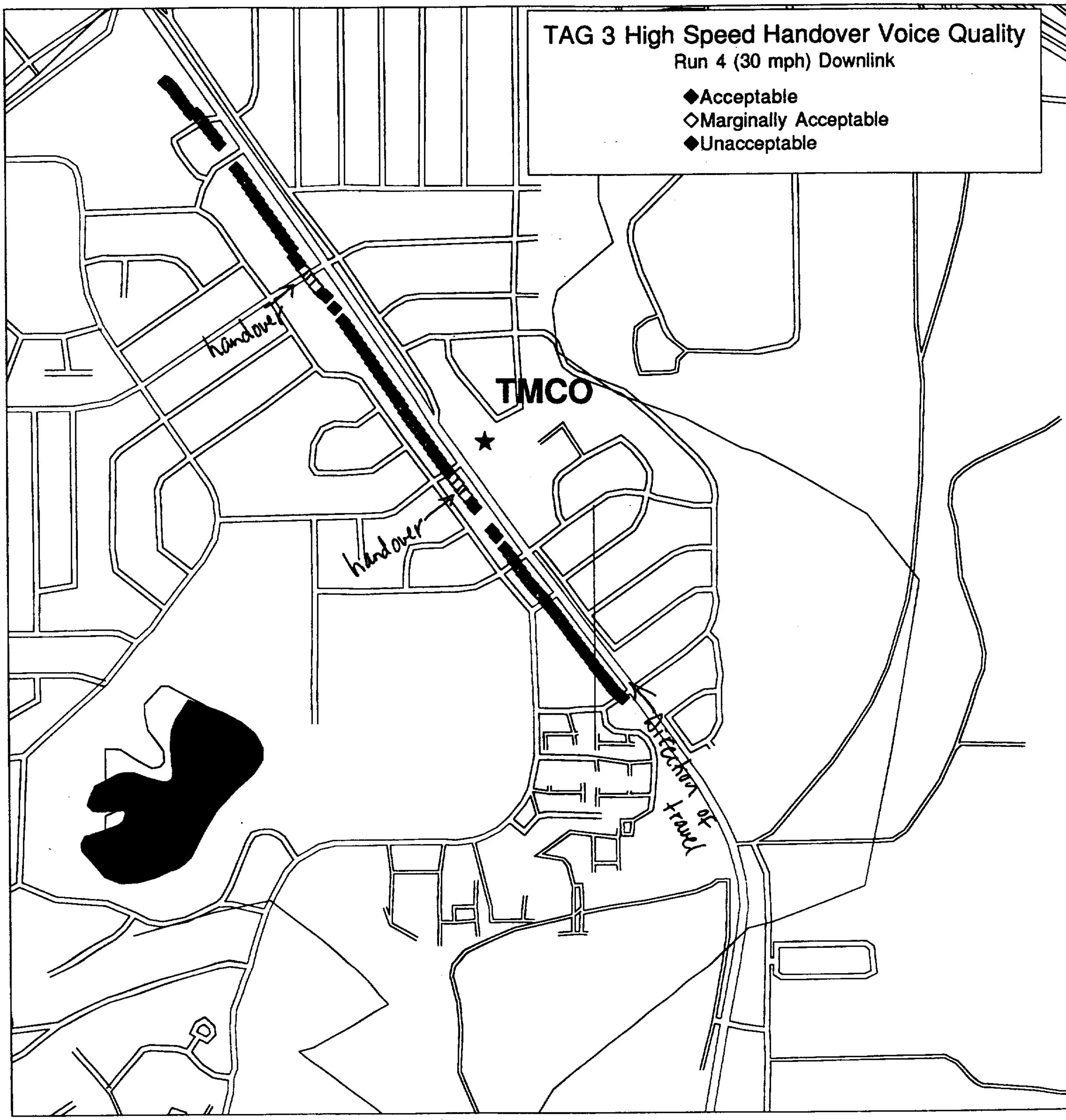
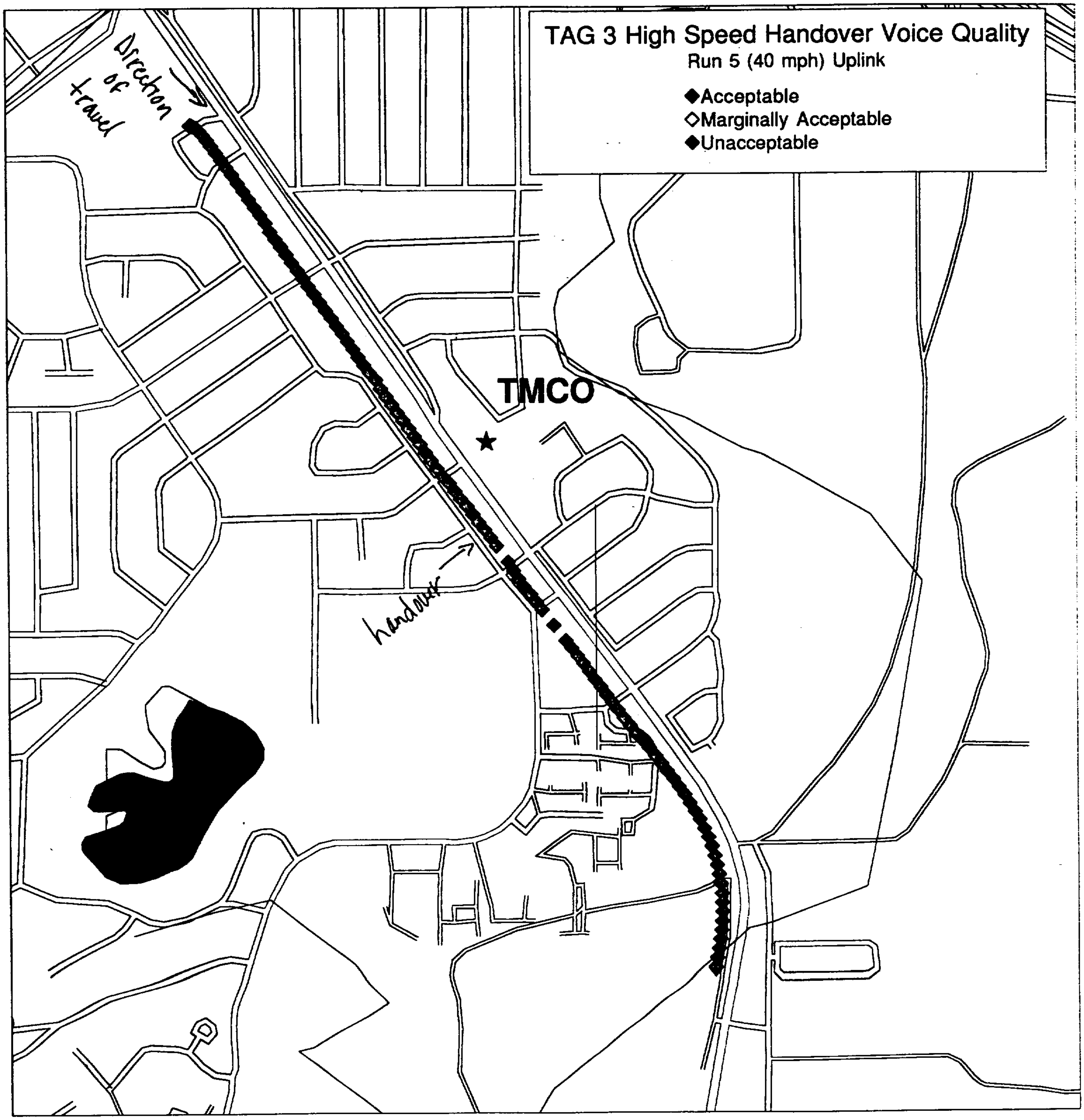
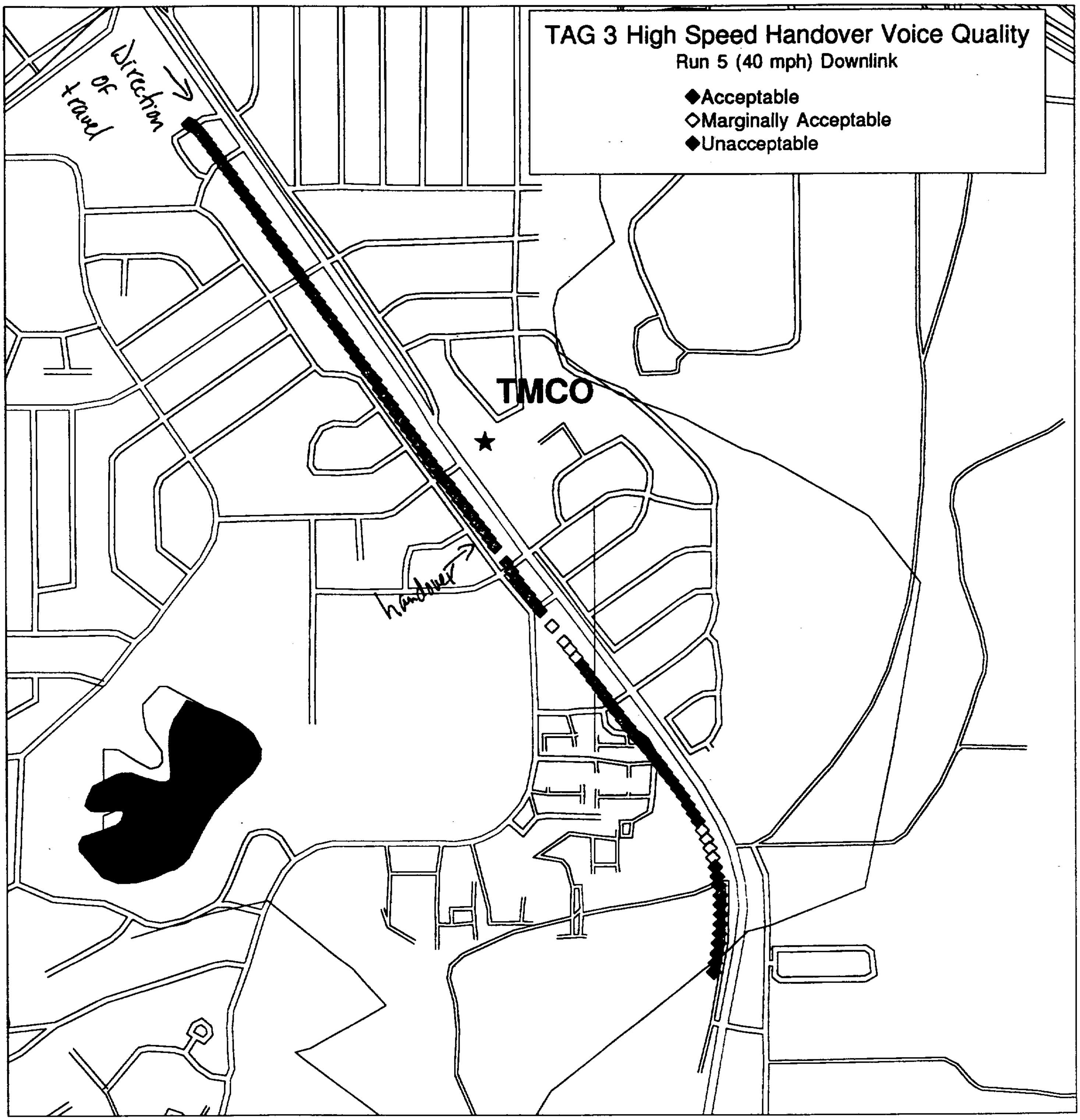

TAG 3 High Speed Handover Voice Quality
Run 4 (30 mph) Downlink
◆Acceptable
◇Marginally Acceptable
◆Unacceptable
TMCO
handover
handover
Direction of travel

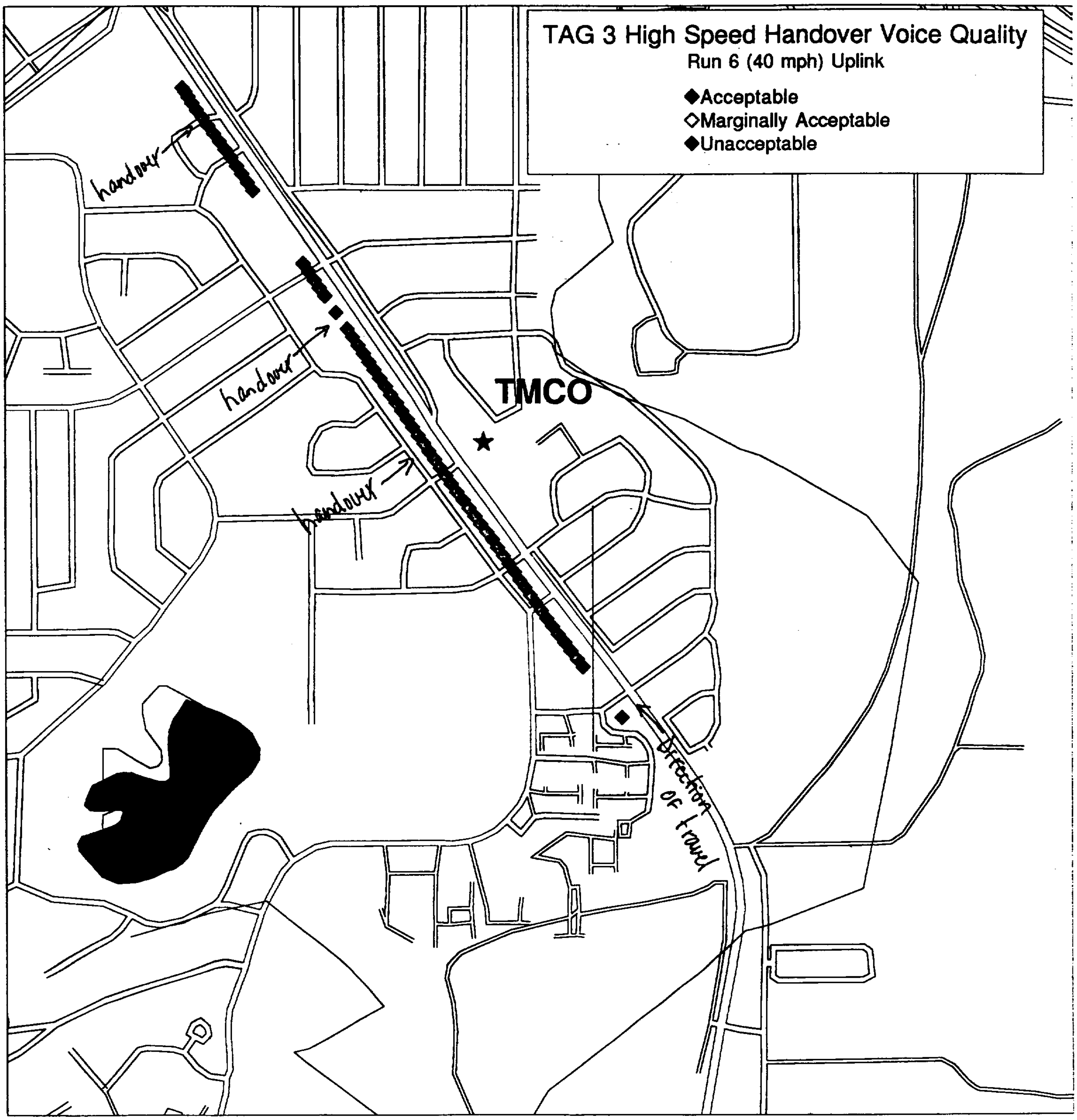
Map 7.3.6.8


TAG 3 High Speed Handover Voice Quality
Run 5 (40 mph) Uplink
◆Acceptable
◇Marginally Acceptable
◆Unacceptable
TMCO
Direction of travel
handover

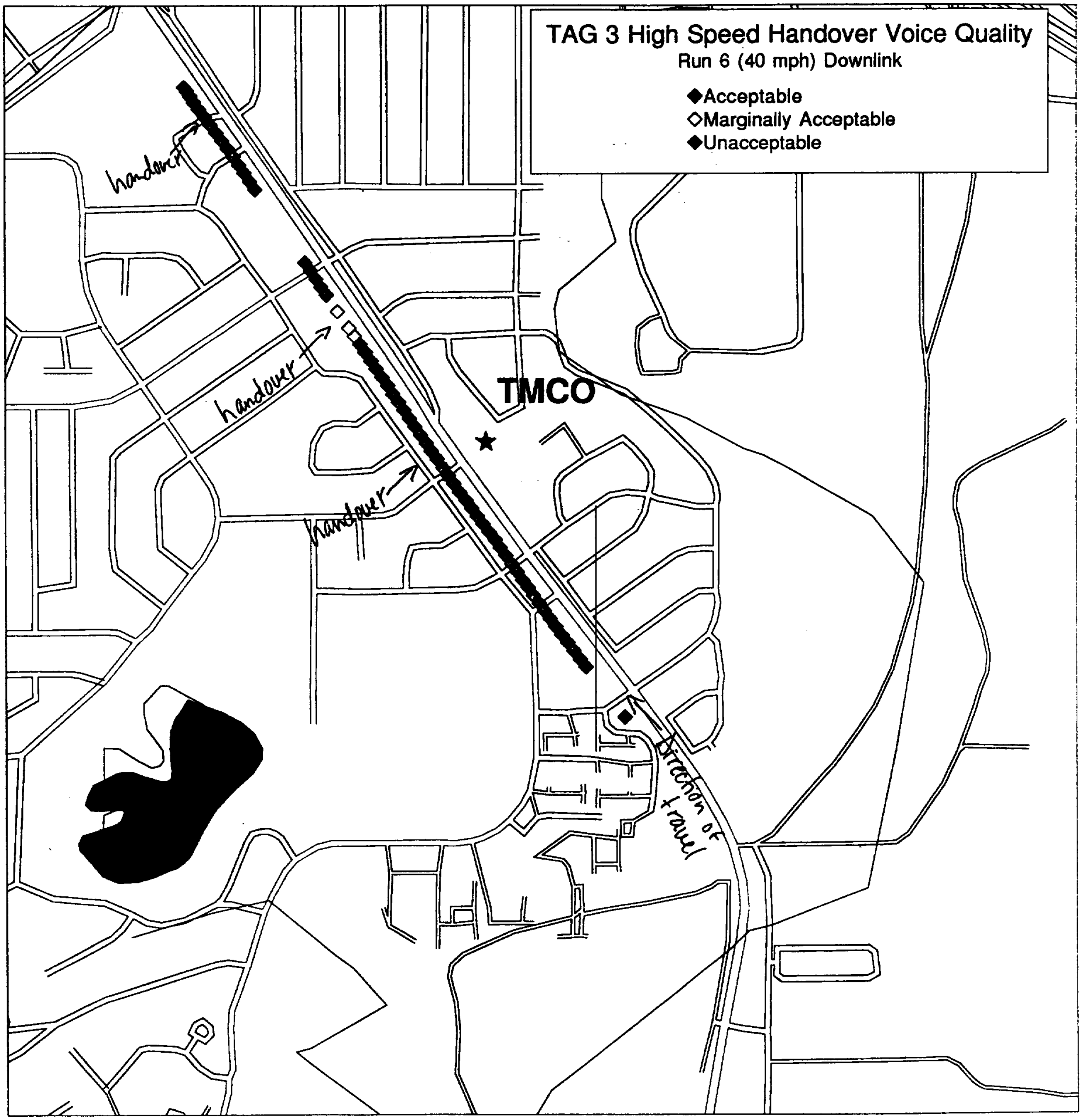
Map 7.3.6.9


TAG 3 High Speed Handover Voice Quality
Run 5 (40 mph) Downlink
Acceptable
Marginally Acceptable
Unacceptable
Direction of travel
TMCO
handover

