AECOM

Air Quality Dispersion Modeling Report in Support of the Application for a Prevention of Significant Deterioration (PSD) Authorization and Significant Revision to Class I Air Quality Permit for Irvington Generating Station

Revision 2

Tucson Electric Power Company

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Quality information

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Appendix B: Technical and Policy Justification for Plume Merging: Tucson Electric Power's IGS RICE Project

Appendix C: Tucson Electric Power Company (Sundt) Generating Station: PLUVUE II Assessment of Visible Plumes at Saguaro National Park East and West

1. Introduction

1.1 Project Overview

The Tucson Electric Power Company ("TEP") owns and operates the Irvington Generating Station ("IGS"), also known as the H. Wilson Sundt Generating Station, pursuant to Class I Air Quality Permit No. 1052 issued by the Pima County Dept. of Environmental Quality ("PDEQ"). The facility currently comprises six electric generating units with a combined, nominal, net generating capacity of 470 megawatts ("MW").

TEP is requesting a revision to the Class I permit for the IGS, an authorization pursuant to the preconstruction Prevention of Significant Deterioration ("PSD") permitting regulations to expand the IGS, and an approval of construction of new affected sources under federal National Emissions Standards for Hazardous Air Pollutants ("NESHAP"). As part of the proposed expansion project, TEP proposes to install up to ten natural gas-fired, reciprocating internal combustion engines ("RICE"), each with a nominal net generating capacity of 19 MW. In conjunction with the RICE project, TEP will permanently cease operation of Units 1 and 2 at IGS, leaving the facility with a nominal, net generating capacity of 498 MW.

The proposed RICE project will modernize and expand the IGS by replacing two 1950's era electric utility steam generating units (IGS Unit 1 and 2) with ten high-efficiency, fast-responding, state-of-the-art RICE, each having a generating capacity of 19 MW (nominal). TEP's basic purpose and fundamental objective for the RICE project is to meet a critical need in its resource portfolio: Reliable, efficient, grid-balancing resources which can ramp up quickly and provide 100 percent of their ELCC during multiple peak periods of any length. In conjunction with ESS projects and other efforts described in the 2017 IRP, the RICE project will support the integration of renewable resources, consistent with TEP's 30 percent target by 2030. Tangential benefits of the proposed RICE project include anticipated reductions in the capacity factors of the less-efficient steam generating units at IGS and improved overall environmental performance, including decreased water usage and wastewater discharge.

The dispersion modeling analyses conducted for the RICE project adhere to the United States Environmental Protection Agency (EPA) "Revisions to the Guideline on Air Quality Models" (GAQM, which is contained in 40 CFR Part 51, Appendix W)[1], direction received from the Pima County Department of Environmental Quality (PDEQ) and local Pima County air quality guidance[2], with the revised air dispersion modeling protocol submitted to PDEQ on December 22, 2017, and with further guidance from EPA Region 9 and the National Park Service.

1.2 Purpose of Modeling Report

The purpose of this document is to present the air dispersion modeling analyses that were performed in support of the air permit application for the RICE project. Modeling methods and assumptions,

[1] 82 FR 5182. https://www.federalregister.gov/documents/2017/01/17/2016-31747/revisions-to-the-guideline-on-air-quality-models-enhancements-to-the-aermod-dispersion-modeling .
[2] PCC § 17.16.590(A)(6). https://library.municode.com/az/pima_county/codes/code_of_ordinances.

including model selection and options, meteorological data and source parameters used in the modeling analyses, are presented in this document for review and approval by PDEQ.

1.3 Contents of the Modeling Report

Section 2 of this report contains a project description, including information regarding the equipment, location and the expected air pollutant emissions. Sections 3 through 5 present a detailed description of the modeling approach used in evaluating air quality impacts of the proposed RICE project including preconstruction ambient air quality, model selection criteria, good engineering practice stack height determination, refined modeling analyses, ambient air quality compliance, and additional impacts analyses.

2. Project Description

2.1 Project Location and Layout

As previously stated, the proposed RICE project will be constructed at the existing IGS located in Tucson, Arizona, approximately 2 miles northeast of Tucson International Airport. The coordinates of the IGS are 509,448.00 meters Easting, 3,557,910.00 meters Northing in Universal Transverse Mercator (UTM) Zone 12 referenced to NAD 83. An aerial map of the site region is provided in **Figure 2-1**. This figure shows the project location, which is located only about 450 meters from existing units at the plant.

The terrain surrounding IGS is generally flat within 10 kilometers before the landscape changes with the addition of rolling hills, rugged canyons and mountain peaks. **Figure 2-2** shows the varying elevations associated with these features near IGS.

2.2 Description of the Proposed Engines

The proposed modification at IGS includes the installation of ten RICEs, each with a nominal net generating capacity of 19 MW. These engines will only be fired with natural gas. The ten engines will be grouped into two sets of five engines as shown in Figure 2-3. The five stacks from each group were modeled as two sets of merged stacks; one merged stack that combines 3 RICE stacks with a separation less than one stack diameter from each other, and a second merged stack that combines the remaining 2 RICE stacks (with a separation less than one stack diameter; as depicted in **Figure 2-4**) in the group of 5 RICEs. This method is consistent with EPA Model Clearinghouse Memo 91-II-01[3], creating the appearance of four new stacks at IGS. In consultation with the reviewing agencies, EPA Region 9 has granted TEP approval to use this configuration of 3-and-2 stacks for each group of 5 stacks in the model (Appendix A of this modeling report) as the stacks being merged are separated by a distance that is less than their diameter. Further justification supporting this more accurate characterization of the sources is provided in Appendix B of this modeling report.

Each of the ten RICE installed at IGS will be equipped with two air pollution control devices:

- An oxidation catalyst system to control emissions of volatile organic compounds ("VOC"), carbon monoxide (CO), and organic hazardous air pollutants such as formaldehyde; and,
- A selective catalytic reduction ("SCR") system to control emissions of nitrogen oxides (NO_X). Aqueous ammonia will be injected upstream of the SCR catalyst module to act as a reductant.

[3] Available at: https://cfpub.epa.gov/oarweb/MCHISRS/index.cfm?fuseaction=main.resultdetails&recnum=91-II%20%20-01.

Figure 2-1 Aerial Image of the Irvington Generating Station

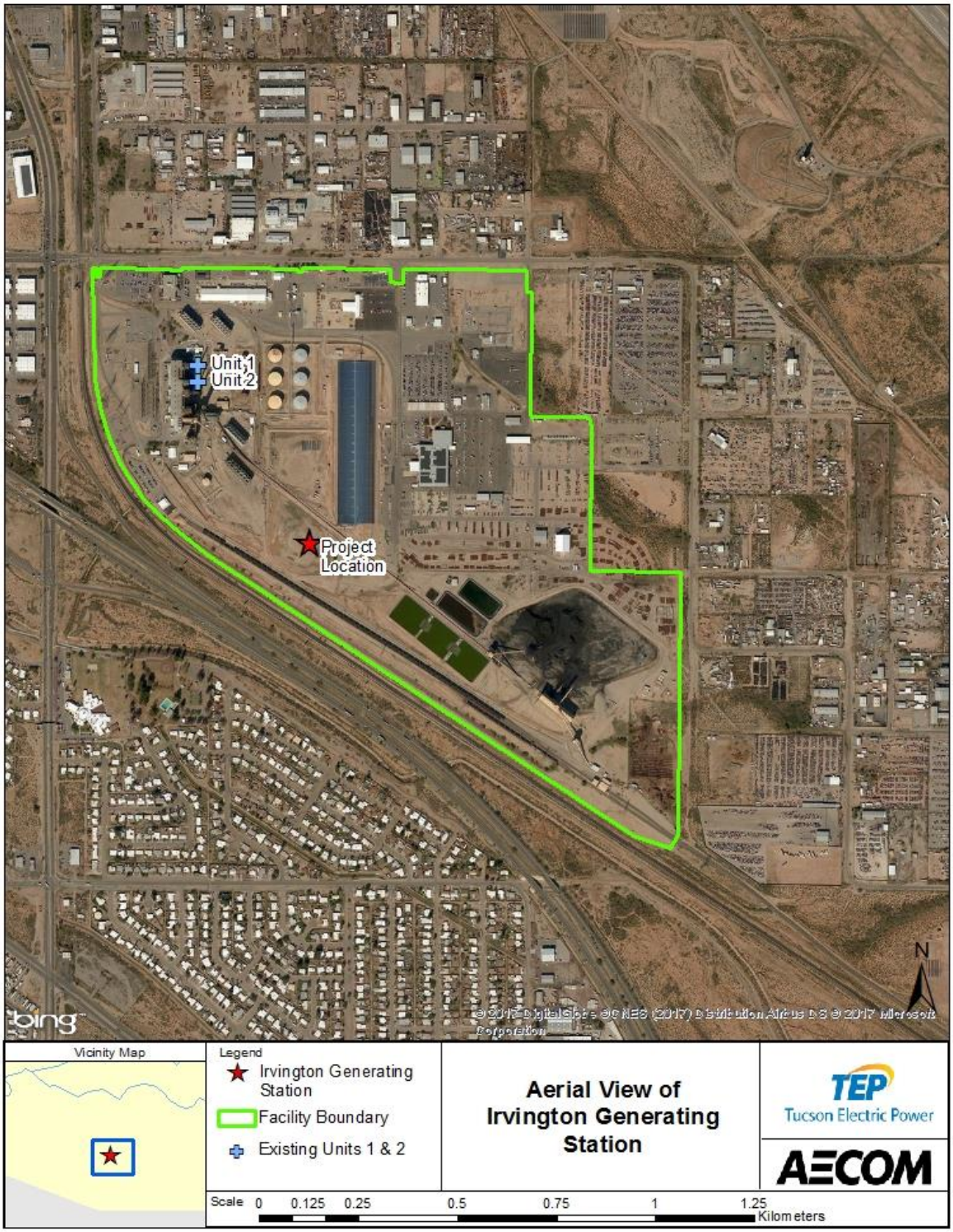


Figure 2-2 Topographic Map Showing Terrain Features Surrounding the Irvington Generating Station

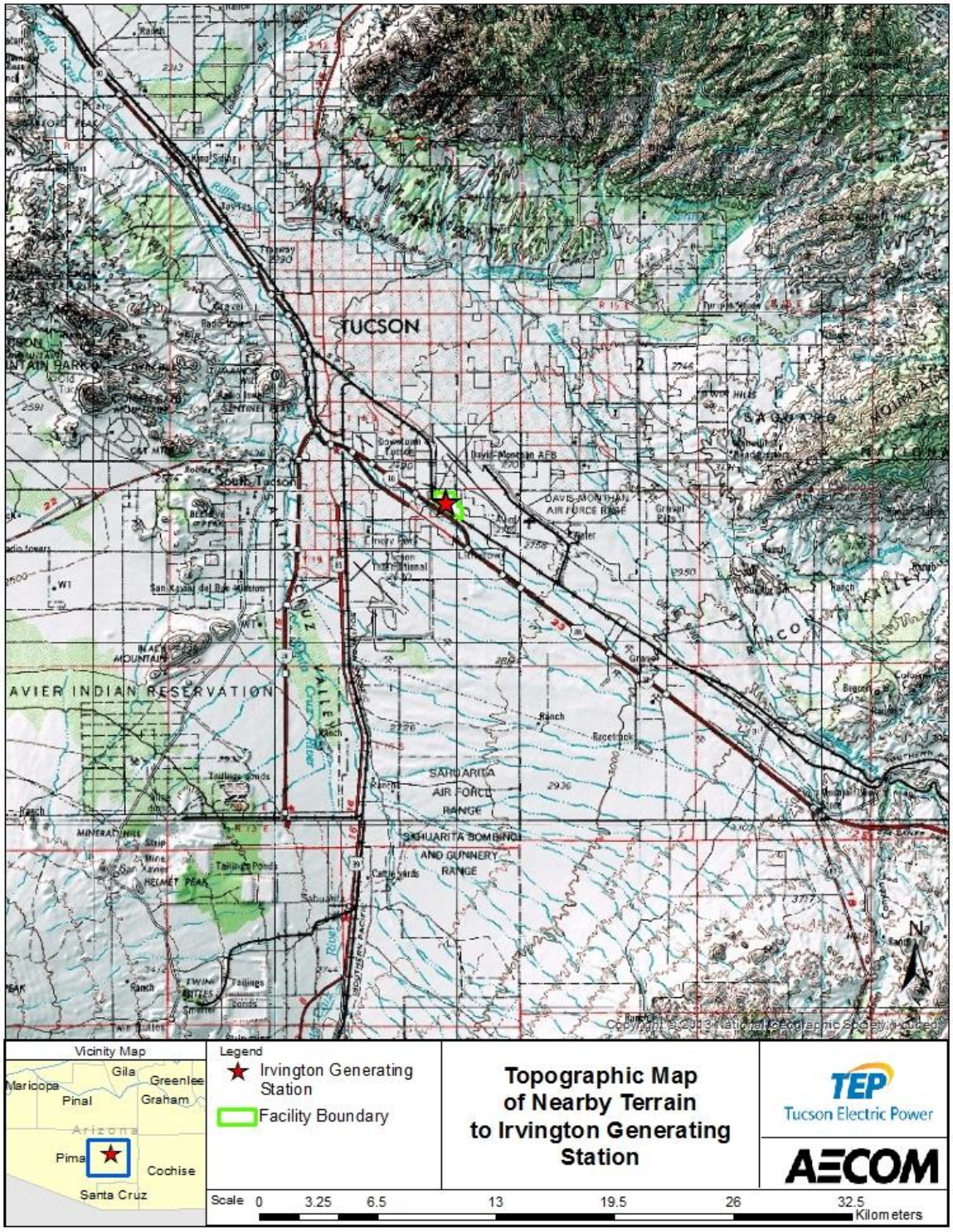


Figure 2-3 Proposed Project Layout in the Vicinity of the RICEs

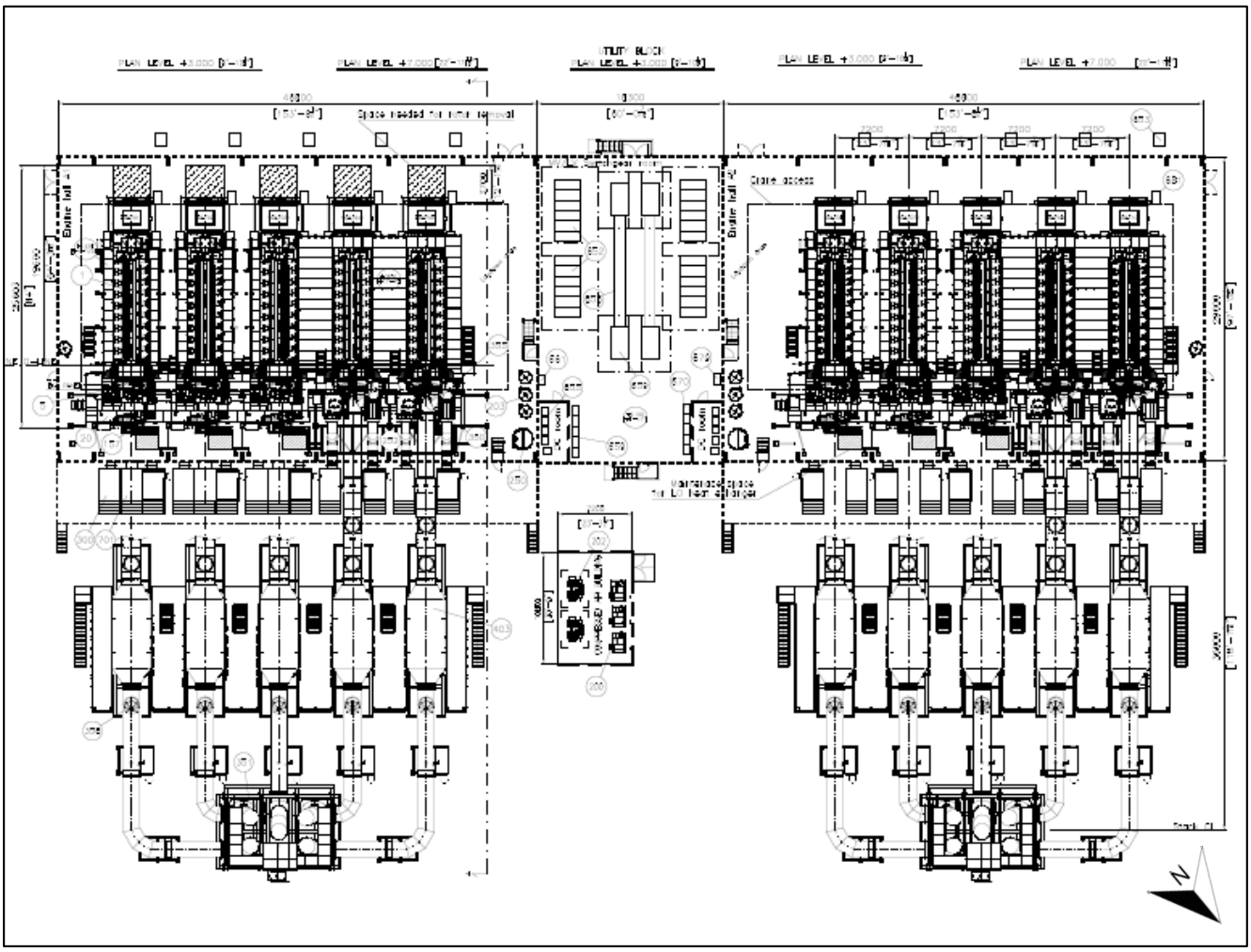
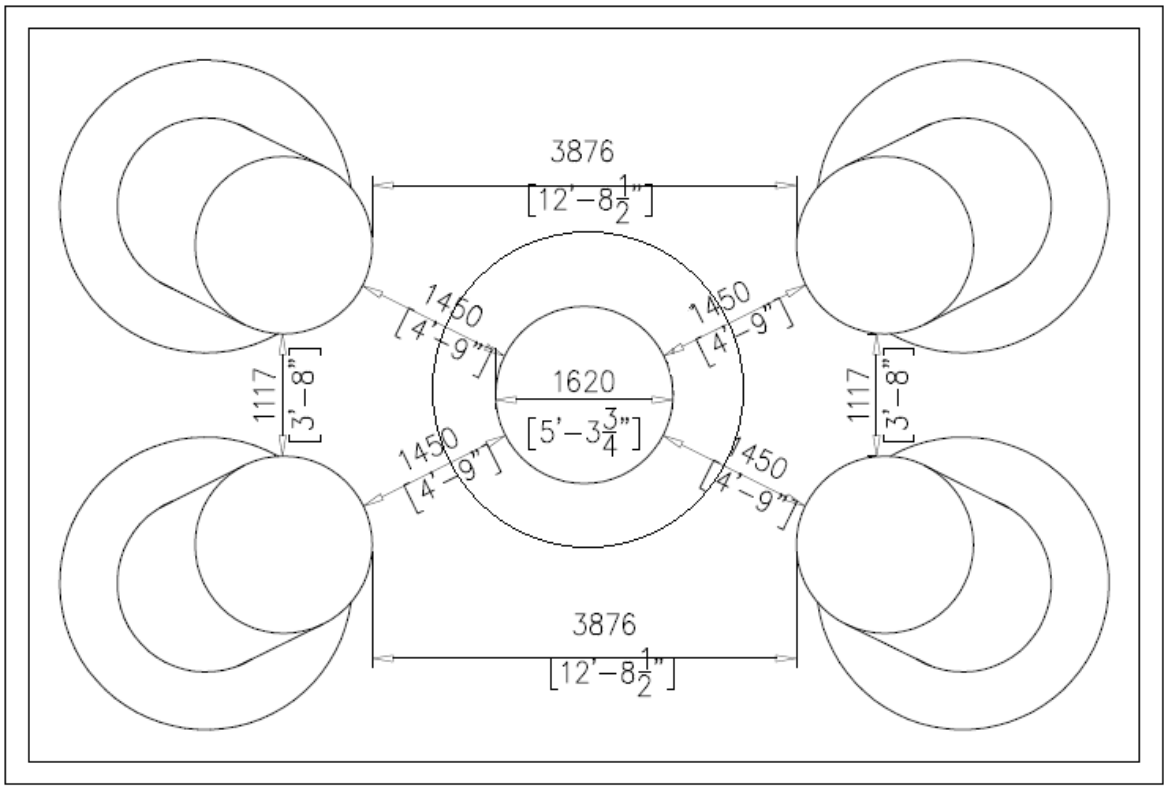


Figure 2-4 Drawing of RICE Stack Configuration with Dimensions



Note: Exterior stack diameter value provided in drawing. The interior flue diameter is 5.25'.

2.3 PSD Applicability

IGS is considered a fossil fuel-fired steam electric plant (one of the "major source categories" identified in section 169 of the Clean Air Act), and is therefore subject to the Prevention of Significant Deterioration (PSD) permitting requirements. The area around IGS is currently designated as attainment or unclassifiable for all criteria pollutants[4]. The expected annual emissions increases from the proposed engines were compared to the PSD significant levels in **Table 2-1** to determine the PSD applicability. The RICE project at IGS will constitute a major modification at IGS and has the potential to increase emissions by more than 100 tons per year of carbon monoxide (CO), 15 tons PM_{10}, 10 tons of $PM_{2.5}$, and 40 tons of volatile organic compounds (VOC). In addition, the project will exceed the PSD threshold for Greenhouse Gas (GHG). The Project will not exceed PSD thresholds for NO_x, SO_2, or Lead. Based on this review, CO, VOC, PM_{10} and $PM_{2.5}$ will trigger dispersion modeling requirements.

Table 2-1 PSD Significant Emission Rate Thresholds

Pollutant	PSD Threshold Emission Rates (tons/year)
Carbon monoxide (CO)	100
Nitrogen oxides (NO_x)	40
Sulfur dioxide (SO_2)	40
Particulate matter (PM)	25
Particulate matter (PM_{10})	15
Particulate matter ($PM_{2.5}$)	10
Volatile Organic Compounds (VOC)	40

[4] 40 CFR § 81.303. https://www.gpo.gov/fdsys/granule/CFR-2012-title40-vol18/CFR-2012-title40-vol18-sec81-303.

3. Background Air Quality and Pre-Construction Monitoring

3.1 Pre-construction Monitoring Requirements

In accordance with pre-construction monitoring requirements (40 CFR 52.21(m)), an application for a PSD permit must contain an analysis of ambient air quality in the vicinity of the proposed Project for each pollutant subject to PSD review. The definition of existing air quality can be satisfied by air measurements from either a state-operated or private network, or by a pre-construction monitoring program that is specifically designed to collect data in the vicinity of the proposed source. A source can fulfill the pre-construction monitoring requirement for PSD without conducting on-site monitoring if data collected from existing monitoring sites are conservatively representative of the air quality in the vicinity of the proposed Project site.

The existing monitoring data must be determined by the reviewing authority to be representative of air quality for the area in which the proposed project would be constructed and operated. In determining whether ambient monitoring data can be considered representative for satisfying the PSD pre-construction monitoring requirement for a project, the EPA guidance in "*Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD)*" (EPA-450/4-87-007, May 1987) was reviewed. The PSD ambient monitoring guidelines note three major items which need to be considered in determining the representativeness of existing data: 1) ambient monitor location, 2) quality of the data, and 3) temporal representativeness (how current the data is). These three criteria are discussed below.

Figure 3-1 shows the locations of these monitors relative to the Project site. The CO/ozone monitor at 22nd and Craycroft is approximately 5 kilometers northeast of IGS. The South Tucson PM10 monitor is located approximately 6 kilometers northwest of IGS and the Children's Park PM2.5 monitor is located approximately 15 kilometers north-northwest of IGS. These monitors are well situated such that emissions from IGS and other sources in the downtown Tucson area would impact these monitors based on the wind rose in **Figure 4-1**.

EPA maintains data capture statistics for all monitors in their design value tables[5]. Data capture for CO is 99%, O3 is 100%, PM10 is 96% and PM2.5 is 90%. These monitors meet the 75% data capture requirements set by EPA for the most recent three-year period available (2014-2016).

For temporal representativeness, it is desirable that the data generally have been collected for the most recent one-year period preceding a PSD permit application. However, in some cases, older ambient monitoring data could be considered conservative for representative background purposes if there have not been substantial changes in the operations of existing sources in the area and no new sources have been permitted in the interim. In fact, it is more likely that emissions have been retired, and the older monitoring data overstates the pollutant concentration levels. This is likely to be the case since various new air pollution control programs, such as the reduction in particulate emissions from diesel vehicles, have been implemented in the interim period between data collection and submittal of the permit application.

[5] https://www.epa.gov/air-trends/air-quality-design-values#report

Table 3-1 provides a summary of the most recent 3-year period (2014-2016) ambient background design values.

Table 3-1 Background Design Values for TEP Project Site

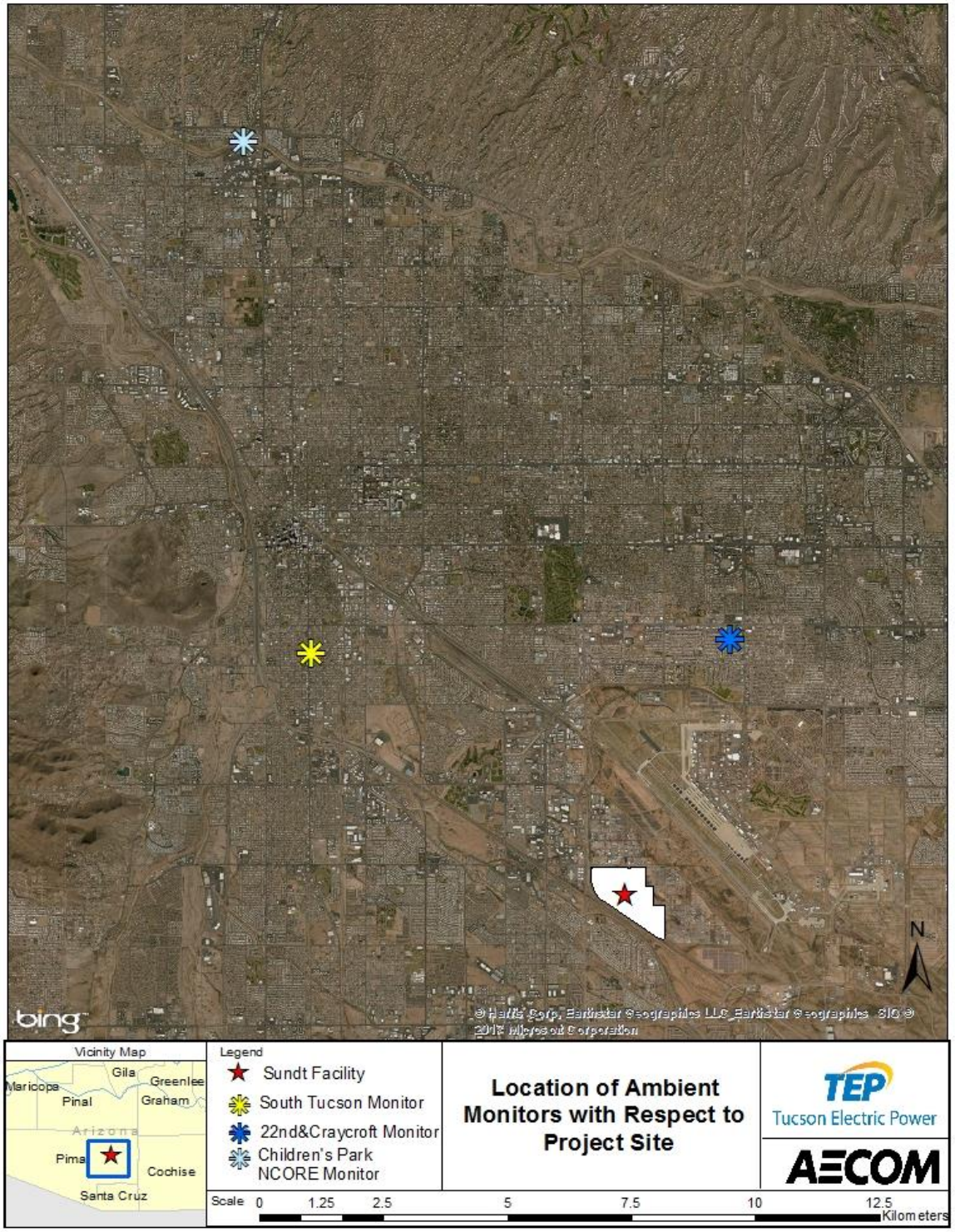
Pollutant	Monitor Location	Avg. Period	Design Value[1]	SIL	NAAQS	Units
CO	22nd & Craycroft	1-hr	1.2	1.75[2]	35	ppm
CO	22nd & Craycroft	8-hr	0.7	0.44[2]	9	ppm
O_3	22nd & Craycroft	8-hr	0.062	0.001[4]	0.070	ppm
PM_{10}	South Tucson	24-hr	101	5.0[2]	150	µg/m³
$PM_{2.5}$	Children's Park NCORE	24-hr	11	1.2[3]	35	µg/m³
		Annual	5.1	0.3[3]	12	

[1] *Design Values based on 2014-2016 period.*
[2] *40 CFR 51.165(b)(2).https://www.gpo.gov/fdsys/pkg/CFR-2011-title40-vol2/pdf/CFR-2011-title40-vol2-sec51-165.pdf.*
[3] *Guidance for $PM_{2.5}$ Permit Modeling.* https://www3.epa.gov/scram001/guidance/guide/Guidance_for_PM25_Permit_Modeling.pdf.
[4] *Draft Guidance on Significant Impact Level for Ozone and Fine Particles.* https://www.epa.gov/sites/production/files/2016-08/documents/pm2_5_sils_and_ozone_draft_guidance.pdf

3.2 Background Concentrations for Modeling

Recent guidance states that modeled impacts should not be compared to the Significant Impact Levels (SILs) if the background monitor values, when added to the SILs, exceed the NAAQS. **Table 3-1** shows the ambient monitor values for the most recent three years in comparison to the SILs and the NAAQS. It is evident that the monitored values plus the SILs are well below the NAAQS, so the SILs may be used to obtain a waiver from cumulative modeling for this modeling application.

Figure 3-1 Locations of Nearby Ambient Monitors



4. Air Quality Impact Assessment

4.1 Background Discussion

The proposed Project will be a major modification for VOCs, CO, $PM_{2.5}$, and PM_{10}; therefore, PSD review and associated dispersion modeling analysis is required for these pollutants. Modeling analyses performed for these pollutants have been evaluated for compliance with applicable thresholds and are presented in Sections 4.7 and 4.8. The evaluation for VOC is discussed in Section 4.9. There are no modeling requirements for GHGs.

As will be discussed in the following sections of this report, the dispersion modeling for the RICE project has been conducted in a manner that tests a range of the engines' operating conditions, as advised by the reviewing agencies, in an effort to predict the highest impact for each pollutant and averaging period.

4.2 Source Data

The air dispersion modeling analysis was conducted with emission rates and flue gas exhaust characteristics (flow rate and temperature) for a range of operating conditions for the proposed RICE project. The stacks from each of the 10 engines were bundled or clustered together in two groups of five and were modeled as four merged stacks. Modeling assumes that the exhaust from three RICE units in each of the two groups of five engines are tied into two of the four merged stacks, while exhaust from two RICEs in the two groups of five engines are tied into the remaining two merged stacks.

A summary of the engine exhaust data for the PSD-regulated pollutants that were modeled is provided in **Table 4-1**. An equivalent diameter and gas exit velocity calculation for the merged stack configuration noted above, is also shown in the table. The formulas used to calculate the equivalent diameter and gas exit velocity of the merged stacks are provided in equations 1 and 2, respectfully.

$$\text{Equivalent Diameter} = 2 * \sqrt{\frac{\left(\pi * \left(\frac{d}{2}\right)^2\right) * n}{\pi}} \quad (1)$$

$$\text{Velocity} = \frac{ACFM * n}{60 * \pi * \left(\frac{equivalent\ d}{2}\right)^2} \quad (2)$$

Where;

ACFM = Gas flow from single stack in units of actual cubic feet per minute,

n is the number of individual engine stacks being merged,

d is the diameter of each individual stack in units of feet,

equivalent diameter is in units of feet, and

velocity is in units of feet per second.

Criteria pollutant emissions for the engines are presented in the following sub-sections.

4.2.1 Normal and Startup Emissions

Each engine was modeled assuming 8,760 hours of operation per year. For CO (a pollutant with a 1-hour average NAAQS), all ten engines were conservatively assumed to start simultaneously for each hour modeled over the course of the 5-year period. Startup conditions apply to engine loads less than 25% of full load; when the 25% load is attained, the pollution control equipment is fully operational. The time needed for a startup is, at most, about 30 minutes for a "cold start" (with several hours in between engine operations), while it is even shorter for starts in which the engine is still warmer than ambient temperature. The modeling for startup for CO emissions was conservatively done assuming a cold start each hour, which is physically impossible.

The vendor for the RICEs provided TEP with estimated emission rates and exhaust parameters for the varying load conditions (25%, 50%, and 100%), as shown in **Table 4-1**. Since these emission specifications are not guaranteed, TEP has added a buffer to the emission rates to ensure they will be able to comply with the proposed PSD conditions, which include 5 startups per day per engine for $PM_{10}/PM_{2.5}$. Startup emission rates are shown in **Table 4-2**. The buffer was calculated by scaling the vendor-supplied emission rates such that the full load emission rate would match the proposed permit value. For example, PM_{10} and $PM_{2.5}$ the scaling factor is 1.331 (2.37 lb/hr (1-hour non-startup) / 1.78 lb/hr (vendor 1-hour non-startup)). This scaling factor was subsequently applied to the vendor-supplied non-startup emission rates for min and mid-loads.

Modeling of PM_{10} and $PM_{2.5}$ (with daily average NAAQS) assumed a maximum of 5 startup events per day. For example, for the full load case, the daily average emission rates assumed 5 startup event emissions (1.8 lb/30 minutes during these events) and 21.5 hours of non-startup (normal) emissions (2.37 lb/hr during these periods). The daily average emission rates in this case would be calculated as: ((2.37 lb/hr x 21.5 hours + 1.8 lb/event x 5 startups) / 24 hours in day) = 2.5 lb/hr. This 24-hour average rate of 2.5 lb/hr was used for the 24-hour and annual averaging periods. For the 8-hour averaging period of CO at full load, the emission rate assumes 8 hours of startup emissions. As stated above, for the 1-hour averaging period of CO at full load, the modeled emission rate assumes all 10 engines start simultaneously in the same hour, every hour of the year.

Table 4-1 Vendor-Supplied Maximum Emission Rates and Exhaust Parameters During Non-Startup Operations for Various Loads

Engine Load (%)	CO[1] (lb/hr)	PM_{10}[1] (lb/hr)	$PM_{2.5}$[1] (lb/hr)	Gas Exit Temperature (K)	Exhaust Gas Flow (lb/s)
100	2.64	1.78	1.78	628.706	64.8
50	1.85	1.47	1.47	700.372	33.8
25	1.14	0.96	0.96	703.706	21

(1) Emission rates are per engine under ambient conditions of 90°F, 9% relative humidity, and altitude of 2,630 ft.

Table 4-2 Vendor-Supplied Cold Startup Emission Rates

Startup	CO[1] (lb/30 min)	PM_{10}[1] (lb/30 min)	$PM_{2.5}$[1] (lb/30 min)
Cold	9.1	1.8	1.8

(1) A cold catalyst start is when the temperature of the catalyst material inside the reactor is close to ambient temperature. Cold catalyst starts are expected after over haul periods or when the engine has not been operated during the last 2-3 days.

The scaled emission rates for each engine at 25%, 50%, and 100% operating loads are summarized in **Table 4-3**. The emission rates during startup conditions are either equal to or greater than the normal operations; therefore the worst-case scenario modeled included the startup emission rates.

The exhaust flow (lb/s) is converted to standard cubic feet per second based on the molecular weight of the flue gas and the ideal gas law for standard conditions (385.55 scf/lb mole at 1 atm and 68 F). The molecular weight of the RICE unit flue gas was not available. Air has an O_2 concentration of 20.9% and a molecular weight of 28.97 lb/lb mole. The molecular weight of flue gas for large natural gas fired gas turbines operating at approximately 13% O_2 is approximately 28.31 lb/lb mole. Lean burn engines such as the RICE units operate with fuel gas O_2 concentrations of approximately 10% resulting in a molecular weight between 28.31 lb/lb mole and 28.97 lb/lb mole.

The exhaust flow as standard cubic feet per second is converted to actual cubic feet per second based on the actual temperature from the RICE units (provided by vendor) and the atmospheric pressure at the site. At the site elevation of 800 m, the atmospheric pressure is 0.91 atm. The actual flow rate is converted to velocity based on the stack cross sectional area.

Table 4-3 Emissions Summary and Stack Parameters for Modeling (pounds per hour per engine)

Scenario[1]	Stack Height (ft)	Stack Diameter (ft)	Exit Temp. (°F)	Exit Velocity (m/s)	Maximum Short-Term Emissions (lb/hr per RICE)[2], [3]		
					CO[3]	PM_{10}[4]	$PM_{2.5}$[4]
100% Load; 2 Merged Stacks	160	7.4	**628.706**	28.985	**18.220**	**2.500**	**2.500**
50% Load; 2 Merged Stacks	160	7.4	700.372	16.842	**18.220**	2.128	2.128
25% Load; 2 Merged Stacks	160	7.4	703.706	**10.513**	**18.220**	1.520	1.520
100% Load; 3 Merged Stacks	160	9.1	**628.706**	28.985	**18.220**	2.500	2.500
50% Load; 3 Merged Stacks	160	9.1	700.372	16.842	**18.220**	2.128	2.128
25% Load; 3 Merged Stacks	160	9.1	703.706	**10.513**	**18.220**	1.520	1.520

(1) Data presented are for multiple operating loads/conditions for 2 types of merged stack configurations.
(2) Bold italicized numbers indicate highest emissions, lowest temperature, and lowest exhaust velocity.
(3) Emission rates based on cold start for every hour.
(4) Emission rates include five 30 minute cold startup events per day.

4.3 Model Selection

The suitability of an air quality dispersion model for a particular application is dependent upon several factors. The following selection criteria were evaluated:

- stack height relative to nearby structures;
- dispersion environment;
- local terrain; and
- representative meteorological data.

Pima County's rule pertaining to air quality modeling refers to EPA's 2005 version of Appendix W and does not yet reflect the recent EPA rule promulgation of Appendix W in May 2017. Section 6 part B of Pima County's rule (PCC § 17.16.590(A)(6)) states that if the "guideline" model is inappropriate it may be modified or substituted with another model. We assume that given the very recent EPA rule that Pima County and the EPA would accept the most recent version of AERMOD as the most appropriate model and the recently promulgated Appendix W guidance as the most appropriate for this analysis. Based on a review of the factors discussed below, the latest version of AERMOD (16216r) was used in this modeling of IGS.

In rulemaking released in the December 20, 2016 Pre-Federal Register Version of the Final Rule, the EPA provided a revised version of AERMOD (16216), which replaces the previous version of AERMOD (15181). On January 17, 2017, EPA re-released AERMOD (version 16216r) that addressed several "bugs" discovered in the December 2016 version. The rulemaking included refinements to EPA's preferred short-range model, AERMOD, involving low wind conditions. These refinements included an adjustment to the computation of the friction velocity ("ADJ_U*") in the AERMET (16216) meteorological pre-processor. The promulgated Final Rule also changed the status of the ADJ_U* refinement from a beta option to an approved regulatory option. The modeling conducted for the proposed project at IGS utilizes the newly approved regulatory low wind model option.

4.4 Rural versus Urban

One of the factors affecting input parameters to dispersion models is the presence of either rural or urban conditions near the project site. According to Section 7.2.1.1. of Appendix W, the applicant should follow one of the following procedures; land use or population density. EPA Region 9 in consultation with EPA's Office of Air Quality Planning and Standards (OAQPS) has recommended that TEP to use the population density procedure in determining the rural or urban selection for the modeling of the RICE project. The population density procedure states that if the average population density is greater than 750 people per square kilometer, use urban, otherwise rural would be appropriate. EPA Region 9 provided TEP with an average population density for the Tucson metro area as 860 people per square kilometer. Therefore, for the TEP RICE project, the urban dispersion option in AERMOD was used.

For urban areas, AERMOD requires the use to provide a representative population value. In 2015, the U.S. Department of Commerce Bureau of Economic Analysis (BEA) reported the Metropolitan Statistical Area (MSA) for Tucson, AZ was 1,010,025 people[6]. This MSA population for Tucson was used to fulfill the population requirement in AERMOD.

4.5 Meteorological Data for AERMOD

Meteorological data required for AERMOD include hourly values of wind speed, wind direction, and ambient temperature. Since the AERMOD dispersion algorithms are based on atmospheric boundary layer dispersion theory, additional boundary layer variables are derived by parameterization formulas, which are computed by the AERMOD meteorological preprocessor, AERMET[7]. These parameters include sensible heat flux, surface friction velocity, convective velocity scale, vertical potential temperature gradient, convective and mechanical mixing heights, Monin-Obukhov length, surface roughness length, Bowen ratio, and albedo.

4.5.1 Available Meteorological Data for AERMOD

Arizona Department of Environmental Quality (ADEQ) has pre-processed meteorological data[8] for 2012-2016 for the Tucson International Airport (surface and upper air), using AERMET version 16216 along with AERMINUTE version 15272 and AERSURFACE version 13016. The recently-approved low wind ADJ_U* guideline option was utilized for this data set. The representative airport site is located approximately 5 kilometers to the southwest of IGS and is the only ASOS station in the Tucson area. It is representative of the application site because there is no intervening terrain between the airport and IGS, and both sites share similar (arid) surface characteristics. This data set was used for the air

[6] BEA. Published on November 17,2016. https://bea.gov/regional/bearfacts/action.cfm?geoType=5&fips=46060&areatype=MSA.

[7] EPA 2016. User's Guide for the AERMOD Meteorological Preprocessor (AERMET). EPA-454/B-16-010 (December 2016). Office of Air Quality Planning and Standards, Research Triangle Park, NC. https://www3.epa.gov/ttn/scram/7thconf/aermod/aermet_userguide.pdf.

[8] Arizona Department of Environmental Quality (ADEQ) AERMOD-ready meteorological data files are available at http://www.azdeq.gov/node/2127.

quality impact analysis. A wind rose using the five-year period from 2012 to 2016 is provided as **Figure 4-2**.

4.6 Good Engineering Practice Stack Height Analysis

A Good Engineering Practice (GEP) stack height analysis was performed to determine the potential for building-induced aerodynamic downwash. The analysis procedures described in EPA's Guidelines for Determination of Good Engineering Practice Stack Height[9], Stack Height Regulations (40 CFR 51), and current Model Clearinghouse guidance was used.

The GEP formula height is based on the observed phenomena of disturbed atmospheric flow in the immediate vicinity of a structure resulting in higher ground-level concentrations at a closer proximity to the building than would otherwise occur. It identifies the minimum stack height at which significant aerodynamics (downwash) are avoided. The GEP formula stack height, as defined in the 1985 final regulations, is calculated from:

$$H_{GEP} = H_{BLDG} + 1.5L$$

where:

H_{GEP} is the maximum GEP stack height;

H_{BLDG} is the height of the nearby structure; and

L is the lesser dimension (height or projected width) of the nearby structure.

Both the height and width of the structure are determined from the frontal area of the structure projected onto a plane perpendicular to the direction of the wind. In all instances, the GEP stack height is based on the plane projections of any nearby building that results in the greatest justifiable height. For purposes of the GEP analysis, “nearby” refers to the “sphere of influence,” defined as five times the height or width of the building, whichever is less, downwind from the trailing edge of the structure. In the case where a stack is not influenced by nearby structures, the maximum GEP stack height is defined as 65 meters.

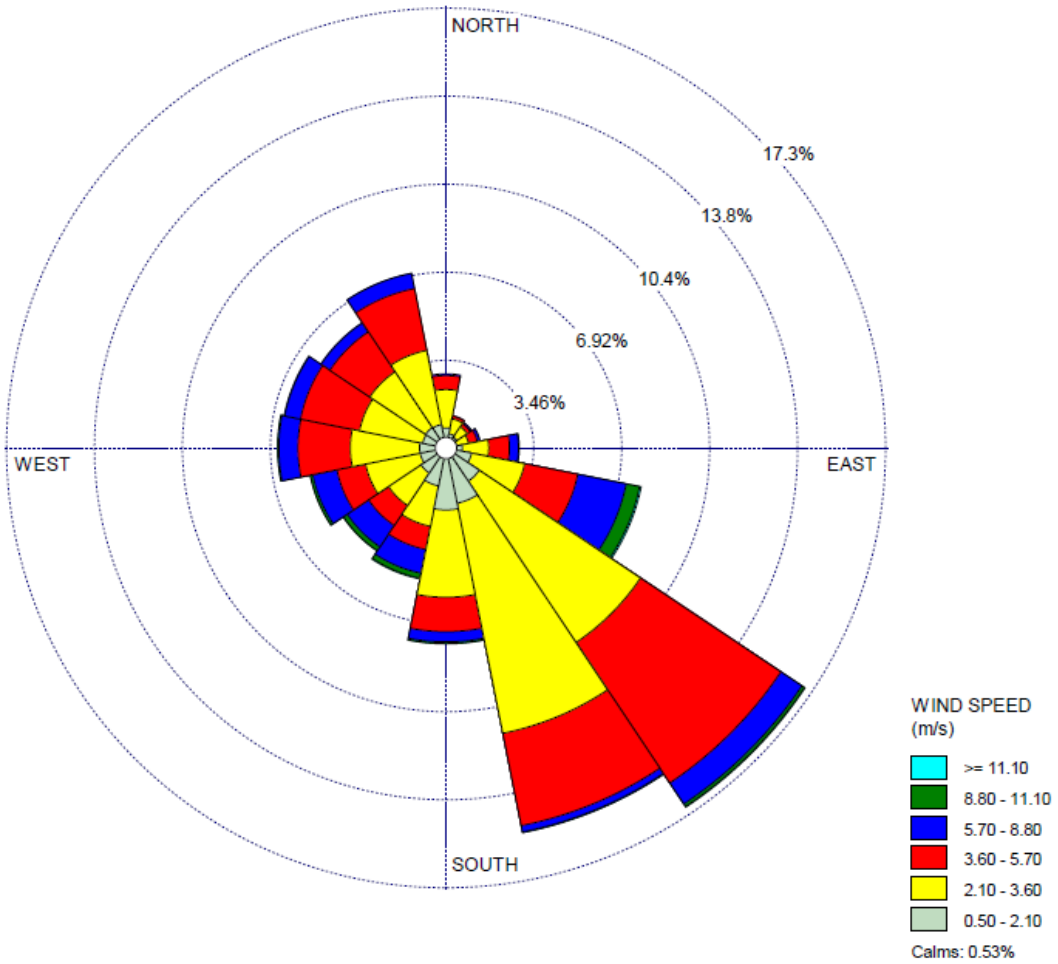
Figure 4-3 is a plot plan showing the locations of the power plant equipment, and structures that could potentially produce aerodynamic downwash of the plumes for the reciprocating RICEs. The direction-specific building dimensions were determined using the latest version of EPA’s Building Profile Input Program software (BPIP PRIME Dated 04274) using the design values of the stack and building heights.

[9] EPA 1985. Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) - Revised. EPA-450/4-80-023R, US EPA, Research Triangle Park, NC 27711. https://www3.epa.gov/scram001/guidance/guide/gep.pdf.

Figure 4-1 Wind Rose from Tucson International Airport 2012-2016

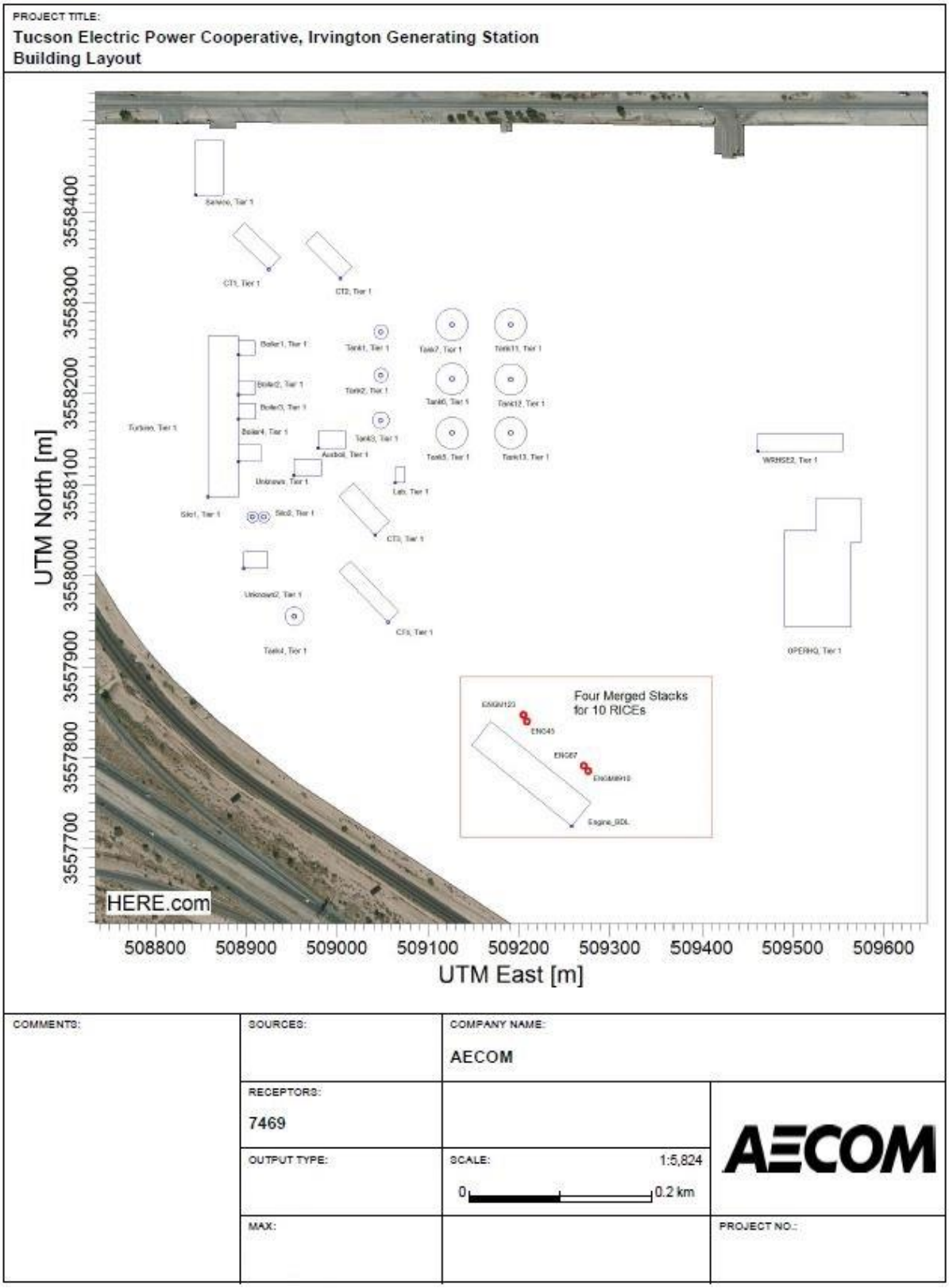
WIND ROSE PLOT:
Tucson International Airport 2012-2016

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 1/1/2012 - 00:00 End Date: 12/31/2016 - 23:59	AECOM	AECOM
	CALM WINDS: 0.53%	TOTAL COUNT: 43696 hrs.	
	AVG. WIND SPEED: 3.53 m/s	DATE: 6/8/2017	PROJECT NO.:

Figure 4-2 Plot Plan Used in the GEP Analysis



4.7 Receptor Grid and AERMAP Processing

The modeling analysis was conducted using the following Cartesian receptor grid design for Class II areas.

- 25-m receptor spacing along the IGS boundary;
- 100-m receptor spacing extending out 2 kilometers from the grid center (located near the center of the facility at 509448.00 meters Easting, 3557910.00 meters Northing);
- 250-m receptor spacing between 2 and 6 kilometers from the grid center;
- 500-m receptor spacing between 6 and 10 kilometers from the grid center;
- 1,000-m receptor spacing between 10 and 20 kilometers from the grid center; and
- 2,000-m receptor spacing beyond 20 kilometers (out to 50 km).

The receptor grid used in the modeling analysis was based on Universal Transverse Mercator (UTM) coordinates referenced to NAD 83 datum Zone 12 and is shown in **Figure 4-3** and **Figure 4-4**.

4.7.1 Terrain Processing (AERMAP)

The latest version of AERMAP (version 11103), the AERMOD terrain preprocessor program, was used to calculate terrain elevations and critical hill heights for the modeled receptors using National Elevation Data (NED). The dataset was downloaded from the USGS website (http://viewer.nationalmap.gov/viewer/) and consists of 1/3 arc second (~10 m resolution) NED. As per the AERMAP User's Guide[10], the domain was sufficient to ensure all significant nodes were included such that all terrain features exceeding a 10% elevation slope from any given receptor, are considered.

4.8 Modeling of Secondary $PM_{2.5}$ Emissions

Based on May 2014 guidance from EPA[11], a tiered approach is recommended for determining which sources would be important to consider when assessing secondary $PM_{2.5}$ concentrations, but the guidance lacks specifics as to how the evaluations should be conducted. The draft guidance suggests four different cases that define what air quality modeling analysis would be needed to consider $PM_{2.5}$ emissions, and any further modeling needed if the consideration of secondary $PM_{2.5}$ would be required. The MERP guidance and Errata Memo can be used as reference should secondary $PM_{2.5}$ consideration be required.

The four cases presented by EPA in the May 2014 guidance include:

- Case 1: If the $PM_{2.5}$ emissions < 10 tons per year (TPY) and NOx and SO2 emissions < 40 TPY; then a $PM_{2.5}$ compliance modeling demonstration IS NOT required.
- Case 2: If the $PM_{2.5}$ emissions > 10 TPY and NO_x and SO_2 emissions < 40 TPY; then a $PM_{2.5}$ compliance modeling demonstration IS required for primary $PM_{2.5}$, but consideration of secondary $PM_{2.5}$ is NOT necessary.

[10] EPA 2004. User's Guide for the AERMOD Terrain Preprocessor (AERMAP). EPA-454/B-03-003 (October 2004 – Addendum March 2011). Office of Air Quality Planning and Standards, Research Triangle Park, NC. https://www3.epa.gov/scram001/dispersion_related.htm.

[11] Available at https://www3.epa.gov/scram001/guidance/guide/Guidance_for_PM25_Permit_Modeling.pdf.

- Case 3: If the $PM_{2.5}$ emissions > 10 TPY and NO_x and/or SO_2 emissions > 40 TPY; then a $PM_{2.5}$ compliance modeling demonstration IS required for primary $PM_{2.5}$ and secondary $PM_{2.5}$ MUST BE accounted for from the project source.
  - EPA suggests the assessment of the effect of precursor emissions on secondary PM2.5 could be completely qualitative in nature, could be a hybrid qualitative/quantitative approach, or may require full photochemical modeling. However, EPA believes that not many cases will require full photochemical modeling.
- Case 4: If the $PM_{2.5}$ emissions < 10 TPY and NO_x and/or SO_2 remissions > 40 TPY; then a $PM_{2.5}$ compliance demonstration is NOT required for primary $PM_{2.5}$ but an assessment of secondary $PM_{2.5}$ is required. Much like Case 3, the assessment could be completely qualitative in nature, could be a hybrid qualitative/ quantitative approach, or may require full photochemical modeling (unlikely).
  - EPA noted that this case is still under review.

$PM_{2.5}$ modeling for the RICE project falls into Case 2 as described above and thus a qualitative / quantitative analysis to address secondary $PM_{2.5}$ is not required. The modeling of particulate emission impacts is restricted to direct emissions without regard to precursor emissions.

4.9 Class II Area Modeling Analysis

A refined modeling analysis was conducted using AERMOD (version 16216r). The analysis was conducted to demonstrate compliance with both federal and local applicable ambient air quality standards.

4.9.1 PSD Class II Significant Impact Level Analysis Results

Impacts were assessed using AERMOD at the Class II receptor locations described previously, and compared to the Class II SILs to determine if the impacts were significant for CO, PM_{10} and $PM_{2.5}$. Five years (2012-2016) of representative meteorological data were used as input to AERMOD, as discussed in **Section 4.5**. Significance for 24-hour and annual $PM_{2.5}$ is determined by averaging the maximum daily concentrations for each year modeled at each receptor over the 5 years and comparing to the SIL (AERMOD performs this calculation internally). All other pollutants/averaging periods are determined by comparing the maximum concentration for any year modeled to the SIL. Since the exhaust parameters and emission rates vary by operating load, minimum (25%), mid-range (50%), and full load (100%) were modeled and compared against the SILs.

