MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Island of Oahu, Hawaii
Survey Area Data: Version 14, Sep 17, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2009—Aug 14, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
HLMG	Helemano silty clay, 30 to 90 percent slopes	A	7.0	2.2%
KlA	Kawaihapai clay loam, 0 to 2 percent slopes, MLRA 158	A	15.3	4.8%
KlaB	Kawaihapai stony clay loam, 2 to 6 percent slopes, MLRA 158	A	8.6	2.7%
KlB	Kawaihapai clay loam, 2 to 6 percent slopes	A	10.9	3.4%
MBL	Mahana-Badland complex	B	3.1	1.0%
McC2	Mahana silty clay loam, 6 to 12 percent slopes, eroded	B	26.6	8.3%
McD2	Mahana silty clay loam, 12 to 20 percent slopes, eroded	B	56.0	17.4%
McE2	Mahana silty clay loam, 20 to 35 percent slopes, eroded	B	129.3	40.1%
MuB	Molokai silty clay loam, 3 to 7 percent slopes, MLRA 158	C	21.7	6.7%
MuC	Molokai silty clay loam, 7 to 15 percent slopes, MLRA 158	C	23.0	7.2%
MuD	Molokai silty clay loam, 15 to 25 percent slopes	C	20.7	6.4%
Totals for Area of Interest			**322.4**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

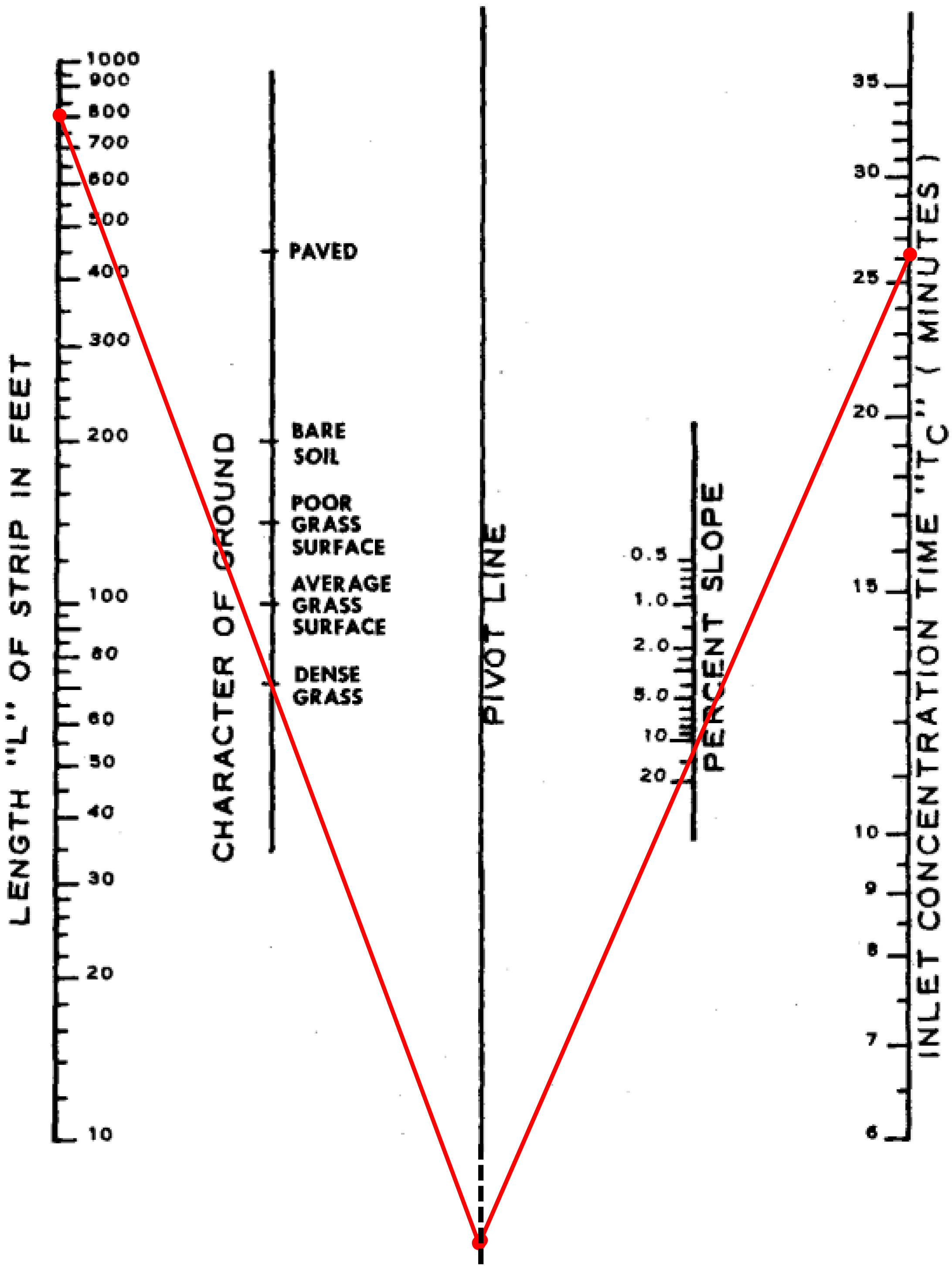
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

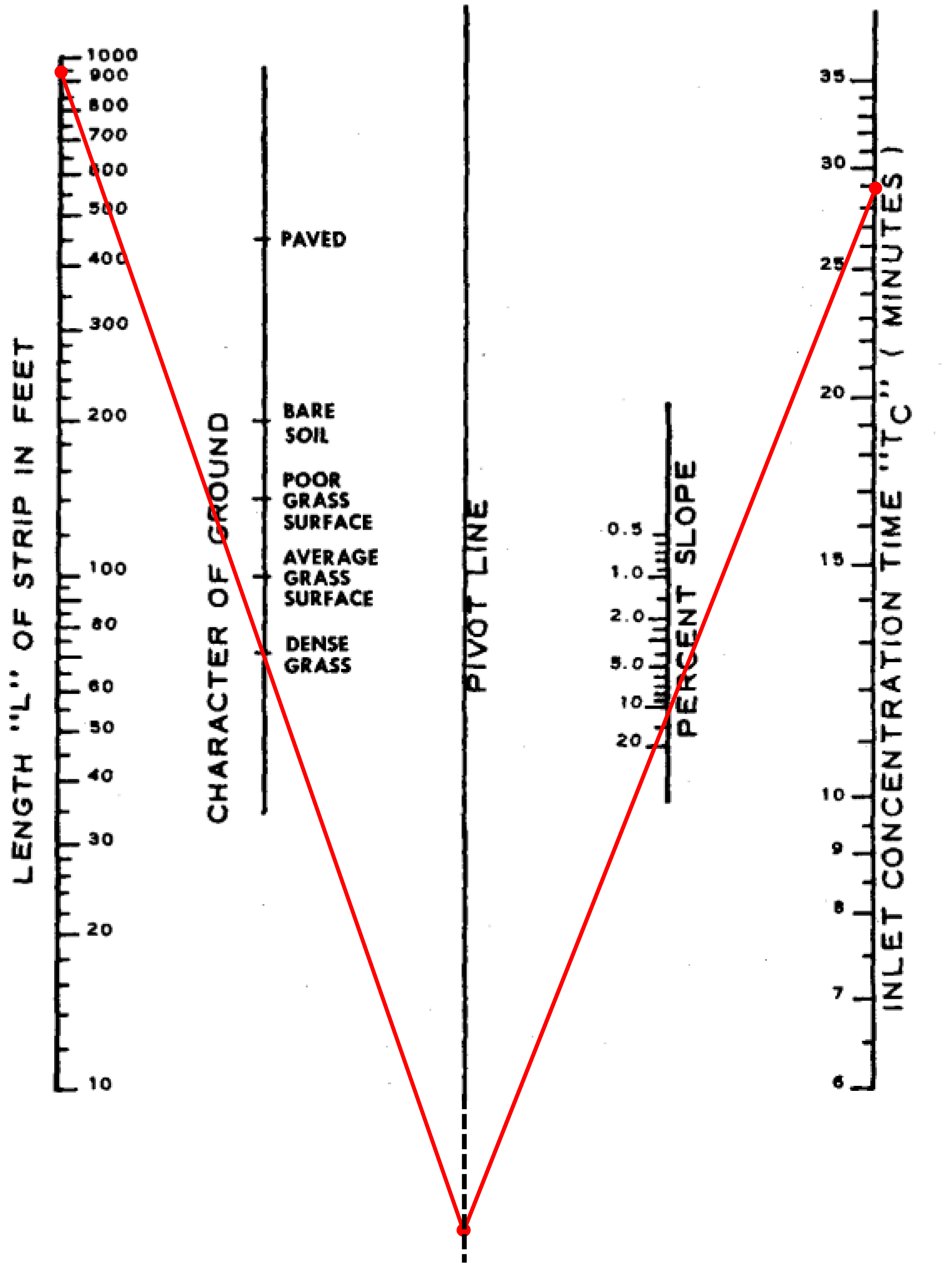
Tie-break Rule: Higher

Time of Concentration (Plate 3 from Storm Drainage Standards)

Basin 1

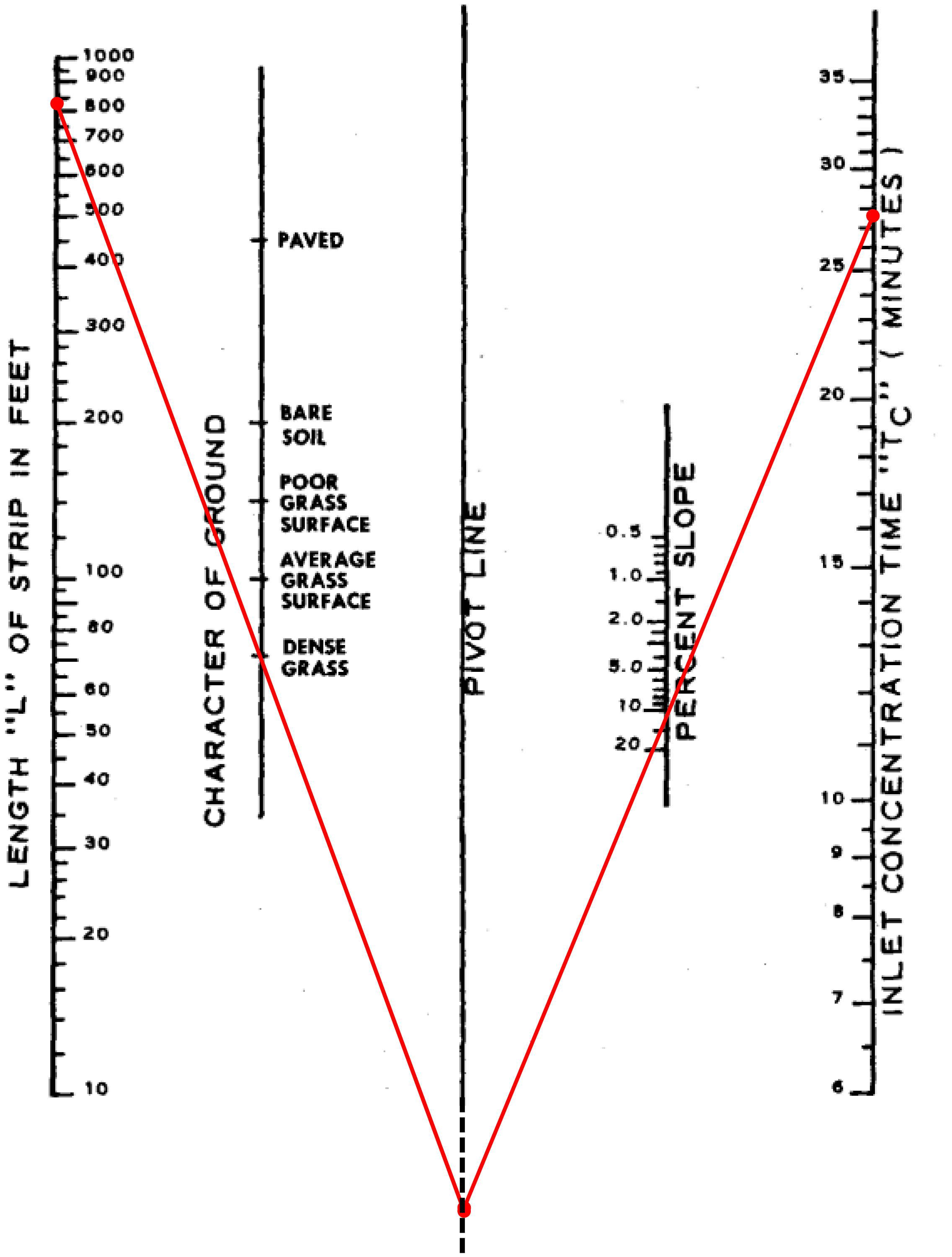


Basin 2



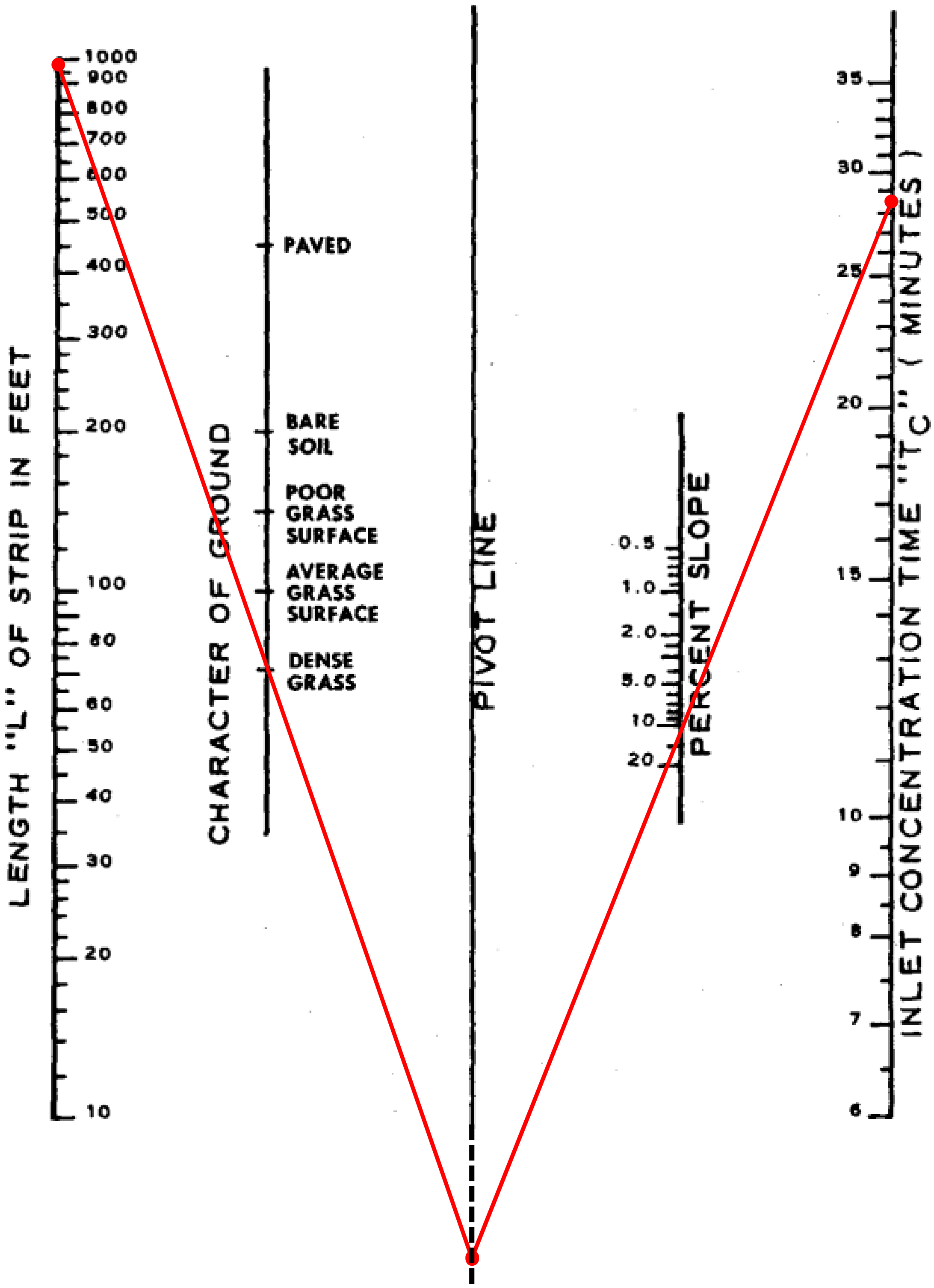
LENGTH "L" OF STRIP IN FEET
1000
900
800
700
600
500
400
300
200
100
80
60
50
40
30
20
10
CHARACTER OF GROUND
PAVED
BARE SOIL
POOR GRASS SURFACE
AVERAGE GRASS SURFACE
DENSE GRASS
PIVOT LINE
PERCENT SLOPE
0.5
1.0
2.0
5.0
10
20
INLET CONCENTRATION TIME "TC" (MINUTES)
35
30
25
20
15
10
9
8
7
6

Basin 3

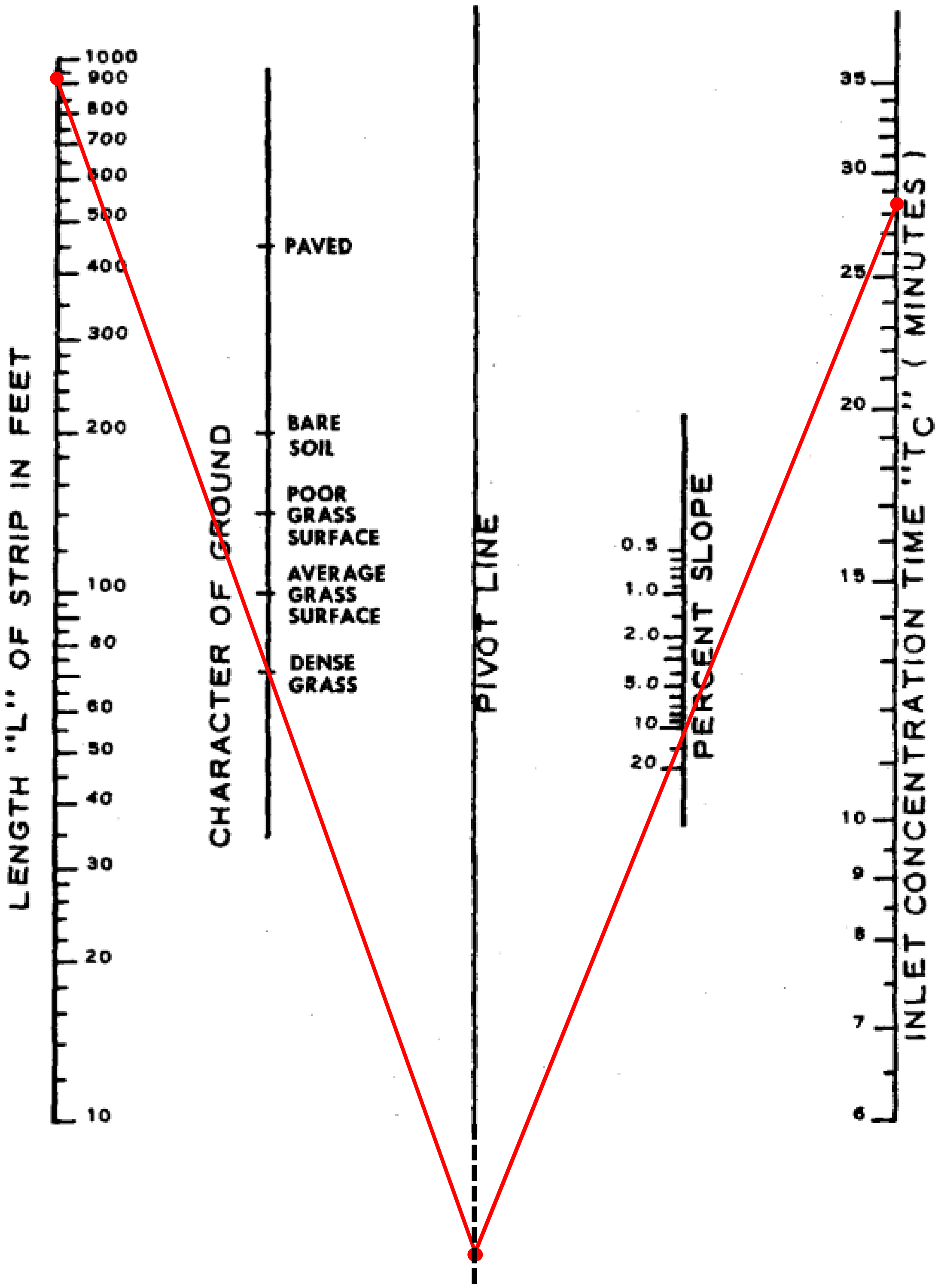


LENGTH "L" OF STRIP IN FEET
1000
900
800
700
600
500
400
300
200
100
80
60
50
40
30
20
10
CHARACTER OF GROUND
PAVED
BARE SOIL
POOR GRASS SURFACE
AVERAGE GRASS SURFACE
DENSE GRASS
PIVOT LINE
PERCENT SLOPE
0.5
1.0
2.0
5.0
10
20
INLET CONCENTRATION TIME "TC" (MINUTES)
35
30
25
20
15
10
9
8
7
6

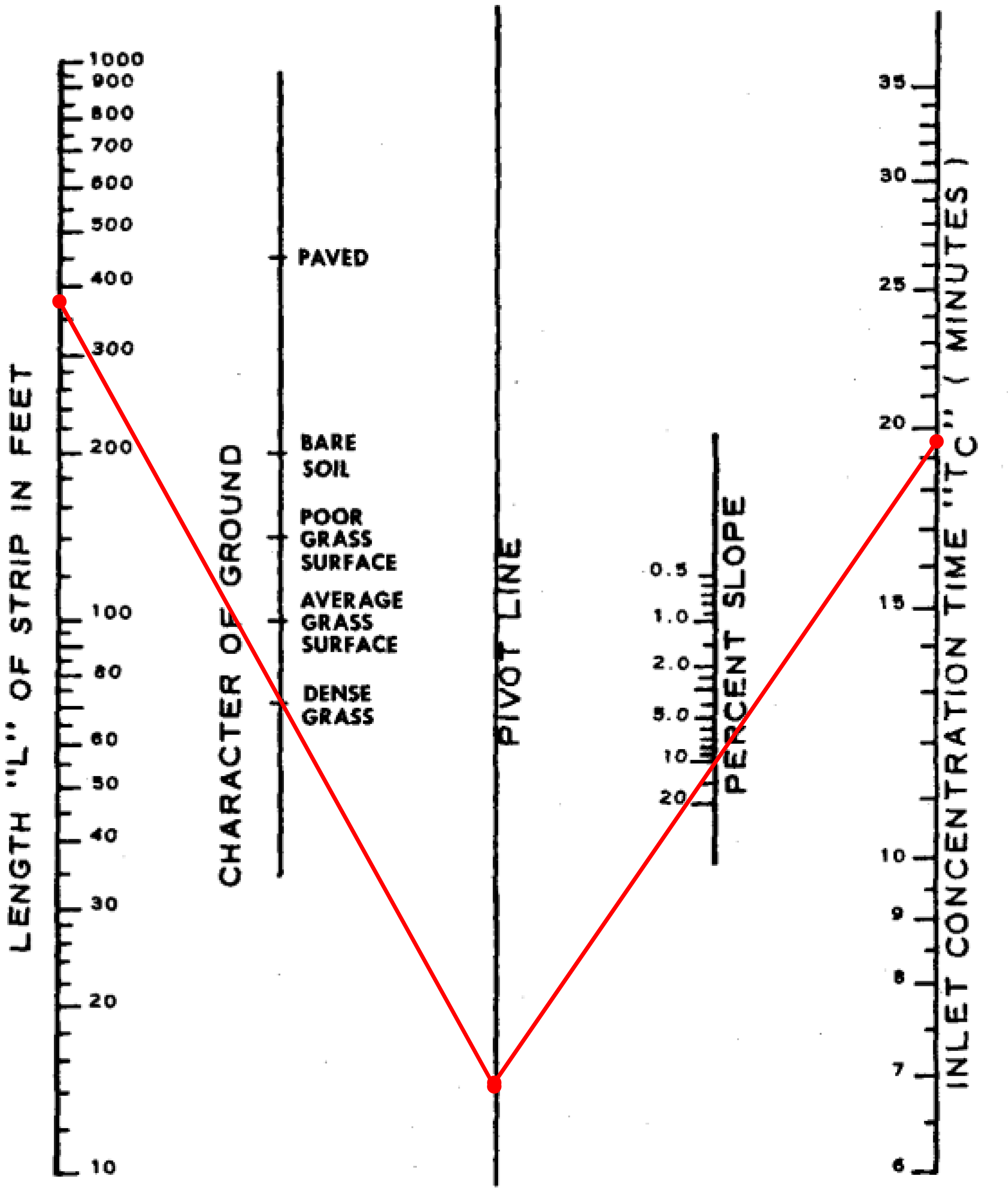
Basin 4


LENGTH "L" OF STRIP IN FEET
1000
900
800
700
600
500
400
300
200
100
80
60
50
40
30
20
10
CHARACTER OF GROUND
PAVED
BARE SOIL
POOR GRASS SURFACE
AVERAGE GRASS SURFACE
DENSE GRASS
PIVOT LINE
PERCENT SLOPE
0.5
1.0
2.0
5.0
10
20
INLET CONCENTRATION TIME "TC" (MINUTES)
35
30
25
20
15
10
9
8
7
6

