Engineering Surveys
Survey & Mapping Services
Technical Services

ENGINEERING SURVEY STANDARDS FOR CONSULTANTS

Version 2.5

Engineering Surveys Contacts

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For list of revisions see page 44

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ENGINEERING SURVEY STANDARDS FOR CONSULTANTS

These survey standards outline the ***minimum*** requirements for Engineering Survey operations. The *appendices* shall form part of these standards.

Notwithstanding any procedure or standard, survey work shall be conducted in compliance with Ontario's ***Occupational Health and Safety Act and its Regulations*** (latest edition) and other applicable health and safety legislation.

1. Abbreviations

- **COSINE** denotes **CO**ntrol **S**urvey **IN**formation **E**xchange database (Ontario)
- **HCM** denotes **H**orizontal **C**ontrol **M**onument as published by COSINE
- **GBM** denotes **G**eodetic **B**ench **M**ark as published by COSINE
- **SCM** denotes **S**ub-**C**ontrol **M**onument
- **TBM** denotes **T**emporary **B**ench **M**ark
- **GPS** denotes **G**lobal **P**ositioning **S**ystem
- **WM** denotes **W**atermain

2. Integrated Survey

- Surveys must be integrated into the existing horizontal and vertical control network and must be geographically referenced to the Ontario Coordinate System (MTM NAD27/CGS 1928).

3. Reconnaissance

- Control points (HCM's) used must be ***verified.***
- **Verified Control Sheet** status, measured ties, crew names and date must be reported to City of Toronto Control Surveys Ken Soubasis @ 416-392-4845
- Destroyed HCM's should be reset if sufficient ties are available;
- SCM's must be **durable** for current and future projects;
- SCM's shall form part of a balanced traverse;
- SCM's must be ***referenced*** to at least 3 ties for future resetting & a **sketch** prepared;
- TBM's must be described and **recorded**.

4. Leveling

- Leveling must begin on a GBM and terminates on another GBM;
- The standard of **accuracy** is a Class 2, as specified in the *Standards.*[1] *(**Appendix 'A'**)*
  - Single run
  - Max. length of sight: 50 m
  - Max. difference in length: 10 m
  - Max. closure: 8 mm x Square root of km
- **Adjust** and balance elevation if closing error is within the ***tolerance*** of:
  - 10 mm in 1st km or
  - 8 mm x square root of km
- If the closing error is greater than the ***tolerance***, then the leveling must be corrected and/or re-run;

5. Traverse Survey

- Hanging lines/points must be verified with an additional independent observation;
- A traverse using existing HCM's and established SCM's must be integrated and documented;
- A closure precision for a given traverse should be greater than 1/7000 as stated in the *Standards.*[1] *(See **Appendix 'A'**);*
- All traverse must be adjusted and balanced;

6. GPS Survey

- A GPS Survey may be used. The survey must be checked and documented to a minimum of three (3) known integrated control monuments in the perimeter of the survey area. GPS must not be used for precise elevations.

7. Pre-engineering Survey

- The pre-engineering survey must completely encompass all of the areas required to achieve a comprehensive design of the project as set out by the City of Toronto Project Engineer.

A. ***Numbering Convention***

- HCM's: COSINE Station Number
- Topograhic features: Points 1000 and upward

B. ***Feature Code and Connectivity***

- The latest version of P-codes must be used
- Consultant must obtain current P-codes prior to commencement of each project

- Apply connectivity where applicable in accordance with Bentley InRoads software
- A curved feature must be defined by a minimum of 5 points

C. ***Subsurface Utility Survey***

Safety hazards must be assessed and the appropriate safety precaution must be taken in accordance with the Ontario Health and Safety Act before any field work can begin.

Subsurface Utility Surveying is the process of gathering underground information about a manhole and its associated attributes.

- Center of lid shall be coordinated
- The following attributes shall be gathered and recorded as per attached ***Appendix 'H'***:
    - Type/purpose of utility, ie. Storm, sanitary, hydro, etc.
    - Size/diameter of pipe and chamber
    - Depth to invert, top of pipe, top of spindle, etc.
    - Location of pipe inlet and outlet
    - Chamber Wall location if required

D. *Locate Survey of sub-surface utilities* (As required)

Sub-surface utility locates are governed by Sub-surface Utility Engineering practices (SUE)

8. Construction/Layout Survey

- Discuss the project thoroughly with the Project Engineer, make written notes of the discussions and instructions

- Bring any observed inconsistencies to the attention of the Project Engineer immediately. Do not continue to work until receiving instructions from the Project Engineer.

- All critical layout points must be recorded and independently verified to ensure their validity and correctness.

- All match points must be verified to satisfy existing conditions.

