NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Washington, D.C. 20594

August 30, 2001

Aircraft Performance

Group Chairman's Aircraft Performance Study

A. ACCIDENT

Location:	Aspen, CO
Date:	March 29, 2001
Time:	1902 MST
Aircraft:	Gulfstream III, N303GA
NTSB Number:	DCA01MA034

B. Group Chairman

Daniel R. Bower, Ph.D.

C. GROUP

Not Applicable

D. SUMMARY

On March 29, 2001, at 19:02 Mountain Standard Time (MST) time, a Gulfstream III, registration number N303GA, operated by AVJET Corp., collided with terrain about 0.4 miles northwest of the Aspen-Pitkin County Airport, Aspen, Colorado. The airplane was destroyed and the flight crew of 2, one flight attendant, and all 15 passengers were fatally injured during impact with sloping terrain. The accident site was about 100 feet above the airport elevation of 7815 feet. The flight had arrived under Instrument Flight Rules and had reported the airport in sight. The flight was operating as an IFR flight under FAR Part 135 operations. The reported weather at 18:53 was wind 250 degrees at 3 knots, visibility 10 miles, light snow, few clouds at 1,500 feet, ceiling 2,500 feet broken, 5,000 feet broken. Approximately 10 minutes after the accident the reported visibility decreased to 1¾ miles in light snow.

The Performance Group chairman arrived on scene the day after the accident and commenced on scene documentation of the accident site and evaluation of the available radar data. Cockpit Voice Recorder (CVR), Federal Aviation Administration

(FAA) radar data, weather data, and Air Traffic Control (ATC) communication data were used to develop the time history of the accident aircraft motion described in this report. Calculations of performance parameters derived from the radar data for the final several minutes of the flight are presented in this report. Composite plots will graphically show the location and orientation of the airplane when key events occurred

E. DETAILS OF FIELD INVESTIGATION

1. Accident Location

The accident aircraft debris was found scattered in and around the main wreckage resting location. The aircraft had initially impacted one side of a large (~ 50 yds) drainage ditch leaving a furrow in the ground, and then impacted the opposite wall of the drainage ditch. The location of various features at the impact location was determined by a Global Positioning Satellite (GPS) receiver. The location of the main wreckage was determined to be 39◦ 14.278' N, 106◦ 52.621' W, at an elevation of 7760 feet. For details, see the Aircraft Performance Group Chairman' s Wreckage Site Factual Report.

F. RADAR DATA

1. Radar Data

Airport Surveillance Radar (ASR) data was obtained from the Aspen TRACON for N303GA and several flights that either performed missed approaches or landed prior to the accident. ASR data was obtained in range-azimuth-altitude format, and converted to x-y-altitude format. Radar data was also obtained from the Denver ARTCC using their NTAP format. A tabular version of the ASR data is given in Attachments I-1 through I-6 showing the raw range –azimuth and converted x-y coordinates. Plots are given in attachments I-7 through I-9 showing the ground track of the accident aircraft from both the NTAP data and Aspen ASR in latitude longitude format and x-y position format relative to the Aspen ASR antenna.

Attachment I -7 depicts the NTAP and ASR radar data for the entire approach of the accident aircraft plotted in latitude–longitude coordinates. Attachment I-8 depicts the altitudes recorded on the ASR radar data as a function of UTC time. Attachment I-9 shows the final four minutes of the approach into Aspen airport. UTC time and transponder altitudes are included on the plot, and the crash site and RWY 15 are noted. At 02:00:49 the flight descends below 10,000 feet and begins it's final descent into the airport. The next minute show the airplane maneuvering to the right slightly, then maintaining a relatively straight track until 02:01:27 when the airplane had descended to 8600 feet. A slight deviation to the right towards the centerline of the runway is noted starting at 02:01:45 until the end of the recorded radar data. The final radar return was at 8000 feet altitude, and was approximately 0.35 n.m. north-northwest of the crash site.

Radar data is overlaid on a topographical map of the area in attachments I-10 through I-12. Attachments I-10 and I-11 show the ground track in different scales. Attachment I-12 shows a three-dimensional view of the overlaid data onto a digital elevation model from the topographical data. The view in attachment I-12 is from 30 degrees elevation (90 degrees is a directly overhead view). Note the terrain elevations are exaggerated in the vertical direction, such that the elevations are 2 times the actual terrain elevation.

The aircraft followed the VOR-DME approach. Attachment I – 13 shows the altitude of N303GA as a function of North Range, relative to the ASR radar antenna. Selected ATC callouts regarding the visibility of the airport are shown on this attachment. Locations of the Red Table VOR, approach fixes and missed approach point (MAP) from the Jeppesen Chart are also shown in this figure. A picture of runway 15, as viewed during the approach to runway 15, is shown in figure 1.

Radar data was also obtained for several aircraft that performed missed approaches, and one aircraft that landed within 30 minutes prior to the accident. All of

Figure 1 – Picture of approach to ASE runway 15

the approaches are compared in attachment I - 14 with the accident airplane approach. Plots of each aircraft individually compared with the groundtrack of N303GA are shown in attachments I – 15 through I - 17. Plots are labeled with the transponder altitude and time of each radar return. Attachment I - 15 show the approach of beacon 6751, which executed a successful landing approximately 10 minutes before the accident. Attachment I-16 shows data for beacon 2266, who performed a missed approach approximately 5 minutes before the accident. Beacon 2266 never descended below 10200 during the missed approach. Attachment I -17 shows the data for beacon 3560, which missed the approach two times. One missed approach was 20 minutes prior to the accident, and the other missed approach was 4 minutes prior to the accident. On the first missed approach by beacon 3560, the aircraft never descended below 10300 feet, and on the second missed approach, the aircraft descended to 9800 before beginning to climb out. The airplane started to climb from 9800 approximately 1.5 miles from the approach end of runway 15.

Radar Data-based Performance Calculations

Aircraft performance data for the final portion of the flight, calculated using radar data, aircraft data, and weather data are presented in this section. The aircraft aerodynamic data was obtained from the manufacturer, and an estimate for the aircraft weight at the time of the accident was obtained from the Operations Group Chairman. The three dimensional radar data, aircraft aerodynamic data, weather data and the local magnetic variation were used to calculate performance parameters such as groundspeed, airspeed, rate of climb, and aircraft orientation parameters such as pitch and roll angles.

Time Correlation

A time correlation was made between the ASR radar data, NTAP radar data, CVR transcript data, and Air Traffic Control (ATC) radio transmission transcript data. Times indicated with the ATC data were used as the reference time, and CVR, and ASR radar clocks were adjusted accordingly. Times given in this report are in 24-hour format, in the form HHMM:SS (UTC). The CVR records information relative to an elapsed time in seconds, and are assigned a time of day correlation.

Cockpit Voice Recorder (CVR) information was correlated with ATC communications time of day utilizing the radio communications between N303GA and the approach control at Aspen Airport, which was recorded on both sources. The ATC transcript and ASR radar data was provided with a time of day. Correlation between the times provided with the radar data, ATC, and correlated CVR time were provided using various altitude callouts recorded on the CVR transcript.

The ASR radar data records each three-dimensional data point approximately every 4.6 seconds, and is subject to system position error tolerances. Since the performance calculations require smoother and evenly spaced input data, the radar

data was smoothed and interpolated to one data point every second. The smoothed and interpolated data is compared with the recorded data in attachment I-12. Data is shown for altitude, east distance, and north distance as a function of time. The smoothed groundtrack is shown in attachment I-19, along with selected callouts from the CVR transcript. The last recorded radar return occurs at 02:01:50. Calculated parameters after that time should be considered approximate.

Weather Data

Upper level wind data was obtained from the Weather Group Chairman for 0000:00 UTC on the day of the accident. For details of the wind data and data collection information, see the Weather Group Chairman's factual report. A profile view of the recorded winds used in the performance calculations is shown in attachment I-20. This attachment shows wind speed, wind direction, and static air temperature as a function of height.

Calculated Performance Parameters

Performance parameters computed for the entire flight are shown graphically in attachments I-21 through I-24. Attachments I - 21 and I - 22 show the calculated parameters for the first half of the flight for the last ten minutes of flight, and the last minute of the flight is shown in attachments I -23 and I -24. The calculated parameters include airspeed, flight path and pitch angle, vertical speed, and magnetic heading. Also shown on these plots are selected excerpts from the CVR transcript.

The flight was following the VOR/DME approach, and was following the altitude step-downs in the approach. The airplane crossed the Red Table VOR at 0157:49 while at 14000 feet, magnetic heading 168, and at an airspeed of approximately 160 knots. At 0157:49, N303GA was cleared to land on runway one five, following a Challenger aircraft. The next step down, D3.0, was crossed at 0158:40, while at an altitude of 12700 feet, and an airspeed of 150 knots. At 0159:00, N303GA started to level near 12200 feet, and reduced speed to approximately 125 knots by 0159:30. N303GA crossed the ALLIX approach fix at 0159:40 at an altitude of 12100 feet.

The aircraft continued its descent after passing ALLIX, maintaining approximately 2200 feet per minute descent rate, and remaining at approximately 125 knots airspeed. V_{ref} for the aircraft's weight was 123 KIAS. At 0200:28, N303GA asked "are the lights all the way up?", to which the local control (LC) tower replied "affirmative…". N303GA leveled at 10,200 feet for approximately 10 seconds, the started to descend again at 0200:49, as the magnetic heading increased approximately 20 degrees as the ariplaned turned to the right slightly. At that instant, the LC asked "…do you have the runway in sight?", and N303GA responded "…in sight…". N303GA continued its descent at the same speed and rate as prior to leveling at 10200. The

aircraft passed the D9.5 approach fix (approximately 2.9 miles north of the approach end on runway 15) at 0201:00 at an altitude of 9500 feet.

At 0201:13, a comment regarding direction is recorded on the CVR while the airplane is at 9000 feet altitude as the heading starts to decrease slightly. Airspeed remained between 125 - 130 knots. The first callout of "one thousand " was recorded on the CVR at 02:01:28.6, when the aircraft was at 8600 feet altitude, followed by the "nine hundred" callout three seconds later. The calculated airplane bank angle started to increase in the RWD direction, and the airplane magnetic heading started increase from approximately 185 degrees at the time of the "eight hundred" callout.

At 02:01:36, a question about location from the captain was recorded on the CVR, as the airplane was banked to the right, with heading decreasing, as the airplane turned to the right. The first officer responded at 02:01:42.5, as the airplane began to bank towards the LWD direction. The "five hundred" callout was recorded 2.5 seconds later as the airplane was flying on a heading of 200 degrees. By the time the "four hundred callout is heard at 02:01:49, the airplane has now banked to 10 degrees LWD, and the heading starts to decrease as the airplane starts to turn back to the left. The last recorded radar return occurs at 02:01:50, while the airplane is at 8000 feet altitude. The "four hundred" callout is repeated at 02:01:53.

The calculated bank angle continued to increase in the LWD direction through the next several callouts. The final recorded altitude callout of "two hundred" occurred at 02:01:55.2 when the aircraft was at approximately 7900 feet altitude. The aircraft bank angle exceeded 40 degrees LWD as the "bank angle "callout is recorded on the CVR at 02:01:57.2. The recording stopped 1 second after the "bank angle" callout. The LWD bank angle in excess of 40 degrees is consistent with ground scar information discussed previously in this report, and shown in the tree strike photograph in figure 1.

Additional Information

Information from the CVR transcript showed several callouts from the Flight Profile Advisory (FPA) system and Ground Proximity Warning System (GPWS) during the final seconds of the approach to runway 15. The callouts were of the airplane height above ground, as determined by the aircraft's on-board radio altimeter. The groundtrack of the aircraft was overlaid onto topographical maps of the area, such that the terrain directly below the aircraft could be determined from the projection of the ground track on the topographical map. The variation of the terrain below the aircraft could have an effect on the callout from the FPA and GPWS system if variations in terrain occurred below the aircraft as it flew its approach to runway 15.

The smoothed and interpolated ground track was used to determine the ground track between recorded radar returns. Shown in attachment I -25 is a representation of the ground terrain under N303GA for the final 30 seconds of the flight. This figure

represents distance from the end of runway 15 on the horizontal axis, and ground elevation along the ground track on the vertical axis. In this figure, the ground track of the airplane travels from right to left as the airplane approaches runway 15. Overlaid onto this chart is ground track location when the height above ground level FPA callouts are recorded on the CVR. Also shown are the groundtrack locations of the final six radar returns, labeled with time and altitude.

Of note in this attachment is the change of terrain below the aircraft between the first “four hundred” callout, and the second callout 2.4 seconds later. During this phase of the approach, the descent rate was approximately constant. However, the second “four hundred” callout occurs as the airplane is traversing a riverbed, and the local terrain drops 140 feet in elevation from one bank to the lowest point in the riverbed. This riverbed is clearly visible on the north side of the road in the photograph in figure 1, and in the topographical information in attachment I – 12. The terrain rises again as the aircraft crosses the riverbed, as the “three hundred” and “two hundred” height callouts are recorded on the CVR. After the final “two hundred” callout, the terrain rose another 25 feet to the elevation of the impact site.

