NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Aviation Engineering Division
Washington, DC 20594

October 16, 2006

STRUCTURES GROUP CHAIRMAN'S FACTUAL REPORT

A. ACCIDENT: DCA06MA009

LOCATION: Chicago Midway Airport

DATE/TIME: December 8, 2005

AIRCRAFT: Boeing 737-700, N471WN
Southwest Airlines, Flight 1248

B. GROUP MEMBERS:

Group Chairman: Robert L. Swaim
National Transportation Safety Board
Washington, DC

Member: Alphonsus Garraway
Federal Aviation Administration
Chicago, Illinois

Member: Mickey McConnell
Southwest Airlines
Dallas, Texas

Member: Mats Sabel
Southwest Airlines
Dallas, Texas

Member: Marshall Gildermaster
Southwest Pilots Union
Baltimore, Maryland

Member: Randy Roberts
AMFA
Houston, Texas

SUMMARY:

On December 8, 2005, 1914 Central Standard Time, Southwest Airlines flight 1248, a Boeing B-737-7H4 registered as N471WN, overran runway 31C at Chicago Midway Airport in Chicago, Illinois, during the landing rollout. The airplane departed the end of the runway, rolled through a blast fence, a perimeter fence, and onto a roadway. The airplane came to a stop after impacting a Pontiac Bonneville. Instrument meteorological conditions prevailed at the time. The airplane was substantially damaged.

A group met at the accident site and in a hangar from December 9, to December 13, 2005, to document the physical aspects of the airplane, surface structures, and two cars.

D. DETAILS OF THE INVESTIGATION:

SITE AND MAPPING:

The airplane was found at the south side of the intersection of 55th Street (east/west) and Central Avenue (north/south), directly past the end of runway 31C. (See Figure 1) The heading of the fuselage was 340 degrees magnetic, with the airplane resting on the engines, both main landing gear, and the nose. The nose was on the west side of Central Avenue, with the nose landing gear folded aft and up into the electronics equipment bay.

Figure 1. Airplane oriented northwest, toward the intersection of 55th Street (east/west) and Central Avenue (north/south), with runway 31C in the background.

The nose of the airplane came to rest where a fire hydrant caught on the upper drag link (also known as the A-frame) of the nose landing gear. (See Figure 2)

Figure 2. Airplane being lifted off of the fire hydrant, upon which the airplane stopped.

A white Pontiac Bonneville was beneath the forward left fuselage, and the base of a street light had penetrated from the region of the left front headlight to inboard of the left front wheel. (See Figures 3 and 4) A dark blue Chevrolet Caprice was parked southbound on Central Avenue, facing the right (#2) airplane engine without making contact. (See Figure 5)

Figure 3. Relation of light post, Pontiac Bonneville, and airplane. A vertical I-beam support for the frangible airport perimeter fence is parallel to the bottom edge of the photo, beneath the left engine.

Figure 4. "As-found" relation of airplane and Pontiac.

Figure 5. “As-found” relation of airplane and the Chevrolet Caprice. Light frangible acoustic panels from the perimeter fence are visible between the airplane engine and the car.

An I-beam from the frangible perimeter fence was protruding from the bottom of the left (#1) engine. (See Figure 3) Electrical conduit pipe from the airport perimeter fence was wrapped over the top of the airplane at about FS 540. Numerous frangible acoustic panels from the airport perimeter fence were found throughout the area, under the airplane, on the right wing root, and against the two cars. The smell of jet fuel was under the center of the airplane and with the slush in the street gutters. Heavy snow had been falling at the time of the accident and afterward, and snow was found covering the debris.

Moving from the airplane toward the runway was a 4” concrete curb, with earth rising about two feet from the street surface to the level of the airfield. (See Figure 6) The airport perimeter fence was open to the street, with the frangible vertical supports separated from fittings sunk into the ground. (See Figure 7) An airport perimeter road with yellow-painted curbs was 21 feet from the perimeter fence, and the road was 33 feet wide. An approximately 8-inch deep depression at the end of the nose wheel track was located 34 feet from the perimeter road, toward the runway. The base of the wood runway-end blast fence was 92 feet from the depression and the end of the pavement (runway over-run area) was an additional 25 feet from the blast fence. About 12 feet from the blast fence toward the street was an approximately 2-foot tall earthen berm that the runway localizer array was sitting upon.

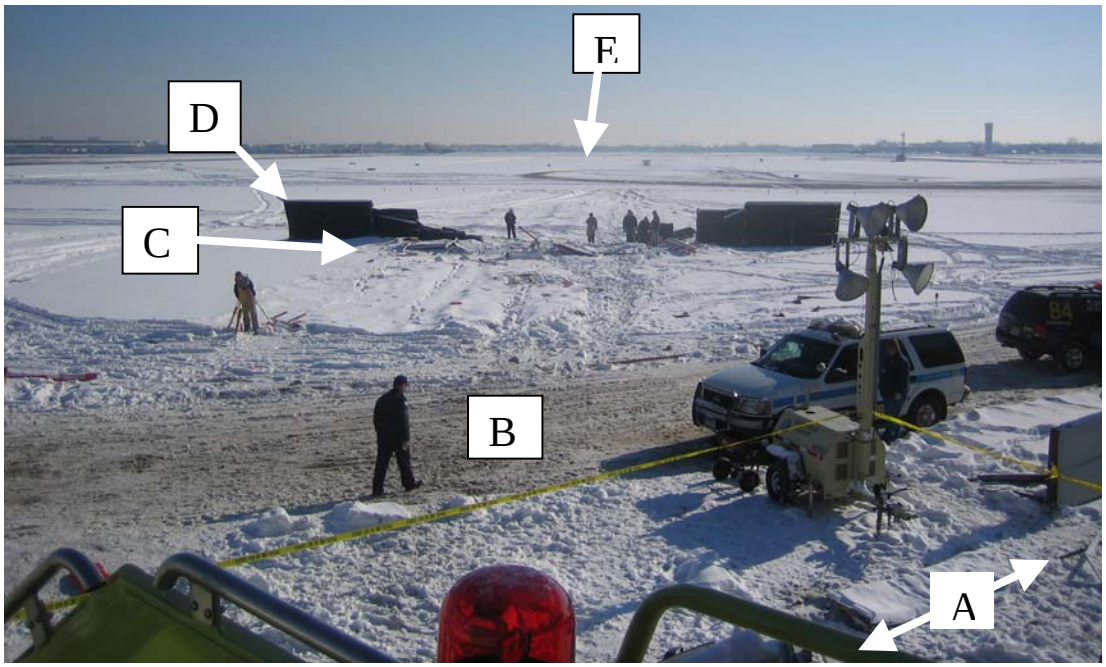


Figure 6. View toward runway from aft right door of airplane, showing street curb (A) with a fragment of the frangible wall, vehicles parked on the perimeter road within airport property (B), destroyed instrument landing system array (C), and hole in blast fence (D). The runway (E) is beyond the blast fence.


Figure 7. Base of vertical fence support, showing slots that the mounting bolts can be driven from in an impact. (For orientation, the runway is toward the lower left and street is to upper right.)

Using the groove in the runway centerline as a sighting device, the rear of the right engine was straight past the extended center of the runway. (See Figure 8)

Figure 8. Runway alignment with the airplane. The white stripe is the runway centerline.

The site was surveyed by the airport's contracted surveyor, Kudrna & Associates, using Total Station survey equipment. In case of conflicts with other site measurements in this report, the attached Kudrna data takes precedence. Measuring with a tape measure, the approach step to the instrument landing system (ILS) antenna array was a 15-inch rise from the grass. The ground dropped 21 inches on the street side of the ILS array, and about 18 inches from the perimeter wall to the surface of Central Avenue.

AIRCRAFT DATA:

The airplane data plate showed the model to be a Boeing 737-7H4 (commonly referred to as a 737-700) and the serial number to be 32471. The Airworthiness Certificate was dated 7/13/2004. The Registration Certificate was dated 8/16/04 and was assigned to Southwest Airlines.

AIRPLANE DAMAGE OBSERVED ON THE FUSELAGE (progressing from nose to tail):

Most of the radome was found on the airplane, with the lower two-thirds extensively crushed and torn, especially toward the left. (See Figure 9) On the right side of the radome and skin behind it were dark red paint transfers that were similar to the dark red of the checkerboard pattern on the blast fence, and the red extended to approximately FS 285. White paint transfers on the left and right sides of the radome and fuselage extended back along the fuselage to approximately FS 360.

Figure 9. Radome and damage aft of it. A yellowish vertical crease matching the spacing and color of a vertical fence support existed slightly to the left of center on the radome and pressure bulkhead. The fire hydrant created the slash into the nose landing gear area.

The nose landing gear had separated from the lower drag strut of the retraction mechanism and folded aft. The tires had entered the electrical equipment ("E/E") compartment through the E/E door and frame, lodging on the edge of the displaced door. The structure between the nose gear well and aft E/E door was crushed upward around the displaced nose landing gear strut. The nose landing gear and structural damage destroyed the forward E/E rack, which was found displaced upward.

