"Wind Fence Proposal No. WSS1089" (15 November 2019) by WeatherSolve Structures

Review by members of the Oceano Dunes Scientific Advisory Group (SAG).
Prepared 8 March 2020, Revised 20 July 2020.

WeatherSolve Structures (WSS) proposes to build a wind fence to mitigate particulate airborne dust at Oceano Dunes State Vehicular Recreation Area (ODSVRA). As shown in a series of examples presented on p. 23-36 of the proposal, wind fences can be effective at mitigating dust emissions when they are placed immediately upwind of a potentially emissive surface. The wind fence works by creating a shelter zone immediately downwind of the porous barrier within which turbulence and shearing stresses responsible for dust emissions are reduced. This zone is thought to extend downwind 10-12 times the height of the fence (p. 3 of proposal) and follows the extensive wind barrier literature that has developed over the past 75 plus years. For the proposed 30-foot fence height (p. 6 of proposal), a substantial reduction in wind speed, sand transport and dust emissions under ideal performance conditions could be expected only within a distance of approximately 360 feet (about 100 meters) downwind of the proposed fence line. As a result of the relatively short downwind area of protection, multiple parallel fences or tree lines, spaced at approximately 10 times the barrier height, are often used to extend the downwind control length. Multiple barriers of this type and the resultant wind flow patterns and the resultant downwind surface shear stress have been studied a great deal through empirical field testing and detailed wind tunnel studies throughout the world

The SAG discussed this proposal at a team meeting in February 2020 and the following comments focus solely on assessing the potential of the proposed wind fence to mitigate particulate airborne dust at ODSVRA. Any review of the considerable and various logistical considerations for installing such a fence in a dynamic beach-dune environment is beyond the scope of SAG review.

The opinion of the SAG is that the proposed wind fence would be completely ineffective at reducing airborne particulate dust generated within ODSVRA. As shown on p. 37 and p. 39 of the WSS proposal, the wind fence would be installed on the downwind edge of the ODSVRA. Thus, the vast majority of emissive surfaces within ODSVRA would experience no change in surface wind speed or shearing stress and, thus, no change in particulate dust emissions. Fundamentally, solving a dust emissions problem with a wind fence or other sheltering barrier (e.g., hedgerows, tree lines) requires that the barrier be placed upwind of the emissive surface. Wind fences are typically not designed to 'catch' emitted particulates from the incoming wind. Because emitted particulate dust is quickly lofted airborne far above the ground, only a negligible fraction of upwind airborne dust would be caught and settled out by the proposed downwind porous wind fence, particularly given the size of the holes in the mesh (74 times greater than a PM_{10} particle), its limited height of only 30 feet, and the complexity of the dune terrain. Though it is possible that some dust emission would be inhibited immediately downwind of the proposed wind fence, the affected area downwind of the fence (pg. 37) has lower dust emissions relative to the majority of the ODSVRA land surface upwind of the proposed fence. Theoretically, the wind fence could be situated close to the shoreline to shelter more emissive regions but, logistical

considerations aside, such an installation would shelter only a narrow swath of the overall ODSVRA from potential dust emissions. Distances to the end of the sand sheet from near the shoreline can exceed 2.8 km, which would leave most of the sand sheet area unprotected by the downwind shelter offered by a single length of the WeatherSolve fence. Similar to the sand fence arrays deployed to reduce coarser sand transport (saltation), multiple lines of wind fencing would need to be emplaced across vast expanses of the dune surfaces for this technology to become effective. The costs to install and maintain such an array of wind fencing would be immense and probably prohibitive, given the costs presented in the proposal. An additional and very important limitation of this type of fence, as described in the proposal, is that it is designed to release the mesh during high wind events (pg. 4), which is when dust emissions on the dunes are typically of greatest concern, further reducing any effectiveness in modulating sand transport and dust emissions.

Therefore, it is the recommendation of the SAG that Parks reject the wind fence proposal submitted by WeatherSolve Structures. This recommendation is not an outright dismissal of the effectiveness of wind fences that, if properly deployed, can be effective at mitigating emissions from concentrated dust sources. Instead, our recommendation is based on the recognition that the use of such a wind fence, as proposed, will be ineffective for addressing the nature and geography of diffuse particulate dust emissions experienced within the ODSVRA.