

**HOWELL TOWNSHIP PLANNING COMMISSION
SUBCOMMITTEE MEETING**

3525 Byron Road
Howell, MI 48855
May 12, 2026
5:30 pm

1. Call to Order
2. Roll Call: () Wayne Williams - Chair
 () Tim Boal
 () Matt Stanley
3. Approval of the Agenda:
4. Call to the Public:
5. Draft Data Center Ordinance
 - A. Resident Research Committee – Report Overview
 - B. Planner’s Draft Ordinance
 - C. Subcommittee Discussion
6. Adjournment

**Re-organized CW Draft (with RRC Edits and Additional Sections)
for Howell Township
High Impact Land Use Overlay District Ordinance**

Definitions:

***1/3 Octave Band Analysis:** A frequency spectrum analysis where the unweighted sound levels of all frequencies in a sound sample are split into sections (octave bands) where the upper limit is twice the frequency of the lower limit, and each octave band is further split into three equal sections providing a more detailed analysis of the intensity and frequency composition of a sound.*

***Air Chiller:** a cooling and heat rejection system which utilizes fans to move ambient air over condenser coils to cool the water or refrigerant in a Closed Loop Cooling System.*

Battery Energy Storage Systems (BESS): A storage system that collects energy from renewable and non-renewable sources in rechargeable batteries for later use.

Closed Loop Cooling System: *Any* cooling system that constantly reuses and recycles an initial load of *process fluid* (water or chemical substance) within its operating components for cooling purposes, *which is not directly exposed to the air or other cooling system components during heat rejection; this process fluid still requires periodic discharge and refill.* ~~*Can sometimes still utilize evaporative cooling for the heat exchange process.*~~

***Cooling Tower:** an industrial-scale heat exchanger that removes heat from the cooling process fluid.*

***Open-Circuit Cooling Tower/Open Loop Cooling System:** a heat rejection system where the warm process water is sprayed directly onto fill media, where it is then exposed to airflow to utilize evaporative cooling; these systems require frequent discharge and refill, consuming large amounts of water, due to the contamination of the process water during the heat-rejection phase.*

***Closed-Circuit Cooling Tower:** utilized in some Closed-Loop Cooling Systems; basin water is sprayed over the closed-loop coils to utilize evaporative cooling. Basin water requires periodic discharge and refill.*

***Mechanical Draft:** Open or Closed Circuit Cooling Towers may use Mechanical Draft, which uses fans to move air through the water to enhance the cooling process by accelerating evaporation and therefore heat transfer.*

***Computer Room Air Conditioners (CRAC):** A type of **Room-Level** HVAC system utilized in computer server rooms/data centers to remove high-density heat generated by IT equipment; CRACs pull hot air from the entire room, and return cool air to the entire room, rather than cooling the IT equipment directly; utilizing refrigerant-based cooling. Commonly*

referred to as **Computer Room Air Handlers** when circulating chilled water instead of refrigerant.

Cryptocurrency Mining Facility: A facility of any size that is dedicated to operating data processing equipment for cryptocurrency mining and the process by which cryptocurrency transactions are verified and added to digital ledgers. This includes data mining facilities.

Data Processing. The collection and manipulation of digital data to analyze and produce meaningful information.

Data Center: A physical facility housing the people, hardware and software organized to provide information processing services. This includes data processing facilities, server farms and artificial intelligence / "AI" data centers. *Data centers are further defined by the following:*

Ancillary Data Center: See definition of a Data Center, also Ancillary Data Centers are data centers that are ancillary to another primary use and a) occupy no more than ten percent of the primary building's footprint, b) are used to serve the enterprise functions of the on-site business and are not used to lease data storage and processing services to third parties, and c) are not housed in a separate, stand-alone structure on the parcel.

Minor Data Center: See definition of a Data Center, also Minor Data Centers shall be under 10,000 total square feet for all buildings and structures on the site. If a minor data center requires an electrical substation and/or water treatment plant, it shall be classified as a Medium Data Center.

Medium Data Center: See definition of a Data Center, also Medium Data Centers shall be between 10,000 square feet and 99,999 total square feet for all buildings and structures on the site.

Major Data Center: See definition of a Data Center, also Major Data Centers shall be between 100,000 square feet and 499,999 total square feet for all buildings and structures on the site.

Data Center Campus: See definition of a Data Center, also a Data Center Campus shall consist of more than one Data Center building but not to exceed 750,000 total square feet for all buildings and structures on the site.

Decibel, dB: A decibel (dB) is a common measure of sound intensity that is one-tenth of a bel (B) on the logarithmic intensity scale.

Decibel-dBA: Decibels measured in dBA are weighted to the frequencies in the middle of the range of human hearing, as a representation of the perceived overall loudness.

Decibel-dBC: Decibels measured in dBC are weighted to the low-frequency, sounds which travel and penetrate farther than treble sound, often a component of tonal noise.

Decibel-dBZ: Decibels measured in dBZ are unweighted, to measure without frequency-based adjustments, for situations requiring a precise measurement of the sound's total energy and frequency content.

Direct Liquid Server Cooling: Server cooling technologies in which liquid coolant directly removes heat from electronic components through immersion or cold-plate contact, rather than through room air circulation.

Direct-to-Chip Cooling: A method of liquid cooling that utilizes coolant to dissipate heat directly from computer processing chips and greatly reduces electrical power and water consumption.

Dry Cooler: a heat rejection system which utilizes fans to move ambient air over a cooling coil; commonly used in closed-loop cooling systems.

Equipment Cooling: Cooling for equipment, including but not limited to machinery, computer component cooling, processor cooling, server cooling, rack cooling, generator cooling, electrical component cooling.

Facility Cooling: Cooling for the facility/structure itself, not for equipment, machinery or components located therein and/or on the property. This includes HVAC cooling.

Generator: A machine that converts one form of energy into another.

High Load Impact Land Use: A term that refers to a) an industry or business with higher than average consumption/use of resources, typically of electricity and/or water, and/or b) an industry or business with operations that are highly impactful from the standpoint of noise, vibration, type of power used such as battery storage systems, nuclear, etc., utilization of private power substations or switch stations, onsite fuel storage and potential negative impacts on health, water, and air quality. This includes data centers, data processing facilities, server farms, "AI" artificial intelligence, cryptocurrency mining facilities, and digital currency mining.

Hydrogen Fuel Cell: An electrochemical device that combines hydrogen and oxygen to produce electricity.

Infrasound: A low frequency sound below a frequency of 20Hz that is typically sub-audible to humans and often perceived as vibrations.

Liquid Immersion Cooling: A method of liquid cooling that utilizes submerging equipment in fluid, including an option for plant based biodegradable non-flammable immersion fluid, that does not utilize water and greatly reduces electrical power consumption.

Megawatt: A unit of power output equal to 1,000,000 watts or 1,000 kilowatts, used to measure power consumption.

Octave Band: A method of splitting the frequency spectrum into sections where the upper

limit is twice the frequency of the lower limit, identified by the center frequency.

Power Usage Effectiveness (PUE): a ratio that describes how a data center uses energy; specifically, how much is used by the IT equipment compared to total power consumption. Calculated by dividing total facility energy by IT equipment energy.

Renewable “Green” Hydrogen: Renewable or “Green” Hydrogen is used for Hydrogen Fuel Cells and is sourced from water, using sustainable electricity sources such as solar or wind.

Electrical Substation: An electric system facility that converts higher voltages to lower voltages within or separate from a **high impact land use** to generate sufficient power at maximum efficiency; can operate independently for dedicated sites once directly connected to the transmission line.

Sensitive Receptors: Schools, preschools, daycares, health facilities such as hospitals, long-term care facilities, retirement and nursing homes, community centers, places of worship, playgrounds, parks, campgrounds, **prisons**, dormitories, and any ~~residence where such residence is not located on a parcel with an existing industrial, commercial, or unpermitted use as determined by the zoning officer.~~ parcels zoned agricultural residential, single-family residential and multi-family residential.

~~**Sound Pressure Level (SPL):** Sound pressure levels stated in dB units referenced to twenty (20) micro pascals, with a C frequency weighting and a ten (10) mS response with peak detection per ANSI S1.4-2014.~~

Standalone Modular Data Center / Cryptocurrency Mining Facility: Pre-engineered, prefabricated, temporary and standardized buildings, including shipping containers, designed to house computer servers and network equipment.

Subject Parcel: The parcel(s) proposed for the location of the high impact land use.

Tonal Noise: A noise characterized by a distinct, recognizable frequency, which stands out significantly against the background broadband noise, considered a nuisance due to the human auditory system’s sensitivity to pure tones, especially when they are continuous.

Total Power-Usage Effectiveness (TUE): A metric similar to PUE but which includes IT power such as server fans and internal power distribution losses with infrastructure overhead, to provide a better metric of energy efficiency across the entire data center development. Calculated by dividing the total facility power usage by the compute power usage.

Water Usage Effectiveness (WUE): a metric that measures how efficiently data centers use water by comparing the total water used to the power used by its IT equipment. Calculated by dividing annual water usage (liters) by IT equipment energy usage (kilowatts).

Amending Articles ~~4-13~~ 5 and 8-13 to allow data centers as Permitted **Principal Accessory Uses or Permitted **Principal Special** Uses with Conditions:**

Ancillary data centers will be allowed as Permitted Accessory Uses in the following districts:

- Article 5– RT Research & Technology– Section 5.04
- Article 8– OS Office Service District– Section 8.04
- Article 9– NSC Neighborhood Service Commercial District– Section 9.04
- Article 10– RSC Regional Service Commercial District– Section 10.04
- Article 11– HSC Highway Service Commercial District– Section 11.04
- Article 12– IF Industrial Flex Zone– Section 12.04
- Article 13– I Industrial District– Section 13.04

Minor data centers will be allowed as Permitted Principal Special Uses with Conditions, subjected to the standards of Section ~~14.48~~ 16.23, in the following districts:

- ~~Article 12 – IF Industrial Flex Zone – Section 12.03~~
- Article 13 – I Industrial District – Section 13.03

Medium data centers will be allowed as Permitted Principal Special Uses with Conditions, subjected to the standards of Section ~~14.48~~ 16.23, in the following district:

- Article 13 – I Industrial District – Section 13.03

Major data centers will be allowed as Permitted Principal Special Uses with Conditions, subjected to the standards of Section ~~14.48~~ 16.23, in the following district:

- Article 13 – I Industrial District – Section 13.03

Campus style data centers will be allowed as Permitted Principal Special Uses with Conditions, subjected to the standards of Section ~~14.48~~ 16.23, in the following district:

- Article 13 – I Industrial District – Section 13.03

Adding New Section ~~14.48: 16.23~~ **Data-Centers** High Impact Land Uses:

A. Purpose and Intent

The purpose of this ordinance is to establish a clear and thoughtful regulatory framework that addresses the unique characteristics of high impact land uses for the suitable zoning, siting, design, construction, operation, compliance and decommissioning of high impact land uses including but not limited to data centers and cryptocurrency mining facilities. These regulations are intended to guide the placement and design of high impact land uses **data-centers** to balance stable local economic growth with the protection of community health, safety, welfare, interests, **and** natural resources, and the area's rural character. The intent of this ordinance is to permit only uses having performance characteristics which emit a minimum of noise, vibration, smoke dust, dirt, glare, toxic materials, offensive odors, gases, electromagnetic radiation or any other physically adverse effect to the extent that they are abnormally discernible or potentially harmful beyond the lot lines of the parcel or site upon which the use activity is located. This is achieved by:

1. Directing **data-centers** high impact land uses to areas where industrial uses are currently permitted and that would have ~~with appropriate infrastructure and~~ minimal impact on residents and surrounding properties ~~through an~~ with the use of a clearly designated high impact land use overlay district located over the existing designated Industrial zone.
2. Minimizing, ~~adverse effects~~ avoiding, and mitigating impacts such as noise, vibration, light/glare, air pollution and emissions, and water pollution through requiring the use of minimally-impactful machinery, equipment, and systems. ~~on residents and adjacent uses, including managing noise from mechanical equipment and generators.~~
3. Ensuring the efficient consumption and use of public utilities, such as water and electricity, by prioritizing renewable energy and conservation cooling systems and facility designs that enable facilities to meet strict usage effectiveness metrics.
4. Promoting context-appropriate ~~a high standard of~~ architectural design and effective visual screening to ensure a visually cohesive design and compatibility with the surrounding ~~context~~ land uses and the desired rural character of the area.
5. Establishing clear expectations and a predictable review process for developers to encourage efficient and well ~~designed development~~ planned designs, while retaining local control over development.
- ~~6. Establish reasonable standards for the siting, design, and operation of data centers.~~
6. Ensuring compatibility with adjacent land uses and the Township's Master Plan.
7. Ensuring compliance with responsible regulations for construction, operation, compliance, decommissioning and site restoration.

B. Applicability

~~This section of the ordinance shall apply to all data centers within the township. In addition to the site plan requirements in Article XX of this ordinance, Applicants must submit materials at the time of submission of a Site Plan that includes any information necessary to evaluate demonstrate conformance with all requirements in this ordinance section. Conditional and Site Plan Approval is contingent upon the applicant demonstrating conformance to the requirements of this ordinance section and all other applicable standards of the Zoning Ordinance.~~

- 1. This section applies to high impact land uses including all types of data centers Ancillary, Minor, Medium, Major, and Data Center Campuses, and cryptocurrency mining facilities.
- 2. A complete Special Use Permit application, and Site Plan application, with any applicable fees are required per Section 16.03* and 16.23*.
- 3. Approval is contingent upon the applicant demonstrating conformance to the requirements of this ordinance and any other provisions of the Zoning Ordinance and all other applicable Township Ordinances.
- 4. Where silent within this provision, other applicable provisions apply (e.g., lighting, landscaping, stormwater, and performance standards).

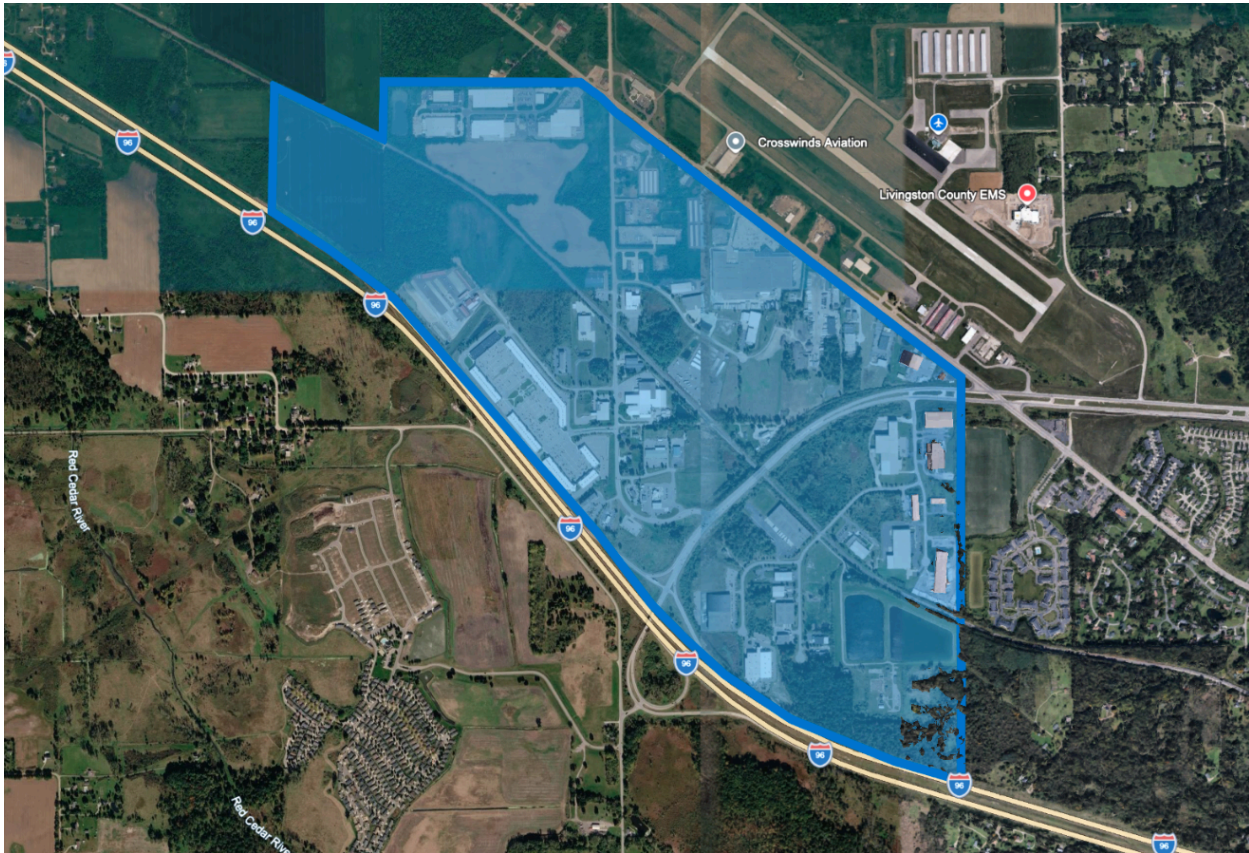
*Please note: Anywhere Section 14.48 is referenced should be corrected to Section 16.23 in order to reflect the intent and planning commission’s desire for HILU & data centers to be considered as special uses, as also seen in Article 16.

C. Districts Permitted

The ~~I-96 Data Center~~ High Impact Land Use Overlay District is hereby established to guide the orderly development of high impact land uses including data centers and cryptocurrency mining facilities of all scales in a location specifically suited for such uses. ~~The Overlay District applies to properties generally located along the I-96 corridor. This area is along the I-96 corridor and in proximity to utility infrastructure, water, and is separated from the established residential neighborhoods, making it appropriate for high-intensity, employment-generating technological uses.~~ High impact land uses including Data centers and cryptocurrency mining facilities may only be allowed with a permitted principal special use permit located in Industrial Zoning districts where permitted if located within the defined High Impact Land Use overlay district. Image W below indicates the High Impact Land Use Overlay District; it is indicated in blue on the image*.

*Alternative Option: Word this Districts Permitted section like the Districts Permitted section of Green Oak Township's High Resource Demand Facility Overlay District Ordinance and say “High impact land uses are allowed by special use permit in the high impact land use overlay district only”, and add “as referenced in Image W below” or reference a map showing the same area indicated in the below image W.

Image W - High Impact Land Use Overlay District, Defined in Blue



D. Use Dimensional Standards and Siting Requirements

1. Dimensional Standards and Siting Requirements for Data Centers and Cryptocurrency Mining Facilities:

Table X below outlines the dimensional regulations and Zoning siting Requirements for data centers and cryptocurrency mining facilities within the High Impact Land Use Overlay District. Where the regulations in Table X are different from the requirements in Section 3.17 the more stringent requirements shall apply.

Table X - Data Center and Cryptocurrency Mining Facility Dimensional Regulations and Siting Requirements for within the High Impact Overlay District

Data Center Facility Type	Allowable Facility Size Ranges in Square Feet	Required Distance in Feet from Residential and Sensitive Receptor Parcels	Distance from other Data Centers Total Allowable Number of Facilities by Type within the Township
Ancillary Data Center	Not to exceed 10% of the associated Principal Use's building footprint	-	-
Cryptocurrency Mining	Not to Exceed 5,000	Greater than 900 feet **	2
Minor Data Center	Not to Exceed 10,000	Greater than 900 feet **	2
Medium Data Center	Within 10,000 – 99,999	>1,500 ft* Greater than 900 feet **	1
Major Data Center	Within 100,000 – 499,999	>2,000 ft* Greater than 1,200 feet **	1
Data Center Campus	Not to Exceed 750,000	>2,640 ft (0.5 miles)* Greater than 1,400 feet **	1

**And if less than ten (10) residentially zoned and/or sensitive receptor parcels are located within the distances outlined above.

2. Siting Requirements

Cryptocurrency Mining Facility: *Shall require a Special Use Permit in the High Impact Land Use overlay area only and shall not abut sensitive receptor parcels, nor shall the property lines for the subject parcel be located within nine hundred (900) feet of any sensitive receptor parcel property lines. No more than two (2) Cryptocurrency Mining Facilities shall be permitted in the township.*

Minor Data Center: *Shall require a Special Use Permit in the High Impact Land Use overlay area only and shall not abut sensitive receptor parcels, nor shall the property lines for the subject parcel be located within nine hundred (900) feet of any sensitive receptor parcel property lines. If a Minor Data Center requires a substation and/or water treatment plant, it shall be classified as a Medium Data Center and subject to those applicable siting standards. No more than two (2) Minor Data Centers shall be permitted in the township.*

Medium Data Center: Shall require a Special Use Permit in the High Impact Land Use overlay and shall not abut sensitive receptor parcels nor shall the property lines for the subject parcel be located within nine hundred (900) feet of any sensitive receptor parcel property lines. No more than two (2) Minor Data Centers shall be permitted in the township. No more than one (1) Medium Data Center shall be permitted in the township.

Major Data Center: Shall require a Special Use Permit in the High Impact Land Use overlay and shall not abut sensitive receptor parcels nor shall the property lines for the subject parcel be located within one thousand two hundred (1,200) feet of any sensitive receptor parcel property lines. No more than one (1) Major Data Center shall be permitted in the township.

Data Center Campus: Shall require a Special Use Permit in the High Impact Land Use overlay and shall not abut sensitive receptor parcels nor shall the property lines for the subject parcel be located within one thousand four hundred (1,400) feet of any sensitive receptor parcel property lines. No more than one (1) Data Center Campus shall be permitted in the township.

E. Application Requirements

1. A Special Use Permit for a High Impact Land Use may only be allowed if the applicant submits clear and convincing evidence that: 1) Such a use will not create any negative secondary effects, such as but not limited to: harm to private wells or the aquifers/groundwater they draw from: tonal, low frequency, and/or infrasound noise impacting residential landowners' right to be free from a private nuisance (interference with the use and enjoyment of their property); and any decline in neighboring real property values, including in the long-term; 2) If the use is a data center or cryptocurrency mining facilities, that there exists, in fact, a proportional demand for services within the Township not met by those services provided by the existing data centers in Southern Michigan. "Long-term" refers to any decline in real property value after the construction period, which may result in a temporary, short-term increase in housing demand.
2. A non-refundable application fee no less than twenty-five thousand dollars (\$25,000) shall be remitted with any application for a high load land use.
3. An escrow account with an initial fifty thousand dollar (\$50,000) deposit shall be set up for the township to use at its discretion to cover any costs related to the consideration, investigation or implementation of a new high impact land use development within the township and shall remain funded until the time in which the proposed development is denied, or upon approval, until the time in which the facility has been fully decommissioned to the satisfaction of the township. The minimum balance for the escrow account shall be twenty-five thousand dollars (\$25,000).
4. Applicants, owners and or operators are not permitted to request non-disclosure agreements or similar confidentiality agreements of any kind from township officials or adjacent/nearby parcel owners.
5. Notification process: Applicants shall notify all property owners within one thousand five hundred (1,500) feet of the subject parcel(s) within fifteen (15) days of submitting any application for a high impact land use.
6. Public involvement: The applicant shall host no fewer than two (2) public meetings for the purpose of sharing information and gathering public input on the proposed project prior to any public hearings to approve rezoning applications or special use permit

- applications being scheduled, with notice being provided at least fifteen (15) days in advance to all property owner and occupants within one thousand five hundred (1,500) feet of the subject parcel property line, and any information having been previously provided, or to be provided at the meeting, shall be made available to the public a minimum of seven (7) days prior to each public meeting.
7. All high impact land use proposed developments are required to provide full disclosure of all involved parties, including but not limited to: developers, owners, operators, subsidiaries, parent companies and any affiliate companies, with the owning parent company being a required legally bound signatory for all applications, documents, agreements, and contracts.
 8. Signed acknowledgement from end-user parent company that the facility will not be considered for Industrial Facility Tax Exemption unless they meet the township's criteria.
 9. Applicant shall provide the following impact studies to accompany any application:
 - a. Economic impact analysis report, per each phase completion and upon full commissioning, to be conducted by an independent 3rd party accredited professional consultant chosen by the township.
 - b. Environmental impact studies, to be conducted by independent 3rd party accredited professional consultants chosen by the township.
 - c. Projected power use.
 - d. Projected water use.
 - e. Projected natural gas use.
 - f. Plans for any onsite power generation.
 - g. Projected PUE, TUE and WUE with supporting documentation.
 - h. Serviceability statements fully disclosing whether any utility needed has current capacity to service the needs of the facility at time of full commissioning, and if not: a plan for what is needed with a signed infrastructure development agreement verifying all costs for needed upgrades will be the owning parent company's responsibility.
 - i. Serviceability statements from local emergency providers, fire, EMS and police fully disclosing their ability to provide services for all phases of construction and upon full commissioning, and if not: a plan for what is needed with a signed development agreement verifying that all costs for needed upgrades, staffing, training and equipment will be the owning parent company's responsibility.
 - j. Projected noise levels (dBA, dBC and dBZ), vibration levels, noise mitigation features/plan and noise monitoring plans for the facility based on being fully operational and for the construction period.
 - k. Emergency and disaster plan for all phases, including construction.
 - l. Decommissioning and site restoration plan.
 - m. Traffic study for all phases, including construction.
 - n. Public facility, utility, and service impact assessment conducted by a licensed professional engineer chosen by the township.
 - o. Market feasibility analysis conducted by a licensed market analyst chosen by the township.
 - p. Projected job creation report including number of long term on site jobs, long term remote jobs and any guaranteed in state construction jobs.
 10. Preliminary architectural plans for all phases of development to include the following:
 - a. All plans/drawings shall be to scale with measurements and include directional indication.
 - b. Overall site drawing with all structures and surfaces indicated, including any retention/detention ponds, set backs and entrances/exits.

- c. All exterior building elevations for each structure.
 - d. Mechanical plans for the overall site.
 - e. Rooftop mechanical and electrical plans.
 - f. Electrical plan for the overall site including underground lines.
11. Preliminary civil engineering site grading and drainage plan, with approval from the county drain commission that any requirements are being met and all options to minimize run off for the site are being utilized.
 12. Preliminary project timeline with estimated durations for each stage of work, including site prep, and detailed schedule for any pile driving.
 13. Equipment cooling system specifications.
 14. List of regulated substances, including any cooling solutions.
 15. Site lighting plan, including lighting plan for during the construction phase.

E-F Site, Design and Use Standards

1. Screening and Landscaping Requirements

- a. All ground level ~~mechanical~~ equipment (including HVAC, generators, transformers, and cooling ~~towers~~ equipment) shall be fully screened by masonry walls, architectural panels, or landscaped berms that contain staggered rows of evergreen landscaping material so that said screening shall achieve 100% opacity and exceed the vertical height of the equipment being screened by at least six (6) inches within two (2) years of planting.
- b. All rooftop mechanical equipment shall be fully screened behind parapet walls, and parapet walls shall not exceed the maximum building height restriction of 50 feet.
- ~~b.~~ c. A minimum 25 foot greenbelt shall be provided along all property lines.
- d. Landscaping shall incorporate the following:
 - i. Berms subject to Article 28.03.A
 - ii. Plantings subject to article 28.03.A of the zoning ordinance.

2. Noise/Sound and Vibration Requirements

- a. Unlike standard dB(A) measurements, which primarily detect mid-range sounds like speech and traffic, dB(C) measurements capture deeper, low-frequency noises such as infrasound from heavy machinery. These sounds can travel farther and penetrate walls, making them more disruptive in residential areas even when the source of the noise is in a non-residential district. Adding dB(C) limits ensures that noise enforcement addresses all types of sound, improving fairness and effectiveness in line with the intent of this ordinance. Because research on the harms of low frequency and infrasound references unweighted decibels, including dB(Z) limits ensures that noise enforcement aligns with the intent of the ordinance and protects the community from potential health impacts in addition to nuisance.

~~a. b.~~ Sound levels shall not exceed 55 dBA, 55dBC and 70dBZ at the any high impact land use parcel property line. and the C-weighted and Z-weighted sound level wavelength level readings shall not exceed the A-weighted sound level by more than 15 decibels at the same location the pre-high impact land use construction wavelength level readings. Backup Generators and cooling equipment shall not exceed 65 dBA, 55dBC and 70dBZ at the high impact land use parcel property line. except during emergency operation. All octave bands and frequencies 200 hertz (Hz) and below shall not exceed 60dBZ at any time.

~~b.~~ A sound monitoring equipment plan shall be prepared.

~~a.c.~~ Sound monitoring reports shall be provided annually.

~~b.d.~~ Routine generator testing shall occur only between 8:00 a.m. and 6:00 p.m. on weekdays.

c. In the event pre-construction sound studies document pre-existing sound levels for A, C, and Z weightings that exceed the limits in this ordinance, then the pre-existing sound levels shall not be exceeded or amplified.

~~b.d.~~ Vibration shall not exceed limits outlined in Section 14.45.C of the Ordinance Book.

~~e.e.~~ Noise and vibration limits apply to all equipment on site including but not limited to HVAC systems, equipment cooling systems, mechanical yards, substations, chillers, renewable energy systems, and generators any of which may need to utilize sound-dampening enclosures, modifications and/or isolation pads to mitigate noise and vibration.

~~e.f.~~ The Township reserves the right to amend, implement and enforce any additional noise and vibration regulations at any time, applicable to all existing and/or new high impact land uses.

~~e.g.~~ Noise/Sound Attenuation Studies: A noise attenuation, or sound modeling study that shall demonstrates compliance with maximum sound levels and must be submitted prior to the approval of a final site plan. This study must be specific to the proposed site topography, layout, and building type, scale, height, and construction proposed. This study must show noise conditions at the site prior to the project development at set locations determined by the Township, and must provide model-predicted noise conditions resulting from the proposed project post-development to demonstrate anticipated compliance with the noise ordinance.

i. The sound study must be prepared by a professional acoustical engineer chosen by the Township and be licensed in accordance with ISO 9613 standards.

ii. All sound studies shall include measurements and reporting for dBA, dBC and dBZ wavelengths, and shall include a full, unweighted one-third ($\frac{1}{3}$) octave band frequency spectrum analysis.

- iii. Sound modeling studies must include recommendations for sound mitigation measures, if they are necessary for the use/facility to comply with sound level requirements. These mitigation measures, if applicable, must be reflected on the site plan and incorporated into conditions of the site plan approval. If mitigation measures are building related, they must be included in the building plans, and if they are landscaping related, they must be included in the landscaping plan prior to issuance of the Special Use permit(s).
- iv. Sound study/routine sound surveillance schedule and additional requirements: a sound study must be submitted to the Township within 60 days of issuance of a certificate of occupancy for each phase of development and upon the facility becoming fully operational. Additional sound studies shall be required at the time modifications of any kind are made, at the time of any ~~resident or~~ sensitive receptor complaint, and at the discretion of the Township.
- v. All sound studies must be conducted at a time known for peak facility use and cooling system operations. In the event the study shows that the facility or use exceeds maximum allowable levels, the operator must immediately undertake all necessary efforts to comply.
- vi. The Township reserves the right to pause facility operations ~~for any reason~~ until noise-mitigating resolutions are made to the Township's satisfaction.

3. Generator Use Requirements

- a. Generator use is limited to emergency backup power generation during area power outages only, shall operate 50% or less of the total facility operations, for no more than 12 hours a day (8am-8pm), with occurrence for use not to exceed three (3) consecutive days without a twenty four (24) hour continuous break/off period, and not to exceed occurrence on more than seven (7) days per each calendar month.
- b. Generators shall be connected to utility provided natural gas only.
- c. ~~Testing Hours: Routine testing of backup generators shall be limited to 8:00 a.m.-6:00 p.m. weekdays.~~ Generator testing hours: Testing of generators shall be limited to 9am-1pm weekdays only, except for holidays, not to exceed occurrence on more than ten (10) days per each calendar month. The facility shall provide a generator testing schedule, posted on a website for public access, updated 60 days in advance.

4. Lot Coverage and Setbacks Requirements

- a. Lot coverage is limited to 50% for all surfaces, permeable or non-permeable.
- b. Setbacks: Minimum setback requirements from all non-participating properties shall be a minimum of one hundred*** (100) feet.

***Set backs will need to be greatly increased if High Impact Land Uses are not limited to Industrial Zoning in the High Impact Land Use Overlay District only as specified in blue in the above Image W.

- i. Setbacks may be subject to change based on site evaluation, mitigating potential negative impacts, and ensuring site design is appropriate for the land's topographic features.
- c. Employee and visitor parking lots shall be set back at least fifty (50) feet from all property lines.
- d. No other structures or surfaces, permeable or non-permeable, with the exception in E.4.c for employee and visitor parking, shall be permitted in the setback areas.

E. Building Massing, Façade Requirements, and Material Requirements

4- 5. Massing, and Scale, Height and Orientation Requirements

- a. Building massing, height, bulk, scale, and proportion shall maintain consistency with the existing character of the adjacent buildings.
- b. Building design should employ coordinated massing to produce overall unity, scale, and interest.
- c. Rooflines and pitches shall be proportionate to nearby structures so as to provide transition or mitigation of significant changes to scale.
- d. Maximum height for all buildings, accessory structures and equipment, is 50 feet, including all rooftop equipment, which shall be concealed by a parapet wall.
- e. Orientation shall prioritize utilization of buildings for sound mitigation and visual buffer(s):
 - i. Where multiple buildings exist they shall be oriented so that service areas face each other and the buildings are placed to surround any equipment, mechanical yards, substations, generators, etc. in order to utilize the buildings as a sound barrier and as a visual buffer between the loudest operations on the site and the site borders.
 - ii. If a site contains two or fewer buildings, the buildings shall be oriented to place any equipment, mechanical yards, substations, generators, etc. on the farthest side/greatest distance away from the highest number of nearby residential and sensitive receptor parcels, and the building(s) between as a sound barrier and as a visual buffer between the loudest operations on the site and the residential and sensitive receptor parcels.

- iii. Any equipment, mechanical yards, substations, generators, etc. must be fully enclosed whenever possible if located within one thousand five hundred (1,500) feet from any residential property line.

2) 6. Architectural Design and Building Materials

- a. Facade variation. Wall designs must provide a minimum of three of the following elements, in addition to transparency requirements, occurring at intervals no greater than 25 feet horizontally and 10 feet vertically:

- i. Expression of structural system and infill panels through change in plane not less than three inches.
- ii. System of horizontal and vertical scaling elements, such as: belt course, string courses, cornice, pilasters.
- iii. System of horizontal and vertical reveals not less than one inch in width/depth.
- iv. Variations in material module, pattern, and/or color.
- v. System of integrated architectural ornamentation.
- vi. Green screen or planter walls.
- vii. Translucent, fritted, patterned, or colored glazing.
- viii. Transparency as required in Section ~~14.48~~ 16.23(F)(2)(b).

- b. Transparency

- ~~i. To ensure facade variation, the use of windows and doors is required. The first floor of any front facade facing a right-of-way shall be no less than 20% clear windows and doors, and the minimum transparency for facades facing a side yard, or parking area shall be no less than 15% of the facade. Ground story transparency is measured between two and eight feet above the ground story elevation. The transparency requirement shall be measured and applied to each separate unit, address or space. Visibility through the required transparency must portray the principal use of the operation and shall not portray secondary or back-of-house operation areas, including, but not limited to, laundry, cleaning supply, stock, or storage areas.~~

- i. Windows for building sides shall be concentrated toward the front edge of the building, in locations most visible from an urban open space or public right-of-way.
- ii. Transparency alternatives. The following alternatives may be used singularly

or in combination for any side or rear facing facade which requires transparency. If used in combination, they may count toward no more than 50% of the transparency requirement set forth in § ~~14.48~~ 16.23(F)(2)(b).

- c. Architectural style shall not be restricted. Rather, evaluation of the appearance of a project shall be based upon compatibility and the quality of its design and relationship to surroundings.
- d. Buildings within the same development should be designed to provide a unified and easily identifiable image. Methods to achieve this include using similar architectural styles and materials, complementary roof forms, signs, and colors.
- e. Minimize monotony of expansive exterior walls by incorporating the following elements: staggering of vertical walls; recessing openings; providing upper-level roof overhangs; using deep score lines at construction joints; contrasting compatible building materials; use of variety and rhythm of window and door openings; use of horizontal and vertical architectural elements, use of horizontal bands of compatible colors; and providing changes in roof shape or roofline.
- f. Facades shall provide visual interest from both vehicular and pedestrian viewpoints.
- g. Entrances to individual buildings shall be readily identifiable to visitors through the use of recesses or pop-outs, roof elements, columns, or other architectural elements.

7. Cooling System Requirements

- a. Because of the potential for high impact land uses such as data centers and cryptocurrency mining facilities to consume a disproportionately large amount of water and power in the community, and because the primary source of water consumption at data centers and cryptocurrency mining facilities are related to cooling systems, in order to align with the intent of this ordinance, to protect and ensure the efficient consumption and use of public utilities and natural resources, any system designed for cooling of the facility and/or equipment shall not negatively impact the surrounding region by conforming to the following requirements:
 - ~~b.~~ i. i. In addition to facilitating all PUE, TUE, and WUE standards in Section G.2.a, Equipment cooling systems shall be designed to minimize potable water use, with preference for air-cooled, hybrid, or closed-loop water systems: shall utilize closed-loop, direct liquid server cooling, with air movement limited to manufacturer-installed internal server fans used for auxiliary component cooling, in the following order of preference:
 - 01. Utilization of liquid immersion cooling systems shall be prioritised, with preference for use of plant based biodegradable non-flammable fluid over traditional dielectric fluid.
 - 02. If a proven incompatibility with liquid immersion cooling can be

demonstrated and verified by an independent third party certified thermal engineer chosen by the Township, then utilization of zero-water direct-to-chip cooling systems may be approved for use as an alternate design option.

03. If the applicant can provide documentation for another equipment cooling system which is equally or more efficient than liquid immersion cooling and zero-water direct-to-chip cooling in terms of ~~or more~~ energy and water consumption, and equally or better at emitting a minimum of all frequencies of noise, ~~efficient as liquid immersion cooling or zero-water direct-to-chip cooling,~~ then the township may approve its use as an alternate equipment cooling system.
04. If another equipment cooling system option proves to be more efficient in terms of energy and water consumption, and its heat-rejection equipment is equally or better at emitting a minimum of all frequencies of noise as liquid immersion cooling and zero-water direct-to-chip cooling, once verified by a independent third party certified thermal engineer that system shall be required as the first preference.
05. If a proven incompatibility can be demonstrated and verified with any preferred equipment cooling system then the next preferred cooling system as outlined above will be the default alternate.

~~v. Cooling towers, evaporative condensers, and hybrid cooling systems, including adiabatic cooling systems, shall not be permitted.~~

~~iv.~~ii. No room-level or facility air/fan-based cooling systems such as, but not limited to, Computer Room Air Conditioning shall be used as the primary means of heat removal.

iii. Open-loop cooling systems and open-circuit cooling towers shall not be permitted.

iv. Cooling towers shall be closed-circuit and utilize drift eliminators.

v. No Dry Coolers, Mechanical Draft, or Air Chillers shall be permitted.*

*If this is not included, additional noise-attenuating features to item vi. will be required.

vi. In order to emit a minimum of noise, as is the intent of this ordinance, cooling systems and towers shall utilize the following features:

01. Sound-absorptive enclosures

02. Fans, motors, and pumps shall be mounted on vibration isolators

03. Intake and discharge/exhaust silencers

04. Aerodynamic fan noise reduction aids

05. Water-splash/basin silencers for water towers.

06. Additional noise mitigation measures, especially for low frequencies and infrasound, may be required to ensure compliance with the noise limits in Section E.2.