Basin 5

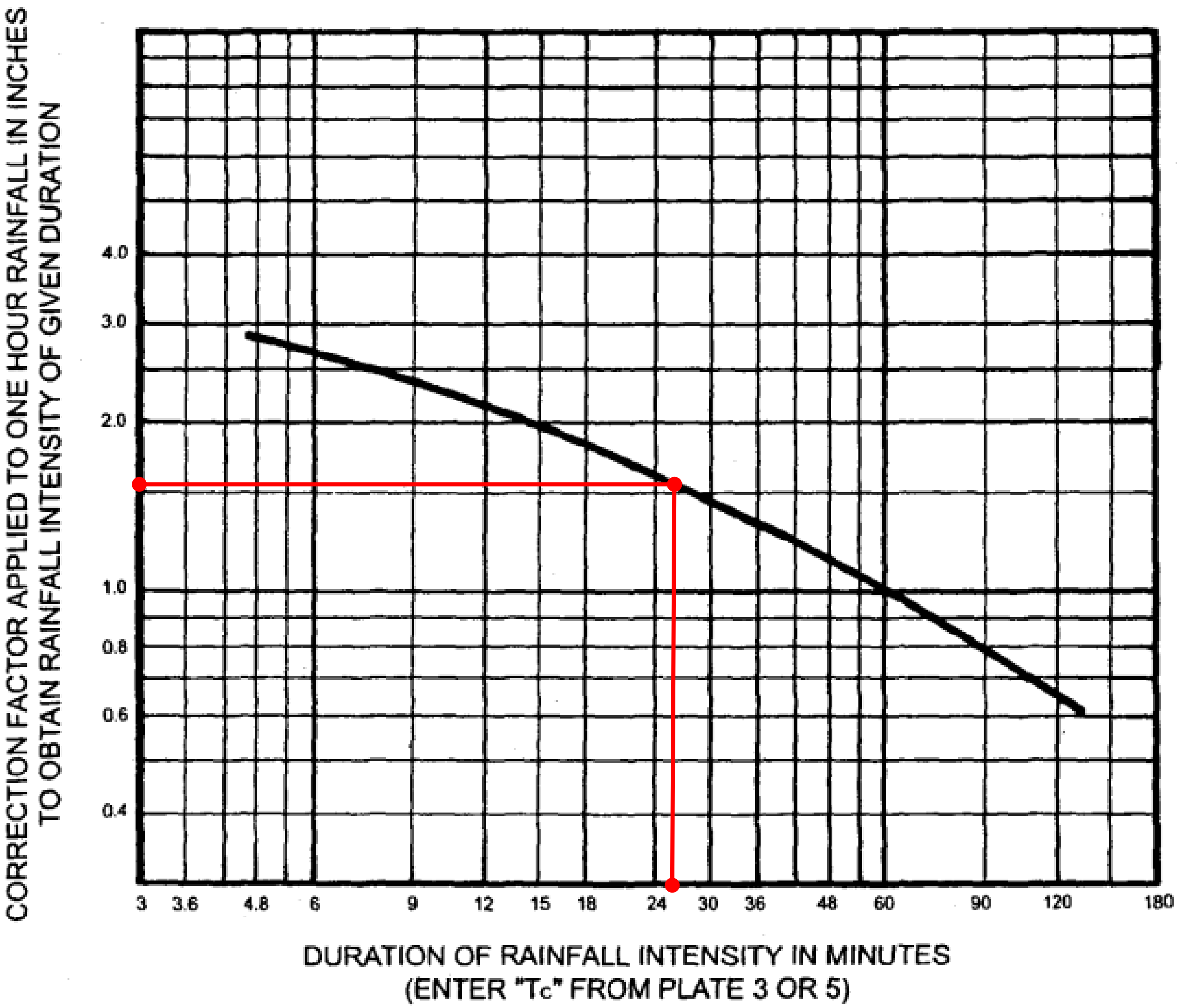

LENGTH "L" OF STRIP IN FEET
1000
900
800
700
600
500
400
300
200
100
80
60
50
40
30
20
10
CHARACTER OF GROUND
PAVED
BARE SOIL
POOR GRASS SURFACE
AVERAGE GRASS SURFACE
DENSE GRASS
PIVOT LINE
PERCENT SLOPE
0.5
1.0
2.0
5.0
10
20
INLET CONCENTRATION TIME "TC" (MINUTES)
35
30
25
20
15
10
9
8
7
6

Basin 6

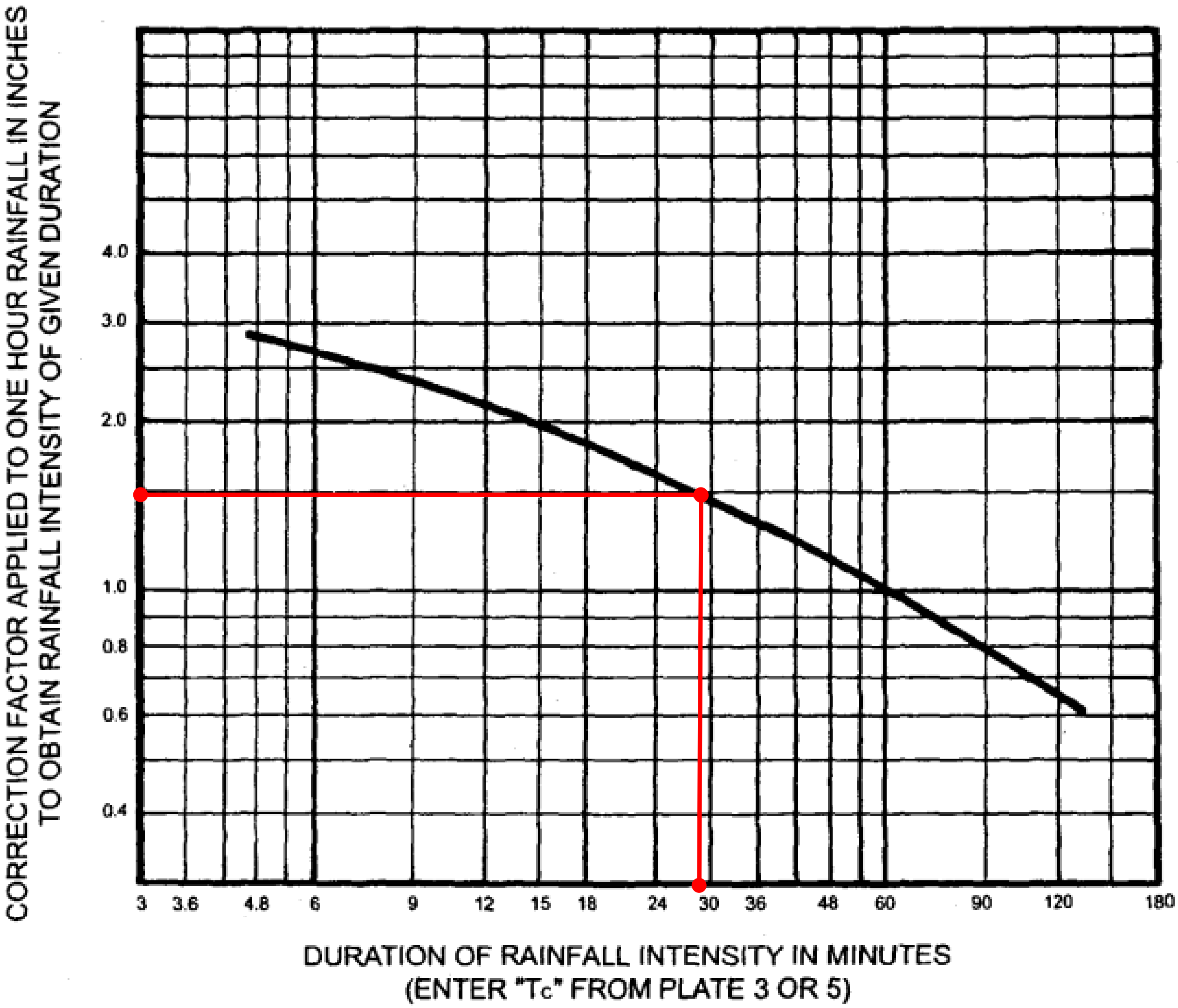

LENGTH "L" OF STRIP IN FEET
1000
900
800
700
600
500
400
300
200
100
80
60
50
40
30
20
10
CHARACTER OF GROUND
PAVED
BARE SOIL
POOR GRASS SURFACE
AVERAGE GRASS SURFACE
DENSE GRASS
PIVOT LINE
PERCENT SLOPE
0.5
1.0
2.0
5.0
10
20
INLET CONCENTRATION TIME "TC" (MINUTES)
35
30
25
20
15
10
9
8
7
6

Rainfall Intensity (Plate 4 from Storm Drainage Standards)

Basin 1

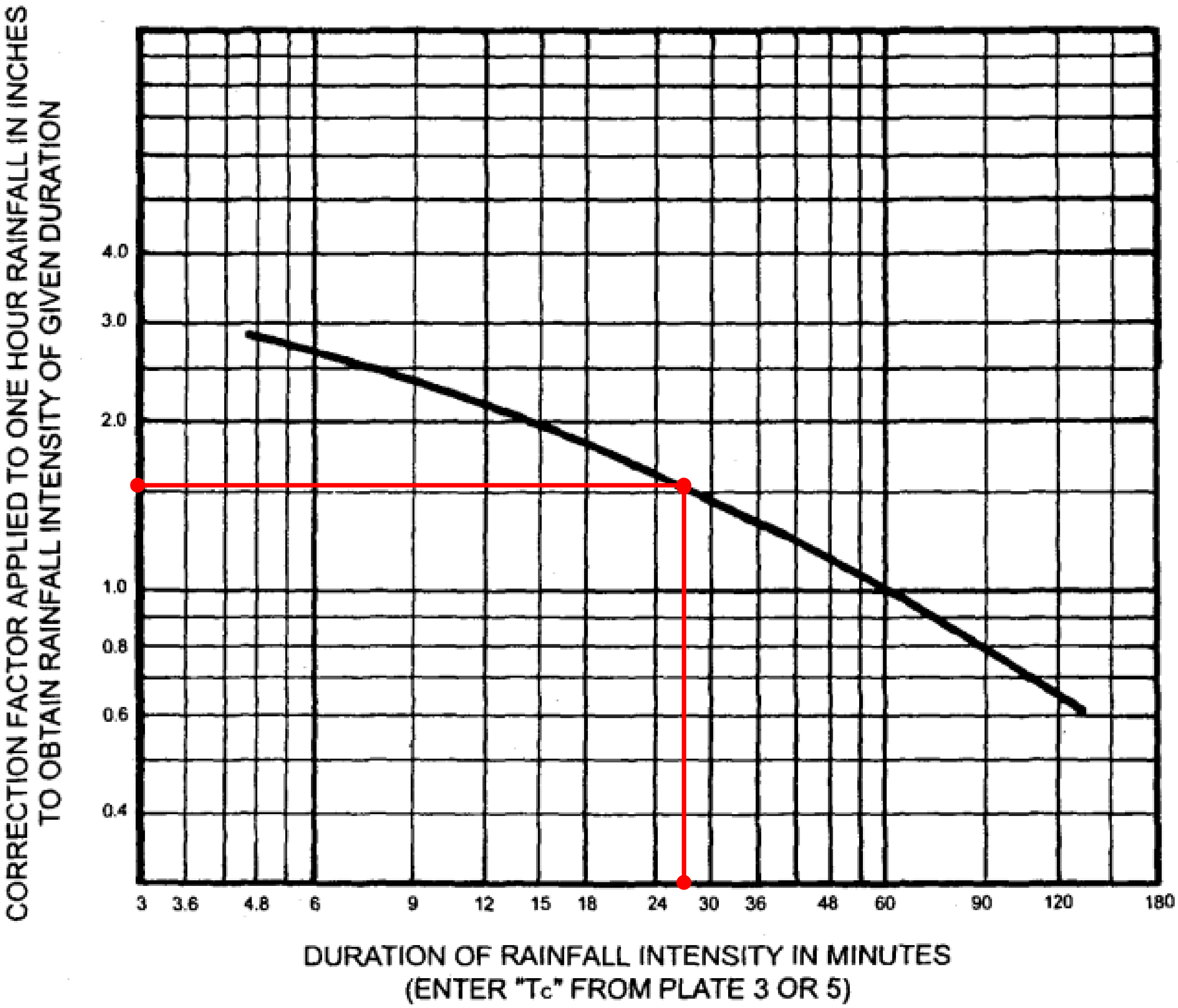


Basin 2



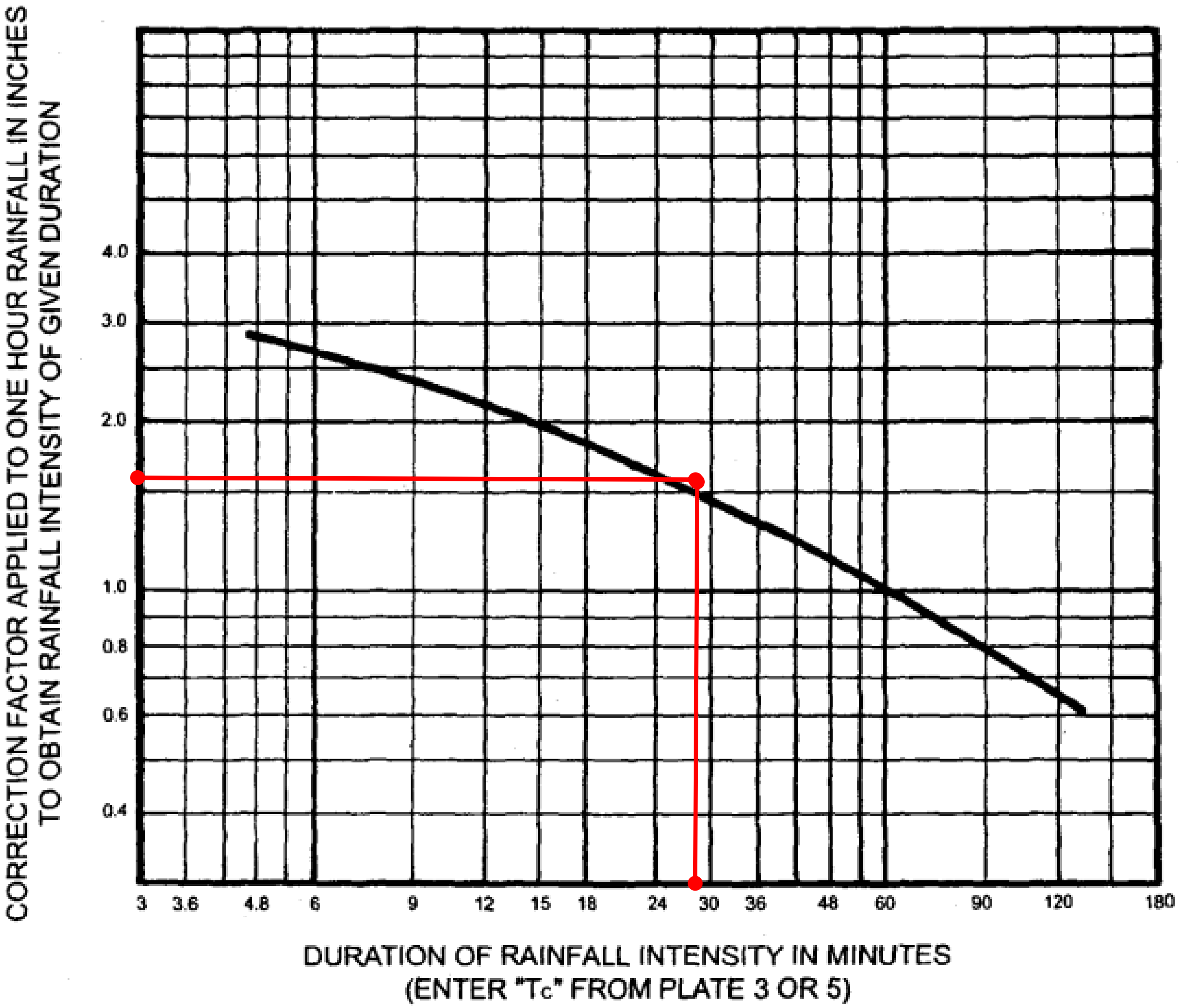
CORRECTION FACTOR APPLIED TO ONE HOUR RAINFALL IN INCHES
TO OBTAIN RAINFALL INTENSITY OF GIVEN DURATION
4.0
3.0
2.0
1.0
0.8
0.6
0.4
3
3.6
4.8
6
9
12
15
18
24
30
36
48
60
90
120
180
DURATION OF RAINFALL INTENSITY IN MINUTES
(ENTER "Tc" FROM PLATE 3 OR 5)

Basin 3

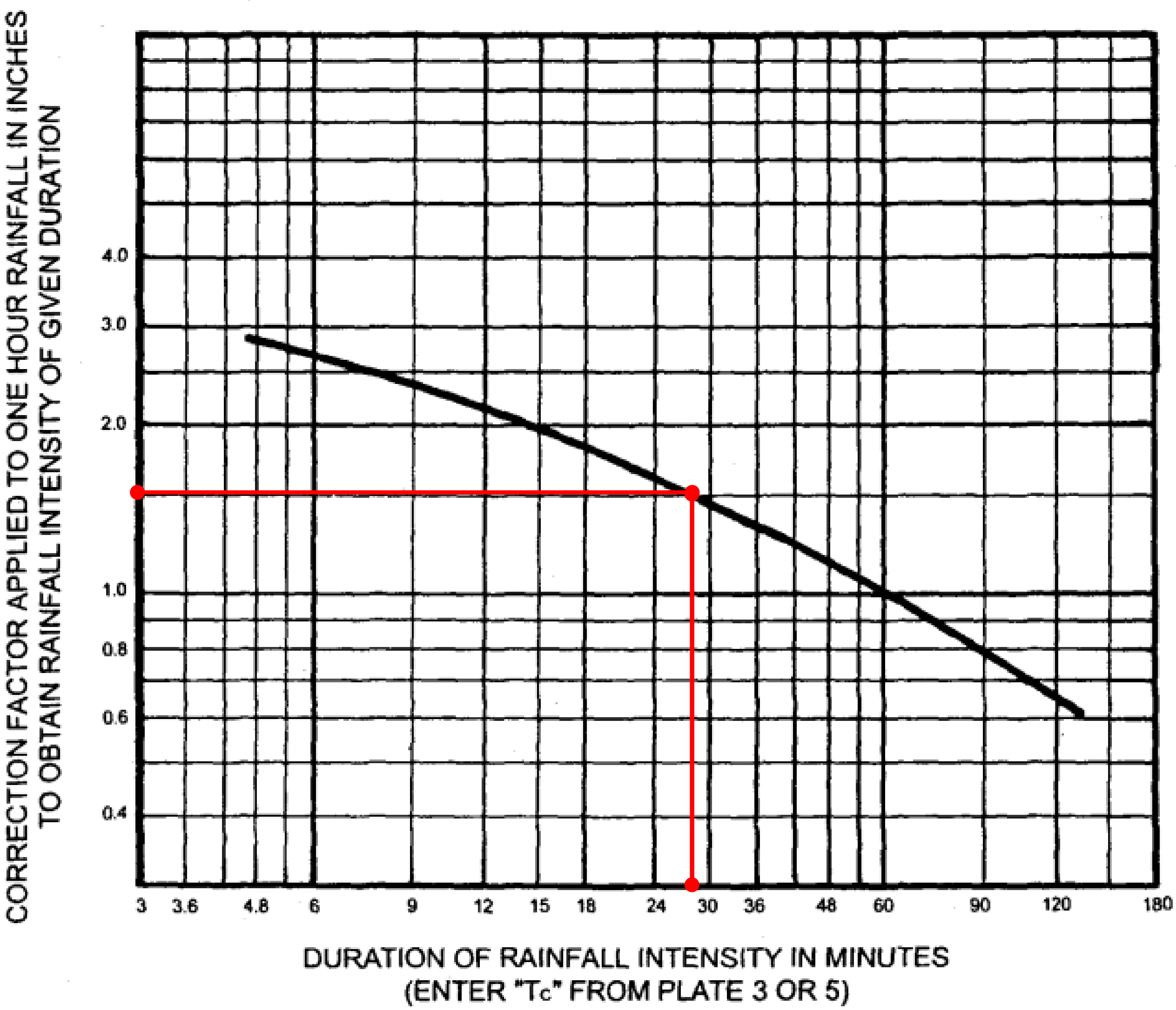


CORRECTION FACTOR APPLIED TO ONE HOUR RAINFALL IN INCHES TO OBTAIN RAINFALL INTENSITY OF GIVEN DURATION
4.0
3.0
2.0
1.0
0.8
0.6
0.4
3 3.6 4.8 6 9 12 15 18 24 30 36 48 60 90 120 180
DURATION OF RAINFALL INTENSITY IN MINUTES
(ENTER "Tc" FROM PLATE 3 OR 5)

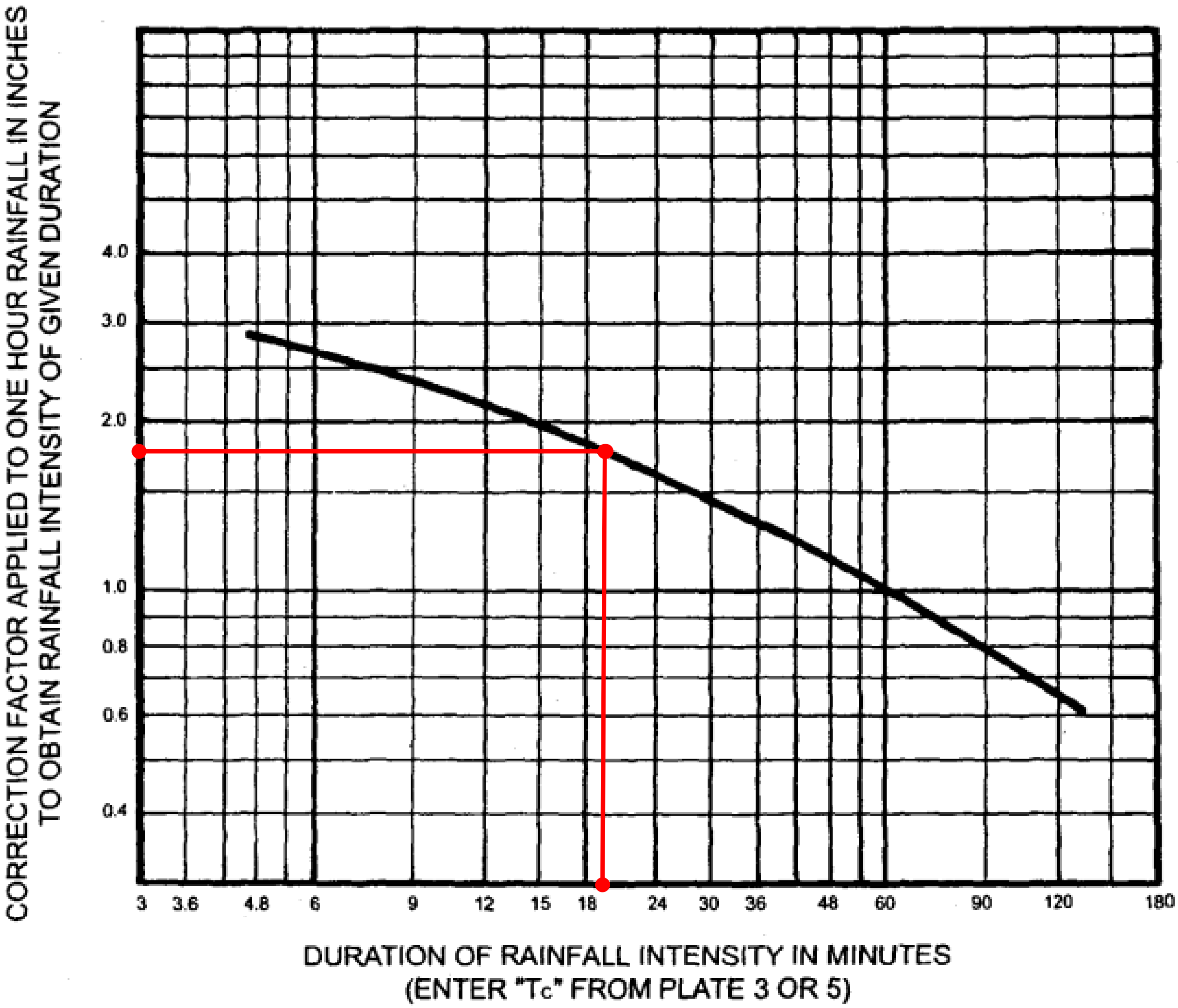
Basin 4


CORRECTION FACTOR APPLIED TO ONE HOUR RAINFALL IN INCHES TO OBTAIN RAINFALL INTENSITY OF GIVEN DURATION
4.0
3.0
2.0
1.0
0.8
0.6
0.4
3
3.6
4.8
6
9
12
15
18
24
30
36
48
60
90
120
180
DURATION OF RAINFALL INTENSITY IN MINUTES
(ENTER "Tc" FROM PLATE 3 OR 5)