Daniel R. Bower, Ph.D.
Senior Aerospace Engineer

ATTACHMENT I

Radar Data

Radar Plots

Calculated Performance Parameters

Aspen ASR Radar Data

HH	MM	SS	ALT	RANGE	ACP	NORTH_NM	EAST_NM	LATITUDE	LON_PSTV_E
01	43	59.27	21000	26.44	2694	-9.54278506	-24.573943	39.0713343	-107.40844
01	44	4.1	21000	25.94	2693	-9.39810028	-24.091776	39.0737917	-107.398149
01	44	8.6	21000	25.38	2694	-9.15765397	-23.582179	39.0778466	-107.387282
01	44	13.46	21000	24.88	2694	-8.97594924	-23.114265	39.0809177	-107.377299
01	44	18.08	21000	24.31	2695	-8.73412384	-22.594182	39.0849946	-107.366206
01	44	22.79	21000	23.81	2696	-8.5191264	-22.138929	39.0886176	-107.356494
01	44	27.32	21000	23.25	2696	-8.31712224	-21.613974	39.0920293	-107.34529
01	44	32.15	21000	22.75	2698	-8.07181565	-21.170037	39.0961547	-107.335823
01	44	36.77	21000	22.19	2699	-7.83966529	-20.656304	39.1000659	-107.324859
01	44	41.6	21000	21.69	2701	-7.59938463	-20.209886	39.1041061	-107.315336
01	44	46.22	21000	21.19	2705	-7.3012151	-19.784579	39.1091087	-107.306268
01	44	51.08	21000	20.75	2712	-6.93964655	-19.445152	39.1151605	-107.299043
01	44	55.79	21000	20.25	2721	-6.50806495	-19.063195	39.1223819	-107.290914
01	45	0.41	21000	19.81	2727	-6.19318499	-18.702079	39.1276563	-107.283217
01	45	5.27	21000	19.44	2734	-5.87877161	-18.412824	39.1329172	-107.277057
01	45	9.89	21000	19	2739	-5.60591731	-18.034465	39.1374915	-107.268986
01	45	14.6	21000	18.56	2748	-5.23076578	-17.685332	39.143768	-107.261548
01	45	19.46	21000	18.19	2756	-4.91205221	-17.389592	39.1490999	-107.255247
01	45	23.96	21000	17.81	2765	-4.57254868	-17.08595	39.1547784	-107.248777
01	45	28.79	21000	17.44	2775	-4.2190714	-16.792466	39.1606887	-107.242525
01	45	33.41	21000	17.13	2783	-3.94026534	-16.539003	39.1653517	-107.237123
01	45	38.27	21000	16.75	2794	-3.57814379	-16.228955	39.1714065	-107.230515
01	45	42.89	21000	16.44	2802	-3.31514837	-15.965486	39.1758061	-107.224895
01	45	47.6	21000	16.06	2813	-2.97368177	-15.642463	39.1815168	-107.218006
01	45	52.46	21000	15.75	2823	-2.67967081	-15.377962	39.1864326	-107.212365
01	45	56.96	21000	15.5	2834	-2.38068407	-15.1716	39.1914277	-107.207969
01	46	1.9	21000	15.25	2847	-2.04351944	-14.965859	39.1970588	-107.203588
01	46	6.41	21000	15.13	2864	-1.63932961	-14.893546	39.2037989	-107.20207
01	46	11.15	21000	15	2881	-1.23946454	-14.800322	39.2104681	-107.200103
01	46	16.1	21000	14.88	2908	-0.62047641	-14.71778	39.2207884	-107.198381
01	46	20.84	21000	14.75	2909	-0.59256526	-14.587414	39.2212611	-107.19559
01	46	25.55	21000	14.69	2924	-0.25571892	-14.536537	39.2268775	-107.194525
01	46	30.41	21000	14.56	2940	0.100188512	-14.406993	39.2328161	-107.191775
01	46	34.91	20900	14.5	2955	0.429887744	-14.34263	39.2383142	-107.190422
01	46	39.74	20800	14.44	2971	0.778569172	-14.269571	39.2441292	-107.188883
01	46	44.36	20700	14.38	2987	1.12392527	-14.18807	39.2498892	-107.187162
01	46	49.1	20500	14.31	3003	1.46495107	-14.090536	39.2555782	-107.185099
01	46	53.84	20400	14.25	3021	1.84577941	-13.986926	39.2619307	-107.182906
01	46	58.67	20200	14.25	3036	2.16781063	-13.945343	39.2673001	-107.182041
01	47	3.5	20100	14.19	3053	2.52023686	-13.826704	39.2731801	-107.179523
01	47	8.12	19900	14.19	3069	2.85972655	-13.765139	39.2788417	-107.17823

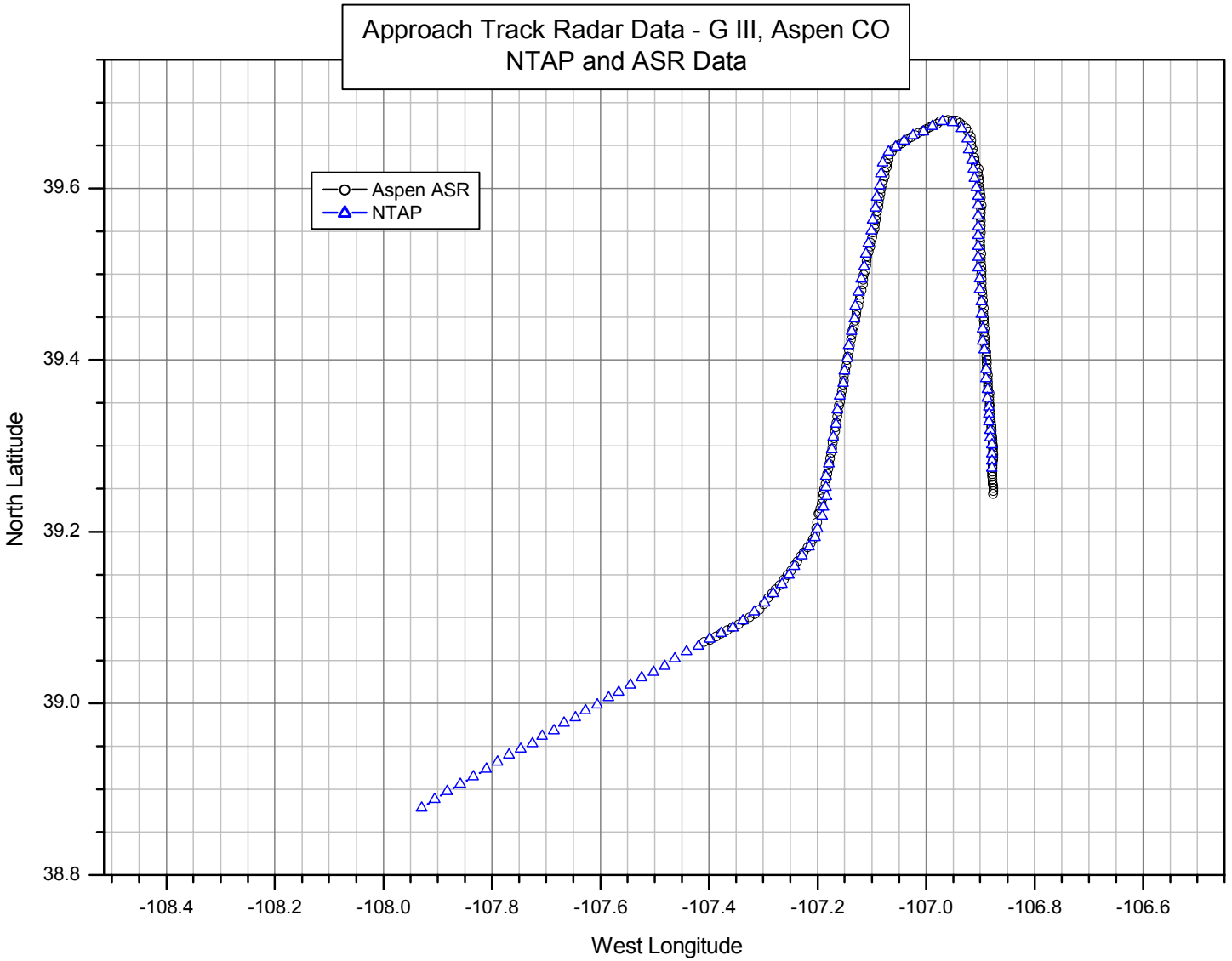
01	47	12.74	19700	14.19	3087	3.23969529	-13.685287	39.285179	-107.176547
01	47	17.48	19600	14.19	3105	3.61685241	-13.592758	39.2914699	-107.17459
01	47	22.22	19500	14.19	3121	3.94995927	-13.501998	39.2970266	-107.172667
01	47	27.05	19300	14.25	3138	4.3204995	-13.45615	39.3032052	-107.171712
01	47	31.67	19200	14.25	3154	4.65012474	-13.348065	39.3087049	-107.169417
01	47	36.41	19100	14.31	3177	5.14074231	-13.234085	39.316888	-107.167006
01	47	41.12	19100	14.38	3189	5.41023375	-13.202536	39.3213811	-107.166348
01	47	45.86	19100	14.44	3204	5.736784	-13.130004	39.3268272	-107.164813
01	47	50.48	19000	14.56	3222	6.14943911	-13.077942	39.3337078	-107.163725
01	47	55.31	19000	14.63	3238	6.50011793	-12.986185	39.339557	-107.161779
01	48	0.17	19000	14.75	3256	6.91326542	-12.908396	39.3464467	-107.160136
01	48	4.79	19000	14.81	3269	7.19889474	-12.820701	39.3512115	-107.158273
01	48	9.5	19000	14.94	3287	7.61737337	-12.729476	39.3581906	-107.156341
01	48	14.36	19000	15.06	3302	7.97268816	-12.653143	39.3641162	-107.154726
01	48	18.98	19000	15.19	3319	8.37258837	-12.549903	39.3707862	-107.152535
01	48	23.81	19000	15.31	3331	8.67109696	-12.492968	39.375764	-107.151331
01	48	28.43	19000	15.5	3344	9.03071589	-12.47258	39.3817585	-107.150916
01	48	33.17	19000	15.63	3358	9.37550656	-12.380143	39.3875094	-107.148953
01	48	38	19000	15.75	3372	9.71419685	-12.270696	39.3931594	-107.146623
01	48	42.5	18900	15.94	3386	10.0985521	-12.208069	39.399569	-107.145303
01	48	47.36	18900	16.06	3395	10.3443926	-12.15949	39.4036686	-107.144275
01	48	51.98	18800	16.25	3411	10.7683114	-12.045849	39.41074	-107.141861
01	48	56.81	18600	16.44	3424	11.1389506	-11.971216	39.4169225	-107.140283
01	49	1.43	18500	16.63	3439	11.5459709	-11.849846	39.4237128	-107.137701
01	49	6.17	18400	16.81	3448	11.8377225	-11.818369	39.4285777	-107.137043
01	49	11	18200	17	3460	12.1932073	-11.733145	39.4345083	-107.135236
01	49	15.62	18100	17.13	3471	12.4862555	-11.615801	39.4393989	-107.132732
01	49	20.36	17900	17.31	3484	12.8525351	-11.487079	39.4455115	-107.129989
01	49	24.98	17800	17.56	3495	13.2356984	-11.433727	39.4519012	-107.128866
01	49	29.81	17600	17.75	3503	13.5231427	-11.395267	39.4566959	-107.128058
01	49	34.64	17500	17.94	3516	13.8970845	-11.244228	39.4629364	-107.124834
01	49	39.26	17300	18.19	3528	14.3018303	-11.142443	39.4696892	-107.12267
01	49	44.12	17200	18.44	3538	14.6723952	-11.073704	39.4758697	-107.121214
01	49	48.74	17100	18.63	3548	14.9955027	-10.960612	39.4812612	-107.118801
01	49	53.57	17100	18.88	3559	15.3832901	-10.850618	39.4877295	-107.116457
01	49	58.31	17100	19.13	3567	15.7220111	-10.803072	39.4933772	-107.115453
01	50	3.02	17100	19.38	3575	16.0618339	-10.748814	39.4990435	-107.114305
01	50	7.76	17100	19.56	3584	16.360131	-10.624393	39.5040206	-107.111644
01	50	12.38	17100	19.81	3593	16.717426	-10.531186	39.5099798	-107.109658
01	50	17	17100	20.06	3599	17.0270303	-10.508573	39.5151411	-107.109188
01	50	21.74	17100	20.31	3606	17.353659	-10.454524	39.5205874	-107.108043
01	50	26.57	17100	20.5	3615	17.6608935	-10.31002	39.5257142	-107.104949
01	50	31.31	17100	20.75	3624	18.019782	-10.188616	39.5317009	-107.102355