A crease that matched the edge of a frangible fence vertical support and dented structure were ahead of the forward E/E door, at about FS 188 to 205, from the centerline to about LBL 10. A longitudinal creased and dented path of about six inch width at the front extended from the torn skin at LBL 17 to about FS 295/LBL 30, where the path curved outboard, ending as a series of scuffs at about FS 310 to FS 325. In this general area of the lower left of the airplane nose was a missing piece of aluminum skin found later in the Pontiac, plus a deep gouge and series of paint transfers that matched the color of the white Pontiac Bonneville. (See Figure 10) (A later section of this report contains further details about the Pontiac.)

Figure 10. Aluminum skin fragment later found beneath the rear window of the Pontiac.

The fire hydrant had entered the fuselage beginning beneath the right side of the nose at about FS 188, creating a roughly foot-wide (to FS 204) cut into the structure, up to the height of the nose landing gear well's ceiling. The cut led to where the fire hydrant came to rest against the upper drag strut (A-frame) of the retraction mechanism. At the breaks in the upper drag strut were paint transfers of the red shade of the fire hydrant. A red paint transfer was on the side of the retraction cylinder where the cylinder had been deformed. The cut destroyed the right side of the forward wall of the nose gear box and the forward portion of the right box wall. Within the nose gear well was additional lesser damage to the stiffeners on the side walls.

On the right side of the nose, the vane for the angle of attack (AOA) probe was broken off and missing from FS 193/WL 205. (See Figure 11) The pitot tube immediately above (WL 213) the AOA probe was broken and the upper pitot tube (WL 225) was intact. A line of scuffs and light dents extended from about FS 180/WL 205 to about FS 225.

Figure 11. The broken pitot tube and wire for the missing angle-of-attack probe are above the triangular hole, which is where the fire hydrant entered the bottom of the fuselage.

The left side of the nose had impact damage from the missing AOA vane and broken pitot tube (FS 194, WL 195 to 235) aft to the lowest point beneath the Captain's side window (FS 225) and the area was covered with green paint transfer. (See Figure 12) A light scuff continued aft to about FS 256. Along the ground path of the airplane was only one green item, which was the light pole at the left front of the white Pontiac. The paint on the pole was scratched from the base to slightly less than five feet above the ground. Further aft on the left forward fuselage, minor dents and gouges were found to about FS 519, between S-14L and S-25L. The #1 VHF antenna was loosely attached to the airplane bottom center of the airplane at FS 470, separated from the base and displaced aft.

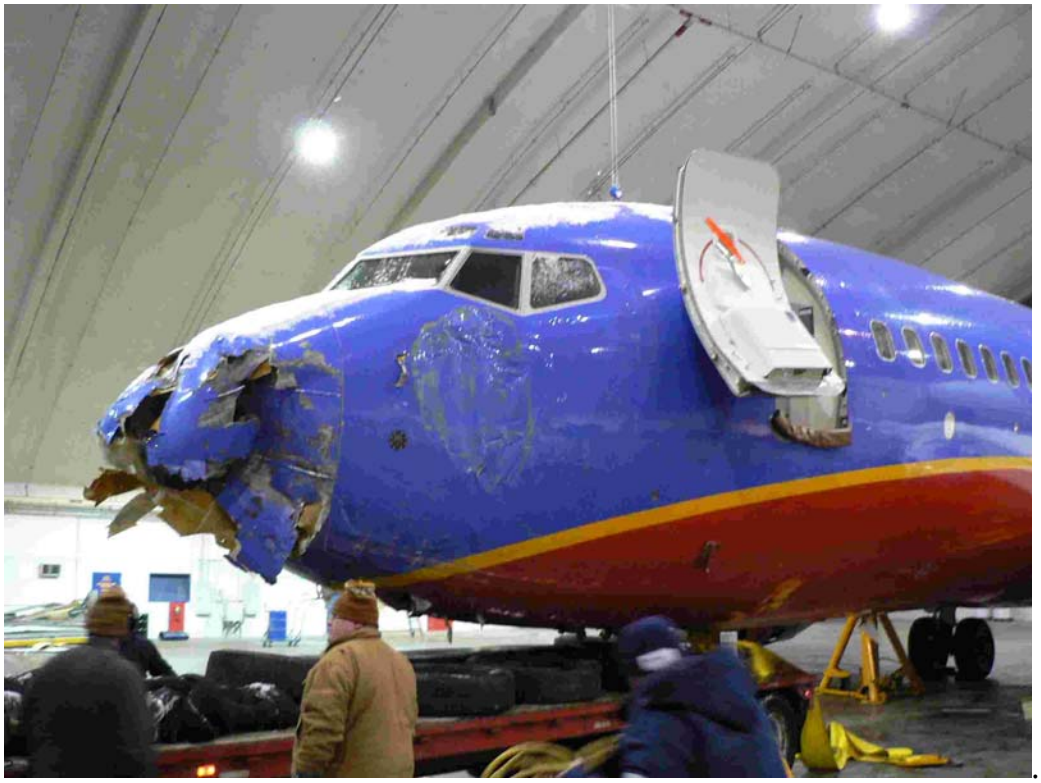


Figure 12. Left side of airplane nose.

A 16-inch dent was located ahead of the forward cargo door (FS 390), between stringers S-21R and S-22R. Another was at about FS360, below S-28R. Aft of the cargo door were gouges and dents at FS530, between S-15R and S-16R, and between S-11R and S-12R.

Examining the upper surfaces, the Captain's windshield wiper was missing and the frame between the windshields was scratched. Scratches, scuffs, and minor dents were found along the crown to where the airport perimeter fence conduit was, at about FS 540.

The composite fairings beneath the wing connection to the fuselage had minor scrapes and punctures. Dents were found in the left air cycle machine inlet and loose debris could be seen in the far end of the ductwork. The most aft fuselage damage was at FS 681, where a puncture in the wing/body fairing was located immediately forward of the left main gear well.

AIRPLANE WING DAMAGE (left to right)

Damage along the wings aligned with the extent of damage to the blast fence and perimeter fence, with no color transfers or other damage matching the observed features of the instrument landing system array. Looking at the airplane from the front, a series of vertically damaged locations were in the leading edges of the wings and the left engine inlet. (See Figures 13 and 14) Along the path of the airplane, the only vertically spaced items with the height and width of the damage were the frangible perimeter fence supports. (See Figure 15) The inboard left Kruger flap, airplane flap panels and fairings (called canoes) had white, red, and black paint transfers, light impact marks, and punctures in the adjacent areas, corresponding to the width of the damaged parts of the blast fence.

Reddish-orange color plastic fragments in the shade of the instrument landing system (ILS, see Figure 15) components were also found on each main landing gear, but no damage to the airplane was attributed to the ILS array.

Figure 13. Even spacing (shown by arrows) of damage along right wing matches spacing of vertical I-beam supports for frangible fencing. Using the same spacing, the next vertical damage to the right of the photo was to the radome, on the nose of the airplane. (See Figure 8)

Figure 14. Even spacing (shown by arrows) of damage along left wing matches spacing of vertical I-beam supports for frangible fencing (beneath winglet, at the right edge of photo). Using the same spacing, the next vertical damage to the left of the photo was at the radome, on the nose of the airplane. (See Figure 8)

Figure 15. Opposite end of the runway, located at the southeast corner of the airport, showing a similar installation of the blast fence, instrument landing system array, and in background is the frangible perimeter fence, using I-beam vertical supports and stacked lightweight acoustic panels.

The eight leading edge slats are numbered from the left wing tip to the right wing tip, with four on the outboard of each engine. The outboard half of the #2 slat had been torn away and was found on Central Avenue. The fixed leading edge was damaged at Wing Station (WS) 567, torn and no apparent spar damage.

The #3 slat inboard section was found bent, torn and buckled. No damage was visible to the structure behind the slat.

Two dents of less than an inch in depth were found in the #4 slat, immediately outboard of the left engine. Behind the slat was the outboard aft flap, where a series of red paint transfers and dents were found and the inboard roller had separate from the track.

On top of the wing, the trailing edge of the #5 spoiler was bent nearly an inch in depth and approximately a foot in span.

The outboard aft corner of the left wing's inboard trailing edge flap had a puncture at WBL 188.

Inboard of each engine are two Kruger flaps on the leading edges, numbered also from one to four. The #1 (outboard) Kruger flap had a crack on the inboard edge, continuing from a set of gouges in the #2 Kruger flap, along with black and red paint transfers. The wing torsion box aft of the Kruger flaps had small paint transfers of dark red and black, similar to the blast fence colors. Another dent was at the inboard edge of the #2 Kruger flap on the leading edge.

The right wing root and landing light assembly was crushed into the front spar. Lower and upper spar T-caps were damaged and no damage to the spar web was observed. Of the #3 and #4 Kruger flaps, the outboard half of #3 was skewed and hanging from one hinge and actuator. The #4 had broken attachment points at several locations. Aft of the #3 and #4 Kruger flap locations were scuffs on the bottom of the wing torsion box, to past the #1 fuel stick location, with a red transfer

immediately ahead of the right main landing gear. On top of the wing, the inboard ground spoiler had several punctures along the outboard trailing edge.

