APPLICATION FOR CERTIFICATION

STAFF QUERIES, SET 2

(RESPONSES TO ANDREA KOCH E-MAIL)

DOCKET
09-AFC-3
DATE RECD. AUG 09 2010

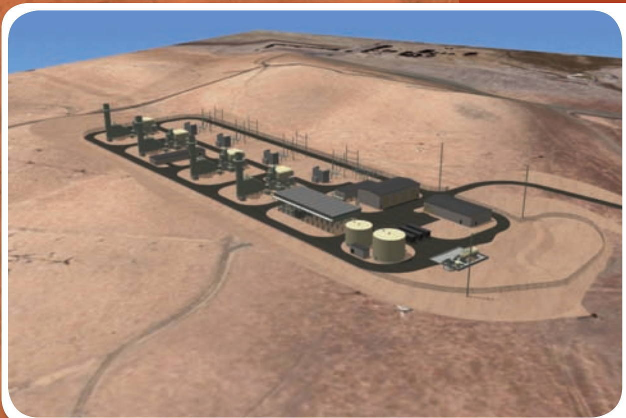
SUBMITTED TO THE

California Energy Commission

FOR THE

Mariposa Energy Project

(09-AFC-03)



SUBMITTED BY

Mariposa Energy, LLC

TECHNICAL ASSISTANCE BY

CH2MHILL

AUGUST 2010

EY012009005SAC

Mariposa Energy Project
(09-AFC-03)

Staff Queries, Set 2
(Responses to Andrea Koch E-mail)

Submitted to
California Energy Commission

Submitted by
Mariposa Energy, LLC

with assistance from

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August 2010

Contents

Attachments

Introduction

Attached are Mariposa Energy's responses to a CEC Staff Query (SQ) from Andrea Koch dated June 30, 2010 regarding the Mariposa Energy Project (MEP) (09-AFC-03) Application for Certification (AFC).

The responses are presented in the same order as the questions within the original correspondence from CEC and are sequentially numbered following Staff Query Set 1. New or revised graphics or tables are numbered in reference to the Staff Query number. For example, the first table used in response to Staff Query 36 would be numbered Table SQ36-1. The first figure used in response to Staff Query 42 would be Figure SQ42-1, and so on. Similarly, the first table used in response to Staff Query 36 would be numbered Table DR36-1, and so on.

Additional tables, figures, or documents submitted in response to a Staff Query (supporting data, stand-alone documents such as plans, folding graphics, etc.) are found at the end of each discipline-specific section and are not sequentially page-numbered consistently with the remainder of the document, though they may have their own internal page numbering system.

Andrea Koch E-mail (Staff Queries 23–27)

Background

CEC Staff Andrea Koch presented five queries regarding the Mariposa Energy Power Plant's (MEP) potential affect on air traffic from the Byron Airport at the MEP June 30, 2010 Data Response Workshop. Following are Ms. Koch's queries followed by Mariposa Energy's responses.

Staff Query

SQ23. Are there any graphics showing air traffic patterns at the Byron Airport?

Response:

Attachment SQ23-1 includes maps from the Contra Costa County Airport Land Use Compatibility Plan: Figure 4C and Exhibits 6D, 6E & 6F. Attachment SQ23-2 presents the AirNav description of runway patterns in the Runway Information portion of the AirNav FAA information. Detailed discussion of the approach patterns can be found in Staff Query Set 1, responses to SQ-2 and SQ-3. Attached also is Attachment SQ23-3, which indicates the typical Visual Flight Rule ("VFR") traffic patterns around Runways 23 & 5 and 30 & 12 based upon FAA Order 7400.2 G, "Procedures for Handling Airspace Matters, Figure 6-3-11, since Byron Airport is approved by the FAA for Category A & B aircraft.

Staff Query

SQ24. Do planes like ultra lights or gliders use other than the standard altitude patterns?

Response:

FAA Advisory Circular (AC 90-66), *Recommended Standard Traffic Patterns and Practices for Aeronautical Operations at Airports without Operating Control Towers* recommends traffic patterns and operational procedures for aircraft, lighter-than-air, glider, parachute, helicopter and ultralight vehicle operations at airports such as Byron, which do not have operating air traffic control towers. The FAA has designed these recommended traffic patterns in order to improve the safety and efficiency of aeronautical operations at such airports.

FAA AC 90-66 recommends that small and medium size airplanes maintain a 1,000 foot AGL traffic pattern altitude. Large and turbine-powered airplanes are recommended to maintain a traffic pattern altitude of 1,500 feet AGL or 500 feet above the established pattern altitude. Gliders are recommended to use a lower (500 foot) and closer in pattern than do powered aircraft, thereby segregating themselves from the powered aircraft traffic pattern.

Staff Query

SQ25. Is there any data on the number of over flights that occur at the site of the proposed MEP?

Response:

In order to determine if aircraft flying in the vicinity of Byron Airport fly in the published approaches and patterns indicated by the Contra Costa County – Airport Land Use Plan and by recommendation issued by the FAA for non-towered airports, Mariposa Energy, LLC obtained radar flight track data for the Byron Airport area. Radar flight tracking data was obtained from the FAA, Northern California Terminal Radar Approach Control (NCT), located at Mather Airport, through the Freedom of Information Act process.

Source & Accuracy of Information

The flight tracks were produced by the FAA by first extracting the track data from the FAA data tapes and then processing the tracks through a software program called the Performance Data Analysis and Reporting System (PDARS). The PDARS system is developed and maintained by ATAC Corporation, Sunnyvale, CA. ATAC developed PDARS under joint sponsorship of the FAA and NASA to monitor, measure, analyze, and graphically display air traffic operations performance based on radar flight track data from air traffic control facilities. The goal was to create a system-wide capability to monitor day-to-day operations of the National Airspace System (NAS) and to measure Air Traffic Control's delivery of services, to ensure that they are safe, efficient, and meet the needs of its customers.

The FAA radar system at Mather Airport tracks all aircraft that are equipped with transponders and are transmitting on discrete or non-discrete beacon codes. Aircraft that typically fly in the San Francisco Bay area must have transponders since they are required to enter Class B and Class C airspace, which includes airspace as far south as San Jose; San Rafael and Vallejo to the north; and Livermore to the east. The vast majority of aircraft currently operating within the national airspace system are equipped with transponders, while other aircraft may add them if required for the airspace they fly in. Aircraft that remain outside of Class B and Class C airspace may or may not have transponders and would not be shown on these radar flight tracks. Aircraft such as ultra lights and power parachutes are unlikely to have transponders. Many, but not all gliders are equipped with transponders.

Radar Track Position Accuracy

According to the FAA, the Radar beacon track data obtained from the NCT ASR-11 digitized Radar system is certified to the following accuracies[1]:

MOE 3.3 Beacon Accuracy: Is the beacon sufficiently accurate in reporting the position of the aircraft to support the air traffic controller?

> **MOP 3.3.1 Beacon Range Accuracy:** 190 feet.
>
> **MOP 3.3.2 Beacon Azimuth Accuracy:** 0.08 degrees RMS.

MOE 3.4 Beacon Resolution: Is the beacon resolution capability to resolve two closely spaced aircraft sufficient to support the air traffic controller?

> **MOP 3.4.1 Beacon Range Resolution:** 95% when identical targets are separated in slant range by 0.05 to 0.5 nmi (304 to 3,040 feet) inclusive (assuming identical transponder reply delays) and 99.9 & when they are separated by more than 0.5 nmi (3,040 feet).
>
> **MOP 3.4.2 Beacon Azimuth Resolution:** 95% for two identical targets, which are 0.05, nmi (304 feet) of each other in slant range and separated by 2.1 degrees (assuming identical transponder delays). Additionally, 99% for the same two targets which are within 0.05 nmi (304 feet) of each other in slant range and have at least one distinguishing characteristic and are separated by 1.5 degrees.

Summary

In other words, the target positions of the depicted Byron Airport radar flight tracks are accurate within the above stated limits, 190 feet for an individual aircraft and when identifying multiple aircraft to within 304 feet of each other, depending on conditions. The aircraft are actually tracking over the ground in the same positions and directions as depicted on the radar flight tracks and radar coverage over Byron Airport extends down to the airport surface. According to the FAA, the only filter used for the track data was distance from the Byron Airport (5 nautical miles). The tracks displayed include all radar targets within 5 nautical miles of the Byron Airport. All depicted aircraft tracks are actual radar targets and are neither extrapolated nor predicted from other observed data.

Results of Flight Track Data

Flight track data has currently been obtained for two time periods, thirteen (13) days in the December 2009 and January 2010 timeframe and fifteen (15) days from March 1 to 15, 2010. In the first group the specific days were, December 8, 10, 11, 12, 13, 24, 25, 26, 27 and 31, along with January 1, 2 and 3, 2010. These days were received from

[1] FAA Acquisition System Tool, Test and Evaluation, Appendix D, MOE 3.3, 3.4, Beacon Accuracy, ASR-11

the FAA in the initial data request and future requests were for continuous fifteen (15) day periods. The combined flight tracks for each period are presented in Attachment SQ25-1.

During the first period there were 209 flight tracks recorded on the radar and most of these were either in expected approaches or flight patterns. Those that were not in expected approaches or patterns tended to be north of the Byron Airport or east near the Clifton Court Forebay. Of the 209 flight tracks only 13 were within 0.5 miles of the proposed Mariposa Energy location, of these 3 were between 500 – 1000 feet AGL (referenced to the Byron Airport elevation), 6 were between 1000 – 1300 feet AGL and 4 were 1300 – 1500 feet AGL. *None were below 500 feet.* Even without the Mariposa Energy facility being located there very few aircraft overfly this area, if the facility was there, aircraft would easily see it and avoid overflight.

For the second period there were 860 flight tracks recorded within 5 miles of the Byron Airport and again most of these are in expected approaches or flight patterns for Byron Airport or located to the northeast of the airport. Of the 860 recorded flight tracks only 14 were within 0.5 miles of the proposed Mariposa Energy site and *only one* was indicated between 0 – 500 feet AGL (0.12%). Four were located between 500 – 1000 feet AGL, 5 were identified as being between 1000 – 1300 feet AGL and 4 were between 1300 – 1500 feet AGL.

The radar flight track data indicates that most aircraft generally follow the air traffic patterns around the two runways at Byron Airport. The few planes that would fly over the proposed site of the Mariposa Energy facility, upon seeing it, could easily maneuver not to overfly the facility, especially if information about Mariposa Energy is posted on the Byron Airport Air Nav site and in the Airport/Facility Directory. Total flight counts would be expected to be higher during summer months; however the geographic usage patterns should be consistent, with the vast majority of aircraft adhering to recommended flight patterns near Byron Airport.

Staff Query

SQ26. Would the project cause any radiofrequency interference with aircraft, such as from walkie-talkies during construction?

Response:

The Mariposa Project would be using walkie-talkies and other communications equipment that has been approved by the FCC for use in local mobile communications and all electrical equipment meets ANSI, ASTM or NEC requirements with respect to possible radio frequency interference. The walkie-talkies used at Mariposa would be similar to the ones used by various individuals at airports to coordinate maintenance and other staff activities. The frequencies used at the Byron Airport are: 123.5 megahertz for CTAF/Unicom; 123.775 megahertz for WXAWOS; NORCAL Approach or Departure at 123.85 megahertz and nearby navigation aids ranging from 114.1 to 117.0 megahertz. MEP will typically be using communications equipment in the 20 to 50 megahertz or 148 to 174 megahertz ranges, which are outside the frequency ranges reserved for aviation use. Currently, the PG&E Gas Compression Station, the California Aqueduct Pumping Station, the

Delta-Mendota Canal Pumping Station and the WAPA Tracy Substation all have mobile communication equipment and it does not appear to interfere with Byron Airport operations.

Staff Query

SQ27. In the "Analysis of Aircraft Loads and Handling," do the aircraft analyzed represent those most often used at the Byron Airport?

Response:

Byron Airport has a mixture of piston engine, turboprop, business jet, historic jet, glider, ultra light and helicopter aircraft using the airport. By evaluating Cessna Citation II, business jet; Cessna 172, piston engine; Vans RV-6, piston engine / experimental; Powered Parachute piston engine / experimental; Beech 99, turboprop; and Learjet 24, business jet; we have looked at the majority of the type of aircraft that would be using the Byron Airport. Additional information for gliders, ultra lights and helicopters is attached as Attachment SQ27-1, Senta Engineering PowerPoint presentation and includes Eurocopter BO-105 and Boeing OH-6A helicopters; MIG-19 and L-39 jet aircraft; along with Grob G-103, Quicksilver MX Sprint and Schweizer 1-36 in the glider and ultra light categories. The most expected aircraft using the Byron Airport would be a single piston engine aircraft like a Cessna 172.

