

U S WEST
COMMUNICATIONS 

1005 17th Street, Room 1750
Denver, Colorado 80202-2002
June 7, 1993

Mr. H. Franklin Wright
Office of Engineering and Technology
Frequency Liason Branch
2025 M Street, N.W.
Room 7326
Washington, DC 20554

RE: U S WEST COMMUNICATIONS, INC.
FIFTH QUARTERLY REPORT
PCS Experimental Licenses:
KK2XCC (File Number ~~3630~~-EX-ML-93) - Boulder, CO
KK2XCD (File Number 2149-EX-PL-91) - Portland, OR

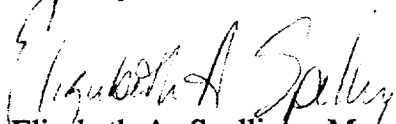
2148-EX-RR.93

Dear Mr. Wright:

Enclosed please find U S WEST's fifth quarterly report addressing the above referenced authorization for PCS field trials in Boulder, Colorado. At this time we have yet to implement experimental trials in Portland, Oregon.

Should you have any questions or require additional information, please contact Beth Spellicy at (303) 896-7576.

Sincerely,



Elizabeth A. Spellicy - Manager
Network Technology Transport Services

ENCLOSURES

U S WEST Wireless Personal Communications Experiments

**Quarterly Progress Report
FCC Experimental Licenses
KK2XCC and KK2XCD**

June 7, 1993

Submitted to

**Federal Communications Commission
Frequency Liaison Branch
Room 7326
Washington, DC 20554**

Prepared by

**U S WEST Advanced Technologies
Wireless Communications Services
4001 Discovery Drive
Boulder, CO 80303**

1 Introduction

This report describes field testing which U S WEST Advanced Technologies has performed under FCC Experimental Licenses KK2XCC for Boulder, Colorado and KK2XCD for Portland, Oregon. The report covers the quarterly period from March 5, 1993, through June 5, 1993.

Four different field trials have been conducted this quarter. All tests were conducted in the 1850-1990 MHz frequency band. The first test was a comparison of the received signal levels from three potential base station antennas. The second set of measurements characterized path loss for obstructed and line-of-site conditions in residential and light urban environments. The third test determined building penetration from outdoor base stations into several typical businesses. The final field trial was a coverage test using a prototype version of the Personal Handy Phone system from Japan.

2 Antenna Comparison Tests

A comparison of three different antennas was conducted by comparing received signal strengths in typical microcell environments. The first antenna was an Andrew Corporation Model PC1N0F-0194P-006, which is a 6 dBi antenna with an omnidirectional horizontal radiation pattern. The second antenna was a prototype 1.9 GHz antenna developed by Bellcore. The final antenna was an Andrew Corporation Model PC2N0F-0194P-008, which is an 8 dBi antenna with an oblong horizontal radiation pattern.

The Andrew 6 dBi omnidirectional antenna and the Bellcore antenna were found to provide received signal strengths within ± 2 dB of each other. The Andrew antenna with the oblong pattern provided generally 1 to 3 dB more signal strength than the Andrew omnidirectional antenna in the direction of maximum gain.

3 Path Loss Measurements

Path loss measurements were conducted in light urban and residential areas of Boulder, CO. Several different base station antenna heights were tested from 7 meters (lamp post height) up to 14 meters (building rooftop height). Figure 1 is a comparison of the non-line-of-site measurements for 7 and 14 meter base station antenna heights in a residential area. Least mean squared error linear curve fits for the curves are shown on the plot. As expected from theory, the 14 m antenna provided approximately 6 dB more received signal strength than the 7 m antenna.

Figure 2 is a comparison of the line-of-site (LOS) and non-line-of-site (NLOS) path loss for the 7 m base station antenna in a residential neighborhood. The obstructed cases have approximately 15 dB more path loss than the unobstructed cases. Figure 3 is a plot of path loss for NLOS and LOS conditions with the 14 meter base station antenna in a residential neighborhood. The difference between LOS and NLOS for the 14 m antenna is approximately 10 dB.

