



Night Values

Prepared for: South Bend Department of Parks and Recreation

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Sites: Rum Village Park and Elbel Park

INTRODUCTION

Purpose

In response to public input about the value of city parks, the South Bend Department of Parks and Recreation initiated an assessment of existing natural resources. Part of the dialogue in community meetings pertained to the night sky as an asset to be recognized, measured, and preserved. Darkness is requisite for the well-being of humans and the natural kingdom alike, but to know what is at risk of being lost, one must quantify what already exists. The South Bend Department of Parks & Recreation requested this survey of the night sky at Rum Village Park and at Elbel Park.

Quantifying Darkness

When one quantifies the darkness of the night sky with a meter, a detector counts incoming photons and displays the result in units of magnitudes per square arcsecond. Those photons come from the combined sources of natural light (like the moon, stars, gegenschein) and artificial light (like sky glow). The intention is to measure the combined light and suggest how much is attributable to unnatural sources—manmade light pollution—above and beyond the natural night sky brightness.

For an accurate assessment, meter readings should be taken when the sky is clear, for even thin clouds reflect artificial lights back down. Additionally, readings should be taken after astronomical twilight, when the sun is greater than 18 degrees below the horizon and not contributing light to the night sky. On the night of June 2-3, 2016, when this survey occurred, the sky was clear, astronomical twilight ended at 11:21 p.m. EDT, and the nearly-new moon had set.

This survey employed two objective and one subjective means of judging the night sky. First, a Sky Quality Meter (SQM) from Unihedron detects photons funneling into a sensor. Aim the meter overhead, press a button, wait briefly, and the meter displays brightness in magnitudes per square arcsecond. The unit, which is logarithmic, suggests you have a star of the given number's magnitude across every square arcsecond of sky. The natural sky is greater than 21 magnitudes per square arcsecond. For comparison, an urban sky may be 17 magnitudes per square arcsecond, as suggested during a power outage in South Bend (<http://www.nightwise.org/#!/Power-Outage-Darkness/c17jj/300319E9-BCA6-48A6-ACE1-4C6AFAD5D818>). The SQM used in this survey is model number 1.16, serial number 0733.

Another means of judging the night sky is a Dark Sky Meter (DSM) app for iPhones (www.darkskymeter.com). You hold the camera against your body and press one button which establishes the baseline for total blackness. Then you aim the phone's camera skyward and press a second button, triggering the photon count by the light-sensing

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camera. It displays a value, again in magnitudes per square arcsecond. You have the option of submitting the value with your phone's location to a website that plots your data on a global map.

The subjective test is a visual estimation of faintest stars visible, in concert with the Globe at Night program (<http://www.globeatnight.org>). An observer compares the backyard view of a given constellation to sky charts with given limiting magnitudes, often in whole numbers. From May 29 to June 7, 2016, Globe at Night uses the constellation Boötes as its prime constellation, for the constellation is high above the horizon on the front end of the night around the new moon. For greater accuracy, this report notes which stars are visible in a starfield and compares the observed stars to a star chart to discern limiting magnitude in less than whole numbers.

The limiting magnitude—a measure of the faintest stars visible—suggests how much brighter the actual night sky is compared to the ideal night sky of mag=6. In practice, skilled observers can see beyond sixth magnitude objects. To correlate magnitudes per square arcsecond to a limiting magnitude, use the conversion calculator at <http://www.unihedron.com/projects/darksky/NELM2BCalc.html>. Each drop in magnitude is equivalent to a logarithmic increase in light pollution, as indicated by the graphic at <http://www.lettherebenight.com/brighter.jpg>.

Disclaimers

This assessment is conducted and reported by Chuck Bueter, an amateur astronomer in St. Joseph County, Indiana. Bueter is an advocate for dark skies, and has been observing and casually measuring the quality of night for many years. His website www.nightwise.org features blog posts and events relevant to preserving the night sky. He is the Past-President of Michiana Astronomical Society Inc. Bueter was an active member of the working group for Dark Skies Awareness, a Cornerstone Project of the 2009 International Year of Astronomy. He was recognized by the International Dark-Sky Association with its Executive Director's Award in that same year. In one community project, www.LetThereBeNight.com, Bueter coordinated 3,400 students who contributed observations to the Globe at Night campaign in St. Joseph County. That said, Bueter is not a lighting expert or licensed light technician. Astronomy is an avocation, and this survey is a voluntary tally of the night made at the request of the South Bend Department of Parks and Recreation.

The high value and low value from a run of about ten meter readings are both dropped. The average meter readings are simply the sum of the numbers divided by the number of readings taken, with no statistical analysis.

The subjective observations of stars within the constellation Boötes are carefully recorded, but specific to Bueter's eyes. For limiting values, the gap between discernible and not discernible is restricted to stars within Boötes. This gap could have been reduced by including more stars beyond Boötes' boundary.