- Layout/offset points and the reference feature must be **recorded** digitally for verification & future reference
- Perform an as-built survey where applicable *(**See Section 10: As-built Survey**)*

Post Construction Duty

- Final inspection of HCM's within the construction area;
- Prepare a summary report on the status of HCM's and GBM's;

9. Construction Measure-Up Survey

At the request of a project engineer, a measure-up survey will be conducted to determine the surface area, volume of material, length of pipe and so on, for the purpose of final payment.

Please refer to ***Appendix 'B'*** for procedural guideline.

10. As-Built Survey

An as-built survey is a standard operating procedure in the life cycle of an engineering project. This survey applies to city-owned underground utilities such as water main, storm and sanitary sewers.

All elevations must be referenced to the same datum as the original pre-engineering survey.

The following utility data must be collected:

a. Top or invert of newly installed pipe, wherever possible;
b. Utility nodes such as vertical and horizontal bends in the pipe;
c. Exposed existing utilities (private and public);
d. New and existing chambers, manholes or structures; and
e. Coordinate a *reference feature* (ie. gutter), if a pre-engineering survey is not available

- Identify type, material, diameter of exposed utilities;

All data must conform to City of Toronto Sewer & Water As-Built standards.See ***Appendix 'N'***

11. Survey Records

Survey record plays a critical part in the operation of our business. It includes documents in both paper and electronic format (ie. letters, e-mails, plans, drawings, old survey notes, new notes, mark-up control sheets, mark-up drawing, etc.) Survey records are the property of the

City of Toronto and must be preserved and protected and shall be provided to Engineering Surveys.

Field Notes

- Field note must be prepared at the time of survey.

*For a guideline on field notes, please see **Appendix 'C'**.*

Data Collector File Output

- All downloaded files containing field raw data must **not** be edited, manipulated or processed;
- A copy of the raw data files will be used for processing and editing.

Survey Folder (Field)

- Use the Check List (***Appendix 'E'***) to ensure that the required items are in the survey folder.

12. Engineering Surveys CAD Standards

- All files must be created using **Bentley MicroStation V8** and **Bentley InRoads Version 8.05**
- Naming convention see *Appendix 'M'*
- Project Directory must be created in accordance with ***Appendix 'D'***
- Create output files in accordance with City of Toronto standards ***Appendix 'G'***
- Create an *As-Constructed Survey Drawing*

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APPENDIX 'A'

Summary of Engineering Survey Standards

The **Geodetic control network** used by The City of Toronto is based on**:**

1. The Horizontal Datum *(A spheroidal reference surface)***:**
   "The North American Datum of 1927 (NAD27)"
   - **Must be able to supply information in "The North American Datum of 1983 (NAD83)"when legislated by the Province of Ontario.**

2. The Vertical Datum *(a geoidal model)***: "G.S.C. 1928"**

3. The projection **: "Modified Traverse Mercator Projection"**

   The parameters are: Zone name = MTM Zone 10
   Zone width = 3 degrees
   Longitude of Origin = –79.5
   Latitude of origin = 0
   False Easting (X) = 304800m
   False Northing (Y) = 0
   Scale Reduction = 0.9999

4. The **standard** used by the Engineering Survey section for sub-control :

   A. Elevation : Second order

   Class 1 (control for large engineering projects)
   Instrument standard : Automatic level
   Double run : forward and backward each section
   Maximum length of sight : 60m
   Maximum difference in length : 5m
   Maximum closure : 6mm x square root of km

   Class 2 (for engineering projects and support for local survey)
   Instrument standard : Geodetic level
   Double run or single run
   Maximum length of sight : 70m
   Maximum difference in length : 10m
   Maximum closure : 8mm x square root of km

   - Run fly levels between **at least two** Geodetic Bench Marks (BM).
   - **Establish** geodetic elevations on all Horizontal Control Monuments (HCM) and Sub-Control Monuments (SCM).
   - All Back Sights (BS) & Fore Sights (FS) on fly levels must be estimated to the nearest 0.001m, to minimize any rounding off errors in closures.

- Difference in elevation between adjacent BM's as obtained from fly levels and check-flys, not to exceed **6mm**.
- Do not use Intermediate Sights (IS) on fly levels.
- Adjust and balance elevation if misclosure is within the tolerances of:
    i. 10mm in 1st km, or
    ii. 8mm x square root of km
    iii. If tolerances are greater than i. or ii. then the fly levels must be corrected and re-run.

B. Horizontal:

- As with all traverses any SCM's set with a closed traverse, must start from 2 fixed HCM's and close on 2 fixed HCM's.
- Azimuth closure at azimuth check point not to exceed 6" per station or 15" x square root of number of stations.
- After azimuth adjustment, the position closure should not exceed **1 part in 7000** (Third Order Class 1 of 1/10000 is preferred). If the error is greater, then the traverse must be rerun and corrected.
- SCM's may be set using the "Free Station Establishment Program". However, attention must be paid to the geometry of the existing HCM's so that a distortion is not created. **At least three existing HCM's** are used for this procedure.

