Save the East Coast, Inc. **Protect Our Coast – LINY**

March 25, 2025

VIA MAIL AND ELECTRONIC SUBMISSION

U.S. Environmental Protection Agency
Region 2
Attn: Air Permitting Branch
290 Broadway
New York, NY 10007-1866

Re: Save the East Coast, Inc. and Protect Our Coast - LINY Requests the Reopening, Reanalysis, and Revocation of Clean Air Act Permit for Empire Offshore Wind, LLC, EPA Permit Number: OCS-EPA-R2 NY 01

Dear Regional Administrator:

This Petition is submitted pursuant to 40 CFR 55.6(a)(3) which incorporates 40 CFR 71.11(n), the latter of which allows for "Public petitions to the permitting authority," and in subsection (1), which provides in pertinent part, "Any interested person (including the permittee) may petition the permitting authority to reopen a permit for cause, and the permitting authority may commence a permit reopening on its own initiative." As such, Save the East Coast, Inc. (hereinafter, "STEC") and Protect Our Coast – LINY (hereinafter, "POC-LINY"), respectfully request that the **EPA reopen the above captioned air permit for cause, and find that the Empire Offshore**

Wind, LLC air permit warrants reanalysis and revocation under the Clean Air Act ("CAA") for the reasons set forth below.

The Empire Offshore Wind final air permit was issued pursuant to 40 CFR part 55 on February 15, 2024.[1]

The arguments contained herein are focus principally on the **construction and commissioning phase**, which is comparatively the more problematic phase from an emissions standpoint.

GENERAL AND SPECIFIC ANALYTIC DEFICIENCIES OF EMPIRE OFFSHORE WIND AIR PERMIT

GENERAL ANALYTIC DEFICIENCIES

[1] Incomplete assessment of blade failure and repair emissions.

The analysis and attendant fact sheet for Empire Offshore Wind does not appear to account for emissions related to and resulting from blade failures, which would warrant emergency repairs or replacement activities. This could involve emissions from specialized heavy-lift vessels (HLVs), additional transport vessels, which could significantly increase volatile organic compounds (VOC), NOX, and particulate matter (PM10 and PM2.5).

Moreover, there is a deficiency in analysis regarding emissions eventuating from operational maintenance/servicing. Customary wear and tear on turbine blades and unanticipated failures due to severe weather conditions should have been explicitly analyzed for emissions. This would also lead to an underestimation of potential emissions.

[1] https://www.epa.gov/system/files/documents/2024-02/final-permit.pdf
Fact Sheet associated with this permit:
https://www.regulations.gov/document/EPA-R02-OAR-2023-0522-0022

Furthermore, the analysis mostly focuses on routine operations and worst-case annualized emissions from construction and operation phases but appears to lack dispersion modelling for short term emission spikes induced by emergencies (blade failures/repairs). This could lead to temporary exceedances of NAAQS for pollutants such as NO_2 and PM.

[2] Insufficient Consideration of Cumulative Vessel Emissions Could Lead to 1-Hour NO_2 Exceedances

The air permit for Empire Offshore Wind inadequately addresses the cumulative effects of concurrent vessel emissions, possibly resulting in exceedances of the 1-hour NAAQS for NO_2.

Primary sources of vessel emissions:

-construction activities (Heavy-lift vessels, jack-up barges, and anchor-handling tug supply vessels used for foundation installation, cable-laying, and turbine assembly; Crew transfer vessels (CTVs) and support vessels operate continuously to transport personnel and equipment).

-operational and maintenance activities (Service operation vessels, CTVs, and auxiliary vessels).

-emergency situations (additional vessels deployed for blade failures and repairs, or cable malfunctions) leading to short term spikes in emissions.

The data provided indicate that there are deficiencies in terms of accounting for situations wherein numerous vessels operate concurrently, such as contemporaneously heavy lift vessels installing foundations while cable laying vessels and CTVs transport materials and personnel. During these high operation periods, innumerable (potentially 10+) vessels can potentially be operating concurrently within a concentrated zone, generating overlapping emissions plumes. While the data provided focuses on annualized emissions, there is a lack of

modelling on 1-hour NO_2 impacts of vessel emissions, particularly during high intensity construction (or emergency) activities. These emissions can induce concentrated plumes of NO_2. Furthermore, there is a lack of modeling on stable atmospheric conditions in the context of contemporaneous vessel operations in concentrated areas, and the resultant impacts on 1-hour pollutants. And finally, Empire Wind's construction activities were not modelled under assumptions of emission generation from other adjacent project emissions – the overlapping emissions plumes could result in exceedances of the 1-hour NO_2.