Figure 4-3 Near-Field Receptor Grid

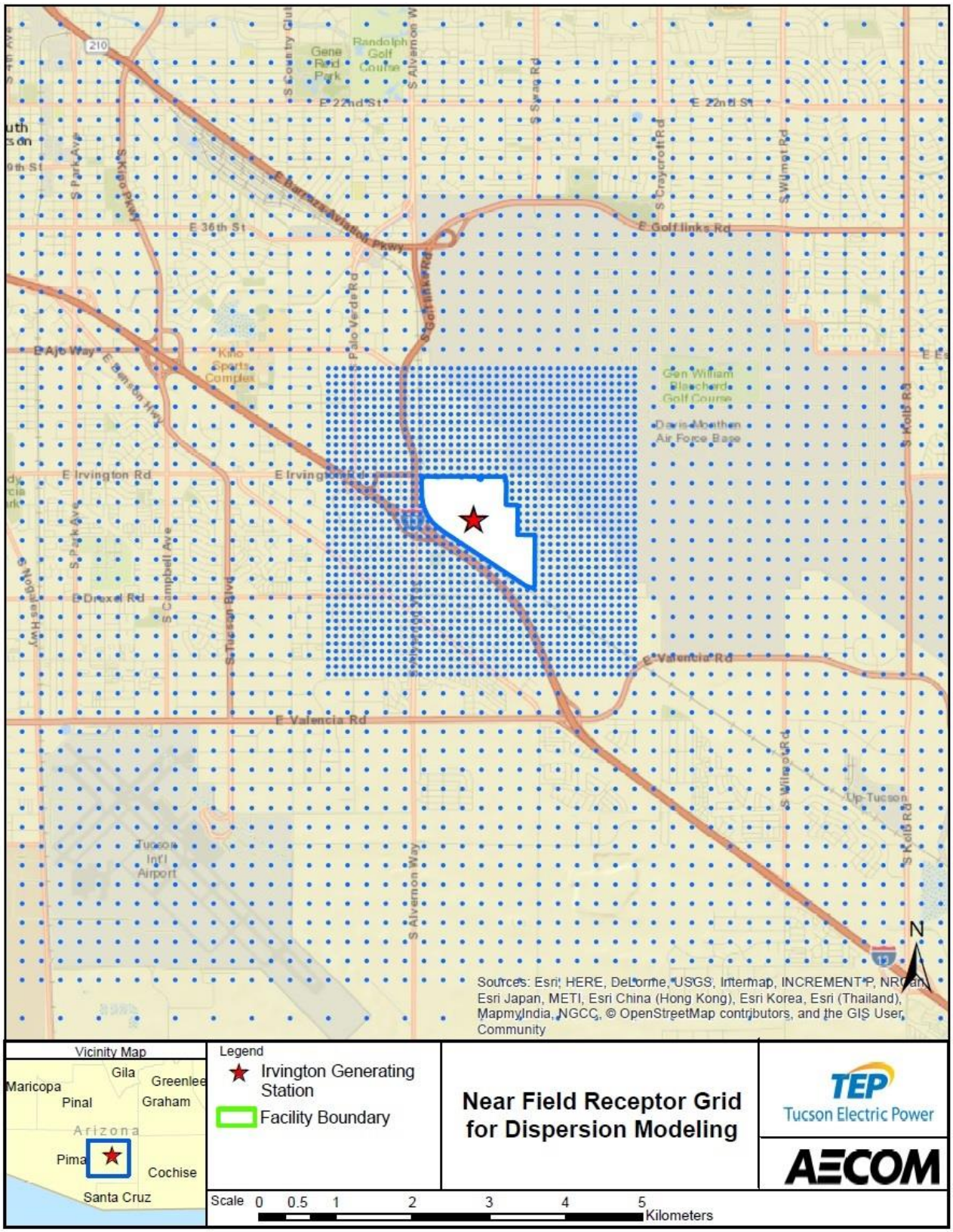
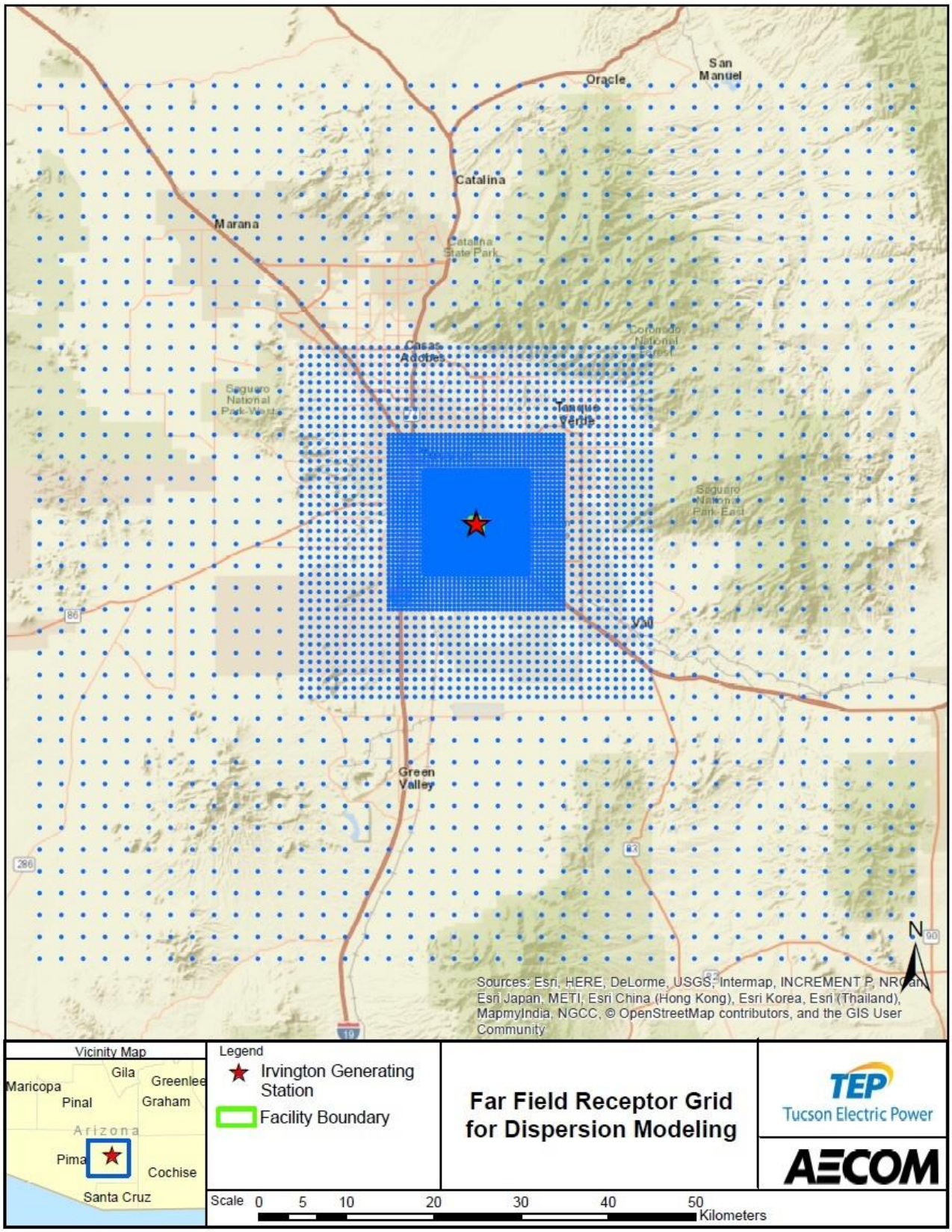


Figure 4-4 Far Field Receptor Grid



For those pollutants and averaging periods with modeled concentrations less than their SILs, no further modeling was required because, by definition, those pollutants and averaging periods cannot cause or contribute to a violation of a NAAQS or exceedances of the PSD increments as discussed in Section 3. A comparison of the overall maximum modeled concentrations with the SILs, across all operating loads (25%, 50%, and 100%) is presented in **Table 4-4** for the worst-case emission rates. and the locations are shown in **Figures 4-5, 4-6** and **4-7** for min, mid and full operating loads, respectfully. As is depicted in **Table 4-4,** all modeled concentrations are below their respective SILs. As such, no further analyses were required for these pollutants.

Table 4-4 Summary of Maximum AERMOD Concentrations to Significant Impact Levels

Pollutant	Averaging Period	Min-Load (25%) Maximum Concentration ($\mu g/m^3$)	Mid-Load (50%) Maximum Concentration ($\mu g/m^3$)	Full-Load (100%) Maximum Concentration ($\mu g/m^3$)	SIL	Significant? (Yes or No)
CO	1-Hour[1]	***78.350***	55.117	31.111	2,000	N
	8-Hour[1]	***34.635***	26.587	20.103	500	N
PM_{10}	24-Hour[1]	1.269	***1.283***	1.120	5	N
	Annual[1]	0.190	***0.194***	0.167	1	N
$PM_{2.5}$	24-Hour[2]	1.012	***1.039***	0.925	1.2	N
	Annual[2]	0.181	***0.182***	0.157	0.3	N

Note: Bold italicized numbers indicate the maximum modeled concentration for each criteria pollutant.
(1) Highest concentration over the 5-year meteorological period (2012-2016) modeled.
(2) Maximum concentration averaged over 5-years.

4.10 Class I Area

PSD guidance[12] recommends that facilities within 100 km of a PSD Class I area perform a modeling evaluation of the ambient air quality in terms of Class I PSD Increments and Air Quality Related Values. In addition, large projects beyond 100 km (but less than 300 km) from the nearest Class I area may be requested to conduct an evaluation of air quality impacts by the Federal Land Managers (FLMs). There are ten Class I areas within 300 km of IGS as shown in **Figure 4-8**:

1. Chiricahua NM
2. Chiricahua Wilderness
3. Galiuro Wilderness
4. Gila Wilderness
5. Mazatzal Wilderness
6. Mount Baldy Wilderness
7. Pine Mountain Wilderness
8. Saguaro National Park (East and West)
9. Sierra Ancha Wilderness
10. Superstition Wilderness

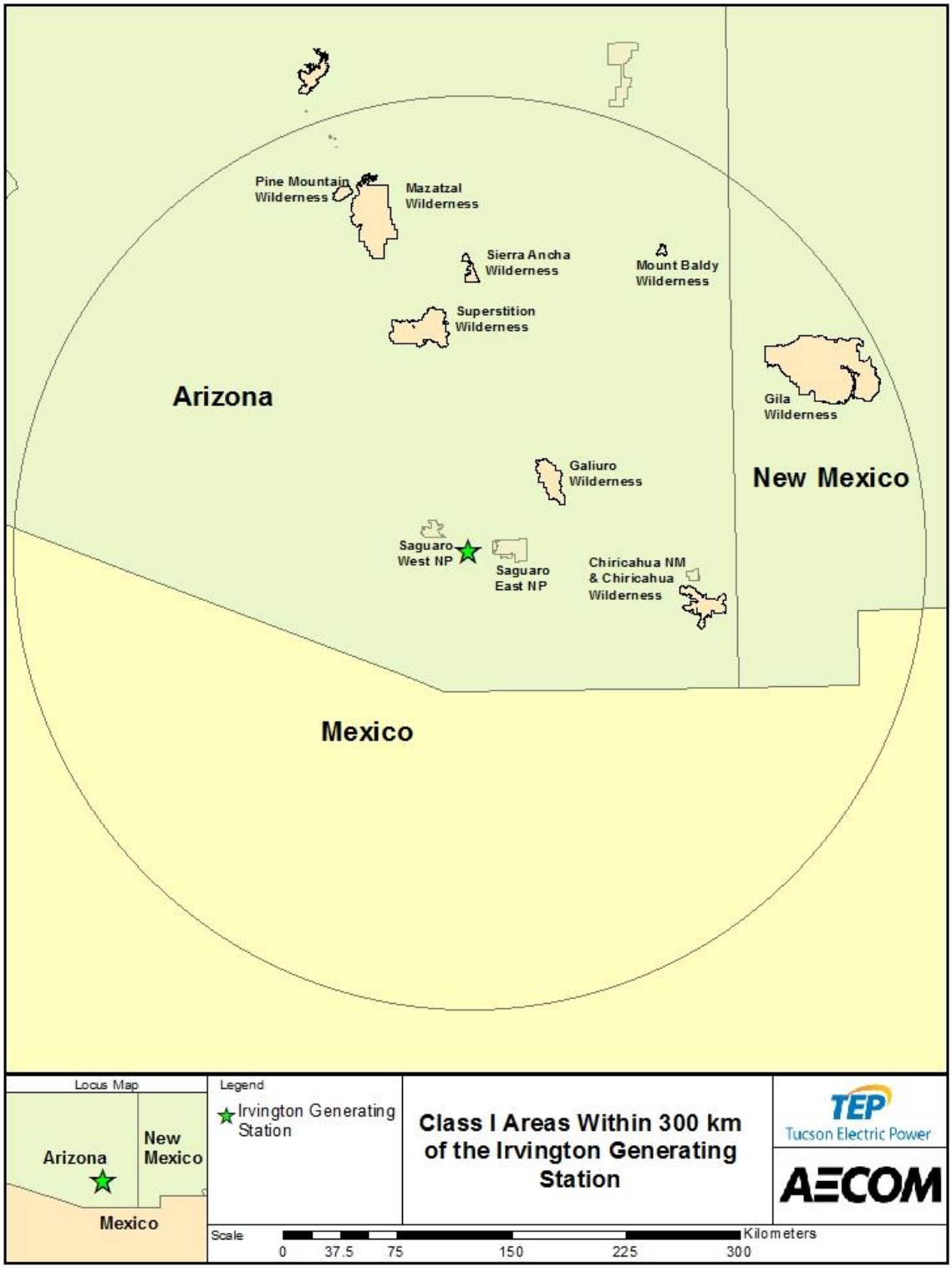
[12] 1992 EPA Memorandum. Clarification of Prevention of Significant Deterioration (PSD) Guidance for Modeling Class I Area Impacts. https://www.epa.gov/sites/production/files/2015-07/documents/class1.pdf.

Figure 4-5 Location of Maximum Concentrations (25% Operating Load)

Figure 4-6 Location of Maximum Concentrations (50%Operating Load)

Figure 4-7 Location of Maximum Concentrations (100% Operating Load)

Figure 4-8 Class I Areas within 300 km of IGS



There are no other Class I areas within 300 km of IGS. Project impacts for PM_{10} and $PM_{2.5}$ pollutants subject to PSD review were assessed for the Class I areas (and portions thereof) within 300 km of the facility. The Class I SILs that the project impacts were compared to are summarized in **Table 4-5**. In 1996, EPA proposed rulemaking[13] for Class I specific SILs for PM_{10} 24-hour (0.3 µg/m^3) and annual (0.2 µg/m^3). Although this rule was never finalized, the proposed SILs for PM_{10} have been widely used in previous permitting applications. The $PM_{2.5}$ SILs are based upon guidance[14] issued by EPA in August, 2016.

Table 4-5 Criteria Pollutant Class I Significant Impact Levels

Pollutant	Averaging Time (1)	
	Annual *µg/m^3*	**24-hour** *µg/m^3*
PM_{10}	0.2	0.3
$PM_{2.5}$	0.05	0.27
(1) Highest concentration		

4.10.1 Class I Significant Impact Level Analysis Results (within 100 kilometers)

This PSD Class I analysis considers the closest Class I areas, Saguaro National Park (East and West) and Galiuro Wilderness, which are within 100 kilometers of IGS. The Significant Impact Analysis for compliance with PSD Class I increments was conducted with AERMOD using the same meteorological data as the Class II modeling.

Class I receptor grids were obtained from EPA Region 9's Class I database[15] and were used for the PSD Class I modeling. The Galiuro Wilderness Class I area resides approximately 60 km from IGS, yet AERMOD has a maximum distance applicability of 50 km. Therefore, modeling for impacts at Galiuro was conducted with receptors conservatively placed at a distance of 50 km along a line connecting the project location to Galiuro. In doing so, all of the Galiuro receptor elevations and hill heights were preserved from what they are at their actual locations. **Figure 4-9** shows the model receptor locations for Class I areas. All of the modeled pollutants and averaging periods resulted in modeled concentrations less than their SILs; therefore, no further analysis was performed.

For those pollutants and averaging periods with modeled concentrations less than their SILs, no further modeling was conducted. A comparison of the overall maximum modeled concentrations with the SILs, for each operating load (25%, 50%, and 100%) is presented in **Table 4-6** for the worst-case emission rates. As is depicted in **Table 4-6**, all modeled concentrations are below their respective SILs. As such, no further analyses were required for these pollutants.

[13] 61 FR 38249. https://www.gpo.gov/fdsys/pkg/FR-1996-08-20/pdf/96-21281.pdf.
[14] https://www.epa.gov/nsr/draft-guidance-comment-significant-impact-levels-ozone-and-fine-particle-prevention-significant.
[15] EPA, Region 9 Federal Class I Areas. https://www3.epa.gov/region9/air/maps/r9_clss1.html .

Figure 4-9 Class I Receptor Grid

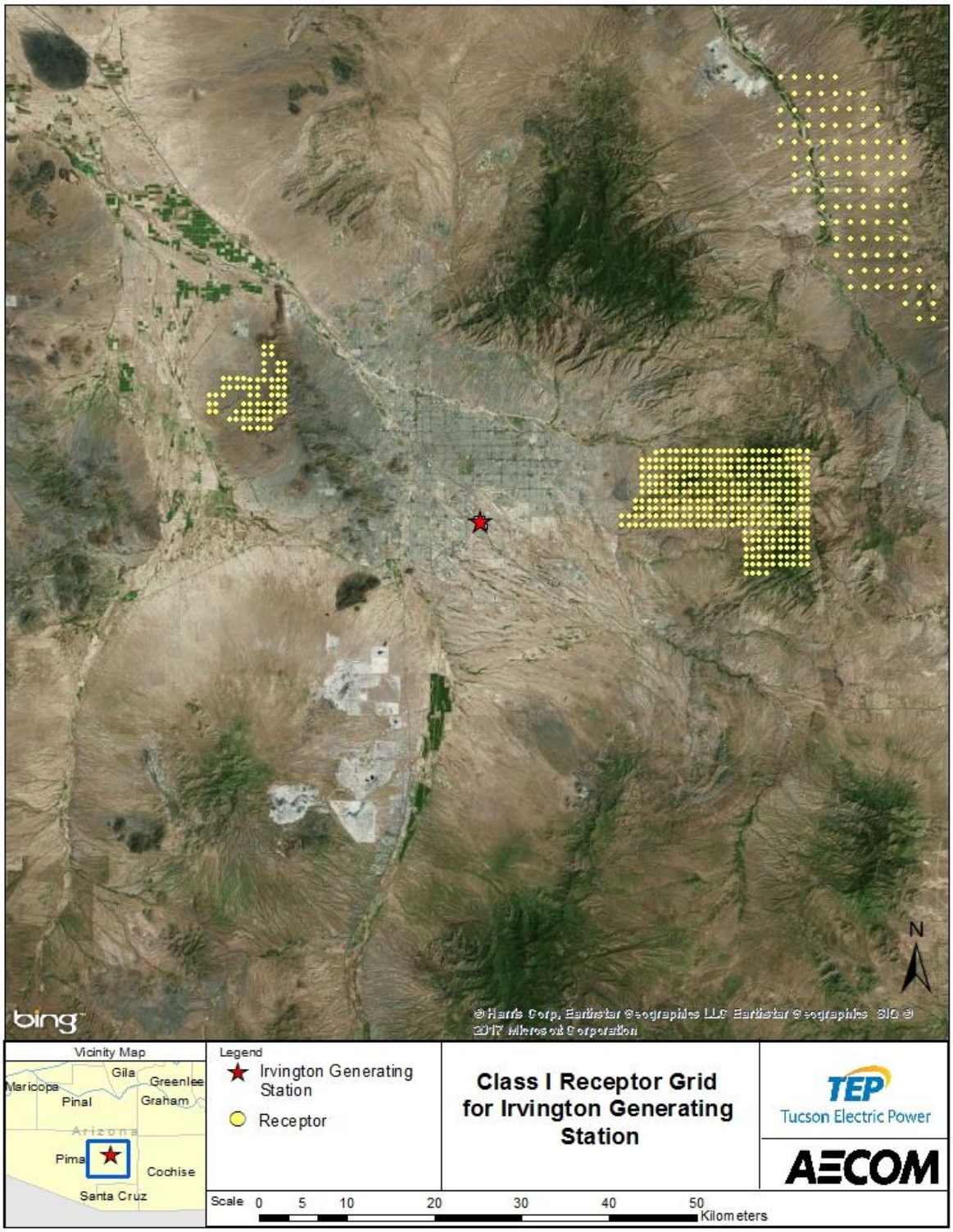


Table 4-6 Summary of Maximum AERMOD Concentrations to Significant Impact Levels

Pollutant	Averaging Period	Min Load (25%) Maximum Concentration (μg/m³)	Mid Load (50%) Maximum Concentration (μg/m³)	Full Load (100%) Maximum Concentration (μg/m³)	SIL	Significant? (Yes or No)
Saguaro National Park - East						
PM_{10}	24-Hour	0.053	**0.061**	*0.060*	0.3	N
	Annual	0.006	0.007	***0.014***	0.2	N
$PM_{2.5}$	24-Hour	0.039	***0.046***	*0.045*	0.27	N
	Annual	0.006	0.007	***0.014***	0.05	N
Saguaro National Park - West						
PM_{10}	24-Hour	0.035	0.045	***0.048***	0.3	N
	Annual	0.007	0.009	***0.012***	0.2	N
$PM_{2.5}$	24-Hour	0.033	0.042	***0.044***	0.27	N
	Annual	0.007	0.009	***0.012***	0.05	N
Galiuro Wilderness Area						
PM_{10}	24-Hour	0.007	***0.009***	***0.009***	0.3	N
	Annual	***0.001***	***0.001***	***0.001***	0.2	N
$PM_{2.5}$	24-Hour	0.006	0.007	***0.008***	0.27	N
	Annual	**0.001**	**0.001**	**0.001**	0.05	N

Note: Bold italicized numbers indicate the maximum modeled concentration for each criteria pollutant.

4.11 Modeling of Ozone Precursors

In rulemaking that was effective as of May 22, 2017, EPA's Appendix W, Revisions to the Guideline on Air Quality Models, provided a more specific procedure for assessing the impacts of an individual source on ozone. In conjunction with this new procedure, the EPA finalized a two-tiered demonstration approach for addressing individual source impacts on ozone. The first tier involves the use of technically credible relationships between precursor emissions and a source's impacts while the second tier involves application of more sophisticated case-specific chemical transport models. The EPA has recently issued draft guidance providing recommendations on air quality modeling and related technical analyses to satisfy compliance demonstration requirements for ozone for permit-related assessments under the PSD program; Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program (December 02, 2016)[16] and Errata Memo (February 23, 2017)[17]. The draft guidance provides a Tier 1 demonstration tool for ozone (and $PM_{2.5}$). The MERPs are screening thresholds for precursor emissions, where VOC and NO_x screening values are provided for ozone, that are expected to result in an insignificant increase in ambient ozone relative to the NAAQS; i.e., an

[16] Available at https://www3.epa.gov/ttn/scram/guidance/guide/EPA454_R_16_006.pdf.
[17] Available at https://www3.epa.gov/ttn/scram/guidance/guide/MERPs_Data_Distribution_and_Errata_Memo-02232017.pdf.

impact less than the 8-hour ozone SIL of 1 ppb. The MERP values were derived based on modeling conducted by EPA for locations across the U.S.

For the IGS RICE project, there is a net decrease in NOx emissions, as shown in **Table 4-7**. As a result, only a comparison against the VOC MERPs can be accomplished. Since the project will involve the retirement of existing boiler units 1 and 2 and cooling towers, RTP determined the maximum combined NOx and PM 24-hour (daily) emission rate based on the most recent two years (2015-2016) of actual emissions to represent the worst case emission rates for Units 1 and 2. Units 1 and 2 emitted 4,096 lbs combined on June 20, 2016 which converts to 747.52 tons/year of NOx.

Table 4-7 Short-Term NOx Emissions for Existing Sources and Future Sources of the Project

Existing Units 1 and 2 NOx	RICE NOx Emissions[1]	Change in NOx for the Project
747.52 tons/year	153.3 tons/year	-594.22 tons/year

(1) Tons per year rate is based on the daily average that consists of 5 startup events (30 minutes) at 10.3 lb/event plus the remaining 21.5 hours at a rate of 1.5 lb/hr.

Table 7.1 of the guidance, as updated in the Errata Memo, provides the "Most Conservative (Lowest) Illustrative MERP Values (tons per year) by Precursor, Pollutant and Region". MERP values are provided for VOCs in the central, eastern and western U.S. To determine whether this project would exceed the critical air quality threshold for ozone, the project VOC emissions increase can be compared to the lowest western MERP for VOC, which is 1,049 tons per year[18]. Since the project net increase of VOC is only 130 tons per year, the project's ozone impact is presumed to have an insignificant impact on ozone concentrations.

Per Pima County Code § 17.16.590(A)(5)(b)), a major modification to a major source of volatile organic compounds or oxides of nitrogen may contribute to violations of the Arizona ambient air quality standards for ozone if it will be located within fifty kilometers of a nonattainment area for ozone. The only ozone nonattainment area in Arizona is located in Maricopa County and a small portion of Pinal County, more than 100 kilometers from IGS. Therefore, a demonstration that the project will not cause or contribute to a violation is not required, especially since the Project's ozone impact is below the EPA-proposed SIL.

[18] Table 7.1 on page 30 of Guidance on the draft MERP guidance (December 2, 2016).

5. Additional Impact Analysis

Under the PSD regulations, permit applicants must prepare an additional impact analysis for each pollutant subject to regulation. This analysis assesses the impacts of air, ground and water pollutions on soils, vegetation, and visibility caused by any increase in emissions of any regulated pollutant from the source or modification under review, and from associated growth. The various components of the additional impact analyses are discussed below.

5.1 Visibility Analysis (within 50 kilometers)

For any new major source or major modification, Pima County requires (PCC § 17.16.630) an analysis of the anticipated impacts of the proposed sources on visibility in any Class I areas which may be affected by the emissions from that source. Furthermore, *Federal Land Managers'Air Quality Related Values Work Group Phase 1 Report – Revised (2010)*[19] recommends that the applicant perform an analysis of visibility impairment (i.e., plume blight) at Class I areas within 50 kilometers of the proposed Project site, in this case Saguaro National Park (eastern and western units).

The preliminary visible plume analysis was conducted with EPA's screening model, VISCREEN to determine if project emission during both normal and startup operations have the potential to cause visibility impairment at the Saguaro National Park units. Upon further review, the National Park Service recommended that a refined visibility analysis using the PLUVUE-II model be conducted. Given the complex nature of the refined visibility assessment using PLUVUE-II, a separate report was developed and submitted to the NPS (see Appendix C).

5.2 Class I Analysis (beyond 50 kilometers)

In accordance with the revised FLAG 2010 guidance that is recommended by the Federal Land Managers, we have excluded from modeling consideration Class I areas that are beyond the FLAG-specified screening distance from IGS. The screening distance is determined by adding the permitted short-term emissions from proposed routine (non-emergency) point sources for SO_2 + NO_x + PM_{10} + H_2SO_4. A FLAG-prescribed screening distance has been calculated for the RICE project to determine what Class I areas will be considered for the Air Quality Related Values (AQRVs) analysis.

The sum of these emissions is not expected to exceed 277.59 tons per year (12.6 tons SO_2 + 153.3 tons NO_x + 109.5 tons PM_{10} and 2.19 tons H_2SO_4) for the RICE project not including the reductions in emissions from Unit 1 and 2. With a FLAG-prescribed screening distance of 278/10 = 27.8 km, this results in the determination that only impacts within the Saguaro National

[19] National Park Service, 2010. Phase I Report of the Federal Land Managers' Air Quality Related Values Workgroup (FLAG) Revised 2010. National Park Service, Air Resources Division; U.S. Forest Service, Air Quality Program; U.S. Fish and Wildlife Service, Air Quality Branch. http://www.nature.nps.gov/air/Pubs/pdf/flag/FLAG_2010.pdf.

Park were considered for Air Quality Related Values (AQRVs), since all other Class I areas are beyond this distance and beyond 50 km from the project location.

5.3 Growth Analysis

A growth analysis examines the potential emissions from secondary sources associated with the proposed Project. While these activities are not directly involved in the RICE project, the emissions involve those that can reasonably be expected to occur; for instance, industrial, commercial, and residential growth that will occur in the RICE project area due to the RICE project itself. Secondary emissions do not include any emissions which come directly from a mobile source, such as emissions from the tailpipe of any on-road motor vehicle or the propulsion of a train. They also do not include sources that do not impact the same general area as the source under review.

The RICE project is not expected to employ additional personnel at this time, especially with the retirement of IGS units 1 and 2. Therefore, population growth from this project is not expected, and thus an analysis of such growth was not performed.

5.4 Soils and Vegetation Analysis

An analysis of the RICE project's potential impact on soils and vegetation in the vicinity of the facility was performed in accordance with the procedures recommended in EPA's "A Screening Procedure for Impacts of Air Pollution Sources on Plants, Soils and Animals"[20]. For particulate matter, the 1980 screening procedure does not have a threshold to compare against; therefore, the impacts were compared to the NAAQS.

The highest modeled concentrations of PM_{10}, O_3 and CO from the RICE project were compared to the screening concentrations as shown in **Table 5-1**. As shown, the modeled concentrations are all well below their screening thresholds; therefore, no significant impacts on local vegetation is expected as a result of the RICE project.

[20] EPA 1980. A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals. EPA-450/2-81-078. EPA, Research Triangle Park, NC 27711.

Table 5-1 Injury Threshold for Vegetation

Pollutants	Averaging Period	Maximum Modeled Concentration (µg/m^3)	NAAQS (µg/m^3)	EPA's 1980 Screening Concentration[1] (µg/m^3)
PM (as PM_{10})	24-hour	1.23	150	None
O_3	1-hour[2]	0.64	None	392
	4-hour[3]	0.16	None	196
	8-hour[4]	0.08	140	118
CO[5]	Weekly	10.00	None	1,800,000

1. "A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals". EPA 450/2-81-078, December 1980.
2. O_3 concentration calculated in Section 4.9 multiplied by 8.
3. O_3 concentration calculated in Section 4.9 multiplied by 4.
4. O_3 concentration calculated in Section 4.9.
5. CO concentration is the 8-hour concentration.

Appendix A EPA Region 9 Letter

Kaplan, Mary

From: Rupesh Patel <Rupesh.Patel@pima.gov>
Sent: Thursday, October 19, 2017 6:12 PM
To: 'Suzanne Kennedy'; 'Kate Graf'; 'Scott McCann'; Brian McNamara; Richard Grimaldi; Mellanie Fuller
Cc: 'CSpencer@tep.com'; Charles W. Komadina; ZFang@tep.com; 'Colin Campbell'; Kaplan, Mary; Paine, Bob; Holladay, Cleveland
Subject: FW: Tucson Electric Power's IGS RICE Project: Urban vs Rural Determination Land Use Classification; Approval of Merge Plumes

Hi Cleve,

Thank you for your comments on the modeling procedures for the Tucson Electric Power's IGS RICE Project.

Rupesh Patel
Air Permit Engineering Manager
Pima County Department of Environmental Quality
33 N. Stone Ave, 7th Floor
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Subject: Tucson Electric Power's IGS RICE Project: Urban vs Rural Determination Land Use Classification; Approval of Merge Plumes

Hi Rupesh,

Here are my comments and approvals of the following modeling procedures. Tucson Electric Power may proceed to the use the "urban" land use option based on the procedure in Section 5 of the AERMOD Implementation Guide (Last Revised December, 2016). The use of this option is also based on population density data indicating urban (867/km2 vs 750 km2) and the Tucson International Airport wind rose showing predominant winds blowing from the southeast over the proposed project to the urban area to the northwest.

Tucson Electric may also proceed to use plume merging provided that the stack arrangement is the following as described in the applicant's "Technical and Policy Justification for Plume Merging: Tucson Electric Power's IGS RICE Project". For each group of the IGS RICE project's five stacks shown in Figure 2, two sets of stacks indicated by red boxes are proposed to be modeled as separate merged stacks (see orange stars in the figure) due to their separation in each group by slightly less than one stack diameter from every other stack in that group. One group of 3 stacks would be modeled as a single merged stack and the remaining 2 stacks would be modeled as a second (smaller) merged stack (a "3 + 2" configuration). This merging approach follows the

policy decisions from past EPA Model Clearinghouse memos that the merged stacks should be within one diameter of each other in the merging approach.

-Cleve Holladay
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Appendix B Technical and Policy Justification for Plume Merging: Tucson Electric Power's IGS RICE Project

AECOM Imagine it. Delivered.

Technical and Policy Justification for Plume Merging: Tucson Electric Power's IGS RICE Project

Project number	Client	Date	Prepared by
60530048	Tucson Electic Power Company	October 10, 2017	AECOM

Introduction

The calculation of plume rise from a point source is a key component in determining the downwind impacts associated with that source. Regulatory models such as AERMOD do not account for merging of plumes from nearby stacks, which can result in enhancements in the plume buoyancy. However, for stacks that are closely spaced, this consideration results in a more accurate characterization of the source.

For flues combined in a single stack, the assumption of enhancement of the plume buoyancy is intuitively obvious. For stacks with some finite separation, the determination of the enhancement is more complicated. In previous policy decisions[1,2], EPA has determined that full enhancement can effectively be assumed for stacks within 1 diameter of each other, citing the similarity of this situation to combining building tiers in EPA's Building Input Profile Program[3]. Studies cited below in this document refer to analyses of actual field data of plume merging as well as wind tunnel studies that indicate that plumes from adjacent, aligned stacks tend to combine, resulting in a buoyant plume rise greater than that from any one of the individual sources. The arrangement of the stacks as well as the stack exhaust parameters are factors involved in calculating the enhanced buoyancy flux.

AECOM has developed a procedure called AERLIFT, as documented in a peer-reviewed paper[4], to determine whether and to what extent the buoyancy of adjacent stacks will be enhanced. This procedure is based upon the Briggs algorithm involving plume rise from a row of stacks[5] that EPA has not yet incorporated into its guideline models.

In the following sections, a review of the Tucson Electric Power Company (TEP) proposed quick-start engine project and components of the AERLIFT formulation provide further support that specific stack groups associated with the TEP project should be modeled as merged.

Project Overview and Stack Merging Issue

TEP is proposing to modify the existing Irvington (Sundt) Generating Station (IGS) located in Tucson, Arizona, approximately 2 miles northeast of Tucson International Airport. The reciprocating internal combustion engine (RICE) project involves adding ten quick-start RICEs for the purpose of load stabilization to accommodate intermittent renewable energy sources (solar and wind) that feed into the system.

Figure 1 shows the proposed project layout for the RICE engines and the updated stack configuration. There are two sets of five RICE engine stacks shown in the Figure. A closer view of one of the two identical stack arrangements is shown in Figure 2.

---

[1] Model Clearinghouse memo 91-II-01, available at https://cfpub.epa.gov/oarweb/mchisrs/.
[2] Model Clearinghouse memo 6-V-10, available at https://cfpub.epa.gov/oarweb/mchisrs/.
[3] BPIP user manual is available at https://www3.epa.gov/scram001/userg/relat/bpipdup.pdf.
[4] Paine, R., Warren, L.L., Moore, G.E.,2016. Source Characterization Refinements for Routine Modeling Applications, *Atm. Env.* 129 (2016), 55-67. doi: 10.1016/j.atmosenv.2016.01.003. http://www.sciencedirect.com/science/article/pii/S1352231016300036
[5] Briggs, G.A., 1984. Plume rise and buoyancy effects. In *Atmospheric Science and Power Production*, edited by D. Randerson. U.S. Department of Energy Document DOE/TIC-27601 (DE84005177).

Figure 1: Proposed project layout in the vicinity of the RICE engines (top of figure faces SW)

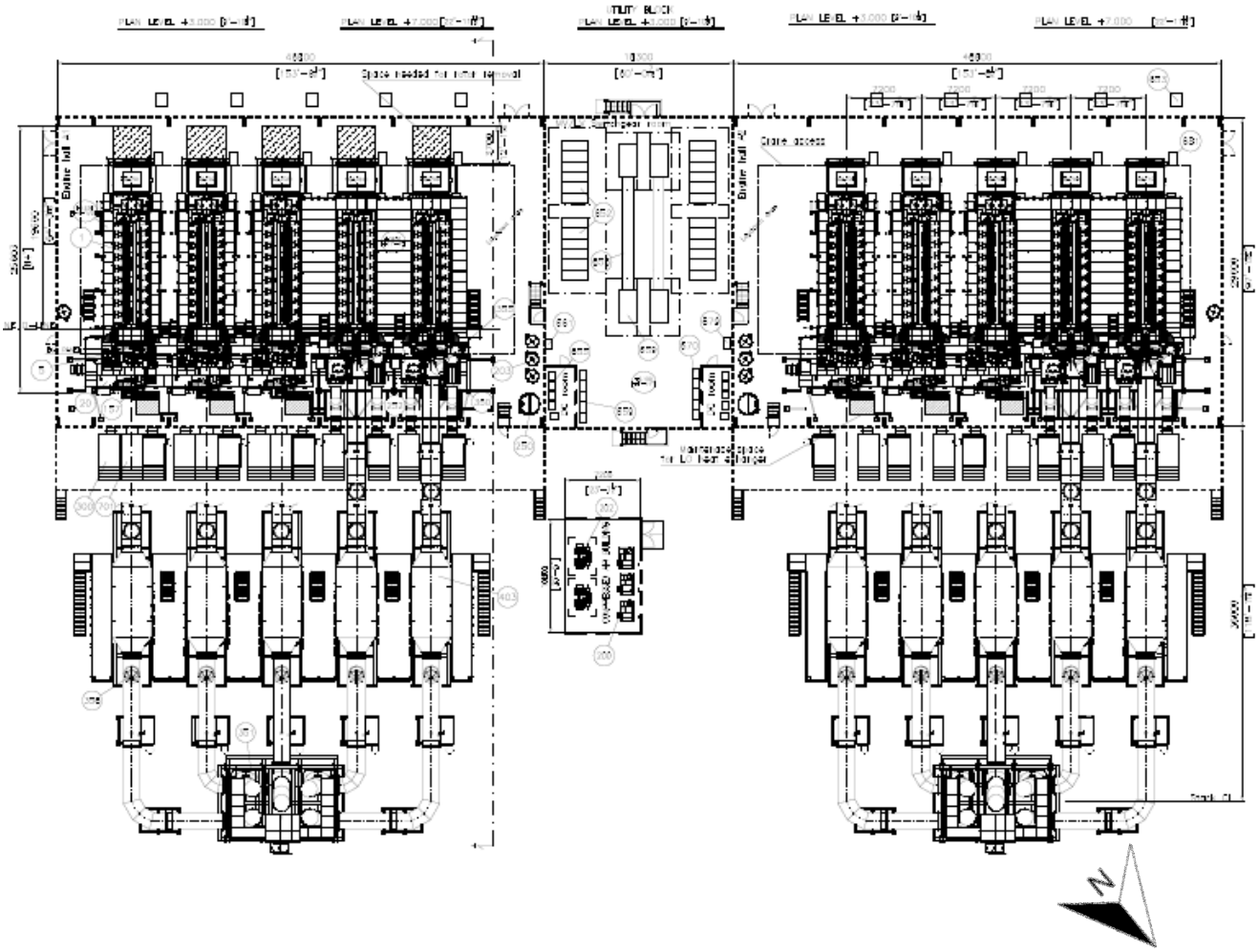
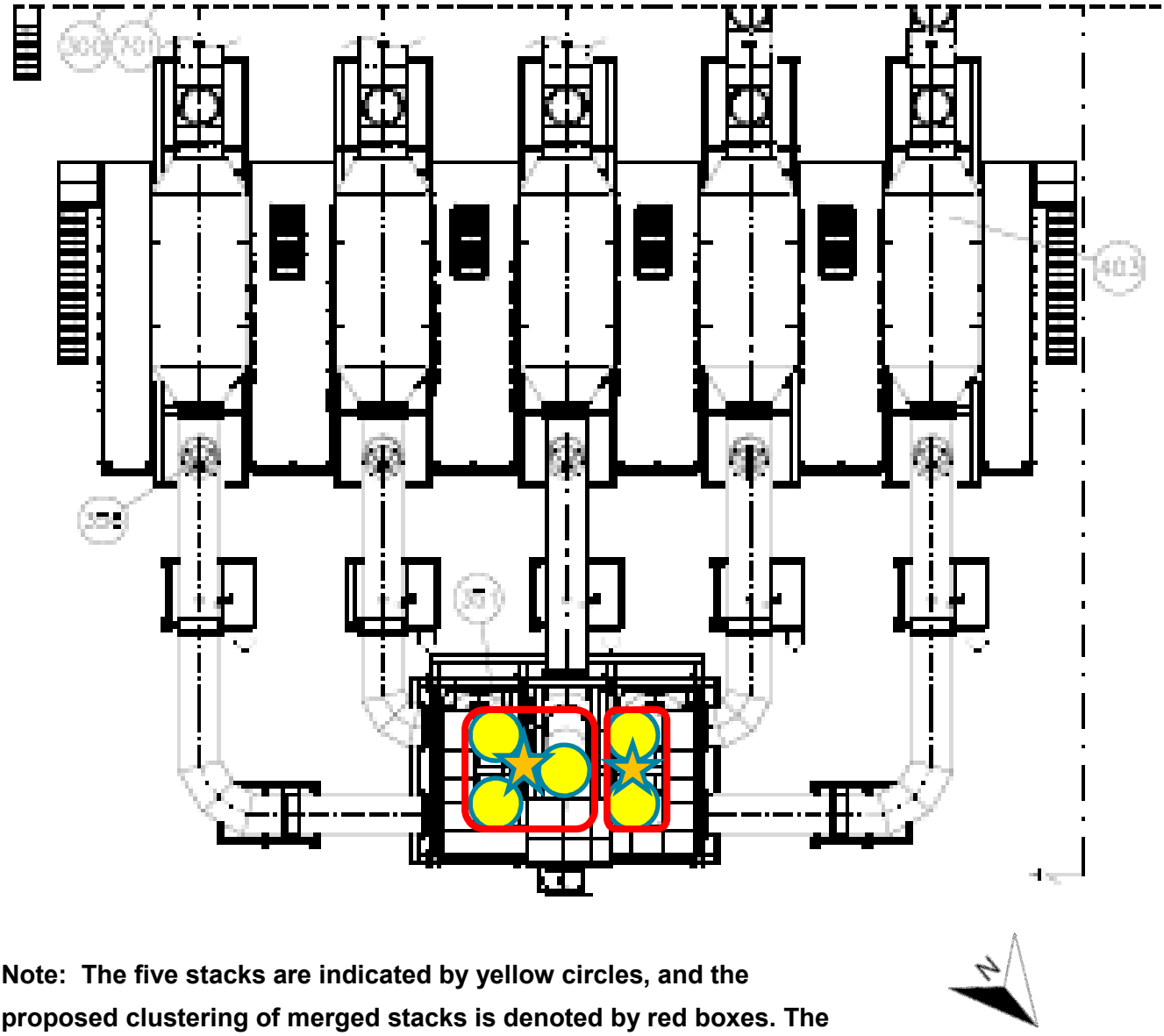


Figure 2: Close-up view of the 3+2 arrangement for one cluster of RICE engine stacks



Note: The five stacks are indicated by yellow circles, and the proposed clustering of merged stacks is denoted by red boxes. The orange stars indicate the locations of the merged stacks for modeling.

The stack configuration for the group of five stacks shown as yellow circles in Figure 2 for the proposed TEP RICE project is nearly identical to a similar project conducted in Oregon. The Port Westward Generating Plant (PWGP), owned and operated by Portland General Electric (located in Portland, Oregon), received approval from the Oregon Department of Environmental Quality to construct and operate 12 RICE generators (in groups of 6) in February of 2013 (see Appendix A, page 36). For the modeling demonstration, the stacks for each group of 6 RICE generators were located adjacent to each other in two rows of three stacks, as shown in Figure 3. Each six-stack group for the PWGP was represented in the modeling as a single point source with an effective stack diameter that equals the area of the six individual stacks. The stack diameters for the PWGP RICEs are 1.6 meters, which is identical to the RICEs that TEP are planning to install. With each of the PGWP stacks being within one diameter of each of the *nearest* stacks, it was realized that the cluster of stacks would result in air flow going around the cluster of plumes, which would effectively merge.

For each group of the IGS RICE project's five stacks shown in Figure 2, two sets of stacks indicated by red boxes are proposed to be modeled as separate merged stacks (see orange stars in the figure) due to their separation in each group by slightly less than one stack diameter from every other stack in that group. One group of 3 stacks would be modeled as a single merged stack and the remaining 2 stacks would be modeled as a second (smaller) merged stack (a "3 + 2" configuration). This merging approach is more conservative (less merging) than that approved for the Port Westward Generating Project, and it strictly follows the policy decisions from past EPA Model Clearinghouse memos that the merged stacks should be within one diameter of each other in the merging approach.

Preliminary modeling of the individual stacks shown in Figure 1 indicates that high SW wind conditions (with ~10 m/s winds blowing in a direction with the stacks lined up), result in peak daily concentrations for $PM_{2.5}$. Accordingly, we examined AERLIFT treatment of adjacent stacks for these conditions in the following section.

Figure 3: Photo of the operational Port Westward Power Plant RICE stacks

Photo Credit: Portland General Electric Company, http://www.pennenergy.com/articles/pennenergy/2015/01/pge-begins-operations-at-new-220-mw-natural-gas-fired-power-plant.html.

AERLIFT Calculations

In his "Plume Rise and Buoyancy Effects" Chapter 8[5], Briggs refers to the results of wind tunnel studies that indicate the usefulness of a merge parameter, S', to determine the effect of the angle of the wind relative to the stack alignment:

$S' = [\Delta s \sin\Theta] / [L_B^{1/3} (\Delta s \cos\Theta)^{2/3}]$ (Eq. 1)

Where,

Δs is the average spacing between the aligned stacks

Θ is the wind angle relative to the alignment angle of the adjacent, inline stacks

L_B is the buoyancy length scale = F_B / U^3 (Eq. 2)

F_B is the buoyancy flux = $g\, v_S^{\,2} D_S^2 / 4\, (T_S - T_A)/T_S$ (Eq. 3)

U is the wind speed at plume height

V_S is the stack gas exit velocity

T_S is the stack gas temperature

T_A is the ambient temperature

D_S is the stack diameter

Due to the stack alignment for winds blowing across the proposed engine building structures (and no downwash for winds blowing perpendicular to the sets of stacks considered for merging), we considered alignment angles up to 75 degrees from a line associated with winds from the SW for this technical review.

Briggs indicated that wind tunnel studies using neutral conditions showed that if S' is less than 2.3, then buoyancy enhancement would take place, while values above 3.3 indicate very little enhancement (intermediate values would indicate partial enhancement).

The value of S' was calculated for the TEP RICE project to determine if buoyancy enhancement would occur for 2 stacks with up to 1 diameter in stack separation (from the outside of the stacks). The stack diameter is 1.6 meters, gas exit temperature is 633.16 K, and gas exit velocity is 29.45 m/s. An ambient temperature of 295 K was used, based on a 5-year annual average from Tucson International Airport. A buoyancy flux (F_B) of 2,906 m^4/s^3 was determined for each individual stack by applying TEP's RICE-specific variables to Eq. 3. The final step required before S' was calculated was the determination of the buoyancy length (L_B) (Eq. 2). A review of the top 50 maximum 24-hour PM near-field impacts (Class II receptors) was conducted to see what the wind speed at plume height (U) was for the controlling modeled impacts. Table 1 summarizes the dates and the corresponding 24-hour average wind speed at plume height. The highest controlling wind speed from this dataset is 8.66 m/s. For this worst-case wind speed, the buoyancy length (L_B) is about 4.47 meters.

For all angles considered, the value of S' was below the threshold value of 2.3, indicating that buoyancy enhancement calculations are appropriate.

Table 1: Dates and 24-hour wind speeds from top 10 modeled impacts for 24-hour Class II modeling

Date (mm/dd/yyyy)	24-hour Average Wind Speed at Plume Height (m/s)
01/02/2012	7.77
11/12/2013	8.66
11/13/2013	7.71
11/26/2013	6.96
01/24/2014	6.90
01/09/2015	6.03
01/02/2016	7.97
01/03/2016	7.68
11/09/2016	8.31
11/26/2016	7.29

With the confirmation that plume merging should be accounted for in an arrangement with any stack within a diameter of any other stack, we then applied an AERLIFT formulation for the buoyancy enhancement of at least 2 stacks. We also accounted for other factors noted above due to the merging of adjacent plumes which can be taken from Manins implementation[6] of Briggs formulation:

Buoyancy enhancement factor $E = [n+S]/[1+S]$ (Eq. 4)

where,

n is the number of stacks in the row

S is a separation factor $= 6 \{[(n-1)\ \Delta s]/[n^{1/3}\ \Delta h]\}^{3/2}$ (Eq. 5)

and

Δh is the plume rise for one stack.

For Eq. 2, we computed the enhancement factor for 2 stacks to determine if the total is close to 2.0, indicating full enhancement.

Modeling for a single RICE engine stack for effective wind speeds of about 8.66 m/s yields a plume rise of at least 42 m.

The appropriate value for Δs in this case is 2 stack diameters (where Δs is the separation of the stacks between stack *centers*) for the case of 1 stack diameter between the stack outer walls.

For a separation between stacks as proposed (Δs = 3.2 meters for 2 stack diameters between stack centers, although the actual separation will be slightly less), the buoyancy enhancement as calculated by Eq. 4 is 1.996, which is very close to a full merging of buoyancy fluxes. The buoyancy enhancement for a cluster of 3 stacks as shown in Figure 2 (e.g., 3 stacks arranged in a triangular formation), would also be expected to be very close to a full merging because the cluster of 3 stacks will be more likely to force air flow around the plume cluster from all directions.

[6] Manins P, Carras J and Williams D, (1992), Plume Rise from Multiple Stacks. Clean Air (Australia). Volume 26, Part 2. pp 65-68.; see http://www.planning.nsw.gov.au/asp/pdf/08_0021_bamarang_ps_stage2_ea_app_c_pt3.pdf

Summary and Conclusions

A technical analysis was conducted to determine the likelihood that enhancement of the plume buoyancy occurs from stacks that are very close in proximity to each other. We have demonstrated, through a quantitative and peer-reviewed approach, that for the proposed RICE stacks with a separation distance slightly less than their diameter, plume buoyancy would effectively be fully enhanced by the interaction of the adjacent stack plumes. The result of this analysis, in addition to precedent policy decisions cited above, supports merging of 3 adjacent stacks arranged in a triangular formation with each stack having a separation from the outside of the stack within 1 diameter of the other 2 stacks, as well as the other 2 adjacent stacks in a line, as shown in Figure 2.

Appendix C Tucson Electric Power Company Irvington (Sundt) Generating Station: PLUVUE II Assessment of Visible Plumes at Saguaro National Park East and West

AECOM

Tucson Electric Power Company Irvington (Sundt) Generating Station: PLUVUE II Assessment of Visible Plumes at Saguaro National Park East and West

Tucson Electric Power Company

Project Number: 60530048

December 22, 2017

Quality information

Prepared by	Checked by	Approved by
David Heinold Sr. Air Quality Meteorologist	Robert J. Paine Associate Vice President	Mary Kaplan Project Manager

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Attachment D: Time-series Plots of the Modeled Case 2 Visibility Parameters for Each Observer for a Background Sky, Black Background Terrain and Gray Background Terrain

1. Introduction

1.1 Project Overview

Tucson Electric Power Company (TEP) is proposing to modify the existing Irvington (Sundt) Generating Station (IGS) located in Tucson, Arizona, approximately 2 miles northeast of Tucson International Airport. The reciprocating internal combustion engine (RICE) project involves adding ten quick-start RICEs for the purpose of load stabilization to accommodate intermittent renewable energy sources (solar and wind) that feed into the system. This project will also allow the retirement of two less efficient, older units (Units 1 & 2) at IGS.

1.2 Purpose of this Supplemental Report

The purpose of this document is to present methods and results of a refined (PLUVUE II) analysis requested by the National Park Service (NPS) to assess the potential for visible plumes to be present within Saguaro National Park due to emissions from project sources. This analysis was conducted in support of the air permit application for the RICE project. The modeling procedures are intentionally conservative in that they do not account for the off-setting effect associated with the removal of sources to be retired at the facility. In addition, the modeling assumes that the RICE units continually operate, either in a start-up mode (Case 1) or at full load (Case 2), and it is assumed that a Park visitor is present at each observation point for all daylight hours. Although it is projected that the utilization of the units will be far less than modeled, this aspect is only qualitatively included in the results discussion. Modeling methods and assumptions, including model selection and options, meteorological data and source parameters, are presented in this report to assist the NPS, U.S. Environmental Protection Agency (EPA), and Pima County Department of Environmental Quality (PDEQ) in their review.

1.3 Contents of the PLUVUE Modeling Report

Section 2 of this document contains a project description, including information regarding the equipment, location and the expected air pollutant emissions. Section 3 presents a detailed description of the modeling approach that was used in evaluating the potential for visible plumes at Saguaro National Park. Section 4 presents the detailed results of the PLUVUE II modeling analysis that was submitted to the NPS in support of the PSD permit application on December 19th, 2017.[1] Section 5 summarizes the results of the plume visibility assessment.

[1] E-mail from John Notar of NPS on December 19, 2017 to Mary Kaplan of AECOM confirmed receipt of the modeling archive.

2. Project Description

2.1 Project Location and Layout

The proposed RICE project will be sited at the existing IGS located in Tucson, Arizona, approximately 2 miles northeast of Tucson International Airport. The coordinates of the IGS are 509,448 meters Easting, 3,557,910 meters Northing in Universal Transverse Mercator (UTM) Zone 12 referenced to NAD 83. An aerial map of the site region is provided in **Figure 2-1**.

The terrain surrounding IGS is generally flat within 10 kilometers before the landscape changes with the addition of rolling hills, rugged canyons and mountain peaks. **Figure 2-2** shows the varying elevations associated with these features near IGS.

2.2 Description of the Proposed Engines

The proposed modification at IGS includes the installation of ten RICEs, in two groups of five engines. Each group of engines has a cluster of five stacks, which for the modeling of CO and $PM_{2.5}$ pollutant concentrations were simulated as merged groups of 2 and 3 stacks in a procedure that has been separately approved by EPA. These engines will only be fired by natural gas and each will be installed with selective catalytic reduction (SCR) control utilizing ammonia and oxidation catalyst for CO and VOC control. The two clusters of five stack sources are separated by a distance of nearly 100 m, aligned at an angle of 130° from true north as shown in **Figure 2-3**. For modeling plume visibility, it is conservatively assumed that the exhausts from the ten engines merge into a single plume, such that the effective emission source is placed at the centroid of the units, located at 509,240 UTM East and 3,557,820 UTM North in Zone 12 as indicated in the figure.

2.3 Emissions and Source Characterization

For the refined PLUVUE II plume visibility assessment, natural gas-fired RICE emissions of three optically active pollutants were considered: sulfur dioxide (SO_2), nitrogen oxides (NO_x) and particulate matter (PM). When released to the atmosphere, a fraction of the nitric oxide (NO) in the NO_x is transformed to NO_2, which preferentially absorbs shorter wavelength portions of visible light spectrum. The primary optical effect of non-carbonaceous particulate matter is to scatter visible light. Both types of optical effects are simulated in PLUVUE II, the refined plume visibility model recommended by the NPS.