5. The standard graphic user interface for the City of Toronto, Engineering Surveys is **MicroStation V8** (Bentley Systems, Incorporated).

- The electronic field book information must be processed using InRoads software **(Bentley Systems, Incorporated)** in accordance with the City of Toronto Engineering Survey standards
- The following resource files are to be used to create MicroStation design files with InRoads software.

· V8engsurv_2008.fwf	InRoads Feature Table
· V8engsurv_elev_2008.fwf	InRoads Feature Table for Elevation Drawing
· V8engsurv_2008.fxp	InRoads import preferences file
· EngSrv_V8_Cells_V11.dgnlib	MicroStation V8 Cell library
· EngSrv_V8_Levels_V11.dgnlib	MicroStation V8 Level library
· lis_udls.rsc	MicroStation Custom LineStyle resource file
· EngSrv_V8_Seed.dgn	MicroStationV8 3-D seed file
· EngSrv_V8_2D_Seed.dgn	MicroStationV8 2-D seed file

NOTES: *For correct working units* EngSrv_V8_Seed.dgn *as the seed file; For correct display the MicroStation default colour table (color.tbl) is used; No custom fonts are used; All annotation in InRoads uses MicroStation delivered fonts.*

These resource files will be provided by Engineering Surveys.

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APPENDIX 'B'

CONSTRUCTION MEASURE-UP PROCEDURE

WATER MAINS (Road)

- Post construction measurement along trench cut: eg. VC to VC (in conjunction with the as-built);
- Vertical Bends/Loops not included. (Inspectors to tie in and depth from surface)

WATER MAINS (Blvd.)

- Mains, tees, crosses, etc. must be tied in manually by inspector, so surveys can re-plot their location and tie in digitally;
- Once they're tied in digitally, measurements can then be extracted;
- Vertical Bends/loops not included (Inspectors to tie in and depth from surface);
- Driveways materials, asphalt cuts, sidewalk, sod, etc. are measured – upon request from Inspector/Engineer;
- If sod is to be measured, surveys must be notified as soon as the restoration is complete.

SEWERS

- Measure-up is done from center line (CL) of lid to CL of lid, unless actual pipe length is requested;
- If radial pipe is being installed, surveys must be contacted to tie in its location during construction.

ROADS (Reconstructs and Local Improvements)

- All road curb
- All new sidewalk (Local Improvement)
- Sidewalk by replacement (Reconstructs – Inspection)
- Base asphalt and overlay – area in sq. m.
- All sod (Local Improvement) – upon request (Reconstructs)
- Driveway Rehabilitation (Inspection)
- Private curb and walks (Inspection)

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APPENDIX 'C'

PAPER FIELD NOTES

Paper field notes should contain a clear and detailed account of everything found, done and observed in the field, in the course of the survey and should show :

i. A North arrow
ii. Description and Location of survey
iii. Date on each page and the names of the crew's members or their initials.
iv. A Job number and a Contract number if available.
v. Identify offset lines and traverse lines.
vi. Pages should be numbered and each page should indicate the total number of pages used.
vii. Annotate the occupied stations interline points, points of intersection, etc.
viii. Reference to record of field calculations.
ix. After the field survey has been completed, entries on field notes found to be incorrect should not be erased, but stroked out in such a manner that they remain legible, but obviously discarded.
x. Paper field notes should be recorded at the time of observation and where it is deemed necessary to re-draw field notes, the original field notes should be retained and attached to the copies.

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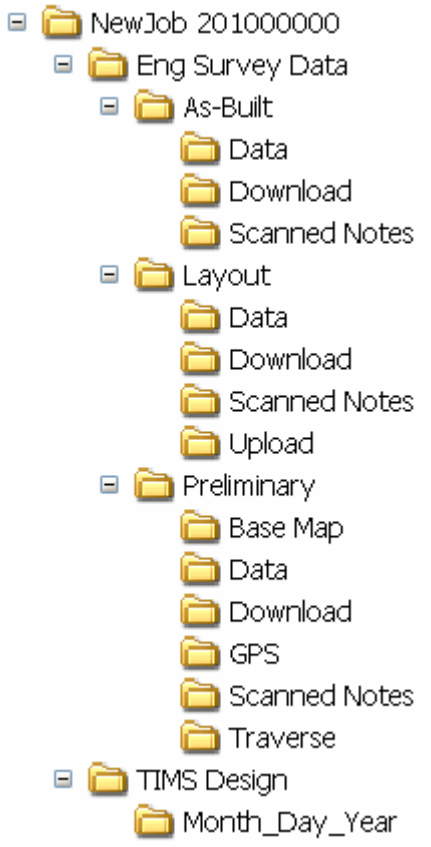
APPENDIX 'D'

FILE STRUCTURE

Refer to ***Appendix 'M'***

FOLDER STRUCTURE

The engineering survey folder structure will be set up as follow:



Note: Files to be placed in the Design folder are those which are finalized and are to be sent for design. Files in the Survey Data folder are working files.