8. Additional/accessory structure requirements:
 - a. Additional or accessory structures shall be permanent in nature and shall have a foundation.
 - b. Temporary or modular structures are not permitted.
 - c. Additional structures shall be cohesive in design and color scheme to main structures on the parcel.
 - d. The use of intermodal shipping containers for storage and/or housing of any materials, substances or equipment is prohibited. Once the facility is operational, shipping containers are limited to shipping and receiving purposes only, shall not remain in place for longer than two (2) weeks at a time, and may not be located within set back areas nor within highly visible areas for any period of time.
9. Parking requirements shall meet article 18 standards or similar.
10. Detention and retention ponds are only permitted as part of the site drainage and stormwater management plan. Detention and retention ponds for discharged facility water holding or use related to cooling purposes are not permitted.
11. Fencing requirements
 - a. Fencing shall not exceed seven (7) feet in height for opaque materials (vinyl privacy fencing) or ten (10) feet in height for transparent materials (aluminum metal or chain link fencing).
 - b. Fencing shall be maintenance free in design and in a neutral earth tone color or white for opaque/privacy fencing or black in color for aluminum metal or chain link style fencing.
 - c. No barbed wire or wood fencing materials shall be permitted.

F. G. Sustainability and Energy Use Requirements

1. Infrastructure Impact Statement

Applicants shall submit an Infrastructure Impact Statement at the time of **Site-Plan review** conditional rezoning or permitted principal special use with conditions application, which must identify:

- a. Utility Capacity Impact Statement from ~~DTE/TC~~the energy natural gas, and municipal water provider confirming service adequacy.
- b. Anticipated electric power demand (MW).
- c. Anticipated water usage for cooling and other operations (gallons per day).
- d. Waste heat recovery, reuse, or discharge methods.
- e. Planned on-site backup generation capacity (MW) and associated fuel type(s) with fuel storage capacity and design****.

**** If generators are required to be connected to natural gas served by the utility company per Section ~~7-F.3.b~~, "...and associated fuel type(s) with fuel storage capacity and design" can be omitted

- f. Anticipated natural gas demand
- g. Anticipated utility infrastructure upgrades required to serve the facility, with an agreement that the developer will pay 100% of all required upgrades

~~4.~~2. Energy Efficiency

- a. Data Centers must be designed to achieve a Power Usage Effectiveness (PUE) of 1.2 or lower, a Total Power-Usage Effectiveness (TUE) of 1.15 or lower, and a Water Usage Effectiveness (WUE) of 0.5L/kWh or lower. Applicants shall provide a report detailing how these parameters will be met, to be verified by an independent third party certified professional energy auditor/consultant chosen by the Township. ~~*or provide documentation demonstrating the highest level of efficiency reasonably achievable based on site-specific constraints.~~

*Please note: If the language for cooling system requirements is broadened (example of broader language: "closed loop" or "the industry's latest most efficient"), then these metrics will need to be changed: PUE will need to be 1.1, TUE will need to be 1.1 and WUE will need to be 0.2

- b. Facilities shall incorporate best practices for energy conservation, including but not limited to: high-efficiency HVAC systems, waste heat reuse, variable-speed drives, and hot/cold aisle containment.
- c. Applicant shall provide an operations Report detailing anticipated power demand and redundancy systems.

- d. Applicant shall provide a heat recovery or reuse feasibility analysis (waste heat for district energy)

~~2.~~3. Renewable Energy Integration

- a. Applicants are encouraged to incorporate on-site renewable energy generation (e.g., solar, wind, geothermal, DAKET, Renewable “Green” Hydrogen Fuel Cells) ~~or to procure renewable energy from off-site sources.~~ No on-site nuclear power generation shall be permitted. Decarbonized “Blue” Hydrogen and Traditional “Gray” Hydrogen are not permitted.
- ~~b. At least 25% of projected annual energy demand shall be demonstrated to be met through renewable energy sources, whether on-site or through power purchase agreements, renewable energy credits, or utility green power programs.~~
- c. ~~Panels for~~ On-site solar generation components are limited to rooftop locations, concealed behind parapet walls as required in section F.1.b., and to locations incorporated into covered parking design.
- d. Energy storage systems shall be limited to system that meet the following: ~~Long-Duration Energy Storage (LDES). Battery Energy Storage Systems (BESS) are not permitted.~~
 - i. Are manufactured domestically
 - ii. Do not utilize lithium or lead components
 - iii. Utilize conflict-free minerals
 - iv. Prevent thermal runaway
 - v. Implement safety features that minimize air, water, and ground contamination risks in the event of a system failure

~~3.~~4. Water Conservation

- a. ~~If approved as an alternate option,~~ Facilities using water-based cooling must demonstrate the use of recycled, reclaimed, or non-potable water sources to the maximum extent feasible. *
- b. No on-site wells shall be permitted.

~~*If Liquid Immersion and Direct to chip are required, this section can be removed, or adjusted to refer to non-cooling facility water usage~~

~~4.~~5. Green Building Practices

- a. ~~New Data Center Structures~~ Facilities shall be designed to achieve LEED Silver certification or an equivalent third-party sustainability certification, to be verified by an independent third party certified

professional chosen by the Township ~~or provide documentation of equivalent performance standards~~, and shall provide documentation of certification within two (2) years of construction for each building.

~~b. The Zoning Administrator may approve alternative documentation demonstrating substantially similar environmental performance.~~

~~5.~~ 6. Air Quality

- a. Regulatory Compliance: All generators, cooling systems, and other emission sources shall comply with federal Clean Air Act requirements and the Michigan Department of Environment, Great Lakes, and Energy (EGLE) air quality rules.
- b. Permitting: Facilities shall obtain and maintain any required Air Use Permit to Install (PTI) or other approvals from EGLE for stationary engines, cooling towers, or fuel storage.
- c. No on-site baseload power generation shall be permitted with the exception of the renewable energy generation listed in section F.3.a.

~~e.~~ d. Generator Emissions

- i. Generators shall meet or exceed current EPA Tier 4 Final emissions standards.
- ii. Generator Dispersion modeling may be required to meet air quality requirements or if a facility is within 500 feet of any residential district, school, park, or hospital. or sensitive receptor parcels.
- f. Renewable “Green” Hydrogen Fuel Cells systems are permitted for backup power generation. Decarbonized “Blue” Hydrogen and Traditional “Gray” Hydrogen are not permitted.

~~7. Any cooling towers shall include drift eliminators and be managed to prevent particulate emissions or microbial contamination.*~~

8. 7. Emissions Reporting: Applicants shall submit an annual statement to the Township confirming compliance with EGLE permits and reporting actual operating/testing hours of backup generators.

~~9.~~ 8. Ongoing Reporting

- a. Owners and operators shall provide an annual sustainability report to the Township, including:
 - i. Actual annual energy consumption (MWh).

- ii. Actual annual water usage withdrawal and discharge (gallons).
- iii. Energy efficiency performance & progress toward renewable energy targets
- iv. Documentation of any energy efficiency, cooling system upgrades, and security upgrades.
 - v. Actual Power Use Effectiveness (PUE), Total Power-Usage Effectiveness (TUE) and Water Usage Effectiveness (WUE).
- vi. Actual generator runtime/use logs (hours).
- vii. Actual job numbers, including how many employees are Livingston County Residents
- viii. Greenhouse gas emissions and/or carbon intensity of energy consumed.

~~40.~~9. Use of Consultants

The Township may hire third-party, independent consultants chosen by resolution of the township, to be funded by the developer through an escrow account to review energy efficiency, water consumption usage, air quality review, renewable energy implementation, and green building practices.

10. Utility / power requirements

a. All utility and electrical transmission lines shall be located underground.

b. Power usage shall be capped per the following specifications:

i. Minor Data Centers shall not exceed 2.5 megawatts.

ii. Medium Data Centers shall not exceed 25 megawatts.

iii. Major Data Centers shall not exceed 125 megawatts.

iv. Data Center Campuses shall not exceed 187.5 megawatts.

v. Cryptocurrency Mining Facility shall not exceed 1.25 megawatts.

c. No onsite power generation shall be permitted other than renewables permitted per section F.2

G. H. Security & Emergency Access

Security and Emergency Access. Data Centers shall be designed and operated to protect the facility, surrounding community, and public safety resources.

1. Perimeter Security

- a. Data Centers shall be fully enclosed with a perimeter security system, which may include fencing, walls, or equivalent barriers not less than eight (8) feet in height.
- b. Security barriers shall be designed to balance safety with community character; opaque fencing must be screened with landscaping where visible from public roads or residential areas.

2. Controlled Access

- a. All site entrances shall include controlled access gates, guard stations, or equivalent security technology to prevent unauthorized entry.
- b. Visitor and delivery access points must be separated from employee access points wherever feasible.

3. Emergency Access

- a. A minimum of two (2) points of emergency vehicle access shall be provided, with clear signage and unobstructed pathways around the building.
- b. Access drives shall be constructed to fire department standards, with sufficient load-bearing capacity for emergency apparatus.
- c. Fire lanes shall be maintained free of obstructions at all times.

4. Camera Surveillance

- a. Data Centers shall install and maintain a perimeter camera surveillance system capable of monitoring all vehicular and pedestrian access points, building entrances, and outdoor mechanical/equipment areas.
- b. Cameras shall be positioned to minimize intrusion into adjoining residential properties and public rights-of-way, while still providing full coverage of the site.
- c. Camera systems shall be continuously operational (24 hours per day, 7 days per week) and recordings shall be retained for a

minimum of 30 days.

- d. A security plan, including camera layout, monitoring procedures, and data retention policies, shall be submitted as part of site plan review.

5. Fire Protection and Suppression.

- a. ~~A letter from all local emergency services (Fire, Police, EMS, etc) confirming ability to address emergencies and listing any additional training or equipment required to provide services to the facility, during construction and once fully operational, as determined by the emergency service providers, and shall be submitted at the time of application. If any additional training or equipment is found to be required then funds from the escrow account funded by the developer shall be utilized to cover expenditures up front and prior to site plan approval.~~
- b. Data Centers shall be equipped with an automatic fire detection and suppression system designed to protect both building occupants and sensitive equipment.
- c. Suppression systems shall comply with National Fire Protection Association (NFPA) standards and be approved by the Fire Marshal.

6. Hazardous Materials Management.

- a. Any use of hazardous materials (including fuels for backup generators, batteries, and chemicals for cooling systems) shall comply with federal, state, and local storage, reporting, and disposal requirements.
- b. Applicants shall provide a Hazardous Materials Management Plan identifying on-site materials, **safety data sheets**, storage methods, spill prevention measures, and emergency response procedures.
- c. Applicant shall provide a fire protection plan.

7. Emergency Response Coordination.

- a. Applicants shall submit an Emergency Response Plan to the Township at the time of Site Plan review, which must include:
 - i. Site layout for emergency responders.
 - ii. Fire suppression and alarm systems description.
 - iii. Backup generator location and fuel storage details.

- iv. Contact information for on-site security and facility management. .
- b. Operators shall provide annual training opportunities or site orientations to local fire, police, and emergency medical services.
- c. A letter from all local emergency services (Fire, Police, EMS, etc) confirming ability to address emergencies and listing any additional training or equipment required to provide services to the facility, during construction and once fully operational, as determined by the emergency service providers, and shall be submitted at the time of application. If any additional training or equipment is found to be required then ~~funds from the escrow account~~ that which is needed shall be funded by the developer and/or owner/operator shall be utilized to cover expenditures up front and prior to site plan approval prior to commissioning and at the time of any changes in equipment or design.

8. Lighting and Surveillance.

- a. ~~Security lighting shall comply with Section (Lighting) and shall be directed downward and shielded to minimize glare and off-site impacts.~~ Lighting shall adhere to Dark Sky principals—full-cutoff, directed downward, and shielded, with the use of motion sensors and timers where able. Illumination shall not exceed 0.1 footcandles onto adjacent properties. (See Dark Sky lighting ordinance template for more details/examples)
- d. Facilities shall incorporate continuous video surveillance of access points, perimeter fencing, and loading areas, with recordings maintained for a minimum of thirty (30) days.

I. Construction Phase Requirements

1. The developer or owner/operator will provide a full time onsite community liaison and 24 hour emergency line that will be available from the start of construction until full facility commissioning, this position shall have the authority to halt construction if necessary. Contact information for the community liaison shall be posted at the site on easily accessible / viewable signage and posted on the township website. All concerns and complaints shall receive confirmation of receipt within 24 hours and response within 5 business days.
2. A detailed schedule for any pile driving necessary and a complaint resolution plan shall be provided to the township prior to any construction work beginning.
3. On site work shall be conducted Monday through Friday between the hours of 7am and 6pm.
4. 24 hour construction work is not permitted. Temporary weekend and after hours site

work is subject to approval by the planning commission, with approval at a hearing open to public comment, and only good for a period of thirty (30) days at a time, with no work being permitted prior to 6am or past 10pm.

H: J. Decommissioning

1. ~~Decommissioning plan requirement~~ Because data centers are, by design, highly-specialized, and are therefore effectively single-purpose structures with low ceilings, specialized and segmented layouts, mechanical and equipment-heavy in design, and lacking windows, prolonged vacancy of these facilities poses a blight risk due the high cost of retrofitting and limited ability for repurposing. As a condition of site plan and special use approval, the applicant shall submit a Decommissioning and Site Restoration Plan that addresses:
 - a. Triggers for decommissioning.
 - b. Methods for removal of structures, equipment, utilities, and impervious surfaces.
 - c. Recycling and disposal of equipment and hazardous materials.
 - d. Final grading, soil stabilization, and revegetation.
 - e. Restoration of the site to a condition compatible with surrounding uses.
2. Triggers for Decommissioning
 - a. A ~~data-center~~ high impact land use shall be considered abandoned if it ceases operations for a period of 12 consecutive months, unless the owner provides evidence of intent to resume operations.
 - b. Decommissioning must begin within 6 months of abandonment and be completed within 12 months.
 - ~~c. If at any time a high impact land use ceases operations for any amount of time, the structures and property, including landscaping and snow removal, shall be maintained at all times.~~
 - c. The revocation of the special use permit resulting from Tier 4 violations shall trigger decommissioning, per Section K.12.e.
 - d. Failure to comply with this ordinance, per Section K.13.
3. Performance Guarantee / Financial Assurance
 - a. Prior to issuance of a building permit, the applicant shall post a financial guarantee in the form of a letter of credit, bond, or escrow account

acceptable to the Township.

- b. The amount shall equal 125% of the estimated decommissioning cost, as determined by a independent third party, qualified engineer and approved by the Township.
- c. Estimates must be updated every 2 years and adjusted for inflation.

4. Removal Standards

- a. All above-ground structures, including buildings, mechanical equipment, cooling towers, security fencing, and pavement not otherwise serving a reuse, shall be removed.
- b. All Below-ground infrastructure, such as foundations and utilities, shall be removed ~~to a minimum depth of 36 inches below grade~~ unless otherwise approved.
- c. Materials shall be recycled to the maximum extent practicable.

d. If the Planning Commission determines, based on independent, third-party contractor analysis and report paid for by the landowner in escrow, that existing primary buildings and/or office buildings have a viable use for other Permitted Principal Uses in the underlying zoning district, then the buildings identified may be exempted from being fully removed.

i. The Planning Commission may allow the primary and office buildings to be renovated to be able to be repurposed for another viable Permitted Principal Use in the underlying zoning district.

ii. The owner/operator shall provide full building plans detailing the renovations, and shall provide the cost, in escrow, for an independent, third-party contractor chosen by the township to verify the viability of the renovations for reuse.

iii. All other specialized structures, mechanical yards, cooling equipment, and infrastructure that are not deemed repurposable for other, existing Permitted Principal Uses in the district shall be fully decommissioned according to Section H.4.a, b, and c.

e. The facility and property shall be maintained at all times, including snow removal and landscaping, even when not operational including during and after decommissioning.

5. Site Restoration

- a. The site shall be restored with topsoil, seeded or planted with native vegetation, and stabilized to prevent erosion.

- b. The Township may approve alternate restoration plans if the site is proposed for redevelopment consistent with the Master Plan and zoning ordinance.

6. Failure to Decommission

- a. If the owner fails to complete decommissioning in accordance with the approved plan, the Township may draw upon the financial guarantee to complete the work.
- b. Any costs exceeding the financial guarantee shall remain the responsibility of the property owner.

~~I. Annual Reporting~~ Covered in section ~~F.9~~ K.10

~~1. In addition to the reports required in Section F.9, Annual reporting, The operator of a data center high impact land use shall provide the following reports annually:~~

- ~~a. Generator runtime logs~~
- ~~b. Water withdrawal and discharge data~~
- ~~c. Energy efficiency performance~~
- ~~d. Greenhouse gas (GHG) emissions or carbon intensity of energy consumed report.~~

K. Monitoring and Compliance Requirements

- 1. Permits. All required county, state and federal permits must be obtained and provided to the township prior to the full or partial operation of a high impact land use facility within the township regardless whether the applicant or owner/ operator is otherwise exempt under state law.
- 2. Insurance. All parties conducting business at the site shall maintain property/casualty insurance and business liability insurance in the appropriate amounts but for no less than five million (\$5,000,000) per occurrence with the township listed as an additional insured on the policy at all times.
- 3. Extraordinary events:
 - a. In the event the facility experiences a failure, fire, leakage of hazardous materials/substances, person injury or other extraordinary or catastrophic event, the applicant or owner/operator must immediately notify local emergency services (fire, police, ems) and the township. Notice to the public must be made as soon as possible but not to exceed twenty (24) hours.
- 4. Regulated materials and substances shall require the following be provided to the township:
 - a. Provisions to protect against discharge to the environment of any regulated material or substance, including cooling solutions, due to spillage,

- accidental damage, corrosion, leakage or vandalism including spill contamination and clean-up procedures.
 - b. Provisions for indoor, secured storage for regulated substances and waste management plan.
 - c. Safety data sheets for all onsite substances and materials shall be provided to the township for each phase of the development including during construction, upon independent building commissioning and within ten (10) days of any new substance or material being brought on site.
 - d. Evidence of compliance with EGLE regulations upon full commissioning and at the time of required renewal intervals, not to exceed every five (5) years.
 - e. Safe disposal plan for any regulated materials or substances, including any used cooling solutions.
- 5. Noise monitoring schedule requirements:
 - a. Baseline sound study prior to the start of construction.
 - b. Upon commissioning of each building phase.
 - c. Upon full facility commissioning.
 - d. At the time of any building design changes.
 - e. At the time of equipment upgrades/changes.
 - f. Every twelve (12) months, during peak operational times.
 - g. Upon receipt of any noise complaint, to be conducted during peak operational times or per description of complaint.
 - h. At any time per request of the township.
- 6. Water testing schedule requirements:
 - a. Baseline water study prior to construction.
 - b. Upon commissioning of each building phase.
 - c. At the time of any building design changes and/or site design changes.
 - d. At the time of any equipment upgrades/changes.
 - e. Every twelve (12) months.
 - f. Upon receipt of any complaint.
 - g. At any time per the request of the township.
- 7. Site drainage and stormwater inspection schedule requirements:
 - a. Drain tile inspection upon commissioning of each building phase, per building department guidelines.
 - b. Upon receipt of any complaint.
 - c. At any time per the request of the township.
- 8. The proposed high impact land use shall fully comply with all Federal Aviation Administration regulations in place at the time of application, during construction, and once operational until the time of decommissioning, to ensure safety and avoid any interference with airport operations and communications.
- 9. Electromagnetic radiation testing schedule requirements:
 - a. Baseline electromagnetic radiation study prior to construction
 - b. Upon full commissioning.
 - c. At the time of any building design changes and/or site design changes.
 - d. At the time of any equipment upgrades/changes.
 - e. Upon receipt of any complaint.
 - f. At any time per the request of the township.
- 10. Annual reporting requirements:
 - a. Current proof of insurance
 - b. Verification of financial security
 - c. Summary of all extraordinary events, complaints, and complaint

- resolutions.
- d. An annual job report detailing all onsite full-time and part-time positions with weekly hourly averages and wages shall be provided to the township every twelve (12) months.
 - e. Noise monitoring test results & recommendations from that year
 - f. Water monitoring test results & recommendations from the year
 - g. Any storm water drain tile inspection results & recommendations from that year
 - h. Any electromagnetic radiation testing results and recommendations from that year
 - i. Power consumption report for that year
 - j. Water consumption report for that year
11. The township reserves the right to inspect the facility or job site at any time by providing twenty-four (24) hour notice via electronic communication to the applicant, developer or owner/operator.
12. **Performance bond: As allowed in the MZEA Section 125.3505, in order to insure compliance with any regulation contained herein for the purpose and intent established in section A, and required as a condition of special land use approval, the owner/operator shall furnish a performance bond for the amount of five million dollars (\$5,000,000), to be drawn upon according to the Remediation Schedule below
- a. Performance Bond Direct Draw: for Tier 2, 3 and 4 outlined below, the performance bond is authorized to be directly drawn on, upon the expiration of the cure period, without requiring a court judgement.
 - b. Treble remediation costs for water: because a single data center can represent 10% or more of an entire county's water consumption, unauthorized water use or material underreporting of water consumption and discharge carries triple the standard per-day remediation cost
 - c. Attorney's Fees Provision: if the township must pursue ordinance enforcement through litigation and prevails, the owner/operator must reimburse all legal costs.
 - d. Annual escalation clause: remediation amounts must be indexed annually to the Consumer Price Index or a 3% escalator, whichever is greater.
 - e. Sunset review trigger: any facility found to have a Tier 4 violation will trigger a mandatory special use permit revocation and triggers decommissioning per section J.2.
 - f. NDA Prohibition: non-Disclosure Agreements prevent the township's ability to disclose operational data to residents and regulatory agencies, and hinders ordinance enforcement and remediation. NDAs are prohibited for any High-Impact Land Use.

** The Performance Bond Violation/Remediation structure in Section K.12 needs to be carefully reviewed by the township's legal counsel; Per the RRC Violations report, this appears to be a viable option to insure compliance, but the structure and language must ultimately be drafted by an attorney. This represents our best attempt to outline what we envision, to ensure the township has the means to insure compliance beyond the existing violation fines which are capped at \$500/day, and unlikely to be effective or provide any meaningful restitution for violations/harm. The attorney may have other solutions to recommend; The RRC strongly encourages the Planning Commission to look into this matter further, to be sure they are utilizing all tools available—even ones not commonly employed.

g. Violations and Remediation Costs

i. Violations shall be subject to the following Tiered Remediation Schedule:

Tiered Remediation Cost Schedule

Tier	Violation Type	Remediation Cost Range	Cure Period	Enforcement Authority
Tier 1	Administrative / Technical	\$1,000–\$10,000/day per violation	30 days; written notice required	Township Administrator
Tier 2	Operational	\$10,000–\$25,000/day per violation	14 days; bond drawable if uncured	Planning Dept. + Township Counsel
Tier 3	Material / Structural	\$50,000/day per violation	None; corrective action plan due in 5 business days	Stop-work authority; bond fully callable
Tier 4	Bad Faith / Repeat	Up to \$100,000/day per violation	None	Permit revocation; injunctive relief at developer's expense

Implementation note: Tier 1 fines may be pursued through standard civil infraction processes. Tiers 2–4 should be structured through conditional zoning agreements and performance bond draw authority, which are not subject to the \$500 statutory cap. Municipal counsel must confirm the appropriate legal vehicle for each tier prior to ordinance adoption.

ii. Violation Tier Descriptions: Ordinance Violations shall be Tiered accordingly by type and severity:

01. Tier 1: Administrative and Technical Violations include but are not limited to late or incomplete filings, missed water or energy reporting deadlines, minor permit deviations not affecting operations or neighbors.

02. Tier 2: Operational Violations include but are not limited to exceeding PUE, TUE, and/or WUE, exceeding noise thresholds at subject property lines, operating backup generators beyond permitted hours, failure to maintain required vegetative buffers.

03. Tier 3: Material and Structural Violations include but are not limited to construction outside the approved footprint or impervious surface limits, operating beyond permitted capacity, failure to maintain or replenish the escrow account or decommissioning performance bond, unauthorized modifications to stormwater infrastructure, negatively impacting residential/private wells, violating wastewater

discharge regulations

04. Tier 4: Bad Faith and Repeat Violations include but are not limited to Tier 1-3 violations recurring within 12 months of a prior finding, material misrepresentation in permit applications or disclosures, violations discovered in connection with state or federal enforcement action.
13. Remedies: If an applicant or owner/operator fails to comply with this ordinance the township may pursue any remedy or enforcement, including but not limited to revocation of the special use permit, which shall trigger decommissioning per section J.2., and the removal of any high impact land use facility pursuant to the zoning ordinance or as otherwise authorized by law. Additionally, the township may pursue any legal or equitable action to abate a violation and recover any and all costs, including the township's actual attorney fees and costs.**

****Please Note: The above language is attorney drafted (from Cohoctah's Data Center Ordinance) and is recommended to remain as is.**

L. Validity and Severability

1. If any portion of this ordinance is found invalid for any reason, such holding will not affect the validity of the remaining portions of the ordinance.

M. Effective Date

1. This ordinance takes effect upon the expiration of 7 days after publication as required by MCL125.3401(7).

March 20, 2026

Howell Township Planning Commission
3525 Byron Road
Howell, MI 48855

To the members of the Howell Township Planning Commission,

The following addendum to the Decibel Limits and Noise Research Report is intended to supplement the report and is being provided for consideration from the Howell Township Resident Research Committee (RRC).

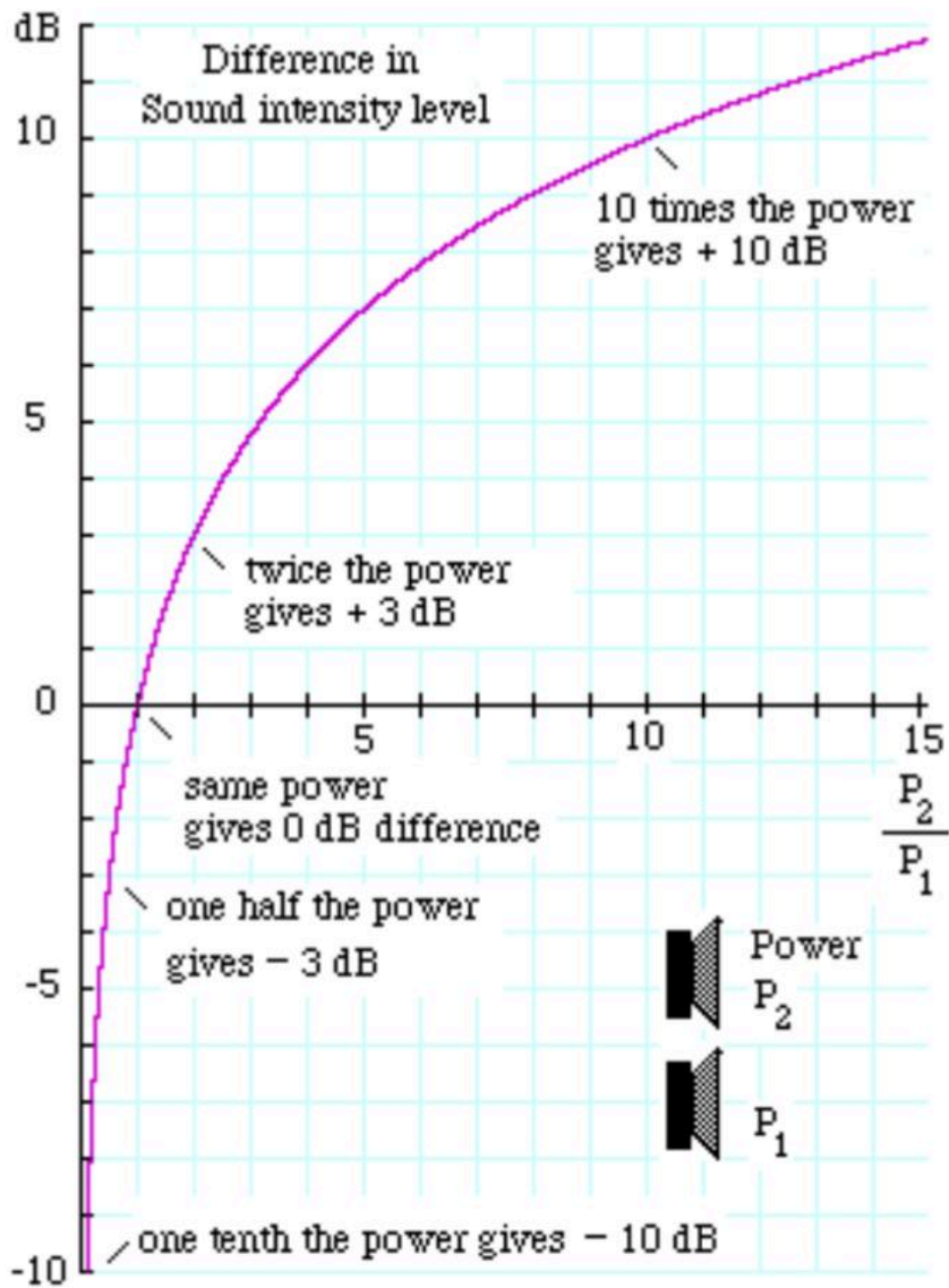
ADDENDUM/BACKGROUND INFO for DECIBEL LIMITS & NOISE RESEARCH

Addendum / Background Information:

In our written report about decibel limits, we realized we may have missed some critical background context about how decibels and frequencies work, because it is an integral piece of understanding when discussing the impacts of noise. When considering whether to allow more or fewer decibels in an ordinance, it is important to keep in mind what the actual impact is on sound levels, because even a small number of additional decibels can have a significant impact on overall noise.

Decibels are not a linear unit of measurement of sound intensity, they are logarithmic (1, 2). It is not like a scale on a measuring stick, it is more akin to an exponential increase, although the rate of logarithmic growth is not constant as with exponential growth. The prefix “deci-“ indicates a base of ten, and an increment of 10dB represents a tenfold increase in the intensity of sound, and an increment of 20dB represents a 100-times increase in intensity (1). To put in perspective of the information we are about to present: 80dB is 100 times more intense than 60dB. An increase of about 3dB is a doubling of the sound intensity, so 60dB is more than double the intensity of 55dB (1). Intensity is not quite the same as “loudness”, in terms of perception by the human ear. An increase of 10dB, to be fair, is not perceived as a tenfold increase in volume; an increase of 10dB is typically perceived as a doubling in volume, or loudness (2).

Below on page 2, are a couple of additional graphics to help put the information presented in this background information and the larger decibel limit and noise research report into context. The first is a graph illustrating how decibels are not linear (3). They are a logarithm of the ratio of two sound pressure levels:



We wanted to provide this additional information for clarity on the topic of decibels in relation to noise limits, how limit adjustments affect overall sound intensity and so that the Planning Commission would have this additional information available for reference at their convenience when diving into the topic of decibel limits and noise.

Respectfully,

The Howell Township Research Committee

Sources:

- 1: <https://engineeryoursound.com/how-to-understand-the-unit-of-decibels-simple-explanation/>
- 2: <https://www.nps.gov/subjects/sound/understandingsound.htm>
3. <https://www.animations.physics.unsw.edu.au/jw/dB.htm>

March 15, 2026

Howell Township Planning Commission
3525 Byron Road
Howell, MI 48855

To the members of the Howell Township Planning Commission,

The following information on decibel limits and noise is being provided for consideration from the Howell Township Resident Research Committee (RRC).

DECIBEL LIMITS & NOISE RESEARCH

The following information on decibel limits is being provided by the RRC so that the planning commission has information and research available for reference on sound/noise related to high impact land uses including data centers, cryptocurrency mining and the impact they have on surrounding areas.

Suggested Limits and Requirements are as Follows:

- All sound studies shall include a full, unweighted $\frac{1}{3}$ Octave Band analysis.
- A maximum of 70dB(Z), 55dB(C), and 55dB(A) shall be required of all high impact land uses. All octave bands 125Hz and below shall not exceed 60dB(Z).

Analysis of Infrasound Impacts, Regulations, & Recommendations:

One of the most frequent complaints from communities with hyperscale data centers, multiple data centers, or cryptocurrency mining facilities, is that of noise. Yet, at quick glance, one passing by may not think much of the low, steady hum of the cooling equipment utilized by these facilities. It is frequently mentioned how 60 decibels is approximately the level of a normal conversation... There are clearly other, louder sources of noise in industrial areas, so what could possibly be the issue? It seems easy to brush this off as nothing more than an excuse to complain from a bunch of NIMBYs.

Aside from the fact that constant, tonal noises are much more of a nuisance than transient sounds, such as a passing train or an airplane lifting off, the sounds emitted by data centers are loaded with low-frequency sound waves. Low frequencies are generally considered to be in the 20Hz-200Hz range, and Infrasound being the frequencies that fall below 20Hz. Although some individuals report being able to hear infrasound as low as 12Hz, 20Hz is generally considered to be the lower threshold of human perception. Low frequencies are also not perceived at the same level of loudness, which is why most sound measurements are done in A-weighted decibel units, which adjusts the measurement to primarily reflect the more perceptible frequencies in the range of human hearing by filtering out low frequencies. This results in a wildly inadequate measure of potential physical harm to anything other than hearing loss. As one study explains, "The A-weighted acoustic measuring method is specifically designed to diminish the inaudible part of the acoustic spectrum. As a result, an exposure to a

high-level 100dBz infrasound signal with a frequency of 16Hz would measure merely 45dBA, deeming it acceptable according to many of the present-day noise regulations” (6). There are other weighting scales used to better reflect the perceptible impacts—both auditory and physical—of low-frequencies and infrasound. As an example, C-weighted decibels, dB(C), is a weighting scale used to adjust for the audible sensations and physical perceptions of low frequencies.

Noise generated by newer high impact land uses such as data centers and cryptocurrency mining facilities comes from generators, cooling equipment, and in some cases, on-site power generation such as gas turbines. These are all significant sources of Low Frequency and Infrasound; generators often operate around 75Hz, cooling equipment between 48 and 98Hz, and gas turbines around 25Hz (9). Another study concludes high decibels (110-132dB(Z)) of infrasound frequencies ranging from 1-12Hz can be found near diesel engines, turbines, piston pumps, compressors, fans, and other large air-blowing machines (6).

Just because we can't necessarily hear many of the lowest frequencies, and don't perceive those that we do as being particularly loud, does not mean they aren't problematic. This can be clearly understood with an analogy to light and vision used in a paper by Alves-Pereira & Branco: “Within electromagnetic spectrum, the human eye perceives light in a certain range of frequencies, just as within the acoustical spectrum, the human ear perceives sound in a specific range of frequencies. There exist electromagnetic phenomena that are not perceived by any of the human senses during actual exposure (e.g. X-rays), and yet, excessive exposure to X-rays can cause severe biological damage” (3). They also say it is a “...scientifically unsubstantiated, but prevalent, notion that noise only affects hearing”. Low frequencies emitted at a high sound pressure level (flat, or unweighted, decibels), are still being received by our bodies, and those vibrations do produce physiological effects.

So, let's take a look at what sort of effects low frequencies and infrasound can have on the human body (there is also research about the effects on animals as well as plant life, which we have not yet fully explored, but for which there is existing information). There are seemingly countless studies documenting the connection between low frequency noise and various ailments in humans, stretching back decades. Complaints from those affected include reports of sleep disturbances, fatigue, annoyance, stress, hypertension, concentration deficits, mood swings, digestive issues, psychiatric disturbances, headaches, severe joint pain, neurological disturbances including late-onset epilepsy, balance disturbances such as dizziness and vertigo, progressive neurological deterioration, endocrine disorders, changes in cardiac rhythm, cardiac arrhythmias, reduction in the force of contraction of the heart muscle, malignant tumors, autoimmune disease...all of this, at statistically-significant levels above the general population's incidences (1, 2, 3, 6).

This is clearly a wide-ranging collection of problems, so we would like to break it down by summarizing a few of the studies:

1. A 2023 article in the peer-reviewed International Journal of Environmental Research and Public Health found that all participants exposed to low-frequencies felt a number of wide-ranging complaints of hearing humming, droning, and buzzing, feeling sensations such as ear pressure, and perceiving vibrations in their torso and limbs. The average rating, on a scale from 1 to 10, on the impact on their daily living was quite high at 7.1 out of 10. These disturbances impacted sleep, caused them to spend less time in their homes, impacted their ability to work, and resulted in overall less full-time work, and even impacted

relationships. Another notable finding was that the perception was impossible to escape; participants used earplugs, noise-cancelling headphones, tried to mask it with white noise, TV, or radio, closing windows, insulating walls, changing sleeping location or relocating their bed, placing their mattress on dampening materials, and even medicating. And yet, the perceptions persisted.

2. A 2010 paper in the journal “Neuroscience” notes that being in the presence of infrasound has been shown to spike cortisol levels. Cortisol is the “stress hormone”, and elevations in cortisol result in occurrences of stress and hypertension, as well as contributing to vestibular issues like vertigo, nausea, and loss of balance. They measured cortisol and rated their subjects’ stress and annoyance before, during, and after being exposed to two hours of low or flat frequency spectrum noises, both at a level of just 40dBA, on two different occasions. This confirmed physiological evidence of increased stress and neuroendocrine activity. Note that *the A-weighted decibels were just 40dB(A)...*
3. A 2007 study published in Hearing Research noted that high levels of infrasound produces large movements of cochlear fluid, and when combined with a 4kHz (4,000Hz) octave band of noise, it can cause high-frequency hearing loss. This is notable, because especially in the context of high impact land uses such as data centers and cryptocurrency mining facilities, low-frequencies do not often exist alone. While high levels of 4kHz octave band frequencies alone can cause hearing damage, that damage is exacerbated when combined with low frequencies.
4. A 2021 study in Noise & Health looked into the effects of infrasound on human myocardial contractility—the force of heart contractions. They found that the higher the dBZ, the weaker the cardiac contraction force. Exposure to high levels of infrasound (over 100dB(Z), which—as mentioned above—may measure as low as 45dB(A), depending on the exact frequency), affects cardiac muscle in as little as one hour. The authors also note that because lower frequencies have longer wavelengths, they reflect, refract, diffract, and resonate more than higher frequencies of more audibly-perceptible sound frequencies. This means infrasound and low-frequency sounds move through and around obstacles like buildings and terrain, while maintaining energy even after traveling very long distances. As such, common noise barriers utilized are often ineffective against them. Also, the decibels of infrasound can actually increase inside residential rooms, especially through open windows or ventilation ducts, because enclosed spaces condense the waves’ energy by means of resonance. It can reach up to 25dB(Z) higher than the measured level outside, and explains why people may complain about the effects despite not being in direct vicinity of the source. The authors also cited a study by Karpova et. al., who tested the effects of infrasound on healthy, young men and found that mental stress, vegetative reactions, and unpleasant auditory sensations occurred within 1 minute of exposure. Within 15 minutes, additional symptoms including fatigue, dizziness, depression were noted. They, too, observed changes in cardiac rhythm, arrhythmias, and a reduction in the force of contraction of the heart muscle.