As such, the EPA should model/quantify the worst-case emissions scenarios (e.g., through Gaussian dispersion models or otherwise), the total NO_2 emissions from contemporaneously operating vessels (various permutations – 30+ vessels), under worst case stable atmospheric conditions, and including background NO_2 levels. These scenarios should also be modelled in the context of possible concurrent project construction activities proximate to Empire Wind.

Without extensive modelling on contemporaneously operating vessels in high intensity construction periods and stable atmospheric conditions, compliance with 1-hour NO_2 NAAQS cannot be affirmatively and unambiguously established.

[3] The Emissions from Pile Driving, such as Hydraulic Hammering, are not Adequately Modelled in Isolation or Synergistically

Hydraulic hammering during pile driving produces significant short-term emissions via hydraulic hammers, Hydraulic power units, and vessels, and heightened activity from vessels / ancillary equipment. Such emissions can occur in concentrated bursts, increasing the probability of localized exceedances of the 1-hour NO_2 NAAQS (188 $\mu g/m^3$).

Note that during peak construction phases, pile driving emissions can occur coterminous with emissions from vessels transporting personnel / materials, and/or equipment. This can amplify NO_2 concentrations.

Critically, there is apparently a lack of short-term modelling for worst-case short-term effects from contemporaneous vessel operations (i.e., multiple vessels

operating concurrently during construction) and pile driving activities (i.e., hydraulic hammering emissions). The emissions from hydraulic hammering do not appear to be separately modeled either.

Not only is the above set of conditions not modelled under stable atmospheric conditions, what about during conditions of temperature inversions? Temperature inversions have the capacity to trap pollutants near the surface, worsening concentrations of NO_2. There is no evidence that this was adequately (or at all) modelled, namely, contemporaneous vessel operations and pile driving at peak construction activity in the presence of temperature inversion conditions. By way of example, Vineyard Wind 1 Mariner Update for the Week of March 10, 2025 indicates 28 currently operating vessels.[2] EPA should run modelling iterations of putative 1-hour NO_2 as a function of different numbers of concurrently operating vessels (under different atmospheric conditions and background emissions, most notably, stable atmospheric conditions).

[4] Prevalence of Glauconite in the waters of NJ/NY Bight Unconsidered as a Determinant

The continental shelf to the east of New Jersey is replete with glauconite, a greenish, iron-rich clay mineral, often found in marine sediments. The high prevalence of mineral poses a significant obstacle for offshore wind related dredging, pile driving, and construction related activities. Indeed, this dilemma was explicitly acknowledged by BOEM:

"Geotechnical site investigations and laboratory studies have shown that the geotechnical properties of glauconite make it an extremely difficult material to build upon, specifically for the installation of fixed bottom foundations that support offshore wind turbine towers. The primary concern is that the crushability of