4 Building Penetration Measurements

Building penetration measurements were conducted to assess the coverage of an outdoor base station into business buildings. Figure 4 is a map of the downtown Boulder area showing the locations of 4 businesses where penetration measurements were conducted. Figure 5 shows the received power levels at the following locations: outside the building,

30 feet inside, and 50 feet inside. At locations 30 feet within the buildings the signal strength was an average of 18 dB lower than the signal outside the buildings. At 50 feet within the buildings the signal level was an average of 23 dB lower than the level outside the building.

5 Personal Handy Phone Coverage Tests

Preliminary tests were conducted with a prototype version of the Personal Handy Phone system. The base station transmitter antenna was located at 13.5 meters height and the handset receiver antenna was 1.5 meters high. Initial results indicate that a 10^{-4} bit error rate can be achieved at approximately 440 meters from the base station for NLOS conditions in a residential area. Further tests are under way to determine the coverage in light urban, heavy urban, and shopping mall areas.

6 Future Research

Additional tests will be conducted in the Boulder test facility over the next quarter. In the next quarterly FCC report, more detailed test results from the Personal Handy Phone system will be presented. A building penetration propagation study has just been completed by U S WEST and NTIA. The results of this study will be detailed in the next quarterly report. In addition, handoff and data services results from tests of the Bellcore Wireless Access Communications Systems (WACS) will be documented.

Figures

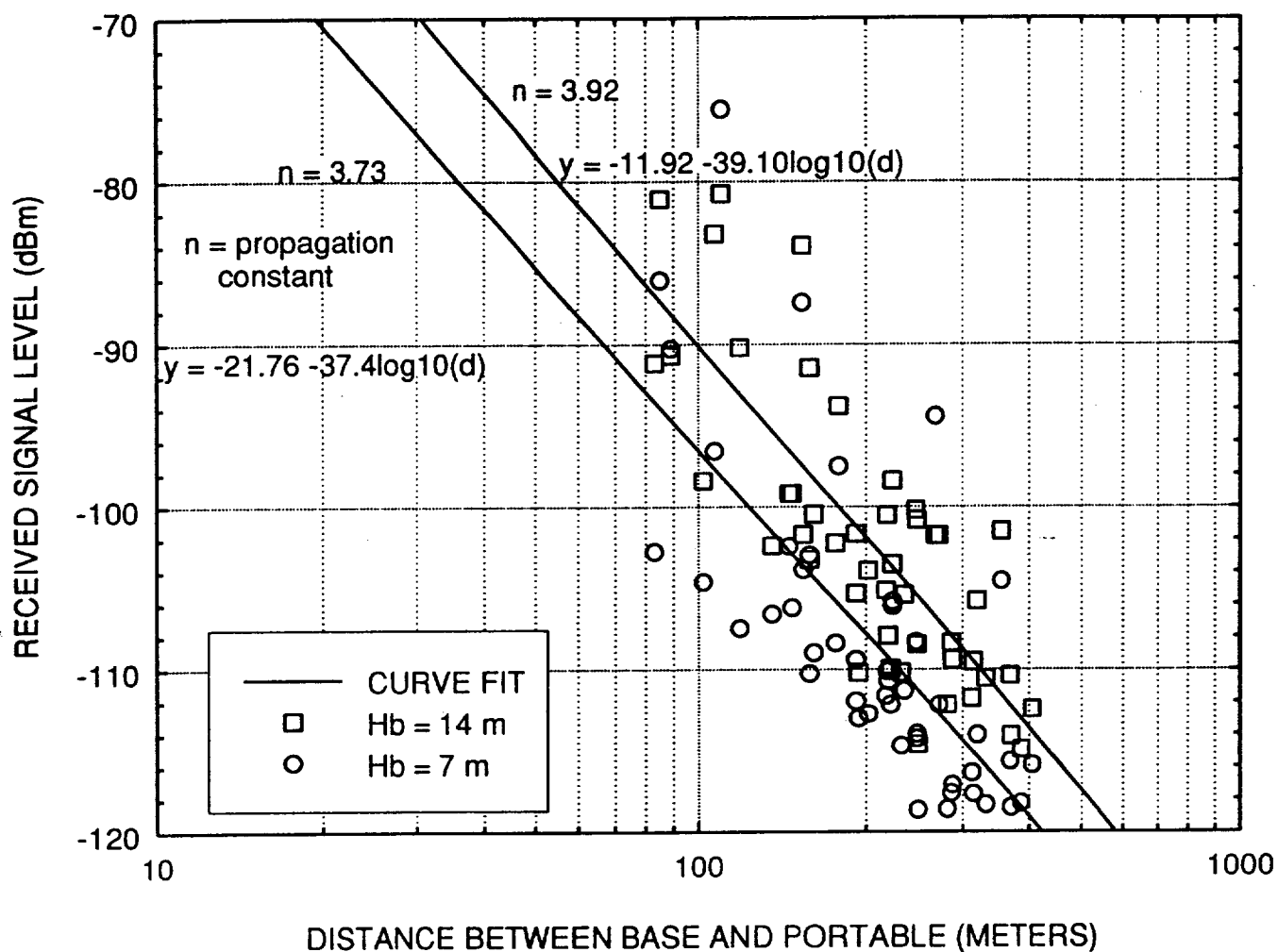
OUTDOOR MEASUREMENTS IN BOULDER, CO, $F_c = 1.9$ GHz