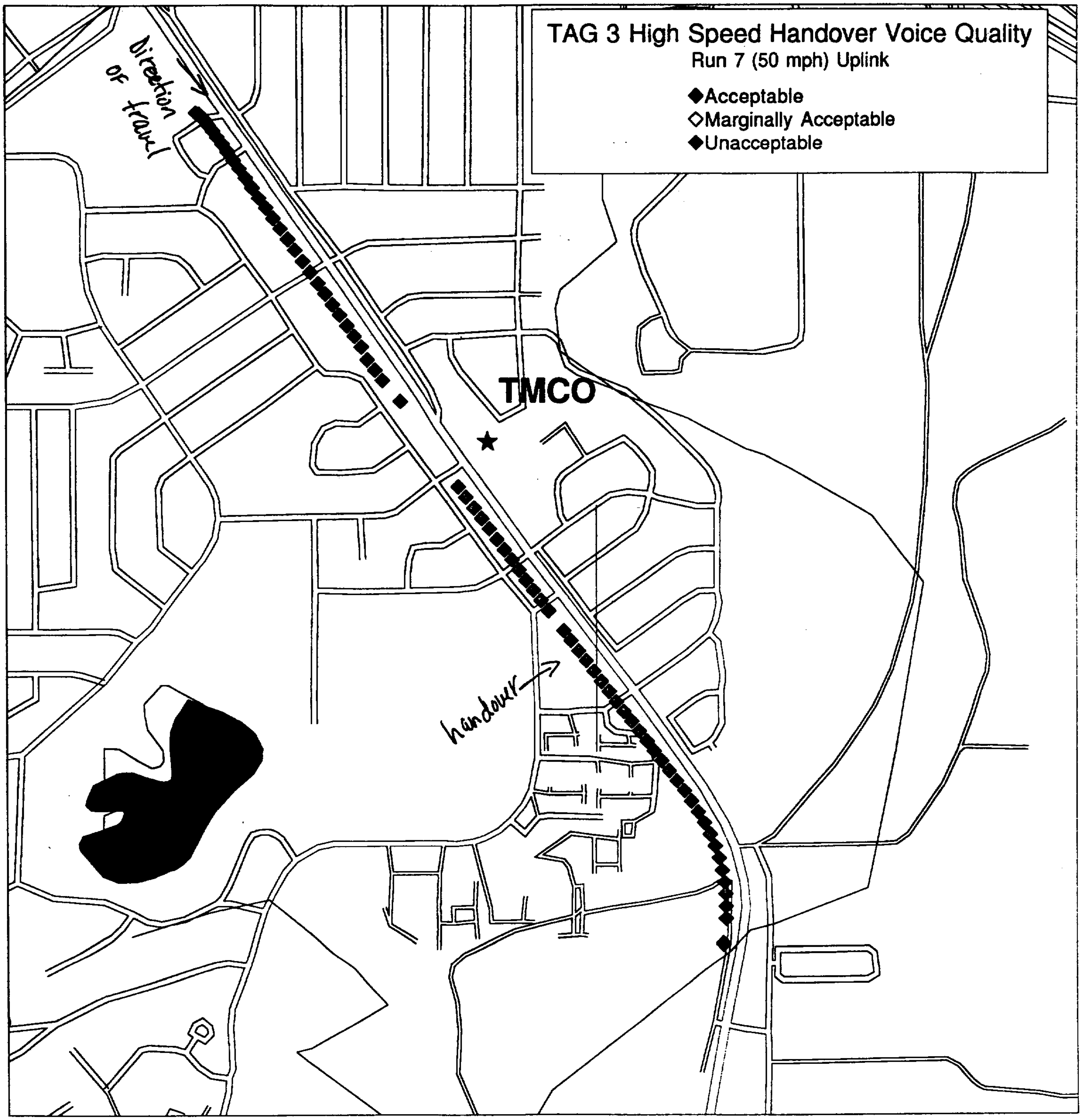
Map 7.3.6.10


TAG 3 High Speed Handover Voice Quality
Run 6 (40 mph) Uplink
◆Acceptable
◇Marginally Acceptable
◆Unacceptable
TMCO
handover
handover
handover
Direction of travel

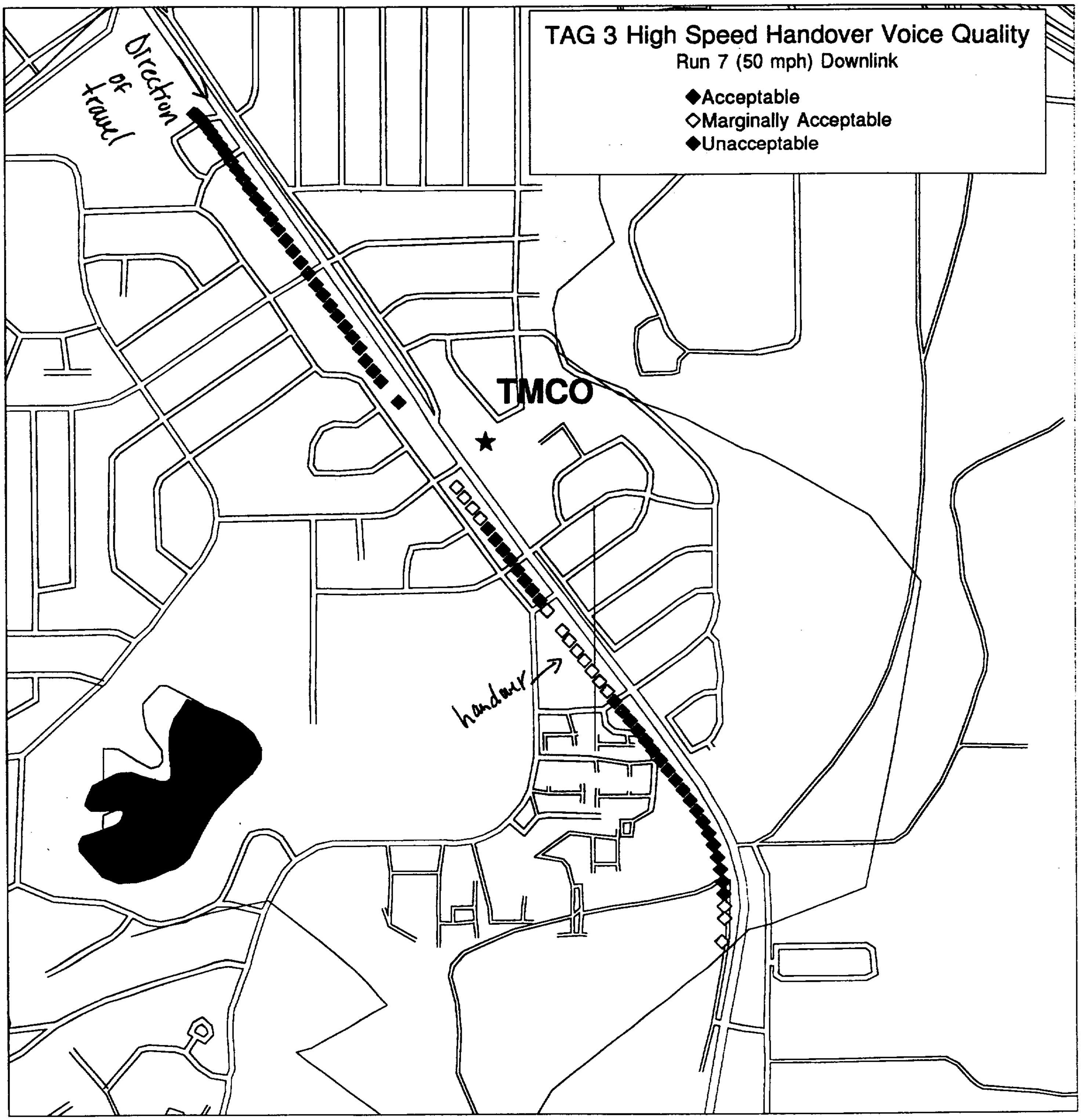
Map 7.3.6.11


TAG 3 High Speed Handover Voice Quality
Run 6 (40 mph) Downlink
◆Acceptable
◇Marginally Acceptable
◆Unacceptable
TMCO
handover
handover
handover
Direction of travel

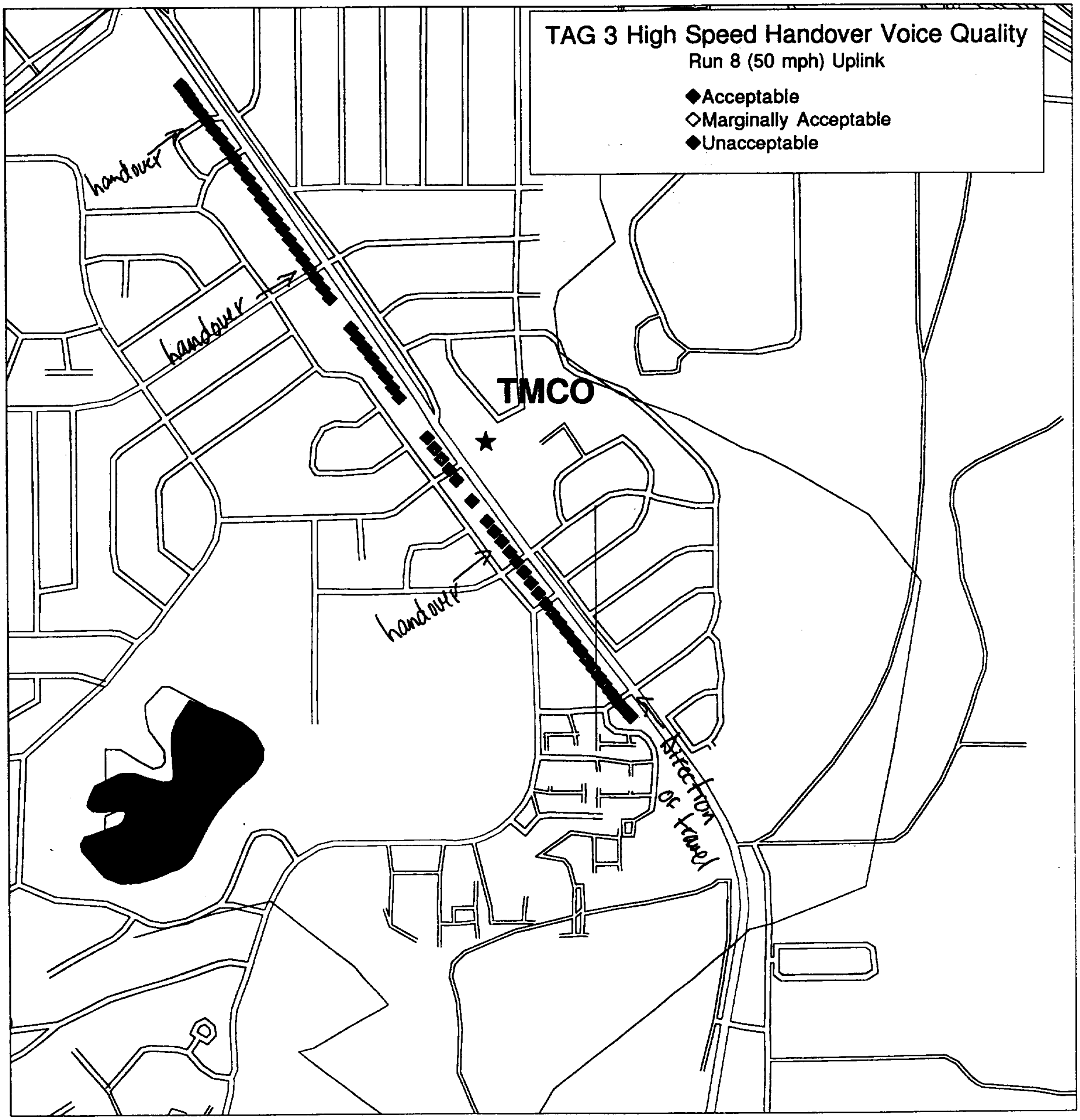
Map 7.3.6.12


TAG 3 High Speed Handover Voice Quality
Run 7 (50 mph) Uplink
Acceptable
Marginally Acceptable
Unacceptable
TMCO
Direction of travel
handover

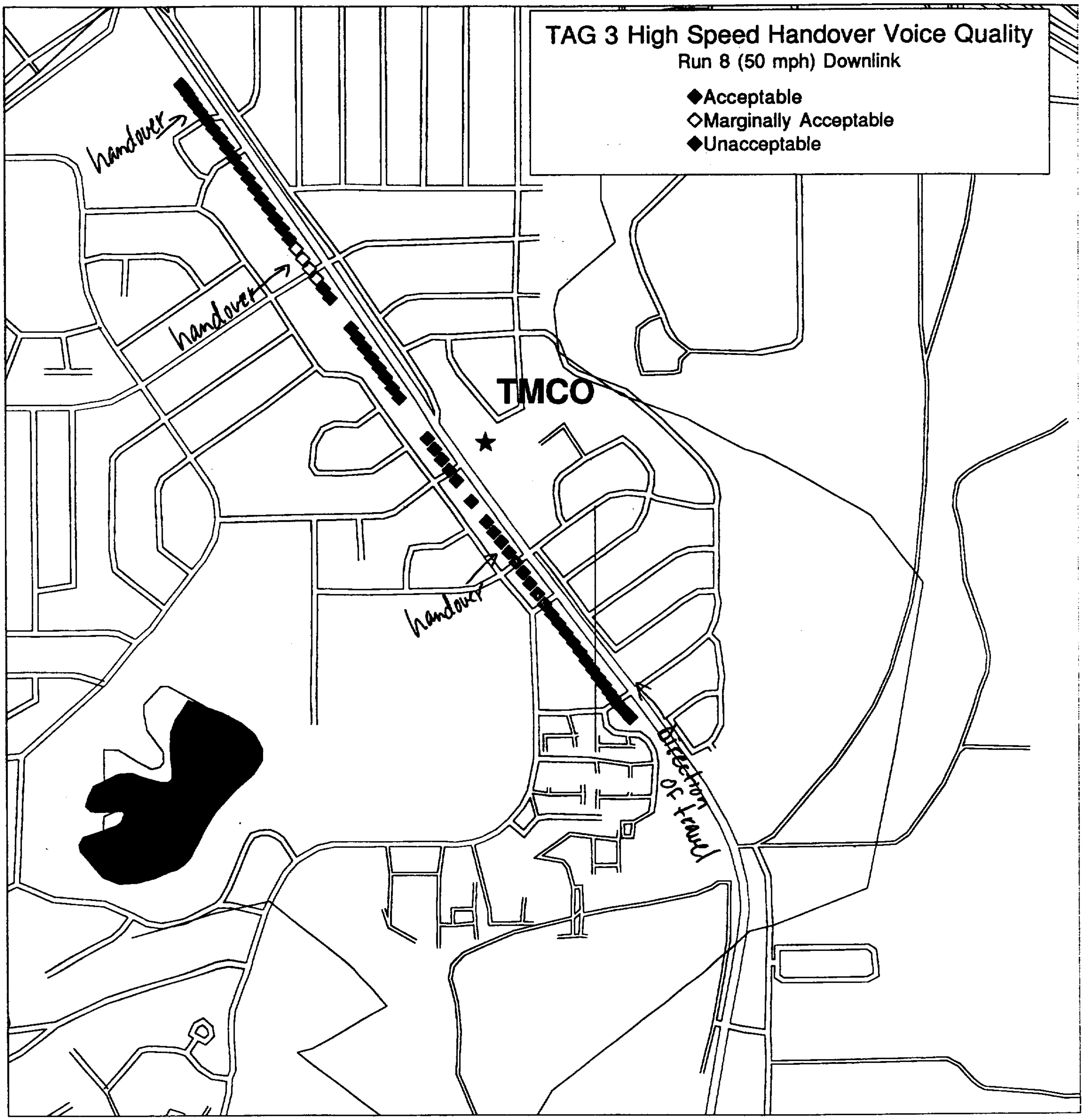
Map 7.3.6.13


TAG 3 High Speed Handover Voice Quality
Run 7 (50 mph) Downlink
◆Acceptable
◇Marginally Acceptable
◆Unacceptable
TMCO
Direction of travel
handover

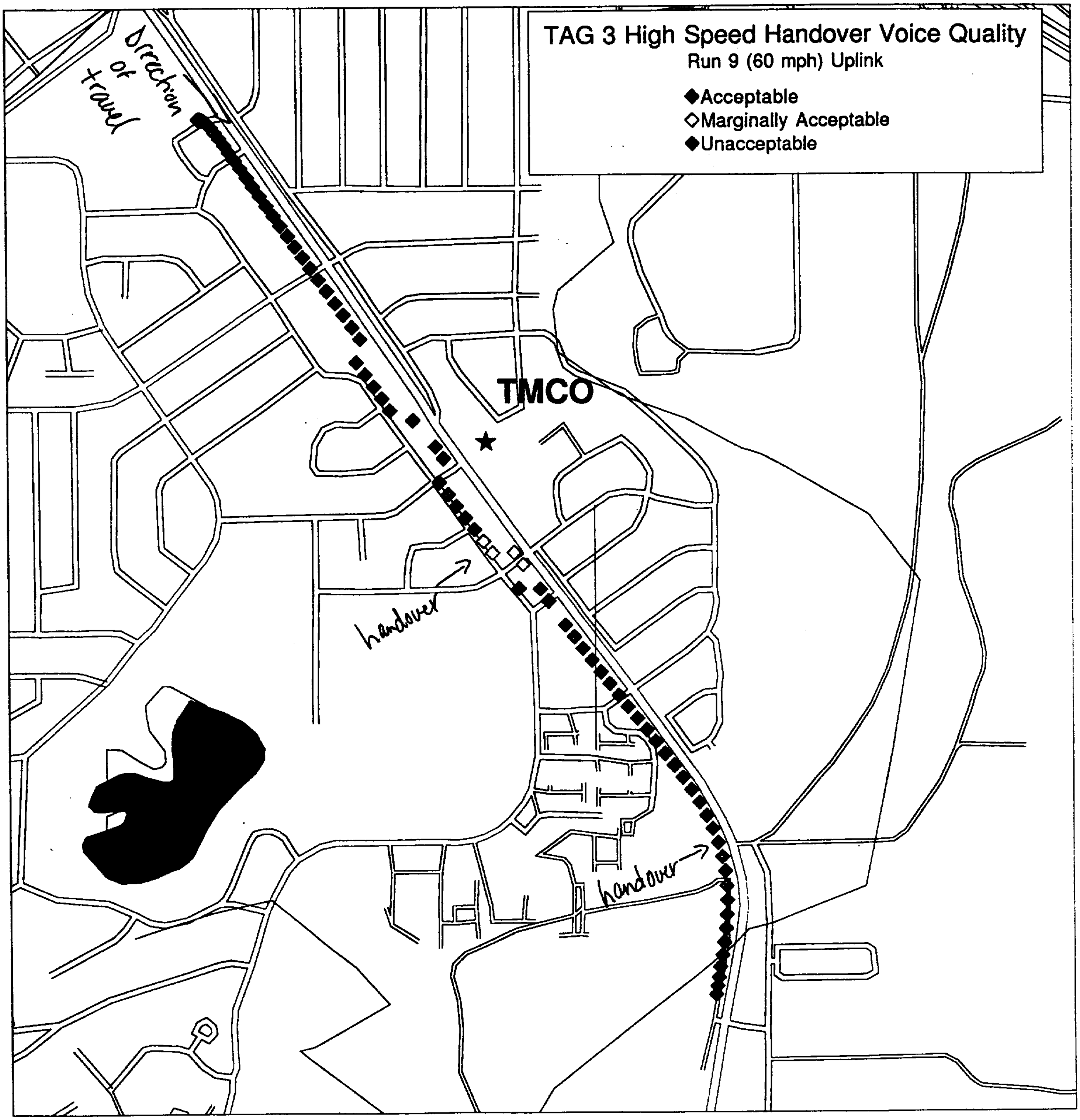
Map 7.3.6.14


TAG 3 High Speed Handover Voice Quality
Run 8 (50 mph) Uplink
◆Acceptable
◇Marginally Acceptable
◆Unacceptable
TMCO
handover
handover
handover
Direction of travel

