Blacksburg Baseline Noise Impact Study

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November 15, 2000

Study Objectives

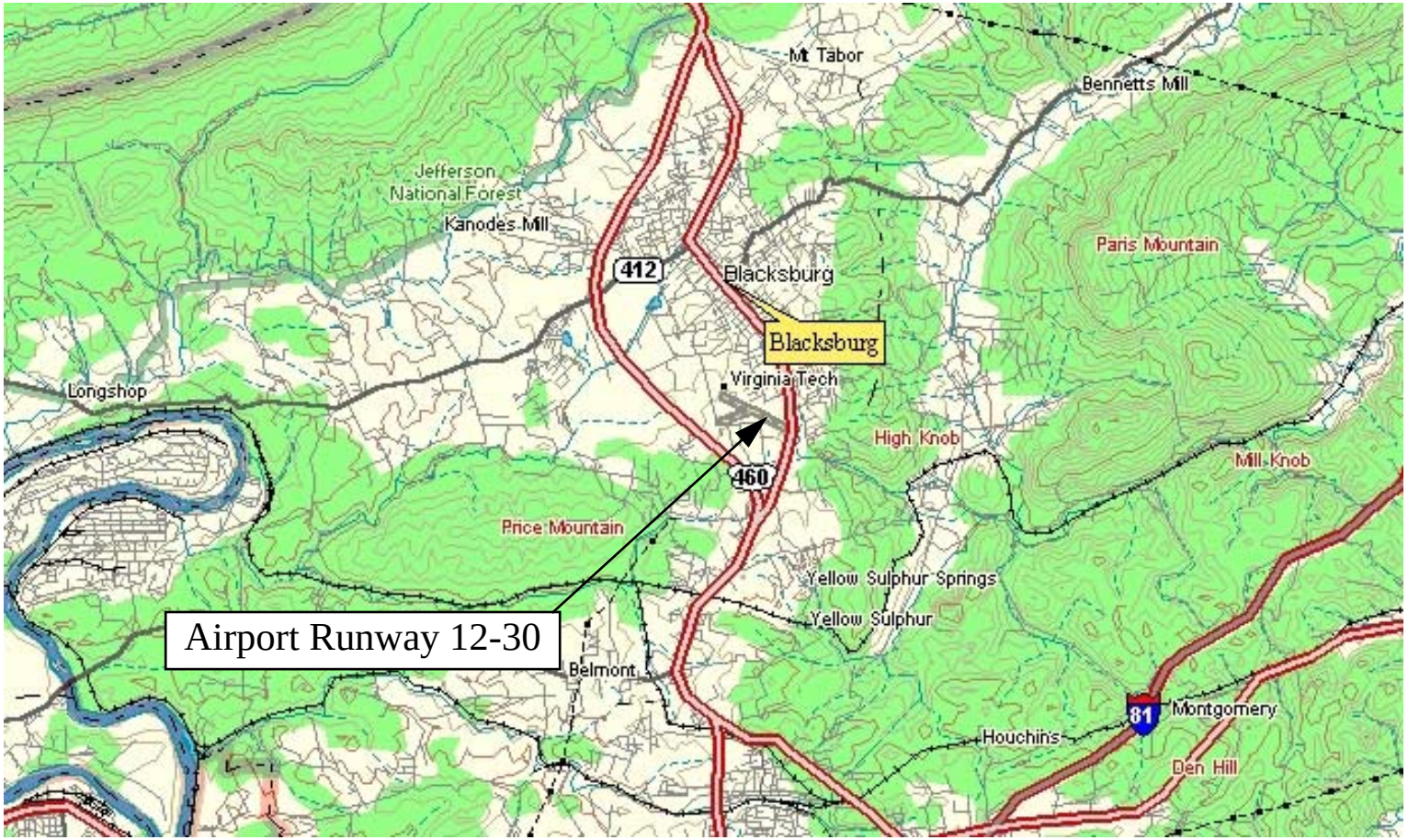
a) To collect and develop data for the noise characteristics of the individual aircraft and helicopters which are currently operating at the Virginia Tech Airport,

b) To estimate the flyover noise at 2500, 5000, and 10,000 feet generated by existing GA aircraft technology aircraft,

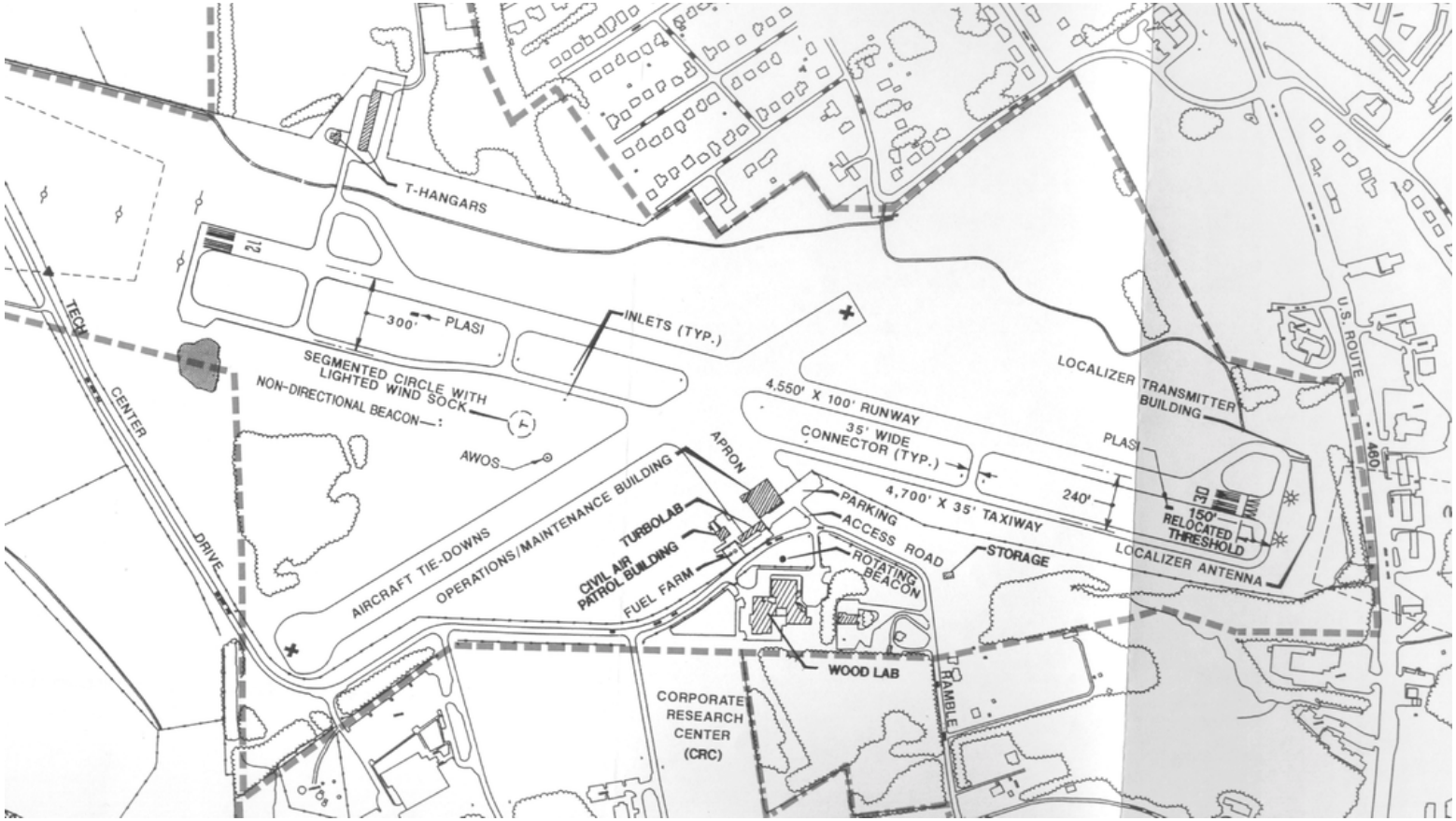
c) To develop baseline airport traffic information, including airport traffic patterns and flight profiles representative of the current situation at the Virginia Tech Airport, and

d) To develop baseline airport noise contours (using the Integrated Noise Model 6.0a), representative of the current situation for the Virginia Tech Airport.

Virginia Tech Airport (Location)

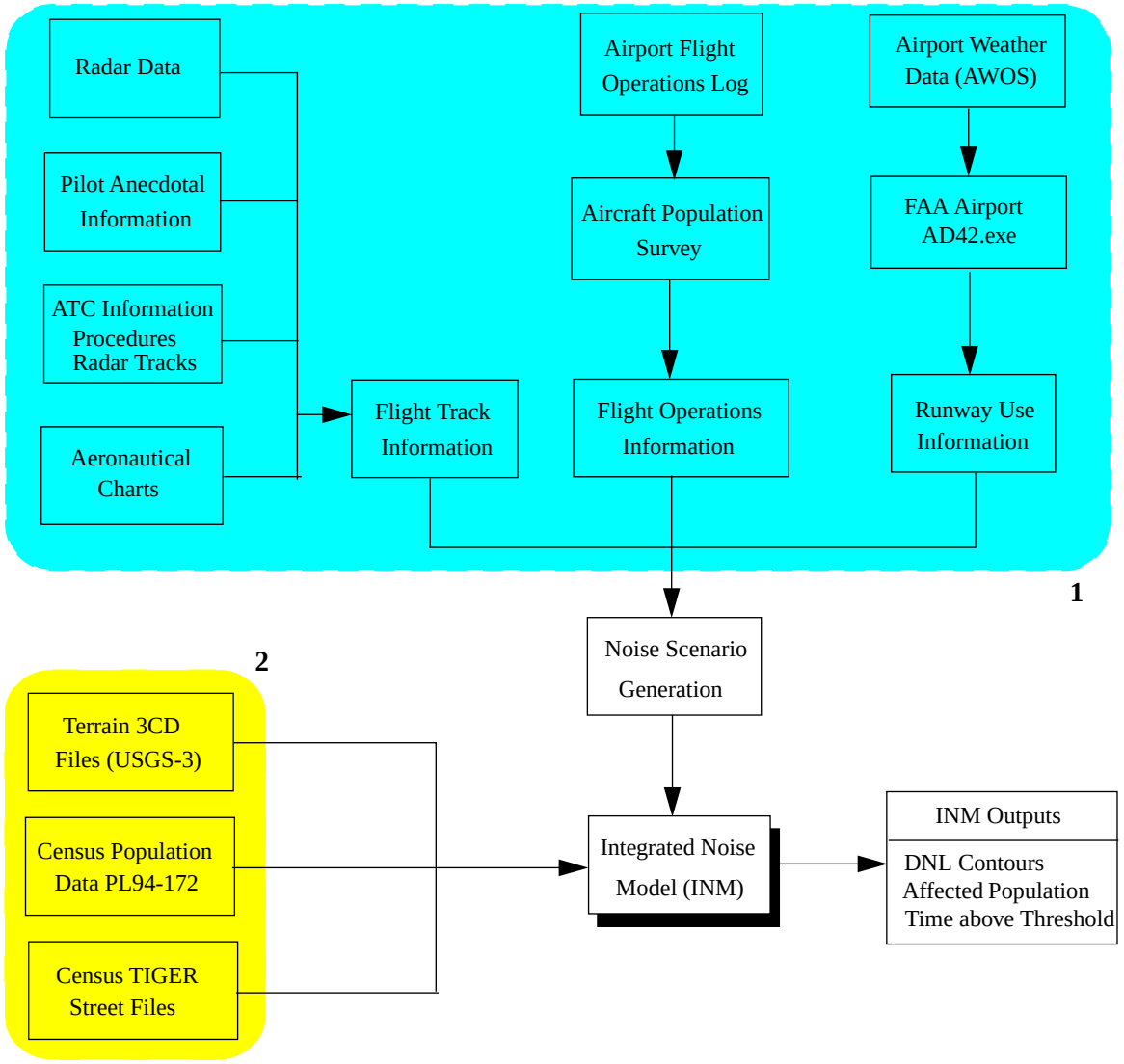


Virginia Tech Airport (Current Layout)