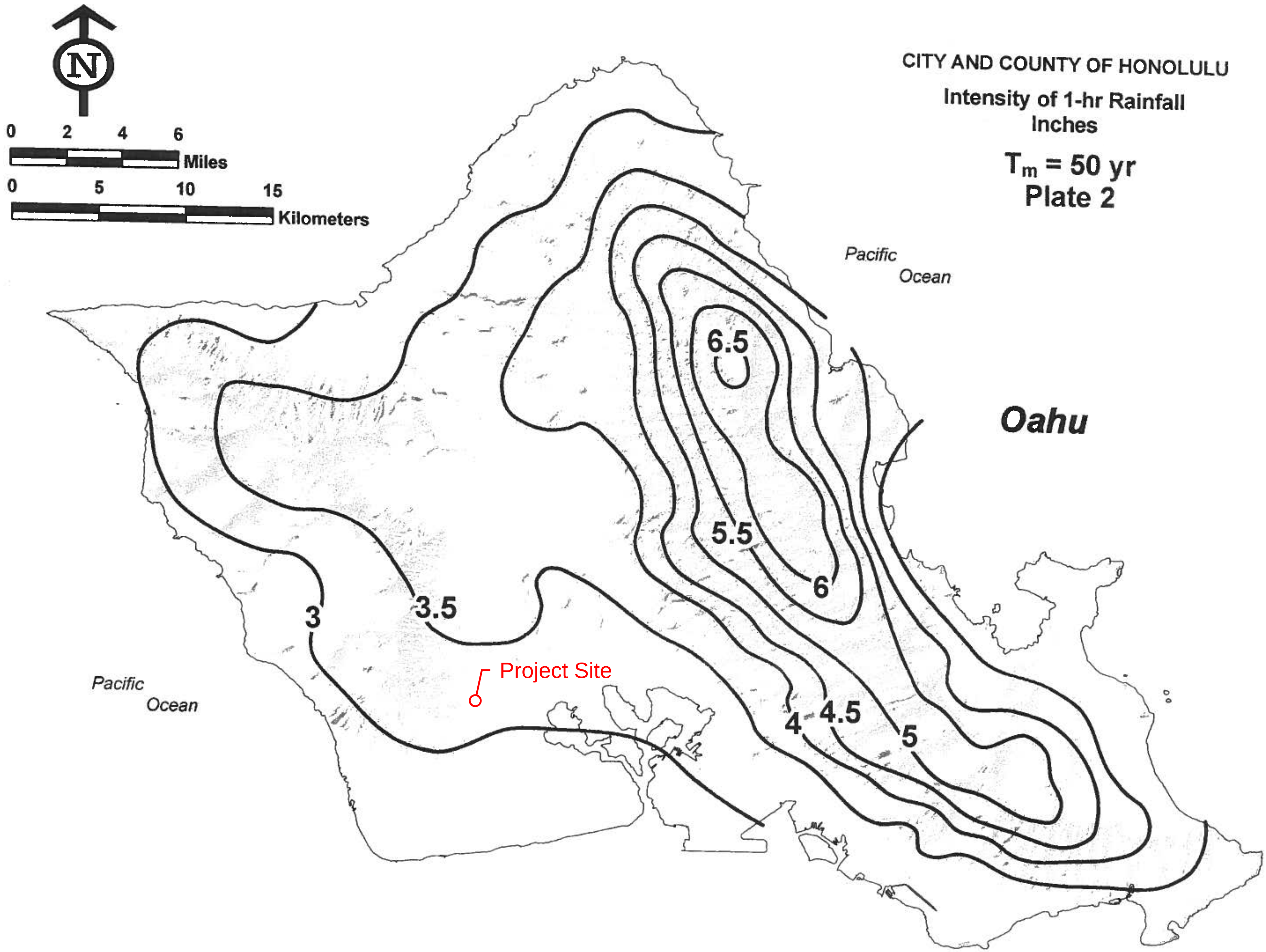
Basin 5


CORRECTION FACTOR APPLIED TO ONE HOUR RAINFALL IN INCHES TO OBTAIN RAINFALL INTENSITY OF GIVEN DURATION
4.0
3.0
2.0
1.0
0.8
0.6
0.4
3
3.6
4.8
6
9
12
15
18
24
30
36
48
60
90
120
180
DURATION OF RAINFALL INTENSITY IN MINUTES
(ENTER "Tc" FROM PLATE 3 OR 5)

Basin 6



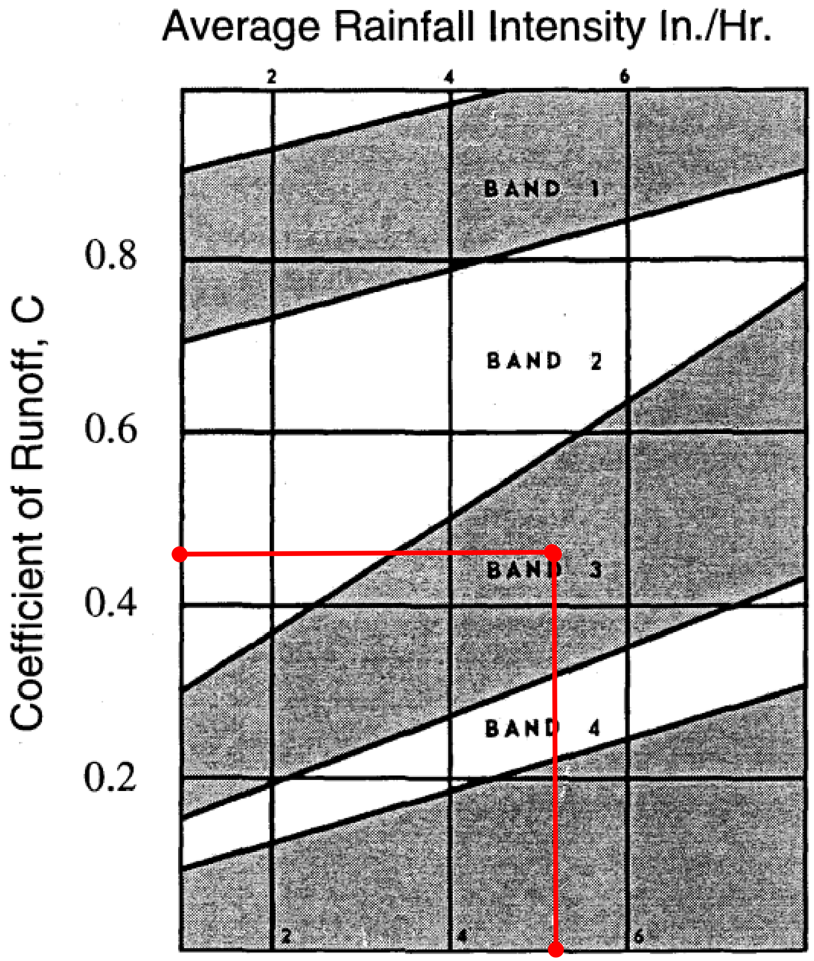
CORRECTION FACTOR APPLIED TO ONE HOUR RAINFALL IN INCHES TO OBTAIN RAINFALL INTENSITY OF GIVEN DURATION
4.0
3.0
2.0
1.0
0.8
0.6
0.4
3
3.6
4.8
6
9
12
15
18
24
30
36
48
60
90
120
180
DURATION OF RAINFALL INTENSITY IN MINUTES
(ENTER "Tc" FROM PLATE 3 OR 5)



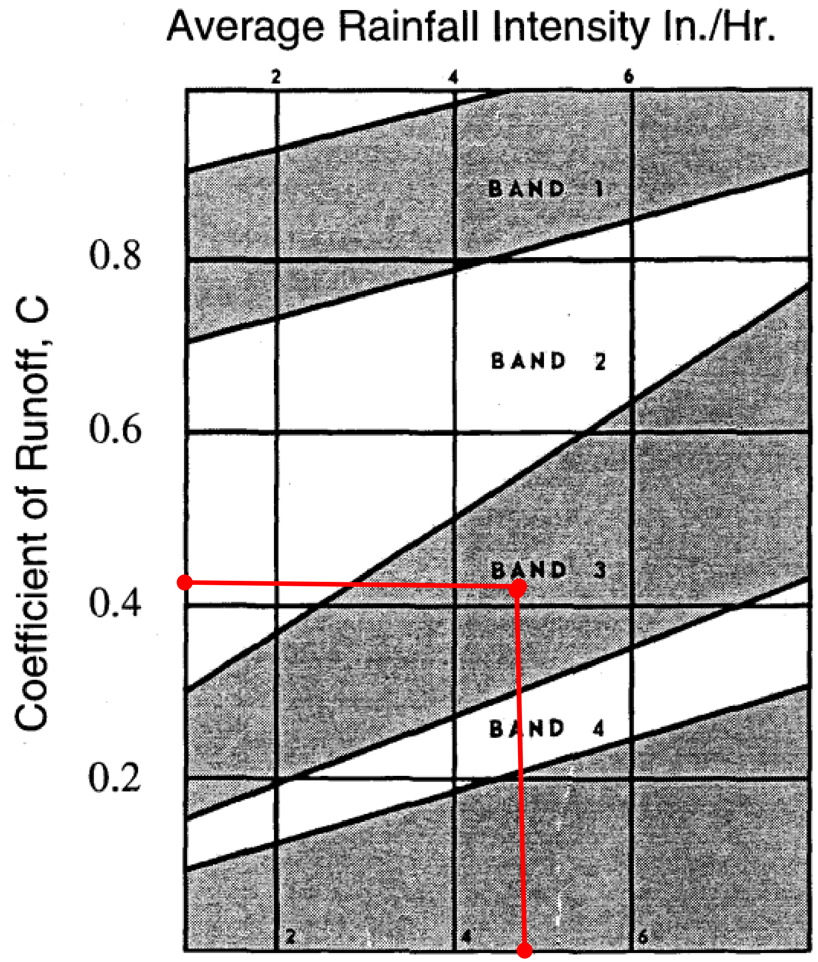
[Eff: APR 0 8 2011] (Auth: Sec 14-12.31, ROH) (Imp: Sec 14-12.31, ROH)
Source: National Oceanic and Atmospheric Administration (NOAA), National Weather Service, Silver Spring, Maryland, 2009

Runoff Coefficient (Table 1 from Storm Drainage Standards)

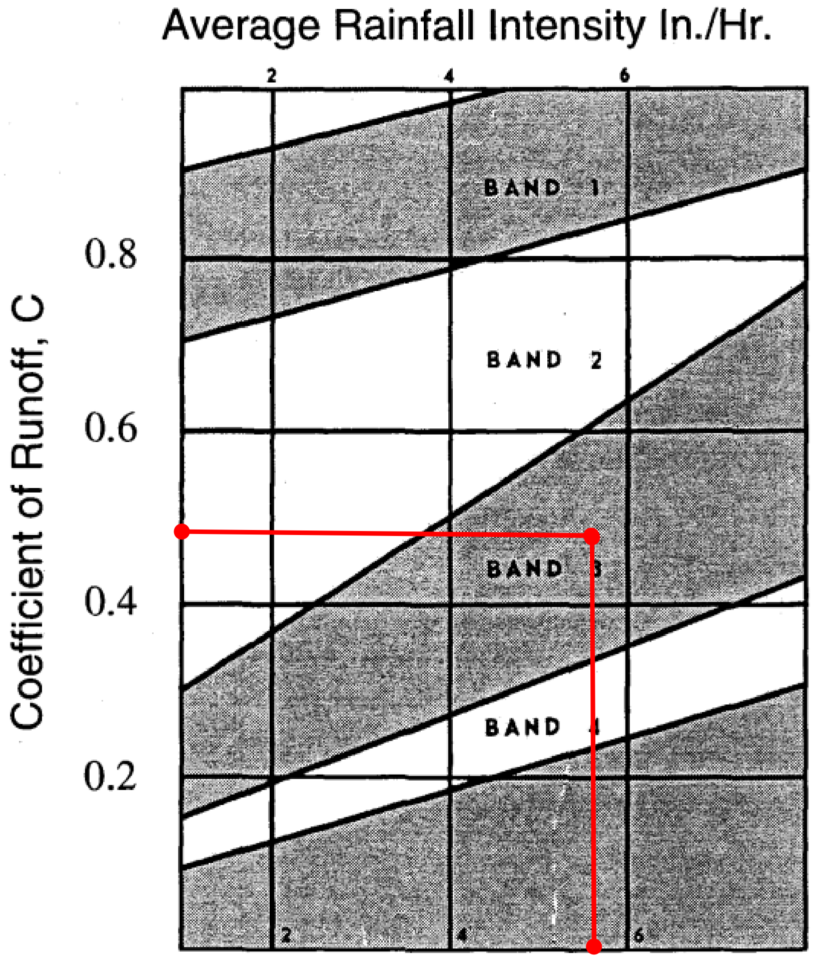
Basins 1 & 3



Basins 2, 4 & 5



Basin 6


Average Rainfall Intensity In./Hr.
2
4
6
BAND 1
BAND 2
BAND 3
BAND 4
Coefficient of Runoff, C
0.8
0.6
0.4
0.2
2
4
6

BMP Sizing Worksheet: Summary Sheet

Project: AES Solar Site - West Oahu **Date:** **1/30/2020**

Overall site

Total Project Area	4216897	sq-ft
Total Self-Mitigating Area	2663932	sq-ft
Total Self-Retaining Area		sq-ft
Total Deminimus Area		sq-ft
Total Drainage Area requiring Treatment	1552965	sq-ft
Drainage Management Area (DMA) treated with retention	1552965	sq-ft
DMA treated with harvest/reuse	0	sq-ft
DMA treated with biofiltration	0	sq-ft
DMA treated with alternative compliance	0	sq-ft

Drainage Management Area 1

Area	135507	sq-ft
Treatment BMP:	Infiltration Trench	
Worksheet No.:	1 of 6	

Drainage Management Area 2

Area	207821	sq-ft
Treatment BMP:	Infiltration Trench	
Worksheet No.:	2 of 6	

Drainage Management Area 3

Area	44510	sq-ft
Treatment BMP:	Infiltration Trench	
Worksheet No.:	3 of 6	

Drainage Management Area 4

Area	123787	sq-ft
Treatment BMP:	Infiltration Trench	
Worksheet No.:	4 of 6	

Drainage Management Area 5

Area	1016446	sq-ft
Treatment BMP:	Infiltration Trench	
Worksheet No.:	5 of 6	

Drainage Management Area 6

Area	24894	sq-ft
Treatment BMP:	Infiltration Trench	
Worksheet No.:	6 of 6	

BMP Sizing Worksheet: Infiltration Trench

Worksheet No. 1 of 6

Project: AES Solar Site - West Oahu **Date:** 1/30/2020

1. Water Quality Volume		
a. BMP Tributary Drainage Area, **A**	3.1	ac
b. % Impervious Area, **I**	8.6	%
c. Water Quality Design Storm Depth, **P**	1.0	in
d. Volumetric Runoff Coefficient, **C**	0.1274	
e. Water Quality Volume, **WQV**	1,439	cu-ft
2. Maximum Storage Depth		
a. Soil Infiltration Rate, **k** (0.5 min)	11.7	in/hr
b. Infiltration Rate Safety Factor, **Fs** (2 min)	2	
c. Drawdown Time, **t**	48	hrs
d. Max. Storage Depth, d_{max}	23.4	ft
3. Design Storage Depths		
a. Ponding Depth, d_p	0.00	ft
b. Backfill Material (Trench Rock) Thickness, l_b	3.00	ft
c. Sand Layer Thickness, l_s	0.0	ft
d. Backfill Material Porosity, n_b	0.35	
e. Sand Porosity, n_s	0.40	
f. Total Effective Storage Depth, d_t	1.05	ft
4. BMP Area Requirements		
a. Reservoir Fill Time, **T**	2	hrs
b. Min. Surface Area excluding pretreatment, A_{BMP}	710	sq-ft

BMP Sizing Worksheet: Infiltration Trench

Worksheet No. 2 of 6

Project: AES Solar Site - West Oahu **Date:** 1/30/2020

1. Water Quality Volume		
a. BMP Tributary Drainage Area, **A**	4.8	ac
b. % Impervious Area, **I**	8	%
c. Water Quality Design Storm Depth, **P**	1.0	in
d. Volumetric Runoff Coefficient, **C**	0.122	
e. Water Quality Volume, **WQV**	2,113	cu-ft
2. Maximum Storage Depth		
a. Soil Infiltration Rate, **k** (0.5 min)	11.7	in/hr
b. Infiltration Rate Safety Factor, **Fs** (2 min)	2	
c. Drawdown Time, **t**	48	hrs
d. Max. Storage Depth, $\mathbf{d_{max}}$	23.4	ft
3. Design Storage Depths		
a. Ponding Depth, $\mathbf{d_p}$	0.00	ft
b. Backfill Material (Trench Rock) Thickness, $\mathbf{l_b}$	3.00	ft
c. Sand Layer Thickness, $\mathbf{l_s}$	0.0	ft
d. Backfill Material Porosity, $\mathbf{n_b}$	0.35	
e. Sand Porosity, $\mathbf{n_s}$	0.40	
f. Total Effective Storage Depth, $\mathbf{d_t}$	1.05	ft
4. BMP Area Requirements		
a. Reservoir Fill Time, **T**	2	hrs
b. Min. Surface Area excluding pretreatment, $\mathbf{A_{BMP}}$	1,043	sq-ft

BMP Sizing Worksheet: Infiltration Trench

Worksheet No. 3 of 6

Project: AES Solar Site - West Oahu **Date:** 1/30/2020

1. Water Quality Volume		
a. BMP Tributary Drainage Area, **A**	1.0	ac
b. % Impervious Area, **I**	19.3	%
c. Water Quality Design Storm Depth, **P**	1.0	in
d. Volumetric Runoff Coefficient, **C**	0.2237	
e. Water Quality Volume, **WQV**	830	cu-ft
2. Maximum Storage Depth		
a. Soil Infiltration Rate, **k** (0.5 min)	11.7	in/hr
b. Infiltration Rate Safety Factor, **Fs** (2 min)	2	
c. Drawdown Time, **t**	48	hrs
d. Max. Storage Depth, d_{max}	23.4	ft
3. Design Storage Depths		
a. Ponding Depth, d_p	0.00	ft
b. Backfill Material (Trench Rock) Thickness, l_b	3.00	ft
c. Sand Layer Thickness, l_s	0.0	ft
d. Backfill Material Porosity, n_b	0.35	
e. Sand Porosity, n_s	0.40	
f. Total Effective Storage Depth, d_t	1.05	ft
4. BMP Area Requirements		
a. Reservoir Fill Time, **T**	2	hrs
b. Min. Surface Area excluding pretreatment, A_{BMP}	410	sq-ft

BMP Sizing Worksheet: Infiltration Trench

Worksheet No. 4 of 6

Project: AES Solar Site - West Oahu **Date:** 1/30/2020

1. Water Quality Volume		
a. BMP Tributary Drainage Area, **A**	2.8	ac
b. % Impervious Area, **I**	8.4	%
c. Water Quality Design Storm Depth, **P**	1.0	in
d. Volumetric Runoff Coefficient, **C**	0.1256	
e. Water Quality Volume, **WQV**	1,296	cu-ft
2. Maximum Storage Depth		
a. Soil Infiltration Rate, **k** (0.5 min)	11.7	in/hr
b. Infiltration Rate Safety Factor, **Fs** (2 min)	2	
c. Drawdown Time, **t**	48	hrs
d. Max. Storage Depth, d_{max}	23.4	ft
3. Design Storage Depths		
a. Ponding Depth, d_p	0.00	ft
b. Backfill Material (Trench Rock) Thickness, l_b	3.00	ft
c. Sand Layer Thickness, l_s	0.0	ft
d. Backfill Material Porosity, n_b	0.35	
e. Sand Porosity, n_s	0.40	
f. Total Effective Storage Depth, d_t	1.05	ft
4. BMP Area Requirements		
a. Reservoir Fill Time, **T**	2	hrs
b. Min. Surface Area excluding pretreatment, A_{BMP}	640	sq-ft

BMP Sizing Worksheet: Infiltration Trench

Worksheet No. 5 of 6

Project: AES Solar Site - West Oahu **Date:** 1/30/2020

1. Water Quality Volume		
a. BMP Tributary Drainage Area, **A**	23.3	ac
b. % Impervious Area, **I**	2.9	%
c. Water Quality Design Storm Depth, **P**	1.0	in
d. Volumetric Runoff Coefficient, **C**	0.0761	
e. Water Quality Volume, **WQV**	6,446	cu-ft
2. Maximum Storage Depth		
a. Soil Infiltration Rate, **k** (0.5 min)	11.7	in/hr
b. Infiltration Rate Safety Factor, **Fs** (2 min)	2	
c. Drawdown Time, **t**	48	hrs
d. Max. Storage Depth, $\mathbf{d_{max}}$	23.4	ft
3. Design Storage Depths		
a. Ponding Depth, $\mathbf{d_p}$	0.00	ft
b. Backfill Material (Trench Rock) Thickness, $\mathbf{l_b}$	3.00	ft
c. Sand Layer Thickness, $\mathbf{l_s}$	0.0	ft
d. Backfill Material Porosity, $\mathbf{n_b}$	0.35	
e. Sand Porosity, $\mathbf{n_s}$	0.40	
f. Total Effective Storage Depth, $\mathbf{d_t}$	1.05	ft
4. BMP Area Requirements		
a. Reservoir Fill Time, **T**	2	hrs
b. Min. Surface Area excluding pretreatment, $\mathbf{A_{BMP}}$	3,183	sq-ft

BMP Sizing Worksheet: Infiltration Trench

Worksheet No. 6 of 6

Project: AES Solar Site - West Oahu **Date:** 1/30/2020

1. Water Quality Volume		
a. BMP Tributary Drainage Area, **A**	0.6	ac
b. % Impervious Area, **I**	28.3	%
c. Water Quality Design Storm Depth, **P**	1.0	in
d. Volumetric Runoff Coefficient, **C**	0.3047	
e. Water Quality Volume, **WQV**	632	cu-ft
2. Maximum Storage Depth		
a. Soil Infiltration Rate, **k** (0.5 min)	11.7	in/hr
b. Infiltration Rate Safety Factor, **Fs** (2 min)	2	
c. Drawdown Time, **t**	48	hrs
d. Max. Storage Depth, d_{max}	23.4	ft
3. Design Storage Depths		
a. Ponding Depth, d_p	0.00	ft
b. Backfill Material (Trench Rock) Thickness, l_b	3.00	ft
c. Sand Layer Thickness, l_s	0.0	ft
d. Backfill Material Porosity, n_b	0.35	
e. Sand Porosity, n_s	0.40	
f. Total Effective Storage Depth, d_t	1.05	ft
4. BMP Area Requirements		
a. Reservoir Fill Time, **T**	2	hrs
b. Min. Surface Area excluding pretreatment, A_{BMP}	312	sq-ft

Attachment O
U.S. Fish and Wildlife Service and State of Hawaiʻi Department of Land and Natural Resources Division of Forestry and Wildlife Consultation Letters

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawai'i 96850

In Reply Refer To:
01EPIF00-2019-TA-460

September 3, 2019

Mr. Nick Molinari
AES Distributed Energy
282 Century Place
Louisville, Colorado 80027

Subject: Response to your Request for Technical Assistance Regarding the Proposed West O'ahu Solar Plus Storage Project

Dear Mr. Molinari,

Thank you for your recent correspondence requesting technical assistance on species biology, habitat, or life requisite requirements. The Pacific Islands Fish and Wildlife Office (PIFWO) of the U.S. Fish and Wildlife Service (Service) appreciates your efforts to avoid or minimize effects to protected species associated with your proposed actions. We provide the following information for your consideration under the authorities of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 *et seq*.), as amended.