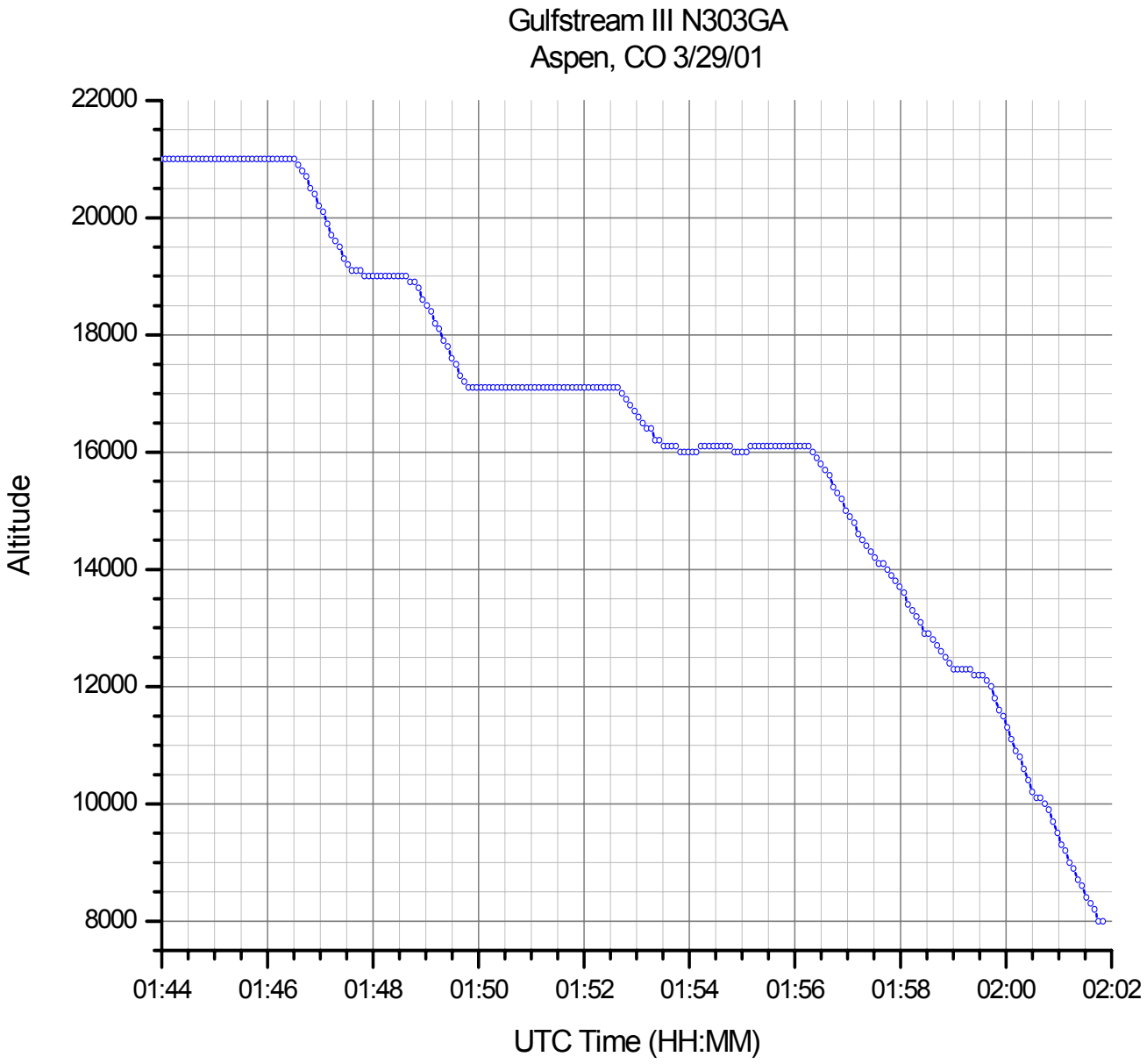
01	50	35.93	17100	21	3628	18.3009359	-10.199902	39.5363866	-107.102613
01	50	40.76	17100	21.25	3638	18.6760511	-10.036645	39.5426453	-107.099118
01	50	45.38	17100	21.5	3645	19.0048028	-9.9518097	39.5481282	-107.097309
01	50	50.12	17100	21.69	3652	19.2802613	-9.8337203	39.552724	-107.09478
01	50	54.95	17100	21.94	3657	19.5792562	-9.7977168	39.5577089	-107.09402
01	50	59.45	17100	22.19	3663	19.8937526	-9.7271877	39.5629535	-107.092518
01	51	4.31	17100	22.44	3668	20.1937493	-9.6826729	39.5679554	-107.091574
01	51	8.93	17100	22.69	3674	20.5089632	-9.6026676	39.5732122	-107.089867
01	51	13.76	17100	22.94	3681	20.8389604	-9.4857109	39.5787169	-107.087364
01	51	18.38	17100	23.19	3685	21.1254627	-9.4600759	39.5834931	-107.086826
01	51	23.12	17100	23.44	3690	21.4268582	-9.3984164	39.5885189	-107.085512
01	51	27.95	17100	23.69	3696	21.7428176	-9.2993377	39.5937888	-107.083393
01	51	32.45	17100	23.94	3701	22.0446078	-9.2290536	39.5988215	-107.081893
01	51	37.31	17100	24.19	3707	22.3605927	-9.1203876	39.6040921	-107.079567
01	51	41.93	17100	24.44	3712	22.662573	-9.0414498	39.6091282	-107.07788
01	51	46.76	17100	24.69	3717	22.9646351	-8.9584073	39.6141657	-107.076105
01	51	51.38	17100	24.94	3720	23.2394079	-8.942594	39.618746	-107.075777
01	51	56.12	17100	25.19	3727	23.5688248	-8.779986	39.6242423	-107.072287
01	52	0.74	17100	25.44	3730	23.8441058	-8.7577913	39.6288313	-107.071821
01	52	5.45	17100	25.69	3735	24.1463483	-8.6592049	39.6338723	-107.06971
01	52	10.4	17100	25.94	3740	24.4484594	-8.5564896	39.6389112	-107.067509
01	52	15.02	17100	26.06	3747	24.652819	-8.3319696	39.6423249	-107.062678
01	52	19.76	17100	26.25	3755	24.9342692	-8.0875419	39.6470239	-107.057421
01	52	24.59	17100	26.31	3762	25.0770449	-7.8372703	39.6494115	-107.052031
01	52	29.12	17100	26.38	3771	25.2500674	-7.5103176	39.6523053	-107.044988
01	52	33.95	17100	26.44	3778	25.3870486	-7.2552746	39.6545959	-107.039494
01	52	38.57	17100	26.5	3786	25.5321621	-6.9589963	39.6570229	-107.033111
01	52	43.4	17000	26.56	3793	25.6644005	-6.6998383	39.659236	-107.027528
01	52	48.02	16900	26.63	3803	25.8330826	-6.3222484	39.6620593	-107.019392
01	52	52.76	16800	26.69	3810	25.9588182	-6.0583458	39.6641636	-107.013706
01	52	57.59	16700	26.75	3821	26.1168945	-5.6323228	39.6668103	-107.004524
01	53	2.12	16600	26.81	3826	26.2189569	-5.4442272	39.6685177	-107.000471
01	53	6.95	16500	26.88	3834	26.3533866	-5.1356327	39.6707669	-106.993819
01	53	11.69	16400	26.94	3841	26.4668835	-4.8633645	39.6726662	-106.98795
01	53	16.4	16400	27	3851	26.5976288	-4.4667632	39.6748528	-106.979399
01	53	21.02	16200	27.13	3858	26.7741795	-4.2013277	39.6778044	-106.973679
01	53	25.76	16200	27.13	3867	26.8296289	-3.8312994	39.6787345	-106.965698
01	53	30.59	16100	27.13	3874	26.8699611	-3.5430886	39.6794131	-106.959483
01	53	35.21	16100	27.06	3883	26.8467	-3.1635974	39.6790305	-106.951296
01	53	40.07	16100	27	3891	26.8237492	-2.8276102	39.6786519	-106.944049
01	53	44.69	16100	26.81	3898	26.6631462	-2.5215098	39.6759782	-106.937444
01	53	49.4	16000	26.63	3904	26.5063732	-2.2607476	39.6733696	-106.931818
01	53	54.25	16000	26.38	3910	26.2764303	-1.9977153	39.6695391	-106.926142

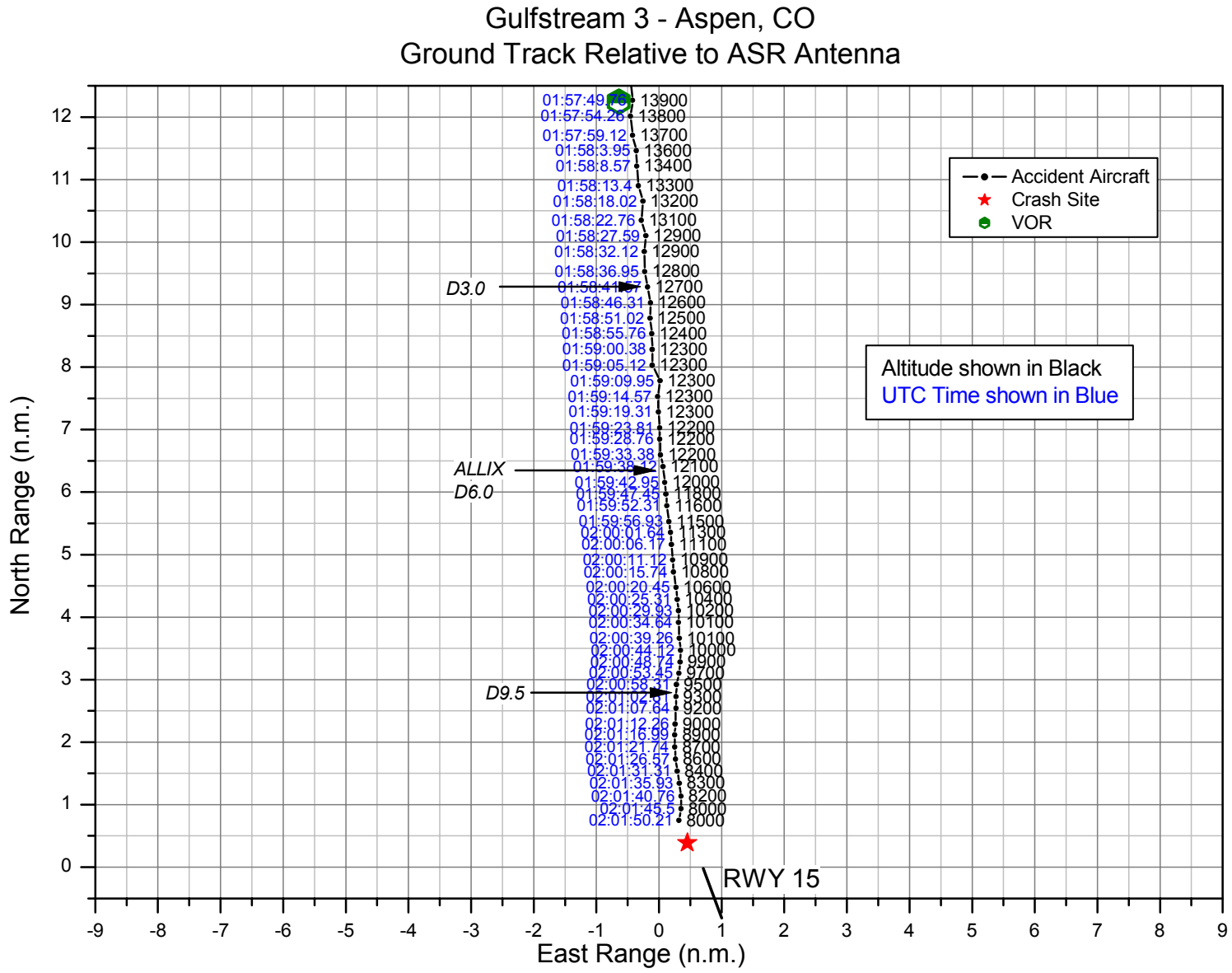
01	53	58.76	16000	26.13	3914	26.0384482	-1.8190018	39.6655737	-106.922285
01	54	3.38	16000	25.81	3919	25.731789	-1.5993579	39.6604637	-106.917546
01	54	8.12	16000	25.5	3920	25.4243234	-1.5411	39.6553391	-106.916287
01	54	12.9	16100	25.19	3919	25.1112587	-1.5607889	39.6501188	-106.916709
01	54	17.65	16100	24.88	3922	24.8081984	-1.4273772	39.6450681	-106.91383
01	54	22.52	16100	24.63	3924	24.5624283	-1.3376435	39.640972	-106.911894
01	54	27.02	16100	24.31	3925	24.2443724	-1.2830249	39.6356709	-106.910714
01	54	31.76	16100	24.06	3925	23.9943018	-1.269791	39.6315027	-106.910427
01	54	36.46	16100	23.81	3928	23.7497545	-1.1472743	39.6274271	-106.907785
01	54	41.33	16100	23.5	3934	23.4490019	-0.9165104	39.622415	-106.902809
01	54	46.07	16100	23.25	3932	23.1958546	-0.9778975	39.6181953	-106.904131
01	54	50.9	16000	23	3933	22.947967	-0.932185	39.6140654	-106.903145
01	54	55.4	16000	22.75	3934	22.6991066	-0.8872005	39.6099175	-106.902174
01	55	0.02	16000	22.5	3935	22.4501536	-0.8429815	39.605768	-106.90122
01	55	4.88	16000	22.25	3935	22.1998567	-0.8335831	39.601596	-106.901017
01	55	9.71	16100	22	3936	21.9498533	-0.7904795	39.5974272	-106.900087
01	55	14.33	16100	21.75	3936	21.6995103	-0.7814639	39.5932545	-106.899891
01	55	19.07	16100	21.5	3937	21.4503161	-0.7395444	39.589101	-106.898987
01	55	23.69	16100	21.25	3935	21.1975953	-0.7959491	39.5848884	-106.900201
01	55	28.4	16100	20.94	3939	20.891563	-0.6561161	39.5797877	-106.897188
01	55	33.02	16100	20.69	3937	20.6390466	-0.7115742	39.5755786	-106.898382
01	55	37.88	16100	20.44	3936	20.3875265	-0.7342154	39.5713861	-106.898869
01	55	42.38	16100	20.13	3935	20.0758744	-0.7538296	39.5661913	-106.89929
01	55	47.21	16100	19.88	3935	19.8254544	-0.7444266	39.5620173	-106.899086
01	55	52.07	16100	19.56	3935	19.504896	-0.7323899	39.5566741	-106.898826
01	55	56.69	16100	19.31	3933	19.2521342	-0.782054	39.5524609	-106.899894
01	56	1.4	16100	19.06	3935	19.0039744	-0.7135808	39.5483247	-106.898419
01	56	5.81	16100	18.75	3931	18.6887122	-0.8166051	39.5430694	-106.900636
01	56	10.88	16100	18.44	3932	18.3793705	-0.7748428	39.5379134	-106.899736
01	56	15.38	16100	18.13	3932	18.0687709	-0.7617485	39.5327362	-106.899452
01	56	20.21	16000	17.88	3932	17.8194398	-0.7512371	39.5285817	-106.899225
01	56	24.94	15900	17.56	3933	17.5010807	-0.7109233	39.5232767	-106.898356
01	56	29.45	15800	17.25	3932	17.1905183	-0.7247228	39.5181014	-106.898652
01	56	34.4	15700	17	3932	16.9411891	-0.7142115	39.5139468	-106.898425
01	56	39.26	15600	16.69	3932	16.6317371	-0.7011656	39.50879	-106.898144
01	56	43.76	15400	16.38	3933	16.3245092	-0.663129	39.5036716	-106.897324
01	56	48.38	15300	16.13	3932	16.074148	-0.6776586	39.4994996	-106.897636
01	56	53.12	15200	15.81	3932	15.7546806	-0.6641904	39.4941757	-106.897345
01	56	57.94	15000	15.5	3932	15.4464228	-0.6511948	39.4890398	-106.897065
01	57	2.45	14900	15.19	3931	15.1359839	-0.6613683	39.4838661	-106.897283
01	57	7.31	14800	14.94	3933	14.8886059	-0.6048002	39.4797438	-106.896065
01	57	11.93	14600	14.63	3934	14.5812258	-0.569911	39.4746224	-106.895314
01	57	16.76	14500	14.31	3934	14.2617289	-0.5574234	39.4692976	-106.895044