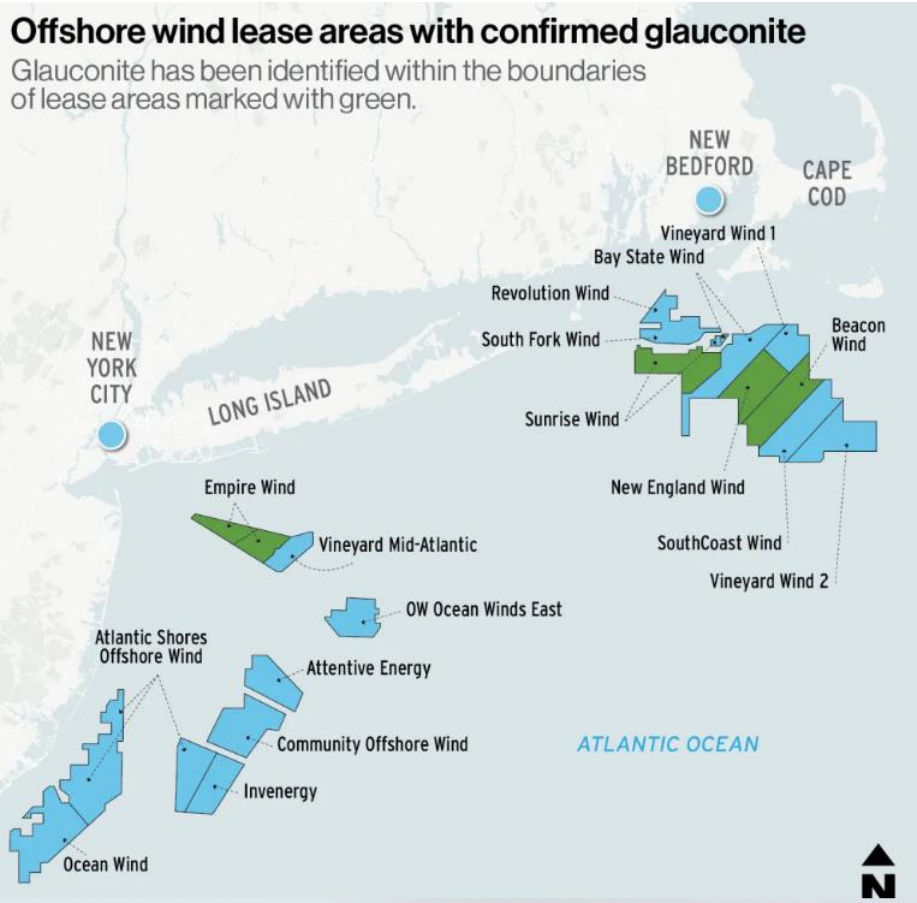
[2] https://info.vineyardwind.com/weekly-report-active-offshore-wind-mariner-updates-1740410053173?ecid=ACsprvtdTMVU_ta8R-ITW6Ny_tZUAL51Ki1x5-3twyU0Y0DtN12hlgp_eqsW19032NlIPq8BagKS&utm_campaign=Weekly%20OWMUs&utm_medium=email&_hsenc=p2ANqtz-8OrK2iR6UYO1IJcT6HPWFuesz269JVh9AXCBbt-QbGtKVZ9SSVVU_O_xq9hlPppxr8e2Tl2WF9-tQlhJqOZ1jOycB4hbF88TxpDcbEr_3qxWaNflY&_hsmi=351010064&utm_content=351010064&utm_source=hs_email

glauconite may result in very high driving resistance or high friction for pile driving during monopile installation as well as reducing pile capacity with depth, which pose a significant risk to project development (Westgate, et al., 2022). Glauconite is crushable due to its low particle strength and turns into a clay-like substance under stress. Therefore, the pressure from driving a monopile into the seabed crushes the glauconite sands, which form a clay-like barrier that is not penetrable. As a result, typical hammering methods will not allow the pile to be installed to the needed penetration depth."[3]

It is integral to note that glauconite was in fact identified within the Wind Development Area of Empire Wind.[4] See the below image.

[3] https://www.boem.gov/sites/default/files/documents/renewable-energy/studies/GlauconiteSand_WhitePaper.pdf#:~:text=Geotechnical%20site%20investigations%20and%20laboratory,support%20offshore%20wind%20turbine%20towers.

[4] https://newbedfordlight.org/a-tricky-sticky-mineral-thats-challenging-offshore-wind-developers/



Among other impacts, glauconite has geotechnical ramifications. For example, *"Offshore substations will utilize traditional jacket pile foundations, often 3 m in diameter and up to 100 m in length. Premature driving refusal can result in added costs which are orders of magnitude greater than those for onshore projects, and is a main risk factor in offshore developments."*[5]

Degradation of glauconite is an important factor in increasing pile driving difficult. *"Glauconite sand is a challenging sediment that can pose risks to foundation installation and performance due to its tendency to transform from coarse-grained material into fine-grained material due to particle crushing."*[6]

What this ineluctably leads to is more operating time, thereby higher fuel usage, which is directly commensurate with generated emissions. While research on the

[5] https://www.sciencedirect.com/science/article/abs/pii/S0029801823014658

[6] Id.

inimical effects of glauconite rich zones on offshore wind construction is rather in its inchoate stages, it is clear that the friable, fracture prone nature of glauconite grains cause glauconite to transform into more clay-like behavior, which destructively interferes with pile driving (more pile refusal). The ramifications that logically follow are increased pile hammering efforts and thus heightened mechanical/machine effort, translating into higher generation of various pollutant emissions, including NO_2.