Due to significant workload constraints, PIFWO is currently unable to specifically address your information request. The table below lists the protected species most likely to be encountered by projects implemented within the Hawaiian Islands. Based on your project location and description, we have noted the species most likely to occur within the vicinity of the project area, in the '**Occurs In or Near Project Area'** column. Please note this list is not comprehensive and should only be used for general guidance. We have added to the PIFWO website, located at https://www.fws.gov/pacificislands/promo.cfm?id=177175840 recommended conservation measures intended to avoid or minimize adverse effects to these federally protected species and best management practices to minimize and avoid sedimentation and erosion impacts to water quality.

If you are representing a federal action agency, please use the official species list on our web-site for your section 7 consultation. You can find out if your project occurs in or near designated critical habitat here: https://ecos.fws.gov/ipac/.

Under section 7 of the ESA, it is the Federal agency's (or their non-Federal designee) responsibility to make the determination of whether or not the proposed project "may affect" federally listed species or designated critical habitat. A "may affect, not likely to adversely affect" determination is appropriate when effects to federally listed species are expected to be discountable (*i.e.*, unlikely to occur), insignificant (minimal in size), or completely beneficial.

This conclusion requires written concurrence from the Service. If a "may affect, likely to adversely affect" determination is made, then the Federal agency must initiate formal consultation with the Service. Projects that are determined to have "no effect" on federally listed species and/or critical habitat do not require additional coordination or consultation.

Implementing the avoidance, minimization, or conservation measures for the species that may occur in your project area will normally enable you to make a "may affect, not likely to adversely affect" determination for your project. If it is determined that the proposed project may affect federally listed species, we recommend you contact our office early in the planning process so that we may assist you with the ESA compliance. If the proposed project is funded, authorized, or permitted by a Federal agency, then that agency should consult with us pursuant to section 7(a)(2) of the ESA. If no Federal agency is involved with the proposed project, the applicant should apply for an incidental take permit under section 10(a)(1)(B) of the ESA. A section 10 permit application must include a habitat conservation plan that identifies the effects of the action on listed species and their habitats, and defines measures to minimize and mitigate those adverse effects.

We appreciate your efforts to conserve endangered species. We regret that we cannot provide you with more specific protected species information for your project site. If you have questions that are not answered by the information on our website, you can contact PIFWO at (808) 792-9400 and ask to speak to the lead biologist for the island where your project is located.

Sincerely,

Island Team Manager
Pacific Islands Fish and Wildlife Office

cc: Ms. Lisa Kettley and Ms. Tiffany Agostini, Tetra Tech, Inc.

The table below lists the protected species most likely to be encountered by projects implemented within the Hawaiian Islands. For your guidance, we’ve marked species that may occur in the vicinity of your project, this list is not comprehensive and should only be used for general guidance.

Scientific Name	**Common Name / Hawaiian Name**	**Federal Status**	**May Occur In Project Area**
Mammals			
Lasiurus cinereus semotus	Hawaiian hoary bat/ ‘ōpe‘ape‘a	E	☒
Reptiles			
Chelonia mydas	Green sea turtle/honu - Central North Pacific DPS	T	☐
Erectmochelys imbricata	Hawksbill sea turtle/ Honu ‘ea	E	☐
Birds			
Anas wyvilliana	Hawaiian duck/ koloa	E	☐
Branta sandvicensis	Hawaiian goose/ nēnē	E	☐
Fulica alai	Hawaiian coot/ ‘alae kea	E	☐
Gallinula galeata sandvicensis	Hawaiian gallinule/ ‘alae ‘ula	E	☐
*Himantopus mexicanu*s *knudseni*	Hawaiian stilt/ Ae‘o	E	☐
Oceanodroma castro	Band-rumped storm-petrel/ ‘akē‘akē	E	☒
Pterodroma sandwichensis	Hawaiian petrel/ ‘ua‘u	E	☒
Puffinus auricularis newelli	Newell’s shearwater/ ‘a‘o	T	☒
Ardenna pacificus	Wedge-tailed Shearwater/ ‘ua‘u kani	MBTA	☐
Gygis alba	White Tern/ manu-o-kū	MBTA	☐
Buteo solitarius	Hawaiian hawk/ ‘io	E	☐
Insects			
Manduca blackburni	Blackburn’s sphinx moth	E	☐
Megalagrion pacificum	Pacific Hawaiian Damselfly	E	☐
M. xanthomelas	Orangeblack Hawaiian Damselfly	E	☐
M. nigrohamatum nigrolineatum	Blackline Hawaiian Damselfly	E	☐

Plants				
Scientific Name	**Common Name or Hawaiian Name**	**Federal Status**	**Locations**	**May Occur In Project Area**
Abutilon menziesii	Koʻoloaʻula	E	O, L, M, H	☐
Achyranthes splendens var. *rotundata*	ʻEwa hinahina	E	O	☐
Bonamia menziesii	No common name	E	K, O, L, M, H	☐
Canavalia pubescens	ʻĀwikiwiki	E	Ni, K, L, M	☐
Colubrina oppositifolia	Kauila	E	O, M, H	☐
Cyperus trachysanthos	Puʻukaʻa	E	K, O	☐
Gouania hillebrandii	No common name	E	Mo, M	☐
Hibiscus brackenridgei	Maʻo hau hele	E	O, Mo, L, M, H	☐
Ischaemum byrone	Hilo ischaemum	E	K, O, Mo, M, H	☐
Isodendrion pyrifolium	Wahine noho kula	E	O, H	☐
Marsilea villosa	ʻIhiʻihi	E	Ni, O, Mo	☐
Mezoneuron kavaiense	Uhiuhi	E	O, H	☐
Nothocestrum breviflorum	ʻAiea	E	H	☐
Panicum fauriei var. *carteri*	Carter's panicgrass	E	Molokini Islet (O), Mo	☐
Panicum niihauense	Lauʻehu	E	K	☐
Peucedanum sandwicense	Makou	E	K, O, Mo, M	☐
Pleomele (Chrysodracon) hawaiiensis	Halapepe	E	H	☐
Portulaca sclerocarpa	ʻIhi	E	L, H	☐
Portulaca villosa	ʻIhi	E	Le, Ka, Ni, O, Mo, M, L, H, Nihoa	☐
Pritchardia affinis (maideniana)	Loulu	E	H	☐
Pseudognaphalium sandwicensium var. *molokaiense*	ʻEnaʻena	E	Mo, M	☐
Scaevola coriacea	Dwarf naupaka	E	Mo, M	☐
Schenkia (*Centaurium*) *sebaeoides*	ʻĀwiwi	E	K, O, Mo, L, M	☐
Sesbania tomentosa	ʻŌhai	E	Ni, Ka, K, O, Mo, M, L, H, Necker, Nihoa	☐
Tetramolopium rockii	No common name	T	Mo	☐
Vigna o-wahuensis	No common name	E	Mo, M, L, H, Ka	☐

Location key: O=Oʻahu, K=Kauaʻi, M=Maui, H=Hawaiʻi Island, L=Lānaʻi, Mo=Molokaʻi, Ka=Kahoʻolawe, Ni=Niʻihau, Le=Lehua

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FORESTRY AND WILDLIFE
1151 PUNCHBOWL STREET, ROOM 325
HONOLULU, HAWAII 96813

JUN 28 2019

Mr. Nick Molinari
AES Distributed Energy, Inc.
4875 Pearl East Circle, Suite 200
Boulder, CO 80301

Log No. 19803

Dear Mr. Molinari:

The Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW) has received your inquiry regarding Hawaii Revised Statutes Chapter 195D consultation for the proposed AES West O'ahu Solar Plus Storage Project near Kapolei in the 'Ewa District on the island of O'ahu, Hawai'i, TMK: (1) 9-2-002:007. Proposed work would include construction and operation of a 12.5 megawatt solar photovoltaic system on an approximately 80 acre parcel of land commonly known as the University of Hawai'i West O'ahu Mauka property.

We appreciate the inclusion of mitigation measures in the submitted Biological Report intended to avoid construction and operational impacts to State listed species. DOFAW provides the following additional comments on the potential of the proposed work to affect listed species in the vicinity of the project area in support of your request for information.

The State endangered Hawaiian Short-eared Owl or Pueo (*Asio flammeus sandwichensis*) is known to occur in the project site vicinity. Pueo are a crepuscular species, most active during dawn and dusk twilights. DOFAW recommends twilight pre-construction surveys by a qualified biologist prior to clearing vegetation. If Pueo nests are present, a buffer zone should be established in which no clearing occurs until nesting ceases, and DOFAW staff should be notified.

We note that artificial lighting can adversely impact seabirds that may pass through the area at night by causing disorientation. This disorientation can result in collision with manmade artifacts or grounding of birds. For nighttime lighting that might be required, DOFAW recommends that all lights be fully shielded and directed to avoid reflecting off the panels to minimize impacts. Solar panels may also reflect moonlight during moonlit nights that may attract and disorient seabirds; monitoring during moon phases should be considered to assess if impacts are occurring. Nighttime work that requires outdoor lighting should be avoided during the seabird fledging season from September 15 through December 15. This is the period when young seabirds take their maiden voyage to the open sea.

Studies have shown that solar power facilities on the mainland have been linked with avian mortality of a variety of bird species including waterbirds and raptors. As aforementioned, the project area is on open habitat where the Pueo may transit or reside near. In addition to pre-construction surveys, you should consider implementing avian mortality avoidance measures during design and conducting surveys and monitoring during operation to assess the impacts of the project on listed species.

We appreciate your efforts to work with our office for the conservation of our native species. Should the scope of the project change significantly, or should it become apparent that threatened or endangered species may be impacted, please contact our staff as soon as possible. If you have any questions, please contact Jim Cogswell, Wildlife Program Manager at (808) 587-4187 or James.M.Cogswell@hawaii.gov.

Sincerely,

DAVID G. SMITH
Administrator

In Reply Refer To:
01EPIF00-2020-TA-0249

April 22, 2020

Mr. Raymond Young
City & County of Honolulu Dept. of Planning and Permitting
650 South King Street, 7th Floor,
Honolulu, Hawaiʻi 96813

Subject: Technical Assistance for the Proposed West Oʻahu Solar Plus Storage Project Honouliuli, Oʻahu

Dear Mr. Young:

The U.S. Fish and Wildlife Service (Service) received your correspondence on April 8, 2020, requesting our comments for the proposed West Oʻahu Solar Plus Storage Project in Honouliuli, on the island of Oʻahu. The work involves the construction and operation of a 12.5-megawatt (MW) solar photovoltaic and 50-MW-hour (MWh) battery energy storage system facility on approximately 97 acres of land located in Honouliuli, about 3 miles northeast of Kapolei, within Tax Map Key (TMK): (1) 9-2-002:007. The solar energy system will contribute towards Hawaiʻi's goal of generating 100% of the state's energy from renewable resources. The power generated by the project would be sold to Hawaiian Electric under a 25-year power purchase agreement. At the end of the Project's operational life, the facilities would be decommissioned and the project area would be returned to substantially the same condition as existed prior to project development.

Our response is in accordance with section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 et seq.). We have reviewed the information you provided and pertinent information in our files, as it pertains to federally listed species and designated critical habitat. Our data indicate the following federally listed species may occur or transit through the vicinity of the proposed project area: the federally endangered Hawaiian hoary bat *(Lasiurus cinereus semotus)*; Hawaiian stilt (*Himantopus mexicanus knudseni*), Hawaiian gallinule (*Gallinula galeata sandvicensis*), Hawaiian coot (*Fulica alai*), and endangered Hawaiian duck (*Anas wyvilliana*) (hereafter collectively referred to as Hawaiian waterbirds); Hawaiian petrel (*Pterodroma sandwichensis*), the Hawaii Distinct Population Segment (DPS) of band-rumped storm petrel (*Oceanodroma castro*), and the federally threatened Newell's shearwater (*Puffinus auricularis newelli*) (hereafter collectively referred to as Hawaiian seabirds) have the potential to be in or fly through the vicinity of the project area. There is no designated critical habitat within the project's action area. The Service offers you the below species-specific avoidance and minimization measures that may be applicable to assist with planning of your proposed project.

Hawaiian hoary bat
The Hawaiian hoary bat roosts in both exotic and native woody vegetation across all islands and will leave young unattended in trees and shrubs when they forage. If trees or shrubs 15 feet (ft.) or taller are cleared during the pupping season, there is a risk that young bats could inadvertently be harmed or killed since they are too young to fly or may not move away. Additionally, Hawaiian hoary bats forage for insects from as low as three feet to higher than 500 ft. above the ground and can become entangled in barbed wire used for fencing.

To avoid and minimize impacts to the endangered Hawaiian hoary bat we recommend incorporating the following applicable measures into your project description:

- Do not disturb, remove, or trim woody plants greater than 15 ft. tall during the bat birthing and pup-rearing season (June 1 through September 15).
- Do not use barbed wire for fencing.

Hawaiian Waterbirds
Listed Hawaiian waterbirds are found in fresh and brackish-water marshes and natural or man-made ponds. Hawaiian stilts may also be found wherever ephemeral or persistent standing water may occur.

To avoid and minimize potential project impacts to the Hawaiian waterbirds we recommend you incorporate the following applicable measures into your project description.

- In areas where waterbirds are known to be present, post and implement reduced speed limits, and inform project personnel and contractors about the presence of endangered species on-site.
- If water resources are located within or adjacent to the project site, incorporate applicable best management practices regarding work in aquatic environments into the project design (see enclosure).
- Have a biological monitor that is familiar with the species' biology conduct nest surveys where appropriate habitat occurs within the vicinity of the proposed project site prior to project initiation. Repeat surveys again within three days of project initiation and after any subsequent delay of work of three or more days (during which the birds may attempt to nest). If a nest or active brood is found:
    - Contact the Service within 48 hours for further guidance.
    - Establish and maintain a 100-foot buffer around all active nests and/or broods until the chicks/ducklings have fledged. Do not conduct potentially disruptive activities or habitat alteration within this buffer.
    - Have a biological monitor that is familiar with the species' biology present on the project site during all construction or earth moving activities until the

chicks/ducklings fledge to ensure that Hawaiian waterbirds and nests are not adversely impacted.

Hawaiian Seabirds

Hawaiian seabirds may traverse the project area at night during the breeding, nesting and fledging seasons (March 1 to December 15). Outdoor lighting could result in seabird disorientation, fallout, and injury or mortality. Seabirds are attracted to lights and after circling the lights they may become exhausted and collide with nearby wires, buildings, or other structures or they may land on the ground. Downed seabirds are subject to increased mortality due to collision with automobiles, starvation, and predation by dogs, cats, and other predators. Young birds (fledglings) traversing the project area between September 15 and December 15, in their first flights from their mountain nests to the sea, are particularly vulnerable.

To avoid and minimize potential project impacts to Hawaiian seabirds we recommend you incorporate the following applicable measures into your project description:

- Fully shield all outdoor lights so the bulb can only be seen from below bulb height and only use when necessary.
- Install automatic motion sensor switches and controls on all outdoor lights or turn off lights when human activity is not occurring in the lighted area.
- Avoid nighttime construction during the seabird fledging period, September 15 through December 15.

Implementing the avoidance, minimization, or conservation measures for the species that may occur in your project area will normally enable you to make a "may affect, not likely to adversely affect" determination for your project. If it is determined that the proposed project may affect federally listed species, we recommend you contact our office early in the planning process so that we may assist you with the ESA compliance. If the proposed project is funded, authorized, or permitted by a Federal agency, then that agency should consult with us pursuant to section 7(a)(2) of the ESA. If no Federal agency is involved with the proposed project, the applicant should apply for an incidental take permit under section 10(a)(1)(B) of the ESA. A section 10 permit application must include a habitat conservation plan that identifies the effects of the action on listed species and their habitats, and defines measures to minimize and mitigate those adverse effects.

Thank you for participating with us in the protection of our endangered species. If you have any further questions or concerns regarding this consultation, please contact Becca Frager, Endangered Species Biologist, 808-792-9462, e-mail: rebecca_frager@fws.gov. When referring to this project, please include this reference number: 01EPIF00-2020-TA-0249.

Sincerely,

Island Team Manager
Oahu, Kauai, Northwestern Hawaiian
Islands, and American Samoa

Attachment P
Glare Study and FAA Determination of No Hazard to Air Navigation

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
10101 Hillwood Parkway
Fort Worth, TX 76177

Aeronautical Study No.
2020-AWP-5926-OE

Issued Date: 06/09/2020

Nick Molinari
AES Distributed Energy
4875 Pearl East Circle
#200
Boulder, CO 80301

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Solar Panel Oahu N
Location:	O'ahu, HI
Latitude:	21-22-41.87N NAD 83
Longitude:	158-03-43.75W
Heights:	419 feet site elevation (SE)
	11 feet above ground level (AGL)
	430 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/ lighting are accomplished on a voluntary basis, we recommend it be installed in accordance with FAA Advisory circular 70/7460-1 L Change 2.

This determination expires on 12/09/2021 unless:

(a) the construction is started (not necessarily completed) and FAA Form 7460-2, Notice of Actual Construction or Alteration, is received by this office.
(b) extended, revised, or terminated by the issuing office.
(c) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO

SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power, except those frequencies specified in the Colo Void Clause Coalition; Antenna System Co-Location; Voluntary Best Practices, effective 21 Nov 2007, will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.This determination includes all previously filed frequencies and power for this structure.

If construction or alteration is dismantled or destroyed, you must submit notice to the FAA within 5 days after the construction or alteration is dismantled or destroyed.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

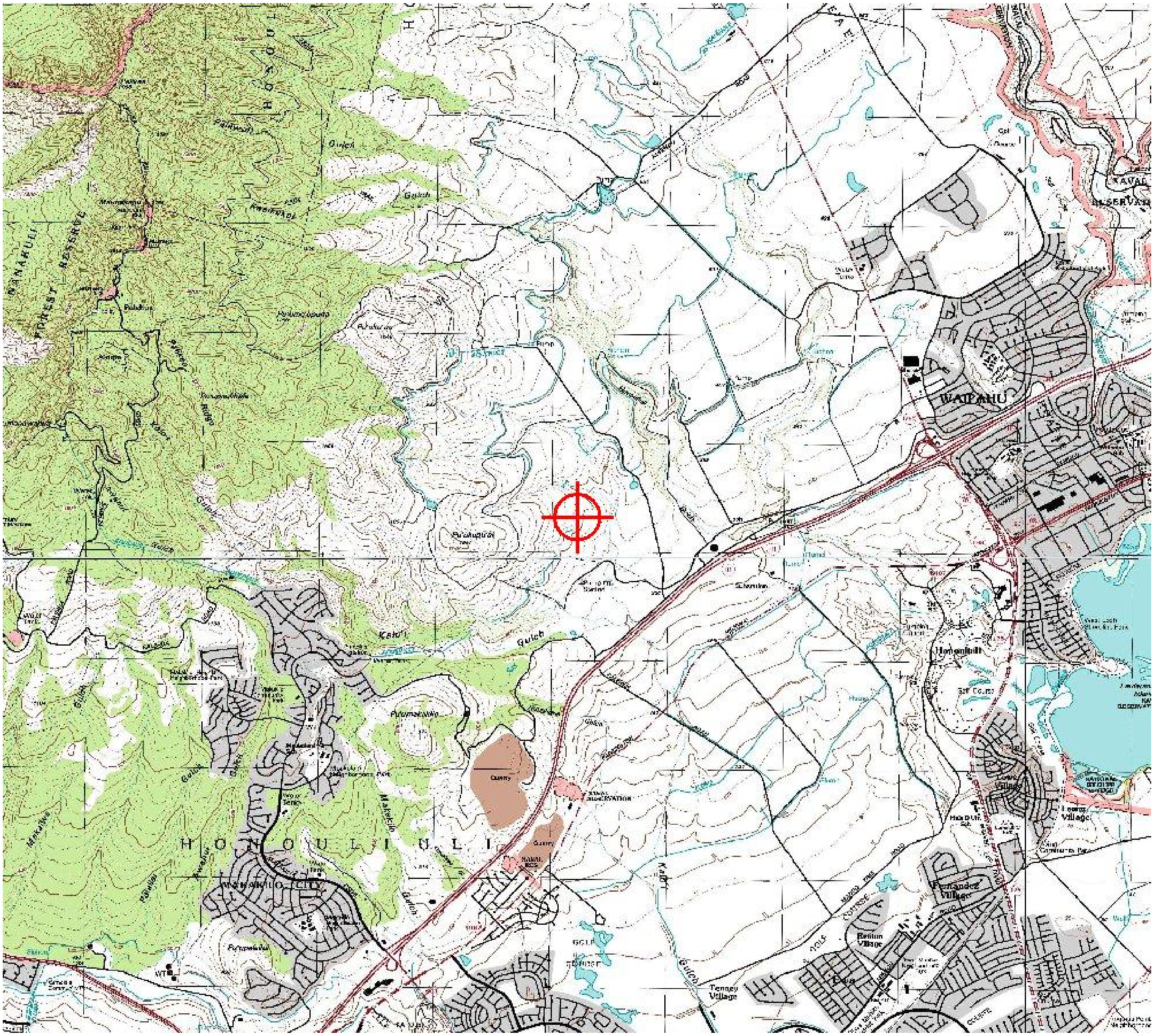
If we can be of further assistance, please contact our office at (907) 271-5863, or robert.van.haastert@faa.gov. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2020-AWP-5926-OE.

Signature Control No: 440873441-442419363 (DNE)

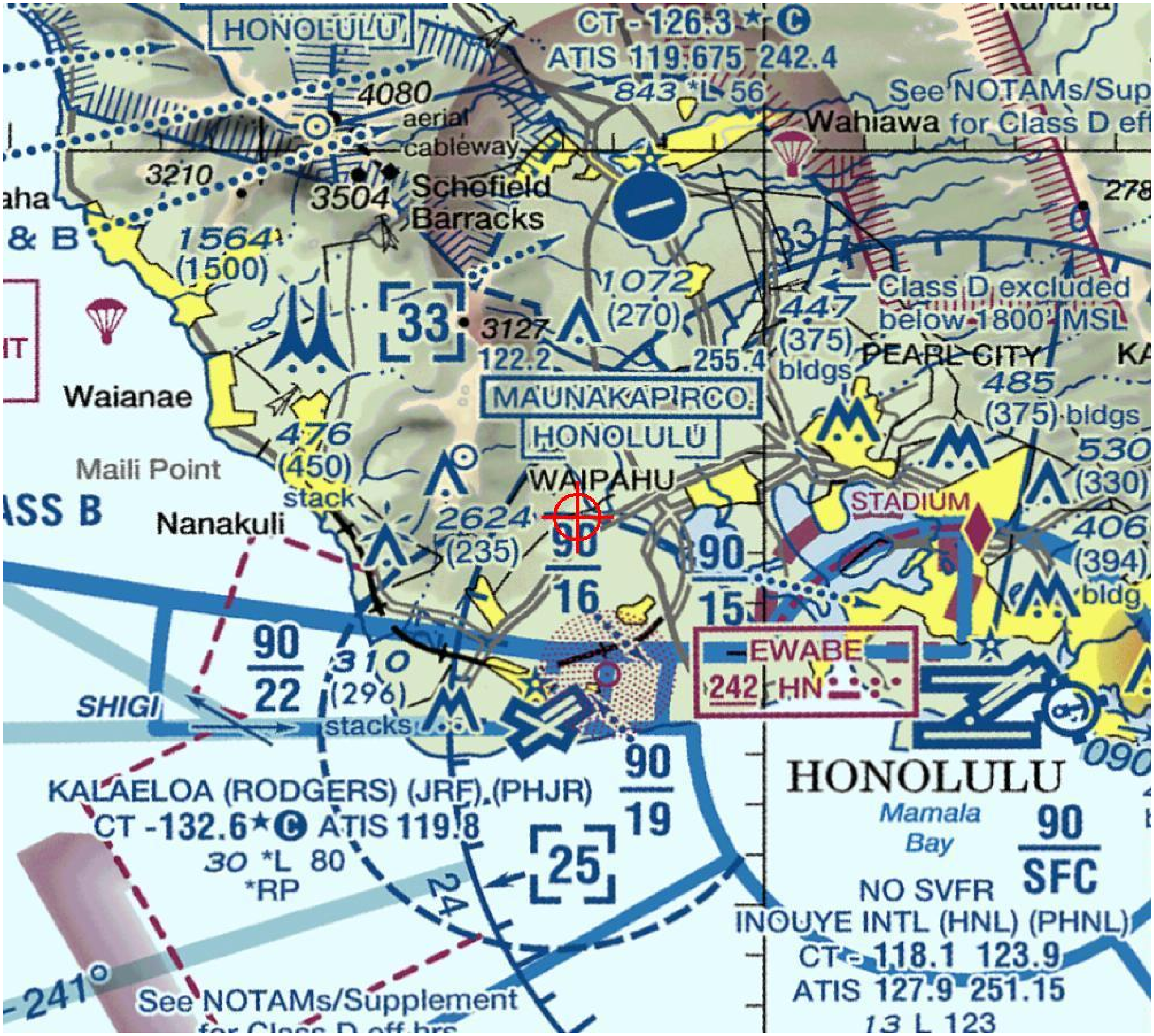
Robert van Haastert
Supervisor

Attachment(s)
Map(s)

TOPO Map for ASN 2020-AWP-5926-OE



Sectional Map for ASN 2020-AWP-5926-OE



Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
10101 Hillwood Parkway
Fort Worth, TX 76177

Aeronautical Study No.
2020-AWP-5927-OE

Issued Date: 06/09/2020

Nick Molinari
AES Distributed Energy
4875 Pearl East Circle
#200
Boulder, CO 80301

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Solar Panel Oahu E
Location:	O'ahu, HI
Latitude:	21-22-32.53N NAD 83
Longitude:	158-03-37.67W
Heights:	303 feet site elevation (SE)
	11 feet above ground level (AGL)
	314 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/ lighting are accomplished on a voluntary basis, we recommend it be installed in accordance with FAA Advisory circular 70/7460-1 L Change 2.