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APPENDIX 'E'

CHECK LIST: CONTENT OF A SURVEY FOLDER

(The content should be checked at the end of each project phase.)

I. **Pre-engineering Phase**
- Used HCM's and their mark-up COSINE Sheets
- Used GBM's and their COSINE Sheets
- Field notes: cover page, traverse, level, sketch
- Adjustment Report (paper copy)
- List of final co-ordinates for the HCM's and SCM's

II. **Construction/Layout Phase**
- Design (engineering) Drawings & proposed layout
- Digital record of offset points
- Reference note to any changes or revision
- Grade sheets

III. **As-Built Phase**
- Used HCM's, GBM's and their COSINE Sheets
- Field note: cover page, sketch, utility depths and dimensions
- Survey Report (*optional*)

APPENDIX 'F'

See Engineering Surveys Microstation V8 Graphic Specification Manual for Feature Code Table

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APPENDIX 'G'

File Deliverables:

G.P.S. Raw File: File containing Datum and Parameters used, number of satellites acquired, and multiple initializations on established control points.

Traverse Report: File showing all errors, method and parameters used to apply corrections.

3 Dimensional Drawing (dgn): A graphical representation of existing conditions containing the field pick-up points in a three dimensional drawing which uses the design standards set out by the District Design groups. (levels, weights, styles, colours, cells, etc)

2 Dimensional Drawing (dgn): A graphical representation of existing conditions containing the field pick-up points in a two dimensional drawing which uses the design standards set out by the District Design groups. (levels, weights, styles, colours, cells, etc)

Elevation Drawing (dgn): A graphical representation containing only the elevations of each point picked up in the field of the existing conditions. The elevations are written graphically to the appropriate levels dictated by the feature table with reference to the feature picked up.

Digital Terrain Model (dtm): Bentley In-Roads file containing the traing-ulated existing surface of the features dictated by the feature table. **Settings**

Alignment File (alg): A Bentley In-Roads file containing the line strings of the existing surface. Features typically included are: Crown of Road, Edge of Pavement, Gutter, Top of Curb (at Back), Front of Sidewalk, Back of Sidewalk, and one other line running parallel behind the sidewalk or curb if no sidewalk is present. **Settings**

Ascii Text file (txt): This file contains all the existing field pick-up points. This file formatted as a space delaminated point file containing: Point number Northing Easting Elevation and Feature code.

Utilities depth report (xls): This file contains all the utility center of lid (X,Y,Z) locations as well the invert depths, invert elevation, direction of invert, and for watermains where measurement was taken **ie:** top of pipe or top of spindle. **Example**

APPENDIX 'H'

CITY OF TORONTO SUBSURFACE UTILITIES REQUIREMENT

APPENDIX 'I'

CITY OF TORONTO INTERSECTION SURVEY REQUIREMENT

APPENDIX 'J'

CITY OF TORONTO CATCHBASIN SURVEY REQUIREMENT

APPENDIX 'K'

CITY OF TORONTO CURB DEPRESSION SURVEY REQUIREMENT

APPENDIX 'L'

CITY OF TORONTO TYPICAL SURVEY LINEWORK REQUIRMENT

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APPENDIX 'M'

Engineering Surveys File Naming Conventions

The Engineering Surveys file naming convention is a combination of prefixes, suffixes, and the project number.

The proposed naming convention would be as follows:

_0800001SVY.*

Project number is used for the tracking of the ongoing project.

_0800001SVY.*

The inclusion of the SVY denotes that these files are produced through direct surveying.

_0800001SVY.*

The prefix denotes the type of survey.

_0800001SVY.***

The suffix denotes the type of Design File. A suffix would be used only for certain design drawings.

The prefixes proposed are:

PS – Preliminary Survey (Pre-Engineering)
FS – Final Survey (As-Built)
MS – Miscellaneous Survey (Sod, Asphalt, Area measure-ups etc.)
BM – Base Mapping Cut-out
LO – Digital Layout files

There would also be suffixes for MicroStation design drawings (dgn):

2D – 2 Dimensional Design Drawing
EL – Elevation Drawing

* 3 Dimensional Drawing would have no suffix.

