Secretary Kathleen A. Theoharides
Executive Office of Energy and Environmental Affairs
Attn: MEPA Office
100 Cambridge Street, Suite 900
Boston, MA 02114
Via email to MEPA@mass.gov

Re: Expanded Environmental Notification Form, March 15, 2021 and May 11, 2021 Supplement
ADM TMUD Wareham Solar Projects
EEA No. 13940-ADM Tihonet Mixed Use Development
Wareham, Plymouth, Carver, Massachusetts

Dear Secretary Theoharides,

The Partnership for Policy Integrity (PFPI) submits the following comments on the Expanded Environmental Notification Form ("EENF") EEA # 13940 to the Massachusetts Environmental Policy ("MEPA") Unit. PFPI's work focuses on forests and climate, and our involvement in state policy matters has up to this point largely been confined to biomass energy. However, we are very concerned at how the state's policy on large-scale solar energy appears to be promoting projects that result in net damage to Massachusetts' forests, and accordingly are submitting these comments on particular aspects of the Wareham solar projects.

General comments on the state's solar policy

First, this project, and the others going in, represent not a success of the state's solar energy policy, but a failure. It is shocking to see that the state's renewable energy policy is actually incentivizing forest clearing for solar. Climate change mitigation is not just about reducing fossil fuel emissions. Climate modeling is crystal-clear that we need to not only reduce emissions, but actually sequester CO2 that has *already* been emitted. Restoring and expanding forests is the only means under our control to achieve this at scale. Accordingly, anything that undermines forest carbon uptake is actively undermining climate mitigation. The state should not have a policy that pits solar against forests. Policies should offer incentives for preserving and expanding forests, not destroying them.

Satellite imagery from Global Forest Watch shows that forest loss in the vicinity of the project is particularly high. Figure 1 shows forest loss just since 2000[1]; it doesn't even include the large amount of conversion to cranberry bogs and other uses from before 2000. In fact, pulling back, this area appears to have one of the highest rates of forest loss since 2000 in the entire state of Massachusetts.

[1] Data from Global Forest Watch at https://bit.ly/3ukdyc0

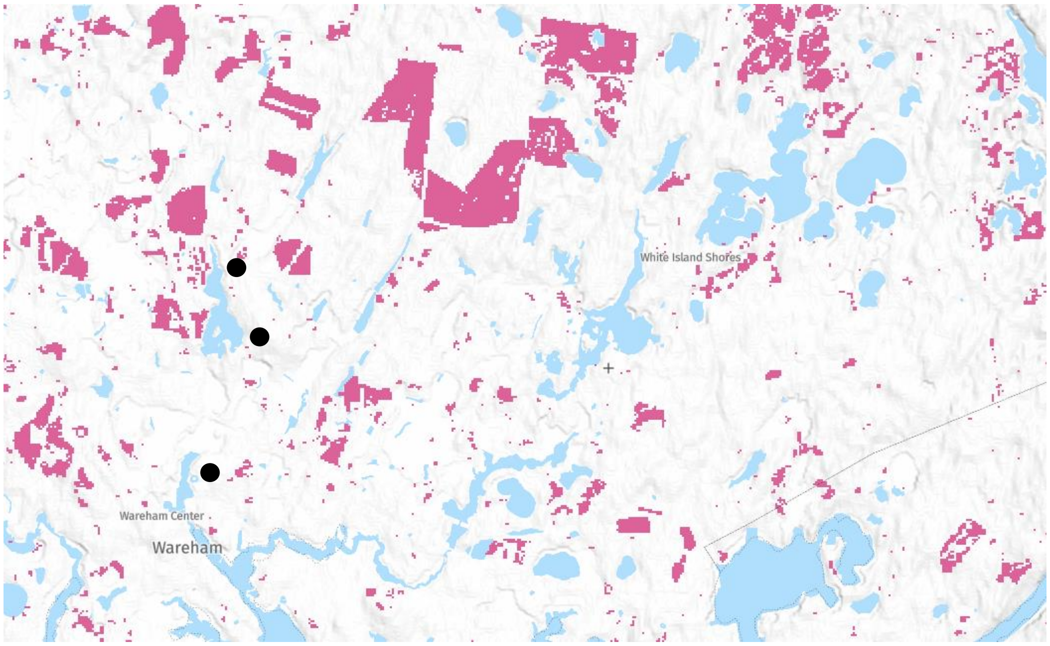

Figure 1. Global Forest Watch overview of forest loss in the area of the project. The three proposed solar fields are marked with black dots.