This determination expires on 12/09/2021 unless:

(a) the construction is started (not necessarily completed) and FAA Form 7460-2, Notice of Actual Construction or Alteration, is received by this office.
(b) extended, revised, or terminated by the issuing office.
(c) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO

SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power, except those frequencies specified in the Colo Void Clause Coalition; Antenna System Co-Location; Voluntary Best Practices, effective 21 Nov 2007, will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.This determination includes all previously filed frequencies and power for this structure.

If construction or alteration is dismantled or destroyed, you must submit notice to the FAA within 5 days after the construction or alteration is dismantled or destroyed.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

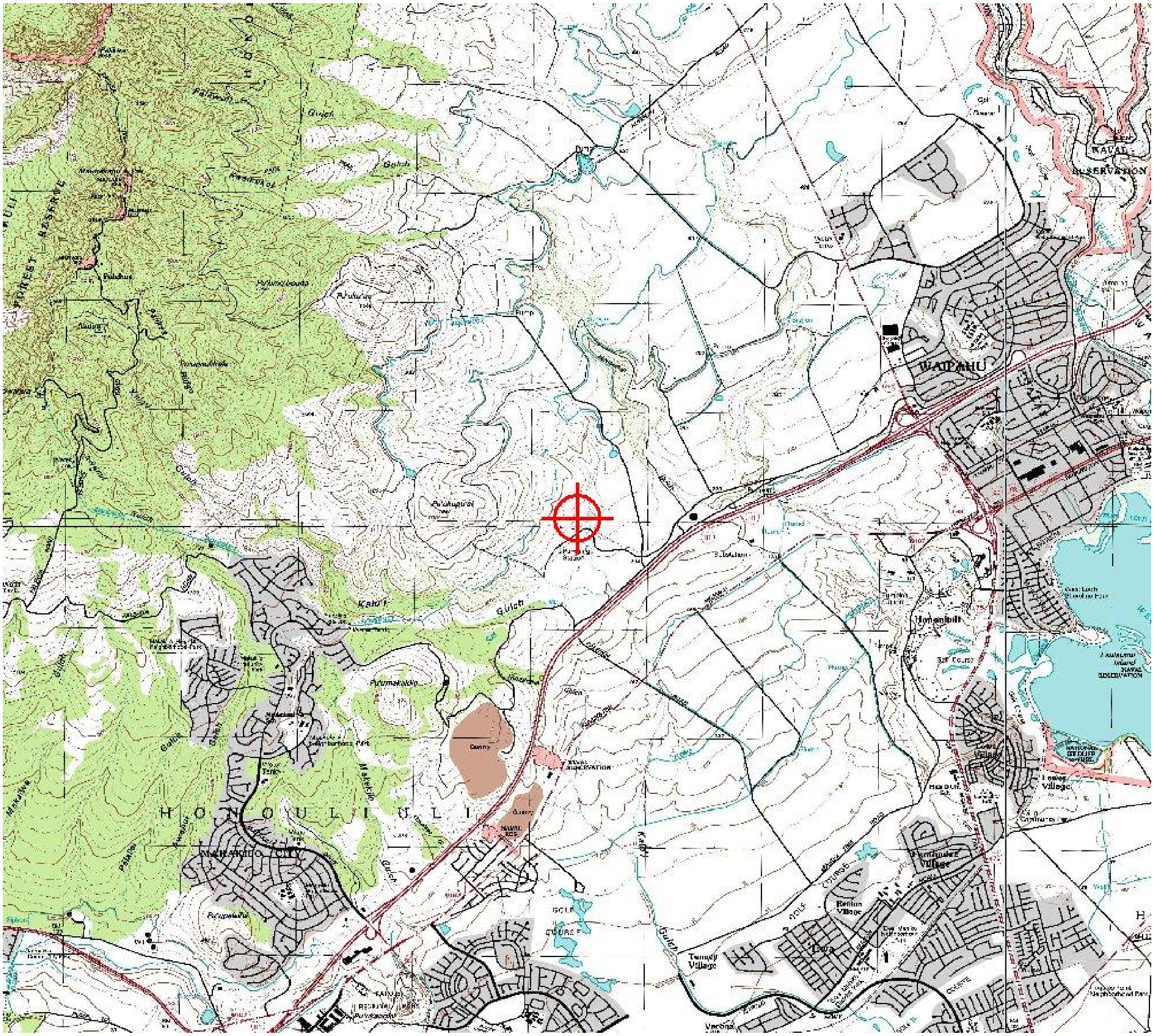
This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (907) 271-5863, or robert.van.haastert@faa.gov. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2020-AWP-5927-OE.

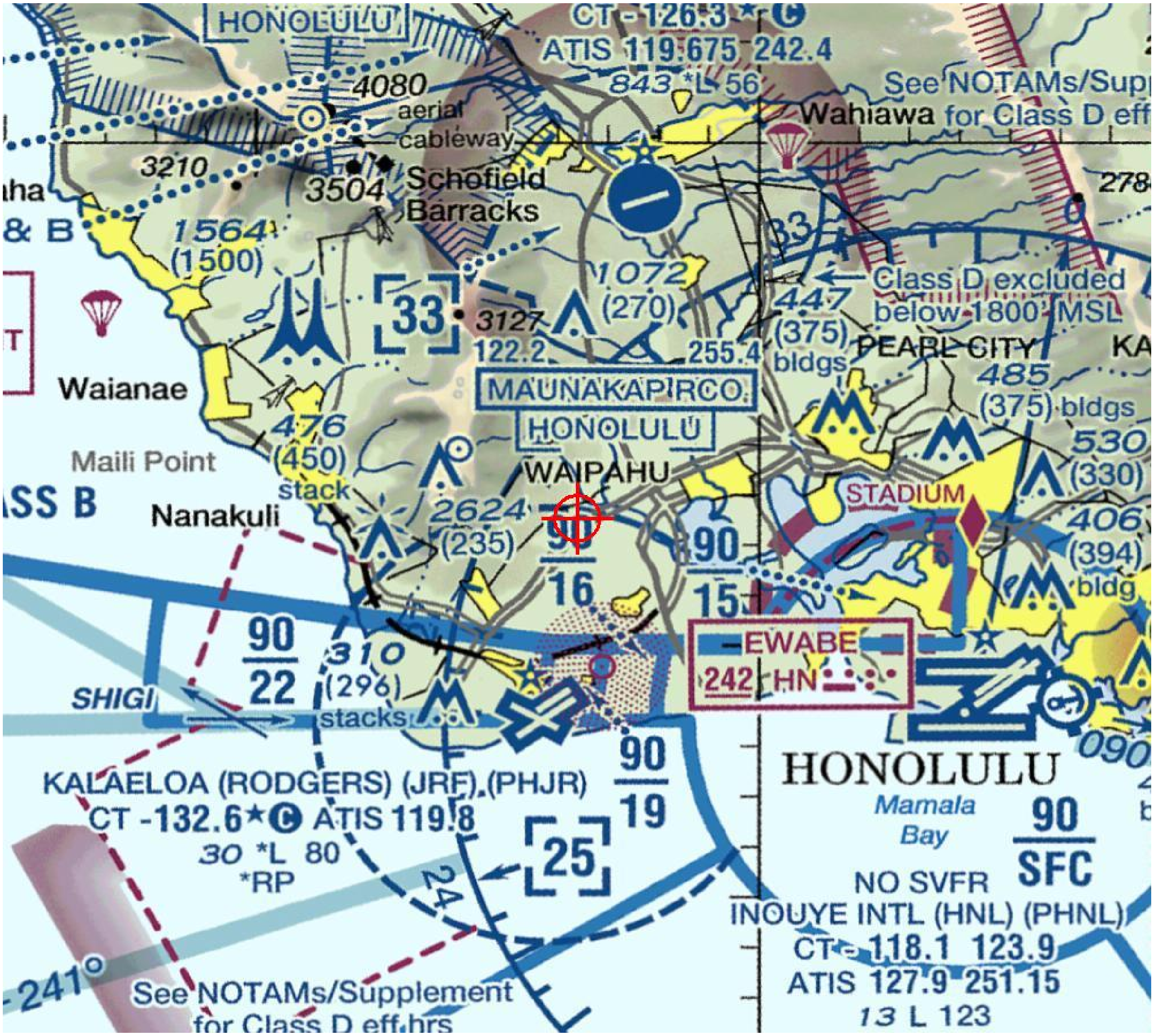
Signature Control No: 440873442-442419364 (DNE)
Robert van Haastert
Supervisor

Attachment(s)
Map(s)

TOPO Map for ASN 2020-AWP-5927-OE



Sectional Map for ASN 2020-AWP-5927-OE



Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
10101 Hillwood Parkway
Fort Worth, TX 76177

Aeronautical Study No.
2020-AWP-5928-OE

Issued Date: 06/09/2020

Nick Molinari
AES Distributed Energy
4875 Pearl East Circle
#200
Boulder, CO 80301

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Solar Panel Oahu Central-SE
Location:	O'ahu, HI
Latitude:	21-22-24.47N NAD 83
Longitude:	158-03-45.57W
Heights:	308 feet site elevation (SE)
	11 feet above ground level (AGL)
	319 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/ lighting are accomplished on a voluntary basis, we recommend it be installed in accordance with FAA Advisory circular 70/7460-1 L Change 2.

This determination expires on 12/09/2021 unless:

(a) the construction is started (not necessarily completed) and FAA Form 7460-2, Notice of Actual Construction or Alteration, is received by this office.
(b) extended, revised, or terminated by the issuing office.
(c) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO

SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power, except those frequencies specified in the Colo Void Clause Coalition; Antenna System Co-Location; Voluntary Best Practices, effective 21 Nov 2007, will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.This determination includes all previously filed frequencies and power for this structure.

If construction or alteration is dismantled or destroyed, you must submit notice to the FAA within 5 days after the construction or alteration is dismantled or destroyed.

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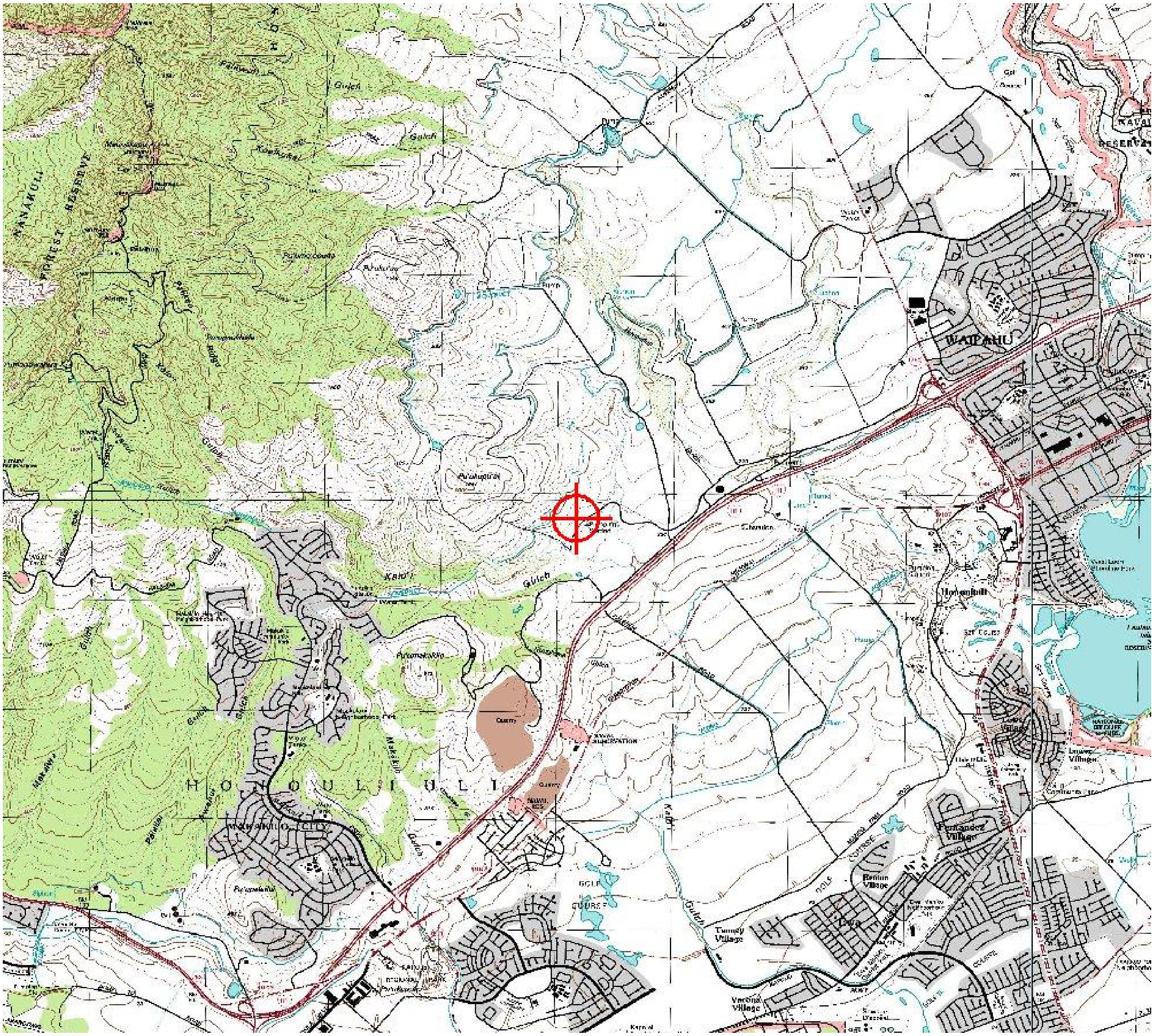
This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (907) 271-5863, or robert.van.haastert@faa.gov. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2020-AWP-5928-OE.

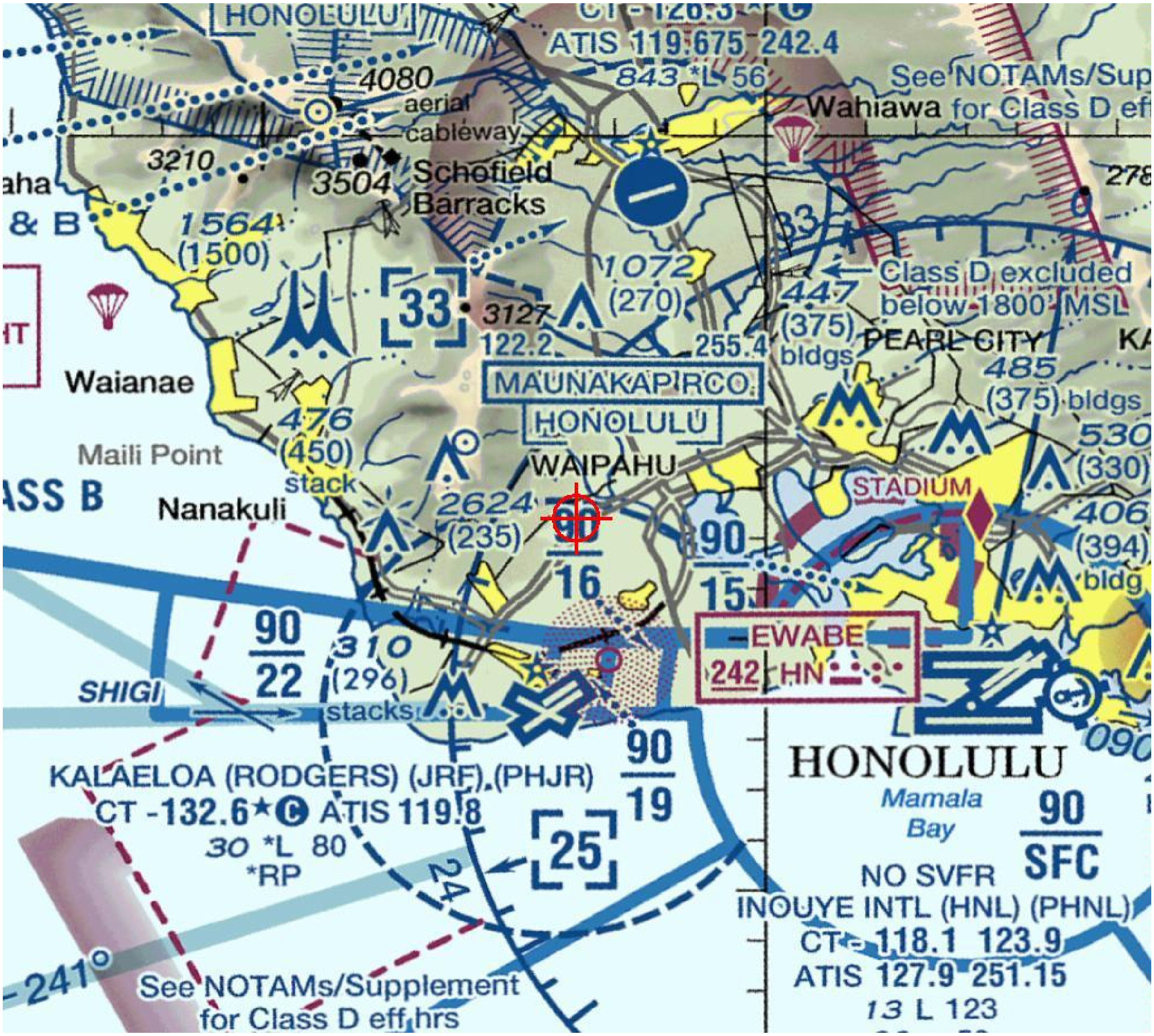
Signature Control No: 440873443-442419367 (DNE)
Robert van Haastert
Supervisor

Attachment(s)
Map(s)

TOPO Map for ASN 2020-AWP-5928-OE



Sectional Map for ASN 2020-AWP-5928-OE



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Obstruction Evaluation Group
10101 Hillwood Parkway
Fort Worth, TX 76177

Aeronautical Study No.
2020-AWP-5929-OE

Issued Date: 06/09/2020

Nick Molinari
AES Distributed Energy
4875 Pearl East Circle
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**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Solar Panel Oahu S
Location:	O'ahu, HI
Latitude:	21-22-16.45N NAD 83
Longitude:	158-03-49.78W
Heights:	280 feet site elevation (SE) 11 feet above ground level (AGL) 291 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/ lighting are accomplished on a voluntary basis, we recommend it be installed in accordance with FAA Advisory circular 70/7460-1 L Change 2.

This determination expires on 12/09/2021 unless:

(a) the construction is started (not necessarily completed) and FAA Form 7460-2, Notice of Actual Construction or Alteration, is received by this office.
(b) extended, revised, or terminated by the issuing office.
(c) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO

SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power, except those frequencies specified in the Colo Void Clause Coalition; Antenna System Co-Location; Voluntary Best Practices, effective 21 Nov 2007, will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.This determination includes all previously filed frequencies and power for this structure.

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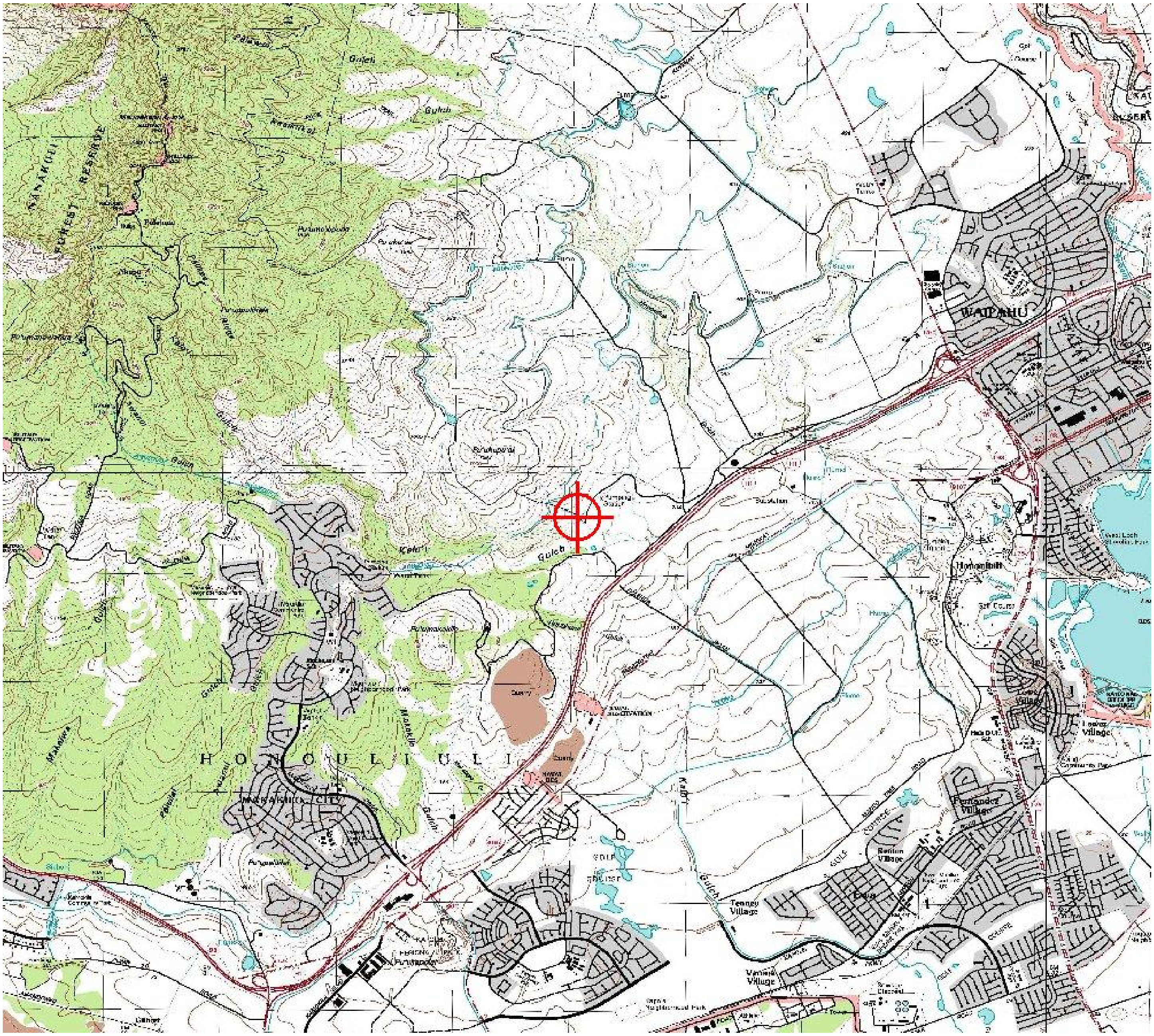
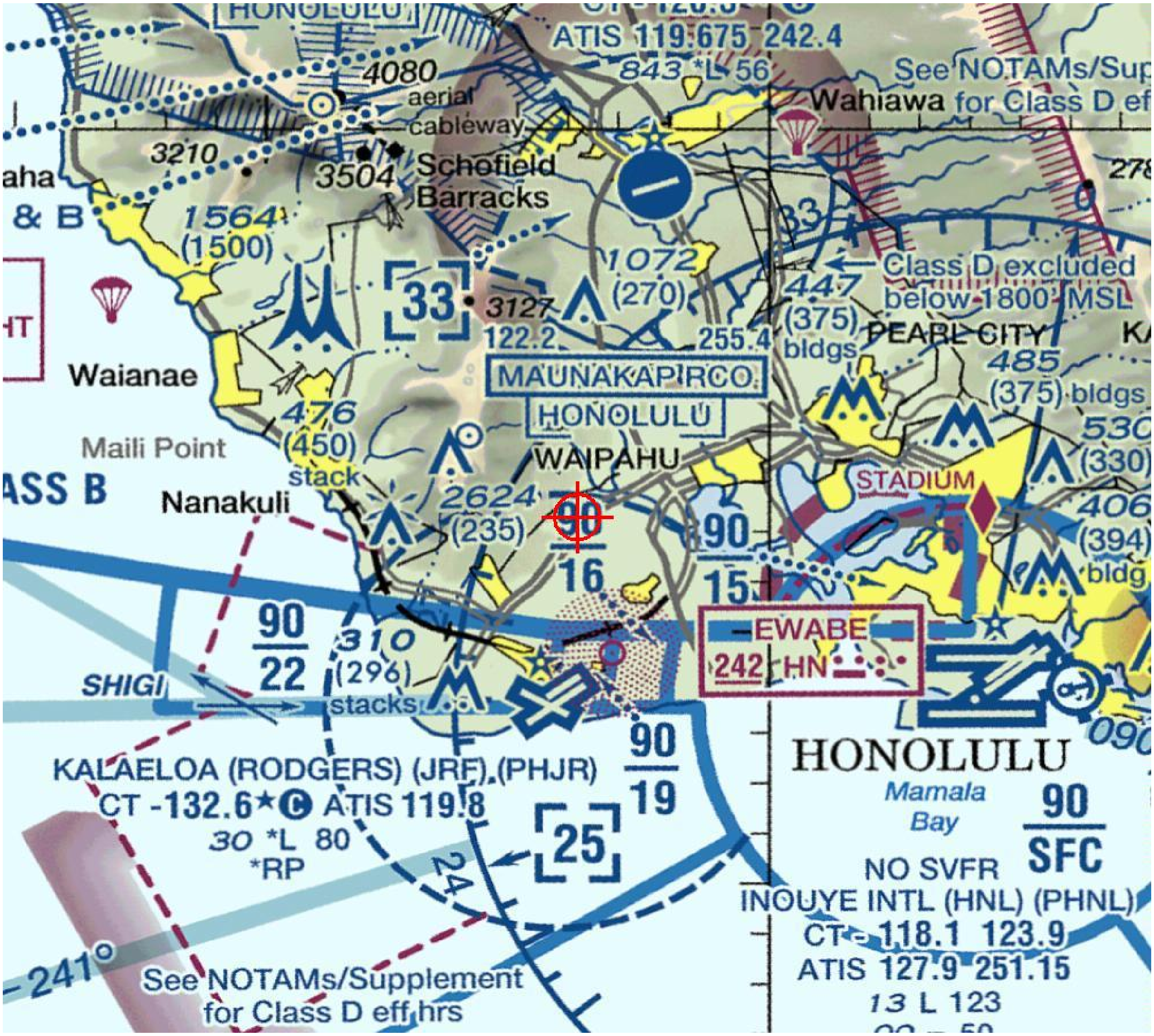
Signature Control No: 440873444-442419365 (DNE)
Robert van Haastert
Supervisor

Attachment(s)
Map(s)

TOPO Map for ASN 2020-AWP-5929-OE



Sectional Map for ASN 2020-AWP-5929-OE



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2020-AWP-5930-OE

Issued Date: 06/09/2020

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4875 Pearl East Circle
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**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Solar Panel Oahu W
Location:	O'ahu, HI
Latitude:	21-22-15.98N NAD 83
Longitude:	158-04-01.25W
Heights:	420 feet site elevation (SE)
	11 feet above ground level (AGL)
	431 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/ lighting are accomplished on a voluntary basis, we recommend it be installed in accordance with FAA Advisory circular 70/7460-1 L Change 2.

