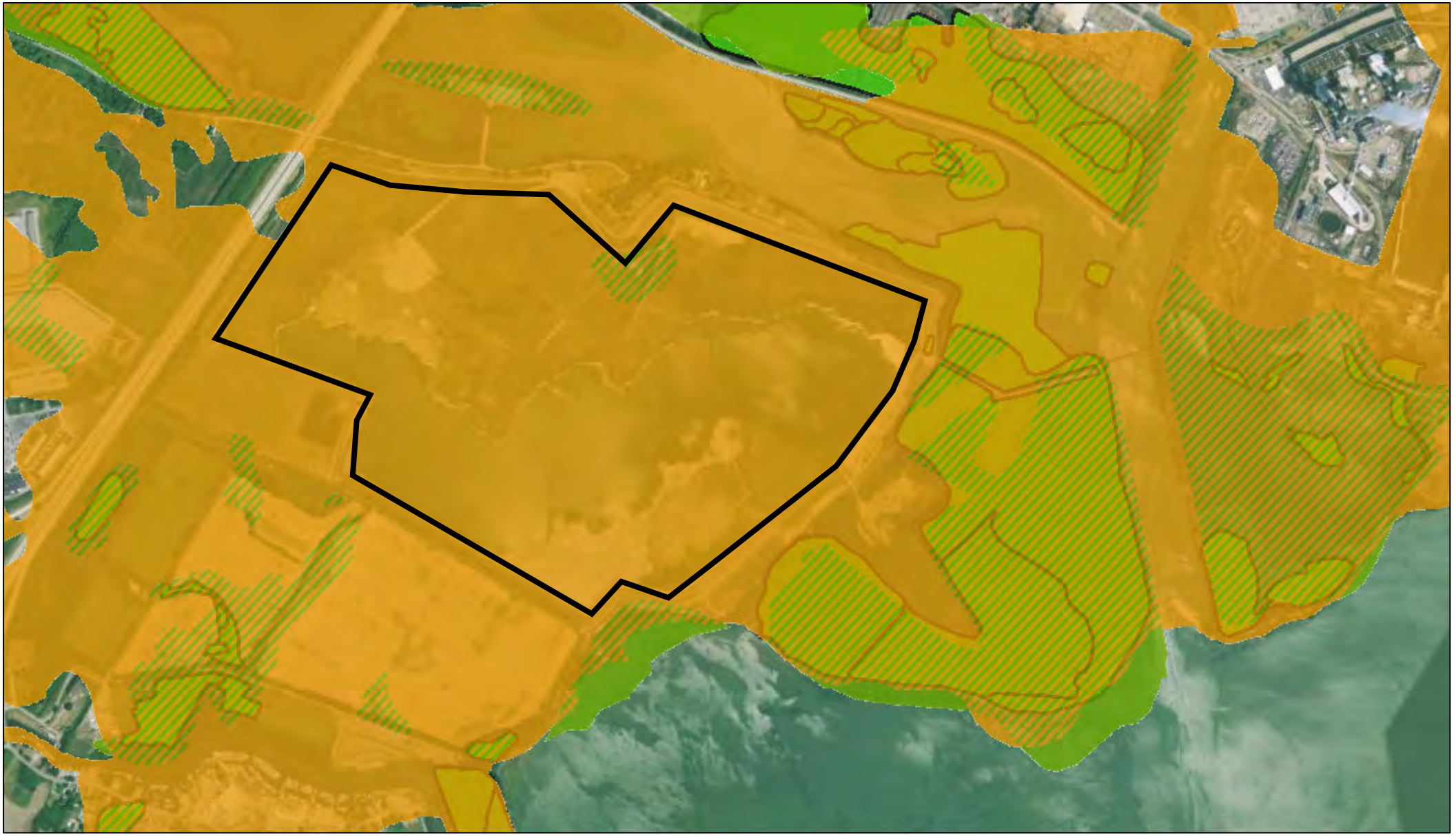
DRAWN BY:	D.Stehle	PROJ NO.:	265996.0001.01.01
CHECKED BY:	S.HOLMSTROM		
APPROVED BY:	V.BUENING		**FIGURE B-3**
DATE:	MAY 2017		