Figure 1. Comparison of non-line-of-site path loss for 7 meter (circles) and 14 meter (squares) base station antenna heights. Lines are least mean squared error curve fits to the measured data.

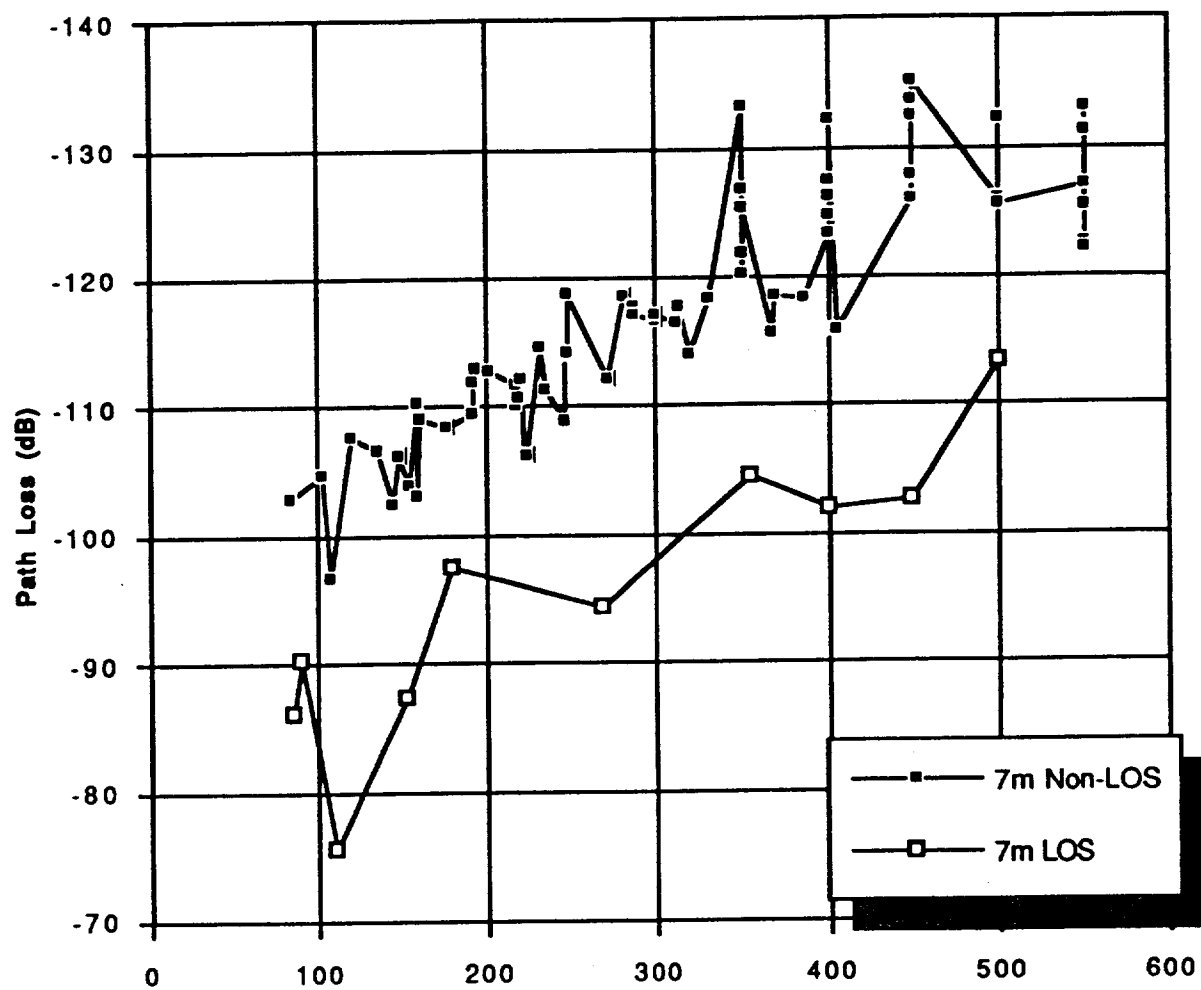


Figure 2. Comparison of line-of-site (LOS) and non-line-of-site (NLOS) path loss values for 7 meter base station antenna height.