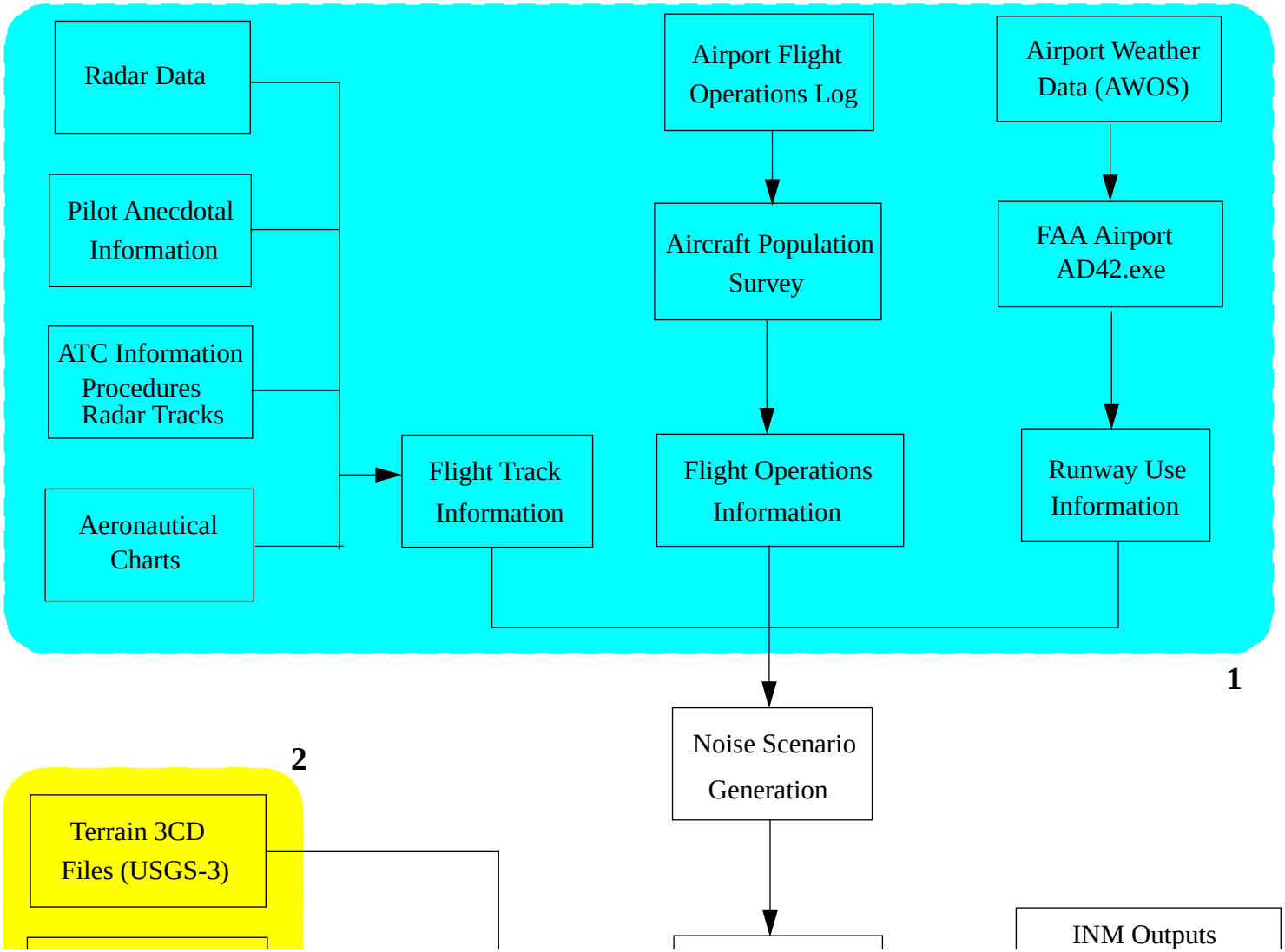


Source: 1995 Virginia Tech Airport Master Plan

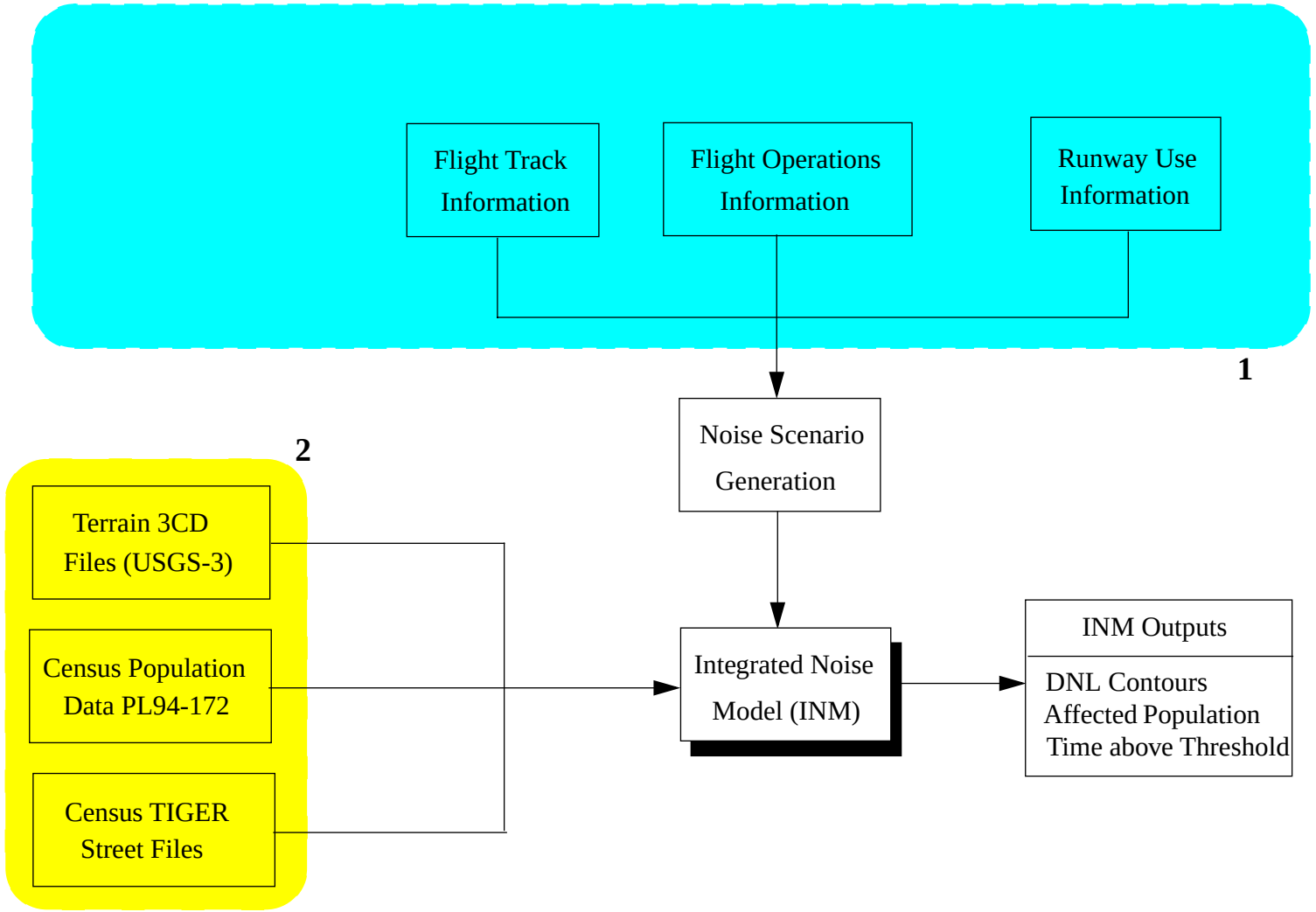
Noise Modeling Process (Flowchart)



Noise Modeling Process (Scenario Analysis)



Noise Modeling Process (Complementary Files)



Sample Noise and Land Use Compatibility Table

Land use	Below 65	65-70	70-75	75-80	80-85	Above 85
Residential						
Residential, other than mobile homes and transient lodgings	Y[a]	N(1)	N(1)	N	N	N
Mobile home parks	Y	N[b]	N	N	N	N
Transient lodgings	Y	N(1)	N(1)	N(1)	N	N
Public Use						
Schools	Y	N(1)	N(1)	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Commercial Use						
Offices, business and professional	Y	Y	25	30	N	N
Wholesale and retail--building						

a. Y (Yes) = Land Use and related structures compatible without restrictions.

b. N (No) = Land Use and related structures are not compatible and should be prohibited.

Integrated Noise Model Analysis

The following subjects will be described in the following pages

- Aircraft Operations at BCB
  - Flight Instruction Operations
  - Flight Operations Other than Flight Instruction
- Weather Information
- Flight Path Data
- Terrain Data
- Population and Street Map Data
- Quality Assurance Issues

Aircraft Operations

- 29 local aircraft
- 3 flight instruction aircraft (owned by the university)
- 55 different types of aircraft (from Lancair to Bombardier Challenger 603)
- Robinson R22 and GAF 2000 gyrocopter (local operations)
- INM has weak modeling capabilities representing GA aircraft
- Modeled 55 aircraft using 11 aircraft in INM database
- Annual operations - 16,972 (landings and departures)

Aircraft Operations (Flight Instruction)

Yearly Aircraft INM Modeling Distribution and Time of Operations (Flight Instruction Operations).

INM Designator	Aircraft Equivalent	VMC Day Time Landings	IMC Day Time Landings	VMC Night Time Landings	IMC Night Time Landings
GASEPF[a]	Single Engine Fixed Pitch Prop	4090	455	215	24

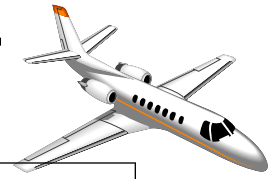
a. Total flight instruction landing operations are 4,784 (9,568 landings and departures).

Aircraft Operations at BCB (Others)

Yearly Aircraft INM Modeling Distribution and Time of Operations.

INM Designator	Aircraft Equivalent	VMC Day Time Landings	IMC Day Time Landings	VMC Night Time Landings	IMC Night Time Landings
CNA500	Cessna 500	216.63	24.07	8.27	0.92
CIT3	Citation III	18.20	0.00	0.00	0.00
CNA441	Cessna Con-quest/Beech King Air	440.55	49.00	17.46	1.94
GASEPF	Single Engine Fixed Pitch Prop	851.07	95.00	6.43	0.71
GASEPV	Single Engine Variable Pitch P	883.83	98.00	2.76	0.31
LEAR25	Bombardier Learjet 25	26.40	3.00	0.92	0.10
BE58P	Raytheon Baron 58P	395.04	44.00	6.43	0.71

Yearly Aircraft INM Modeling Distribution and Time of Operations.



INM Designator	Aircraft Equivalent	VMC Day Time Landings	IMC Day Time Landings	VMC Night Time Landings	IMC Night Time Landings
COMSEP	Single Engine Composite	41.87	5.00	0.92	0.10
HELO[a]	Helicopters	233.02	26.00	0.92	0.10
GYRO[b]	Gyrocopter	164.75	18.00	0.00	0.00
FAL20	Falcon 20 Jet	11.83	1.00	0.00	0.00
Totals		3283.20	363.07	44.10	4.90

a. User-defined aircraft
b. User-defined aircraft

Weather Information

- Needed to quantify runway use
  - 83% of the time Runway 30 is used
  - 17% of the time Runway 12 is used
- Also needed to quantify percent of operations IMC and VMC (affects flight track analysis)
- No NOAA or NWS data available
- Used Automated Weather Observation System (AWOS) available at the Virginia Tech Airport
- AWOS data only available in hard copy format (labor intensive data reduction process)
- Developed a parser program to automate process

Sample AWOS Reduced Data

AWOS-Derived Wind Speed and Direction Matrix for the Virginia Tech Airport.

Wind Direction (degrees)	Wind Speed (miles per hour)									
	0-3	**4-6**	**7-10**	**11-16**	**17-21**	**22-27**	**28-33**	**34-40**	**>41**	**Subtotal**
10	9	7	2	1	0	0	0	0	0	19
20	5	10	2	0	0	0	0	0	0	17
30	5	10	6	1	0	0	3	0	0	25
40	6	16	3	1	0	0	0	0	0	26
50	9	21	10	0	0	0	0	0	0	40
...	...	..								
330	4	14	7	11	2	0	0	0	0	38
340	6	14	11	2	0	0	0	0	0	33
350	2	8	4	0	0	0	0	0	0	14
360	1	3	1	0	0	0	0	0	0	5
Calm winds	1494	0	0	0	0	0	0	0	0	1494
Totals	1908	1063	603	352	77	11	4	0	0	4018

Flight Path Data

The flight data required by INM 6.0a can derived from four independent sources:

1) flight tracks described by flight instructors,

2) flight track assignments employed by Roanoke Air Traffic Controllers (ROA ATC) while handling flights into and out of the BCB airport area,

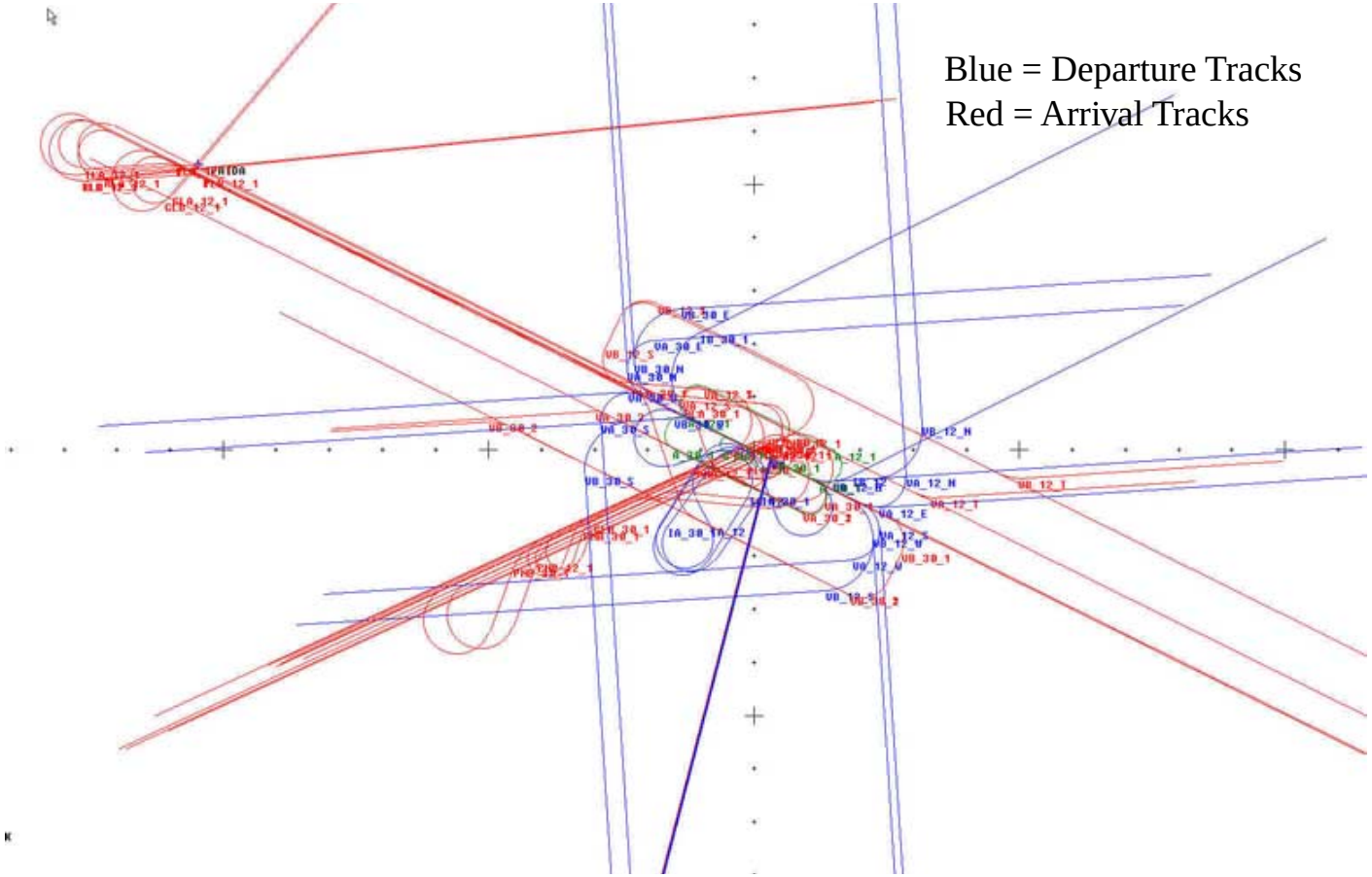
3) radar tracks from ROA TRACON ARTS II system, and

4) published arrival and departure procedures.