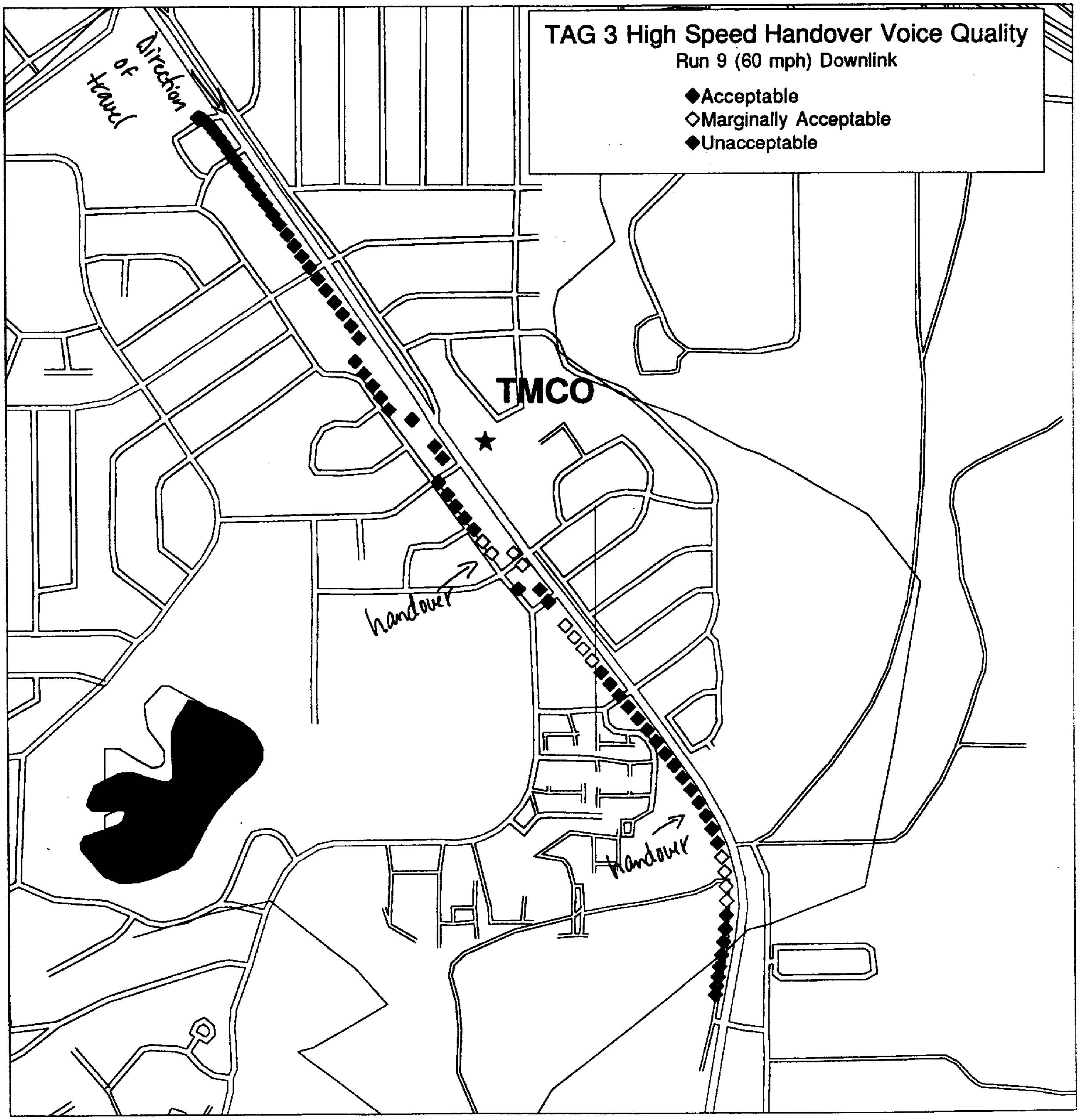
Map 7.3.6.15


TAG 3 High Speed Handover Voice Quality
Run 8 (50 mph) Downlink
◆Acceptable
◇Marginally Acceptable
◆Unacceptable
TMCO
handover
handover
handover
Direction of travel

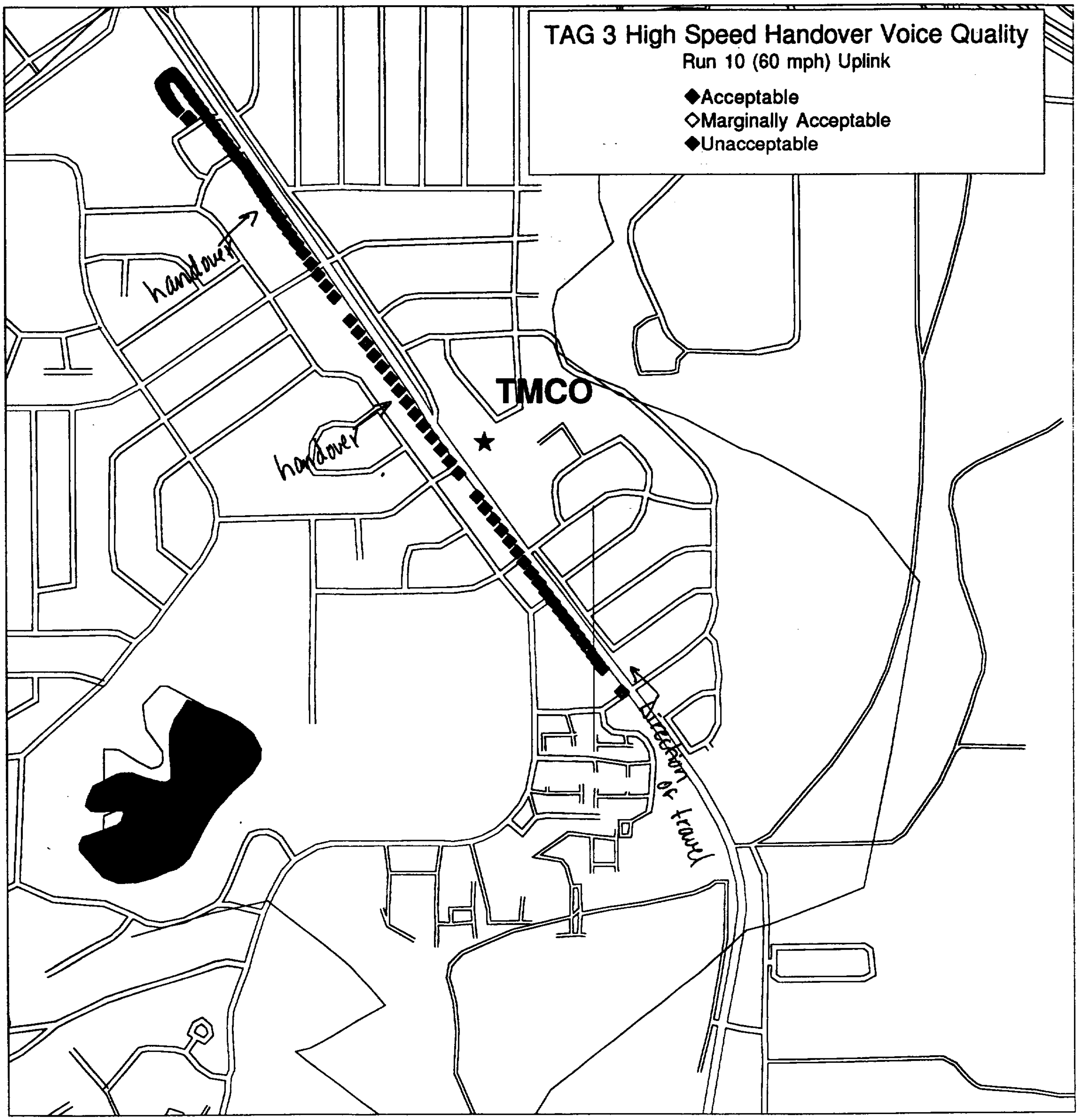
Map 7.3.6.16


TAG 3 High Speed Handover Voice Quality
Run 9 (60 mph) Uplink
◆Acceptable
◇Marginally Acceptable
◆Unacceptable
TMCO
Direction of travel
handover
handover

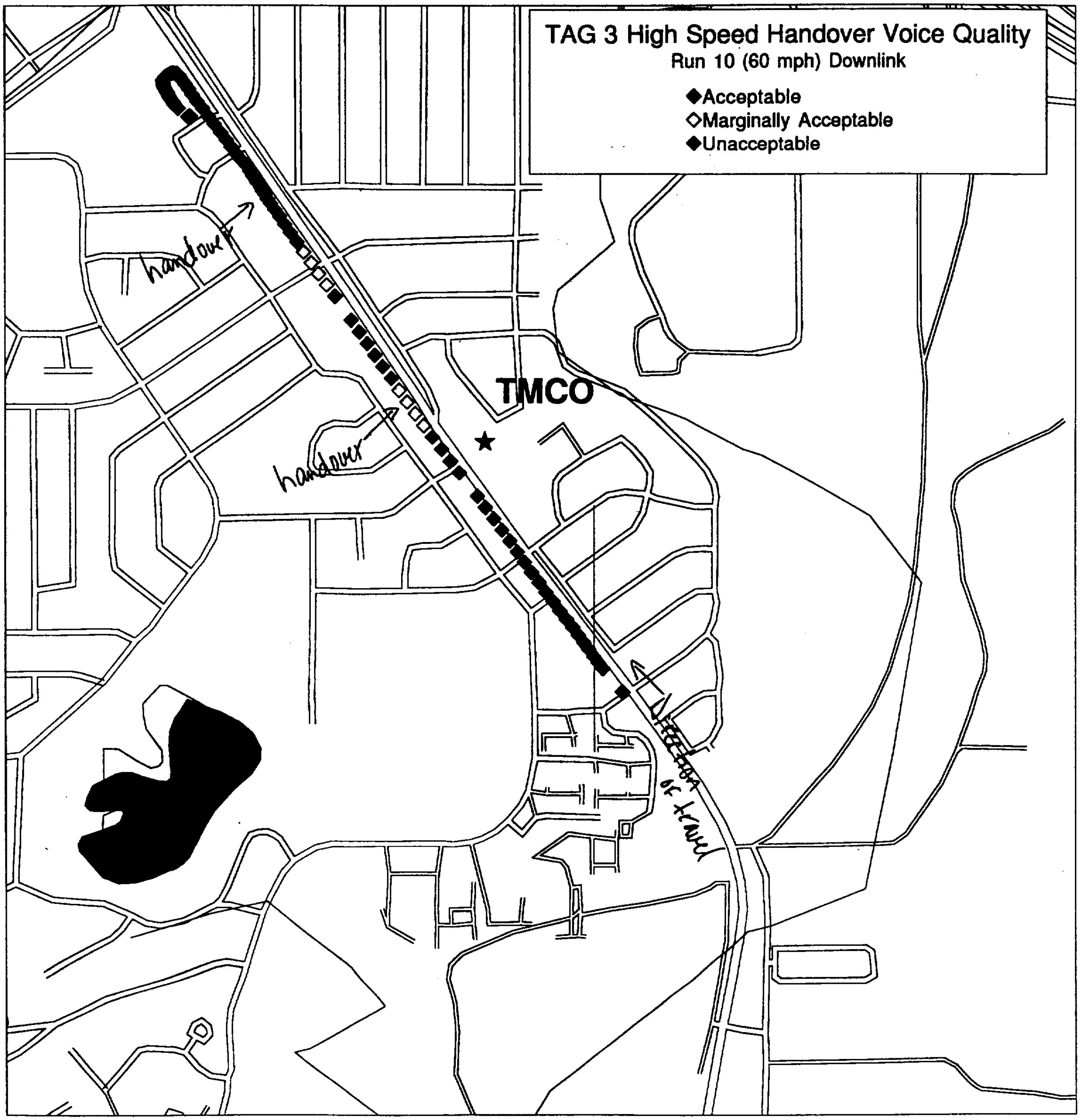
Map 7.3.6.17


TAG 3 High Speed Handover Voice Quality
Run 9 (60 mph) Downlink
◆Acceptable
◇Marginally Acceptable
◆Unacceptable
TMCO
Direction of travel
handover
handover

Map 7.3.6.18


TAG 3 High Speed Handover Voice Quality
Run 10 (60 mph) Uplink
◆Acceptable
◇Marginally Acceptable
◆Unacceptable
TMCO
handover
handover
Direction of travel

Map 7.3.6.19


TAG 3 High Speed Handover Voice Quality
Run 10 (60 mph) Downlink
◆Acceptable
◇Marginally Acceptable
◆Unacceptable
TMCO
handover
handover
Direction of travel

Map 7.3.6.20

Appendix B. Manufacturers Statements

Motorola Statement

The PACS development team from Motorola believes the primary BITB trial objectives to record Range, Voice Quality and Hand Off performance were successfully completed. The trial results indicate the low tier, low power PACS system has good range, excellent voice quality and nearly indiscernible hand off characteristics. Additionally, the initial high speed test results indicate the PACS standard may have very good wireless telephony performance even in this demanding environment. Antenna diversity both at the radio ports (base) and subscriber units (mobiles) along with the short frame rate helps improve performance for all these parameters.

We would like to thank US West Advanced Technologies for providing the facilities to perform the required tests and the Institute for Telecommunication Sciences for their participation in the calibration and test phases of the trial. More importantly, we want to thank the USWAT personnel for the their support to get the PACS system up and functional in such a short time. Finally, we want to acknowledge the cooperation from NEC and Matsushita engineering teams in helping Motorola polish the last few remaining system issues that subsequently facilitated a very successful field trial.

Appendix C. Independent Observers Statement

The Institute for Telecommunication Sciences (ITS) was asked by the JTC to function as the independent observer of the JTC technology field trials. Michael G. Laflin, of ITS, was the primary observer for this field trial.

ITS would first of all wish to express its deep appreciation to Jim Corliss, Vladan Jevremovic, Jaye Matthews and Michelle Owens of US West Advanced Technologies. Without their high degree of competence and dedication this technology field trial would not have been possible. We would also like to thank the members of the TAG 3 team for their hard work and cooperation in the conduct of this trial.

The fifth technology to undergo field testing at the US West Advanced Technologies Boulder Industry Testbed is that standardized in the JTC Technology Ad Hoc Group 3 (TAG 3).

The Independent Observer's (IO) job is to ensure that the tests are conducted according to the JTC approved test plan and that the resulting test data is accurate and complete. In this the function the IO was deeply involved in the planning of the test, directed the calibration/verification, assisted in the execution of the tests, served as a primary field note taker, and assisted with the report writing and was the editor of this report.

The report of the IO is that the testing was conducted in accordance with the test plan and that the testing was conducted with the integrity and honesty expected from a group of professionals such as those that worked on this field trial. As stated in the previous field trial reports, there is always more detailed analysis one would have wished to do and additional tests that one would have liked to have performed. However, under the extreme time constraints and limited resources, the tests were done well and the results are representative of the system performance in this deployment scenario.

STANDARDS PROJECT: Joint Technical Committee on Wireless Access

TITLE: Test Report For The TAG 7 Technology Field Testing At The BITB

ABSTRACT: This technology field test was performed at the US WEST Advanced Technologies (USWAT) Boulder Industry Test Bed (BITB), located in Boulder, Colorado, in cooperation with the Joint Technical Committee on Wireless Access (JTC). The Technology Ad Hoc Group (TAG) 7, Wideband Code Division Multiple Access (W-CDMA) technology is one of several technologies being standardized within the JTC. All technologies being standardized in the JTC are required to submit to testing at the BITB. High tier systems each use the same cell sites and cell site antennas. Low tier systems each use the same microcell sites and cell site antennas. The cell site layout, antenna type, and antenna orientation are given and do not vary from technology to technology. TAG 7 testing was carried out at the BITB from August 23, 1995 Through September 15, 1995. A visitor day was held on September 15, 1995.

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DATE: January 15, 1996

DISTRIBUTION: Members of the Joint Technical Committee on Wireless Access

5. Voice Quality

5.1 Data Collection Methodology

5.1.1 Test Stimuli

Prerecorded Harvard test sentences on digital audio tape (DAT) were used in the voice quality tests. The source tapes were recorded and provided by U S WEST Advanced Technologies (USWAT) and were the same tapes used in previous TAG tests. They consisted of ten Harvard sentences, which are phonetically balanced and include all sounds in the American English language. The digitally recorded sentences were 75-80 seconds in length. DAT recorders were electrically connected to the mobile and landline phones. A call was established between the mobile and landline phones and the test sentences were transmitted over the radio link in either the uplink or downlink direction. Voice samples of transmitted sentences were recorded onto DATs. For the quasi-stationary test, one set of Harvard sentences were played for each run: ten sentences spoken by a male, and 10 sentences spoken by a female.

5.1.2 Test Conditions - Quasi-Stationary Test

Quasi-stationary tests were conducted at points along a 200 meter grid that enclosed the expected coverage for the Table Mesa and Walnut sites. A total of 120 measurements (on the forward and reverse links) were collected at 60 different grid points. Sixty-three measurements were taken within the Walnut site and 57 were taken within the Table Mesa site.

Voice recordings were taken for the same vehicular speed and duration (sample time) at all locations. The vehicle traveled 10 meters over the sample time. The measurement locations were recorded with a GPS. For each location, both uplink and downlink voice recordings were taken at the same time. Engineering data, including RSS and BER were collected on a separate run, immediately following the voice recording run, at each location.

Later, the taped voice samples were digitized into a Macintosh SoundEdit 16 application at a rate of 16 bits, 22 kHz. All data were stored in a 1.2 Gbyte hard drive. For MOS testing, the first sentence of the male speaker and the last sentence of the female speaker of each recorded sample were dropped to avoid the possible inclusion of sentences that had been cut short due to the starting of a recording too late or the stopping of a recording too soon. Therefore, during MOS testing, a total of 18 sentences (out of the original 20 sentences) were presented to listeners for each sample. Voice quality of the quasi-stationary samples was assessed using both the MOS and expert listener methodologies, described below.

5.1.3 Engineering Data

During each quasi-stationary run, the following RF data were collected and recorded every second: Bit Error Count, Received Signal Strength (in dBm), Transmit Power and average Ec/Io. The following information was also collected every second: date, GPS time, longitude, and latitude. Additionally, notes describing the physical location of the quasi-stationary point were taken.

For the voice quality data analysis, average BER and RSS were assessed. To do so, bit error count was converted to Bit Error Rate (BER) then averaged over the length of a given voice sample. For RSS, dBm's per second were converted to mW using the following formula: dBm = 10 * log (x mW/1mW). The resultant powers were then averaged over the length of a voice sample, then converted back into dBm's.

5.2 Voice Quality Assessment Methodology

5.2.1 MOS Methodology

5.2.1.1 Subjects

Thirty-one subjects were recruited from the Boulder area to participate. One to two extra subjects were scheduled per day in case there were any that did not show. Three of the 4 days include data from 8 subjects, and the fourth day includes data from 7 subjects. Subjects were run in groups of three, four, or five at a time, for a total of eight groups. Every listener within a group listened to the same samples. A total of four sets of unique voice stimuli were used, with two groups listening to each set of stimuli. Each of the following age ranges were represented within the subject pool: 18-25 yrs, 25-35 yrs, 35-45 yrs, 45-55 yrs, and over 55 yrs. Subjects consisted of 17 males and 14 females. Subjects were cordless but non-cellular telephone users. Subjects were paid $35.00 for their participation, or subjects deferred receipt of payment to the organization from which they were recruited. When 9 subjects were run on a given day, one subject was dropped from the data set. The decision to disclude a given subject was based on demographics, so that the optimal number of subjects in each age range and gender were maintained.