Examples:

Preliminary:

- PS_0800001SVY2D.dgn 2 Dimensional MicroStation Design Drawing
- PS_0800001SVY.dgn 3 Dimensional MicroStation Design Drawing
- PS_0800001SVYEL.dgn Elevation MicroStation Drawing
- PS_0800001SVY.alg In-Roads Alignment File
- PS_0800001SVY.dtm In-Roads Digital Terrain Model File
- PS_0800001SVY.txt Point Text File space delimitated (Pt N E Elv Code)

As-Built:

- FS_0800001SVY2D.dgn 2 Dimensional MicroStation Design Drawing
- FS_0800001SVY.dgn 3 Dimensional MicroStation Design Drawing
- FS_0800001SVYEL.dgn Elevation MicroStation Drawing
- FS_0800001SVY.txt Point Text File space delimitated (Pt N E Elv Code)

Base Mapping Cut-out:

- BM_0800001SVY.dgn MicroStation Drawing

Miscellaneous:

- MS_0800001SVY.dgn MicroStation Drawing

APPENDIX 'N'

CITY OF TORONTO Sewer & Watermain Design As-Built Required Features

APPENDIX 'O'

CITY OF TORONTO PEDESTRAIN RAMP SURVEY REQUIREMENT

APPENDIX 'P'

CITY OF TORONTO SIDEWALK RAMP SURVEY REQUIREMENT

APPENDIX 'Q'

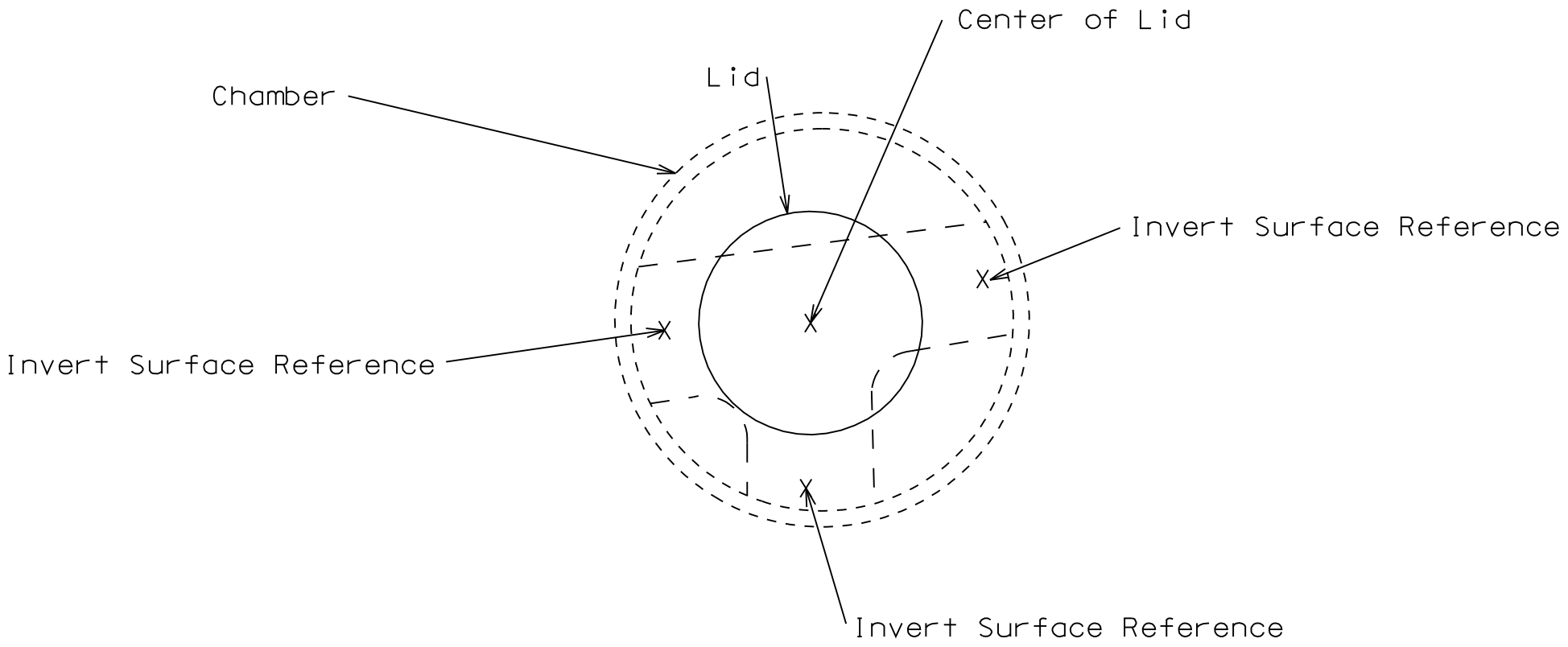
CITY OF TORONTO DRIVEWAY CURB RAMP SURVEY REQUIREMENT

Utility Depth Report

Street: **Here St.**
From: Nowhere Rd.
To: Somewhere St.