This determination expires on 12/09/2021 unless:

(a) the construction is started (not necessarily completed) and FAA Form 7460-2, Notice of Actual Construction or Alteration, is received by this office.
(b) extended, revised, or terminated by the issuing office.
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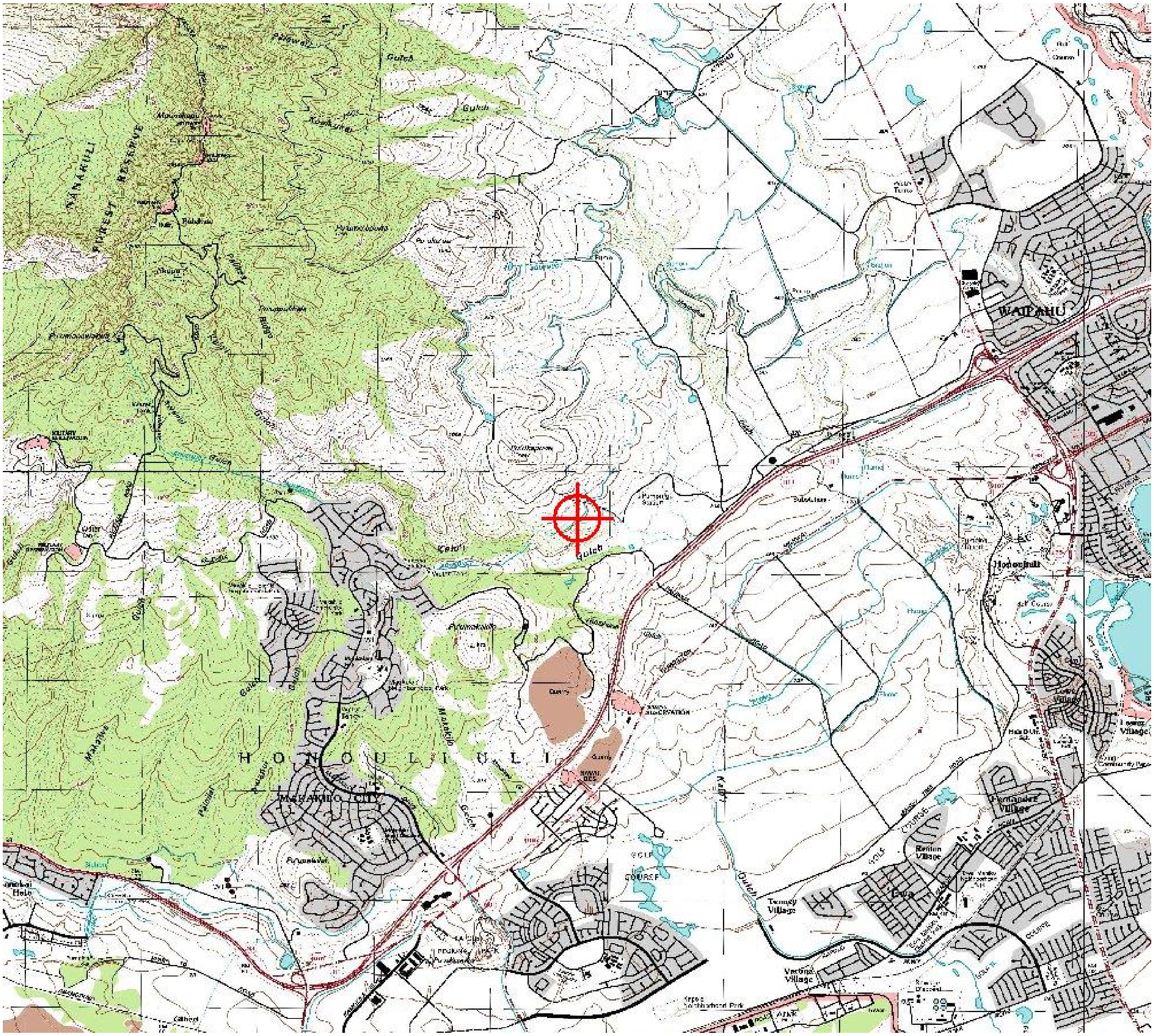
If we can be of further assistance, please contact our office at (907) 271-5863, or robert.van.haastert@faa.gov. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2020-AWP-5930-OE.

Signature Control No: 440873445-442419366 (DNE)

Robert van Haastert
Supervisor

Attachment(s)
Map(s)

TOPO Map for ASN 2020-AWP-5930-OE



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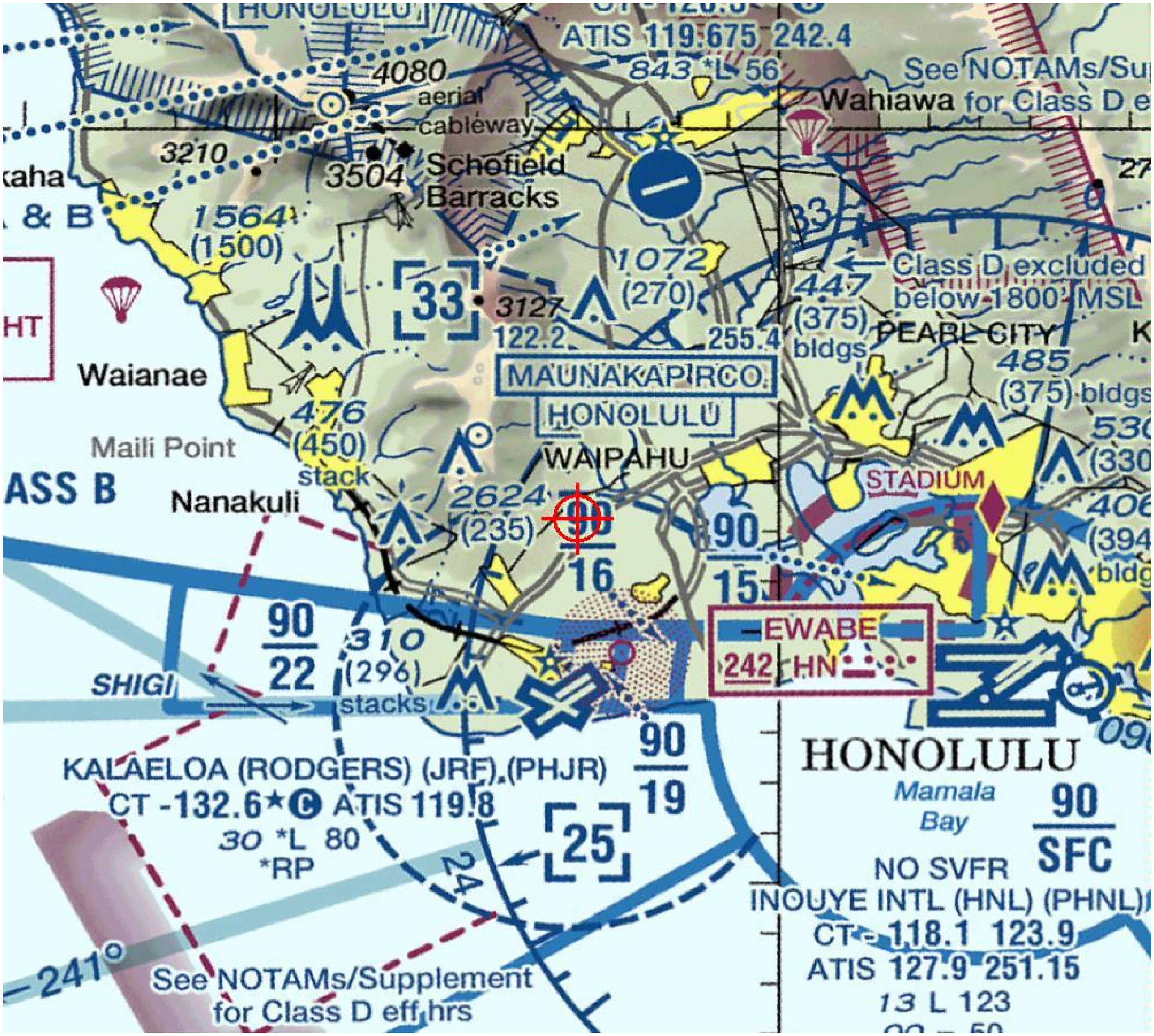

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2020-AWP-5931-OE

Issued Date: 06/09/2020

Nick Molinari
AES Distributed Energy
4875 Pearl East Circle
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**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Solar Panel Oahu Central-SE
Location:	O'ahu, HI
Latitude:	21-22-27.78N NAD 83
Longitude:	158-03-51.21W
Heights:	418 feet site elevation (SE) 11 feet above ground level (AGL) 429 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/ lighting are accomplished on a voluntary basis, we recommend it be installed in accordance with FAA Advisory circular 70/7460-1 L Change 2.

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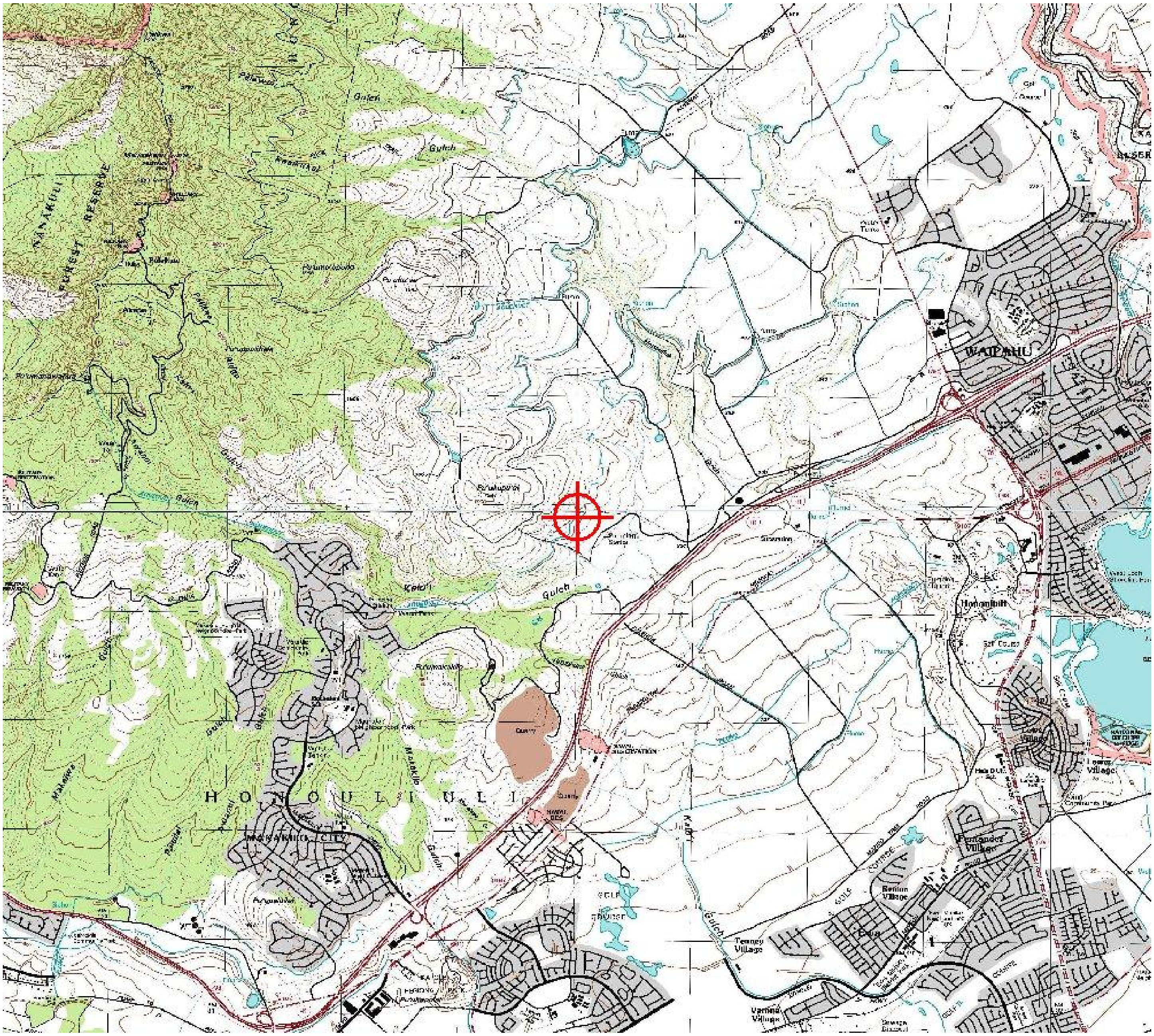
Signature Control No: 440873446-442419362 (DNE)

Robert van Haastert
Supervisor

Attachment(s)
Map(s)

TOPO Map for ASN 2020-AWP-5931-OE



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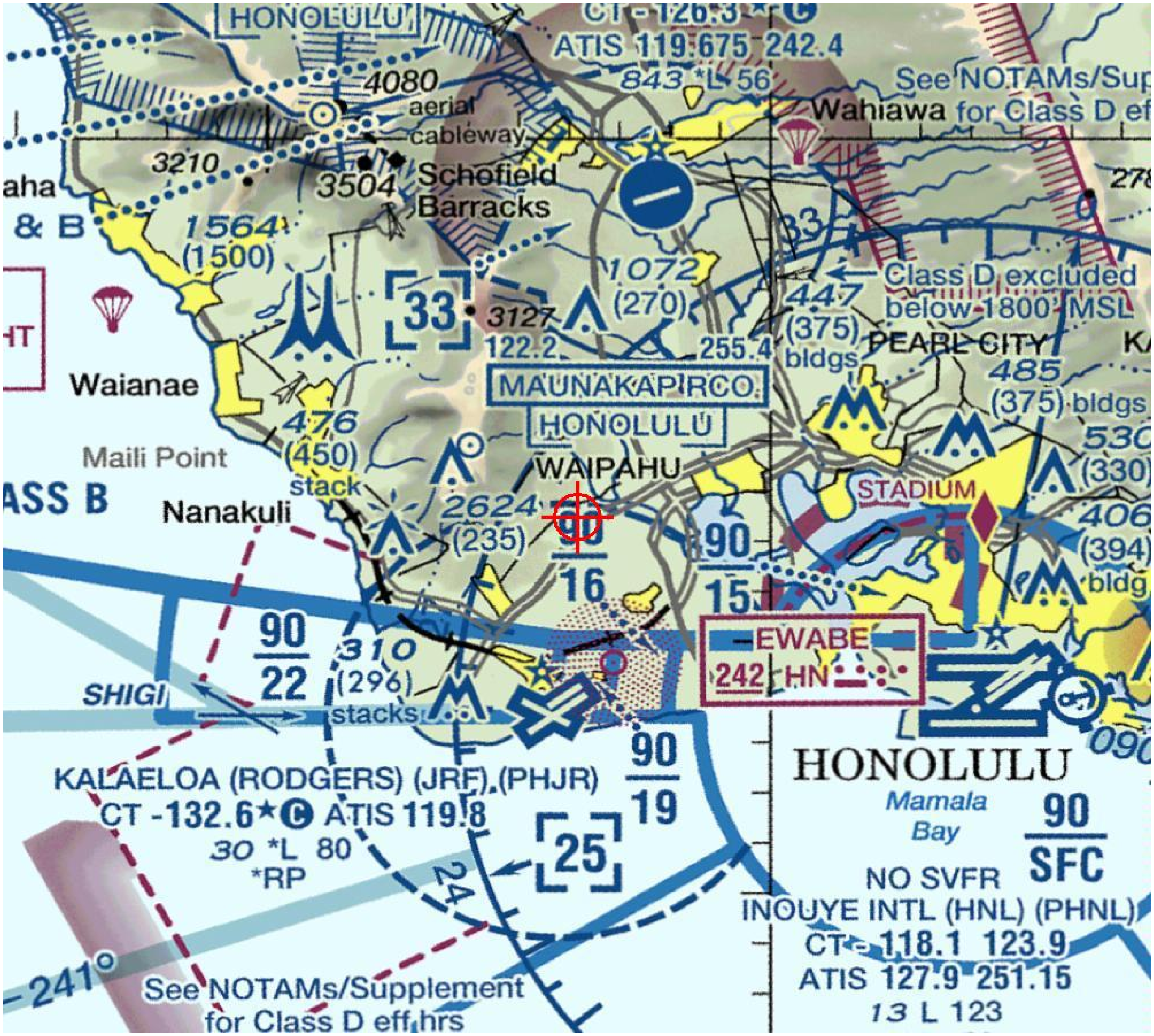

Glare Analysis Report for the West O‘ahu Solar Plus Storage Project

‘Ewa District, O‘ahu, Hawai‘i

Prepared for:

AES Distributed Energy

Prepared by:

Tetra Tech, Inc.

February 2020

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Executive Summary

At the request of AES Distributed Energy (AES), Tetra Tech, Inc. (Tetra Tech) conducted a glint and glare analysis of the proposed West Oahu Solar Plus Storage Project (Project). The analysis was conducted using the Solar Glare Hazard Analysis Tool (SGHAT) software through an online tool (GlareGauge) developed by Sandia National Laboratories and hosted by ForgeSolar. A total of three glare analyses were conducted for the Project. The first two analyses included three observation points from the surrounding community (to the west, south and east) and three segmented traffic routes (H-1 Freeway, Farrington Highway, and Kualakai Parkway). Analysis 1 represents the point of view from an average first floor residential/commercial structure and typical commuter car, while Analysis 2 represents the point of view from an average second floor residential/ commercial structure and typical semi-tractor-trailer truck. The third analysis included 14 final approach flight paths and two air traffic control towers (ATCTs) associated with Kalaeloa Airport, Daniel K. Inouye International Airport and Wheeler Army Airfield.

The results of the analysis indicate that none of the residential/commercial observation points would experience glare as a result of the Project. Analysis 1 and 2 predicted that a limited amount of green glare (the least severe type of glare) would occur at two segments along Farrington Highway and at two segments along H-1 Freeway southeast of the Project area. In addition, a very limited amount of yellow glare was predicted along one segment of H-1 Freeway. The predicted occurrences of glare along these roadway segments would occur intermittently in the evening hours during certain months of the year, for a period of less than 15 minutes per day. The results of Analysis 3 indicate that no glare would be experienced at Kalaeloa Airport or Wheeler Army Airfield. A limited amount of green glare was predicted for three of the final approach paths and the ATCT for Daniel K. Inouye International Airport, located approximately 8 miles from the Project area. The predicted occurrences of glare from these locations would occur intermittently in the evening hours during certain months of the year, for a period of less than 10 minutes per day. As recommended by the Federal Aviation Administration (FAA) Notice Criteria Tool (NCT), the Project will be formally filed with the FAA Obstruction Evaluation Group (OEG).

It is important to note that the GlareGauge model does not account for varying ambient conditions (i.e., cloudy days, precipitation), atmospheric attenuation, screening due to existing topography not located within the defined array layouts, or existing vegetation or structures (including fences or walls); nor does the tool allow proposed landscaping to be included. In this instance, an existing berm and vegetation are located along portions of the northern side of H1 Freeway and would be expected to screen views of the Project from vehicular traffic along the modeled segments of H1 Freeway; views of portions of the Project from vehicular traffic along the modeled segments of Farrington Highway may also be intermittently screened by vegetation and other existing features. Therefore, the model results are conservative and may predict glare at locations where glare will not actually be experienced.

1.0 Introduction

The Project involves construction and operation of a solar photovoltaic and battery energy storage system on land owned by University of Hawai'i (UH), approximately 3 miles northeast of Kapolei on the southwest side of O'ahu. The Project area encompasses approximately 95.5 acres in an area commonly referred to as the UH West O'ahu Mauka Lands property and is within tax map key (TMK) 9-2-002:007. The topography of the site ranges from relatively flat to moderately sloping. The elevation along the southeastern boundary of the Project area is approximately 280 feet above mean sea level (amsl) and rises to approximately 675 feet amsl in the northwestern portion.

The UH West O'ahu Mauka Lands property is bordered on its southeastern edge by the H1 Freeway, beyond which is the UH West O'ahu campus and the city of Kapolei. The southern and western portions of the property are bordered by vacant land, with Makakilo Quarry and the residential community of Makakilo located just beyond. The area north of the Project area generally comprises open space associated with the Waianae Mountains. The former Honouliuli Internment Camp site, which the National Park Service (NPS) is currently working to incorporate as a National Monument, is located to the northeast. The eastern portion of the property is bordered by Honouliuli Gulch and a variety of agricultural operations; further east is Kunia Road and the Village Park community.

As an industry standard, the term "glint and glare" analysis is typically used to describe an analysis of potential ocular impacts to defined receptors. As a point of clarification, ForgeSolar defines glint and glare in the following statement:

> *Glint is typically defined as a momentary flash of bright light, often caused by a reflection off a moving source. A typical example of glint is a momentary solar reflection from a moving car. Glare is defined as a continuous source of bright light. Glare is generally associated with stationary objects, which, due to the slow relative movement of the sun, reflect sunlight for a longer duration.*

Based on the ForgeSolar definitions of glint and glare and the stationary nature of the Project solar photovoltaic modules (fixed tilt), the potential reflectance from the Project modeled throughout this report is referred to as glare.

Tetra Tech completed a glare analysis using the SGHAT software, developed by Sandia Laboratories, now hosted by ForgeSolar (as discussed further below). The SGHAT software is considered an industry best practice and conservative model that effectively models the potential for glare at defined receptors from defined solar energy generating facilities. As discussed further below, the model is conservative in that it does not account for potential screening such as existing or proposed vegetation, topography outside of the defined areas, buildings, walls, or fences.

This report summarizes the glare analysis conducted based on the preliminary Project layout provided by AES dated December 4, 2019. Included as attachments are the Preliminary Site Plan that formed the basis of the analysis (Attachment A); Figure 1: PV Array Areas, Figure 2: Receptors and Figure 3: Airport Receptors (Attachment B); and the glare analysis reports generated by the ForgeSolar tool (Attachment C).