Figure 2-1 Aerial Image of the Irvington Generating Station

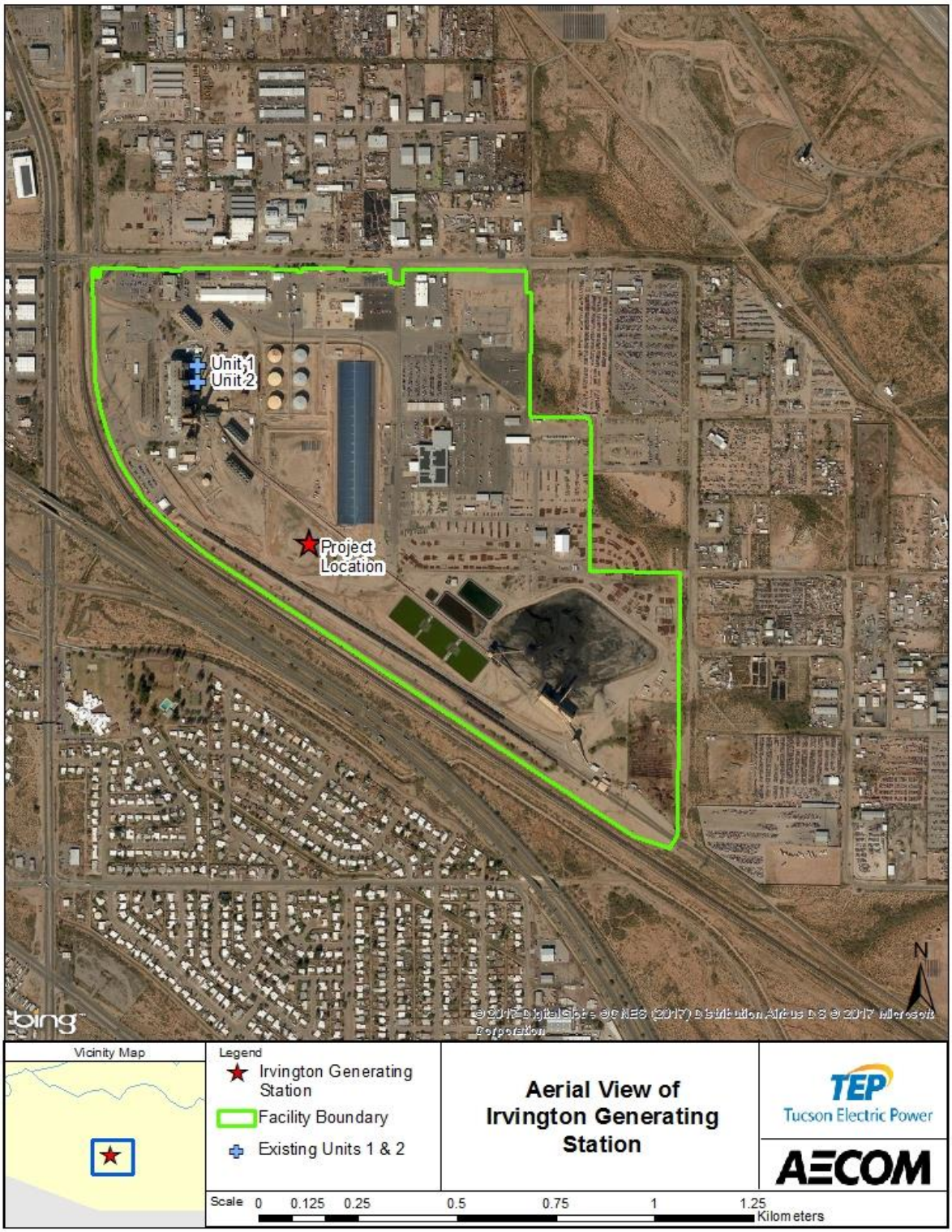


Figure 2-2 Topographic Map Showing Terrain Features Surrounding the Irvington Generating Station

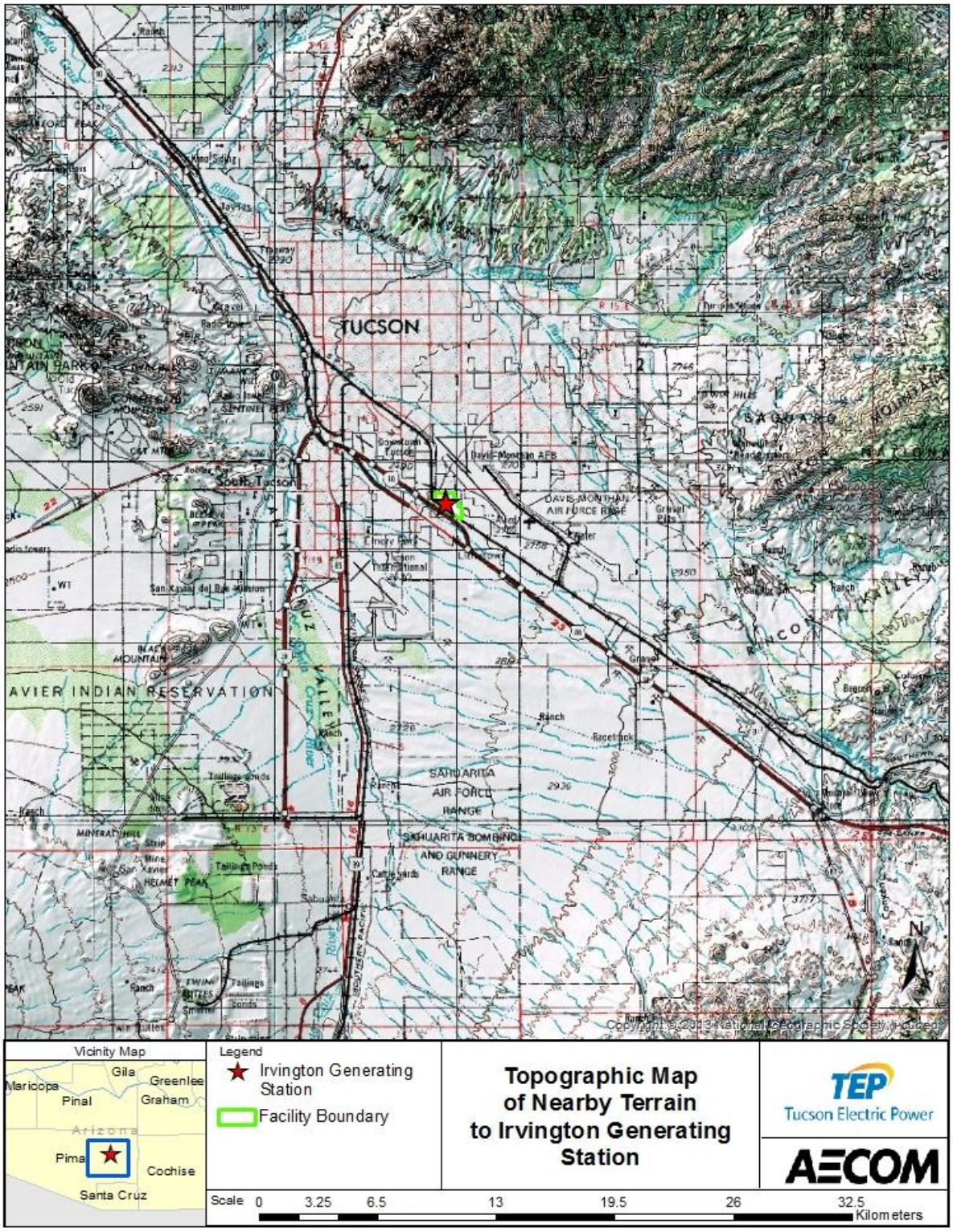
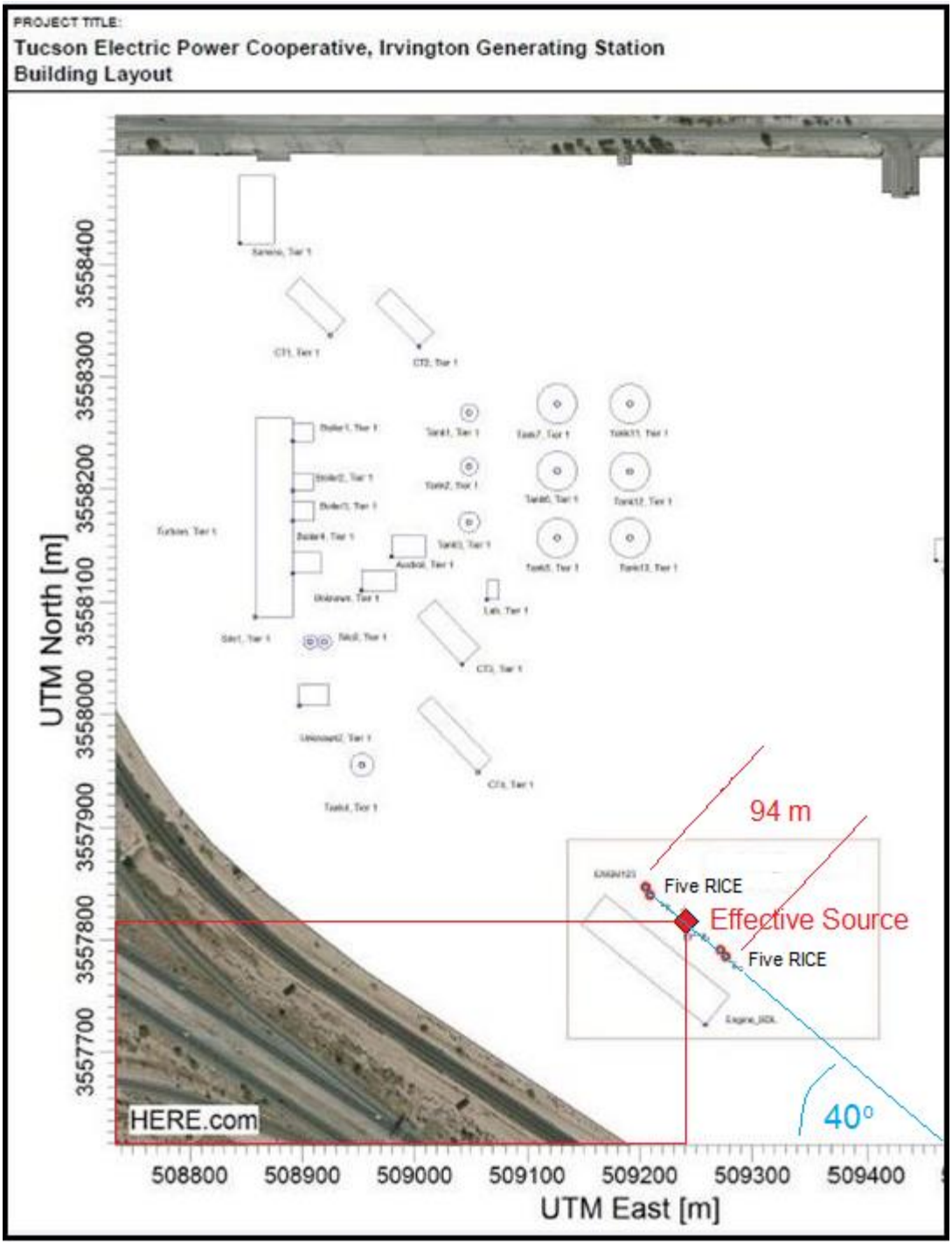


Figure 2-3 Location of RICE Units and Effective Source for the Plume Visibility Assessment



Two emission cases were considered for the plume visibility assessment:

- Case 1: maximum 1-hour average emissions accounting for the rare simultaneous start-up of all 10 RICE units within 30 minutes, plus 30 minutes running at 100% load in the same hour (this is a conservative case since one RICE unit is typically operating at a minimum of 50% load and the simultaneous start of all other engines is not typical); and
- Case 2: emissions from all 10 RICE units at 100% load (this case is more likely, especially in summer, but is still not expected to occur more than about 10% of the time on an annual basis).

While it is understood that that the Case 1 start-up emissions are of primary interest because they are higher, the more likely event is Case 2. The emission rates for the two emission cases that were modeled in the plume visibility assessment are provided in **Table 2-1.**

Table 2-1 Emissions Summary for All Ten RICE Units (pounds per hour)

Pollutant	Case 1	Case 2
SO_2	0.33	0.33
PM	29.85	23.7
NOx	110.5	15

For purposes of modeling with PLUVUE, which simulates dispersion from a single location, the emissions of all 10 units are combined. Note that because PLUVUE is limited to simulate dispersion from a single stack, the source characterization necessarily differs from the approach approved by EPA for criteria pollutant modeling, in which four effective stacks were modeled, two stacks for each RICE cluster of 5 units[2,3]. For PLUVUE, the effective stack parameters for the proposed project used the actual release height, exhaust temperature and exit velocity for each RICE unit. In order to simulate plume rise that approximates the criteria pollutant modeling that used 4 stacks, 1/4th of the total exhaust flow rate from all 10 RICE units combined was used for the single PLUVUE stack. The stack parameters for the effective source used in the visibility assessment are provided in **Table 2-2.**

Table 2-2 Stack Parameters Applied in the PLUVUE II Visibility Assessment

Description	Stack Height (ft)	Temperature (K)	Volumetric Flow Rate (acfm)	Exit Velocity (m/s)
Engines 1-10	160	629	308,800	28.985

To accommodate spatial separation of emission sources in PLUVUE, the separation between the two groups of stacks (to the outermost stacks, about 94 meters) was accounted for by an initial plume width, represented by the dispersion coefficient sigma-y. Because the RICE units are in two clusters, the effective horizontal spread is dependent on wind direction. When the wind direction is either 130° or 310°, the plumes from both clusters align and there is no additional horizontal dispersion due to the separation of the stack groups. When the wind direction is perpendicular to the stack lineup (40° or 220°), δy_o = 94/4.3, or about 22 m (following the EPA guidance for volume sources[4]). For other wind directions, the initial horizontal dispersion is in between these values. As such, the value of the initial sigma-y applied in the PLUVUE II simulations was based on the wind direction for the selected hour of meteorology.

[2] E-mail from Cleveland Holladay, EPA Region 9, to Rupesh Patel, Pima County, Arizona, dated October 19, 2017.
[3] EPA approved the merging of groups of stacks that are within one diameter of each other. This has resulted in a division of the cluster of 5 stacks at each RICE group into sets of 2 and 3 stacks being modeled as if the stacks were in a single merged stack.
[4] Table 3-2. Summary of Suggested Procedures for Estimating Initial Lateral Dimensions σyo and Initial Vertical Dimensions σzo for Volume and Line Sources, User's Guide for the AMS/EPA Regulatory Model (AERMOD) EPA-454/B-16-011, December, 2016

3. PLUME Visibility Assessment Procedures

The plume visibility assessment followed guidance provided by the National Park Service in consultation with staff at Saguaro National Park and applying AECOM's experience in conducting refined plume visibility assessments. Modeling protocols for this analysis were submitted in original form on November 17, 2017, and in revised form (responding to National Park Service comments) on December 7, 2017. Minor technical issues were also noted in subsequent e-mail communications between David Heinold of AECOM and John Notar of the National Park Service[5]. This report documents the final procedures used and presents the results of the modeling approach.

3.1 Model Selection

Two EPA plume visibility models were applied in this assessment, VISCREEN and PLUVUE II. VISCREEN was applied first to determine under what atmospheric stability conditions the visible plume impacts are certain to be insignificant. This information was then used to determine the remaining hours that are appropriate for a refined assessment using PLUVUE II. VISCREEN is appropriate as a screening model for this type of application because it incorporates an observer's line-of-site through a plume and sun angle that maximizes the absolute value of the modeled plume perceptibility parameters. A prior VISCREEN analysis has been documented in a modeling package submitted to the reviewing agencies on October 26, 2017. PLUVUE II is appropriate for the refined assessment because it incorporates specified observer points and lines of sight for various hours of the day, times of year and corresponding weather conditions.

Meteorological data required for AERMOD includes hourly values of wind speed, wind direction, and ambient temperature, but it computes dispersion differently than VISCREEN and PLUVUE II, which use discrete stability classes. Stability classes vary from Stability A, representing highly unstable midday conditions, to Stability F, representing stable nighttime conditions. As noted below, PLUVUE II also requires the derivation of other meteorological parameters not used in AERMOD.

3.1.1 Available Meteorological Data for PLUVUE II

The Arizona Department of Environmental Quality (ADEQ) has pre-processed meteorological data[6] for 2012-2016 for the Tucson International Airport (surface and upper air), using AERMET version 16216 along with AERMINUTE version 15272 and AERSURFACE version 13016. The airport is located approximately 5 kilometers to the southwest of IGS and is the only ASOS station in the Tucson area. This data set was used for the air quality impact analysis. A wind rose using the five-year period from 2012 to 2016 is provided as **Figure 3-1**.

PLUVUE II requires the following additional meteorological parameters not provided by AERMET:

- atmospheric stability category

[5] E-mails from David Heinold of AECOM to John Notar of NPS 1) "TEP Protocol" 12/4/17; 2)"TEP Plume Assessment" 12/14/17
[6] Arizona Department of Environmental Quality (ADEQ) AERMOD-ready meteorological data files are available at http://www.azdeq.gov/node/2127.

- temperature lapse rate near the surface and
- Holzworth mixing depth[7].

Stability and mixing height for input to PLUVUE were determined using the PCRAMMET[8] program that was in use for the ISC model (prior to AERMOD). The temperature lapse rate for each hour was computed from the potential temperature lapse rates for stability categories as specified in the Industrial Source Complex Model User's Guide: Stability F: 0.035 K/m, Stability E: 0.02 K/m. For neutral and unstable conditions, the potential temperature lapse rate was set to zero.

3.2 Class I Areas for the Visible Plume Analysis

FLAG Guidance indicates that proposed sources within 50 km of a PSD Class I area need to perform a modeling evaluation of visible plumes as an Air Quality Related Value. As shown in **Figure 3-2**, Saguaro National Park East and West Units are the only Class I areas within 50 km of the RICE units.

3.3 Background Data for PLUVUE II Modeling

PLUVUE requires the input of background concentrations of ozone, NO_x and NO_2 as well as background visual range. Hourly background pollutant concentrations were taken from a local ADEQ monitor located in Tucson at 22nd and Craycroft (yellow star in **Figure 3-3**).

The background visual range is a measure of the amount of ground-level light extinction in the background atmosphere through which the plume is viewed. For the VISCREEN assessment, the background visual range was set to the natural background of 252 km specified by the NPS, which corresponds to the highest monthly value.

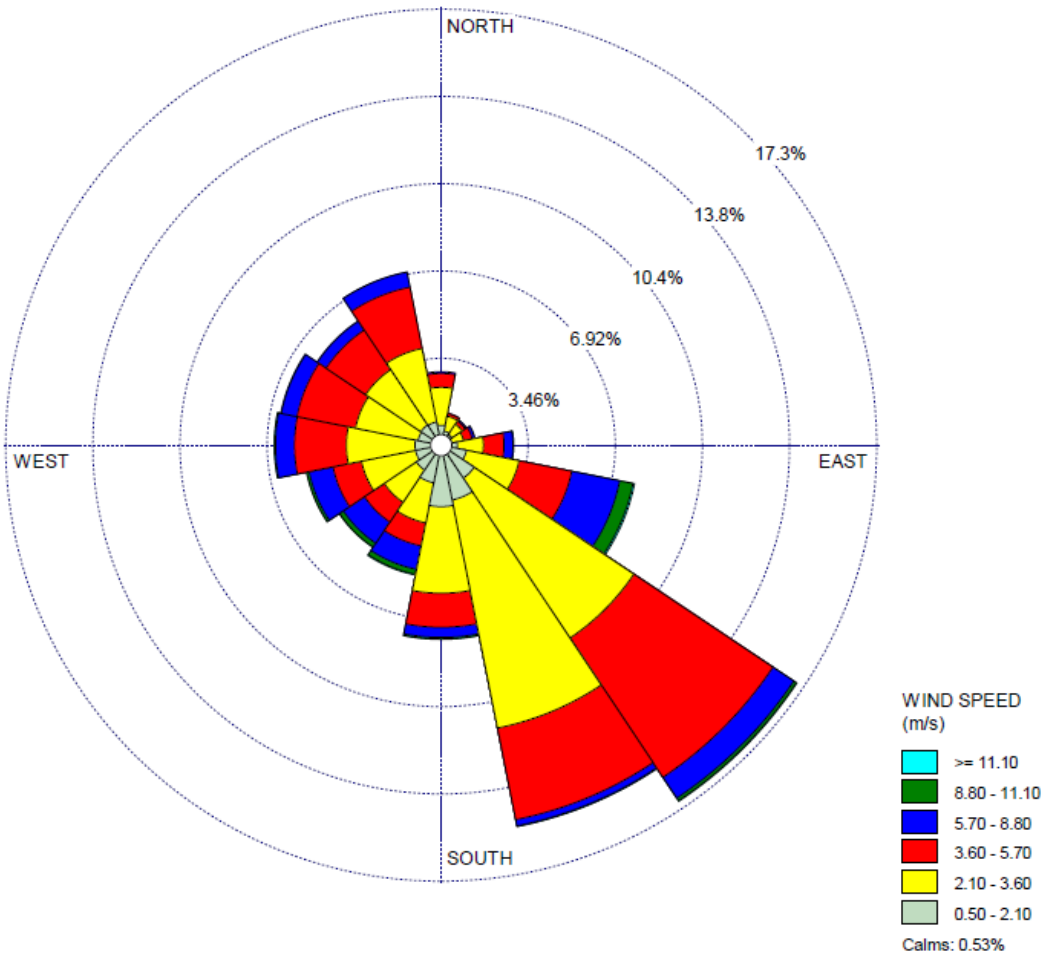
PLUVUE II uses the background visual range to calculate the concentration of fine particulate in the atmosphere. For hours where the specified background concentrations of NO_2 result in a greater degree of extinction than accounted for by the background visual range, the model will not run because the concentration of fine particulate would have to be negative to match the very low level of assumed (naturally clean) background extinction. This was an issue that occasionally prevented model from running to completion. A sensitivity analysis determined that the modeled parameters were not sensitive to the NO_2 specification and thus, rather than excluding these hours, the background NO_2 concentration for these hours was set to zero, allowing the model to run.

[7] Holzworth, 1972, Mixing Heights, "Wind Speed and Potential for Urban Air Pollution Throughout the Contiguous United States", AP-101, Appendix B, page 110
[8] Available at https://www.epa.gov/scram/meteorological-processors-and-accessory-programs#pcrammet.

Figure 3-1 Wind Rose from Tucson International Airport 2012-2016

WIND ROSE PLOT:
Tucson International Airport
2012-2016

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 1/1/2012 - 00:00 End Date: 12/31/2016 - 23:59	AECOM	
	CALM WINDS: 0.53%	TOTAL COUNT: 43696 hrs.	AECOM
	AVG. WIND SPEED: 3.53 m/s	DATE: 6/8/2017	PROJECT NO.:

Figure 3-2 Class I Areas within 50 km of IGS

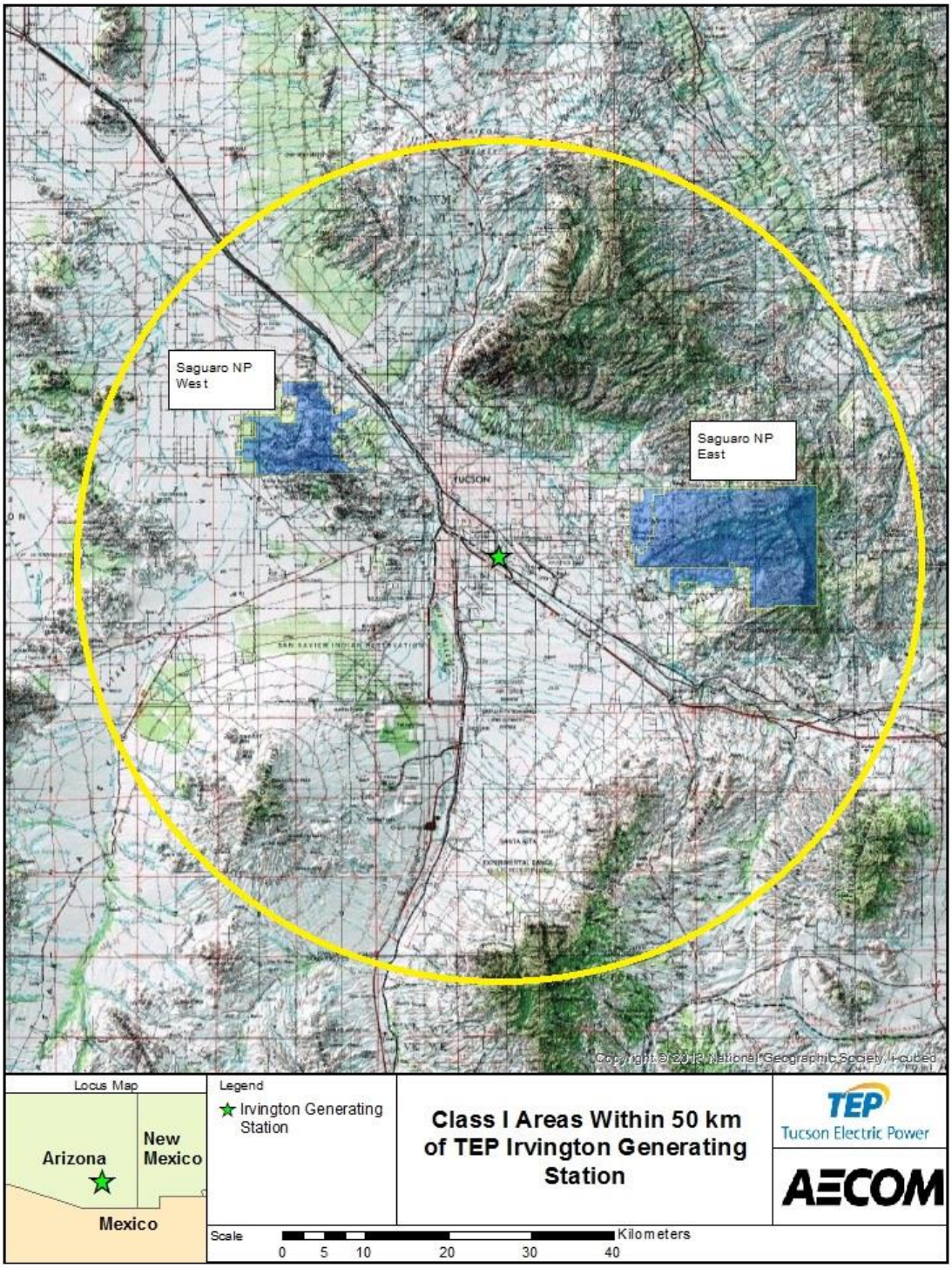
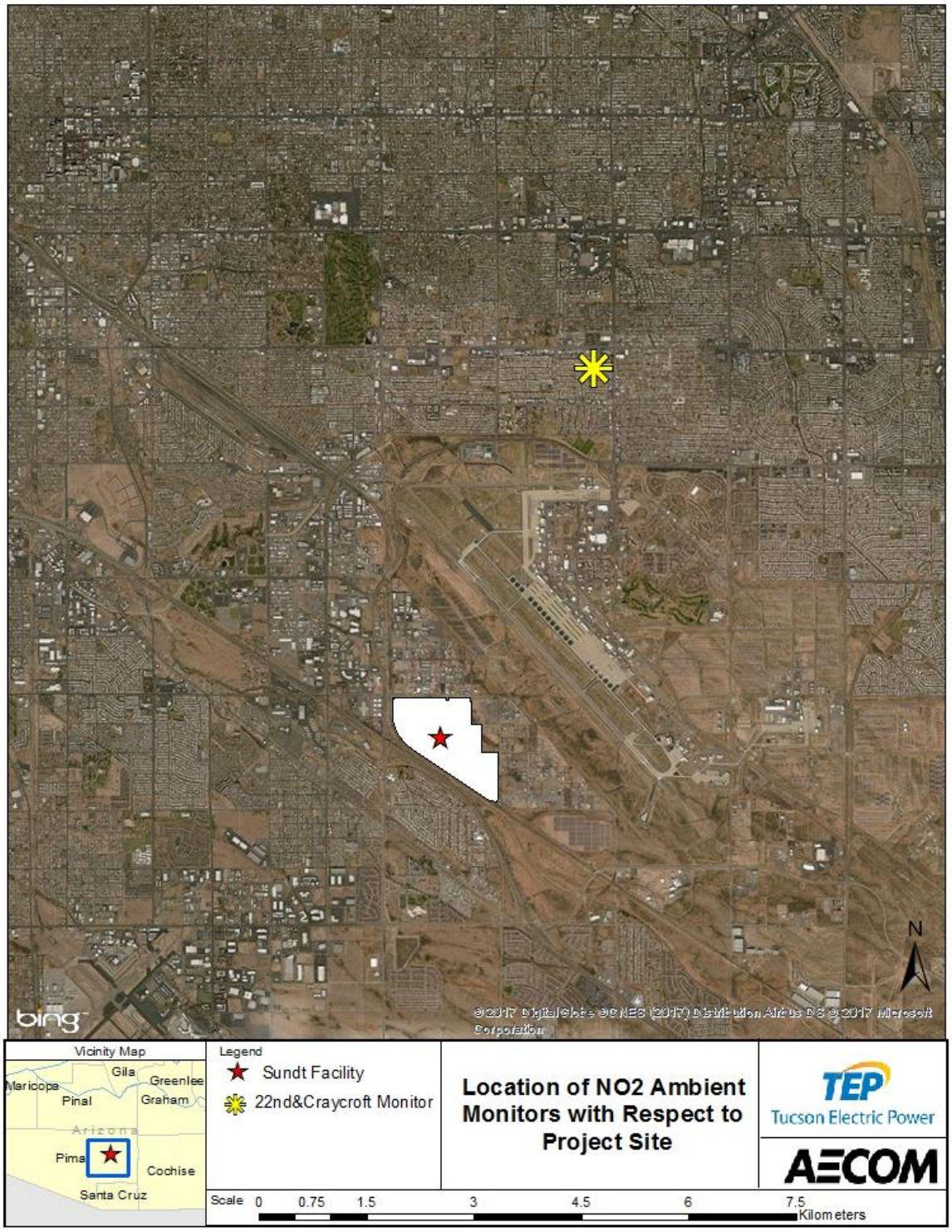


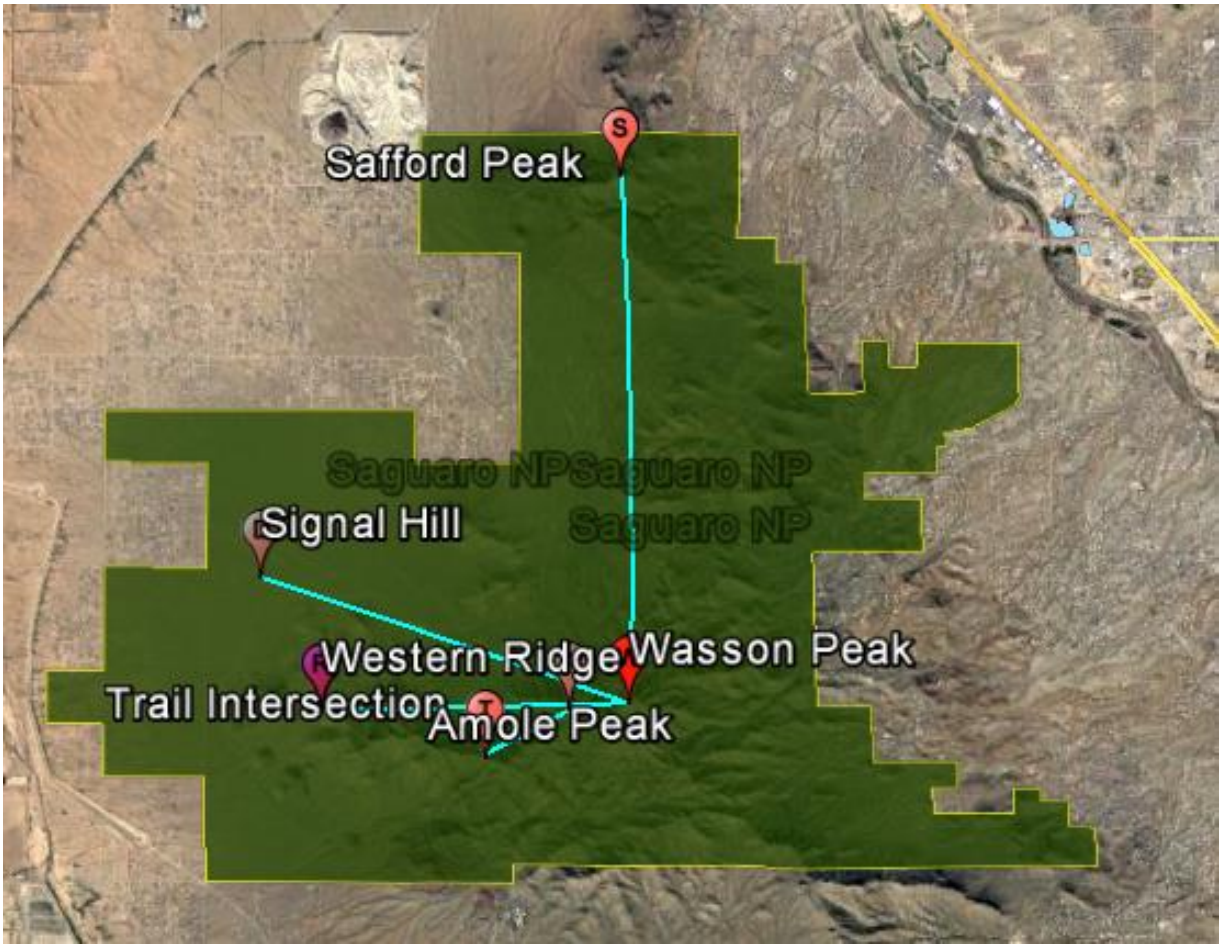
Figure 3-3 Locations of Nearby Ambient Monitor for Ozone and NO_2



3.4 Selection of Observer Locations for PLUVUE Modeling

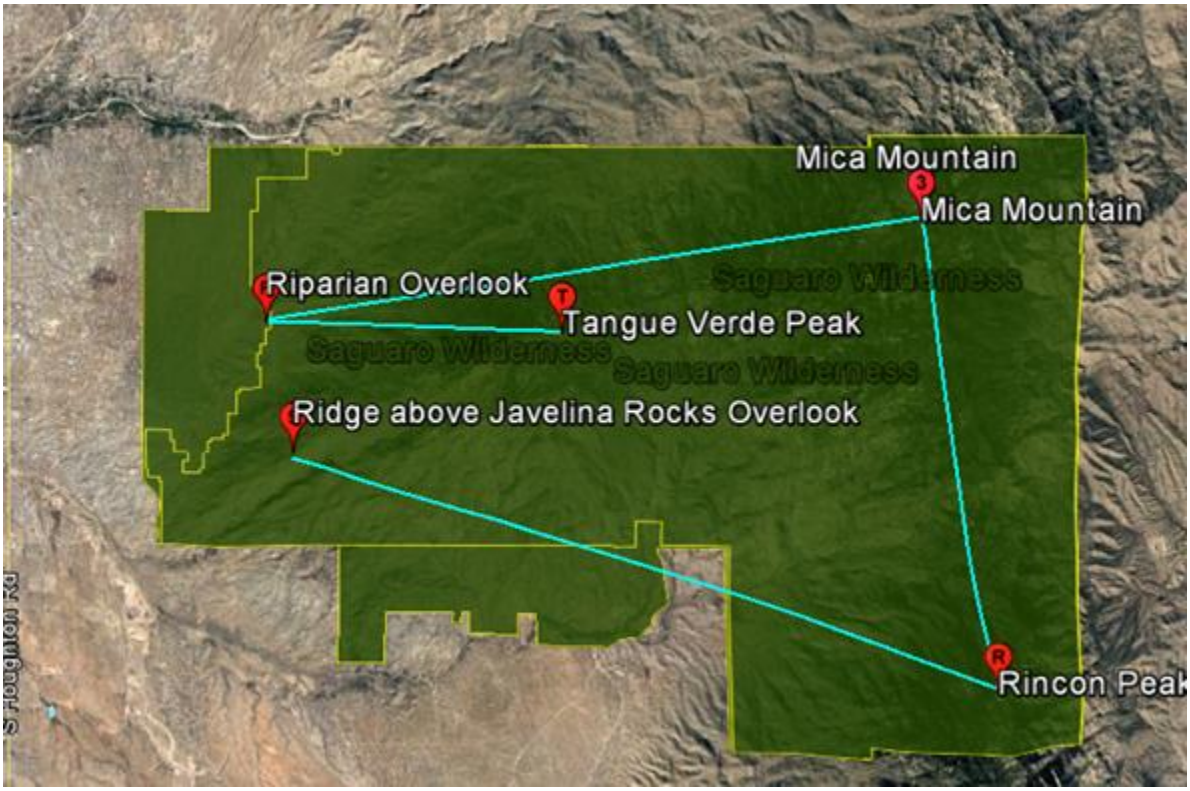
As specified by the National Park Service[9], the visible plume assessment addressed 16 combinations of observer locations and terrain features. These locations are shown in **Figures 3-4** and **3-5** for West and East units, respectfully. An observer was placed on each end of the primary line-of-sight indicated by the light blue lines, looking toward the terrain on which the corresponding observer was assumed to be standing. Details of the geometry for each observer-terrain pair are provided in **Table 3-1**. Hours with wind directions which cause the centerline of the plume to cross the line-of-sight and which also meet criteria discussed below were assessed with PLUVUE II.

Figure 3-4 Observer-Terrain Target Combinations at SNPW



[9] 8 observer locations in each unit of Saguaro National Park were finalized by the National Park Service on November 29, 2017 after several e-mail and conference call informational exchanges.

Figure 3-5 Observer-Terrain Target Combinations at SNPE



In addition to the primary line-of-sight, other lines of sight through which the plume could potentially be observed within the Class I area from each observer location were simulated, ensuring the simulation of observer-plume-sun geometries that maximize the modeled plume visibility parameters. To accomplish this, PLUVUE was applied in an observer-based mode with lines of sight passing through the plume at 16 downwind distances (the maximum number allowed in PLUVUE II). These distances included the four prescribed in the User's Guide (1, 2.5, 5 and 10 km) that are required for the model to run properly. Note that these first four distances were not analyzed for plume visibility since they reside outside the Class I areas. The distances that were evaluated for the plume visibility assessment included the NPS-recommended primary line-of-sight plus another eleven distances, evenly spaced between the closest and furthest point in the Class I area for a plume path that bisects the observer and the terrain target. The model requires as input the terrain elevation (feet above mean sea level) to be specified for each of these downwind distances along this path.

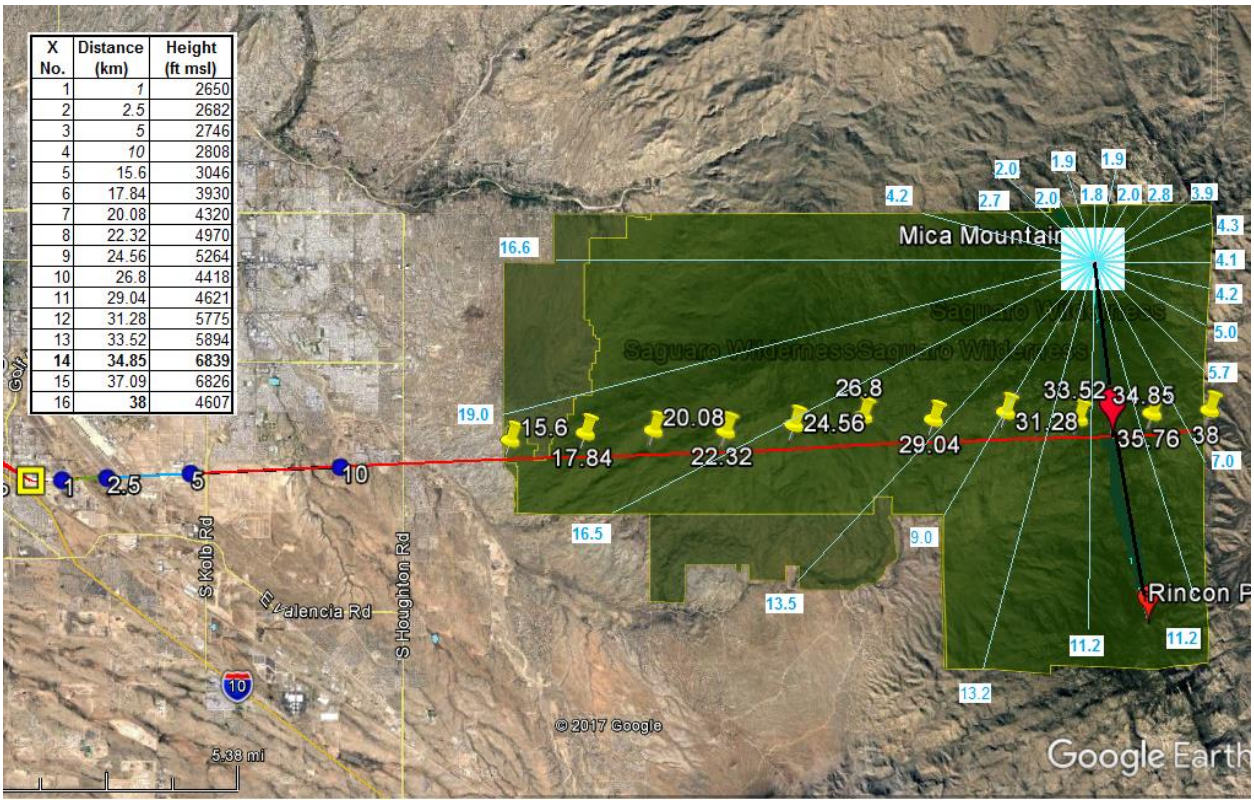
Another parameter that was specified is the straight-line distance (km) from the observer to the terrain of interest. This was specified in 15° intervals around the compass. For the 15° intervals that bracket the primary line-of-sight, the terrain distance was specified as the distance between the observer and the terrain target specified by the NPS. For other directions, the terrain distance was set to the distance to the nearest Class I area boundary.

An illustration of how the various parameters were specified for a selected observer is provided in **Figure 3-6**, which depicts an observer at Mica Mountain at Saguaro National Park East with a primary line-of-sight toward Rincon Peak at a distance of 11.2 km. Depictions of each observer-terrain pair with selected downwind distances and terrain elevation, are provided in **Attachment A**.

Table 3-1 Details for Recommended Lines-of-Site

Class I Area	Line-of-Sight ID	Observer	Viewing Target	Observer		Viewing Target		Observer-Target Distance (km)	WD to Observer (deg)	WD to Target (deg)	Size of WD Window (deg)	LOS-Plume Angle (deg)
				UTME (m)	UTMN (m)	UTME (m)	UTMN (m)					
SNPW	W1	Trail Intersection	Amole Peak	483884	3569878	485214	3570618	1.5	115.4	118.0	2.6	87.6
SNPW	W2	Amole Peak	Trail Intersection	485214	3570618	483884	3569878	1.5	118.0	115.4	2.6	87.6
SNPW	W3	Wasson Peak	Western Ridge	486161	3570726	481258	3570571	4.9	119.2	114.5	4.7	115.0
SNPW	W4	Western Ridge	Wasson Peak	481258	3570571	486161	3570726	4.9	114.5	119.2	4.7	115.0
SNPW	W5	Wasson Peak	Signal Hill	486161	3570726	480321	3572622	6.1	119.2	117.1	2.1	100.1
SNPW	W6	Signal Hill	Wasson Peak	480321	3572622	486161	3570726	6.1	117.1	119.2	2.1	100.1
SNPW	W7	Wasson Peak	Safford Peak	486161	3570726	485884	3578731	8.0	119.2	131.8	12.6	37.5
SNPW	W8	Safford Peak	Wasson Peak	485884	3578731	486161	3570726	8.0	131.8	119.2	12.6	37.5
SNPE	E1	Rincon Peak	Ridge above Javelina Rocks Overlook	544996	3553814	528384	3559211	17.5	276.4	265.9	10.5	16.8
SNPE	E2	Ridge above Javelina Rocks Overlook	Rincon Peak	528384	3559211	544996	3553814	17.5	265.9	276.4	10.5	16.8
SNPE	E3	Rincon Peak	Mica Mountain	544996	3553814	543063	3564890	11.2	276.4	258.2	18.2	82.8
SNPE	E4	Mica Mountain	Rincon Peak	543063	3564890	544996	3553814	11.2	258.2	276.4	18.2	82.8
SNPE	E5	Mica Mountain	Riparian Overlook	543063	3564890	527712	3562246	15.6	258.2	256.6	1.6	22.4
SNPE	E6	Riparian Overlook	Mica Mountain	527712	3562246	543063	3564890	15.6	256.6	258.2	1.6	22.4
SNPE	E7	Riparian Overlook	Tangue Verde Peak	527712	3562246	534751	3562179	7.0	256.6	260.4	3.8	12.1
SNPE	E8	Tangue Verde Peak	Riparian Overlook	534751	3562179	527712	3562246	7.0	260.4	256.6	3.8	12.1

Figure 3-6 Illustration of Plume Trajectory, Observation Points, Plume Path Elevation and Radial Terrain Distances for an Observer at Mica Mountain and Target at Rincon Peak



X No.	Distance (km)	Height (ft msl)
1	1	2650
2	2.5	2682
3	5	2746
4	10	2808
5	15.6	3046
6	17.84	3930
7	20.08	4320
8	22.32	4970
9	24.56	5264
10	26.8	4418
11	29.04	4621
12	31.28	5775
13	33.52	5894
14	**34.85**	**6839**
15	37.09	6826
16	38	4607

3.5 Selection of Hours Simulated with PLUVUE II

VISCREEN was applied using Case 1 emission rates for an observer at Saguaro NP East, which is closer to the project sources than Saguaro NP West, with the specifications provided in **Table 3-1**. All other Level 1 screening mode parameters were applied to evaluate the plume visibility parameters C_p and ΔE within the Class I area for the six unstable turbulence categories, A, B, C, D, E and F. The maximum values of C_p and ΔE for each stability class indicates modeled visibility parameters are less than the screening-level thresholds of 2.0 for ΔE and +/- 0.05 for C_p for stabilities A, B and C for Saguaro West and stabilities A and B for Saguaro East, respectively. Thus, in analyzing the five years of hourly meteorological data for PLUVUE II, these stability categories were excluded.

Table 3-2 VISCREEN Modeling Parameters

Parameter	SNPW	SNPE
Background Ozone (ppm)	0.03	0.03
Background Visual Range (km)	252	252
Source-Observer Distance (km)	19.10	15.49
Min. Source-Class I Distance (km)	19.10	15.49
Max. Source-Class I Distance (km)	35.96	39.06
Wind Speed (m/s)	1.00	1.00

Table 3-3 VISCREEN Level 1 Results by Stability Category

Stability	SNPW		SNPE	
	Cp	ΔE	Cp	ΔE
A	0	0	0	0
B	0.004	0.515	0.005	0.747
C	0.011	1.519	0.019	2.197
D	-0.067	6.424	0.102	11.06
E	10.732	0.131	0.188	18.564
F	16.849	0.235	0.333	27.083

Note: Shaded values indicate insignificant impacts

The hourly meteorological data were parsed according to the following criteria:

1. Emission hours were considered between the hour prior to sunrise through the hour prior to sunset.

2. For SNPW, hours were considered with stability classes of D, E, or F and for SNPE, and hours with stability classes of C, D, E, or F.

3. For both park units, the selected hours were required to be free of precipitation and have an observed relative humidity less than 90%, to eliminate cases of natural obscuration.

4. The full range of wind directions corresponding to each portion of the Class I area is illustrated in **Figure 3-7**:

   - For SNPE: 243° to 281° (west-southwest to west) and
   - For SNPW: 109° to 136° (east-southeast to southeast).

   The selected simulated hours have wind directions within these windows that represent plume transport directions that cross between the observer and the target terrain listed **Table 3-1**. For instance, the wind direction window is 119.17° and 131.80° for observer W7.

If the wind direction varies during the time it would take for the plume to reach the line-of-sight, then a plume may meander and pass outside of the line-of-sight. Thus, an additional criterion was imposed based on wind persistence. If after one hour of transport the plume would not reach the Class I area, the wind speed and direction for the following hour is checked to determine if the wind direction is within the line-of-sight window and the wind speed is sufficient to reach the Class I area in two hours. This step is repeated until there is a sufficient number of hours of a persistent wind direction is achieved for the plume to reach the specified line-of-sight within the Class I area.

PLUVUE requires a solar elevation angle of at least 2° for considering the hour to be simulated. Accounting for travel time in setting the observation hour in PLUVUE allowed for the inclusion of stable pre-dawn emission hours as suggested by the NPS.

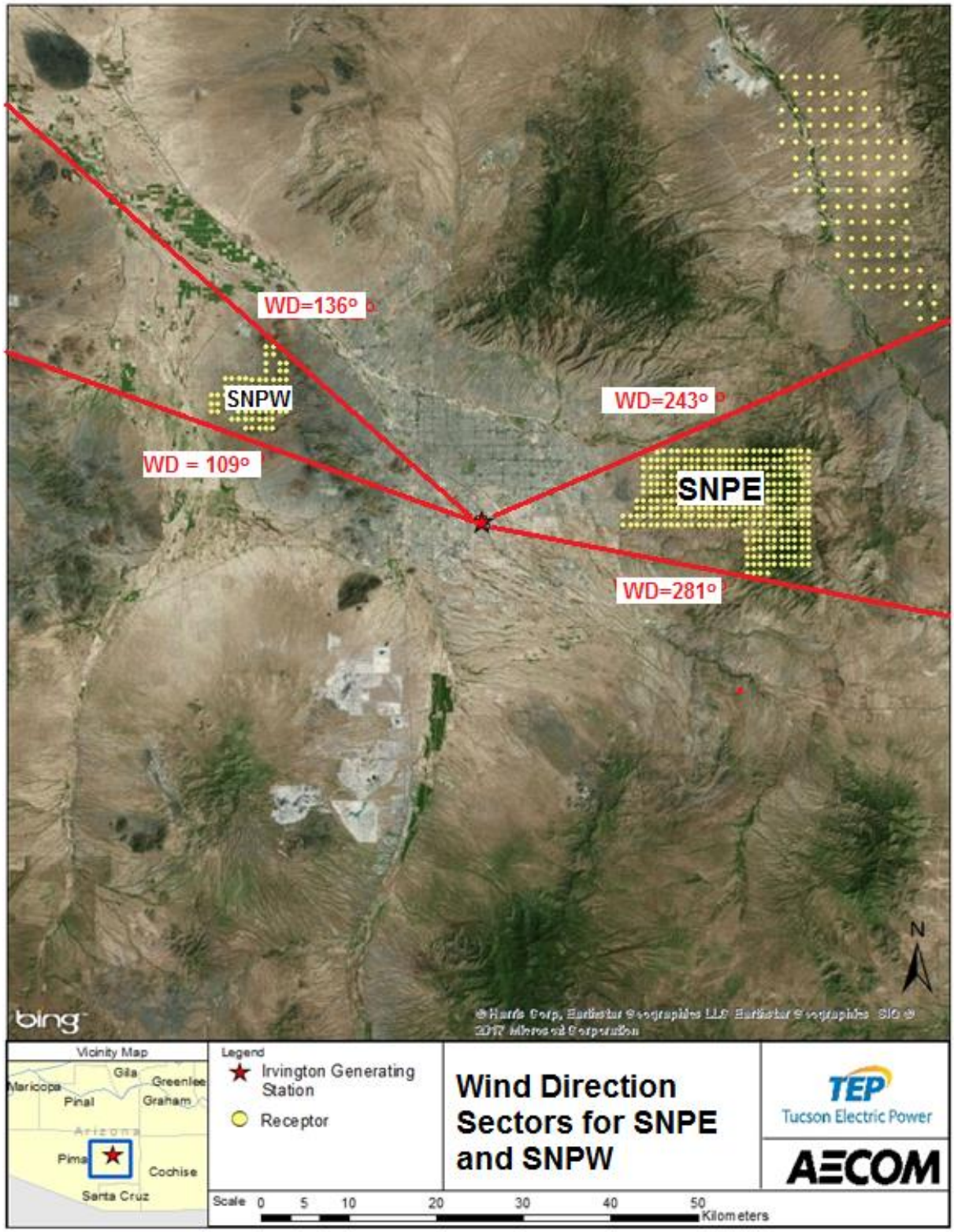
The spreadsheet sent with the PLUVUE protocol (also included in the modeling archive; *PLUVUE Hours.xlsx*) carried out this filtering process on the five years of meteorological data. This resulted in a total of 4,648 simulations for each emission case, totaled over the 16 lines-of-

sight. The number of hours simulated for each line-of-sight defined by observer-terrain target combination is provided in **Table 3-4**.

Table 3-4 Number of Hours Simulated for Each Observer-Terrain Target Combination

Class I Area	Observer-Target Combination	Number of Hours Simulated
SNPW	W1	137
SNPW	W2	137
SNPW	W3	324
SNPW	W4	324
SNPW	W5	119
SNPW	W6	119
SNPW	W7	665
SNPW	W8	665
SNPE	E1	348
SNPE	E2	348
SNPE	E3	548
SNPE	E4	548
SNPE	E5	54
SNPE	E6	54
SNPE	E7	128
SNPE	E8	128

Figure 3-7 Wind Direction Sectors for Saguaro National Park East and West



3.6 Other Specifications for PLUVUE II runs

An example PLUVUE II input file for the observer-target combination illustrated in **Figure 3-8** is provided in **Figure 3-9**. For PLUVUE II inputs that are not discussed above nor related to the site-specific application (such as particle distributions and optical properties), PLUVUE II default values were applied. Each run applied the meteorological conditions and the measured background concentrations at the time of emission to estimate dispersion, transport and chemical processes. The time of day for the observer to view a plume as it passes over the Class I area was from one to four hours after the emissions hour, depending on the average wind speed starting at the hour of the release to the hour the plume reached the nearest point of the Class I area. In this illustration, for a wind speed of 13.3 mph (21.4 km/hr), the plume would reach the Class I area after an hour of transport. As such, the time of the observation was set to 9 AM, or one hour after the time of emission.

In analyzing the output of PLUVUE II, based on discussion with the NPS, results for lines of sight aimed almost straight up and down the plume were excluded. This situation occurs if a plume centerline passes very close to an observer so that it is nearly overhead and the observer is looking either toward or directly away from the project location. In VISCREEN, these lines of sight are excluded by setting a minimum value of the angle between the line of sight and the plume centerline (alpha) to 11.25 degrees. For the PLUVUE assessment, the minimum alpha for which the results were analyzed was set to 10 degrees.

4. Interpretation of Model Results

Results of the PLUVUE assessment have been summarized in tabular format. Results of plume visibility parameters, plume contrast (C_p) and perceptibility (ΔE) have been evaluated for background sky and both black and gray terrain for each line of sight. It is understood that there are no established thresholds for either magnitude or frequency of the modeled plume visibility parameters that define the degree of acceptability and that the determination needs to account for multiple factors. Some refined approaches to interpreting PLUVUE II results that may be considered are discussed below.

The PLUVUE II parameters used to evaluate the potential for visible plumes are plume contrast (C_p) and the plume perceptibility parameter (ΔE). Values for these parameters were computed for the NPS-provided observation points within the two units of Saguaro National Park. For PLUVUE II assessments, Federal Land Managers (FLMs) suggest in the FLAG 2010 guidance that the sensitive detection thresholds of +/- 0.02 for C_p and 1.0 for ΔE apply for a keen observer with an enhanced ability to detect changes in the viewed resource. In addition to these thresholds, results were also compared to the VISCREEN thresholds of +/- 0.05 for C_p and 2.0 for ΔE. These are levels are more in-line with plumes that could be noticed by the typical observer. For each parameter, two additional levels were also evaluated (+/- 0.035, 0.075 for C_p and 1.5 and 3 for ΔE) to provide supplemental information on the magnitude and frequency. These supplemental frequency analyses are provided in **Attachment B** for Case 1 and **Attachment C** for Case 2.

The frequency analysis for cases exceeding the Cp and ΔE thresholds was based on the following model parameters computed by PLUVUE II. These included:

- C_p and ΔE with a sky background;
- C_p and ΔE with background terrain for an observer whose eyes have adjusted to the terrain[10], idealistically represented by two uniformly reflective backgrounds (black and gray).

A summary of the modeling results for the background sky and using the more the stringent threshold recommended by the NPS for refined plume visibility assessments are provided in **Table 4-1** and **4-2** (for black background and for gray background, respectively) for Emissions Case 1 and **Tables 4-3** and **4-4** for Emissions Case 2. The results summarized in these tables represent the maximum magnitude among the 12 lines of sight modeled for each observer for each simulated hour. The tables were generated by a computer program "POSTPLU", which reads the output file and compiles statistics for each PLUVUE II simulation. These tables indicate that the number of hours with excursions of one or more of the visibility parameters comprise a very small percentage of the daylight hours. The greatest percent of excursion hours Case 1 at observer W8 is only 0.82% of the daytime hours if the background terrain were black. For a more applicable gray terrain, the frequency is only 0.59%. For Case 2, the

[10] The addendum to the PLUVUE II User's Guide (EPA, 1996) indicates that the additional terrain calculation for C_p was incorporated based on unpublished correspondence from Warren White a professor at Washington University in St. Louis indicating that *"for black terrain backgrounds, it is more likely that the eye is accommodated…to the horizon sky".* This concept is inappropriate for Saguaro National Park because there are no truly black terrain backgrounds.

corresponding maximum black terrain and gray terrain frequencies are slightly lower (0.70% and 0.52%, respectively. TEP estimates that the mode of operation corresponding to Case 1 would be expected to occur less than 1% of the time and that Case 2 is expected to occur less than 10% percent of the time annually. Thus the actual frequency of these modeled excursions will be much lower than indicated by the modeling, which assumes continuous operation of all ten RICE units in these two modes.

Figures 4-1 through **4-16** provide time-series plots of the modeled Case 1 visibility parameters for each observer for a background sky, black background terrain and gray background terrain (Case 2 time-series plots are provided in **Attachment D**). These plots indicate that the modeled visibility parameters are generally well below the NPS thresholds, with relatively few excursions. When considering the plume screening level thresholds, which are more indicative of when a plume could be seen by a casual observer, the number of excursions indicated in the plots decrease considerably. [Note that the plotting routine in Excel depicts the black, gray and sky background results in order. Thus, in cases where model results for the three backgrounds overlap, the plots depict only the results for the black background.]

A review of photographs taken within the parks, which are available for example, from Google Earth™, indicated that a gray background terrain is likely to generally more applicable than black terrain. The example of a scenic vista provided in **Figure 4-17** illustrates this point. Because there are no snow-covered peaks, modeled results for a white terrain background were computed, but not analyzed for this assessment.

