CITY OF TUCSON, ARIZONA
DEPARTMENT OF TRANSPORTATION

ENGINEERING DIVISION
ACTIVE PRACTICES GUIDELINES

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EFFECTIVE: 2/10/2000

APPROVED BY: [signature] — City Engineer

DATE: 2/10/2000

SUBJECT: GENERAL REQUIREMENTS FOR PRELIMINARY ENGINEERING SURVEYS PREPARED FOR THE ENGINEERING DIVISION OF THE CITY OF TUCSON, ARIZONA

1. <u>GENERAL REQUIREMENTS:</u>

1.1 The City Surveyor is responsible for establishing criteria for field notes and survey accuracy. The City Surveyor is available for consultation during normal business hours in the office of the City Engineer (phone 791-5100). Special criteria for specific projects may be established by the City Project Manager / Engineer.

1.2 These guidelines are intended to be used in conjunction with and as a supplement to other Engineering Division Office Procedures. The following procedures are to be used in the course of performing preliminary engineering surveys for the City of Tucson. Should it become necessary to deviate from these guidelines, the City Engineer or his designee shall outline a course of action that will best suit the particular situation.

1.3 Surveys intended to be used for establishing new or existing rights-of-way shall utilize all techniques, equipment, research and materials required to produce accurate, professional, state of the art result.

1.4 Field points in the form of monuments, offset control, station nails, etc., shall be left in place to facilitate retracement work.

1.5 The survey shall begin with a title page stating: the project name, survey crew members, date(s) of survey work, purpose of survey, special instruction, weather conditions, and index, and the seal and signature of the responsible registrant. A location map is desirable for all projects and required if the project is not near existing major street locations.

1.6 The boundary survey or control survey will show all measured distances, angles, found and set monuments/survey points, and include ties to nearby survey points not utilized on this survey. Sufficient information shall be included to enable a new surveyor to retrace the survey.

2. VERTICAL CONTROL

2.1 Bench circuits shall be established throughout the length of an improvement project. Maximum distance between established B.M.'s shall be 500 feet.

2.2 Preferred B.M.'s are atop concrete slabs or curbs that will not be disturbed by the construction of the project. B.M.'s shall be fully described by material, location, and elevation.

2.3 The beginning point shall be fully described, and a reference (by number and page) to a City of Tucson, Department of Transportation Field Book is required. References to Pima County, Sanitary District, A.D.O.T. or private system is allowed only when no City of Tucson B.M.'s are within one mile of the project.

2.4 If the project is one mile or more in distance form a City B.M., the City Surveyor will be notified in an attempt to allow the City to establish a B.M. within the one mile limit. If the City cannot establish a B.M. within five working days after receiving notice, the consultant surveyor/engineer shall proceed in a manner consistent with good engineering judgement.

2.5 Where B.M.'s cannot be set because of a lack of permanent location, a turning point may be used. Turning points shall be described as fully as possible. In no situation is it permissible to exceed 1200 feet between B.M.'s.

2.6 Notes for bench circuits shall be neatly kept in a standard sized, bound, field book approved by the City Engineer (Lietz No. 8152-75 or equivalent, size 6-1/2" x 8-1/2"). The preferred format for keeping bench circuit field notes is shown in Figure 1.

2.7 Bench circuits shall be run between approved B.M.'s. The bench circuit shall be returned to the point of beginning, checking each intermittent B.M. Double rodding a line is acceptable. No B.M. circuit shall be dead-ended. <u>Closure error shall not be greater than 0.02 feet per ½ mile</u>. If the field circuit does not close, the circuit must be re-run in the field. Office adjustment of a circuit is not acceptable and will not be approved.

2.8 Bench circuits shall only be run using a conventional level (3-wire method preferred) or an electronic digital level. Total Station or TRIG. Leveling is not permitted unless approved in advance by the City Surveyor.

3. HORIZONTAL CONTROL

3.1 Horizontal control lines shall be Section lines, Quarter Section lines, Sixteenth Section lines, Centerline, Monument line or an offset line parallel to one of the above lines. Random lines are not permitted unless approved in advance by the City Surveyor.