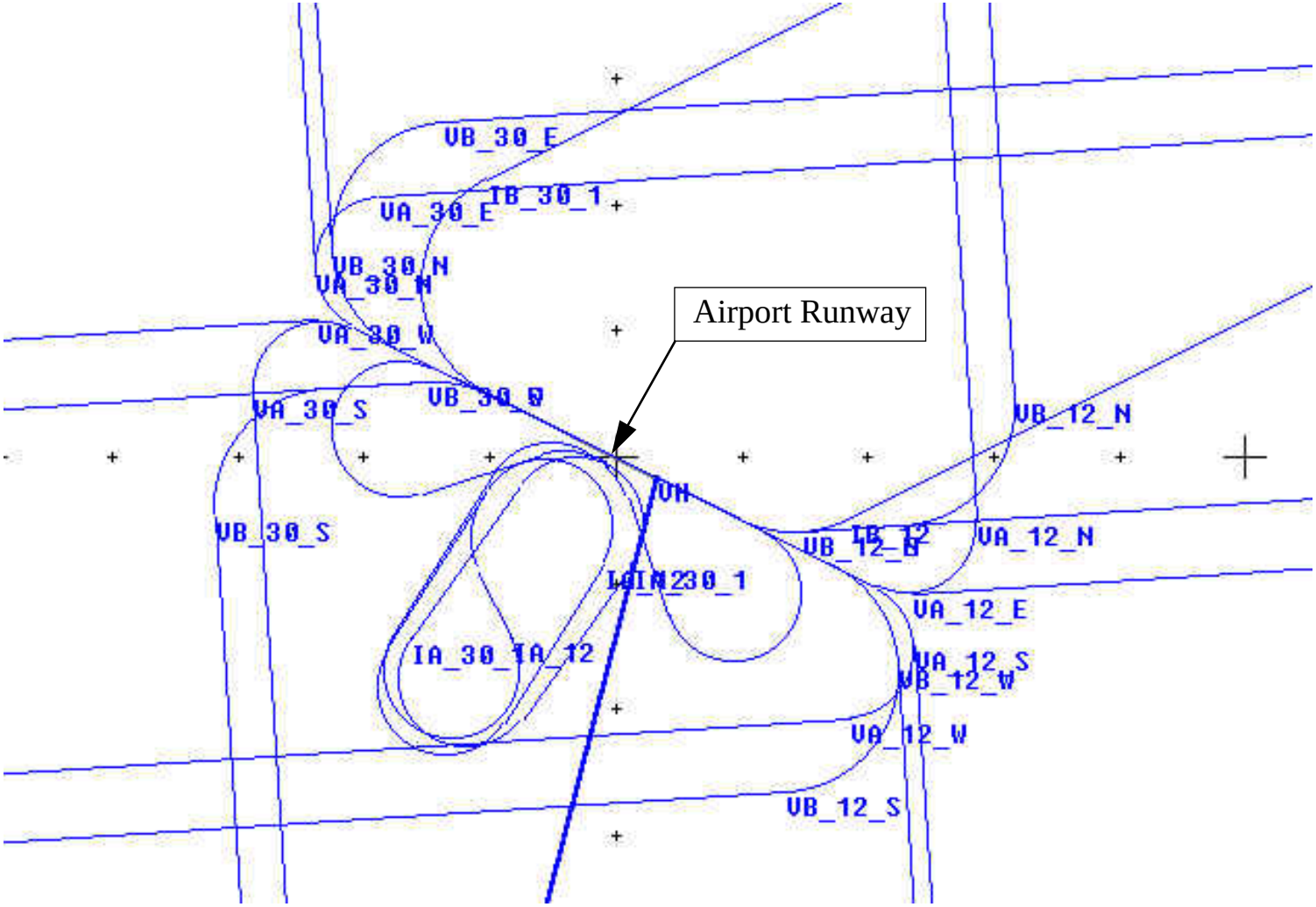
- Used sources 1,2, and 4

Sample Flight Tracks

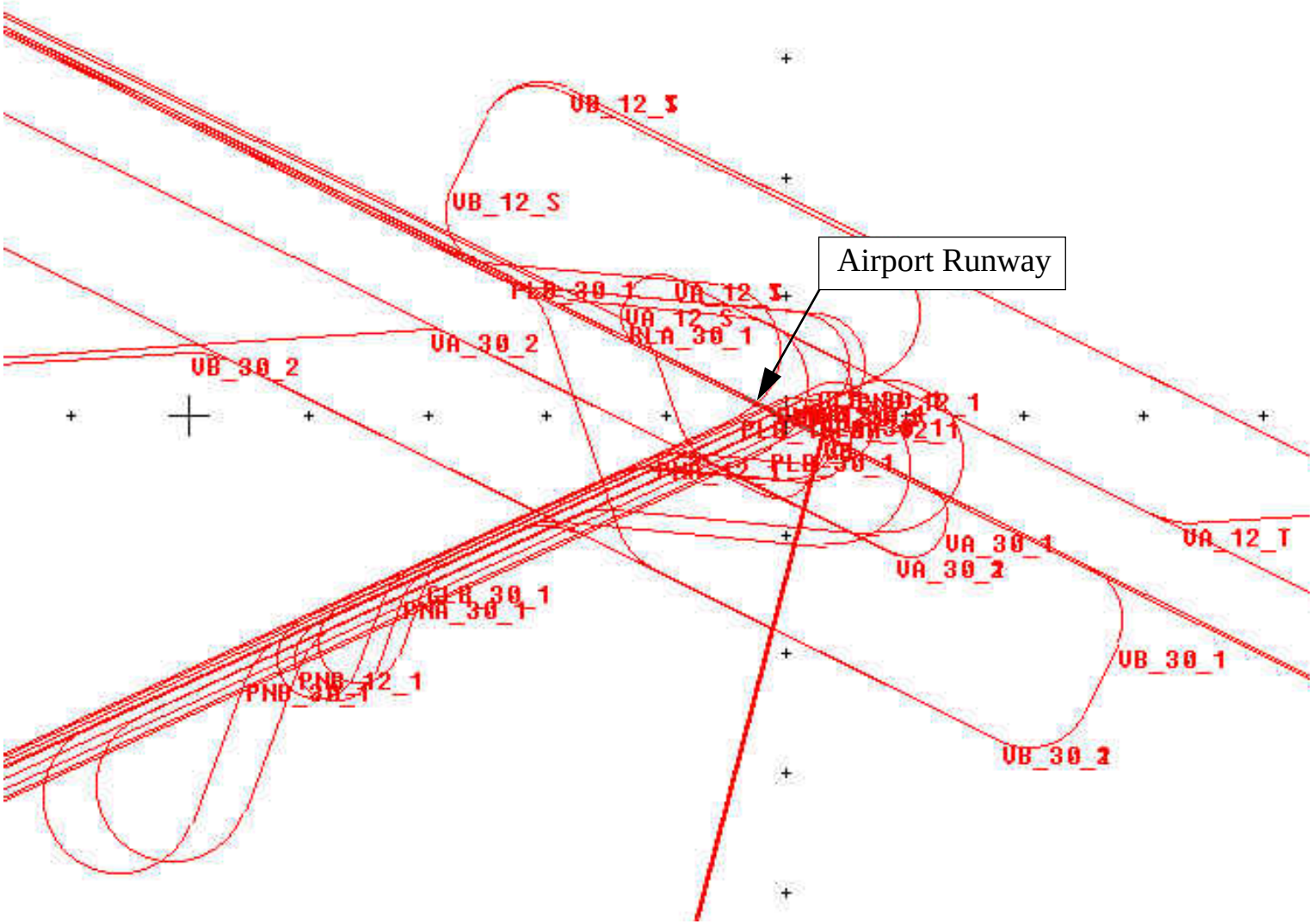
64 flight tracks were generated (including TERP A and B tracks and IMC and VMC tracks)



Sample Vector Departure Tracks



Sample Vector Arrival Tracks



Terrain, Street and Population Data

Terrain Data

- Modified USGS-3 topographical data
- Terrain contours represented every 6.08 meters (20 ft.)

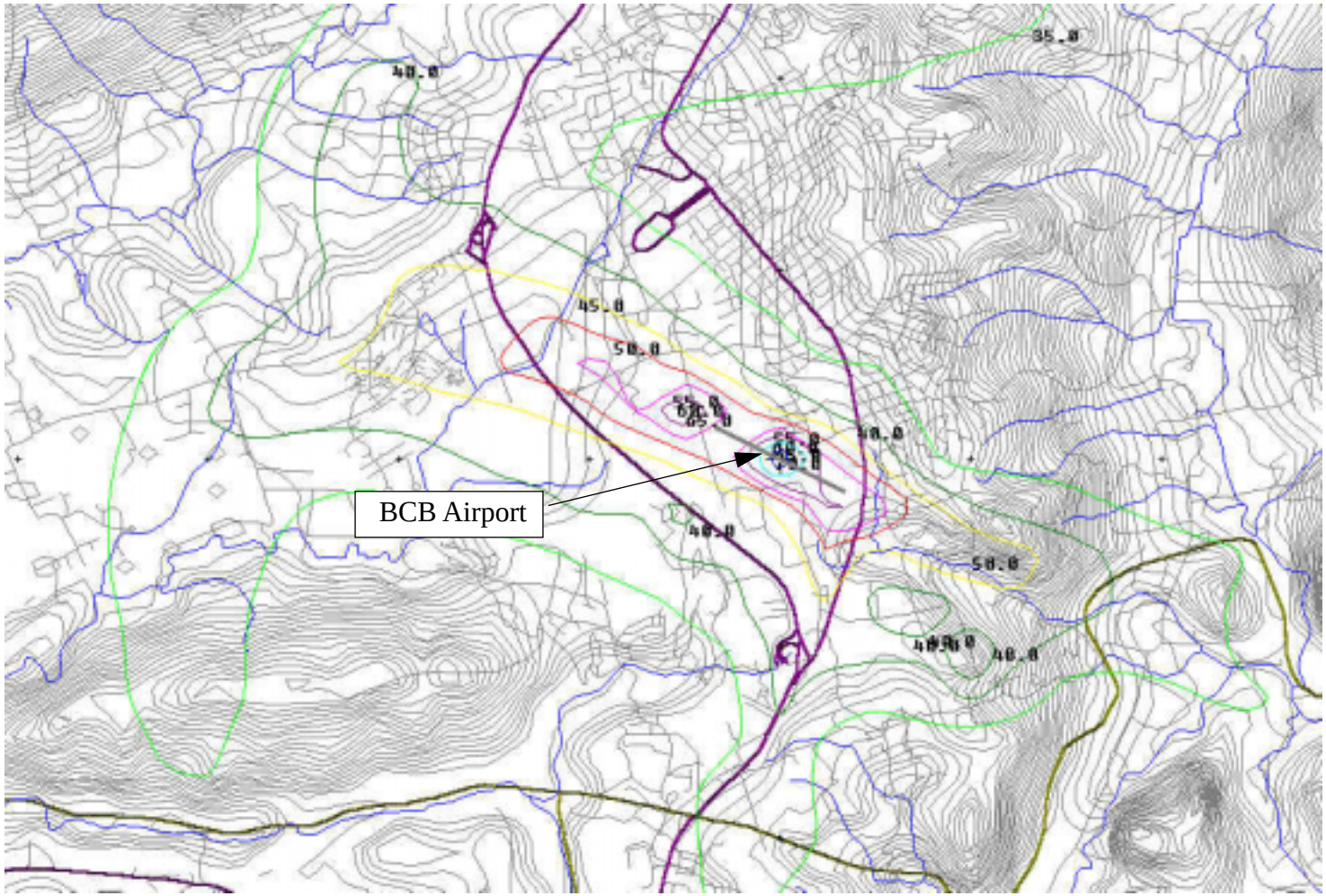
Population Data

- Census data file (Virginia)

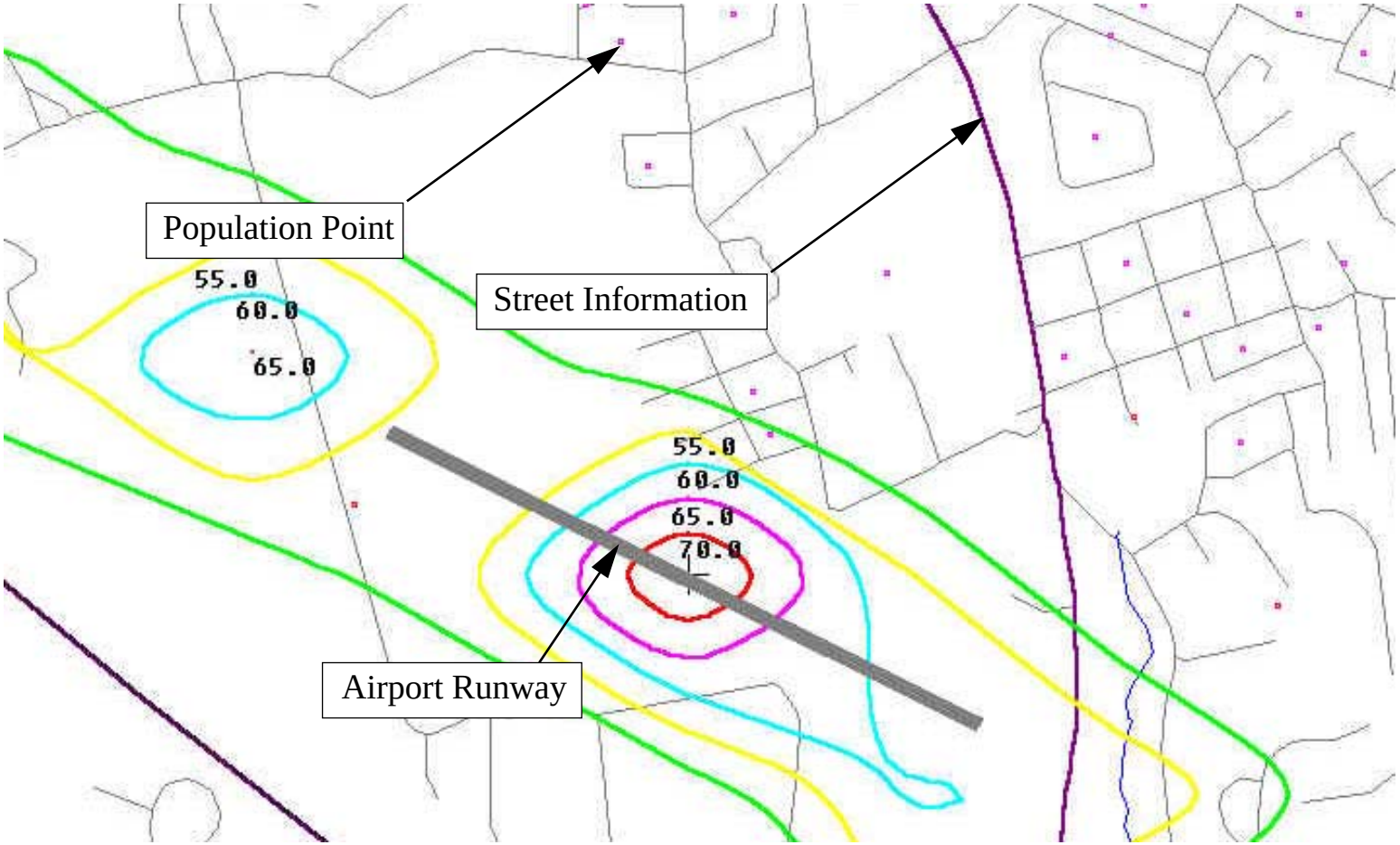
Street Data

- Standard TIGER files for the region

Sample Terrain Data (near BCB)



Sample Street and Population Data



Results and Findings

Several scenarios have been studied:

- Standard Annualized Baseline (1999-2000 traffic activity)
- FAA Terminal Area Forecast (TAF) 2000 scenario
- Special event scenario (night time football game)
- Overflights (762 m., 1,524 m., and 3,048 m.)