5. One of the most thorough articles we reviewed is a 2007 study in the journal *Progress in Biophysics and Molecular Biology*, titled “Vibroacoustic disease: Biological effects of infrasound and low-frequency noise explained by mechanotransduction cellular signalling”. Vibroacoustic disease (VAD) is a “whole-body pathology that develops in individuals excessively exposed to infrasound and low-frequency noise”. It was seemingly originally diagnosed within the aeronautical and other heavy industrial uses, but is increasingly being diagnosed in the general population as new sources of infrasound begin to grow in our communities (such as wind turbines, data centers, cryptocurrency mining facilities, and the like). The findings of this study involve abnormal growth in cells that thickens blood vessels, affects cardiac structures, as well as in the cells of the trachea, lungs, and kidneys of VAD patients and animals. They studied a group of 306 aircraft technicians, and found all of them had abnormal pericardial and/or cardiac valve thickening. In this group, 10% of them presented with late-onset epilepsy, when the general population was just 0.2%. It was determined back in the early ‘90’s that infrasound and low frequency noise (ILFN) was the agent for disease for aircraft technicians. In the mid-‘90’s, animal studies showed the respiratory tract could be a primary target for ILFN, with studies finding abnormal amounts of fibrosis in the trachea and lungs, damaged tracheal and bronchial cilia, among other abnormalities. At this same time, in addition to epilepsy, other neurological disorders were identified in ILFN-exposed populations as well: palmo-mental reflex (usually only seen in newborns and the elderly), balance disturbances, and facial dyskinesia. They tracked the development of VAD symptoms over the course of many years and charted them into stages. The symptoms in these stages were identified in over 50% of the aircraft technicians. Stage 1, which is 1-4 years of exposure, typically results in slight mood swings, indigestion, heart burn. Stage 2, from 4-10 years, brings chest pain, definitive mood swings, back pain, fatigue, fungal, viral, and parasitic skin infections, inflammation of the stomach lining, pain and blood in urine, conjunctivitis, and allergies. Stage 3, over 10 years, involved psychiatric disturbances, hemorrhages of nasal, digestive, and conjunctive mucosa, varicose veins and hemorrhoids, duodenal ulcers, spastic colitis, decrease in visual acuity, headaches, severe joint pain, intense muscular pain, and neurological disturbances. There were additional, statistically significant symptoms occurring well above the general population incidences, experienced by fewer than 50% of the aircraft technicians, including: respiratory problems, late-onset epilepsy (whose seizures subsided when away from work), progressive neurological deterioration and early aging, endocrine disorders, malignant tumors (often multiple different types at once), among other problems. It might be tempting to brush off this data, as the levels of low-frequencies must surely be higher than that of high impact land uses such as data center or cryptocurrency mining facilities, but as you’ll see in the conversion decibel weighting conversions chart below on page 7—even seemingly-reasonable dB(A) levels can result in astonishingly high dB(Z) levels of low-frequencies...on par with, if not exceeding, that which the airline technicians were exposed to.

To address the question – what to do about this – we are lucky to have the opportunity to not only address, but hopefully prevent this problem proactively, before the community is subjected to unsafe levels of sound that lead to any number of the ailments outlined above. Some of the studies referenced have also provided recommendations for prevention of harm.

Additional Recommendations for Prevention of Harm:

- Conduct noise assessments, before any development is permitted. Specifically, for existing dB(C) and dB(Z) levels in the township, particularly in the industrial area and in the residential areas in the closest vicinity to the proposed High Impact Land Use Overlay District. The current, pre-development low-frequency and infrasound levels must be documented before any data centers come to town.
- The assessment should include a 1/3 Octave Band analysis, with no weighting (ie, in Linear Decibels/dB(Z)), down to the lowest frequency the equipment is able to detect, ideally including the lowest 1/3 octave bands.
- If a spectral analysis is not possible, the dB(C) and/or dB(Lin/Z) Leq measurements should be performed, under real-world conditions.
- An absolute maximum of 80dB(Z) should be the limit on infrasound in the ordinance, as that is the threshold for significant symptoms to begin with chronic exposure.

Given the nature of low frequency sounds, especially with regard to resonance and traveling long distances, we were inclined to suggest even lower than that. But, we wanted to see what other ordinances have already set as their limits.

Examples from Ordinances:

6. Fort Lauderdale, FL, includes some context in their ordinance:

“Unlike standard dBA measurements, which primarily detect mid-range sounds like speech and traffic, dBC measurements capture deeper, low-frequency noises such as bass from music or heavy machinery. These sounds can travel farther and penetrate walls, making them more disruptive in residential areas. Adding dBC limits ensures that noise enforcement addresses all types of sound, improving fairness and effectiveness”.

They include both dBA and dBC, and for Commercial and Industrial uses, differentiate between indoor and outdoor limits. They also note that measurements are to be taken 5 feet from the building or structure, to ensure a clear, consistent standard. However, their Industrial limit is 85dB(C) during the day and 75dB(C) at night, both of which exceed the evidence-based recommendation of no more than 80dB(Z), mentioned above. (Residential outdoor limits are 70dB(C) day, and 60 dB(C) night; indoor is lower, at 55/45dB(C).

7. Fort Pierce, FL limits sounds by use-occupancy of receiving properties. For residential properties, that limit is 55 dBA, C, and Z; Commercial properties are 60 dBA, C, and Z; and Industrial properties are 65 dBA, C, and Z. They go further, and specifically regulate low-frequency and infrasound octave bands (31.5, 63, and 125 Hz), all which must not exceed 65dB. This approach appears to be the most evidence-based and comprehensive attempt we have seen to account for frequency variations of perceived loudness, and ensure residential properties are adequately protected from low-frequency noise. It is important to note the difference in regulating from a sending property versus a receiving property.

8. The Wisconsin Citizens Safe Wind Siting Guidelines recommend that the dBC from wind turbines shall not exceed 50dBC at residences, or 55 near highways, or a

difference between dBC and dBA over 20dB, whichever is lower. Wind Turbines are a significant source of infrasound, with an increasing amount of data and research.

9. The Wind Energy Conversion Systems Zoning Ordinance says not to exceed 45dBA or 55dBC Lmax.

As you can see, there are a variety of approaches to consider and to put into context of the research. To recap the research: an absolute maximum of 80dB(Z) for infrasound (frequencies less than 20Hz) is recommended, as that is the point at which *perceptible* symptoms begin. Many places include dB(C) and dB(A), and even dB(Z). Some locations limit sound from the sending property, others set limits at the receiving properties.

To help visualize what limits will accomplish the desired outcome without being mutually exclusive or impossible to achieve, we have constructed a chart, based on the standard A and C weighting curves (10), to illustrate how different limits affect unweighted low frequency and overall community impact. The numbers in red indicate an unsafe (unweighted) noise level. The darkest gray boxes are the 1/3 octave bands in the infrasound range, while the lighter gray boxes are low-frequency octave bands.

Decibel Weighting Conversions by Frequency

Octave Band (Hz)	70dB(C)→Z	60dB(C)→Z	55dB(C)→Z	55dB(C)→dB(A)	70dB(A)→Z	55dB(A)→Z
1	122.5	112.5	107.5	-41.1	218.6	203.6
6.3	91.3	81.3	71.3	-14.1	155.4	140.4
8	87.6	77.6	72.6	-5	147.6	132.6
10	84.3	74.3	69.3	-1.1	140.4	125.4
12.5	81.3	71.3	66.3	2.7	133.6	118.6
16	78.4	68.4	63.4	7	126.4	111.4
31.5	73	63	58	18.5	109.5	94.5
63	70.8	60.8	55.8	29.6	96.2	81.2
125	70.2	60.2	55.2	39	86.2	71.2
250	70	60	55	46.3	78.7	63.7
500	70	60	55	51.8	73.2	58.2
1000	70	60	55	55	70	55
2000	70.2	60.2	55.2	56.4	68.8	53.8
4000	70.8	60.8	55.8	56.8	69	54
8000	73	63	58	56.9	71.1	56.1
16000	78.6	68.6	63.6	56.9	76.7	61.7
20000	81.3	71.3	71.3	62	79.3	64.3

The octave band frequency spectrum includes all the infrasonic and low-frequency 1/3 octave bands (125Hz and below), and 1/1 octave bands for everything above. We converted levels of 70dB(C), 60dB(C), and 55dB(C) to flat, zero-weighted decibels. The unweighted decibels that exceed the maximum safe level of 80dB(Z) are noted in red. The C-weighted decibels clearly do a much better job of reflecting the impact of low-frequency and infrasound. A limit of 55dB(C) ensures virtually all but the absolute lowest frequencies will remain at safe levels. The incredible inadequacy of A-weighting is illustrated here in the two columns to the furthest right; at the current Industrial zoning limit of 70dB(A), infrasound and low frequencies

may still be astonishingly, and dangerously strong. It is especially interesting to notice how lowering dB(A) all the way to 55dB(A) will not make a significant change to the overall low-frequency impact on the community if the sound is primarily composed of low frequencies and infrasound; virtually *all* low frequencies could potentially be dangerously high. Combine this data with the fact that low frequency wavelengths are not easily buffered or mitigated by barriers or atmosphere, it is clear to see why residents, even those several miles away from sources of low-frequency noise (like that from high impact land uses such as data centers, crypto currency mining facilities, and the like), report problems despite the facilities meeting the seemingly-reasonable dB(A) limits in applicable ordinances.

Based on this chart, a limit of 55dB(C) appears to be the highest threshold where most of the low frequencies and infrasound will not pose a threat to the community. For further comparison, we also converted it to dB(A), as seen in the column labeled “dB(C)—>dB(A)”. You can see that you would need impossibly-low dB(A) limits to adequately address low frequencies and infrasound. Additionally, you can see the frequencies that are the most audibly-perceptible to humans (500-8,000Hz) are comparable between the two weightings: they are both in the 55dB(A) range, which is in line with the original intent of a 55dB(A) limit. In other words, 55dB(C) will ensure *both* the low-frequency physical impacts and the mid-range frequency (audible) impacts are compatible with the community. While dB(C) is clearly the primary metric to regulate, including a dB(A) limit will ensure the tonal and continuous, audible noises emitted from a data center and other high-impact land uses do not pose an audible nuisance to the community, either.

To further ensure that there are not a significant amount of low-frequency sounds impacting the community, establishing a dB(Z) limit will help cover those <10Hz frequencies. An overall limit of 70dB(Z) is compatible with the ideal 55dB(C) limit, and will provide an additional layer of protection for the community from nuisances related to data center and high-impact land uses. However, as one of the studies above noted (and it is widely acknowledged in the scientific community), low frequencies have a tendency to resonate and therefore amplify their sound levels in enclosed spaces. To understand this, think of two guitars: one electric guitar (that is not plugged in or amplified), and one acoustic guitar. The body of the electric guitar is flat and solid. When you pluck a string on an electric guitar that is not plugged in, the sound is relatively soft. Now, picture an acoustic guitar: its body is hollow, and there are holes near the strings. These holes are not merely decorative, they are strategically placed to allow the sound from the string to enter into the hollow body of the guitar. The sound waves enter the body of the guitar, where they resonate... and amplify. This is why an acoustic guitar is magnitudes louder than an unamplified electric guitar. This means, if a 70dB(Z) low-frequency sound wave travels the relatively short distance to a nearby residence and enter through windows or ventilation ducts, that low frequency or infrasound wave may amplify by up to an additional 20+dB(Z)— *a 100-times greater intensity*—suddenly subjecting them to unsafe levels *in their own home*, even if the decibels outside are reasonable. This likely explains why noise complaints are one of the most common reasons for resident lawsuits against their cities for data centers; most noise ordinances do not adequately account for low frequency, and certainly not for the potential for resonance. To prevent this and protect the community from the far-reaching impacts of low-frequency sound waves, given that 80dB(Z) is the absolute maximum the current research shows as being safe, setting a lower limit of 60dB(Z) for low-frequency octave bands, a strategy Fort Pierce, FL employs, would ensure residents will remain safe and comfortable in their homes.

Therefore, we feel the best approach to ensuring the community is adequately protected from high levels of continuous, tonal, low-frequencies, is to set the following limits which must *all* be (and as the chart illustrates, can be) met:

- 70dB(Z) maximum for octave bands >125Hz; 60dB(Z) maximum for all octave bands <125Hz
- 55dB(C) maximum
- 55dB(A) maximum

Given how far infrasound and low frequencies travel without being attenuated by atmosphere or environment (potentially, hundreds of miles (11)), if the intent is to ensure levels do not exceed safe limits at the relatively-nearby residential properties, the limits at the high impact land use property lines should be set at these levels. Fort Pierce, FL appears to do almost exactly this, and is among one of the only ordinances which appear to take a genuinely evidence-based approach. Their ordinance sets limits at receiving property lines, but we feel that would add a lot of complexity to enforcement. It is important to keep in mind that when far-reaching, low frequencies get trapped indoors, they resonate and may become amplified by 10-20dB(Z), which represents a ten to one-hundredfold increase in intensity. For that reason, the township may wish to consider setting dB(Z) for low-frequency octave bands even lower, to 60dB(Z), which would bring Howell Township’s ordinances closer in line with the limits that Fort Pierce, FL has established, and our research supports, to be acceptable for receiving residential properties to be exposed to.

Examples in Other Ordinances & Guidelines:

6. Fort Lauderdale, Florida:

“Unlike standard dBA measurements, which primarily detect mid-range sounds like speech and traffic, dBC measurements capture deeper, low-frequency noises such as bass from music or heavy machinery. These sounds can travel farther and penetrate walls, making them more disruptive in residential areas. Adding dBC limits ensures that noise enforcement addresses all types of sound, improving fairness and effectiveness”.

	Day	Night
Residential outdoor:	70dBC	60dBC
Residential indoor:	55dBC	45dBC
	Outdoor	Indoor
Commercial:	75dBC	65dBC
Industrial:	85dBC	75dBC

-Noise measurements to be taken 5ft from building/structure/establishment-clear, consistent standard

-Noise complaints are assessed from property line of complainant, and at the noise source

7. Fort Pierce, Florida:

-Low-frequency octave band limits: 31.5Hz, 63Hz, 125Hz- must not exceed 65dB

-Sound limits by use-occupancy of receiving property:

	dBA	dBC	dBZ
Residential	55	55	55
Commercial	60	60	60
Industrial	65	65	65

8. Wisconsin Citizens Safe Wind Siting Guidelines:

1. dBC from Wind Turbines anywhere on non-participating properties shall not exceed the lower of either:

- -maximum 50dBC at residences,Maximum 55dBC near highways
- -dBC-dBA L90A > 20dB

2. If modeling or testing at any time shows dBC-dBA > 10 dB, a frequency analysis shall be performed to determine the source and nature of the low frequency sound.

- L90 is noise level exceeded for 90% of the time of the measurement duration (used to determine ambient/background noise level)

9. Wind energy Conversion Systems Zoning Ordinance:

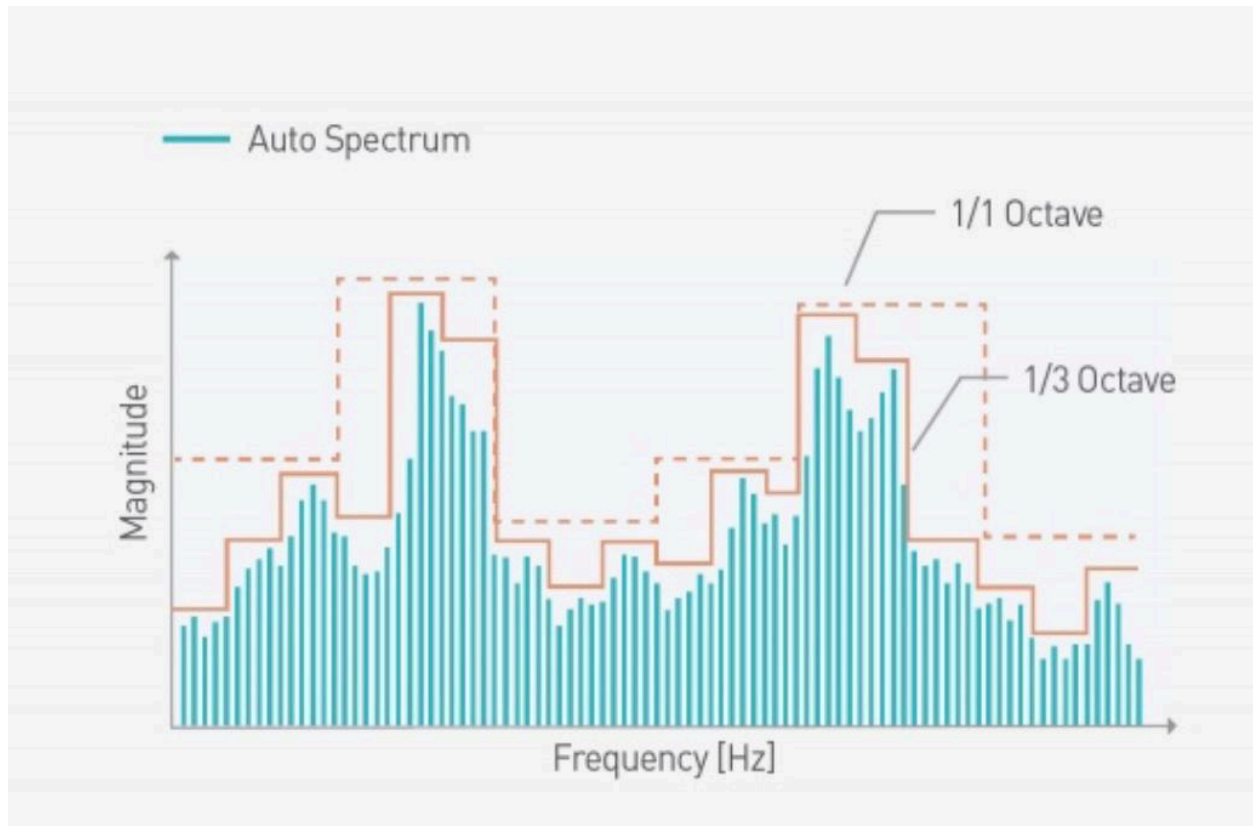
1. 45dBA, or 55dBC Lmax- exceeding either is considered a nuisance

Additional Notes on Octave Bands:

Most people are probably familiar with an “octave” in music—from one note to another of the same sound, but with an exact doubling of pitch, or frequency. The acoustical frequency spectrum is often similarly broken up into octaves, where the upper frequency is double that of the lower frequency. Most noises have a variety of frequencies within them; performing an octave band analysis helps illustrate which frequencies are being projected the loudest. Octave bands can be further broken into thirds, and the 1/3 Octave Band analysis provides a more detailed breakdown of the types of frequencies emitted from a noise source.

This is useful to understand, because while the chart above contains conversions of various A and C-weighted decibels into flat decibels, it is important to remember that, for example, a noise which measures 60dB (of any weighting) does not mean it contains all of the frequencies in the spectrum, nor are all of the frequencies which are emitted being projected at the same force or volume.

The image below from Daeil Systems (10) illustrates this concept:



The blue bars show the various frequencies emitted from a noise sample. You can see how there is a great deal of variability in magnitude (or “volume”) of each frequency in the spectrum. The 1/1 Octave Bands are outlined in the orange, dashed lines. The $\frac{1}{3}$ Octave Bands are outlined in the solid, orange lines. You can see how the $\frac{1}{3}$ octaves more closely resemble what is actually being emitted by the noise as compared to the 1/1 octaves, which are much more generalized.

By requiring sound studies and monitoring to include a full $\frac{1}{3}$ Octave Band analysis of unweighted sound levels, the township will be able to see the actual impact of infrasound and low-frequencies, and how they are contributing to the overall decibel levels being emitted. If, despite the township’s noise ordinances, residents are still reporting disturbances (especially related to low-frequencies), this type of analysis will be able to confirm the nature of the nuisance, and will help inform the township in revising their ordinances to adequately address any ongoing complaints.

Sources:

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March 22, 2026

Howell Township Planning Commission
3525 Byron Road
Howell, MI 48855

To the members of the Howell Township Planning Commission,

The following information on Battery Energy Storage Systems (BESS) is being provided for consideration from the Howell Township Resident Research Committee (RRC).

BATTERY ENERGY STORAGE SYSTEMS (BESS) RESEARCH

RRC Recommendations:

Avoid lithium-ion BESS where possible and prioritize instead the use of energy storage systems like Long Duration Energy Storage Systems (LDES) that meet the following parameters...

- 1. Are manufactured domestically**
- 2. Do not utilize lithium or lead components**
- 3. Prevent thermal runaway**
- 4. Implement safety features that minimize air, water and ground contamination risks in the event of a system failure**

Please note: if lithium-ion BESS is not prohibited then it is important to require robust disaster response plans that detail public notification and evacuation protocols in the event of fire, spill, flood or other hazard and require a comprehensive BESS ordinance; lithium-ion BESS should not be permitted without well thought out regulations in place.

Battery Energy Storage System Information:

Data centers often utilize dozens of Battery Energy Storage Systems (BESS) as part of their supplemental and backup power. Google alone has more than *100 million* utility-scale lithium-ion cells across their global portfolio of data center facilities (1). They are often considered an indispensable part of the renewable energy systems that data centers utilize to help minimize their impact on carbon emissions and electrical grid strain. However, BESS are not necessarily as environmentally-friendly as they are often made out to be. As with any lithium-ion battery, they carry environmental risks and ethical concerns. From a social-ethical perspective, the raw materials used, such as cobalt and lithium, often involve unethical labor practices among other human rights violations (2). The extraction of these raw materials also involves water pollution, air pollution, destruction of ecosystems, depletion of scarce natural resources, and creation of hazardous waste in countries with minimal regulations to adequately address these issues which ultimately results in far reaching global effects (2).

Lithium-ion batteries contain a number of heavy metals (nickel, manganese, cobalt, lithium, iron, aluminum, copper, steel) and hazardous materials (PFAS, plastic components, carbon-based solvents, fluorine, etc), which are often referred to as “volatile electrolytes” (3, 4). If the battery overheats, these volatile elements pose a significant risk of thermal runaway, which is a chain reaction of uncontrolled heating which can easily lead to fires and explosions (4). The flammable nature of these units create a risk of propagation, as the heat and fire spread. The resulting fires, especially those from utility or industrial-scale BESS, come with additional, unique problems and risks. The hazardous chemical components will be released into the air through the smoke plume, and are also carried though the water used to put out the fires (which makes its way into groundwater) (4). These may be in the form of toxic gasses including the liquid electrolyte vaporization, carbon monoxide, hydrocarbons, hydrogen cyanide, sulfur dioxide, and other volatile organic compound emissions, among others (4). Aerosol emissions resulting from a fire may include the heavy metals Nickel, Aluminum, Copper, Cobalt, Manganese, and Lithium, as well as other toxic particles that may easily be inhaled (4). Water and soil are likewise contaminated with these chemicals and elements through firefighting and cleanup/disposal efforts. Another issue is the risk of reignition, sometimes even days later; BESS fires are extremely difficult to extinguish and have been known to last for several days (3, 5). Fighting BESS fires involves special training, equipment, and strategies that small towns may not have the resources for, especially with regard to a large number of BESS.

While there have been improvements in safety designs in recent years, these risks inherently remain, and the more BESS units there are, the greater the risk to the community. The US Environmental Protection Agency has compiled considerations and recommendations for communities to properly regulate and site these systems. They recommend communities consult BESS safety experts to help guide installation design; before the township considers allowing any industrial-scale BESS, this should be a priority (5). Just a year ago, a BESS fire in California resulted in an evacuation of 1,200 residents...an example of the sort of emergency response plan the township should be prepared with before industrial or utility-scale use of battery energy storage systems are installed within the township (5). One of the installation considerations offered by the EPA is for local first responders to help the community develop emergency response plans for incidents at any facility with BESS; this is the rationale behind our request for a letter from local emergency and first responders confirming their ability to respond to potential calls at a data center. If they lack the property training or equipment, the data center developer should be responsible for covering the cost of ensuring our first responders have what they need to adequately protect the community from the unique risks they bring with them. The EPA also recommends an “isolation zone” for large commercial, lithium-ion BESS, of at least 330 feet—something that the township needs to have clearly outlined in the ordinance, should BESS be permitted.

In addition to the environmental risks and ethical concerns, lithium-ion is not ideal for long-duration energy storage. It is only able to store two to four hours of energy, and that storage capacity degrades relatively rapidly, meaning the units have short lifespans (which contributes to a growing issue of how to properly recycle retired units) (6). In addition to being problematic for communities, they may not even be particularly ideal for certain industries—such as data centers—who rely on consistent, long-duration backup power supplies to either offset

their power draw from the grid, or to provide supplemental emergency backup power during grid outages.

That is where Long-Duration Energy Storage (LDES) comes in. As with all technology, there are a number of lithium-alternatives already emerging, providing additional electrochemical options that also offer improvements to the environmental risks and the power supply duration problem.

- One such alternative is sodium-ion batteries, which are far less ethically and environmentally problematic than lithium (6, 7). They do not carry risk of thermal runaway, making them a safe and viable alternative (7).
- Flow batteries, using vanadium redox, are also able to provide long discharge times and have virtually no degradation (6). They also have zero risk of thermal runaway (8). However, the electrolyte mixtures could leak and pose some risks to the environment, and they may produce toxic gases if there is an overcharging failure (9). Still, the risks posed by accidents relating to vanadium redox flow batteries are lower than that of lithium-ion batteries, especially since their primary failure is gradual (unlike lithium ion thermal runaway) and can largely be avoided and mitigated through proper monitoring and maintenance (10).
- Zinc-ion is yet another possible alternative, which is an abundant mineral which is much easier (and less expensive) to source compared to lithium (11). It can also be sourced domestically, and therefore far more ethically (12). The safety of zinc-ion battery energy storage is superior to lithium-ion as well, with no thermal runaway risk and non-toxic minerals (12). While there are some drawbacks related to corrosion and degradation, there are advances already happening to overcome these challenges, making them another viable option for long-duration energy storage (11, 12).
- A fourth potential alternative mineral for lithium is magnesium. Another abundant, cheap material, it is attracting attention for long-duration energy storage. While magnesium itself is safe, the electrolytes needed for energy storage are not as stable as sodium or zinc, posing potential community and environmental risks (13). There are already technological improvements being made, however, to help address these drawbacks (13).

Aside from other minerals, there are other energy storage systems being explored, including gravity-based and thermal systems, which harness the power of gravity and heat to store energy (6).

- Solid gravity-energy storage systems (SGES) are suitable for large applications, are highly efficient, and can store a large amount of capacity—up to several Gigawatt hours (14). This is a type of mechanical energy storage, which uses surplus power to lift a heavy weight. When additional power is required during a shortage, the energy is discharged by lowering the weight. This general technology has been used for a long time, often utilizing water or air as the “weight”. Using a solid material for weight makes the system more geographically adaptable, creates higher energy density, and is more efficient (14). This type of system carries no fire risk or health risks regarding air, ground, or water pollution, but is also not without problems of its own. These systems require a

relatively large, permanent land-use, either by erecting towers or digging underground shafts. As such, these systems also create visual and noise pollution, and carry risks associated with structural failures and mechanical hazards.

- Thermal energy storage captures heat, such as from solar or geothermal systems, and either stores it in a medium, or in chemical bonds (15). These systems can carry some health and environmental risks as well, as the phase change materials and other toxic chemicals can cause corrosion and contamination (16).

The bottom line is that there are a number of viable alternatives to lithium-ion battery storage, and while they carry variable risks and problems of their own, they are all generally considered to be substantially safer than lithium-ion. It is our hope that the township will soon address Battery Energy Storage Systems in its own ordinance, but until then, we recommend including as precise language as possible in the High Impact Land Use Overlay ordinance, to ensure whatever energy storage systems are used on large, industrial scales do not pose unnecessary risks to the community.

We would suggest limiting energy storage systems to sodium-ion and zinc-ion, but at the very least prohibiting the use of lithium-ion, encouraging domestically and ethically sourced materials, requiring zero risk of thermal runaway, and minimal risk of air, ground, and water contamination will ensure that developers carefully assess their energy storage options and select a system that works for their needs—and ours.

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Data Center Ordinance Enforcement: Recommended Violation Penalty Structure

With Real-World Enforcement Evidence and Michigan Statutory Analysis

Prepared for RRC Review and Incorporation into Township Ordinance Framework

Executive Summary

This updated recommendation establishes a tiered violation penalty structure for Howell Township's data center ordinance and incorporates new findings from real-world enforcement cases, Michigan statutory law, and Howell Township's existing fine schedule. The research confirms that standard ordinance fines - at the state-capped level and at Howell Township's current schedule - are categorically insufficient to deter a capital-intensive industry. This finding strengthens the case for the performance bond direct-draw provision as the indispensable enforcement mechanism in any data center ordinance.

This document is intended as a standalone policy input. The RRC is best positioned to determine how this language integrates into the broader ordinance framework, risk management reports, and planning commission presentations.

⚠ Critical Finding: Michigan Law Caps Township Ordinance Fines at \$500

Under Michigan Charter Township Act MCL 42.21, standard ordinance violations - whether prosecuted as misdemeanors or municipal civil infractions - carry a maximum fine of \$500 per offense. Each day of a continuing violation may be charged as a separate offense, but the per-day ceiling remains \$500. At that rate, a data center operating in continuous violation faces a maximum annual penalty exposure of approximately \$182,500. For a facility representing a \$100–\$300 million capital investment, this is not a deterrent. It is a line item.

This finding does not undermine the recommended penalty framework - it clarifies how to structure it. The performance bond direct-draw provision operates as a contractual instrument, not an ordinance fine, and is not subject to the \$500 statutory cap. Conditional zoning agreements and circuit court injunctive relief under the Michigan Zoning Enabling Act (MCL 125.3407) provide additional pathways. Municipal counsel must be engaged to structure these provisions correctly.

Part I: Howell Township’s Current Enforcement Baseline

Before recommending a new penalty framework, the RRC examined what penalties Howell Township currently imposes for ordinance violations. The results establish the baseline against which the adequacy of any data center enforcement regime must be measured.

Current Fine Schedule — Ordinance No. 134 (Municipal Ordinance Violations Bureau)

Howell Township’s adopted schedule of civil fines, as established by Ordinance No. 134 (effective March 15, 2002), is as follows:

Offense Level	Civil Fine
First offense (any civil infraction)	\$100
First repeat offense (within 12 months)	\$250
Second or subsequent repeat offense	\$500 (statutory maximum)

To be clear about what this means in practice: a data center that violates its ordinance conditions in Howell Township - whether by exceeding its approved water withdrawal, running diesel generators beyond permitted hours, or failing to file required reports - faces a first-offense civil fine of \$100. A repeat offender, after a 12-month pattern of violations, faces a maximum fine of \$500 per day.

Context: What \$500 Means to a Data Center Developer

A hyperscale data center earns revenue on the order of millions of dollars per day of operation. The \$500 maximum daily fine under current Howell Township ordinance represents less than one second of operating revenue for a facility of that scale. It is not a deterrent. It is a rounding error in the facility’s daily accounting.

Current Fine Schedule vs. Recommended Framework

Violation Type	Howell Twp. Current Fine	Recommended Fine	Gap
First offense / administrative	\$100	\$1,000–\$5,000/day	10x–50x gap
Repeat operational violation	\$500/day	\$10,000–\$25,000/day	20x–50x gap
Material / structural violation	\$500/day	\$50,000/day	100x gap

Violation Type	Howell Twp. Current Fine	Recommended Fine	Gap
Bad faith / repeat violation	\$500/day	Up to \$100,000/day	200x gap
Water violation (treble damages)	\$500/day	Up to \$300,000/day	600x gap

Note: The “recommended fine” amounts require municipal counsel to structure through conditional zoning agreements, performance bond draw authority, and/or circuit court injunctive relief rather than solely through standard ordinance civil infraction penalties, due to Michigan’s \$500 statutory cap.

Part II: Real-World Enforcement Evidence from Peer Jurisdictions

The RRC examined documented cases in which data center operators have been fined or penalized by regulatory authorities. The record is instructive - not because the fines are adequate, but precisely because they are not.

Company / Jurisdiction	Violation Type	Fine Paid	Significance
Amazon / Oregon DEQ (2025)	Water quality (3 violations): failed monitoring, unauthorized wastewater pond construction, generator overrun	\$10,400 total	Self-reported. Took 2 years for DEQ to issue penalty due to agency resource constraints. Reporters described it as “paltry.” Amazon absorbed it without comment.
Compass Datacenters / Leesburg, VA (2024)	Exceeding air emissions limits for multiple pollutants	~\$68,000	Facility continues to operate with a high-priority violation unresolved after the fine was paid. Fine did not achieve compliance.
Microsoft / Quincy, WA (utility penalty)	Overestimating power use (utility contract violation)	\$210,000 assessed; waived to \$60,000	Microsoft wasted millions of watts of electricity unnecessarily—deliberately burning power to reduce its metered consumption—to avoid paying the fine. The utility board ultimately waived all but \$60,000.
xAI (Elon Musk) / Memphis, TN (2025)	Operating unpermitted gas turbines at data center; Clean Air Act violation	Citizen suit filed; permit obtained under pressure	Developer installed turbines without permits, received Notice of Intent to Sue under Clean Air Act, then obtained permit retroactively. Permit is now being appealed by community stakeholders.

Company / Jurisdiction	Violation Type	Fine Paid	Significance
Microsoft / Bay Area, CA (2008–2009)	Diesel generator emissions; air toxics “Hot Spots” review	No fine reported; regulatory review initiated	Listed as one of the largest stationary diesel polluters in the Bay Area. Cancer risk threshold exceeded for employees at nearby businesses. No significant financial penalty documented.

What the Record Shows

Three patterns emerge from the documented enforcement record that are directly relevant to Howell Township’s ordinance design:

- **Fines do not achieve compliance.** In the Compass Datacenters case, a \$68,000 fine was paid and violations continued. In the xAI/Memphis case, a developer operated unpermitted equipment and obtained retroactive permits only under threat of litigation. The pattern is consistent: at fine levels that are manageable relative to facility revenue, developers calculate and accept the cost rather than change behavior.
- **Regulatory agencies lack the resources to enforce promptly.** Oregon DEQ took two years to process Amazon’s self-reported violations. DEQ staff acknowledged this directly, noting that first-time violators are deprioritized due to resource constraints. A township with no dedicated enforcement staff and a \$500 maximum fine is in a materially weaker position than a state environmental agency.
- **Developers will game enforcement mechanisms if they can.** The Microsoft/Quincy case is the most significant behavioral data point in the record. When faced with a \$210,000 penalty, Microsoft deliberately wasted millions of watts of electricity - burning power unnecessarily for weeks - to reduce its metered consumption figures and eliminate the fine. The utility board ultimately capitulated. This is not aberrant corporate behavior; it is rational cost minimization by a well-resourced actor facing a poorly designed enforcement mechanism. Howell Township must design for this behavior, not against it.

Federal Environmental Penalty Benchmarks for Comparison

For additional context, the following are the maximum civil penalties per day per violation under federal environmental statutes:

Federal Statute	Maximum Civil Penalty / Day / Violation
Clean Air Act	\$93,750
RCRA (hazardous waste)	\$70,117
Clean Water Act	\$51,570
Safe Drinking Water Act / EPCRA / CERCLA	\$53,907

Federal Statute	Maximum Civil Penalty / Day / Violation
Howell Township current maximum (for comparison)	\$500

Part III: Recommended Penalty Framework

Core Principle: The Performance Bond Is the Only Mechanism That Works at Scale

The research record, combined with Howell Township’s \$500 fine ceiling and the Michigan statutory cap, points to a single conclusion: ordinance fines alone cannot deter a data center developer. The recommended framework therefore treats financial penalties as a secondary mechanism and the performance bond direct-draw provision as primary.

The performance bond functions differently from a fine in a critical respect: it is a contractual instrument held in escrow, not a statutory penalty subject to MCL 42.21’s \$500 cap. When the ordinance authorizes direct draw on the bond upon expiration of a cure period, the Township can access meaningful financial leverage - without going to court, without waiting years for a state agency, and without being outspent in litigation by a developer whose legal budget dwarfs the Township’s annual operating costs.

This is the mechanism that makes the rest of the framework enforceable. Without it, the tiered penalty schedule is aspirational. With it, it has teeth.

Tiered Penalty Schedule

Tier	Violation Type	Penalty Range	Cure Period	Enforcement Authority
Tier 1	Administrative / Technical	\$1,000–\$5,000/day per violation	30 days; written notice required	Township Administrator
Tier 2	Operational	\$10,000–\$25,000/day per violation	14 days; bond drawable if uncured	Planning Dept. + Township Counsel
Tier 3	Material / Structural	\$50,000/day per violation	None; corrective action plan in 5 business days	Stop-work authority; bond fully callable
Tier 4	Bad Faith / Repeat	Up to \$100,000/day per violation	None	Permit revocation; injunctive relief at developer’s expense

Implementation note: Tier 1 fines may be pursued through standard civil infraction processes. Tiers 2–4 should be structured through conditional zoning agreements and performance bond draw authority, which are not subject to the \$500 statutory cap. Municipal counsel must confirm the appropriate legal vehicle for each tier prior to ordinance adoption.

Tier Detail

Tier 1 — Administrative and Technical Violations

Examples: Late or incomplete filings; missed water or energy reporting deadlines; minor permit deviations not affecting operations or neighbors.

Penalty: \$1,000–\$5,000 per day, per violation. 30-day cure period with written notice. No escalation if cured within the period.

Rationale: Motivates timely correction without triggering an adversarial posture. The Amazon/Oregon case demonstrates that even large developers will absorb minimal fines without changing behavior; this tier is designed to make non-compliance administratively inconvenient rather than invisible.

Tier 2 — Operational Violations

Examples: Exceeding approved daily water withdrawal volumes; exceeding noise thresholds at adjacent property lines; operating diesel generators beyond permitted hours; failure to maintain required vegetative buffers.

Penalty: \$10,000–\$25,000 per day, per violation. 14-day cure period. Upon expiration, the Township draws directly on the performance bond for the accrued amount without a court order.

Rationale: Direct harm to neighboring residents or shared resources. The bond draw authority is the critical element - it removes the incentive to outlast the Township in litigation, which is the strategy Microsoft demonstrated in the Quincy, Washington case.

Tier 3 — Material and Structural Violations

Examples: Construction outside approved footprint or impervious surface limits; operating beyond permitted capacity; failure to maintain or replenish the decommissioning performance bond; unauthorized modifications to stormwater infrastructure.

Penalty: \$50,000 per day, per violation. No cure period. Corrective action plan required within 5 business days. Stop-work authority triggered immediately. Performance bond fully callable.

Rationale: These violations represent a fundamental departure from the terms under which the facility was approved. The absence of a cure period reflects the seriousness of the breach.