On the outboard side of the right engine and above a missing area of the right outboard thrust reverser, from about Wing station 253 to WS 290, was significant damage to the leading edge. The inboard portion of the #5 slat was torn and twisted under the attach points, with extensive yellow paint transfers matching the vertical portions of the frangible perimeter fence. The lower spar T-cap was deeply cut in three places, including ahead of the #2 engine spar valve for fuel, which had damaged electrical wiring. Aft of the inboard damage was a imprint in the lower wing skin. Further aft and on the outboard corner of the inboard flap was a small puncture. About a foot further outboard was a white impact mark on the inboard end of the outboard training edge flap. The canoe (#7) had a deep gouge on the lower surface and scuff marks on the trailing edge, as well as a three-inch crack on the outboard side of the tip.

The inboard quarter of the span of the trailing edge flap (attached to the outboard flap) was extensively buckled and damaged, with punctures and impact marks in the bottom. The white, red, and black paint transfers matched the colors of the blast fence on the trailing edge flap. The inboard roller had separated from the track in the outboard flap.

The # 6 slat had vertically–oriented damage at WS 455, extending to the forward wing spar. No spar damage was observed. The outboard two slat attach points were torn from the leading edge spar where the slat had been cut in half and a portion was missing. Aft of this damage were scuffs on the bottom of the right wing surface. The #8 canoe had a large white paint transfer on the red base color, gouges, and the upper half of the trailing edge of the canoe was partially separated. About a foot outboard of the canoe, the trailing edge flap had a dark red paint transfer at the trailing edge and the roller was displaced inboard of the track.

WHITE PONTIAC BONNEVILLE

A white Pontiac Bonneville was found under the lower left fuselage, forward of the wing with the nose of the car angled away from the airplane. (See Figures 3 and 4) The car was pinned between the airplane and the base of a street light, which went into the front left of the car from the left corner of the front bumper (at about the headlight) to the suspension A-frame. Under the airplane and wrapped around parts of the car were acoustic fence panels (5 inches thick each). A fragment of a nose landing gear door was found in the exposed portion of the trunk and black rubber transfers similar to the window seal were found on the fuselage of the airplane, above and below a deep gouge in the lower left fuselage.

During reconstruction in the hangar, the group placed the car in front of the airplane at about the angle of the street to the runway. (See Figure 16) This orientation was different than how the car came to rest beneath the left side of the airplane. (See Figure 3) Scratches and paint transfers on the roof and on the aft right corner of the trunk spoiler were at about the orientation of the runway to the street. The scratches on the top right surface of the car's spoiler were oriented at 20 degrees from the right of a projected centerline. (See Figure 17) On top of the left portion of the spoiler were additional red and yellow paint transfers in orientations that ranged from 41 to 60 degrees from the left of direct aft.

Figure 16. The photo shows orientation of scratching on corner of rear spoiler and is approximately the orientation of the runway to the northbound lanes of the street. The colors of the scratches match the airplane colors.

Figure 17. The car was placed in front of the airplane at about the angle of the street to the runway. This orientation was different than how the car came to rest beneath the left side of the airplane.

The car in general was buckled with the aft half displaced to the right. (See Figure 18) The aft right portion of the car had crush damage oriented from aft forward. The left aft roof pillar had compression damage downward and to the left. The right rear of the roof had compression damage and blue paint matching the airplane was found 7 inches aft of the windshield and 15 inches inboard from the front right corner of the roof. The direction of the scratches on the roof were the same direction as those on the right rear of the spoiler, oriented from aft to forward. The right rear quarter panel of the white car had blue, yellow, and red paint transfers at 23 inches aft of the right rear door and 28 inches from ground level (if undamaged). The colored paint transfers along the

right side of the Pontiac were intermittently found to the forward edge of the right front door, ahead of the missing mirror.

Figure 18. Downward view on the Pontiac, showing crush and deformation. The nose of the car is to the right and the tail is to the left. In relative terms, the airplane came from the lower left of the photo into the northbound traffic lanes that the Pontiac had been in. This direction aligns with scratches on the trunk spoiler and roof. With the front left of the car (upper right in the photo) as-found, wrapped around the post of the street-light, the relative direction of travel for the airplane was from the upper left of the photo toward the lower center, in the direction of deformation.

A fragment of blue-painted aluminum was found in a fold that had been the upper right corner of the trunk, near the hinge. The fragment had similar edges to a missing area on the fuselage of the airplane, immediately aft of the radome and at the beginning of a deep gouge along the lower left fuselage, beginning at FS 178, WL 180. (See Figure 10) Immediately above where the fragment was found, a bolt head had been built into a concealed location, in the lower right corner of the rear car window. The bolt head had extensive paint deposits in colors that matched the airplane. Measuring from the ground, as undamaged, the bolt was at an elevation of about 37 inches. The most aft marks on the fuselage from the car were at FS 511.

The car interior had deformation damage, with deployed airbags on both sides (left and right). The drivers seat was found shifted slightly aft. The top section of the right front seat was rotated outboard. The seatbelts were found cut at each front seat and unbuckled for the center and right rear seats. No seatbelts had stretch marks. The left rear seatbelt was found fastened around a booster seat, marked Dorel Juvenile Group, Model # 22-296-WAL, MFG-HIGH RISE, BB1A 113938204/01/05. A loose Cosco infant seat was found outside of the car, marked Model #02-450-JEF, 12-28-00 OH. The driver and left rear door windows were partially down.

Basic data for the car were:
White Pontiac Bonneville, with the date of manufacture shown as 8/94.
Odometer mileage 107,627
VIN: 1G2HX52K7S4214316.
Indiana Temporary License I323062, Expiration 01/07/06, Dealer 6282M.

The fuel line was cut during removal from the scene and the fuel tank was drained.

CHEVROLET CAPRICE

A dark blue 1994 Chevrolet Caprice was parked southbound on Central Avenue, ahead of the right airplane engine. The license plate was Illinois 658 4201, VIN 1G1JC4T8R7189838. No damage to the Caprice was noted and the car did not contact the airplane. Between the car and the right airplane engine were acoustic fence panels.

Robert L. Swaim
National Resource Specialist,
Aircraft Systems engineering
National Transportation Safety Board

ATTACHMENT A

December 11, 2005, interview with Southwest Airlines A&P Mechanic & Inspector,
Mr. Dana Wojcik, Employee #40444,

Mr. Wojcik arrived about 15 minutes after the accident and believes that he was the first mechanic on-scene. Passengers were still coming off the air stair at the rear door. The first airport person he saw was Mr. Al Perez, who said that Mr. Wojcik should help the firefighters, who were foaming the area. Mr. Wojcik offered his assistance and was asked if electrical power was still active, and then to shut off the battery power and fuel. He entered through the air stair and in the cockpit found some lights illuminated and that the stick shaker was active. He did not have good light in the circuit breaker area, so pulled about five circuit breakers until he had the battery breakers pulled, which deactivated the stick shaker and cockpit lights. Mr. Wojcik said that he noted the fuel gauges before pulling the circuit breakers, because of the fuel leak at the right inboard wing area. He clearly remembers that the fuel indication was 6100 pounds for the left tank and 5900 pounds for the right tank. The center tank gauge was "blank" which he said did not surprise him, as crews will first use center fuel or not fill the center tank. All fire handles were pulled and turned to the left. He did not notice the positions of the fuel switches. A fire chief of some rank asked him to stay in the front left door for further help, if required. Mr. Wojcik opened the Captain's window and did not see either pilot. The left throttle was slightly advanced from the position of the right by about an inch and the thrust reverser levers were down. Mr. Wojcik was asked to check for remaining passengers and looked under seats and in the restrooms, where he saw nobody. He walked with Ed Malinowski of the NTSB, while Mr. Malinowski took photos and saw that fuel was about ankle-deep, until some other mechanics closed a valve somewhere.

ATTACHMENT B
GROUP MEMBER SKETCHES OF DAMAGE.

Note: When differences exist between sketches and text, the text takes precedence.

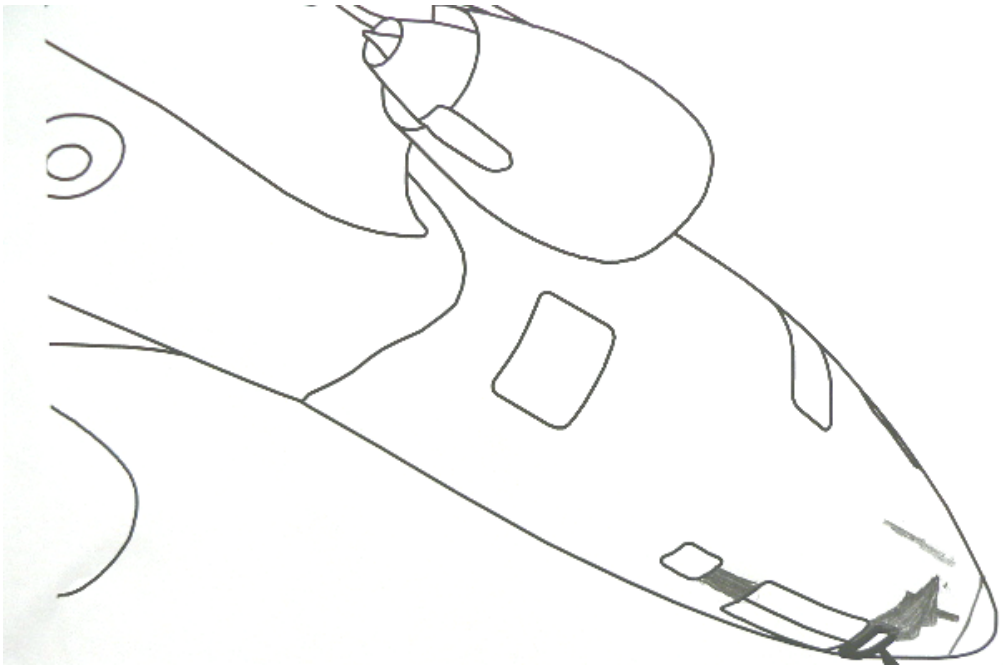


Figure B1. Cuts in bottom of fuselage from fire hydrant and nose landing gear collapse, as drawn by Mike McConnell.