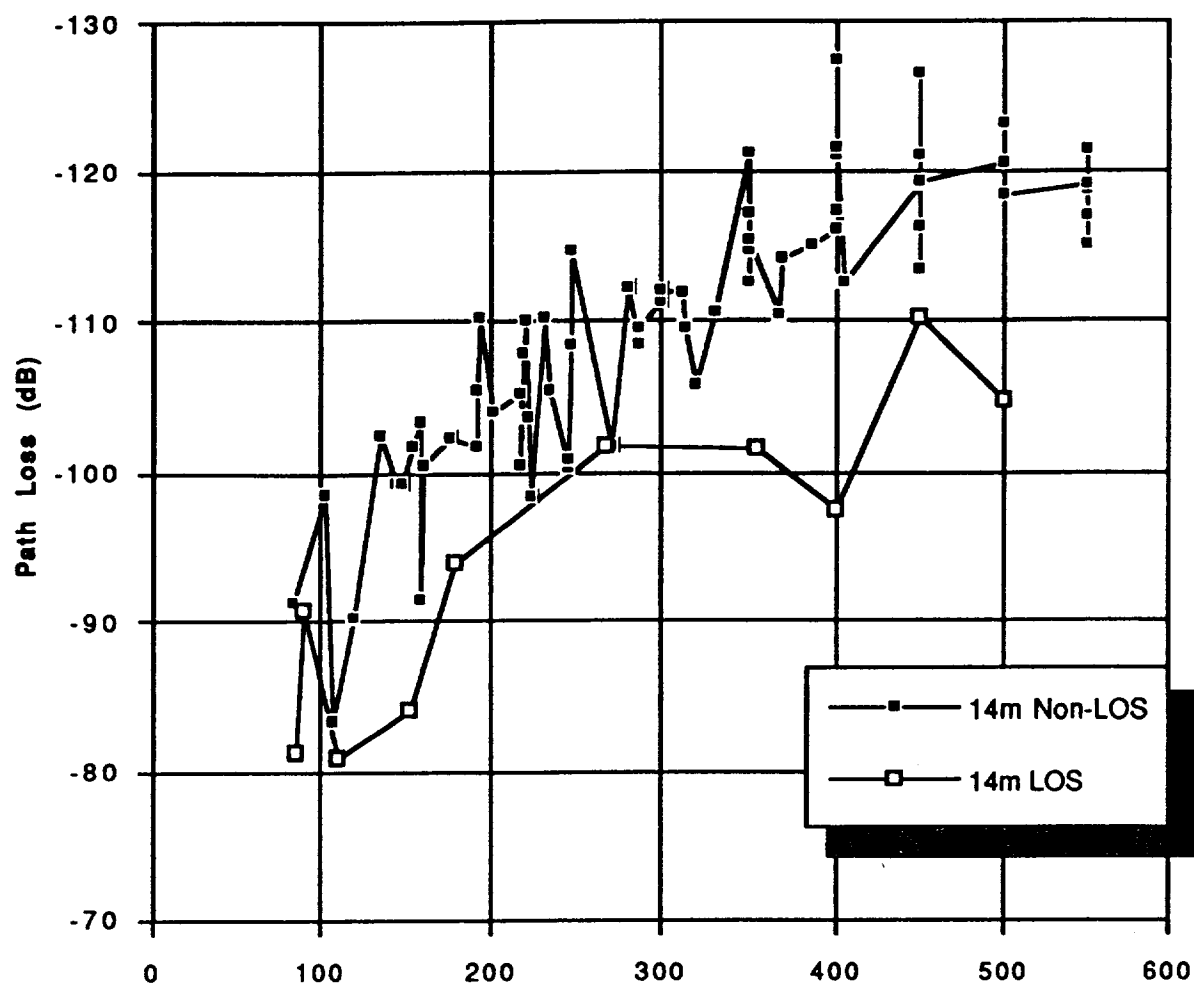