Regarding this specific project, it is tone-deaf for the EENF to claim (page 11) that "*Furthermore, the Master Plan's Natural and Cultural Resources Goal 1 is to, 'Coordinate and strategically implement several ongoing efforts to increase climate resilience in Wareham.' While the Project will not contribute directly to climate resilience specifically in Wareham, it will advance the Commonwealth's renewable energy initiatives, which broadly address the issues surrounding climate change*."

We would argue that any project that causes more forest loss in Wareham is actually undermining the town's climate resilience.

General comments on the project

These projects are extraordinarily damaging

Using Google Earth to view other solar projects installed in the same area as the proposal makes it evident how damaging these projects are. Removal of forest and land preparation scrapes the soil down to essentially white sand, and even beyond this, further sand mining is occurring. This essentially resets the ecosystem to where it was right after the glaciers retreated. Transpiration from vegetation cools and moistens the air, but the sand pit is a glaring, radiating zone without any ability to affect or modify its microclimate. The subsoil is sterile sand with few available nutrients, meaning nothing much will grow here again in any human timeframe, even after the solar panels are removed. This may be within the owner's rights – but why is it being subsidized with Massachusetts clean energy subsidies? Approval of the project and receipt of the subsidies should at a minimum be made contingent on the ability to fully restore the site to forest. In few years, these projects are going to be seen as dinosaurs and be viewed with shame for the forest destruction they caused. Assuming a sane climate policy prevails, forest protection and restoration will be prioritized, and solar will be built in places that are already sacrifice zones, such a parking lots, road medians, and perhaps the cranberry bogs of Wareham.

Figure 2. A recent solar and sand mining project in the vicinity of the proposed project (at 41.800214°, -70.703461°)

Comments on the analysis for the proposal

The proposal contains questionable assumptions and analyses in at least two respects – consideration of mitigation for the loss of forests, and consideration of net GHG impacts of the project.

Mitigation of habitat loss

The 2014 certificate on the ENF states, "*NHESP indicates that a long term net benefit can be developed through a) permanent protection of appropriate habitat in the vicinity of previously designated conservation areas, and b) providing funding for long-term habitat management to benefit the affected species*."

We wonder if the program would use similar language today. There is no "net" benefit given the accelerating forest loss in the region, as shown in Figure 1.

At page 5 of the March 2021 EENF, it states, "*Although portions of the 150 Tihonet Road PV+ES Project lie within identified but unmapped pine barrens habitat, the Proponent is coordinating with NHESP and will undertake appropriate mitigation in the form of conservation lands and habitat funding*."

Even if these minimal set-asides are actually happening, this does not constitute "mitigation" given that the entire pine barrens ecosystem is being obliterated where the solar panels are installed. Setting aside other land for conservation is nice, but there is a net loss of ecosystem that is occurring. There is no "mitigation."

Other impacts

The loss of vegetation also changes the hydrology of the site. The proponent is developing stormwater retention basins, the planning for which needs to take into account changes in rainfall amount and intensity now underway with climate change. Has this occurred? Does the modeling actually recognize non-stationarity of rainfall?

The ponds already have issues with dissolved oxygen and phosphorous pollution, which is evident with satellite photos that show extensive algae growth. Also, it appears that there is potentially some planting activity planned for the area under the solar panels. We wonder if the project will use herbicides to reduce growth of the meadow? If so, has the potential for water contamination been evaluated, given the sandy soils and the proximity to ponds?

We also note that wetland resources in this rare pine barrens ecosystem are being disturbed. This area of eastern MA has extremely fragile ecosystems. It seems a real failure of state policy, both in terms of MEPA review and in terms of solar incentives, that this project is moving forward and seemingly headed for state approval and even financial support.