3.2 Once a control line is established, all cross streets shall be referenced to the control line by use of existing monuments, or occupation. Each intersection shall have a station of the cross street, and an angle from the control line to the cross-street, monument, or centerline.

3.3 Horizontal control error of closure shall be verified by a closing traverse. Maximum allowable error shall be one part in 50,000.

3.4 Stations shall increase towards the east and south.

3.5 Field notes shall detail each monument found, used, or established on the project. A complete written description (including all markings) shall be used for each monument. All survey points found, whether correct or not, shall be referenced to control lines.

3.6 All projects will be referenced to at least two local geodetic control points. Data for local geodetic control is available through the City Surveyor's office or over the Internet by following the instructions in Figure 2.

4. CULTURE

4.1 Culture measurements shall consist of locating physical features, natural or man-made, by referencing to a control line. Any physical feature or object that would have an effect on the design of the project shall be located. If there is any doubt, LOCATE THE OBJECT.

4.2 Any object that is found in the potential property acquisition or easement area shall be located.

4.3 Objects that need to be located include pavement, curbs, catch basins, drainage structures, utilities, manholes, water valves and boxes, cleanouts, traffic signals, light poles, pull boxes, fences, walls, sidewalks, housewalks, gates, buildings, drainage ditches, sprinklers, landscaping, driveways, and other items affecting the design of projects. In determining what to locate ask "Does this object have to be joined, removed, relocated, or replaced because of this project?" All culture shall be measured to the nearest 0.1' for outs, and 1 for stationing.

4.4 The standard note keeping procedure is to locate culture by means of sketch (see Figure 3) on the left-hand page. The right-hand page is reserved for cross-sections (see Figure 4). The use of City of Tucson drafting standards for physical objects is required. A note identifying unusual objects is required. Buildings shall be shown, stationed at the outer walls and outs provided to the nearest part of the building. Addresses shall be so noted for each building. Landscaping within the public right-of-way shall be noted by boundaries unless a large tree or cactus is encountered. Those objects shall be individually located.

4.5 Data collection is an acceptable alternative to standard note taking. A culture plot with symbols and point numbers (see Figure 5) on one page and northing, easting, station, offset, elevation, and description (Figure 6) on the next page is acceptable. All data collected projects will be submitted in hard copy and digital formats (DXF or DWG). City of Tucson Drafting Standards, office procedure number 8-1552-002, shall be strictly adhered to.

4.6 A complete blue staking of the project area is required. Stations and offsets of all blue staked lines will included in the field notes and digital files. Blue stake data shall include, but not be limited to: date, time and attendees of blue stake meeting (if required), rim elevations of manholes, clean-outs and water valves, flow line details and elevations of sanitary sewers and storm drain manholes, elevations of water valve nuts, serial numbers of water meters and location of all over-head lines.

5. CROSS SECTIONS

5.1 Elevations shall be based on City of Tucson bench circuits, as approved by the City Engineer or City Surveyor. Elevations should be taken outside the boundaries of culture. Such detail is necessary and in some instances, mandatory. Major intersecting streets shall be sectioned at 50' intervals plus all break points. Outs may be paced if the rod carrier has an accurate pace. Frequent checking of paced-outs against culture is mandatory. Major intersections shall be cross-sectioned a minimum of 200' on each side of the centerline. Streets with flat grades (less than 0.4%) shall be cross-sectioned to a greater extent than other streets. When cross sectioning major intersections, a section shall be taken at centerline, along the curb line of a median (top and gutter) if a median exists, along outer curb line (top and gutter), along back (property side) of sidewalk, and along property line. Elevations for all concrete and asphalt shall be to the nearest 0.01'. Earth elevations may be to the nearest 0.1'. Elevations of all drainage inlets and outlets shall be taken to the nearest 0.01'.