Baseline Scenario

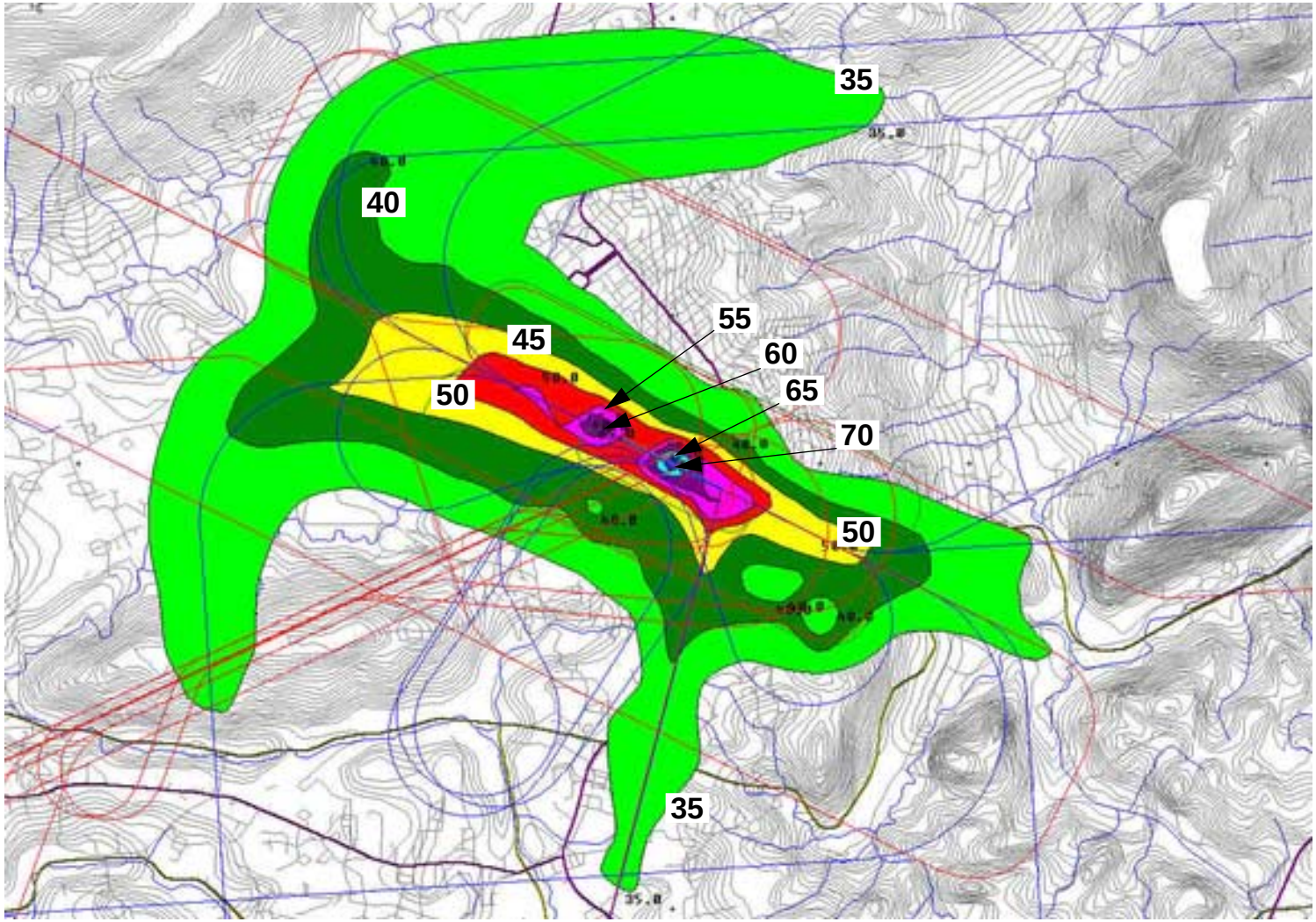
- Represents the level of activity recorded between August 1999 and August 2000
- 16,972 operations
- 56% of the operations are instruction flights
- Only 5% of the flights are night time operations
- 11 representative aircraft
- Modeled gyrocopter and local helicopter operations

INM 6.0a Results (Baseline Scenario)

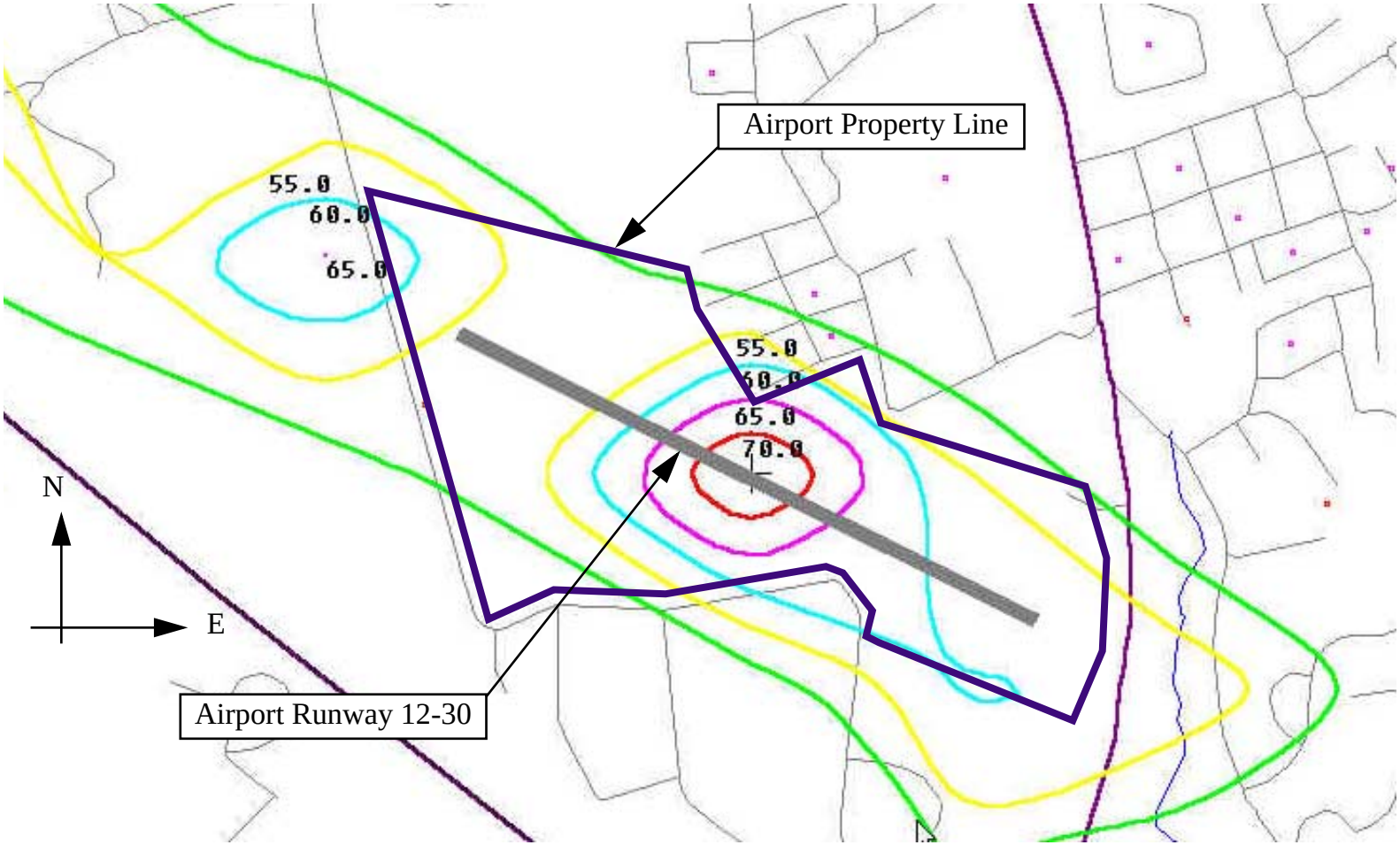
Baseline Noise Contour Results for BCB Airport (Average Day).

DNL Level	Population Affected	Area of Contour (km^2)	Area of Contour (mi^2)	Area of Contour (acres)
25.0	90634	261.456	100.949	64607.1
30.0	77926	138.433	53.449	34207.5
35.0	51368	49.682	19.182	12276.6
40.0	12642	18.035	6.963	4456.6
45.0	4206	6.809	2.629	1682.6
50.0	868	2.784	1.075	688.0
55.0	862	1.062	0.410	262.3
60.0	0	0.382	0.147	94.3
65.0	0	0.115	0.044	28.4
70.0	0	0.034	0.013	8.5
75.0	0	0.001	0.000	0.2

Baseline Scenario Noise Contours (Wide Area)

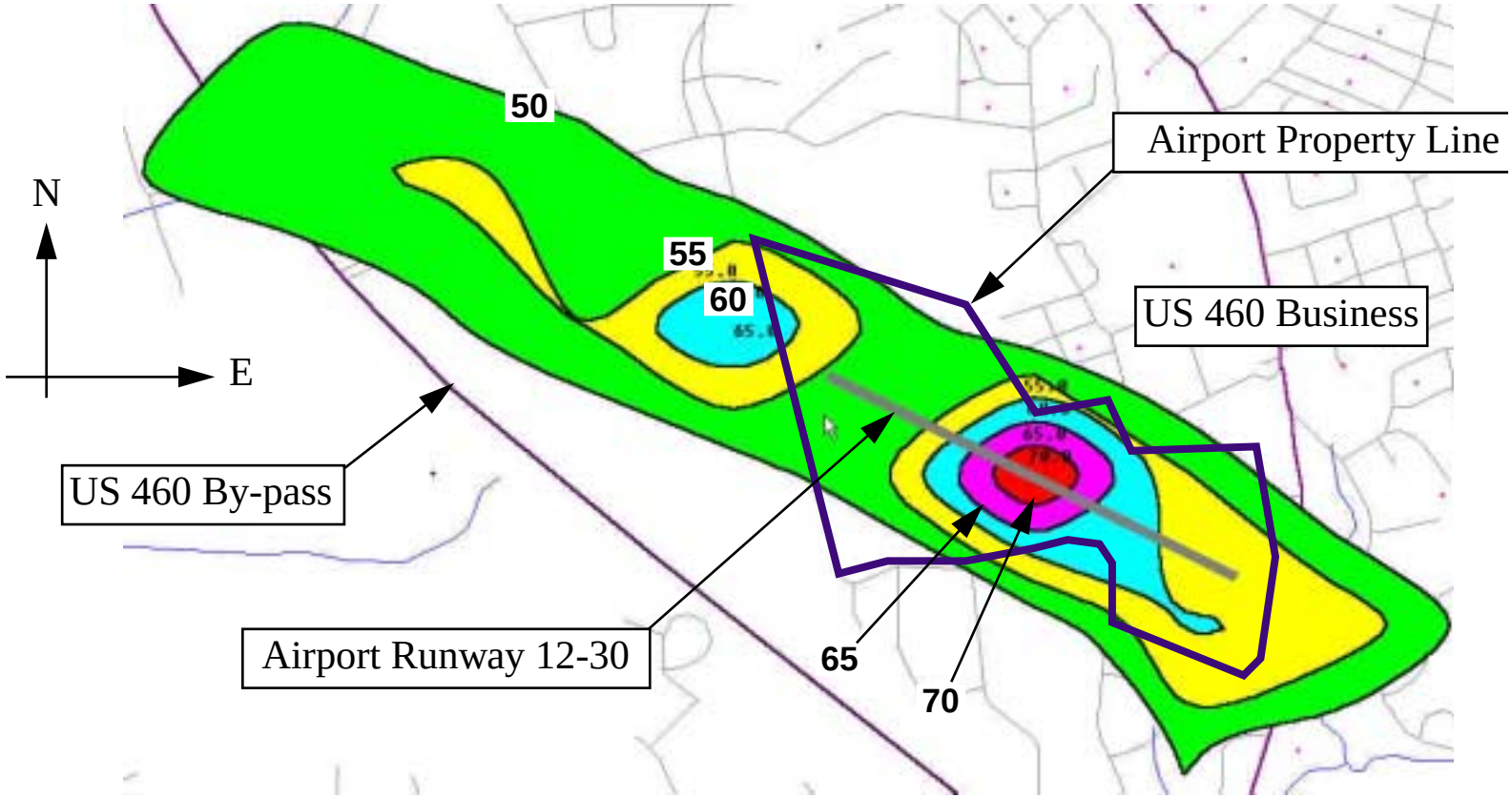


Baseline Scenario Noise Contours (Near BCB)



Baseline Scenario Noise Contours (Near BCB)

Note the asymmetry of the contours due to asymmetrical tracks



FAA 2000 TAF Scenario

- Represents the level of activity predicted by FAA using an econometric model (for the year 2000)
- 34,000 operations
- 56% of the operations are instruction flights
- Only 5% of the flights are night time operations
- 11 representative aircraft
- Modeled gyrocopter and local helicopter operations

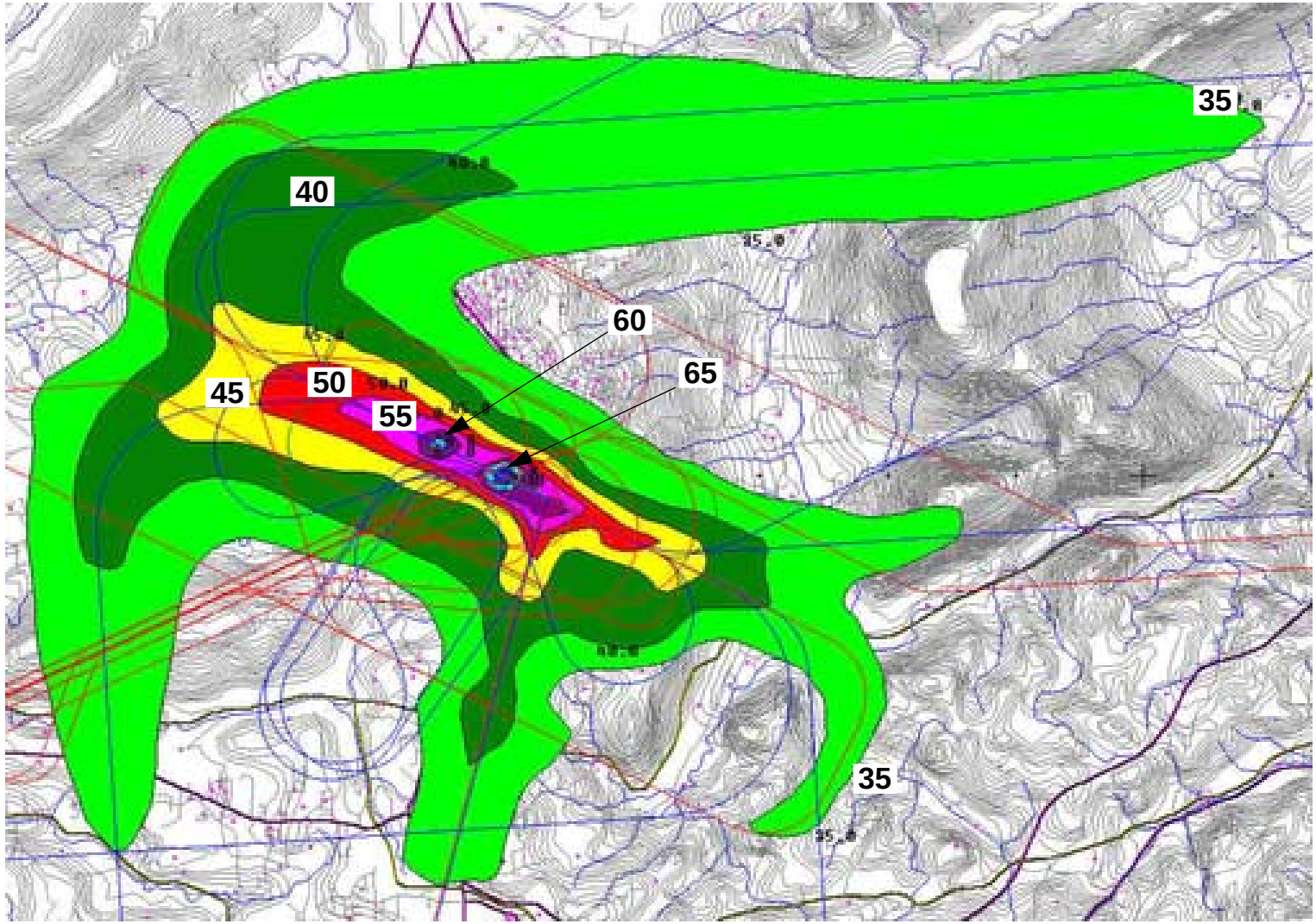
NOTE: the TAF model predicts about twice the number of operations per year.