5.2.1.2 Schedule and Resources

Testing occurred between October 18, 1995 and October 20, 1995 at the U S WEST Advanced Technologies Human Factors lab in Boulder, CO. Each testing session lasted approximately two hours. Michelle Owens and Jaye Matthews were the experimenters. Two or three testing sessions were conducted per day.

5.2.1.3 Methodology

Subjects first filled out a consent form and a demographic survey. The experimenter then read procedural instructions to them (see Appendix 5.A). After instructions were read by the experimenter participants were shown how to use the computer and mouse (if necessary). For training, subjects were presented with ten practice samples of voice segments and given a chance to rate them (see Appendix 5.B). The practice samples included one 64 kbps wireline sample, 2 samples collected from the field (one with an expert listener rating of 3, and one with an expert listener rating of 1), and 7 MNRU (Modulated Noise Reference Unit) samples. The MNRU samples were used at the request of the TAG 7 vendor. MNRUs have been used in subjective tests as a reference condition with impairment that sounds similar to the impairment in the coders being tested. The impairment produced by the MNRU is denoted as Q and is defined as the ratio in dB of speech power to speech correlated noise power. For the TAG 7 Listener Panels, MNRUs were produced by artificially adding Gaussian (white) noise of varying ratios of Signal to Noise (SNR) to the 64kb Harvard sentence samples. MNRU samples played during training were at the following dB levels: 5dB, 10dB, 15dB, 20dB, 25dB, 30dB, 40dB.

Once training was complete, each subject provided an Opinion Score for 33 voice segments. Thirty segments were field test samples; the remaining three were one 64 kbps wireline, and two poor (15dBm and 25dBm) MNRU samples. For each group of listeners, a total of 43 samples were rated. The order of presentation of each voice segment (presented after training) was randomized. Each segment consisted of 18 Harvard sentences. Nine sentences were spoken by a male and, nine were spoken by a female. The order of presentation of male or female sentences first was also randomized.

Subjects answered the following questions after each segment using the computer: 1) How would you rate the overall QUALITY of the sound? (on a 5-point scale: Excellent, Good, Fair, Poor, Bad) ; 2) How annoying are any ADDITIONAL sounds you may hear? (on a 5-point scale, from Not at All Annoying to Extremely Annoying); and 3) Would this be ACCEPTABLE as portable service (Yes or No)? (see Appendix 5.B)

Subjects were given two breaks during each the session. After all segments were presented, subjects filled out a post-trial questionnaire (see Appendix 5.C), and a receipt of payment form.

The answers to question one (How would you rate the overall QUALITY of the sound?) were averaged across all subjects for each sample, and the resulting score is the Mean Opinion Score (MOS) for that sample. This methodology allowed us to obtain MOSs for a total of 120 samples, or 60 locations of forward and reverse link transmissions.

5.2.2 Expert Listener Methodology

Voice segments were also rated using an expert listener methodology before results of listener panels were analyzed. A 3-point scale of acceptability was utilized: Definitely acceptable, Marginally acceptable, and Unacceptable. The expert listener, Jaye Matthews, was trained to emulate the responses of panels of listeners to question number 3) Would you consider this acceptable as portable service. USWAT has been conducting voice quality tests since 1993, and has numerous voice samples and analysis for such technologies as DECT, WACs, and PHS. A training software package was compiled which outlined samples of each type of acceptability level determined by listener panel testing. The expert listener was trained using this software package until she demonstrated a reasonable level of proficiency in matching listener panel ratings of acceptability. Note: the training samples are limited to those samples we had listener panel data on, therefore it is unlikely that all types of digital noise and distortions were represented in the training material.

Listener panel responses to question three: Would this be ACCEPTABLE as portable service? were transfered to a 3-point scale of acceptability (percent acceptability):

Definitely acceptable (more than 70% of subjects rated acceptable), Marginally acceptable (30 to 70% rated acceptable), and
Not acceptable (below 30% of subjects rated acceptable).

The expert listener ratings match this 3-point scale in the following ways:

Green = Definitely acceptable,
Yellow = Marginally acceptable, and
Red = Unacceptable.

For the quasi-stationary voice measurements, a single rating was given for each sample, and later compared to the listener panel results, see data analysis below. Percent acceptability ratings along with average RSS and average BER are plotted in Maps 5.3.3.1 through 5.3.3.12.

5.3 Voice Quality Data Analysis and Discussion

5.3.1 MOS Data Analysis and Discussion

Voice quality ratings from question one were averaged across subjects in order to obtain a Mean Opinion Score (MOS) for each sample. Recall, a MOS was generated for each of 60 locations around Boulder, in both the forward and reverse links at each location (n = 120).

The histogram of all MOS scores is diagrammed in Figure 5.3.1.1 below. Overall the voice samples were rated favorably, with 70% of the samples being rated between fair (3.0) and excellent (5.0). The average of all MOSs is 3.347, with a standard deviation of 1.05.

3.549

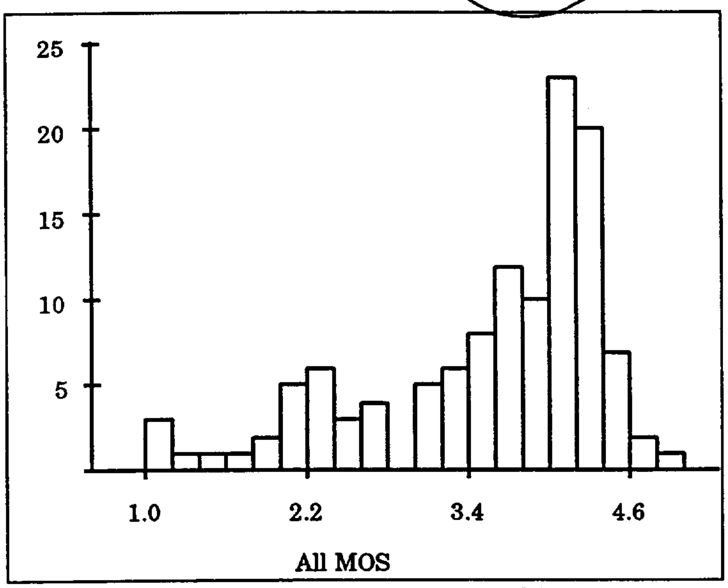


Figure 5.3.1.1 Frequency Distribution of all MOSs

Downlink and uplink MOSs are compared to one another in Figures 5.3.1.2 and 5.3.1.3, below. The averages of MOSs by link type are 3.513 and 3.584 for the downlink and uplink, respectively. A paired t-test reveals that there is not a significant difference in MOSs between the two links (t-stat= 0.599, with 59 d.f., p = 0.5514: therefore, fail to reject H_0 at α=0.05).

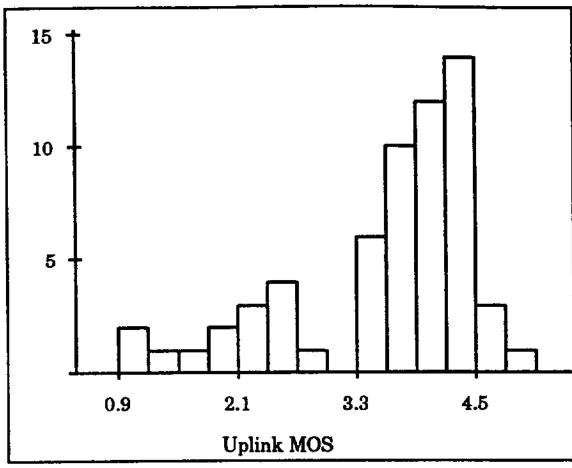


Figure 5.3.1.2

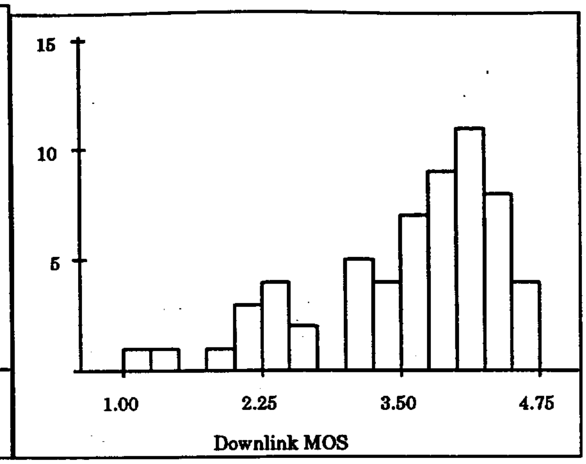


Figure 5.3.1.3

Figure 5.3.1.4 compares all MOS scores against one objective measure: average RSS (dBm). Figure 5.3.1.5 and 5.3.1.6 compares MOSs with average BER on the downlink and uplink, respectively.

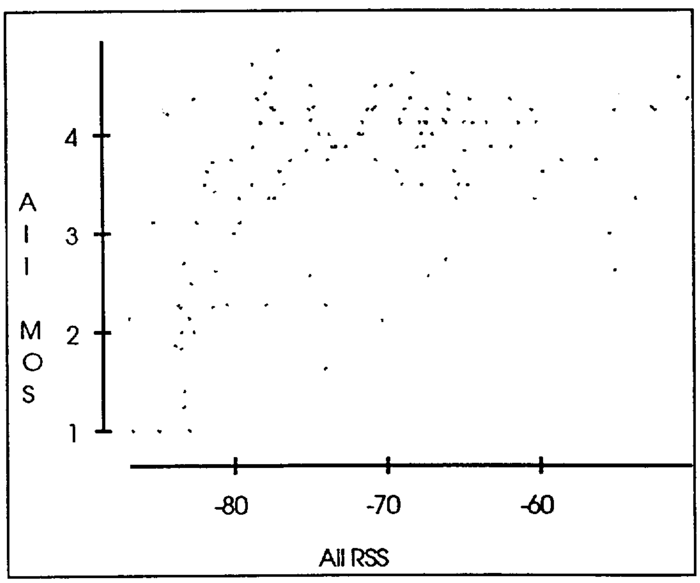


Figure 5.3.1.4

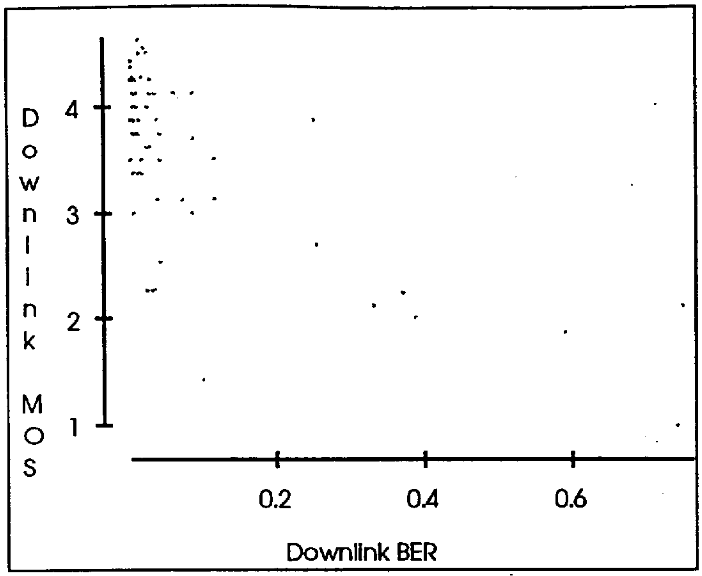


Figure 5.3.1.5

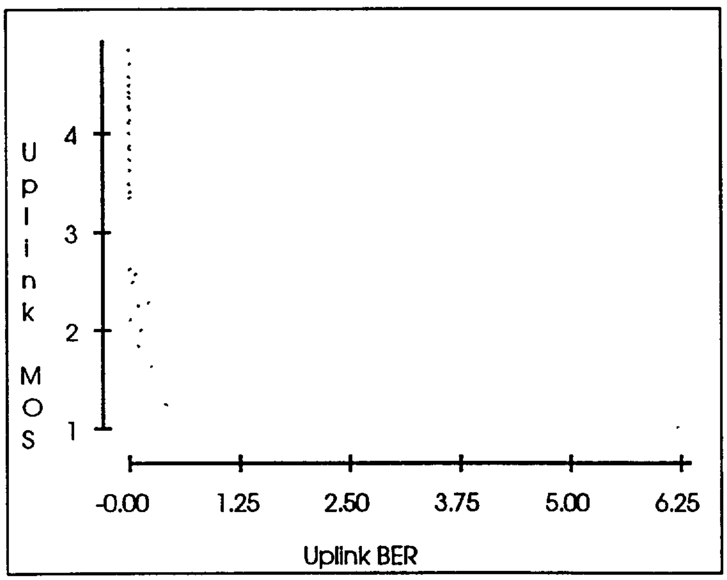


Figure 5.3.1.6

Figure 5.3.1.7 is a Pearson Product-Moment correlation table and outlines the correlation coefficients of MOS vs. RSS and BER. The results reveal some correlations between averaged engineering measures and MOS, the highest being BER at -0.461 (the negative sign denotes higher MOS corresponds to lower BER, as expected). Therefore, there does appear to be a linear relationship between MOS and the engineering measures. Notice that the correlation between MOS and BER is stronger than the correlation between BER and RSS. When averaged over the length of a voice sample, the correlation between RSS and BER is -0.248. We expected to see a higher correlation between the two engineering measures.

Pearson Product-Moment Correlation

	All MOS	All RSS	All BER
All MOS	1.000		
All RSS	0.493	1.000	
All BER	-0.461	-0.248	1.000

Figure 5.3.1.7

There is a weak linear relationship between MOS and the engineering measures, but there may be stronger relationships that are non-linear, as a Spearman Rank Correlation table might reveal. A Spearman Rank Correlation was performed to analyze the ranks of MOS vs. the ranks of the various engineering measures, in order to consider possible non-linear relationships. Figure 5.3.1.8 diagrams the results. ***There appear to be weak non-linear relationships between RSS, BER and MOSs.***

Spearman Rank Correlation

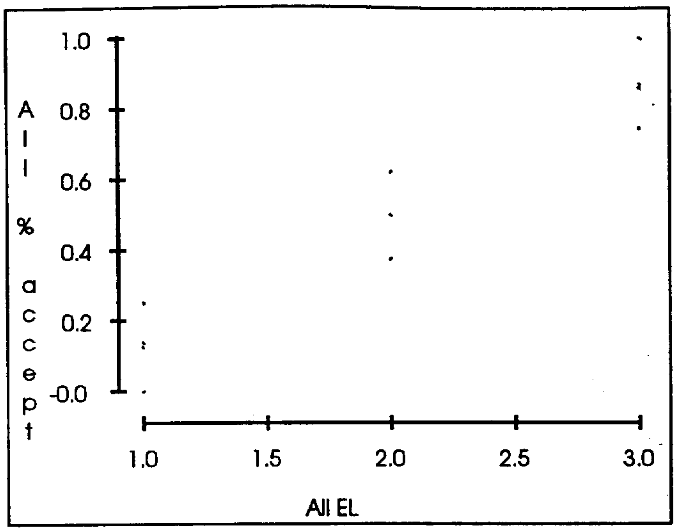
	All MOS	All RSS	All BER
All MOS	1.000		
All RSS	0.449	1.000	
All BER	-0.541	-0.637	1.000

Figure 5.3.1.8

Note, the engineering values were averaged over the entire voice sample length. By analyzing the engineering data within the voice sample time frame, further insight may be gained on the behavior of MOS. By considering the minimum and maximum values for BER and RSS over the length of a given sample, we might see higher correlations to MOSs.

5.3.2 Expert Listener Data Analysis and Discussion

Recall, the expert listener ratings were performed on a 3 point scale, and were made in an attempt to emulate listener panels' ratings of acceptability (vs. MOS).
Figures 5.3.2.1 and 5.3.2.2 show the relationship between expert listener (EL) ratings and listener responses to question three, or %acceptability [p(A)]. Percent acceptability is the percent of listeners rating a given sample as acceptable.



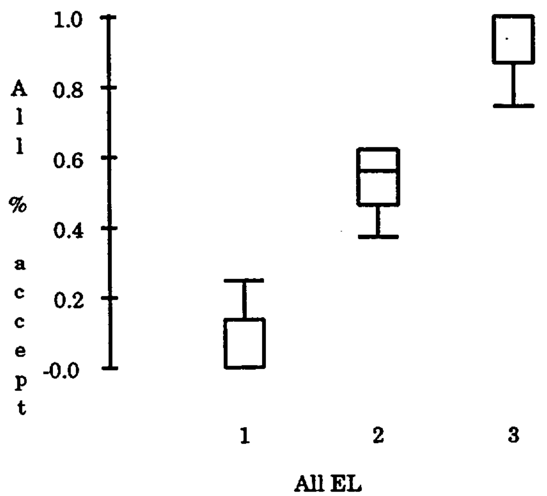


Figure 5.3.2.1

Figure 5.3.2.2

Figure 5.3.2.1 on the left shows the %acceptability, or p(A), data in relation to EL categories. Figure 5.3.2.2 on the right summarizes the same data. The boxes represent the middle half of the data (from the 25th percentile to the 75th percentile). The line intersecting the boxes are the median p(A)s for each of the EL ratings. The lines extending out of the boxes depict the spread of the data. Our goal was for Expert Listener scores to accurately predict Listener Panel % acceptability scores, and this goal was met for 96% of the 120 voice samples.

When we examine the relationship between listener responses to question 1 (MOS) and question 3 [p(A)] we see that they are strongly correlated as we would expect. The correlation coefficient between MOS and p(A) is 0.912. The EL ratings are strongly correlated with MOS, with a coefficient of 0.887, and strongly correlated with percent acceptability, or p(A), with a correlation coefficient of 0.975 (see Figure 5.3.2.3).

Pearson Product-Moment Correlation

	All MOS	All p(A)	All EL
All MOS	1.000		
All p (A)	0.912	1.000	
All EL	0.887	0.975	1.000

Figure 5.3.2.3

It is possible that EL ratings, average RSS, and average BER can be predictors of MOS when all are taken together. A multiple regression analysis was completed in order to determine if MOS is related to a combination of all the above factors. Interactions among the various factors were not considered in the analysis.

Regression Analysis

Dependent variable is: **All MOS**

R squared = 81.8% R squared (adjusted) = 81.4%
s = 0.3890 with 120 - 4 = 116 degrees of freedom

Source	**Sum of Squares**	**df**	**Mean Square**	**F-ratio**
Regression	79.0517	3	26.35	174
Residual	17.5539	116	0.151327	

Variable	**Coefficient**	**s.e. of Coeff**	**t-ratio**
Constant	1.56296	0.4203	3.72
All EL	0.890192	0.0523	17.0
All RSS	0.003084	0.0047	0.652
All BER	-0.200642	0.0457	-4.39

Figure 5.3.2.4: Regression Analysis Results

The result is an R squared (adjusted) of 81.4%. In other words, 81.4% of the variance in MOSs can be explained by EL, RSS, and BER. The F-ratio is high (174), revealing all factors reliably account for the 81.4% of variance. By including all of the factors into the equation, we see some predictive power over MOS (see Figure 5.3.2.4 above).

A second regression analysis was performed, this time with only the Expert Listener (EL) variable. Not surprisingly, the result was an R squared (adjusted) of 78.4%. This demonstrates that a great deal of the variance in MOSs can be explained by EL alone, and the RSS and BER variables are less predictive.

