

## Auburn Range #3 RF Test System - STA Information for Boeing Auburn

### Exhibit 1 Summary

See Descriptions and Drawings for Details

| Test System | Location    | Frequency Band |            | EIRP    |         |        |        |
|-------------|-------------|----------------|------------|---------|---------|--------|--------|
|             |             | Start (GHz)    | Stop (GHz) | Min dBm | Max dBm | Min mW | Max mW |
| Range 3     | 17-80 Bldg. | 0.8            | 1.232      | 21      | 25      | 141    | 334    |
|             |             | 1.298          | 1.507      | 26      | 27      | 371    | 500    |
|             |             | 1.625          | 1.661      | 28      | 28      | 582    | 608    |
|             |             | 1.85           | 1.91       | 29      | 29      | 754    | 804    |
|             |             | 1.93           | 1.99       | 29      | 29      | 821    | 873    |
|             |             | 2.16           | 2.24       | 30      | 30      | 1028   | 1106   |
|             |             | 2.246          | 2.255      | 30      | 30      | 1112   | 1120   |
|             |             | 2.36           | 3.014      | 31      | 33      | 1227   | 2002   |
|             |             | 3.24           | 3.36       | 34      | 34      | 2313   | 2488   |
|             |             | 3.54           | 4.11       | 34      | 36      | 2761   | 3722   |
|             |             | 4.29           | 4.48       | 33      | 33      | 1802   | 1966   |
|             |             | 4.72           | 5.48       | 33      | 35      | 2182   | 2941   |
|             |             | 6.58           | 6.7        | 36      | 36      | 4240   | 4396   |
|             |             | 7.238          | 7.37       | 37      | 37      | 5131   | 5319   |
|             |             | 9.3            | 9.631      | 35      | 35      | 3287   | 3525   |
|             |             | 9.834          | 9.856      | 36      | 36      | 3675   | 3692   |
|             |             | 9.87           | 10.05      | 36      | 36      | 3702   | 3839   |
|             |             | 10.55          | 10.57      | 36      | 36      | 4230   | 4246   |
|             |             | 11.33          | 12.7       | 37      | 38      | 4879   | 6130   |
|             |             | 13.16          | 13.43      | 36      | 36      | 4240   | 4416   |
|             |             | 16.98          | 17.02      | 38      | 39      | 7059   | 7092   |
|             |             | 17.88          | 18.27      | 39      | 39      | 7827   | 8172   |
|             |             | 18.68          | 18.72      | 39      | 39      | 8543   | 8580   |
|             |             | 19.18          | 19.22      | 40      | 40      | 9007   | 9044   |
|             |             | 19.67          | 19.71      | 40      | 40      | 9473   | 9511   |
|             |             | 20.6           | 21.8       | 40      | 41      | 10390  | 11635  |
|             |             | 22.66          | 23.98      | 41      | 41      | 12572  | 14079  |
|             |             | 24.38          | 24.42      | 42      | 42      | 14552  | 14600  |
|             |             | 25.47          | 25.53      | 42      | 42      | 15883  | 15958  |
|             |             | 26.82          | 26.88      | 40      | 40      | 10015  | 10060  |
|             |             | 28.77          | 28.83      | 41      | 41      | 11524  | 11572  |
|             |             | 30.9           | 33.22      | 41      | 42      | 13294  | 15365  |
|             |             | 33.96          | 34.04      | 42      | 42      | 16057  | 16133  |
|             |             | 35.75          | 36.54      | 43      | 43      | 17794  | 18589  |
|             |             | 36.57          | 36.63      | 43      | 43      | 18620  | 18681  |
|             |             | 38.36          | 38.44      | 43      | 43      | 20487  | 20573  |

## **Exhibit 1**

### **Auburn Range 3 (1-40 GHz)**

**Purpose:** Range 3 is an open air test range used to test the operational characteristics of commercial aircraft full scale antennas or to validate aircraft antenna patterns using scale models. These tests are used to qualify new antennas or new aircraft configurations, verify manufacturing processes or evaluate repairs to damaged antennas. Antenna radiation pattern, directivity, gain, side lobes and f/b ratio are some of the parameters that can be measured. Boeing also sells antenna measurement services to non-Boeing and non-aviation related industries.