FAA 2000 TAF Scenario

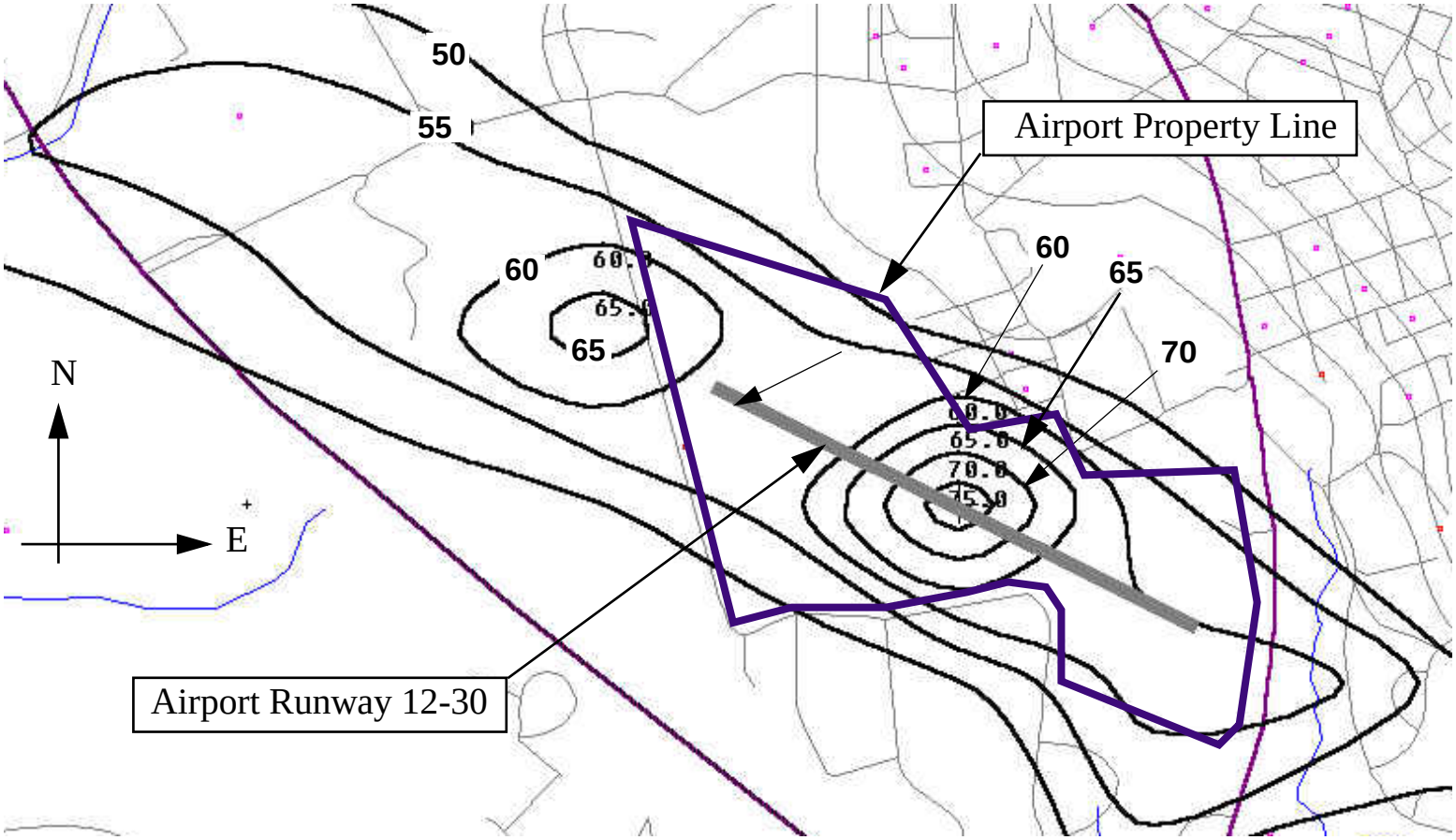
Noise Contour Results for BCB Airport (2000 TAF Scenario).

DNL Level	Population Affected	Area of Contour (km^2)	Area of Contour (mi^2)	Area of Contour (acres)
25.0	99904	347.810	134.290	85945.7
30.0	84898	206.415	79.697	51006.2
35.0	68394	94.289	36.405	23299.2
40.0	45610	33.067	12.767	8171.0
45.0	11422	11.480	4.432	2836.7
50.0	1786	4.809	1.857	1188.4
55.0	862	2.077	0.802	513.3
60.0	0	0.730	0.282	180.4
65.0	0	0.216	0.084	53.5
70.0	0	0.077	0.030	19.0
75.0	0	0.016	0.006	3.8

2000 TAF Scenario Noise Contours (Wide Area)

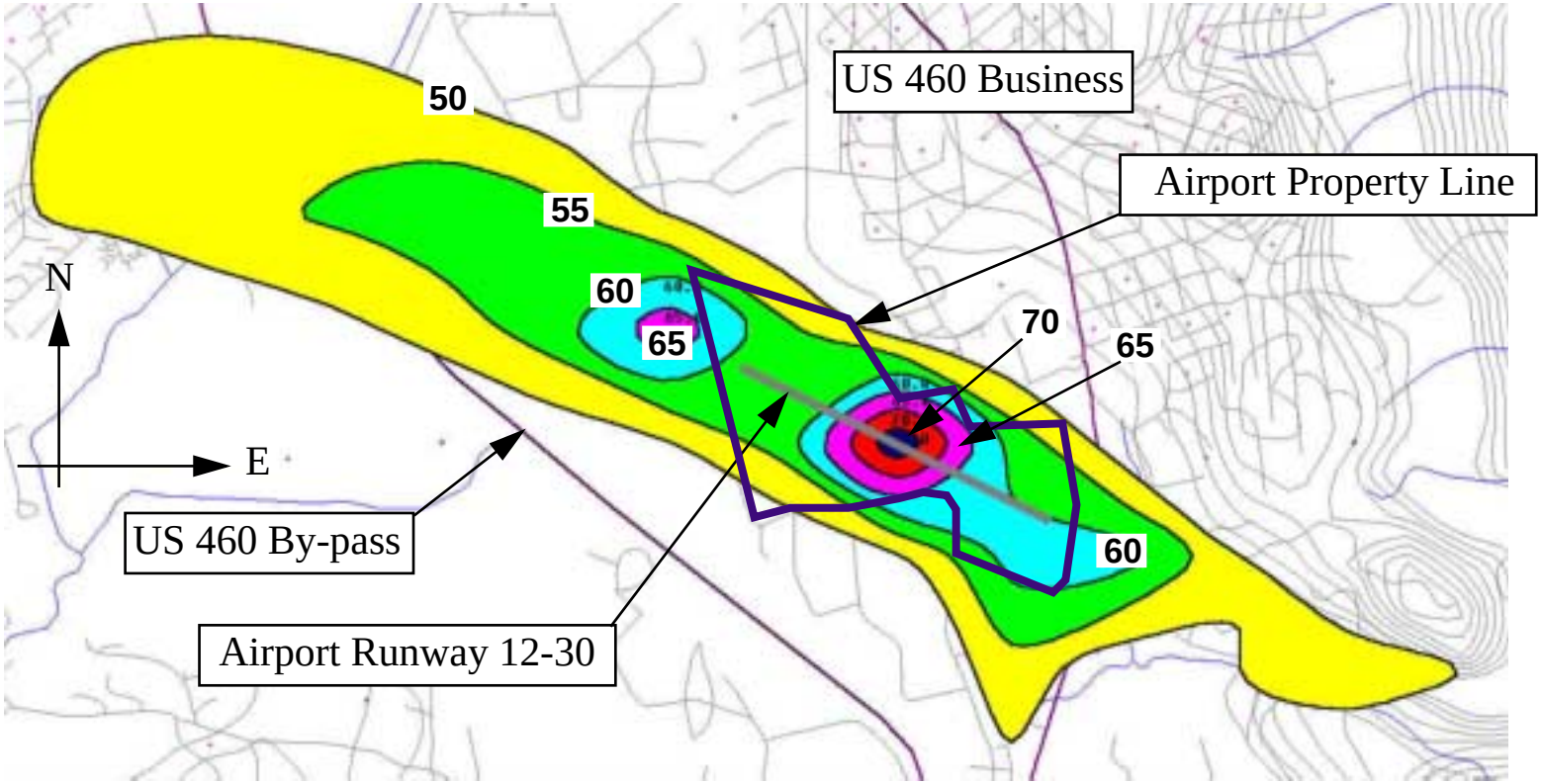


2000 TAF Scenario Noise Contours (Near BCB)



2000 TAF Scenario Noise Contours (Near BCB)

Note growth pattern in DNL contours with twice the number of operations

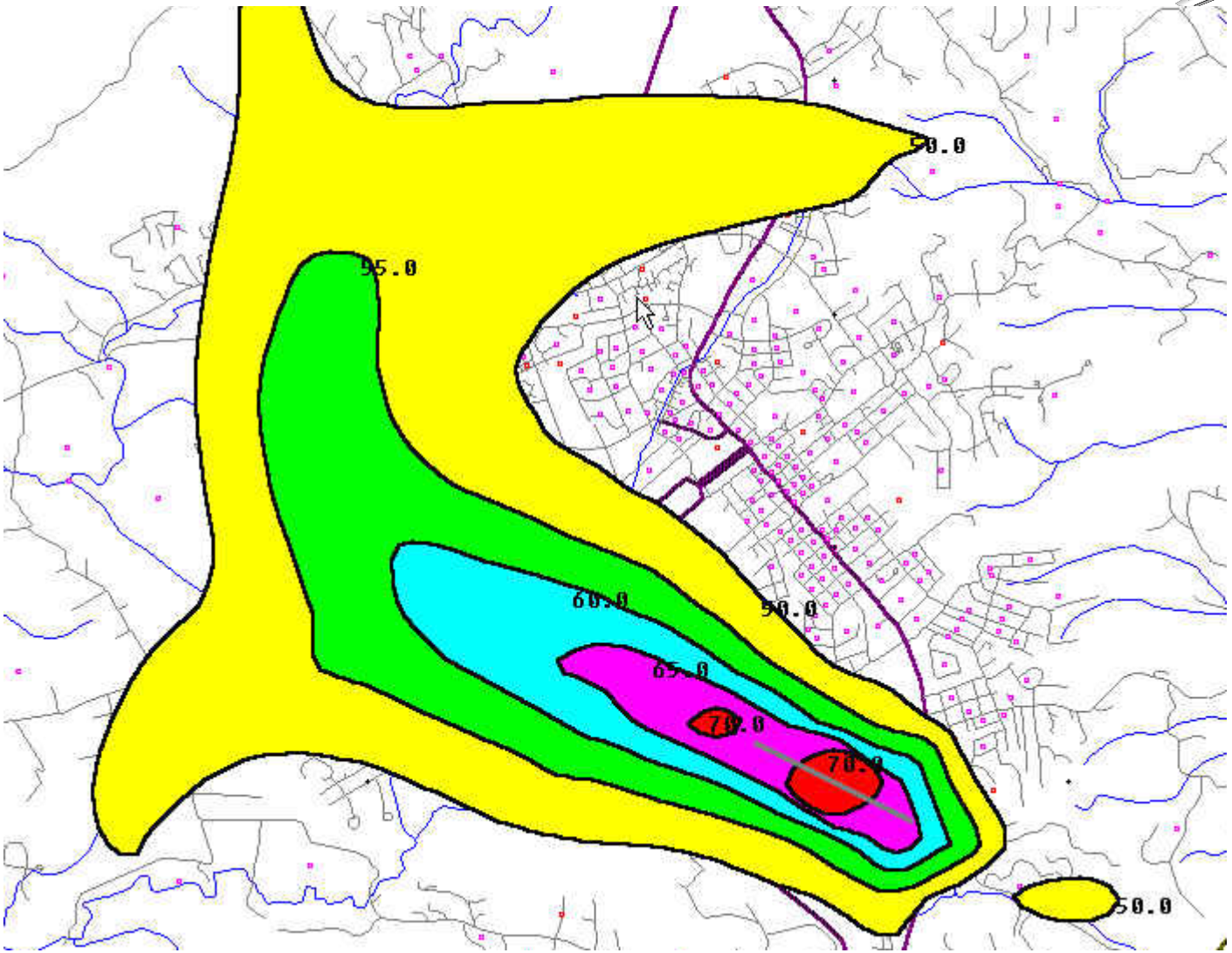


Special Event Scenario (Night Time Football Game)

- Represents the level of activity today plus aircraft operations recorded on a recent football game
  - 64 day time landings
  - 60 night time departures
- Includes 8 corporate jets, 12 turboprops, 16 twin-engine piston-powered aircraft, 20 GASEPF, 8 GASEPV
- Equivalent to 51,000 operations
- Represents abnormal operations (4-5 times per year)
- 11 representative aircraft
- Modeled gyrocopter and local helicopter operations