Table 4-1 PLUVUE II Summary for Case 1 with a Black Terrain Background

Modeled Statistics for 5 Years of Simulations*	SNPE1	SNPE2	SNPE3	SNPE4	SNPE5	SNPE6	SNPE7	SNPE8
Number of PLUVUE Output Files	348	348	548	548	54	54	128	128
Total Number of Excursions Found	31	41	32	30	0	3	14	10
Number of Excursion Hours found	17	19	20	17	0	3	10	6
Number of Excursion Days with Multiple Hours	1	0	1	0	0	0	0	0
Number of Excursion Days with Consecutive Hours	1	0	1	0	0	0	0	0
Number of Excursion Hours due to BOTH CP & DE	8	10	9	8	0	0	4	3
Number of Excursion Hours due to ONLY CP (no DE)	2	8	7	5	0	2	6	3
Number of Excursion Hours due to ONLY sky CP	0	5	0	1	0	0	0	0
Number of Excursion Hours due to ONLY background CP	10	18	16	13	0	2	10	6
Number of Excursion Hours due to ONLY DE (no CP)	7	1	4	4	0	1	0	0
Number of Excursion Hours due to ONLY sky DE	7	7	7	6	0	0	0	1
Number of Excursion Hours due to ONLY background DE	14	11	9	10	0	1	4	3
Percent of Excursion Hours Over 5-years (Daylight Hours)	***0.14%***	***0.19%***	***0.15%***	***0.14%***	***0.00%***	***0.01%***	***0.06%***	***0.05%***

Modeled Statistics for 5 Years of Simulations*	SNPW1	SNPW2	SNPW3	SNPW4	SNPW5	SNPW6	SNPW7	SNPW8
Number of PLUVUE Output Files	137	137	324	324	119	119	665	665
Total Number of Excursions Found	80	48	80	161	21	75	81	180
Number of Excursion Hours found	44	25	46	73	11	34	63	105
Number of Excursion Days with Multiple Hours	1	1	3	2	0	0	1	3
Number of Excursion Days with Consecutive Hours	1	0	2	2	0	0	0	3
Number of Excursion Hours due to BOTH CP & DE	27	13	18	55	6	26	12	41
Number of Excursion Hours due to ONLY CP (no DE)	15	8	11	16	3	8	33	52
Number of Excursion Hours due to ONLY sky CP	3	4	5	11	1	6	2	17
Number of Excursion Hours due to ONLY background CP	42	21	28	71	9	34	44	92
Number of Excursion Hours due to ONLY DE (no CP)	2	4	17	2	2	0	18	12
Number of Excursion Hours due to ONLY sky DE	13	12	29	29	5	12	24	40
Number of Excursion Hours due to ONLY background DE	22	11	18	50	6	23	11	31
Percent of Excursion Hours Over 5-years (Daylight Hours)	***0.36%***	***0.22%***	***0.36%***	***0.73%***	***0.10%***	***0.34%***	***0.37%***	***0.82%***
* Plume Contrast Threshold	2%							
Delta E Threshold	1							

Table 4-2 PLUVUE II Summary for Case 1 with a Gray Terrain Background

Modeled Statistics for 5 Years of Simulations*	SNPE1	SNPE2	SNPE3	SNPE4	SNPE5	SNPE6	SNPE7	SNPE8
Number of PLUVUE Output Files	348	348	548	548	54	54	128	128
Total Number of Excursions Found	18	30	17	14	0	1	8	4
Number of Excursion Hours found	11	10	10	7	0	1	4	2
Number of Excursion Days with Multiple Hours	1	0	1	0	0	0	0	0
Number of Excursion Days with Consecutive Hours	1	0	1	0	0	0	0	0
Number of Excursion Hours due to BOTH CP & DE	2	8	2	3	0	0	4	1
Number of Excursion Hours due to ONLY CP (no DE)	0	0	2	0	0	0	0	0
Number of Excursion Hours due to ONLY sky CP	0	5	0	1	0	0	0	0
Number of Excursion Hours due to ONLY background CP	2	8	4	2	0	0	4	1
Number of Excursion Hours due to ONLY DE (no CP)	9	2	6	4	0	1	0	1
Number of Excursion Hours due to ONLY sky DE	7	7	7	6	0	0	0	1
Number of Excursion Hours due to ONLY background DE	9	10	6	5	0	1	4	2
Percent of Excursion Hours Over 5-years (Daylight Hours)	***0.08%***	***0.14%***	***0.08%***	***0.06%***	***0.00%***	***0.00%***	***0.04%***	***0.02%***

Modeled Statistics for 5 Years of Simulations*	SNPW1	SNPW2	SNPW3	SNPW4	SNPW5	SNPW6	SNPW7	SNPW8
Number of PLUVUE Output Files	137	137	324	324	119	119	665	665
Total Number of Excursions Found	53	28	61	129	11	67	38	108
Number of Excursion Hours found	29	13	33	56	6	27	26	51
Number of Excursion Days with Multiple Hours	0	0	1	0	0	0	0	0
Number of Excursion Days with Consecutive Hours	0	0	1	0	0	0	0	0
Number of Excursion Hours due to BOTH CP & DE	15	4	5	40	2	24	3	21
Number of Excursion Hours due to ONLY CP (no DE)	7	1	3	11	0	3	2	9
Number of Excursion Hours due to ONLY sky CP	3	4	5	11	1	6	2	17
Number of Excursion Hours due to ONLY background CP	22	5	6	51	2	26	3	28
Number of Excursion Hours due to ONLY DE (no CP)	7	8	25	5	4	0	21	21
Number of Excursion Hours due to ONLY sky DE	13	12	29	29	5	12	24	40
Number of Excursion Hours due to ONLY background DE	15	7	21	38	3	23	9	23
Percent of Excursion Hours Over 5-years (Daylight Hours)	***0.24%***	***0.13%***	***0.28%***	***0.59%***	***0.05%***	***0.31%***	***0.17%***	***0.49%***
* Plume Contrast Threshold	2%							
Delta E Threshold	1							

Table 4-3 PLUVUE II Summary for Case 2 with a Black Terrain Background

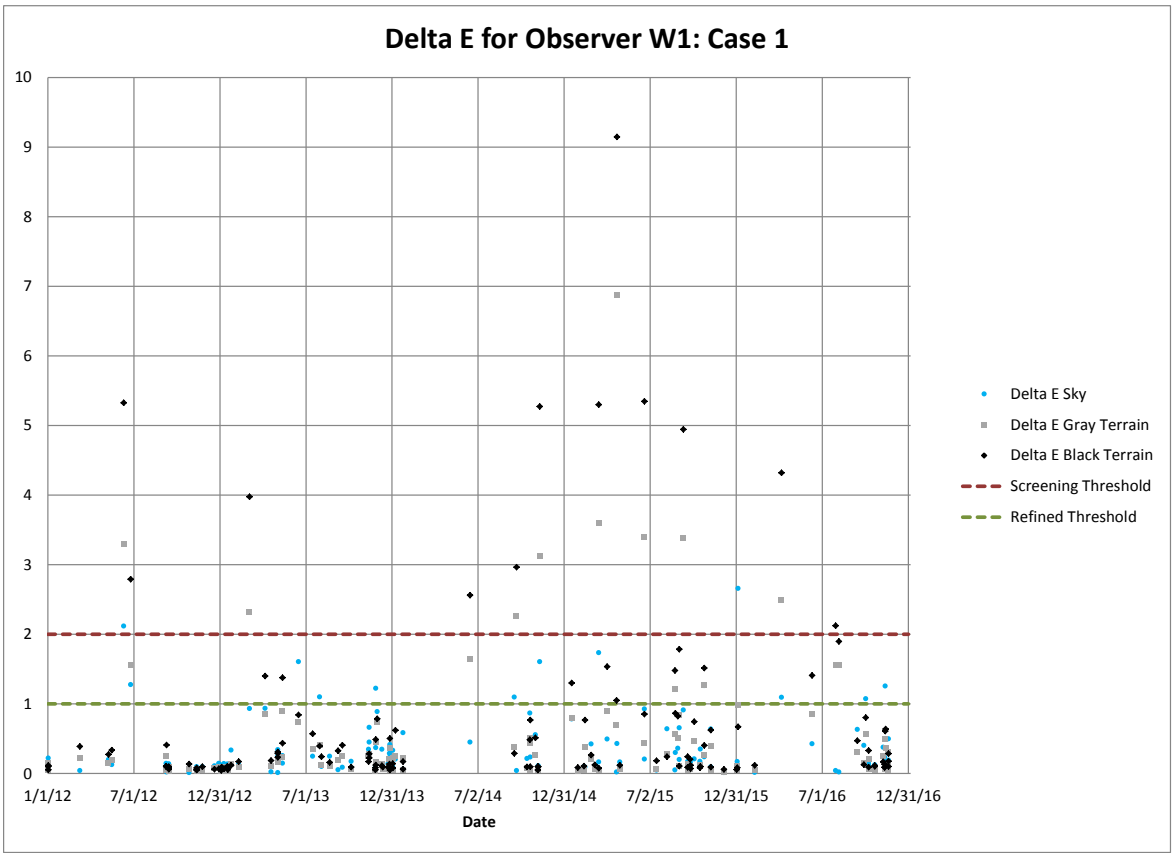
Modeled Statistics for 5 Years of Simulations*	SNPE1	SNPE2	SNPE3	SNPE4	SNPE5	SNPE6	SNPE7	SNPE8
Number of PLUVUE Output Files	348	348	548	548	54	54	128	128
Total Number of Excursions Found	22	38	18	15	0	2	11	4
Number of Excursion Hours found	12	18	11	9	0	2	7	2
Number of Excursion Days with Multiple Hours	0	0	1	0	0	0	0	0
Number of Excursion Days with Consecutive Hours	0	0	1	0	0	0	0	0
Number of Excursion Hours due to BOTH CP & DE	4	8	3	3	0	0	4	2
Number of Excursion Hours due to ONLY CP (no DE)	4	7	4	4	0	1	3	0
Number of Excursion Hours due to ONLY sky CP	1	5	0	0	0	0	0	0
Number of Excursion Hours due to ONLY background CP	8	15	7	7	0	1	7	2
Number of Excursion Hours due to ONLY DE (no CP)	4	3	4	2	0	1	0	0
Number of Excursion Hours due to ONLY sky DE	5	8	6	4	0	0	0	1
Number of Excursion Hours due to ONLY background DE	8	10	5	4	0	1	4	1
Percent of Excursion Hours Over 5-years (Daylight Hours)	***0.10%***	***0.17%***	***0.08%***	***0.07%***	***0.00%***	***0.01%***	***0.05%***	***0.02%***
Modeled Statistics for 5 Years of Simulations*	**SNPW1**	**SNPW2**	**SNPW3**	**SNPW4**	**SNPW5**	**SNPW6**	**SNPW7**	**SNPW8**
Number of PLUVUE Output Files	137	137	324	324	119	119	665	665
Total Number of Excursions Found	71	39	80	143	22	69	66	153
Number of Excursion Hours found	39	21	46	68	11	32	51	89
Number of Excursion Days with Multiple Hours	1	0	2	2	0	0	1	1
Number of Excursion Days with Consecutive Hours	1	0	2	2	0	0	0	1
Number of Excursion Hours due to BOTH CP & DE	24	9	19	43	7	24	8	35
Number of Excursion Hours due to ONLY CP (no DE)	13	8	8	23	2	8	24	34
Number of Excursion Hours due to ONLY sky CP	3	3	5	10	1	5	3	16
Number of Excursion Hours due to ONLY background CP	37	17	24	66	9	32	30	68
Number of Excursion Hours due to ONLY DE (no CP)	2	4	19	2	2	0	19	20
Number of Excursion Hours due to ONLY sky DE	10	12	34	28	7	12	26	44
Number of Excursion Hours due to ONLY background DE	21	7	17	39	5	20	7	25
Percent of Excursion Hours Over 5-years (Daylight Hours)	***0.32%***	***0.18%***	***0.36%***	***0.65%***	***0.10%***	***0.31%***	***0.30%***	***0.70%***
* Plume Contrast Threshold	2%							
Delta E Threshold	1							

Table 4-4 PLUVUE II Summary for Case 2 with a Gray Terrain Background

Modeled Statistics for 5 Years of Simulations*	SNPE1	SNPE2	SNPE3	SNPE4	SNPE5	SNPE6	SNPE7	SNPE8
Number of PLUVUE Output Files	348	348	548	548	54	54	128	128
Total Number of Excursions Found	13	30	12	8	0	1	7	3
Number of Excursion Hours found	6	11	7	4	0	1	4	2
Number of Excursion Days with Multiple Hours	0	0	1	0	0	0	0	0
Number of Excursion Days with Consecutive Hours	0	0	1	0	0	0	0	0
Number of Excursion Hours due to BOTH CP & DE	1	7	1	0	0	0	3	0
Number of Excursion Hours due to ONLY CP (no DE)	0	1	0	0	0	0	1	1
Number of Excursion Hours due to ONLY sky CP	1	5	0	0	0	0	0	0
Number of Excursion Hours due to ONLY background CP	1	8	1	0	0	0	4	1
Number of Excursion Hours due to ONLY DE (no CP)	5	3	6	4	0	1	0	1
Number of Excursion Hours due to ONLY sky DE	5	8	6	4	0	0	0	1
Number of Excursion Hours due to ONLY background DE	6	9	5	4	0	1	3	1
Percent of Excursion Hours Over 5-years (Daylight Hours)	***0.06%***	***0.14%***	***0.05%***	***0.04%***	***0.00%***	***0.00%***	***0.03%***	***0.01%***

Modeled Statistics for 5 Years of Simulations*	SNPW1	SNPW2	SNPW3	SNPW4	SNPW5	SNPW6	SNPW7	SNPW8
Number of PLUVUE Output Files	137	137	324	324	119	119	665	665
Total Number of Excursions Found	49	26	63	115	13	53	40	105
Number of Excursion Hours found	26	12	37	49	7	26	26	55
Number of Excursion Days with Multiple Hours	0	0	1	0	0	0	0	0
Number of Excursion Days with Consecutive Hours	0	0	1	0	0	0	0	0
Number of Excursion Hours due to BOTH CP & DE	15	3	6	33	2	15	5	20
Number of Excursion Hours due to ONLY CP (no DE)	6	0	2	12	0	10	0	8
Number of Excursion Hours due to ONLY sky CP	3	3	5	10	1	5	3	16
Number of Excursion Hours due to ONLY background CP	21	3	5	45	2	24	2	24
Number of Excursion Hours due to ONLY DE (no CP)	5	9	29	4	5	1	21	27
Number of Excursion Hours due to ONLY sky DE	10	12	34	28	7	12	26	44
Number of Excursion Hours due to ONLY background DE	15	8	19	32	3	12	9	21
Percent of Excursion Hours Over 5-years (Daylight Hours)	***0.22%***	***0.12%***	***0.29%***	***0.52%***	***0.06%***	***0.24%***	***0.18%***	***0.48%***
* Plume Contrast Threshold	2%							
Delta E Threshold	1							

Figure 4-1 Time Series of Delta E and Cp for Case 1: Observer W1



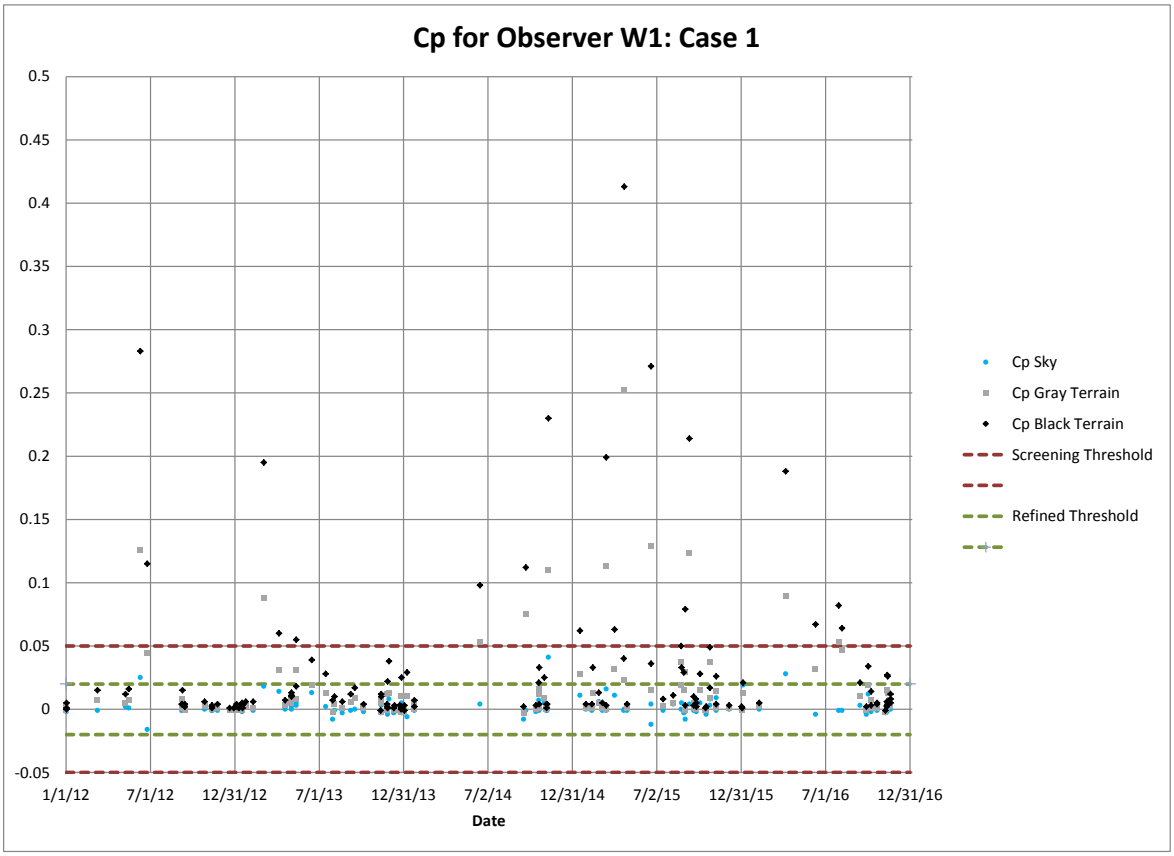
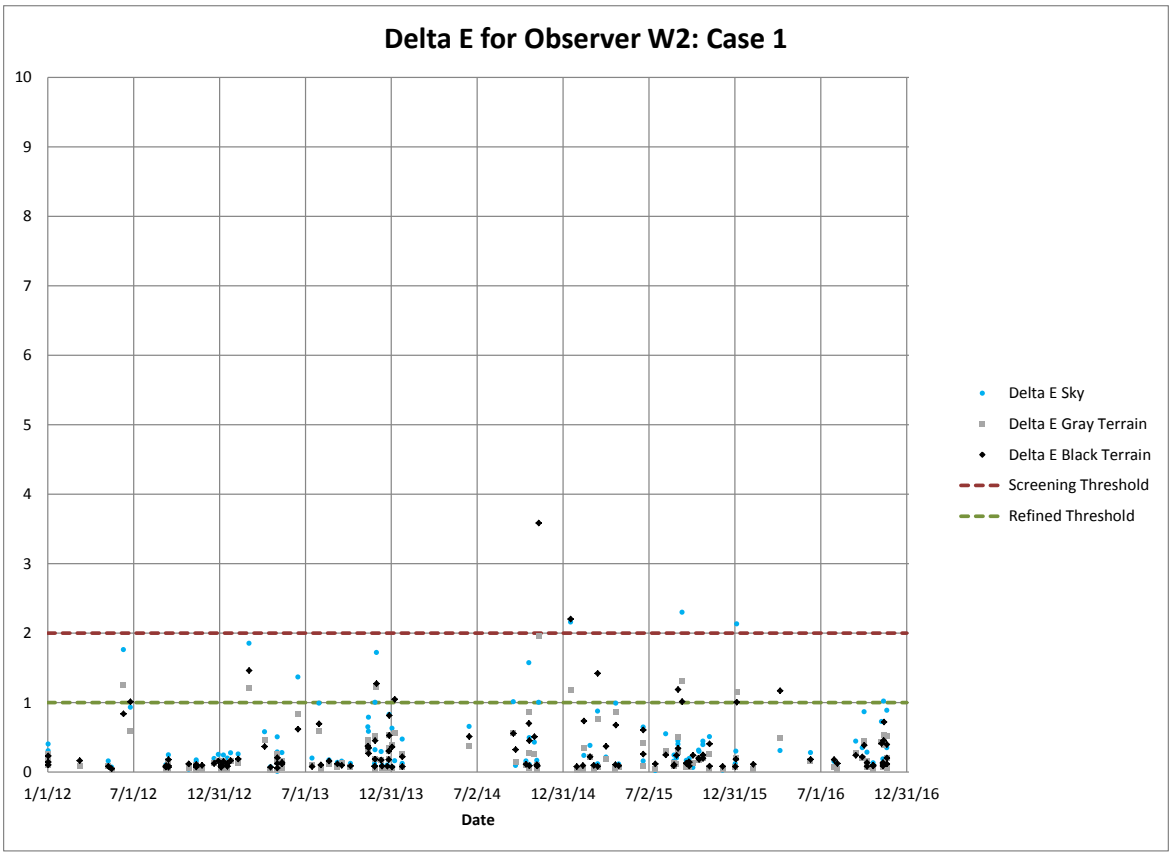


Figure 4-2 Time Series of Delta E and Cp for Case 1: Observer W2



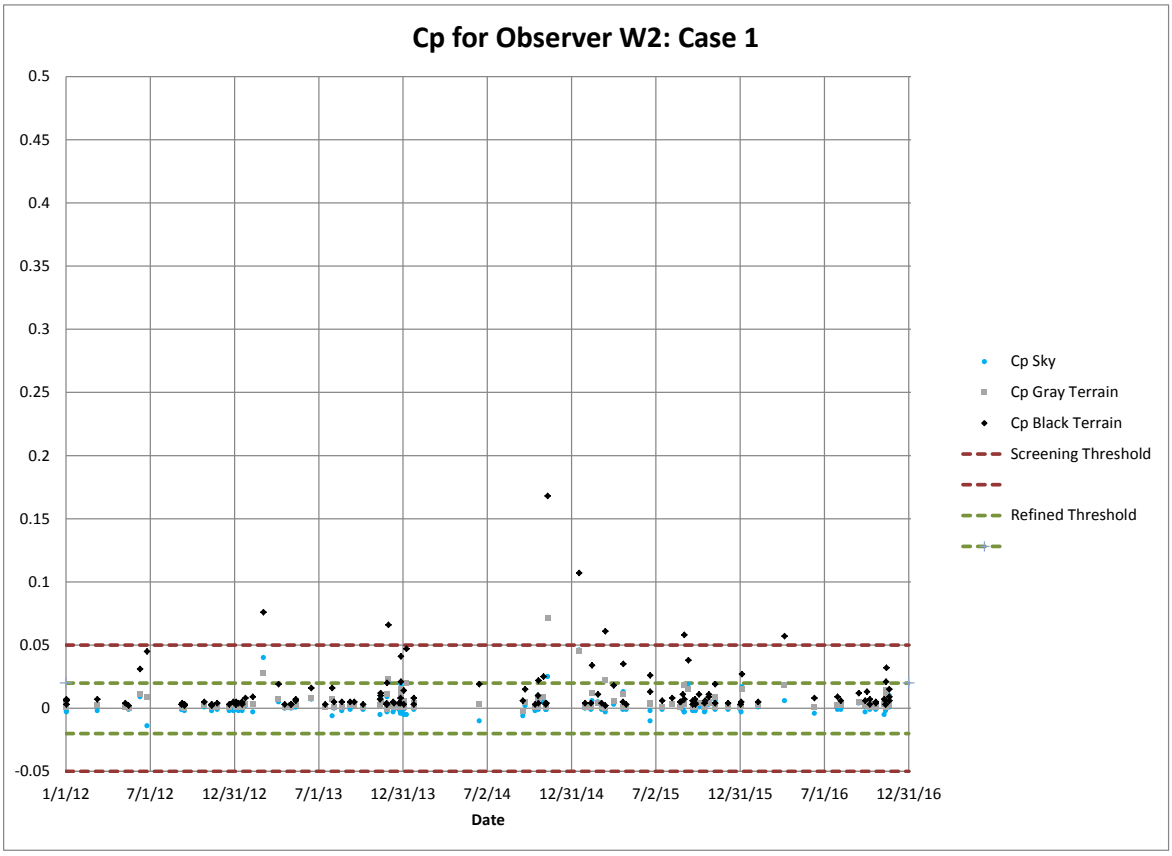
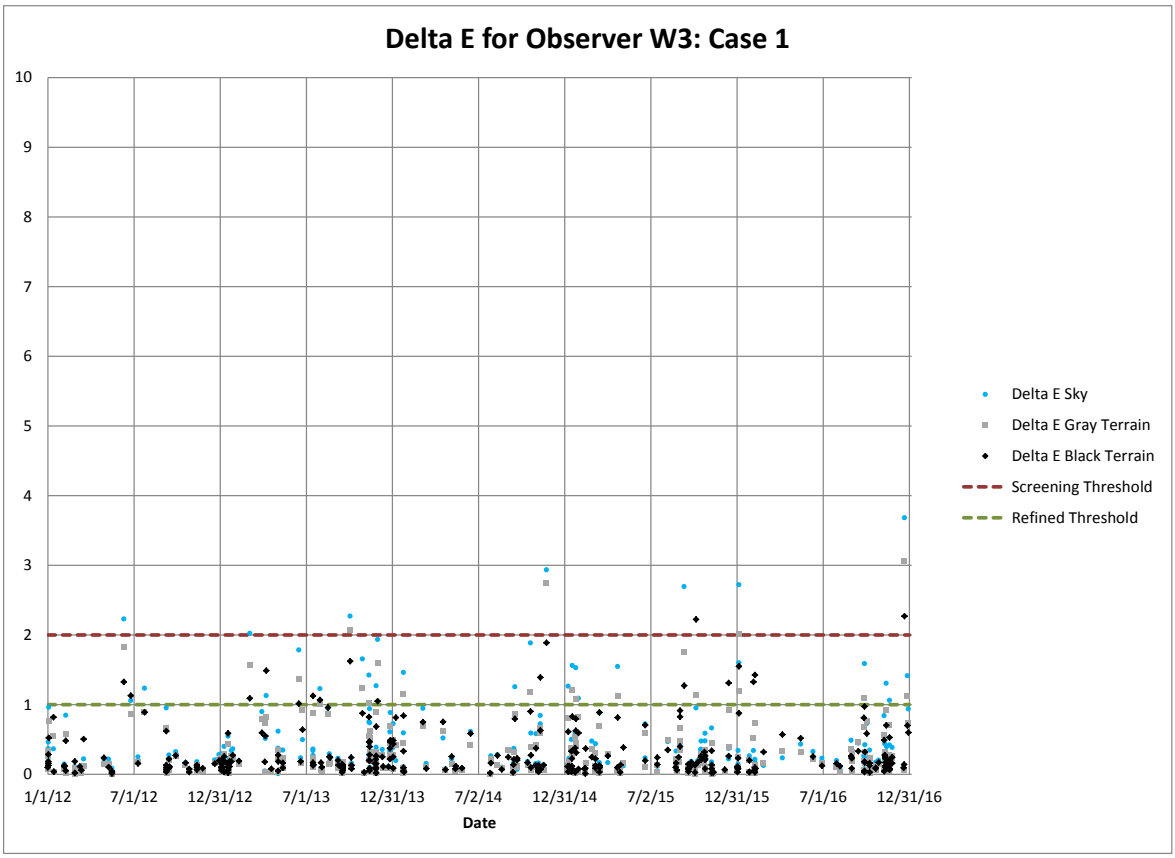


Figure 4-3 Time Series of Delta E and Cp for Case 1: Observer W3



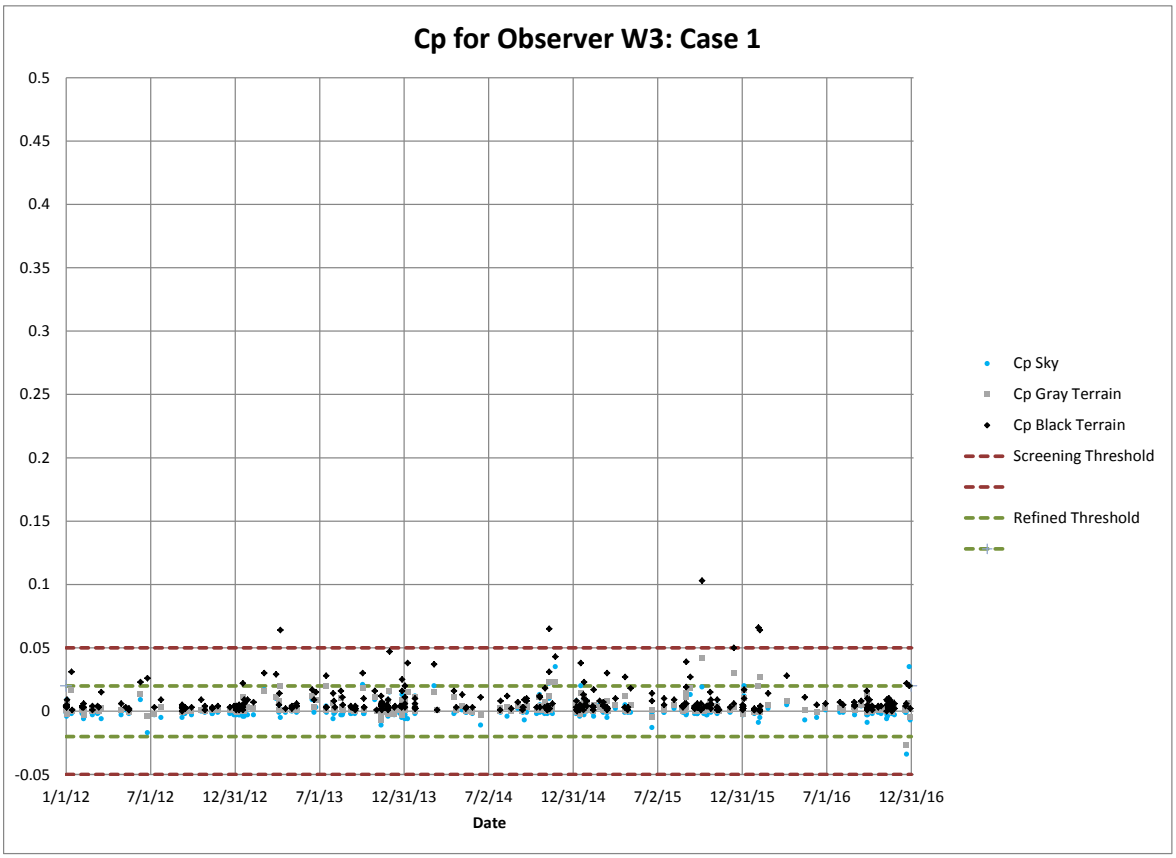
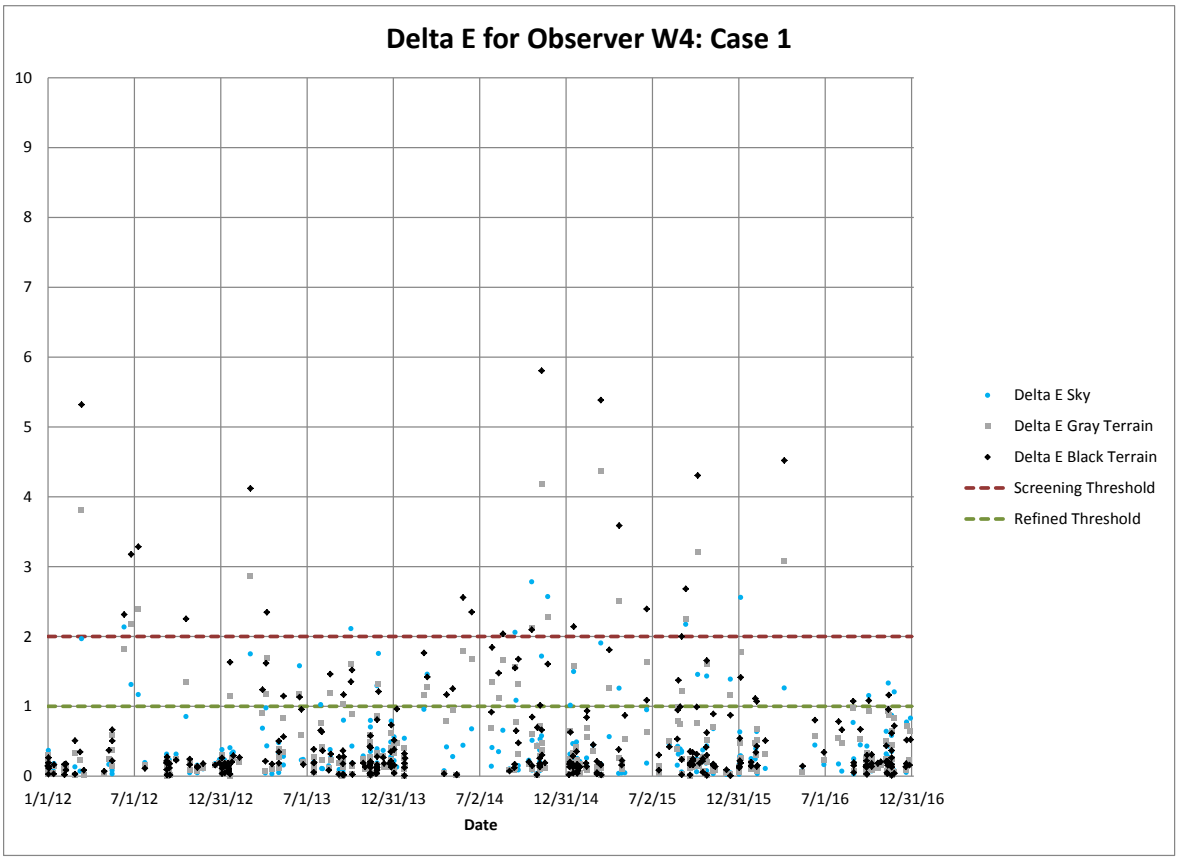


Figure 4-4 Time Series of Delta E and Cp for Case 1: Observer W4



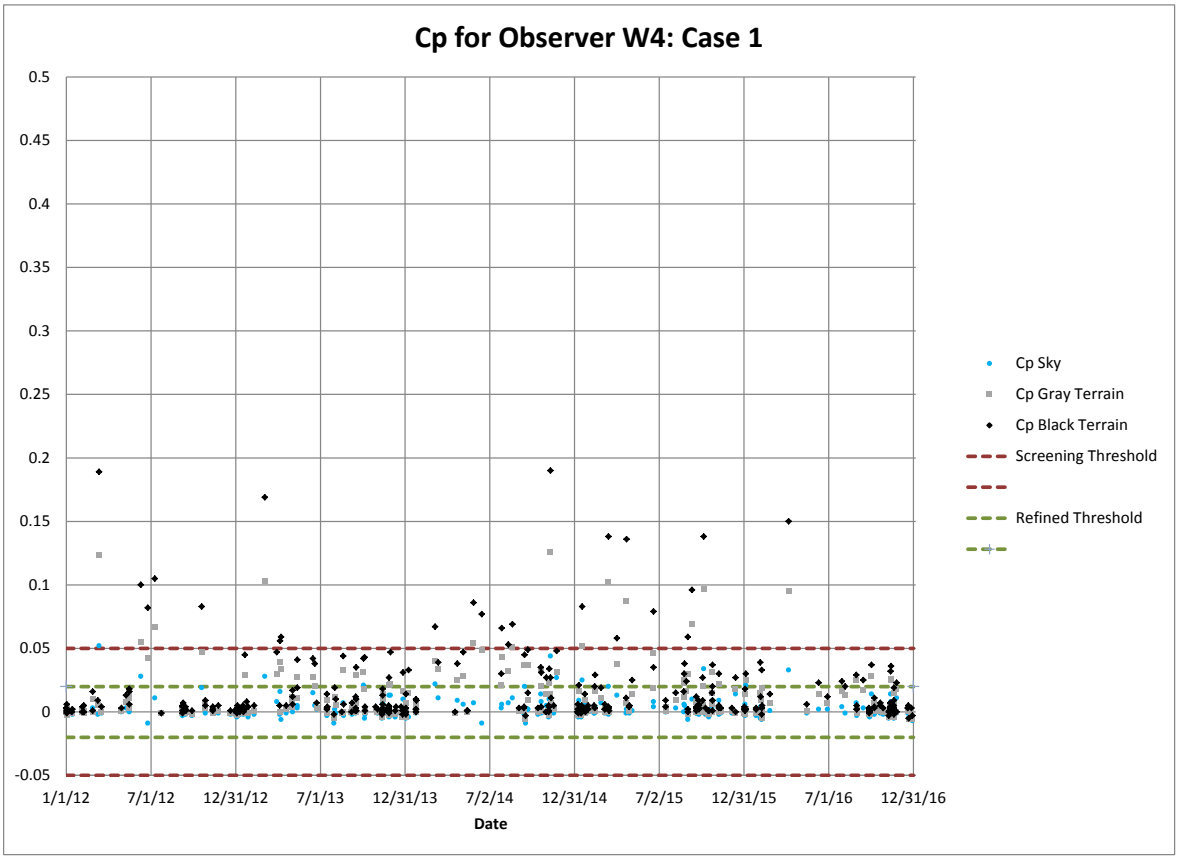
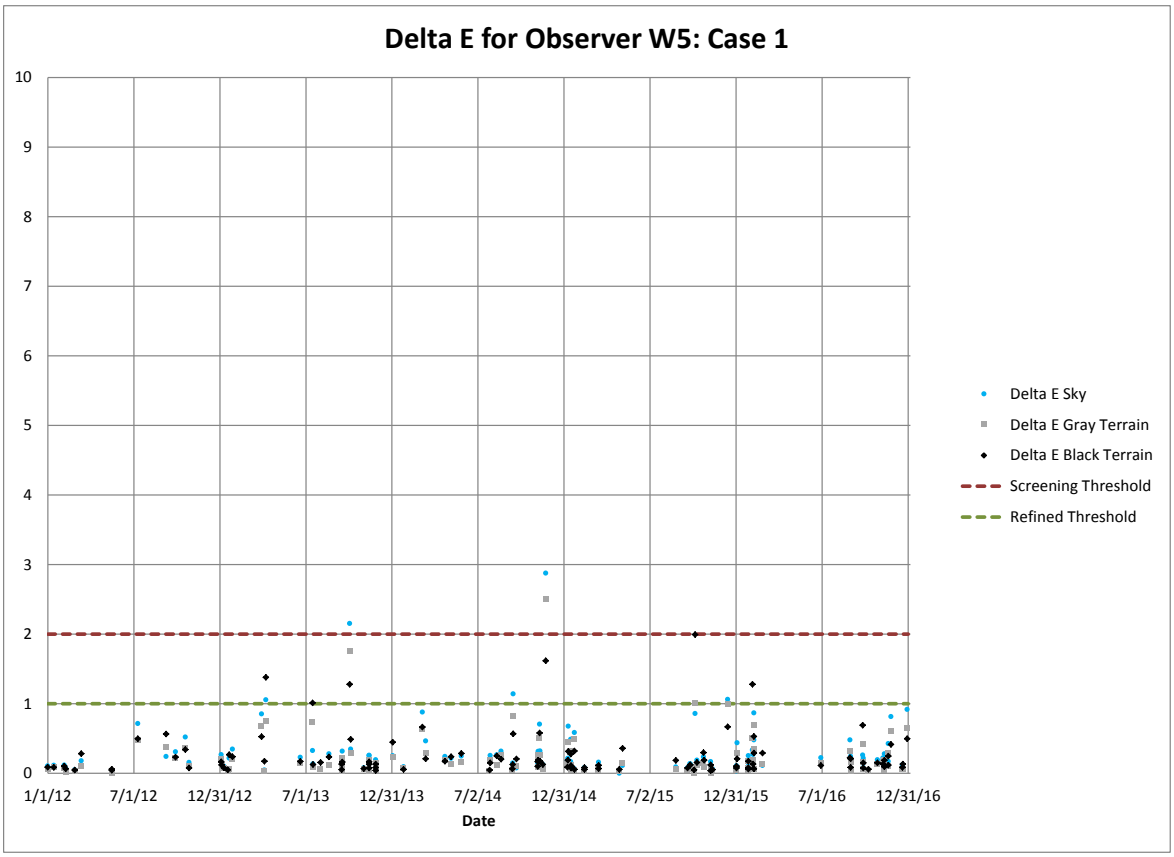


Figure 4-5 Time Series of Delta E and Cp for Case 1: Observer W5



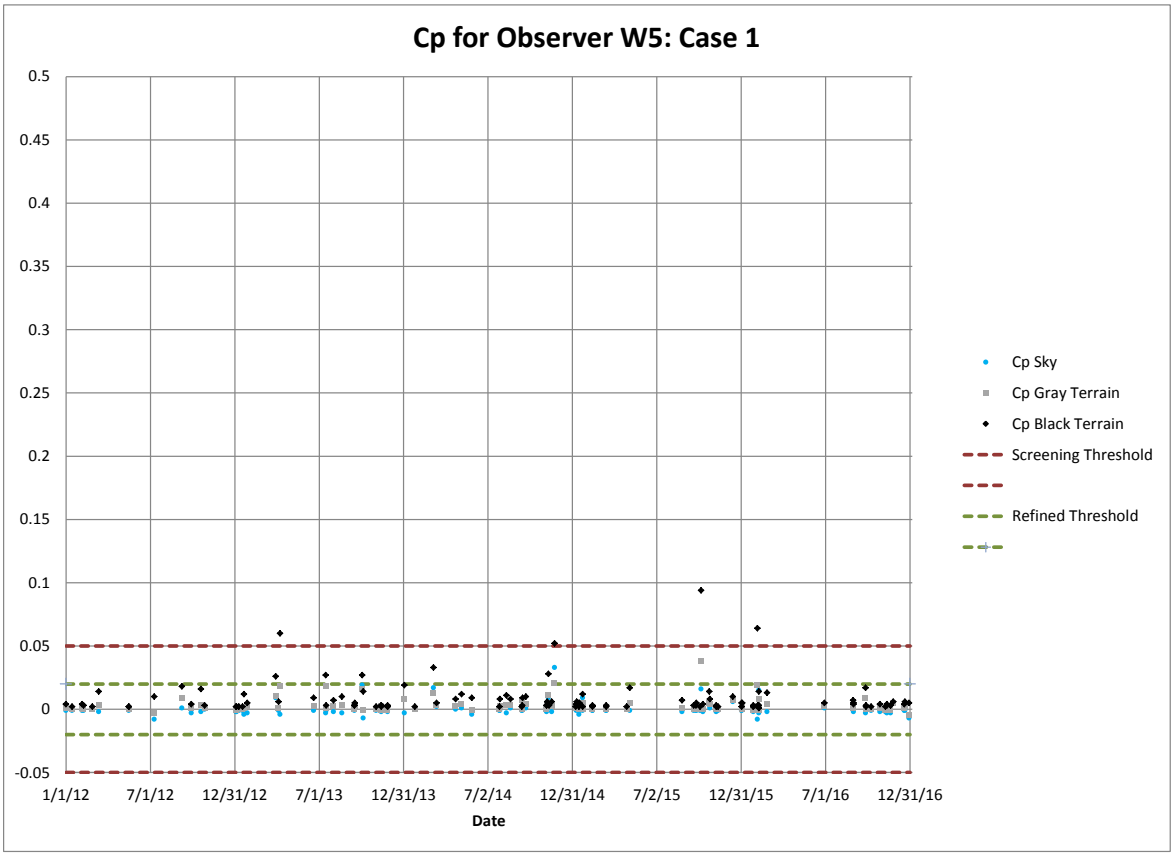
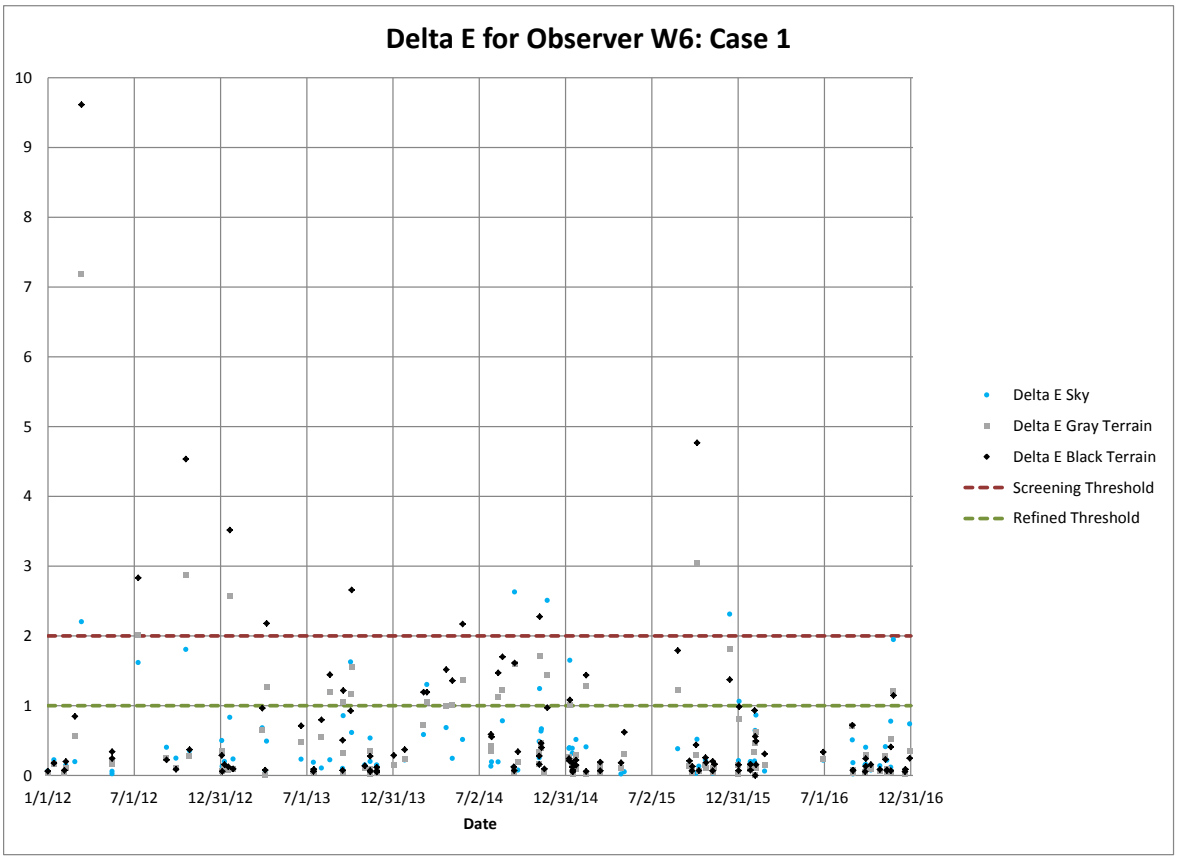


Figure 4-6 Time Series of Delta E and Cp for Case 1: Observer W6



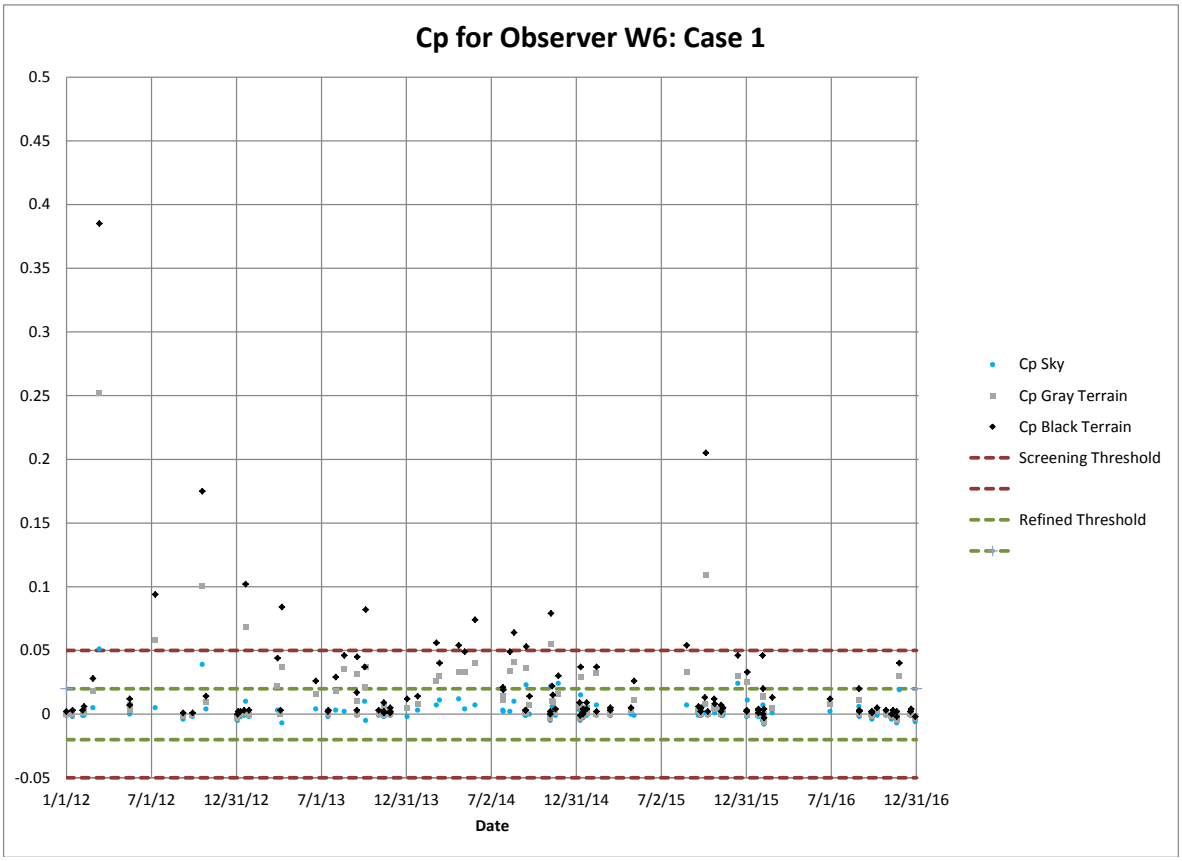
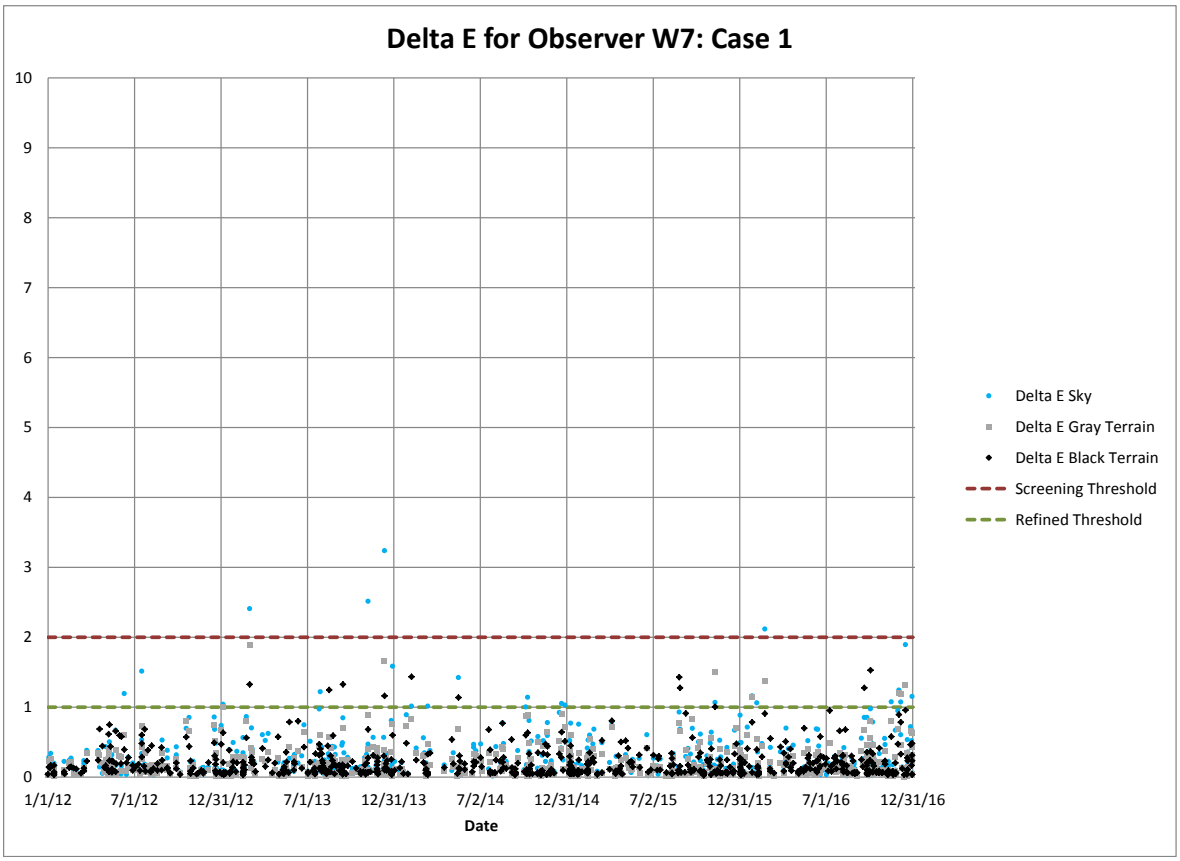


Figure 4-7 Time Series of Delta E and Cp for Case 1: Observer W7



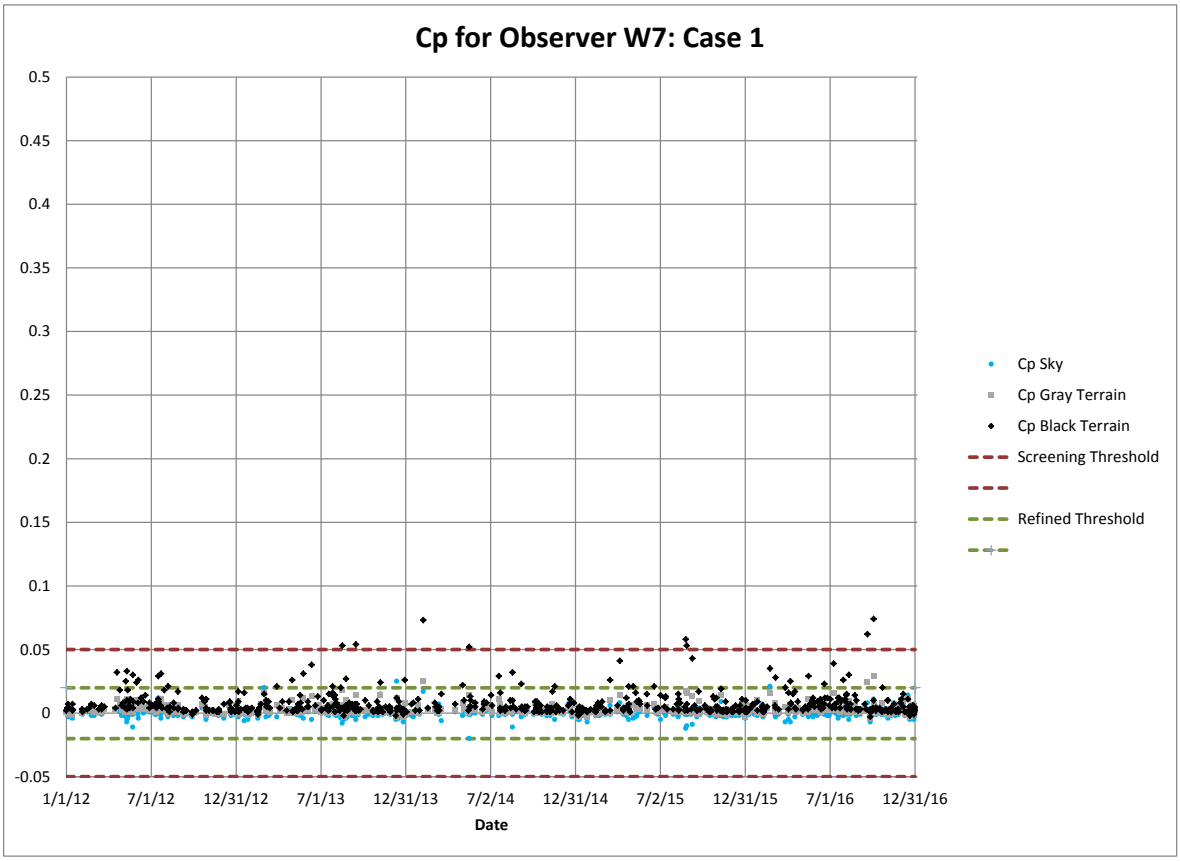
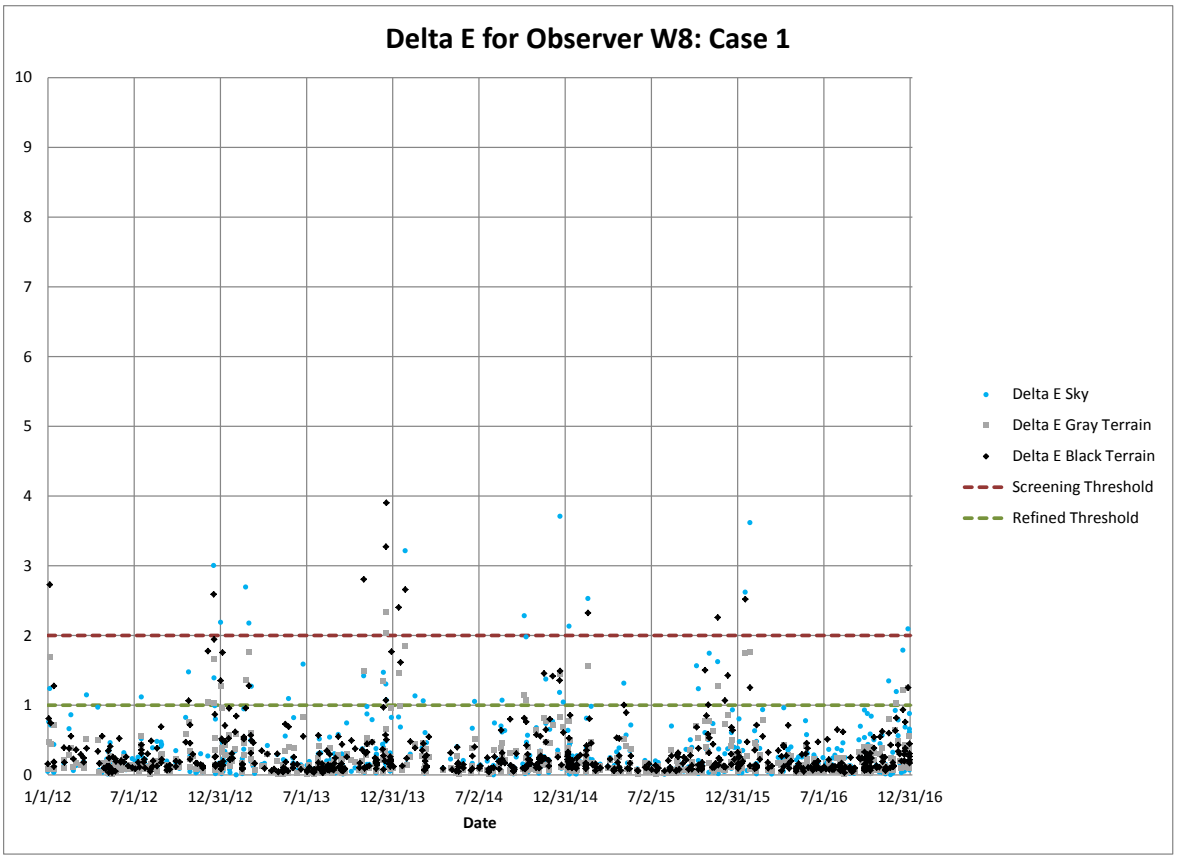