GHG analysis

Failure of the state to provide guidance

The 2014 certificate discusses developing a protocol for evaluating GHG impacts, but apparently this has not been done. Why not? There has been plenty of time. There should have been a protocol for the proponents to follow, instead of being left to make it up as they go along. Why is the state so lax on these matters?

Failure to include ecosystem carbon loss

In calculating the GHG "benefit" of the project, the proponent simply ignores the carbon emissions from removing the forest from the site. Why do they assume this is legitimate? It is not, because this is stored carbon. They appear to claim it would only be emitted to the atmosphere if it were burned (page 2 of memo), but in fact even if the trees were converted into long-lived wood products, a significant portion of the wood would be lost right away during processing.

The basic IPCC protocol for assessing emissions impacts of forest clearing treats felling trees as an instantaneous emission of stored carbon, though more refined approaches are possible when data are available. The appropriate protocol to require here appears to be the one for "Other Land"[2]:

Tier 1

A Tier 1 method follows the approach in Equation 2.16 in Chapter 2 where the amount of above-ground biomass that is removed is estimated by multiplying the area (e.g., forest area) converted annually to Other Land by the average carbon content of biomass in the land prior to conversion (B_{BEFORE}). In this case, B_{AFTER} in Equation 2.16 is set to zero by default. ***The default assumption for the Tier 1 calculation is that all carbon in biomass (less harvested wood products removed from the area) is released to the atmosphere immediately*** *(i.e., in the first year after conversion) through decay processes either on- or off-site.*

Tier 2

[2] https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_09_Ch9_Other_Land.pdf

A Tier 2 method can be developed and used if country-specific data on carbon stocks before conversion to Other Land (i.e., B_{BEFORE} in Equation 2.16) are obtainable. B_{AFTER} remains at zero. In addition, under Tier 2, carbon losses can be apportioned to specific conversion processes, such as burning or harvesting. This allows for more accurate estimation of non-CO_2 greenhouse gas emissions. A portion of biomass removed is sometimes used as wood products or as fuel wood. Chapter 2, Section 2.4 provides the basic method for estimating non-CO_2 greenhouse gas emissions from biomass burning. Chapter 12 provides guidance for estimation techniques for carbon stored in harvested wood products.

Tier 3
A Tier 3 method requires more detailed data/information than the Tier 2 approach, e.g.,:
• Geo-referenced disaggregated areas converted annually are used for each land use converted to Other Land;
• Carbon densities are based on locally specific information and; and
• Biomass stock values are based on inventories and/or the model estimations.
• Where data are available, Tier 3 methods may be used to track the dynamic behaviour of carbon stocks and greenhouse gas emissions following conversion. ***Where the land remains in a vegetation-free state (due to severe degradation), there will generally be a continuing decline in carbon stocks****. If this is not the case, countries should consider whether the land should be classified under another land use, as indicated in Chapter 3.*

In the case of this project, where stumps and roots will be removed, the lost of biomass carbon is especially notable. The loss of soil carbon is also extreme. According to the data the proponents themselves cite (from EPA), soil carbon can constitute more than 50 - 60% of ecosystem carbon. The total removal of topsoil and the layers of subsoil that are most likely to store soil organic carbon in dissolved forms also needs to be taken into consideration. The state should require the proponents to find data that accurately reflect the aboveground and belowground carbon loss, including from soils, and do the calculation properly.

Failure to include timing of GHG emissions

The proponent draws attention to the future gain of carbon on the site, stating that the calculations are "likely conservative" because they do not include the carbon that will be sequestered in the "meadow" growing beneath the solar panels (to be planted?) and the future carbon sequestration in the forest that will replace the solar panels when the project is decommissioned. These hypothetical impacts are in the future, while the liquidation of site carbon is happening now, just when it is most urgent to reduce emissions. Carbon loss happening in the near term with certainty needs to be valued more highly than future potential carbon gain. Further, it appears that the proponent is actually misrepresenting the developer's intentions when they say the area will be reforested, because the developer is on video[3] as saying that after the "fad" of solar passes, the "junk" will be hauled away and the site will be turned into a housing development.