Regression Analysis (with only EL variable)

Dependent variable is: **All MOS**

R squared = 78.6% **R squared (adjusted) = 78.4%**
s = 0.3890 with 120 - 4 = 116 degrees of freedom

Source	Sum of Squares	df	Mean Square	F-ratio
Regression	75.9597	1	75.96	434
Residual	20.6458	118	0.174965	

Variable	Coefficient	s.e. of Coeff	t-ratio
Constant	1.09572	0.1238	8.85
All EL	0.974624	0.0468	20.8

Figure 5.3.2.4: Regression Analysis Results (only EL variable)

By gathering listeners' comments from post-test questionnaires, more information is available about the nature of MOSs. Namely, it is evident from questionnaires that there are several types of distortions in quality possible in the TAG 7 voice samples according to listeners:

1) bursts of loud static
2) "whine" or "feedback noises"
3) "background hiss"

The nature of these distortions are likely judged differently by different listeners. Intelligibility and speaker recognition are two main aspects of perceived quality. In the case of most of the voice samples, intelligibility remained high. As a result, overall MOSs were high.

5.3.3 Voice Quality Conclusions

Overall the voice samples were rated favorably, with ~~70% of the~~ samples being rated between fair (3.0) and excellent (5.0). The average of all MOSs is 3.347, with a standard deviation of 1.05.
3.549

On the whole, average BERs were between 0% and 0.7%, with two outliers at 6.227% and 6.645%, while MOSs varied from 1.0 to 4.857.

There was not a significant difference ~~in~~ MOSs for uplink and downlink when paired MOSs were analyzed. Average uplink MOS was 3.584 and average downlink MOS was 3.513.

5.3.4 Appendix 5.A: Voice Quality Instructions

- Good afternoon/evening and thank you for coming. My name is (name), your test administrator.
- Tonight/today you will be listening to a series of recordings and telling us what you think about them.
- Before we begin, I would like to point out some features of our lab. There are two video cameras set up in the room. I will be recording this session. The resulting tapes would be used for research purposes only, and will not be distributed for advertising, etc. Is it okay with everyone if I continue recording? Also in our lab we have a two-way mirror. There may be other product designers and testers observing this session, to see how things are progressing and how the product is performing.
- As I already mentioned, you will be listening to a series of recordings and offering your opinions on them. For each recording we would like you to compare the sound quality of the recording to the service you have on your home phone and then enter your rating of that sound into the computer in front of you. For each, you will rate 3 things:

    1) What do you think of the QUALITY of the sound? That is, how good is the sound of the voice being captured by the recording? Remember, we'd like you to compare the samples to what you might hear at home.

    2) How annoying are any additional sounds you might hear? That is, How much do any additional sounds interfere with your ability to understand what is being said?

    3) Would you find this recording ACCEPTABLE as portable phone service? What we mean by "portable" is that you can take this phone with you as you travel around town and make calls from places like shopping centers, parking lots, and sporting events. Any questions so far?
- In front of you is a telephone handset which is connected to my computer here. I would like you to hold the handset up to your ear and listen to the sound I will play.
- I will announce the number of the sound you are about to hear and that number should match the number at the top of the screen. You should all have a #1 at the tops of your screens.
- You can use the mouse or the keypad to enter your ratings. Once you have entered your rating for one question the computer will move on to the next question for you. If you need to change an answer, you can tab through to go back to the answer you wish to change.
- The first few will be for practice, and you will have a chance to practice answering the questions with the computer. I will play the first practice sample sound for you now. SOUND.
- NOW, for practice, I would like you to rate that sound as Excellent for the overall quality of the sound. You can do this by entering a 1 on your keyboard or by pointing to the circle next to the word Excellent using the mouse and clicking the button on the mouse.
- Was everyone able to do that?
- Now please do the same to say that the additional sounds were Not at all Annoying and that the sound was Acceptable.
- Was everyone able to do that?
- Once you entered an answer for each question, A picture appeared in the bottom of the window which says "DONE". You can indicate that you are finished by clicking on "Done" with the mouse OR by hitting the return key on your keyboard.
- You can use either the mouse or the keyboard, whichever you like best.
- You will be hearing the same sentences in each sound bite. I realize that they are a bit unusual and at the end I will explain why we use these sentences. In some of the samples you will hear the male voice first, and in some the female voice first.
- Now try the next practice sample. SOUND

- Was everyone able to do that? Please rate that one as Bad by selecting #5. Any questions?

- If you have any questions as we are working, please feel free to speak-up. Also, If you are having difficulty using the computer please tell me.
- About half way through the voice segments we will take a 15 minute break and then finish up the rest of the samples.
- I would like you to rate the rest of the samples on you own.

5.3.5 Appendix 5.B: Computer Response Questions

How would you rate the overall QUALITY of the sound?

1. Excellent
2. Good
3. Fair
4. Poor
5. Bad

How annoying are any ADDITIONAL sounds you might hear?

1. Not at all annoying
2. Slightly annoying
3. Annoying
4. Very annoying
5. Extremently Annoying

Would this be ACCEPTABLE as portable service?

1. Acceptable
2. Not acceptable

5.3.6 Appendix 5.C: Post-Test Questionnaire

1) What is your gender?
____ MALE
____ FEMALE

2) What is your age?
___ Under 20
___ 21-24
___ 25-34
___ 35-44
___ 45-54
___ 55 or above

3) What is your occupation? ______________________________

4) How much computer experience do you have?
___ None
___ Used a few times before
___ Use once/month
___ Use once/week
___ Use every day

Did you ever work with a computer on a regular basis in a previous job? If so, how much? _______

5) Have you ever used a cordless phone (works on standard phone jack)?
____ YES _____ NO

Do you OWN a cordless phone?
_____ YES and use it more than 50% of the time
_____ YES and use it less than 50% of the time
_____ NO

IF YES, How does the sound quality of the samples you heard here compare to the sound on a cordless phone?

____

____

____

IF YES, Who made the phone? ______________________________

6) Have you ever used a cellular phone? ___ YES ____ NO
If so, how often:
___ everyday
___ once or twice per week
___ once or twice per month
___ once or twice per year
___ only once or twice before

Have you ever received a call from someone using a cellular phone?
(that you know of) ___ YES ____ NO

If so, how often:
- ___ everyday
- ___ once or twice per week
- ___ once or twice per month
- ___ once or twice per year
- ___ only once or twice before

If you have used a cellular phone or received a call from a person using a cellular phone, how does the sound quality of the samples you heard tonight compare to the sound of a cellular phone?

____

____

____

7) Would your ratings of the Acceptability of these sounds be different if we told you that this would NOT be a portable phone?

____ YES _____ NO

IF YES, How would they differ and why?

____

____

____

8) How does the sound from these recordings differ from the sound on your home phone?

____

____

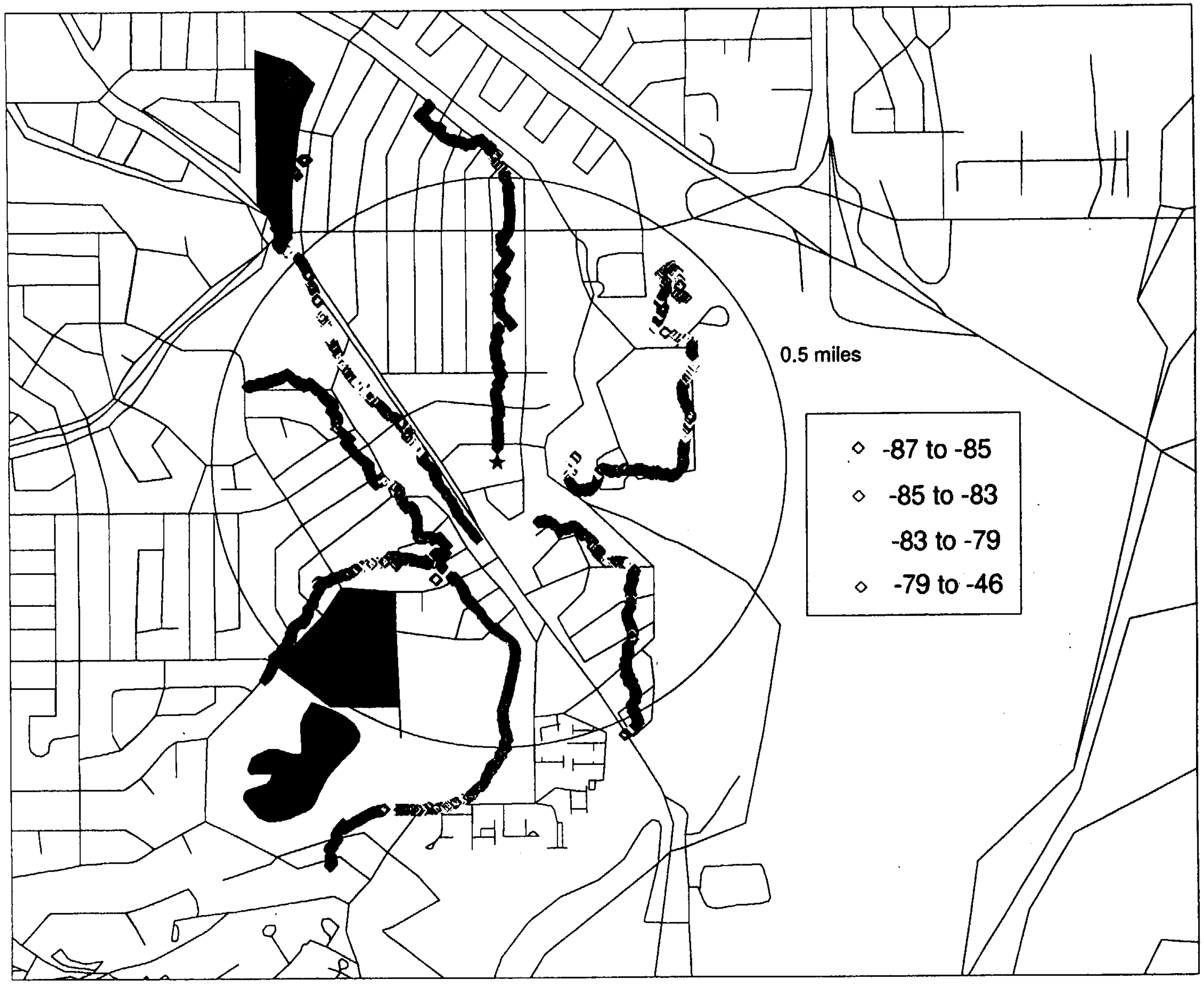
____

9) Any other comments?

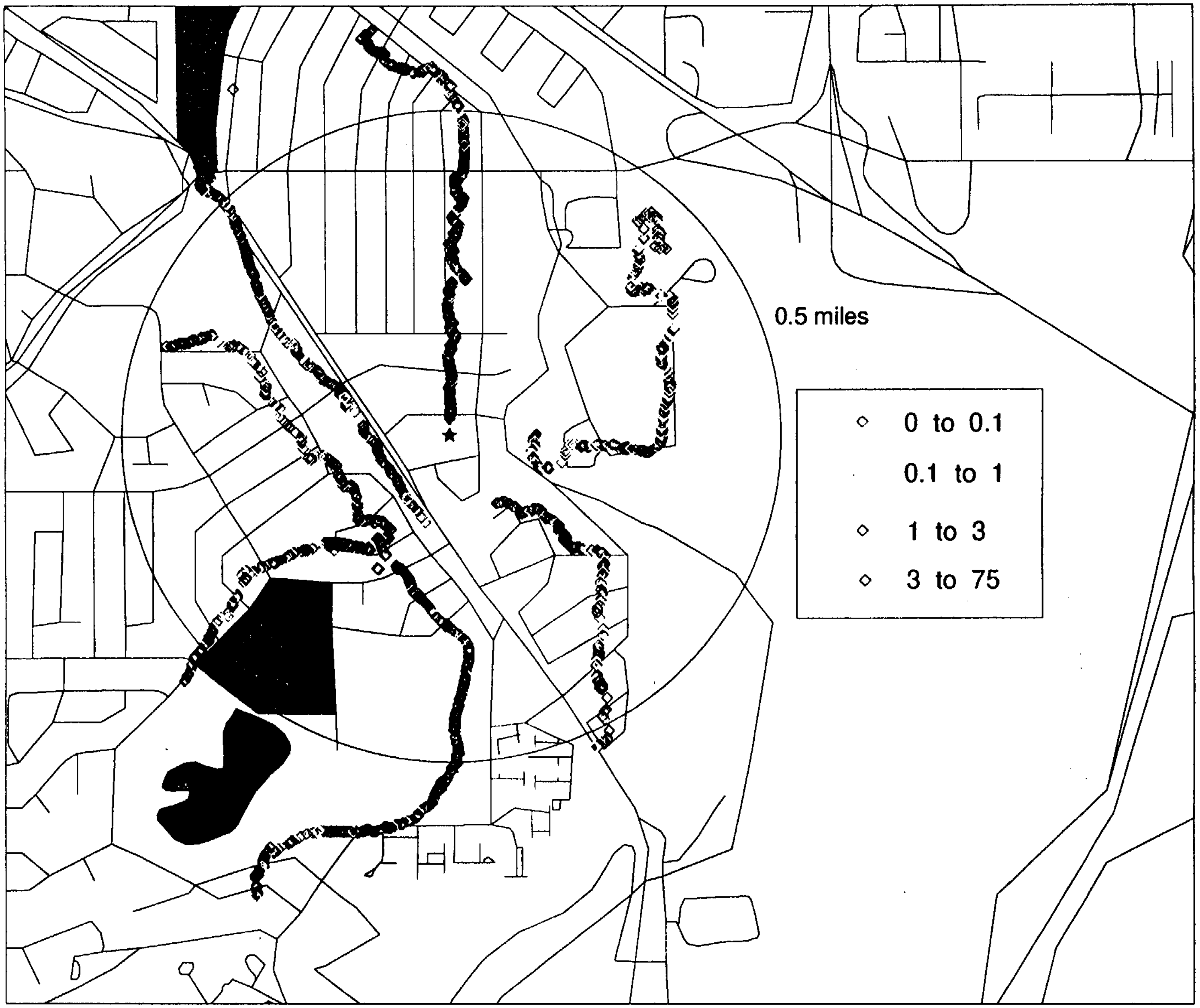
____

____

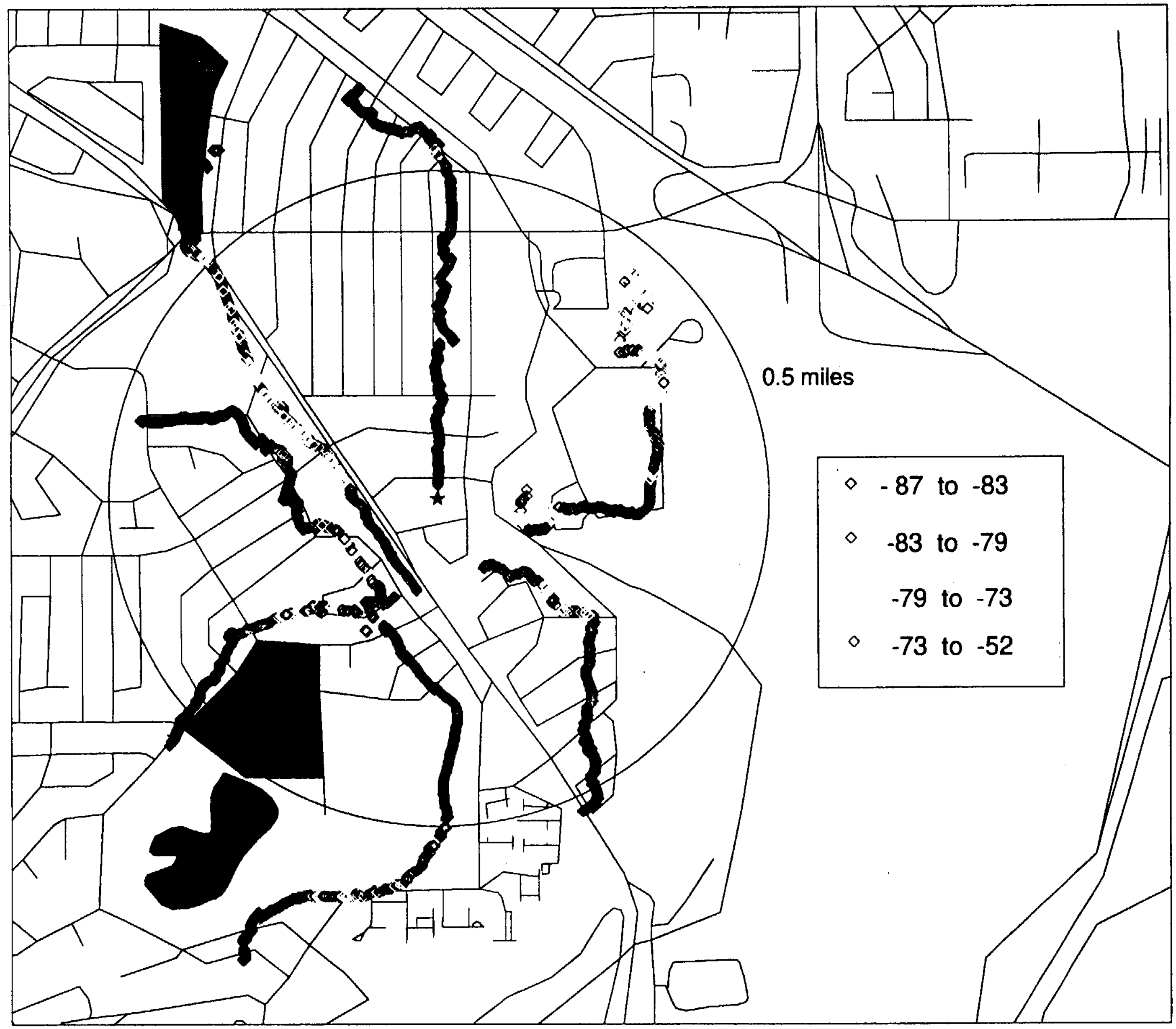
____



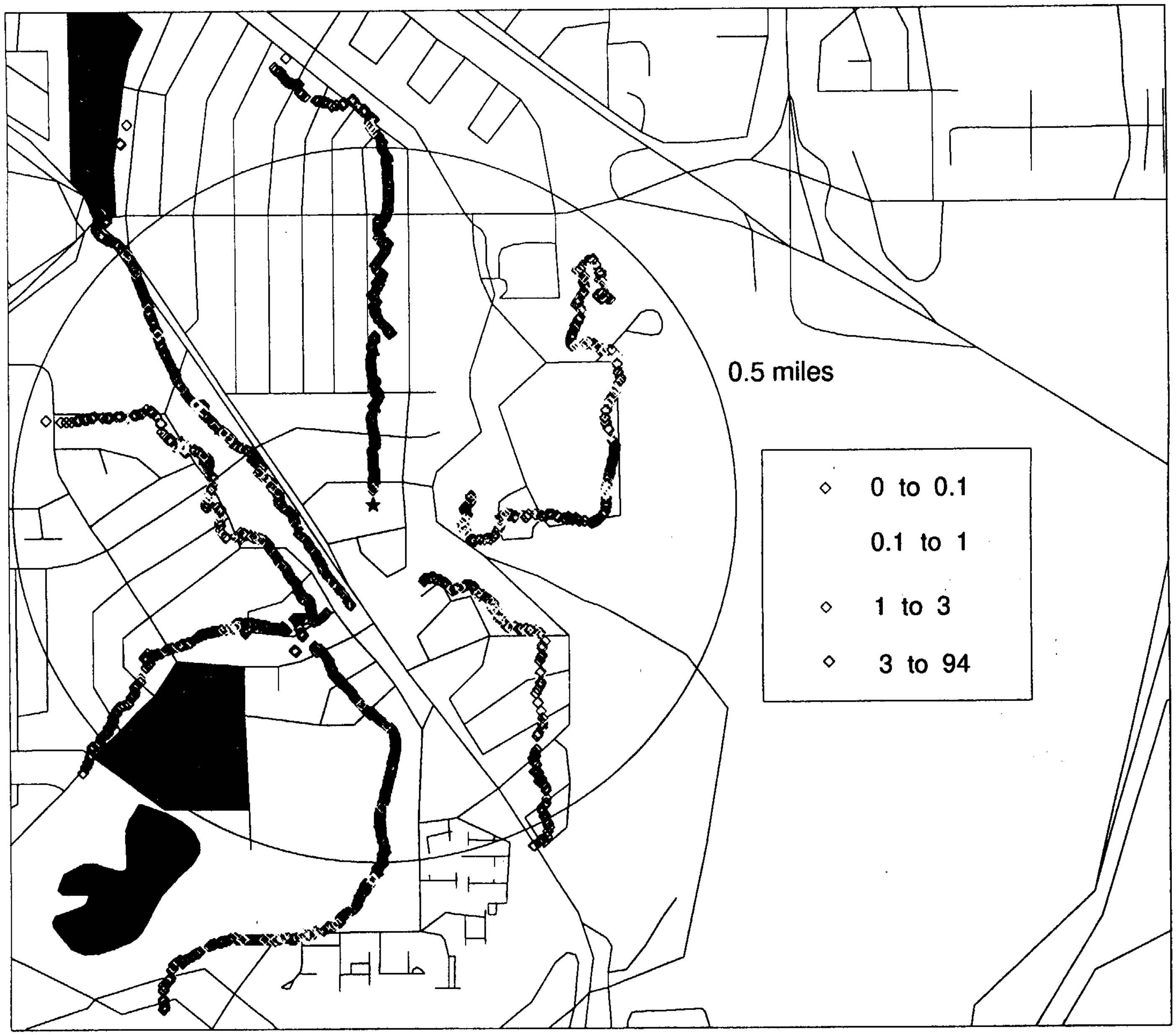
Map 4.2.1.1: Table Mesa CO by downlink Rx (dBm)