**Equipment:** One of the referenced parabolic dish transmit antennas is mounted on the roof of the 17-80 building. The antenna or scale model under test is mounted on an antenna positioner installed on top of a movable test cube. The test cube moves on tracks out to a maximum distance of 500 feet on a bearing of 181° True from the transmit dish. The actual test distance is determined by the far field distance of the transmit dish or the size of the article under test. Low level CW signals from calibrated laboratory grade synthesized RF sources are transmitted from the parabolic dish at the antenna or model under test. A partially wooded wetland owned by Boeing extends an additional 1300 feet beyond the end of the receive antenna tower tracks.

An equipment list, block diagram and site layout are attached.

**Frequency:** See the Exhibit 1 Summary for the list of test frequency bands.

**Power:** Operation of this range with a maximum of 0 dBm at the RF source and calculated EIRP is presented in Exhibit 1. The RF path loss between the RF source and the transmit antenna is variable because the configurations change for different frequency bands. The power delivered to the transmit antenna will always be less than 0 dBm.

**Emissions:** The emissions will be CW (N0N).

**Mitigation Features:** A partially wooded wetland owned by Boeing extends an additional 1300 feet beyond the receive antenna tower. The beam width of the transmit antennas are also very narrow.

Pictures are attached.

## Attachment 1

### Range 3 Transmit Dish Antennas

(Note: All the transmit parabolic dishes were built by Boeing and use either a horn or a cross polarized dipole as the feed antenna.)

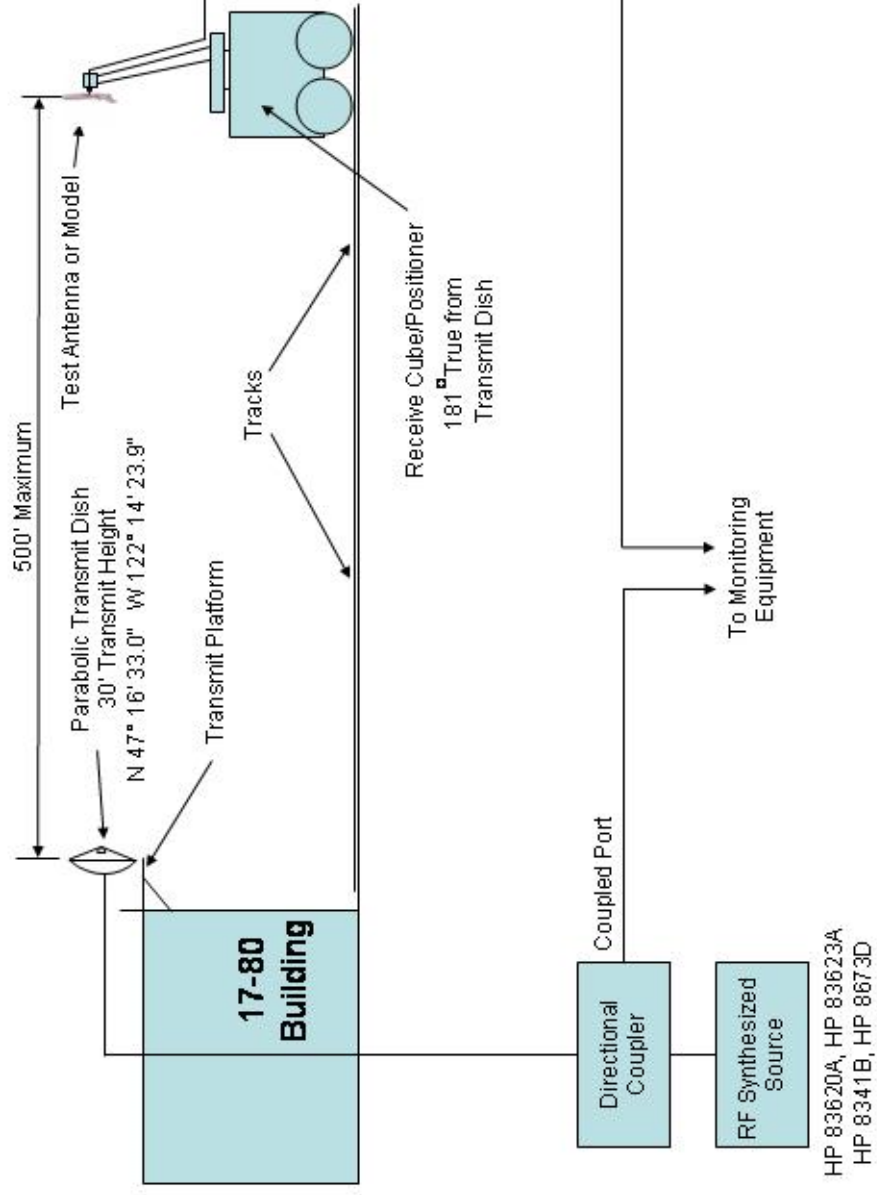
| Frequency<br>(GHz) | Diameter<br>(Feet) | Diameter<br>(Meters) | Efficiency | Gain<br>(dB) | Beam<br>Width<br>(Deg) |
|--------------------|--------------------|----------------------|------------|--------------|------------------------|
| 0.800              | 6.00               | 1.83                 | 0.6        | 21.5         | 14.58                  |
| 1.000              | 6.00               | 1.83                 | 0.6        | 23.4         | 11.67                  |
| 2.000              | 6.00               | 1.83                 | 0.6        | 29.4         | 5.83                   |
| 4.000              | 6.00               | 1.83                 | 0.6        | 35.5         | 2.92                   |
| 4.001              | 4.00               | 1.22                 | 0.6        | 31.9         | 4.37                   |
| 6.000              | 4.00               | 1.22                 | 0.6        | 35.5         | 2.92                   |
| 8.000              | 4.00               | 1.22                 | 0.6        | 38.0         | 2.19                   |
| 8.001              | 2.50               | 0.76                 | 0.6        | 33.9         | 3.50                   |
| 10.200             | 2.50               | 0.76                 | 0.6        | 36.0         | 2.75                   |
| 12.400             | 2.50               | 0.76                 | 0.6        | 37.7         | 2.26                   |
| 12.410             | 2.00               | 0.61                 | 0.6        | 35.8         | 2.82                   |
| 15.200             | 2.00               | 0.61                 | 0.6        | 37.5         | 2.30                   |
| 18.000             | 2.00               | 0.61                 | 0.6        | 39.0         | 1.94                   |
| 18.001             | 2.00               | 0.61                 | 0.6        | 39.0         | 1.94                   |
| 22.000             | 2.00               | 0.61                 | 0.6        | 40.7         | 1.59                   |
| 26.000             | 2.00               | 0.61                 | 0.6        | 42.2         | 1.35                   |
| 26.000             | 1.50               | 0.46                 | 0.6        | 39.7         | 1.79                   |
| 33.000             | 1.50               | 0.46                 | 0.6        | 41.8         | 1.41                   |
| 40.000             | 1.50               | 0.46                 | 0.6        | 43.4         | 1.17                   |