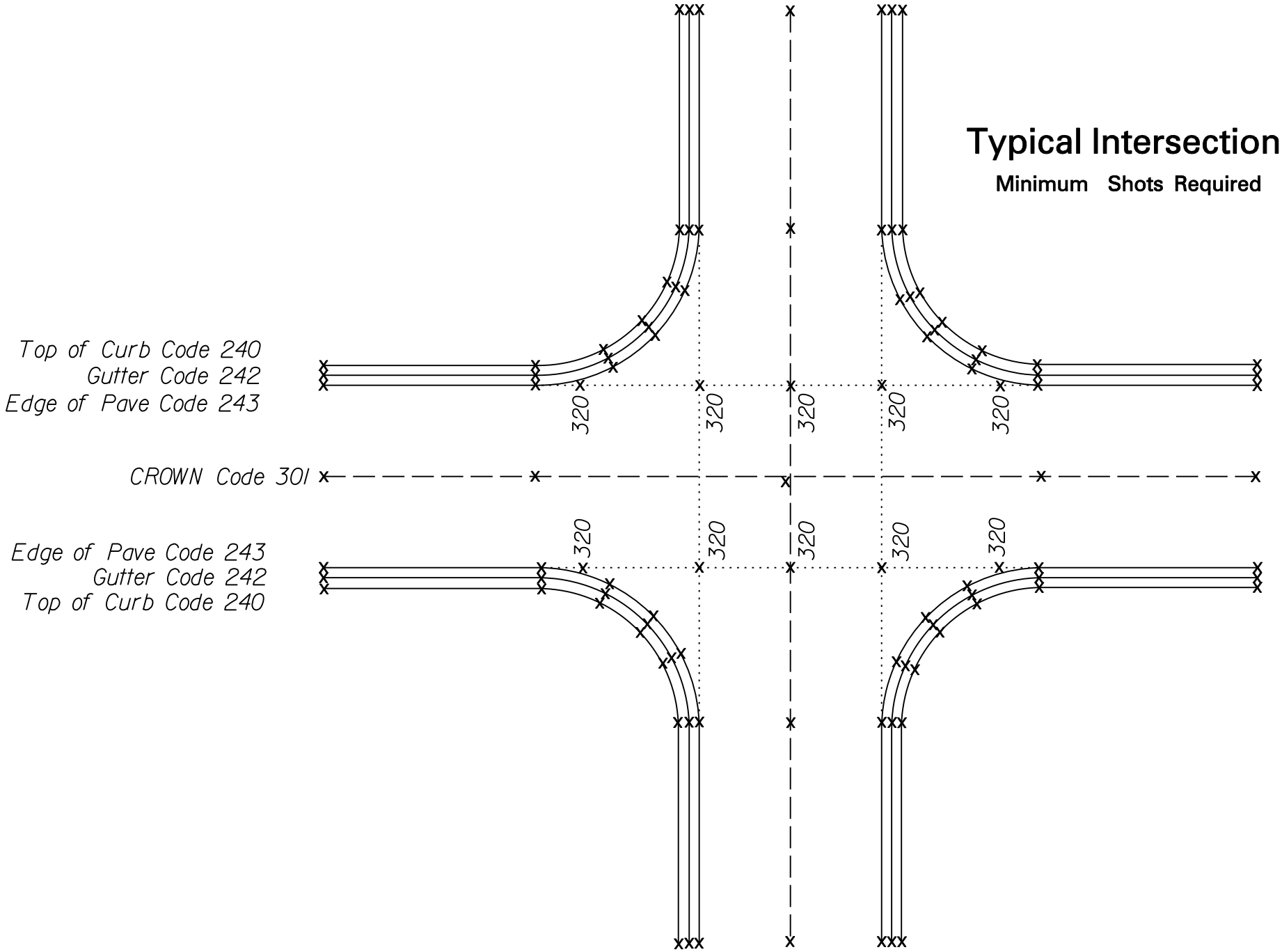
PT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION	DEPTH	INVERT	DIR	COMMENTS
1015	840341.005	315279.781	141.886	Sanitary	3.42	138.466	N	Dia.=450mm
1015	840341.005	315279.781	141.886	Sanitary	3.13	138.756	S	Dia.=300mm
1015	840341.005	315279.781	141.886	Sanitary	3.46	138.426	E	Dia.=600mm
1015	840341.005	315279.781	141.886	Sanitary	3.39	138.496	W	Dia.=600mm
1016	840343.763	315281.133	141.807	Sanitary	Unknown	Unknown	N	Dia.=Unknown
1016	840343.763	315281.133	141.807	Sanitary	4.02	137.787	E	Dia.=Unknown
1052	840335.820	315170.994	145.102	Sanitary	3.24	141.862	N	Dia.=300mm
1052	840335.820	315170.994	145.102	Sanitary	3.07	142.032	S	Dia.=300mm Possible Stub
1052	840335.820	315170.994	145.102	Sanitary	Unknown	Unknown	E	Dia.=600mm
1052	840335.820	315170.994	145.102	Sanitary	3.56	141.542	W	Dia.=600mm
1077	840307.513	315059.763	146.734	Sanitary	2.32	144.414	NE	Dia.=375mm
1077	840307.513	315059.763	146.734	Sanitary	2.32	144.414	W	Dia.=375mm
1085	840314.998	315063.556	146.740	Sanitary	3.20	143.540	N	Dia.=300mm
1085	840314.998	315063.556	146.740	Sanitary	Unknown	Unknown	SW	Dia.=375mm
1085	840314.998	315063.556	146.740	Sanitary	3.24	143.500	E	Dia.=600mm
1085	840314.998	315063.556	146.740	Sanitary	3.20	143.540	W	Dia.=300mm
1012	840332.333	315280.710	141.706	V.C.	1.53	140.176	N/S	Dia.=150mm
1017	840345.575	315289.603	141.535	V.C.	Unknown	Unknown	E/W	Dia.=300mm Full of Dirt.
1022	840352.270	315273.731	141.789	V.C.	1.30	140.489	N/S	Dia.=150mm Top of Spindle
1025	840346.172	315268.942	142.051	V.C.	0.92	141.131	E/W	Dia.=300mm Top of Spindle
1045	840342.175	315186.704	144.553	V.C.	1.45	143.103	E/W	Dia.=300mm Top of Spindle
1055	840338.080	315153.225	145.429	V.C.	1.89	143.539	E/W	Dia.=300mm Top of Spindle
1056	840344.565	315157.389	145.330	V.C.	2.56	142.770	N/S	Dia.=150mm Top of Pipe
5000	840322.501	315161.355	145.505	V.C.	1.89	143.615	N/S	Dia.=150mm Top of Pipe
1080	840316.042	315052.083	146.839	V.C.	2.53	144.309	E/W	Dia.=Unknown Top of Pipe
1081	840322.670	315056.581	146.661	V.C.	2.55	144.111	N/S	Dia.=150mm Top of Pipe
1086	840321.389	315071.639	146.426	V.C.	2.16	144.266	E/W	Dia.=300mm Top of Pipe
1087	840319.574	315072.605	146.524	V.C.	1.75	144.774	E/W	Dia.=300mm Top of Pipe