Tier 4 — Bad Faith and Repeat Violations

Examples: Any Tier 1–3 violation recurring within 12 months of a prior finding; material misrepresentation in permit applications or disclosures; violation discovered in connection with state or federal enforcement action.

Penalty: Up to \$100,000 per day, per violation. No cure period. Permit revocation authority triggered. Township may seek injunctive relief with legal costs borne by the developer. Performance bond fully callable.

Rationale: The xAI/Memphis and Compass Datacenters cases both demonstrate that developers will continue operating in violation when fines are manageable. Permit revocation is the ultimate backstop; its existence in the ordinance changes the risk calculation even if it is rarely exercised.

Part IV: Essential Companion Provisions

The tiered penalty schedule is necessary but not sufficient. The following structural provisions must accompany it:

1. Performance Bond Direct Draw (Non-Negotiable)

For Tier 2, 3, and 4 violations, the ordinance must explicitly authorize direct draw on the performance bond upon expiration of the applicable cure period - without requiring a court judgment. This is the single most important provision in the entire enforcement framework. The Microsoft/Quincy case demonstrates what happens when a well-capitalized developer faces enforcement without this backstop: they absorb or manipulate their way around the penalty. Bond draw authority closes that option.

2. Treble Damages for Water Violations

Unauthorized water use or material underreporting of water consumption must carry triple the standard per-day penalty. The Lincoln Institute of Land Policy has documented that a single large data center can represent 10% or more of an entire county's daily water consumption. In the Amazon/Oregon case, violations included both failing to monitor water quality and constructing a wastewater pond without approval. A \$10,400 total fine for both offenses is not commensurate with the potential harm. Treble damages for water violations are consistent with environmental enforcement practice in other regulatory contexts.

3. Attorney's Fees Provision

If the Township must pursue enforcement through litigation and prevails, the developer must reimburse all legal costs. This provision is essential given the resource asymmetry between a township and a hyperscale developer. Without it, litigation itself becomes a developer's enforcement strategy - as the Quincy utility board's decision to waive most of Microsoft's fine illustrates, sustained legal pressure from a well-resourced party produces capitulation.

4. Annual Escalation Clause

All penalty amounts must be indexed annually to the Consumer Price Index (CPI) or a fixed 3% escalator, whichever is greater. Data centers are designed to operate for 15–25 years. A penalty schedule written in 2025 dollars must retain meaningful deterrent value in 2040.

5. Sunset Review Trigger

Any facility receiving two or more Tier 2 or higher violations within a rolling 36-month period should trigger mandatory permit review. This provision responds directly to the Compass Datacenters pattern: fine paid, violation unresolved, facility continues operating. Mandatory

review creates a structured opportunity to reassess whether continued operation meets the conditions of original approval.

6. Non-Disclosure Agreement Prohibition

The Lincoln Institute has documented that data center developers routinely require host communities to sign non-disclosure agreements covering water usage, energy consumption, air quality impacts, and emissions data. Howell Township's ordinance should explicitly prohibit any NDA provision that restricts the Township's ability to disclose operational data to residents, regulatory agencies, or the planning commission. Enforcement without transparency is impossible.

Part V: Supporting Evidence Summary

The following sources underpin the findings and recommendations in this report:

- **Amazon / Oregon DEQ (2025):** Documented case of \$10,400 total fine for three violations at two data center facilities, including unauthorized wastewater pond construction and generator overrun. Self-reported violations took two years to result in a penalty. Source: Oregon DEQ Enforcement Actions newsroom; East Oregonian; KEPR-TV.
- **Compass Datacenters / Leesburg, VA (2024):** Documented \$68,000 fine for exceeding air emissions limits. Facility continues to operate with a high-priority violation unresolved. Source: Mississippi Free Press (February 2026, citing EPA compliance data).
- **Microsoft / Quincy, WA:** Documented case in which Microsoft wasted millions of watts of electricity deliberately to reduce metered consumption and avoid a \$210,000 utility penalty. Penalty ultimately reduced to \$60,000 by utility board. Source: New York Times; CSO Online; Computerworld.
- **xAI / Memphis, TN (2025):** Data center operated unpermitted gas turbines, received Clean Air Act citizen suit Notice of Intent to Sue, obtained retroactive permit under pressure. Permit now under community appeal. Source: American College of Environmental Lawyers (ACOEL) blog.
- **Loudoun County, Virginia:** Board of Supervisors public statements acknowledge that the county cannot become overly dependent on a single revenue source and is actively restructuring its tax rate to reduce data center concentration. The county has over 27 million square feet of data center space generating revenues approaching the size of its entire operating budget. Source: Loudoun County FAQ on data center tax revenues; Lincoln Institute of Land Policy (October 2025).
- **Lincoln Institute of Land Policy (October 2025):** Documents that data center operators routinely conceal water usage, energy consumption, and air quality data from host communities behind non-disclosure agreements. Identifies transparency requirements with meaningful penalties as a structural remedy. Source: "Data Drain: The Land and Water Impacts of the AI Boom," Land Lines magazine.

- **Michigan Charter Township Act, MCL 42.21:** Establishes \$500 maximum per-offense fine for standard municipal ordinance violations. Daily violations may be charged as separate offenses. Performance bond draw authority and circuit court injunctive relief under MCL 125.3407 are the appropriate vehicles for penalties exceeding this cap.
- **Howell Township Ordinance No. 134 (Municipal Ordinance Violations Bureau, 2002):** Establishes the Township's current civil fine schedule: \$100 (first offense), \$250 (first repeat), \$500 (subsequent repeats). This is the current enforcement baseline against which any data center ordinance must be measured.
- **Federal EPA civil penalty benchmarks:** Clean Air Act maximum: \$93,750/day/violation. Clean Water Act: \$51,570/day/violation. RCRA: \$70,117/day/violation. These federal figures provide a reference point for the scale of meaningful deterrence in environmental enforcement contexts.

Prepared by the Howell Township Resident Research Committee. This recommendation reflects the RRC's independent analysis and does not constitute legal advice. The RRC recommends that the Township obtain qualified municipal counsel—with experience in Michigan zoning enabling act enforcement and conditional zoning agreements—to review and structure penalty provisions prior to ordinance adoption.

~~Sound levels shall not exceed 55 dBA at the any high impact land use parcel property line, and the C-weighted and Z-weighted sound level wavelength level readings shall not exceed the A-weighted sound level by more than 15 decibels at the same location the pre- high impact land use construction wavelength level readings. Backup Generators and cooling equipment shall not exceed 65 dBA at the high impact land use parcel property line. except during emergency operation.~~

Suggestion is as follows:

Sound levels shall comply with the table below during normal operation.

Table Y		
Type of Sound	Frequency	Criteria at Property Line
Infra Sound	0-20 Hertz	Not Permitted
Tonal Sound	21- 200 Hertz	50 Decibel C
Higher Sound	201-20000 Hertz	60 Decibel A

During emergency situations the higher sound levels shall not exceed 65 Decibels

In addition, due to external noises in the area, there shall be a maximum of six (6) additional Decibel increase.

- See Noise Charts/Maps for Proposed Warrenton AWS Data Center By John W. Lyver, IV, Ph.D.
- See I-96 Flex Route Traffic Noise Analysis Technical Memorandum JANUARY 2019
 - Data on the study indicates that measured noise was 55 to 70 Decibel range, with higher traffic that between Howell and Fowlerville, the suggested value is 60-65 Decibel A. (My estimate)
- MDOT measures noise only during construction. Here is the MDOT website.
 - [Regulations And Guidance - Noise - ENVIRonment - FHWA](#)

d. The Township reserves the right to amend, implement and enforce any additional noise and vibration regulations at any time, applicable to all existing and/or new high impact land uses.

I disagree with this position because once a project meets the requirements of the ordinance and receives township approval, it should not be subject to changes from a revised ordinance. If the ordinance is amended after approval, properties that were compliant under the original rules would become non-conforming sites. These might then be considered "grandfathered."

- i. Sound study/routine sound surveillance schedule and additional requirements: a sound study must be submitted to the Township within 60 days of issuance of a certificate of occupancy for each phase of development and upon the facility becoming fully operational. ~~Additional sound studies shall be required at the time modifications of any kind are made, at the time of any resident or sensitive receptor complaint and at the discretion of the Township.~~

My thought is

Additional sound studies shall be required under the following circumstances;

- When modifications are made to the operations and hardware systems.
- During the initial 12 months to establish an annual baseline.
- Annually, to ensure compliance.
- Upon receipt of complaints from residents or sensitive receptors.
- At the discretion of the Township.

The recommendations are based on 46 years of experience maintaining chilling units for precise chemical operations. There are notable maintenance challenges related to ensuring consistent uptime, particularly when regulating temperature during periods of elevated summer temperatures.

Why did I select sound values, in Table Y

Infra sound is a true hazard. Reference is Handbook of Human Vibration 1990 Griffin, explains low frequency sound on organs. This was in relation to seats in cars.

Tonal Sounds; Are caused by the chillers and generators, all of which can be abated with dampening materials to meet 50 decibel. Will avoid the irritation of hum values

Higher sounds : 60 Decibel should work, because the problem sounds should be captured in the other ranges.

Good summary of potential sound issues

Proper management of infrasound and tonal sound using the proposed table will resolve this community sound issue.

Appendix: Health Effects Attributed to Increased Noise Levels

The following analysis was assembled by Dr. Ally Stoeger (Chair of the Health and Safety Committee, HOA Roundtable of PWC) and is gratefully used with her permission.

Persistent 24/7 Data Center Noise in the community can cause:

- **Chronic Sleep Deprivation**
- **Anxiety and Depression due to combination of noise and lack of control when residents realize this noise even permeates their homes**
- **Difficulty with Concentration**
- **Increases stress related conditions such as:**
 - **gastrointestinal problems**
 - **auto-immune diseases**
 - **hypertension and cardiovascular disease**
- **Increased health risk as residents avoid outdoor exercise**

Chronic sleep deprivation affects both your brain and body and can cause:

- **Anxiety, depression, mood swings, suicidal thoughts**
- **Memory and concentration**
- **For children it can decrease growth hormones**
- **Vehicular and Workplace accidents**
- **Impacts insulin release and increases risk of diabetes**
- **Less interest in exercise due to fatigue**
- **Hypertension, cardiovascular health, and stroke:**
June 2022: American Heart Association updated the cardiovascular checklist by adding the importance of 7 – 9 hours sleep

PERSISTENT 24/7 NOISE, AS WELL AS SLEEP DEPRIVATION DUE TO NOISE, CAN IMPACT MENTAL AND PHYSICAL HEALTH AND DRAMATICALLY LOWER QUALITY OF LIFE.



I-96 Flex Route Traffic Noise Analysis Technical Memorandum

JANUARY 2019

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1 Executive Summary

This report evaluates the potential noise impacts of the proposed improvements to the Interstate Highway 96 (I-96) corridor from Kent Lake Road to the Interstate Highway 275 (I-275)/Interstate Highway 696 (I-696)/Michigan State Highway 5 (M-5) interchange in conformance with corresponding Federal regulations and guidance, and the National Environmental Policy Act (NEPA).

The location of this project is shown in Figure 1.

Figure 1. I-96 Flex Route Study Corridor



The proposed improvements include the addition of Active Traffic Management (ATM) solutions as well as reconstruction of the median shoulder in each direction to serve as a temporary through-lane during certain periods of the day. The project is being studied as a Type I project because of the addition of an a through-traffic lane. This report evaluates the potential noise impacts of the proposed improvements of the project in conformance with corresponding Federal regulations and guidance, and NEPA. The noise analysis presents the existing and future acoustical environment at various receptors located in the I-96 noise study area.

The determination of noise abatement measures and locations complies with the Federal Highway Administration’s (FHWA) Procedures for Abatement of Highway Traffic Noise and Construction Noise as presented in the Code of Federal Regulations, Title 23 Part 772 (23 CFR 722), and the Michigan Department of Transportation (MDOT): *Highway Noise Analysis and Abatement Handbook*, dated July 2011 (Handbook). The Handbook complies with the State Transportation Commission Policy 10136 Noise Abatement, dated July 31, 2003.

Existing noise level measurements were conducted on August 23, 2018 at eight representative sites in the project vicinity. Fifteen-minute measurements were taken at each site. Measurement locations are shown in Appendix A. Traffic was counted and classified concurrently during each noise measurement by vehicle type: cars, medium trucks, heavy trucks, buses, and motorcycles. The measured noise levels are then compared to modeled noise levels based on the traffic counts. The model is validated if measured highway

traffic noise levels and predicted highway traffic noise levels for the existing conditions using the concurrent traffic counts are within +/- 3 dB(A)¹. This modeling, as required by the FHWA, is performed with TNM version 2.5.

FHWA's TNM version 2.5, was used to model existing (2017) and design year (2040) worst hourly traffic noise levels within the I-96 noise analysis study area. 109 receptors (Category B, C, and D) were modeled. Appendix A shows the modeled receptors and highlights the receptors along the project corridor that are impacted, that is, they approach or exceed the FHWA Noise Abatement Criteria (NAC). Predicted future design year (2040) noise levels adjacent to the proposed improvements would approach or exceed the NAC at 37 receptors (28 residential receptors, one day care center receptor, one television studio receptor and seven trail receptors). The noise levels at these 37 impacted receptors would range from 66.2 to 76.0 dB(A) $L_{eq}(h)$. Changes in L_{eq} noise levels under the future Build condition will range from 0.2 to 1.2 dB(A) compared to existing conditions. Therefore, none of the predicted future noise levels would substantially exceed existing noise levels (MDOT has defined a substantial increase as being a 10 dB(A) or greater increase between existing and design year noise level).

Eight noise barriers (NB) have been evaluated for this noise study. See Table 1 and Appendix A.

NB1, NB3, NB4, and NB7 meet preliminary feasibility criteria but did not meet the reasonableness criteria as the design goal for these barriers was not met. NB2, NB5, NB6, and NB8 meet preliminary feasibility criteria but did not meet the reasonableness criteria as the cost per benefited receptor for each barrier exceeds the cost per benefited unit cost established by MDOT. Descriptions and analysis of each barrier is described below:

- NB1 is located on the north side of I-96 between the westbound Milford Road off ramp and South Hill Road and was designed to mitigate residential uses and the Huron Valley Trail. NB1 meets preliminary feasibility criteria but did not meet the reasonableness criteria as the design goal for this barrier was not met (50 percent of the benefited receptors did not receive a noise reduction of 7 dB(A)).
- NB2 is located on the north side of I-96 between South Hill Road and the eastern terminus of South Hill Court and was designed to mitigate residential uses. NB2 meets preliminary feasibility criteria but did not meet the reasonableness criteria as the cost per benefited receptor (\$303,739) exceeds the cost per benefited unit cost established by MDOT (\$46,967)².
- NB3 is located on the north side of I-96 from approximately 900 feet west of Old Plank Road to Old Plank Road and was designed to mitigate residential uses. NB3 meets preliminary feasibility criteria but did not meet the reasonableness criteria as the design goal for this barrier was not met (did not achieve a 10 dB(A) or more reduction for at least one benefited receptor).
- NB4 is located on the north side of I-96 between Old Plank Road and approximately 1,800 feet east of Old Plank Road and was designed to mitigate residential uses. NB4 meets preliminary feasibility criteria but did not meet the reasonableness criteria as the design goal for this barrier was not met (did not achieve a 10 dB(A) or more reduction for at least one benefited receptor).
- NB5 is located on the north side of I-96 to the east and west of Taft Road and was designed to mitigate residential uses. NB5 meets preliminary feasibility criteria but did not meet the reasonableness criteria as the cost per benefited receptor (\$598,680) exceeds the cost per benefited unit cost established by MDOT (\$46,967).

¹ *Highway Noise Analysis and Abatement Handbook*, Michigan Department of Transportation, 2011, page 16.

² Thomas Hanf email regarding "Re: Noise and Air Quality Guidance – I-375". MDOT Air Quality & Noise Abatement, April 17, 2018.

- NB6 is located on the south side of I-96 between Beck Road and Wixom Road and was designed for residential uses and a day care center. NB6 meets preliminary feasibility criteria but did not meet the reasonableness criteria as the cost per benefited receptor (\$237,165) exceeds the cost per benefited unit cost established by MDOT (\$46,967).
- NB7 is located on the south side of I-96 between Milford Road and just east of the Huron Valley Trail passing under I-96 and was designed to mitigate a trail receptor. NB7 meets preliminary feasibility criteria but did not meet the reasonableness criteria as the design goal for this barrier was not met (did not achieve a 10 dB(A) or more reduction for at least one benefited receptor).
- NB8 is located on the south side of I-96 between Milford Road and Kent Lake Road (two sections designed) and was designed for receptors along the Huron Valley Trail. This barrier meets preliminary feasibility criteria but did not meet the reasonableness criteria as the cost per benefited receptor (\$604,926) exceeds the cost per benefited unit cost established by MDOT (\$46,967).

Table 1. Noise Barrier Summary

Noise Barrier ID	Receiver IDs	Feasible ¹	Meets Design Goal ²	Benefited Receptors	Length (ft)	Height (ft)	Square Footage (Sq ft)	Barrier Cost (\$45 per sq ft)	Cost per Benefited Receptor	Reasonable
NB1	B-1 to B-20, B-28 to B-43, NN-1	Yes	No	27	4,085	24	98,033	\$4,411,485	NA ³	No
NB2	B-21 to B-27, B-44 to B-62	Yes	Yes	4	1,399	12 – 24	26,999	\$1,214,955	\$303,739	No
NB3	C-1 to C-3	Yes	No	2	1,114	24	26,742	\$1,203,390	NA ³	No
NB4	C-4 to C-7	Yes	No	2	997	24	23,930	\$1,076,850	NA ³	No
NB5	J-3 to J-7	Yes	Yes	2	1,130	20 - 24	26,608	\$1,197,360	\$598,680	No
NB6	Z-1, Z-2, AA-1	Yes	Yes	3	1,108	10 - 18	15,811	\$711,495	\$237,165	No
NB7	NN-2	Yes	No	1	1,314	24	31,545	\$1,419,525	NA ³	No
NB8	NN-3 to NN-6, OO-1 to OO-10	Yes	Yes	5	3,946	6 - 24	67,214	\$3,024,630	\$604,926	No

¹ MDOT requires that noise barriers achieve a 5-dB reduction at 75 percent of the impacted receptors. If a barrier cannot achieve this, abatement is considered to not be acoustically feasible.

² The design year attenuation requirement for Michigan is to provide a noise reduction of 10 dB(A) for at least one benefited receptor and at least a 7 dB(A) reduction for 50 percent or more of the benefited receptor sites.

³ NA – Noise barrier is not feasible or does not meet the design goal.

MDOT's noise policy states that all noise abatement measures determined to be feasible and reasonable shall be incorporated into the transportation improvement project. Based on the study completed, preliminary abatement measures for the project do not meet the MDOT's reasonableness criteria for the impacted units.

2 Purpose of this Report

This report evaluates the potential noise impacts of the proposed improvements to the Interstate Highway 96 (I-96) corridor from Kent Lake Road to the Interstate Highway 275 (I-275)/Interstate Highway 696 (I-696)/Michigan State Highway 5 (M-5) interchange in conformance with corresponding Federal regulations and guidance, and the National Environmental Policy Act (NEPA).

2.1 Project Description

I-96 ATM is a project to install intelligent transportation systems (ITS) equipment on trusses and cantilevers over the roadway at approximately ½ mile spacing on I-96 from east of Kent Lake Road to the I-275/I-696/M-5 interchange, as well as adding ramp meters to the on ramps within the project corridor. The project also includes reconstruction of the median shoulders and barrier wall, installation of additional median drainage structures and an HMA overlay of the mainline lanes and outside shoulders. The reconstruction of the median shoulders will provide an extra travel lane in each direction that will only be activated during peak hour periods in the morning and afternoon.

The project is in Oakland County, Michigan. Project location is shown in Figure 1.

2.2 Noise Analysis Overview

The noise analysis presents the existing and future acoustical environment at various receptors located in the study area.

The determination of noise abatement measures and locations complies with the Federal Highway Administration's (FHWA) Procedures for Abatement of Highway Traffic Noise and Construction Noise as presented in the Code of Federal Regulations, Title 23 Part 772 (23 CFR 722), and the Michigan Department of Transportation (MDOT): *Highway Noise Analysis and Abatement Handbook*, dated July 2011 (Handbook). The Handbook complies with the State Transportation Commission Policy 10136 Noise Abatement, dated July 31, 2003.

Existing noise level measurements were conducted on August 23, 2018 at eight representative sites in the project vicinity. Fifteen-minute measurement were taken at each site. Traffic classification counts along I-96 were taken at each site concurrent with the noise measurements.

FHWA's Traffic Noise Model version 2.5 (TNM) was used to model existing (2017) and future (2040) Build design hour traffic noise levels within the study area.

Eight noise barriers (NB) have been evaluated for this noise study. See Table 1 and Appendix A.

MDOT's policy is to install feasible and reasonable noise barriers associated with transportation improvements. Based on the noise analysis completed, mitigation of noise impacts for the proposed I-96 project would not be feasible and reasonable for the analyzed noise barrier locations.

3 Traffic Noise Concepts, Policy and Guidelines

3.1 Basic Noise Information

Noise is defined as unwanted and disruptive sound. The ear is sensitive to pressure variation and perceives it as sound. The intensity of these pressure variations causes the ear to discern different levels of loudness. These pressure differences are most commonly measured in decibels.

The decibel (dB) is the unit of measurement for sound. The decibel scale audible to humans spans approximately 140 dB. A level of zero decibels corresponds to the lower limit of audibility, while 140 dB produces a sensation more akin to pain than sound. The decibel scale is a logarithmic representation of the actual sound pressure variations. Therefore, a 26 percent change in the energy level only changes the sound level 1-dB. The human ear would not detect this change except in an acoustical laboratory. A doubling of the energy level would result in a 3-dB increase, which would be barely perceptible in the natural environment. A tripling in energy sound level would result in a clearly noticeable change of 5-dB in the sound level. A change of 10 times the energy level would result in a 10-dB change in the sound level. This would be perceived as a doubling (or halving) of the apparent loudness. Table 2 provides a comparison of sound level changes with relative loudness.

The human ear has a non-linear sensitivity to noise. To account for this in noise measurements, electronic weighting scales are used to define the relative loudness of different frequencies. The “A” weighting scale is widely used in environmental work because it closely resembles the non-linearity of human hearing. Therefore, the unit of measurement for an A-weighted noise level is dB(A).

Table 2. Logarithmic Nature of Sound

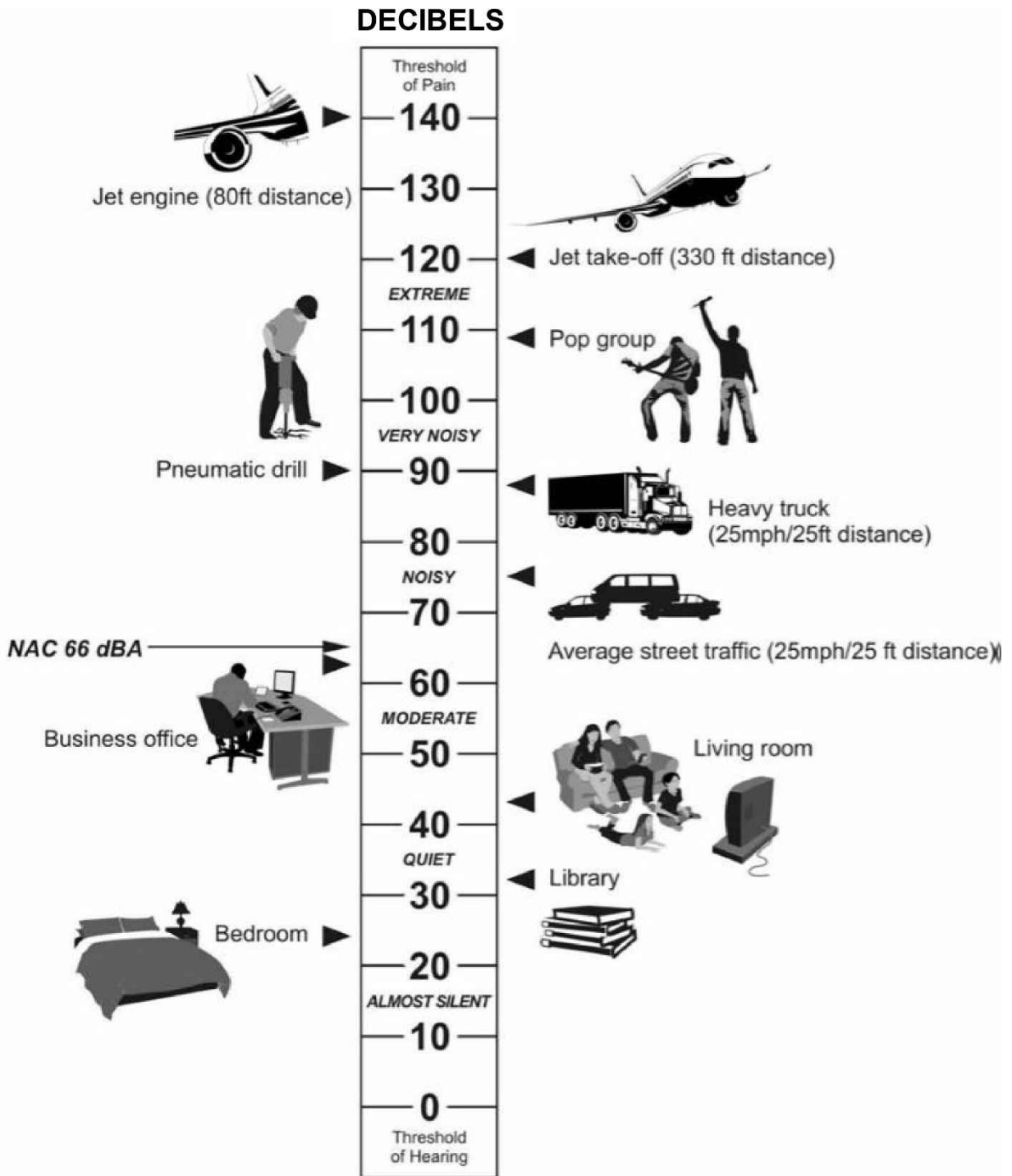
Change in L_{eq} (1h) Sound Level Relative Loudness in the Natural Environment	Change in L_{eq} (1h) Sound Level Relative Loudness in the Natural Environment
+/- 3 dB(A)	Barely Perceptible Change
+/- 5 dB(A)	Readily Perceptible Change
+/- 10 dB(A)	Considered Twice or Half as Loud

Traffic noise is not constant. It varies as each vehicle passes through a certain location. The time-varying characteristics of environmental noise are analyzed statistically to determine the duration and intensity of noise exposure. In an urban environment, noise is made up of two distinct components. One is ambient or background noise. Wind noise and distant traffic noise make up the ambient acoustical environment surrounding the project. These sounds are not readily recognized but combine to produce a non-irritating ambient sound level. This background sound level varies throughout the day, being lowest at night and highest during the day. The other component of urban noise is intermittent and louder than the background noise. Transportation noise and local industrial noise are examples of this type of noise. It is for these reasons that environmental noise is analyzed statistically.

It is necessary to use a method of measure that will account for the time-varying nature of sound when studying environmental noise. The equivalent sound pressure level (L_{eq}) is defined as the continuous steady sound level that would have the same total A-weighted sound energy as the real fluctuating sound measured over a given period of time. As a result, the three characteristics of noise combine to form a single descriptor (L_{eq} in dB(A)) that is used to evaluate human response to noise and has been chosen for use in this study. The time-period used to determine traffic noise levels is one hour and uses the descriptor $L_{eq}(1h)$.

Traffic noise at a receiver is influenced by the following major factors: distance from the traffic to the receiver, volume of traffic, speed of traffic, vehicle mix, and acoustical shielding. Tire sound levels increase with vehicle speed but also depend upon road surface, vehicle weight, tread design and wear. Change in any of these can vary noise levels. At lower speeds, especially in trucks and buses, the dominant noise source is the engine and related accessories. Figure 2 provides sound levels of typical noise sources.

Figure 2. Sound Levels of Typical Noise Sources



Adopted from "Environmental Criteria for Road Traffic Noise", Environmental Protection Authority, South Sydney, NSW, May 1999, Page 38.

3.2 Federal Regulations and Guidance

The FHWA's *Procedures for Abatement of Highway Traffic Noise and Construction Noise* as presented in the Code of Federal Regulations, Title 23 Part 772 (23 CFR 772). This regulation, plus other guidance documents written to explain the regulation, sets forth the process for performing a traffic noise analysis. The process includes the following:

- 1) Identification of highway traffic noise impacts
- 2) Examination of potential abatement measures
- 3) Gathering of public input approval for feasible and reasonable abatement measure
- 4) Incorporation of feasible and reasonable highway traffic noise abatement measures into the highway project
- 5) Coordination with local officials to provide helpful information on compatible land use planning and control
- 6) Identification and incorporation of necessary measures to abate construction noise

The highway traffic noise impact identification process involves a review of the existing land use activity categories that parallel the highway corridor and determining existing and future noise levels within those areas. Existing land use of developed lands is identified by inspecting aerial photography and performing site reconnaissance. Highway traffic noise analyses are also performed for undeveloped lands that have received a building permit.

After the existing and proposed land uses are established, ambient noise levels are measured along the corridor with simultaneous traffic counts. The measured noise levels are then compared to modeled noise levels based on the traffic counts. The model is validated if measured highway traffic noise levels and predicted highway traffic noise levels for the existing conditions are within +/- 3 dB(A)³. This modeling, as required by the FHWA, is performed with TNM version 2.5. Once the model is validated, TNM is used to model the existing and the future build loudest hour for traffic noise analysis.

The FHWA Noise Abatement Criteria (NAC), which is presented in 23 CFR 772, establishes the NAC for various land uses, and is presented in Table 3. A traffic noise impact is defined as a future noise level that approaches or exceeds the NAC; or a future noise level that creates a substantial noise increase over existing noise levels. An approaching noise level is defined as being at least one dB(A) less than the noise level value listed in the NAC for Activity Category A through G. The FHWA allows states to define a substantial noise increase as an increase of anywhere between 5 and 15 dB(A).

³ *Highway Noise Analysis and Abatement Handbook*, Michigan Department of Transportation, 2011, page 16.

Table 3. Noise Abatement Criteria (NAC)

Activity Category	Activity Criteria ^{1 2}		Evaluation Locator	Activity Description
	L _{eq} (h) ³	L10(h) ⁴		
A	57	60	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67	70	Exterior	Residential
C	67	70	Exterior	Active sport areas, amphitheatres, auditoriums, campgrounds, cemeteries, daycare centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	55	Interior	Auditoriums, daycare centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E ⁵	72	75	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F.
F	N/A	N/A	N/A	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	N/A	N/A	N/A	Undeveloped lands that are not permitted.

¹ MDOT identifies a significant noise impact as a 10 dB(A) increase between the existing and predicted design year sound levels, or a measured or modeled noise level 1 dB(A) less than the NAC standard

² Either L_{eq}(h) or L10(h) (but not both) may be used on a project. MDOT uses L_{eq}(h). The L_{eq}(h) and L10(h) Activity Criteria values are for impact determination only and are not design standards for noise abatement measures.

³ L_{eq} is the equivalent steady-state sound level which in a stated period of time contains the same acoustic energy as the time-varying sound level during the same time period, with L_{eq}(h) being the hourly value of L_{eq}.

⁴ L10 is the sound level that is exceeded 10 percent of the time (90th percentile) for the period under consideration, with L10 being the hourly value of L10.

⁵ Includes undeveloped lands permitted for this activity category

Source: *Highway Noise Analysis and Abatement Handbook*, Michigan Department of Transportation, 2011.

After traffic noise impacts were identified, potential abatement alternatives were examined. The following abatement alternatives, which are listed in 23 CFR 772.15(c) are permitted and can be evaluated where applicable:

- 1) Construction of noise barriers including acquisition of property rights, either within or outside the highway right-of-way
- 2) Traffic management measures
- 3) Alteration of horizontal and vertical alignments
- 4) Acquisition of real property or interests therein to serve as a buffer zone to preempt development
- 5) Noise insulation of Activity Category D land use activities listed in Table 3

At a minimum, state highway agencies are required to consider noise abatement in the form of noise barriers.

FHWA defines feasible highway traffic noise abatement as objective engineering considerations (e.g., can a barrier be built given the topography of the location; can a substantial noise reduction be achieved given certain access, drainage, safety, or maintenance requirements; are other noise sources present in the area, etc.). An abatement measure must achieve a noise reduction of at least 5 dB(A) to be considered feasible, according to 23 CFR 772.13 (d)(1)(i). MDOT's feasibility criteria are provided in Section 5.1 of this document.

The FHWA lists three required reasonableness factors when considering noise barriers: cost effectiveness, viewpoints of benefiting receptors, and achievement of noise reduction design goals. For reasonableness, 23 CFR 772.13 (d)(2)(iii) requires state departments of transportation to define design year reduction goals somewhere between 7 and 10 dB(A). FHWA lists **optional reasonableness factors** that can be added to but not overrule the required reasonableness factors.

3.3 State Rules and Procedures

The Handbook is the State's tool for implementing 23 CFR 772. The Handbook expands on 23 CFR 772 by refining definitions and establishing milestones within the design phase for the completion of noise impact analysis and mitigation development.

The Handbook includes the following definitions:

Noise Impact: A substantial noise increase or a predicted design year noise level that is 1 dB(A) less, equal to, or greater than the NAC level.

Substantial Noise Increase: A 10 dB(A) or greater increase between the existing noise level and the design year predicted noise level.

Feasible Noise Barrier: A barrier that has no construction impediments, meets safety requirements for the traveling public, and provides at least 5 dB(A) noise reduction at 75 percent of the impacted receptors.

Reasonable Noise Barrier: A barrier that is cost effective, favorable to the majority of benefited receptors, and achieves noise reduction design goals by meeting or exceeding the reasonableness factor.

Cost Effective Noise Barrier: A noise barrier analyzed for environmental clearance with a preliminary construction cost that is not more than three percent above the allowable cost per benefited receptor unit (CPBU) of \$46,967 (year 2018)⁴, assuming a \$45.00 per square foot noise barrier construction cost.

Benefited Receptor: A receptor that receives a 5 dB(A) or greater traffic noise reduction as a result of a proposed noise barrier.

Design Year Reduction Goal: Noise reduction of 10 dB(A) for at least one benefited receptor and provide at least a 7 dB(A) reduction for 50 percent or more of the benefited receptor sites.

Permitted Development: Any presently undeveloped lands that have received a building permit from the local township or city.

⁴ Thomas Hanf email regarding "Re: Noise and Air Quality Guidance – I-375". MDOT Air Quality & Noise Abatement, April 17, 2018.

4 Noise Analysis

4.1 FHWA Traffic Noise Model (TNM)

TNM version 2.5 is FHWA's computer program for highway traffic noise prediction and analysis. The following parameters are used in this model to calculate an hourly $L_{eq}(1h)$ at a specific receiver location:

- Distance between roadway and receiver
- Relative elevations of roadway and receiver
- Hourly traffic volume in light-duty (two axles, four tires), medium-duty (two axles, six tires), and heavy-duty (three or more axles) vehicles
- Vehicle speed
- Ground absorption
- Topographic features, including retaining walls and berms

Highway noise sources have been divided into five types of vehicles; automobiles (A), medium trucks (MT), heavy trucks (HT), Buses (B) and Motorcycles (MC). Each vehicle type is defined as follows⁵:

- Automobiles – all vehicles with two axles and four tires, includes passenger vehicles and light trucks, less than 10,000 pounds
- Medium trucks – all vehicles having two axles and six tires, vehicle weight between 10,000 and 26,000 pounds
- Heavy trucks – all vehicles having three or more axles, vehicle weight greater than 26,000 pounds
- Buses – all vehicles designed to carry more than nine passengers
- Motorcycles – all vehicles with two or three tires and an open-air driver/passenger compartment

Noise levels produced by highway vehicles can be attributed to three major categories:

- Running gear and accessories (tires, drive train, fan and other auxiliary equipment)
- Engine (intake and exhaust noise, radiation from engine casing)
- Aerodynamic and body noise

4.2 Analysis

4.2.1 Land Use and Field Measurement Levels

The I-96 noise analysis area includes residential, day care center, television studio, active sport area, medical facility, trail, school, motel, office, restaurant, retail, and industrial areas. The criteria stated in Table 3 helps to determine if the proposed project will produce noise levels that approach or exceed the NAC throughout the corridor.

The project corridor was divided into common noise environments (CNE) to facilitate the analysis of highway noise of areas of like land uses. The CNE listed boundaries are identified in Table 4 and illustrated in Appendix A.

⁵ G.S. Anderson, C.S.Y. Lee, G.G. Fleming and C. Menge, "FHWA Traffic Noise Model®, Version 1.0 User's Guide", Federal Highway Administration, January 1998, p.60.

Table 4. Project Area Common Noise Environments

CNE	Site Description
A	Retail and industrial uses bounded by I-96 on the south, Milford Road on the west and Alta Equipment Company on the east.
B	Residential uses bounded by I-96 on the south, Alta Equipment Company on the west, and Walnut Drive on the east.
C	Residential uses north of I-96 and centered around Old Plank Road.
D	Active sports area. North of I-96. Lyon Oaks Golf Course.
E	Retail use bounded by I-96 on the south, along Assembly Park Drive, and west of Wixom Road.
F	Hotel and office uses north of I-96, east of Wixom Road, and along Alpha Drive.
G	Retail use north of I-96, east of Beck Road, and along Twelve Mile Road.
H	Residential uses north of I-96, east of CNE G, and along Twelve Mile Road.
I	Medical facility north of I-96, east of CNE H, and along Twelve Mile Road.
J	Residential uses north of I-96, to the east and west of Taft Road.
K	Restaurants and motel uses north of I-96, west of Novi Road along Fountain Walk Avenue.
L	Office uses south of I-96, east of Meadowbrook Road, and north of Bridge Street.
M	School (Walsh College – Novi Campus) south of I-96, west of Meadowbrook Road, along Gardenbrook Road.
N	Office uses south of I-96, west of Meadowbrook Road, along Gardenbrook Road, west of CNE M.
O	Industrial use south of I-96, east of Delwal Drive.
P	Hotel south of I-96, along Crescent Boulevard.
Q	Restaurant uses south of I-96, east of Novi Road, along Crescent Boulevard.
R	Retail use south of I-96, south of Crescent Boulevard.
S	Restaurant uses south of I-96, west of Novi Road, along Crescent Boulevard.
T	Industrial uses south of I-96, along Grand River Avenue from Novi Road to Taft Road.
U	Hotel and other developed land (Suburban Collection Showplace) uses south of I-96, along Suburban Collection Showplace Drive.
V	Retail and industrial uses south of I-96, east of Beck Road.
W	Restaurant uses south of I-96, west of Beck Road, along Grand River Avenue.
X	Retail use south of I-96, west of Beck Road, along Grand River Avenue.
Y	Retail use south of I-96, at the eastern terminus of West Twelve Mile Road.
Z	Residential uses south of I-96, along West Twelve Mile Road, between CNE Y and AA.
AA	Day care center use south of I-96, along West Twelve Mile Road, west of CNE Z.
BB	Retail and industrial uses south of I-96, west of CNE AA, along West Twelve Mile Road.
CC	Retail uses south of I-96, west of Wixom Road, adjacent to SW quadrant of I-96 interchange.
DD	Hotel use south of I-96, west of Wixom Road along Meijer access road.
EE	Industrial uses south of I-96, along Grand River Avenue, centered on Grand Oaks Court, Center Oaks Court, and Oakland Oaks Court.
FF	Television studio use south of I-96, along Clever Court.
GG	Industrial uses south of I-96, along Grand River Avenue, west of Clever Court, east of Old Plank Road.
HH	Office use south of I-96, along Grand River Avenue, just west of Old Plank Road.
II	Industrial use south of I-96, along Grand River Avenue, west of CNE HH, east of CNE JJ along Lyon Center Drive East.
JJ	Restaurant use south of I-96, along Lyon Center Drive East, west of CNE II.
KK	Retail uses south of I-96, along Lyon Center Drive East, west of CNE JJ.
LL	Restaurant uses south of I-96, along Lyon Center Drive East, west of CNE KK.
MM	Retail uses south of I-96, along Lyon Center Drive East, east of Milford Road.
NN	Trail uses north and south of I-96, running along the right-of-way on the south side from the eastern side of Lyon Center Drive to Kent Lake Road.
OO	Residential uses north of Grand River Avenue along Bramley Circle and Topping Court, just west of James F. Atchison Memorial Park.