Figure 4-8 Time Series of Delta E and Cp for Case 1: Observer W8



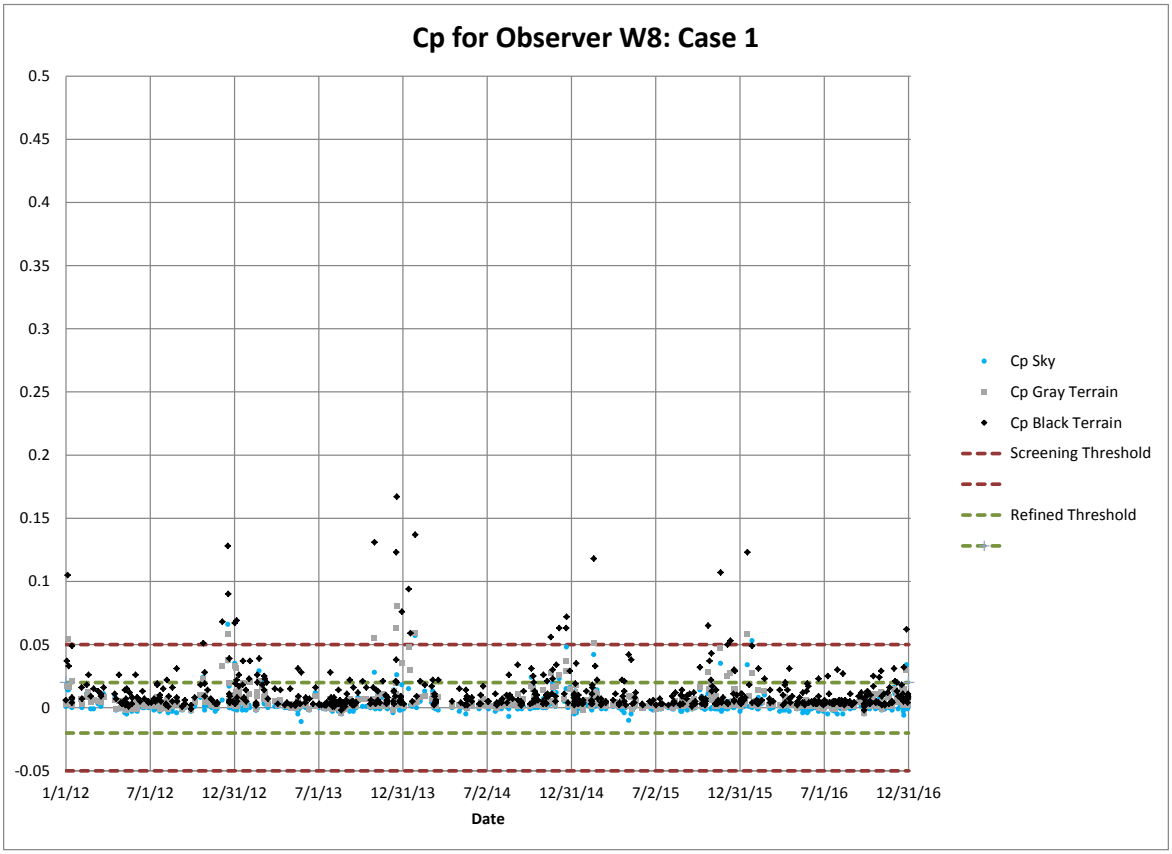
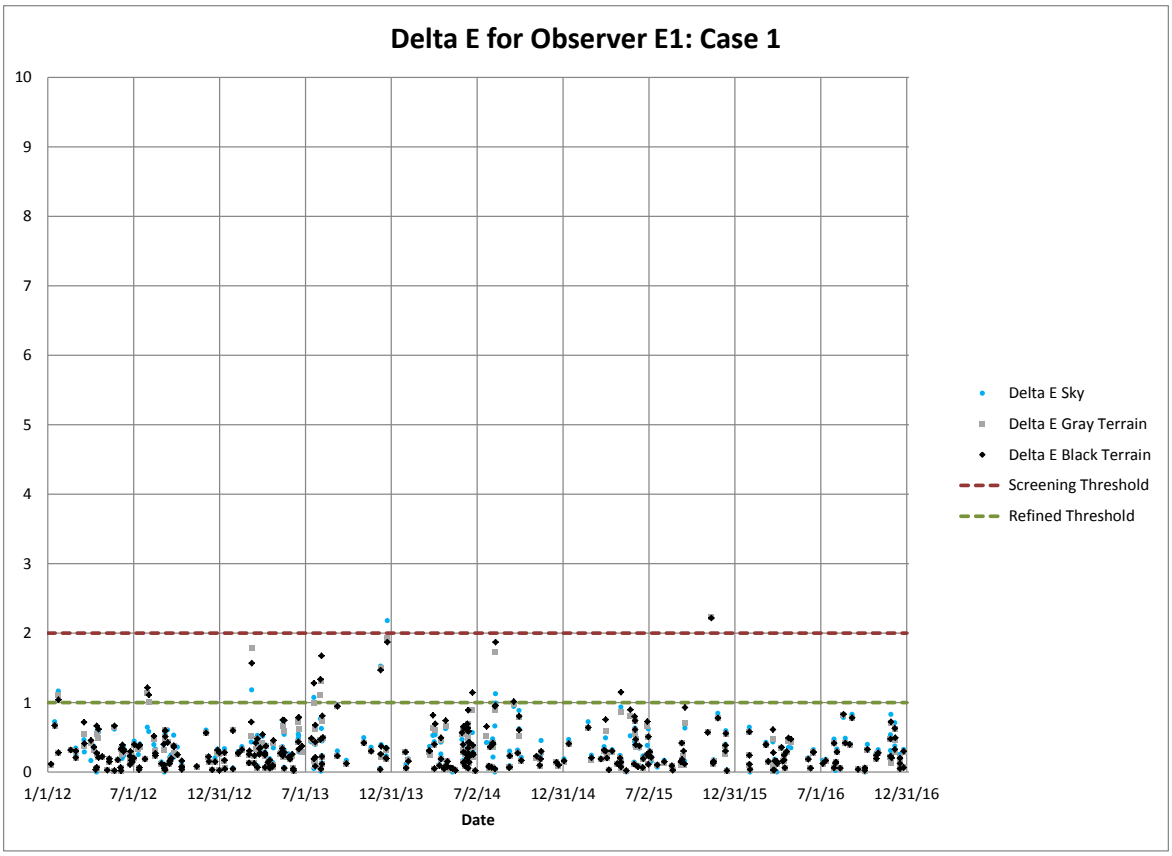


Figure 4-9 Time Series of Delta E and Cp for Case 1: Observer E1



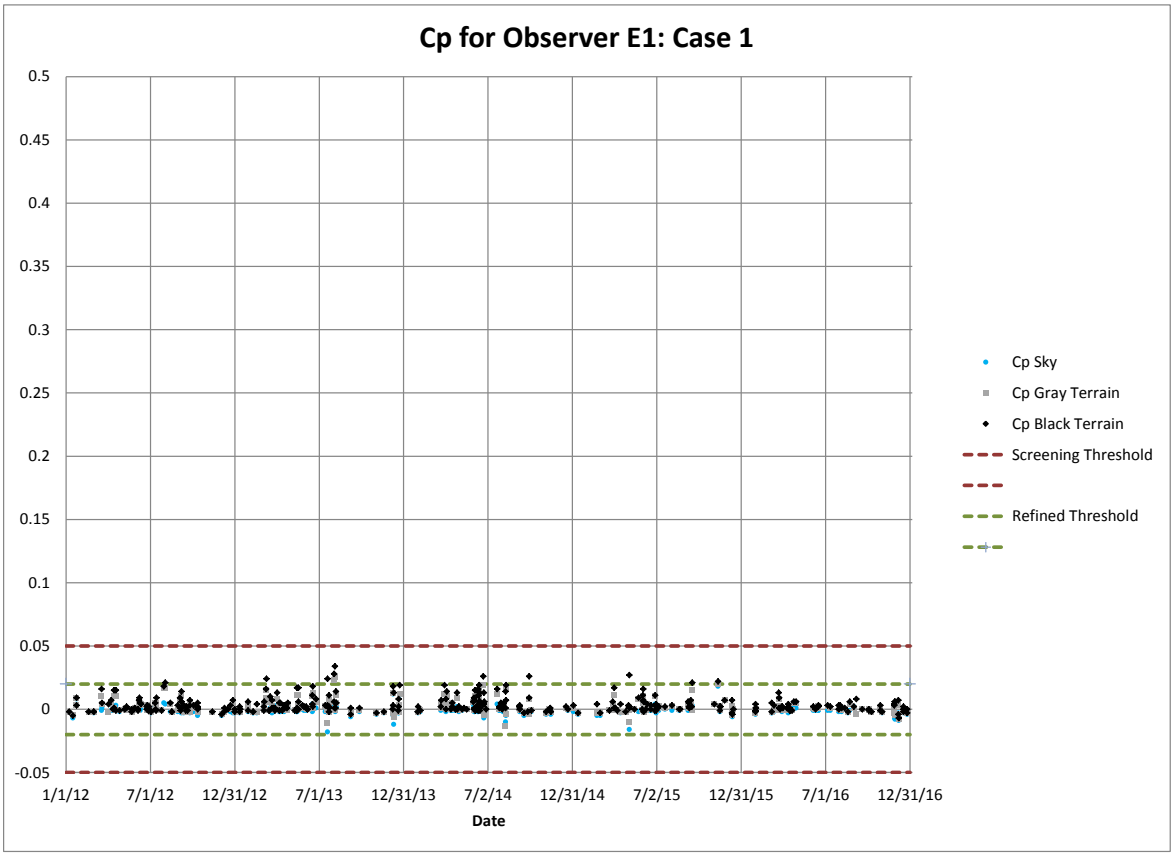
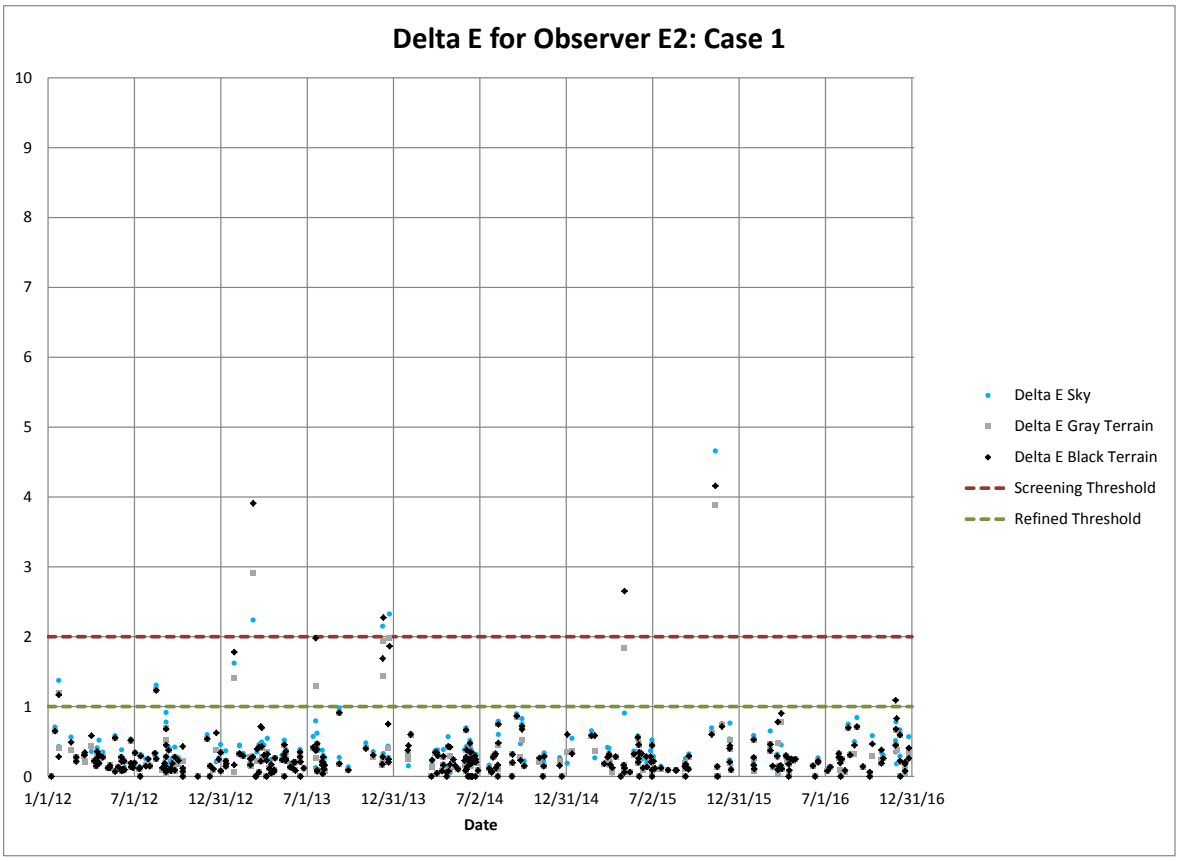


Figure 4-10 Time Series of Delta E and Cp for Case 1: Observer E2



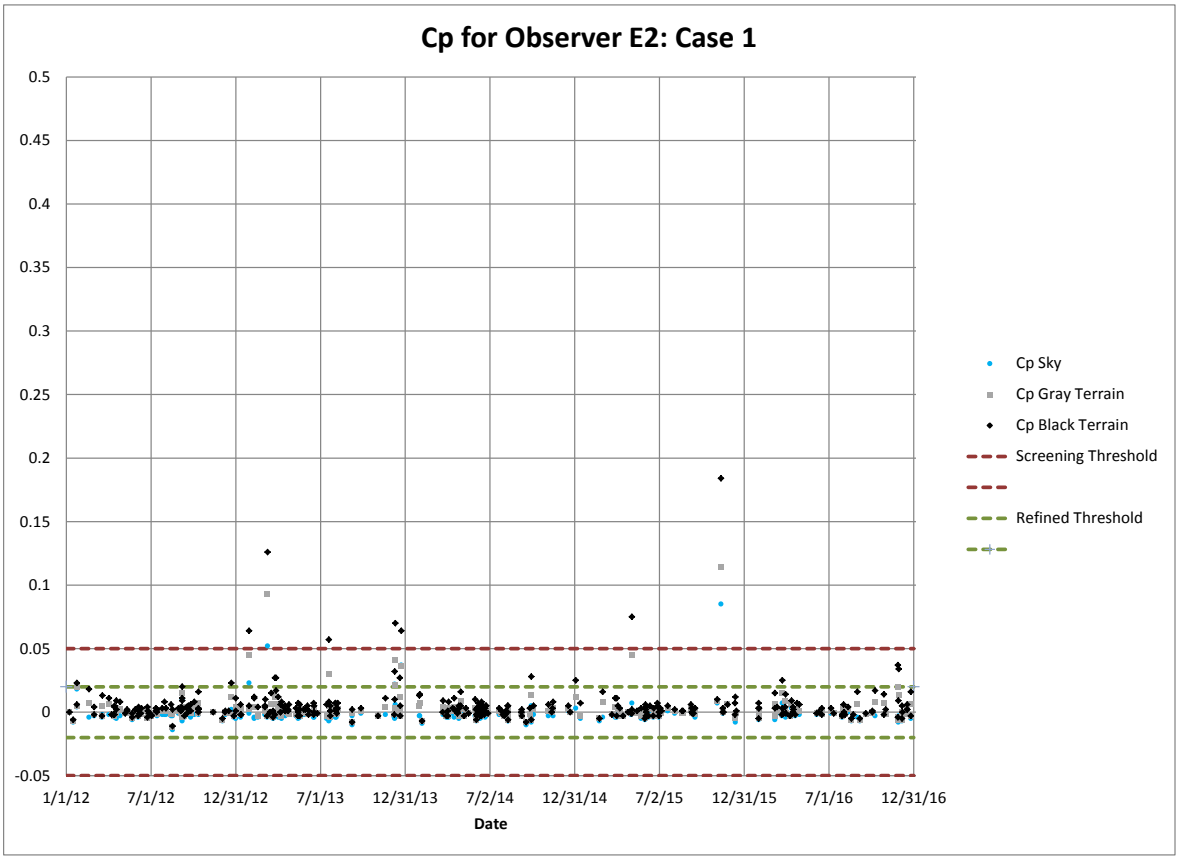
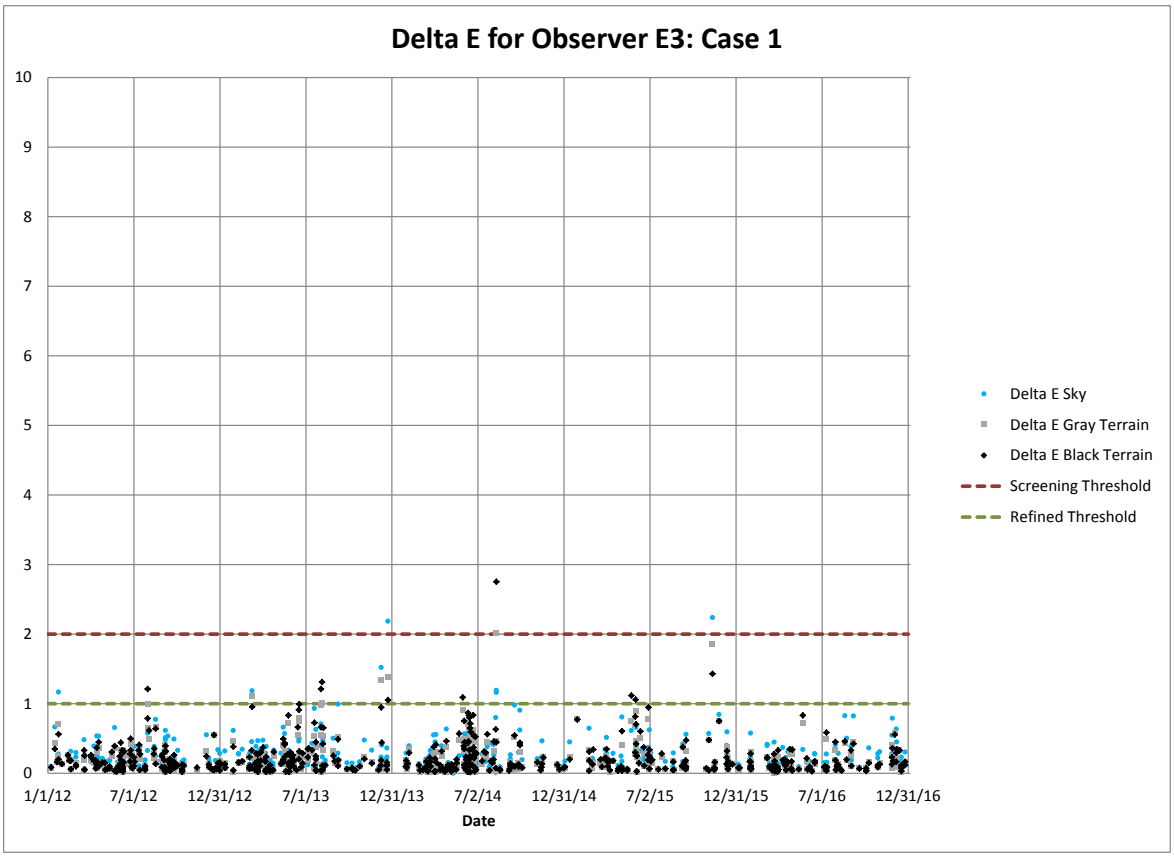


Figure 4-11 Time Series of Delta E and Cp for Case 1: Observer E3



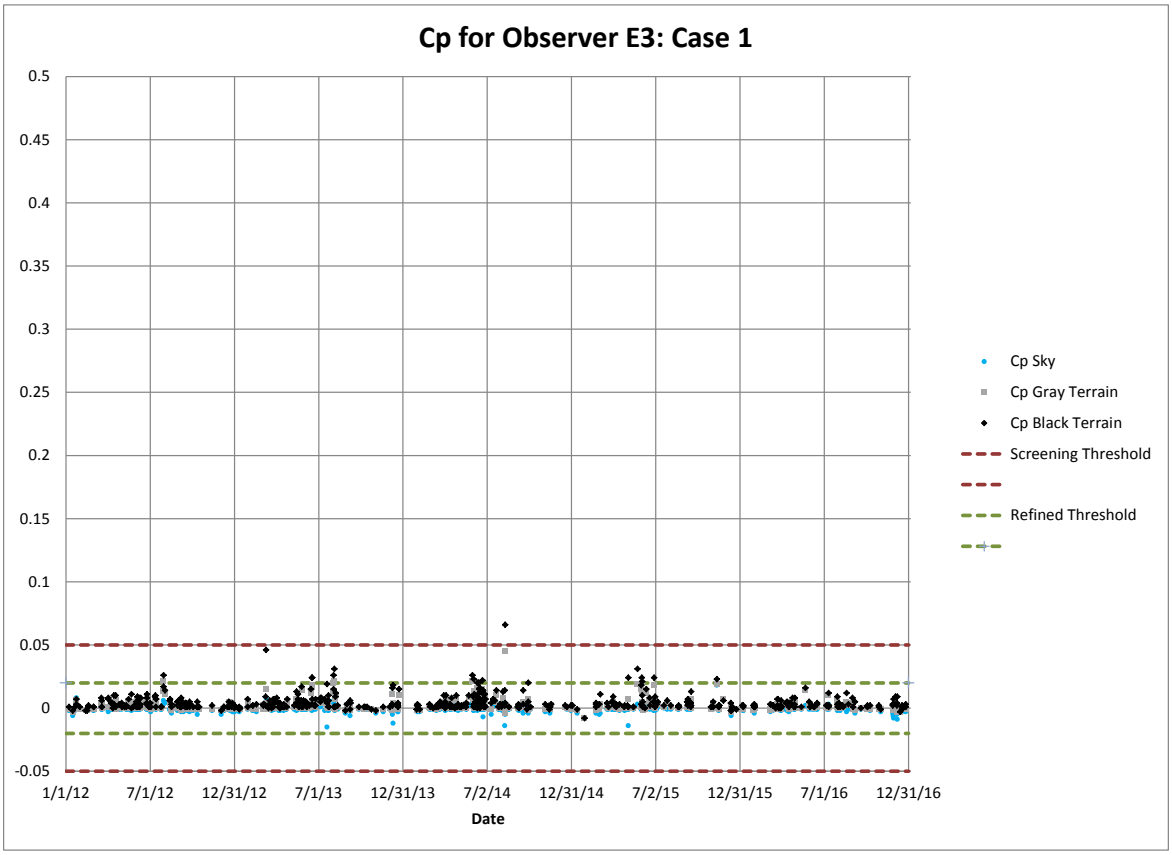
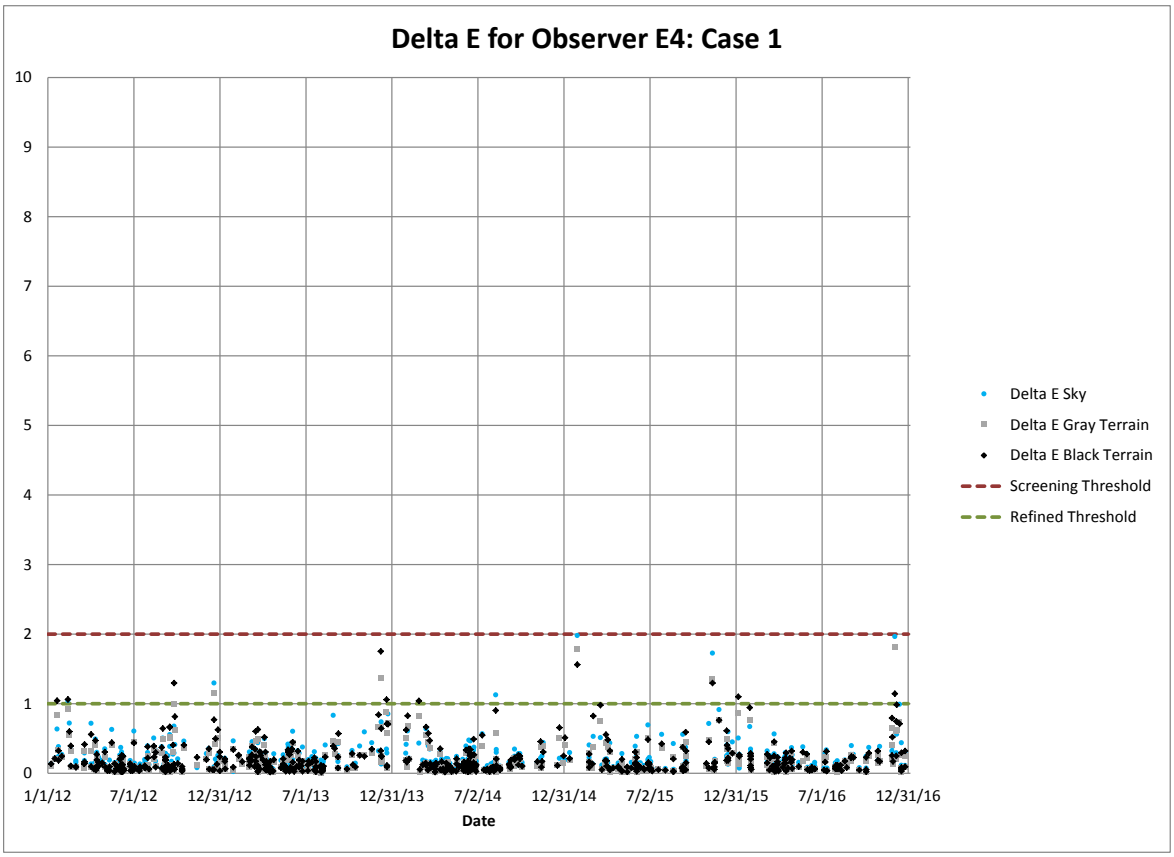


Figure 4-12 Time Series of Delta E and Cp for Case 1: Observer E4



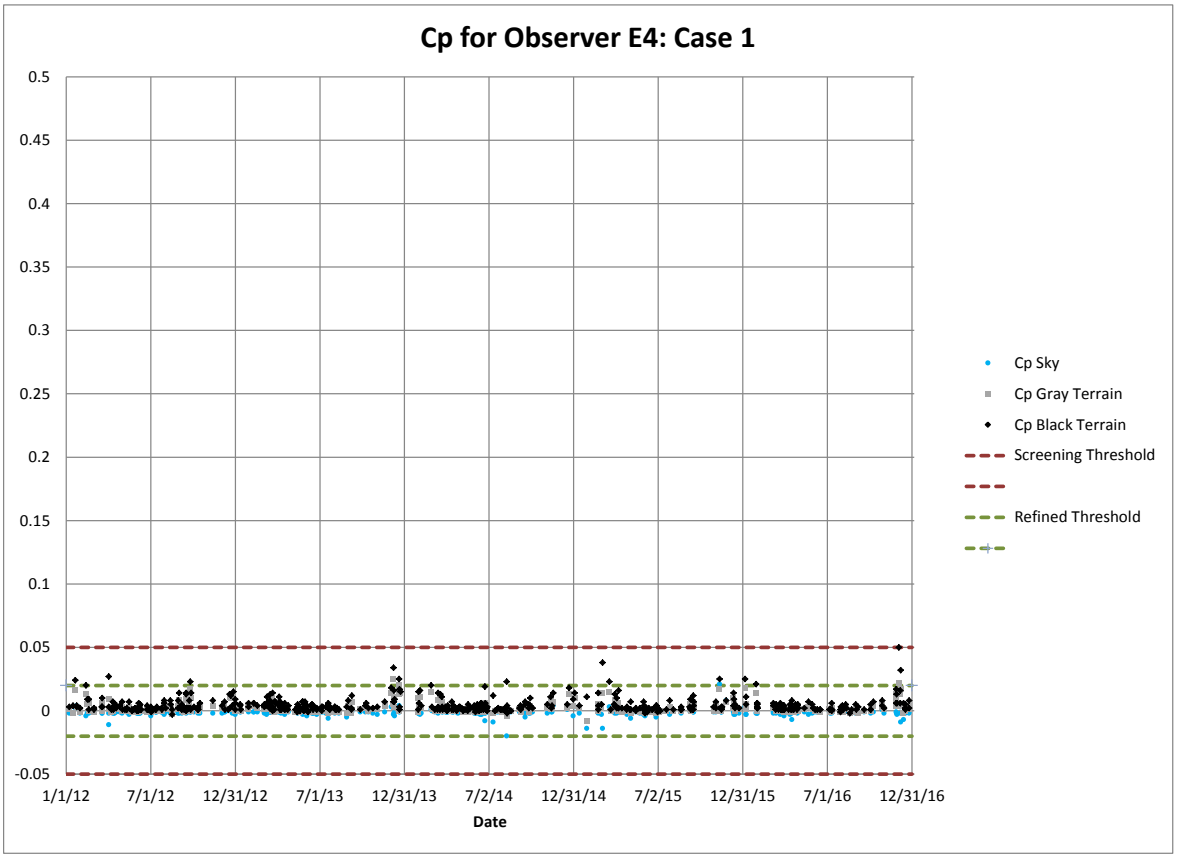
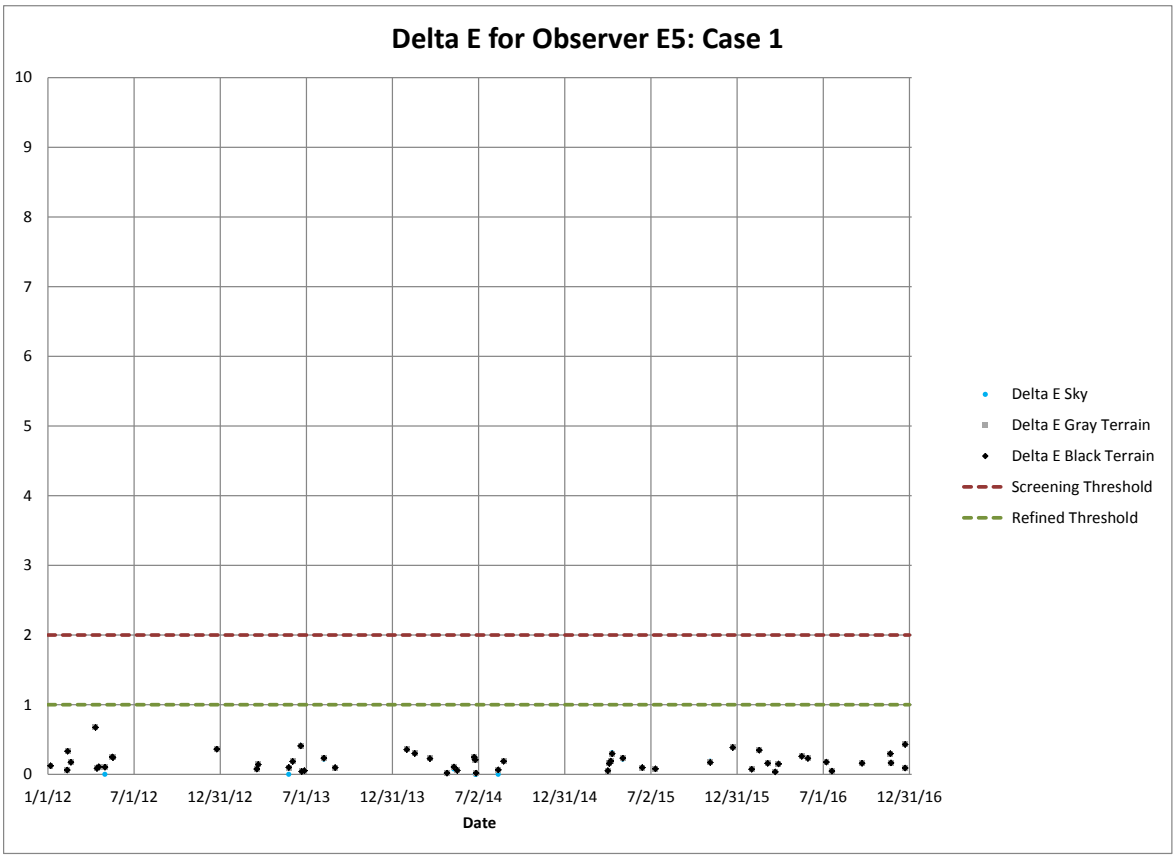


Figure 4-13 Time Series of Delta E and Cp for Case 1: Observer E5



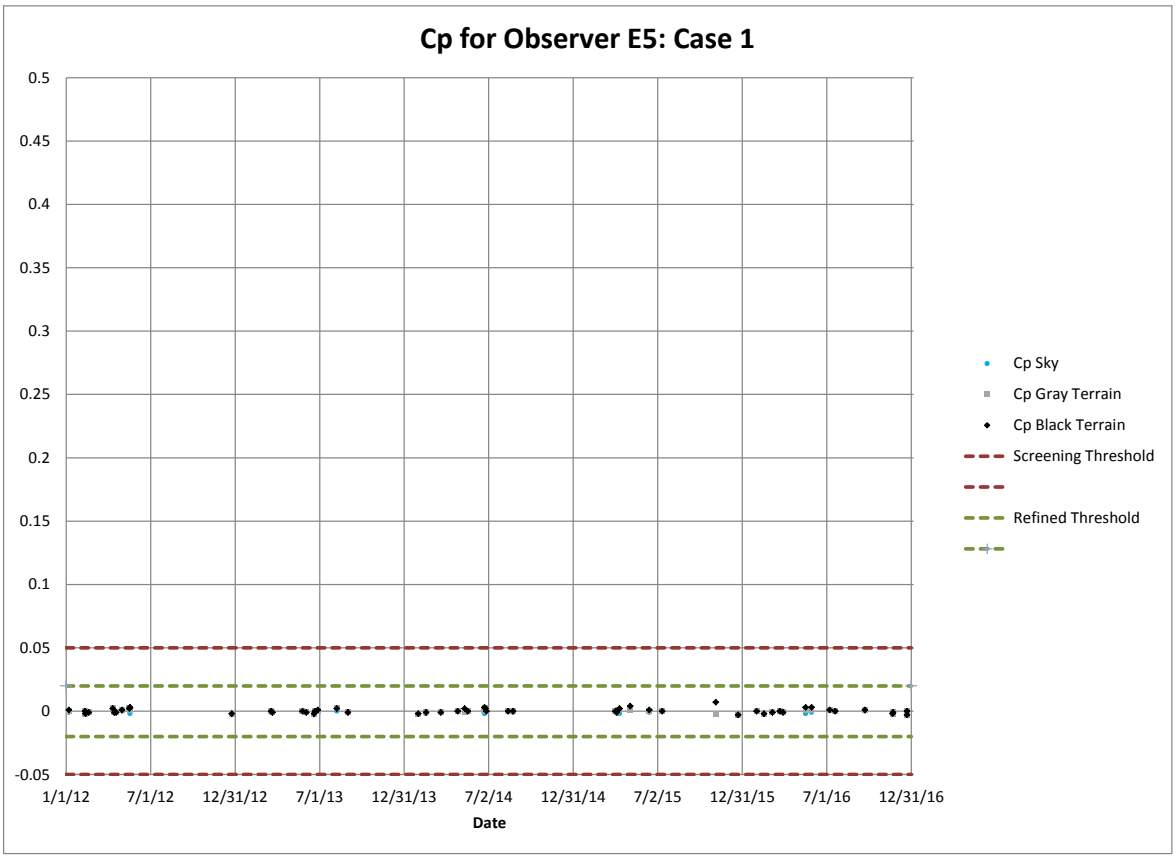
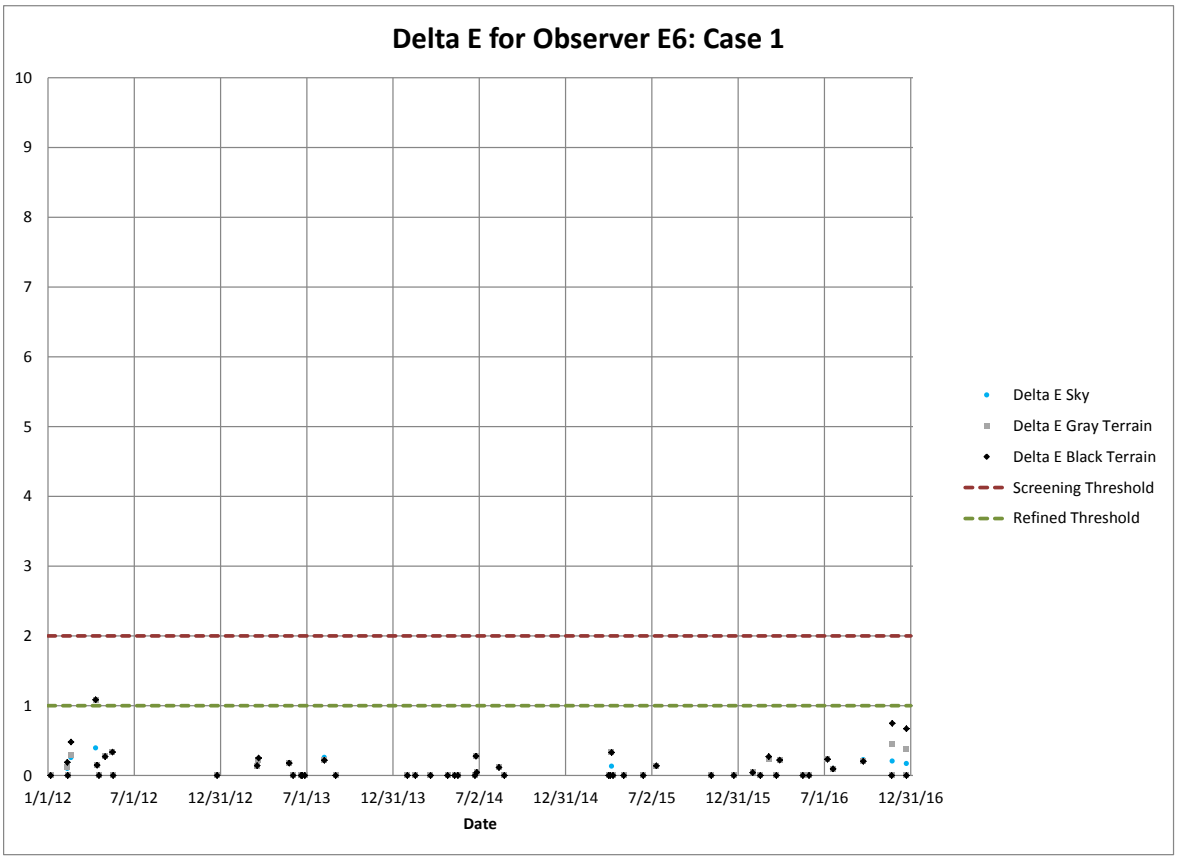


Figure 4-14 Time Series of Delta E and Cp for Case 1: Observer E6



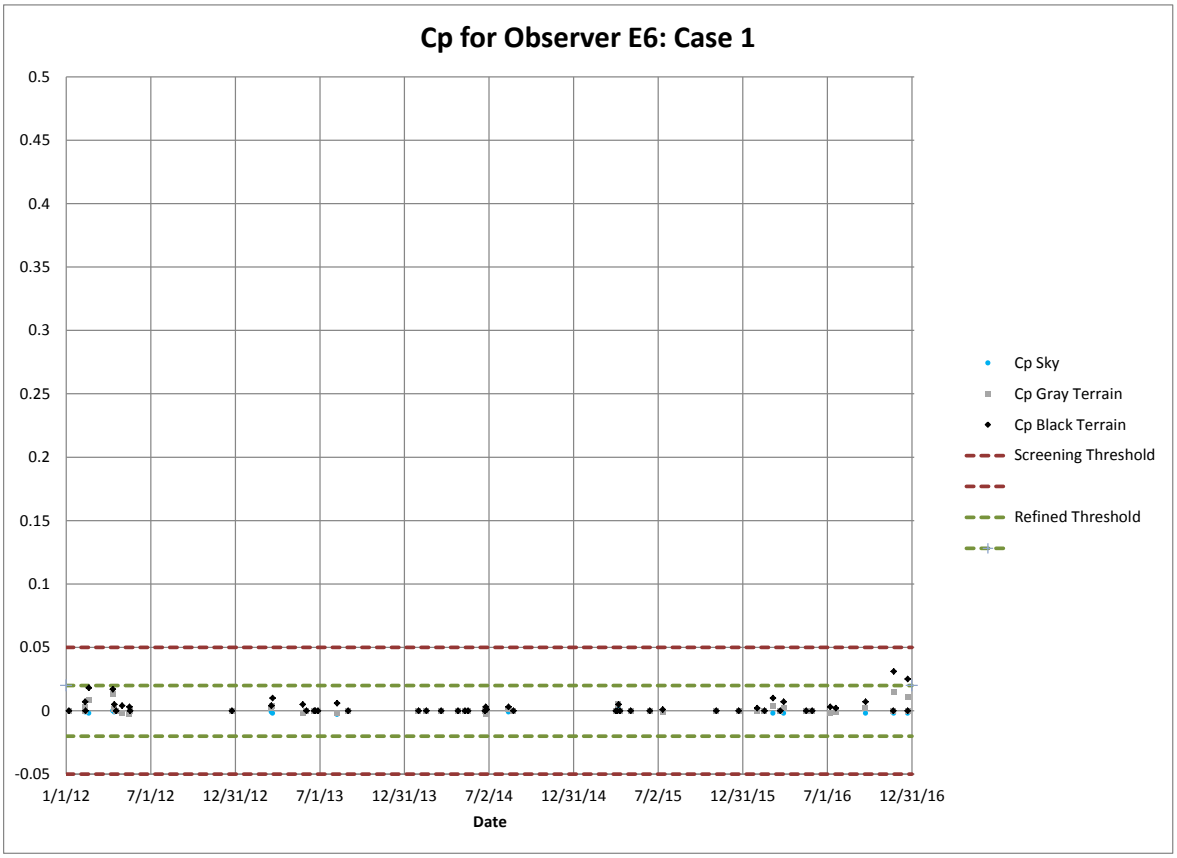
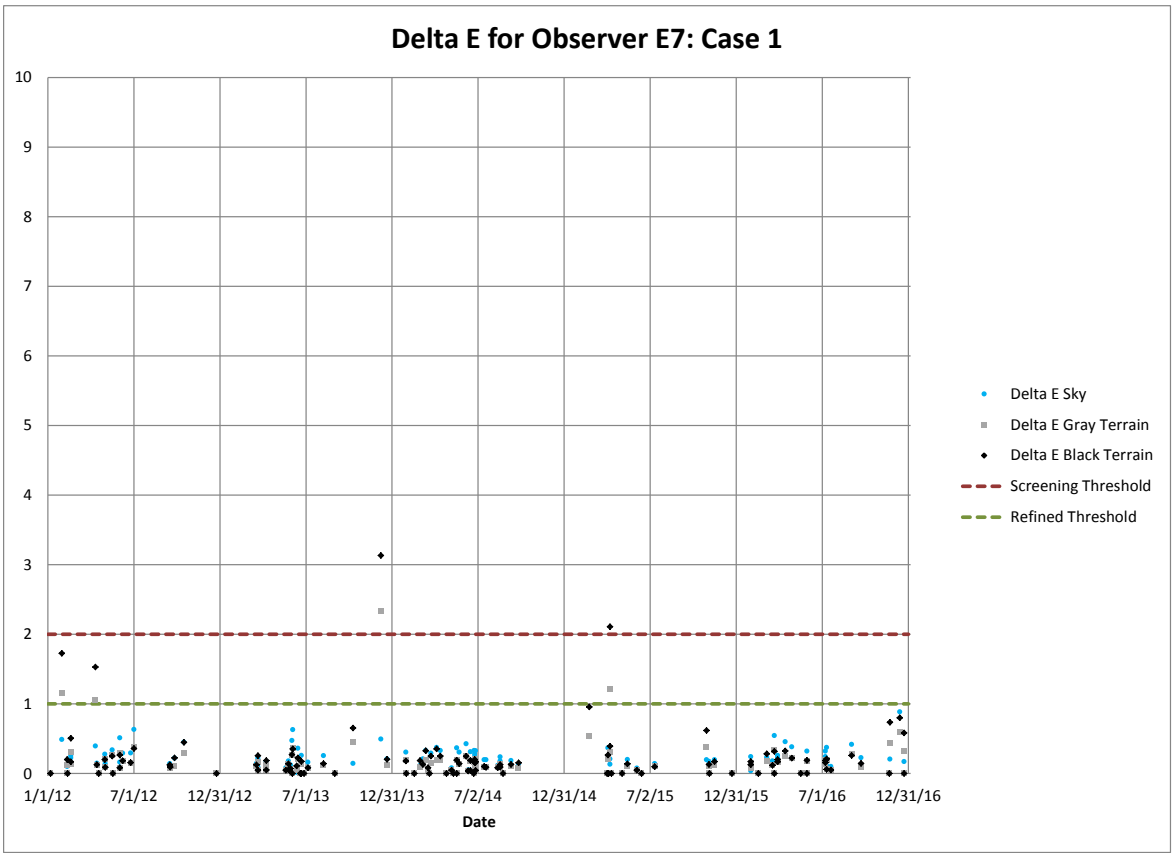


Figure 4-15 Time Series of Delta E and Cp for Case 1: Observer E7



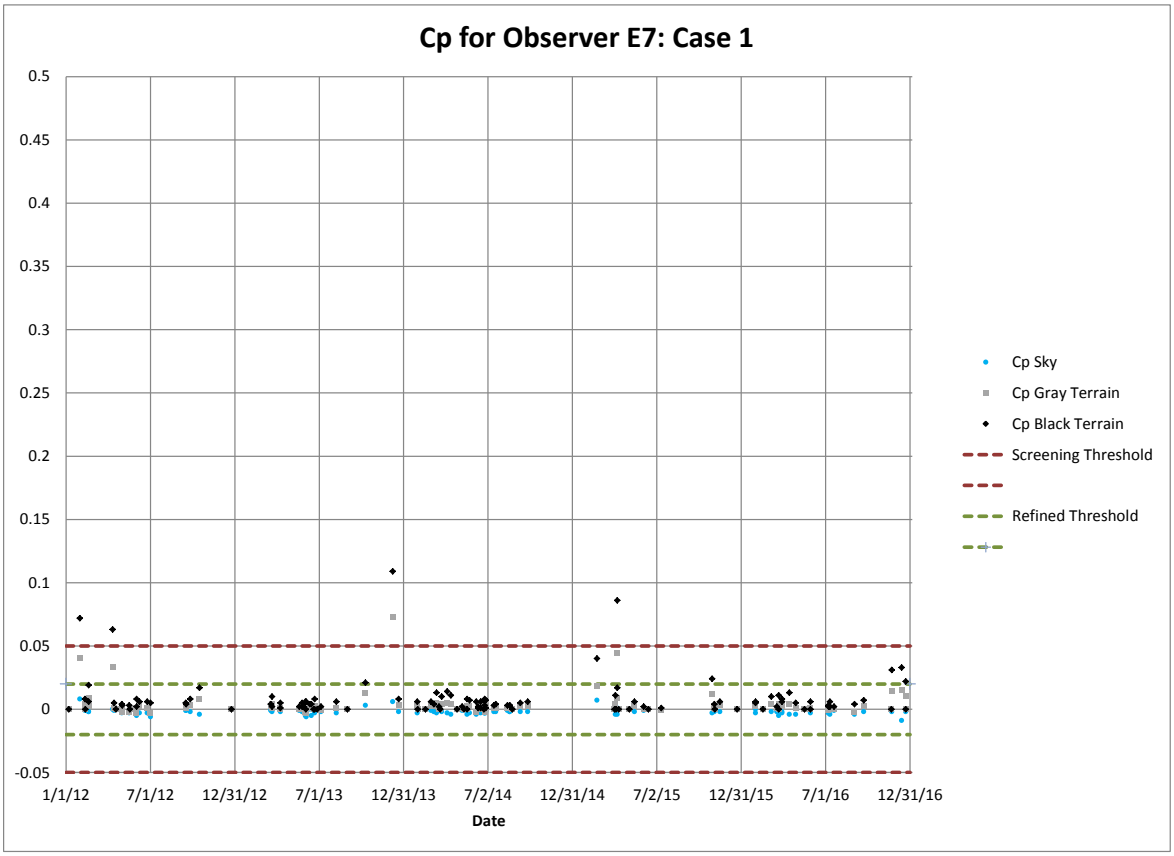
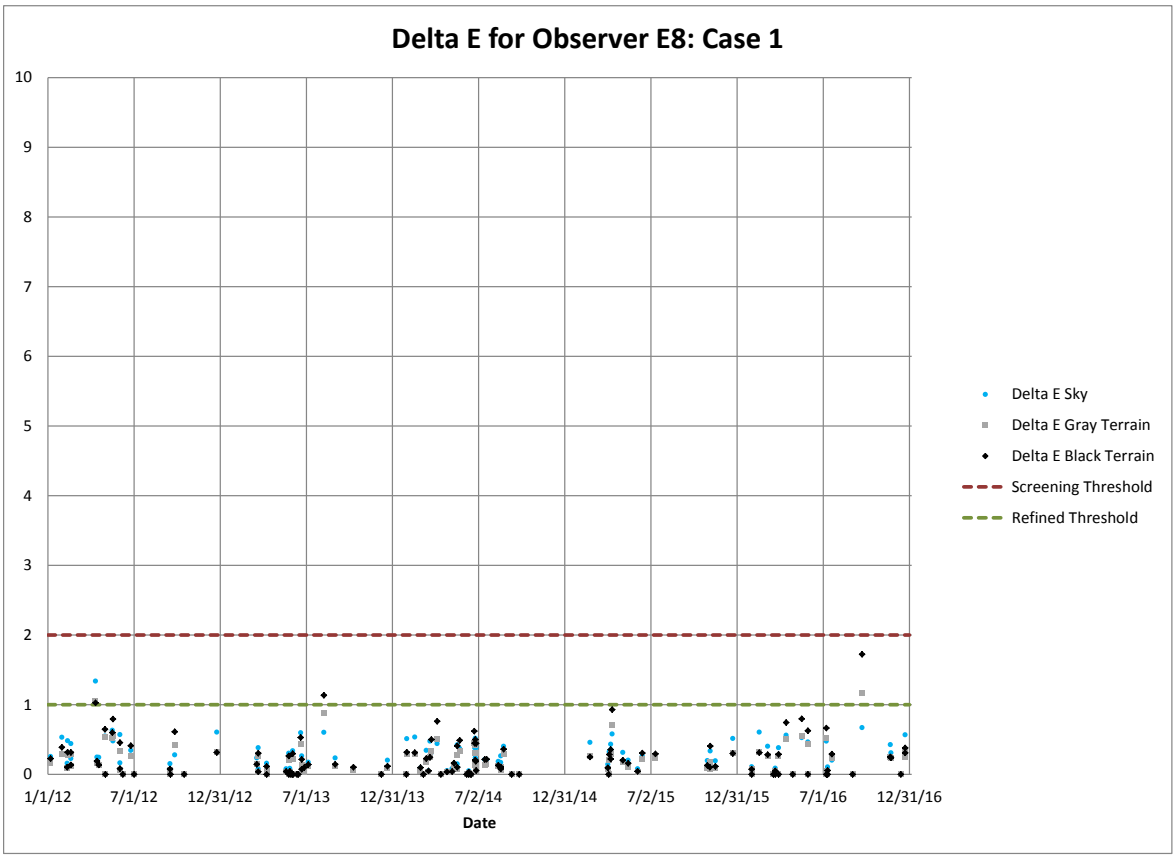
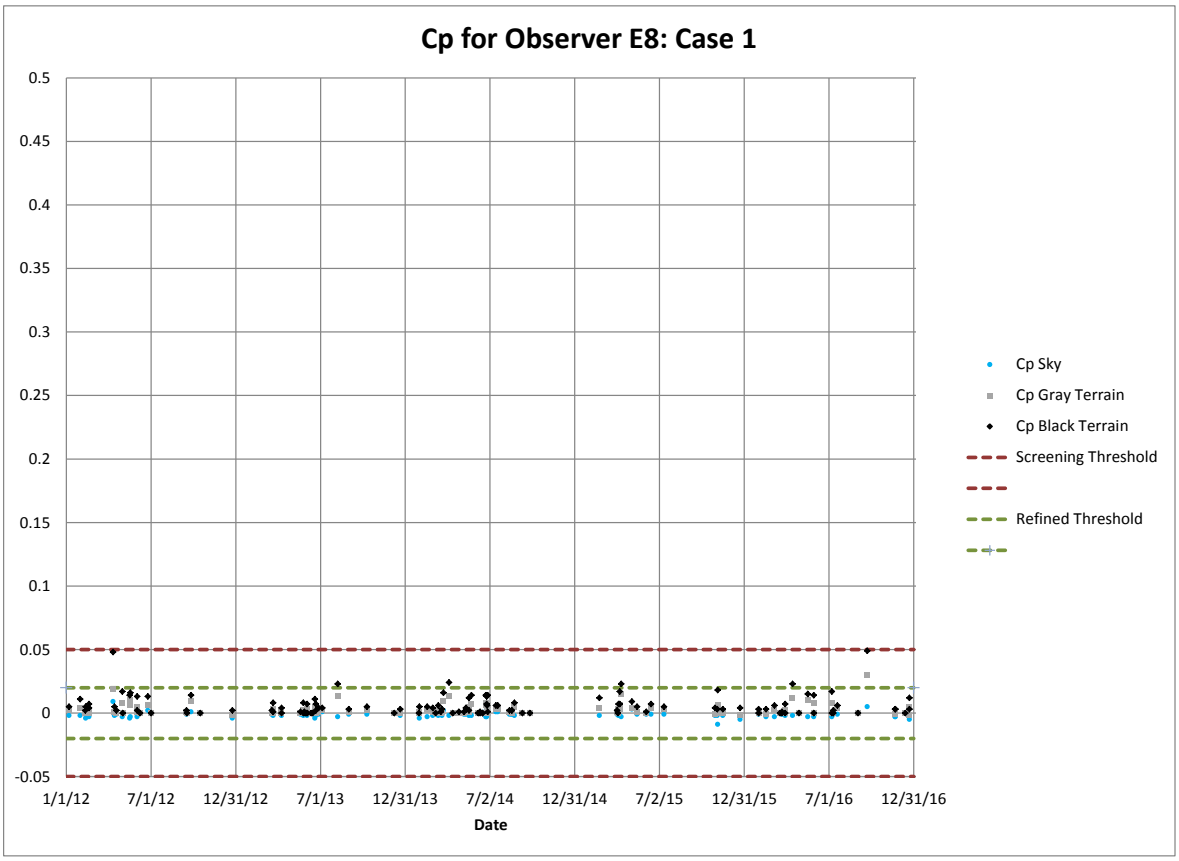


Figure 4-16 Time Series of Delta E and Cp for Case 1: Observer E8





A confounding factor when interpreting terrain background calculations is that they are based on the highly idealized assumption that terrain has no color (gray or black) and is uniform (like a blank wall). This simplistic characterization results in an exaggeration overestimate of the ability of a plume to be seen. As can be seen in **Figure 4-17,** the background is colorful and mottled rather than uniformly gray or black.

Figure 4-17 Photo of Saguaro National Park

Photo credit: https://www.expedia.com/pictures/arizona/southern-arizona.d6054714/landscape/.

5. Summary and Conclusions

A refined visibility assessment was conducted following guidance from the NPS. A total of 16 combinations of observer and target terrain points identified by the NPS were evaluated over five years of hourly meteorological conditions. This analysis was conducted for two emission cases, Case 1 representing simultaneous start of the 10 RICE units and Case 2 representing all 10 RICE units at 100% load. This resulted in applying EPA's plume visibility model, PLUVUE II for nearly 10,000 model runs, each representing an hour for which a plume from the RICE units could pass between the observer and the specified terrain target.

The resulting conservative analysis demonstrated that modeled excursions of the NPS visibility parameter thresholds were very infrequent and rarely occurred on the same day or on consecutive hours. Even at the observer with the highest modeled frequency of excursions, this occurred on well below 1% of the daylight hours. Given that the expected frequency of the RICE units operating at the modeled loads is small, the actual frequency of excursions will be much smaller than that modeled.