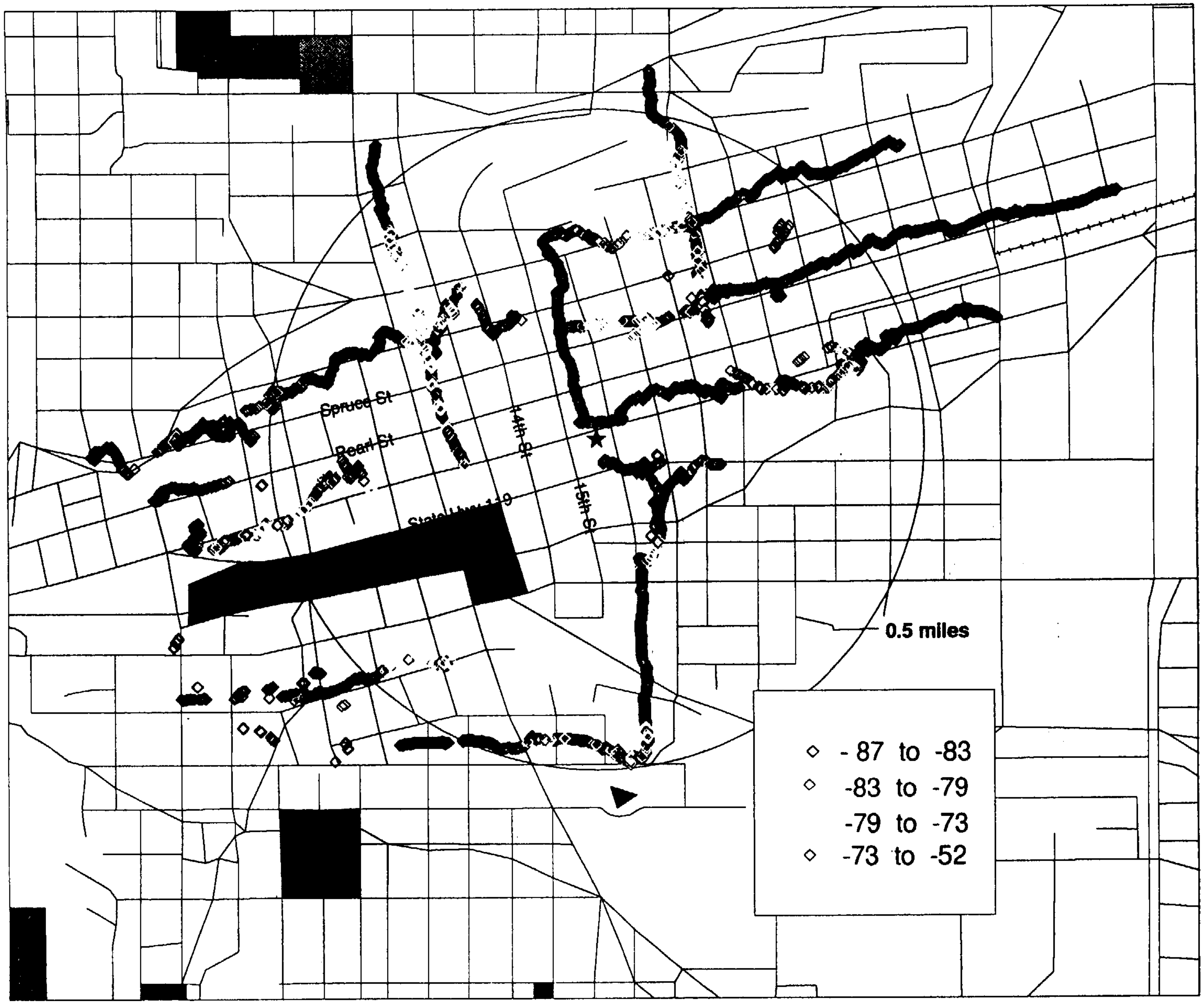
Map 4.2.1.2: Table Mesa CO by downlink BER %



Map 4.2.1.3: Table Mesa CO by uplink Rx (dBm)



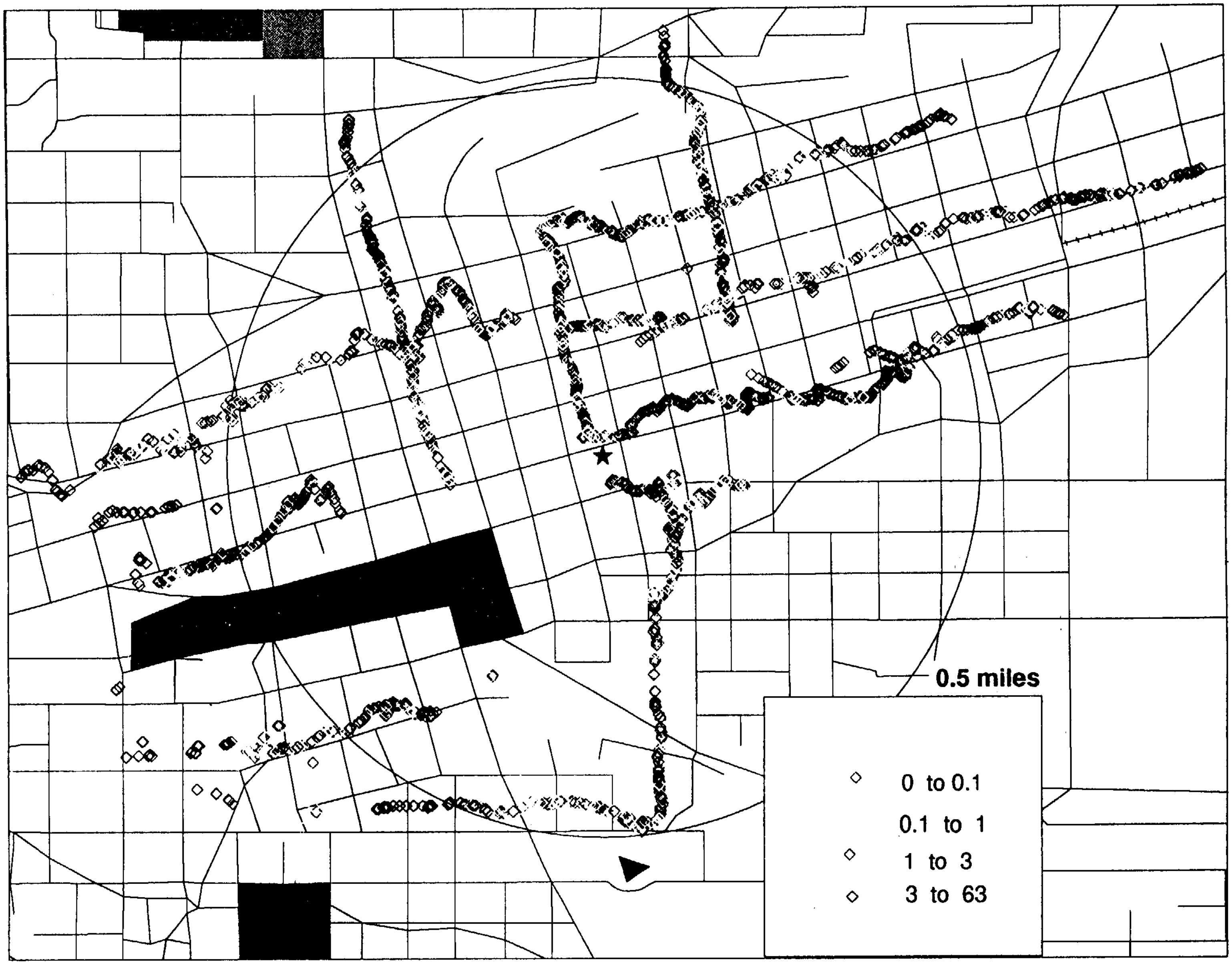
Map 4.2.1.4: Table Mesa CO by uplink BER %



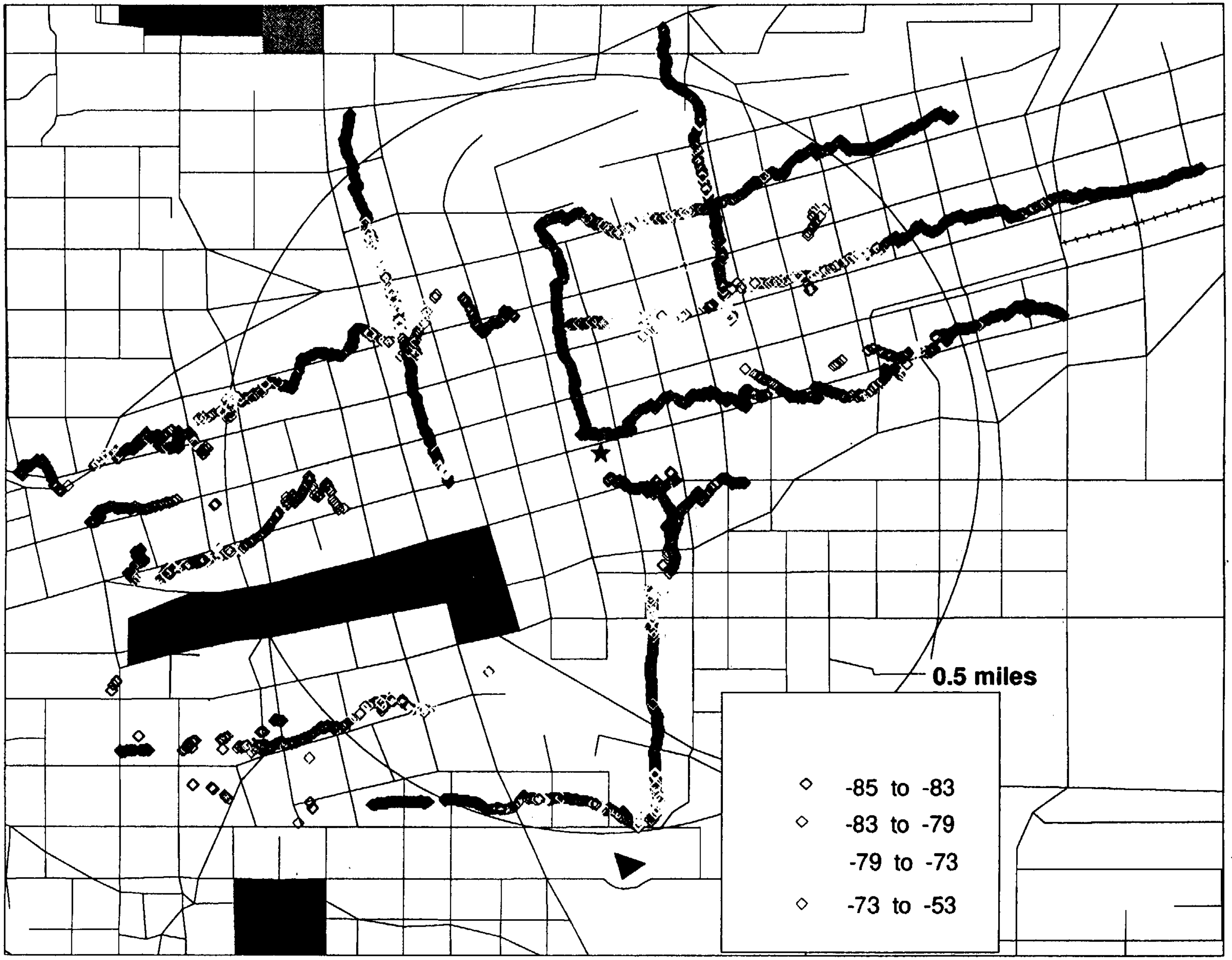
Map 4.2.2.1: Walnut CO by downlink Rx (dBm)


TAG 7 Quasi-stationary Grid
Wal Downlink Voice Quality
Acceptable
Marginally Acceptable
Unacceptable
WCO

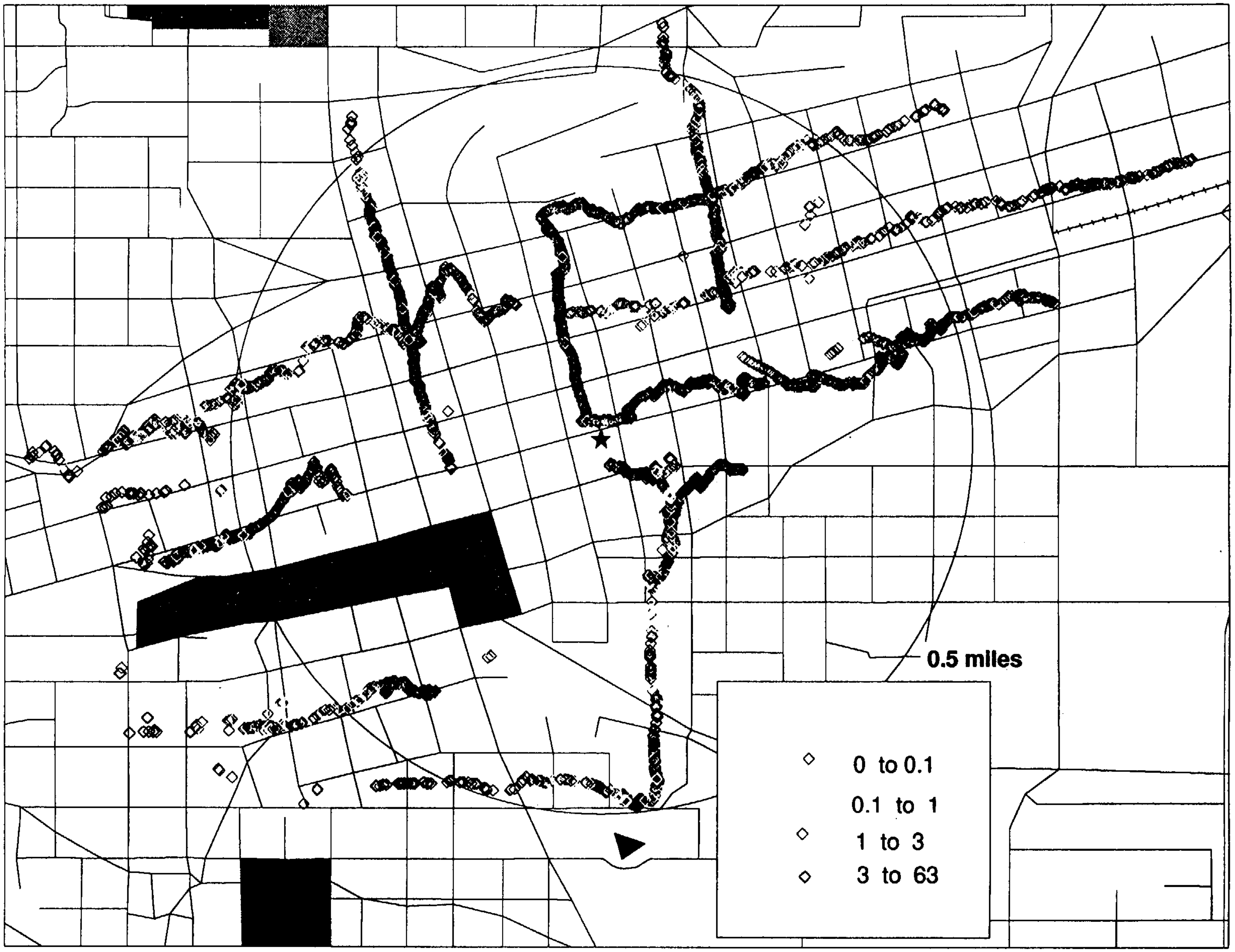
Map 5.3.3.1



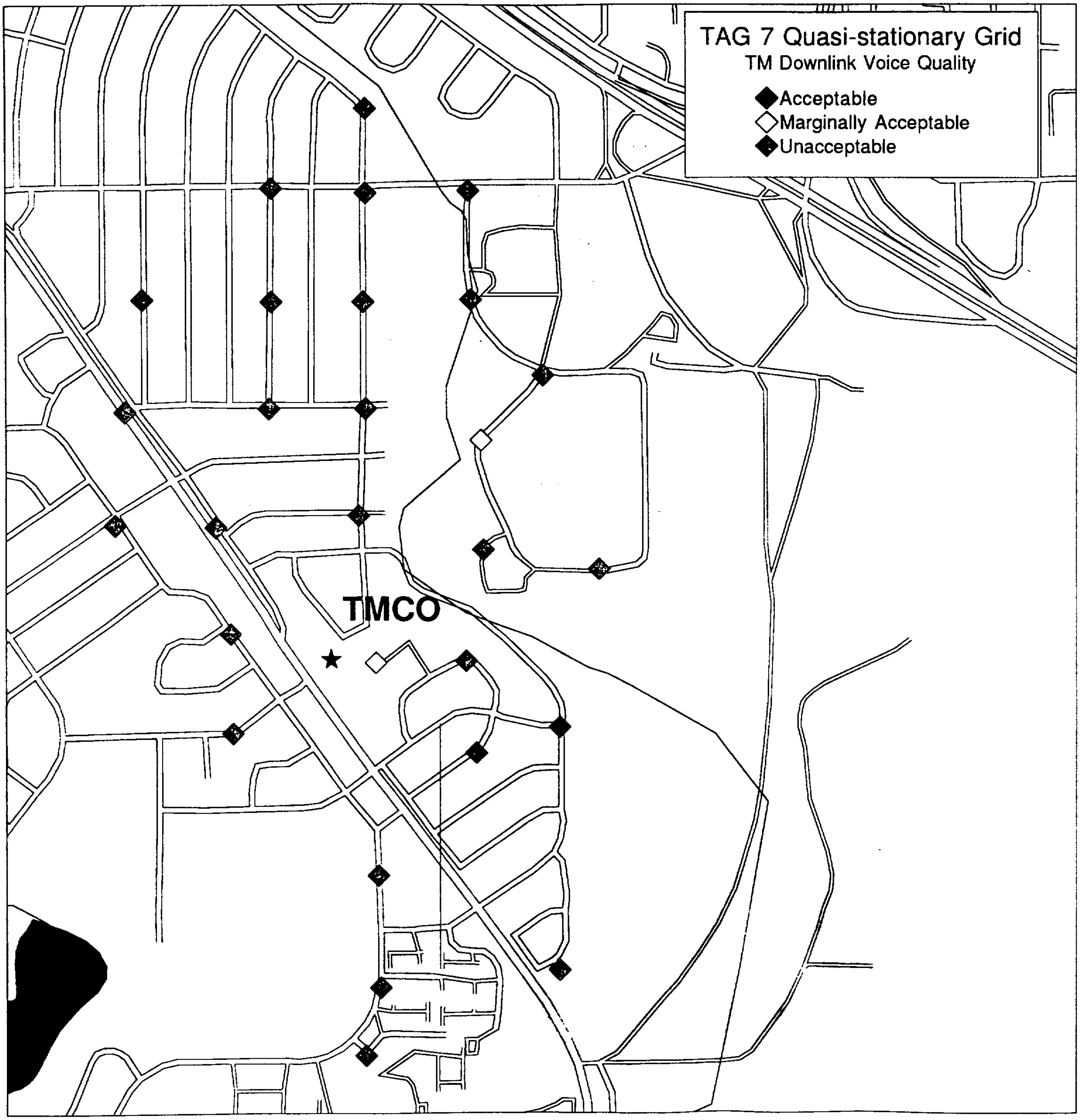
Map 4.2.2.2: Walnut CO by downlink BER %