Sequestration analysis is incorrect

The proponents' assessment of carbon emissions from the project is confined to estimates of future forest carbon sequestration that will be foregone. They analyze this using two approaches. The first approach uses data they say they obtained from Northeast Survey Consultants, but they do not say what the data are, or how they were obtained, though they do refer to diameter at breast height (DBH)

[3] https://www.youtube.com/watch?v=nh7fnq2y3Sg

measurements "where applicable." It is not clear what this means. It is also not clear how the tree volume estimates were made or how they relate to the DBH. The report further makes an error in converting the dry weight to green weight of 72.5%, citing an unpublished online document[4] with no citations which states, "Taking all species in the table into account, the average tree is 72.5% dry matter and 27.5% moisture." This is not correct for trees in New England, where moisture content of freshly harvested wood is around 50% and sometimes more.

Given this failure and the proponents' evident unfamiliarity with protocols for ecosystem carbon assessment, we have no confidence in the approach to calculating increased DBH and volume through time, which uses a "simplified, linear growth rate formula." They do cite a reference for this approach, but it is not clear if their analysis of forest biomass takes into account the fact that trees with bigger circumference tend to also be taller, meaning their overall volume is greater. In fact, the regression curve that proponents provide for volume/weight (cubic meters) looks very similar to a standard curve of the relationship between diameter and area of a cross-section of a tree (square meters), which if the trunk is circular in cross-section would follow the relationship of "pi-r-squared." We graphed up that simple relationship (in blue) and overlaid it on the on the proponents' graph (Figure 3):

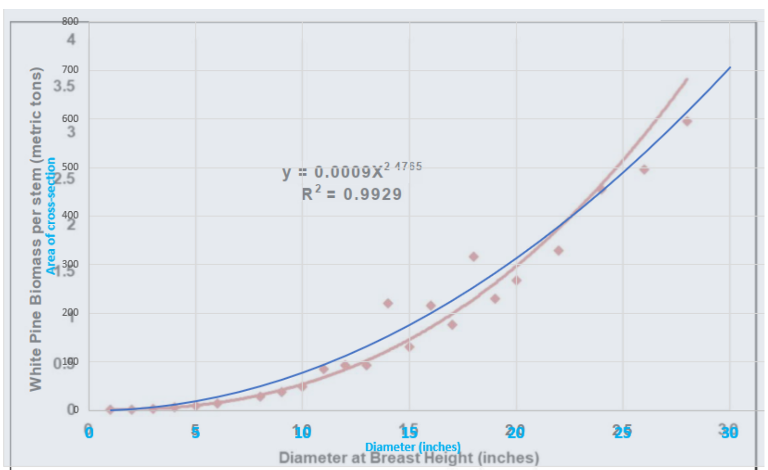

Figure 3. The graph of the relationship between diameter and area (square meters) overlaid on the proponents' graph of diameter and volume (cubic meters) translated in some unknown way to weight of biomass.

It appears that the proponents' analysis of biomass per stem does not correctly reflect the overall increase in volume, because it traces a relationship of DBH to stem cross-sectional area, rather than full tree volume. Further, a stem analysis does not really tell much about forest biomass as a whole, unless there is a detailed count of stems per acre, and the analysis includes the volume of stumps and roots. Even with that information, the analysis of carbon *stocks* is incomplete, because it does not include soil carbon. For an analysis of future sequestration (carbon sinks), however, soil carbon may be difficult to quantify.

For a more credible approach, at a minimum the proponents could use the USFS Forest Inventory and Analysis data and tools that the Forest Service makes available for estimating forest carbon stocks and sinks. Additionally, research suggests carbon sequestration by larger, older trees has in some cases been

[4] https://www.unm.edu/~jbrink/365/Documents/Calculating_tree_carbon.pdf

underestimated, for instance see Stephenson et al 2014[5] and most recently Leverett et al 2021,[6] with Figure 1 from that paper reproduced below. While growth patterns from individual trees can not be directly extrapolated to whole stands, the data suggest that the *apparent* "slowing" of growth by older trees is often not reflected in their volume, which continues to increase.