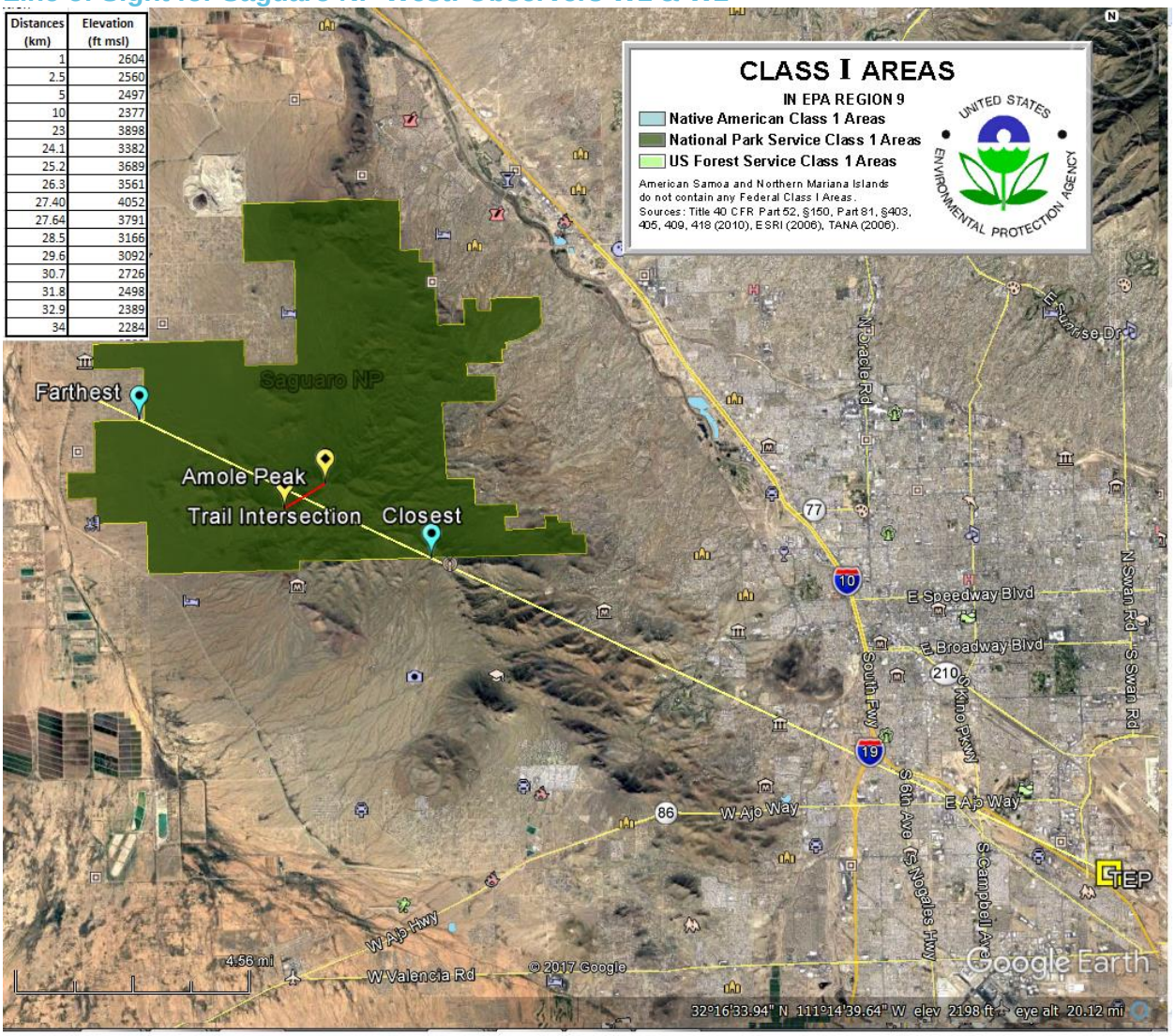
Another aspect to interpreting model results for terrain backgrounds is that the actual background, rather than being a uniform gray or black, is mottled and with a variety of color, which would tend to further mask the plume visibility. To account for this effect, one could use higher thresholds for plume contrast (C_p) and perceptibility (ΔE). Consideration of more applicable (higher) thresholds would result in a much lower frequency of modeled excursions.

Attachment A

Line of Sights Used in PLUVUE II Modeling for Observers in Saguaro NP East and West Units

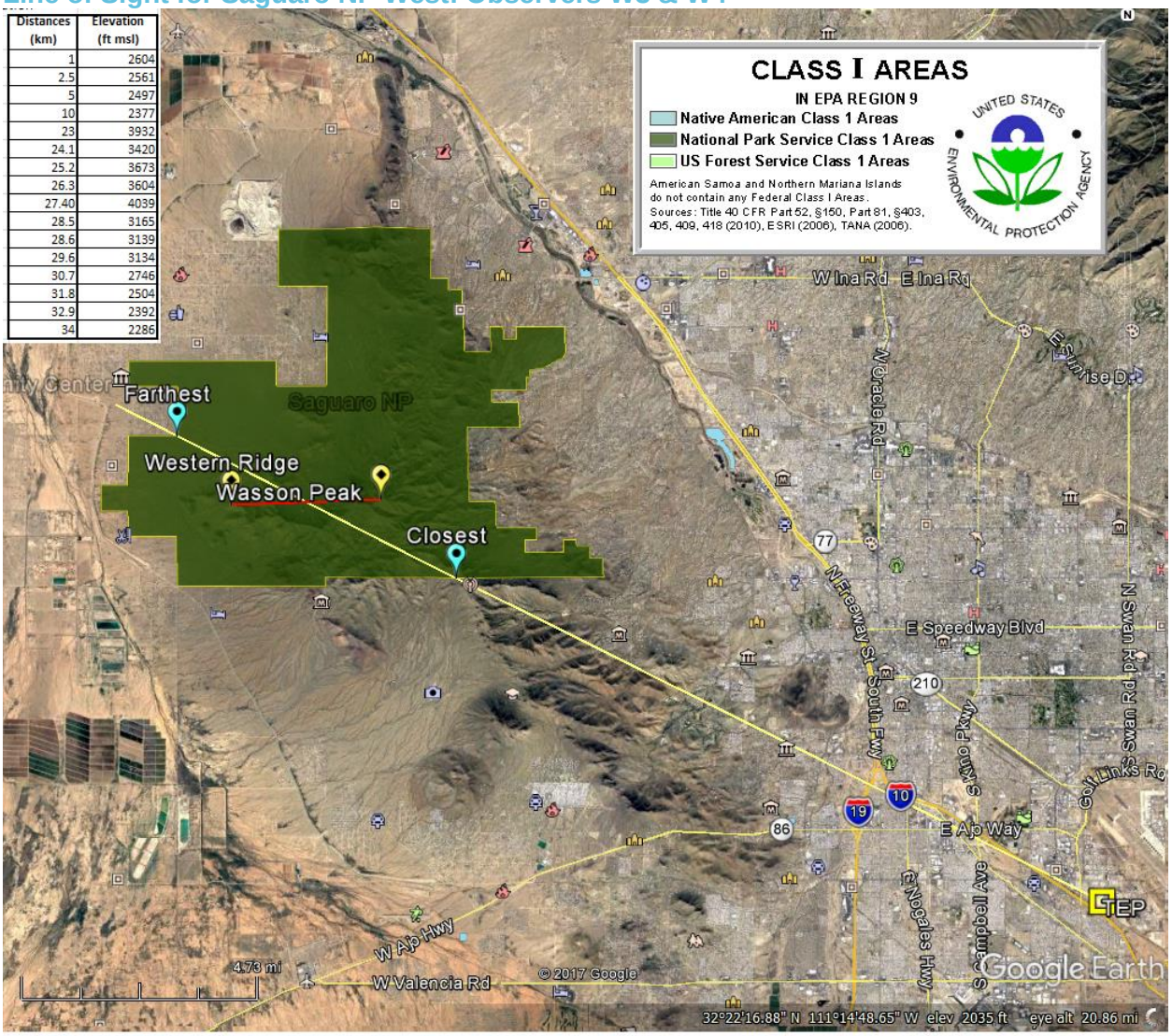
Line of Sight for Saguaro NP West: Observers W1 & W2

Distances (km)	Elevation (ft msl)
1	2604
2.5	2560
5	2497
10	2377
23	3898
24.1	3382
25.2	3689
26.3	3561
27.40	4052
27.64	3791
28.5	3166
29.6	3092
30.7	2726
31.8	2498
32.9	2389
34	2284



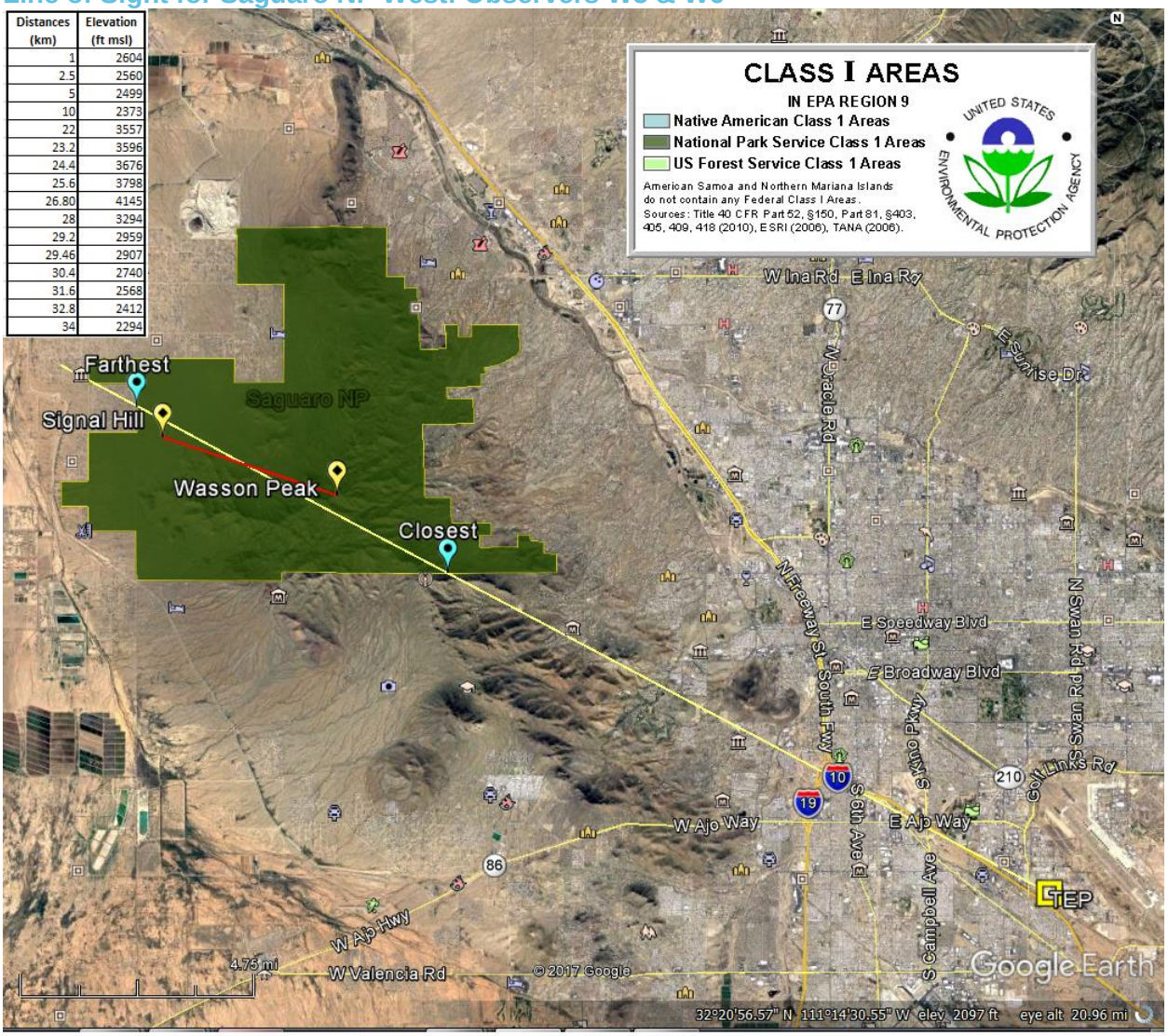
Line of Sight for Saguaro NP West: Observers W3 & W4

Distances (km)	Elevation (ft msl)
1	2604
2.5	2561
5	2497
10	2377
23	3932
24.1	3420
25.2	3673
26.3	3604
27.40	4039
28.5	3165
28.6	3139
29.6	3134
30.7	2746
31.8	2504
32.9	2392
34	2286



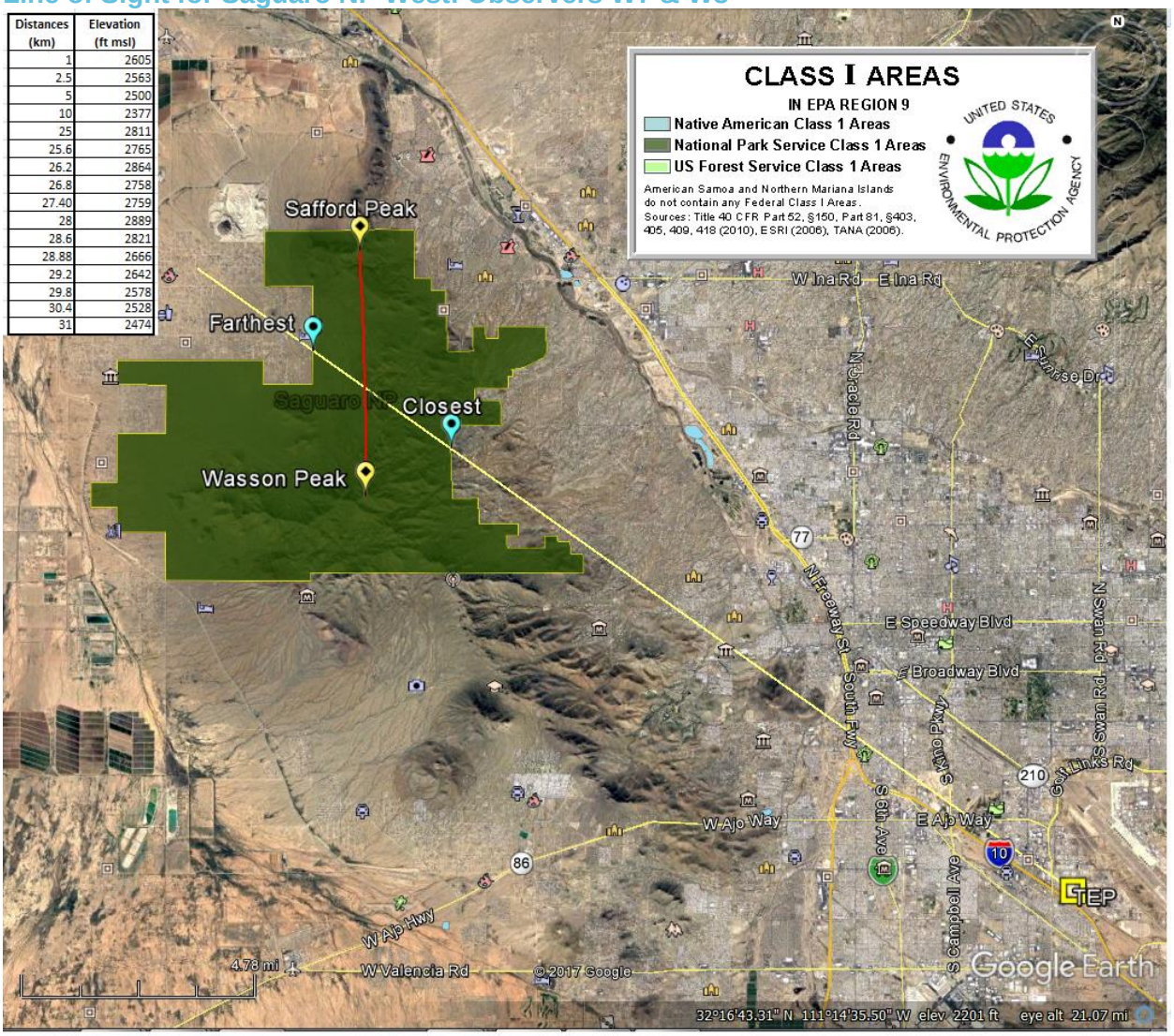
Line of Sight for Saguaro NP West: Observers W5 & W6

Distances (km)	Elevation (ft msl)
1	2604
2.5	2560
5	2499
10	2373
22	3557
23.2	3596
24.4	3676
25.6	3798
26.80	4145
28	3294
29.2	2959
29.46	2907
30.4	2740
31.6	2568
32.8	2412
34	2294



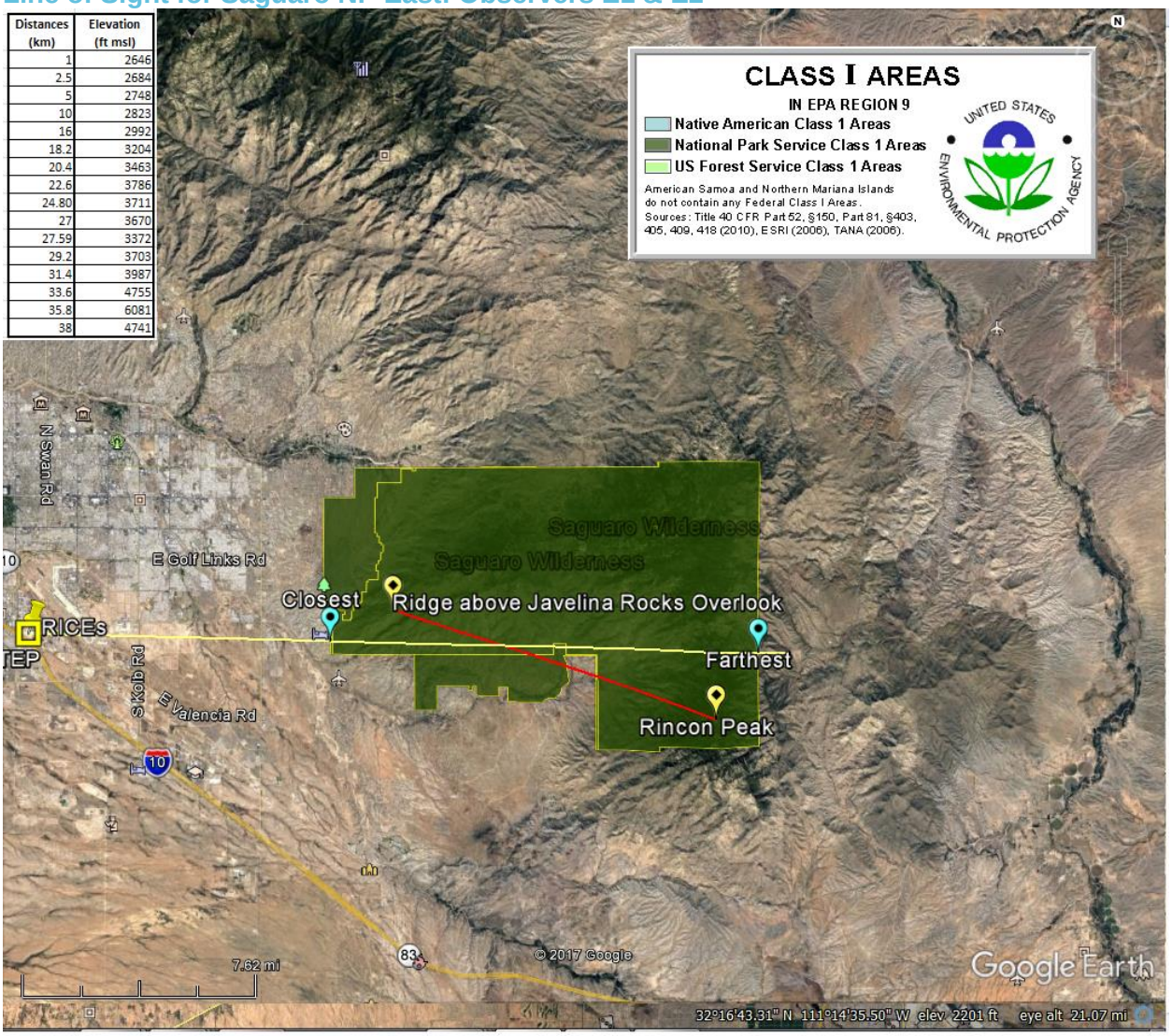
Line of Sight for Saguaro NP West: Observers W7 & W8

Distances (km)	Elevation (ft msl)
1	2605
2.5	2563
5	2500
10	2377
25	2811
25.6	2765
26.2	2864
26.8	2758
27.40	2759
28	2889
28.6	2821
28.88	2666
29.2	2642
29.8	2578
30.4	2528
31	2474



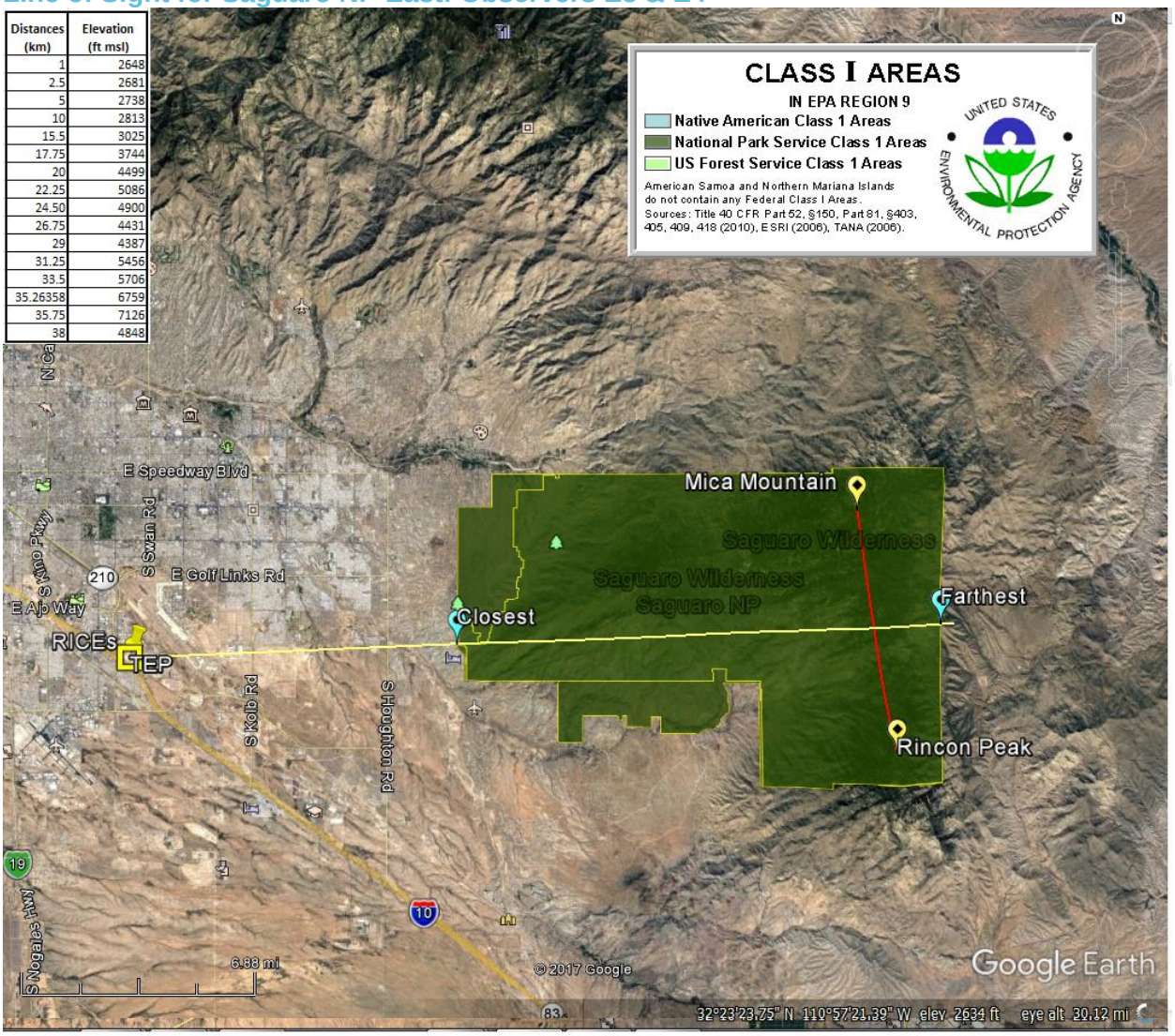
Line of Sight for Saguaro NP East: Observers E1 & E2

Distances (km)	Elevation (ft msl)
1	2646
2.5	2684
5	2748
10	2823
16	2992
18.2	3204
20.4	3463
22.6	3786
24.80	3711
27	3670
27.59	3372
29.2	3703
31.4	3987
33.6	4755
35.8	6081
38	4741



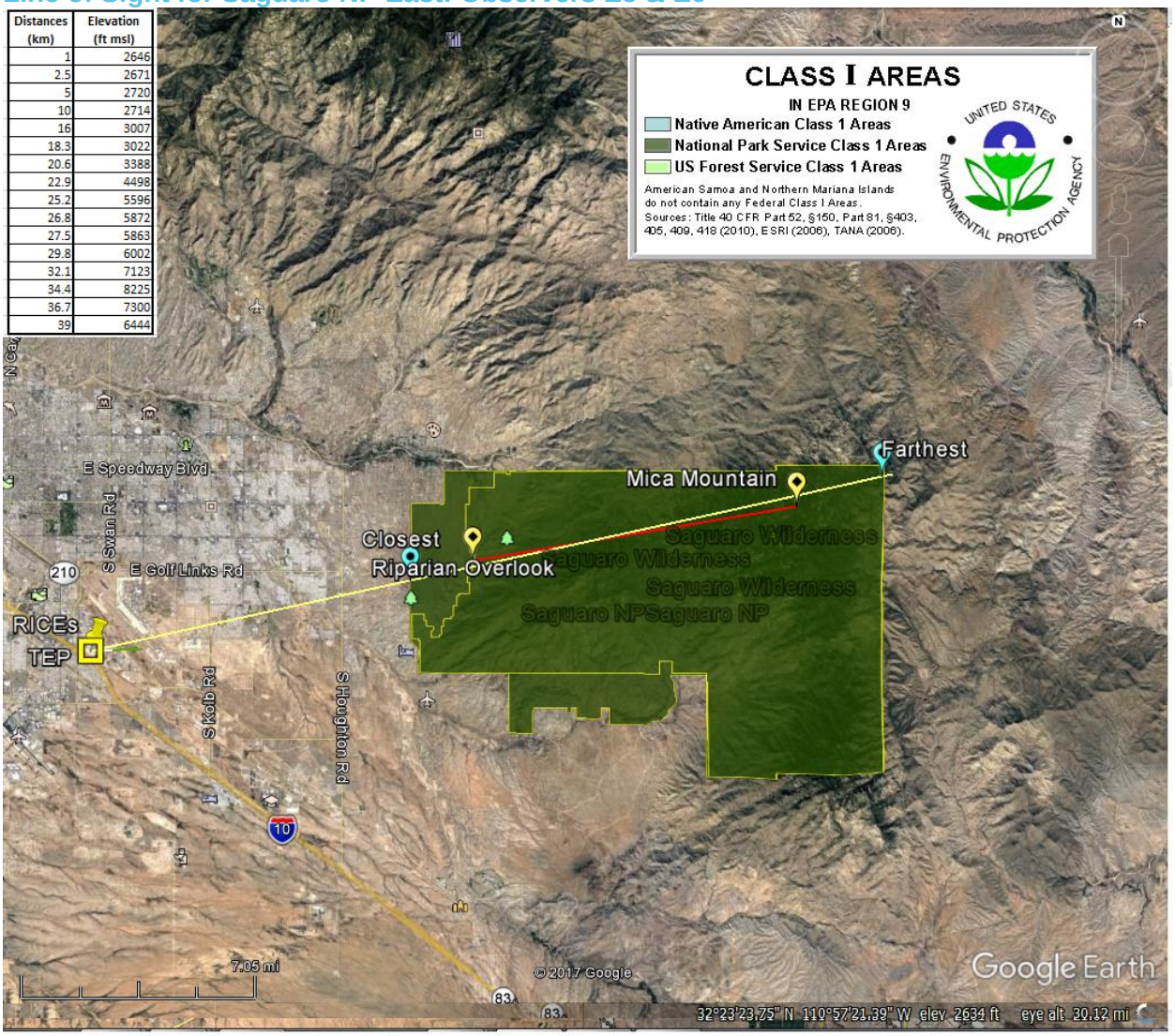
Line of Sight for Saguaro NP East: Observers E3 & E4

Distances (km)	Elevation (ft msl)
1	2648
2.5	2681
5	2738
10	2813
15.5	3025
17.75	3744
20	4499
22.25	5086
24.50	4900
26.75	4431
29	4387
31.25	5456
33.5	5706
35.26358	6759
35.75	7126
38	4848



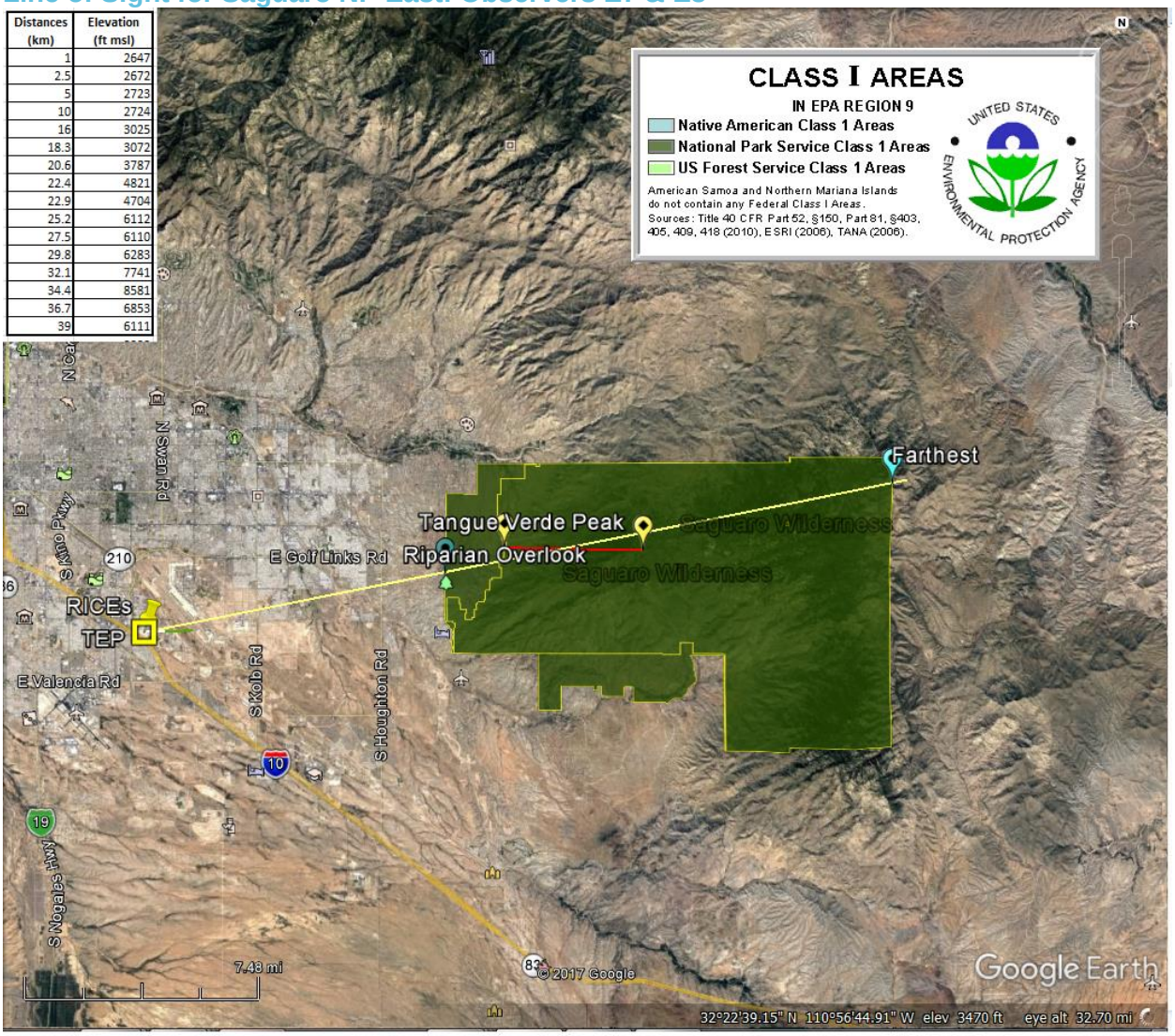
Line of Sight for Saguaro NP East: Observers E5 & E6

Distances (km)	Elevation (ft msl)
1	2646
2.5	2671
5	2720
10	2714
16	3007
18.3	3022
20.6	3388
22.9	4498
25.2	5596
26.8	5872
27.5	5863
29.8	6002
32.1	7123
34.4	8225
36.7	7300
39	6444



Line of Sight for Saguaro NP East: Observers E7 & E8

Distances (km)	Elevation (ft msl)
1	2647
2.5	2672
5	2723
10	2724
16	3025
18.3	3072
20.6	3787
22.4	4821
22.9	4704
25.2	6112
27.5	6110
29.8	6283
32.1	7741
34.4	8581
36.7	6853
39	6111



Attachment C

Statistical Summaries for Case 2 at Saguaro NP East and West Units

Observer E1

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)															
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0	0.2	0	0	0	0	0	0	0	0.2	0.4	1	1	0	0	0.4	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0.2	0.4	0.6	0.6	0	0	0.2	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.4	0.4	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)															
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0	0.2	0	0	0	0	0.6	0	0	0.2	0.4	1.6	1.6	0	0	0.4	0.4	0.2	0	0	0	0	0	0	0	0	0.2	0.4	0	0
1.5	0	0	0.2	0	0	0	0	0	0	0	0.2	0.4	0.8	0.8	0	0	0.4	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)															
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0	0.2	0	0	0	0	0.2	0	0	0.2	0.4	1.2	1.2	0	0	0.4	0.4	0.2	0	0	0	0	0	0	0	0	0.2	0	0	0
1.5	0	0	0.2	0	0	0	0	0	0	0	0.2	0.4	0.8	0.8	0	0	0.4	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)															
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)															
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0.2	0	0.2	0.2	0.2	0.4	0.2	0	0.2	0	1.6	1.6	0	0.4	0.4	0	0.2	0	0	0	0	0	0	0	0	0	0.6	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)															
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer E2

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)															
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.4	0	0.2	0	0	0	0	0.2	0.2	0	0.2	0.4	1.6	1.6	0	0	0.4	0.8	0.2	0	0	0	0	0	0	0	0.2	0	0	0	0
1.5	0.2	0	0.2	0	0	0	0	0	0	0	0.2	0.4	1	1	0	0	0.4	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0.2	0	0	0	0	0	0	0	0.2	0.4	0.8	0.8	0	0	0.4	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)															
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.4	0	0.2	0	0.2	0	0.2	0.2	0	0	0.2	0.6	2	2	0	0.4	0.4	0.8	0.2	0	0	0	0	0	0	0	0.2	0	0	0	0
1.5	0	0	0.2	0	0.2	0	0	0	0	0	0.2	0.6	1.2	1.2	0	0.2	0.4	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)															
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.4	0	0.2	0	0.2	0	0	0.2	0	0	0.2	0.6	1.8	1.8	0	0.2	0.4	0.8	0.2	0	0	0	0	0	0	0	0.2	0	0	0	0
1.5	0	0	0.2	0	0	0	0	0	0	0	0.2	0.4	0.8	0.8	0	0	0.4	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0.2	0	0	0	0	0	0	0	0.2	0.4	0.8	0.8	0	0	0.4	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)															
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.2	0	0.2	0	0	0	0	0	0	0	0.2	0.4	1	1	0	0	0.4	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)															
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.2	0	0.8	0	0.2	0	0.2	0	0.2	0	0.6	0.8	3	3	0	0.4	0.4	1	0.4	0	0	0	0	0	0	0	0.4	0.4	0	0	0
0.035	0.2	0	0.2	0	0.2	0	0.2	0	0	0	0.2	0.4	1.4	1.4	0	0.4	0.4	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0.2	0	0.2	0	0.2	0	0	0	0	0	0.2	0.2	1	1	0	0.2	0.4	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)															
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.2	0	0.2	0	0.2	0	0.2	0	0	0	0.2	0.6	1.6	1.6	0	0.4	0.4	0.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0.2	0	0.2	0	0.2	0	0	0	0	0	0.2	0	0.8	0.8	0	0.2	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer E3

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0	0.2	0	0	0	0	0.2	0	0	0.2	0.4	1.2	1.2	0	0	0.4	0.4	0.2	0	0	0	0	0	0	0	0.2	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0.2	0.4	0.6	0.6	0	0	0.2	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.4	0.4	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Delta E-Black Terrain	**Monthly Distribution of Average Hours per year**												**Hrs/**	**Days**	**Consecutive**	**Observed Hour per year (Local Standard Time)**														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0.2	0	0	0	0	0.2	0	0	0.2	0.4	1	1	0	0	0.4	0.2	0.2	0	0	0	0	0	0	0	0	0.2	0	0	0
1.5	0	0	0	0	0	0	0	0.2	0	0	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0
2	0	0	0	0	0	0	0	0.2	0	0	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Delta E-Gray Terrain	**Monthly Distribution of Average Hours per year**												**Hrs/**	**Days**	**Consecutive**	**Observed Hour per year (Local Standard Time)**														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0.2	0	0	0	0	0.2	0	0	0.2	0.4	1	1	0	0	0.4	0.2	0.2	0	0	0	0	0	0	0	0	0.2	0	0	0
1.5	0	0	0	0	0	0	0	0.2	0	0	0.2	0	0.4	0.4	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cp - Sky	**Monthly Distribution of Average Hours per year**												**Hrs/**	**Days**	**Consecutive**	**Observed Hour per year (Local Standard Time)**														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cp - Black Terrain	**Monthly Distribution of Average Hours per year**												**Hrs/**	**Days**	**Consecutive**	**Observed Hour per year (Local Standard Time)**														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0.2	0	0.2	0	0.2	0.6	0	0	0.2	0	1.4	1.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0.6	0.4	0	0
0.035	0	0	0.2	0	0	0	0	0.2	0	0	0	0	0.4	0.4	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0
0.05	0	0	0	0	0	0	0	0.2	0	0	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cp - Gray Terrain	**Monthly Distribution of Average Hours per year**												**Hrs/**	**Days**	**Consecutive**	**Observed Hour per year (Local Standard Time)**														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0.2	0	0	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0
0.035	0	0	0	0	0	0	0	0.2	0	0	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer E4

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0	0	0	0	0	0	0	0	0	0.2	0.4	0.8	0.8	0	0	0.2	0.2	0.2	0	0	0	0	0	0.2	0	0	0	0	0	0
1.5	0.2	0	0	0	0	0	0	0	0	0	0.2	0.2	0.6	0.6	0	0	0.2	0.2	0	0	0	0	0	0	0.2	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Delta E-Black Terrain	**Monthly Distribution of Average Hours per year**												**Hrs/**	**Days**	**Consecutive**	**Observed Hour per year (Local Standard Time)**														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0	0	0	0	0	0	0	0	0	0.2	0.4	0.8	0.8	0	0	0.2	0.2	0	0	0	0	0	0	0.2	0.2	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Delta E-Gray Terrain	**Monthly Distribution of Average Hours per year**												**Hrs/**	**Days**	**Consecutive**	**Observed Hour per year (Local Standard Time)**														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0	0	0	0	0	0	0	0	0	0.2	0.4	0.8	0.8	0	0	0.2	0.2	0.2	0	0	0	0	0	0.2	0	0	0	0	0	0
1.5	0.2	0	0	0	0	0	0	0	0	0	0	0.2	0.4	0.4	0	0	0	0.2	0	0	0	0	0	0	0.2	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cp - Sky	**Monthly Distribution of Average Hours per year**												**Hrs/**	**Days**	**Consecutive**	**Observed Hour per year (Local Standard Time)**														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cp - Black Terrain	**Monthly Distribution of Average Hours per year**												**Hrs/**	**Days**	**Consecutive**	**Observed Hour per year (Local Standard Time)**														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0.2	0.2	0	0	0	0.2	0	0	0.2	0.6	1.4	1.4	0	0	0.6	0.6	0	0	0	0	0	0	0	0.2	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cp - Gray Terrain	**Monthly Distribution of Average Hours per year**												**Hrs/**	**Days**	**Consecutive**	**Observed Hour per year (Local Standard Time)**														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer E5

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer E6

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0.2	0	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0.2	0	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer E7

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0	0	0.4	0	0	0	0	0	0	0	0.2	0.8	0.8	0	0	0	0.4	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0
1.5	0	0	0	0.2	0	0	0	0	0	0	0	0.2	0.4	0.4	0	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0.4	0	0	0	0	0	0	0	0.2	0.6	0.6	0	0	0	0.4	0	0	0	0	0	0	0	0.2	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.2	0.2	0	0.4	0	0	0	0	0	0	0	0.6	1.4	1.4	0	0	0	0.4	0.2	0	0	0	0	0.2	0.2	0.2	0.2	0	0	0	0
0.035	0.2	0	0	0.4	0	0	0	0	0	0	0	0.2	0.8	0.8	0	0	0	0.4	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0
0.05	0.2	0	0	0.4	0	0	0	0	0	0	0	0.2	0.8	0.8	0	0	0	0.4	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												ours/	ays/y	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12			Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.2	0	0	0.4	0	0	0	0	0	0	0	0.2	0.8	0.8	0	0	0	0.4	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0
0.035	0	0	0	0.2	0	0	0	0	0	0	0	0.2	0.4	0.4	0	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer E8

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0.2	0	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0	0	0	0	0	0.2	0	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0	0	0	0	0	0.2	0	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0.2	0	0	0	0	0.2	0	0	0	0.4	0.4	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0.2	0	0	0
0.035	0	0	0	0.2	0	0	0	0	0.2	0	0	0	0.4	0.4	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0.2	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0.2	0	0	0	0	0.2	0	0	0	0.4	0.4	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0.2	0	0	0
0.035	0	0	0	0.2	0	0	0	0	0.2	0	0	0	0.4	0.4	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0.2	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer W1

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0	0	0.4	0	0.4	0	0	0	0.4	0.6	0	2	2	0	0.2	1.2	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0.2	0	0	0	0	0.4	0	0	0	0	0.2	0	0.8	0.8	0	0.2	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0.2	0	0	0	0	0.2	0	0	0	0	0	0	0.4	0.4	0	0.2	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0	0.4	0.8	0.2	1	0.2	0.4	0.6	0.2	0.2	0	4.2	4.2	0	1.4	2.2	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0.4	0.4	0	0.8	0.2	0	0.4	0	0.2	0	2.4	2.4	0	1	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0.4	0.4	0	0.6	0	0	0.4	0	0.2	0	2	2	0	0.8	1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0.4	0.4	0	0.4	0	0	0.2	0	0.2	0	1.6	1.6	0	0.6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0	0.4	0.4	0	0.8	0.2	0.2	0.4	0.2	0.2	0	3	3	0	1	1.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0.4	0.4	0	0.4	0	0	0.4	0	0.2	0	1.8	1.8	0	0.6	1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0.2	0.2	0	0.4	0	0	0.2	0	0.2	0	1.2	1.2	0	0.6	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0.2	0	0	0	0	0	0	0	0	0.2	0.2	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0.2	0	0.2	0	0	0	0	0.2	0	0.6	0.6	0	0.2	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.4	0.2	0.4	1	0.2	1.4	0.4	0.8	0.6	0.8	1	0.2	7.4	7.2	1	1.6	3.6	1.6	0.6	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0.2	0	0.4	0.8	0.2	1	0.2	0.4	0.6	0.2	0.2	0	4.2	4.2	0	1.4	2.2	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0.4	0.4	0	1	0.2	0	0.6	0	0.2	0	2.8	2.8	0	1.2	1.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0.4	0.4	0	0.8	0	0	0.4	0	0.2	0	2.2	2.2	0	1	1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.2	0	0.4	0.8	0.2	1	0.2	0.4	0.6	0.2	0.2	0	4.2	4.2	0	1.4	2.2	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0.4	0.4	0	0.8	0.2	0.2	0.4	0	0.2	0	2.6	2.6	0	1	1.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0.4	0.4	0	0.4	0	0	0.4	0	0.2	0	1.8	1.8	0	0.6	1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0.2	0.2	0	0.4	0	0	0.2	0	0.2	0	1.2	1.2	0	0.6	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer W2

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.4	0	0.2	0.2	0	0.4	0	0	0.2	0.2	0.8	0	2.4	2.4	0	0.4	1	0.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0.4	0	0.2	0	0	0.2	0	0	0.2	0.2	0.2	0	1.4	1.4	0	0.2	0.6	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0.4	0	0.2	0	0	0	0	0	0.2	0	0	0	0.8	0.8	0	0	0.4	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.4	0	0.4	0	0	0	0	0	0.2	0	0.4	0	1.4	1.4	0	0	0.8	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0.2	0	0	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.4	0	0.2	0.2	0	0.2	0	0	0.2	0	0.4	0	1.6	1.6	0	0.4	0.6	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.2	0	0.2	0	0	0	0	0	0	0	0.2	0	0.6	0.6	0	0	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0.2	0	0.2	0	0	0	0	0	0	0	0	0	0.4	0.4	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.6	0.2	0.4	0.4	0	0.6	0	0	0.4	0	0.6	0.2	3.4	3.4	0	0.8	1.2	0.8	0.6	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0.4	0	0.4	0.2	0	0.2	0	0	0.2	0	0.4	0	1.8	1.8	0	0.2	0.8	0.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0.2	0	0.2	0	0	0	0	0	0	0	0.4	0	0.8	0.8	0	0	0.4	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0.2	0	0	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.2	0	0.2	0	0	0	0	0	0	0	0.2	0	0.6	0.6	0	0	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0.2	0	0	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer W3

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.6	0	1	0.6	0	0.4	0	0	0.4	1.2	1.2	0.2	5.6	5.6	0	0.4	3	1.8	0.4	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0.4	0	0.6	0.2	0	0.4	0	0	0.4	0.6	0.6	0	3.2	3.2	0	0.4	1.8	0.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0.2	0	0	0	0	0.2	0	0	0.4	0.4	0.2	0	1.4	1.4	0	0.2	0.6	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.6	0	1.2	1	0.2	1	0.4	0.8	0.8	1.2	0.6	0	7.8	7.8	0	2.2	3.6	1.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0.2	0	0.6	0.6	0.2	0.8	0.2	0.2	0.2	0.6	0.4	0	4	4	0	1.6	2	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0.6	0.4	0	0.2	0.2	0	0.2	0.2	0.2	0	2	2	0	0.6	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0.6	0.2	0	0	0	0	0	0.2	0.2	0	1.2	1.2	0	0	1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.4	0	1	0.8	0.2	1	0.4	0.2	0.6	1	0.6	0.2	6.4	6.4	0	1.8	3.2	1	0.4	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0.2	0	0.6	0.4	0	0.2	0.2	0	0.2	0.6	0.4	0	2.8	2.8	0	0.6	1.6	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0.6	0.4	0	0	0	0	0.2	0.4	0.4	0	2	2	0	0.2	1.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.4	0	0.6	0.2	0	0.2	0	0	0	0.2	0.4	0	2	2	0	0.2	1.2	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.8	0.6	1.2	1.2	0.8	1.4	0.6	1.2	1.2	1.8	2	0.4	13.2	12.8	2	3.2	5.4	3.4	1.2	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0.4	0	1	1	0.4	0.8	0.4	0.4	0.8	0.8	0.6	0	6.6	6.6	0	2.2	2.6	1.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0.2	0	0.8	0.4	0.2	0.8	0.4	0.2	0.2	0.4	0.2	0	3.8	3.8	0	1.8	1.6	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0.6	0.4	0	0.2	0.2	0	0.2	0.2	0.2	0	2	2	0	0.6	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.6	0	1.2	1.2	0.6	1	0.4	0.8	1	1.2	1	0	9	9	0	2.6	4.4	1.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0.2	0	0.6	0.4	0.2	0.8	0.2	0.2	0.2	0.4	0.2	0	3.4	3.4	0	1.6	1.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0.6	0.4	0	0	0.2	0	0.2	0.2	0.2	0	1.8	1.8	0	0.4	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0.6	0.2	0	0	0	0	0	0.2	0.2	0	1.2	1.2	0	0	1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer W4

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.6	0	1	0.6	0	0.4	0	0	0.4	1.2	1.2	0.2	5.6	5.6	0	0.4	3	1.8	0.4	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0.4	0	0.6	0.2	0	0.4	0	0	0.4	0.6	0.6	0	3.2	3.2	0	0.4	1.8	0.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0.2	0	0	0	0	0.2	0	0	0.4	0.4	0.2	0	1.4	1.4	0	0.2	0.6	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.6	0	1.2	1	0.2	1	0.4	0.8	0.8	1.2	0.6	0	7.8	7.8	0	2.2	3.6	1.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0.2	0	0.6	0.6	0.2	0.8	0.2	0.2	0.2	0.6	0.4	0	4	4	0	1.6	2	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0.6	0.4	0	0.2	0.2	0	0.2	0.2	0.2	0	2	2	0	0.6	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0.6	0.2	0	0	0	0	0	0.2	0.2	0	1.2	1.2	0	0	1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.4	0	1	0.8	0.2	1	0.4	0.2	0.6	1	0.6	0.2	6.4	6.4	0	1.8	3.2	1	0.4	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0.2	0	0.6	0.4	0	0.2	0.2	0	0.2	0.6	0.4	0	2.8	2.8	0	0.6	1.6	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0.6	0.4	0	0	0	0	0.2	0.4	0.4	0	2	2	0	0.2	1.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.4	0	0.6	0.2	0	0.2	0	0	0	0.2	0.4	0	2	2	0	0.2	1.2	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.8	0.6	1.2	1.2	0.8	1.4	0.6	1.2	1.2	1.8	2	0.4	13.2	12.8	2	3.2	5.4	3.4	1.2	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0.4	0	1	1	0.4	0.8	0.4	0.4	0.8	0.8	0.6	0	6.6	6.6	0	2.2	2.6	1.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0.2	0	0.8	0.4	0.2	0.8	0.4	0.2	0.2	0.4	0.2	0	3.8	3.8	0	1.8	1.6	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0.6	0.4	0	0.2	0.2	0	0.2	0.2	0.2	0	2	2	0	0.6	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.6	0	1.2	1.2	0.6	1	0.4	0.8	1	1.2	1	0	9	9	0	2.6	4.4	1.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0.2	0	0.6	0.4	0.2	0.8	0.2	0.2	0.2	0.4	0.2	0	3.4	3.4	0	1.6	1.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0.6	0.4	0	0	0.2	0	0.2	0.2	0.2	0	1.8	1.8	0	0.4	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0.6	0.2	0	0	0	0	0	0.2	0.2	0	1.2	1.2	0	0	1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer W5

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0.4	0	0	0	0	0	0.2	0.4	0.2	0.2	1.4	1.4	0	0	0.4	0.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0.4	0.4	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0.4	0.4	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0.2	0	0.2	0	0	0	0	0	0.4	0.2	0	1	1	0	0	0.4	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0.4	0.4	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0	0	0	0	0	0	0.2	0.2	0.2	0.6	0.6	0	0	0	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0.4	0.4	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0.2	0.4	0.2	0	0	0.2	0	0	0.4	0.4	0	1.8	1.8	0	0	0.4	1	0.2	0	0	0	0	0	0	0	0	0	0.2	0	0
0.035	0	0.2	0	0.2	0	0	0	0	0	0.2	0.2	0	0.8	0.8	0	0	0.4	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0.2	0	0	0	0	0	0	0	0.2	0	0	0.4	0.4	0	0	0.2	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0.4	0.4	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer W6

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.4	0	0.4	0	0	0	0	0.2	0.2	0.4	0.6	0.2	2.4	2.4	0	0.2	1	1	0.2	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0.2	0	0.2	0	0	0	0	0	0.2	0.4	0.4	0.2	1.6	1.6	0	0	0.6	0.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0.2	0	0	0	0	0	0.2	0.2	0.4	0.2	1.2	1.2	0	0	0.6	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0.2	0.2	0.4	0.4	0	0.2	0.8	0.2	0.6	0.6	0.2	4	4	0	1.2	1.6	1	0.2	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0.2	0	0.2	0.2	0.2	0	0.2	0	0	0.6	0.2	0	1.8	1.8	0	0.4	1	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0.2	0	0.2	0	0	0	0.2	0	0	0.4	0	0	1	1	0	0.2	0.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0.2	0	0	0	0	0	0	0.4	0	0	0.6	0.6	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0	0.2	0	0	0	0.2	0	0.2	0.8	0.6	0.2	2.4	2.4	0	0.2	1	1	0.2	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0.2	0	0.2	0	0	0	0	0	0.2	0.4	0.2	0.2	1.4	1.4	0	0	0.8	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0.2	0	0	0	0	0	0	0.4	0	0	0.6	0.6	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0.2	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0.2	0	0	0	0	0	0.2	0.2	0.2	0.2	1	1	0	0	0.6	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0.2	0	0	0	0	0	0	0.2	0	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.6	0.6	0.8	0.4	0.6	0.2	0.2	1	0.4	0.8	0.6	0.2	6.4	6.4	0	1.4	2.4	2	0.6	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0.2	0.2	0.6	0.4	0.4	0	0.2	0.8	0.4	0.6	0.2	0.2	4.2	4.2	0	1.2	1.8	0.8	0.4	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0.2	0	0.2	0.2	0.2	0	0.2	0.2	0	0.6	0.2	0	2	2	0	0.6	1	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0.2	0	0.2	0	0	0	0	0	0	0.4	0	0	0.8	0.8	0	0	0.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.6	0.2	0.6	0.4	0.4	0	0.2	0.8	0.4	0.6	0.4	0.2	4.8	4.8	0	1.2	2	1.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0.2	0	0.2	0	0	0	0.2	0	0	0.4	0.2	0	1.2	1.2	0	0.2	0.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0.2	0	0.2	0	0	0	0	0	0	0.4	0	0	0.8	0.8	0	0	0.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0.2	0	0	0	0	0	0	0.4	0	0	0.6	0.6	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer W7

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.4	0.6	0.4	0	0	0.2	0.6	0	0.2	0.6	0.6	1.6	5.2	5.2	0	0	1.2	3.2	0.8	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0.2	0.2	0	0	0	0.2	0	0	0	0.2	0.6	1.4	1.4	0	0	0.2	1	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0.2	0.2	0	0	0	0	0	0	0	0.2	0.2	0.8	0.8	0	0	0.2	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	16	9.4	6.6	6.2	12.2	6.6	10	14	12	12.4	14	13.6	133	89.4	161	14.2	22.4	30.8	17.2	12.6	12	7	7.4	2.8	2.2	2	1.6	0.8	0	0	0
1.5	16	9.4	6.6	6.2	12.2	6.6	10	14	12	12.4	14	13.6	133	89.4	161	14.2	22.4	30.8	17.2	12.6	12	7	7.4	2.8	2.2	2	1.6	0.8	0	0	0
2	16	9.4	6.6	6.2	12.2	6.6	10	14	12	12.4	14	13.6	133	89.4	161	14.2	22.4	30.8	17.2	12.6	12	7	7.4	2.8	2.2	2	1.6	0.8	0	0	0
3	16	9.4	6.6	6.2	12.2	6.6	10	14	12	12.4	14	13.6	133	89.4	161	14.2	22.4	30.8	17.2	12.6	12	7	7.4	2.8	2.2	2	1.6	0.8	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.4	0.2	0.2	0	0	0	0	0	0	0	0.2	0.8	1.8	1.8	0	0	0	1.4	0.4	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0.2	0	0	0	0	0	0	0	0.2	0.2	0.6	0.6	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0.2	0.2	0	0	0	0	0	0	0	0	0.2	0.6	0.6	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0.4	0.4	0.4	1.2	0.4	1	1.2	0.6	0.2	0	0.2	6	6	0	4	1.2	0.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0.2	0	0	0.2	0	0	0.6	0.4	0.2	0	0	1.6	1.6	0	0.8	0.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0.2	0	0	0	0	0	0	0	0.2	0	0	0.4	0.4	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0.2	0	0	0	0	0	0	0	0.2	0	0	0.4	0.4	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer W8

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1	1.2	0.8	0.4	0	0.4	0.2	0.2	0.2	1.2	1	2.2	8.8	8.8	0	0	2	4.8	2	0	0	0	0	0	0	0	0	0	0	0	0
1.5	1	0.4	0.2	0	0	0.2	0	0	0	1	0.4	0.8	4	4	0	0	0.6	2.6	0.8	0	0	0	0	0	0	0	0	0	0	0	0
2	1	0.4	0.2	0	0	0	0	0	0	0.4	0	0.6	2.6	2.6	0	0	0	2	0.6	0	0	0	0	0	0	0	0	0	0	0	0
3	0.4	0	0	0	0	0	0	0	0	0	0	0.2	0.6	0.6	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1.6	0.2	0.2	0	0	0	0	0	0	0.4	0.4	2.2	5	5	0	0	0.4	3.2	1.4	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0.8	0.2	0	0	0	0	0	0	0	0.2	0.2	0.8	2.2	2.2	0	0	0.2	1.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0.6	0	0	0	0	0	0	0	0	0.2	0	0.6	1.4	1.4	0	0	0.2	1	0.2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1.2	0.4	0.2	0	0	0	0	0	0	0.6	0.2	1.6	4.2	4.2	0	0	0.2	3.2	0.8	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0.6	0	0.2	0	0	0	0	0	0	0	0	0.4	1.2	1.2	0	0	0	1	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.8	0.4	0.2	0	0	0	0	0	0	0.6	0.2	1	3.2	3.2	0	0	0.4	2.2	0.6	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0.4	0.2	0	0	0	0	0	0	0	0	0	0.4	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0.2	0	0	0	0	0	0	0	0	0	0	0.2	0.4	0.4	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	2.6	1.4	0	0.4	1	0	0.6	0.6	0.2	1.8	1.4	3.6	13.6	13.4	1	2.6	1.4	6	3.4	0.2	0	0	0	0	0	0	0	0	0	0	0
0.035	1.8	0.2	0	0	0.2	0	0	0	0	0.6	0.4	2.4	5.6	5.6	0	0.2	0.6	3.2	1.6	0	0	0	0	0	0	0	0	0	0	0	0
0.05	1.2	0.2	0	0	0	0	0	0	0	0.4	0.2	1.4	3.4	3.4	0	0	0.4	2.4	0.6	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0.6	0.2	0	0	0	0	0	0	0	0.2	0.2	0.6	1.8	1.8	0	0	0.2	1.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	/yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	1.6	0.2	0	0	0	0	0	0	0	0.4	0.4	2.2	4.8	4.8	0	0	0.4	3	1.4	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0.8	0.2	0	0	0	0	0	0	0	0.2	0.2	0.6	2	2	0	0	0.2	1.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Attachment B