The heightened degree of machine effort necessary to effectively drive piles into the continental shelf seabed – well established to contain glauconite – has not been adequately examined in the Empire Offshore Wind analysis. This increased mechanical effort and operation time leads and will lead to higher fuel usage and thus emissions (including NO_2, the focus here). This is yet another determinant that – in totality with all factors discussed herein – strongly suggests the 1-hour NO_2 NAAQS standard will be contravened. EPA should revisit and re-examine the glauconite issue.

SPECIFIC ANALYTIC DEFICIENCIES

[5] Specific Analytic Deficiencies Leading to Likely Underestimation of 1-hour NO_2 and thus Exceedances of that NAAQS Standard

Empire Offshore Wind analysis concludes a putative total concentration of NO_2 of **183.9 μ g/m^3**, which is very marginally lower than the upper limit of **188 μ g/m^3** for 1-hour NO_2 NAAQS compliance (assertion of **marginal** compliance by 4.1 μ g/m^3). This conclusion is apparently predicated upon use of AERMOD with AEROCOARE preprocessor followed up by Ambient Ratio Method 2 (ARM2) implementation for 1-hour NO_2 dispersion modeling.

However, there are a number of critical inputs/assumptions incorporated in the analysis that tend to undercut the conclusion of compliance with NAAQS.

[A] One of those critical assumptions, which is highly questionable, was the selection of onshore monitoring data for background/ambient conditions: *"Ambient background data is used from the nearest ambient air quality monitoring sites to the project. There are no monitoring stations offshore, hence the closest land monitors were used."*[7] While the analysis states that some receptors were placed offshore, the background conditions are onshore derived, and in concert with the AERMOD-ARM2 simplifications discussed here, the analysis likely underestimates NO_2.

Offshore environments vary significantly from onshore in terms dispersion dynamics and photochemical reactions, and as such onshore data may not veraciously represent conditions near the WDA.

[B] ARM2[8] simplifies the chemistry of NO_X-to-NO_2 conversion and **may not account for offshore specific factors** including the following:

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[7] https://www.regulations.gov/document/EPA-R02-OAR-2023-0522-0022

[8] According to an EPA whitepaper in 2021, ARM2, among other models, is properly classified as "screening" rather than a refined modeling technique. https://www.epa.gov/sites/default/files/2021-01/documents/no2_modeling_techniques_white_paper.pdf

In addition, EPA has said regarding ARM2, "It is not clear that the AQS [air quality system] data represent the direct impact from any specific source, much less the direct impact from any major NO2 sources that have relatively high ISRs, as the AQS monitors are usually placed to determine the general background levels of air quality in an area. **Thus, the AQS data alone does not necessarily represent the highest impacts that might occur near a major NOx source. As a result, ARM2 may not represent the behavior of these impacts."** https://www.tceq.texas.gov/assets/public/permitting/air/memos/no2-clarification-memo-20140930.pdf

In a study discussing dispersion model limitations (including ARM2 used here) underscored, *"Existing dispersion models use different techniques and assumptions to represent NO to NO_2 conversion and do not fully characterize all of the important atmospheric chemical and mechanical processes . . . The atmospheric chemistry of NO to NO_2 conversion is complex and involves multiple chemical and photolytic reactions, as described in Atkinson (2000) and Seinfeld and Pandis (2012). **The most common pathway for the conversion of NO to NO_2 occurs via oxidation by ozone (O_3).***
It continues, *"Of these models, only the **ARM2 method incorporated into AERMOD does not take into account any explicit O_3 chemistry**."* https://pmc.ncbi.nlm.nih.gov/articles/PMC5846501/

How then can ARM2 be justifiably relied upon if one of the integral chemical processes of NO to NO_2 conversion is unincorporated?

- Higher humidity levels,[9] which can augment NO_2 formation.[10] See footnotes, and in addition (one select study), the following: *"The results show that RH can significantly enhance the production of gaseous NO_2 from the photolysis of NH_4NO_3 . . . Under high RH and UV light, the main product of NH_4NO_3 photolysis is NO_2, rather than NO and HONO."* A key highlight of that study is *"High RH promotes the photolysis of NH_4NO_3 to produce more NO_2."*

  Source: https://www.sciencedirect.com/science/article/abs/pii/S004896972203577X#:~:text=The%20results%20show%20that%20RH,atmospheric%20pollution%20and%20ozone%20pollution.