Existing noise level measurements were conducted on August 23, 2018 at eight representative sites in the project corridor. A 15-minute measurement was taken at each site. The measurements were made in accordance with MDOT guidelines using an integrating sound level analyzer meeting ANSI and IEC Type 1 specifications. Sound level analyzer calibration certification documentation is provided in Appendix B. Traffic classification counts were taken concurrently with the noise measurements. The locations of the field measurement sites are presented in Appendix A. The data collected at the eight sites are presented in Table 5.

Table 5. Measured Existing Noise Levels

Field Site #	Site Description	Date	Start Time	Duration	Traffic ¹⁾						Noise Level, dB(A) L _{eq} (h)	
					Direction	Auto	Med Truck	Heavy Truck	Buses	MC		Speed mph
1	James F. Atchison Memorial Park along the Huron Valley Trail near eastbound I-96 off-ramp to Milford Road.	8/23/18	9:16 am	15 min	Eastbound I-96	685	37	73	4	3	20	69.5
					Westbound I-96	629	20	63	6	0	65	
2	Residential area 160' east of the eastern terminus of South Hill Court, adjacent to right-of-way fence.	8/23/18	9:46 am	15 min	Eastbound I-96	717	29	65	2	1	65	73.2
					Westbound I-96	701	18	59	0	0	65	
3	In line with the eastern edge of the Michigan Public Television Studio building at the right-of-way fence.	8/23/18	10:20 am	15 min	Eastbound I-96	757	33	62	0	2	65	74.2
					Westbound I-96	595	28	77	2	0	65	
4	Near residential land uses at the eastern terminus of Twelve Mile Road at the right-of-way fence.	8/23/18	10:50 am	15 min	Eastbound I-96	790	34	67	1	1	65	75.3
					Westbound I-96	772	23	106	2	0	65	
5	On southern edge of an electrical tower off of Twelve Mile Road (north side of I-96), east of Beck Road, adjacent to right-of-way fence.	8/23/18	11:18 am	15 min	Eastbound I-96	967	49	80	0	2	65	78.4
					Westbound I-96	970	35	101	3	0	65	
6	On south side of I-96 in line west side of hotel (Hyatt Place), adjacent to right-of-way fence.	8/23/18	11:42 am	15 min	Eastbound I-96	1,058	46	81	0	0	65	69.8
					Westbound I-96	998	30	96	1	2	65	
7	On north side of I-96 in line with Cabaret Drive adjacent to right-of-way fence. Approximately 510' east of railroad.	8/23/18	12:14 pm	15 min	Eastbound I-96	1,068	54	79	1	1	65	69.1
					Westbound I-96	1,112	41	90	0	1	65	
8	On south side of I-96 at terminus of Crescent Boulevard on the north sidewalk along Crescent Boulevard.	8/23/18	12:40 pm	15 min	Eastbound I-96	1,184	62	68	2	3	65	69.7
					Westbound I-96	1,166	35	84	2	3	65	
1) Automobiles – all vehicles with two axles and four tires, includes passenger vehicles and light trucks, less than 10,000 pounds; Medium trucks – all vehicles having two axles and six tires, vehicle weight between 10,000 and 26,000 pounds; Heavy trucks – all vehicles having three or more axles, vehicle weight greater than 26,000 pounds; Buses – all vehicles designed to carry more than nine passengers; and Motorcycles – all vehicles with two or three tires and an open-air driver/passenger compartment.												

Source: HNTB Corporation, August 23, 2018

4.2.2 Field Measurements versus Modeled Noise Levels

TNM was used to validate the model by comparing the measured noise levels to the predicted noise levels. Traffic was counted and classified concurrently during the noise measurement by vehicle type: cars, medium trucks, heavy trucks, buses and motorcycles. The model is validated if the measured highway traffic noise levels and predicted highway traffic noise levels for the existing conditions using the concurrent traffic counts are within +/- 3 dB(A)⁶. Comparing the modeled noise levels to the measured noise levels validates the model for use on the specific project. All the modeled data compared within 3 dB(A) of the measured levels, which satisfies the MDOT requirement for validating the predicted noise level. The site by site comparison is presented in Table 6.

Table 6. Comparison of Measured and Modeled Noise Levels

Field Site	Appendix A Map Page#	Noise Level, dB(A) L _{eq} (1h)		Difference in Noise Level, dB(A) L _{eq} (1h) (Modeled Minus Measured)
		Measured	Modeled	
FS-1	2	69.5	71.6	2.1
FS-2	3	73.2	75.3	2.1
FS-3	4	74.2	75.8	1.6
FS-4	5, 6	75.3	76.5	1.2
FS-5	6	78.4	77.3	-1.1
FS-6	6	69.8	71.7	1.9
FS-7	7	69.1	70.5	1.4
FS-8	7	69.7	70.3	0.6

Source: HNTB Corporation, August 2018

4.2.3 Traffic Noise Levels and Noise Impact Analysis

FHWA's TNM version 2.5, was used to model existing (2017) and design year (2040) worst hourly traffic noise levels within the I-96 noise analysis study area.

Existing I-96 traffic data exhibits congestion in the eastbound or westbound direction during the morning and afternoon peak travel periods. Due to this, a theoretical free-flow traffic capacity was developed for both existing (2017) and design year (2040) worst hourly traffic⁷. The traffic volumes were distributed to three lanes for the existing model, and four lanes for the future model.

Modeled receptors were placed in accordance with FHWA requirements in areas with evidence of frequent human use. This area is typically located between the highway and any structure, such as a residence. MDOT considers this area within 35 feet from the back of a residence as the back-yard area. Modeling receptors along the Huron Valley Trail was discussed with MDOT staff and a methodology for modeling impacts along the trail was developed. Appendix C provides further explanation for the modeling trail locations along the Huron Valley Trail.

109 receptors (Category B, C, and D) were modeled. These receptors were selected to model noise impacts as shown in Appendix A.

The existing and design year noise levels of modeled sites are presented in Table 7.

⁶ Highway Noise Analysis and Abatement Handbook, Michigan Department of Transportation, 2011, page 16.

⁷ Thomas Hanf email regarding "Re: I-96 Kensington Road to I-275/I-696/M-5". MDOT Air Quality & Noise Abatement, September 28, 2018.

Table 7. Impact Analysis Results, dB(A) $L_{eq}(1h)$

Receiver ID	Noise Abatement Criteria (NAC)			Receptors	Noise Level – dB(A) $L_{eq}(1h)$			
	Description	Category	Criteria, $L_{eq}(h)$		Existing (2017)	Future (2040)		
						NL	Change from Existing	Impact (Y/N)
A-1	Retail	F	-	-	-	-	-	-
A-2	Industrial	F	-	-	-	-	-	-
A-3	Industrial	F	-	-	-	-	-	-
B-1	Residential	B	67	1	63.9	64.4	0.5	No
B-2	Residential	B	67	1	65.8	66.2	0.4	Yes
B-3	Residential	B	67	1	65.0	65.4	0.4	No
B-4	Residential	B	67	1	64.4	64.9	0.5	No
B-5	Residential	B	67	1	64.1	64.5	0.4	No
B-6	Residential	B	67	1	63.5	64.0	0.5	No
B-7	Residential	B	67	1	62.2	62.8	0.6	No
B-8	Residential	B	67	1	66.0	66.5	0.5	Yes
B-9	Residential	B	67	1	66.1	66.6	0.5	Yes
B-10	Residential	B	67	1	66.0	66.5	0.5	Yes
B-11	Residential	B	67	1	66.2	66.6	0.4	Yes
B-12	Residential	B	67	1	66.7	67.2	0.5	Yes
B-13	Residential	B	67	1	67.5	67.8	0.3	Yes
B-14	Residential	B	67	1	68.7	69.6	0.9	Yes
B-15	Residential	B	67	1	67.3	68.2	0.9	Yes
B-16	Residential	B	67	1	64.0	64.7	0.7	No
B-17	Residential	B	67	1	63.7	64.3	0.6	No
B-18	Residential	B	67	1	63.1	63.8	0.7	No
B-19	Residential	B	67	1	62.3	63.0	0.7	No
B-20	Residential	B	67	1	67.0	67.9	0.9	Yes
B-21	Residential	B	67	1	62.5	63.2	0.7	No
B-22	Residential	B	67	1	59.8	60.4	0.6	No
B-23	Residential	B	67	1	66.7	67.0	0.3	Yes
B-24	Residential	B	67	1	70.1	70.3	0.2	Yes
B-25	Residential	B	67	1	71.1	71.3	0.2	Yes
B-26	Residential	B	67	1	68.9	69.2	0.3	Yes
B-27	Residential	B	67	1	69.8	70.0	0.2	Yes
B-28	Residential	B	67	1	61.7	62.2	0.5	No
B-29	Residential	B	67	1	62.1	62.5	0.4	No
B-30	Residential	B	67	1	60.8	61.3	0.5	No
B-31	Residential	B	67	1	60.3	60.8	0.5	No
B-32	Residential	B	67	1	61.6	62.0	0.4	No
B-33	Residential	B	67	1	59.5	59.9	0.4	No
B-34	Residential	B	67	1	60.7	61.2	0.5	No
B-35	Residential	B	67	1	60.4	60.9	0.5	No

Boldface indicates receptors with noise levels that approach, equal or exceed the NAC and create an impact.

E* – Category E receiver with "no exterior use". Noise levels presented for informational purposes only. There are no impacts.

D – Building Type – Masonry, Window Condition – Double Glazed, Noise Reduction Due to Exterior of the Structure – 35 dB

Receiver ID	Noise Abatement Criteria (NAC)			Receptors	Noise Level – dB(A) L _{eq} (1h)			
	Description	Category	Criteria, L _{eq} (h)		Existing (2017)	Future (2040)		
						NL	Change from Existing	Impact (Y/N)
B-36	Residential	B	67	1	60.4	60.8	0.4	No
B-37	Residential	B	67	1	61.6	62.0	0.4	No
B-38	Residential	B	67	1	60.3	60.7	0.4	No
B-39	Residential	B	67	1	59.8	60.5	0.7	No
B-40	Residential	B	67	1	58.7	59.3	0.6	No
B-41	Residential	B	67	1	59.4	60.0	0.6	No
B-42	Residential	B	67	1	58.2	58.9	0.7	No
B-43	Residential	B	67	1	57.3	58.0	0.7	No
B-44	Residential	B	67	1	58.1	58.7	0.6	No
B-45	Residential	B	67	1	57.6	58.2	0.6	No
B-46	Residential	B	67	1	57.3	57.8	0.5	No
B-47	Residential	B	67	1	56.8	57.4	0.6	No
B-48	Residential	B	67	1	56.5	57.1	0.6	No
B-49	Residential	B	67	1	56.0	56.5	0.5	No
B-50	Residential	B	67	1	55.5	56.0	0.5	No
B-51	Residential	B	67	1	54.9	55.4	0.5	No
B-52	Residential	B	67	1	56.7	57.2	0.5	No
B-53	Residential	B	67	1	58.4	58.8	0.4	No
B-54	Residential	B	67	1	58.2	58.6	0.4	No
B-55	Residential	B	67	1	59.7	60.1	0.4	No
B-56	Residential	B	67	1	60.3	60.8	0.5	No
B-57	Residential	B	67	1	59.3	59.7	0.4	No
B-58	Residential	B	67	1	58.6	59.0	0.4	No
B-59	Residential	B	67	1	57.0	57.5	0.5	No
B-60	Residential	B	67	1	56.2	56.7	0.5	No
B-61	Residential	B	67	1	55.1	55.7	0.6	No
B-62	Residential	B	67	1	54.5	55.0	0.5	No
C-1	Residential	B	67	1	66.9	68.1	1.2	Yes
C-2	Residential	B	67	1	70.3	71.2	0.9	Yes
C-3	Residential	B	67	1	61.0	61.9	0.9	No
C-4	Residential	B	67	1	70.4	71.2	0.8	Yes
C-5	Residential	B	67	1	63.5	64.3	0.8	No
C-6	Residential	B	67	1	67.5	67.7	0.2	Yes
C-7	Residential	B	67	1	62.2	62.6	0.4	No
D-1	Active sport area	C	67	1	61.2	61.7	0.5	No
E-1	Retail	F	-	-	-	-	-	-
F-1	Motel (no exterior use)	E*	-	0	59.5	60.0	0.5	No
F-2	Motel (no exterior use)	E*	-	0	61.4	61.8	0.4	No
F-3	Office (no exterior use)	E*	-	0	67.4	67.7	0.3	No

Boldface indicates receptors with noise levels that approach, equal or exceed the NAC and create an impact.

E* – Category E receiver with "no exterior use". Noise levels presented for informational purposes only. There are no impacts.

D – Building Type – Masonry, Window Condition – Double Glazed, Noise Reduction Due to Exterior of the Structure – 35 dB

Receiver ID	Noise Abatement Criteria (NAC)			Receptors	Noise Level – dB(A) L _{eq} (1h)			
	Description	Category	Criteria, L _{eq} (h)		Existing (2017)	Future (2040)		
						NL	Change from Existing	Impact (Y/N)
F-4	Office (no exterior use)	E*	-	0	69.6	69.9	0.3	No
F-5	Office (no exterior use)	E*	-	0	70.9	71.2	0.3	No
F-6	Office (no exterior use)	E*	-	0	71.1	71.4	0.3	No
F-7	Office (no exterior use)	E*	-	0	70.8	71.2	0.4	No
G-1	Retail	F	-	-	-	-	-	-
H-1	Residential	B	67	1	59.7	60.3	0.6	No
H-2	Residential	B	67	1	58.9	59.5	0.6	No
I-1	Medical facility	C	67	1	59.5	60.4	0.9	No
J-1	Residential	B	67	1	62.1	62.9	0.8	No
J-2	Residential	B	67	1	54.3	54.9	0.6	No
J-3	Residential	B	67	1	72.2	72.5	0.3	Yes
J-4	Residential	B	67	1	69.8	70.0	0.2	Yes
J-5	Residential	B	67	1	60.8	61.3	0.5	No
J-6	Residential	B	67	1	59.0	59.5	0.5	No
J-7	Residential	B	67	1	57.5	58.0	0.5	No
K-1	Restaurant	E	72	1	63.7	64.2	0.5	No
K-2	Restaurant	E	72	1	63.1	63.6	0.5	No
K-3	Motel/Restaurant (no exterior use)	E*	-	0	68.8	69.2	0.4	No
K-4	Restaurant (no exterior use)	E*	-	0	63.2	63.6	0.4	No
L-1	Office (no exterior use)	E*	-	0	73.0	73.3	0.3	No
L-2	Office (no exterior use)	E*	-	0	72.6	73.2	0.6	No
L-3	Office (no exterior use)	E*	-	0	72.6	73.2	0.6	No
M-1	School (no exterior use)	D	52	1	41.0	42.2	1.2	No
N-1	Office (no exterior use)	E*	-	0	72.1	73.2	1.1	No
N-2	Office	E	72	1	65.0	65.9	0.9	No
O-1	Industrial	F	-	0	61.3	62.4	1.1	No
P-1	Motel	E	72	1	65.7	66.6	0.9	No
Q-1	Restaurant (no exterior use)	E*	-	0	73.4	74.2	0.8	No
Q-2	Restaurant (no exterior use)	E*	-	0	72.2	72.9	0.7	No
Q-3	Restaurant (no exterior use)	E*	-	0	63.4	64.2	0.8	No
Q-4	Restaurant (no exterior use)	E*	-	0	59.9	60.6	0.7	No
R-1	Retail	F	-	-	-	-	-	-
S-1	Restaurant	E	72	1	61.2	61.8	0.6	No
S-2	Restaurant	E	72	1	59.2	59.8	0.6	No
T-1	Industrial	F	-	-	-	-	-	-
T-2	Industrial	F	-	-	-	-	-	-
T-3	Industrial	F	-	-	-	-	-	-
T-4	Industrial	F	-	-	-	-	-	-
U-1	Motel (no exterior use)	E*	-	0	71.6	71.8	0.2	No

Boldface indicates receptors with noise levels that approach, equal or exceed the NAC and create an impact.

E* – Category E receiver with "no exterior use". Noise levels presented for informational purposes only. There are no impacts.

D – Building Type – Masonry, Window Condition – Double Glazed, Noise Reduction Due to Exterior of the Structure – 35 dB

Receiver ID	Noise Abatement Criteria (NAC)			Receptors	Noise Level – dB(A) L _{eq} (1h)			
	Description	Category	Criteria, L _{eq} (h)		Existing (2017)	Future (2040)		
						NL	Change from Existing	Impact (Y/N)
U-2	Other Developed Land (no exterior use)	E*	-	0	67.9	68.5	0.6	No
V-1	Industrial	F	-	-	-	-	-	-
V-2	Industrial	F	-	-	-	-	-	-
V-3	Industrial	F	-	-	-	-	-	-
W-1	Restaurant (no exterior use)	E*	-	0	65.5	66.4	0.9	No
X-1	Retail	F	-	-	-	-	-	-
Y-1	Retail	F	-	-	-	-	-	-
Z-1	Residential	B	67	1	74.4	75.1	0.7	Yes
Z-2	Residential	B	67	1	74.7	75.3	0.6	Yes
AA-1	Day Care Center	C	67	1	70.0	70.3	0.3	Yes
BB-1	Retail	F	-	-	-	-	-	-
BB-2	Retail	F	-	-	-	-	-	-
BB-3	Retail	F	-	-	-	-	-	-
BB-4	Retail	F	-	-	-	-	-	-
CC-1	Retail	F	-	-	-	-	-	-
CC-2	Retail	F	-	-	-	-	-	-
DD-1	Motel (no exterior use)	E*	-	0	61.8	62.8	1.0	No
EE-1	Industrial	F	-	-	-	-	-	-
EE-2	Industrial	F	-	-	-	-	-	-
EE-3	Industrial	F	-	-	-	-	-	-
EE-4	Industrial	F	-	-	-	-	-	-
EE-5	Industrial	F	-	-	-	-	-	-
EE-6	Industrial	F	-	-	-	-	-	-
EE-7	Industrial	F	-	-	-	-	-	-
EE-8	Industrial	F	-	-	-	-	-	-
EE-9	Industrial	F	-	-	-	-	-	-
EE-10	Industrial	F	-	-	-	-	-	-
EE-11	Industrial	F	-	-	-	-	-	-
EE-12	Industrial	F	-	-	-	-	-	-
FF-1	Television Studio	C	67	1	73.2	74.0	0.8	Yes
GG-1	Retail	F	-	-	-	-	-	-
GG-2	Retail	F	-	-	-	-	-	-
GG-3	Retail	F	-	-	-	-	-	-
GG-4	Retail	F	-	-	-	-	-	-
GG-5	Industrial	F	-	-	-	-	-	-
GG-6	Industrial	F	-	-	-	-	-	-
HH-1	Office	E	72	1	60.6	61.5	0.9	No
II-1	Industrial	F	-	-	-	-	-	-
II-2	Industrial	F	-	-	-	-	-	-

Boldface indicates receptors with noise levels that approach, equal or exceed the NAC and create an impact.

E* – Category E receiver with "no exterior use". Noise levels presented for informational purposes only. There are no impacts.

D – Building Type – Masonry, Window Condition – Double Glazed, Noise Reduction Due to Exterior of the Structure – 35 dB

Receiver ID	Noise Abatement Criteria (NAC)			Receptors	Noise Level – dB(A) L _{eq} (1h)			
	Description	Category	Criteria, L _{eq} (h)		Existing (2017)	Future (2040)		
						NL	Change from Existing	Impact (Y/N)
II-3	Industrial	F	-	-	-	-	-	-
II-4	Industrial	F	-	-	-	-	-	-
II-5	Industrial	F	-	-	-	-	-	-
II-6	Industrial	F	-	-	-	-	-	-
II-7	Industrial	F	-	-	-	-	-	-
II-8	Industrial	F	-	-	-	-	-	-
II-9	Retail	F	-	-	-	-	-	-
JJ-1	Restaurant (no exterior use)	E*	-	0	73.2	73.5	0.3	No
KK-1	Retail	F	-	-	-	-	-	-
KK-2	Retail	F	-	-	-	-	-	-
KK-3	Retail	F	-	-	-	-	-	-
LL-1	Restaurant (no exterior use)	E*	-	0	72.1	72.6	0.5	No
LL-2	Restaurant (no exterior use)	E*	-	0	69.8	70.2	0.4	No
MM-1	Retail	F	-	-	-	-	-	-
MM-2	Retail	F	-	-	-	-	-	-
NN-1	Trail	C	67	1	66.5	66.8	0.3	Yes
NN-2	Trail	C	67	1	66.4	66.8	0.4	Yes
NN-3	Trail	C	67	2	66.2	66.6	0.4	Yes
NN-4	Trail	C	67	1	67.2	67.4	0.2	Yes
NN-5	Trail	C	67	1	66.4	67.4	1.0	Yes
NN-6	Trail	C	67	1	65.6	66.4	0.8	Yes
OO-1	Residential	B	67	1	68.4	69.3	0.9	Yes
OO-2	Residential	B	67	1	67.8	68.5	0.7	Yes
OO-3	Residential	B	67	1	69.6	70.3	0.7	Yes
OO-4	Residential	B	67	1	68.9	69.7	0.8	Yes
OO-5	Residential	B	67	1	75.4	76.0	0.6	Yes
OO-6	Residential	B	67	1	58.3	58.9	0.6	No
OO-7	Residential	B	67	1	57.9	58.5	0.6	No
OO-8	Residential	B	67	1	59.7	60.4	0.7	No
OO-9	Residential	B	67	1	61.6	62.5	0.9	No
OO-10	Residential	B	67	1	63.2	64.2	1.0	No

Boldface indicates receptors with noise levels that approach, equal or exceed the NAC and create an impact.

E* – Category E receiver with "no exterior use". Noise levels presented for informational purposes only. There are no impacts.

D – Building Type – Masonry, Window Condition – Double Glazed, Noise Reduction Due to Exterior of the Structure – 35 dB

4.3 Impact Assessment

A traffic noise impact is defined as a future noise level that approaches⁸ or exceeds the NAC; or a future noise level that creates a substantial noise increase over existing noise levels. MDOT identifies a significant noise impact as a 10 dB(A) increase between the existing and predicted design year sound levels, or a measured or modeled noise level 1 dB(A) less than the NAC standard.

Predicted future design year (2040) noise levels adjacent to the proposed improvements would approach or exceed the NAC at 37 receptors (28 residential receptors, one day care center receptor, one television studio receptor and seven trail receptors). The noise levels at these 37 impacted receptors would range from 66.2 to 76.0 dB(A) $L_{eq}(h)$.

Changes in L_{eq} noise levels under the future Build condition will range from 0.2 to 1.2 dB(A) compared to existing conditions. Therefore, none of the predicted future noise levels would substantially exceed existing noise levels.

⁸ A noise level 'approaches' when the noise level is 1 dB(A) less than the NAC standard.

5 Noise Abatement Measures

5.1 Federal and State Abatement Guidance

The Handbook has established the criteria for determining where noise abatement must be provided.⁹

The policy is summarized as follows:

- Where adverse noise impacts are expected to occur, noise abatement will be considered and will be implemented if found feasible and reasonable for existing developments, and future developments that were approved before the date of public knowledge of the project. Approved means that a building permit has been received. After the date of public knowledge, MDOT is not responsible for providing noise abatement for new developments. The date of the clearance of the Categorical Exclusion will be the date of public knowledge. The provision of noise abatement for new developments becomes the responsibility of local governments and private developers.
- All sites will be considered; however, it is generally known that commercial and industrial sites prefer that there be no interference with the view to their establishments. Therefore, when commercial and residential sites expected to convert to a commercial or industrial land use (e.g., some of the residential units have converted to commercial/industrial, or the area has been rezoned commercial) are found to be reasonable and feasible, they will be asked if they want noise abatement. If they do not want it, it will not be provided.
- Feasible – This refers to engineering considerations such as: constructability of a noise barrier on the existing topography; achievement of substantial noise reductions; the presence of other noise sources in the area; and the ability to maintain access, drainage, safety, utilities in the area. While every reasonable effort should be made to obtain a substantial noise reduction, a noise abatement measure is not feasible if it cannot achieve at least a 5 dB(A) noise reduction for 75 percent of impacted receivers during design year traffic noise.
- Reasonable - Noise mitigation will be considered reasonable if:
 - During the environmental clearance phase, the preliminary cost per benefiting unit is less than three percent above allowable per benefiting unit level (\$46,967 in 2018 dollars);
 - The public viewpoint reasonableness factor for the environmental clearance phase receives generally positive comments from the benefiting units; and
 - The noise barrier provides a design year traffic noise reduction of 10 dB(A) for at least one benefited unit and at least a 7 dB(A) for 50 percent or more of the benefited units.

Highway traffic noise abatement alternatives, which are listed in 23 CFR 772.15(c) include:

- 1) Construction of noise barriers including acquisition of property rights, either within or outside the highway right-of-way;
- 2) Traffic management measures;
- 3) Alteration of horizontal and vertical alignments;
- 4) Acquisition of real property or interests therein to serve as a buffer zone to preempt development;
- 5) Noise insulation of Activity Category D land use facilities listed in Table 3.

Upon review of the listed abatement alternatives, it has been determined that:

- Reductions of speed limits, although acoustically beneficial, are seldom practical unless the design speed of the proposed roadway is also reduced;
- Restriction or prohibition of trucks is extremely undesirable;

⁹ The Handbook and other MDOT resources can be found at https://www.michigan.gov/mdot/0,4616,7-151-9621_11041_25846---,00.html.

- Design criteria, project limits, and the existing alignment and land use preclude substantial horizontal and vertical alignment shifts that could potentially produce noticeable changes in the projected acoustical environment;
- Cost restrictions typically prohibit the acquisition of property for any reason; and
- The construction of noise berms is neither feasible nor reasonable because of the amount of space that would be required.

Therefore, the construction of noise barriers within the existing Right-of-Way was the only mitigation measure that received in-depth evaluation.

5.2 Abatement Analysis

Abatement analysis was completed for eight noise barriers. At a minimum, the Handbook requires that noise barriers be analyzed as a noise abatement measure. To satisfy this requirement, a noise barrier has been evaluated for the CNE areas with impacted noise receptors as a part of this noise study. Noise barrier locations are shown in Appendix A.

Based on the future design year noise levels, eight noise barriers adjacent to impacted receptor areas were modeled:

- NB1 is located on the north side of I-96 between the westbound Milford Road off ramp and South Hill Road and was designed to mitigate residential uses and the Huron Valley Trail.
- NB2 is located on the north side of I-96 between South Hill Road and the eastern terminus of South Hill Court and was designed to mitigate residential uses.
- NB3 is located on the north side of I-96 approximately 900 feet west of Old Plank Road to Old Plank Road and was designed to mitigate residential uses.
- NB4 is located on the north side of I-96 between Old Plank Road and approximately 1,800 feet east of Old Plank Road and was designed to mitigate residential uses.
- NB5 is located on the north side of I-96 to the east and west of Taft Road and was designed to mitigate residential uses.
- NB6 is located on the south side of I-96 between Beck Road and Wixom Road and was designed for residential uses and a day care center.
- NB7 is located on the south side of I-96 between Milford Road and just east of the Huron Valley Trail pass under I-96 and was designed to mitigate a trail receptor.
- NB8 is located on the south side of I-96 between Milford Road and Kent Lake Road (two sections designed) and was designed for receptors along the Huron Valley Trail.

CNE FF has a television studio that exceeds the NAC. A noise barrier was not analyzed for this receptor for the following reason: The length of noise barrier is a function of the distance the receptor is from the noise source and the elevation change between the receptor and noise source. It is not uncommon for the length of the noise barrier to be four times the distance from the receptor to the noise source. Therefore, a receptor 250 feet (the approximate distance from the television studio to the centerline) from the centerline of the noise source would require a noise barrier at least 1,000 feet long. If the noise barrier was only 10 feet tall the cost would be \$450,000. The cost for one receptor exceeds MDOT's reasonableness criteria of an upper cost limit of \$46,967 (2018) per benefited receptor. Therefore, a noise barrier for this single receptor would not be reasonable and mitigation was not analyzed for this location.

The results of each evaluated barrier, including future $L_{eq}(1h)$ noise levels without and with a barrier, barrier length and height, and the noise reduction provided by the barrier are presented in Table 8. The noise reduction for individual receptors based on the analyzed noise barrier design in Table 8 is shown in Table 9.

Table 8. Evaluated Noise Barriers

Noise Barrier ID	Receiver IDs	Existing Noise Levels dB(A)	Range of Future Noise Levels dB(A)		Noise Reduction dB(A)	Barrier Characteristics	
			w/o Barrier	With Barrier		Length (ft)	Height (ft)
NB1	B-1 to B-20, B-28 to B-43, NN-1	57.3 – 68.7	58.0 – 69.6	55.0 – 66.1	1.0 – 10.3	4,085	24
NB2	B-21 to B-27, B-44 to B-62	54.5 – 71.1	55.0 – 71.3	54.1 – 64.4	0.5 – 10.0	1,399	12 – 24
NB3	C-1 to C-3	61.0 – 70.3	61.9 – 71.2	58.6 – 65.7	3.3 – 6.0	1,114	24
NB4	C-4 to C-7	62.2 – 70.4	62.6 – 71.2	59.6 – 63.5	1.9 – 7.7	997	24
NB5	J-3 to J-7	57.5 – 72.2	58.0 – 72.5	56.5 – 62.6	1.5 – 10.0	1,130	20 – 24
NB6	Z-1, Z-2, AA-1	70.0 – 74.7	70.3 – 75.3	65.1 – 67.4	5.2 – 10.2	1,108	10 – 18
NB7	NN-2	66.4	66.8	61.6	5.2	1,314	24
NB8	NN-3 to NN-6, OO-1 to OO-10	57.9 – 75.4	58.5 – 76.0	57.1 – 66.1	0.3 – 11.5	3,946	6 – 24

Table 9. Noise Reduction Results by Receptor

Receiver ID	Description	Category	Criteria, L _{eq} (h)	Receptors	Future without Barrier	Future with Barrier	Noise Barrier Reduction	Benefited Receptor
NB1								
B-1	Residential	B	67	1	64.4	57.6	6.8	Yes
B-2	Residential	B	67	1	66.2	60.0	6.2	Yes
B-3	Residential	B	67	1	65.4	59.6	5.8	Yes
B-4	Residential	B	67	1	64.9	59.2	5.7	Yes
B-5	Residential	B	67	1	64.5	58.7	5.8	Yes
B-6	Residential	B	67	1	64.0	58.0	6.0	Yes
B-7	Residential	B	67	1	62.8	57.3	5.5	Yes
B-8	Residential	B	67	1	66.5	59.2	7.3	Yes
B-9	Residential	B	67	1	66.6	58.7	7.9	Yes
B-10	Residential	B	67	1	66.5	58.1	8.4	Yes
B-11	Residential	B	67	1	66.6	57.8	8.8	Yes
B-12	Residential	B	67	1	67.2	58.2	9.0	Yes
B-13	Residential	B	67	1	67.8	58.4	9.4	Yes
B-14	Residential	B	67	1	69.6	59.3	10.3	Yes
B-15	Residential	B	67	1	68.2	59.3	8.9	Yes
B-16	Residential	B	67	1	64.7	59.1	5.6	Yes
B-17	Residential	B	67	1	64.3	60.0	4.3	No
B-18	Residential	B	67	1	63.8	60.3	3.5	No
B-19	Residential	B	67	1	63.0	60.0	3.0	No
B-20	Residential	B	67	1	67.9	63.8	4.1	No
B-28	Residential	B	67	1	62.2	56.5	5.7	Yes
B-29	Residential	B	67	1	62.5	56.7	5.8	Yes
B-30	Residential	B	67	1	61.3	55.9	5.4	Yes
B-31	Residential	B	67	1	60.8	55.4	5.4	Yes
B-32	Residential	B	67	1	62.0	56.6	5.4	Yes
B-33	Residential	B	67	1	59.9	55.0	4.9	No
B-34	Residential	B	67	1	61.2	55.7	5.5	Yes
B-35	Residential	B	67	1	60.9	55.6	5.3	Yes
B-36	Residential	B	67	1	60.8	55.4	5.4	Yes
B-37	Residential	B	67	1	62.0	55.7	6.3	Yes
B-38	Residential	B	67	1	60.7	55.5	5.2	Yes
B-39	Residential	B	67	1	60.5	55.9	4.6	No
B-40	Residential	B	67	1	59.3	55.7	3.6	No
B-41	Residential	B	67	1	60.0	56.7	3.3	No
B-42	Residential	B	67	1	58.9	55.8	3.1	No
B-43	Residential	B	67	1	58.0	55.1	2.9	No
NN-1	Trail	C	67	1	66.8	61.1	5.7	Yes

Boldface indicates receptors with noise levels that approach, equal or exceed the NAC and create an impact.

Receiver ID	Description	Category	Criteria, L _{eq} (h)	Receptors	Future without Barrier	Future with Barrier	Noise Barrier Reduction	Benefited Receptor
NB2								
B-21	Residential	B	67	1	63.2	62.4	0.8	No
B-22	Residential	B	67	1	60.4	59.4	1.0	No
B-23	Residential	B	67	1	67.0	63.4	3.6	No
B-24	Residential	B	67	1	70.3	60.9	9.4	Yes
B-25	Residential	B	67	1	71.3	61.3	10.0	Yes
B-26	Residential	B	67	1	69.2	60.9	8.3	Yes
B-27	Residential	B	67	1	70.0	64.4	5.6	Yes
B-44	Residential	B	67	1	58.7	58.2	0.5	No
B-45	Residential	B	67	1	58.2	57.6	0.6	No
B-46	Residential	B	67	1	57.8	57.1	0.7	No
B-47	Residential	B	67	1	57.4	56.5	0.9	No
B-48	Residential	B	67	1	57.1	56.0	1.1	No
B-49	Residential	B	67	1	56.5	55.3	1.2	No
B-50	Residential	B	67	1	56.0	54.8	1.2	No
B-51	Residential	B	67	1	55.4	54.1	1.3	No
B-52	Residential	B	67	1	57.2	55.2	2.0	No
B-53	Residential	B	67	1	58.8	56.3	2.5	No
B-54	Residential	B	67	1	58.6	56.1	2.5	No
B-55	Residential	B	67	1	60.1	57.1	3.0	No
B-56	Residential	B	67	1	60.8	58.1	2.7	No
B-57	Residential	B	67	1	59.7	57.7	2.0	No
B-58	Residential	B	67	1	59.0	57.9	1.1	No
B-59	Residential	B	67	1	57.5	56.7	0.8	No
B-60	Residential	B	67	1	56.7	55.9	0.8	No
B-61	Residential	B	67	1	55.7	54.9	0.8	No
B-62	Residential	B	67	1	55.0	54.2	0.8	No
NB3								
C-1	Residential	B	67	1	68.1	62.1	6.0	Yes
C-2	Residential	B	67	1	71.2	65.7	5.5	Yes
C-3	Residential	B	67	1	61.9	58.6	3.3	No
NB4								
C-4	Residential	B	67	1	71.2	63.5	7.7	Yes
C-5	Residential	B	67	1	64.3	62.4	1.9	No
C-6	Residential	B	67	1	67.7	62.5	5.2	Yes
C-7	Residential	B	67	1	62.6	59.6	3.0	No

Boldface indicates receptors with noise levels that approach, equal or exceed the NAC and create an impact.

Receiver ID	Description	Category	Criteria, L _{eq} (h)	Receptors	Future without Barrier	Future with Barrier	Noise Barrier Reduction	Benefited Receptor
NB5								
J-3	Residential	B	67	1	72.5	62.5	10.0	Yes
J-4	Residential	B	67	1	70.0	62.6	7.4	Yes
J-5	Residential	B	67	1	61.3	58.3	3.0	No
J-6	Residential	B	67	1	59.5	57.3	2.2	No
J-7	Residential	B	67	1	58.0	56.5	1.5	No
NB6								
Z-1	Residential	B	67	1	75.1	74.1	1.0	No
Z-2	Residential	B	67	1	75.3	67.4	7.9	Yes
AA-1	Day Care Center	C	67	1	70.3	65.1	5.2	Yes
NB7								
NN-2	Trail	C	67	1	66.8	61.6	5.2	Yes
NB8								
NN-3	Trail	C	67	2	66.6	58.7	7.9	Yes
NN-4	Trail	C	67	1	67.4	62.4	5.0	Yes
NN-5	Trail	C	67	1	67.4	60.0	7.4	Yes
NN-6	Trail	C	67	1	66.4	66.1	0.3	No
OO-1	Residential	B	67	1	69.3	62.6	6.7	Yes
OO-2	Residential	B	67	1	68.5	61.4	7.1	Yes
OO-3	Residential	B	67	1	70.3	62.8	7.5	Yes
OO-4	Residential	B	67	1	69.7	62.9	6.8	Yes
OO-5	Residential	B	67	1	76.0	64.5	11.5	Yes
OO-6	Residential	B	67	1	58.9	57.5	1.4	No
OO-7	Residential	B	67	1	58.5	57.1	1.4	No
OO-8	Residential	B	67	1	60.4	58.7	1.7	No
OO-9	Residential	B	67	1	62.5	60.7	1.8	No
OO-10	Residential	B	67	1	64.2	62.6	1.6	No

Boldface indicates receptors with noise levels that approach, equal or exceed the NAC and create an impact.