TRC
1540 Eisenhower Place
Ann Arbor, MI 48108
Phone: 734.971.7080
www.trcsolutions.com

FILE NO.: 265996.0001.01.01.04-05.dwg

Appendix C
National Wetland Inventory Map

Wetlands Map Viewer



August 17, 2018

Part 303 Final Wetlands Inventory

- Wetlands as identified on NWI and MIRIS maps
- Soil areas which include wetland soils
- Wetlands as identified on NWI and MIRIS maps and soil areas which include wetland soils
- Gage Stations
- National Wetlands Inventory 2005

1:15,382

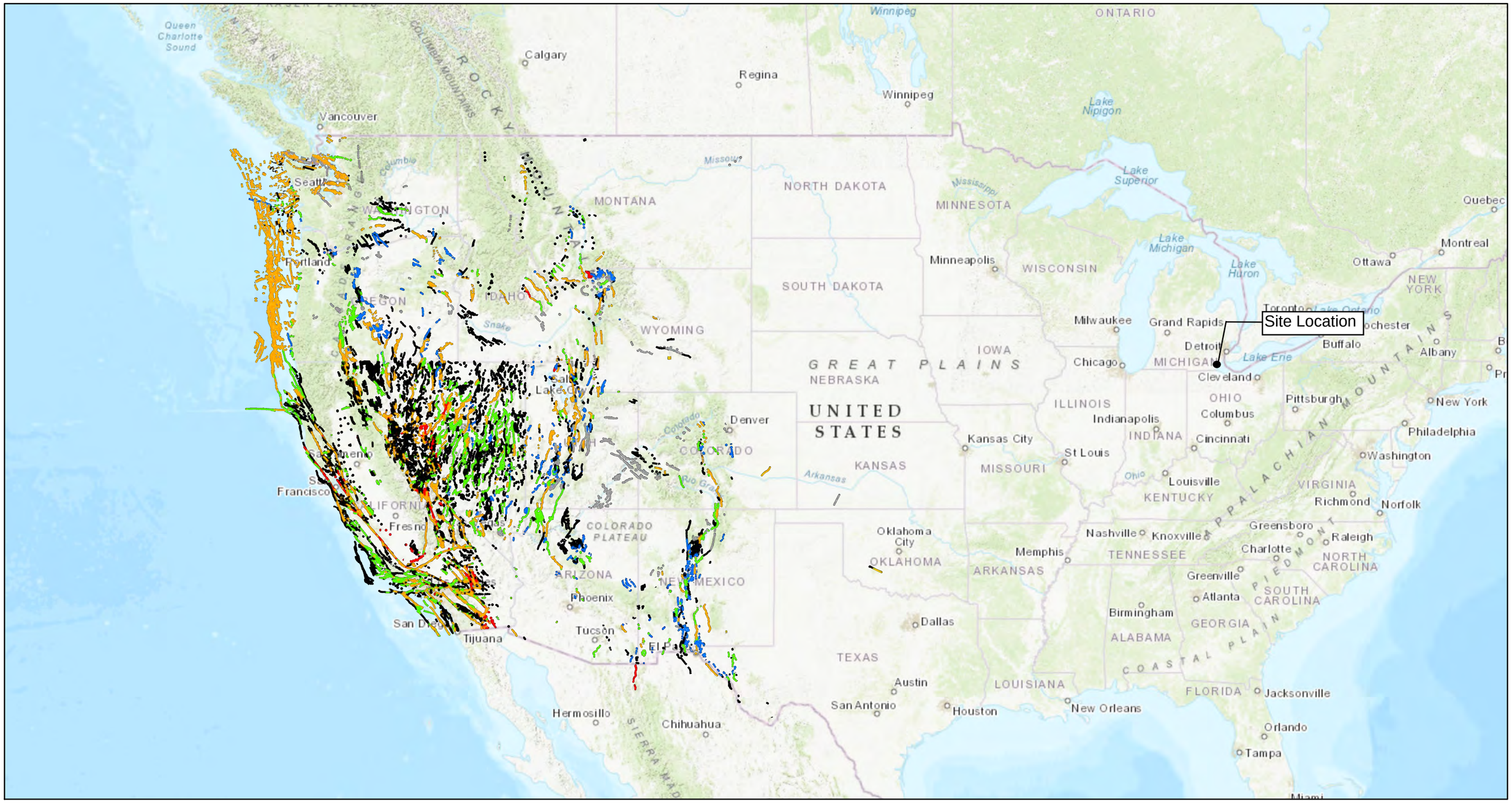
0 0.125 0.25 0.5 mi

0 0.2 0.4 0.8 km

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community

Appendix D
U.S. Quaternary Faults and Folds Map

US Quaternary Faults and Folds



9/7/2018, 3:20:39 PM

1:18,489,298

Quaternary faults

- unspecified age, well constrained location
- unspecified age, moderately constrained location
- unspecified age, inferred location
- undifferentiated Quaternary (< 130,000 years), well constrained location
- undifferentiated Quaternary (< 130,000 years), moderately constrained location
- undifferentiated Quaternary (< 130,000 years), inferred location
- middle and late Quaternary (< 1.6 million years), well constrained location
- middle and late Quaternary (< 1.6 million years), moderately constrained location
- middle and late Quaternary (< 1.6 million years), inferred location
- latest Quaternary (<15,000 years), well constrained location
- latest Quaternary (<15,000 years), moderately constrained location
- latest Quaternary (<15,000 years), inferred location
- late Quaternary (< 130,000 years), well constrained location

0 175 350 700 mi

0 275 550 1,100 km

Web AppBuilder for ArcGIS
USGS | Esri, FAO, NOAA |

Appendix E
U.S. Seismic Design Maps

U.S. Geological Survey - Earthquake Hazards Program

Due to insufficient resources and the recent development of similar web tools by third parties, this spring the USGS will be streamlining the two U.S. Seismic Design Maps web applications, including the one below. Whereas the current applications each interact with users through a graphical user interface (GUI), the new web services will receive the inputs (e.g. latitude and longitude) in the form of a web address and return the outputs (e.g. S_{DS} and S_{D1}) in text form, without supplementary graphics. Though designed primarily to be read by the aforementioned third-party web GUIs, the text outputs are also human-readable. To preview the new web services, please click here. Step-by-step instructions for using one of these web services, namely that for the recently published 2016 ASCE 7 Standard, are posted here.