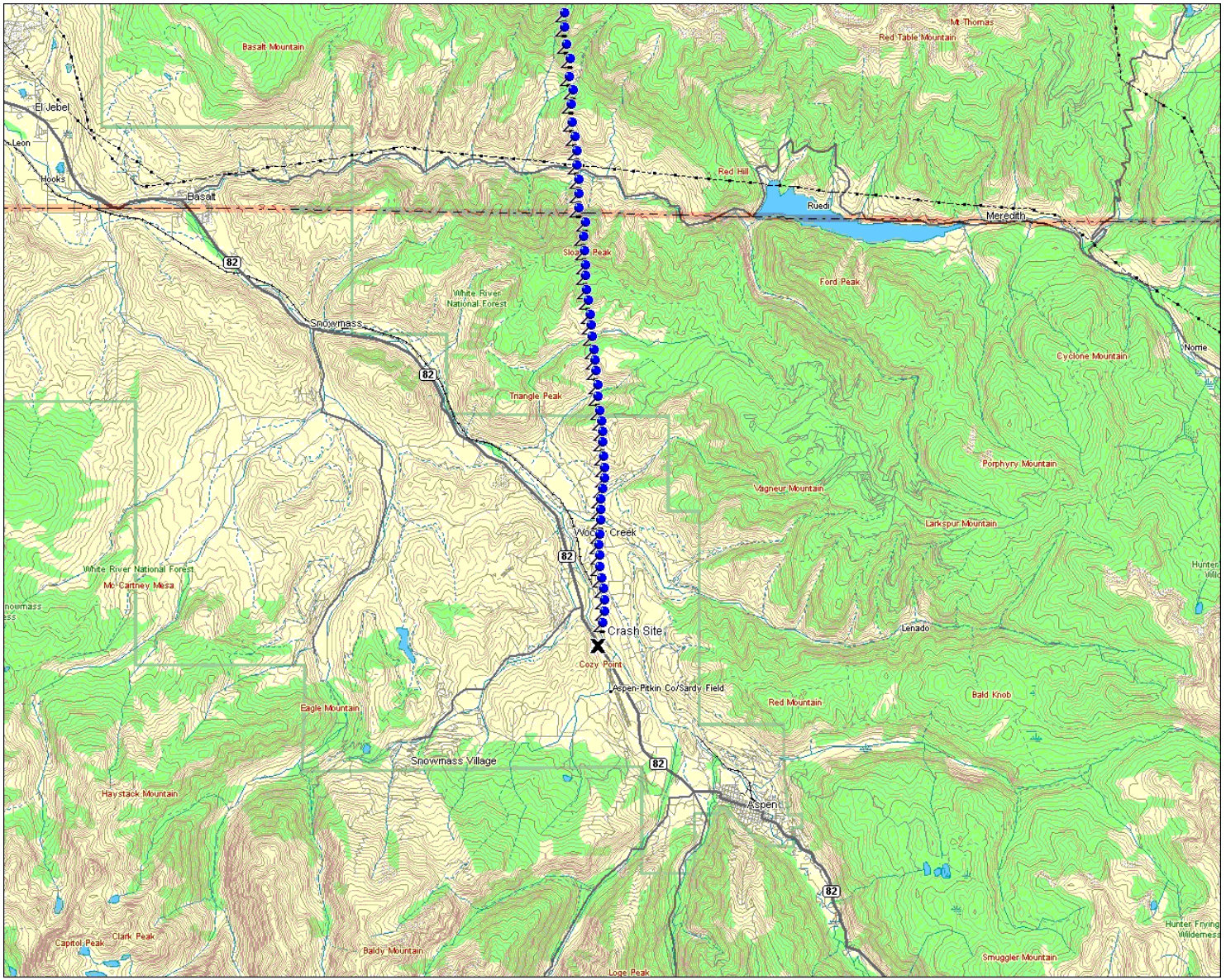
01	57	21.38	14400	14.06	3933	14.0115255	-0.5691717	39.4651279	-106.895296
01	57	26.12	14300	13.75	3936	13.7044837	-0.4935392	39.4600108	-106.893669
01	57	30.74	14200	13.44	3935	13.3942132	-0.5029397	39.4548397	-106.89387
01	57	35.45	14100	13.13	3935	13.0847138	-0.4913183	39.4496814	-106.89362
01	57	40.31	14100	12.88	3936	12.8348411	-0.4622208	39.4455161	-106.892994
01	57	44.93	14000	12.63	3936	12.585463	-0.4532399	39.4413599	-106.8928
01	57	49.76	13900	12.31	3937	12.2665698	-0.4229156	39.436045	-106.892147
01	57	54.26	13800	12.06	3935	12.0158501	-0.4511835	39.4318663	-106.892754
01	57	59.12	13700	11.75	3936	11.7069925	-0.4216036	39.4267185	-106.892118
01	58	3.95	13600	11.5	3939	11.4593908	-0.3598913	39.4225919	-106.890791
01	58	8.57	13400	11.25	3939	11.2112523	-0.3520983	39.4184571	-106.890623
01	58	13.4	13300	10.94	3940	10.9021871	-0.3256524	39.4133057	-106.890054
01	58	18.02	13200	10.69	3944	10.654514	-0.2528319	39.4091777	-106.888489
01	58	22.76	13100	10.38	3942	10.3440631	-0.2772203	39.404003	-106.889013
01	58	27.59	12900	10.13	3946	10.0973777	-0.2086173	39.3998922	-106.887538
01	58	32.12	12900	9.88	3944	9.84592954	-0.2336441	39.3957002	-106.888076
01	58	36.95	12800	9.56	3944	9.52623892	-0.2260579	39.3903714	-106.887912
01	58	41.57	12700	9.31	3947	9.27768291	-0.1774446	39.3862284	-106.886868
01	58	46.31	12600	9.06	3950	9.02888579	-0.1311239	39.3820814	-106.885872
01	58	51.02	12500	8.81	3949	8.77916356	-0.1409674	39.3779189	-106.886084
01	58	55.76	12400	8.56	3951	8.53003209	-0.1107918	39.3737662	-106.885435
01	59	0.38	12300	8.31	3951	8.28050823	-0.1075508	39.3696069	-106.885366
01	59	5.12	12300	8.06	3951	8.02958197	-0.1042917	39.3654235	-106.885296
01	59	9.95	12300	7.81	3961	7.77923086	1.83E-02	39.3612498	-106.882663
01	59	14.57	12300	7.56	3958	7.52816108	-1.69E-02	39.357064	-106.883419
01	59	19.31	12300	7.31	3959	7.27703387	-5.21E-03	39.3528773	-106.883167
01	59	23.81	12200	7.06	3961	7.02739847	1.65E-02	39.348716	-106.882701
01	59	28.76	12200	6.88	3961	6.84650643	1.61E-02	39.3457002	-106.88271
01	59	33.38	12200	6.63	3962	6.59515647	2.56E-02	39.3415097	-106.882505
01	59	38.12	12100	6.44	3966	6.4055374	6.42E-02	39.3383489	-106.881677
01	59	42.95	12000	6.19	3969	6.15551515	9.00E-02	39.3341811	-106.881123
01	59	47.45	11800	6	3972	5.96743332	0.11474337	39.3310463	-106.880592
01	59	52.31	11600	5.81	3974	5.7794345	0.12886722	39.3279129	-106.880289
01	59	56.93	11500	5.56	3978	5.52898196	0.15723009	39.3237377	-106.87968
02	00	1.64	11300	5.38	3982	5.35039687	0.18501391	39.3207611	-106.879084
02	00	6.17	11100	5.19	3985	5.16192173	0.20228376	39.3176195	-106.878714
02	00	11.12	10900	4.94	3989	4.91281258	0.22272032	39.3134669	-106.878275
02	00	15.74	10800	4.75	3992	4.7226539	0.2358823	39.3102968	-106.877993
02	00	20.45	10600	4.5	3999	4.47226928	0.27154646	39.3061228	-106.877228
02	00	25.31	10400	4.31	4004	4.28269147	0.29302065	39.3029626	-106.876767
02	00	29.93	10200	4.13	4009	4.1030105	0.31236116	39.2999674	-106.876352
02	00	34.64	10100	3.94	4012	3.91283901	0.31600095	39.2967968	-106.876274
02	00	39.26	10100	3.69	4018	3.65976964	0.32949303	39.2925772	-106.875985

02	00	44.12	10000	3.5	4025	3.46767019	0.34977307	39.2893745	-106.875551
02	00	48.74	9900	3.31	4027	3.27829005	0.34083406	39.2862171	-106.875743
02	00	53.45	9700	3.13	4026	3.10195114	0.31769162	39.2832774	-106.876239
02	00	58.31	9500	2.94	4022	2.91679485	0.2806547	39.2801906	-106.877034
02	01	2.81	9300	2.75	4025	2.728408	0.275206	39.2770499	-106.877151
02	01	7.64	9200	2.56	4029	2.53843332	0.27178789	39.2738824	-106.877225
02	01	12.26	9000	2.31	4033	2.28999703	0.25940988	39.2697402	-106.877491
02	01	16.99	8900	2.13	4037	2.1103215	0.25218053	39.2667444	-106.877646
02	01	21.74	8700	1.94	4046	1.91994726	0.25636218	39.2635703	-106.877557
02	01	26.57	8600	1.75	4060	1.72685462	0.26844042	39.2603506	-106.877298
02	01	31.31	8400	1.56	4083	1.53098211	0.29364095	39.2570847	-106.876757
02	01	35.93	8300	1.38	19	1.34027268	0.32597795	39.2539046	-106.876064
02	01	40.76	8200	1.19	61	1.13551213	0.35500643	39.2504903	-106.875442
02	01	45.5	8000	1	100	0.934872287	0.35492047	39.2471447	-106.875444
02	01	50.21	8000	0.81	128	0.744195585	0.31973166	39.2439651	-106.876199


Approach Track Radar Data - G III, Aspen CO
NTAP and ASR Data
Aspen ASR
NTAP
North Latitude
39.6
39.4
39.2
39.0
38.8
-108.4
-108.2
-108.0
-107.8
-107.6
-107.4
-107.2
-107.0
-106.8
-106.6
West Longitude

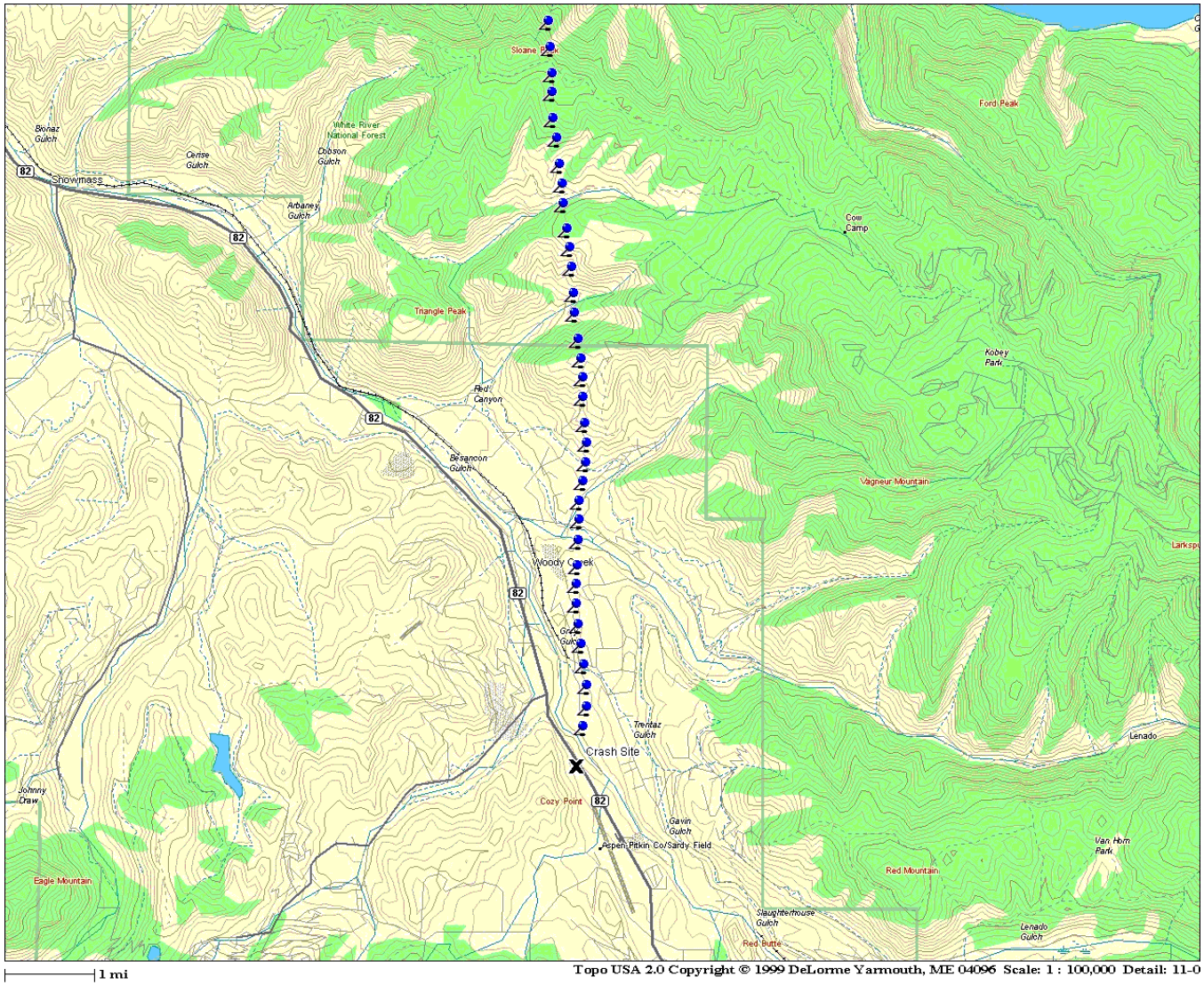

Gulfstream III N303GA
Aspen, CO 3/29/01
Altitude
22000
20000
18000
16000
14000
12000
10000
8000
01:44
01:46
01:48
01:50
01:52
01:54
01:56
01:58
02:00
02:02
UTC Time (HH:MM)


Gulfstream 3 - Aspen, CO
Ground Track Relative to ASR Antenna
Accident Aircraft
Crash Site
VOR
Altitude shown in Black
UTC Time shown in Blue
D3.0
ALLIX
D6.0
D9.5
RWY 15
North Range (n.m.)
East Range (n.m.)