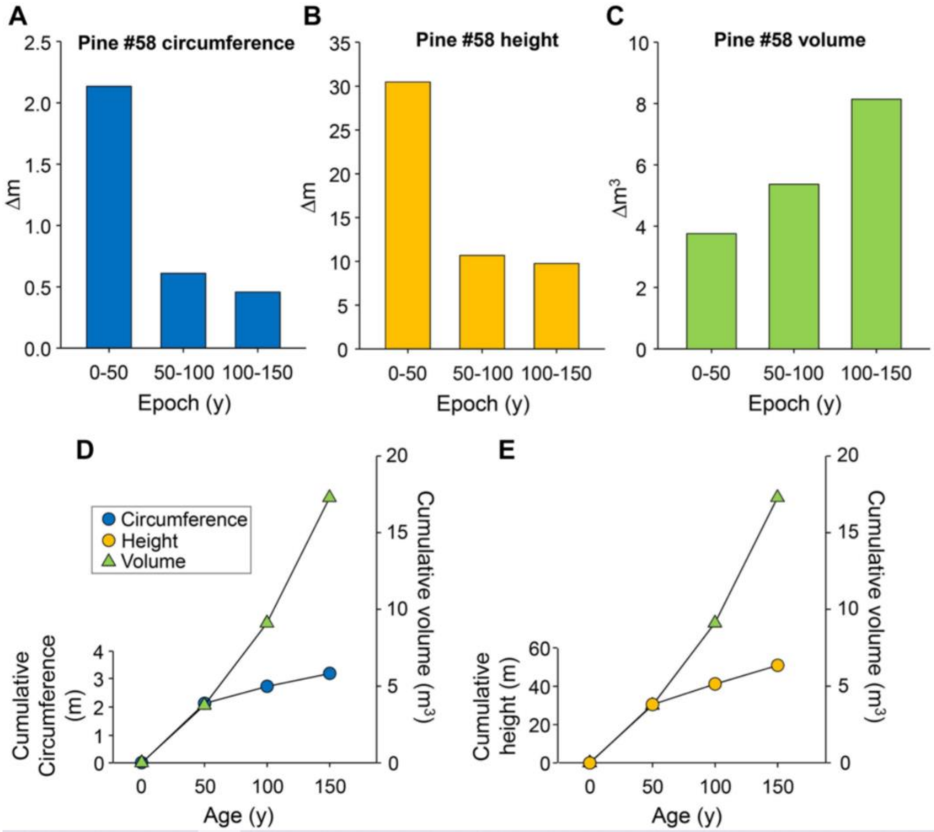

Figure 4, which is Figure 1 from Leverett et al, 2021. *Changes in circumference, height and volume of a stand-grown individual eastern white pine (Pine #58) in three 50-y intervals. Upper panels* ***(A)*** *Change in circumference during 0–50, 50–100, and 100–150 years.* ***(B)*** *Change in height between 0–50, 50–100, and 100–150 years.* ***(C)*** *Change in above-ground tree volume (trunk plus limbs) between 0–50, 50–100, and 100–150 years. Lower panels* ***(D)*** *Cumulative circumference at 50, 100, and 150 years compared to cumulative above-ground volume.* ***(E)*** *Cumulative height at 50, 100, and 150 years compared to cumulative above-ground volume. On each lower panel initial slopes were matched to reflect the rapid change in circumference and height during the first 50-years interval. Note that volume is a proxy for above-ground carbon. Values for circumference, height and volume of Pine #58 were determined by a combination of direct measurement and chronosequence and described in the text and in Supplement.*

[5] Stephenson, N. L., et al. (2014). "Rate of tree carbon accumulation increases continuously with tree size." Nature 507(7490): 90-93. https://www.nature.com/articles/nature12914#Sec14. Supplementary information at https://www.nature.com/articles/nature12914#Sec14