ATTACHMENT SQ23-1

Contra Costa County Airport Land Use Compatibility Plan Traffic Pattern Exhibits

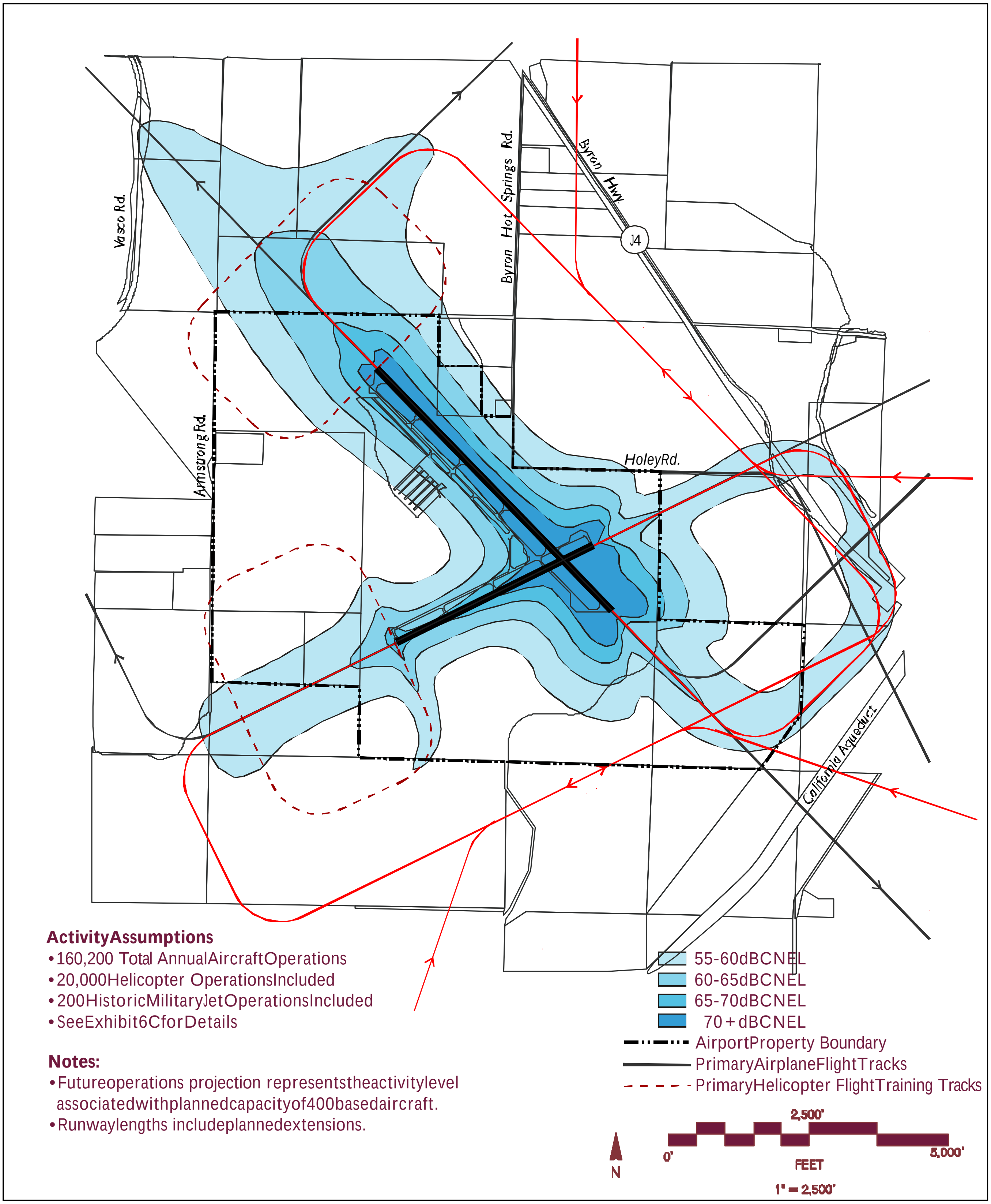


Figure 4C

Projected Noise Contours

Byron Airport

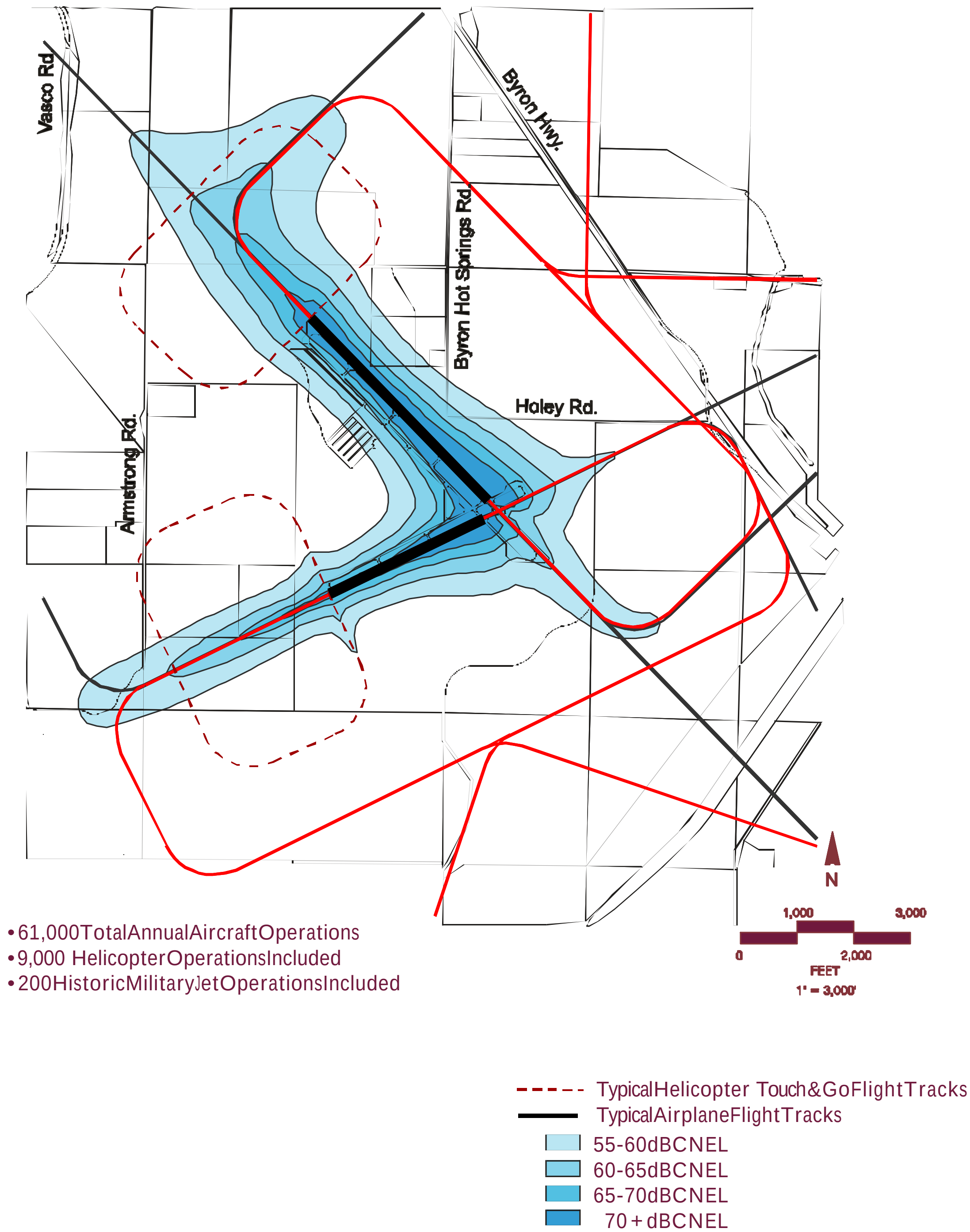
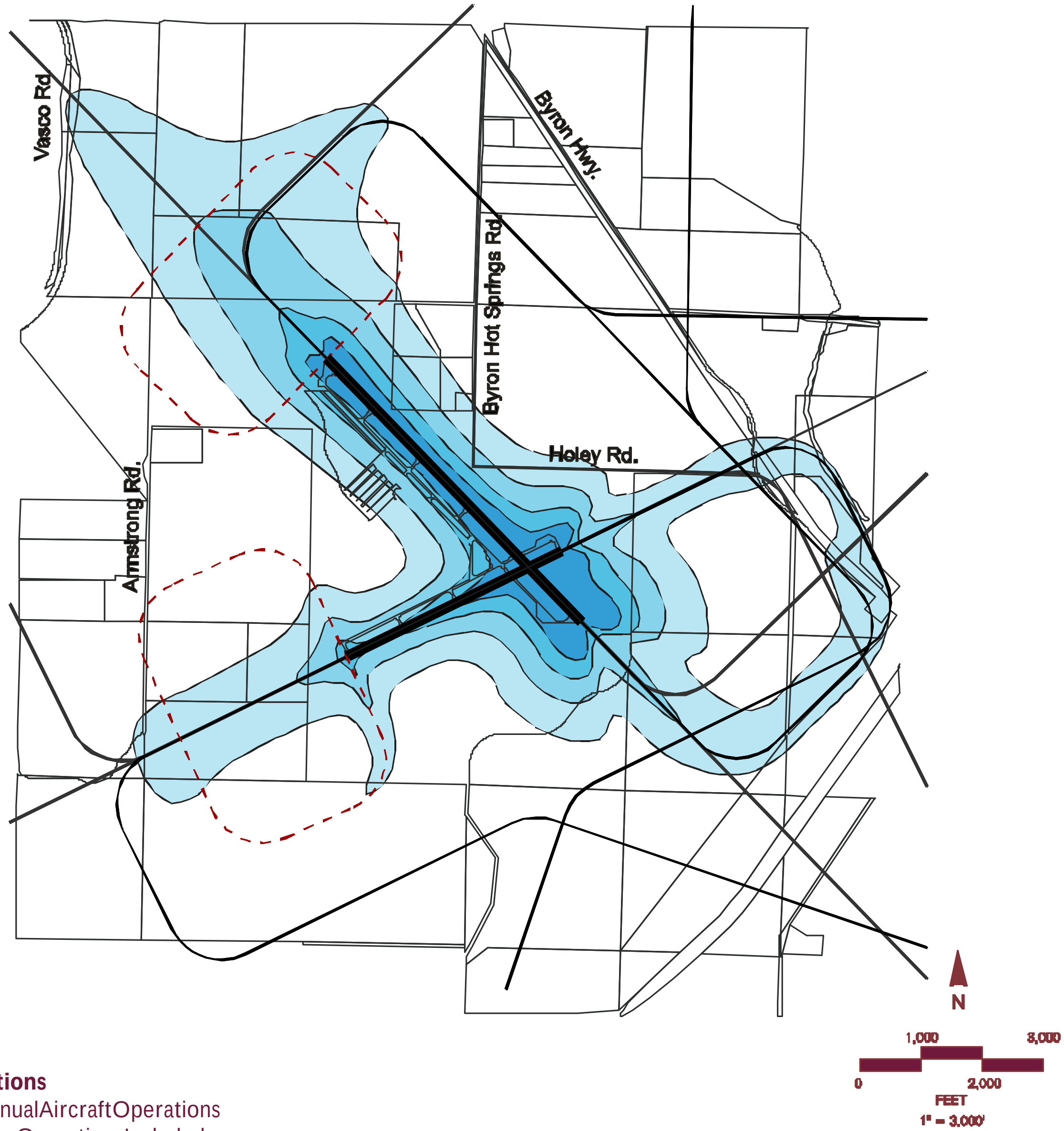


Exhibit 6D

Current Noise Contours

Total Activity

Byron Airport



Activity Assumptions

- 160,200 Total Annual Aircraft Operations
- 20,000 Helicopter Operations Included
- 200 Historic Military Jet Operations Included

Note:

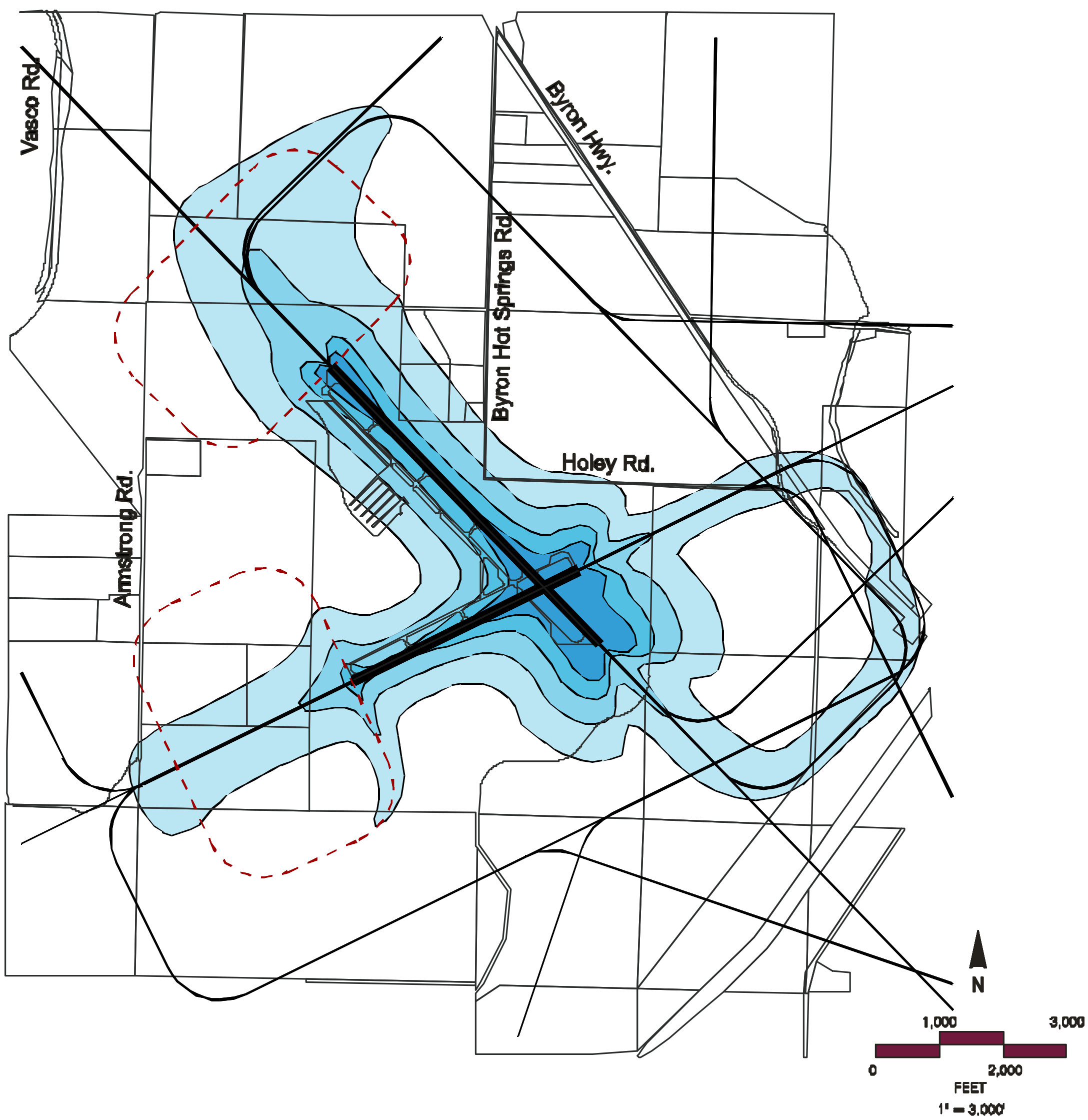
- Future operations projection represents the activity level associated with planned capacity of 380 based aircraft.