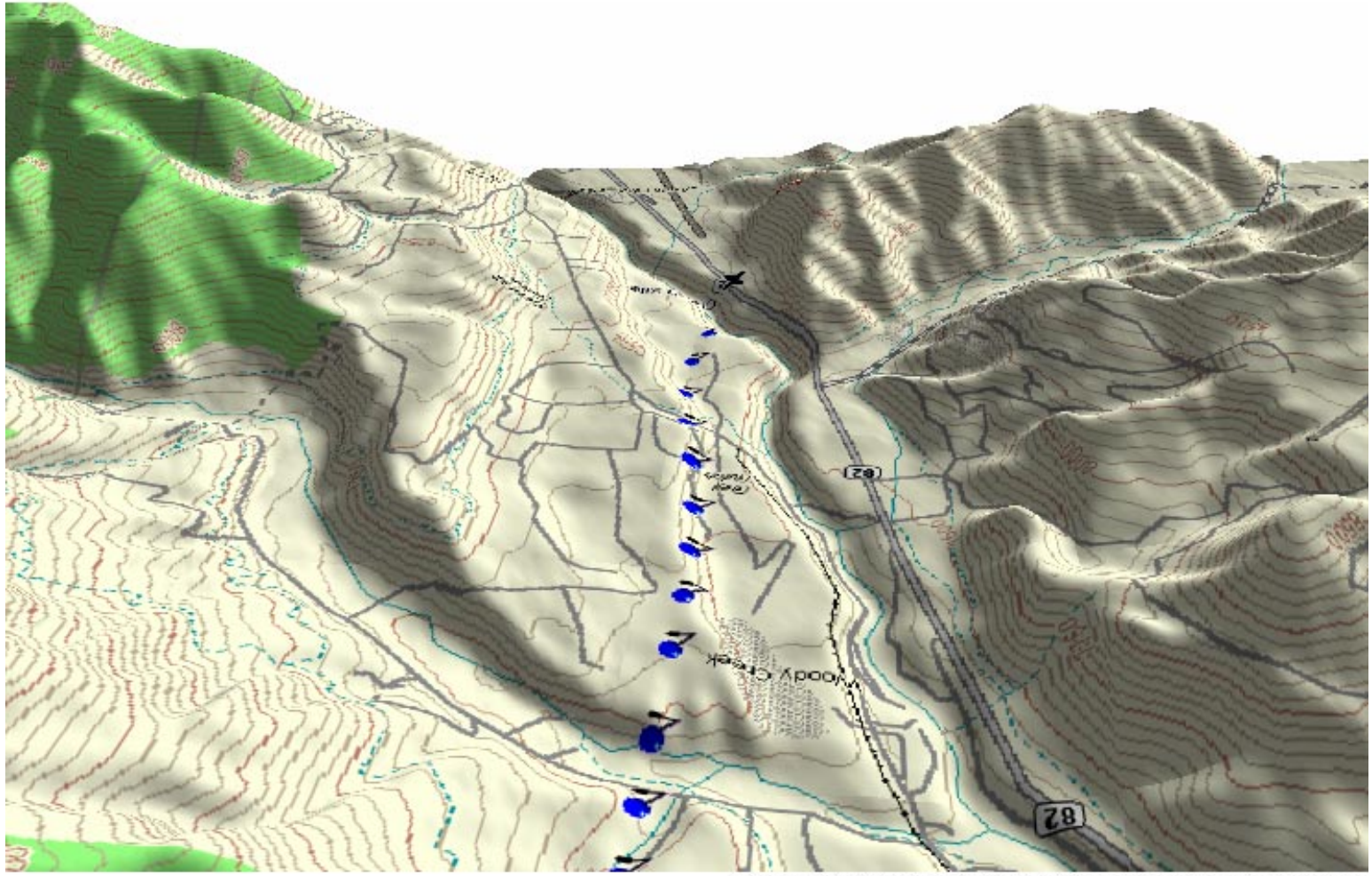

Basalt Mountain
Mt Thomas
Red Table Mountain
El Jebel
Leon
Hooks
Basalt
Red Hill
Ruedi
Meredith
Sloan Peak
Ford Peak
White River National Forest
Snowmass
Norrie
Cyclone Mountain
Triangle Peak
Porphyry Mountain
Vagneur Mountain
Larkspur Mountain
Woody Creek
White River National Forest
Mc Cartney Mesa
Crash Site
Lenado
Cozy Point
Aspen-Pitkin Co/Sardy Field
Bald Knob
Red Mountain
Eagle Mountain
Snowmass Village
Haystack Mountain
Aspen
Capitol Peak
Clark Peak
Baldy Mountain
Lodge Peak
Smuggler Mountain
Hunter Frying Wilderness
82
2 mi
Topo USA 2.0 Copyright © 1999 DeLorme Yarmouth, ME 04096 Scale: 1 : 162,500 Detail: 10-3

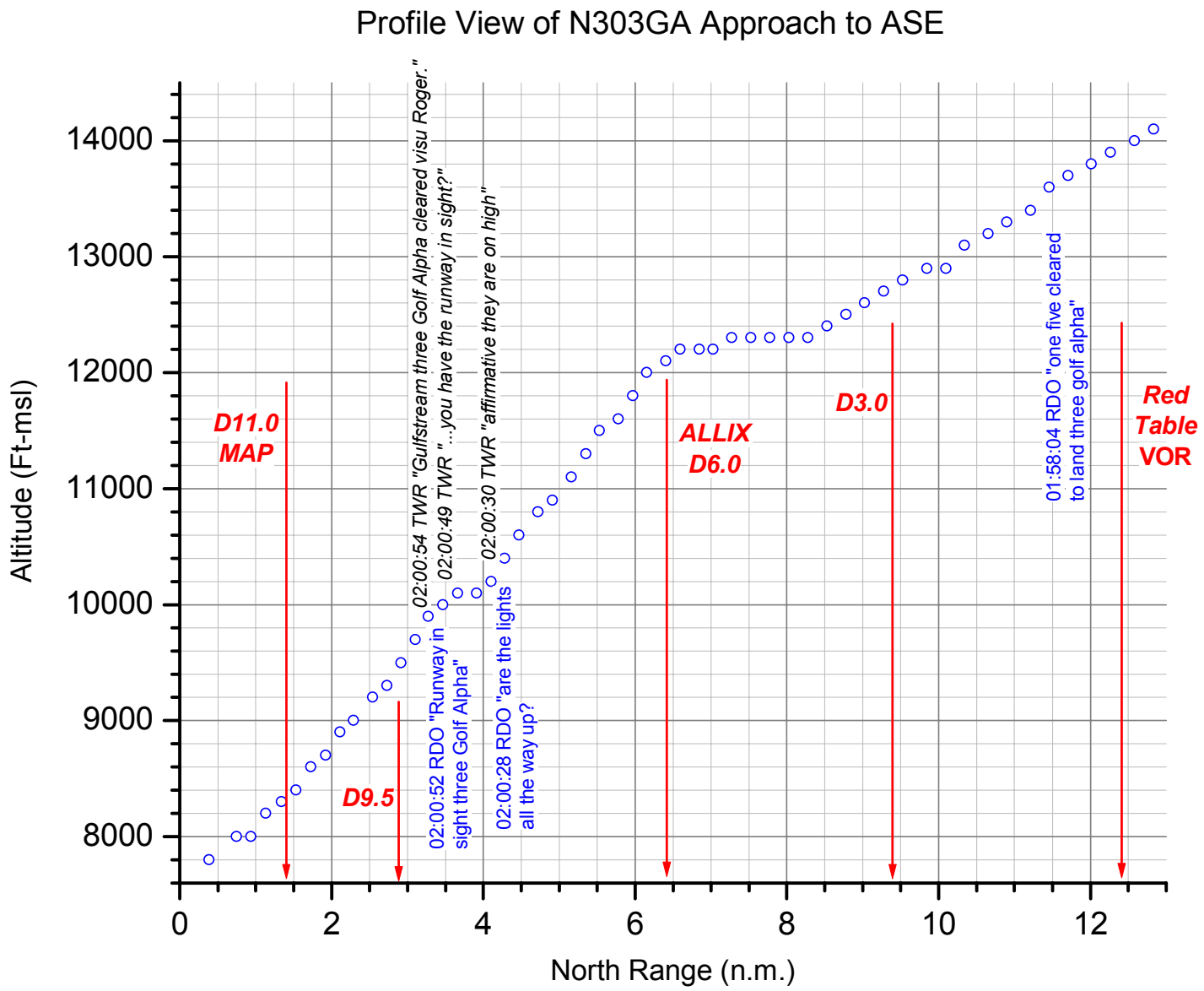
N

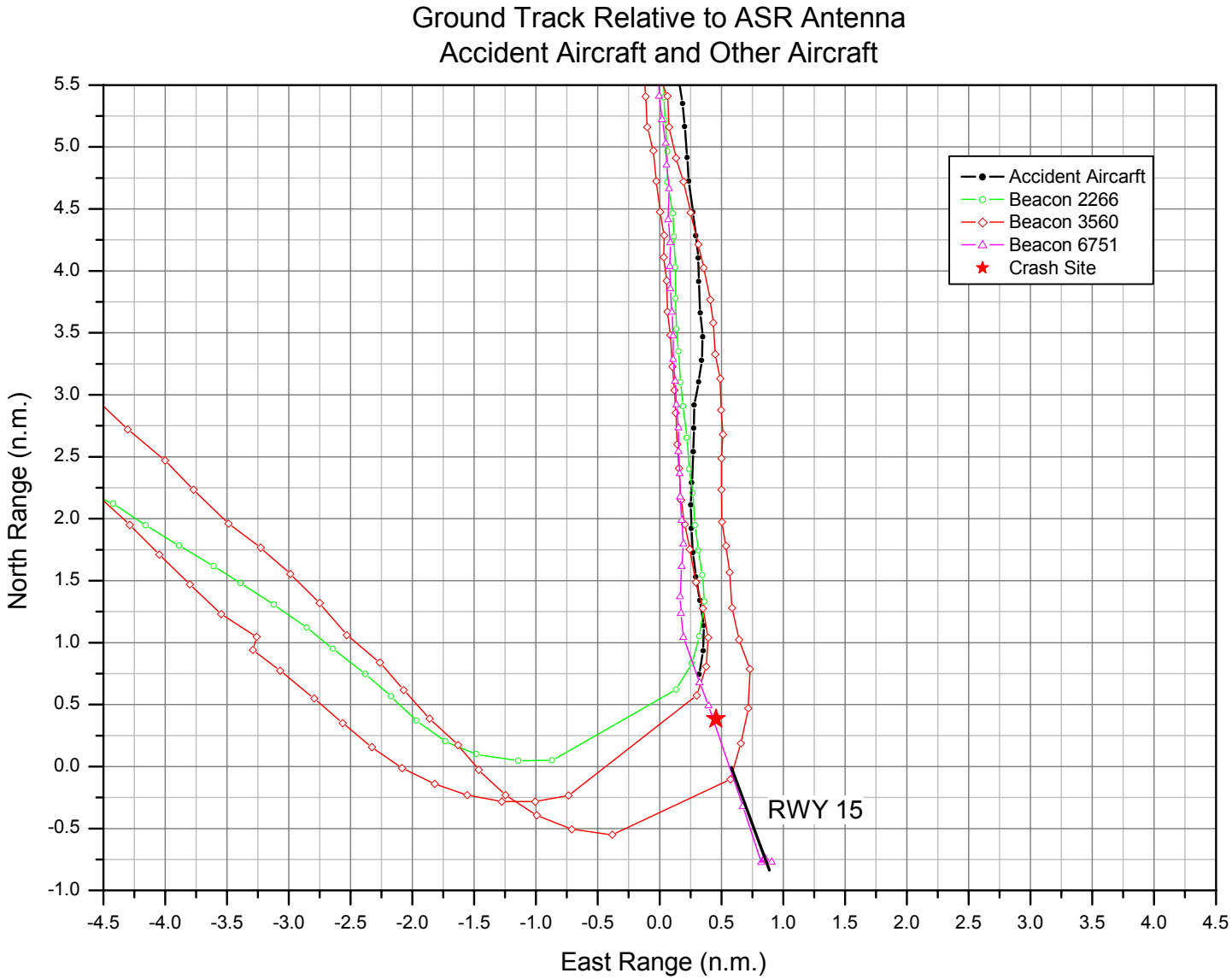
S

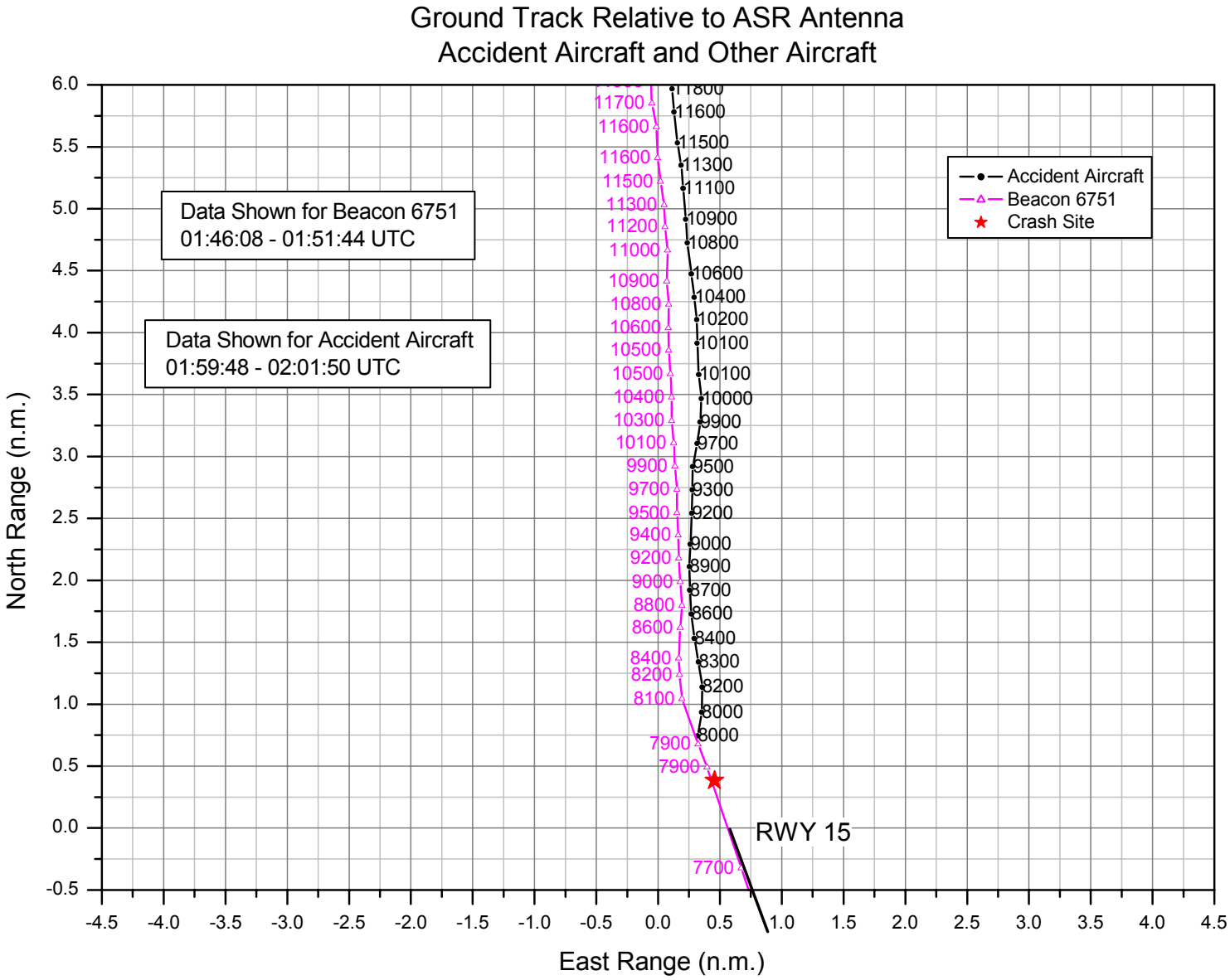

Sloane Peak
Ford Peak
Bonaz Gulch
White River National Forest
Dobson Gulch
Owl Gulch
82
Snowmass
Arbaney Gulch
Cow Camp
Triangle Peak
Kobey Park
Red Canyon
Besancon Gulch
Vagneur Mountain
Larkspur
Woody Creek
Crash Site
Trenitaz Gulch
Lenado
Johnny Draw
Cozy Point
Gavin Gulch
Aspen-Pitkin Co/Sardy Field
Van Horn Park
Red Mountain
Eagle Mountain
Slaughterhouse Gulch
Lenado Gulch
Red Butte
1 mi
Topo USA 2.0 Copyright © 1999 DeLorme Yarmouth, ME 04096 Scale: 1 : 100,000 Detail: 11-0