SQM and DSM values consistently differ slightly. Some people consider the SQM, being a dedicated light meter, to be more accurate than the DSM phone app.

RUM VILLAGE

Site

Rum Village Park is a heavily wooded area encircled by a road with trails and shelters. The best site where trees would not impinge on the meter readings was a parking lot on the northeast side of the park. Parking lot lights were far enough away not to fall significantly into the detection cone of the SQM.

Sky Quality Meter (SQM)

Of 9 measurements from around 11:10 p.m. EDT, the average SQM reading was 18.89 magnitudes per square arcsecond. A second run of 6 readings after astronomical twilight yielded an average value of **18.93**. The corresponding limiting magnitude is **mag=4.7**.

Dark Sky Meter (DSM)

Of 9 measurements from around 11:22 p.m. EDT, the average DSM reading was **18.79** magnitudes per square arcsecond. The corresponding limiting magnitude is **mag=4.6**.

Globe at Night

The fainter stars visible in Boötes were Pi1 Boötis at mag=4.86; 20 Boötis at mag=4.84, and 34 Boötis at mag=4.80. Not visible were 50 Boötis at mag=5.38 and HR5741 at mag=5.44, suggesting a limiting magnitude of at least **mag>4.86**.

Existing Lights

On the night of June 2, 2016, predominant artificial lights included cobra-head parking lot lights and exposed lights at some shelters and out-buildings. The Rum Village Nature Center was illuminated with shielded, downward-pointed lights that created wall wash but no direct glare.

Comments

Specific changes to the lighting scheme are beyond the scope of this assessment and would require follow-up with the Parks and Recreation Department. However, general recommendations would be to improve the lighting on outbuildings and, when making upgrades to parking lot lights, to install fully shielded LED lights rated at or below 3000K.

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ELBEL

Site

Elbel Park includes a golf course located northwest of the South Bend city limits. Because of the bright lights in the parking lot, observations were made just short of the 250 yard marker in the driving range, north and down the slope.

Sky Quality Meter (SQM)

Of 13 measurements from around 12:35 a.m. EDT, the average SQM reading was **20.15** magnitudes per square arc-second. The corresponding limiting magnitude is **mag=5.6**.

Dark Sky Meter (DSM)

Of 13 measurements from around 12:48 a.m. EDT, the average DSM reading was **19.69** magnitudes per square arcsecond. The corresponding limiting magnitude is **mag=5.3**.

Globe at Night

The fainter stars visible in Boötes were e Boötis at mag=4.90, 34 Boötis at mag=4.8; A Boötis at mag=4.8. Not visible were 50 Boötis at mag=5.38 and HR5741 at mag=5.44, suggesting a limiting magnitude of at least **mag>4.90**.

Existing Lights

On the night of June 2-3, 2016, predominant artificial lights included two harsh cobra-head parking lot lights (a third was apparently burned out), a couple exposed lights at the Clubhouse, and wall-wash lights under a breezeway.

Comments

Specific changes to the lighting scheme are beyond the scope of this assessment and would require follow-up with the Parks and Recreation Department. However, general recommendations would be to improve the lighting (including timers, dimmers, and motion-sensors) around the golf center and, when making upgrades to parking lot lights, to install fully shielded LED lights rated at or below 3000K.

CONCLUSION

Darkness has evolutionary value for the well-being of humans and the natural kingdom. In order to understand what is at risk of being lost, one needs to know the condition of the night sky now. To assess the quality of the night sky at Rum Village Park and at Elbel Park, Chuck Bueter used a Sky Quality Meter (SQM), a Dark Sky Meter (DSM) app, and a naked-eye judgment of visible stars.

At Rum Village Park, the average SQM reading of 18.93 magnitudes per square arcsecond suggests a limiting magnitude of **mag=4.7**. The average DSM reading of 18.79 magnitudes per square arcsecond suggests a limiting magnitude of **mag=4.6**. The naked eye assessment suggests a limiting value of **mag>4.86**.

At Elbel Park, the average SQM reading of 20.15 magnitudes per square arcsecond suggests a limiting magnitude of **mag=5.6**. The average DSM reading of 19.69 magnitudes per square arcsecond suggests a limiting magnitude of **mag=5.3**. The naked eye assessment suggests a limiting value of **mag>4.90**.

The City of South Bend Department of Parks and Recreation can lessen its impact on the nighttime environment by using lights only where necessary; by striving to minimize glare, light trespass, and sky glow; and by installing high-efficiency fixtures that are not blue-rich, such as LEDs rated 3000K or less. Bueter will meet to make specific recommendations to the Department of Parks and Recreation upon request.

Additional images from the Rum Village and Elbel Parks and copies of the original data are available upon request.