MONPP FAB – Seismic Impact Zone

Latitude = 41.884°N, Longitude = 83.375°W

Location

Reference Document

2015 NEHRP Provisions

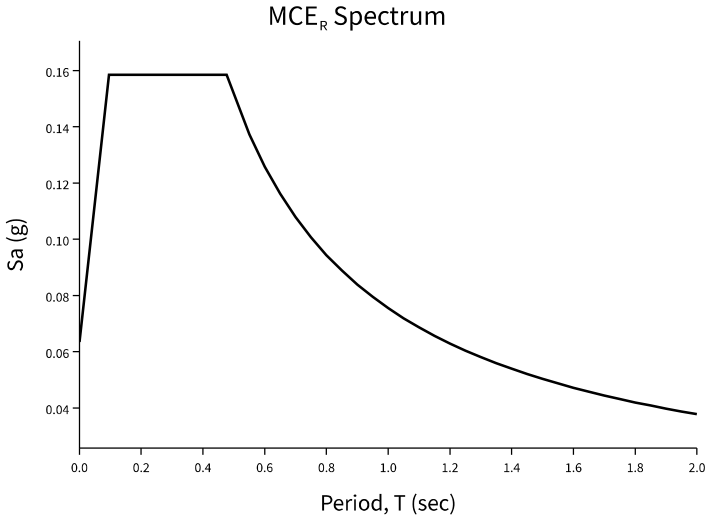
Site Class

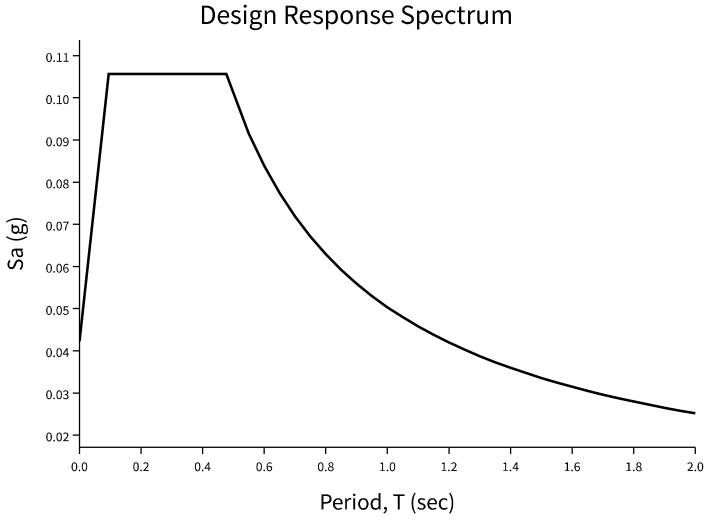
C: Very Dense Soil and Soft Rock

Risk Category

I or II or III

S_S =	0.122 g	S_{MS} =	0.158 g	S_{DS} =	0.106 g
S_1 =	0.050 g	S_{M1} =	0.076 g	S_{D1} =	0.050 g


MCE$_R$ Spectrum
Sa (g)
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Period, T (sec)


Design Response Spectrum
Sa (g)
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Period, T (sec)

Mapped Acceleration Parameters, Long-Period Transition Periods, and Risk Coefficients

Note: The S_S and S_1 ground motion maps provided below are for the direction of maximmum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) 1.3 (to obtain S_1).

- FIGURE 22-1 S_S Risk-Targeted Maximum Considered Earthquake (MCE_R) Ground Motion Parameter for the Conterminous United States for 0.2 s Spectral Response Acceleration (5% of Critical Damping), Site Class B
- FIGURE 22-2 S_1 Risk-Targeted Maximum Considered Earthquake (MCE_R) Ground Motion Parameter for the Conterminous United States for 1.0 s Spectral Response Acceleration (5% of Critical Damping), Site Class B
- FIGURE 22-9 Maximum Considered Earthquake Geometric Mean (MCE_G) PGA, %g, Site Class B for the Conterminous United States
- FIGURE 22-14 Mapped Long-Period Transition Period, T_L (s), for the Conterminous United States
- FIGURE 22-18 Mapped Risk Coefficient at 0.2 s Spectral Response Period, C_{RS}
- FIGURE 22-19 Mapped Risk Coefficient at 1.0 s Spectral Response Period, C_{R1}

Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site class as Site Class , based on the site soil properties in accordance with Chapter 20.

Table 20.3-1 Site Classification

Site Class	$\bar{v}_S$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index PI > 20 • Moisture content w ≥ 40%, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		
For SI: 1ft/s = 0.3048 m/s 1lb/ft^2 = 0.0479 kN/m^2			

Site Coefficients and Risk-Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Risk-targeted Ground Motion (0.2 s)

$C_{RS}S_{SUH} = 0.950 \times 0.128 = 0.122$ g

Deterministic Ground Motion (0.2 s)

$S_{SD} = 1.500$ g

$S_S \equiv$ "Lesser of $C_{RS}S_{SUH}$ and S_{SD}" = 0.122 g

Risk-targeted Ground Motion (1.0 s)

$C_{R1}S_{1UH} = 0.903 \times 0.056 = 0.050$ g

Deterministic Ground Motion (1.0 s)

$S_{1D} = 0.600$ g

$S_1 \equiv$ "Lesser of $C_{R1}S_{1UH}$ and S_{1D}" = 0.050 g

Table 11.4-1: Site Coefficient F_a

Site Class	Spectral Reponse Acceleration Parameter at Short Period					
	$S_S \leq 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S = 1.25$	$S_S \geq 1.50$
A	0.8	0.8	0.8	0.8	0.8	0.8
B (measured)	0.9	0.9	0.9	0.9	0.9	0.9
B (unmeasured)	1.0	1.0	1.0	1.0	1.0	1.0
C	1.3	1.3	1.2	1.2	1.2	1.2
D (determined)	1.6	1.4	1.2	1.1	1.0	1.0
D (default)	1.6	1.4	1.2	1.2	1.2	1.2
E	2.4	1.7	1.3	1.2 *	1.2 *	1.2 *
F	See Section 11.4.7					

* For Site Class E and $S_S \geq 1.0$ g, see the requirements for site-specific ground motions in Section 11.4.7 of the 2015 NEHRP Provisions. Here the exception to those requirements allowing F_a to be taken as equal to that of Site Class C has been invoked.