- Reduced photolysis rates over water due to lower ground reflectance, which tends to decelerate NO_2 breakdown.[11] Critically, the rate at which NO_2 photolyzes into NO and O varies depending upon albedo. Over

[9] Relative humidity is approximately 80% at 2-meter height over oceans. https://www.gfdl.noaa.gov/blog_held/47-relative-humidity-over-the-oceans/.

See also, "*Observations and models show that near-surface relative humidity is nearly constant at ~80% over the ocean in the current climate,"* https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2023MS004168.

[10] See, e.g., https://pubmed.ncbi.nlm.nih.gov/10081534/. Higher humidity can enhance NO_2 related processes, i.e., one pathway is that higher relative humidity increases NO oxidation to NO_2 under UV light by supplying hydroxyl radicals (and Ozone) with the efficiency of conversion increasing as a function of RH. Analogously, the conditions over an ocean near the WDA support increased conversion efficiency from NO to NO_2.

[11] This study demonstrates that photolysis rate of NO2 is substantially higher over land versus water; in the study's context, measured differences across the spatial domain of Antarctica and adjacent ocean. The high albedo of the snow promotes increased reflectivity and NO2 photolysis. However, note the very low photolysis rates over open water. This can be applied here, again, it is well established that water has much lower reflectivity, on the order of 5-10%, versus 10-30% for the land uses common in New England. https://acp.copernicus.org/articles/23/10413/2023/acp-23-10413-2023.pdf

surfaces with higher albedo, such as land, upward scattered UV radiation is increased, enhancing photolysis and concomitant breakdown of NO_2. However, it is well established the water (ocean) exhibits much lower albedo (i.e., 0.05-0.10) leading to significantly reduced upward scattered radiation and thus much lower breakdown rates of atmospheric NO_2.

- Heightened concentration of emissions from vessel activities causing underestimation pockets of NO_2 peaks adjacent to the WDA site.

[C] In terms of meteorological considerations: short term atmospheric phenomena, such as lower wind speeds and temperature inversions, have the capacity to trap pollutants, increasing their concentration near the surface. Indeed, offshore atmospheric conditions exhibit a higher propensity for temperature inversions (cooler air trapped underneath warmer air) which has the effect of reducing vertical mixing and thus potentiating the pollutant (NO_2) concentration closer to ground level. Atmospheric conditions over water tend to feature heightened stability and lower vertical mixing. This can have the functional effect of trapping pollutants to a greater degree than onshore.[12]

Concordantly, in another study[13], the researchers examined pollutant transport and properties, noting, critically, "*During pollution episodes, the air over land in daytime is warmer than the sea surface, so air transported from land over water becomes statically stable and the formerly well-mixed boundary layer separates into possibly several layers, each transported in a different direction . . .* ***The boundary layer***

[12] See, e.g., *"Air pollution episodes in northern New England often are caused by transport of pollutants over water. Two such episodes in the summer of 2002 are examined (22–23 July and 11–14 August). In both cases, the pollutants that affected coastal New Hampshire and coastal southwest Maine were transported over coastal waters in stable layers at the surface. These layers were at least intermittently turbulent but retained their chemical constituents. The lack of deposition or deep vertical mixing on the overwater trajectories allowed pollutant concentrations to remain strong."* https://journals.ametsoc.org/view/journals/apme/43/10/jam2148.1.xml

[13] https://journals.ametsoc.org/view/journals/apme/45/1/jam2333.1.xml

stability over the cold water is weaker in the model than in reality." Again, the boundary layer stability enhancement over cool water (common in Northeast coastal regions) is an integral factor in potentiating pollutant concentrations.