Statistical Summaries for Case 1 at Saguaro NP East and West Units

Observer E1

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0	0.2	0	0	0	0.2	0.2	0	0	0.2	0.4	1.4	1.4	0	0.2	0.4	0.4	0	0	0.2	0	0	0	0	0	0.2	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0.2	0.4	0.6	0.6	0	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.4	0.4	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0	0.2	0	0.2	0.2	0.4	0.8	0.2	0	0.2	0.4	2.8	2.8	0	0.4	0.4	0.4	0	0	0.2	0	0	0	0.2	0	0	0.6	0.6	0	0
1.5	0	0	0.2	0	0	0	0	0.4	0	0	0.2	0.2	1	1	0	0	0.4	0.2	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0
2	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0	0.2	0	0	0	0.2	0.6	0	0	0.2	0.4	1.8	1.8	0	0	0.4	0.4	0	0	0.2	0	0	0	0	0	0	0.4	0.4	0	0
1.5	0	0	0.2	0	0	0	0	0.2	0	0	0.2	0.2	0.8	0.8	0	0	0.4	0.2	0	0	0	0	0	0	0	0	0	0.2	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0.2	0	0.2	0.2	0.2	0.6	0.4	0	0.2	0	2	2	0	0.4	0.4	0	0.2	0	0	0	0	0	0	0	0	0.4	0.6	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0.4	0	0	0	0	0.4	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.4	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer E2

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.4	0	0.2	0	0	0	0	0.2	0	0	0.2	0.4	1.4	1.4	0	0	0.4	0.6	0.2	0	0	0	0	0	0	0	0.2	0	0	0	0
1.5	0.2	0	0.2	0	0	0	0	0	0	0	0.2	0.4	1	1	0	0	0.4	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0.2	0	0	0	0	0	0	0	0.2	0.4	0.8	0.8	0	0	0.4	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.4	0	0.2	0	0.2	0	0.2	0.2	0	0	0.4	0.6	2.2	2.2	0	0.4	0.4	0.8	0.2	0	0	0	0	0	0	0	0.4	0	0	0	0
1.5	0.2	0	0.2	0	0.2	0	0.2	0	0	0	0.2	0.6	1.6	1.6	0	0.4	0.4	0.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0.2	0	0.2	0	0	0	0	0	0.2	0.2	0.8	0.8	0	0.2	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.4	0	0.2	0	0.2	0	0.2	0.2	0	0	0.2	0.6	2	2	0	0.4	0.4	0.8	0.2	0	0	0	0	0	0	0	0.2	0	0	0	0
1.5	0	0	0.2	0	0.2	0	0	0	0	0	0.2	0.4	1	1	0	0.2	0.4	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.2	0	0.2	0	0	0	0	0	0	0	0.2	0.4	1	1	0	0	0.4	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0.2	0	0	0	0	0	0	0	0.2	0.2	0.6	0.6	0	0	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.6	0	0.8	0	0.2	0	0.2	0	0.2	0	0.6	1	3.6	3.6	0	0.4	0.4	1.2	0.4	0	0	0	0	0	0	0.4	0.4	0.4	0	0	0
0.035	0.2	0	0.2	0	0.2	0	0.2	0	0	0	0.4	0.4	1.6	1.6	0	0.4	0.4	0.6	0	0	0	0	0	0	0	0	0.2	0	0	0	0
0.05	0.2	0	0.2	0	0.2	0	0.2	0	0	0	0.2	0.4	1.4	1.4	0	0.4	0.4	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.2	0	0.2	0	0.2	0	0.2	0	0	0	0.2	0.6	1.6	1.6	0	0.4	0.4	0.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0.2	0	0.2	0	0.2	0	0	0	0	0	0.2	0.4	1.2	1.2	0	0.2	0.4	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer E3

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0	0.2	0	0	0	0	0.4	0	0	0.2	0.4	1.4	1.2	1	0	0.4	0.4	0.2	0	0	0	0	0	0	0	0.2	0.2	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0.2	0.4	0.6	0.6	0	0	0.2	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.4	0.4	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0	0.4	0.2	0.2	0.6	0	0	0.2	0.2	1.8	1.8	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0.6	0.8	0	0
1.5	0	0	0	0	0	0	0	0.2	0	0	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0
2	0	0	0	0	0	0	0	0.2	0	0	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0.2	0	0	0	0	0.4	0	0	0.2	0.4	1.2	1.2	0	0	0.4	0.2	0.2	0	0	0	0	0	0	0	0	0.2	0.2	0	0
1.5	0	0	0	0	0	0	0	0.2	0	0	0.2	0	0.4	0.4	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0
2	0	0	0	0	0	0	0	0.2	0	0	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0.2	0	0.6	1.4	0.2	0.6	0	0	0.2	0	3.2	3.2	0	0.2	0.4	0	0	0	0	0	0	0	0	0	0	0.6	2	0	0
0.035	0	0	0.2	0	0	0	0	0.2	0	0	0	0	0.4	0.4	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0
0.05	0	0	0	0	0	0	0	0.2	0	0	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0.2	0	0.2	0.4	0	0	0	0	0.8	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0.4	0.4	0	0
0.035	0	0	0	0	0	0	0	0.2	0	0	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer E4

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0.2	0	0	0	0	0	0.2	0	0	0.2	0.4	1.2	1.2	0	0	0.4	0.2	0.2	0	0	0	0	0	0.2	0	0.2	0	0	0	0
1.5	0.2	0	0	0	0	0	0	0	0	0	0.2	0.2	0.6	0.6	0	0	0.2	0.2	0	0	0	0	0	0	0.2	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.6	0.4	0	0	0	0	0	0	0.2	0	0.2	0.6	2	2	0	0	0.2	0.2	0	0	0	0	0	0.2	0.2	0.8	0.4	0	0	0
1.5	0.2	0	0	0	0	0	0	0	0	0	0	0.2	0.4	0.4	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0	0	0	0	0	0	0	0	0	0.2	0.6	1	1	0	0	0.2	0.2	0.2	0	0	0	0	0	0.2	0.2	0	0	0	0	0
1.5	0.2	0	0	0	0	0	0	0	0	0	0	0.2	0.4	0.4	0	0	0	0.2	0	0	0	0	0	0	0.2	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.6	0	0.4	0.2	0	0	0	0.2	0.2	0	0.2	0.8	2.6	2.6	0	0	0.6	0.6	0	0	0	0	0	0	0	0.2	0.8	0.4	0	0	0
0.035	0	0	0.2	0	0	0	0	0	0	0	0	0.2	0.4	0.4	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0	0.4	0.4	0.4	0	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer E5

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer E6

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0.2	0	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0.2	0	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.4	0.4	0	0	0	0	0	0	0	0.2	0	0	0	0	0.2	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer E7

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0	0	0.4	0	0	0	0	0	0	0	0.2	0.8	0.8	0	0	0	0.4	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0
1.5	0.2	0	0	0.4	0	0	0	0	0	0	0	0.2	0.8	0.8	0	0	0	0.4	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0
2	0	0	0	0.2	0	0	0	0	0	0	0	0.2	0.4	0.4	0	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0	0	0.4	0	0	0	0	0	0	0	0.2	0.8	0.8	0	0	0	0.4	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.2	0.2	0	0.4	0	0	0	0	0	0.4	0.2	0.6	2	2	0	0	0	0.6	0.2	0	0.2	0.2	0	0.2	0	0.2	0.4	0	0	0	0
0.035	0.2	0.2	0	0.4	0	0	0	0	0	0	0	0.2	1	1	0	0	0	0.4	0.2	0	0	0	0	0	0	0.2	0.2	0	0	0	0
0.05	0.2	0	0	0.4	0	0	0	0	0	0	0	0.2	0.8	0.8	0	0	0	0.4	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0
0.075	0	0	0	0.2	0	0	0	0	0	0	0	0.2	0.4	0.4	0	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.2	0	0	0.4	0	0	0	0	0	0	0	0.2	0.8	0.8	0	0	0	0.4	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0
0.035	0.2	0	0	0.2	0	0	0	0	0	0	0	0.2	0.6	0.6	0	0	0	0.2	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer E8

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0	0	0	0.2	0	0	0	0	0	0.2	0.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0	0	0	0.2	0.2	0	0	0	0	0.6	0.6	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0	0	0	0.2	0	0	0	0	0	0.4	0.4	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0.2	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0.2	0	0.2	0.2	0	0	0	0.2	1.2	1.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0.8	0.2	0	0
0.035	0	0	0	0	0	0	0.2	0	0	0	0	0	0.4	0.4	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0.2	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer w1

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0	0.2	0.2	0	0.6	0.2	0	0.2	0.4	0.6	0	2.6	2.6	0	0.4	1.2	0.6	0	0	0	0	0	0	0	0	0.4	0	0	0	0
1.5	0.2	0	0.2	0	0	0.4	0	0	0	0	0.2	0	1	1	0	0.2	0.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0.2	0	0	0	0	0.2	0	0	0	0	0	0	0.4	0.4	0	0.2	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0	0.4	1	0.2	1	0.2	0.4	0.6	0.2	0.2	0	4.4	4.4	0	1.4	2.2	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0.4	0.6	0	0.8	0.2	0.2	0.6	0.2	0.2	0	3.2	3.2	0	1	2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0.4	0.4	0	0.8	0.2	0	0.4	0	0.2	0	2.4	2.4	0	1	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0.4	0.4	0	0.4	0	0	0.2	0	0.2	0	1.6	1.6	0	0.6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0.4	0.4	0	0.8	0.2	0.4	0.4	0.2	0.2	0	3	3	0	1	1.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0.4	0.4	0	0.8	0.2	0.2	0.4	0	0.2	0	2.6	2.6	0	1	1.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0.4	0.4	0	0.4	0	0	0.4	0	0.2	0	1.8	1.8	0	0.6	1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0.2	0.2	0	0.4	0	0	0.2	0	0.2	0	1.2	1.2	0	0.6	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0.2	0	0.2	0	0	0	0	0.2	0	0.6	0.6	0	0.2	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.6	0.2	0.4	1	0.2	1.4	0.4	0.8	0.8	1	1.4	0.2	8.4	8.2	1	1.6	3.8	2.4	0.6	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0.2	0	0.4	1	0.2	1.4	0.2	0.4	0.6	0.2	0.4	0	5	4.8	1	1.4	2.6	0.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0.2	0	0.4	0.8	0.2	1	0.2	0.2	0.6	0	0.2	0	3.8	3.8	0	1.4	2	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0.4	0.4	0	0.8	0.2	0	0.6	0	0.2	0	2.6	2.6	0	1	1.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.2	0	0.4	1	0.2	1	0.2	0.4	0.6	0.2	0.2	0	4.4	4.4	0	1.4	2.2	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0.4	0.4	0	0.8	0.2	0.4	0.4	0.2	0.2	0	3	3	0	1	1.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0.4	0.4	0	0.6	0.2	0	0.4	0	0.2	0	2.2	2.2	0	0.8	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0.4	0.4	0	0.4	0	0	0.2	0	0.2	0	1.6	1.6	0	0.6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer w2

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.4	0	0.2	0	0	0.4	0	0	0.4	0.2	0.8	0	2.4	2.4	0	0.2	1	0.8	0.2	0	0	0	0	0	0	0	0.2	0	0	0	0
1.5	0.4	0	0.2	0	0	0.2	0	0	0.2	0.2	0.2	0	1.4	1.4	0	0.2	0.6	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0.4	0	0	0	0	0	0	0	0.2	0	0	0	0.6	0.6	0	0	0.2	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.6	0	0.4	0.2	0	0.2	0	0	0.4	0	0.4	0	2.2	2.2	0	0.2	1	0.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0.2	0	0	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0.2	0	0	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.4	0	0.2	0	0	0.2	0	0	0.2	0	0.4	0	1.4	1.4	0	0.2	0.6	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.2	0	0.2	0	0	0	0	0	0	0	0.4	0	0.8	0.8	0	0	0.4	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0.2	0	0.2	0	0	0	0	0	0	0	0	0	0.4	0.4	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.6	0.2	0.4	0.4	0	0.6	0	0	0.4	0.2	1	0.4	4.2	4	0	0.8	1.2	1.4	0.6	0	0	0	0	0	0	0	0.2	0	0	0	0
0.035	0.4	0	0.4	0.2	0	0.2	0	0	0.4	0	0.4	0.2	2.2	2.2	0	0.2	1	0.6	0.4	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0.2	0	0.4	0.2	0	0	0	0	0.2	0	0.4	0	1.4	1.4	0	0	0.8	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0.2	0	0.2	0	0	0	0	0	0	0	0.2	0	0.6	0.6	0	0	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.2	0	0.4	0	0	0	0	0	0	0	0.4	0	1	1	0	0	0.6	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0.2	0	0	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer w3

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1.2	0.4	0.2	0.2	0.2	0.6	0.2	0.2	0.4	0.6	1	0.2	5.8	5.6	0	0.4	0.4	1.4	0.6	0.4	0.4	1	0.2	0.4	0	0	0	0.2	0	0	0
1.5	0.8	0.2	0.2	0	0.2	0.4	0	0	0.2	0.6	0.2	0.2	3.2	3.2	0	0.2	0.4	0.4	0.4	0.2	0.2	0.6	0.2	0.4	0	0	0	0	0	0	0
2	0.4	0	0.2	0	0	0.2	0	0	0.2	0.2	0	0	1.4	1.4	0	0.2	0	0.2	0.2	0.2	0	0.2	0	0.2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0.4	0.2	0.2	0	0.6	0.4	0	0.2	0.4	0.6	0.4	3.6	3.6	0	0.4	1.2	0.6	0.6	0	0	0	0	0	0.2	0.2	0.2	0	0.2	0	0
1.5	0.2	0	0	0	0	0	0	0	0	0.4	0.2	0.2	1	1	0	0	0.2	0.6	0	0	0	0	0	0	0.2	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.4	0.4	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1	0.2	0.2	0	0.2	0.4	0	0.2	0.2	0.8	0.4	0.2	4.2	4	0	0.2	0.4	0.6	0.6	0.2	0.4	0.6	0.2	0.4	0.2	0	0	0	0	0	0
1.5	0.4	0	0.2	0	0	0.2	0	0	0.2	0.2	0	0.2	1.6	1.6	0	0.2	0	0.2	0.2	0.2	0	0.4	0	0.2	0	0	0	0	0	0	0
2	0.4	0	0	0	0	0	0	0	0	0.2	0	0	0.8	0.8	0	0	0	0	0.2	0.2	0	0	0	0.2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.2	0	0	0	0	0	0	0	0	0.2	0.2	0	1	0.8	0	0	0	0	0.2	0.4	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	1	0.4	0.8	0.6	0	0.4	0.2	0	0.4	0.4	0.8	0.6	5.6	5.4	1	0.6	1.4	1.6	0.8	0	0	0	0	0	0.2	0.4	0.4	0	0.2	0	0
0.035	0.4	0.4	0.2	0.2	0	0	0	0	0.2	0.2	0.6	0.2	2.4	2.4	0	0	0.6	1	0.6	0	0	0	0	0	0	0.2	0	0	0	0	0
0.05	0	0.4	0	0.2	0	0	0	0	0	0.2	0.2	0	1	1	0	0	0.6	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0.2	0	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.4	0	0	0.2	0	0	0	0	0	0.2	0.2	0	1.2	1.2	0	0	0.2	0.2	0	0.4	0	0	0	0	0.2	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0.2	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer w4

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.6	0	0.8	0.4	0	0.6	0.4	0	0.6	1	1.2	0.2	5.8	5.8	0	0.8	2.6	1.6	0.4	0	0	0	0	0	0	0	0.4	0	0	0	0
1.5	0.2	0	0.6	0	0	0.4	0	0	0.4	0.4	0.6	0	2.6	2.6	0	0.2	1.6	0.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0.2	0	0	0	0	0.2	0	0	0.4	0.4	0.2	0	1.4	1.4	0	0.2	0.6	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.6	0.4	1.2	1.2	0.6	1.2	0.4	1	1	1.4	1	0	10	9.8	1	2.6	5	1.8	0.6	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0.4	0	0.8	1	0.2	0.8	0.4	0.2	0.8	1	0.4	0	6	6	0	1.8	3	1.2	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0.2	0	0.6	0.6	0.2	0.8	0.2	0.2	0.2	0.6	0.2	0	3.8	3.8	0	1.6	2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0.6	0.4	0	0.2	0.2	0	0	0.2	0.2	0	1.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.6	0	1	1	0.2	1	0.4	0.6	1	1	0.6	0.2	7.6	7.6	0	2.2	3.6	1.4	0.4	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0.4	0	0.6	0.6	0.2	0.8	0.2	0.2	0.4	0.8	0.4	0	4.6	4.6	0	1.6	2.2	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0.6	0.4	0	0.2	0.2	0	0.2	0.4	0.4	0	2.4	2.4	0	0.6	1.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0.4	0.2	0	0	0	0	0	0.2	0.2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.4	0	0.6	0.2	0	0.2	0	0	0	0.4	0.4	0	2.2	2.2	0	0.2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0.2	0	0	0	0	0	0	0	0.2	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0.2	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	1	0.6	1.2	1.2	0.8	1.6	0.8	1.4	1.2	1.8	2.2	0.4	14.2	13.8	2	3.4	5.8	3.8	1.2	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0.4	0.2	1.2	1.2	0.6	1.2	0.4	0.8	0.8	1.2	0.8	0	8.8	8.8	0	2.8	4	1.6	0.4	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0.2	0	0.8	1	0.2	0.8	0.4	0.4	0.4	0.4	0.2	0	4.8	4.8	0	2	2.2	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0.2	0	0.6	0.4	0.2	0.8	0.2	0	0.2	0.4	0.2	0	3.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.6	0	1.2	1.2	0.6	1	0.6	1.2	1	1.2	1.6	0	10.2	10.2	0	3	4.8	2.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0.2	0	0.8	0.8	0.2	0.8	0.4	0.2	0.6	0.4	0.2	0	4.6	4.6	0	1.8	2.4	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0.2	0	0.6	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0	2.6	2.6	0	1	1.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0.6	0.4	0	0	0	0	0	0.2	0.2	0	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer w5

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0.2	0	0	0	0	0.2	0.2	0.2	0.2	1	1	0	0	0.4	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0.4	0.4	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0.4	0.4	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0.2	0	0.2	0	0	0.2	0	0	0.4	0.2	0	1.2	1.2	0	0	0.4	0.4	0.2	0	0	0	0	0	0	0	0	0	0.2	0	0
1.5	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0.4	0.4	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0	0	0	0	0	0	0.4	0.2	0	0.6	0.6	0	0	0.2	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0.4	0.4	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	0.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0.2	0.4	0.2	0	0	0.2	0	0	0.4	0.4	0	1.8	1.8	0	0	0.4	1	0.2	0	0	0	0	0	0	0	0	0	0.2	0	0
0.035	0	0.2	0	0.2	0	0	0	0	0	0.2	0.2	0	0.8	0.8	0	0	0.4	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0.2	0	0.2	0	0	0	0	0	0.2	0.2	0	0.8	0.8	0	0	0.4	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0.2	0	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0.4	0.4	0	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0.2	0	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer w6

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.4	0	0.4	0	0	0	0.2	0	0.2	0.4	0.6	0.2	2.4	2.4	0	0.2	1	1	0.2	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0.2	0	0.2	0	0	0	0.2	0	0.2	0.4	0.4	0.2	1.8	1.8	0	0.2	0.6	0.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0.2	0	0	0	0	0	0.2	0	0.2	0.2	0.8	0.8	0	0	0.4	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.4	0.2	0.6	0.4	0.4	0	0.2	0.8	0.4	0.6	0.4	0.2	4.6	4.6	0	1.2	2	1.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0.2	0	0.2	0.4	0.2	0	0.2	0.4	0.2	0.6	0.2	0	2.6	2.6	0	0.6	1.6	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0.2	0	0.2	0.2	0.2	0	0.2	0	0	0.6	0.2	0	1.8	1.8	0	0.4	1	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0.2	0	0.2	0	0	0	0	0	0	0.4	0	0	0.8	0.8	0	0	0.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.4	0.2	0.4	0.2	0.4	0	0.2	0.8	0.4	0.8	0.6	0.2	4.6	4.6	0	1.2	1.8	1.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0.2	0	0.2	0	0	0	0.2	0	0.2	0.6	0.2	0.2	1.8	1.8	0	0.2	1	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0.2	0	0.2	0	0	0	0.2	0	0	0.4	0	0	1	1	0	0.2	0.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0.2	0	0	0	0	0	0	0.2	0	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0	0.2	0	0	0	0	0	0.2	0.2	0.4	0.2	1.2	1.2	0	0	0.8	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0.2	0	0	0	0	0	0	0.2	0	0	0.4	0.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0.2	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.6	0.6	0.8	0.4	0.6	0.2	0.4	1	0.4	0.8	0.8	0.2	6.8	6.8	0	1.6	2.4	2.2	0.6	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0.4	0.4	0.8	0.4	0.4	0	0.2	0.8	0.4	0.8	0.4	0.2	5.2	5.2	0	1.2	2	1.6	0.4	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0.2	0	0.4	0.4	0.2	0	0.2	0.4	0.2	0.6	0.2	0	2.8	2.8	0	0.6	1.6	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0.2	0	0.2	0.2	0	0	0.2	0	0	0.6	0.2	0	1.6	1.6	0	0.2	1	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.6	0.2	0.8	0.4	0.4	0	0.2	0.8	0.4	0.8	0.4	0.2	5.2	5.2	0	1.2	2	1.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0.2	0	0.2	0.2	0.2	0	0.2	0.2	0.2	0.6	0.2	0	2.2	2.2	0	0.6	1.2	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0.2	0	0.2	0	0	0	0.2	0	0	0.4	0.2	0	1.2	1.2	0	0.2	0.8	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0.2	0	0	0	0	0	0	0.4	0	0	0.6	0.6	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer w7

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.4	0.6	0.4	0	0.2	0.2	0.4	0	0	0.4	0.6	1.6	4.8	4.8	0	0.2	0.6	3.2	0.8	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0.2	0.2	0	0	0	0.2	0	0	0	0.2	0.6	1.4	1.4	0	0	0.2	1	0.2	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0.2	0.2	0	0	0	0	0	0	0	0.2	0.2	0.8	0.8	0	0	0.2	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0.2	0.2	0	0.2	0	0	0.6	0.4	0.2	0.2	0.2	2.2	2.2	0	0.8	0.6	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0.2	0	0	0.2	0.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.4	0.2	0.2	0	0	0	0	0	0	0	0.2	0.8	1.8	1.8	0	0	0	1.4	0.4	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0.2	0	0	0	0	0	0	0	0.2	0.2	0.6	0.6	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0.2	0	0	0	0	0	0	0	0	0	0.2	0.4	0.4	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0.4	0.6	0.8	2	0.8	1.2	1.4	0.8	0.2	0.4	0.2	8.8	8.8	0	5.6	2	1	0.2	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0.2	0	0.2	0.2	0.2	0.2	0.6	0.6	0.2	0	0	2.4	2.4	0	1.2	0.8	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0.2	0	0	0.2	0	0	0.6	0.4	0.2	0	0	1.6	1.6	0	0.8	0.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0	0.2	0	0	0	0	0	0	0.2	0.2	0	0	0.6	0.6	0	0	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Observer w8

Delta E - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1	0.8	0.8	0	0.4	0.4	0.2	0.2	0	1.2	0.8	2.2	8	8	0	0.4	1.4	3.4	0.8	0.6	1	0.2	0	0	0.2	0	0	0	0	0	0
1.5	0.8	0.6	0.2	0	0	0.2	0	0	0	0.6	0.4	0.8	3.6	3.6	0	0	0.2	1.8	0.2	0.4	0.8	0	0	0	0.2	0	0	0	0	0	0
2	0.8	0.6	0.2	0	0	0	0	0	0	0.2	0	0.6	2.4	2.4	0	0	0	1.6	0.2	0.2	0.4	0	0	0	0	0	0	0	0	0	0
3	0.2	0.2	0	0	0	0	0	0	0	0	0	0.4	0.8	0.8	0	0	0	0.6	0	0.2	0	0	0	0	0	0	0	0	0	0	0

Delta E-Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1.8	0.2	0.2	0	0.2	0	0	0	0	0.8	0.4	2.6	6.2	6	1	0.2	0.8	3.4	1.8	0	0	0	0	0	0	0	0	0	0	0	0
1.5	1.2	0.2	0	0	0	0	0	0	0	0.4	0.2	1.2	3.2	3.2	0	0	0.4	2.4	0.4	0	0	0	0	0	0	0	0	0	0	0	0
2	0.8	0.2	0	0	0	0	0	0	0	0.2	0.2	0.6	2	2	0	0	0.2	1.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0.4	0.4	0.4	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0

Delta E-Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1	0.6	0.2	0	0	0	0	0	0	0.6	0.2	2	4.6	4.6	0	0	0.2	3	0.2	0.2	0.8	0	0	0	0.2	0	0	0	0	0	0
1.5	0.6	0.4	0.2	0	0	0	0	0	0	0	0	0.6	1.8	1.8	0	0	0	1.4	0	0.2	0.2	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0.4	0.4	0.4	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Sky	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	0.6	0.6	0.2	0	0	0	0	0	0	0.6	0.2	1.2	3.4	3.4	0	0	0.4	1.8	0.4	0.2	0.6	0	0	0	0	0	0	0	0	0	0
0.035	0.2	0.4	0	0	0	0	0	0	0	0	0	0.6	1.2	1.2	0	0	0	1	0	0.2	0	0	0	0	0	0	0	0	0	0	0
0.05	0.2	0.2	0	0	0	0	0	0	0	0	0	0.2	0.6	0.6	0	0	0	0.4	0	0.2	0	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

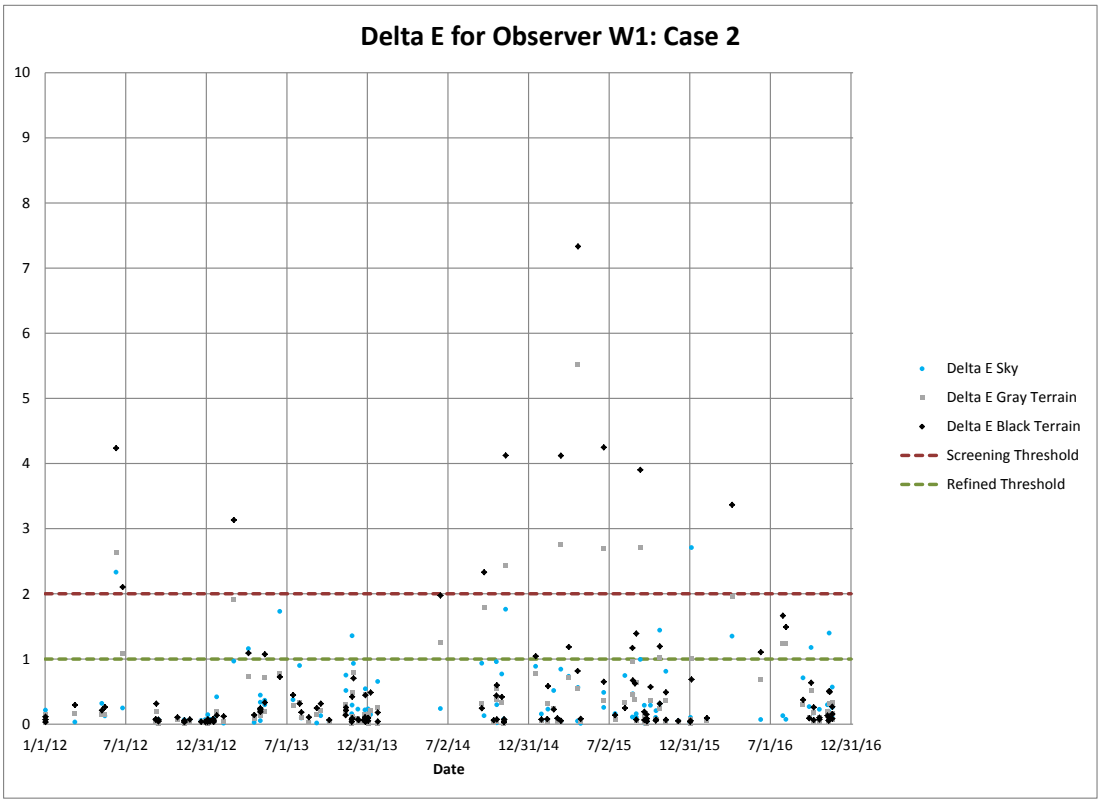
Cp - Black Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	3	2.2	0.8	0.8	1	0.2	0.6	0.8	0.4	2.6	2	4	18.4	17.8	3	3.2	3	7.2	4.8	0.2	0	0	0	0	0	0	0	0	0	0	0
0.035	2.2	0.6	0	0	0.4	0	0	0	0	1	0.4	2.8	7.4	7.2	1	0.4	1	3.8	2.2	0	0	0	0	0	0	0	0	0	0	0	0
0.05	1.4	0.2	0	0	0	0	0	0	0	0.6	0.4	2.2	4.8	4.8	0	0	0.6	2.8	1.4	0	0	0	0	0	0	0	0	0	0	0	0
0.075	0.8	0.2	0	0	0	0	0	0	0	0.2	0.2	1	2.4	2.4	0	0	0.2	1.8	0.4	0	0	0	0	0	0	0	0	0	0	0	0

Cp - Gray Terrain	Monthly Distribution of Average Hours per year												Hrs/	Days/	Consecutive	Observed Hour per year (Local Standard Time)														
Greater than	1	2	3	4	5	6	7	8	9	10	11	12	yr	yr	Hours	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.02	1.6	0.6	0	0	0	0	0	0	0	0.6	0.4	2.4	5.6	5.6	0	0	0.6	3	1	0.4	0.6	0	0	0	0	0	0	0	0	0	0
0.035	0.8	0.2	0	0	0	0	0	0	0	0.2	0.2	1	2.4	2.4	0	0	0.2	1.8	0	0	0.4	0	0	0	0	0	0	0	0	0	0
0.05	0.6	0.2	0	0	0	0	0	0	0	0.2	0	0.6	1.6	1.6	0	0	0.2	1.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0
0.075	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0

Attachment D

Time-series Plots of the Modeled Case 2 Visibility Parameters for Each Observer for a Background Sky, Black Background Terrain and Gray Background Terrain

Figure D-1 Time Series of Delta E and Cp for Case 2: Observer W1



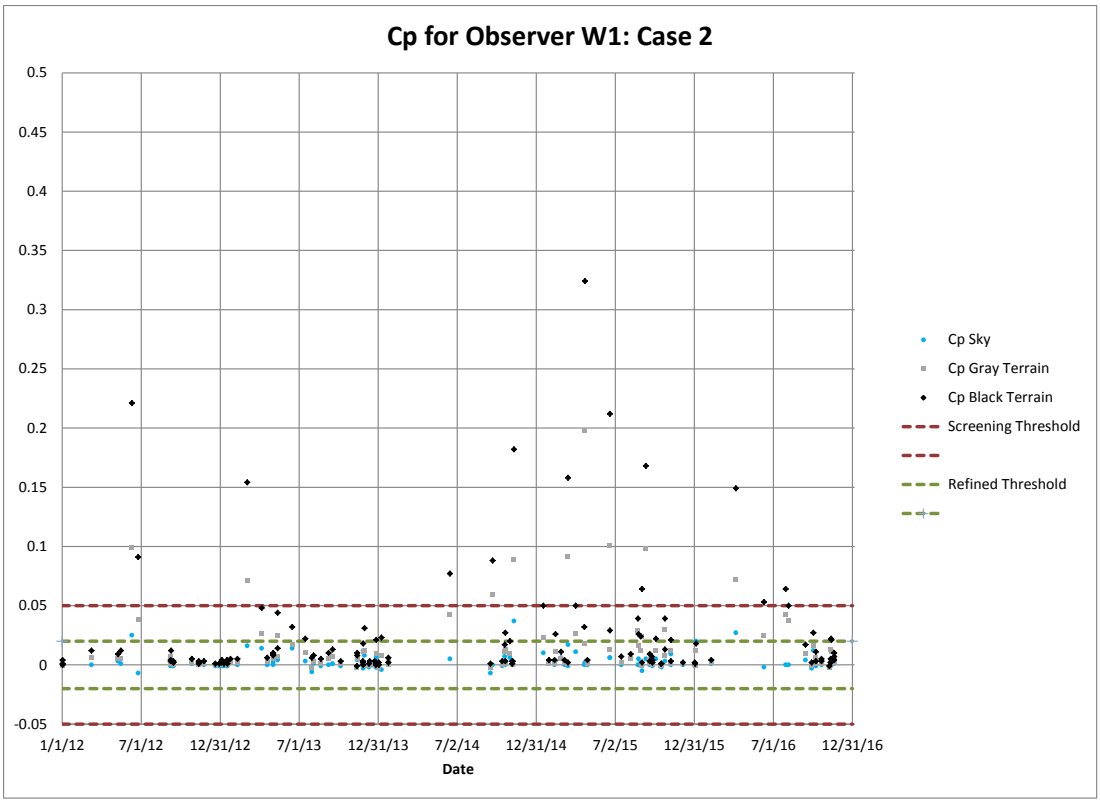
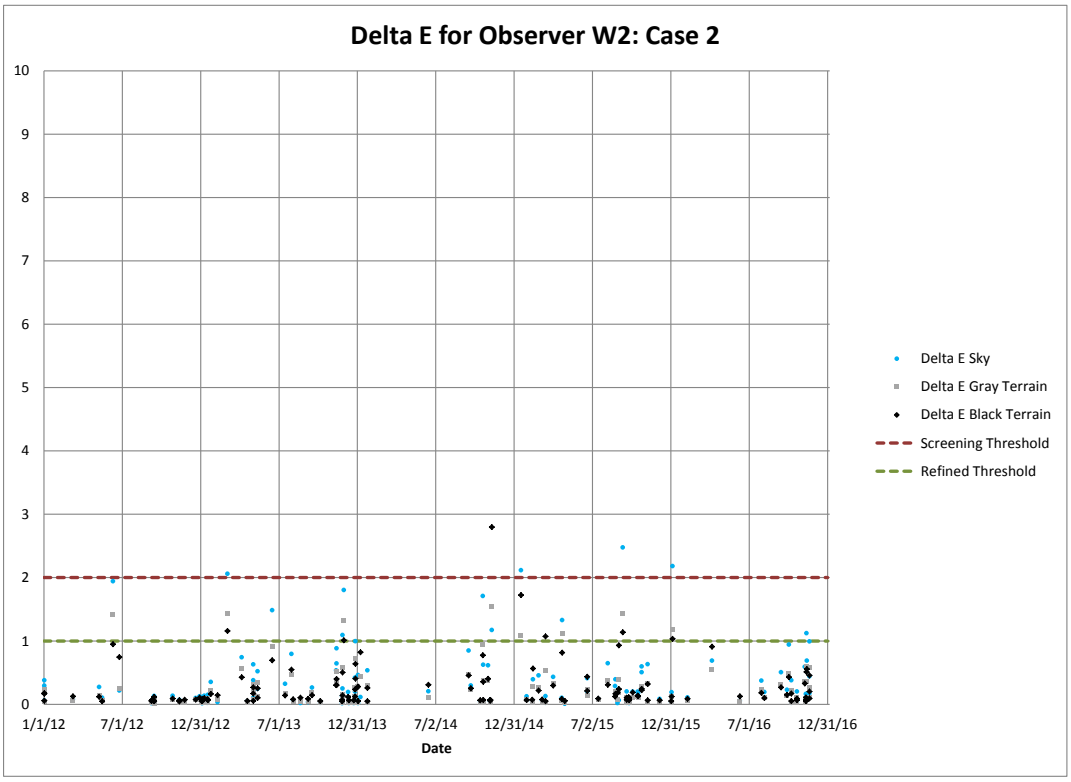


Figure D-2 Time Series of Delta E and Cp for Case 2: Observer W2



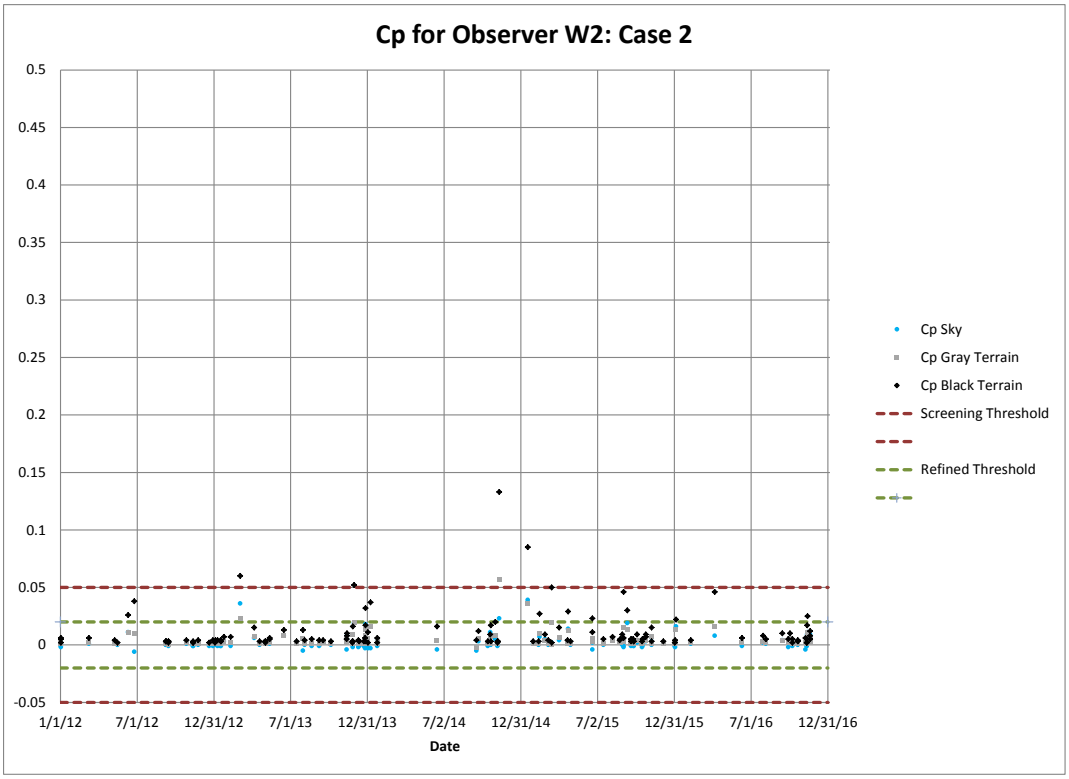
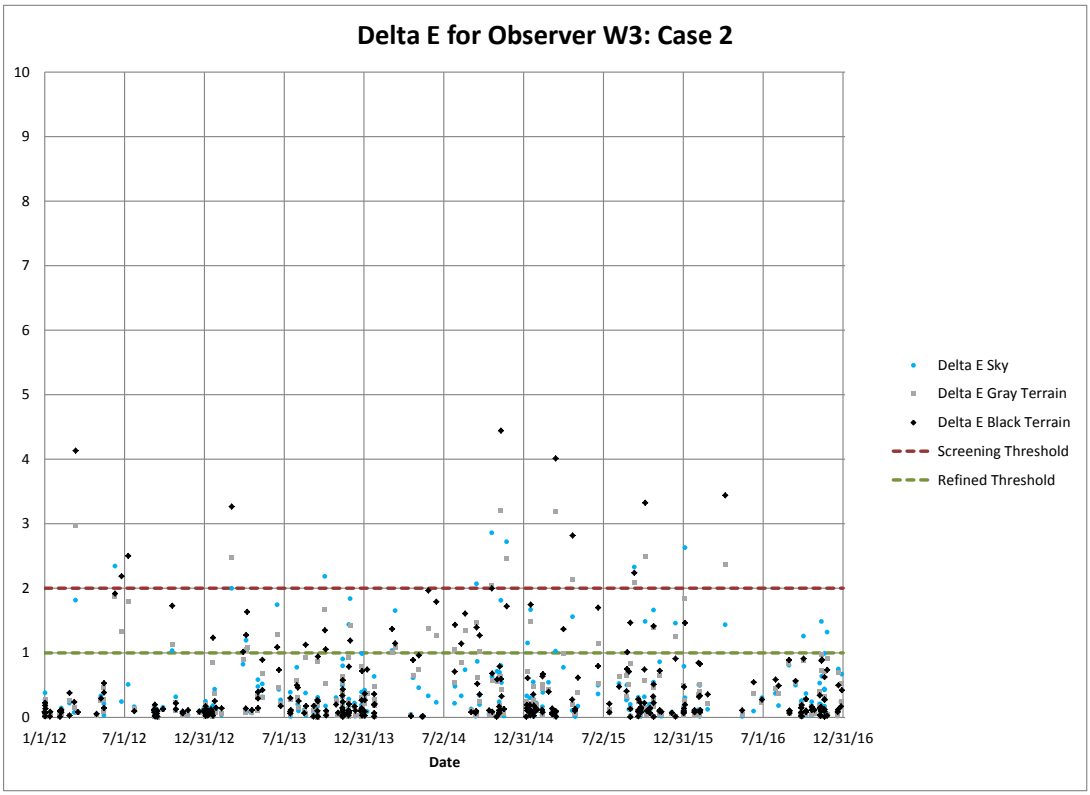


Figure D-3 Time Series of Delta E and Cp for Case 2: Observer W3



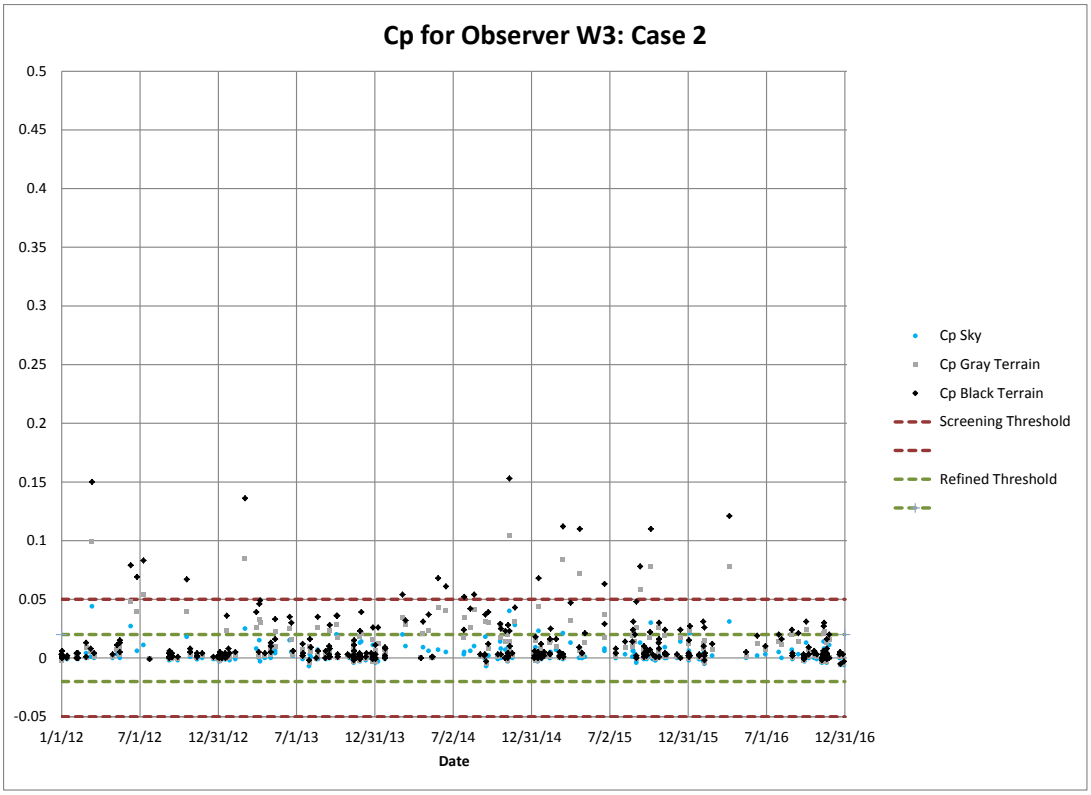
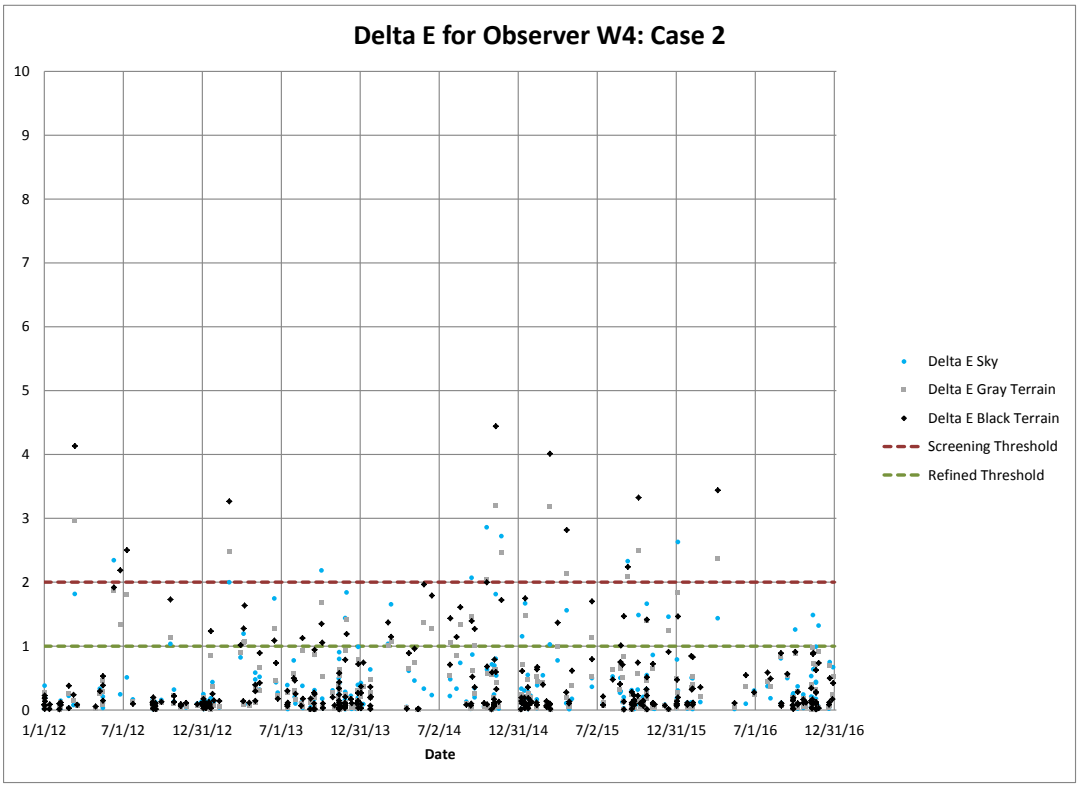


Figure D-4 Time Series of Delta E and Cp for Case 2: Observer W4



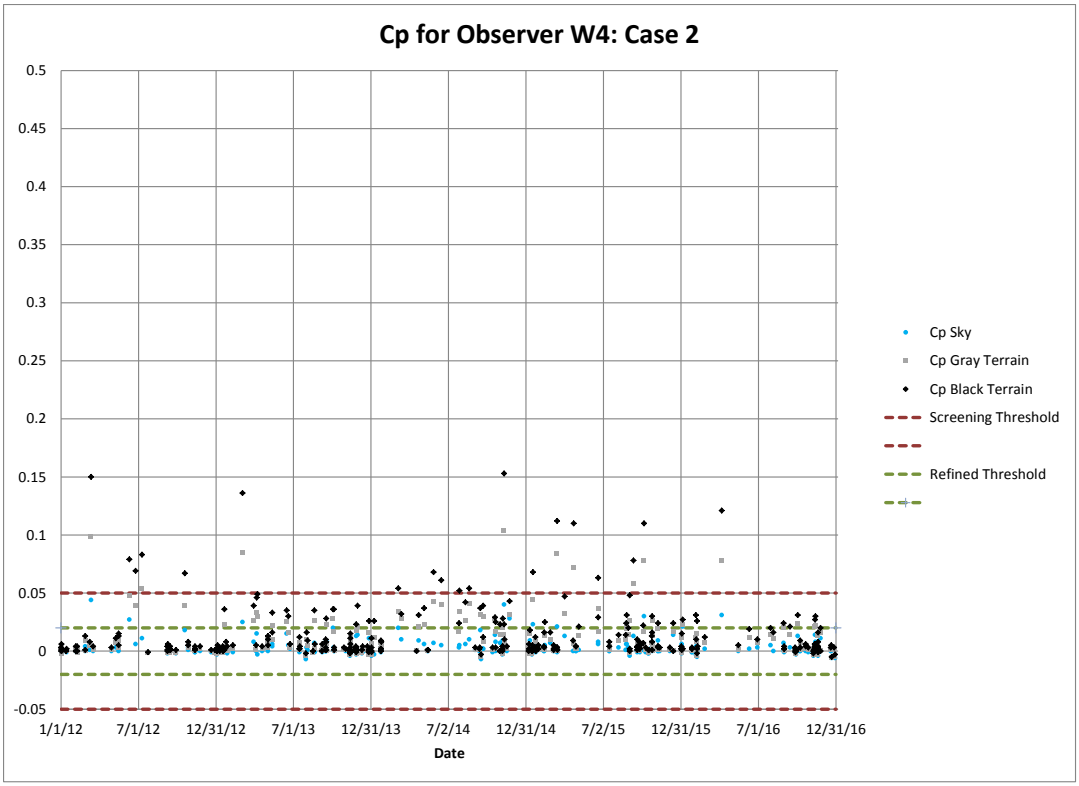
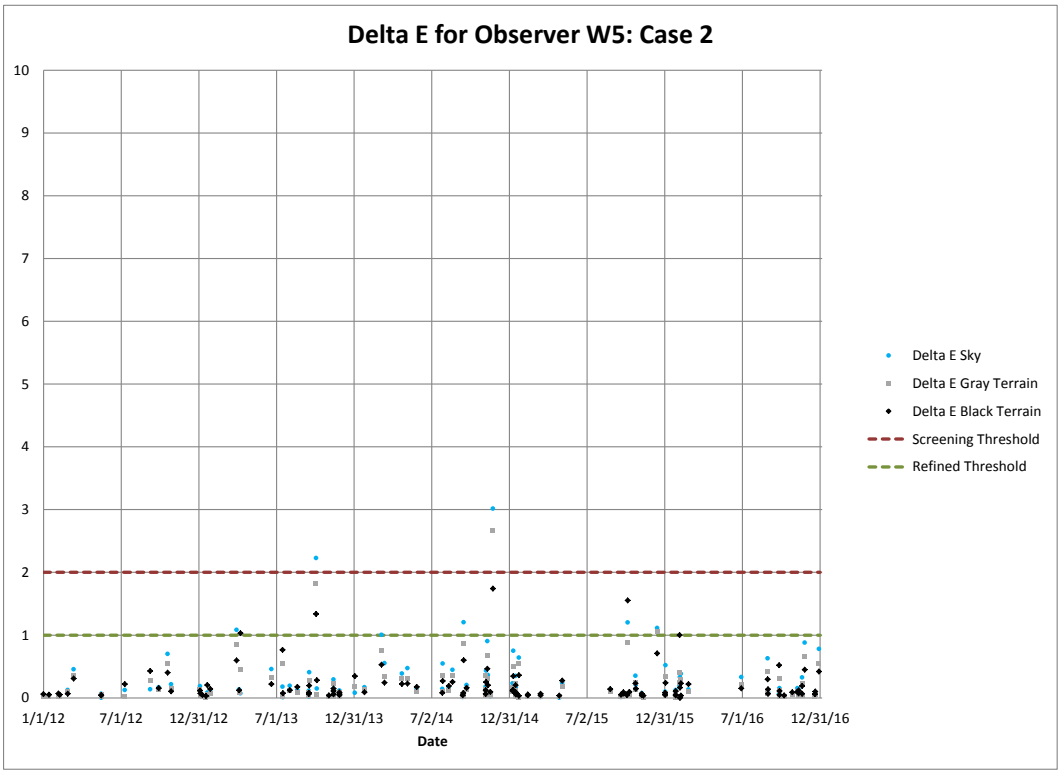


Figure D-5 Time Series of Delta E and Cp for Case 2: Observer W5



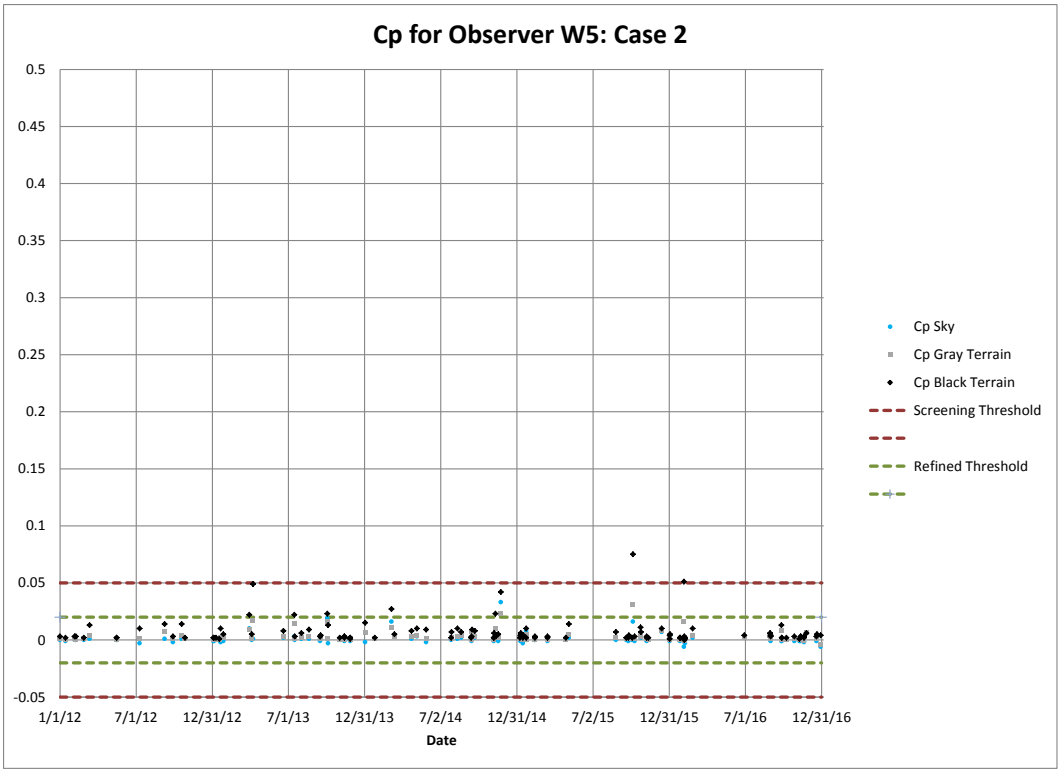
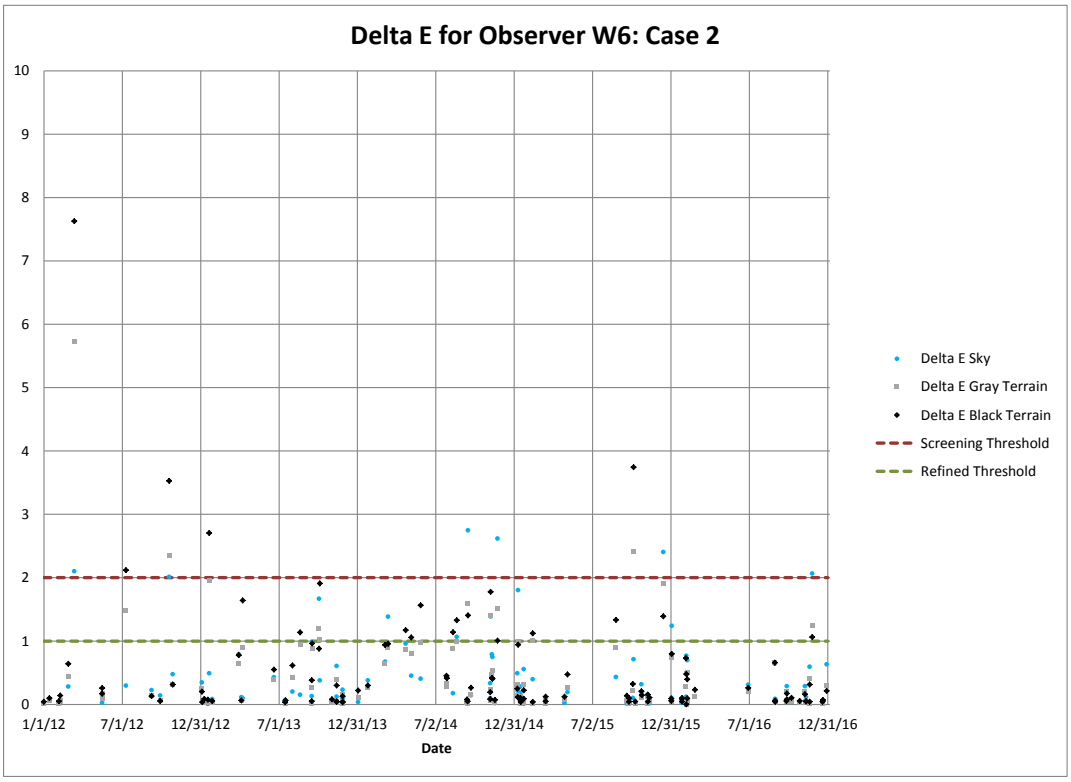