Table 10. Noise Barrier Designs Analyzed

Noise Barrier ID	Receiver IDs	Feasible ¹	Meets Design Goal ²	Benefited Receptors	Length (ft)	Height (ft)	Square Footage (Sq ft)	Barrier Cost (\$45 per sq ft)	Cost per Benefited Receptor	Reasonable
NB1	B-1 to B-20, B-28 to B-43, NN-1	Yes	No	27	4,085	24	98,033	\$4,411,485	NA ³	No
NB2	B-21 to B-27, B-44 to B-62	Yes	Yes	4	1,399	12 – 24	26,999	\$1,214,955	\$303,739	No
NB3	C-1 to C-3	Yes	No	2	1,114	24	26,742	\$1,203,390	NA ³	No
NB4	C-4 to C-7	Yes	No	2	997	24	23,930	\$1,076,850	NA ³	No
NB5	J-3 to J-7	Yes	Yes	2	1,130	20 - 24	26,608	\$1,197,360	\$598,680	No
NB6	Z-1, Z-2, AA-1	Yes	Yes	3	1,108	10 - 18	15,811	\$711,495	\$237,165	No
NB7	NN-2	Yes	No	1	1,314	24	31,545	\$1,419,525	NA ³	No
NB8	NN-3 to NN-6, OO-1 to OO-10	Yes	Yes	5	3,946	6 - 24	67,214	\$3,024,630	\$604,926	No

¹ MDOT requires that noise barriers achieve a 5-dB reduction at 75 percent of the impacted receptors. If a barrier cannot achieve this, abatement is considered to not be acoustically feasible.

² The design year attenuation requirement for Michigan is to provide a noise reduction of 10 dB(A) for at least one benefited receptor and at least a 7 dB(A) reduction for 50 percent or more of the benefited receptor sites.

³ NA – Noise barrier is not feasible or does not meet the design goal.

Whether the barrier meets the design goal, total estimated cost (based on \$45.00 per square foot), the number of benefited receptors (i.e. residential, commercial, or equivalent), the cost per benefited receiver, feasibility determination, and reasonableness determination for each of the barriers is presented in Table 10. The location of the evaluated noise barriers are shown in Appendix A.

NB1 meets preliminary feasibility criteria but did not meet the reasonableness criteria as the design goal for this barrier was not met (50 percent of the benefited receptors did not receive a noise reduction of 7 dB(A)).

NB2 meets preliminary feasibility criteria but did not meet the reasonableness criteria as the cost per benefited receptor (\$303,739) exceeds the cost per benefited unit cost established by MDOT (\$46,967).

NB3 meets preliminary feasibility criteria but did not meet the reasonableness criteria as the design goal for this barrier was not met (did not achieve a 10 dB(A) or more reduction for at least one benefited receptor).

NB4 meets preliminary feasibility criteria but did not meet the reasonableness criteria as the design goal for this barrier was not met (did not achieve a 10 dB(A) or more reduction for at least one benefited receptor).

NB5 meets preliminary feasibility criteria but did not meet the reasonableness criteria as the cost per benefited receptor (\$598,680) exceeds the cost per benefited unit cost established by MDOT (\$46,967).

NB6 meets preliminary feasibility criteria but did not meet the reasonableness criteria as the cost per benefited receptor (\$237,165) exceeds the cost per benefited unit cost established by MDOT (\$46,967).

NB7 meets preliminary feasibility criteria but did not meet the reasonableness criteria as the design goal for this barrier was not met (did not achieve a 10 dB(A) or more reduction for at least one benefited receptor).

NB8 meets preliminary feasibility criteria but did not meet the reasonableness criteria as the cost per benefited receptor (\$604,926) exceeds the cost per benefited unit cost established by MDOT (\$46,967).

6 Undeveloped Lands

The distances to 66 and 71 dB(A) $L_{eq}(1h)$, which vary along the project corridor, were developed to assist local planning authorities in developing land use control over the remaining undeveloped lands along the project to prevent further development of incompatible land uses. Undeveloped areas exist throughout the corridor. Appendix A provides setback distances for 66 and 71 dB(A) for areas throughout the corridor.

It is recommended that any future development proposed in the project be modeled with accurate survey data to avoid creating incompatible land uses adjacent to the project.

7 Conclusions and Recommendations

NB1, NB3, NB4, and NB7 meet preliminary feasibility criteria but did not meet the reasonableness criteria as the design goal for these barriers was not met. NB2, NB5, NB6, and NB8 meet preliminary feasibility criteria but did not meet the reasonableness criteria as the cost per benefited receptor for each barrier exceeds the cost per benefited unit cost established by MDOT. Additionally, based on the scattered locations of noise impacts along the corridor, noise barriers are not reasonable for individual receptors.

7.1 Statement of Likelihood

Based on the studies thus far accomplished, MDOT does not intend to install highway traffic noise abatement as discussed in this document. The preliminary assessment is based on preliminary design for barrier cost(s) and noise abatement as discussed in this document. If it subsequently develops during final design that these conditions have substantially changed, abatement measures will be reanalyzed.

7.2 Construction Noise

In addition to noise from traffic, construction activities themselves can produce increased noise of a temporary nature. MDOT will be sensitive to local needs and may adjust work practices to reduce inconvenience to the public.

The major construction elements of this project are expected to be demolition, hauling, grading, and paving. Construction of the proposed improvements will result in a temporary increase in the ambient noise level along I-96. General construction noise impacts for passerby and those individuals living or working near the project can be expected particularly from demolition, earth moving, and paving operations. Equipment associated with construction generally includes backhoes, graders, pavers, concrete trucks, compressors, and other miscellaneous heavy equipment. Considering the relatively short-term nature of construction noise, impacts are not expected to be substantial. The transmission loss characteristics of nearby structures are believed to be sufficient to moderate the effects of intrusive construction noise.

8 References

Anderson, G. S., C.S.Y. Lee, G.G. Fleming and C. Menge, "FHWA Traffic Noise Model[®], Version 1.0 User's Guide", Federal Highway Administration, January 1998, p. 60.

FHWA, Noise Policy FAQs – Frequently Asked Questions

https://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/faq_nois.cfm#D4e

FHWA, *Procedures for Abatement of Highway Traffic Noise and Construction Noise*, Code of Federal Regulations, Title 23 Part 772 (23 CFR 722).

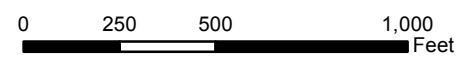
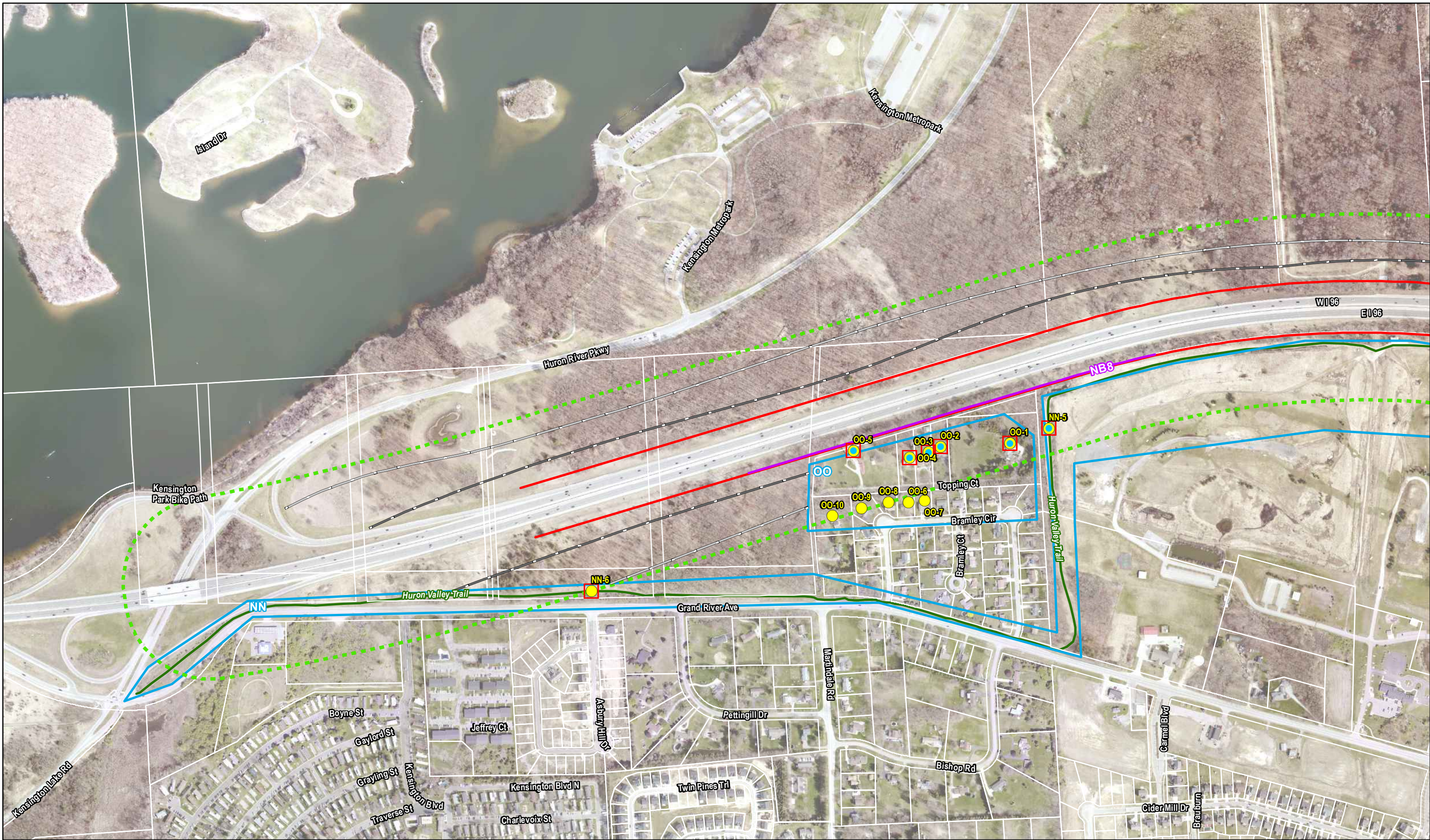
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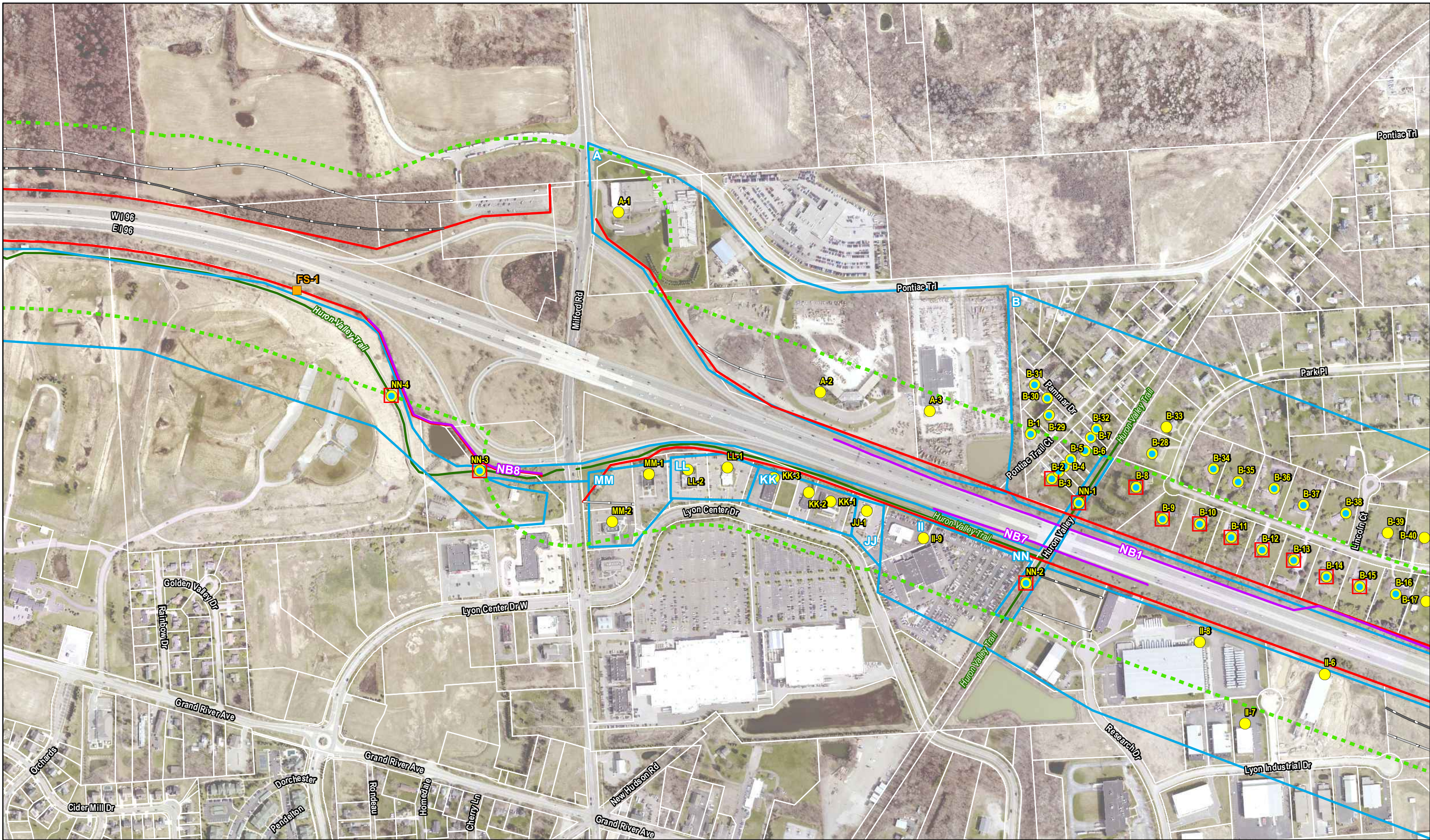
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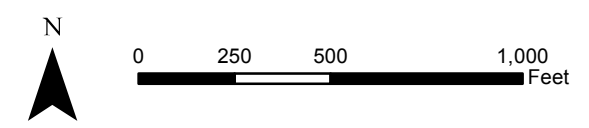
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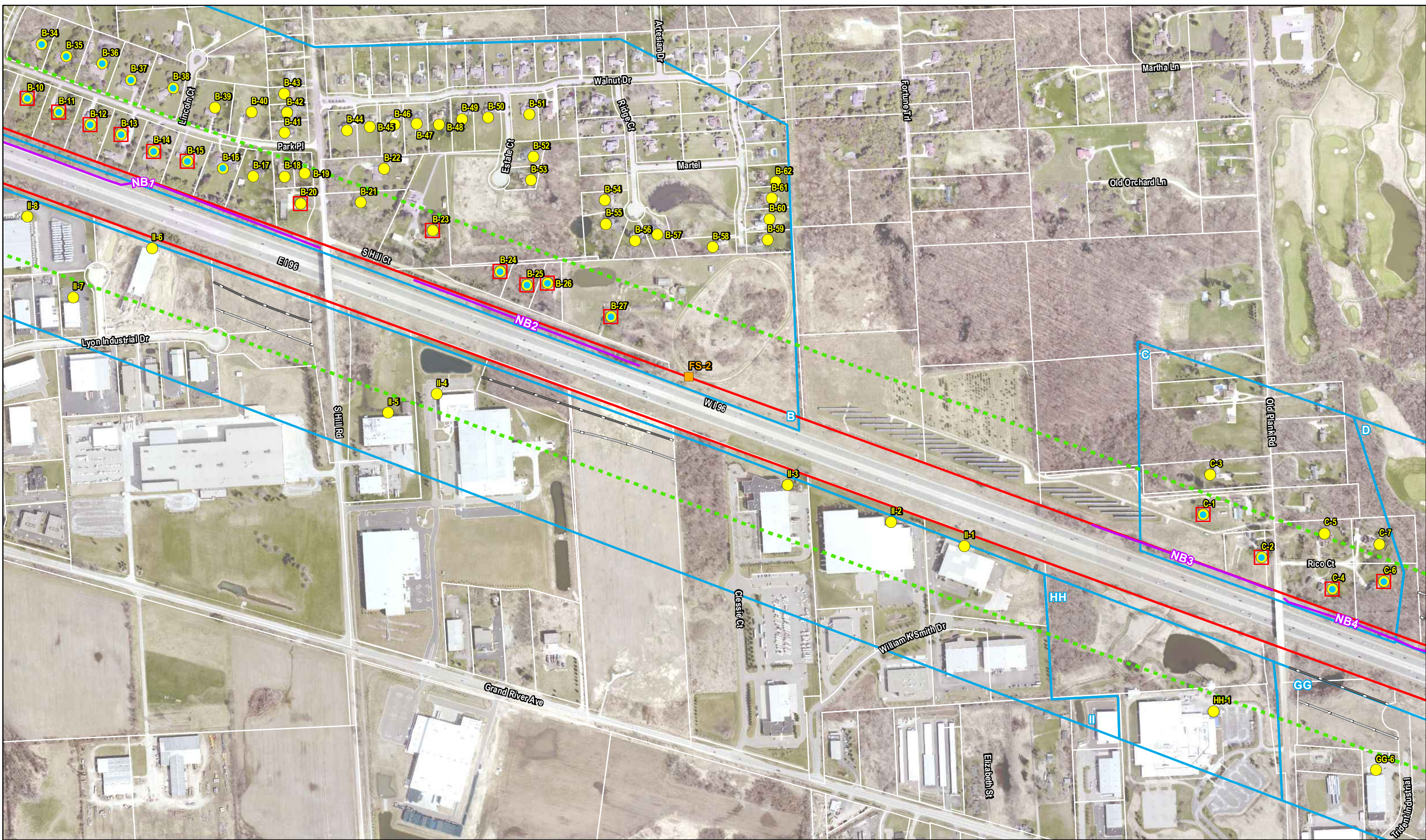
Appendix A: Traffic Noise Study Exhibits



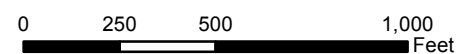


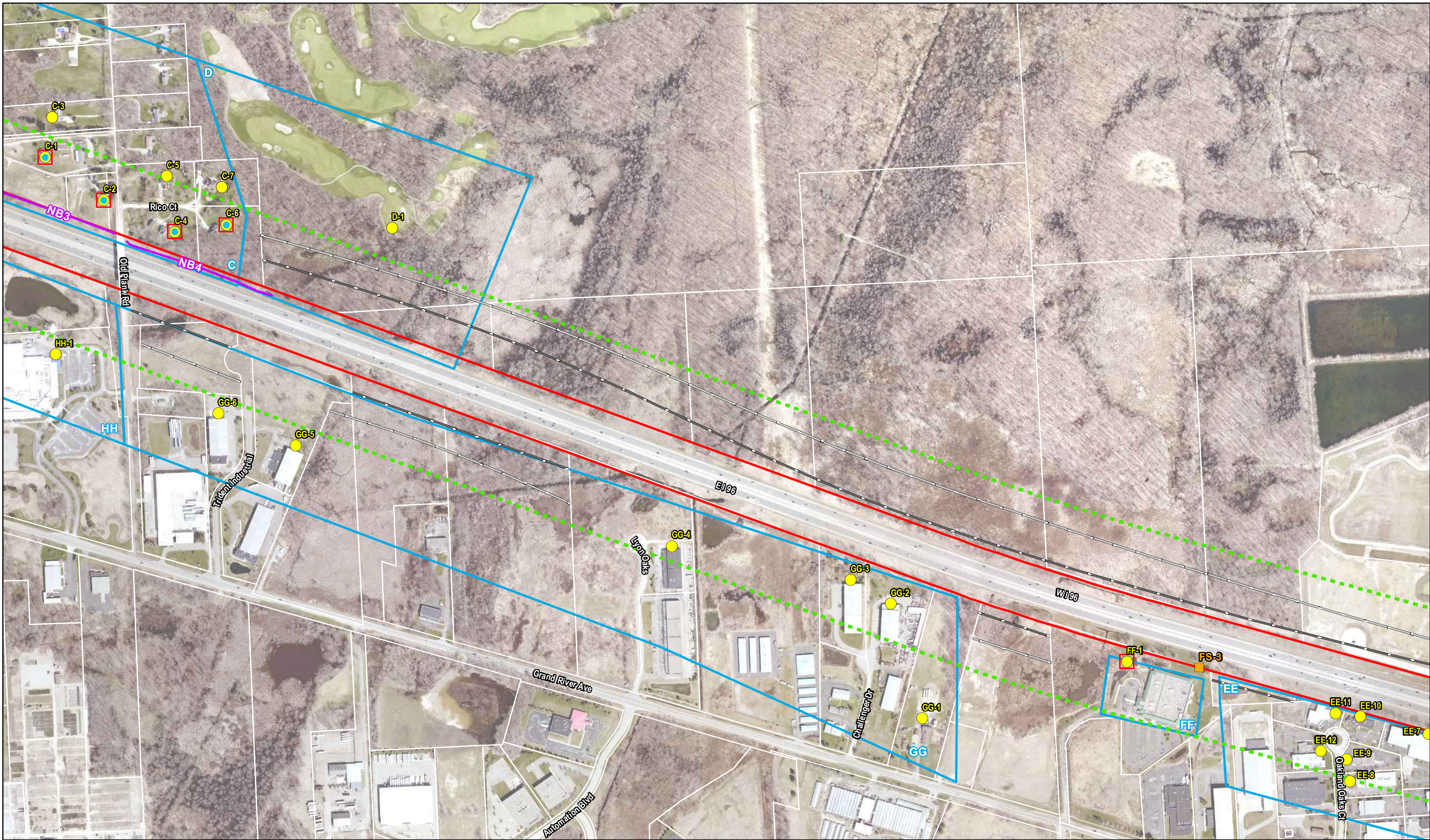
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- Future Impact
- Modeled Receiver
- Field Site
- 66 dB(A) Setback
- 71 dB(A) Setback
- Noise Barriers Analyzed
- Existing ROW
- Huron Valley Trail
- A CNE
- 500' Buffer



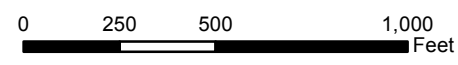


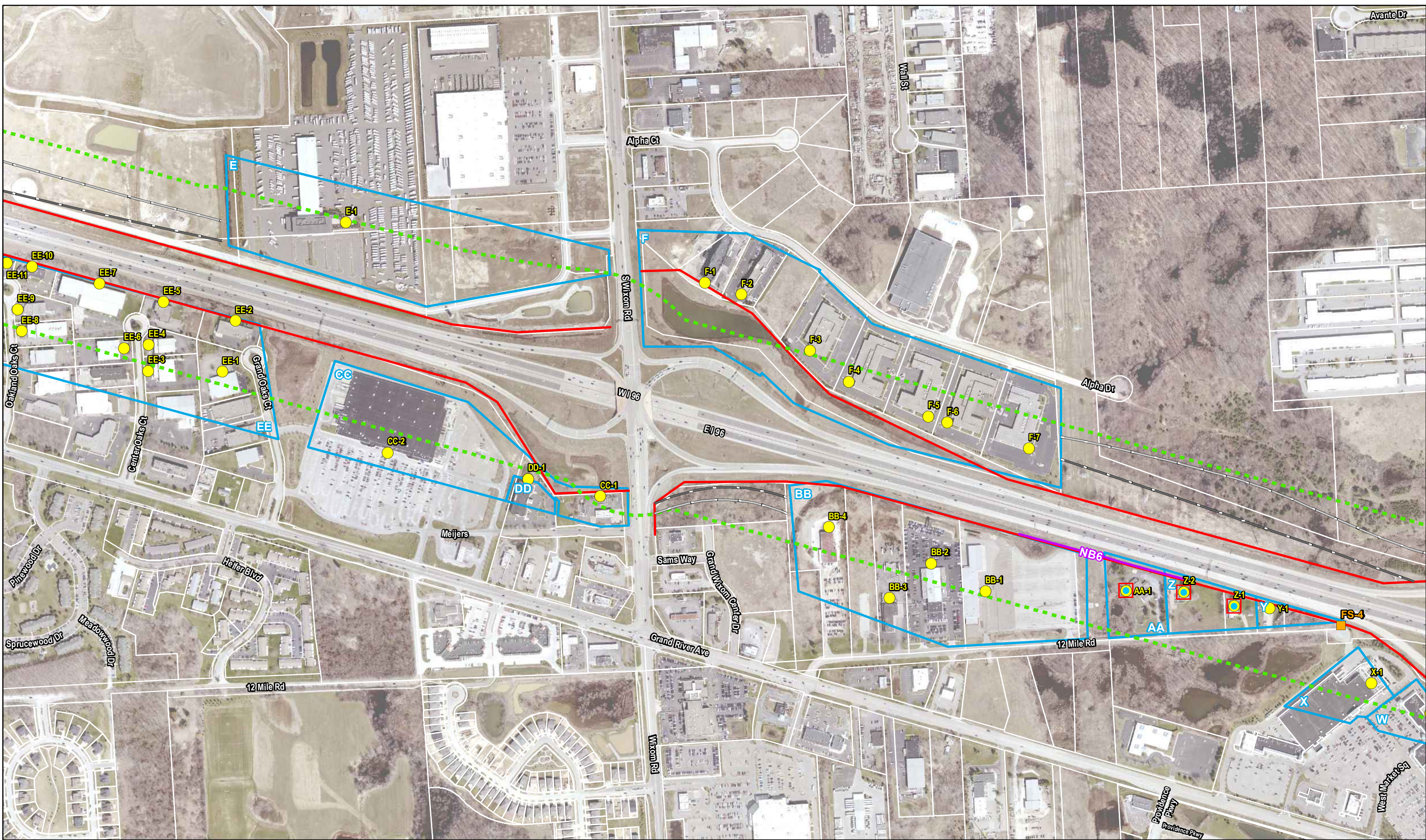
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- 66 dB(A) Setback
- Existing ROW
- 500' Buffer
- Modeled Receiver
- 71 dB(A) Setback
- Huron Valley Trail



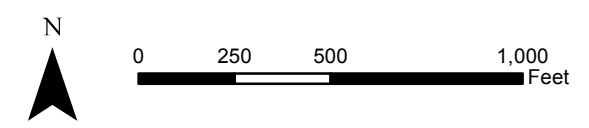


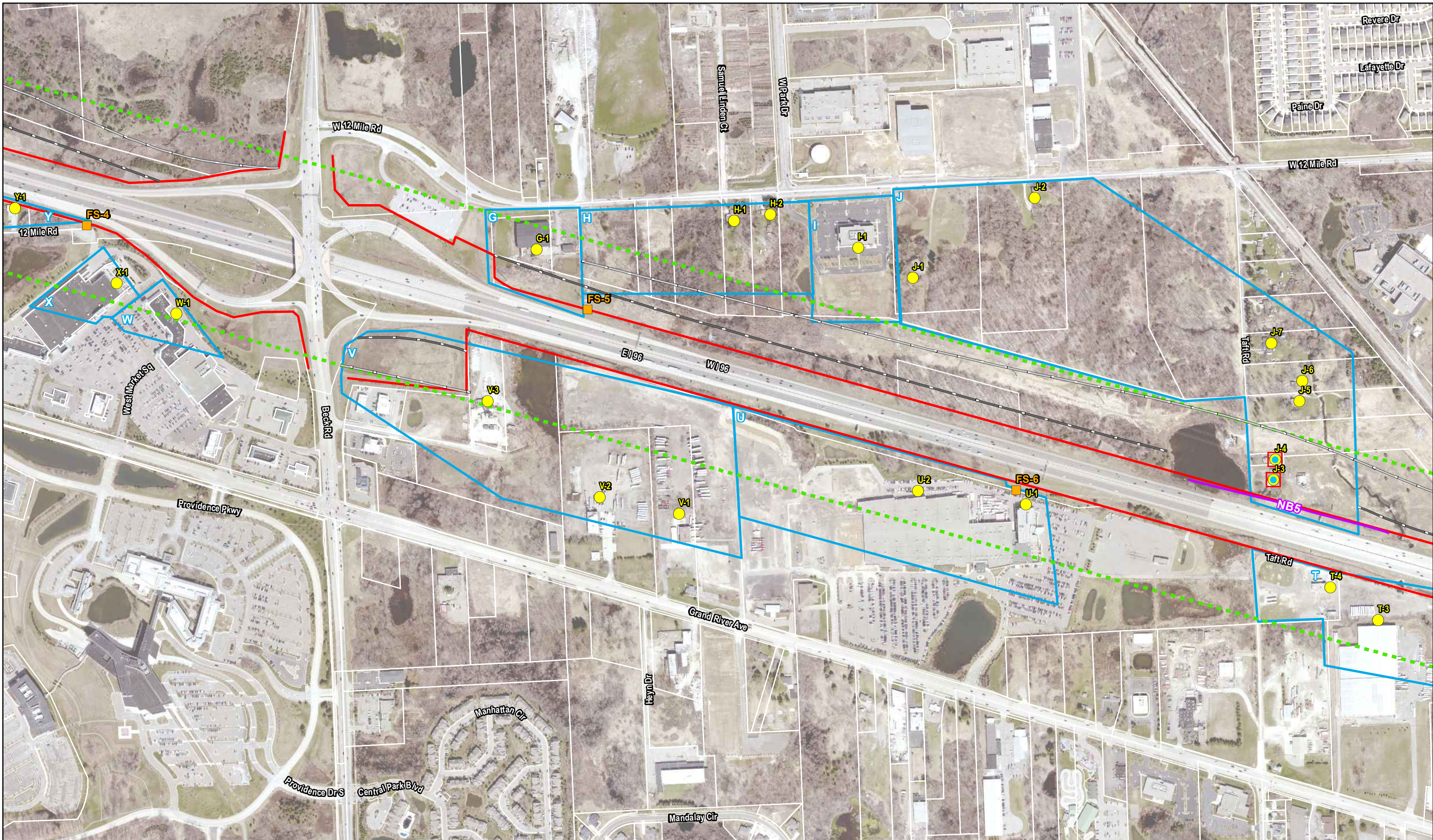
- Benefitted
- Field Site
- Noise Barriers Analyzed
- A CNE
- Future Impact
- 66 dB(A) Setback
- Existing ROW
- 500' Buffer
- Modeled Receiver
- 71 dB(A) Setback
- Huron Valley Trail



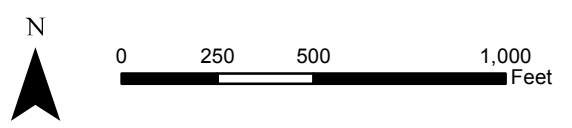


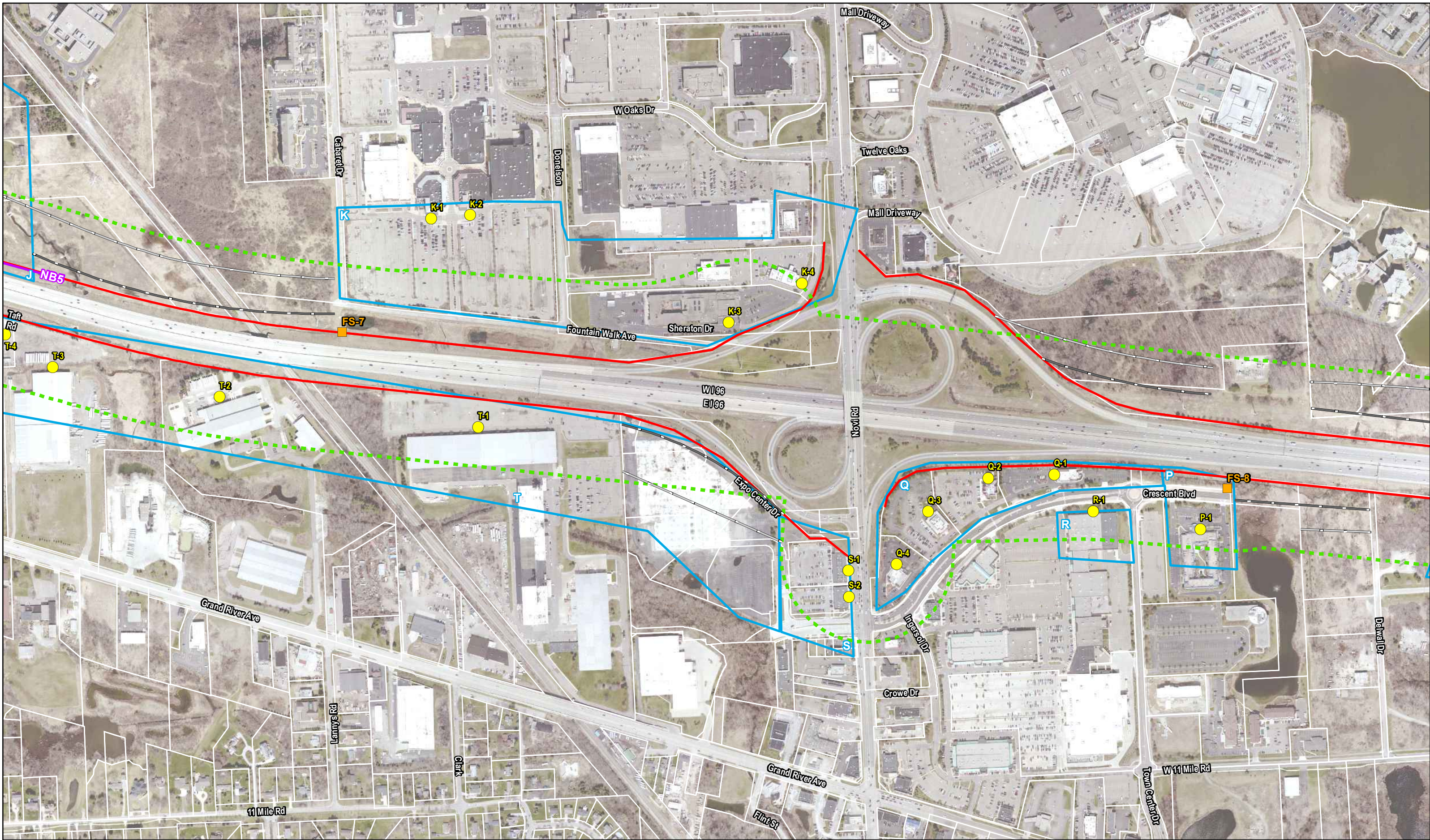
- Benefitted
- Future Impact
- Modeled Receiver
- Field Site
- 66 dB(A) Setback
- 71 dB(A) Setback
- Noise Barriers Analyzed
- Existing ROW
- Huron Valley Trail
- A CNE
- 500' Buffer



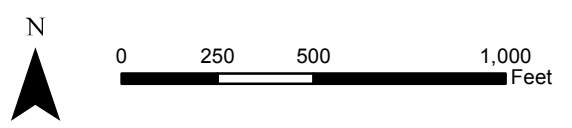


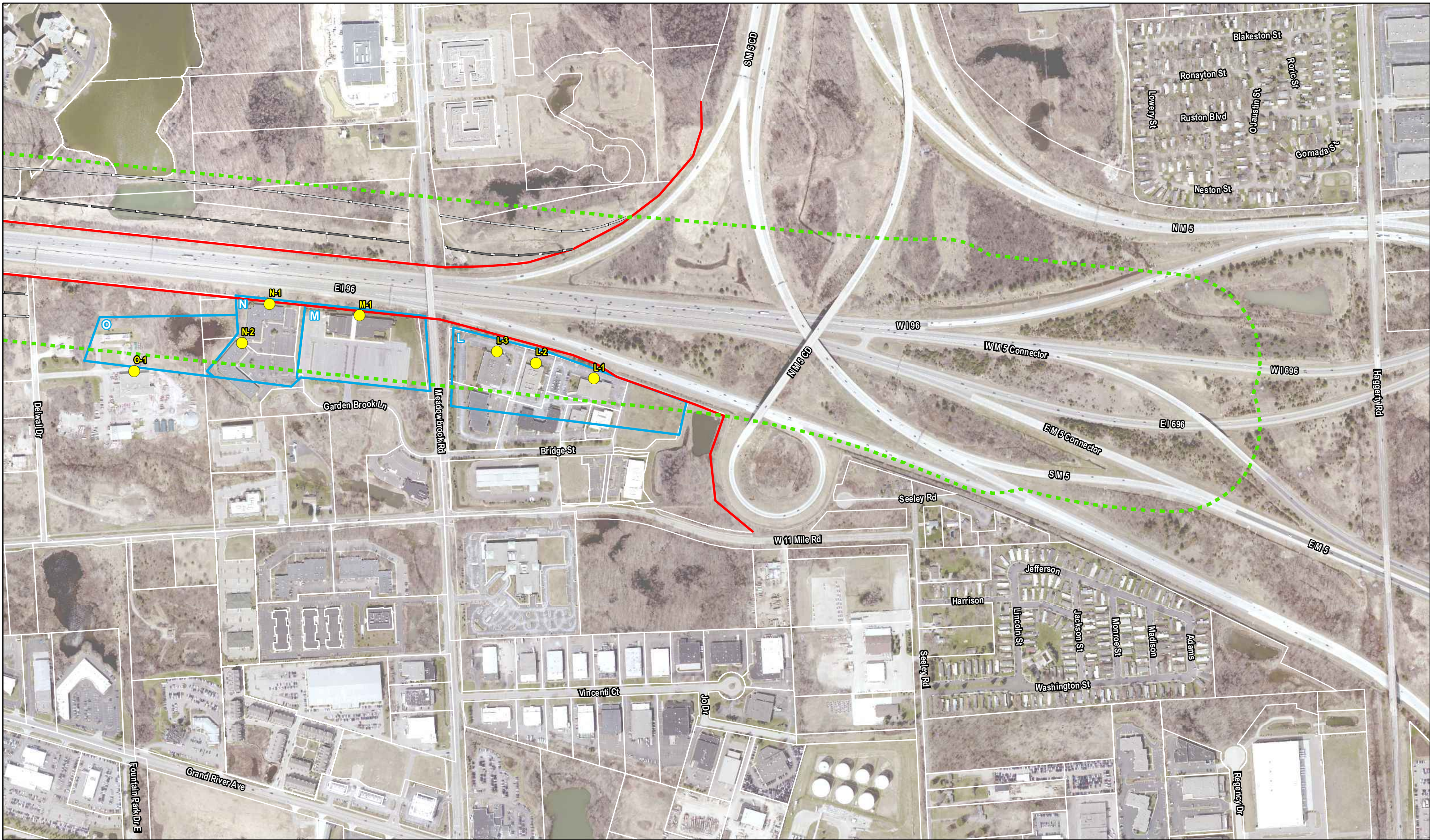
- Benefitted
- Field Site
- Noise Barriers Analyzed
- A CNE
- Future Impact
- 66 dB(A) Setback
- Existing ROW
- 500' Buffer
- Modeled Receiver
- 71 dB(A) Setback
- Huron Valley Trail



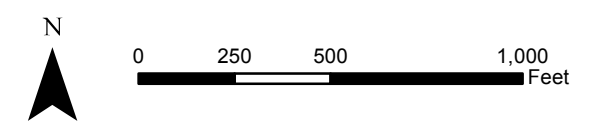


- Benefitted
- Field Site
- Noise Barriers Analyzed
- A CNE
- Future Impact
- 66 dB(A) Setback
- Existing ROW
- 500' Buffer
- Modeled Receiver
- 71 dB(A) Setback
- Huron Valley Trail





- Benefitted
- Field Site
- Noise Barriers Analyzed
- A CNE
- Future Impact
- 66 dB(A) Setback
- Existing ROW
- 500' Buffer
- Modeled Receiver
- 71 dB(A) Setback
- Huron Valley Trail



Appendix B: Calibration Certification

Calibration Certificate No.38003

Instrument: Acoustical Calibrator
Model: 1251
Manufacturer: Norsonic
Serial number: 30825
Class (IEC 60942): 1
Barometer type:
Barometer s/n:

Date Calibrated: 3/7/2017 **Cal Due:** 3/7/2018
Status:

Received	Sent
X	X

In tolerance:

X	X
---	---

Out of tolerance:

--	--

See comments:

--	--

Contains non-accredited tests: Yes X No

Customer: HNTB Corporation
Tel/Fax: 414-359-2300 / 414-359-2314

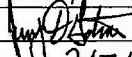
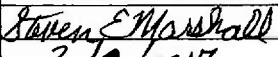
Address: 11414 West Park Place, Suite 300
Milwaukee, WI 53224

Tested in accordance with the following procedures and standards:
Calibration of Acoustical Calibrators, Scantek Inc., Rev. 10/1/2010

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence	Cal. Due
				Cal. Lab / Accreditation	
483B-Norsonic	SME Cal Unit	25747	Jul 6, 2016	Scantek, Inc./ NVLAP	Jul 6, 2017
DS-360-SRS	Function Generator	61646	Aug 12, 2015	ACR Env./ A2LA	Aug 12, 2017
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Aug 16, 2016	ACR Env. / A2LA	Aug 16, 2017
DPI 141-Druck	Pressure Indicator	790/00-04	Dec 22, 2016	ACR Env./ A2LA	Dec 22, 2018
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Oct 1, 2015	ACR Env./ A2LA	Apr 1, 2017
8903A-HP	Audio Analyzer	2514A05691	Dec 19, 2016	ACR Env./ A2LA	Dec 19, 2019
PC Program 1018 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
4134-Brüel&Kjær	Microphone	950698	Nov 10, 2016	Scantek, Inc. / NVLAP	Nov 10, 2017
1203-Norsonic	Preamplifier	14059	Feb 13, 2017	Scantek, Inc./ NVLAP	Feb 13, 2018

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK)

Calibrated by:	Jeremy Gotwalt	Authorized signatory:	Steven E. Marshall
Signature		Signature	
Date	3/7/17	Date	3/8/2017

Results summary: Device was tested and complies with following clauses of mentioned specifications:

CLAUSES ¹ FROM STANDARDS REFERENCED IN PROCEDURES:	MET ²	NOT MET	COMMENTS
Manufacturer specifications			
Manufacturer specifications: Sound pressure level	X		
Manufacturer specifications: Frequency	X		
Manufacturer specifications: Total harmonic distortion	X		
Current standards			
ANSI S1.40:2006 B.3 / IEC 60942: 2003 B.2 - Preliminary inspection	X		
ANSI S1.40:2006 B.4.4 / IEC 60942: 2003 B.3.4 - Sound pressure level	X		
ANSI S1.40:2006 A.5.4 / IEC 60942: 2003 A.4.4 - Sound pressure level stability	-	-	
ANSI S1.40:2006 B.4.5 / IEC 60942: 2003 B.3.5 - Frequency	X		
ANSI S1.40:2006 B.4.6 / IEC 60942: 2003 B.3.6 - Total harmonic distortion	X		

¹ The results of this calibration apply only to the instrument type with serial number identified in this report.