5.2 Cross sections at mid block shall be taken every half station. At full station, the section shall include center of road, pavement edge (if any), grade breaks, drainage swales (flow line and tops of banks), property line and 100' or greater from centerline. At +50 stations the section may stop at property line with elevations taken at the same locations as at full stations. Floor elevations shall be taken to the nearest 0.01'. Existing elevation of the ground at the building shall also be measured. When housewalks or paved driveways are encountered, the elevation of the ground and top of walk or driveway shall be measured and noted. Elevations shall be measured at the north-most rim of manholes. The manhole lid shall be removed and a depth from rim to inlet/outlet flow lines shall be measured. The inlet and outlet pattern shall be shown schematically in the field notes in accordance with attached examples (Figure 7). The depth of the neck of the manhole shall also be measured and noted.

5.3 Field notes for cross sections shall be shown on the right-hand page. If at all possible, the section shall be written directly opposite the culture of the same section. The note for that section shall have the station on the left side of the page. In the center of the page, the centerline elevation shall be noted and sections to right or left of centerline shall be noted similarly on the page. Elevations shall be shown in fraction form with the numerator being the elevation and the denominator being the out. The direction of the out (north, south, east, or west) shall be noted on top of the page or at the first out away from centerline.

5.4 When drainage channels or swales are encountered, they are sectioned similarly to street intersections. Sections shall be taken at property line for the channel (if it is a dedicated easement or right-of-way), top of bank, toe of bank, flow line, thalwag/scour line and any unusual conditions. Major drainage channels may require establishment of the dedicated center of the channel, and culture and sections measured along the channel. If the major channel is not dedicated, an estimated centerline should be traversed as a control line. In either case, the length of the channel to be measured depends on conditions at each site. In general 300' to 500' each side of the road is sufficient. Verification of the extent of measurement may be made with the City Project Manager/Engineer.

5.5 When unusual conditions are encountered, written notes explaining the situation will be necessary. The notes shall be concise but complete. If any doubt exists, the measurement should be recorded, the situation described, and the City Surveyor consulted.

Figure1

B.M. CIRCUIT: 29TH ST.
FROM SWAN RD. TO CRAYCROFT RD.

MAY '95
VALENZUELA
WINGSTROM

(WILD NA 2002 DIGITAL LEVEL)

#	BS	HI	FS	ELEV.	DESCRIPTIONS
1				2567.940	'X' ON CENTER OF HEADWALL OF CULVERT ON S/E COR. OF 29TH ST. & SWAN RD. (F.B. 1775 PG. 26 BM 23)
2	5.838	2573.778	5.014	2568.764	'X' ON N/W COR. OF BUS SHELTER PAD, JUST E. OF SWAN RD. & N. SIDE OF 29TH ST.
3	5.146	2573.91	3.142	2570.768	FND. CROWSFOOT ON BACK OF SIDEWALK IN FRONT OF FIRE HYRANT ON THE N/E COR. OF 29TH ST. & MT. VIEW AV.
4	6.169	2576.937	4.784	2572.153	T.P.
5	6.387	2578.54	5.434	2573.106	'X' ON S/E COR. OF WALKWAY IN FRONT OF BLDG. #4857 E. 29TH ST.
6	6.346	2579.452	4.969	2574.483	T.P.
7	5.760	2580.243	4.777	2575.466	FND. 'X' ON BACK OF WALKWAY ON THE S/E COR. PORCH OF BLDG. #4901 E. 29TH ST.
8	6.581	2582.047	3.957	2578.090	'X' ON WALKWAY ON THE S/W COR. OF BLDG. #4963 E. 29TH ST.

INSTRUCTIONS FOR USING PIMA COUNTY'S MAPGUIDE TO DOWNLOAD GEODETIC DATA FOR THE TUCSON METROPOLITAN AREA

The City of Tucson's Geodetic Control Data is now available on the Internet using Pima County's MapGuide site. The following is a brief explanation of how to access this information. If you are unable to use this site the City of Tucson's Survey Section will continue to provide this information to you.

If you are already familiar with the MapGuide site jump ahead to step 6.

1. Begin by starting your internet browser. The address for the Pima County MapGuide site is **//www.dot.co.pima.az.us/**. You will probably want to bookmark this site.

2. Once you have reached the Department of Transportation home page select: **VIEW PIMA COUNTY DATA LAYERS**.

3. Under the heading of TO VIEW PIMA COUNTY DATA LAYERS select **download**. This will take you to AutoDesk MapGuide site; follow the installation instructions for MapGuide.