In fact, in an analysis conducted by BOEM itself, the agency found "pronounced" temperature inversion conditions over offshore wind farm sites 10-30% of the calendar year. Weaker but notable inversions may occur on a higher proportion of days. *"Based on assessments using HRRR atmospheric model data at the proposed wind farm sites, meteorological conditions conducive to pronounced temperature and moisture inversions - and thus potential ducting - occur 10% to 30% of the time, on average through the year."*[14]

[6] Total Effect of Unconsidered Variables on 1-hour NO_2

Temperature inversion induced increases in pollutant concentration in the lower troposphere is a well-established phenomenon.[15] One study indicates night time inversion induced increase in NO_2 of about 50%.[16] As an example of the effect of inversions, 93% of severe polluted days occurred concurrent with a temperature inversion (Chinese study).[17] As conceded by the Utah Department of Environmental Quality, *"Surface temperature inversions play a major role in air quality,"*[18] – why

[14] https://www.boem.gov/sites/default/files/documents/environment/Radar-Interferance-Atlantic-Offshore-Wind_0.pdf

[15] https://link.springer.com/article/10.1007/s11600-024-01417-0

[16] https://www.sciencedirect.com/science/article/abs/pii/S0048969709005166

[17] https://www.sciencedirect.com/science/article/abs/pii/S0048969718330547#:~:text=%E2%80%A2,accompanied%20by%20severe%20air%20pollution.

[18] https://deq.utah.gov/air-quality/inversions#:~:text=Surface%20temperature%20inversions%20play%20a,leading%20to%20poor%20air%20quality.

then, were inversions not more extensively modeled and analyzed for this air permit?[19]

If we consider, in totality, that the following determinants were inadequately considered or not examined at all:

- reduced photolysis over water[20]
- enhanced NO_2 formation (via higher relative humidity levels) [21]
- propensity for weak dispersion and increase low level atmospheric stability
- temperature inversion conditions more frequent
- localized hotspots via numerous concurrently operating vessels under stable and inverted temperature atmospheric conditions
- Blade failure repair and replacement emissions, and emissions generated from marine debris clean-up/remediation efforts
- Emissions generated from increased operational efforts/fuel usage due to glauconite rich zone within Empire Offshore Wind WDA
- Use of onshore monitoring data for background, ambient conditions not necessarily representative of WDA conditions as it may not account for marine vessel traffic or other pollutant generating offshore sources
- Given the aforesaid factors, the fact that modeled NO_2 levels were **already** 97.82% of the standard (183.9 μ g/m^3 of 188 μ g/m^3)

[19] See also, Salt Lake City example of temperature inversion effects on pollutant concentration: https://www.inscc.utah.edu/~u0546592/daqstudy.xhtml
[20] Presuming a 10-20% increase in relative humidity land vs. ocean, and albedo difference of 0.05-0.1 ocean versus 0.2-0.4 onshore, leading to higher photolysis rates on land vs. ocean.
[21] Id.

The analysis likely **underestimates** localized effects, i.e., emissions from vessels/equipment likely **modeled** as more dispersed across the area. However, the localized peaks due to tight congregation of emission sources (e.g., numerous vessels operating concurrently) were spatial and temporal elements seemingly unconsidered in the Empire Offshore Wind analysis. Moreover, offshore-specific factors (which again, ostensibly unconsidered), including slower photolysis over water and higher relative humidity levels, both serving to reduce degradation/dissociation of NO_2 and increase its formation through complex chemical processes (including, among other processes, reduced albedo induced UV scattering). Temperature inversion atmospheric conditions, prevalent over water, were also unconsidered. These inversions have the functional effect of potentiating pollutant concentrations in the lower levels of the troposphere. And finally, the use of onshore monitoring data to estimate background conditions could spuriously ignore marine vessel traffic/other offshore emissions rendering those baselines improper. If one were to conservatively postulate that the above factors yield only a 10% increase in 1-hour NO_2 persistently, the actual value would be near 202.29 μ g/m^3 rather than 183.9 μ g/m^3, **resulting in non-compliance with 1-hour NO_2**. Even a **mere 3% underestimation** of 1-hour NO_2 based upon the above factors would result in a violation of the NAAQS standard (189.42 μ g/m^3 vs 188 μ g/m^3). However, when considering the temperature inversion induced spikes in concert with contemporaneously operating vessels near the WDA under those favorable atmospheric conditions of stability and pollutant trapping, it is highly plausible and even likely that periodic spikes substantially greater occur. As such, a violation of 1-hour NO_2 is probable to likely. Intensive modeling and re-examination should be undertaken for all of the aforesaid variables.

Conclusion

Therefore, given the aforesaid inadequately considered or unconsidered determinants in the Empire Wind Offshore analysis for their air permit, the EPA should exercise its authority to reopen, re-examine and withdraw this permit.

Thank you for your careful attention to this matter.

Respectfully submitted,

Thank you for your consideration of these comments.

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