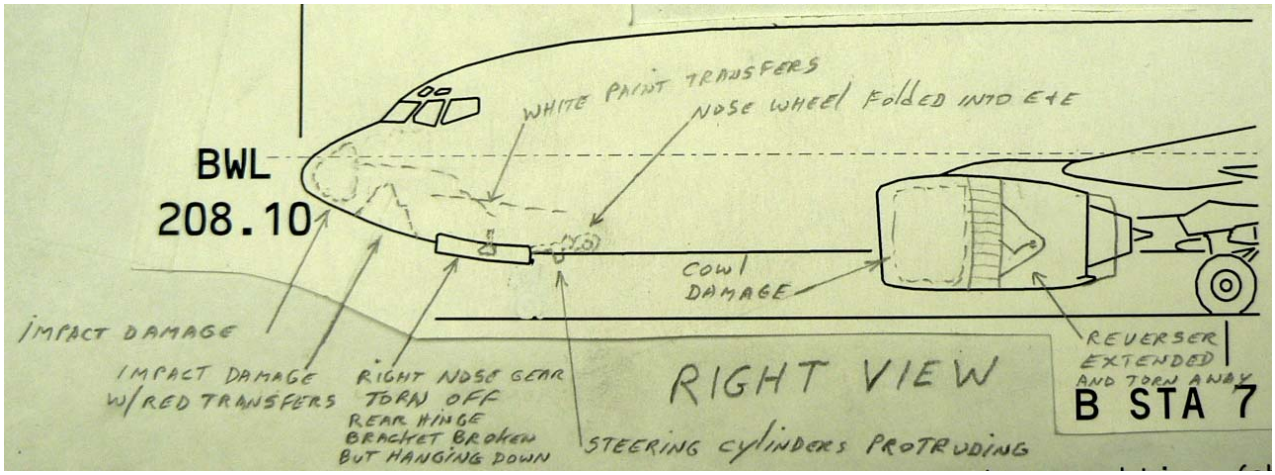


Figure B2. Right side damage shown on illustration from the left, as drawn by Marshall Gildermaster.

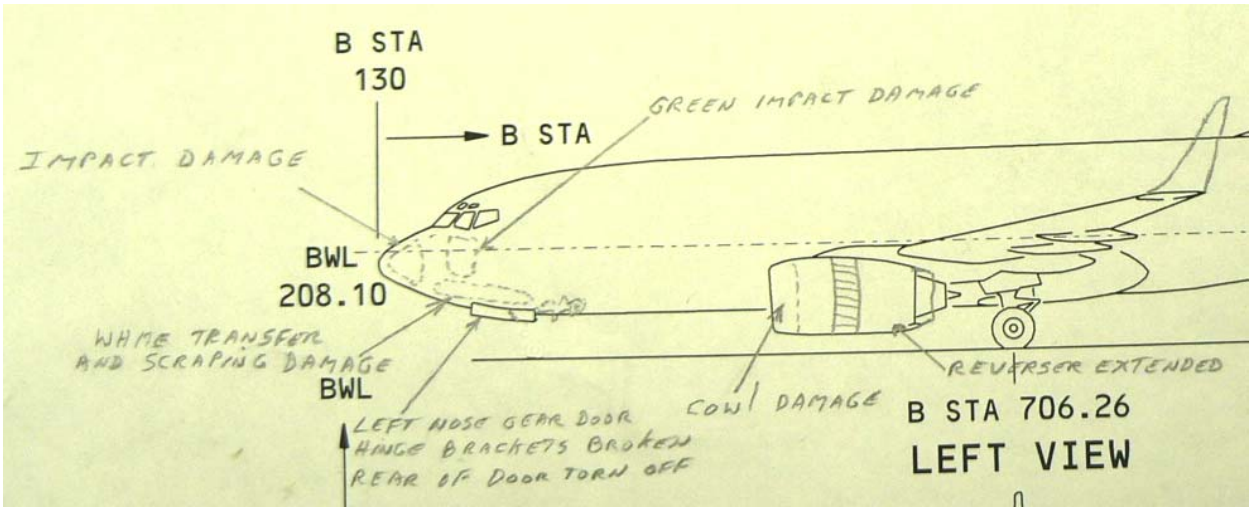


Figure B3. Left side damage sketch, as drawn by Marshall Gildermaster.

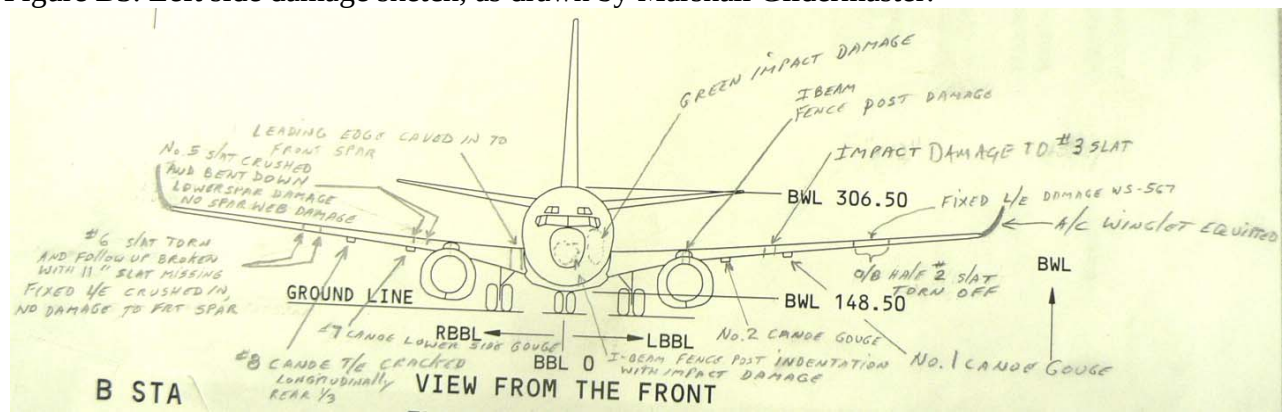


Figure B4. Frontal sketch, as drawn by Marshall Gildermaster.

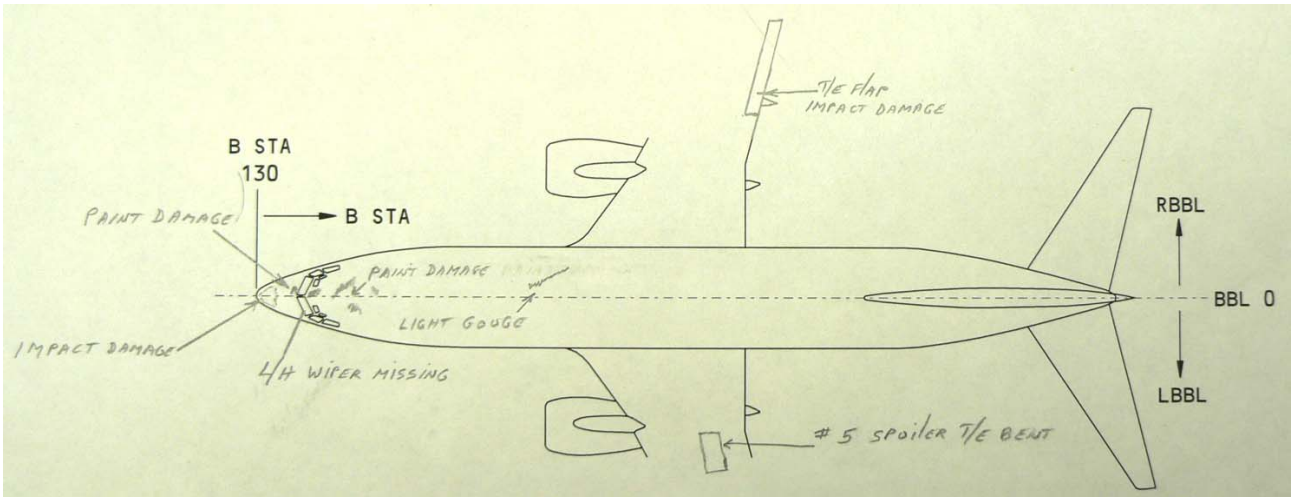


Figure B5. Plan view sketch, as drawn by Marshall Gildermaster.