Figure D-6 Time Series of Delta E and Cp for Case 2: Observer W6



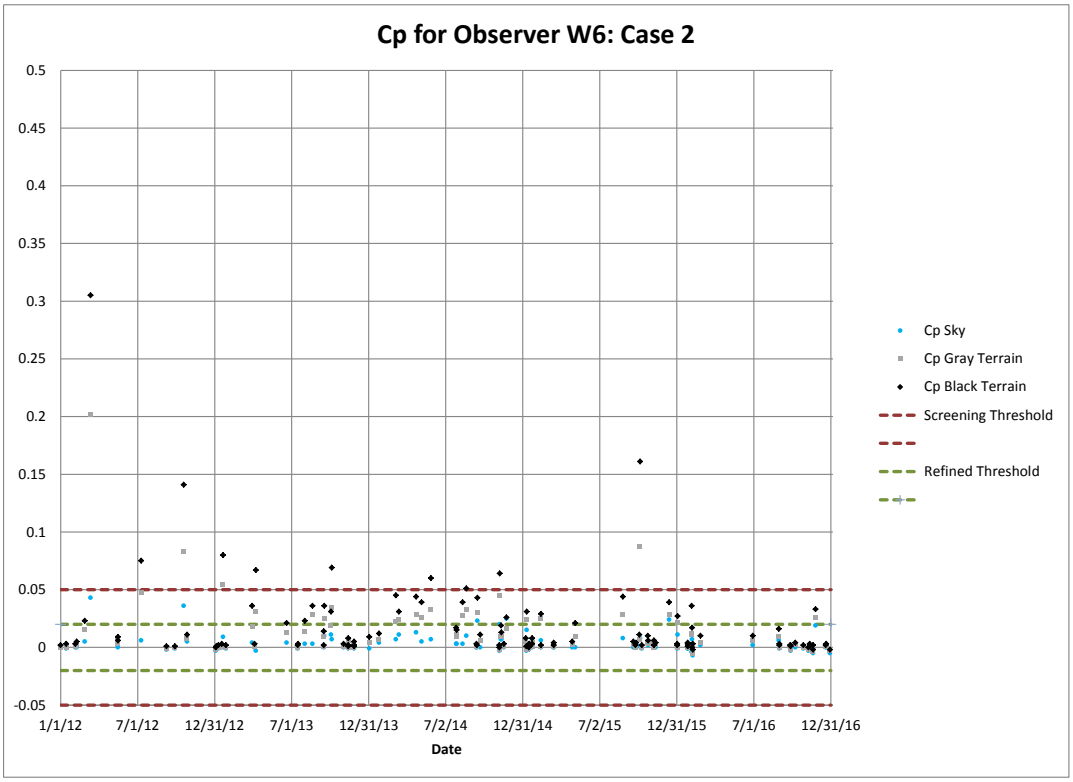
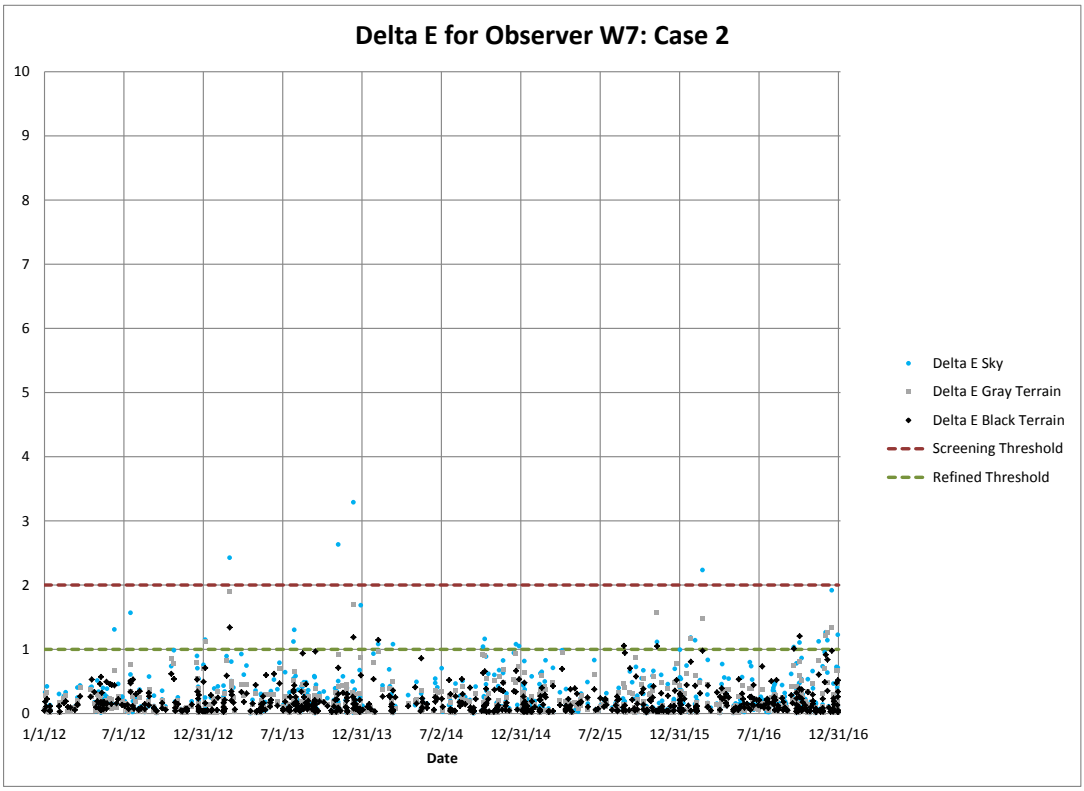


Figure D-7 Time Series of Delta E and Cp for Case 2: Observer W7



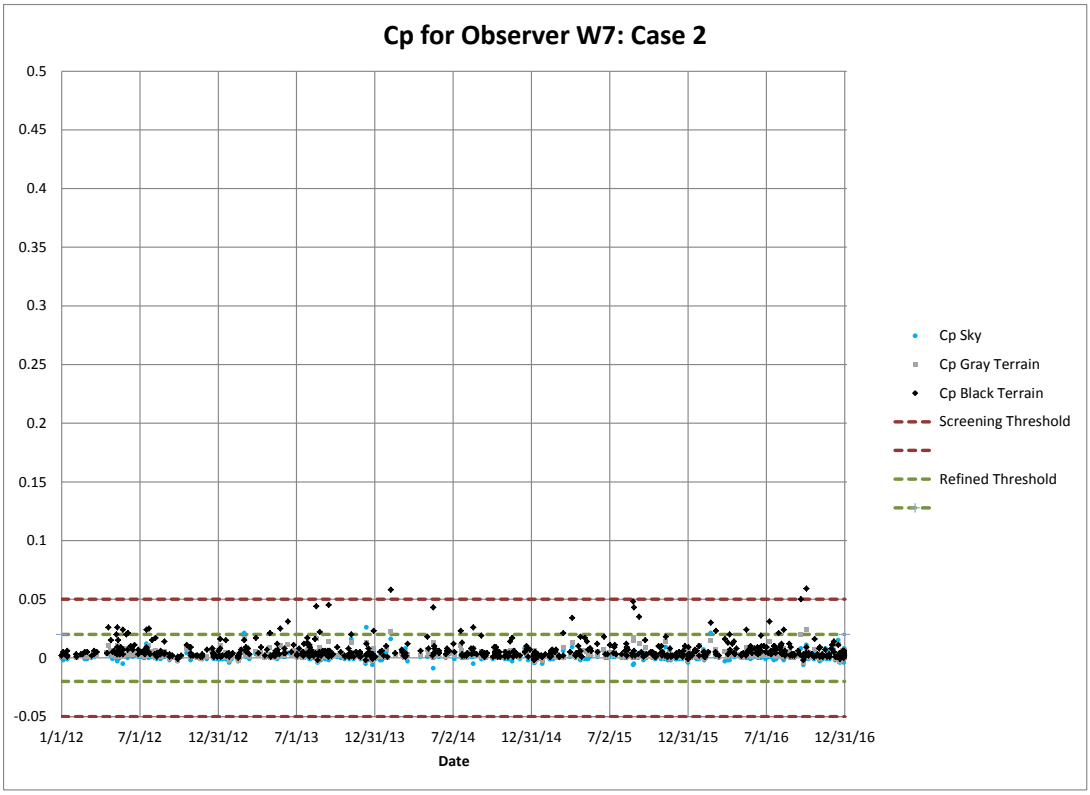
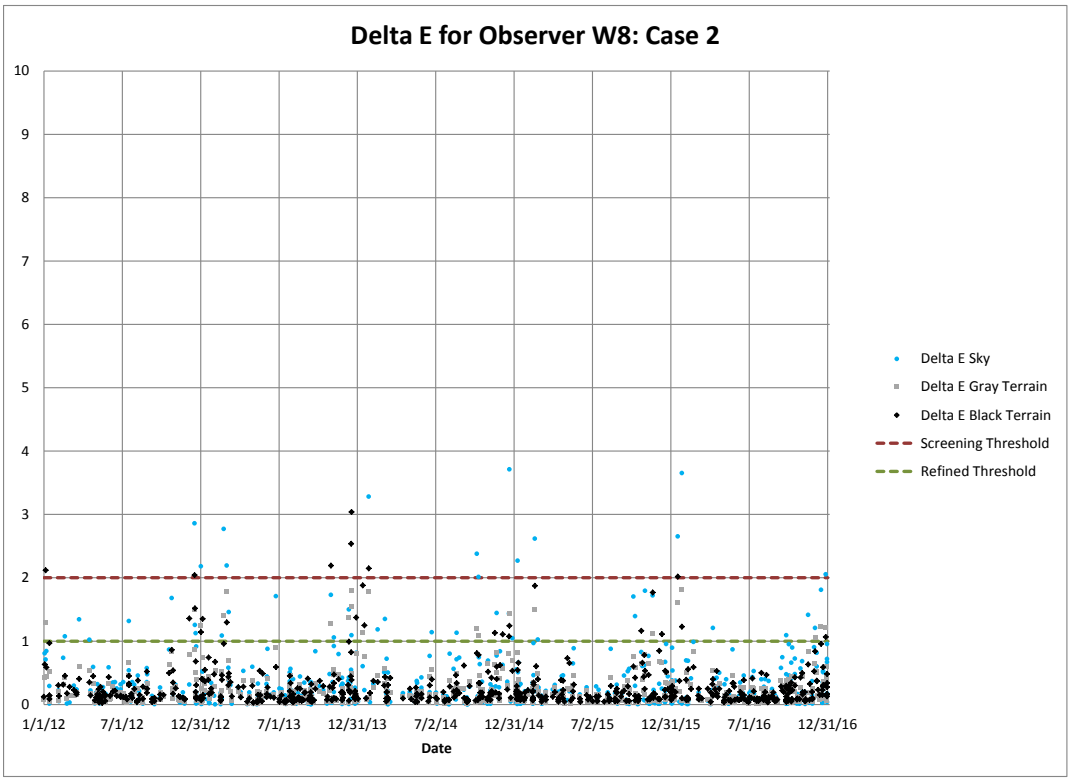


Figure D-8 Time Series of Delta E and Cp for Case 2: Observer W8



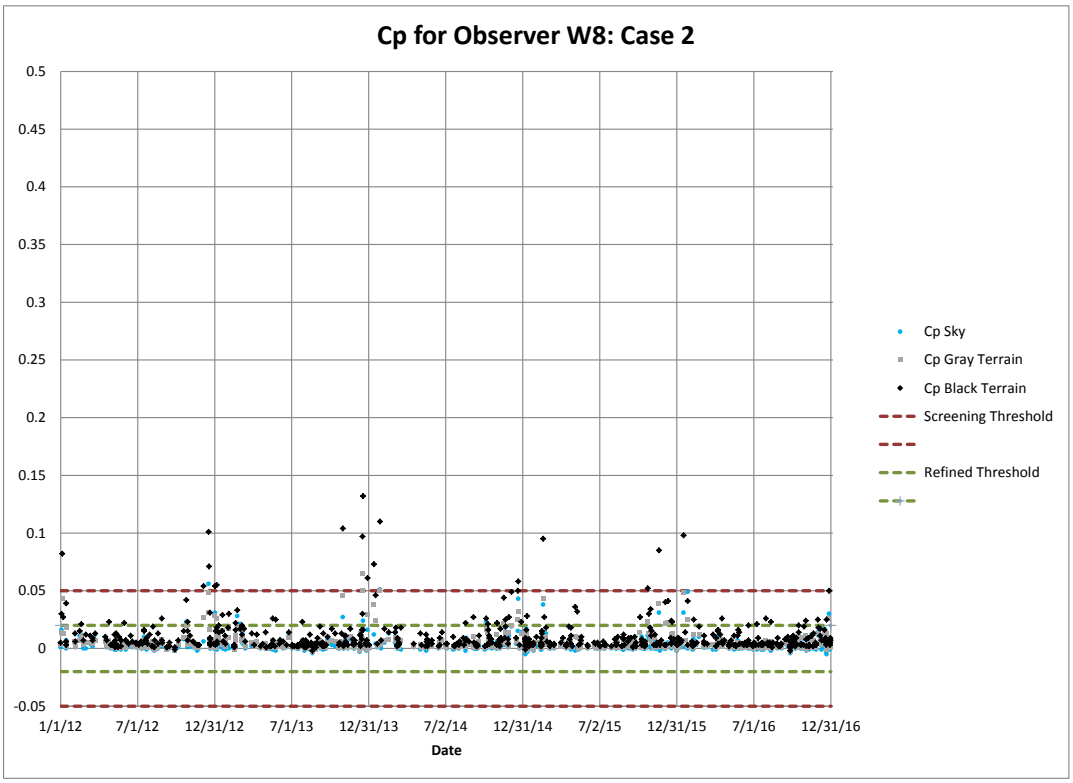
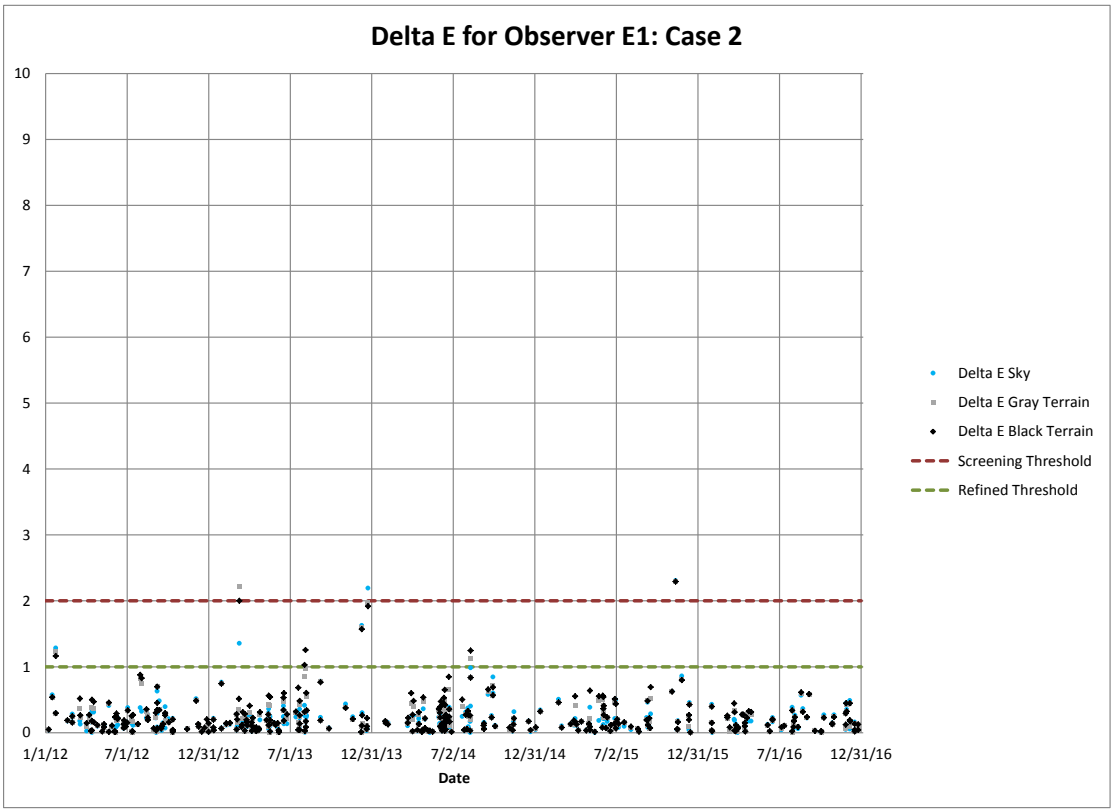


Figure D-9 Time Series of Delta E and Cp for Case 2: Observer E1



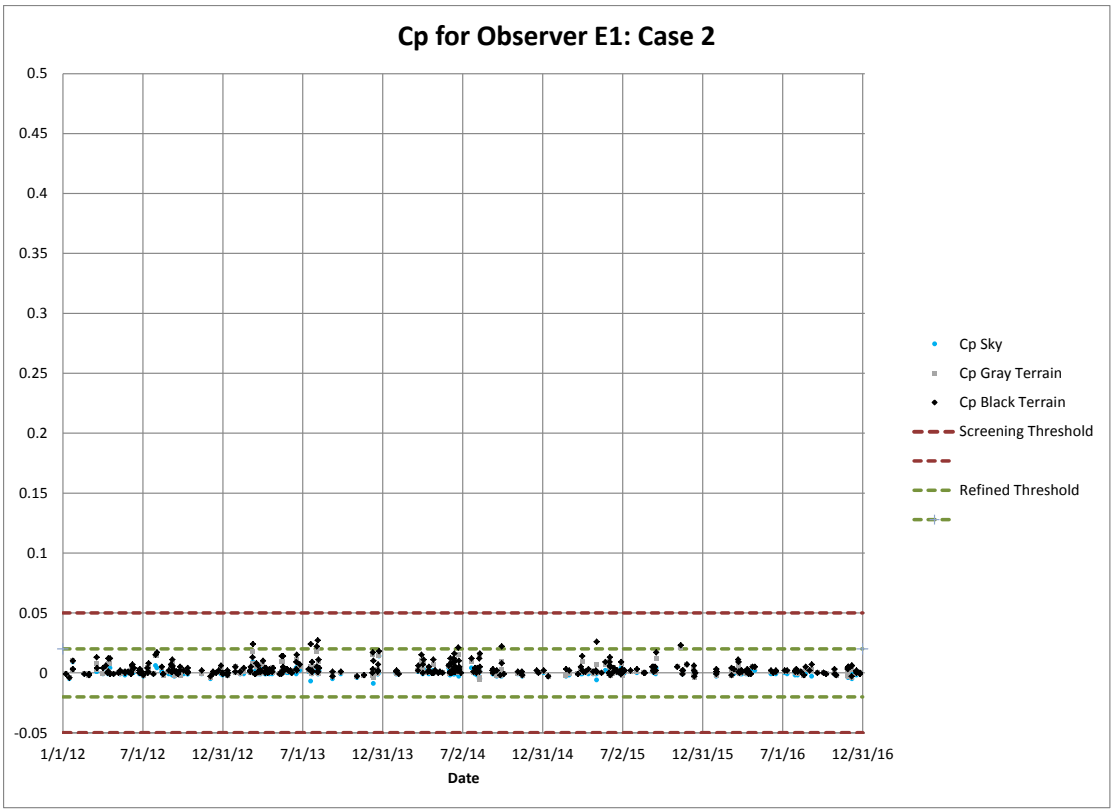
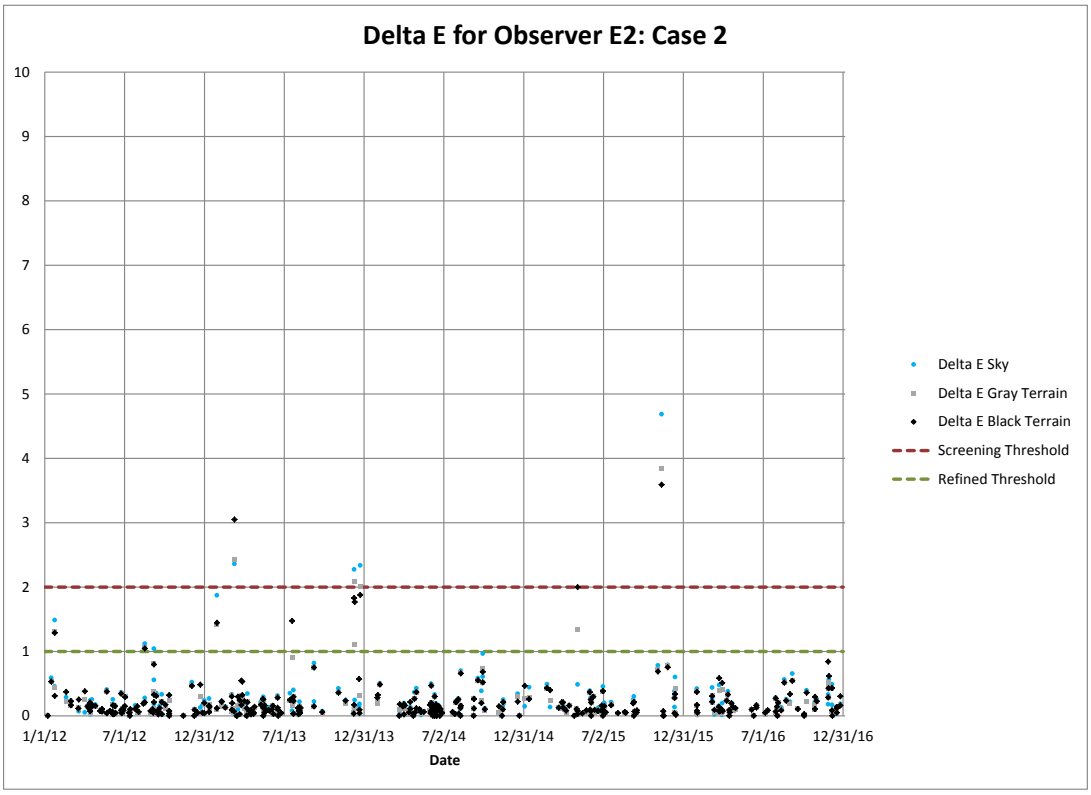


Figure D-10 Time Series of Delta E and Cp for Case 1: Observer E2



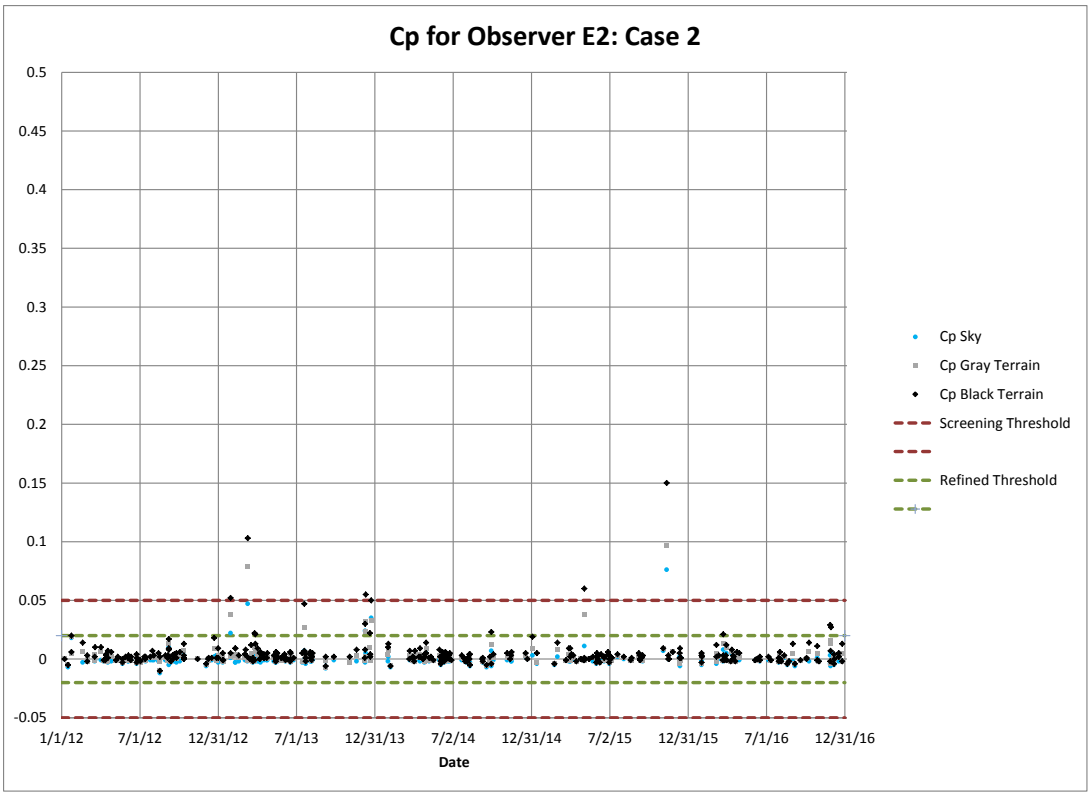
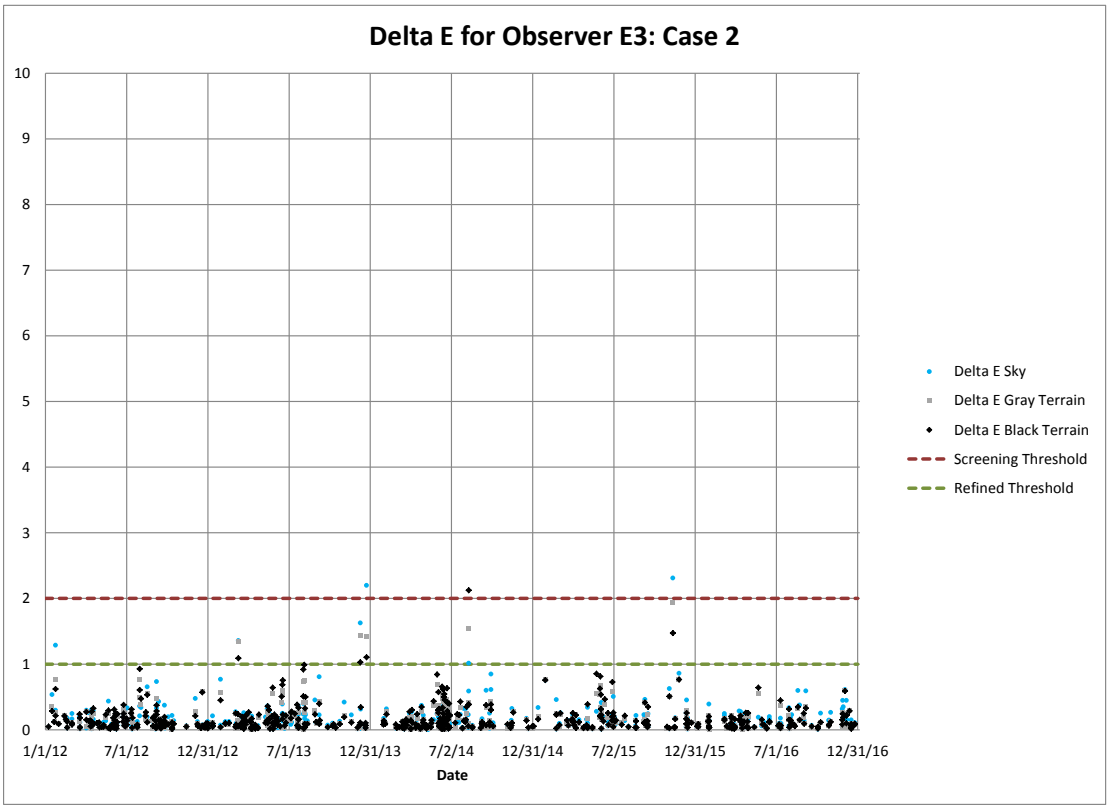


Figure D-11 Time Series of Delta E and Cp for Case 2: Observer E3



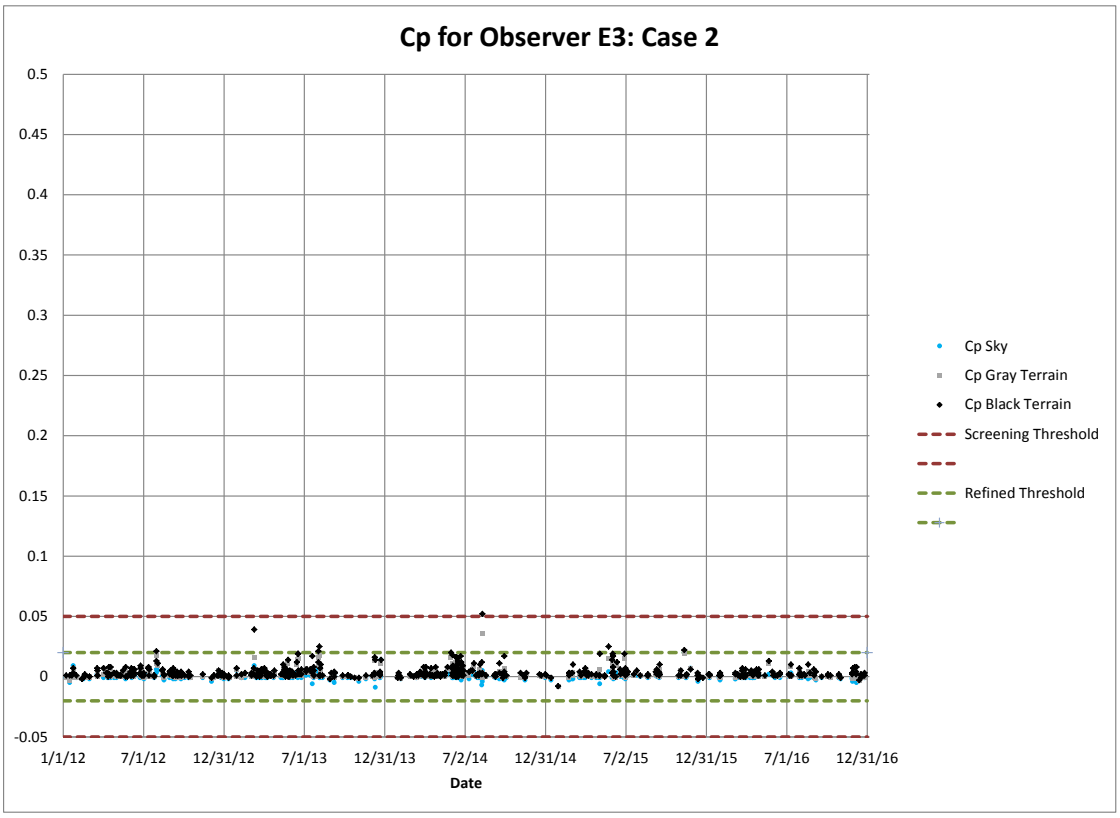
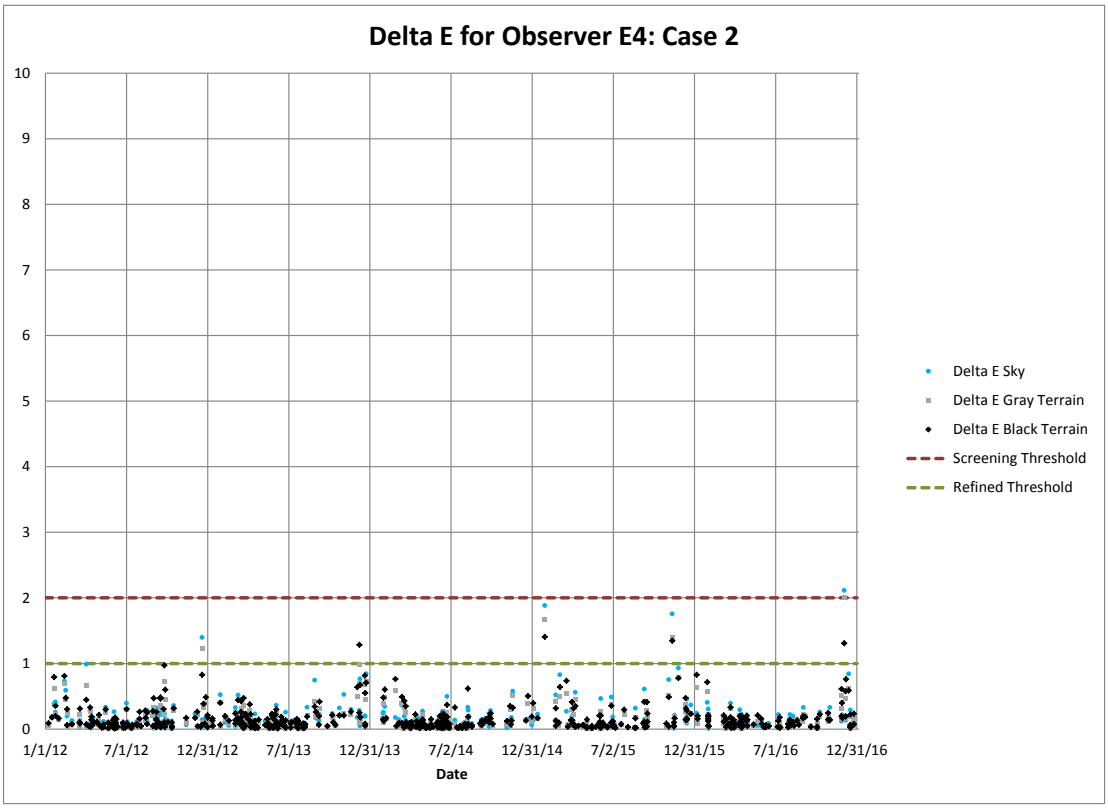


Figure D-12 Time Series of Delta E and Cp for Case 2: Observer E4



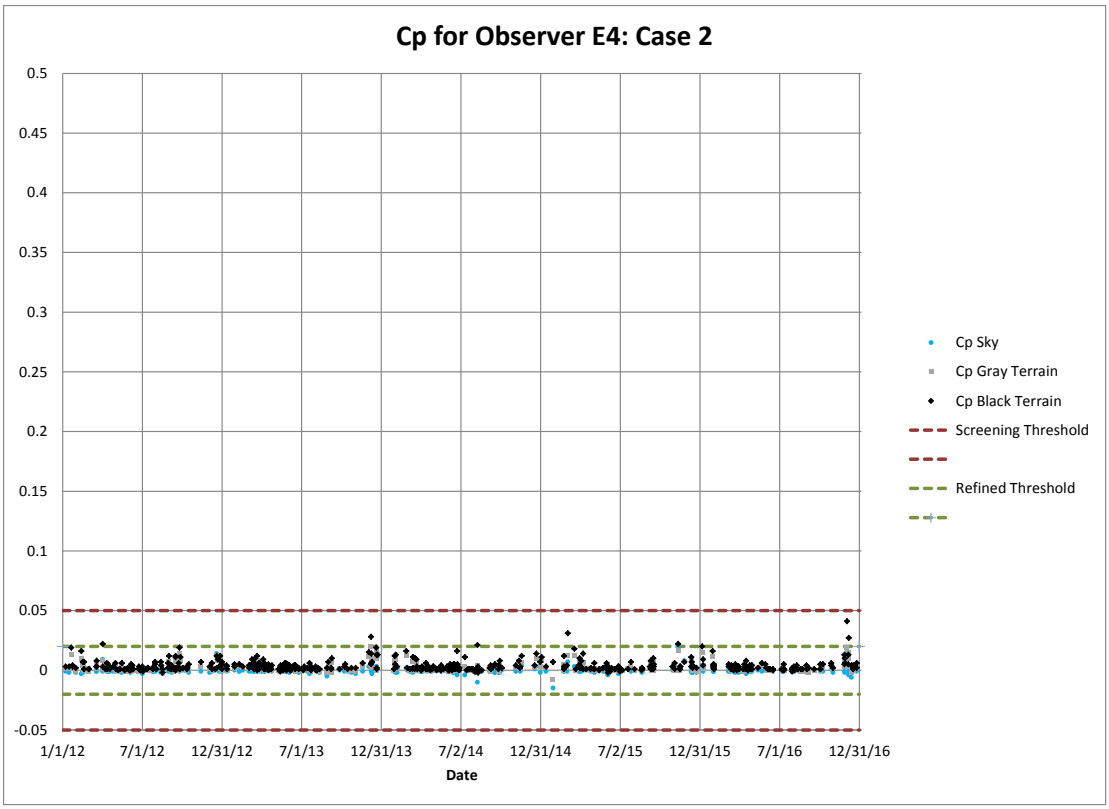
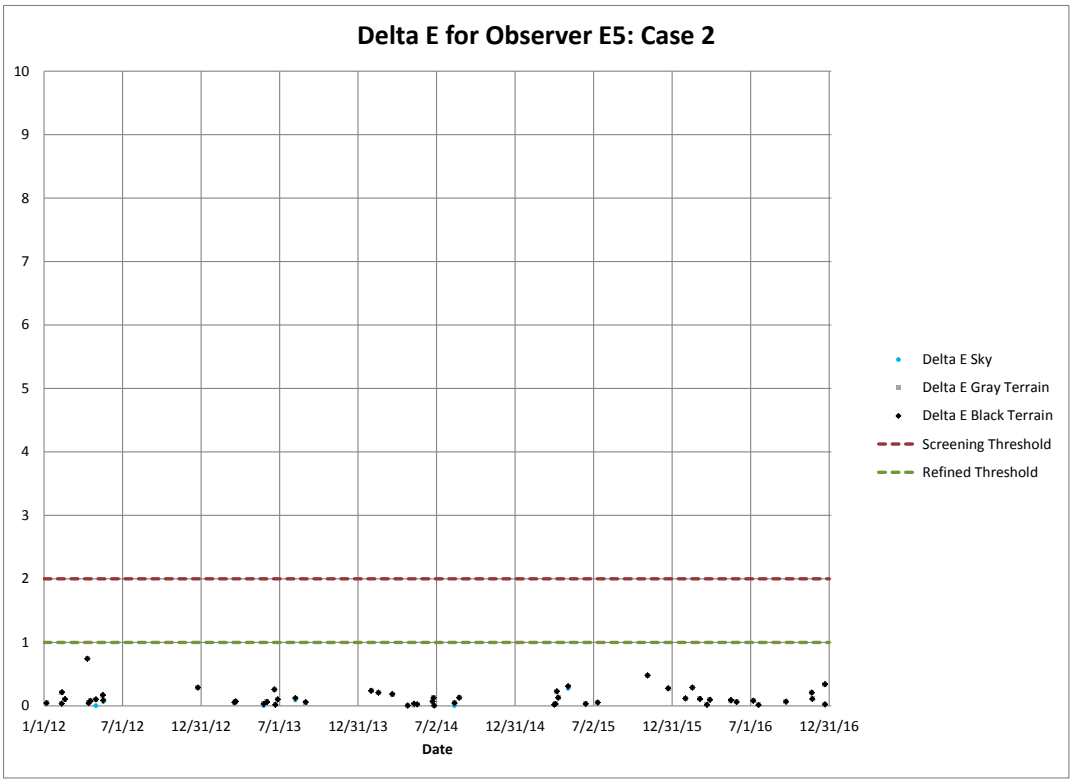


Figure D-13 Time Series of Delta E and Cp for Case 2: Observer E5



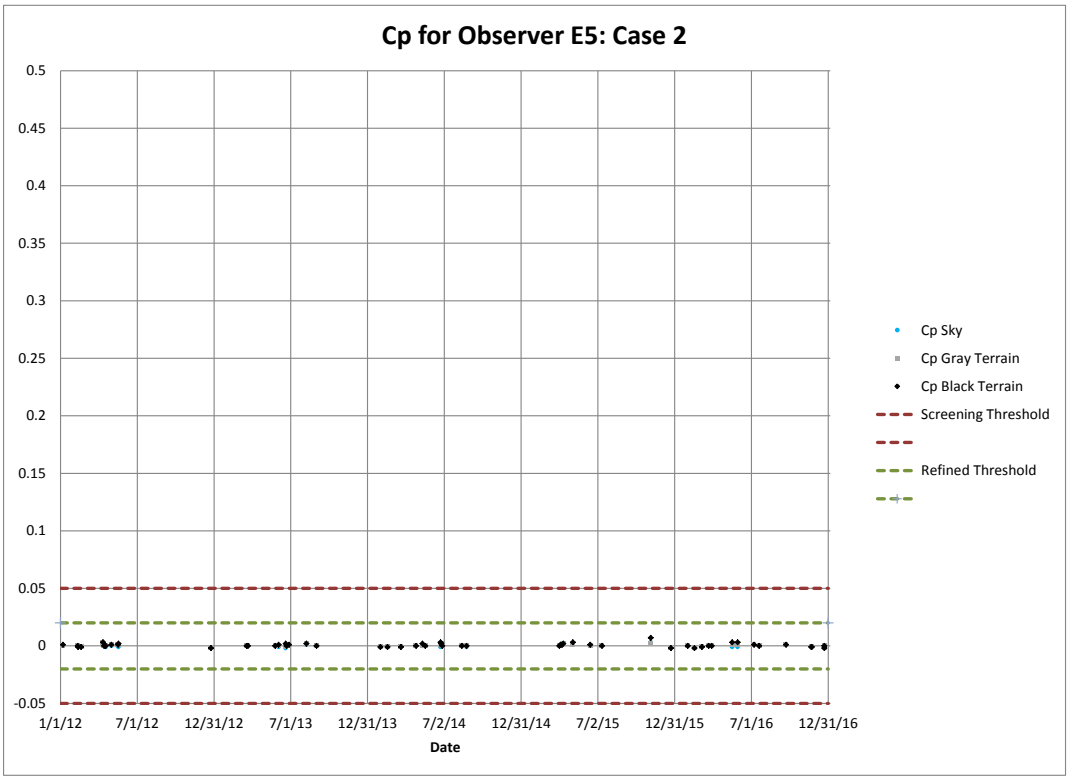
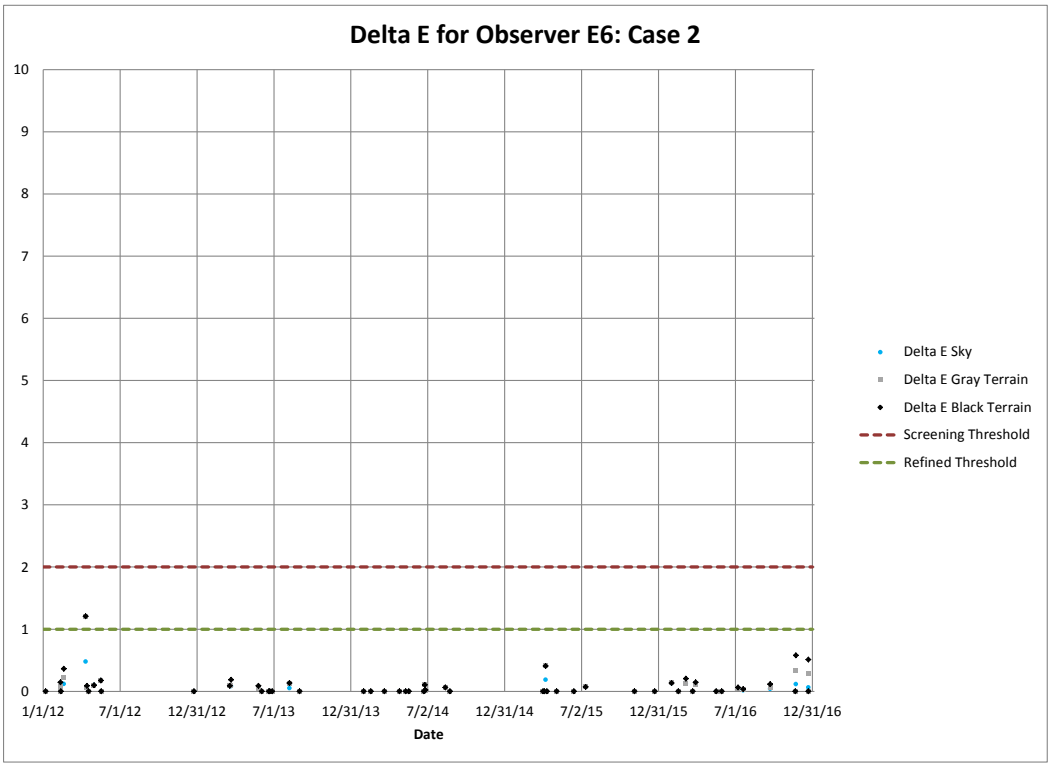


Figure D-14 Time Series of Delta E and Cp for Case 1: Observer E6



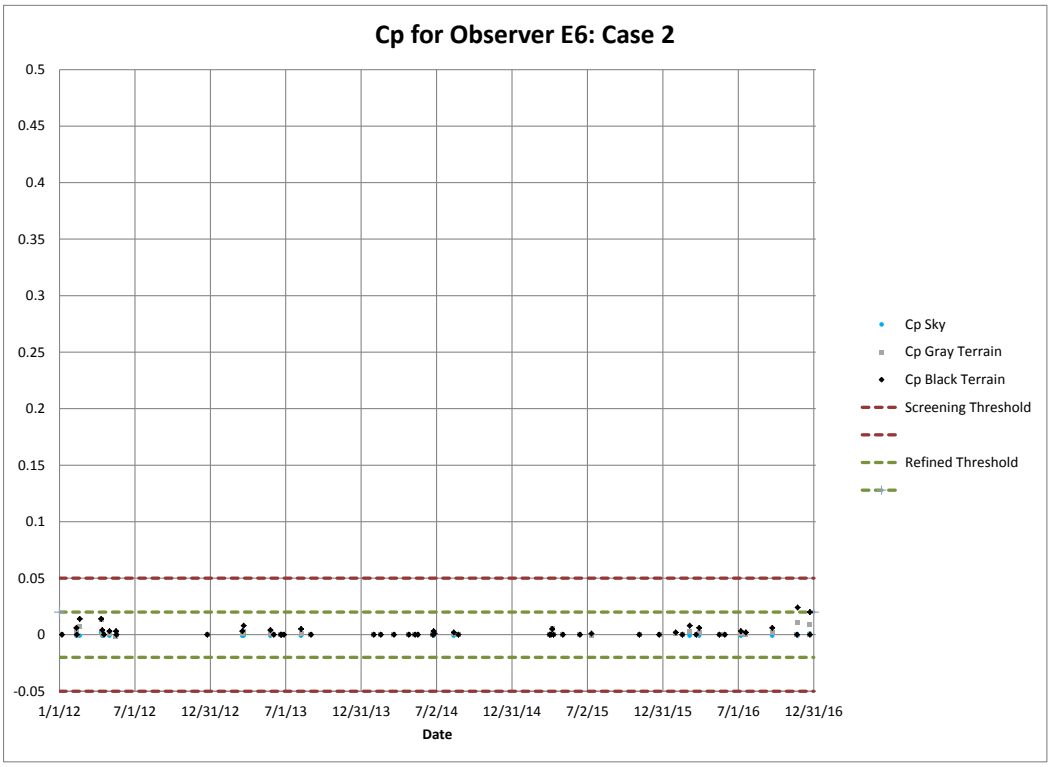
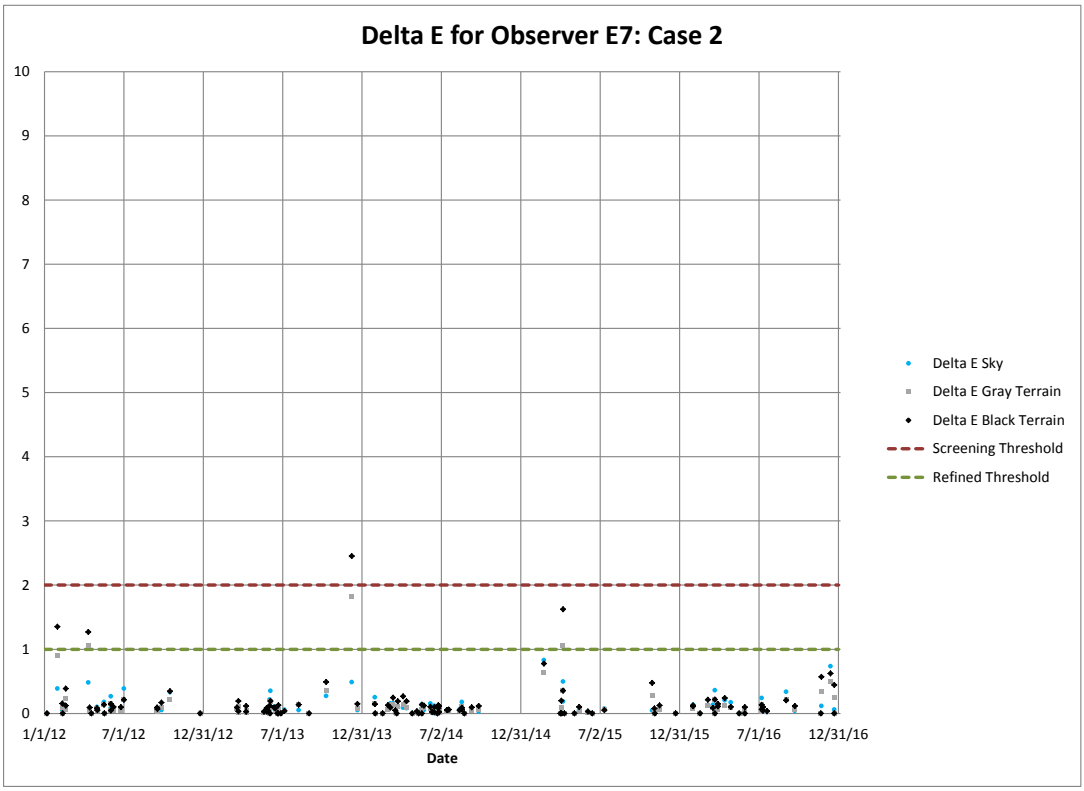


Figure D-15 Time Series of Delta E and Cp for Case 2: Observer E7



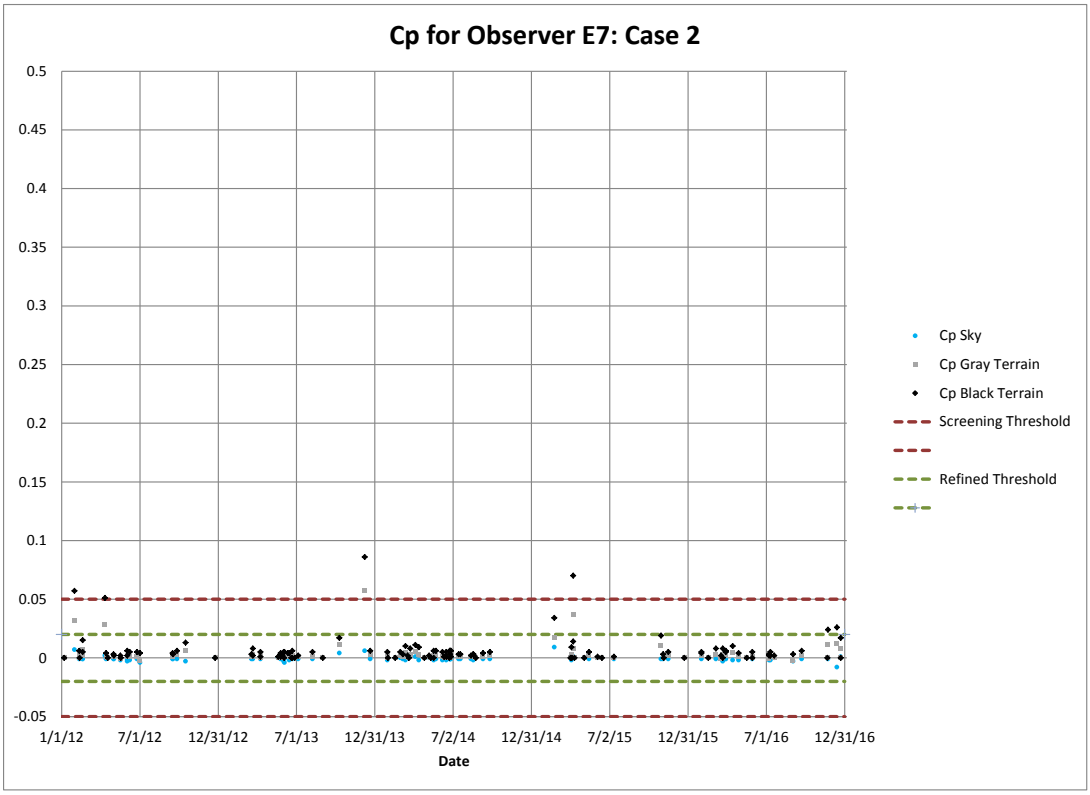
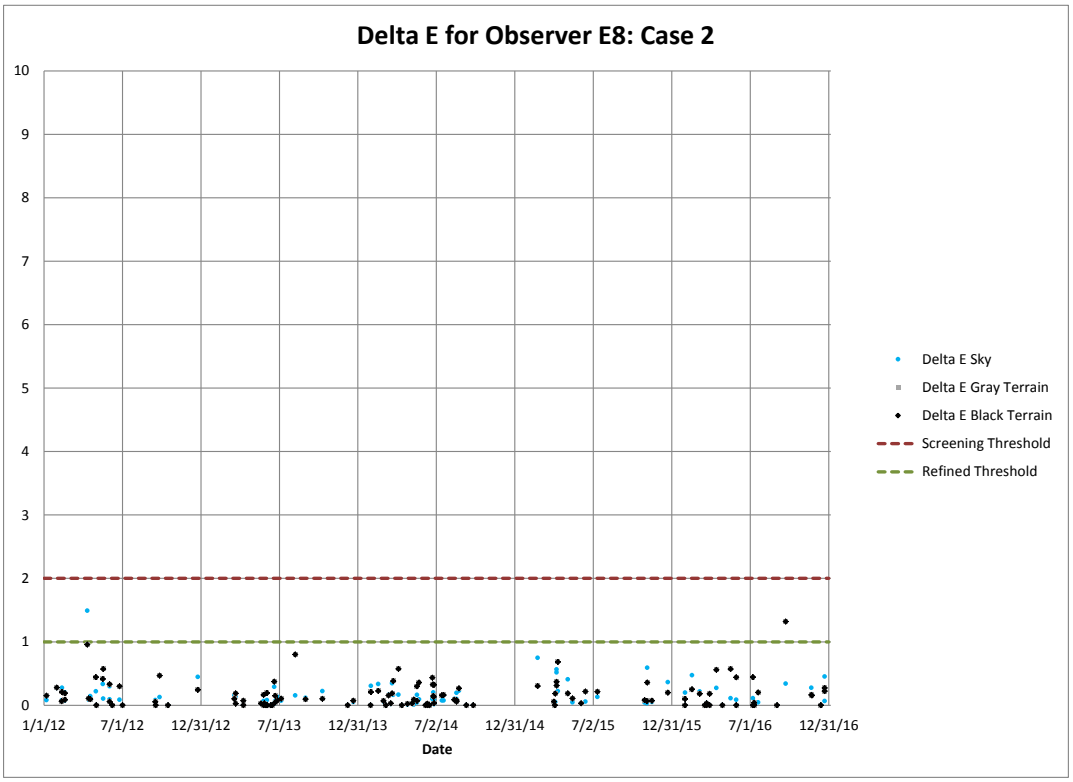
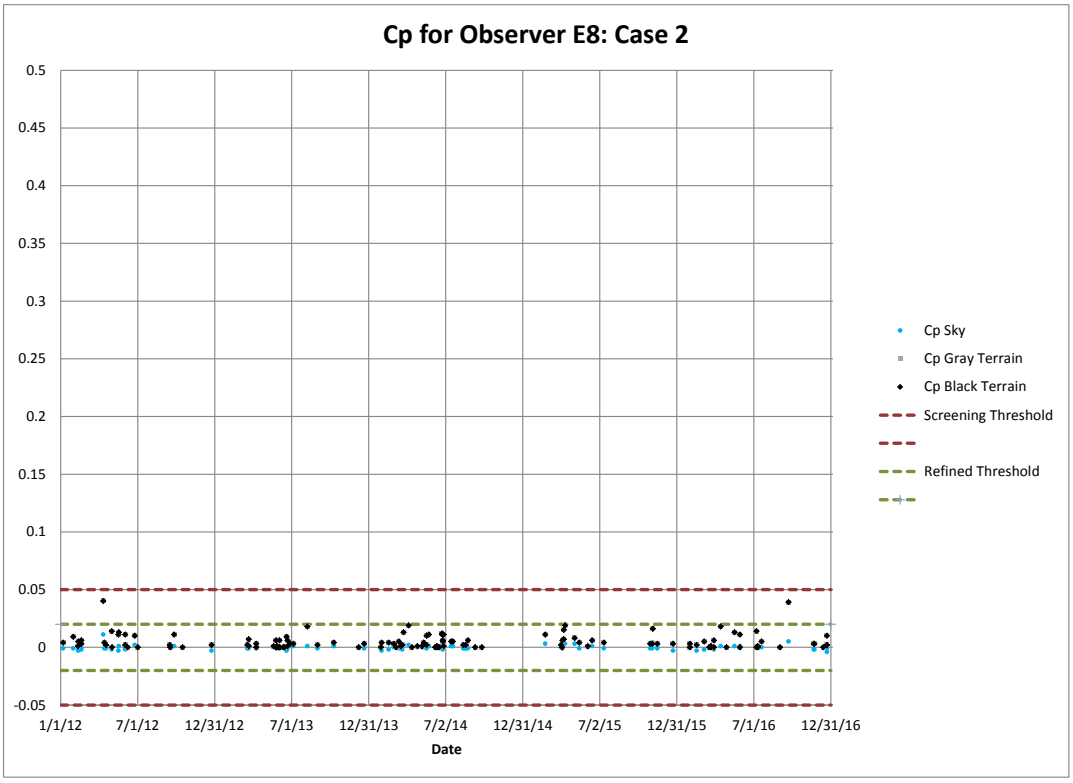


Figure D-16 Time Series of Delta E and Cp for Case 2: Observer E8





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