## Attachment 2

### Radome Range Additional Equipment List

| Other RF Equipment Used                                                                                     |
|-------------------------------------------------------------------------------------------------------------|
|                                                                                                             |
| <b>RF Sources which are used interchangeably:</b>                                                           |
| Hewlett Packard 83620A (10 MHz - 20 GHz)                                                                    |
| Hewlett Packard 83623A (10 MHz - 20 GHz)                                                                    |
| Hewlett Packard 8341B (10 MHz - 20 GHz)                                                                     |
| Hewlett Packard 8673D (10 MHz - 26.5 GHz)                                                                   |
|                                                                                                             |
| <b>Other Components:</b>                                                                                    |
| Hewlett Packard X281A N-WG Adapters (4 ea.)                                                                 |
| Hewlett Packard X382A Precision Waveguide Attenuator                                                        |
| RG-214 Coaxial Cable - 6 feet                                                                               |
| Ku, K and Ka Band Waveguide - 6 feet                                                                        |
| Narda 3292-1 1-18 GHz Directional Coupler                                                                   |
| Narda 4226-10 0.5-18 GHz Directional Coupler                                                                |
| Ku, K and Ka Band Waveguide Directional Couplers                                                            |
|                                                                                                             |
| Note: Waveguide components are used in place of coaxial components in bands above 12.4 GHz.                 |
| A frequency doubler is used to double the CW frequency output of the source for frequencies above 19.99 GHz |
|                                                                                                             |
| <b>Transmitter Information:</b>                                                                             |
| 17-80 Building, Auburn, WA                                                                                  |
| Lat/Lon: N 47° 16' 33.0" W 122° 14' 23.9"                                                                   |
| Antenna Height: 30 feet                                                                                     |
| Beam Direction: 181° True                                                                                   |
| Beam Elevation Angle: 0°                                                                                    |
| Signal Modulation: CW                                                                                       |
| Bandwidth: CW                                                                                               |
| Maximum RF Source Power: 0 dBm                                                                              |
| Transmission Line Loss: 5 dB                                                                                |
| Maximum Power at Antenna Input: -5 dBm                                                                      |