4. Return to the Department of Transportation home page and again select **VIEW PIMA COUNTY DATA LAYERS**. Then select **View Pima County GIS data layers.**

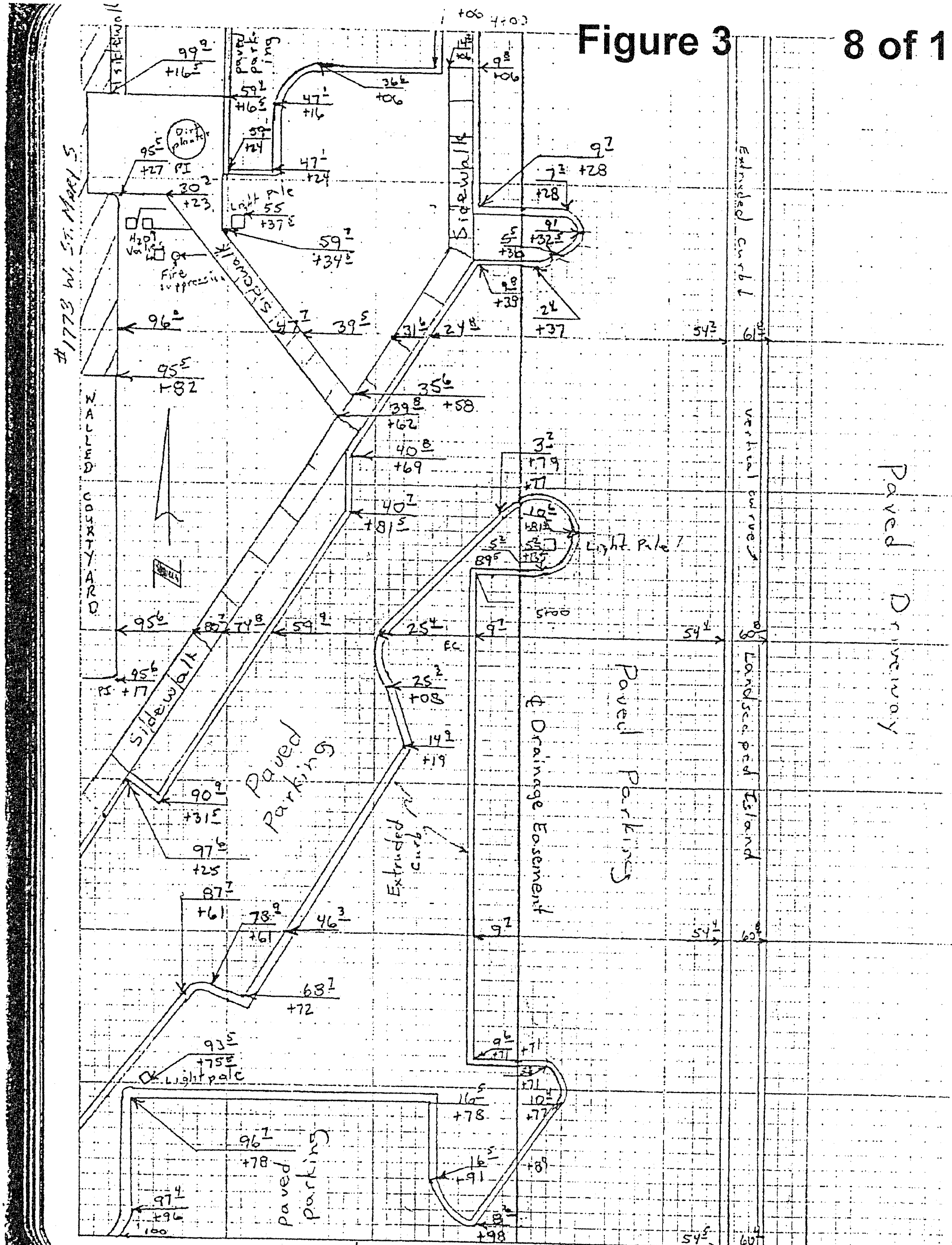
5. You should now be looking at a map of Pima county. Zoom into your area of interest by either right clicking and selecting zoom or by using the zoom button on the tool bar.