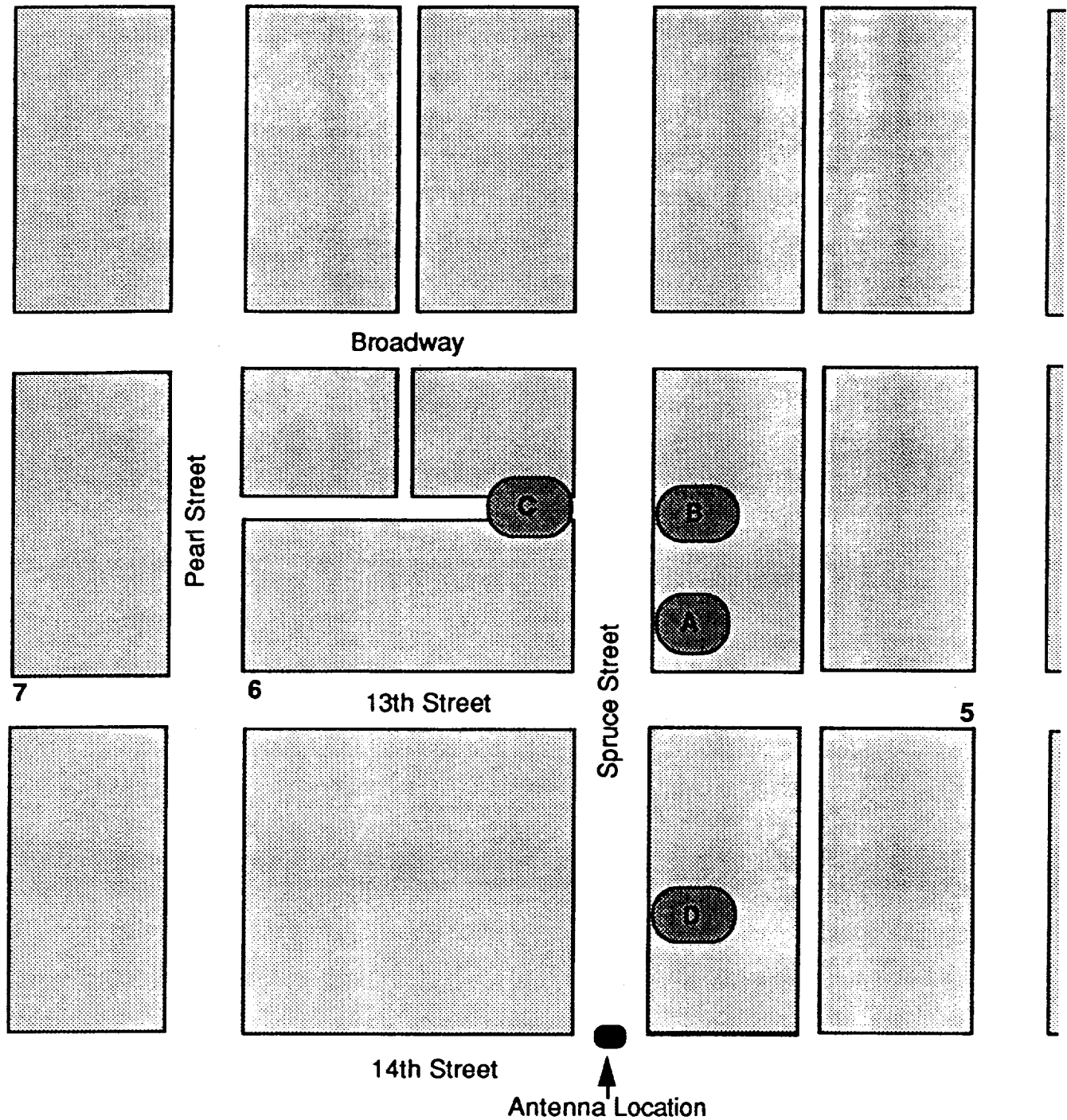


