

WINDBLOWN SAND RESOURCES IN THE HAZEN EAST QUADRANGLE

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INTRODUCTION

Windblown sand resources in the Hazen East Quadrangle are characterized in this geomorphologically based geologic resource investigation. Recent sampling and testing of windblown sand deposits in this area (Anderson, 2019) has demonstrated that sand found in dune deposits exhibit properties that are suitable for use as proppant in the hydraulic fracturing of oil wells in the Williston Basin of North Dakota based on current industry requirements.

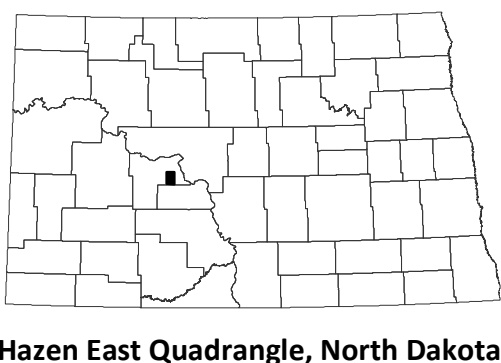
DUNE DEPOSIT MAPPING

The dune deposits depicted on this map were identified and mapped from Light Detection and Ranging (LiDAR) elevation data overlain with National Agricultural Imagery Program images from 2016. The Hazen dune deposits were delineated by mapping the topographic boundary between areas of generally flat topography that surround the high-relief dunes that occurs as a relatively large (2,324 acres) dune field.

RESOURCE ESTIMATION METHODOLOGY

The topographic data for the deposits (Figure 1) was volumetrically modeled as extracted from the overall LiDAR data set. Resource volumes were calculated in selected intervals, beginning from the topographic bottom of the deposit. Based on this resource modeling the high-dune areas are estimated to contain nearly 67 million tons of windblown sand. Most of the deposit is concentrated within the 10 to 15 yard intervals. These areas contain the greatest volume of sand per acre and are likely to be the most suitable areas for sand production.

This map with detailed resource breakdowns by modeled elevations enables more accurate determinations of potential resource volumes at larger map scales.



Hazen East Quadrangle, North Dakota

PROPPANT SAND CHARACTERISTICS

Testing for proppant potential has revealed that the windblown sands found throughout this area are well sorted, medium to very-fine grained, quartz dominated sand with crush-resistance values ranging from 4,000 to 6,000 psi (4K to 6K) in washed samples sized in the 70/140 and 50/140 sand size classes, respectively. Acid solubilities are low (<6%) as these windblown sands are found to be generally devoid of carbonates. Particle shape factors are consistent with values of a pproximately 0.5 and 0.7 for grain roundness and sphericity (Anderson, 2019).

DUNE GEOMORPHOLOGY AND GROUNDWATER CONDITIONS

Maximum relief is found within the central portions of the dune field with relief up to 93 ft (28.3 m). Groundwater is shallow throughout this area commonly occurring at depths ranging from five to ten feet (1.5 to 3 m) below land surface outside of the high-relief dunes.

REFERENCES

Anderson, F.J., 2019, The potential of the Hazen-Stanton Dunes for use as Natural Sand Proppant: North Dakota Geological Survey, Geologic Investigation No. 216, 15 p.