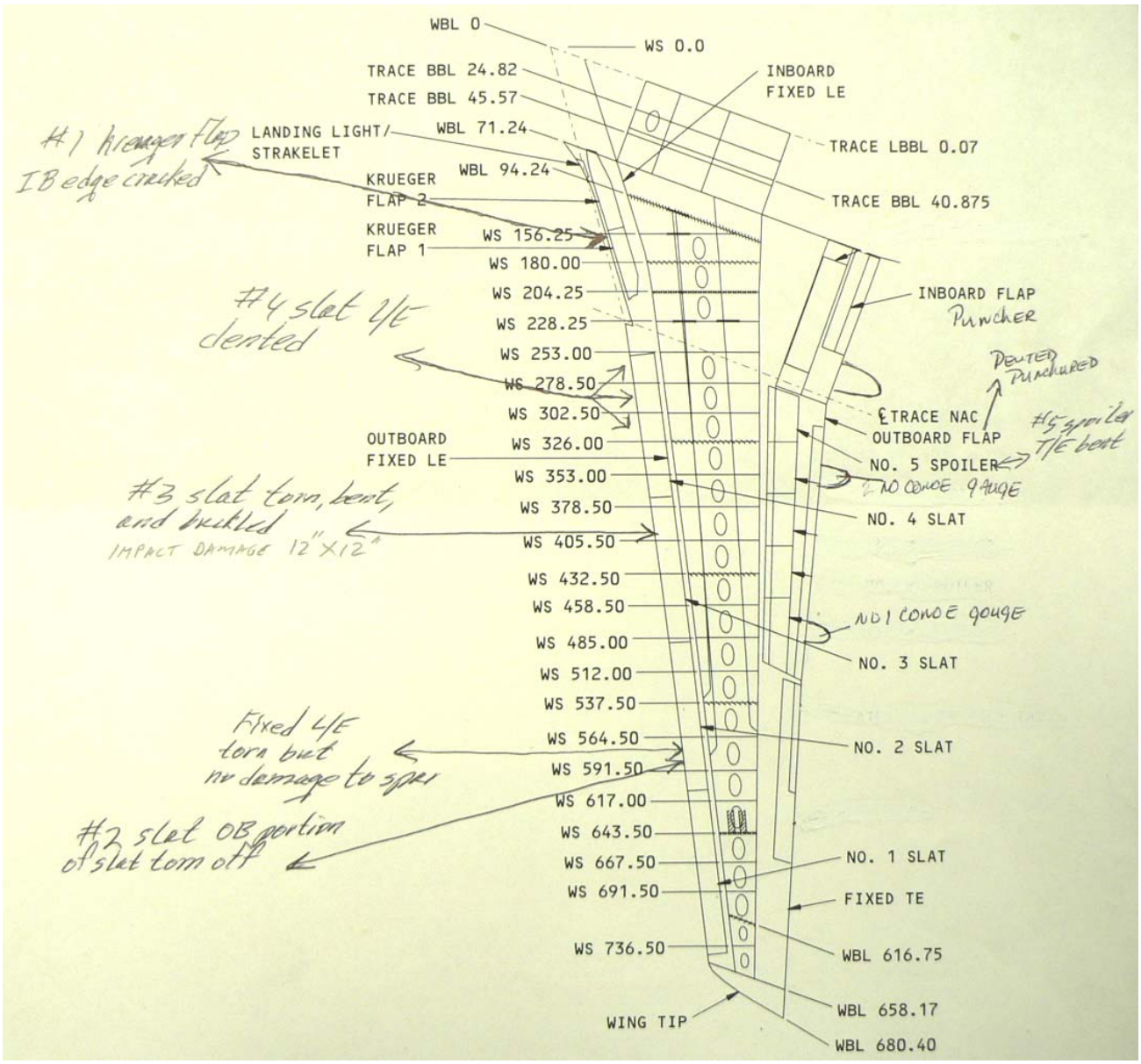


Figure B6. Left wing damage sketch, as drawn by Mats Sabel.

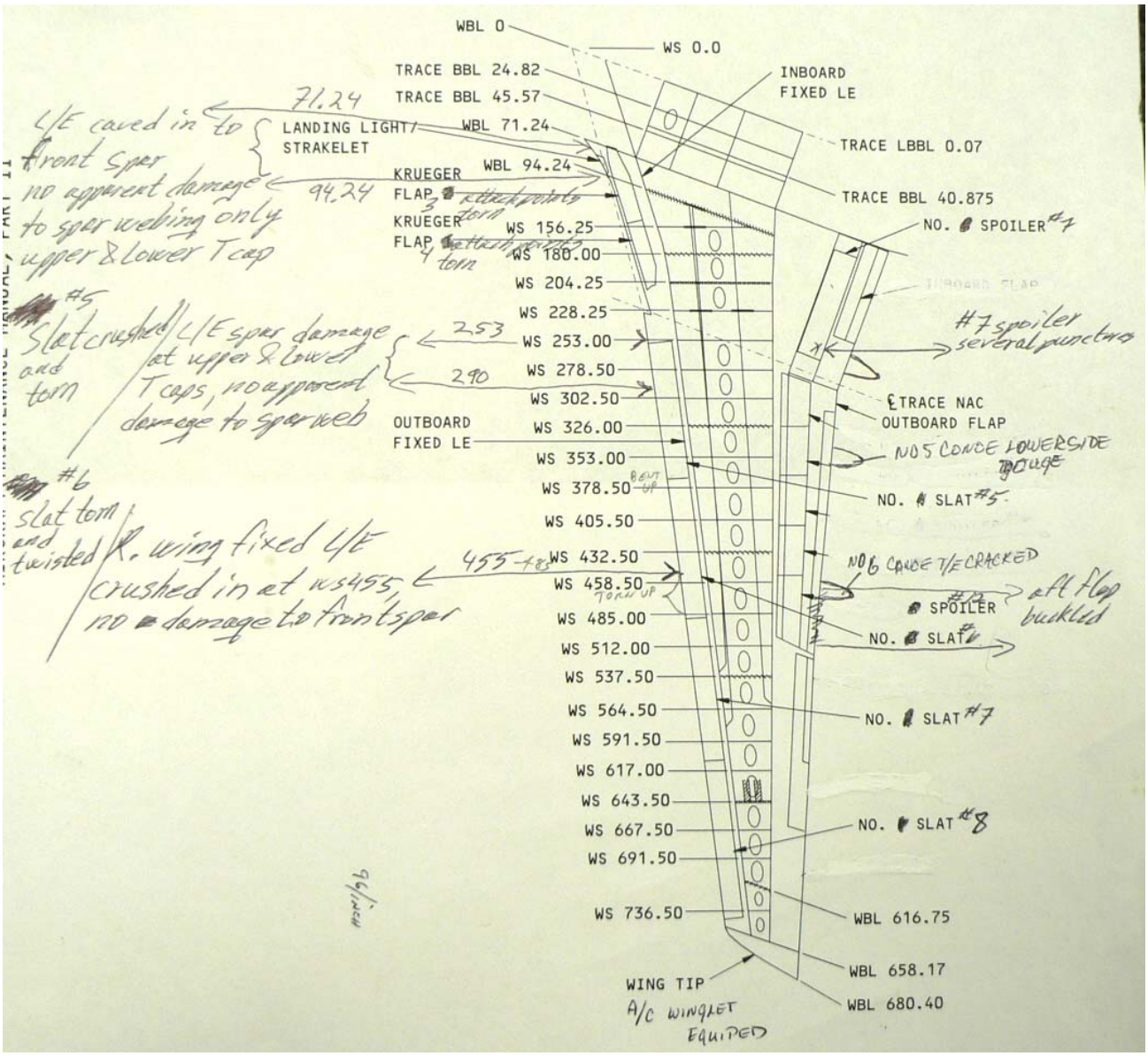


Figure B7. Right wing damage sketch, as drawn by Mats Sabel.