² The tests marked with (*) are not covered by the current NVLAP accreditation.

Main measured parameters³:

Measured ⁴ /Acceptable ⁵ Tone frequency (Hz):	Measured ⁴ /Acceptable ⁵ Total Harmonic Distortion (%):	Measured ⁴ /Acceptable Level ⁵ (dB):
1000.20 ± 1.0/1000.0 ± 10.0	0.44 ± 0.10/ < 3	114.06 ± 0.12/114.0 ± 0.4

³ The stated level is valid at reference conditions.

⁴ The above expanded uncertainties for frequency and distortion are calculated with a coverage factor k=2; for level k=2.00

⁵ Acceptable parameters values are from the current standards

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.9 ± 1.0	100.86 ± 0.002	42.4 ± 2.2

Tests made with following attachments to instrument:

Calibrator ½" Adaptor Type: Norsonic Type 1443
Other:

Adjustments: Unit was not adjusted.

Comments: The instrument was tested and met all specifications found in the referenced procedures.

Note: The instrument was tested for the parameters listed in the table above, using the test methods described in the listed standards. All tests were performed around the reference conditions. The test results were compared with the manufacturer's or with the standard's specifications, whichever are larger.

Compliance with any standard cannot be claimed based solely on the periodic tests.

Measured Data: in Acoustical Calibrator Test Report # 38003 of one page.

Place of Calibration: Scantek, Inc.

6430 Dobbin Road, Suite C
Columbia, MD 21045 USA

Ph/Fax: 410-290-7726/ -9167
callab@scantekinc.com

Calibration Certificates or Test Reports shall not be reproduced, except in full, without written approval of the laboratory.

This Calibration Certificate or Test Reports shall not be used to claim product certification, approval or endorsement by NVLAP, NIST, or any agency of the federal government.

Document stored as: Z:\Calibration Lab\Cal 2017\NOR1251_30825_M1.doc

Calibration Certificate No.34247

Instrument: **Acoustical Calibrator**
Model: **1251**
Manufacturer: **Norsonic**
Serial number: **30825**
Class (IEC 60942): **1**
Barometer type:
Barometer s/n:

Date Calibrated: **7/9/2015** Cal Due:

Status:	Received	Sent
In tolerance:	X	X
Out of tolerance:		
See comments:		
Contains non-accredited tests: <u> </u> Yes <u> </u> X No		

Customer: **HNTB Corporation**
Tel/Fax: **414-359-2300 / -2314**

Address: **11414 West Park Place, Suite 300**
Milwaukee, WI 53224

Tested in accordance with the following procedures and standards:
Calibration of Acoustical Calibrators, Scantek Inc., Rev. 1/16/2015

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence	Cal. Due
				Cal. Lab / Accreditation	
483B-Norsonic	SME Cal Unit	25747	Jul 2, 2015	Scantek, Inc./ NVLAP	Jul 2, 2016
DS-360-SRS	Function Generator	61646	Nov 11, 2014	ACR Env./ A2LA	Nov11, 2016
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Nov 11, 2014	ACR Env. / A2LA	Nov 11, 2015
DPI 141-Druck	Pressure Indicator	790/00-04	Nov 18, 2014	ACR Env./ A2LA	Nov 18, 2016
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Mar 17, 2014	ACR Env./ A2LA	Sep 17, 2015
8903A-HP	Audio Analyzer	2514A05691	Dec 12, 2013	ACR Env./ A2LA	Dec 12, 2016
PC Program 1018 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
4134-Brüel&Kjær	Microphone	906763	Oct 15, 2013	NPL-UK / UKAS	Oct 15, 2015
1203-Norsonic	Preamplifier	14059	Jan 5, 2015	Scantek, Inc./ NVLAP	Jan 5, 2016

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK)

Calibrated by:	Valentin Buzduga	Authorized signatory:	Mariana Buzduga
Signature	<i>[Signature]</i>	Signature	<i>[Signature]</i>
Date	7/09/2015	Date	7/9/2015

Results summary: Device was tested and complies with following clauses of mentioned specifications:

CLAUSES ¹ FROM STANDARDS REFERENCED IN PROCEDURES:	.MET ²	NOT MET	COMMENTS
Manufacturer specifications			
Manufacturer specifications: Sound pressure level	X		
Manufacturer specifications: Frequency	X		
Manufacturer specifications: Total harmonic distortion	X		
Current standards			
ANSI S1.40:2006 B.3 / IEC 60942: 2003 B.2 - Preliminary inspection	X		
ANSI S1.40:2006 B.4.4 / IEC 60942: 2003 B.3.4 - Sound pressure level	X		
ANSI S1.40:2006 A.5.4 / IEC 60942: 2003 A.4.4 - Sound pressure level stability	-	-	
ANSI S1.40:2006 B.4.5 / IEC 60942: 2003 B.3.5 - Frequency	X		
ANSI S1.40:2006 B.4.6 / IEC 60942: 2003 B.3.6 - Total harmonic distortion	X		

¹ The results of this calibration apply only to the instrument type with serial number identified in this report.

² The tests marked with (*) are not covered by the current NVLAP accreditation.

Main measured parameters³:

Measured ⁴ /Acceptable ⁵ Tone frequency (Hz):	Measured ⁴ /Acceptable ⁵ Total Harmonic Distortion (%):	Measured ⁴ /Acceptable Level ⁵ (dB):
1000.61 ± 1.0/1000.0 ± 10.0	0.23 ± 0.10/ < 3	114.13 ± 0.12/114.0 ± 0.4

³ The stated level is valid at reference conditions.

⁴ The above expanded uncertainties for frequency and distortion are calculated with a coverage factor k=2; for level k=2.00

⁵ Acceptable parameters values are from the current standards

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.3 ± 1.0	100.13 ± 0.003	41.6 ± 2.2

Tests made with following attachments to instrument:

Calibrator ½" Adaptor Type: 1443

Other:

Adjustments: Unit was not adjusted.

Comments: The instrument was tested and met all specifications found in the referenced procedures.

Note: The instrument was tested for the parameters listed in the table above, using the test methods described in the listed standards. All tests were performed around the reference conditions. The test results were compared with the manufacturer's or with the standard's specifications, whichever are larger.

Compliance with any standard cannot be claimed based solely on the periodic tests.

Measured Data: in Acoustical Calibrator Test Report # 34247 of one page.

Place of Calibration: Scantek, Inc.

6430 Dobbin Road, Suite C
Columbia, MD 21045 USA

Ph/Fax: 410-290-7726/ -9167
callab@scantekinc.com

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Document stored as: Z:\Calibration Lab\Cal 2015\NOR1251_30825_M1.doc

Calibration Certificate No. 35788

Instrument: Sound Level Meter
Model: 118
Manufacturer: Norsonic
Serial number: 31483
Tested with: Microphone 1225 s/n 52318
Preamplifier 1206 s/n 30522
Type (class): 1
Customer: HNTB Corporation
Tel/Fax: 414-359-2300 / 414-359-2314

Date Calibrated: 3/14/2016 **Cal Due:**
Status:

Received	Sent
X	X

In tolerance:

X	X
---	---

Out of tolerance:

--	--

See comments:
Contains non-accredited tests: Yes No
Calibration service: Basic Standard
Address: 11414 West Park Place, Suite 300,
Milwaukee, WI 53224

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/26/2015
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence	Cal. Due
				Cal. Lab / Accreditation	
483B-Norsonic	SME Cal Unit	31052	Oct 23, 2015	Scantek, Inc./ NVLAP	Oct 23, 2016
DS-360-SRS	Function Generator	33584	Oct 20, 2015	ACR Env./ A2LA	Oct 20, 2017
34401A-Agilent Technologies	Digital Voltmeter	US36120731	Oct 6, 2015	ACR Env./ A2LA	Oct 6, 2016
HM30-Thommen	Meteo Station	1040170/39633	Oct 23, 2015	ACR Env./ A2LA	Oct 23, 2016
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Nov 10, 2015	Scantek, Inc./ NVLAP	Nov 10, 2016

Jul 24, 2016

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
24.1	99.86	39.2

Calibrated by:	Lydon Dawkins	Authorized signatory:	Valentin Brzduga
Signature	<i>Lydon Dawkins</i>	Signature	<i>Valentin Brzduga</i>
Date	3/14/2016	Date	3/14/2016

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This Calibration Certificate or Test Reports shall not be used to claim product certification, approval or endorsement by NVLAP, NIST, or any agency of the federal government.

Results summary: Device complies with following clauses of mentioned specifications:

CLAUSES ¹ FROM IEC/ANSI STANDARDS REFERENCED IN PROCEDURES:	RESULT ^{2,3}	EXPANDED UNCERTAINTY (coverage factor 2) [dB]
INDICATION AT THE CALIBRATION CHECK FREQUENCY - IEC61672-3 ED.2 CLAUSE 10	Passed	0.15
SELF-GENERATED NOISE - IEC 61672-3 ED.2 CLAUSE 11	Passed	0.30
FREQUENCY WEIGHTINGS: A NETWORK - IEC 61672-3 ED.2.0 CLAUSE 13	Passed	0.20
FREQUENCY WEIGHTINGS: C NETWORK - IEC 61672-3 ED.2.0 CLAUSE 13	Passed	0.20
FREQUENCY WEIGHTINGS: Z NETWORK - IEC 61672-3 ED.2.0 CLAUSE 13	Passed	0.20
FREQUENCY AND TIME WEIGHTINGS AT 1 KHZ IEC 61672-3 ED.2.0 CLAUSE 14	Passed	0.20
LEVEL LINEARITY ON THE REFERENCE LEVEL RANGE - IEC 61672-3 ED.2 CLAUSE 16	Passed	0.25
TONEBURST RESPONSE - IEC 61672-3 ED.2.0 CLAUSE 18	Passed	0.30
PEAK C SOUND LEVEL - IEC 61672-3 ED.2.0 CLAUSE 19	Passed	0.35
OVERLOAD INDICATION - IEC 61672-3 ED.2.0 CLAUSE 20	Passed	0.25
HIGH LEVEL STABILITY TEST - IEC 61672-3 ED.2.0 CLAUSE 21	Passed	0.10
LONG TERM STABILITY TEST - IEC 61672-3 ED.2.0 CLAUSE 15	Passed	0.10
FILTER TEST 1/OCTAVE: RELATIVE ATTENUATION - IEC 61260, CLAUSE 4.4 & #5.3	Passed	0.25
FILTER TEST 1/3OCTAVE: RELATIVE ATTENUATION - IEC 61260, CLAUSE 4.4 & #5.3	Passed	0.25
COMBINED ELECTRICAL AND ACOUSTICAL TEST - IEC 61672-3 ED.2.0 CLAUSE 13	Passed	See test report

¹ The results of this calibration apply only to the instrument type with serial number identified in this report.

² Parameters are certified at actual environmental conditions.

³ The tests marked with (*) are not covered by the current NVLAP accreditation.

Comments: The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organization responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2, to demonstrate that the model of sound level meter fully conforms to the requirements in the IEC 61672-2, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1.

Note: The instrument was tested for the parameters listed in the table above, using the test methods described in the listed standards. All tests were performed around the reference conditions. The test results were compared with the manufacturer's or with the standard's specifications, whichever are larger. Compliance with any standard cannot be claimed based solely on the periodic tests.

Tests made with the following attachments to the instrument:

Microphone: Norsonic 1225 s/n 52318 for acoustical test
Preamplifier: Norsonic 1206 s/n 30522 for all tests
Other: line adaptor ADP005 (18pF) for electrical tests
Accompanying acoustical calibrator: none
Windscreen: Norsonic Nor1451 (ø 60mm)

Measured Data: in Test Report # 35788 of 9 + 1 pages.

Place of Calibration: Scantek, Inc.

6430 Dobbin Road, Suite C
Columbia, MD 21045 USA

Ph/Fax: 410-290-7726/ -9167
callab@scantekinc.com

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Document stored Z:\Calibration Lab\SLM 2016\NOR118_31483_M1.doc

Scantek, Inc.

CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1

ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP[®]

NVLAP Lab Code: 200625-0

Calibration Certificate No.35789

Instrument: **Microphone**
 Model: **1225**
 Manufacturer: **Norsonic**
 Serial number: **52318**
 Composed of:

Date Calibrated: **3/14/2016** Cal Due:

Status:	Received	Sent
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: Yes X No

Customer: **HNTB Corporation**
 Tel/Fax: **414-359-2300/414-359-2314**

Address: **11414 West Park Place, Suite 300,
 Milwaukee, WI 53224**

Tested in accordance with the following procedures and standards:

Calibration of Measurement Microphones, Scantek, Inc., Rev. 2/25/2015

Instrumentation used for calibration: N-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence	Cal. Due
				Cal. Lab / Accreditation	
483B-Norsonic	SME Cal Unit	31052	Oct 23, 2015	Scantek, Inc./ NVLAP	Oct 23, 2016
DS-360-SRS	Function Generator	33584	Oct 20, 2015	ACR Env./ A2LA	Oct 20, 2017
34401A-Agilent Technologies	Digital Voltmeter	US36120731	Oct 6, 2015	ACR Env. / A2LA	Oct 6, 2016
HM30-Thommen	Meteo Station	1040170/39633	Oct 23, 2015	ACR Env./ A2LA	Oct 23, 2016
PC Program 1017 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1253-Norsonic	Calibrator	28326	Nov 10, 2015	Scantek, Inc./ NVLAP	Nov 10, 2016
1203-Norsonic	Preamplifier	14052	Aug 24, 2015	Scantek, Inc./ NVLAP	Aug 24, 2016
4180-Brüel&Kjær	Microphone	2246115	Oct 26, 2015	NPL-UK / UKAS	Oct 26, 2017

Instrumentation and test results are traceable to SI - BIPM through standards maintained by NPL (UK) and NIST (USA)

Calibrated by:	Lydon Dawkins	Authorized signatory:	Valentin Buzduga
Signature	<i>Lydon Dawkins</i>	Signature	<i>Valentin Buzduga</i>
Date	3/14/2016	Date	3/14/2016

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Document stored as: Z:\Calibration Lab\Mic 2016\NOR1225_52318_M1.doc

Page 1 of 2

Results summary: Device was tested and complies with following clauses of mentioned specifications:

CLAUSES / METHODS ¹ FROM PROCEDURES		MET ^{2,3}	NOT MET	NOT TESTED	MEASUREMENT EXPANDED UNCERTAINTY (coverage factor 2)
Open circuit sensitivity (insert voltage method, 250 Hz)		X			See below
Frequency response	Actuator response	X			63 – 200Hz: 0.3 dB 200 – 8000 Hz: 0.2 dB 8 – 10 kHz: 0.5 dB 10 – 20 kHz: 0.7 dB 20 – 50 kHz: 0.9 dB 50 – 100 kHz: 1.2 dB
	FF/Diffuse field responses	X			63 – 200Hz: 0.3 dB 200 – 4000 Hz: 0.2 dB 4 – 10 kHz: 0.6 dB 10 – 20 kHz: 0.9 dB 20 – 50 kHz: 2.2 dB 50 – 100 kHz: 4.4 dB
	Scantek, Inc. acoustical method			X	31.5 – 125 Hz: 0.16 dB 250, 1000 Hz: 0.12 dB 2 – 8 kHz: 0.8 dB 12.5 – 16 kHz: 2.4 dB

¹ The results of this calibration apply only to the instrument type with serial number identified in this report.

² Results are normalized to the reference conditions.

³ The tests marked with (*) are not covered by the current NVLAP accreditation.

Note: The free field/diffuse field characteristics were calculated based on the measured actuator response and adjustment coefficients as provided by the manufacturer. The uncertainties reported for these characteristics may include assumed uncertainty components for the adjustment coefficients.

Comments: The instrument was tested and met all specifications found in the referenced procedures.

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.9 ± 1.1	99.88 ± 0.025	37.8 ± 2.1

Main measured parameters:

Tone frequency (Hz)	Measured ⁴ /Nominal Open circuit sensitivity (dB re 1V/Pa)	Sensitivity (mV/Pa)
250	-26.24 ± 0.12/ -26.0	48.73

⁴ The reported expanded uncertainty is calculated with a coverage factor k=2.00

Tests made with following attachments to instrument and auxiliary devices:

Protection grid mounted for sensitivity measurements
Actuator type: G.R.A.S. RA0014

Measured Data: Found on Microphone Test Report # 35789 of one page.

Place of Calibration: Scantek, Inc.

6430 Dobbin Road, Suite C
Columbia, MD 21045 USA

Ph/Fax: 410-290-7726/ -9167
callab@scantekinc.com

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Document stored as: Z:\Calibration Lab\Mic 2016\NOR1225_52318_M1.doc

Page 2 of 2

Appendix C: Trail Modeling

**METHODOLOGY FOR DETERMINING
DWELLING UNIT EQUIVALENT FOR TRAIL**

STEPS FOR ANALYZING HURON VALLEY TRAIL (Guidance from Tom Hanf 10/3/2018 email to Michael Zabel).	
1. Determine the impacted sections of the trail using the 66 dB(C5) contour (see Appendix C, Page 2 for length of trail within Future 66 dB(A) noise contour)	
2. Segment the trail by using the square footage of the properties on Pontiac Trail Court	
3. Determine dwelling unit equivalent (DUE)	

Length of Trail within the Future 66 dB(A) noise contour (ft)	Average Trail Width (ft)	Noise Impacted Area (Sq Ft)	Average lot size (Sq Ft)	Dwelling Unit Equivalent (Noise impacted area/Average Lot Size)
280.0	10	2,800.0	17,324.8	0
172.0	10	1,720.0	17,324.8	0
2,838.0	10	28,380.0	17,324.8	2
545.2	10	5,451.6	17,324.8	0
4,748.0	10	47,480.0	17,324.8	3
2,930.0	10	29,300.0	17,324.8	2
11,513.2	10	115,131.6		7

TOTAL

Parcels used to calculate average lot size along Pontiac Trail Court



49,321.7
14,233.9
13,899.5
13,076.8
27,473.9
15,608.3
10,982.4
22,823.6
15,682.2
8,355.1
14,960.2
12,927.4
7,662.6
15,539.1
<hr/>
Average 17,324.8



Huron Valley Trail  500' Buffer
 Impact
 No Impact

0 1,000 2,000 4,000
 Feet



Huron Valley Trail Impact Analysis



Carlisle | Wortman
ASSOCIATES, INC.

117 NORTH FIRST STREET SUITE 70 ANN ARBOR, MI 48104 734.662.2200 734.662.1935 FAX

To: Howell Township Planning Commission and Data Center Subcommittee
From: Paul Montagno, AICP, Principle and Brady Heath, Township Planner
Date: May 7, 2026
Re: Data Centers

The Resident Research Committee has done considerable research on data centers and other “high impact land uses” and provided recommendations to incorporate in the data center ordinance. We appreciate the work they have done and the input that has been provided for consideration by the Planning Commission as they develop a draft ordinance. At this point it will be important of the Planning Commission members on the subcommittee to provide feedback on the draft and any specific direction on updates they would like to see in the current draft.

We have incorporated many of the suggestions that have been provided. However, there are some suggestions that have not been incorporated for a number of reasons. For example, there may be other sections of the ordinance that address specific requirements, suggestions are covered in other township ordinances or documents, or regulations are not enabled by state law. This memo lists the items that were recommended and indicates where in the ordinance it was added, where it already exists in the ordinance or where it should be incorporated somewhere else, and why it wasn’t incorporated. Additionally, there are some suggestions that we have incorporated but would rely on the committee to review and discuss to determine if the regulation is appropriate for inclusion. Ultimately, we will need to vet the ordinance through legal council to ensure all requirements are defensible

In the attached draft dated 5/7/26, does not show track changes because the draft was becoming too cumbersome. You can generally tell what sections were suggested by the RRC by comparing the current draft to the edits that were previously provided.

We would like to use this memo as a guide for our next discussion in order address some of the outstanding suggestions. We encourage you to go through this memo and the draft ordinance and be prepared with specific feedback and direction at the next meeting.

Benjamin R. Carlisle, *President* John L. Enos, *Vice President* Douglas J. Lewan, *Principal*
David Scurto, *Principal* Sally M. Elmiger, *Principal* R. Donald Wortman, *Principal* Craig Strong, *Principal*
Paul Montagno, *Principal* Megan Masson-Minock, *Principal* Laura Kreps, *Principal*
Richard K. Carlisle, *Past President/Senior Principal*

Additional Ordinance Sections to Incorporate

Application

1. A fee of X% of the total proposed development investment shall be remitted with application.
 - **Not included in the ordinance.** The township has a general fee schedule that includes the fees for various permits and applications which is updated from time to time. It would be most appropriate to include fees for a “High Impact Land Use” in the fee schedule.
2. The applicant shall not be permitted to request township officials to sign Non-Disclosure Agreements (NDAs) for the sake of accessing any and all information relevant to approving the project.
 - **Not included in the ordinance.** This is not a zoning issue. This would be a township policy and could be adopted as a standalone policy resolution or could be incorporated in the Township Code of Ordinances. We defer to the township attorney on this issue.
3. Applicant shall notify all property owners within one thousand five hundred (1,500) feet of the proposed development of the Special Use Permit request.
 - **Not included in the ordinance.** It is not typical for an applicant to do the public hearing notices. Per Section 16.05 of the ZO, the township is responsible for notices. Currently the requirement is for 300 feet. We can change the requirement for data centers to notify people within one thousand five hundred (1,500) feet, if the Planning Commission determines that the additional distance is appropriate.
4. Before any Public Hearings take place, the developer shall host no fewer than two (2) town hall meetings open to the public for the purpose of sharing information, questions, and answers about the project.
 - **Needs to be discussed further.** We would like to discuss this further at the next subcommittee meeting.
5. All information which will be provided to the township for the purposes of the special use permit process shall be made available to the public at least seven (7) days prior to the first town hall event.
 - **Not included in the ordinance.** *Once an application is made to the township all information is considered public. The township Clerk should be consulted on how information is to be made available for public review.*
6. Application shall clearly and explicitly name all owners and invested parties, including

end-users. End-users must be the party apply for and signing agreements with the township.

- **Not included in the ordinance.** If the township determines that this is appropriate it should be required on the application. An end user for a development project is not always known or relevant. Any land use approvals by the Township or agreements with the Township would be binding on all successors.

7. A complete, preliminary site plan for all phases of development shall be provided with application.

- **Added in the ordinance.** In section 16.2316.23.B.2.

8. Applicability section

- **Updated.** Section 16.23.B was updated to be clearer and more concise indicating that that the section applies to high impact uses and what permits and application are require.

9. Districts Permitted

- **Updated.** Section 16.23.C. was updated to be clearer and more concise, mimicking the language found in the Green Oak Ordinance, and the Township's renewable energy ordinance referencing the zoning map where the overlay district will be depicted if adopted.

10. Additional application requirements.

- **Added in the ordinance.** Additional application requirements specific to high impact uses were added to section 16.23.D. Some of the elements that were included in the RRC's recommendation were not included because they were already covered in Article 20, belonged in the fee schedule, or are part of the special use procedures already required in the ordinance.

11. Utilities Impact Statement from all utility providers confirming capacity to serve, any required infrastructure upgrades, and a signed acknowledgement that any and all such upgrades shall be 100% paid for by the applicant.

- **Already in the ordinance.** In Section 16.23.G.1.

12. Statement from emergency services (Police, Fire, EMS, etc) describing their ability to respond to abilities, and what additional training and/or equipment would be required to do so; a signed acknowledgement from the applicant that they will fund 100% of the cost of providing said training and equipment.

- **Not included in the ordinance.** The Fire Department, the Livingston County Road

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Commission, and the Township Engineer perform their own reviews, and will cite their concerns in the review.

13. Stormwater Management Plan demonstrating their commitment to minimizing runoff to the greatest extent possibly by adhering to the Drain Commissioner's recommendations and requirements.

- **Not included in the ordinance.** The Township Engineer reviews the plans and will cite any concerns with stormwater along with the Drain Commissioner. This is required for site plan reviews in Section 20.08.D.

14. Cooling system specs.

- **Included.** This section may need further discussion.

15. An escrow shall be funded with \$X at all times through occupancy.

- **Not included in the ordinance.** This can be included in the fee schedule.

16. List of regulated substances, including cooling solutions.

- **Included.** In Section 16.23.D.1.s

17. Signed acknowledgement from the developer and end user of our public notification and involvement process and our High Impact Land Use Overlay District and Data Center Ordinances.

- **Not included.** If a development agreement is required, this can be incorporated there.

18. Signed acknowledgement from applicant and end user that the facility will not be considered for IFT Abatements.

- **Not included.** This would be a township board policy decision, not a zoning ordinance regulation.

19. Construction lighting photometric diagram.

- **Added in the ordinance.** Added in Section 16.23.G.8.A.

Site Design

1. Siting Requirements

Cryptocurrency Mining Facility: Shall require a Special Use Permit in the High Impact Land Use overlay area only and shall not abut sensitive receptor

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parcels, nor shall the property lines for the subject parcel be located within nine hundred (900) feet of any sensitive receptor parcel property lines. No more than two (2) Cryptocurrency Mining Facilities shall be permitted in the township.

Minor Data Center: Shall require a Special Use Permit in the High Impact Land Use overlay area only and shall not abut sensitive receptor parcels, nor shall the property lines for the subject parcel be located within nine hundred (900) feet of any sensitive receptor parcel property lines. If a Minor Data Center requires a substation and/or water treatment plant, it shall be classified as a Medium Data Center and subject to those applicable siting standards. No more than two (2) Minor Data Centers shall be permitted in the township.

Medium Data Center: Shall require a Special Use Permit in the High Impact Land Use overlay and shall not abut sensitive receptor parcels nor shall the property lines for the subject parcel be located within nine hundred (900) feet of any sensitive receptor parcel property lines. No more than two (2) Minor Data Centers shall be permitted in the township. No more than one (1) Medium Data Center shall be permitted in the township.

Major Data Center: Shall require a Special Use Permit in the High Impact Land Use overlay and shall not abut sensitive receptor parcels nor shall the property lines for the subject parcel be located within one thousand two hundred (1,200) feet of any sensitive receptor parcel property lines. No more than one (1) Major Data Center shall be permitted in the township.

Data Center Campus: Shall require a Special Use Permit in the High Impact Land Use overlay and shall not abut sensitive receptor parcels nor shall the property lines for the subject parcel be located within one thousand four hundred (1,400) feet of any sensitive receptor parcel property lines. No more than one (1) Data Center Campus shall be permitted in the township.

- **Not added in the Ordinance.** It is mentioned in the table above and all data centers except for Ancillary have to go through a special land use as they are Permitted Principal Special Uses with Conditions. Additionally, the prohibition of abutting a sensitive receptor doesn't make sense when there are already substantial setback requirements. Why limit the number if they meet the regulations that are designed to protect the public interest.
2. Unlike standard dB(A) measurements, which primarily detect mid-range sounds like speech and traffic, dB(C) measurements capture deeper, low-frequency noises such as infrasound from heavy machinery. These sounds can travel farther and penetrate walls, making them more disruptive in residential areas even when the source of the noise is in a non-residential district. Adding dB(C) limits ensures that noise enforcement addresses all types of sound, improving fairness and effectiveness in line with the intent of this ordinance. Because research on the harms of low frequency and infrasound references unweighted decibels, including dB(Z) limits ensures that noise enforcement aligns with the intent of the ordinance and protects the community from potential health impacts in addition to nuisance.

- **Not Added in the ordinance.** This feels informative rather than a requirement of Zoning.
3. Parking: Data center parking regulations must be established in Article 18 and added to the chart; or is PC comfortable using a similar use as the guidelines?
- **Added in the ordinance.** Added in Section 16.23.E.2.
 - **Requires further discussion.** Does the subcommittee want to add parking requirements for data centers in Section 18.02, or add it to 21 in Section 18.02 Manufacturing, Fabricating, Processing and Bottling Plants, Research and Testing Laboratories, or other related, permitted Industrial Uses. Which requires One (1) space for each employee working during the largest working shift or one (1) space for every 550 square feet of total floor space, whichever is greater.
4. Because of the potential for high impact land uses such as data centers and cryptocurrency mining facilities to consume a disproportionately large amount of water and power in the community, and because the primary source of water consumption at data centers and cryptocurrency mining facilities are related to cooling systems, in order to align with the intent of this ordinance, to protect and ensure the efficient consumption and use of public utilities and natural resources, any system designed for cooling of the facility and/or equipment shall not negatively impact the surrounding region by conforming to the following requirements:
- **Not Added in the ordinance.** This feels more informational rather than a zoning requirement. This is generally covered in the intent section.
5. Substations shall be located as far from property lines as possible, ideally situated behind buildings to provide a visual buffer from road frontage and the nearest residential parcel.
- **Added in the ordinance.** Added in Section 16.23.E.6.e.iv.
6. Detention/Retention ponds are not allowed except as part of the Drain Commission's stormwater management plan.
- **Added in the ordinance.** Added to section 16.23.F.11
7. Walls (height, material, etc) and other noise mitigating features may be allowed for the purpose of adhering to noise ordinances, even if they do not comply with the ordinance requirement.
- **Added in the ordinance.** But this must be reconciled with Section 14.14 states that mechanical equipment is not included in the height. Data centers can be 50 feet in height, but mechanical equipment is not included in the 50 feet.

8. Fencing requirements (barbed wire? Chain link?).
 - **Already in the ordinance.** In Section 16.23. H.1.A. There are standards on fencing and walls in Sections 14.26 and 28.08. This section has been modified to reflect Sections 14.26 and 28.08 with the 8-foot-tall requirement.
9. Drain Tile inspection requirements.
 - **Not added in ordinance.** This is required for all projects by the Livingston County Building Department.

Utilities/Power

1. All utility and electrical transmission lines shall be located underground.
 - **Added in the Ordinance.** Added in Section 16.2316.23.E.5.a.
2. Power use shall be capped according to the following:
 - a. Minor Data Centers:
 - b. Medium Data Centers:
 - c. Major Data Centers:
 - d. Campus Data Centers:
 - e. Township Data Center Total:
 - **Not added in ordinance.** The Township does not have the authority to regulate this. However, we can require power use reporting which is required in Section 16.23.7.a.1.
3. No onsite power generation shall be permitted other than renewables permitted per section F.2.
 - **Not added in ordinance and needs further discussion.** Not sure if we can require this.
4. Fuel Storage limits? Requirements?
 - **Added in the ordinance.** Added in Section 16.23.F.4.d.

Construction

1. Applicant shall have a community complaint resolution liaison available 24 hours a day beginning with construction. The contact information shall be posted in a visible location from the road frontage, as well as provided to the township to be published on the website.

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- **Added in the ordinance.** Added in new Section 16.23.I.1 – Construction standards.
2. All complaints shall be responded to within 24 hours, and if not completely resolved then a resolution plan shall be provided to the township and complainant.
 - **Added in the ordinance.** Added in Section 16.23.I.2.
 3. Applicant shall provide a construction lighting photometric diagram showing predicted, maintained lighting levels produced by the proposed lighting fixtures. Maximum maintained vertical footcandle at any adjoining property lines shall be 0.5 footcandles, measured three feet above ground.
 - **Added in the ordinance.** Added in Section 16.23.H.8.a.i.
 4. Construction shall adhere to the hours in the Ordinance Book; absolutely no variance will be allowed.
 - **Added in the ordinance.** Added in Section 16.23.I.3.

Maintenance

1. Applicant shall submit documentation of seasonal HVAC maintenance for any facility cooling systems to ensure quiet equipment operation.
 - **Added in Ordinance.** Added in Section 16.23.F.3.c.i.

Monitoring

1. Jobs report
 - **Already in the ordinance.** Section 16.23.F.7.vii.
2. Compliance.
 - **Not added in Ordinance.** This needs further discussion.
3. Revocation of Special Use Permit. If at any time the data center operation exceeds the standards as set forth in this section, the special use permit shall be revoked, and operations shall cease.
 - **Added in the ordinance.** Added in Section 16.23.B.d.
4. Confirmation from FAA about airspace compliance.
 - **Requires further discussion.** We would like to discuss this further at the next

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subcommittee meeting.

5. Mandatory Performance Guarantee (ie Section 20.15).
 - **Added in the ordinance.** Added in Section 16.23.B.c.i.
6. Penalties for violations scaled for large corporations; revocation of SUP for multiple violations of the same nature?
 - **Not added in the ordinance/requires further discussion.** We would like to discuss this further at the next subcommittee meeting.
7. Post construction, pre-occupancy documentation of compliance with noise, PUE/TUE/WUE
 - **Added in the ordinance.** Added in Section 16.23.7.a.v.

We look forward to discussing this further with you all at our next subcommittee meeting. Please let us know if you have any comments or questions in the meantime.

Sincerely,



CARLISLE/WORTMAN ASSOC., INC.
Paul Montagno, AICP
Principal



CARLISLE/WORTMAN ASSOC., INC.
Brady Heath
Community Planner

Draft High Impact Land Use Overlay District

Definitions proposed to be added to Section 2.02.

1/3 Octave Band Analysis: A frequency spectrum analysis where the unweighted sound levels of all frequencies in a sound sample are split into sections (octave bands) where the upper limit is twice the frequency of the lower limit, and each octave band is further split into three equal sections providing a more detailed analysis of the intensity and frequency composition of a sound.

Air Chiller: a cooling and heat rejection system which utilizes fans to move ambient air over condenser coils to cool the water or refrigerant in a Closed Loop Cooling System.

Battery Energy Storage Systems (BESS): A storage system that collects energy from renewable and non-renewable sources in rechargeable batteries for later use.

Closed Loop Cooling System: Any cooling system that constantly reuses and recycles an initial load of process fluid (water or chemical substance) within its operating components for cooling purposes, which is not directly exposed to the air or other cooling system components during heat rejection; this process fluid still requires periodic discharge and refill.

Cooling Tower: an industrial-scale heat exchanger that removes heat from the cooling process fluid.

Open-Circuit Cooling Tower/Open Loop Cooling System: a heat rejection system where the warm process water is sprayed directly onto fill media, where it is then exposed to airflow to utilize evaporative cooling; these systems require frequent discharge and refill, consuming large amounts of water, due to the contamination of the process water during the heat-rejection phase.

Closed-Circuit Cooling Tower: utilized in some Closed-Loop Cooling Systems; basin water is sprayed over the closed-loop coils to utilize evaporative cooling. Basin water requires periodic discharge and refill.

Mechanical Draft: Open or Closed Circuit Cooling Towers may use Mechanical Draft, which uses fans to move air through the water to enhance the cooling process by accelerating evaporation and therefore heat transfer.

Computer Room Air Conditioners (CRAC): A type of Room-Level HVAC system utilized in computer server rooms/data centers to remove high-density heat generated by IT equipment; CRACs pull hot air from the entire room, and return cool air to the entire room, rather than cooling the IT equipment directly; utilizing refrigerant-based cooling.

Commonly referred to as Computer Room Air Handlers when circulating chilled water instead of refrigerant.

Cryptocurrency Mining Facility: A facility of any size that is dedicated to operating data processing equipment for cryptocurrency mining and the process by which cryptocurrency transactions are verified and added to digital ledgers. This includes data mining facilities.

Data Processing. The collection and manipulation of digital data to analyze and produce meaningful information.

Data Center: A physical facility housing the people, hardware and software organized to provide information processing services. This includes data processing facilities, server farms and artificial intelligence / "AI" data centers. Data centers are further defined by the following:

- 1) **Ancillary Data Center:** A data centers that is ancillary to another primary use and a) occupy no more than ten percent of the building's footprint, b) are used to serve the enterprise functions of the on-site business and are not used to lease data storage and processing services to third parties, and c) are not housed in a separate, stand-alone structure on the parcel.
- 2) **Minor Data Center:** A Data Center that is under 10,000 total square feet (for all buildings and structures on the site). If a minor data center requires an electrical substation and/or water treatment plant, it shall be classified as a Medium Data Center.
- 3) **Medium Data Center:** A Data Center that is between 10,000 square feet and 99,999 total square feet (for all buildings and structures on the site).
- 4) **Major Data Center:** A Data Center that is between 100,000 square feet and 499,999 total square feet (for all buildings and structures on the site).
- 5) **Data Center Campus:** A Data Center Campus shall consist of more than one Data Center building and may be any combination of sizes of Data Center buildings, not to exceed a total of 750,000 total square feet (for all buildings and structures on the site).