Note: Use straight-line interpolation for intermediate values of S_S.

Note: Where Site Class B is selected, but site-specific velocity measurements are not made, the value of F_a shall be taken as 1.0 per Section 11.4.2.

Note: Where Site Class D is selected as the default site class per Section 11.4.2, the value of F_a shall not be less than 1.2 per Section 11.4.3.

For Site Class = C and S_S = 0.122 g, F_a = 1.300

Table 11.4-2: Site Coefficient F_v

Site Class	Spectral Response Acceleration Parameter at 1-Second Period					
	$S_1 \leq 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 = 0.50$	$S_1 \geq 0.60$
A	0.8	0.8	0.8	0.8	0.8	0.8
B (measured)	0.8	0.8	0.8	0.8	0.8	0.8
B (unmeasured)	1.0	1.0	1.0	1.0	1.0	1.0
C	1.5	1.5	1.5	1.5	1.5	1.4
D (determined)	2.4	2.2 [1]	2.0 [1]	1.9 [1]	1.8 [1]	1.7 [1]
D (default)	2.4	2.2 [1]	2.0 [1]	1.9 [1]	1.8 [1]	1.7 [1]
E	4.2	3.3 [1]	2.8 [1]	2.4 [1]	2.2 [1]	2.0 [1]
F	See Section 11.4.7					

[1] For Site Class D or E and $S_1 \geq 0.2$ g, site-specific ground motions might be required. See Section 11.4.7 of the 2015 NEHRP Provisions.

Note: Use straight-line interpolation for intermediate values of S_1.

Note: Where Site Class B is selected, but site-specific velocity measurements are not made, the value of F_v shall be taken as 1.0 per Section 11.4.2.

For Site Class = C and S_1 = 0.050 g, F_v = 1.500

Site-adjusted MCE_R (0.2 s)

$$S_{MS} = F_a S_S = 1.300 \times 0.122 = 0.158 \text{ g}$$

Site-adjusted MCE_R (1.0 s)

$$S_{M1} = F_v S_1 = 1.500 \times 0.050 = 0.076 \text{ g}$$

Design Spectral Acceleration Parameters

Design Ground Motion (0.2 s)