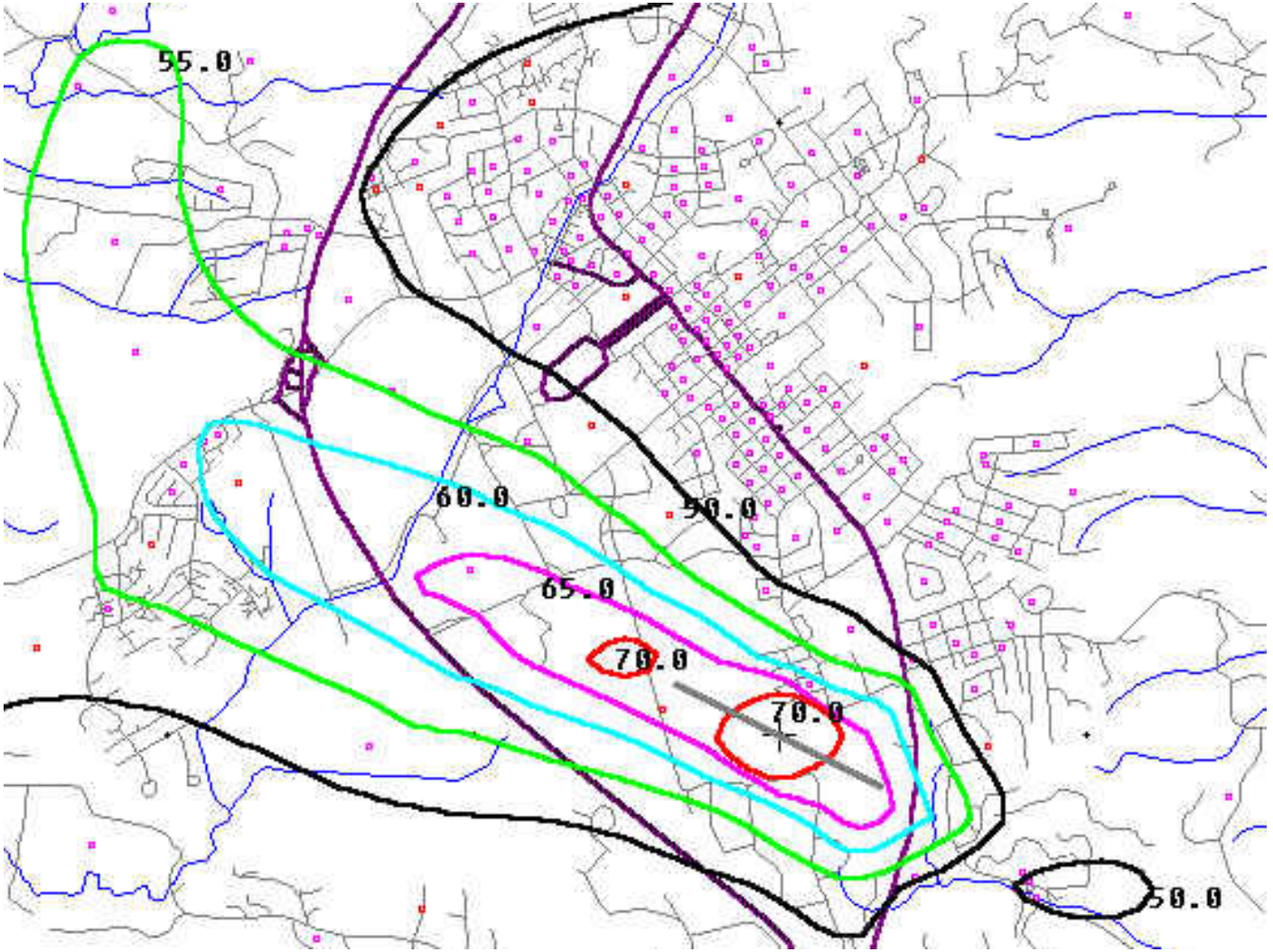
Special Event Scenario Noise Contours (Wide

Area)



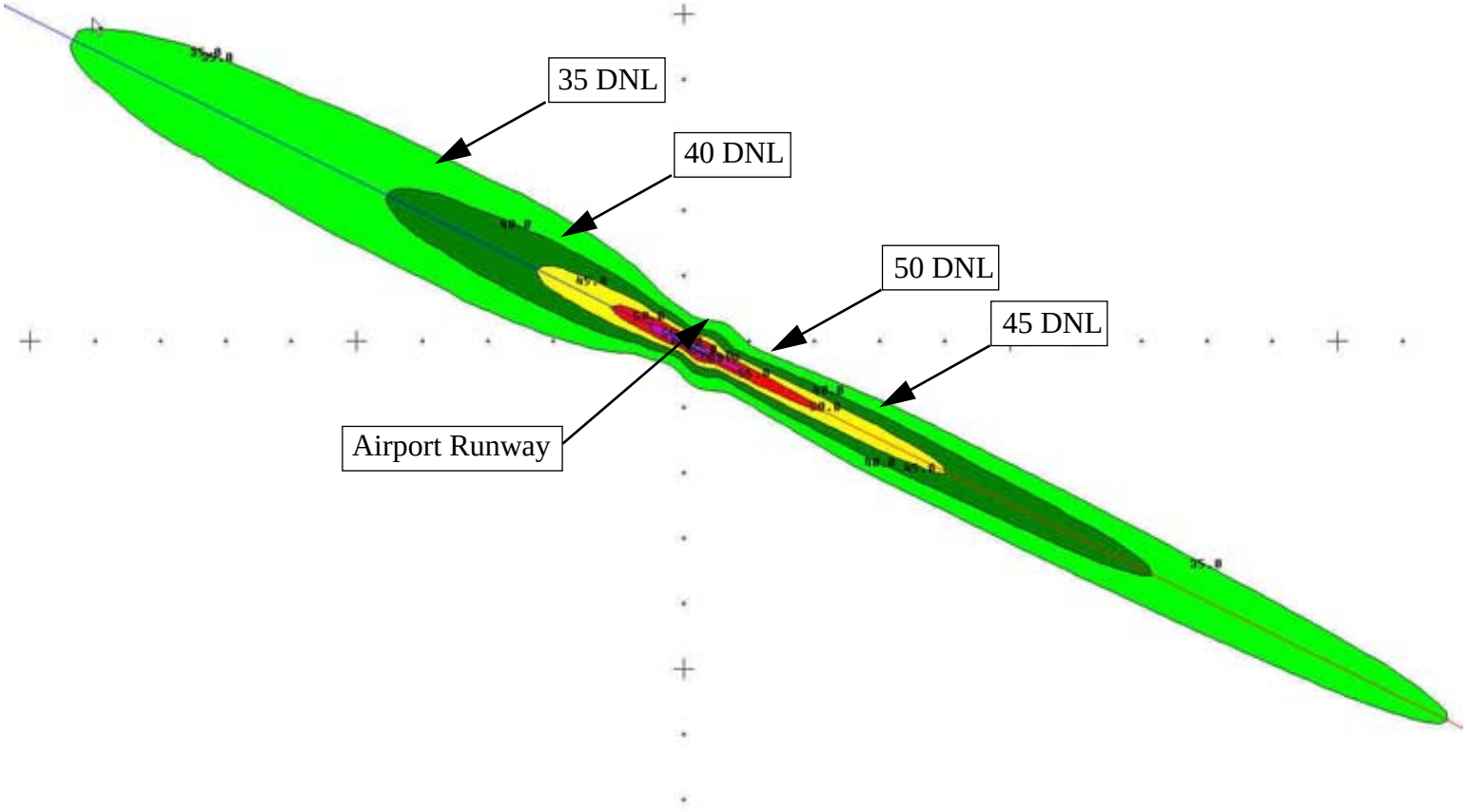
Special Event Scenario Noise Contours (Near

BCB)

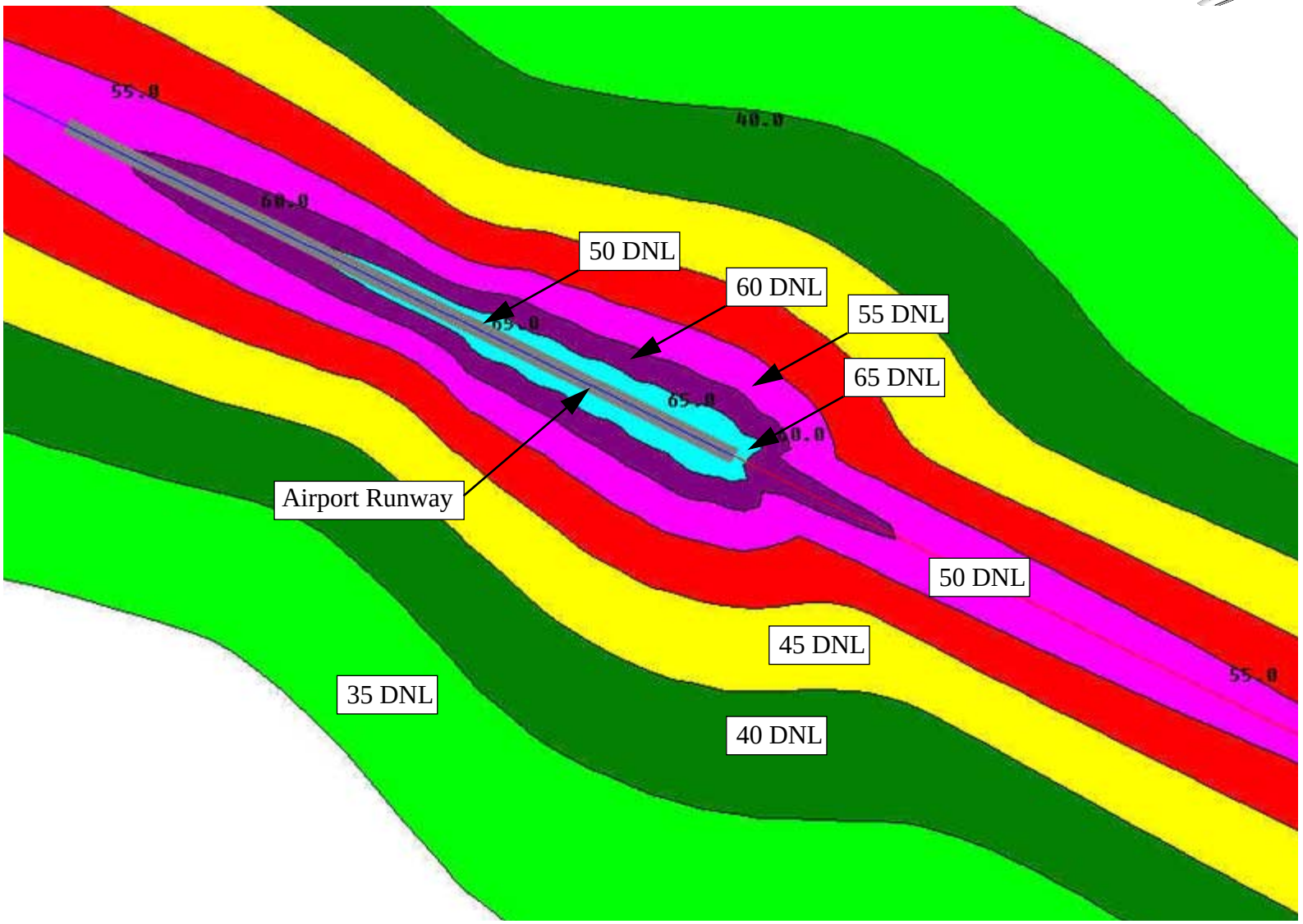


Quality Assurance of Contours

Straight-in and out contours (terrain algorithm off)

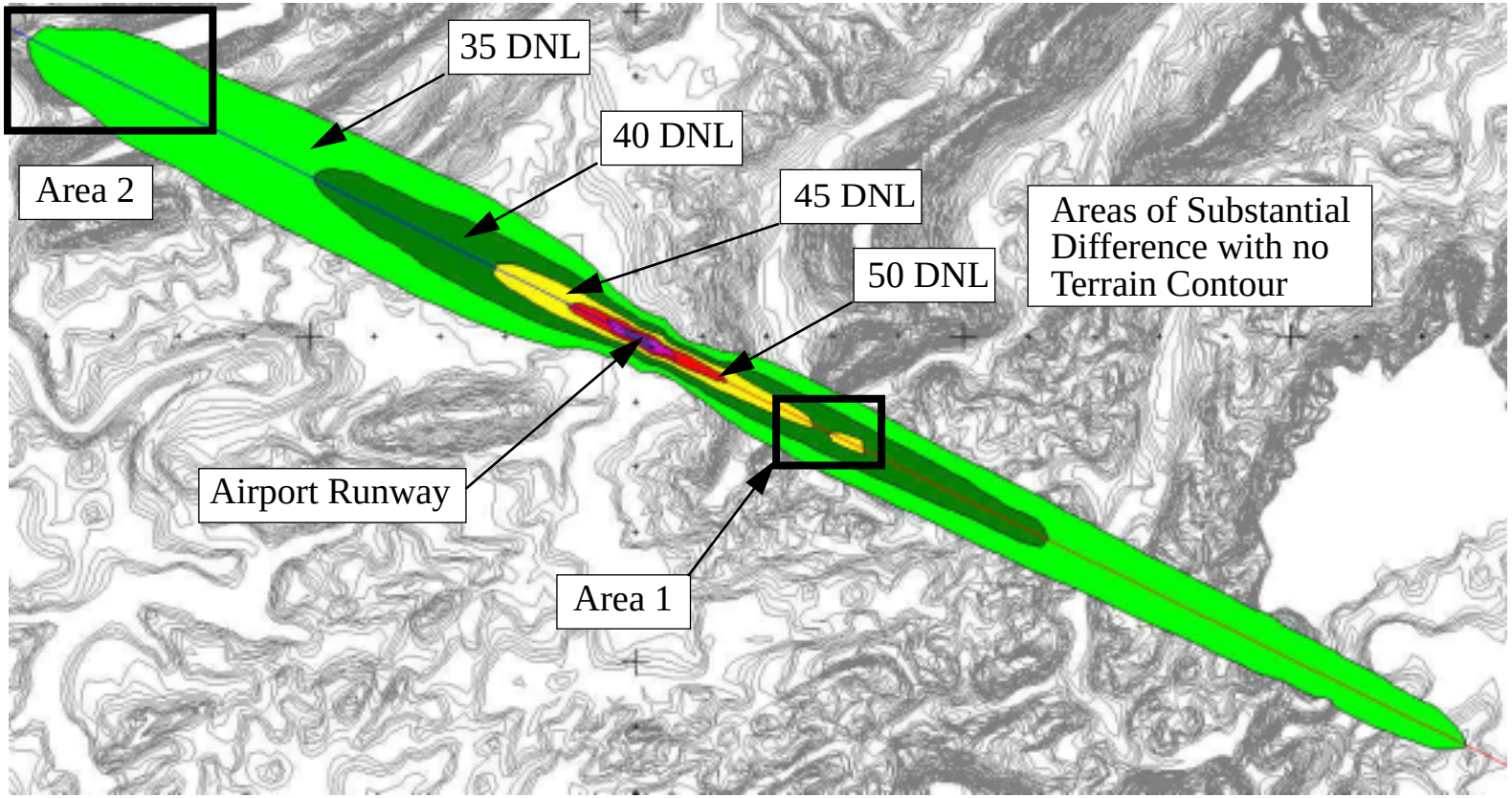


Close Up Contours (terrain algorithm off)