- - - - Typical Helicopter Touch & Go Flight Tracks
—— Typical Airplane Flight Tracks

- 55-60 dB CNEL
- 60-65 dB CNEL
- 65-70 dB CNEL
- 70+ dB CNEL

Exhibit 6E

Projected Noise Contours
with Historic Aircraft
Byron Airport



- 160,000 Total Annual Aircraft Operations
- 20,000 Helicopter Operations Included

Typical Helicopter Touch & Go Flight Tracks
Typical Airplane Flight Tracks

55-60 dB CNEL
60-65 dB CNEL
65-70 dB CNEL
70+ dB CNEL

Note: Future operations projection represents the activity level associated with planned capacity of 380 based aircraft.

Source: Shutt Moen Associates (April 2000)

Exhibit 6F

Projected Noise Contours
without Historic Aircraft
Byron Airport

ATTACHMENT SQ23-2

AirNav Description of Byron Airport Runway Patterns

Airports | Navaids | Airspace Fixes | Aviation Fuel | AIRBOSS | Pilot Shop

1790 users online LOGIN

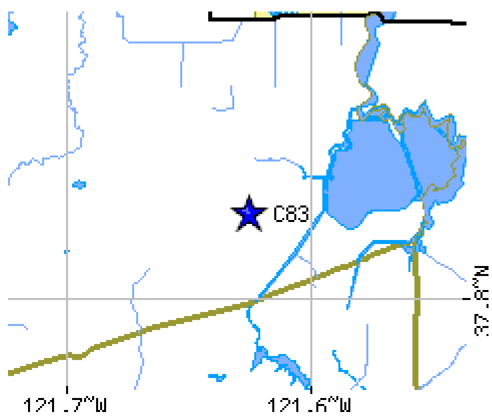
C83 Byron Airport
Byron, California, USA

FAA INFORMATION EFFECTIVE 03 JUNE 2010

Loc | Ops | Rwys | IFR | FBO | Links
Com | Nav | Svcs | Stats | Notes

Location

FAA Identifier: C83
Lat/Long: 37-49-42.4000N / 121-37-33.0000W
37-49.706667N / 121-37.550000W
37.8284444 / -121.6258333
(estimated)
Elevation: 79 ft. / 24.1 m (surveyed)
Variation: 15E (1995)
From city: 2 miles S of BYRON, CA
Time zone: UTC -7 (UTC -8 during Standard Time)
Zip code: 94514



Road maps at: MapQuest MapPoint Yahoo! Maps Google Rand McNally
Satellite photo at: TerraServer Virtual Earth

Airport Operations

Airport use: Open to the public
Activation date: 11/1994
Sectional chart: SAN FRANCISCO
Control tower: no
ARTCC: OAKLAND CENTER
FSS: OAKLAND FLIGHT SERVICE STATION
NOTAMs facility: OAK (NOTAM-D service available)
Attendance: 0800-1800
Segmented circle: yes
Lights: DUSK-DAWN
ACTVT MIRL RYS 12/30 & 05/23 & REIL RY 30 - CTAF.
Beacon: white-green (lighted land airport)

Aerial photo

WARNING: Photo may not be current or correct

Airport Communications

CTAF/UNICOM: 123.05
WX AWOS-3: 123.775 (925-634-0906)
NORCAL APPROACH: 123.85
NORCAL DEPARTURE: 123.85
WX AWOS-3 at TCY (12 nm SE): 118.375 (209-831-4335)

WX ASOS at LVK (12 nm SW): PHONE 925-606-5412
WX ASOS at SCK (19 nm E): PHONE 209-982-4270

Nearby radio navigation aids

VOR radial/distance	VOR name	Freq	Var
ECAr252/21.5	MANTECA VORTAC	116.00	17E
CCRr106/23.7	CONCORD VOR/DME	117.00	17E
OAKr061/29.0	OAKLAND VORTAC	116.80	17E
SJCr013/31.2	SAN JOSE VOR/DME	114.10	16E
TZZr147/(32.2)	TRAVIS VOR	116.40	17E
LINr226/32.9	LINDEN VORTAC	114.80	17E
MODr274/33.9	MODESTO VOR/DME	114.60	17E
SACr168/37.1	SACRAMENTO VORTAC	115.20	17E
SFOr054/37.7	SAN FRANCISCO VOR/DME	115.80	17E

NDB name	Hdg/Dist	Freq	Var	ID	
REIGA	003/8.6	374	16E	LV	.-.. ...-
TRACY	299/11.9	203	15E	TCY	- -.-. -.--

Airport Services

Fuel available: 100LL
FUEL AVBL 24 HRS BY CREDIT CARD.

Runway Information

Runway 12/30

Dimensions:	4500 x 100 ft. / 1372 x 30 m	
Surface:	asphalt, in good condition	
Weight bearing capacity:	Single wheel: 29.5	
Runway edge lights:	medium intensity	
	RUNWAY 12	**RUNWAY 30**
Latitude:	37-50.141590N	37-49.614882N
Longitude:	121-37.892008W	121-37.234142W
Elevation:	64.1 ft.	48.4 ft.
Traffic pattern:	left	right
Runway heading:	120 magnetic, 135 true	300 magnetic, 315 true
Markings:	nonprecision, in good condition	nonprecision, in good condition
Visual slope indicator:		2-light PAPI on left (3.50 degrees glide path)
Runway end identifier lights:		yes
Touchdown point:	yes, no lights	yes, no lights
Obstructions:	61 ft. pole, 1591 ft. from runway, 261 ft. right of centerline, 22:1 slope to clear	65 ft. hill, 3218 ft. from runway, 729 ft. left of centerline, 46:1 slope to clear

Photo by Amelia Andrea Mihutoni
Photo taken 06-Mar-2009

Do you have a better or more recent aerial photo of Byron Airport that you would like to share? If so, please **send us your photo**.

Sectional chart

Airport distance calculator

Flying to Byron Airport? Find the distance to fly.

From to C83
CALCULATE DISTANCE

Sunrise and sunset

Times for 26-Jul-2010

	Local (UTC-7)	Zulu (UTC)
Morning civil twilight	05:36	12:36
Sunrise	06:06	13:06
Sunset	20:20	03:20
Evening civil twilight	20:50	03:50

Current date and time

Zulu (UTC)	26-Jul-2010 18:10:18
Local (UTC-7)	26-Jul-2010 11:10:18

METAR

KLVK 12nm SW	261753Z 29010KT 10SM CLR 19/11 A2988 RMK AO2 SLP115

Runway 5/23

Dimensions:	3000 x 75 ft. / 914 x 23 m	
Surface:	asphalt, in good condition	
Weight bearing capacity:	Single wheel: 29.5	
Runway edge lights:	medium intensity	
	RUNWAY 5	**RUNWAY 23**
Latitude:	37-49.339182N	37-49.562193N
Longitude:	121-37.806992W	121-37.250970W
Elevation:	78.5 ft.	48.6 ft.
Traffic pattern:	right	left
Runway heading:	048 magnetic, 063 true	228 magnetic, 243 true
Markings:	basic, in good condition	basic, in good condition
Visual slope indicator:		2-light PAPI on left (3.50 degrees glide path)
Touchdown point:	yes, no lights	yes, no lights

Airport Ownership and Management from official FAA records

Ownership: Publicly-owned
Owner: CONTRA COSTA COUNTY
550 SALLY RIDE DR
CONCORD, CA 94520
Phone 925-646-5722
Manager: KEITH FREITAS
550 SALLY RIDE DR
CONCORD, CA 94250
Phone 925-646-5722
MANAGER OF ARPTS CONTRA COSTA COUNTY.

Airport Operational Statistics

Aircraft based on the field:	109
Single engine airplanes:	64
Multi engine airplanes:	8
Jet airplanes:	11
Helicopters:	2
Gliders airplanes:	20
Ultralights:	4

Aircraft operations: avg 164/day *
92% local general aviation
8% transient general aviation
<1% military
* for 12-month period ending 29 January 2004

Additional Remarks

- ULTRALIGHT & SAILPLANE ACTIVITY ON & INVOF ARPT.
- RISING TERRAIN WITH NUMEROUS WINDMILLS ON RIDGES WEST OF ARPT.
- HANGAR APRON & TIEDOWN APRON 12500 LBS MAX.
- RY 30 CALM WIND RY.

T01890111 10189 20128 51001

KSCK 20nm E	261755Z VRB03KT 10SM CLR 22/11 A2983 RMK AO2 SLP101 T02220111 10222 20128 50005
KCCR 23nm NW	261753Z 26013KT 10SM CLR 18/10 A2988 RMK AO2 SLP103 T01830100 10183 20128 50001

TAF

KSCK 20nm E	261729Z 2618/2718 30006KT P6SM SKC FM262100 30011KT P6SM FEW150 FM270700 34005KT P6SM SKC

NOTAMs

Click for the latest **NOTAMs**

NOTAMs are issued by the DoD/FAA and will open in a separate window not controlled by AirNav.

- 200' TOWER 5600 FEET FROM RUNWAY 05.

- 100' TOWER 5100 FEET FROM RUNWAY 23.

Instrument Procedures

NOTE: All procedures below are presented as PDF files. If you need a reader for these files, you should download the free Adobe Reader.

NOT FOR NAVIGATION. Please procure official charts for flight.
FAA instrument procedures published for use between 1 July 2010 at 0901Z and 29 July 2010 at 0900Z.

IAPs - Instrument Approach Procedures

RNAV (GPS) RWY 30	download (274KB)
NOTE: Special Take-Off Minimums/Departure Procedures apply	download (40KB)

Other nearby airports with instrument procedures:

KTCY - Tracy Municipal Airport (12 nm SE)
KLVK - Livermore Municipal Airport (12 nm SW)
KSCK - Stockton Metropolitan Airport (19 nm E)
O88 - Rio Vista Municipal Airport (22 nm N)
KCCR - Buchanan Field Airport (23 nm NW)

FBO, Fuel Providers, and Aircraft Ground Support

Business Name	Contact	Services / Description	Fuel Prices	Comments
Contra Costa County (FBO)	925-634-0147	no information available If you are affiliated with Contra Costa County (FBO) and would like to show here your services, contact info, web link, logo, and more, click here	100LL SS $4.39 Updated 26-May-2010	3 read write

SS=Self service

UPDATE PRICES

Where to Stay: Hotels, Motels, Resorts, B&Bs, Campgrounds

In this space we feature lodging establishments that are convenient to the Byron Airport. If your hotel/inn/B&B/resort is near the Byron Airport, provides convenient transportation, or is otherwise attractive to pilots, flight crews, and airport users, consider listing it here.

FEATURE A LODGING ESTABLISHMENT

Hotels in other cities near Byron Airport

1 in Oakley	14 in Pleasanton
7 in Tracy	7 in Dublin
13 in Livermore	5 in Lathrop
3 in Antioch	7 in San Ramon

Would you like to see your business listed on this page?

If your business provides an interesting product or service to pilots, flight crews, aircraft, or users of the Byron Airport, you should consider listing it here. To start the listing process, click on the button below