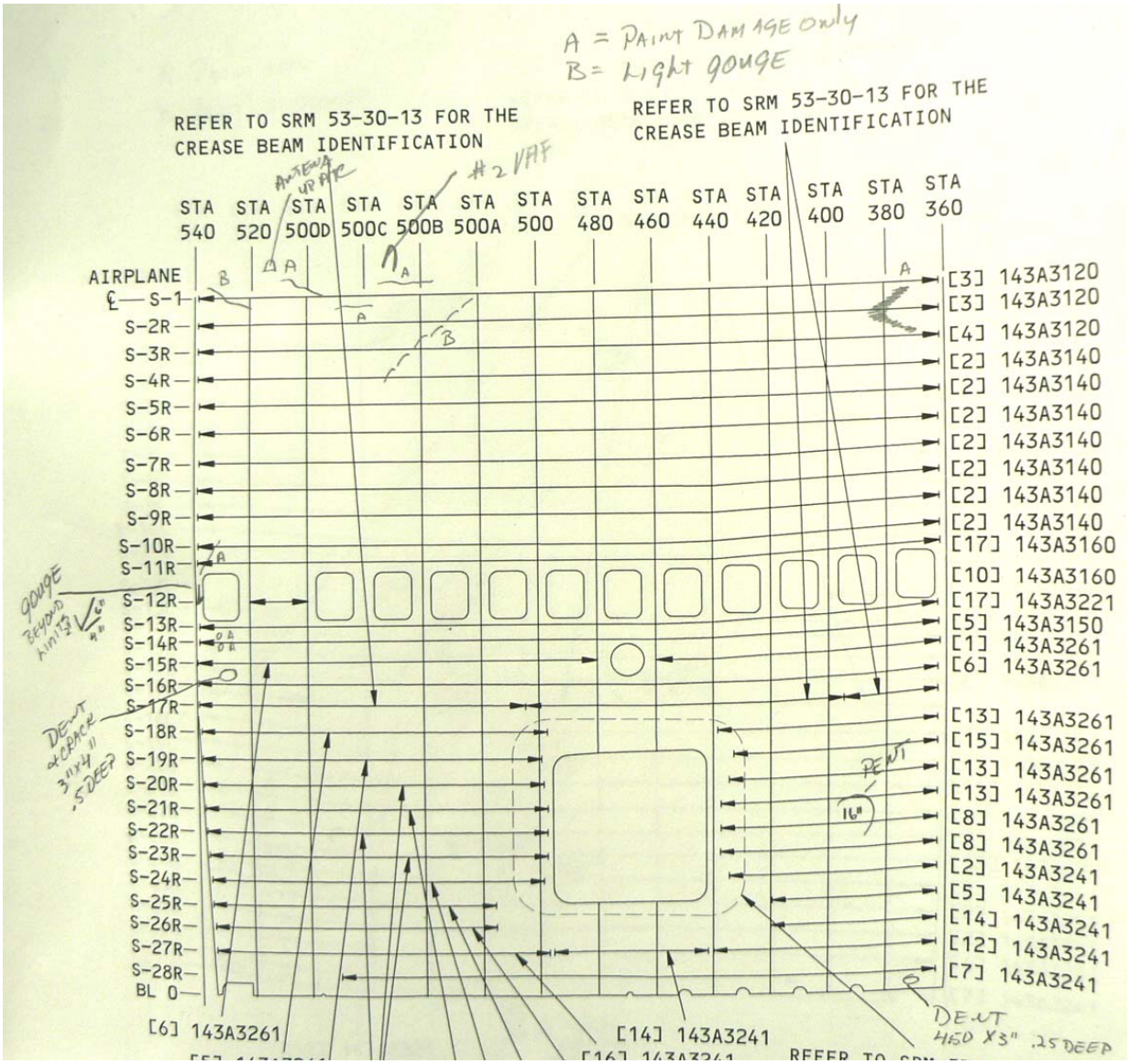


Figure B8. Damage sketch of forward right fuselage, as drawn by Randy Roberts.

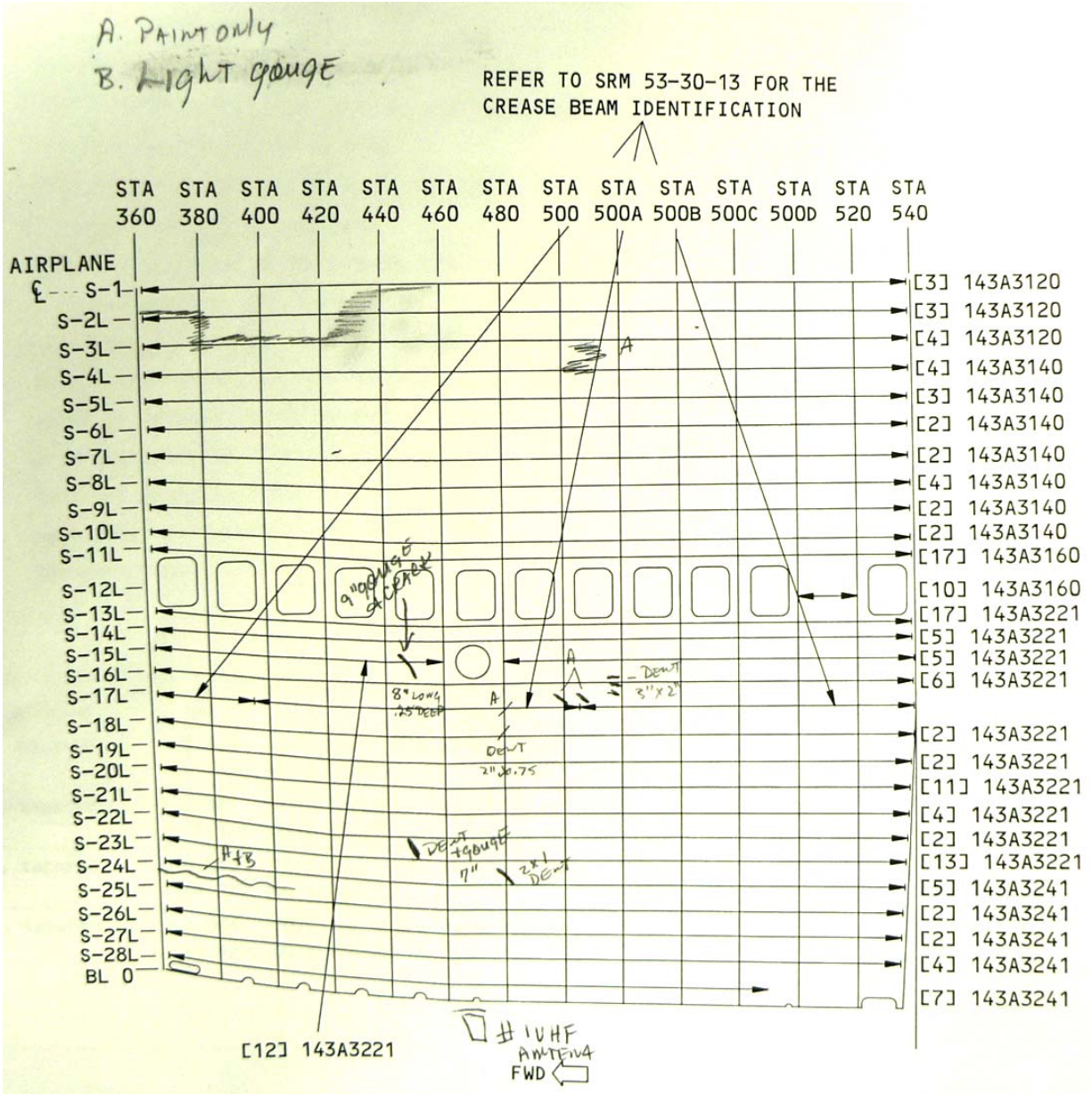


Figure B9. Damage sketch of forward left fuselage, as drawn by Randy Roberts

Appendix C
Kudrna Survey Results

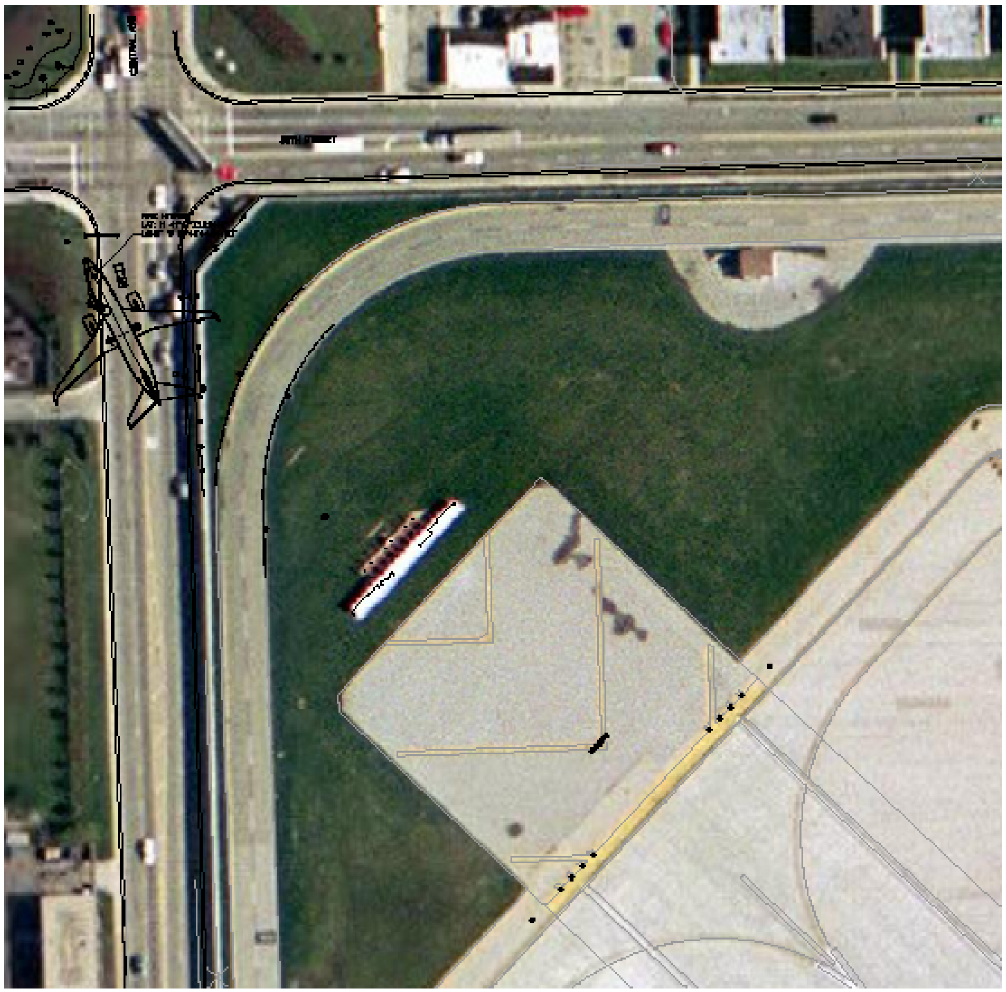
KUDRNA & ASSOCIATES, LTD.
CIVIL ENGINEERING
PLANNING • DESIGN • LAND SURVEY • CONSTRUCTION MANAGEMENT
200 NORTH CASS AVENUE • WESTMONT, ILLINOIS • 60559 • (630) 968-3060
400 SOUTH OGDEN STREET • SUITE 354 • CHICAGO, ILLINOIS • 60607 • (312) 226-1822