Map 4.2.2.3: Walnut CO by uplink Rx (dBm)

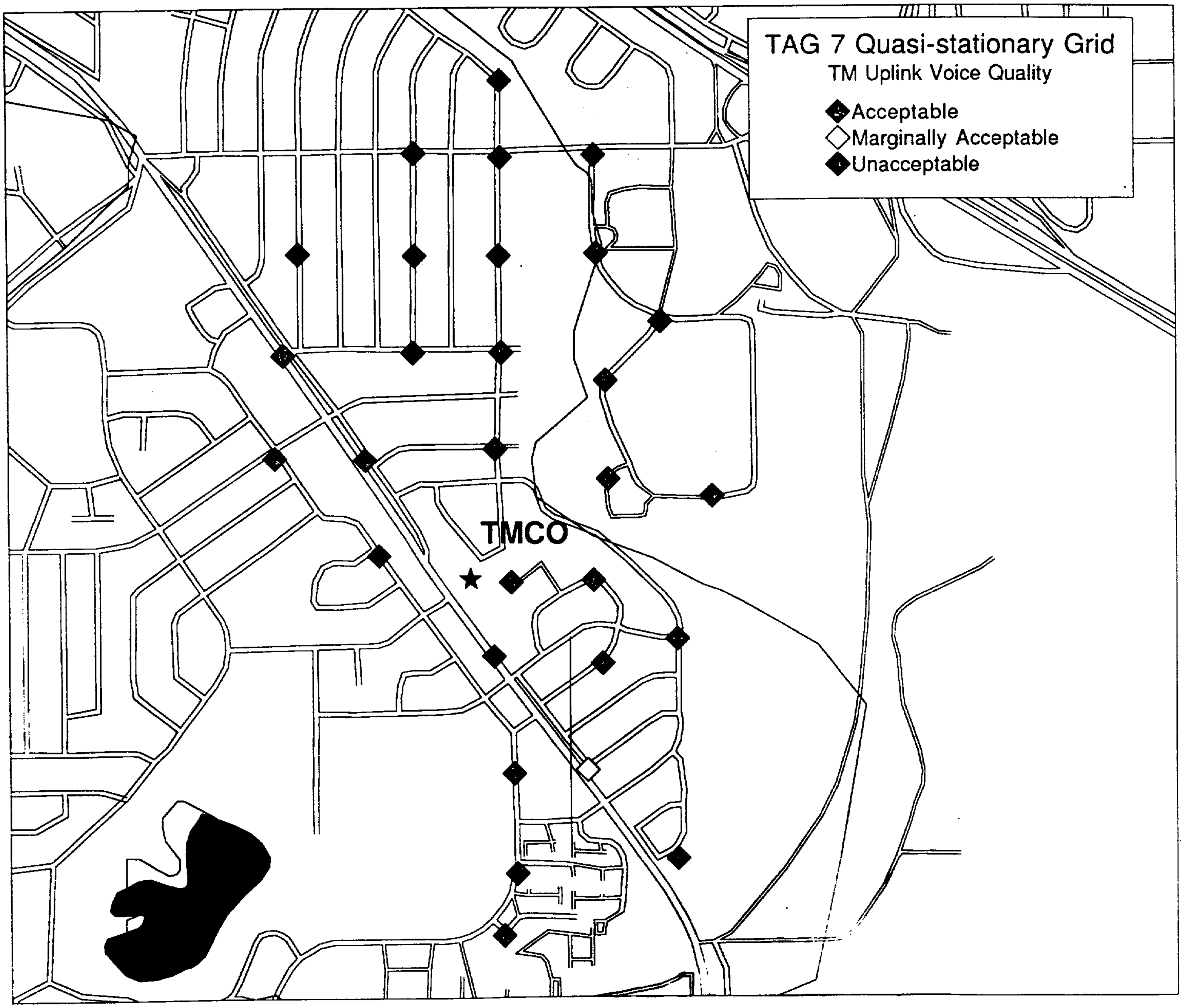


Map 4.2.2.4: Walnut CO by uplink BER %

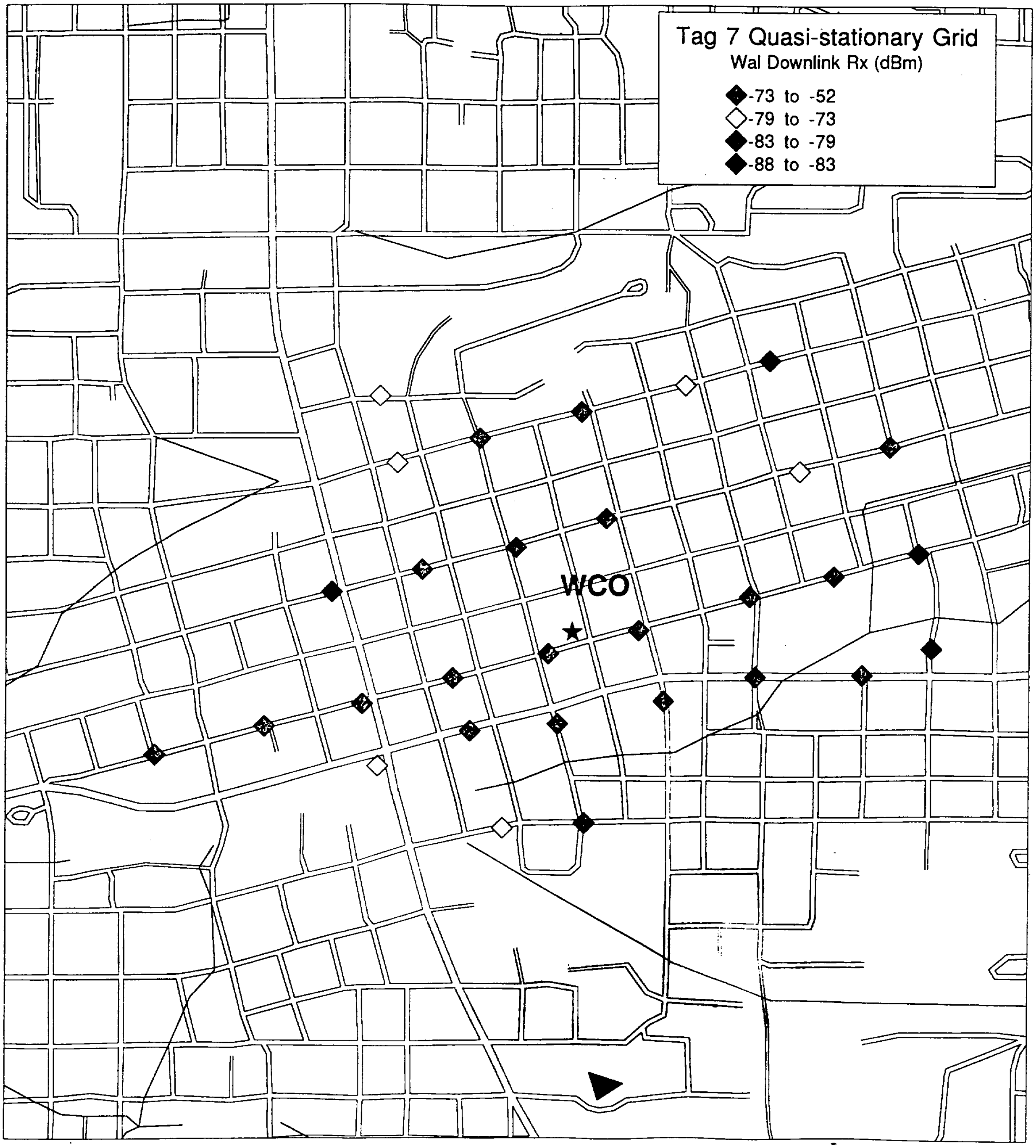


TAG 7 Quasi-stationary Grid
TM Downlink Voice Quality
Acceptable
Marginally Acceptable
Unacceptable
TMCO

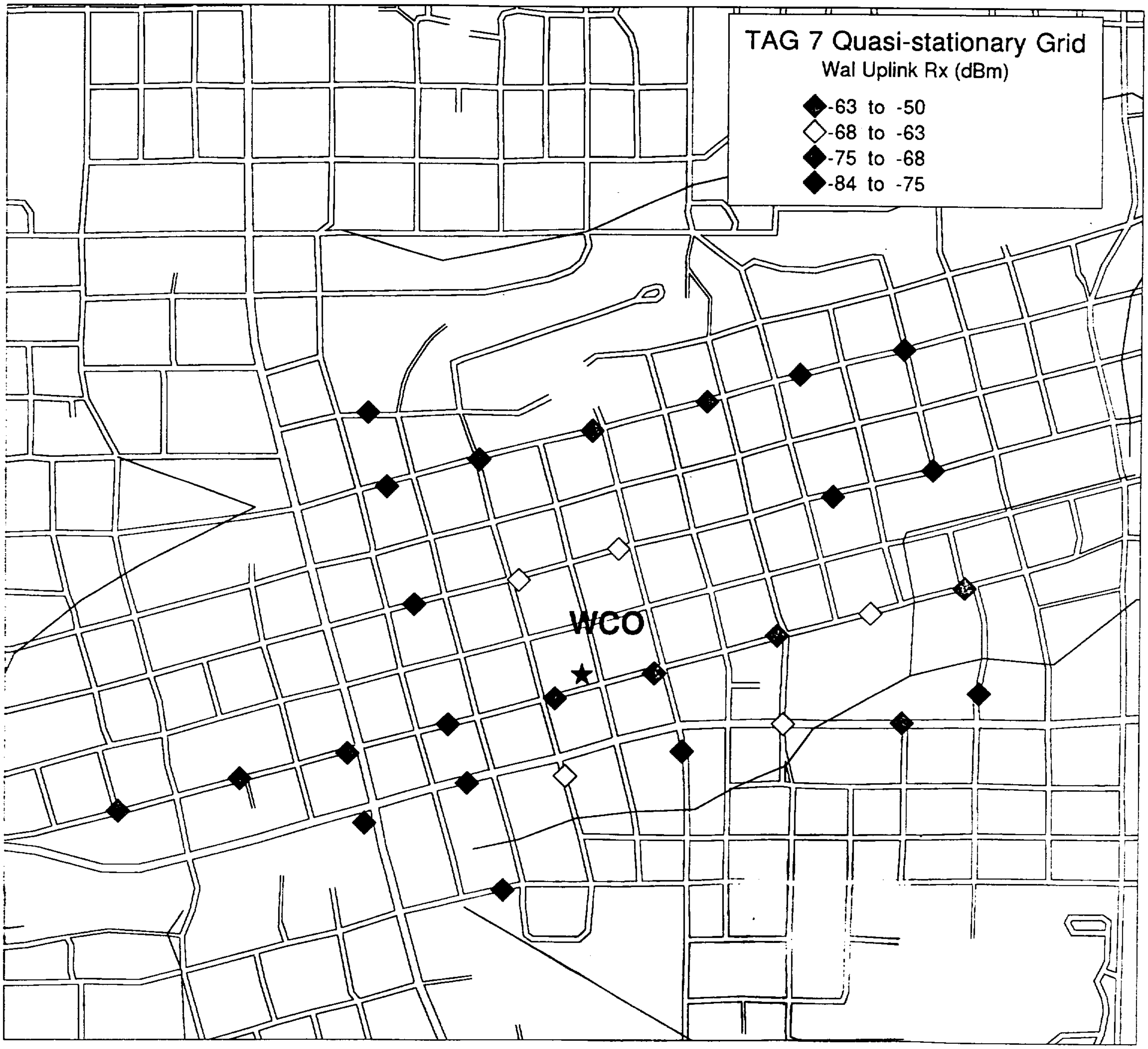
Map 5.3.3.3


TAG 7 Quasi-stationary Grid
TM Uplink Voice Quality
Acceptable
Marginally Acceptable
Unacceptable
TMCO

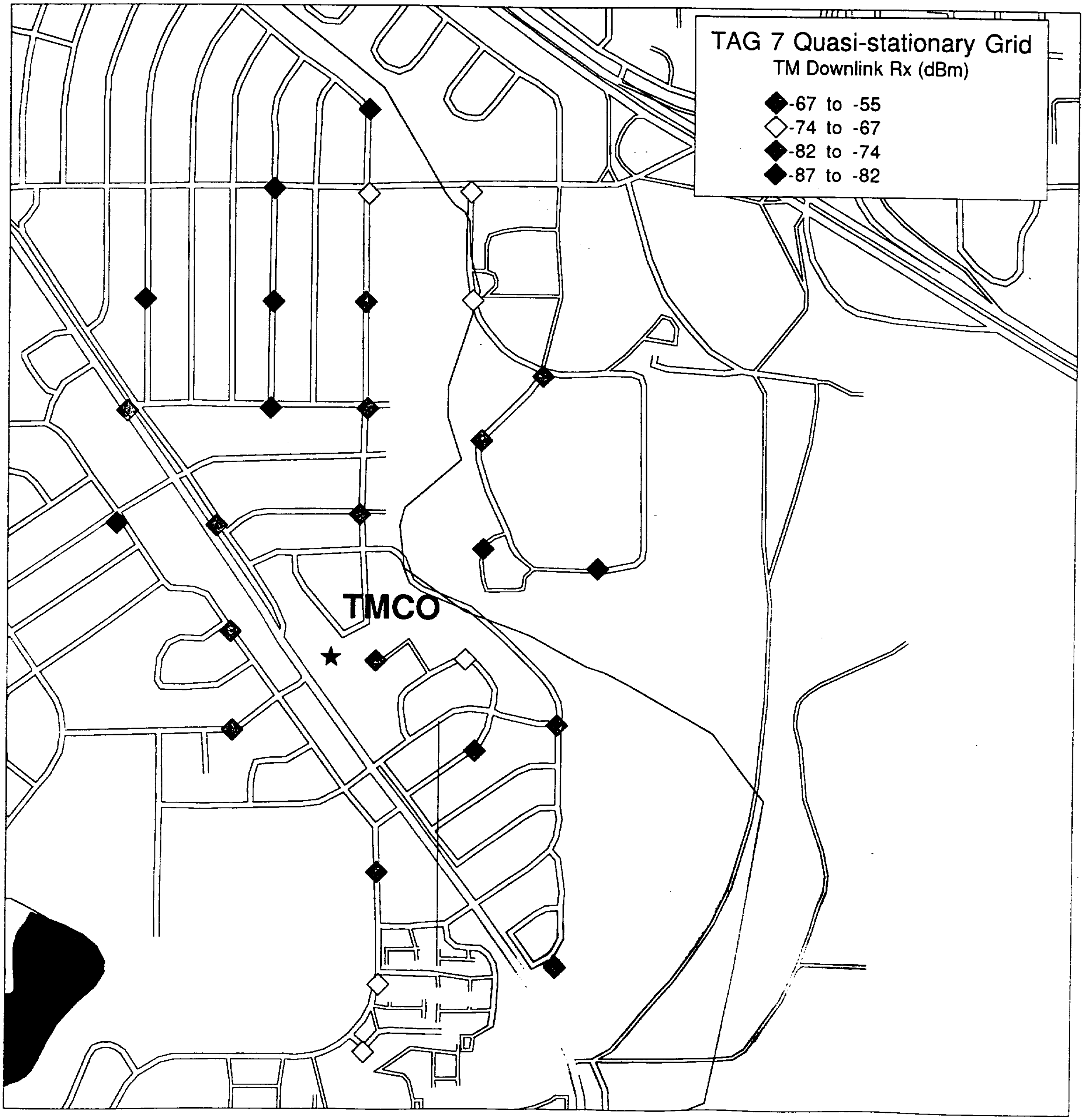
Map 5.3.3.4


Tag 7 Quasi-stationary Grid
Wal Downlink Rx (dBm)
-73 to -52
-79 to -73
-83 to -79
-88 to -83
WCO

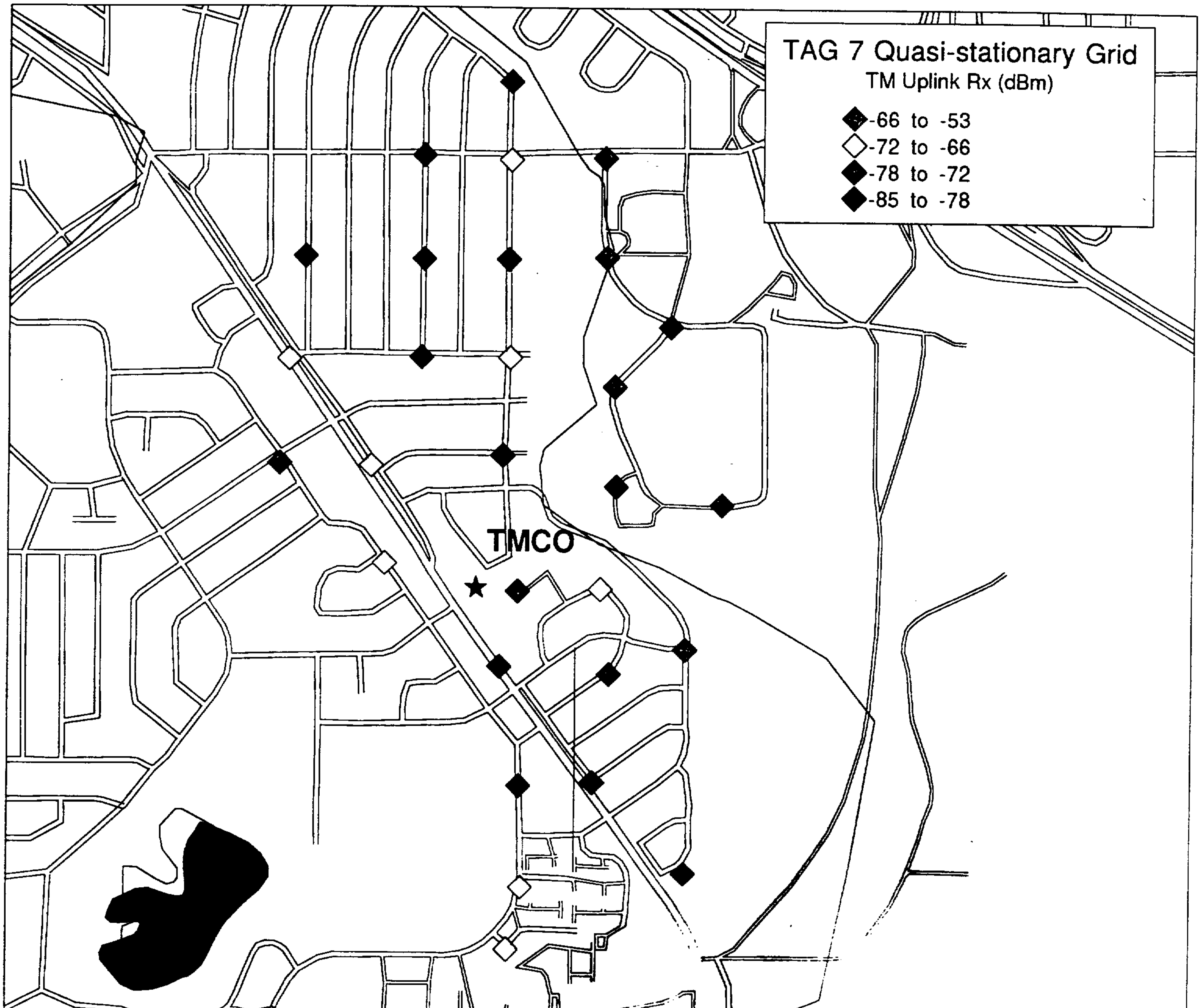
Map 5.3.3.5


TAG 7 Quasi-stationary Grid
Wal Uplink Rx (dBm)
-63 to -50
-68 to -63
-75 to -68
-84 to -75
WCO