ADD YOUR BUSINESS OR SERVICE

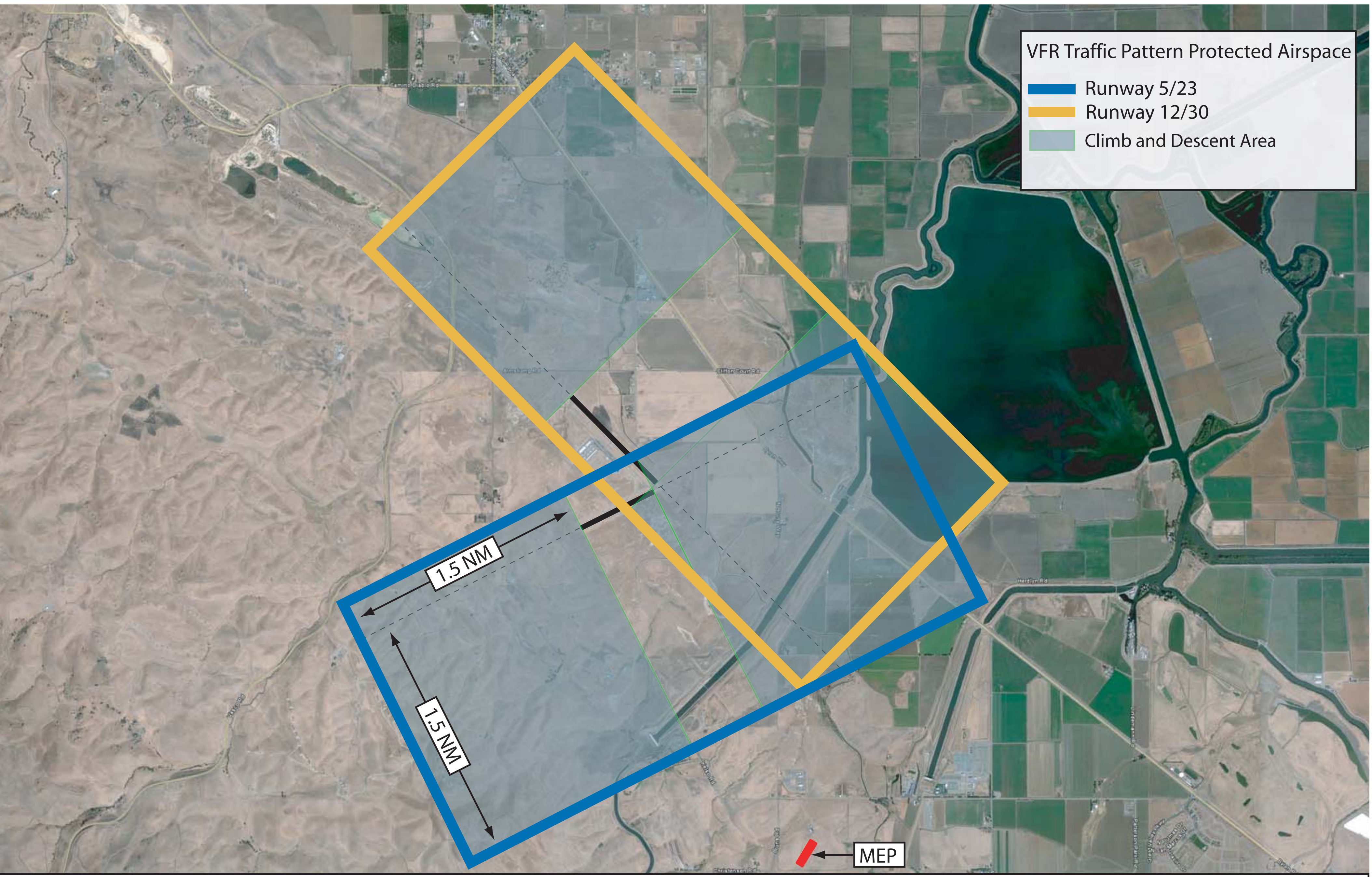
Other Pages about Byron Airport

- www.buchananfield-byronairports.org

UPDATE, REMOVE OR ADD A LINK

ATTACHMENT SQ23-3

Visual Flight Rule Traffic Pattern Protected Airspace



VFR Traffic Pattern Protected Airspace

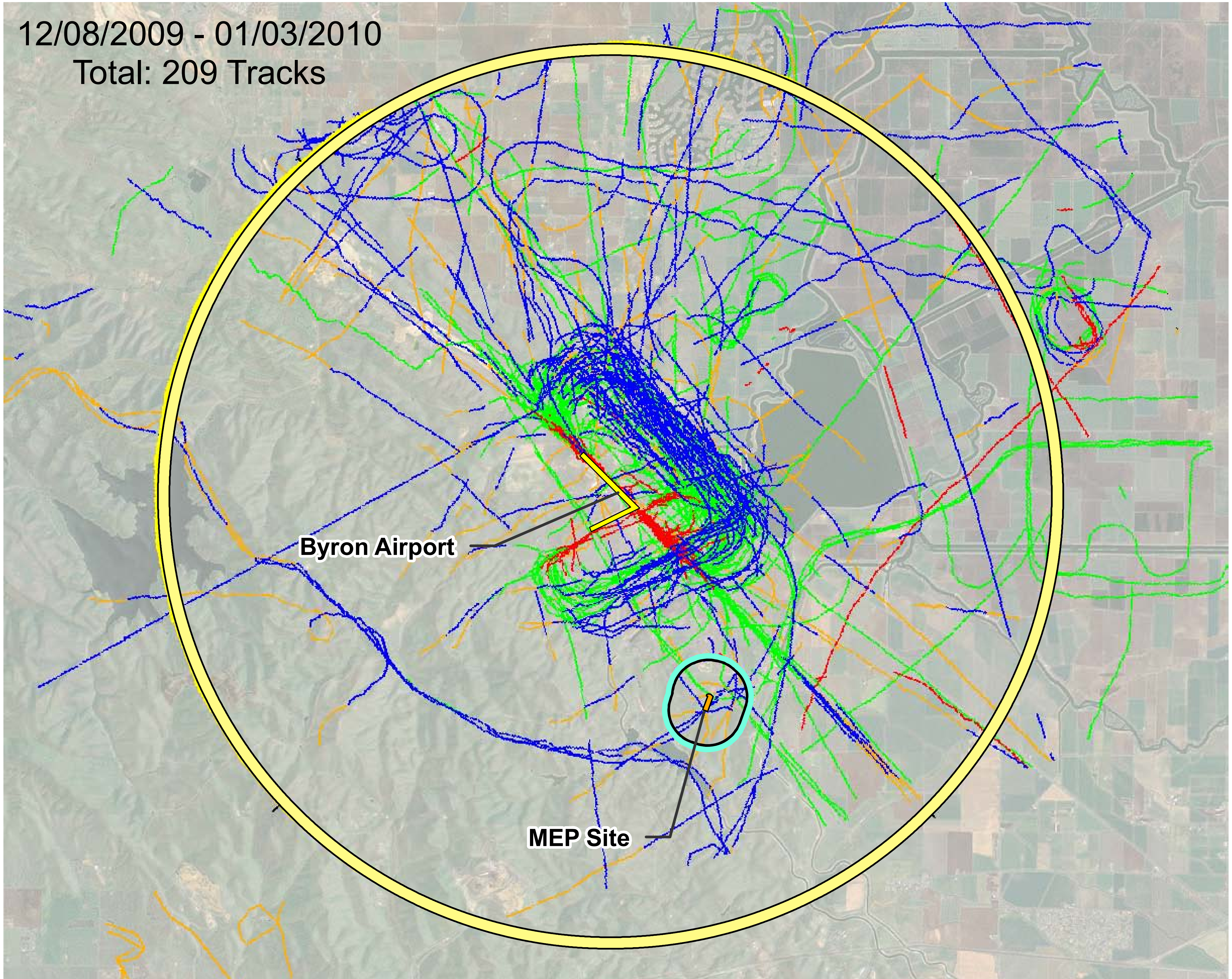
In conducting an Aeronautical Study, the FAA also evaluates the effect of an object on VFR traffic pattern operations. The traffic pattern protected airspace for Byron Airport is depicted as shown. The area extends outward from the runway thresholds for 1 ½ nautical miles and also extends for 1 ½ nautical miles abeam the runway on the side containing the traffic pattern downwind leg. (FAA Order 7400.2 Procedures for Handling Airspace Matters, Figure 6-3-11)

The shaded areas depict the VFR Traffic Pattern Climb/Descent Areas. The climb/descent area begins abeam the runway threshold being used and is the area where the pilot is either descending to land on the runway or climbing to pattern altitude. (FAA Order 7400.2 Procedures for Handling Airspace Matters, paragraph 6-3-8)

Note that the MEP is not located within the Byron Airport traffic pattern protected airspace and therefore the MEP will not have an adverse aeronautical impact on the Byron VFR traffic pattern.

ATTACHMENT SQ25-1

Byron Airport Flight Track Data



LEGEND

- BYRON AIRPORT RUNWAY
- PROJECT SITE
- HALF MILE PROJECT SITE BUFFER
- AIRPORT BUFFER 5 NAUTICAL MILE RADIUS

ALTITUDE

- 0 - 500 FEET
- 500 - 1000 FEET
- 1000 - 1300 FEET
- 1300 - 1500 FEET

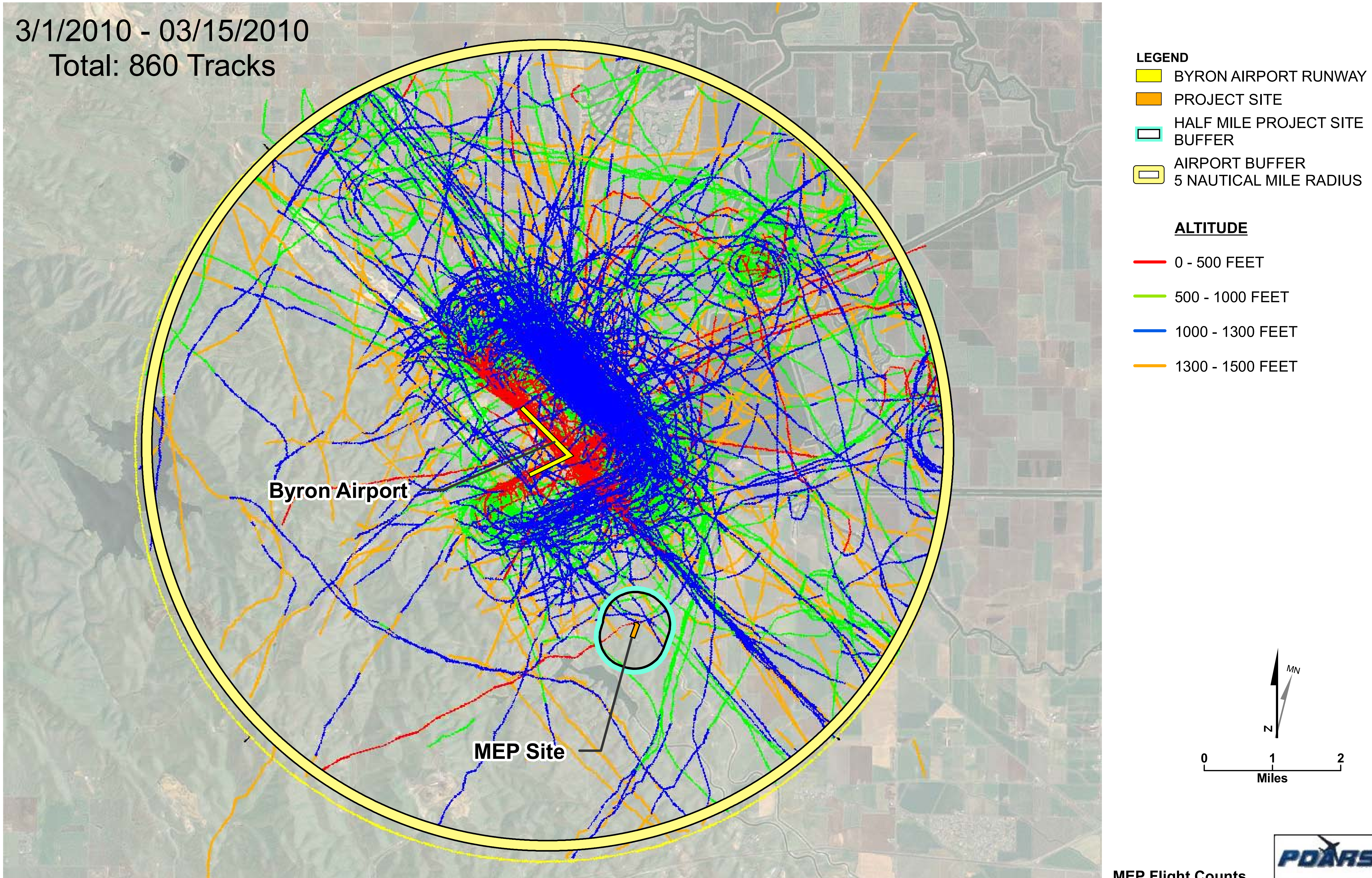
MN
N

0 1 2
Miles

MEP Flight Counts

POARS
CH2MHILL

SAC \\ZION\SACGIS\PROJ\DIAMOND_376670\MAPFILES\BYRON_AIRFIELD\BYRONAIRPORT_FLIGHTPATTERNS_DEC2009_JAN2010.MXD KMORGAN 6/29/2010 15:09:26



MEP Flight Counts

CH2MHILL

SAC\\ZION\SACGIS\PROJ\DIAMOND_376670\MAPFILES\BYRON_AIRFIELD\BYRONAIRPORT_FLIGHTPATTERNS_MAR2010.MXD MSCHROCK 6/7/2010

ATTACHMENT SQ27-1

Senta Engineering PowerPoint Presentation

Mariposa Energy Project
Plume Effects on Local Aviation

C.P. “Case” van Dam
Ronald Hess
Henry Shiu
Stephen Shaw

Martinez, CA
28 July 2010, Revision A

Outline

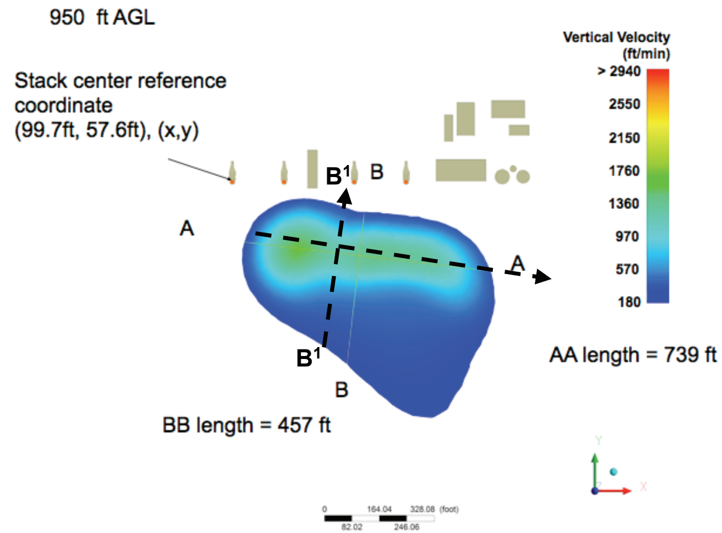
- Analysis team
- Plume modeling and assumptions
- Cockpit simulation of aircraft traversing the plume
- Modeling of helicopter and small airplane dynamics in the plume (including pilot response)
- Aircraft vertical acceleration and structural loading
- Roll upset analysis (including roll analysis)
- Considerations for an airplane towing a glider
- Vortex ring state
- Conclusions

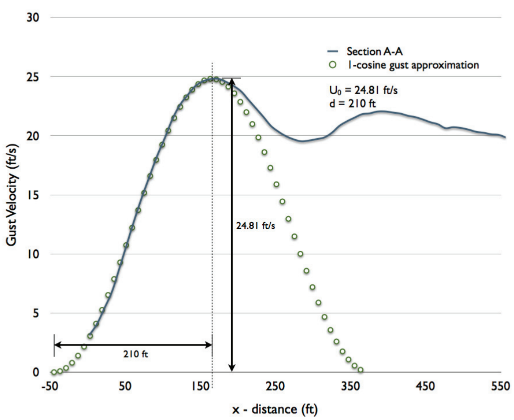
Analysis Team

- **C.P. (Case) van Dam**
  - Professor of Aeronautical Engineering at UC Davis since 1985
  - Specializes in airplane aerodynamics, performance, and design
  - More than 100 publications
- **Ron Hess**
  - Professor of Aeronautical Engineering at Naval Postgraduate School and UC Davis since 1970
  - Specializes in aircraft dynamics, stability & control, handling qualities, man-machine systems, flight simulation, automatic control
  - More than 200 publications
- **Henry Shiu**
  - Aeronautical engineer since 1995
  - MS in aeronautical engineering
  - Specializes in aerodynamics and data analysis
- **Stephen Shaw**
  - Aeronautical engineer since 1995
  - MS in aeronautical engineering
  - Specializes in aircraft aerodynamics