2.0 FAA Notice Criteria Consultation

The FAA developed Technical Guidance for Evaluating Selected Solar Technologies on Airports in 2010, in addition to FAA regulatory guidance under 78 FR 63276 Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports (collectively referred to as FAA Guidance). The FAA Guidance recommends that glare analyses should be performed on a site-specific basis using the Sandia Laboratories SGHAT. This guidance applies to solar facilities located on federally-obligated airport property; it is not mandatory for a proposed solar installation that is not on an airport (and for which a Form 7460-1 is filed with FAA pursuant to CFR Title 14 Part 77.9, as discussed below), but is considered to be an industry best practice for solar facilities in general. The SGHAT is the standard for measuring potential ocular impact as a result of solar facilities (78 FR 63276).

According to 78 FR 63276, the FAA has determined that "glint and glare from solar energy systems could result in an ocular impact to pilots and/or air traffic control (ATC) facilities and compromise the safety of the air transportation system." The FAA has developed the following criteria for analysis of solar energy projects located on jurisdictional airports:

- No potential for glint or glare in the existing or planned ATCT cab; and
- No potential for glare or "low potential for after-image" along the final approach path for any existing landing threshold or future landing thresholds (including any planned interim phases of the landing thresholds) as shown on the current FAA-approved Airport Layout Plan (ALP). The final approach path is defined as two miles from 50 feet above the landing threshold using a standard three-degree glidepath.

The online FAA NCT reports whether a proposed structure is in proximity to a jurisdictional air navigation facility and if formal submission to the FAA OEG under CFR Title 14 Part 77.9 (Safe, Efficient Use, and Preservation of the Navigable Airspace) is recommended. The NCT also identifies final approach flight paths that may be considered vulnerable to a proposed structure's impact on navigation signal reception. The NCT was utilized to determine if the proposed Project is located within an FAA-identified impact area based on the Project boundaries and height above ground surface. The FAA NCT Report stated that a formal filing with the FAA OEG is recommended, and referenced Kalaeloa Airport (John Rodgers Field, JRF) to the south, Daniel K. Inouye International Airport (Honolulu International, HNL) to the east, and Wheeler Army Airfield (HHI) to the northeast. Based on this information, these three airport facilities were included in the SGHAT analysis, as further discussed below.

3.0 Glare Analysis Methods

The SGHAT is considered to be an industry best practice for analysis of glare related to solar energy generating facilities. Tetra Tech utilized the SGHAT technology as part of an online tool (GlareGauge) developed by Sandia National Laboratories and hosted by ForgeSolar. GlareGauge provides a quantitative assessment of the following:

- When and where glare has the potential to occur throughout the year for a defined solar array polygon; and
- Potential effects on the human eye at locations where glare is predicted.

The following statement was issued by Sandia Laboratories regarding the SGHAT technology:

> *Sandia developed SGHAT v. 3.0, a web-based tool and methodology to evaluate potential glint/glare associated with solar energy installations. The validated tool provides a quantified assessment of when and where glare will occur, as well as information about potential ocular impacts. The calculations and methods are based on analyses, test data, a database of different photovoltaic module surfaces (e.g. anti-reflective coating, texturing), and models developed over several years at Sandia. The results are presented in a simple easy-to-interpret plot that specifies when glare will occur throughout the year, with color indicating the potential ocular hazard (Sandia Laboratories, 2016).*

Note, however, that technology changes continue to occur to address issues such as reflectivity. The model, therefore, presents a conservative assessment based upon simplifying assumptions inherent in the model, as well as industry improvements since the most recent update of such assumptions.

Based on the predicted retinal irradiance (intensity) and subtended angle (size/distance) of the glare source to receptor, the GlareGauge categorizes potential glare where it is predicted by the model to occur in accordance with three tiers of severity (ocular hazards) that are shown by different colors in the model output:

- Red glare: glare predicted with a potential for permanent eye damage (retinal burn)
- Yellow glare: glare predicted with a potential for temporary after-image
- Green glare: glare predicted with a low potential for temporary after-image

These categories of glare are calculated using a typical observer's blink response time, ocular transmission coefficient (the amount of radiation absorbed in the eye prior to reaching the retina), pupil diameter, and eye focal length (the distance between where rays intersect in the eye and the retina). As a point of comparison, direct viewing of the sun without a filter is considered to be on the border between yellow glare and red glare, while typical camera flashes are considered to be lower tier yellow glare. Upon exposure to yellow glare, the observer may experience a temporary spot in their vision temporarily lasting after the exposure. Upon exposure to green glare, the observer may experience a bright reflection but typically no spot lasting after exposure.

4.0 Glare Analysis Inputs

The modules to be used for the proposed Project are smooth glass surface material with an anti-reflection coating (ARC), which are parameters selected in the glare analyses. Values associated with panel reflectivity and reflective scatter were not altered from the GlareGauge standard input averaged from various module reflectance profiles produced from module research concluded in 2016; therefore, as previously noted, the model does not incorporate further advances in anti-reflective coatings since that time.

Tetra Tech performed three separate glare analyses: the first two analyses included three proximal segmented vehicular traffic routes and three observation points (OPs; two taken from the Tetra Tech visual simulation viewpoints and one taken near residential and commercial receptors to the east). Analysis 1 and 2 differ in the heights assumed for the OP and vehicular routes; Analysis 1 represents the point of view from an average first floor residential/commercial structure and typical commuter car, while Analysis 2 represents the point of view from an average second floor residential/commercial structure and typical semi-tractor-trailer truck. Analysis 3 is focused on modeling the airport receptors referenced in the NCT results; it includes 14 two-mile final approach flight paths and two ATCTs associated with Kalaeloa Airport (John Rodgers Field, JRF), Daniel K. Inouye International Airport (Honolulu International, HNL), and Wheeler Army Airfield (HHI). In Analysis 3, a typical 30-degree maximum downward viewing angle and 50-degree maximum azimuthal viewing angle from the aircraft cockpit were included among other parameters presented in Table 2. For all three analyses, the Project Area consisted of nine separate “PV Array Areas”, which are segmented polygons generally representative of the proposed Project layout dated December 4, 2019 (Attachment A). Segmentation of the Project layout allows GlareGauge to more accurately represent potential ocular impacts as a result of the Project. The additional input features used in the analyses are summarized in Table 1 and Table 2.

Table 1. Glare Analyses Input Features

Analysis No.[1]	Racking Type	Module Orientation	Tilt[2] (degrees)	Module Height[3] (feet)	OP Height[4] (feet)	Route Height[5] (feet)	ATCT	Flight Paths
1	Fixed	South-facing	15	7.6	6	5	-	-
2	Fixed	South-facing	15	7.6	16	9	-	-
3	Fixed	South-facing	15	7.6	-	-	2	14

1.Noted on page 1 of each analysis in Attachment C.

2. Module tilt for fixed arrays.

3. Average module centroid height above ground surface.

4. Height of observation point receptor: 6 feet represents an average first floor residential/commercial point of view and 16 feet represents an average second floor residential/commercial point of view.

5. Height of vehicular route receptor: 5 feet represents typical commuter car height and 9 feet represents typical semi-tractor-trailer truck views.

Table 2. Analysis 3 Input Features

Flight Path/ATCT Name	Associated Airport	True Direction (degrees)	Threshold Crossing Height (feet)	Glide Path[1] (degrees)	Height Above Ground (feet)
HHI RWY 24	Wheeler Army Airfield	248[2]	50[3]	3[3]	-
HHI RWY 6	Wheeler Army Airfield	68[2]	50[3]	3[3]	-
HNL RWY 04L	Daniel K. Inouye International Airport	53	50	3	-
HNL RWY 04R	Daniel K. Inouye International Airport	53	71	3	-
HNL RWY 08R	Daniel K. Inouye International Airport	90	96	3.25	-
HNL RWY 22L	Daniel K. Inouye International Airport	233	80	3.44	-
HNL RWY 22R	Daniel K. Inouye International Airport	233	50[3]	3[3]	-
HNL RWY 26L	Daniel K. Inouye International Airport	270	75	3	-
JRF RWY 04L	Kalaeloa Airport	55	35	3	-
JRF RWY 04R	Kalaeloa Airport	55	55	3	-
JRF RWY 11	Kalaeloa Airport	118	48	3	-
JRF RWY 22L	Kalaeloa Airport	235	32	3	-
JRF RWY 22R	Kalaeloa Airport	235	33	3	-
JRF RWY 29	Kalaeloa Airport	298	52	3	-
1-ATCT	Kalaeloa Airport	-	-	-	50[4]
2-ATCT	Daniel K. Inouye International Airport	-	-	-	50[4]

1. Angle of descent along final approach flight path.

2.Unable to be confirmed based on public information. Estimated based on runway direction on aerial photography.

3. Unable to be confirmed based on public information. Default parameters in the SGHAT software which references the FAA criteria found in Section 2.0 were used.

4. Unable to be confirmed based on public information. A conservative height of 50 feet was used based on aerial photography and Google street views.

5.0 Glare Analysis Assumptions

The GlareGauge model is bound by conservative limitations. The following assumptions provide a level of conservatism to the GlareGauge model:

- The GlareGauge model simulates PV arrays as infinitesimally small modules within planar convex polygons exemplifying the tilt and orientation characteristics defined by the user. Gaps between modules, variable heights of the PV array within the polygons, and supporting structures are not considered in the analysis. Since the actual module rows will be separated by open space, this model assumption could result in indication of glare in locations where panels will not be located. In addition, the supporting structures are considered to have reflectivity values that are negligible relative to the module surfaces included in the model.
- The GlareGauge model does not consider obstacles (either man-made or natural) between the defined PV arrays and the receptors such as vegetative screening (existing or planted), buildings, topography, etc. Where such features exist, they would screen views of the Project and, thus, minimize or eliminate glare from those locations.
- The GlareGauge model does not consider the potential effect of shading from existing topography between the sun and the Project outside of the defined areas. In this instance, the lower slopes of the Waianae Mountains are located to the northwest of the Project. This ridgeline may shade the Project from the sun's position at certain times of the year in the evening hours. The GlareGauge model does not account for this potential shading effect.
- The direct normal irradiance (DNI) is defined as variable using a typical clear day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum of 1,000 Watts per square meter (W/m^2) at solar noon. The irradiance profile uses the coordinates from Google Maps and a sun position algorithm to scale the DNI throughout the year. The actual daily DNI would be affected by precipitation, cloud cover, atmospheric attenuation (radiation intensity affected by gaseous constituents), and other environmental factors not considered in the GlareGauge model. This may result in modeled predicted glare occurrences when in fact the glare is not actually occurring due to cloud cover, rain, or other atmospheric conditions.

Note that hazard zone boundaries shown in the Glare Hazard plots are an approximation; actual ocular impacts encompass a continuous, not discrete, spectrum.

6.0 Glare Analysis Results

Tetra Tech performed three separate glare analyses to provide a quantitative assessment of the potential for glare from the Project based on different receptor characteristics. The GlareGauge model's predicted results for the Project are summarized in the following sections partitioned according to the receptor parameters.

6.1 Analysis 1: First Story and Commuter Car View Results

Analysis 1 included three OPs at six feet above ground surface (typical first story receptor height) and three segmented vehicular traffic routes at five feet above ground surface (typical commuter vehicle receptor height). The southern (OP 1) and western (OP 2) residential OPs were selected in the glare analysis to match representative residential viewpoints selected in the visual simulation analysis. The eastern OP (OP 3) was selected in order to capture a representative viewpoint of the residential and commercial receptors in Village Park. The route segment extents were based on the results of a preliminary viewshed analysis dated November 2019.

Table 3 represents the glare summary in annual minutes of glare for Analysis 1. In general, green glare is predicted in limited amounts on Farrington Highway and H1 Freeway and a very limited amount of yellow glare is predicted on H1 Freeway. No red glare is predicted at the defined receptors.

Table 3. Analysis 1 Annual Minutes of Glare Summary

Receptor	Green Glare	Yellow Glare	Red Glare
OP 1	0	0	0
OP 2	0	0	0
OP 3	0	0	0
Farrington-1[1]	1,578	0	0
Farrington-2	4,785	0	0
H1 Freeway-1[2]	0	0	0
H1 Freeway-2	104	0	0
H1 Freeway-3	2,498	35	0
H1 Freeway-4	0	0	0
Kualakai-1[3]	0	0	0
Kualakai-2	0	0	0
Kualakai-3	0	0	0
Kualakai-4	0	0	0
Kualakai-5	0	0	0

1. Segments of Farrington Highway to the south of the Project. Segment 1 is to the east of Segment 2 as depicted in Figure 2.
2. Segments of H1 Freeway (Queen Liliuokalani Freeway) to the south of the Project. Segment 1 to Segment 4 is from east to west.
3. Segments of Kualakai Parkway to the south of the Project. Segment 1 to Segment 5 is from north to south.

Table 4 represents the detailed glare summary for both Analysis 1 and Analysis 2. The predicted green glare at the receptors is between the hours of 6:00 PM and 7:00 PM and ranges from April through mid-September. Less than 15 minutes of green glare per day is predicted within the one-hour period. The limited amount of yellow glare on H1 Freeway-3 is predicted between 6:00 PM and 7:00 PM from mid-May to mid-July. Less than 5 minutes of yellow glare per day is predicted within the one-hour period. Glare was not predicted at the defined residential/commercial OPs or along Kualakai Parkway.

Table 4. Analysis 1 and Analysis 2 Detailed Glare Summary

Receptor	Green Glare Time of Day Range	Green Glare Time of Year Range	Yellow Glare Time of Day Range	Yellow Glare Time of Year Range
Farrington-1	6:00 - 7:00 PM	April to May; mid-July to mid-September	N/A	N/A
Farrington-2	6:00 - 7:00 PM	April to mid-September	N/A	N/A
H1 Freeway-2	6:00 - 7:00 PM	April to mid-May; August to mid-September	N/A	N/A
H1 Freeway-3	6:00 - 7:00 PM	April to May; July to mid-September	6:00 - 7:00 PM	mid-May to mid-July

6.2 Analysis 2: Second Story and Tractor-Trailer View Results

Analysis 2 included the same OP locations at 16 feet above ground surface (typical second story receptor height) and the same segmented vehicular traffic routes at nine feet above ground surface (typical tractor-trailer receptor height).

Table 5 represents the glare summary in annual minutes of glare for Analysis 2. Similar to Analysis 1, green glare is predicted at limited amounts on Farrington Highway and H1 Freeway and a very limited amount of yellow glare is predicted on H1 Freeway. No red glare is predicted at the defined receptors.

Table 5. Analysis 2 Annual Minutes of Glare Summary

Receptor	Green Glare	Yellow Glare	Red Glare
OP 1	0	0	0
OP 2	0	0	0
OP 3	0	0	0
Farrington-1[1]	1,608	0	0
Farrington-2	4,840	0	0
H1 Freeway-1[2]	0	0	0
H1 Freeway-2	118	0	0
H1 Freeway-3	2,624	50	0
H1 Freeway-4	0	0	0
Kualakai-1[3]	0	0	0

Receptor	Green Glare	Yellow Glare	Red Glare
Kualakai-2	0	0	0
Kualakai-3	0	0	0
Kualakai-4	0	0	0
Kualakai-5	0	0	0

As seen in Table 5, the second story and tractor-trailer view results show a minimal increase in annual glare minutes from each receptor exhibiting glare. For example, green glare at H1 Freeway-3 increased by 126 annual minutes, which is a 5% increase in annual green glare minutes from the commuter car height at the H1 Freeway-3 route segment (as shown in Table 3). No significant changes were noted from the time of day and/or the time of year for predicted glare in Analysis 2 (see Table 4 for detailed glare summary).

6.3 Analysis 3: Flight Path and ATCT Results

Analysis 3 included 14 proximal two-mile final approach flight paths and two ATCTs (as outlined in Table 2). The final approach flight paths that were modeled are located at the airports that were referenced in the NCT results: Kalaeloa Airport (John Rodgers Field, JRF), Daniel K. Inouye International Airport (Honolulu International, HNL), and Wheeler Army Airfield (HHI). Table 5 represents the glare summary in annual minutes of glare for Analysis 3.

Table 6. Analysis 3 Annual Minutes of Glare Summary

Receptor	Green Glare	Yellow Glare	Red Glare
HHI RWY 24	0	0	0
HHI RWY 6	0	0	0
HNL RWY 04L	0	0	0
HNL RWY 04R	0	0	0
HNL RWY 08R	0	0	0
HNL RWY 22L	847	0	0
HNL RWY 22R	866	0	0
HNL RWY 26L	2,149	0	0
JRF RWY 04L	0	0	0
JRF RWY 04R	0	0	0
JRF RWY 11	0	0	0
JRF RWY 22L	0	0	0
JRF RWY 22R	0	0	0
JRF RWY 29	0	0	0
1-ATCT	0	0	0
2-ATCT	749	0	0

As noted in Section 2.0, the FAA has developed the following criteria (78 FR 63276) for analysis of solar energy projects located on jurisdictional airports:

- No potential for glint or glare in the existing or planned ATCT cab; and
- No potential for glare or "low potential for after-image" along the final approach path for any existing landing threshold or future landing thresholds (including any planned interim phases of the landing thresholds) as shown on the current FAA-approved ALP.

The green glare noted in the SGHAT and summarized in this report is considered the "low potential for after-image" described in the applicable FAA criteria. As seen in Table 6, a low potential for after-image (green glare) is predicted in limited amounts along three two-mile final approach paths and the ATCT at Daniel K. Inouye International Airport. The potential green glare is predicted at the flight paths facing the southwest (HNL RWY 22L and HNL RWY 22R) and west (HNL RWY 26L). As summarized in Table 7, the green glare along the flight paths is sporadically limited to April to September between 6:00PM and 7:00PM, not exceeding 10 minutes per day. The green glare at the ATCT (2-ATCT) is sporadically limited to May to August, also between 6:00PM and 7:00PM and not exceeding 10 minutes per day. No yellow glare or red glare was predicted in Analysis 3. As previously noted, in addition to the other conservative values built into the model, visual screening by existing or proposed vegetation or other visual barriers cannot be accounted for in the GlareGauge model. In addition, the model assumes constant ideal (sunny) conditions; however, this area has an average of 78 days of precipitation per year (WRCC 2012). These atmospheric conditions would further reduce the actual occurrence of glare from the Project, such that actual glare conditions are expected to be less than predicted.

Table 7. Analysis 3 Detailed Glare Summary

Receptor	Green Glare Time of Day Range	Green Glare Time of Year Range	Yellow Glare Time of Day Range	Yellow Glare Time of Year Range
HNL RWY 22L	6:00 - 7:00 PM	Mid-April to May; mid-August to September	N/A	N/A
HNL RWY 22R	6:00 - 7:00 PM	Mid-April to May; mid-August to September	N/A	N/A
HNL RWY 26L	6:00 - 7:00 PM	Mid-May to August	N/A	N/A
2-ATCT	6:00 - 7:00 PM	Mid-May to August	N/A	N/A

7.0 Summary

The preliminary Project layout was modeled using GlareGauge to evaluate the potential extent of glare the Project may cause to receptors at three observation points to the east, south and west; receptors along segments of Farrington Highway, H1 Freeway, and Kualakai Parkway; and 14 proximal two-mile final approach flight paths and two ATCTs associated with Kalaeloa Airport (John Rodgers Field, JRF), Daniel K. Inouye International Airport (Honolulu International, HNL), and Wheeler Army Airfield (HHI). In order to better analyze the potential for glare as a result of sunlight reflectance from the Project and accommodate GlareGauge conservatisms noted in Section 4.0, nine array segments (PV Arrays) were modeled within the Project Area. Three separate glare analyses (Analysis 1, Analysis 2 and Analysis 3) were performed to provide a quantitative assessment of the potential for glare as a result of the Project, based on views from first- and second-story structures, commuter vehicles and semi-tractor-trailer trucks, and proximal two-mile final approach flight paths and ATCTs at airports referenced in the FAA NCT results. A summary of total glare predicted based on the analyses is presented in Table 8.

Table 8. Project Glare Summary

Analysis No.	OP Height (feet)	Route Height (feet)	Total Green Glare Predicted (annual minutes)[1]	Total Yellow Glare Predicted (annual minutes)	Total Red Glare Predicted (annual minutes)	Total Glare Predicted (annual minutes)	Total Potential Glare Percentage of Annual Daylight Hours[2]
1	6	5	8,965	35	0	9,000	3.4
2	16	9	9,190	50	0	9,240	3.5
3	50 (ATCTs)	Variable (flight paths)	4,611	0	0	4,611	1.8
1. Total annual daylight minutes equal approximately 262,800. 2. Total annual daylight hours equal approximately 4,380.							

None of the residential/commercial OPs to the east (OP 3), south (OP 1) and/or west (OP 2) of the Project were predicted to experience glare as a result of the Project. Green glare (the least severe type of glare) was predicted in Analysis 1 and Analysis 2 at two segments along Farrington Highway (Farrington-1 and Farrington-2) and at two segments along H1 Freeway (H1 Freeway-2 and H1 Freeway-3) to the south of the Project. In addition, a very limited amount of yellow glare (85 combined annual minutes) was predicted at segment H1 Freeway-3. As previously noted, the GlareGauge model does not account for varying ambient conditions (i.e., cloudy days, precipitation); atmospheric attenuation; screening due to existing topography not located within the defined array layouts; or existing vegetation or structures (including fences or walls); nor does the tool allow proposed landscaping to be included. In this instance, an existing berm and vegetation are located along portions of the northern side of H1 Freeway and would be expected to screen views of the Project from vehicular traffic along the modeled segments of H1 Freeway; views of portions of the

Project from vehicular traffic along the modeled segments of Farrington Highway may also be intermittently screened by vegetation and other existing features. Therefore, the model results are conservative and may predict glare at locations where glare will not actually be experienced.

Based on Analysis 3, a total of 4,611 annual minutes (approximately 1.8% of annual daylight hours) of green glare was predicted at three two-mile final approach flight paths (RWY 22L, RWY 22R, and RWY 26L) and the ATCT at the Daniel K. Inouye International Airport, located approximately eight miles east of the Project. As recommended by the NCT, the Project will be formally filed with the FAA OEG to more comprehensively study the impacts of the Project to proximal navigable airspace. In addition, it is recommended that the State of Hawaiʻi Department of Transportation (DOT) Airports Division be consulted regarding these results.

8.0 References

FAA, 2010a. Federal Aviation Administration. CFR Title 14 Part 77.9 Notice of Proposed Construction or Alteration Requiring Notice. 2010.

FAA, 2010b. Federal Aviation Administration. Technical Guidance for Evaluating Selected Solar Technologies on Airports. 2010.

Ho et al. Sandia National Laboratories, Solar Glare Hazard Analysis Tool (SGHAT) Technical Reference Manual. March 2015.

Sandia Solar Glare Hazard Analysis Tool, GlareGauge hosted by ForgeSolar. Accessed online https://www.forgesolar.com/.

Sandia, 2016. Sandia National Laboratories, Solar Glare Hazard Analysis Tool (SGHAT) User's Manual v. 3.0. December 6, 2016.