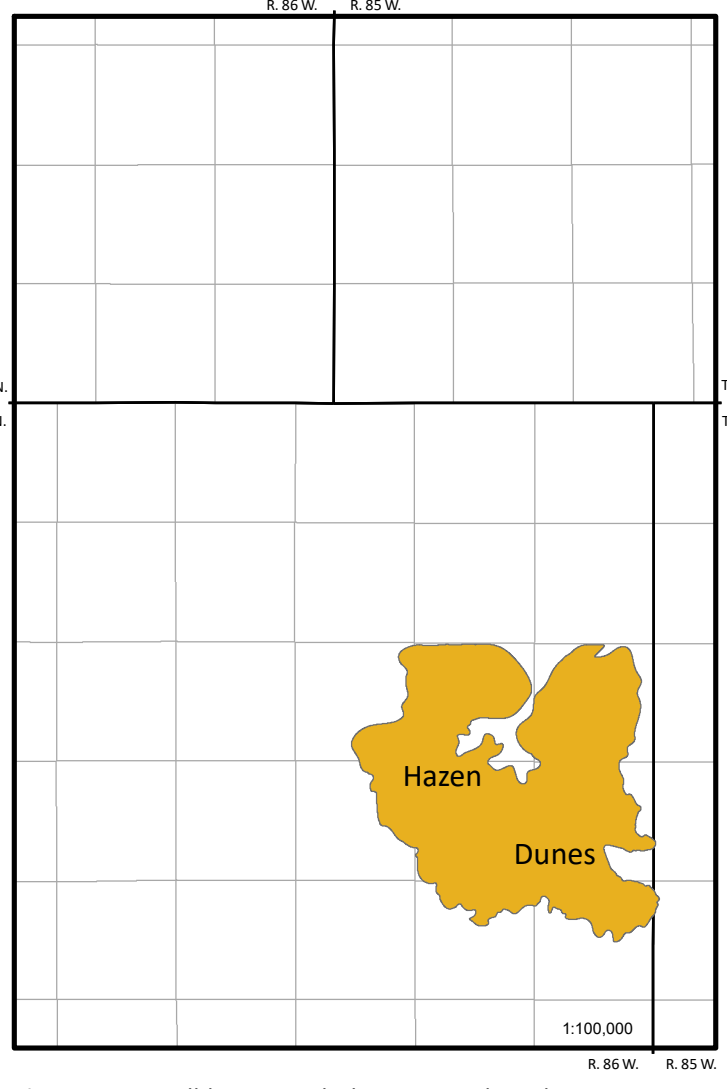
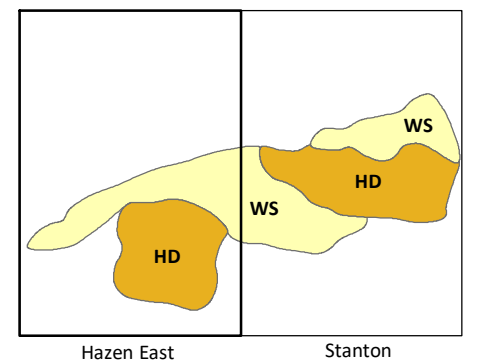
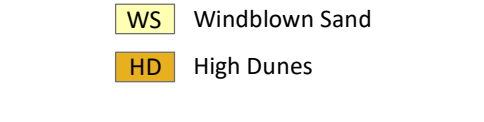


Figure 1. Windblown sand deposits within the Hazen East Quadrangle.

Table 1. LiDAR-based volume and tonnage estimates for windblown sand deposits in the Hazen East Quadrangle. Volume and tonnage estimates are shown for the entire deposit along with the thickness interval (e.g. 10–15 yd).

| Area | | Volume | | Resources | | Deposit Volume (yd ³) | | | | | Deposit Mass (tons) | | | | | | |
|----------------|-------|----------------|-----------------|------------|---------|-----------------------------------|------------|------------|------------|-----------|---------------------|-----------|------------|------------|------------|-----------|-------|
| m ² | acres | m ³ | yd ³ | tons | | 0–1 | 1–4 | 4–7 | 7–10 | 10–15 | 15–24 | 0–1 | 1–4 | 4–7 | 7–10 | 10–15 | 15–24 |
| 9,405,825 | 2,324 | 42,679,657 | 55,822,883 | 67,062,331 | 504,830 | 7,324,541 | 10,806,098 | 12,360,517 | 17,637,385 | 7,189,512 | 592,845 | 8,601,537 | 12,690,085 | 14,515,509 | 20,712,371 | 8,442,966 | |



Adjacent 24K Quadrangles