N
S

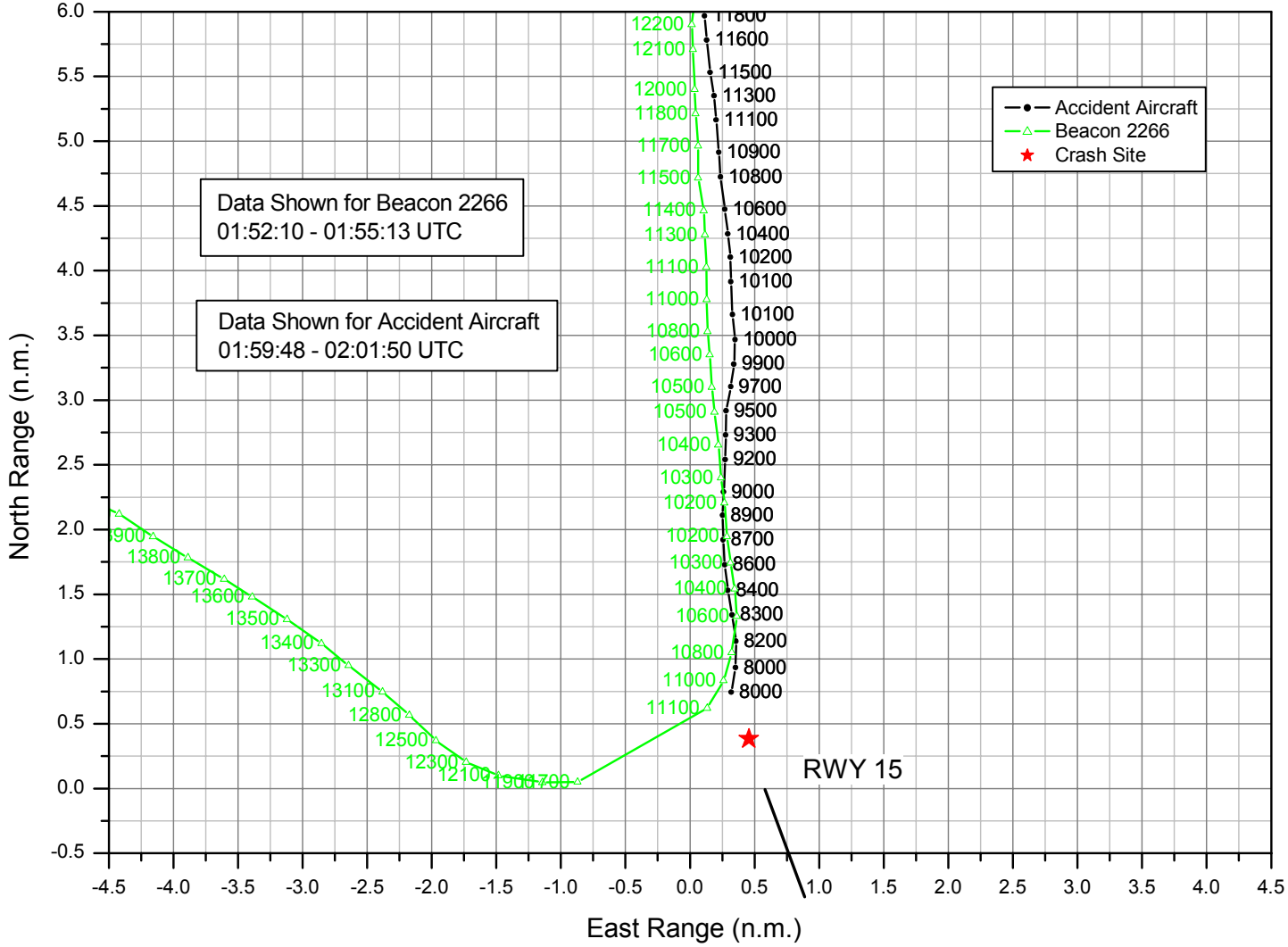


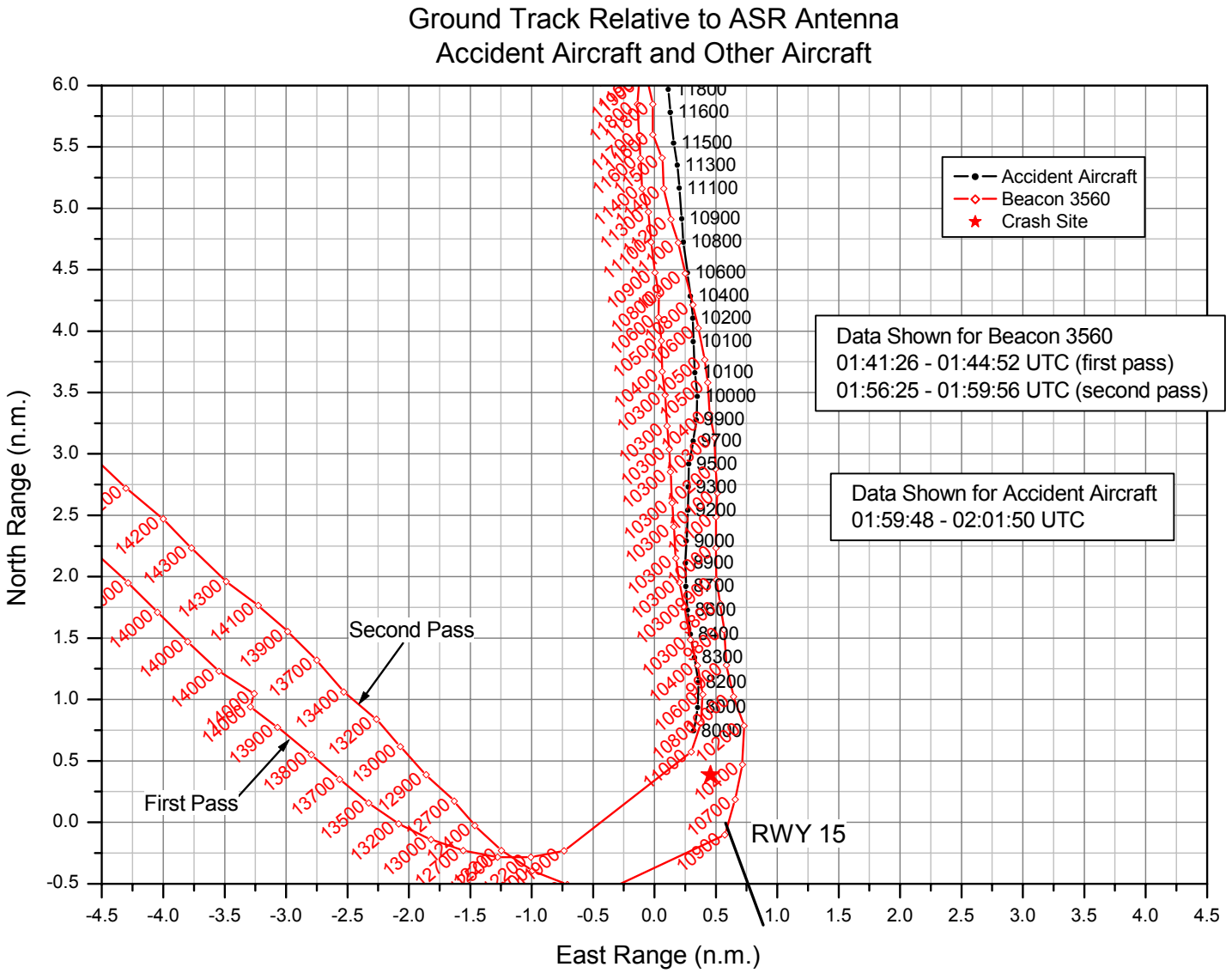

Profile View of N303GA Approach to ASE
Altitude (Ft-msl)
14000
13000
12000
11000
10000
9000
8000
0
2
4
6
8
10
12
North Range (n.m.)
D11.0
MAP
D9.5
ALLIX
D6.0
D3.0
Red
Table
VOR
02:00:54 TWR "Gulfstream three Golf Alpha cleared visu Roger."
02:00:49 TWR "...you have the runway in sight?"
02:00:52 RDO "Runway in sight three Golf Alpha"
02:00:30 TWR "affirmative they are on high"
02:00:28 RDO "are the lights all the way up?
01:58:04 RDO "one five cleared to land three golf alpha"

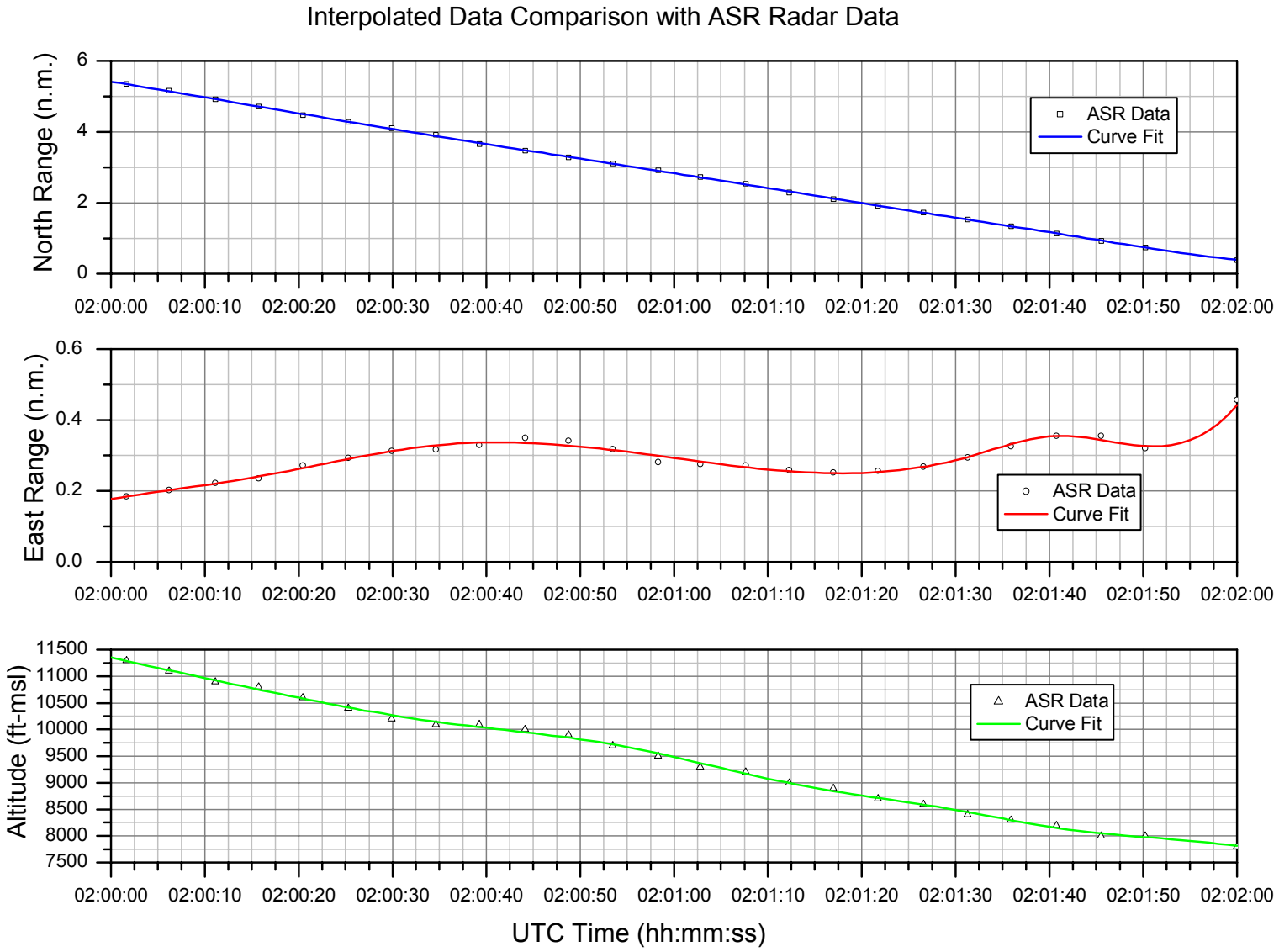

Ground Track Relative to ASR Antenna
Accident Aircraft and Other Aircraft
North Range (n.m.)
East Range (n.m.)
Accident Aircarft
Beacon 2266
Beacon 3560
Beacon 6751
Crash Site
RWY 15
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-4.5
-4.0
-3.5
-3.0
-2.5
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5


Ground Track Relative to ASR Antenna
Accident Aircraft and Other Aircraft
Data Shown for Beacon 6751
01:46:08 - 01:51:44 UTC
Data Shown for Accident Aircraft
01:59:48 - 02:01:50 UTC
Accident Aircraft
Beacon 6751
Crash Site
RWY 15
North Range (n.m.)
East Range (n.m.)
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-4.5
-4.0
-3.5
-3.0
-2.5
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
11700
11600
11600
11500
11600
11300
11500
11100
11300
10900
11200
10800
11000
10600
10900
10400
10800
10200
10600
10100
10500
10100
10500
10000
10400
9900
10300
9700
10100
9500
9900
9300
9700
9200
9500
9000
9400
8900
9200
8700
9000
8600
8800
8400
8600
8300
8400
8200
8200
8000
8100
8000
7900
7900
7700