Subsurface Utility Pickup

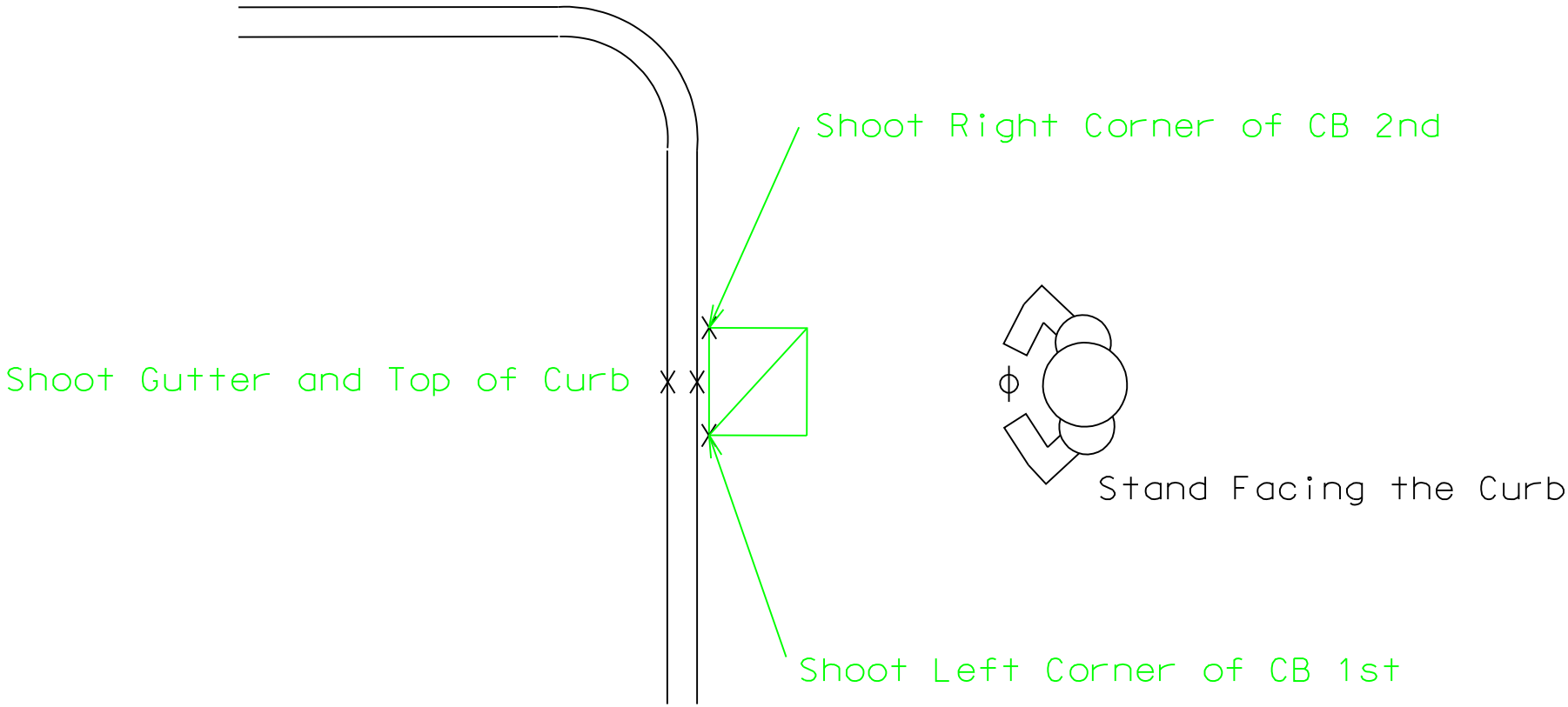