[6] Leverett, R. T., et al. (2021). "Older Eastern White Pine Trees and Stands Accumulate Carbon for Many Decades and Maximize Cumulative Carbon." Frontiers in Forests and Global Change 4(40). https://www.frontiersin.org/articles/10.3389/ffgc.2021.620450/full

The second approach employed by the proponents to estimate foregone sequestration relies on an EPA estimate of forest carbon stocks that includes soil carbon, deadwood, etc. However, the proponents incorrectly apportion sequestration based on stocks, assuming that because living biomass constitutes 31% of the ecosystem carbon, then it must be responsible for the same proportion of active carbon sequestration. If only this were true! If mineral soils added new carbon to stocks at the same rate as living biomass, maybe we wouldn't have a climate crisis (though we'd be up to our eyeballs in soil). In fact among the several problems with this analysis, the proponents have underestimated the amount of ecosystem carbon uptake for which living biomass is responsible, so have underestimated the total ecosystem C sink.

Assumption of fossil fuel displacement is not valid

The entire GHG benefit of the project is based on the assumption that it will displace fossil fuels. The proponents make several statements to this effect. However, for there to be a net reduction in GHG emissions, there does need to be actual, verifiable substitution. Climate warming is a function of the total amount of CO_2 loading, not the GHG intensity of generation. Therefore if solar and other relatively emission-free technology comes online, but the total amount of fossil fuel burning stays the same or increases, there will be no decrease in the amount of CO_2 emitted per year. Yes, it seems likely that fossil fueled electricity generation decreases as solar and wind generation come online and become cheaper, but the other thing that happens is that electricity use increases as consumers become aware that more "green" energy is available, and as electricity becomes cheaper. As electrification increases, for instance of vehicles, overall use will rise, keeping pressure on fossil generators to continue operating. Substitution can only occur if the total amount of electricity generation from fossil sources is capped[7] - otherwise there is simply additional generation, and no net reduction in emissions. As there is no requirement for fossil generation to be taken offline as new solar generation comes online, there can be no assumption that substitution is occurring – as attractive as this concept appears.

Valuing forests solely as "carbon sinks"

Overall, the very concept embodied in the EENF, that forests are valued in this context solely for their ability to sequester carbon is, frankly, insane. Yes, it is probably possible to calculate a GHG "benefit" to building the solar field and replacing forests, making dubious assumptions as the proponent does. In that case, why not clear all the forests in Wareham? Isn't that the logical outcome of such calculations? Perhaps the state should provide incentives to remove *all* the forest in eastern MA and replace it with solar – then we could claim even more GHG "reductions."

The obvious absurdity of that suggestion indicates that there is some scale at which this policy of allowing forest removal for solar no longer makes sense. To us, it seems obvious that this point has already been reached. Forest loss occurring for any reason is hugely counterproductive for ecosystem values and climate alike; clearing forests for solar, specifically, when there are so many alternative places it could be built, is repugnant.

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[7] Leturcq, P. (2020). "GHG displacement factors of harvested wood products: the myth of substitution." Scientific Reports 10(1): 20752. https://doi.org/10.1038/s41598-020-77527-8

Decommissioning should include reforestation

The proponent states that funds are set aside for decommissioning. In fact, given the current rapid rate of forest loss in the region now, we suspect that in the future, the highest use of the site will be as forest. Accordingly, the decommissioning cost should include reforestation as a value to society. There is precedent for this – for instance, the landowner has currently been benefitting from Chapter 61, which is a program that reduces taxes because of the public benefit of keeping land in forests. Making approval of these projects and receipt of publicly funded renewable energy subsidies contingent on future mitigation back to the natural state is completely reasonable. At a minimum, state officials should require real mitigation, which returns the land to its natural forested state, as a condition for approval. If this can not be assured, the project should not be approved. Ideally, the state should change its policies and stop approving any so-called "green" energy projects that rely on clearcutting, and in this case obliterating, the natural ecosystem. In the case of this particular project, it seems likely this area will functionally be a waste land, and that forest regeneration will be paltry, if it occurs at all, due to sandy soils that will be rendered even more nutrient-poor with removal of topsoil and sand mining.

Thank you for the opportunity to comment.

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