WRCC (Western Regional Climate Center), 2012. Period of Record General Climate Summary – Precipitation. Ewa Plantation 741, Hawaii. Available online at: https://wrcc.dri.edu/cgi-bin/cliGCStP.pl?hi0507

Attachment A. Preliminary Site Plan

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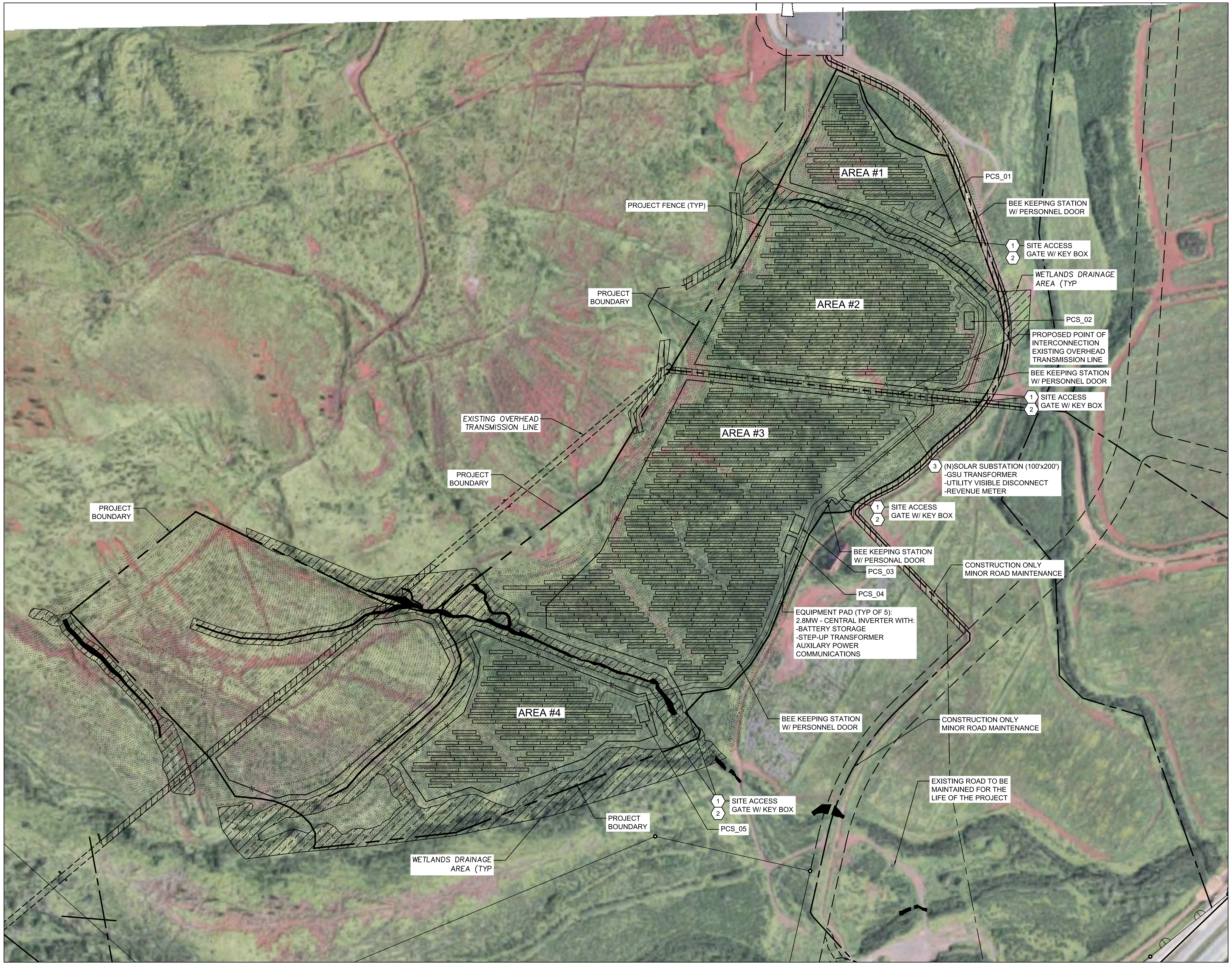


LEGEND

PCS	PCS POWER CONVERSION STATION
	PCS BOUNDARY

GENERAL NOTES

1. REFER TO CIVIL DRAWINGS FOR PERIMETER FENCE, ROADS AND GATES.
2. REFER TO SOLTEC DRAWINGS FOR TRACKER PILE LOCATIONS.
3. PV SITE WILL NOT HAVE SITE LIGHTING OR SECURITY CAMERAS.

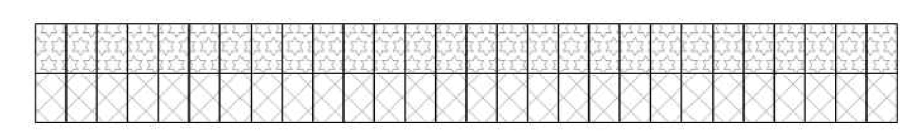
KEYED NOTES

1. CONTRACTOR TO FURNISH AND INSTALL KNOX BOX ACCESS ENCLOSURE AT ENTRANCE TO EVERY ROAD.
2. INSTALL FENCE GROUNDING. SEE E511 FOR DETAILS.
3. SUBSTATION LOCATION IS PENDING, AND SUBJECT TO CHANGE.

DESIGN SPECIFICATIONS

DC SYSTEM VOLTAGE	1500V	
ARRAY CAPACITY	17.407MW DC	
	12.5MW AC POI	
DC/AC RATIO	1.39	
MODULE	JINKO - EAGLE BIFACIAL 4C-72M	
MODULE WATTAGE	405Wp	
MODULE QUANTITY	AREA #1	3,192
	AREA #2	12,656
	AREA #3	20,776
	AREA #4	6,384
	AREA #5	-
	TOTAL	43,008
STRINGS	1,536 STRINGS OF 28 MODULES	
INVERTERS (QTY)	(5) 2.8MW CENTRAL INVERTERS WITH INTEGRAL BESS DC/DC CONVERSION	
BATTERY STORAGE	(10) 1,300kW BATTERY CONTAINERS	
RACKING SYSTEM	FIXED TILT 15°	
AZIMUTH	0°	
PANEL TILT ANGLE	15°	
ROW TO ROW SPACING	21' - 7"	
GROUND COVER RATIO	0.62 (TBC)	
FENCED IN AREA	AREA #1	APPROX. 4.6 ACRES
	AREA #2	APPROX. 13.26 ACRES
	AREA #3	APPROX. 22.04 ACRES
	AREA #4	APPROX. 8.18 ACRES
	AREA #5	APPROX. 7.79 ACRES
	TOTAL	APPROX. 56.23 ACRES

1. MODULES ARE POSITIONED TWO DEEP IN PORTRAIT ORIENTATION.



NOTE: EACH TRACKER CONTAINS (2) STRINGS OF (28) PV MODULES.

2 / - TRACKER STRING DETAIL

SCALE: NONE

N W E S

SCALE: 1" = 200'

0 200' 400' FT

Distributed Energy

AES Distributed Energy
282 Century Pl. Suite 2000
Louisville, CO 80027 USA

3J CONSULTING
CIVIL ENGINEERING
WATER RESOURCES
COMMUNITY PLANNING
9600 SW NIMBUS AVE, SUITE 100; BEAVERTON, OR 97008

SYSTEM DESCRIPTION

REVISIONS

REV	BY	DATE	DESCRIPTION

PE STAMP

OVERALL SITE PLAN
WEST OAHU SOLAR
AES DE
OAHU, HI

PROJECT NUMBER
19537
PHASE
ISSUED FOR REVIEW
MILESTONE
30% DESIGN

ELECTRICAL DESIGNER

STRUCTURAL DESIGNER

DATE 12-04-2019 **SCALE** 1"=200'

TITLE

DRAWING
C200

Attachment B. Figures

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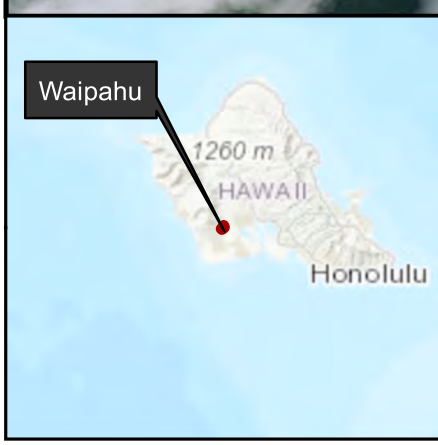


Legend

Project Layout (PV Array Areas)

*Locations are approximate

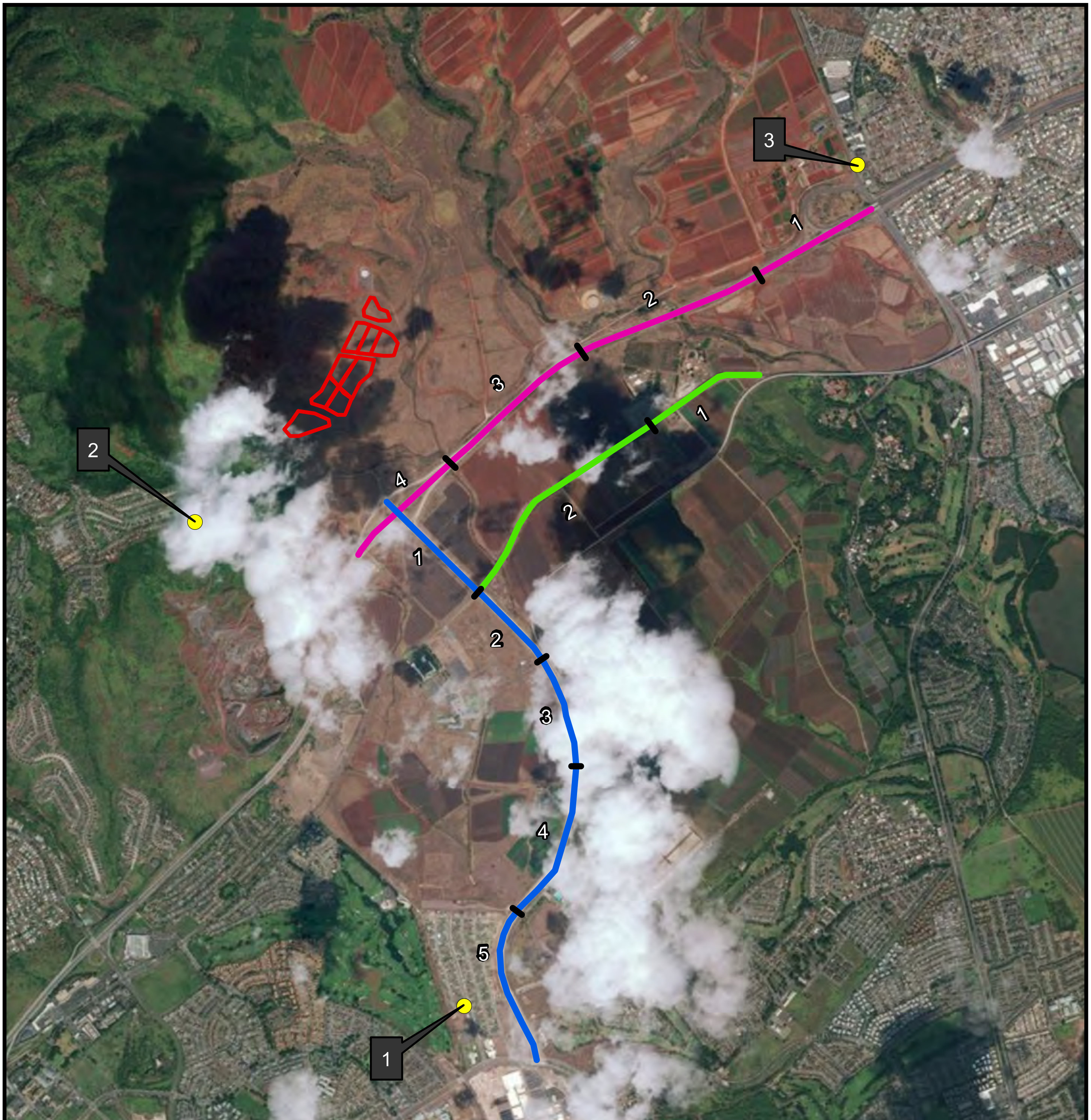
0 375 750 1,500 Feet

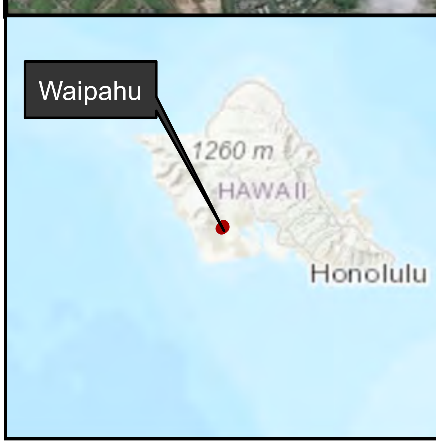
TETRA TECH

Figure 1
PV Array Areas

West Oahu Solar
Oahu, Hawaii

Sources: ESRI Digital Globe 2018 (Basemap)





Legend

- Project Layout (PV Array Areas)
- OPs
- Farrington
- Highway 1 (H1)
- Kualakai

*Locations are approximate

Feet: 0, 1,625, 3,250, 6,500

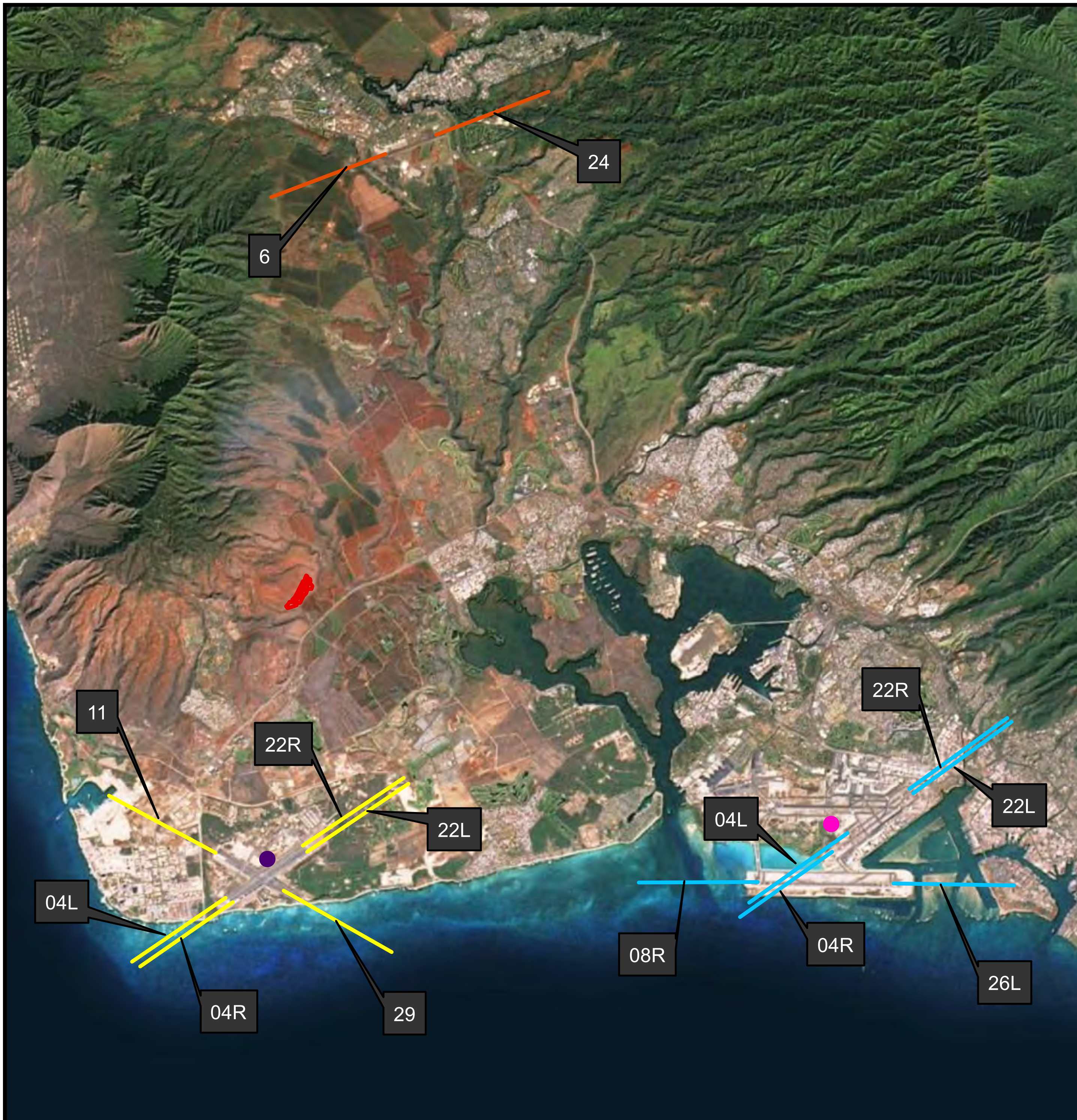
N

TETRA TECH

Figure 2
Receptors

West Oahu Solar
Oahu, Hawaii

Sources: ESRI Digital Globe 2018 (Basemap)



Legend

(red outline)	Project Layout (PV Array Areas)	(yellow line)	JRF Final Approach
(blue line)	HNL Final Approach	(purple dot)	JRF ATCT
(pink dot)	HNL ATCT	(orange line)	HHI Final Approach

*Locations are approximate

Miles: 0, 1.25, 2.5, 5

TETRA TECH

Figure 3
Airport Receptors

West Oahu Solar
Oahu, Hawaii

Sources: ESRI Digital Globe 2018 (Basemap)

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Attachment C. ForgeSolar Glare Analysis Reports

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FORGESOLAR GLARE ANALYSIS

Project: **AES - Hawaii**
Site configuration: **West Oahu Solar**
Analysis conducted by Josh Burdett (joshua.burdett@tetratech.com) at 20:36 on 12 Dec, 2019.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	N/A	No flight paths analyzed
ATCT(s)	N/A	No ATCT receptors designated

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

SITE CONFIGURATION

Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 34061.6258

PV Array(s)

Name: PV Area 1
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.378202	-158.062098	414.48	7.60	422.08
2	21.377800	-158.062280	419.04	7.60	426.64
3	21.377602	-158.062377	415.86	7.60	423.46
4	21.377450	-158.062465	411.42	7.60	419.02
5	21.377213	-158.062374	398.76	7.60	406.36
6	21.376973	-158.061441	350.35	7.60	357.96
7	21.377008	-158.060918	333.62	7.60	341.22
8	21.377120	-158.060923	338.28	7.60	345.88
9	21.377490	-158.061106	356.91	7.60	364.51
10	21.377622	-158.061476	374.30	7.60	381.90
11	21.378147	-158.061891	404.33	7.60	411.93

Name: PV Area 2-1
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.376881	-158.062833	410.48	7.60	418.08
2	21.376459	-158.063010	418.17	7.60	425.77
3	21.375907	-158.063270	403.44	7.60	411.04
4	21.375544	-158.063457	390.88	7.60	398.48
5	21.375315	-158.063565	394.11	7.60	401.71
6	21.375277	-158.063152	370.95	7.60	378.55
7	21.375227	-158.062736	356.59	7.60	364.19
8	21.375574	-158.062618	369.95	7.60	377.55
9	21.376031	-158.062454	383.79	7.60	391.39
10	21.376511	-158.062293	385.02	7.60	392.62
11	21.376713	-158.062218	382.76	7.60	390.36
12	21.376833	-158.062401	392.49	7.60	400.09

Name: PV Area 2-2
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.376711	-158.062205	381.82	7.60	389.42
2	21.376361	-158.062326	386.07	7.60	393.67
3	21.375894	-158.062492	380.15	7.60	387.75
4	21.375450	-158.062645	364.88	7.60	372.48
5	21.375217	-158.062728	355.93	7.60	363.53
6	21.375152	-158.062331	344.64	7.60	352.24
7	21.375065	-158.061803	333.62	7.60	341.22
8	21.375484	-158.061666	342.96	7.60	350.56
9	21.375989	-158.061513	354.20	7.60	361.80
10	21.376499	-158.061365	347.02	7.60	354.62
11	21.376598	-158.061776	365.54	7.60	373.14

Name: PV Area 2-3
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.376496	-158.061349	345.68	7.60	353.28
2	21.376129	-158.061451	353.34	7.60	360.94
3	21.375649	-158.061591	344.73	7.60	352.33
4	21.375267	-158.061711	337.77	7.60	345.37
5	21.375055	-158.061786	333.19	7.60	340.80
6	21.375025	-158.061175	318.48	7.60	326.08
7	21.375050	-158.060813	303.34	7.60	310.94
8	21.375095	-158.060542	290.44	7.60	298.04
9	21.375475	-158.060413	294.34	7.60	301.94
10	21.375724	-158.060362	297.35	7.60	304.95
11	21.376002	-158.060582	314.55	7.60	322.15
12	21.376299	-158.060797	321.82	7.60	329.42

Name: PV Area 3-1
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.374960	-158.063771	403.94	7.60	411.54
2	21.374550	-158.064018	409.08	7.60	416.68
3	21.374006	-158.064372	405.79	7.60	413.39
4	21.373486	-158.063921	358.12	7.60	365.72
5	21.374071	-158.063321	356.56	7.60	364.16
6	21.374800	-158.062698	341.18	7.60	348.79
7	21.375030	-158.063702	401.45	7.60	409.05

Name: PV Area 3-2
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.373471	-158.063900	356.53	7.60	364.13
2	21.373052	-158.063605	329.89	7.60	337.49
3	21.372872	-158.063063	308.33	7.60	315.93
4	21.373132	-158.062811	306.55	7.60	314.15
5	21.373511	-158.062468	302.42	7.60	310.02
6	21.373911	-158.062012	300.71	7.60	308.31
7	21.374650	-158.061711	322.58	7.60	330.18
8	21.374790	-158.062634	337.82	7.60	345.42
9	21.374361	-158.063010	346.18	7.60	353.78
10	21.373771	-158.063557	360.52	7.60	368.12
11	21.373431	-158.063927	356.09	7.60	363.69

Name: PV Area 3-3
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.373971	-158.064423	405.46	7.60	413.06
2	21.373346	-158.064702	408.59	7.60	416.19
3	21.372987	-158.064917	407.08	7.60	414.68
4	21.372597	-158.065507	390.32	7.60	397.92
5	21.372397	-158.065474	370.08	7.60	377.68
6	21.372093	-158.064670	325.30	7.60	332.90
7	21.372627	-158.064343	352.86	7.60	360.46
8	21.373376	-158.063887	352.43	7.60	360.03

Name: PV Area 3-4
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.373311	-158.063844	348.21	7.60	355.81
2	21.372912	-158.064117	354.61	7.60	362.22
3	21.372332	-158.064477	337.76	7.60	345.36
4	21.372073	-158.064616	321.88	7.60	329.48
5	21.371838	-158.064101	301.52	7.60	309.12
6	21.371713	-158.063763	289.80	7.60	297.40
7	21.371698	-158.063415	280.75	7.60	288.35
8	21.372113	-158.063200	288.24	7.60	295.85
9	21.372807	-158.063007	305.71	7.60	313.31
10	21.372967	-158.063495	325.17	7.60	332.77
11	21.373032	-158.063661	332.00	7.60	339.60
12	21.373232	-158.063774	341.54	7.60	349.14

Name: PV Area 4
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.371341	-158.066427	397.82	7.60	405.42
2	21.371151	-158.066598	400.08	7.60	407.68
3	21.370776	-158.066875	379.77	7.60	387.37
4	21.370671	-158.066832	364.94	7.60	372.54
5	21.370531	-158.066590	351.04	7.60	358.64
6	21.370651	-158.065957	338.58	7.60	346.18
7	21.370836	-158.065356	317.01	7.60	324.61
8	21.371091	-158.064434	293.63	7.60	301.23
9	21.371416	-158.064423	295.80	7.60	303.40
10	21.371675	-158.065072	321.71	7.60	329.31
11	21.371765	-158.065963	374.69	7.60	382.29

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 1	1	21.338918	-158.055780	62.34	6.00
OP 2	2	21.365603	-158.072233	580.70	5.00
OP 3	3	21.386054	-158.033239	227.55	5.00

Route Receptor(s)

Name: Farrington -1
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.374314	-158.038678	145.95	5.00	150.95
2	21.374270	-158.040953	161.53	5.00	166.53
3	21.374074	-158.041468	165.25	5.00	170.25
4	21.371476	-158.045244	172.88	5.00	177.88

Name: Farrington - 2
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.371337	-158.045416	172.99	5.00	177.99
2	21.368939	-158.049107	172.07	5.00	177.07
3	21.366881	-158.052196	167.23	5.00	172.23
4	21.366321	-158.052604	164.96	5.00	169.96
5	21.362824	-158.054514	154.31	5.00	159.31
6	21.362164	-158.055179	155.55	5.00	160.55

Name: H 1 - 1
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.383670	-158.032421	174.50	5.00	179.50
2	21.383101	-158.033311	183.18	5.00	188.18
3	21.382202	-158.034942	180.15	5.00	185.15
4	21.381033	-158.037012	192.95	5.00	197.95
5	21.379864	-158.039115	181.51	5.00	186.51

Name: H 1 - 2
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.379784	-158.039212	180.23	5.00	185.23
2	21.378825	-158.040950	184.82	5.00	189.83
3	21.378086	-158.042849	176.17	5.00	181.17
4	21.377196	-158.045166	170.51	5.00	175.51
5	21.376093	-158.047863	197.59	5.00	202.59
6	21.375454	-158.049472	200.45	5.00	205.45

Name: H 1 - 3
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.375384	-158.049558	200.81	5.00	205.81
2	21.374635	-158.050770	224.53	5.00	229.53
3	21.373785	-158.051961	218.02	5.00	223.02
4	21.372457	-158.053453	212.66	5.00	217.66
5	21.370868	-158.055212	204.08	5.00	209.08
6	21.369140	-158.057100	199.86	5.00	204.86

Name: H 1 - 4
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.369060	-158.057143	198.86	5.00	203.86
2	21.366202	-158.060383	213.91	5.00	218.92
3	21.365253	-158.061435	206.63	5.00	211.63
4	21.364254	-158.062325	213.41	5.00	218.41

Name: Kualakai - 1
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.366859	-158.060799	229.85	5.00	234.85
2	21.366040	-158.059962	204.96	5.00	209.96
3	21.365001	-158.058804	185.96	5.00	190.96
4	21.363982	-158.057624	172.93	5.00	177.93
5	21.362703	-158.056143	160.77	5.00	165.77
6	21.362083	-158.055499	157.30	5.00	162.30