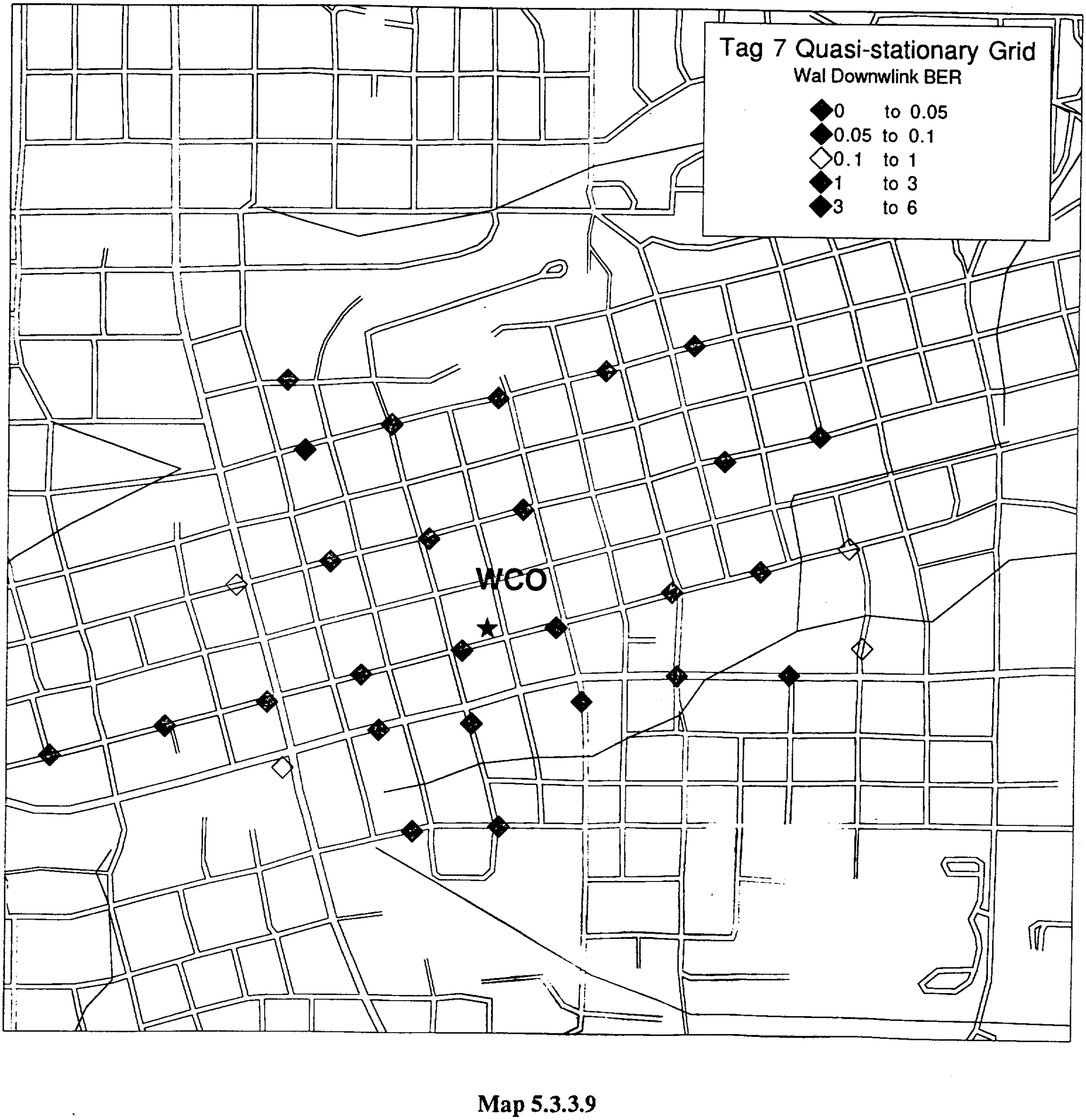
Map 5.3.3.6


TAG 7 Quasi-stationary Grid
TM Downlink Rx (dBm)
-67 to -55
-74 to -67
-82 to -74
-87 to -82
TMCO

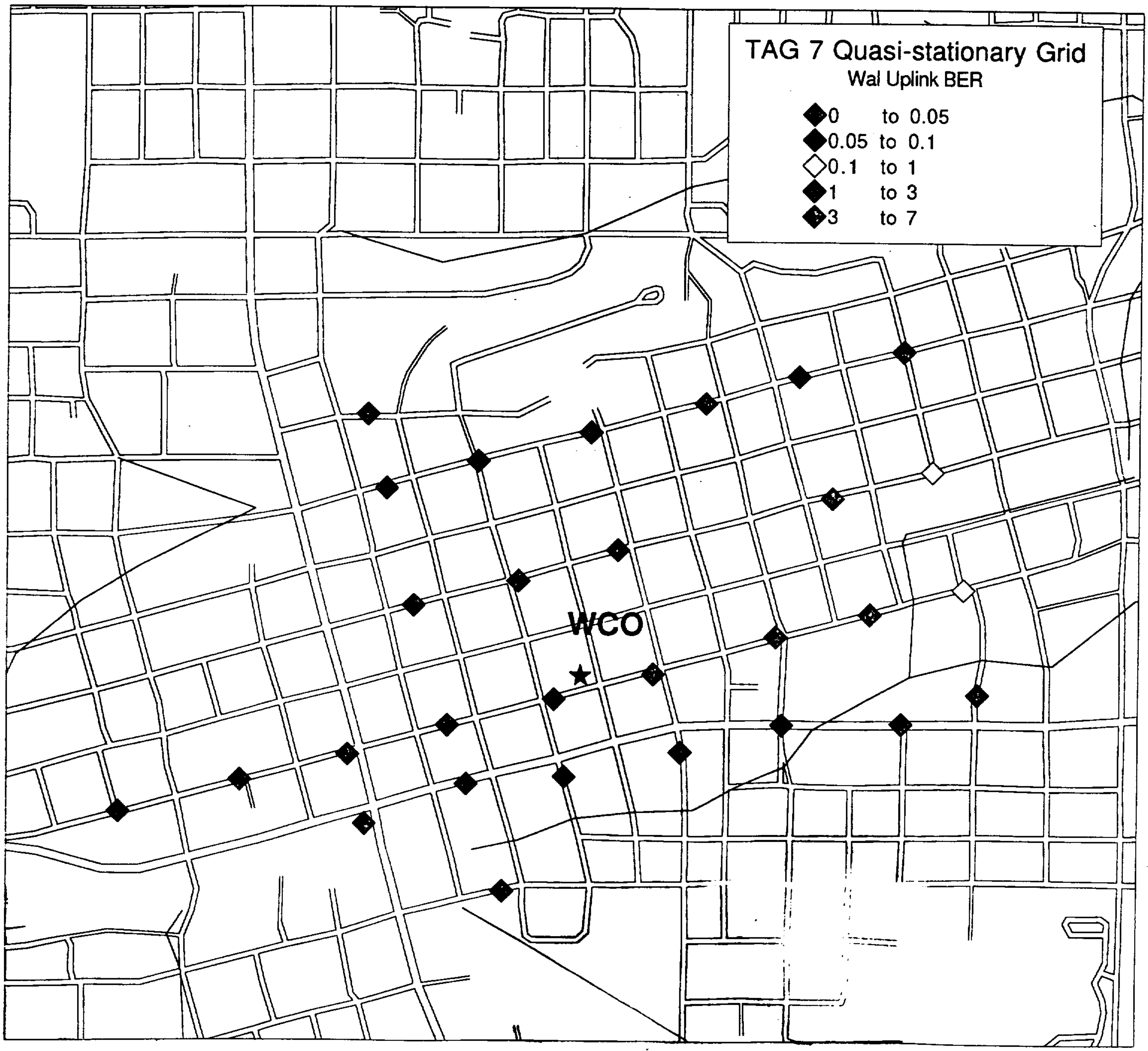
Map 5.3.3.7


TAG 7 Quasi-stationary Grid
TM Uplink Rx (dBm)
-66 to -53
-72 to -66
-78 to -72
-85 to -78
TMCO

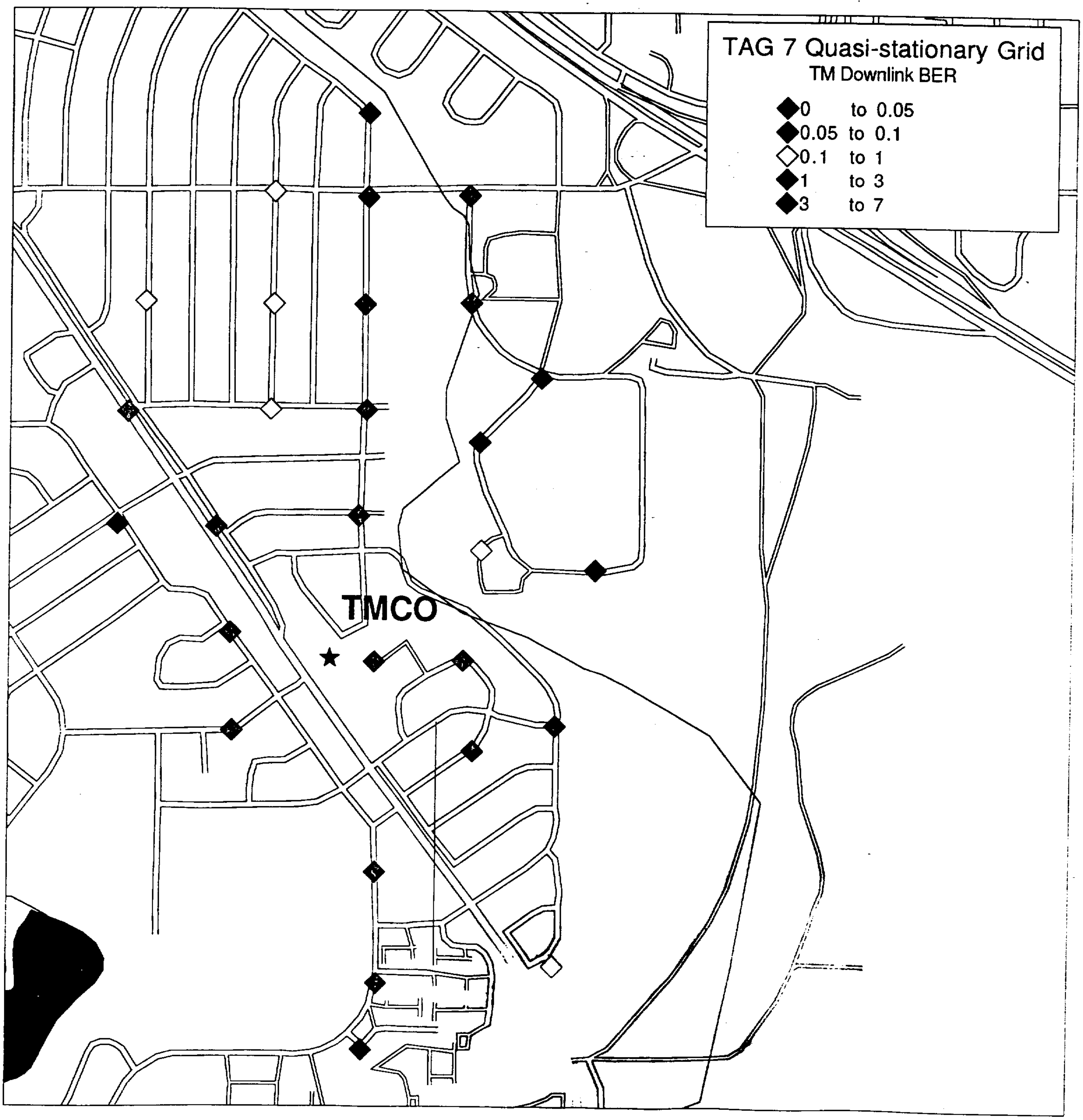
Map 5.3.3.8


Tag 7 Quasi-stationary Grid
Wal Downwlink BER
0 to 0.05
0.05 to 0.1
0.1 to 1
1 to 3
3 to 6
WCO

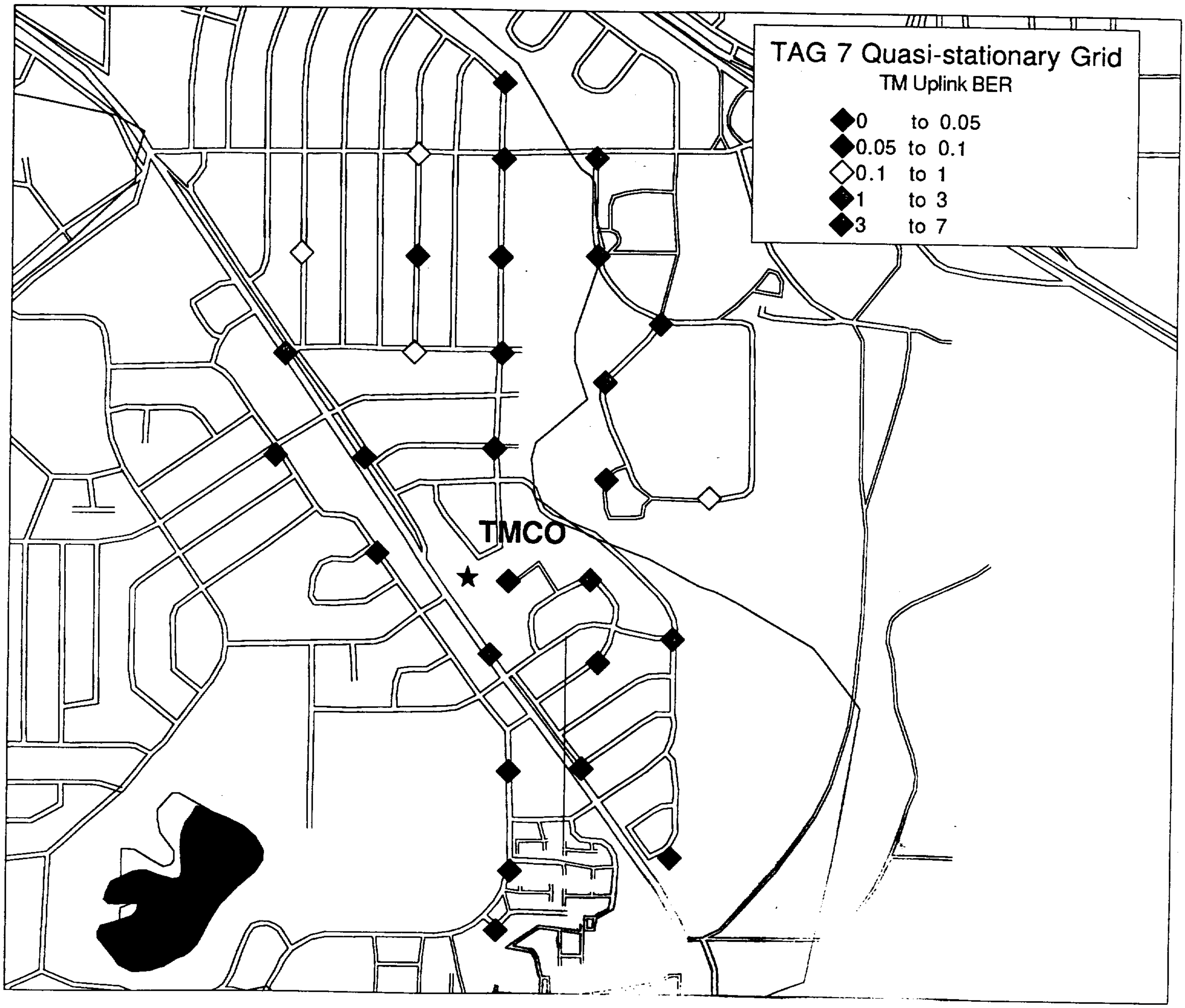
Map 5.3.3.9


TAG 7 Quasi-stationary Grid
Wal Uplink BER
0 to 0.05
0.05 to 0.1
0.1 to 1
1 to 3
3 to 7
WCO

Map 5.3.3.10


TAG 7 Quasi-stationary Grid
TM Downlink BER
0 to 0.05
0.05 to 0.1
0.1 to 1
1 to 3
3 to 7
TMCO

Map 5.3.3.11


TAG 7 Quasi-stationary Grid
TM Uplink BER
0 to 0.05
0.05 to 0.1
0.1 to 1
1 to 3
3 to 7
TMCO

Map 5.3.3.12

Appendix B Manufacturers Statement

Oki Electric Industry Co. Ltd. would like to thank U S WEST, NTIA and the Institute for Telecommunication Sciences (ITS) for their support during the demonstration of the performance of the W-CDMA radio air interface at the Boulder Industry Test Bed (BITB) in Colorado. We found the atmosphere and attitude during the tests positive and cooperative.

The purpose of this test was to prove the air interface functionality and to ascertain coverage area and speech quality. These tasks were successfully accomplished.

The test was done with non-commercial hardware. The BS and PS transmitter output power was 200 50 mW which met the specification. The ADPCM speech quality was excellent when the PS was inside the coverage area. The W-CDMA coverage area was smaller than the specification because of the following hardware imperfections:

RF shielding was imperfect. The resulting 1.9 Ghz leakage produced a 2 kHz beat signal which reduced tracking capability of the RAKE receiver. The degraded receiver sensitivity reduced the coverage radius to less than half of that expected.

The W-CDMA MOS value was also lower than the specification because of the same hardware imperfection.

Appendix C STATEMENT OF THE INDEPENDENT OBSERVER

The Institute for Telecommunication Sciences (ITS) was asked by the JTC to function as the independent observer of the JTC technology field trials. Michael G. Laflin, of ITS, was the primary observer for this field trial.

ITS would first of all wish to express its deep appreciation to Jim Corliss, Vladan Jevremovic, and Michelle Owens of US West Advanced Technologies. Without their high degree of competence and dedication this technology field trial would not have been possible. We would also like to thank the members of the TAG 4 team for their hard work and cooperation in the conduct of this trial.

The fourth technology to undergo field testing at the US West Advanced Technologies Boulder Industry Testbed is that standardized in the JTC Technology Ad Hoc Group 7 (TAG 7).

The Independent Observer's (IO) job is to ensure that the tests are conducted according to the JTC approved test plan and that the resulting test data is accurate and complete. In this the function the IO was deeply involved in the planning of the test, directed the calibration/verification, assisted in the execution of the tests, served as a primary field note taker, and assisted with the report writing and was the editor of this report.

The report of the IO is that the testing was conducted in accordance with the test plan and that the testing was conducted with the integrity and honesty expected from a group of professionals such as those that worked on this field trial. As stated in the previous field trial reports, there is always more detailed analysis one would have wished to do and additional tests that one would have liked to have performed. However, under the extreme time constraints and limited resources, the tests were done well and the results are representative of the system performance in this deployment scenario.