MIDWAY INTERNATIONAL AIRPORT
N.T.S.B.
SOUTHWEST AIRLINES CRASH
INVESTIGATION

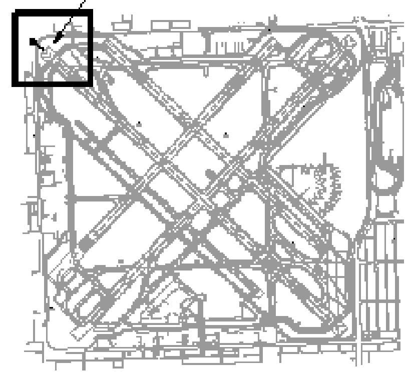
RUNWAY 4R/22L
PLAN AND PROFILE

Sheet 6 of 6

SOUTHWEST AIRLINES FLIGHT 1248
ACCIDENT INVESTIGATION



SITE LOCATION



VICINITY MAP

PREPARED BY:
KUDRNA AND ASSOCIATES
FOR:
MIDWAY INTERNATIONAL AIRPORT/
D.O.A./N.T.S.B.

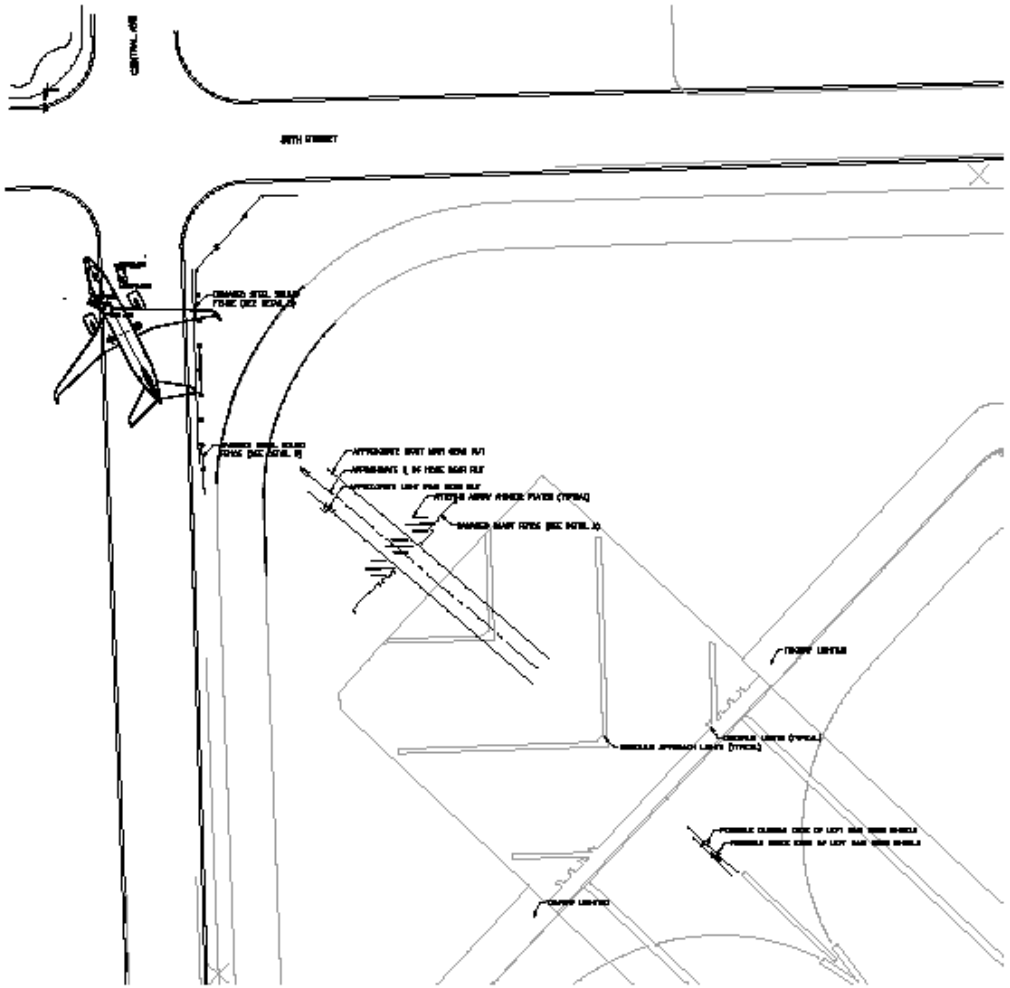
MIDWAY INTERNATIONAL AIRPORT
NATIONAL TRANSPORTATION SAFETY BOARD

SOUTHWEST AIRLINES CRASH INVESTIGATION

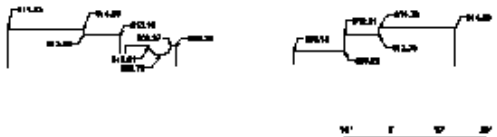
KUDRNA & ASSOCIATES, LTD.

1 of 5

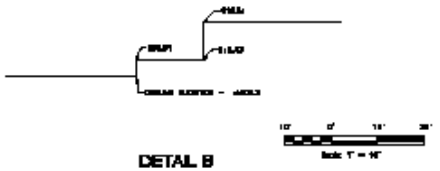
SOUTHWEST AIRLINES FLIGHT 1248
ACCIDENT INVESTIGATION



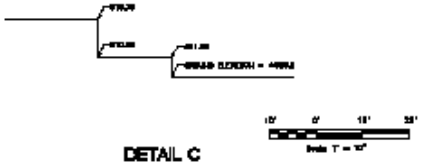
OVERALL SITE PLAN



DETAIL A
DAMAGED BLAST FENCE



DETAIL B
DAMAGED STEEL BOUND FENCE



DETAIL C
DAMAGED STEEL BOUND FENCE

DETAIL D
POSSIBLE LEFT MAIN GEAR RUTS

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SOUTHWEST AIRLINES CRASH INVESTIGATION

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DESIGNED BY
SD

DRAWN BY
JLP

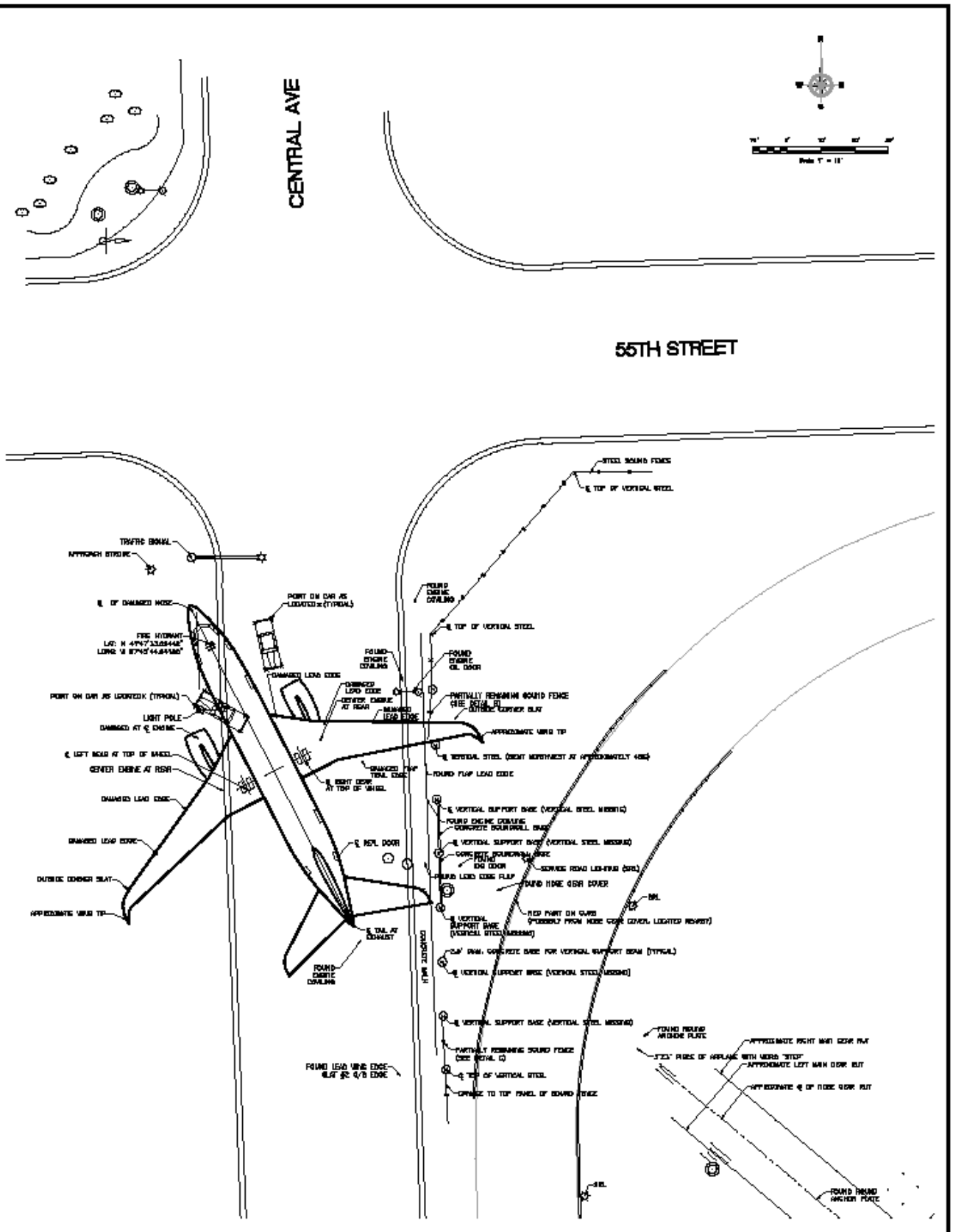
DATE
DECEMBER 10, 2005

Scale
1"=10'