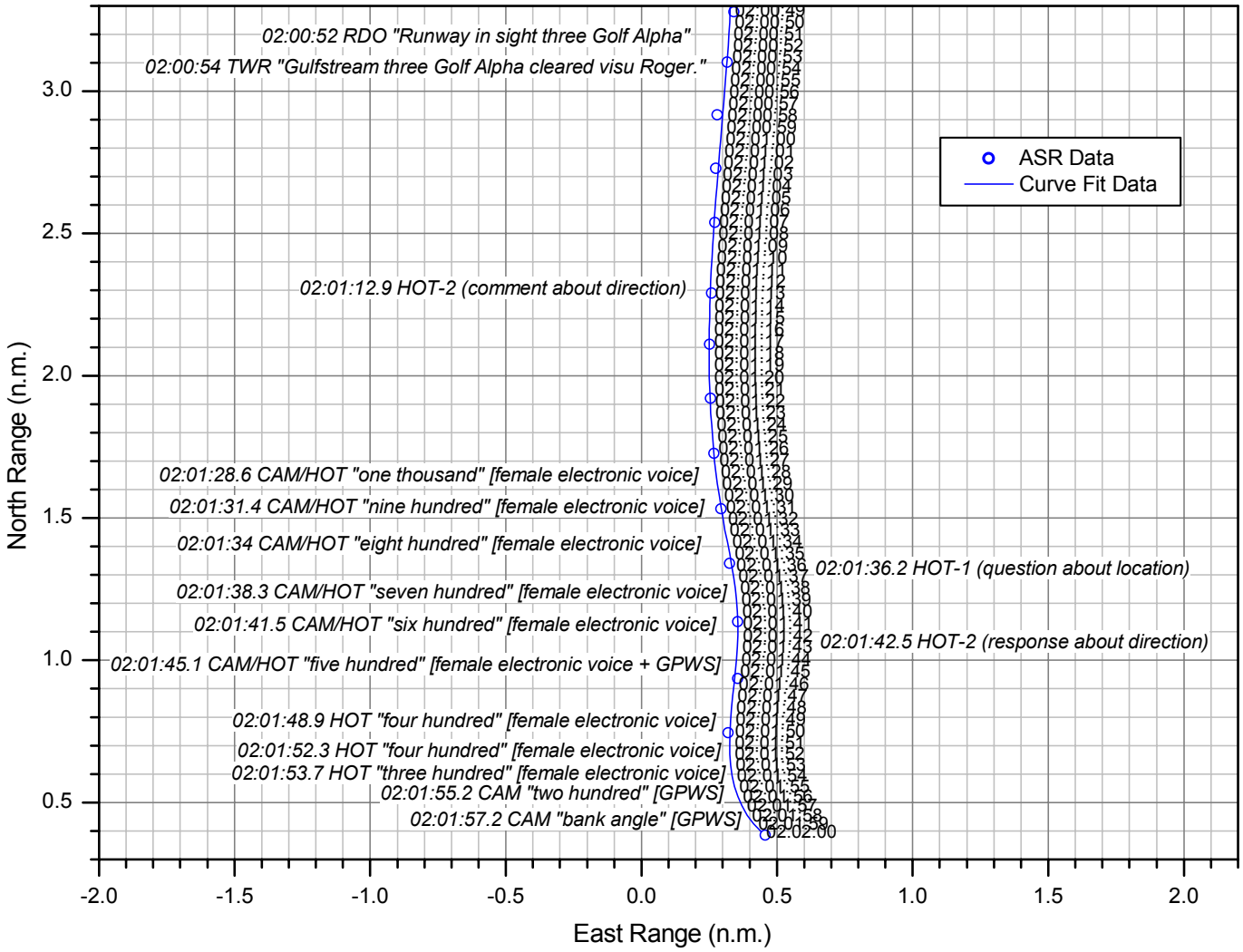
Ground Track Relative to ASR Antenna
Accident Aircraft and Other Aircraft

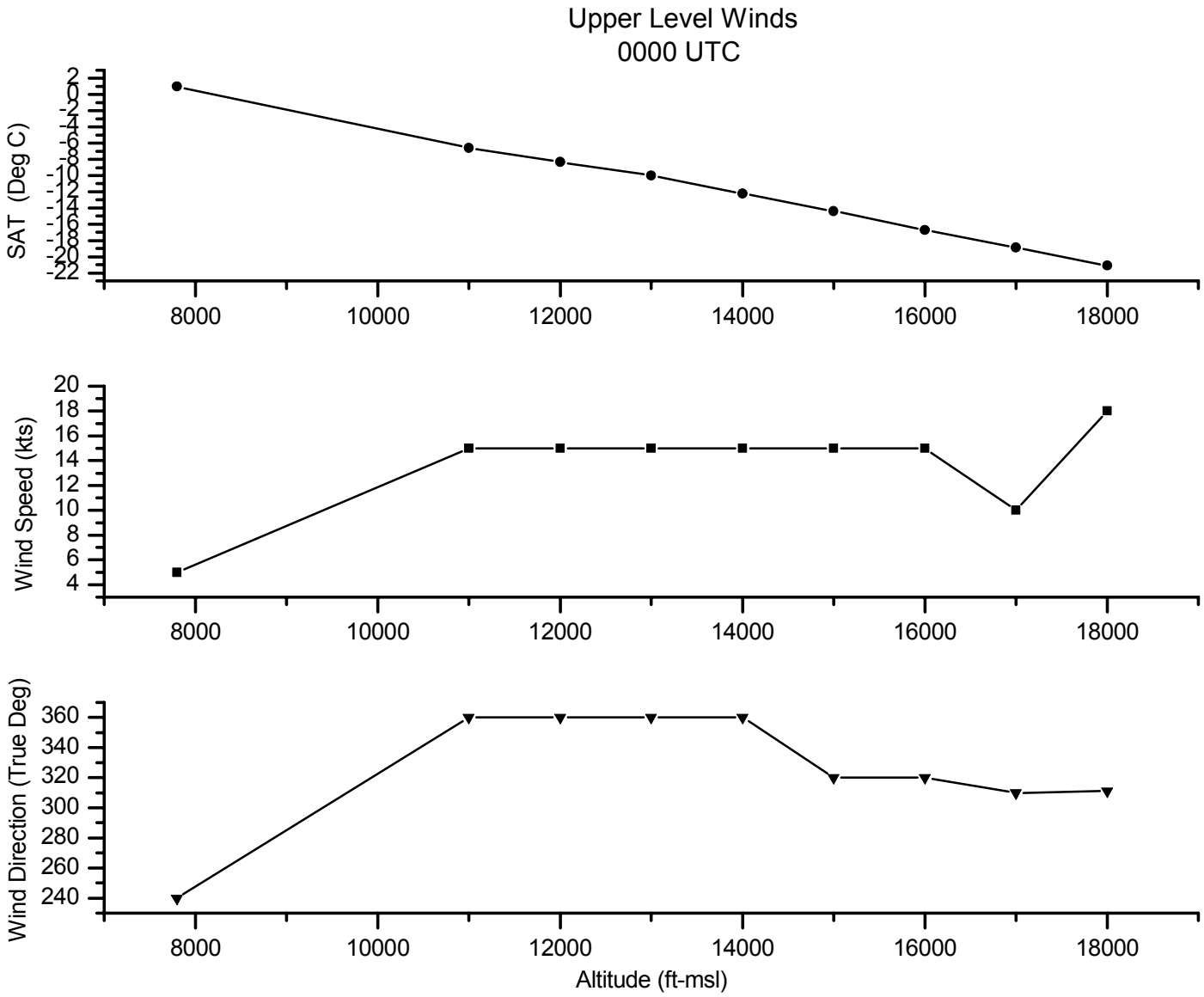


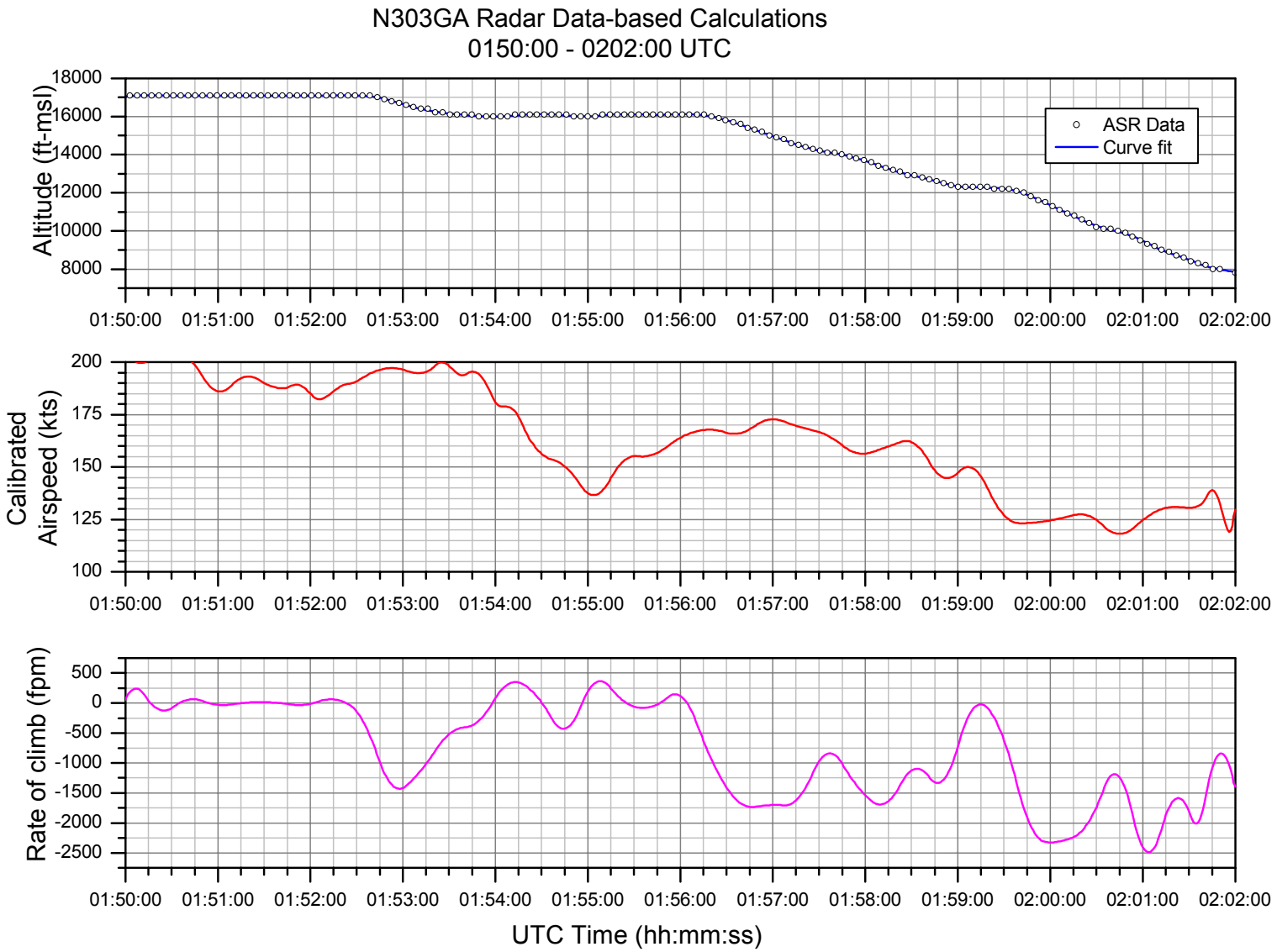

Ground Track Relative to ASR Antenna
Accident Aircraft and Other Aircraft
North Range (n.m.)
East Range (n.m.)
Accident Aircraft
Beacon 3560
Crash Site
Data Shown for Beacon 3560
01:41:26 - 01:44:52 UTC (first pass)
01:56:25 - 01:59:56 UTC (second pass)
Data Shown for Accident Aircraft
01:59:48 - 02:01:50 UTC
Second Pass
First Pass
RWY 15

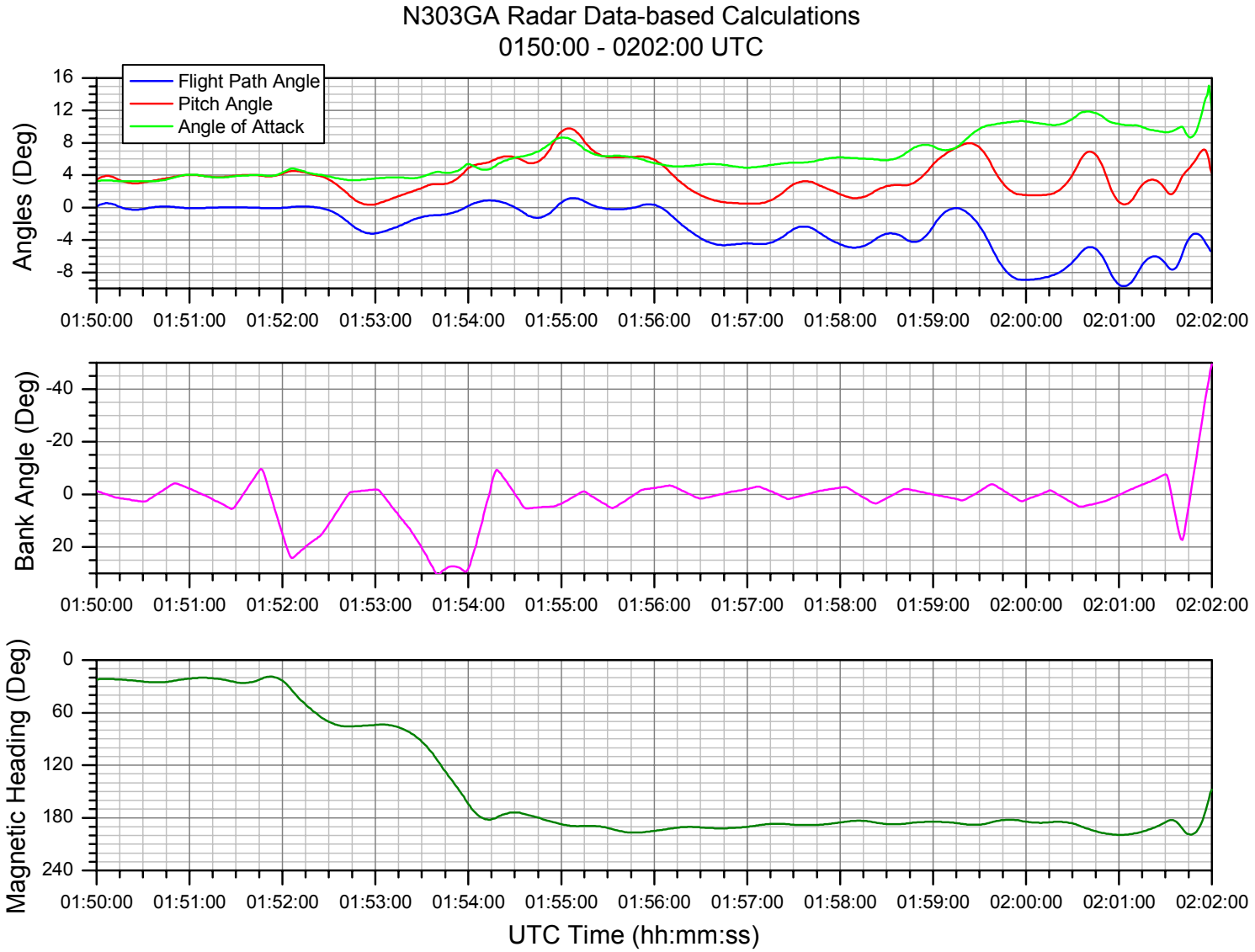

Interpolated Data Comparison with ASR Radar Data
North Range (n.m.)
6
4
2
0
ASR Data
Curve Fit
East Range (n.m.)
0.6
0.4
0.2
0.0
ASR Data
Curve Fit
Altitude (ft-msl)
11500
11000
10500
10000
9500
9000
8500
8000
7500
ASR Data
Curve Fit
02:00:00
02:00:10
02:00:20
02:00:30
02:00:40
02:00:50
02:01:00
02:01:10
02:01:20
02:01:30
02:01:40
02:01:50
02:02:00
UTC Time (hh:mm:ss)