6. Once you are viewing your area of interest, select the **Geodetic Control** Layer on the left side of the screen. Now blue and white boxes should be visible; these represent the Geodetic Control points. Double click on the point that you want.

7. This will bring you to the geodetic values for that point; you may want to print this page. If you would like a description of this point, select **GPS Static Data Session Sheet(s)**. At this point you may need to download a TIFF viewer. If so follow the prompts. If not, you should now see the session sheet.

If you have any problems or questions just give us a call at the City of Tucson Survey Section at 791-5100, we will be happy to assist you.

Figure 3



NOTE! 6+00 IS THE SOUTH END of DEDICATED EASEMENT.

West 4+00 East (30)

1773
2362.11 FLR 61.8 GND

Figure 4

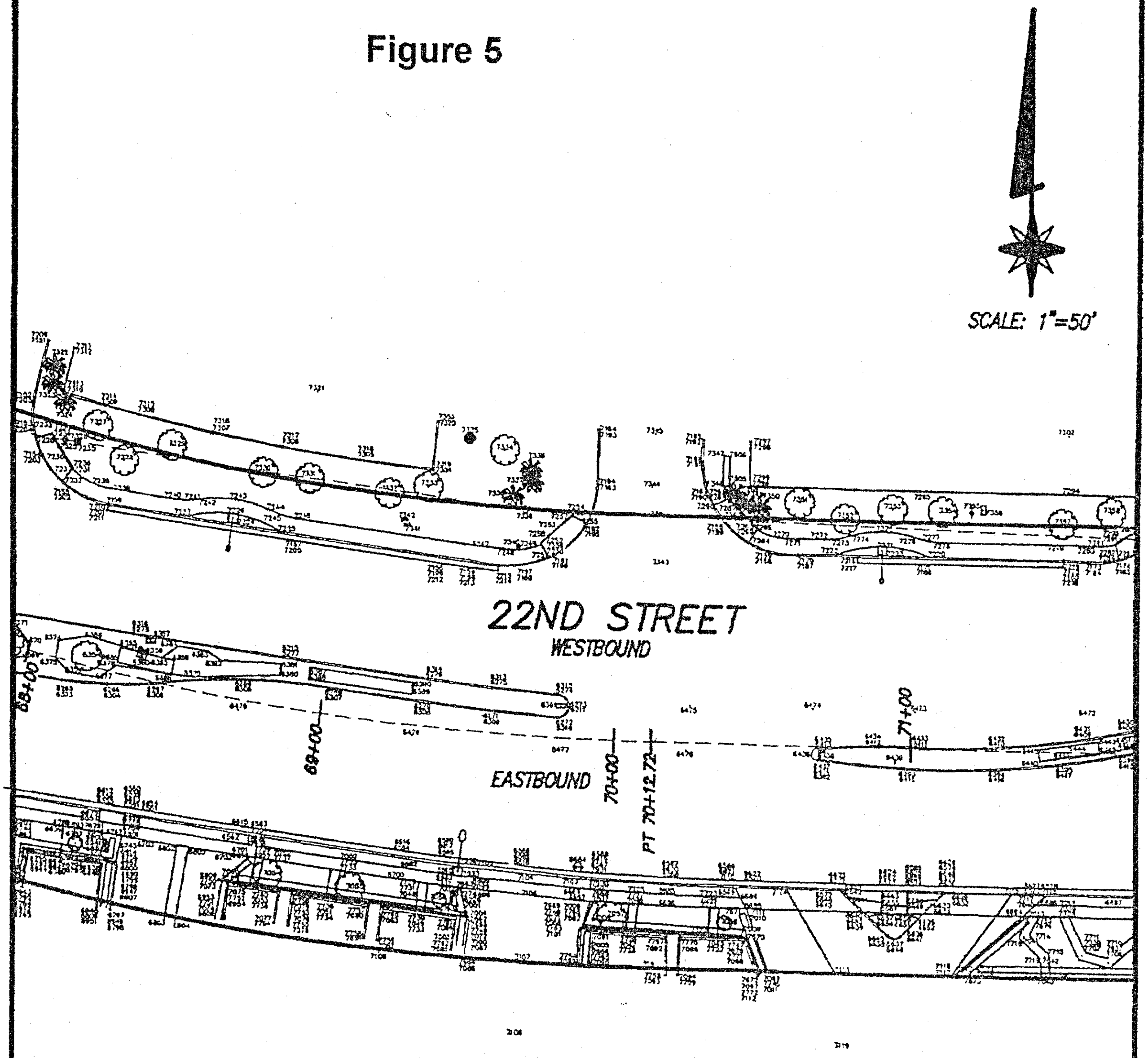
4+50 26 61.8/96 58.81/47.7 SW 58.77/39.5 SW 58.59/31.6 SW 58.41/✓ TC 57.97/24.8 Gut 57.56/0 57.55/30 57.83/54.2 Gut 58.29/✓ TC 58.39/61.8 TC 57.51/✓ Gut 57.00/100