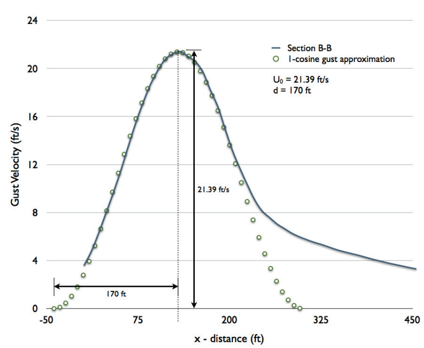
MEP Plume Modeling and Assumptions

- **Worst-case plume velocity distribution assumed**
  - Provided via CFD modeling performed by CH2M Hill
  - All four gas turbines at full operation
  - Calm winds: 0.7 to 1.4 mph
  - 950 feet AGL (1075 feet AMSL) which corresponds to approximate pattern altitude at Byron Airport
- **Three transects analyzed**
  - A-A, B-B
    - Modeled as 1 – cosine profile (consistent with FAR §23.333) to capture vertical velocity gradient
  - B^1-B^1
    - Asymmetric across aircraft span
    - Modeled as a perpendicular cut of A-A, with linear variation from plume edge





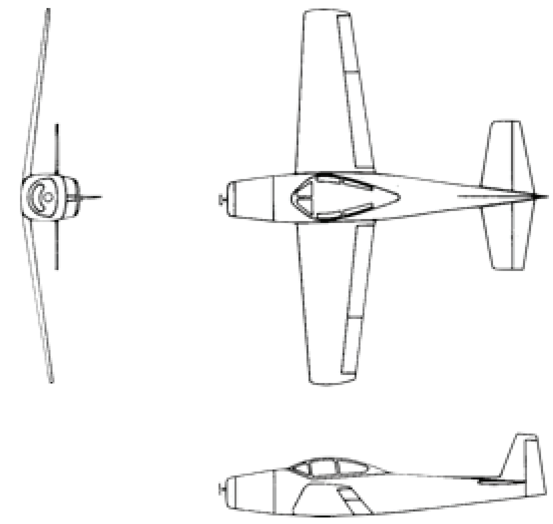
A-A

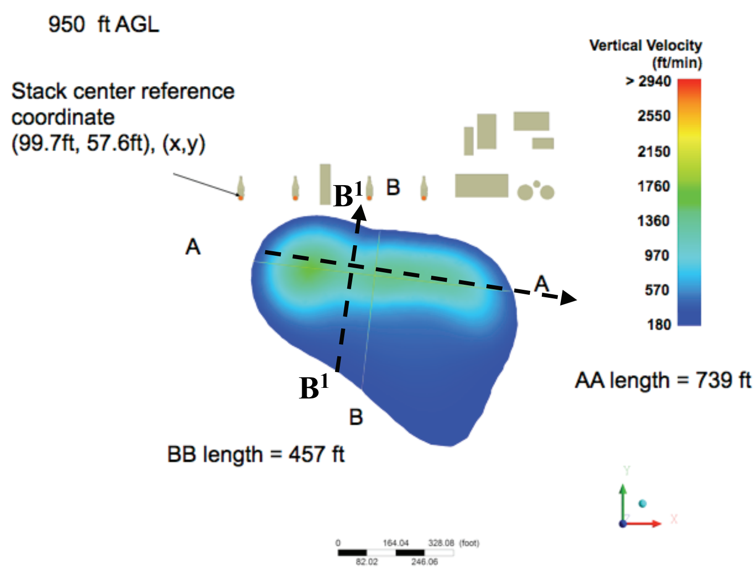


B-B

Cockpit Simulation

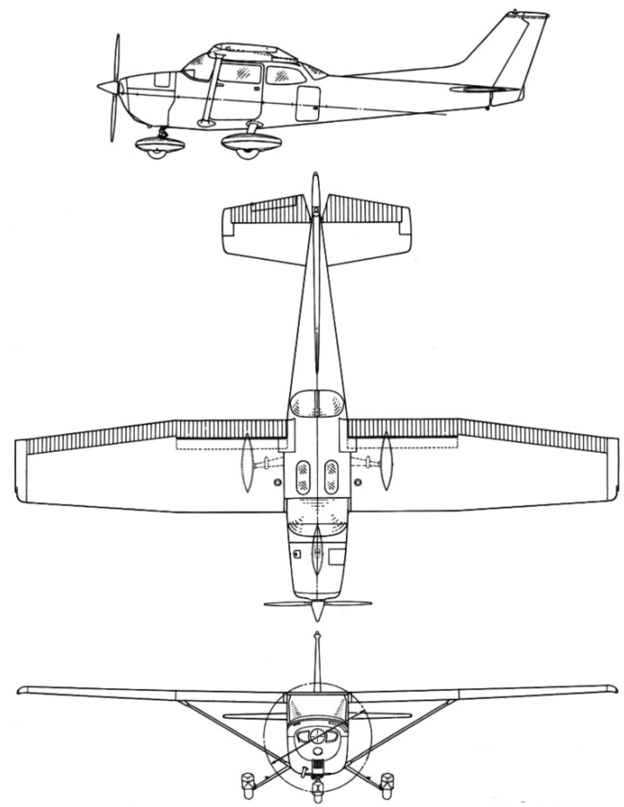
- **6 DOF model**
- **Ryan Navion**
  - Single engine, four seat
  - Span 33.4 ft
  - Wing Area 184 ft^2
  - Weight 2750 lbs
  - Airspeed 104 knots
- **Plume transects**
  - A-A
    - Modeled as 1 – cosine profile
  - B^1-B^1
    - Asymmetric across aircraft span
    - Modeled as a perpendicular cut of A-A, with linear variation from plume edge





Small Airplane Flight Dynamics in MEP Plume with Pilot Model in Loop

- **Cessna 172**
  - Airspeed: 130 knots
- **Human pilots modeled**
  - Nominal pilot: well trained, well motivated
  - Less experienced pilots
    - High gain: aggressive with 200 ms delay
    - Low gain: hesitant with 200 ms delay
  - Controlling pitch and roll attitude
- **Plume transects:**
  - A-A: Sharpest gust gradient
  - B^1-B^1: Asymmetric velocity distribution, inducing both pitch and roll



Cessna 172 Flight Modeling, Path A-A

	Parameter	Nominal Pilot Well-trained, well-motivated	Less Experienced Pilot: High Gain Aggressive	Less Experienced Pilot: Low Gain Hesitant	Normal, Safe Range
θ	Pitch attitude, ° Positive nose up	-1.4 to +0.77	-1.19 to +1.1	-1.75 to +0.74	Dependent on flight conditions†
ϕ	Roll attitude, ° Positive right wing down	0	0	0	
α	Angle of attack, °	-1.76 to +2.37	-2.04 to +2.52	-1.56 to +2.27	±15
q	Pitch rate, °/s	-2.77 to +3.49	-2.97 to +4.38	-2.96 to +3.76	Dependent on flight conditions†
p	Roll rate, °/s	0	0	0	
an_z	Vertical acceleration, g Positive acceleration up	-0.44 to +0.59	-0.52 to +0.64	-0.43 to +0.57	-1.52 to +3.8 *
δ_e	Elevator deflection, ° Positive trailing edge down	-1.4 to +0.94	-1.98 to +1.77	-1.16 to +0.74	±27
δ_a	Aileron deflection, ° Positive right aileron down	0	0	0	±17

† "Normal" ranges for attitude and pitch/roll rates depend heavily on flight conditions; in general, the aircraft responses shown here are very low

* Structural limits; +3.8g includes +1g for normal gravitational acceleration

Cessna 172 Flight Modeling, Path B^1-B^1

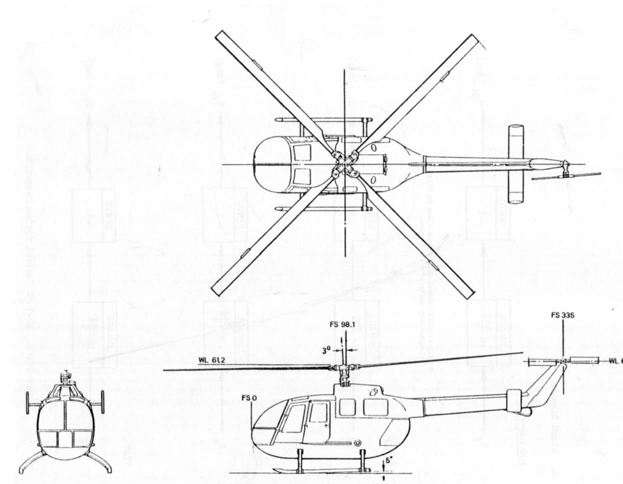
	Parameter	Nominal Pilot Well-trained, well-motivated	Less Experienced Pilot High Gain Aggressive	Less Experienced Pilot Low Gain Hesitant	Normal, Safe Range
θ	Pitch attitude, ° Positive nose up	-0.63 to +0.33	-0.48 to +0.45	-0.97 to +0.34	Dependent on flight conditions†
ϕ	Roll attitude, ° Positive right wing down	-1.42 to 0	-1.0 to +0.12	-2.54 to 0	
α	Angle of attack, °	-1.0 to +4.9	-0.83 to +1.12	-0.23 to +0.16	±15
q	Pitch rate, °/s	-0.82 to +1.5	-1.04 to +1.94	-1.3 to +1.67	Dependent on flight conditions†
p	Roll rate, °/s	-2.02 to +1.49	-1.33 to +1.64	-3.28 to +1.61	
an_z	Vertical acceleration, g Positive acceleration up	-0.18 to +0.27	-0.21 to +0.28	-0.16 to +0.23	-1.52 to +3.8 *
δ_e	Elevator deflection, ° Positive trailing edge down	-0.6 to +0.4	-0.83 to +0.7	-0.42 to +0.21	±27
δ_a	Aileron deflection, ° Positive right aileron down	0 to +1.86	-0.08 to +2.11	0 to +1.52	±17

† "Normal" ranges for attitude and pitch/roll rates depend heavily on flight conditions; in general, the aircraft responses shown here are very low

* Structural limits; +3.8g includes +1g for normal gravitational acceleration

Helicopter Flight Dynamics in MEP Plume with Pilot Model in Loop

- **Eurocopter BO-105**
  - Soft-in-plane rigid rotor: sensitive to atmospheric disturbances
  - Airspeed: 60 knots
- **Human pilots modeled**
  - Nominal pilot: well trained, well motivated
  - Less experienced pilots
    - High gain: aggressive with 200 ms delay
    - Low gain: hesitant with 200 ms delay
  - Controlling pitch, roll, yaw rate, and vertical velocity
- **Traversing plume at:**
  - A-A: Sharpest gust gradient
  - B^1-B^1: Asymmetric velocity distribution, inducing both pitch and roll



BO-105 Flight Modeling, Path A-A

	Parameter	Nominal Pilot Well-trained, well-motivated	Less Experienced Pilot High Gain Aggressive	Less Experienced Pilot Low Gain Hesitant	Normal, Safe Range
θ	Pitch attitude, ° Positive nose up	-1.29 to +0.08	-0.72 to +0.06	-2.1 to +0.26	Dependent on flight conditions†
ϕ	Roll attitude, ° Positive right wing down	-0.63 to +0.19	-0.26 to +0.13	-1.43 to +0.4	
an_z	Vertical acceleration, g Positive acceleration up	-0.04 to +0.04	-0.02 to +0.02	-0.06 to +0.07	$\leq$ -0.5 to $\geq$ +2.0 *
p	Roll rate, °/s	-0.54 to +0.32	-0.27 to +0.27	-1.17 to +0.48	Dependent on flight conditions†
q	Pitch rate, °/s	-0.89 to +0.88	-0.62 to +0.59	-1.36 to +1.24	
δ_A	Lateral cyclic input, % Positive stick right	-0.73 to 2.17	-0.86 to +1.98	-0.66 to +2.09	-50 to 50
δ_B	Longitudinal cyclic input, % Positive stick back	-3.69 to 0.22	-4.45 to +0.27	-2.66 to +0.28	-50 to 50
δ_C	Main-rotor collective input, % Positive collective lever up	-16.41 to +0.08	-18.29 to +0.02	-13.86 to +0.78	-50 to 50
δ_P	Tail-rotor collective input, % Positive left pedal	-2.07 to 5.22	-1.14 to +6.82	-2.71 to +3.38	-50 to 50

† "Normal" ranges for attitude and pitch/roll rates depend heavily on flight conditions; in general, the aircraft responses shown here are very low