Decibel, dB: A decibel (dB) is a common measure of sound intensity that is one-tenth of a bel (B) on the logarithmic intensity scale.

Decibel-dBA: Decibels measured in dBA are weighted to the frequencies in the middle of the range of human hearing, as a representation of the perceived overall loudness.

Decibel-dBC: Decibels measured in dBC are weighted to the low-frequency, sounds which travel and penetrate farther than treble sound, often a component of tonal noise.

Decibel-dBZ: Decibels measured in dBZ are weighted to measure without frequency-based adjustments, for situations requiring a precise measurement of the sound's total energy and frequency content.

Direct Liquid Server Cooling: Server cooling technologies in which liquid coolant directly removes heat from electronic components through immersion or cold-plate contact, rather than through room air circulation.

Direct-to-Chip Cooling: A method of liquid cooling that utilizes coolant to dissipate heat directly from computer processing chips and greatly reduces electrical power and water consumption.

Dry Cooler: a heat rejection system which utilizes fans to move ambient air over a cooling coil; commonly used in closed-loop cooling systems.

Electrical Substation: An electric system facility that converts higher voltages to lower voltages within or separate from a data center to generate sufficient power at maximum efficiency; can operate independently for dedicated sites once directly connected to the transmission line.

Equipment Cooling: Cooling for equipment, including but not limited to machinery, computer component cooling, processor cooling, server cooling, rack cooling, generator cooling, electrical component cooling.

Facility Cooling: Cooling for the facility/structure itself, not for equipment, machinery or components located therein and/or on the property. This includes HVAC cooling.

Generator: A machine that converts one form of energy into another.

High Impact Land Use: A term that refers to a) an industry or business with higher than average consumption/use of resources, typically of electricity and/or water, and/or b) an industry or business with operations that are highly impactful from the standpoint of noise, vibration, type of power used such as battery storage systems, nuclear, etc., utilization of private power substations or switch stations, onsite fuel storage and potential negative impacts on water and air quality. This includes data centers, data processing facilities, server farms, "AI" artificial intelligence, cryptocurrency mining facilities, and digital currency mining.

Hydrogen Fuel Cell: An electrochemical device that combines hydrogen and oxygen to produce electricity.

Infrasound: A low frequency sound below a frequency of 20Hz that is typically sub-audible to humans and often perceived as vibrations.

Liquid Immersion Cooling: A method of liquid cooling that utilizes submerging equipment in fluid.

Megawatt: A unit of power output equal to 1,000,000 watts or 1,000 kilowatts, used to measure power consumption.

Octave Band: A method of splitting the frequency spectrum into sections where the upper limit is twice the frequency of the lower limit, identified by the center frequency.

Power Usage Effectiveness (PUE): a ratio that describes how a data center uses energy; specifically, how much is used by the IT equipment compared to total power consumption. Calculated by dividing total facility energy by IT equipment energy.

Renewable “Green” Hydrogen: Renewable or “Green” Hydrogen is used for Hydrogen Fuel Cells and is sourced from water, using sustainable electricity sources such as solar or wind.

Sensitive Receptors: Schools, preschools, daycares, health facilities such as hospitals, long-term care facilities, retirement and nursing homes, community centers, places of worship, playgrounds, parks, campgrounds, prisons, dormitories, hotels, motels, and any parcels zoned agricultural residential, single-family residential and multi-family residential.

Standalone Modular Data Center / Cryptocurrency Mining Facility: Pre-engineered, prefabricated, temporary and standardized buildings, including shipping containers, designed to house computer servers and network equipment.

Tonal Noise: A noise characterized by a distinct, recognizable frequency, which stands out significantly against the background broadband noise, considered a nuisance due to the human auditory system’s sensitivity to pure tones, especially when they are continuous.

Total Power-Usage Effectiveness (TUE): A metric similar to PUE but which includes IT power such as server fans and internal power distribution losses with infrastructure overhead, to provide a better metric of energy efficiency across the entire data center development. Calculated by dividing the total facility power usage by the compute power usage.

Water Usage Effectiveness (WUE): a metric that measures how efficiently data centers use water by comparing the total water used to the power used by its IT equipment. Calculated by dividing annual water usage (liters) by IT equipment energy usage (kilowatts).

Amending Articles 4-13 to allow data centers as Permitted Accessory Uses or Permitted Principal Special Uses with Conditions.

Ancillary data centers will be allowed as Permitted Accessory Uses in the following districts:

- Article 5– RT Research & Technology– Section 5.04
- Article 8– OS Office Service District– Section 8.04
- Article 9– NSC Neighborhood Service Commercial District– Section 9.04
- Article 10– RSC Regional Service Commercial District– Section 10.04
- Article 11– HSC Highway Service Commercial District– Section 11.04
- Article 12– IF Industrial Flex Zone– Section 12.04
- Article 13– I Industrial District– Section 13.04

Minor data centers will be allowed as Permitted Principal Special Uses with Conditions, subjected to the standards of Section 16.23, in the following districts if also located within the High Impact Land Use Overlay District:

- Article 12 – IF Industrial Flex Zone – Section 12.03
- Article 13 – I Industrial District – Section 13.03

Medium data centers will be allowed as Permitted Principal Special Uses with Conditions, subjected to the standards of Section 16.23, in the following district if also located within the High Impact Land Use Overlay District :

- Article 13 – I Industrial District – Section 13.03

Major data centers will be allowed as Permitted Principal Special Uses with Conditions, subjected to the standards of Section 16.23, in the following district if also located within the High Impact Land Use Overlay District:

- Article 13 – I Industrial District – Section 13.03

Campus style data centers will be allowed as Permitted Principal Special Uses with Conditions, subjected to the standards of Section 16.23, in the following district if also located within the High Impact Land Use Overlay District:

- Article 13 – I Industrial District – Section 13.03

Adding New Section 16.23: High Impact Land Use Overlay District

A. Purpose and Intent

The purpose of this ordinance is to establish a clear and thoughtful regulatory framework that addresses the unique characteristics of high impact land uses for the suitable zoning, siting, design, construction, operation, compliance and decommissioning of high impact land uses including but not

limited to data centers and cryptocurrency mining facilities. These regulations are intended to guide the placement and design of high impact land uses to balance stable local economic growth with the protection of community health, safety, welfare, natural resources, and the area's rural character. The intent of this ordinance is to permit only uses having performance characteristics which emit a minimum of noise, vibration, smoke dust, dirt, glare, toxic materials, offensive odors, gases, electromagnetic radiation or any other physically adverse effect to the extent that they are abnormally discernible or potentially harmful beyond the lot lines of the parcel or site upon which the use activity is located. This is achieved by:

1. Directing high impact land uses to areas where industrial uses are currently permitted or planned and that would have minimal impact on residents and surrounding properties with the use of a clearly designated high impact land use overlay district located.
2. Minimizing, avoiding, and mitigating impacts such as noise, vibration, light/glare, air pollution and emissions, and water pollution through requiring the use of minimally impactful machinery, equipment, and systems.
3. Ensuring the efficient consumption and use of public utilities, such as water and electricity, prioritizing renewable energy and conservation.
4. Promoting context-appropriate architectural design and effective visual screening to ensure a visually cohesive design and compatibility with the surrounding land uses and the desired rural character of the area.
5. Establishing clear expectations and a predictable review process for developers to encourage efficient and well-planned designs, while retaining local control over development.
6. Ensuring compatibility with adjacent land uses and the Township's Master Plan.
7. Ensuring compliance with responsible regulations for operation, compliance, decommissioning and site restoration.

B. Applicability

1. This section shall apply to high impact land uses including all types of data centers Ancillary, Minor, Medium, Major, and Data Center Campuses, and cryptocurrency mining facilities.
2. A complete preliminary site plan for all phases of the development that meets the requirements in Article XX shall be included in the application.
3. All developments subject to this section shall require an application of a special land use subject to the requirements of Article 16.

4. Approval is contingent upon the applicant demonstrating conformance to the requirements of this section, any other provisions of the Zoning Ordinance, and all other applicable Township Ordinances.
5. The applicant must enter in a development agreement with the Township.
6. All developments subject to this section shall be required to have a performance guarantee as outlined in Section 20.15.
7. The township board shall establish a fee for all hi high impact land uses applications to be added to the fee schedule.

C. Districts Permitted

High impact land uses including data centers and cryptocurrency mining facilities shall only be developed in districts where permitted as an Accessory Use, Principle Use or Principal Special Uses with Conditions if the property is located within the High Impact Land Use Overlay District on the Township's Official Zoning Map.

D. Application Requirements

1. In addition to the required information for a site plan in Article XX and Applicant shall provide the following impact studies to accompany any application:
 - a. Projected power use.
 - b. Projected water use.
 - c. Projected natural gas use.
 - d. Plans for any onsite power generation.
 - e. Projected PUE, TUE and WUE with supporting documentation.
 - f. Serviceability statements fully disclosing whether any utility needed has current capacity to service the needs of the facility at time of full commissioning, and if not: a plan for what is needed with a signed infrastructure development agreement verifying all costs for needed upgrades will be the developer or operator's responsibility.
 - g. Serviceability statements from local emergency providers, fire, EMS and police fully disclosing their ability to provide services for all phases of construction and upon full commissioning, and if not: a plan for what is needed with a signed development agreement verifying that all costs for needed upgrades, staffing, training and equipment will be the owning parent company's responsibility.
 - h. Projected noise levels (dBA, dBC and dBZ), vibration levels, noise mitigation features/plan and noise monitoring plans for the facility based on being fully operational and for the construction period.
 - i. Emergency and disaster plan for all phases, including construction.
 - j. Decommissioning and site restoration plan.
 - k. Traffic study for all phases, including construction.
 - l. Public facility, utility, and service impact assessment conducted by a licensed professional engineer.
 - m. All exterior building elevations for each structure.
 - n. Mechanical plans for the overall site.
 - o. Rooftop mechanical and electrical plans.

- p. Electrical plan for the overall site including underground lines.
- q. Preliminary project timeline with estimated durations for each stage of work, including site prep, and detailed schedule for any pile driving.
- r. Equipment cooling system specifications.
- s. List of regulated substances, including any cooling solutions.
- t. Site lighting plan, including lighting plan for during the construction phase.
- u.

E. Dimensional Standards and Siting Requirements

Table X below outlines the dimensional regulations and siting Requirements for data centers and cryptocurrency mining facilities within the High Impact Land Use Overlay District. Where the regulations in table X are different from the requirements in Section 3.17 the more stringent requirements shall apply.

Table X - Dimensional Regulations and Siting Requirements for within the High Impact Land Uses

Facility Type	Allowable Facility Size Ranges in Square Feet	Required Distance in Feet from Residential and Sensitive Receptor Parcels	Total Allowable Number of Facilities by Type within the Township
Ancillary Data Center	Not to exceed 10% of the associated Principal Use's building footprint	-	-
Cryptocurrency Mining	Not to Exceed 5,000	Greater than 900 feet	2
Minor Data Center	Not to Exceed 10,000	Greater than 900 feet	2
Medium Data Center	Within 10,000 – 99,999	Greater than 900 feet	1
Major Data Center	Within 100,000 – 499,999	Greater than 1,200 feet	1

Data Center Campus	Not to Exceed 750,000	Greater than 1,400 feet	1
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F. Site, Design and Use Standards

1. Screening and Landscaping Requirements.

- a. All ground level equipment (including HVAC, generators, transformers, and cooling towers) shall be fully screened by masonry walls, architectural panels, or landscaped berms that contain staggered rows of evergreen landscaping material so that said screening shall achieve 100% opacity and exceed the vertical height of the equipment being screened by at least six (6) inches within two (2) years of planting.
- b. All rooftop mechanical equipment shall be fully screened behind parapet walls, which shall not exceed the maximum building height restriction.
- c. A minimum 25-foot greenbelt shall be provided along all property lines.

Landscaping requirements are subjected to Section 28.03.A.

2. Parking requirements

- a. Parking requirements shall follow the standards of Section 18.02 for Data Centers.
- b. Employee and visitor parking lots shall be set back at least fifty (50) feet from all property lines.

3. Noise, Sound and Vibration Requirements

- a. Sound levels shall not exceed 55 dBA, 55dBC and 70dBZ at any high impact land use parcel. Generators shall not exceed 65 dBA, 55dBC and 70dBZ at the high impact land use parcel property line. All octave bands and frequencies 200 hertz (Hz) and below shall not exceed 60dBZ at any time.
- b. In the event pre-construction sound studies document pre-existing sound levels for A, C, and Z weightings that exceed the limits in this ordinance, then the pre-existing sound levels shall not be exceeded or amplified.
- c. Vibration shall not exceed limits outlined in Section 14.45.C of the Township Ordinance.

- d. Noise and vibration limits apply to all equipment on site including but not limited to hvac systems, equipment cooling systems, mechanical yards, substations, chillers, renewable energy systems, and generators, any of which may need to utilize sound-dampening enclosures, modifications and/or isolation pads to mitigate noise and vibration.
 - i. Applicant shall submit documentation of seasonal HVAC maintenance for any facility cooling systems to ensure quiet equipment operation.

- e. Noise/Sound Studies: A noise attenuation, or sound modeling study shall demonstrate compliance with maximum sound levels and must be submitted prior to the approval of a final site plan. This study must be specific to the proposed site topography, layout, and building type, scale, height, and construction proposed. This study must show noise conditions at the site prior to the project development must provide model-predicted noise conditions resulting from the proposed project post-development to demonstrate anticipated compliance with the noise ordinance.
 - i. The sound study must be prepared by a professional sound/acoustical engineer chosen by the Township and be licensed in accordance with ISO 9613 standards.
 - ii. All sound studies shall include measurements and reporting for dBA, dBC and dBZ wavelengths, and shall include a full, unweighted one-third (1/3) octave band frequency spectrum analysis.
 - iii. Sound modeling studies must include recommendations for sound mitigation measures, if they are necessary for the use/facility to comply with sound level requirements. These mitigation measures, if applicable, must be reflected on the site plan and incorporated into conditions of the site plan approval. If mitigation measures are building related, they must be included in the building plans, and if they are landscaping related, they must be included in the landscaping plan prior to issuance of the Special Use permit(s).
 - iv. Sound study/routine sound surveillance schedule and additional requirements: a sound study must be submitted to the Township within 60 days of issuance of a certificate of occupancy for each phase of development and upon the facility becoming fully operational. Additional sound studies may be required at the time modifications of any kind are made, at the discretion of the Township.
 - v. All sound studies must be conducted at a time known for peak facility, use, and cooling system operations. In the event the study shows that

the facility or use exceeds maximum allowable levels, the operator must immediately undertake all necessary efforts to comply.

4. Generator Use Requirements

- a. Generator use is limited to emergency backup power generation during area power outages only , shall operate 50% or less of the total facility operations, for no more than 12 hours a day (8am-8pm), with occurrence for use not to exceed three (3) consecutive days without a twenty four (24) hour continuous break/off period.
- b. Generators shall be connected to utility provided natural gas only.
- c. Generator testing hours: Testing of generators shall be limited to 9am-1pm weekdays only, except for holidays, not to exceed occurrence on more than ten (10) days per each calendar month. The facility shall provide a generator testing schedule, posted on a website for public access, updated 60 days in advance.
- d. Generator fuel storage requirements.
 - i. Fuel storage tanks shall not be within the required setbacks.
 - ii. Fuel storage tanks shall be placed underground or be screened on all four (4) sides with a fence or wall following the requirements of Sections 14.26 and 28.08.
 - iii. Fuel storage tanks shall have a maximum capacity of two thousand five hundred (2,500) gallons.

5. Electrical and Utility Lines

- a. All electrical and utility lines shall be placed underground.

6. Lot Coverage and Setbacks Requirements

- a. Lot coverage is limited to 50% for all impermeable surfaces.
- b. Setbacks: Minimum setback requirements for all structures equipment and storage yards shall comply with Table X except that employee and visitor parking lots may be set back no less fifty (50) feet from all property lines.

7. Massing, Scale, Height and Orientation Requirements

- a. Building mass, height, bulk, scale, and proportion shall maintain consistency with the existing character of the adjacent buildings.
- b. Building design should employ coordinated massing to produce overall unity, scale, and interest.
- c. Rooflines and pitches shall be proportionate to nearby structures so as to provide transition or mitigation of significant changes to scale.
- d. Maximum height for all buildings is 50 feet, including all rooftop equipment, which shall be concealed by a parapet wall.
- e. Orientation shall prioritize utilization of buildings for sound mitigation and visual buffer(s):
 - i. Where multiple buildings exist they shall be oriented so that service areas face each other and the buildings are placed to surround any equipment, mechanical yards, substations, generators, etc. in order to utilize the buildings as a sound barrier and as a visual buffer between the loudest operations on the site and the site borders.
 - ii. If a site contains two or fewer buildings, the buildings shall be oriented to place any equipment, mechanical yards, substations, generators, etc. on the farthest side/greatest distance away from the highest number of nearby residential and sensitive receptor parcels, and the building(s) between as a sound barrier and as a visual buffer between the loudest operations on the site and the residential and sensitive receptor parcels.
 - iii. Any equipment, mechanical yards, substations, generators, and similar elements shall be fully enclosed whenever possible if located within one thousand five hundred (1,500) feet from any residential property line.

8. Architectural Design and Building Materials

- a. Facade variation. Wall designs must provide a minimum of three of the following elements, in addition to transparency requirements, occurring at intervals no greater than 25 feet horizontally and 10 feet vertically:
 - i. Expression of structural system and infill panels through change in plane not less than three inches.
 - ii. System of horizontal and vertical scaling elements, such as belt course, string courses, cornice, pilasters.

- iii. System of horizontal and vertical reveals not less than one inch in width/depth.
- iv. Variations in material module, pattern, and/or color.
- v. System of integrated architectural ornamentation.
- vi. Green screen or planter walls.
- vii. Translucent, fritted, patterned, or colored glazing.
- vii. Transparency as required in Section 16.23(F)(2)(b).

b. Transparency

- i. Windows for building sides shall be concentrated toward the front edge of the building, in locations most visible from an urban open space or public right-of-way.
 - ii. Transparency alternatives. The following alternatives may be used singularly or in combination for any side or rear facing facade which requires transparency. If used in combination, they may count toward no more than 50% of the transparency requirement set forth in Section 16.23(F)(2)(b).
- c. Architectural style shall not be restricted. Rather, evaluation of the appearance of a project shall be based upon compatibility and the quality of its design and relationship to surroundings.
 - d. Buildings within the same development should be designed to provide a unified and easily identifiable image. Methods to achieve this include using similar architectural styles and materials, complementary roof forms, signs, and colors.
 - e. Minimize monotony of expansive exterior walls by incorporating the following elements: staggering of vertical walls; recessing openings; providing upper-level roof overhangs; using deep score lines at construction joints; contrasting compatible building materials; use of variety and rhythm of window and door openings; use of horizontal and vertical architectural elements, use of horizontal bands of compatible colors; and providing changes in roof shape or roofline.
 - f. Facades shall provide visual interest from both vehicular and pedestrian viewpoints.

- g. Entrances to individual buildings shall be readily identifiable to visitors through the use of recesses or pop-outs, roof elements, columns, or other architectural elements.

9. Cooling System Requirements

- a. Any system designed for cooling of the facility and/or equipment shall not negatively impact the surrounding region by conforming to the following requirements:
- b. In addition to facilitating all PUE, TUE, and WUE standards in Section G.2.a, equipment cooling systems shall utilize closed-loop, direct liquid server cooling, with air movement limited to manufacturer-installed internal server fans used for auxiliary component cooling, in the following order of preference:
 - i. Utilization of liquid immersion cooling systems shall be prioritized, with preference for use of plant-based biodegradable non-flammable fluid over traditional dielectric fluid.
 - ii. If a proven incompatibility with liquid immersion cooling can be demonstrated and verified by an independent third party certified thermal engineer chosen by the Township, then utilization of zero-water direct-to-chip cooling systems may be approved for use as an alternate design option.
 - iii. If the applicant can provide documentation for another equipment cooling system which is equally or more efficient than liquid immersion cooling and zero-water direct-to-chip cooling in terms of energy and water consumption, and equally or better at emitting a minimum of all frequencies of noise, then the township may approve its use as an alternate equipment cooling system.
 - iv. If another equipment cooling system option proves to be more efficient in terms of energy and water consumption, and its heat-rejection equipment is equally or better at emitting a minimum of all frequencies of noise as liquid immersion cooling and zero-water direct-to-chip cooling, once verified by a independent third party certified thermal engineer that system shall be required as the first preference.
 - v. If a proven incompatibility can be demonstrated and verified with any preferred equipment cooling system then the next preferred cooling system as outlined above will be the default alternate.
 - vi. No room-level or facility air/fan-based cooling systems such as, but not limited to, Computer Room Air Conditioning shall be used as the primary means of heat removal.
 - vii. Open-loop cooling systems and open-circuit cooling towers shall not be permitted.
 - viii. Cooling towers shall be closed-circuit and utilize drift eliminators.
 - ix. No Dry Coolers, Mechanical Draft, or Air Chillers shall be permitted.
 - x. In order to emit a minimum of noise, as is the intent of this ordinance, cooling systems and towers shall utilize the following features:
 - a. Sound-absorptive enclosures
 - b. Fans, motors, and pumps shall be mounted on vibration isolator

- c. Intake and discharge/exhaust silencers
- d. Aerodynamic fan noise reduction aids
- e. Water-splash/basin silencers for water towers.
- f. Additional noise mitigation measures, especially for low frequencies and infrasound, may be required to ensure compliance with the noise limits in Section E.2.

10. Accessory structure requirements:

- a. Temporary or modular structures are not permitted.
- b. Accessory structures shall be cohesive in design and color scheme to main structures on the parcel.
- c. The use of intermodal shipping containers for storage and/or housing of any materials, substances or equipment is prohibited. Once the facility is operational, shipping containers are limited to shipping and receiving purposes only, shall not remain in place for longer than two (2) weeks at a time, and may not be located within set back areas nor within highly visible areas for any period of time.

11. Detention ponds

- a. Detention and retention ponds are only permitted as part of the site drainage and stormwater management plan.
- b. Detention and retention ponds for discharged facility water holding or use related to cooling purposes are not permitted.

G. Sustainability and Energy Use Requirements

1. Infrastructure Impact Statement

Applicants shall submit an Infrastructure Impact Statement at the time of conditional rezoning or permitted principal special use with conditions application, which must identify:

- a. Utility Capacity Impact Statement from-the following providers to confirm service adequacy:
 - i. DTE or Consumers Energy
 - ii. Marion-Howell-Oceola-Genoa (MHOG) Water Authority
- b. Anticipated electric power demand (MW).
- c. Anticipated water usage for cooling and other operations (gallons per day).

- d. Waste heat recovery, reuse, or discharge methods.
- e. Planned on-site backup generation capacity (MW) and associated fuel type(s) with fuel storage capacity and design.
- f. Anticipated natural gas demand.
- g. Anticipated utility infrastructure upgrades required to serve the facility, with an agreement that the developer will pay 100% of all required upgrades.

2. Energy Efficiency

- a. Data Centers must be designed to achieve a Power Usage Effectiveness (PUE) of 1.2 or lower, a Total Power-Usage Effectiveness (TUE) of 1.15 or lower, and a Water Usage Effectiveness (WUE) of 0.5L/kWh or lower. Applicant shall provide a report detailing how these parameters will be met, to be verified by a 3rd party professional consultant chosen by the Township.
- b. Facilities shall incorporate best practices for energy conservation, including but not limited to: high-efficiency HVAC systems, waste heat reuse, variable-speed drives, and hot/cold aisle containment.
- c. Applicant shall provide an operations Report detailing anticipated power demand and redundancy systems.
- d. Applicant shall provide a heat recovery or reuse feasibility analysis (waste heat for district energy)

3. Renewable Energy Integration

- a. Applicants are encouraged to incorporate on-site renewable energy generation (e.g., solar, wind, geothermal, DAKET, Renewable “Green” Hydrogen Fuel Cells) or to procure renewable energy from off-site sources. No on-site nuclear power generation shall be permitted. Decarbonized “Blue” Hydrogen and Traditional “Gray” Hydrogen are not permitted.
- b. At least 25% of projected annual energy demand shall be demonstrated to be met through renewable energy sources, whether on-site or through power purchase agreements, renewable energy credits, or utility green-power programs.

- c. On-site solar generation components shall comply with the requirements for solar in section ____ of the ordinance.
- d. Energy storage systems shall be limited to Long-Duration Energy Storage (LDES). Battery Energy Storage Systems (BESS) are not permitted.

4. Water Conservation

- a. If approved as an alternate option, facilities using water-based cooling must demonstrate the use of recycled, reclaimed, or non-potable water sources to the maximum extent feasible.
- b. No on-site wells shall be permitted.

5. Green Building Practices

- a. Facilities shall be designed to achieve LEED Silver certification or an equivalent third-party sustainability certification, to be verified by an independent third party certified professional consultant chosen by the Township, and shall provide documentation of certification within two (2) years of construction for each building.

6. Air Quality

- a. Regulatory Compliance: All generators, cooling systems, and other emission sources shall comply with federal Clean Air Act requirements and the Michigan Department of Environment, Great Lakes, and Energy (EGLE) air quality rules.
- b. Permitting: Facilities shall obtain and maintain any required Air Use Permit to Install (PTI) or other approvals from EGLE for stationary engines, cooling towers, or fuel storage.
- c. No on-site baseload power generation shall be permitted with the exception of the renewable energy generation listed in section G.3.a.
- d. Generator Emissions
 - i. Generators shall meet or exceed current EPA Tier 4 Final emissions standards.
 - ii. Generator Dispersion modeling could be required to meet air quality requirements or if a facility is within 500 feet of any residential, or sensitive receptor parcels.

- e. Renewable “Green” Hydrogen Fuel Cells systems are permitted for backup power generation. Decarbonized “Blue” Hydrogen and Traditional “Gray” Hydrogen are not permitted.
- f. Emissions Reporting: Applicants shall submit an annual statement to the Township confirming compliance with EGLE permits and reporting actual operating/testing hours of backup generators.

7. Ongoing Reporting

- a. Owners and operators shall provide an annual sustainability report to the Township, including:
 - i. Actual annual energy consumption (MWh).
 - ii. Actual annual water usage withdrawal and discharge (gallons).
 - iii. Energy efficiency performance & progress toward renewable energy targets.
 - iv. Documentation of any energy efficiency, cooling system upgrades, and security upgrades.
 - v. Actual Power Use Effectiveness (PUE), Total Power-Usage Effectiveness (TUE) and Water Usage Effectiveness (WUE).
 - vi. Actual generator runtime/use logs (hours).
 - vii. Actual job numbers, including how many employees are Livingston County Residents.
 - viii. Greenhouse gas emissions and/or carbon intensity of energy consumed.

10. Use of Consultants

The Township may hire third-party, independent consultants chosen by resolution of the township, to be funded by the developer through an escrow account to review energy efficiency, water consumption usage, air quality review, renewable energy implementation, and green building practices.

H. Security & Emergency Access

Security and Emergency Access. Data Centers shall be designed and operated to protect the facility, surrounding community, and public safety resources.

1. Perimeter Security

- a. Data Centers shall be fully enclosed with a perimeter security system, which may include fencing, or walls that meet the requirements of Sections 14.26 and 28.08. All fences or walls shall not be less than eight (8) feet in height.
- b. Security barriers shall be designed to balance safety with community character; opaque fencing must be screened with landscaping where visible from public roads or residential areas.

2. Controlled Access

- a. All site entrances shall include controlled access gates, guard stations, or equivalent security technology to prevent unauthorized entry.
- b. Visitor and delivery access points must be separated from employee access points wherever feasible.

3. Emergency Access

- a. A minimum of two (2) points of emergency vehicle access shall be provided, with clear signage and unobstructed pathways around the building.
- b. Access drives shall be constructed to fire department standards, with sufficient load-bearing capacity for emergency apparatus.
- c. Fire lanes shall be maintained free of obstructions at all times.

4. Camera Surveillance

- a. Data Centers shall install and maintain a perimeter camera surveillance system capable of monitoring all vehicular and pedestrian access points, building entrances, and outdoor mechanical/equipment areas.
- b. Cameras shall be positioned to minimize intrusion into adjoining residential properties and public rights-of-way, while still providing full coverage of the site.

- c. Camera systems shall be continuously operational (24 hours per day, 7 days per week) and recordings shall be retained for a minimum of 30 days.
- d. A security plan, including camera layout, monitoring procedures, and data retention policies, shall be submitted as part of site plan review.

5. Fire Protection and Suppression.

- a. Data Centers shall be equipped with an automatic fire detection and suppression system designed to protect both building occupants and sensitive equipment.
- b. Suppression systems shall comply with National Fire Protection Association (NFPA) standards and be approved by the Fire Marshal.

6. Hazardous Materials Management.

- a. Any use of hazardous materials (including fuels for backup generators, batteries, and chemicals for cooling systems) shall comply with federal, state, and local storage, reporting, and disposal requirements.
- b. Applicants shall provide a Hazardous Materials Management Plan identifying on-site materials, safety data sheets, storage methods, spill prevention measures, and emergency response procedures.
- c. Applicant shall provide a fire protection plan.

7. Emergency Response Coordination.

- a. Applicants shall submit an Emergency Response Plan to the Township at the time of Site Plan review, which must include:
 - i. Site layout for emergency responders.
 - ii. Fire suppression and alarm systems description.
 - iii. Backup generator location and fuel storage details.
 - iv. Contact information for on-site security and facility management.
- b. Operators shall provide annual training opportunities or site orientations to local fire, police, and emergency medical services.

8. Lighting and Surveillance.

- a. A lighting plan is required. The lighting plan shall include a photometric grid overlaid on proposed site plan showing light intensity (in foot-candles) on site and 25 feet beyond parcel lines.
 - i. Lighting shall adhere to Dark Sky principals—full-cutoff, directed downward, and shielded, with the use of motion sensors and timers where able. Illumination shall not exceed 0.1 footcandles onto adjacent properties measured three (3) feet from the ground.
- b. Facilities shall incorporate continuous video surveillance of access points, perimeter fencing, and loading areas, with recordings maintained for a minimum of thirty (30) days.

I. Construction Standards

1. Applicant shall have a community complaint resolution liaison available 24 hours a day beginning with construction. The contact information shall be posted in a visible location from the road frontage, as well as provided to the township to be published on the website.
2. All complaints shall be responded to within 24 hours, and if not completely resolved then a resolution plan shall be provided to the township and complainant.
3. Construction shall adhere to the hours in the Township Ordinance. No construction is allowed to take place outside of those hours.
4. Construction Phase Requirements:
 - a. The developer or owner/operator will provide a full time onsite community liaison and 24 hour emergency line that will be available from the start of construction until full facility commissioning, this position shall have the authority to halt construction if necessary. Contact information for the community liaison shall be posted at the site on easily accessible / viewable signage and posted on the township website. All concerns and complaints shall receive confirmation of receipt within 24 hours and response within 5 business days.
 - b. A detailed schedule for any pile driving necessary and a complaint resolution plan shall be provided to the township prior to any construction work beginning.
 - c. On site work shall be conducted Monday through Friday between the hours of 7am and 6pm.

J. Decommissioning

1. Decommissioning Plan Requirement. As a condition of site plan and special use approval, the applicant shall submit a Decommissioning and Site Restoration Plan that addresses
 - a. Triggers for decommissioning.
 - b. Methods for removal of structures, equipment, utilities, and impervious surfaces.
 - c. Recycling and disposal of equipment and hazardous materials.
 - d. Final grading, soil stabilization, and revegetation.
 - e. Restoration of the site to a condition compatible with surrounding uses.
2. Triggers for Decommissioning
 - a. A use with high resource use shall be considered abandoned if it ceases operations for a period of 12 consecutive months, unless the owner provides evidence of intent to resume operations.
 - b. Decommissioning must begin within 6 months of abandonment and be completed within 12 months.
 - c. If at any time a high impact land use ceases operations for any amount of time, the structures and property, including landscaping and snow removal, shall be maintained at all times.
3. Performance Guarantee / Financial Assurance
 - a. Prior to issuance of a building permit, the applicant shall post a financial guarantee in the form of a letter of credit, bond, or escrow account acceptable to the Township.
 - b. The amount shall equal 125% of the estimated decommissioning cost, as determined by an independent third-party, qualified engineer and approved by the Township.
 - c. Estimates must be updated every 2 years and adjusted for inflation.
4. Removal Standards

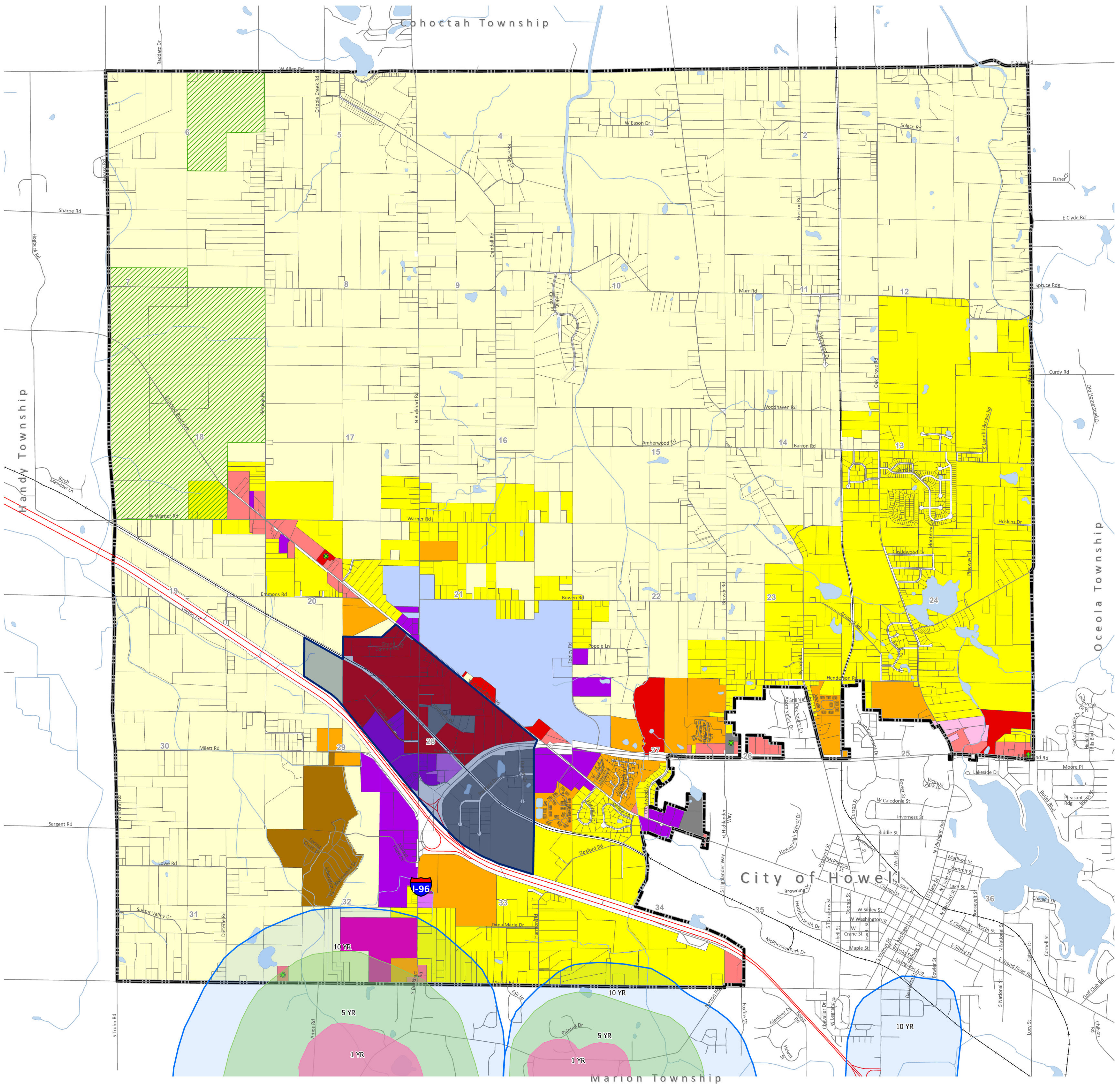
- a. All above-ground structures, including buildings, mechanical equipment, cooling towers, security fencing, and pavement not otherwise serving a reuse, shall be removed.
- b. All Below-ground infrastructure, such as foundations and utilities, shall be removed to unless otherwise approved.
- c. Materials shall be recycled to the maximum extent practicable.
- d. If the Planning Commission determines, based on independent, third-party contractor analysis and report paid for by the landowner in escrow, that existing primary buildings and/or office buildings have a viable use for other Permitted Principal Uses in the underlying zoning district, then the buildings identified may be exempted from being fully removed.
 - i The Planning Commission may allow the primary and office buildings to be renovated to be able to be repurposed for another viable Permitted Principal Use in the underlying zoning district.
 - ii The owner/operator shall provide full building plans detailing the renovations, and shall provide the cost, in escrow, for an independent, third-party contractor chosen by the township to verify the viability of the renovations for reuse.
 - iii All other specialized structures, mechanical yards, cooling equipment, and infrastructure that are not deemed to be repurposed for other, existing Permitted Principal Uses in the district shall be fully decommissioned according to Section H.4.a, b, and c.
- e. The facility and property shall be maintained at all times, including snow removal and landscaping, even when not operational including during and after decommissioning.

5. Site Restoration

- a. The site shall be restored with topsoil, seeded or planted with native vegetation, and stabilized to prevent erosion.
- b. The Township may approve alternate restoration plans if the site is proposed for redevelopment consistent with the Master Plan and zoning ordinance.

6. Failure to Decommission

- a. If the owner fails to complete decommissioning in accordance with the approved plan, the Township may draw upon the financial guarantee to complete the work.
- b. Any costs exceeding the financial guarantee shall remain the responsibility of the property owner.



Zoning Designation			
	Conditional Zoning		Proposed Data Center Overlay District
	PUD - Planned Unit Development		HSC - Highway Service Commercial
	AR - Agricultural Residential		IFZ - Industrial Flex Zone
	SFR - Single Family Residential		I - Industrial
	MFR - Multiple Family Residential		RT - Research & Technology
	MHD - Manufactured Housing District		Renewable Energy Overlay District
	OS - Office Service		NSC - Neighborhood Service Commercial
			1 YR Wellhead Protection Area
			5 YR Wellhead Protection Area
			10 YR Wellhead Protection Area

PROPOSED ZONING DISTRICTS MAP

Howell Township
Livingston County

0 0.5 1 2 Miles



Carlisle/Wortman Associates, Inc.
Ann Arbor, Michigan
May 2026