5+00 60.99/95.6 59.49/80.7 SW 59.44/74.8 SW 59.17/✓ TC 58.68/39.9 Gut 58.21/✓ Gut 58.72/25.4 TC 58.34/✓ TC 58.36/9.7 Gut 58.27/0 58.00/30 58.22/54.4 Gut 58.69/✓ TC 58.60/60.8 TC 57.76/✓ Gut 57.33/100.

5+50 23 59.07/100 59.65/✓ TC 59.16/44.3 Gut 59.6/30 59.36/✓ TC 59.28/9.7 Gut 58.90/0 58.47/30 58.32/54.4 Gut 59.29/✓ TC 58.87/60.8 TC 58.00/✓ Gut 57.65/✓ 100

6+00 2 59.70/100 59.46/50 59.35/30 59.04/0 58.9[illegible]/30 59.17/54.6 Gut 59.[illegible]/✓ TC 59.17/60.4 TC 58.[illegible]/✓ Gut 57.9[illegible]/100

Figure 5

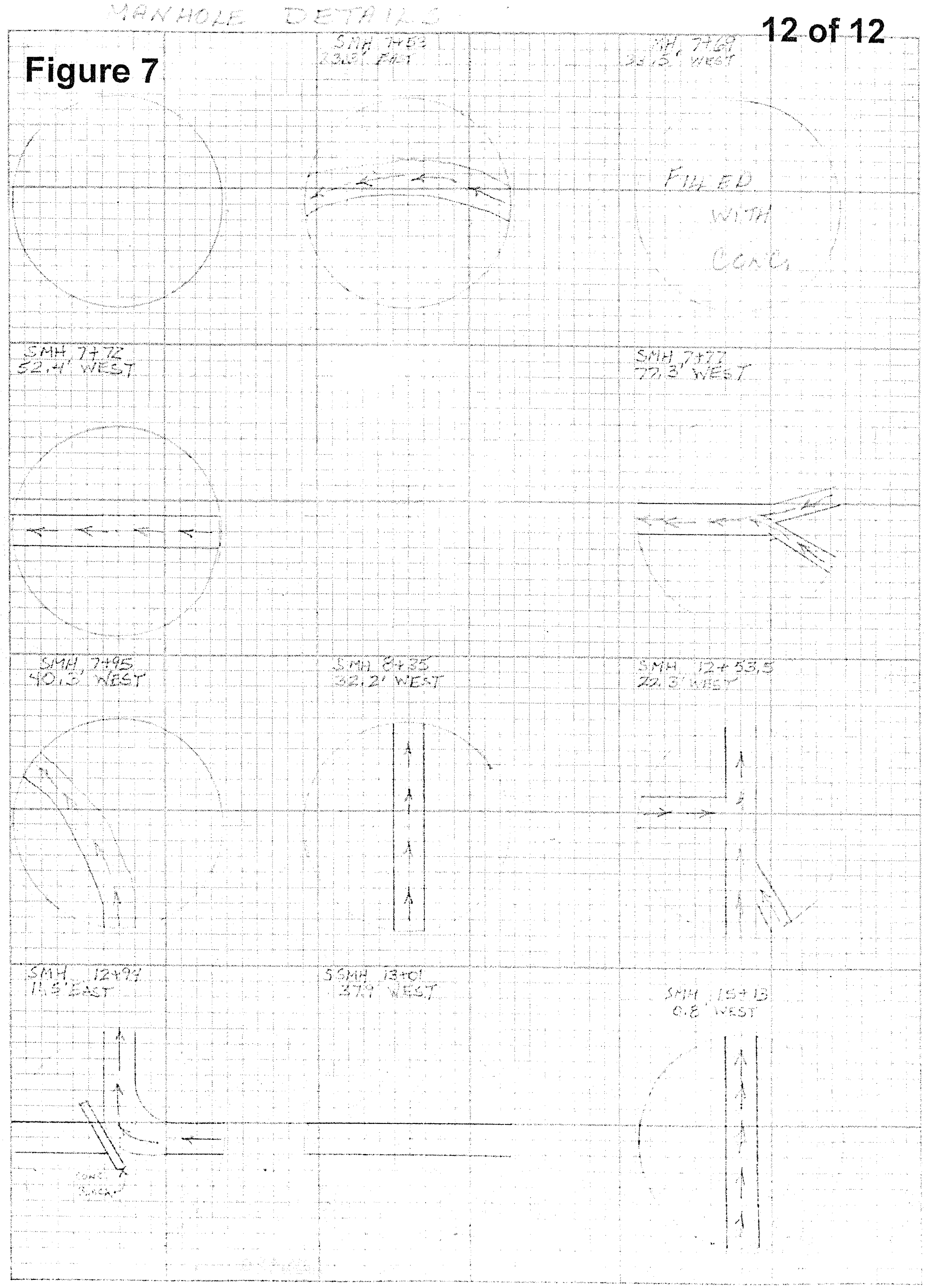


SCALE: 1"=50'
22ND STREET
WESTBOUND
EASTBOUND
68+00
69+00
70+00
71+00
PT 70+12.72

Figure 6

68+13.09	6.41	6265	BOC1	8015.779	8447.829	2616.87
68+13.68	74.70	6745	HEDGEL	7949.235	8432.498	2617.98
68+13.68	64.02	6913	MFCE	7959.622	8434.989	
68+14.01	64.31	6755	MFCE	7959.248	8435.269	2617.06
68+14.53	-54.03	7156	BOC	8074.235	8463.251	2615.49
68+14.57	75.91	6912	MFCE	7947.829	8433.163	
68+14.59	-53.24	7201	GUT	8073.460	8463.122	2614.99