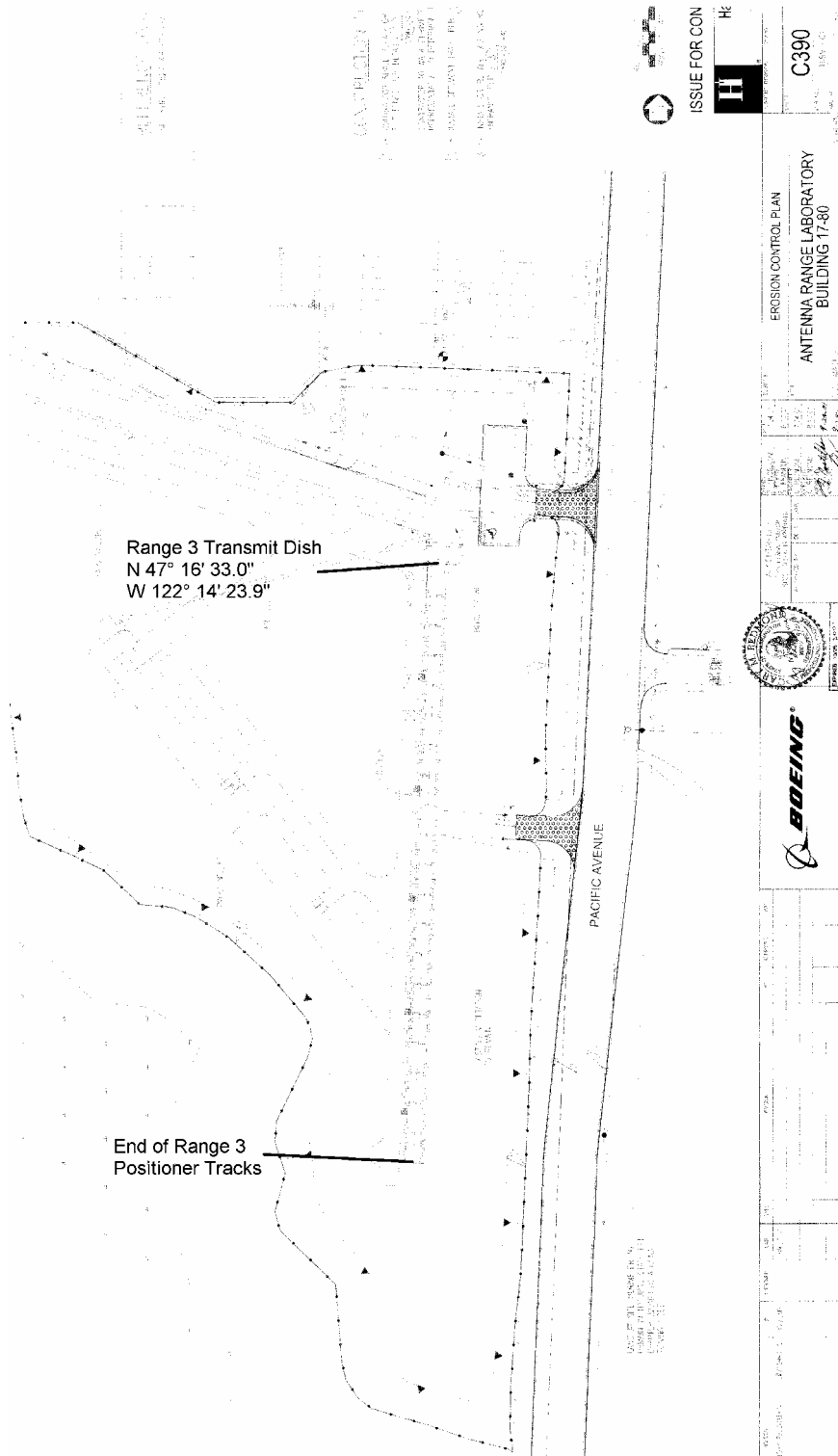
### Attachment 3



**Auburn Range 3 Block Diagram**

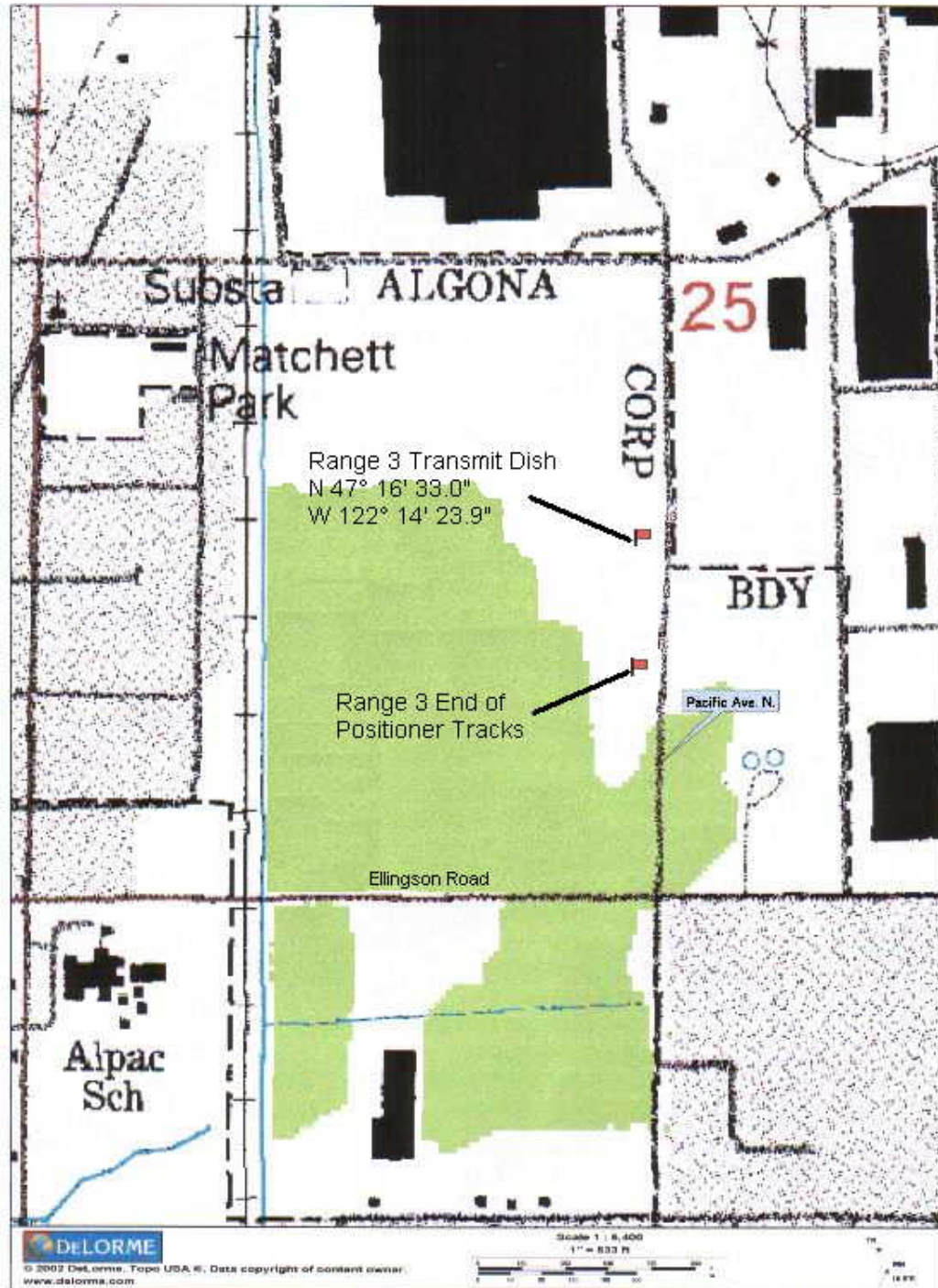