$S_{DS} = ⅔\ S_{MS} = ⅔ \times 0.158 = 0.106$ g

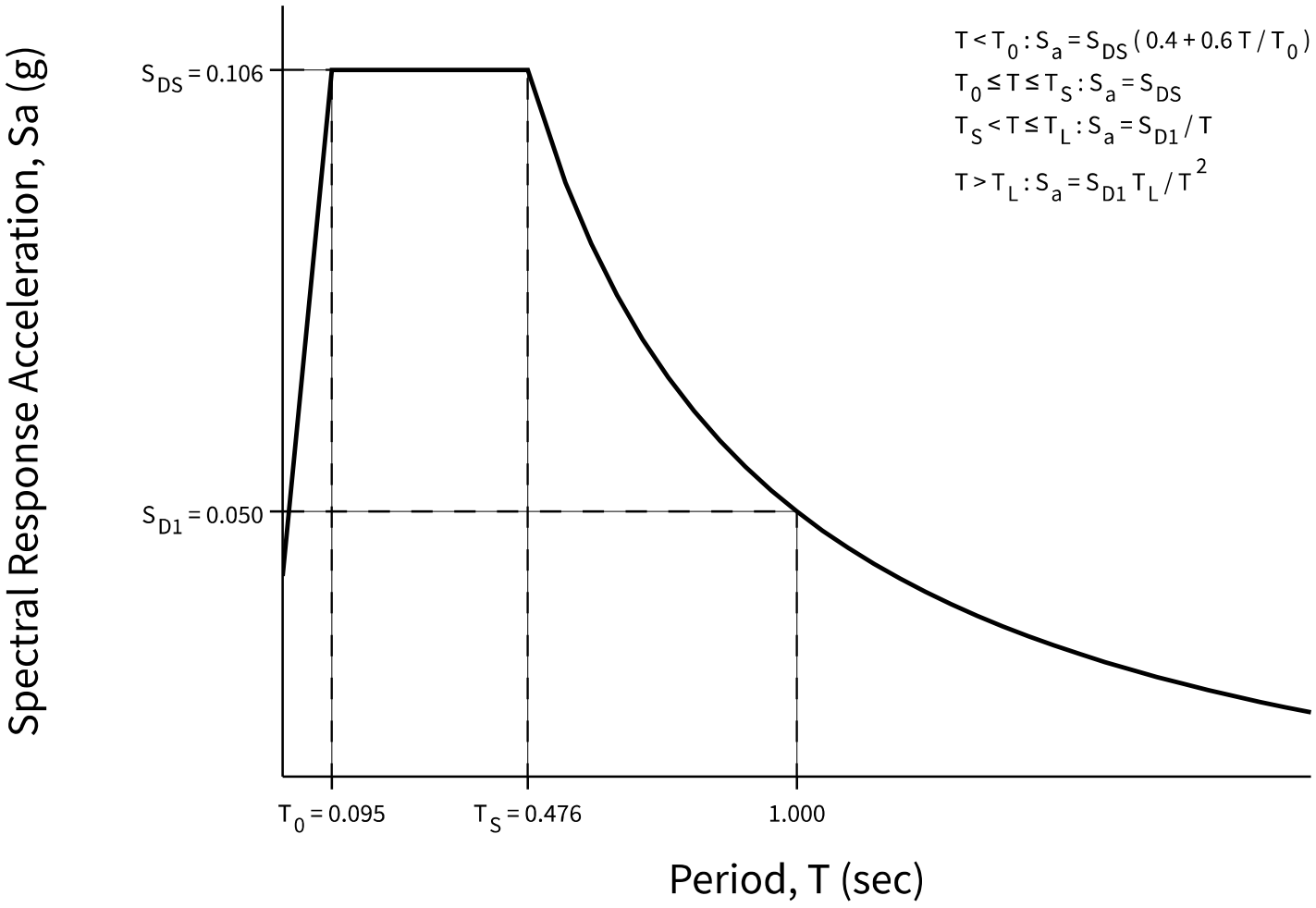
Design Ground Motion (1.0 s)