68+14.78	3.19	6353	SN	8018.524	8450.229	2616.52
68+14.81	-51.60	7211	LIP	8071.814	8462.942	2615.03
68+14.83	64.90	6944	GUTX	7958.476	8435.981	
68+14.84	-53.28	7210	LIP	8073.442	8463.362	2614.95
68+14.90	76.21	6754	MFCE	7947.453	8433.442	2618.28
68+14.91	3.69	6376	CONC	8018.001	8450.236	2616.82
68+15.41	65.42	6793	GUTX	7957.820	8436.471	2617.52
68+15.81	77.13	6943	GUTX	7946.327	8434.188	
68+16.34	77.08	6792	GUTX	7946.243	8434.762	2618.18
68+16.67	-59.21	7239	SW	8078.817	8466.396	2615.66
68+16.86	-69.23	7328	TREE1	8088.531	8468.859	2615.81
68+18.60	-9.67	6386	CFCONC	8030.159	8456.878	2616.52
68+18.69	-84.66	7308	BOC	8103.167	8474.007	2616.36
68+18.71	-85.25	7315	GUT	8103.743	8474.160	2615.88
68+19.42	-3.12	6354	TREE1	8023.597	8456.183	2616.40
68+24.23	54.19	6939	ROCK	7966.632	8448.199	

Figure 7


MANHOLE DETAILS
FILLED WITH CONC.
SMH 7+72
52.4' WEST
SMH 7+77
72.3' WEST
SMH 7+95
40.3' WEST
SMH 8+35
32.2' WEST
SMH 12+53.5
22.3' WEST
SMH 12+97
11.9' EAST
SSMH 13+01
37.9' WEST
SMH 15+13
0.8' WEST