* Per FAR §27.337; unverified sources report -1.0g to +3.1g

BO-105 Flight Modeling, Path B^1-B^1

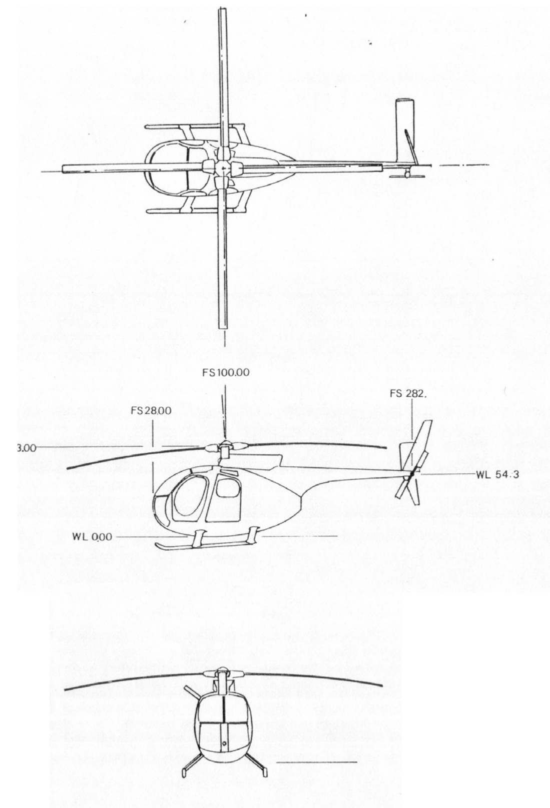
	Parameter	Nominal Pilot Well-trained, well-motivated	Less Experienced Pilot High Gain Aggressive	Less Experienced Pilot Low Gain Hesitant	Normal, Safe Range
θ	Pitch attitude, ° Positive nose up	-0.04 to +0.68	-0.034 to +0.37	-0.18 to +1.28	Dependent on flight conditions†
ϕ	Roll attitude, ° Positive right wing down	-0.05 to +0.02	-0.017 to +0.007	-0.25 to +0.128	
an_z	Vertical acceleration, g Positive acceleration up	-0.002 to +0.002	-0.0007 to +0.0005	-0.006 to +0.005	$\leq$ -0.5 to $\geq$ +2.0 *
p	Roll rate, °/s	-0.05 to +0.03	-0.05 to +0.05	-0.12 to +0.12	Dependent on flight conditions†
q	Pitch rate, °/s	-0.44 to +0.43	-0.37 to +0.27	-0.79 to +0.83	
δ_A	Lateral cyclic input, % Positive stick right	-0.05 to +0.16	-0.03 to +0.1	-0.17 to +0.35	-50 to 50
δ_B	Longitudinal cyclic input, % Positive stick back	-0.11 to +2.07	-0.14 to +2.28	-0.18 to +1.74	-50 to 50
δ_C	Main-rotor collective input, % Positive collective lever up	-0.83 to +0.07	-0.48 to +0.04	-1.39 to +0.21	-50 to 50
δ_P	Tail-rotor collective input, % Positive left pedal	-0.19 to +0.37	-0.08 to +0.244	-0.39 to +0.5	-50 to 50

† "Normal" ranges for attitude and pitch/roll rates depend heavily on flight conditions; in general, the aircraft responses shown here are very low

* Per FAR §27.337; unverified sources report -1.0g to +3.1g

Helicopter Flight Dynamics in MEP Plume with Pilot Model in Loop (2)

- **Boeing OH-6A**
  - Small helicopter
  - Airspeed: 60 knots
- **Human pilots modeled**
  - Nominal pilot: well trained, well motivated
  - Less experienced pilots
    - High gain: aggressive with 200 ms delay
    - Low gain: hesitant with 200 ms delay
  - Controlling pitch, roll, yaw rate, and vertical velocity
- **Traversing plume at:**
  - A-A: Sharpest gust gradient
  - B^1-B^1: Asymmetric velocity distribution, inducing both pitch and roll



Boeing OH-6A Flight Modeling, Path A-A

	Parameter	Nominal Pilot Well-trained, well-motivated	Less Experienced Pilot High Gain Aggressive	Less Experienced Pilot Low Gain Hesitant	Normal, Safe Range
θ	Pitch attitude, ° Positive nose up	-1.91 to +0.03	-0.88 to +0.01	-3.61 to +0.28	Dependent on flight conditions†
ϕ	Roll attitude, ° Positive right wing down	-1.21 to +0.13	-0.53 to +0.11	-2.09 to +0.31	
an_z	Vertical acceleration, g Positive acceleration up	-0.03 to -0.03	-0.015 to -0.015	-0.054 to +0.055	$\leq$ -0.5 to $\geq$ +2.0 *
p	Roll rate, °/s	-0.56 to +0.37	-0.40 to +0.33	-0.911 to +0.908	Dependent on flight conditions†
q	Pitch rate, °/s	-1.33 to +1.22	-0.92 to +0.78	-2.38 to +2.34	
δ_A	Lateral cyclic input, % Positive stick right	-0.7 to +4.77	-0.85 to +4.97	-0.64 to +3.53	-50 to 50
δ_B	Longitudinal cyclic input, % Positive stick back	-7.7 to +0.1	-8.51 to +0.016	-6.26 to +0.62	-50 to 50
δ_C	Main-rotor collective input, % Positive collective lever up	-21.6 to +0.92	-24.5 to +0.003	-17.52 to +1.12	-50 to 50
δ_P	Tail-rotor collective input, % Positive left pedal	-3.7 to +5.75	-2.46 to +8.4	-3.51 to +3.19	-50 to 50

† "Normal" ranges for attitude and pitch/roll rates depend heavily on flight conditions; in general, the aircraft responses shown here are very low

* Per FAR §27.337; unverified sources report -1.0g to +3.1g

Boeing OH-6A Flight Modeling, Path B^1-B^1

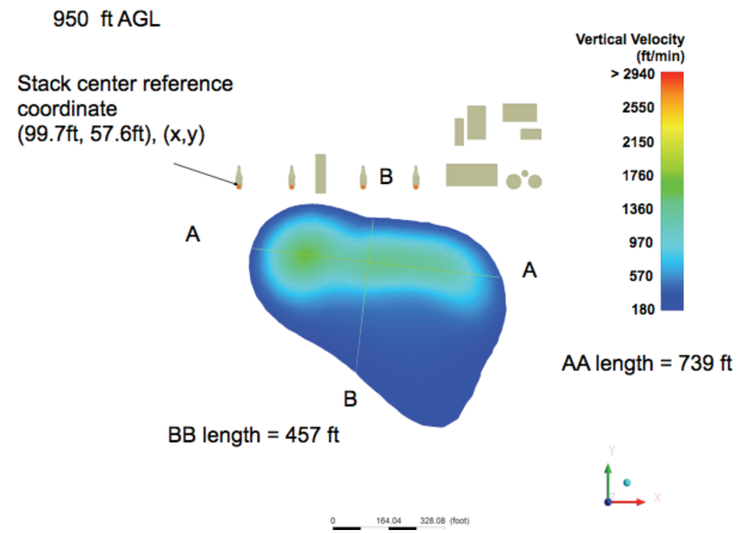
	Parameter	Nominal Pilot Well-trained, well-motivated	Less Experienced Pilot: High Gain Aggressive	Less Experienced Pilot: Low Gain Hesitant	Normal, Safe Range
θ	Pitch attitude, ° Positive nose up	-0.005 to +0.13	-0.02 to +0.07	-0.18 to +0.26	Dependent on flight conditions†
ϕ	Roll attitude, ° Positive right wing down	-0.02 to +0.002	-0.01 to +0.01	-0.09 to +0.02	
an_z	Vertical acceleration, g Positive acceleration up	-0.0003 to +0.0003	-0.0002 to +0.0001	-0.001 to +0.001	$\leq$ -0.5 to $\geq$ +2.0 *
p	Roll rate, °/s	-0.015 to +0.01	-0.05 to +0.05	-0.06 to +0.04	Dependent on flight conditions†
q	Pitch rate, °/s	-0.08 to +0.08	-0.11 to +0.08	-0.17 to +0.16	
δ_A	Lateral cyclic input, % Positive stick right	-0.007 to +0.09	-0.05 to +0.06	-0.03 to +0.15	-50 to 50
δ_B	Longitudinal cyclic input, % Positive stick back	-0.05 to +0.57	-0.09 to +0.64	-0.07 to +0.47	-50 to 50
δ_C	Main-rotor collective input, % Positive collective lever up	-0.22 to +0.01	-0.13 to +0.02	-0.38 to +0.03	-50 to 50
δ_P	Tail-rotor collective input, % Positive left pedal	-0.06 to +0.91	-0.03 to +0.06	-0.1 to +0.11	-50 to 50

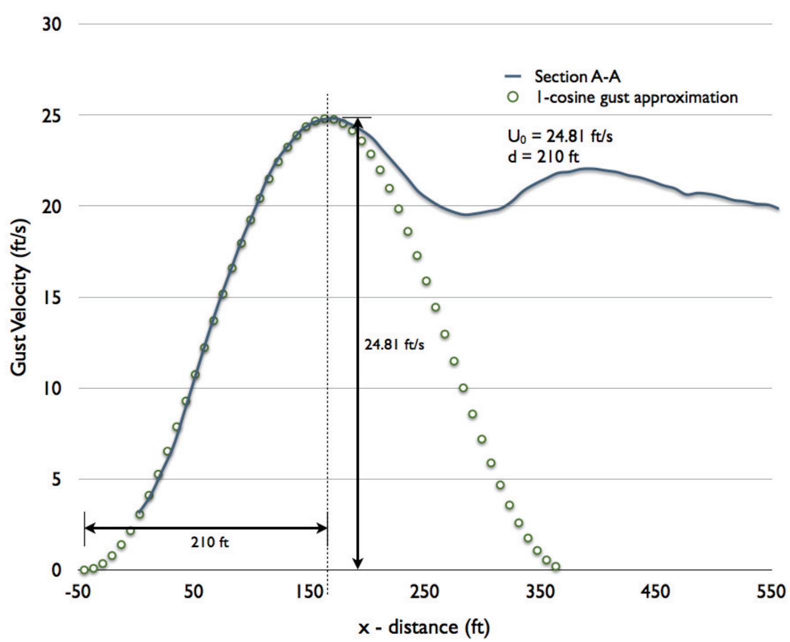
† "Normal" ranges for attitude and pitch/roll rates depend heavily on flight conditions; in general, the aircraft responses shown here are very low

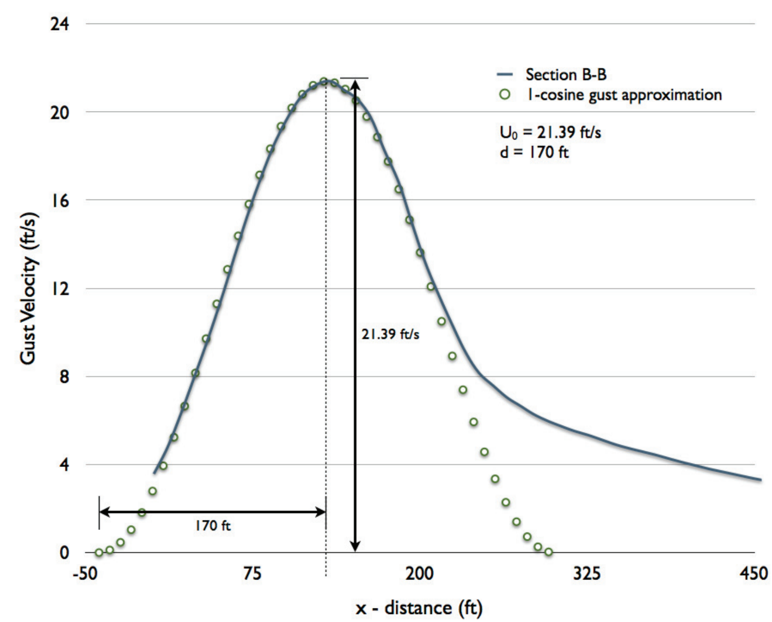
* Per FAR §27.337; unverified sources report -1.0g to +3.1g

Plume Modeling for Structural Loading Assessment

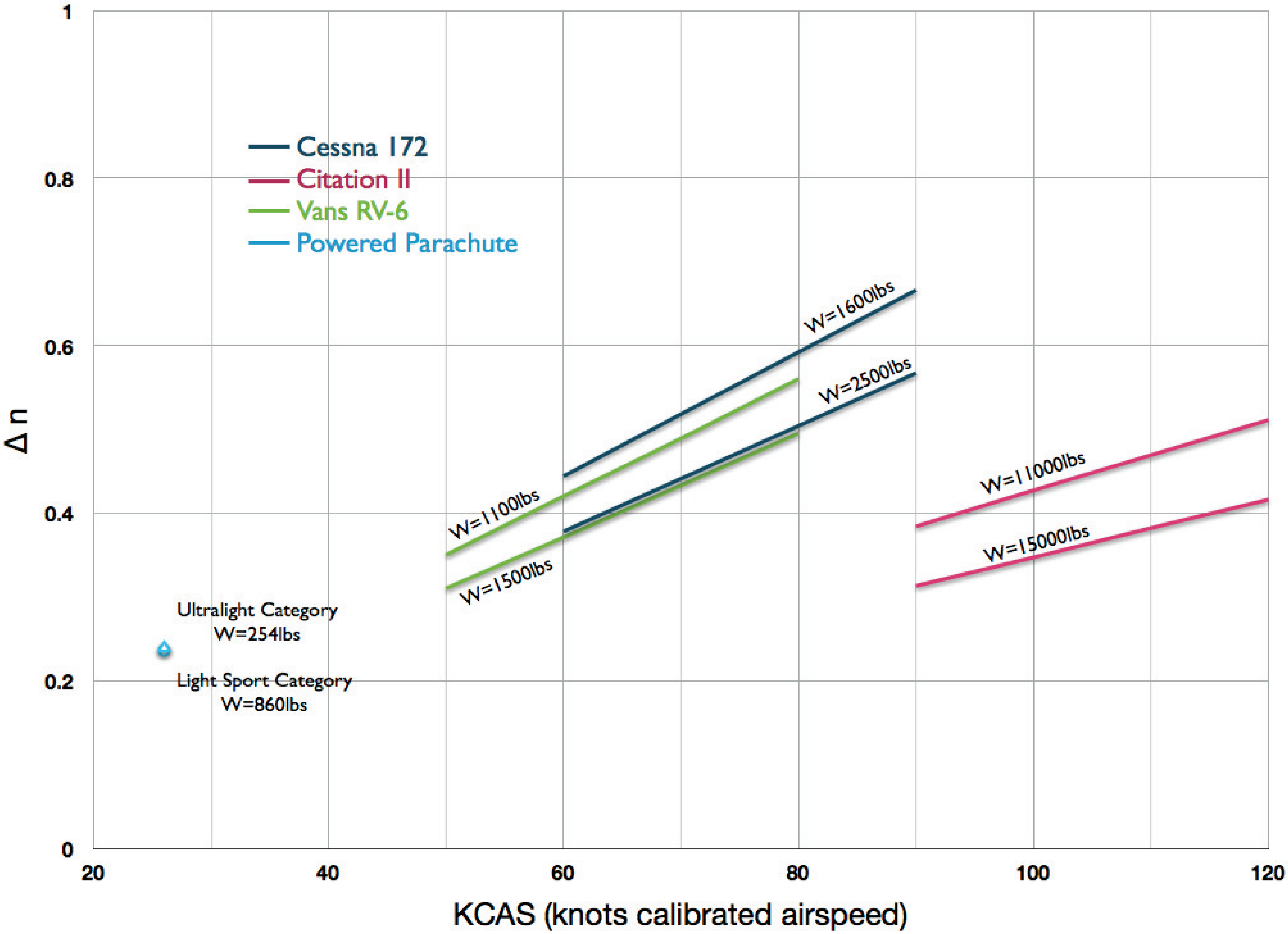
- **Transects A-A and B-B**
  - Modeled with 1 - cosine profile
  - Methodology similar to that used in FAR §23.333
- **Loads calculated with 1 DOF vertical gust model**