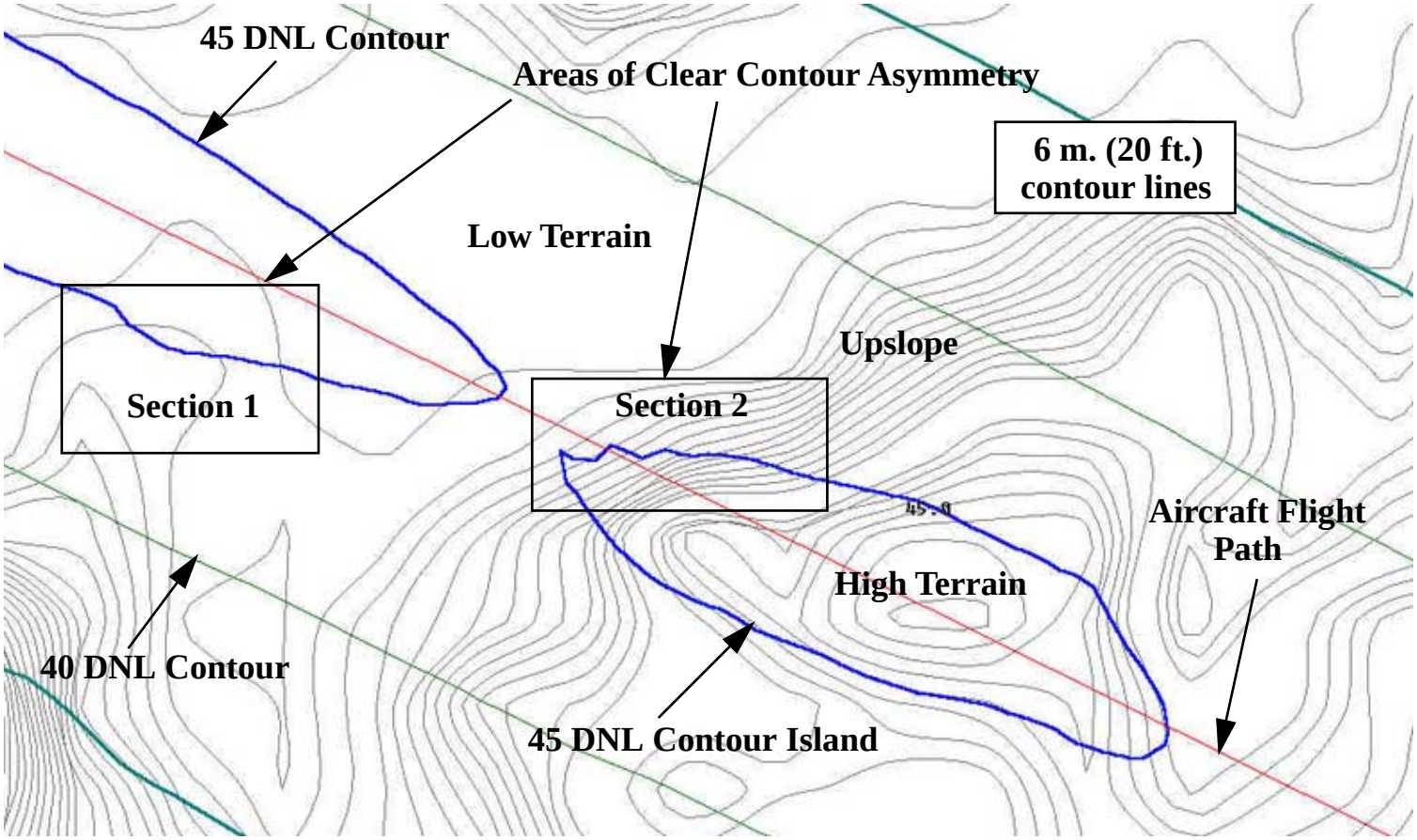
Quality Assurance of Contours

- Straight-in and out contours (terrain algorithm on)
- Note the formation of island contours



Close Up Contours (terrain algorithm on)

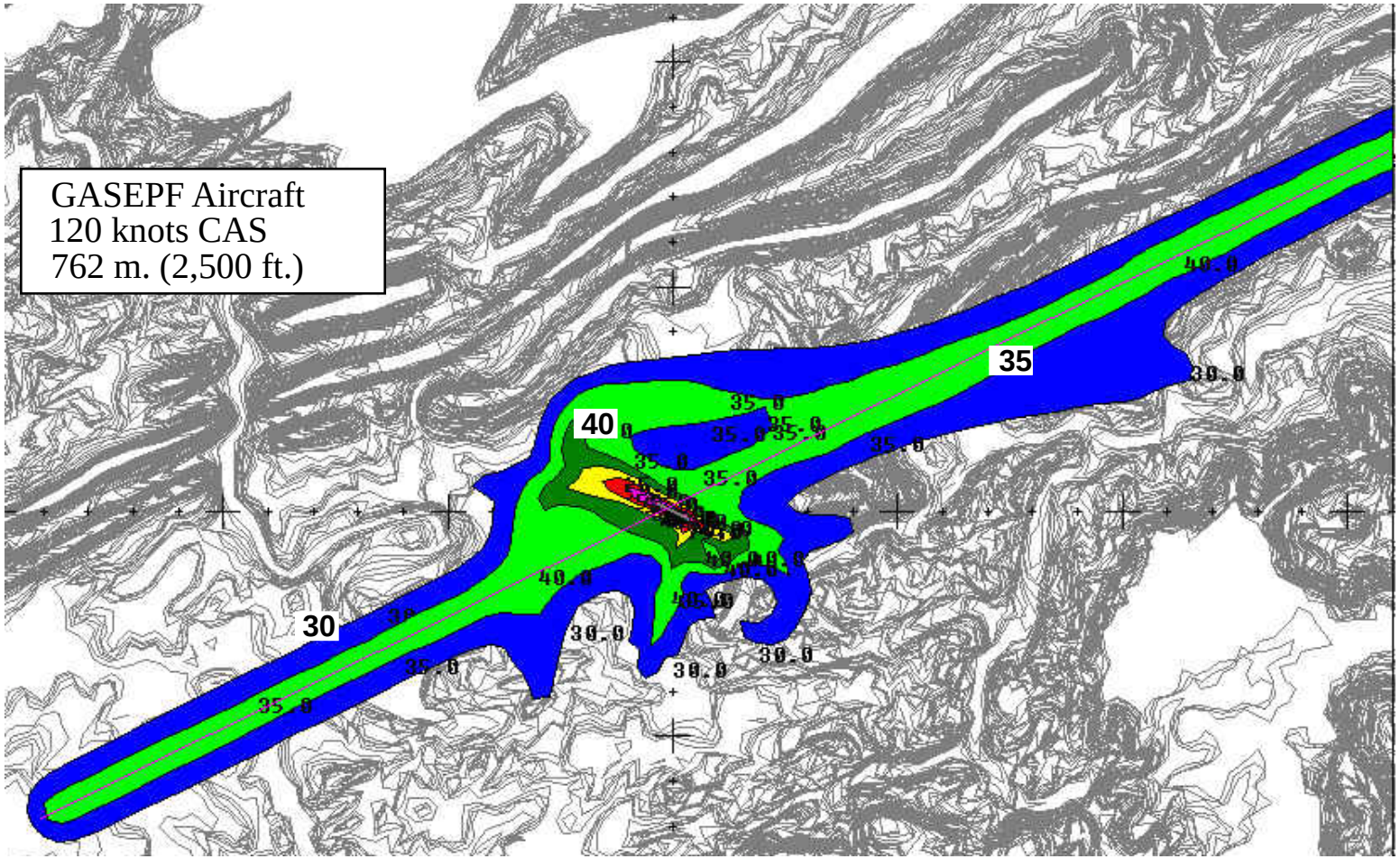
- Note substantial changes in noise contours with the terrain algorithm turned on



Overflight Scenario

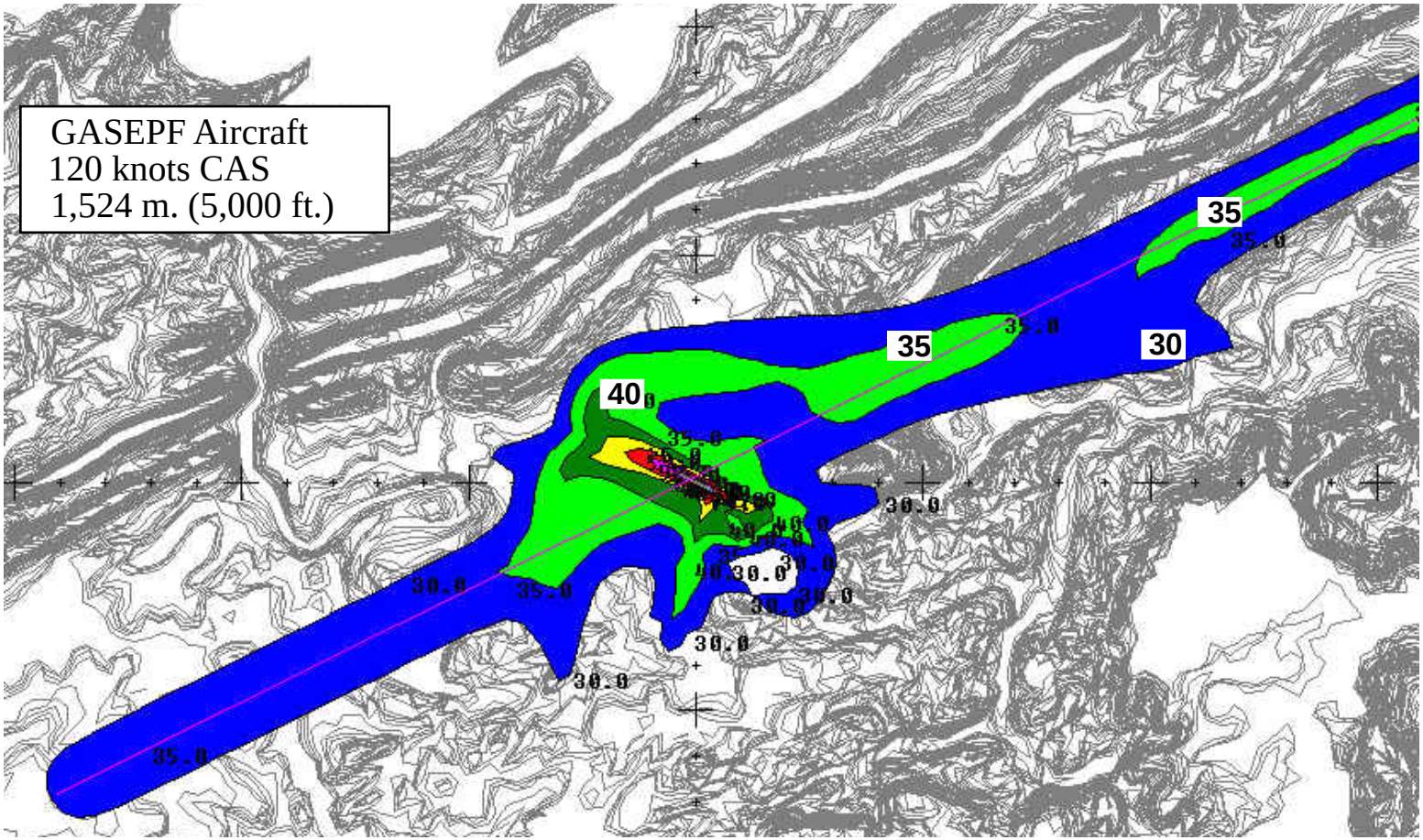
- Attempts to understand impact of night time overflight operations
- Baseline scenario plus:
- 10 night time overflights from Pulaski (PSK) to Roanoke (ROA) VORs
- 11 representative aircraft (like baseline scenario)
- Modeled gyrocopter and local helicopter operations
- Adds one aircraft of the following three:
  - GASEPF - single-engine, fixed pitch propeller aircraft
  - CNA441 - twin-engine, turboprop aircraft
  - CNA500 - twin-engine, turbofan aircraft

Overflight Contours (Single-engine Aircraft)