# Attachment 4

## Site Layout



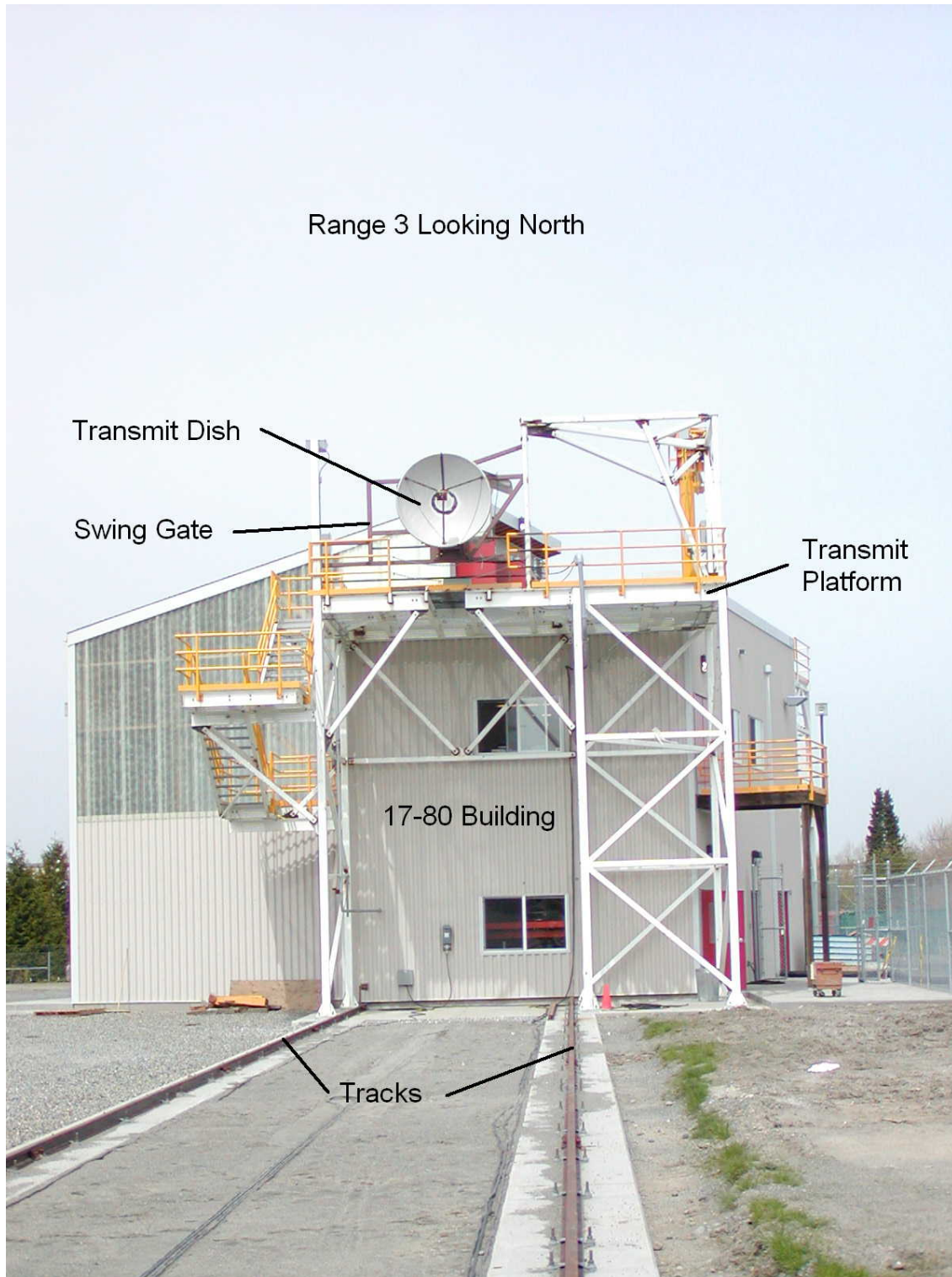
## Attachment 5

### Site Map



## Attachment 6

### Range 3 Looking North



## Attachment 7

### Range 3 Looking South

Range 3 Looking South