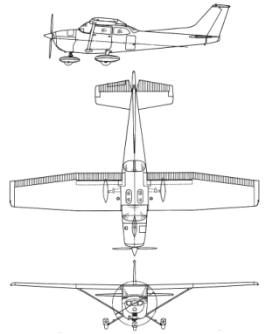




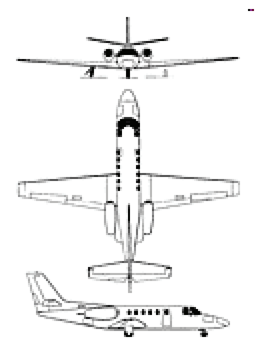


Vertical Loads Imparted by MEP Plume (1)

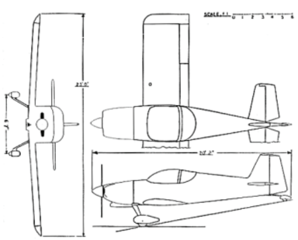




Cessna 172

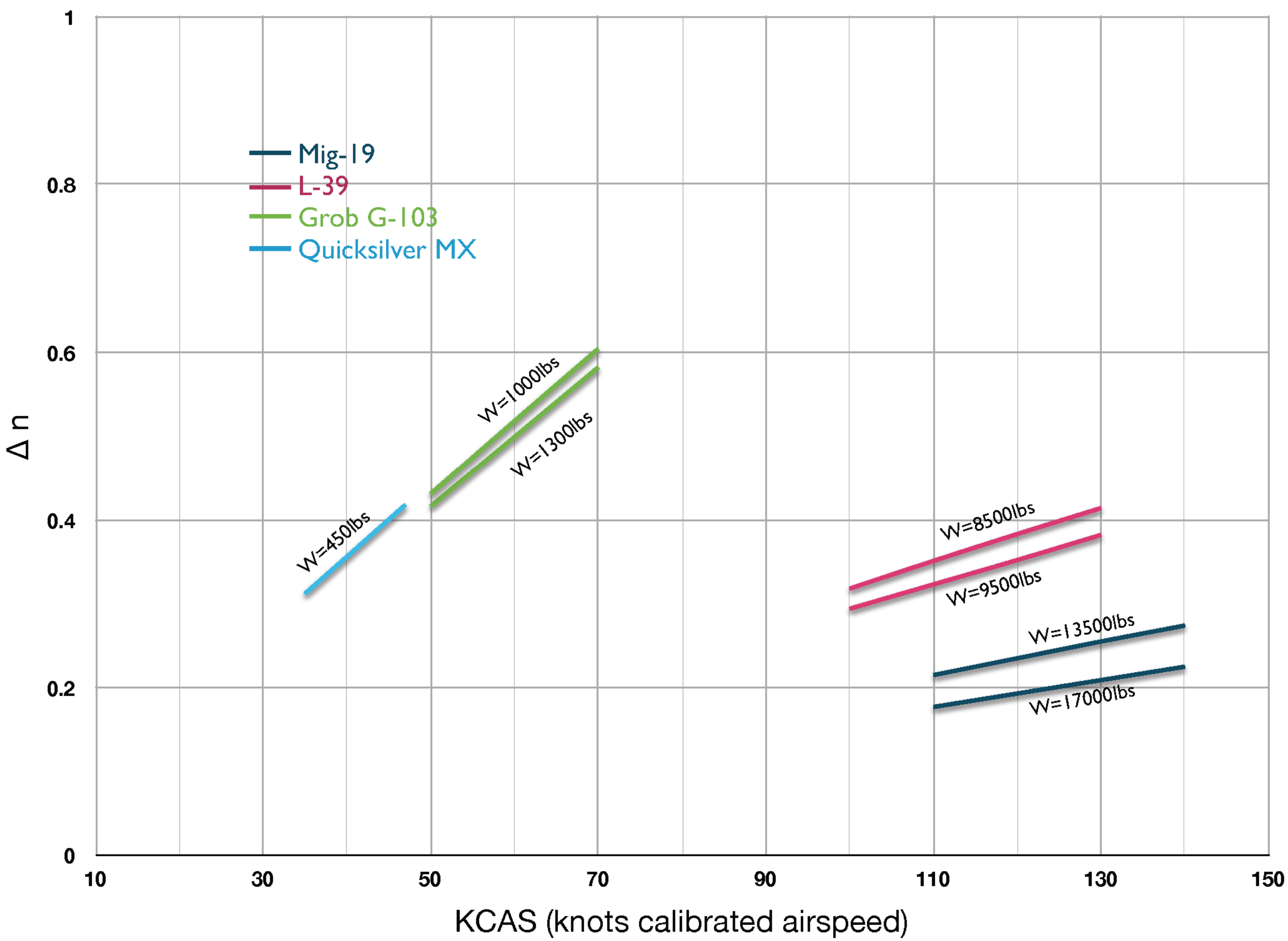


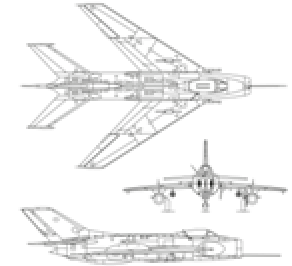
Citation II



Vans RV-6

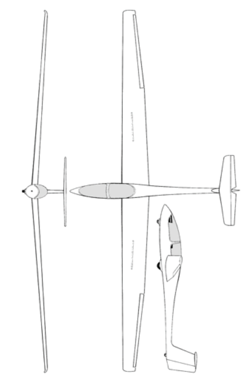
Vertical Loads Imparted by MEP Plume (2)





MiG 19

L-39 Albatross



Grob G-103

Quicksilver MX

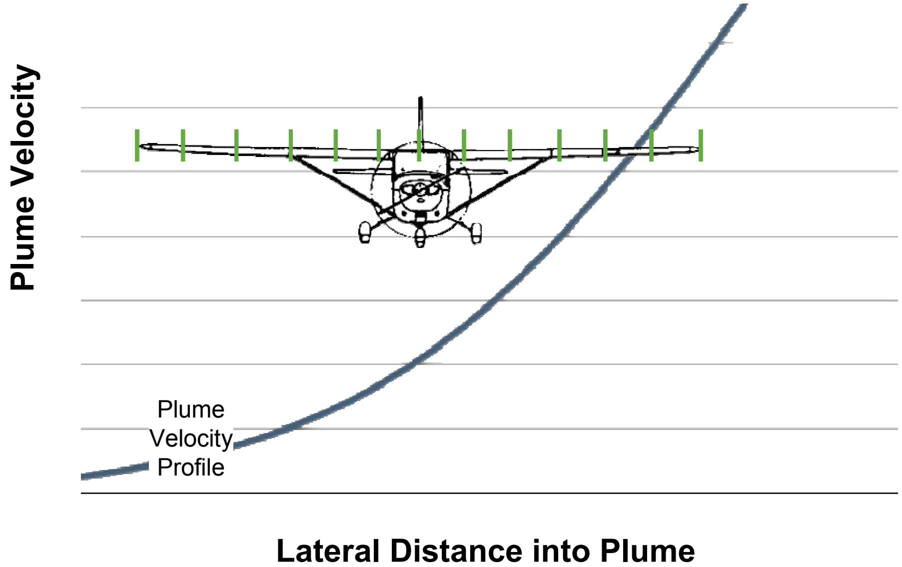
Plume Loads and Aircraft Structural Design Limits

Aircraft	Load Limit	Required per FARs	Load Imparted by Plume + 1 g (normal gravitational load)
Cessna Citation II	+2.5g, -1.0g	+2.5g, -1.0g †	1.31 - 1.51
Cessna 172	Flaps Up: +3.8g, -1.52g Flaps Down: +3.0g	+3.8g, -1.52g †	1.38 - 1.67
Vans RV-6	+6.0g, -3.0g +4.4g, -1.75g *	n/a	1.31 - 1.56
Powered Parachute	+6.0g	n/a	1.24
MiG-19	Unknown	n/a	1.18 - 1.27
L-39	+8g, -4g	n/a	1.29 - 1.41
Grob G-103	+5.3g, -2.65g +4.0g, -1.5g **		1.43 - 1.67
Quicksilver MX Sprint	Unknown	n/a	1.31 - 1.42

* +6.0g, -3.0g at or below aerobatic gross weights; +4.4g, -1.75g between aerobatic gross weight to maximum design gross weights
** +5.3g, -2.65g at maneuvering speed; +4.0g, -1.5g at VNE
† See FAR §23.337 and §23.557 for full details.

Roll Upset Analysis

- How significant is the roll upset imparted by the aircraft?

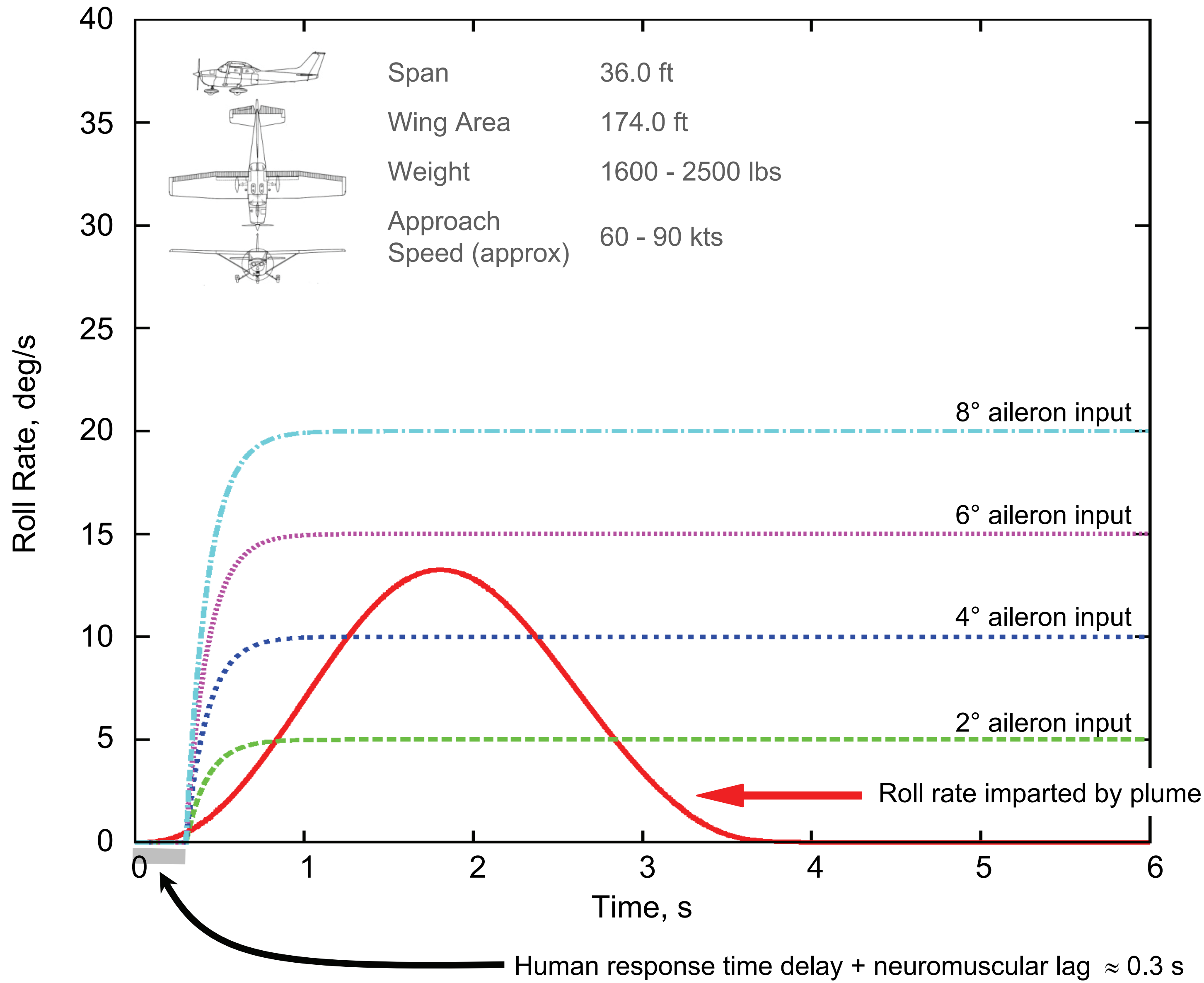


- “Insert” aircraft laterally into sharpest plume gradient to determine maximum instantaneous rolling moment
- Determine amount of aileron deflection required to neutralize this rolling moment
- Compare roll rates imparted by plume to roll rates from aileron input (including roll damping)