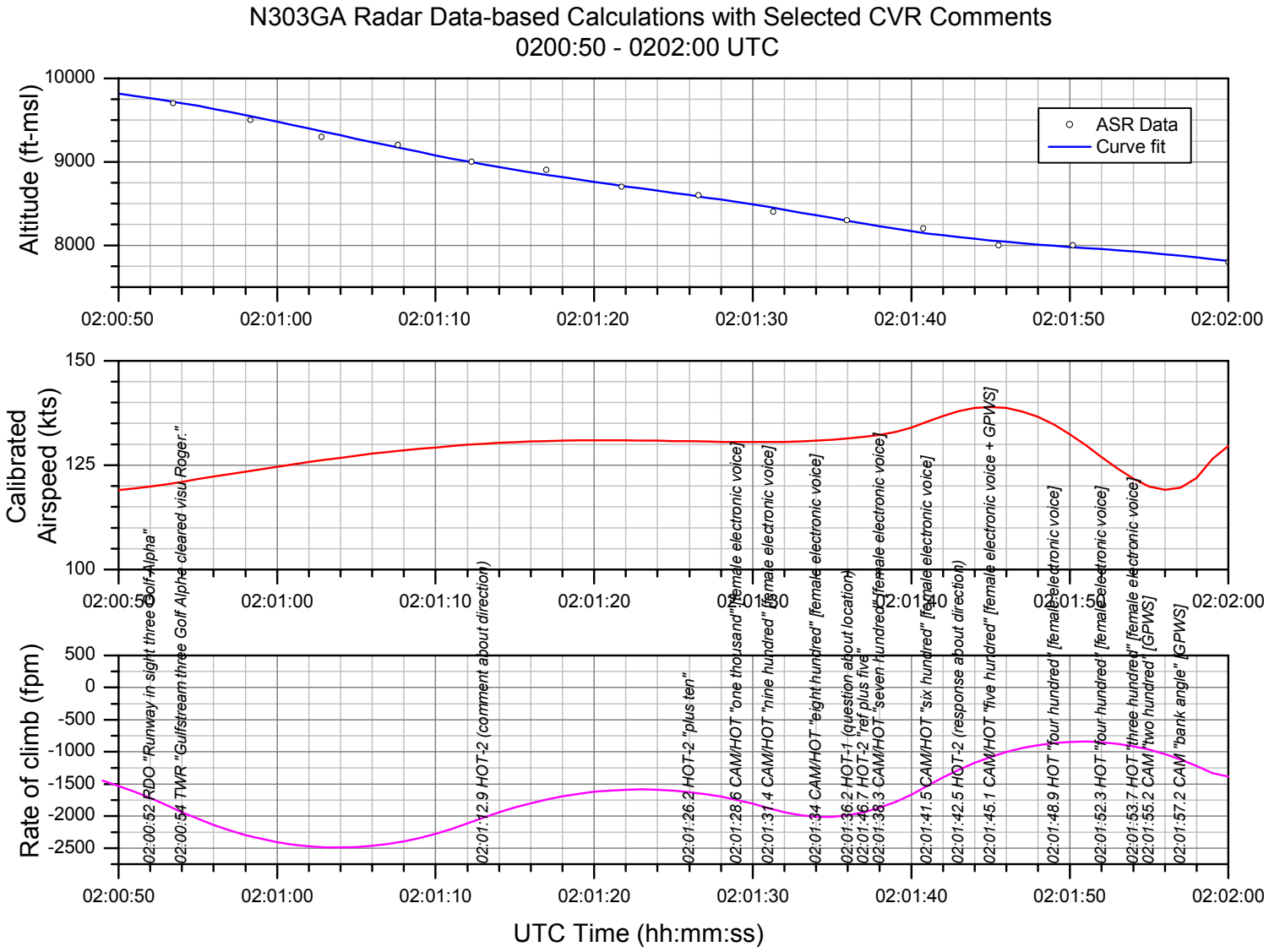
N303GA Groundtrack with Selected CVR Comments
0200:20 - 0202:00 UTC

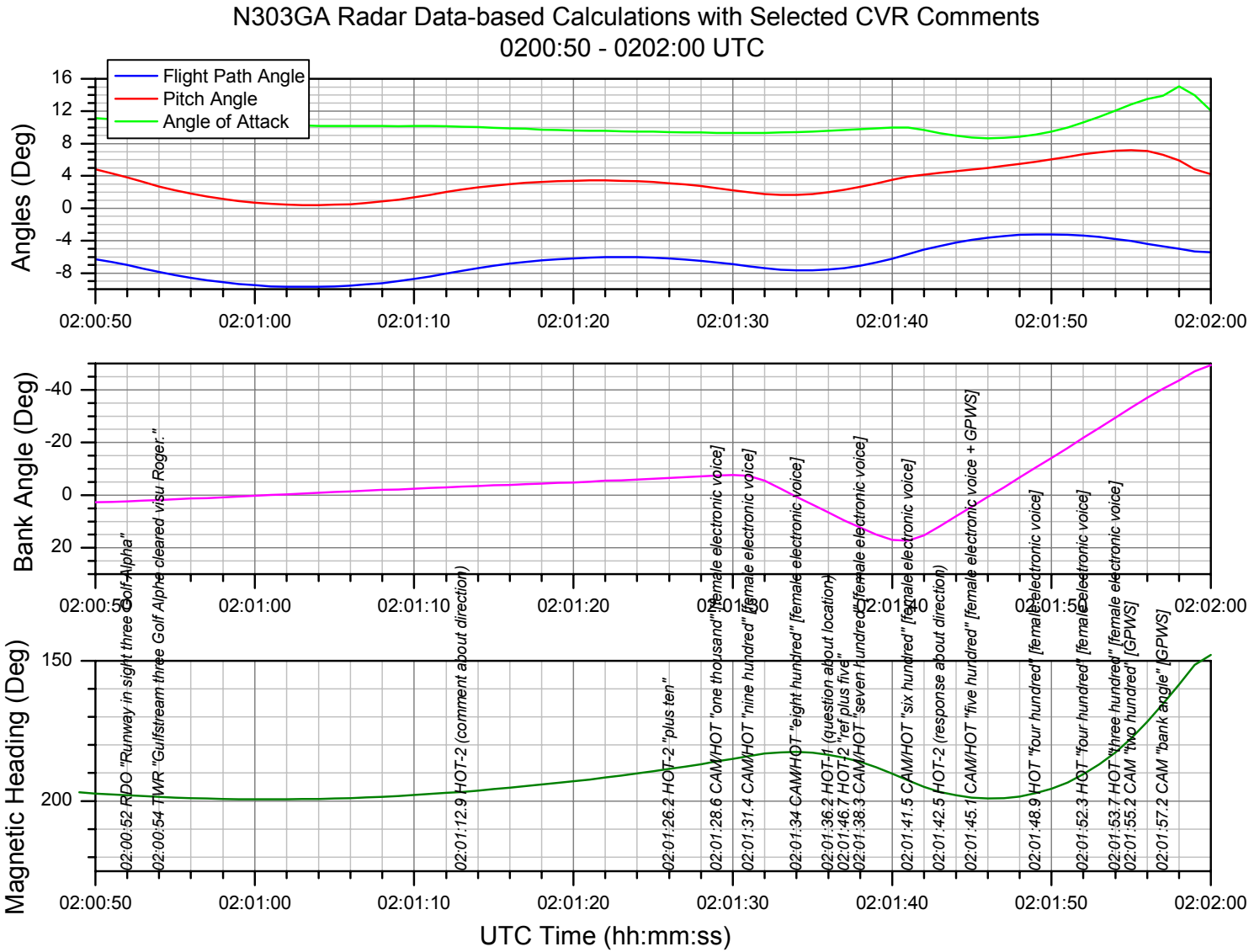



Upper Level Winds
0000 UTC
SAT (Deg C)
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
8000
10000
12000
14000
16000
18000
Wind Speed (kts)
20
18
16
14
12
10
8
6
4
8000
10000
12000
14000
16000
18000
Wind Direction (True Deg)
360
340
320
300
280
260
240
8000
10000
12000
14000
16000
18000
Altitude (ft-msl)


N303GA Radar Data-based Calculations
0150:00 - 0202:00 UTC
Altitude (ft-msl)
18000
16000
14000
12000
10000
8000
ASR Data
Curve fit
Calibrated Airspeed (kts)
200
175
150
125
100
Rate of climb (fpm)
500
0
-500
-1000
-1500
-2000
-2500
01:50:00
01:51:00
01:52:00
01:53:00
01:54:00
01:55:00
01:56:00
01:57:00
01:58:00
01:59:00
02:00:00
02:01:00
02:02:00
UTC Time (hh:mm:ss)


N303GA Radar Data-based Calculations
0150:00 - 0202:00 UTC
Flight Path Angle
Pitch Angle
Angle of Attack
Angles (Deg)
16
12
8
4
0
-4
-8
Bank Angle (Deg)
-40
-20
0
20
Magnetic Heading (Deg)
0
60
120
180
240
01:50:00
01:51:00
01:52:00
01:53:00
01:54:00
01:55:00
01:56:00
01:57:00
01:58:00
01:59:00
02:00:00
02:01:00
02:02:00
UTC Time (hh:mm:ss)


N303GA Radar Data-based Calculations with Selected CVR Comments
0200:50 - 0202:00 UTC
Altitude (ft-msl)
10000
9000
8000
ASR Data
Curve fit
02:00:50
02:01:00
02:01:10
02:01:20
02:01:30
02:01:40
02:01:50
02:02:00
Calibrated Airspeed (kts)
150
125
100
02:00:52 RDO "Runway in sight three Golf Alpha"
02:00:54 TWR "Gulfstream three Golf Alpha cleared visual Roger."
02:01:12.9 HOT-2 (comment about direction)
02:01:26.2 HOT-2 "plus ten"
02:01:28.6 CAM/HOT "one thousand" [female electronic voice]
02:01:31.4 CAM/HOT "nine hundred" [female electronic voice]
02:01:34 CAM/HOT "eight hundred" [female electronic voice]
02:01:36.2 HOT-1 (question about location)
02:01:46.7 HOT-2 "ref plus five"
02:01:38.3 CAM/HOT "seven hundred" [female electronic voice]
02:01:41.5 CAM/HOT "six hundred" [female electronic voice]
02:01:42.5 HOT-2 (response about direction)
02:01:45.1 CAM/HOT "five hundred" [female electronic voice + GPWS]
02:01:48.9 HOT "four hundred" [female electronic voice]
02:01:52.3 HOT "four hundred" [female electronic voice]
02:01:53.7 HOT "three hundred" [female electronic voice]
02:01:55.2 CAM "two hundred" [GPWS]
02:01:57.2 CAM "bank angle" [GPWS]
Rate of climb (fpm)
500
0
-500
-1000
-1500
-2000
-2500
UTC Time (hh:mm:ss)


N303GA Radar Data-based Calculations with Selected CVR Comments
0200:50 - 0202:00 UTC
Flight Path Angle
Pitch Angle
Angle of Attack
Angles (Deg)
Bank Angle (Deg)
Magnetic Heading (Deg)
UTC Time (hh:mm:ss)
02:00:50
02:01:00
02:01:10
02:01:20
02:01:30
02:01:40
02:01:50
02:02:00
02:00:52 RDO "Runway in sight three Golf Alpha"
02:00:54 TWR "Gulfstream three Golf Alpha cleared visu Roger."
02:01:12.9 HOT-2 (comment about direction)
02:01:26.2 HOT-2 "plus ten"
02:01:28.6 CAM/HOT "one thousand" [female electronic voice]
02:01:31.4 CAM/HOT "nine hundred" [female electronic voice]
02:01:34 CAM/HOT "eight hundred" [female electronic voice]
02:01:36.2 HOT-1 (question about location)
02:01:46.7 HOT-2 "ref plus five"
02:01:38.3 CAM/HOT "seven hundred" [female electronic voice]
02:01:41.5 CAM/HOT "six hundred" [female electronic voice]
02:01:42.5 HOT-2 (response about direction)
02:01:45.1 CAM/HOT "five hundred" [female electronic voice + GPWS]
02:01:48.9 HOT "four hundred" [female electronic voice]
02:01:52.3 HOT "four hundred" [female electronic voice]
02:01:53.7 HOT "three hundred" [female electronic voice]
02:01:55.2 CAM "two hundred" [GPWS]
02:01:57.2 CAM "bank angle" [GPWS]

Direction of Flight