Technical Memorandum

Subject
Carbon Sequestration in Trees: Considerations for Alternatives 3 and 4

Project name
South Jersey Transportation Authority Grassland Conservation and Management Area Relocation

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As requested by the Pinelands Commission, AECOM has evaluated the potential carbon sequestration differences between Alternative 3 and Alternative 4, both of which are detailed in our Preliminary Alternatives Analysis Technical Memorandum of April 19, 2021. Under Alternative 3, approximately 16.35 acres of relatively young forest (less than 25 years old) would be removed. Under Alternative 4 approximately 1.58 acres of older forest would be removed. Although AECOM field investigation revealed no trees in the older forest area exceeding approximately 20" diameter at breast height (dbh), the older forest does not appear to have been clear-cut since at least 1930 based on a review of aerial photography for the years 1930, 1940, 1957, 1963, 1970, 1977, 1983, 1995, 2000, 2007, 2009, 2013, 2017 (https://www.atlantic-county.org/gis/AGO/aerialview.html).

According to the Congressional Research Service's *Forest Carbon Primer* (Congressional Research Service, 2020), forests are a significant part of the global carbon cycle, because they contain the largest store of terrestrial (land-based) carbon and continuously transfer carbon between the terrestrial biosphere and the atmosphere. Consequently, forest carbon optimization and management strategies are often included in climate mitigation policy proposals.

The forest carbon cycle starts with the sequestration and accumulation of atmospheric carbon due to tree growth. The accumulated carbon is stored in five different pools in the forest ecosystem including: (1) aboveground biomass (e.g., leaves, trunks, limbs), (2) belowground biomass (e.g., roots), (3) deadwood, (4) litter (e.g., fallen leaves, branches and stems), and (5) soils. As trees or parts of trees die, the carbon cycles through those different pools, from the living biomass pools to the deadwood, litter, and soil pools. The length of time carbon stays in each pool varies considerably, ranging from months (litter) to millennia (soil). The cycle continues as carbon flows out of the forest ecosystem and returns to the atmosphere through several processes, including respiration, combustion, and decomposition. A general depiction of the forest carbon sequestration and respiration cycle is shown in **Figure 1**.

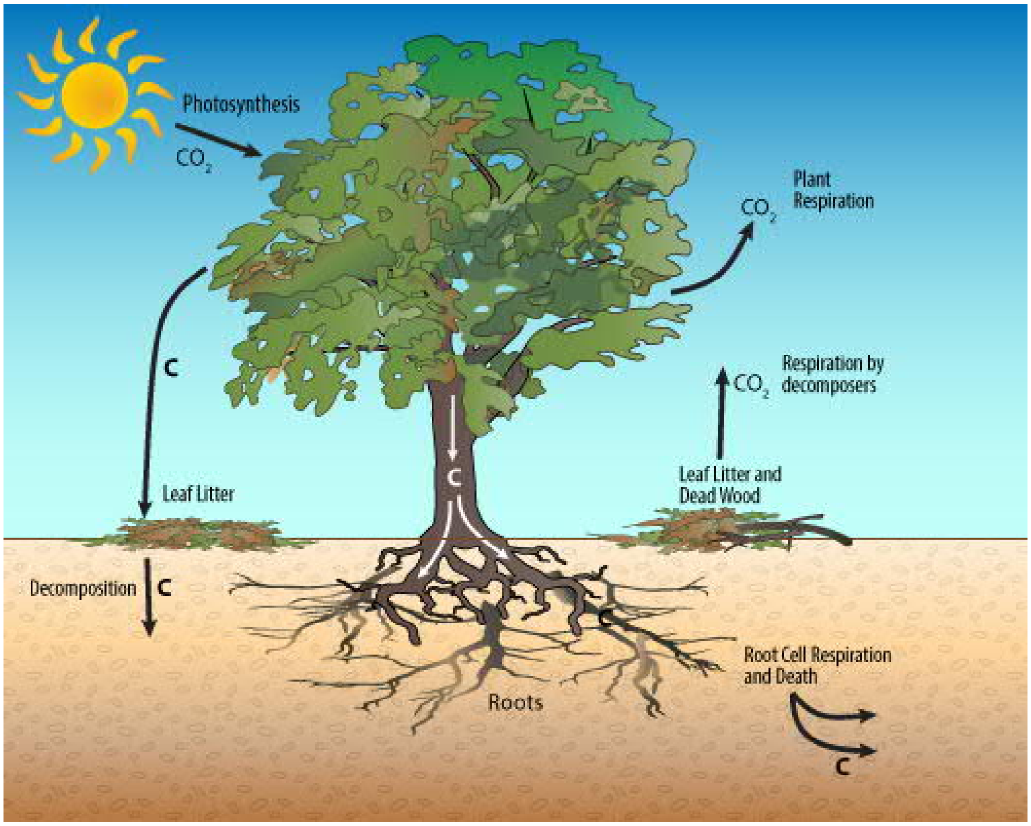

Figure 1: Forest Carbon Cycle

The amount of carbon sequestered in a forest relative to the amount of carbon that forest releases into the atmosphere is constantly changing with tree growth, death, and decomposition. If a disturbed site regenerates as forest, the carbon releases caused by the disturbance generally are offset over time. If, however, the site changes to a different land use (e.g., agriculture, roads), the carbon releases may not be offset (Congressional Research Service, 2020).

Older forests may have more carbon storage than the younger forests, but since there are more trees in the younger site there would be more carbon storage in the younger site due to quantity as well as variety of trees (Anwar, 2001). The younger trees are also storing carbon in a faster rate because they are growing more quickly than the older forest (Anwar, 2001).