Job Number
05054-16

Title
SWA FLIGHT 1248
CRASH INVESTIGATION

Sheet
2
of 5



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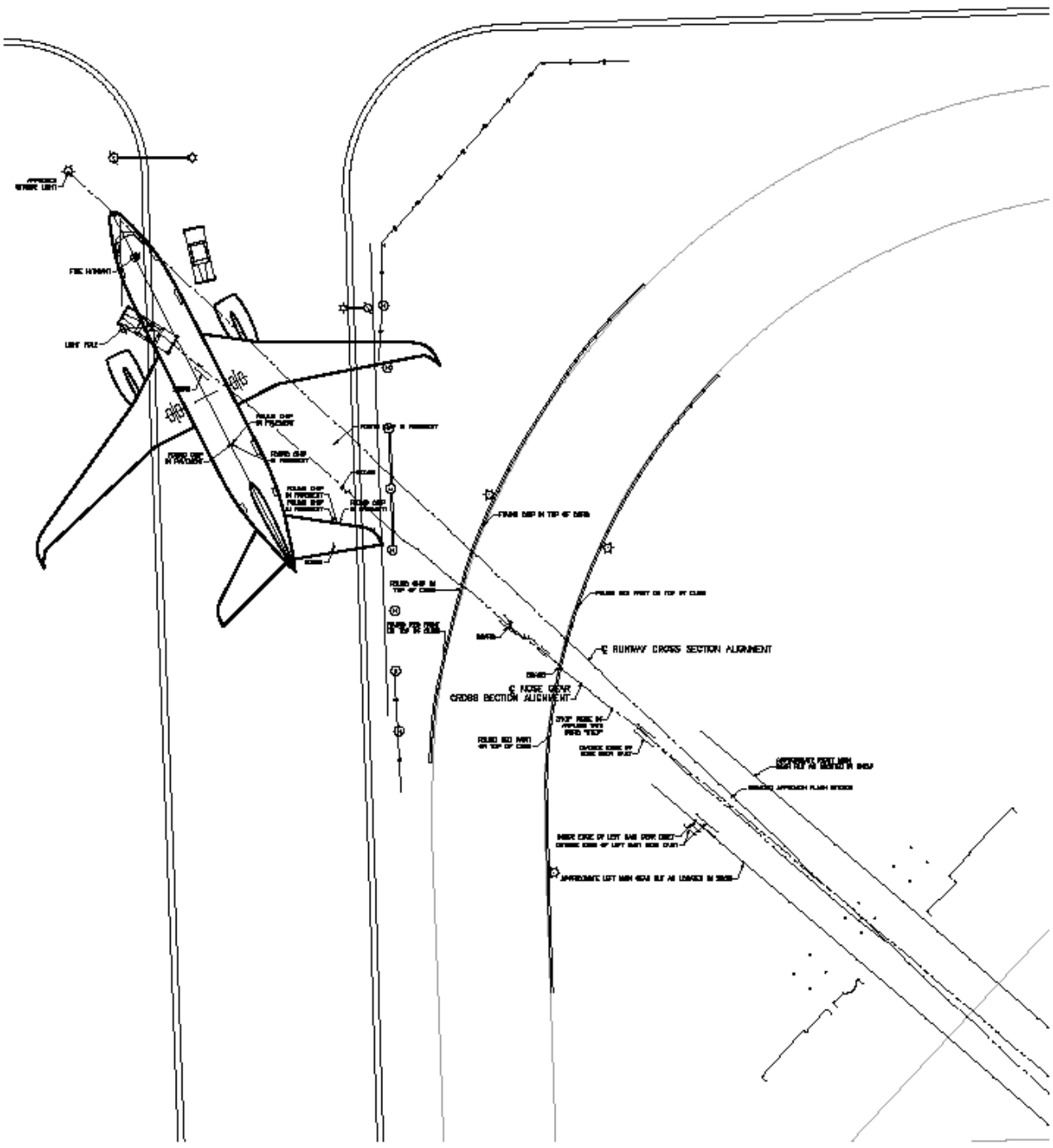
Sheet 3 of 5

CHIP AND SCAR LOCATIONS

55TH STREET



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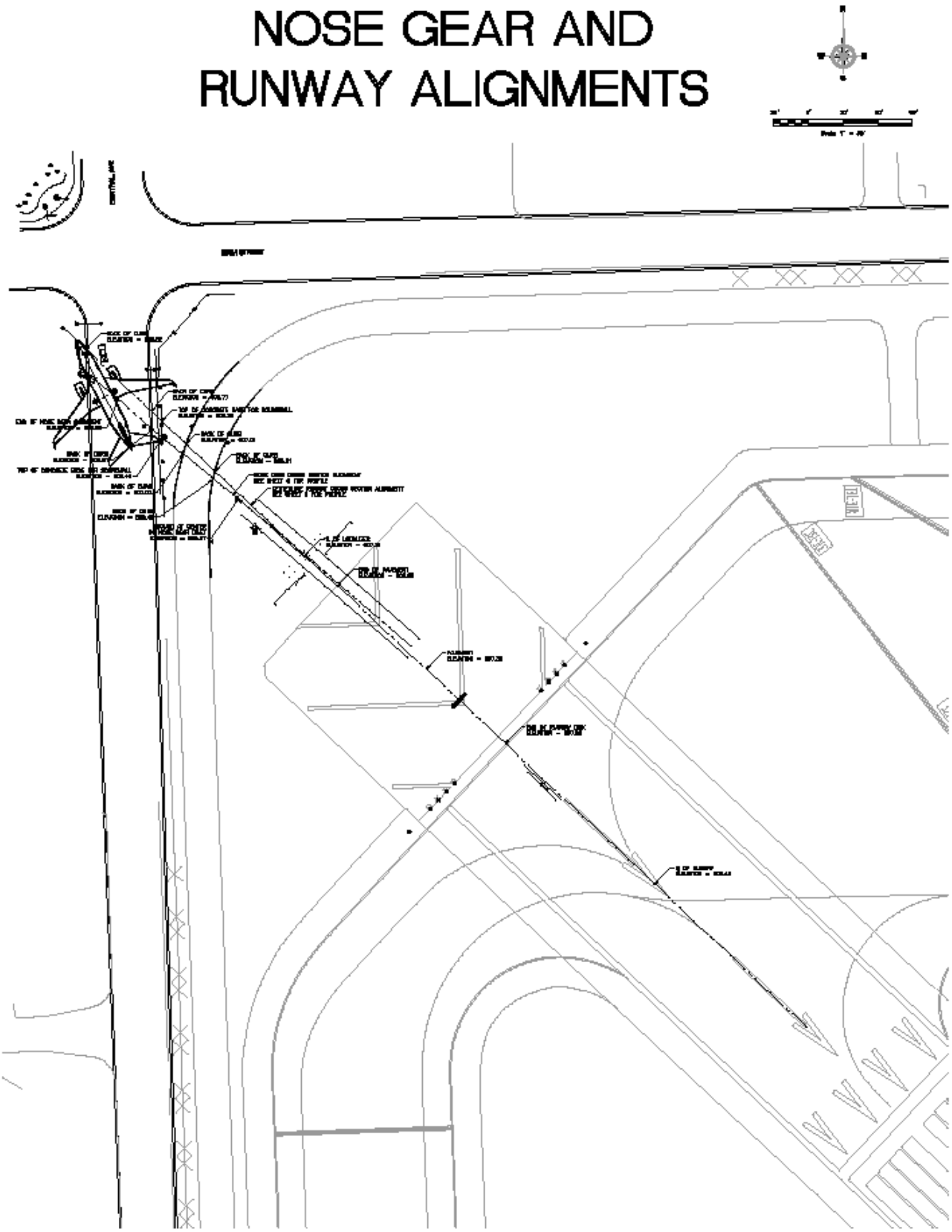
NOSE GEAR AND RUNWAY ALIGNMENTS



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