$S_{D1} = ⅔\ S_{M1} = ⅔ \times 0.076 = 0.050$ g

Design Response Spectrum

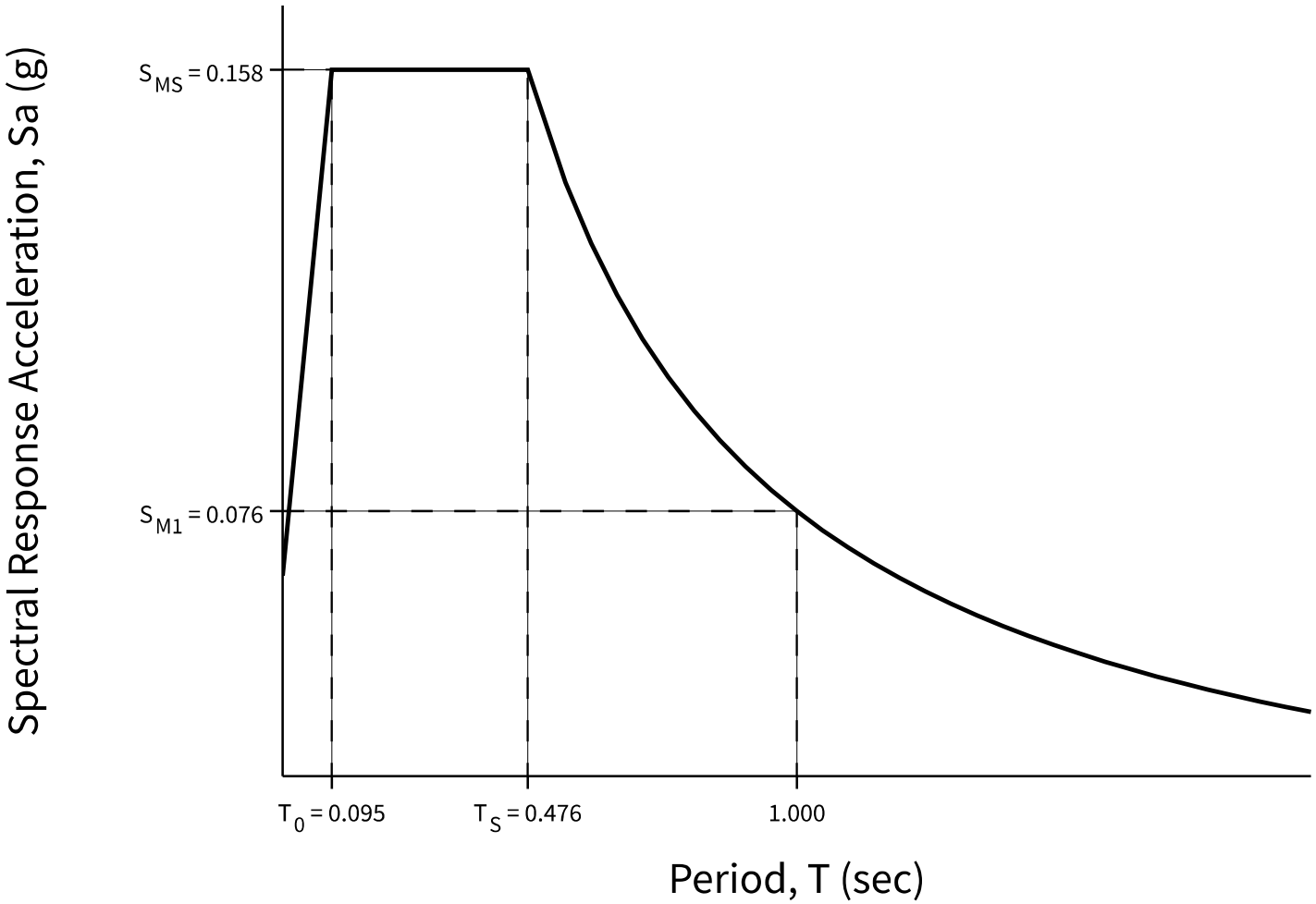
Long-Period Transition Period = T_L = 12 s

Figure 11.4-1: Design Response Spectrum



MCE_R Response Spectrum

The MCE_R response spectrum is determined by multiplying the design response spectrum above by 1.5.



Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

Table 11.8–1: Site Coefficient for F_{PGA}

Site Class	Mapped MCE Geometric Mean (MCE_G) Peak Ground Acceleration					
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA = 0.50	PGA ≥ 0.60
A	0.8	0.8	0.8	0.8	0.8	0.8
B (measured)	0.9	0.9	0.9	0.9	0.9	0.9
B (unmeasured)	1.0	1.0	1.0	1.0	1.0	1.0
C	1.3	1.2	1.2	1.2	1.2	1.2
D (determined)	1.6	1.4	1.3	1.2	1.1	1.1
D (default)	1.6	1.4	1.3	1.2	1.2	1.2
E	2.4	1.9	1.6	1.4	1.2	1.1
F	See Section 11.4.7					

Note: Use straight-line interpolation for intermediate values of PGA

Note: Where Site Class D is selected as the default site class per Section 11.4.2, the value of F_{pga} shall not be less than 1.2.

For Site Class = C and PGA = 0.063 g, F_{PGA} = 1.300

Mapped MCE_G

PGA = 0.063 g

Site-adjusted MCE_G

$PGA_M = F_{PGA}PGA = 1.300 \times 0.063 = 0.082$ g