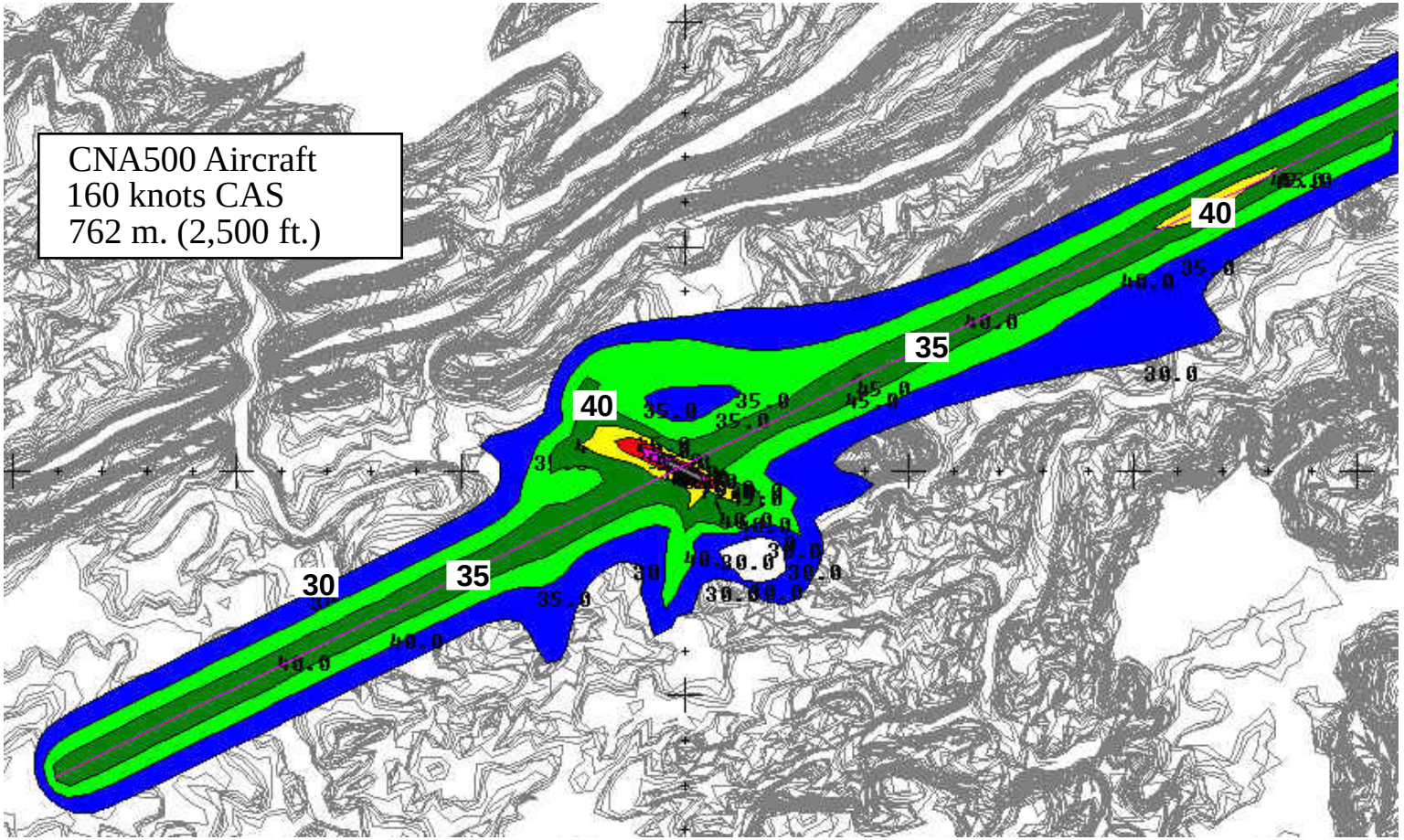


Sample Overflight Scenario (Single-engine

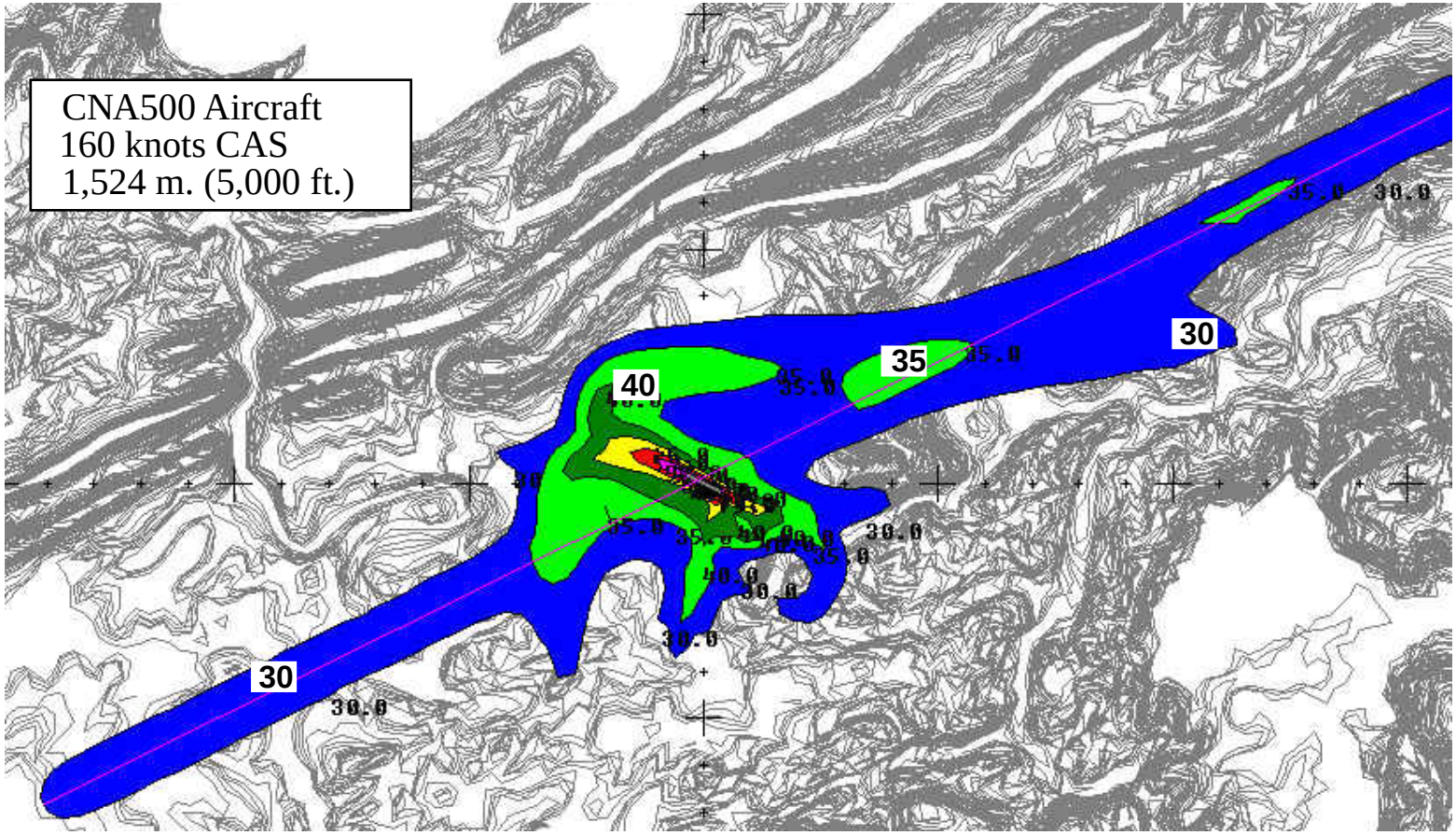
Aircraft)


GASEPF Aircraft
120 knots CAS
1,524 m. (5,000 ft.)
35
35
30
40
35.0
30.0

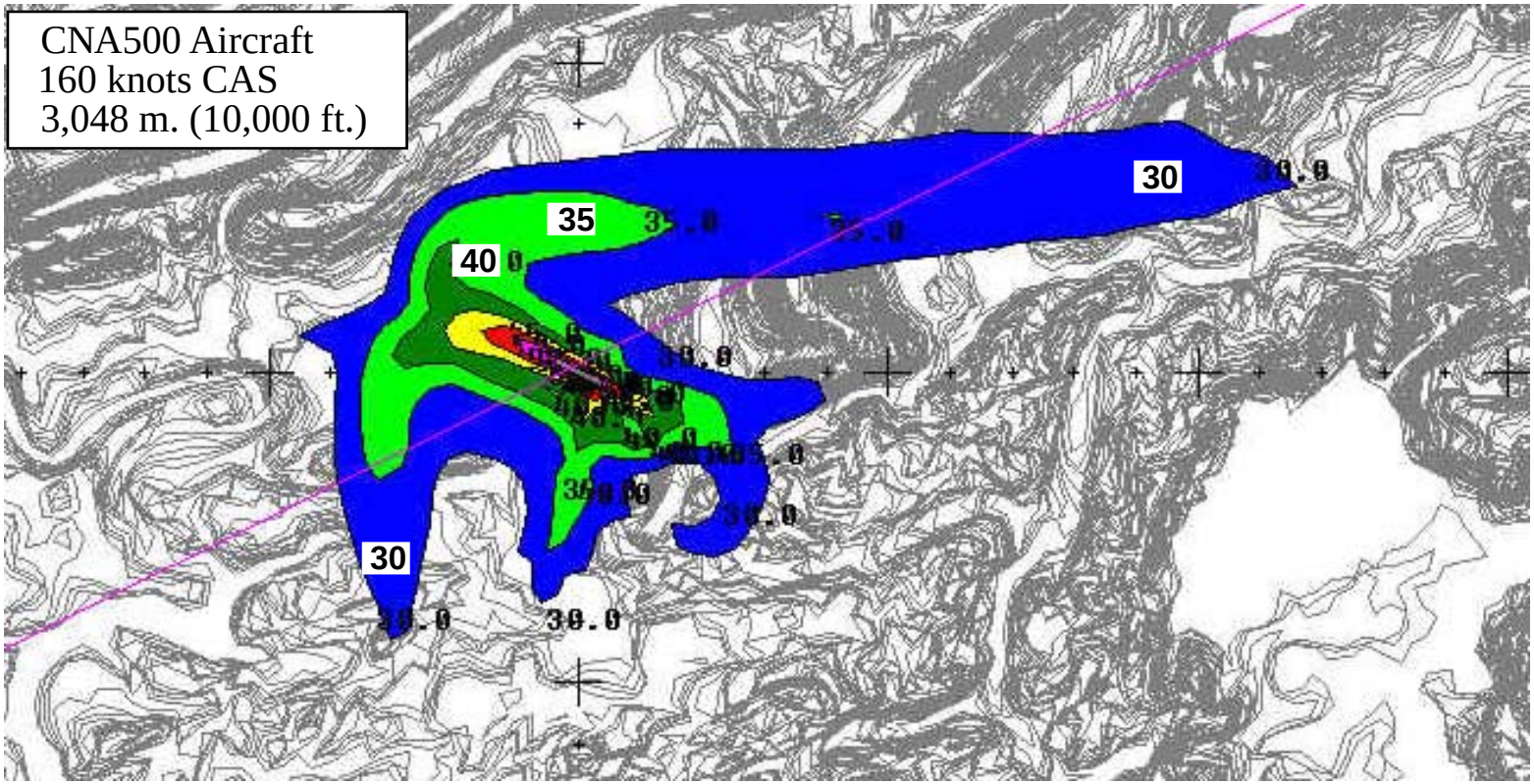
Sample Overflight Scenario (Jet Flights)



Sample Overflight Scenario (Jet Flights)

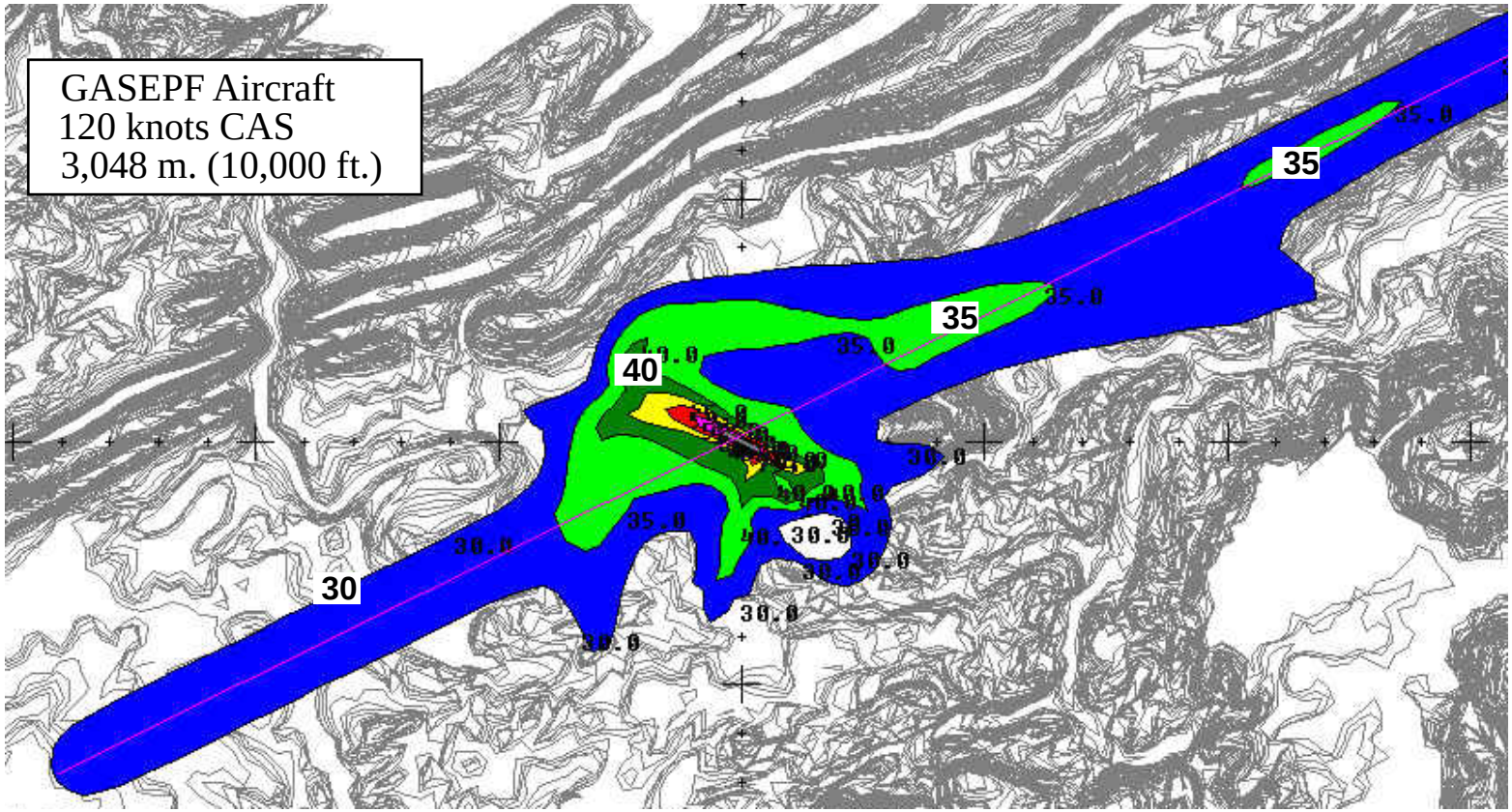


Sample Overflight Scenario (Jet Flights)



Sample Overflight Scenario (Single-engine

Aircraft)


GASEPF Aircraft
120 knots CAS
3,048 m. (10,000 ft.)
35
35
40
30
35.0
30.0

Conclusions

- The resulting noise contours show significant differences with those presented in the 1995 Master Plan (no touch-and-go operations were apparently modeled in that study).
- BCB seems to contain most of the annoying effect within the airport boundary (i.e., DNL < 65).
- INM could be a vehicle to explain communities the effects of SATS operations (in the future)
- The noise contours obtained in the analysis of overflight operations indicate that modest nigh time activity (i.e., 10 night flights) of current aircraft should not create major disturbances to population centers.

Conclusions

- The completed task has added value in the early identification of the challenges that will be involved in doing environmental analysis of 5,000 SATS airports across the nation (lack of data).

Anecdotal Evidence

- Chronic complainers in the town of Blacksburg.
- The inferences made about the flight tracks around BCB demonstrate how unique and time consuming each airport really is without regards to airport size.
- Records of airport activity are available in hard copy only and require a large amount of manual data reduction.
- The study conducted represents a procedure that NASA and VDOA could undertake at any airport added to the SATS network.

Recommendations

- The present study demonstrated the need for well established an agreed- upon easy-to-use methods to record traffic at BCB and other Virginia airports
- The Virginia Tech research team recommends a simple change to the AWOS software in order to obtain weather records at various state airports in electronic format.
- There is a need to collect more noise signatures for additional small aircraft and SATS aircraft as they appear in the market.
- The use of complex noise metrics like DNL addresses only one part of the problem that the SATS concept will face if successful across many communities. Perhaps more research should be done in this area.

Recommendations

- A recommendation is made to support the establishment of better databases on how GA flights are conducted in NAS.