Figure 3. Comparison of line-of-site (LOS) and non-line-of-site (NLOS) path loss values for 14 meter base station antenna height.



Business A: New Hope Inc.: 1309 Spruce. Brick front, glass windows. Approx. 200 radial feet from base.

Business B: First World Travel: 1227 Spruce: Aprox. 500 radial feet. from base.

Business C: Sienna Square: Glass walled lobby and hallway. Aprox. 500 radial feet from base.

Business D: Consulting Structural Engineers: 1319 Spruce. Heavy brick front, glass windows. Approx. 150 radial feet from base.

Figure 4. Test sites for building penetration measurements.

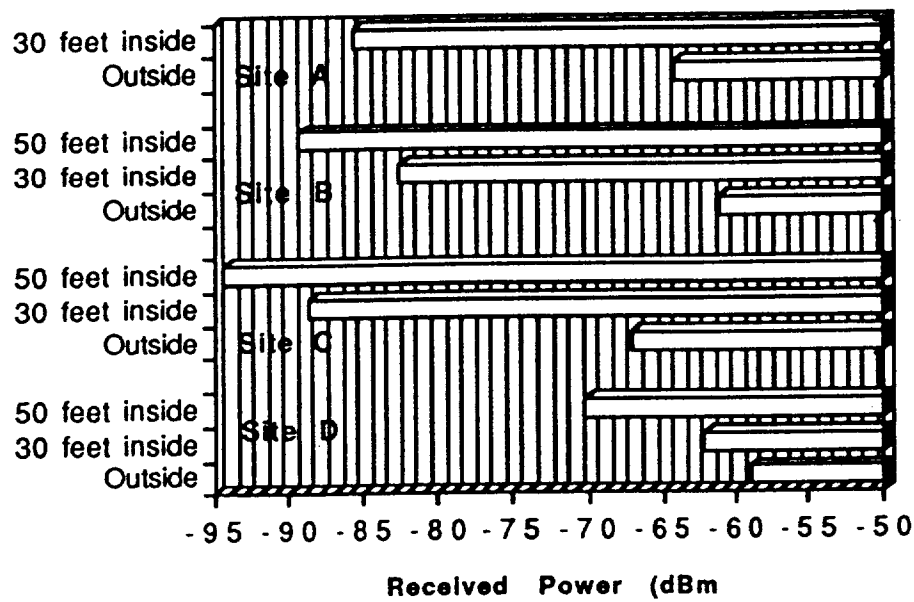


Figure 5. Building penetration measurements showing received power within 4 different business sites.