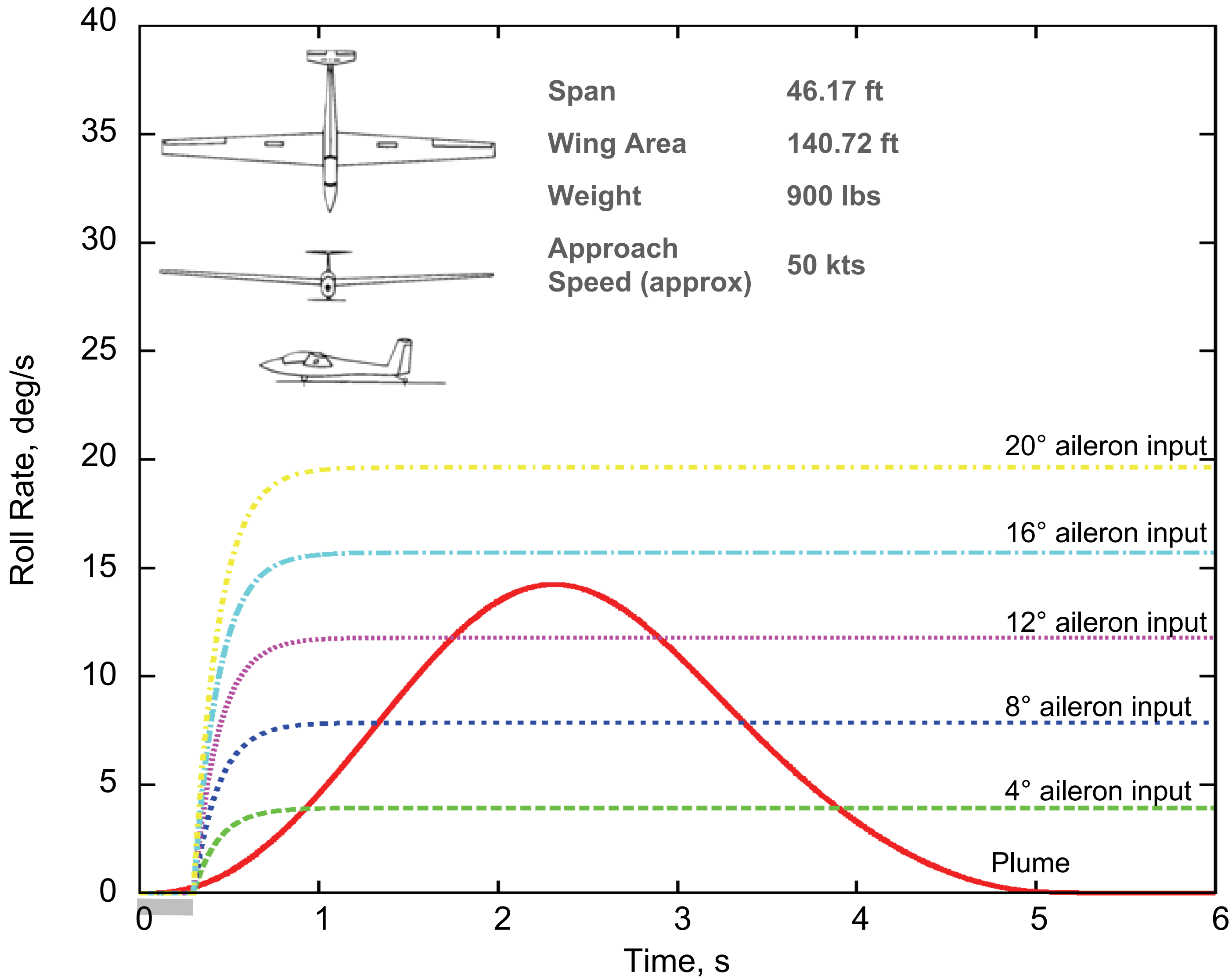
Roll Upset and Neutralizing Aileron Input

Aircraft	Maximum Rolling Moment Coefficient	Neutralizing Aileron Deflection (degrees)	Maximum Aileron Deflection Range (degrees)
Cessna 172	0.0178	5.7	17
Beech 99	0.0182	6.7	19
Learjet 24	0.0131	5.0	18
MiG-19	0.0045	3.4	20
L-39	0.0103	3.6	
Grob G 103	0.0371	12.8	19
QuickSilver MX Sprint	0.03	7.9	

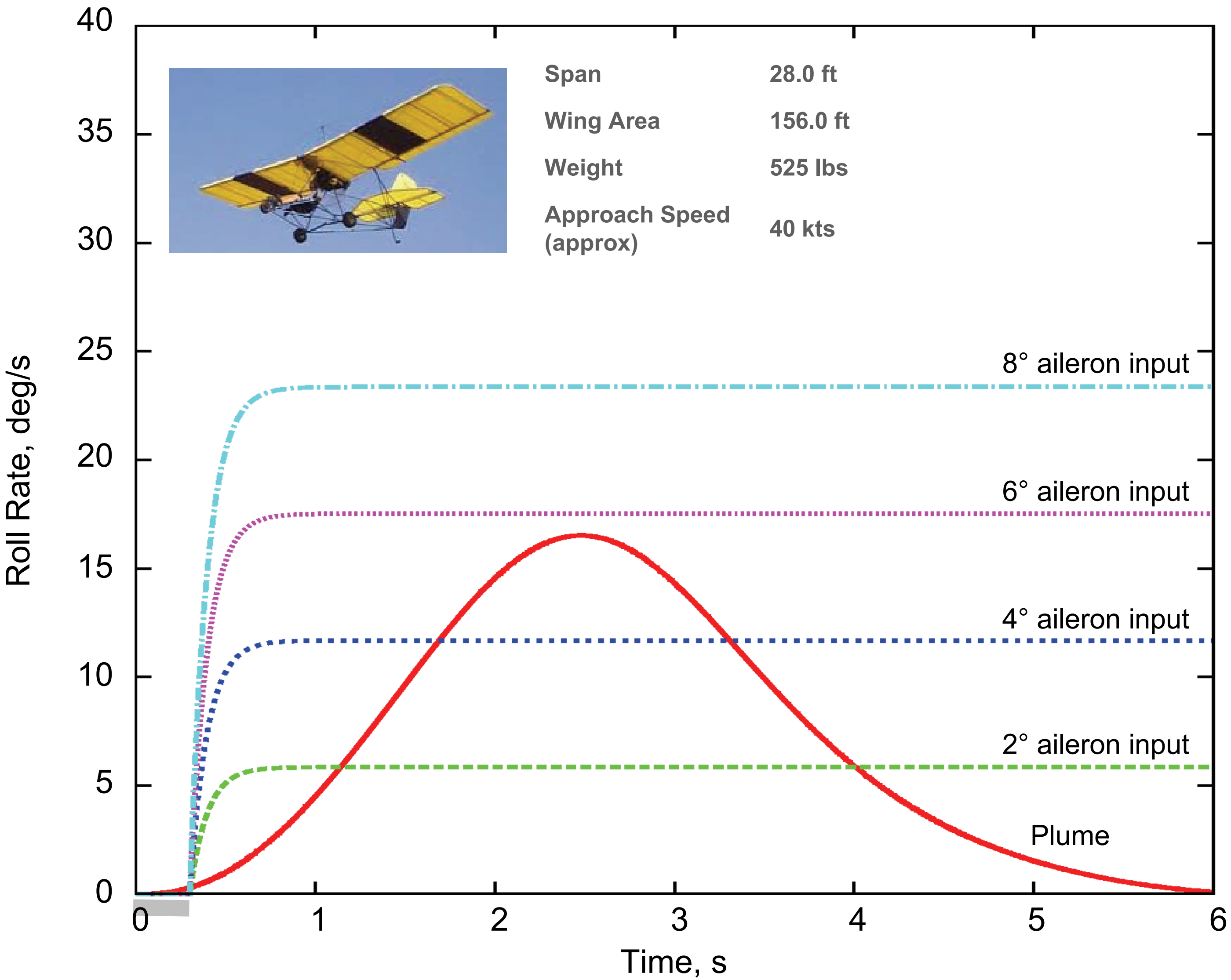
Roll Rate of Cessna 172 due to MEP Plume and Aileron Input



Roll Rate of Schweizer 1-36 Sprite due to MEP Plume and Aileron Input



Roll Rate of Quicksilver MX Sprint due to MEP Plume and Aileron Input



Considerations for Airplane Towing A Glider

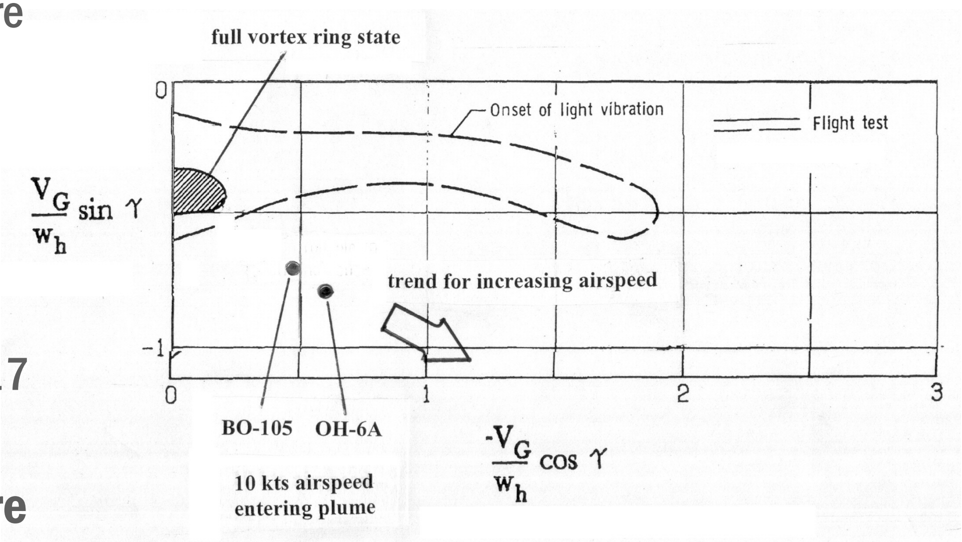
- **Good lift for soaring normally coincides with turbulence. Gliders and towplanes must routinely operate in turbulence.**
- **Turbulence from the MEP plumes in worst-case conditions will be relatively low.**
- **Should a towplane-glider overfly MEP and need to release prematurely:**
  - Assuming a relatively low altitude of 1000 ft AGL, a glider with a low L/D of 20 would have a range of 20,000 ft (3.8 miles), which is sufficient for the 2.7 mile return to Byron Airport

Aircraft	L/D	Range with 1000 ft AGL (miles)
Grob G 102, G103	33 - 38	6.25 – 7.2
L-13 Blanik	28	5.3
SGS 1-26	23	4.4

  - Assuming the towplane-glider were departing from Byron Aiport and climbing out, their altitude over MEP would likely be much higher, with a correspondingly longer range
  - Glider pilots commonly practice towline breaks at 200 ft AGL during training to simulate towline breakage during takeoff/climb-out

Vortex Ring State

- **Vortex ring state is a hazardous condition which can occur when helicopters rapidly descend**
  - Analogous to stall of fixed-wing aircraft, but aerodynamically a very different phenomenon
  - Induces very high descent rates and degrades control effectiveness
  - Most likely to occur when descending rapidly with low horizontal velocity
- **If a helicopter in level flight in the upward vertical flow of the plume is equivalent to a helicopter descending through still air, can the plume induce the vortex ring state?**
  - Assume 25 ft/s plume velocity across entire helicopter rotor
    - Equivalent to helicopter descending at 25 ft/s
  - Assume 10 knots horizontal velocity (very slow)
  - Analysis based on Heyson, NASA TN D-7917



- **Under these conditions, both the Eurocopter BO-105 and Boeing OH-6A are outside the operating region in which the vortex ring state is encountered and even that in which light vibration is encountered**
  - Increasing horizontal velocity moves the aircraft further away from these regions

Summary

- **Flight dynamics analyses assume worst case path through the plume at worst case meteorological conditions**
- **Flight dynamics with pilot-in-the-loop modeling of the Cessna 172, Eurocopter BO-105, and Boeing OH-6A indicate small control inputs are required while flying through the worst-case plume, with small changes in aircraft attitude**
  - Vertical acceleration (loads) on the helicopters are extremely small
- **Conservative estimates for a variety of aircraft indicate that loads imparted by the worst-case plume are 0.24g to 0.67g**
- **These loads are well within the structural design limits of the aircraft**
- **The potential for roll upset was analyzed over a range of aircraft. All had sufficient roll authority to counter the upset, even when including lag in human response**
- **Should a glider need to release from its towplane over MEP, it will have sufficient range to reach the airport**
- **Analyses of the Eurocopter BO-105 and Boeing OH-6A indicate that the plume will not induce the vortex ring state in helicopters passing through the plume**

BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA
1516 NINTH STREET, SACRAMENTO, CA 95814
1-800-822-6228 – WWW.ENERGY.CA.GOV

APPLICATION FOR CERTIFICATION FOR THE *MARIPOSA ENERGY PROJECT* (MEP)

Docket No. 09-AFC-3

PROOF OF SERVICE
(Revised 2/8/2010)

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DECLARATION OF SERVICE

I, Stephanie Moore, declare that on August 9, 2010, I served and filed copies of the attached Staff Queries, Set 2, Responses to Andrea Koch e-mail. The original document, filed with the Docket Unit, is accompanied by a copy of the most recent Proof of Service list, located on the web page for this project at:
[http://www.energy.ca.gov/sitingcases/mariposa/index.html].
The document has been sent to both the other parties in this proceeding (as shown on the Proof of Service list) and to the Commission's Docket Unit, in the following manner:

(*Check all that Apply*)

For service to all other parties:

_X_ sent electronically to all email addresses on the Proof of Service list;

___ by personal delivery or by depositing in the United States mail at Sacramento, California, with first-class postage thereon fully prepaid and addressed as provided on the Proof of Service list above to those addresses **NOT** marked "email preferred."

AND

For filing with the Energy Commission:

_X_ **sending an original paper copy and one electronic copy, mailed and emailed respectively, to the address below (preferred method);**

OR

___ depositing in the mail an original and 12 paper copies, as follows:

CALIFORNIA ENERGY COMMISSION
Attn: Docket No. 09-AFC-3
1516 Ninth Street, MS-4
Sacramento, CA 95814-5512
docket@energy.state.ca.us

I declare under penalty of perjury that the foregoing is true and correct.

SMoore

Stephanie Moore