A recent study by Pugh et al. (2019) calculated that old-growth forests sequestered 950 million to 1.11 billion metric tons of carbon per year while younger forests, those that have been growing less than 140 years, stored between 1.17 and 1.66 billion metric tons per year, supporting this conclusion. They write that the newly deforested areas are open and sunny and are easily recolonized by fast-growing species, which can extract carbon from the air and incorporate it into their biomass more quickly than mature trees that must contend with more competition and less sunlight.

For the proposed action, approximately 16.35 acres of relatively young trees would be removed under Alternative 3 and 1.58 acres of older trees would be removed under Alternative 4. Given that Alternative 4 would remove less than a tenth of forest than Alternative 3, it is considered to be a better option for maximizing carbon sequestration. Alternative 4 would provide the benefit of the faster growing rate of younger trees, and will also retain a much greater area of forested land as compared to Alternative 3 (see **Figure 2**).

Literature Cited

Anwar, A. 2001. Does the Age of a Tree Effect Carbon Storage? National Aeronautic and Space Administration, Goddard Institute for Space Studies, Institute on Climate and Planets. Available at: https://icp.giss.nasa.gov/research/ppa/2001/anwar/

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Pugh, T. A., M. M. Lindeskog, B. Smith, B. Poultere, A. Arneth, V. Haverd, and L. Calle. 2019. Role of forest regrowth in global carbon sink dynamics. Proceedings of the National Academy of Sciences March 5, 2019 116 (10) 4382-4387; https://doi.org/10.1073/pnas.1810512116

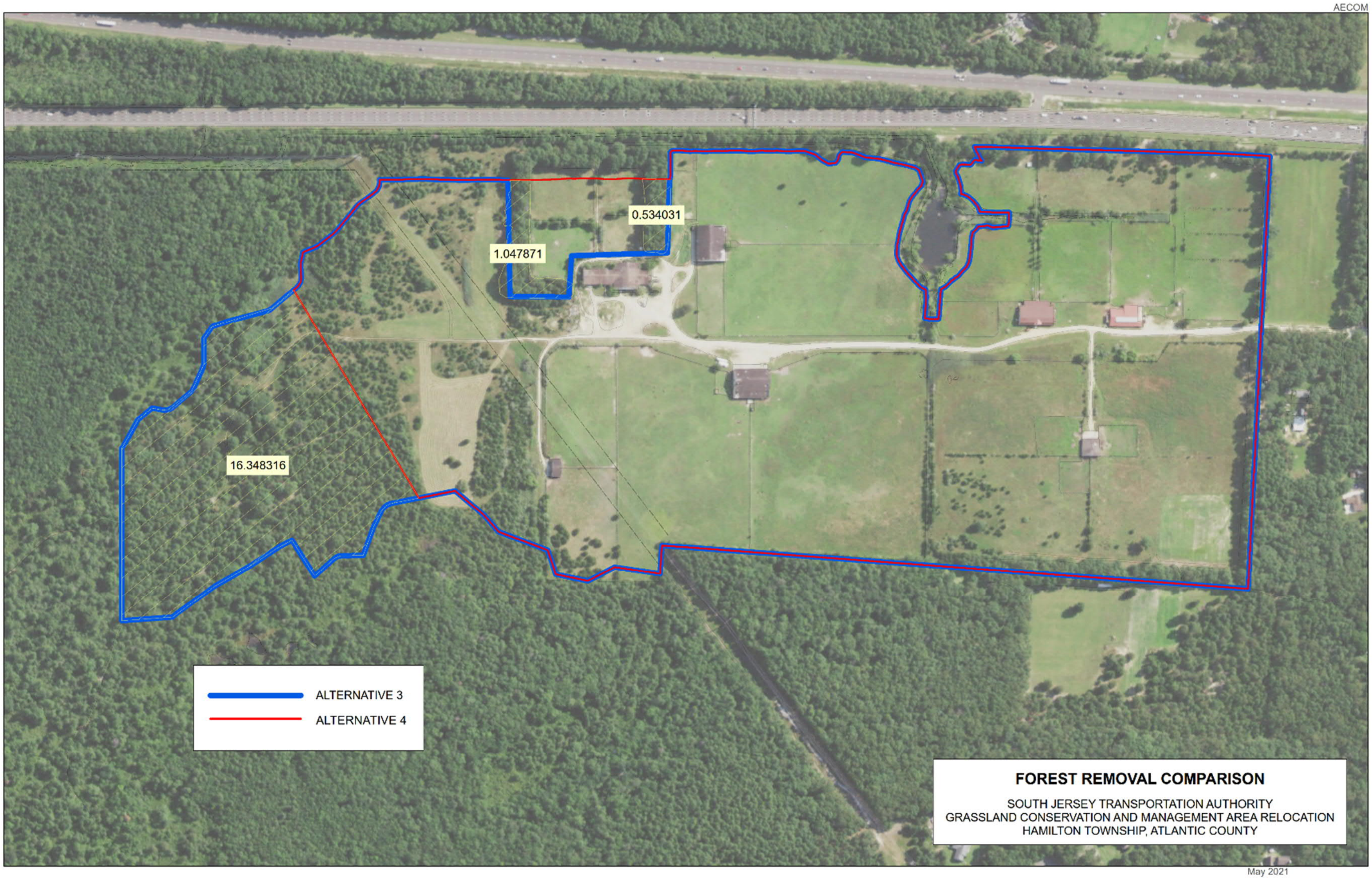

Figure 2: Forest Removal Acreage Comparison for Alternatives 3 and 4