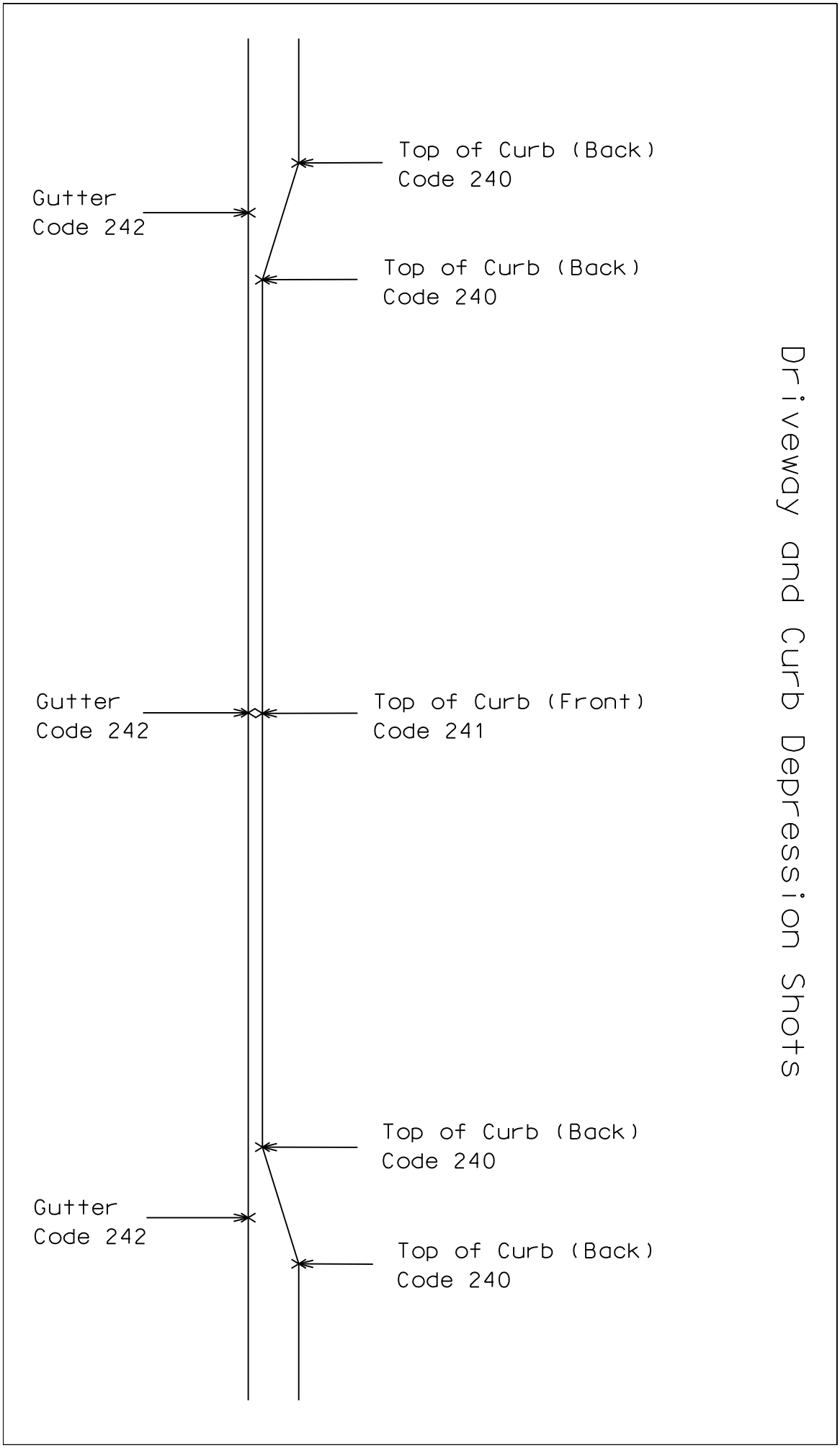
Typical Intersection

Minimum Shots Required

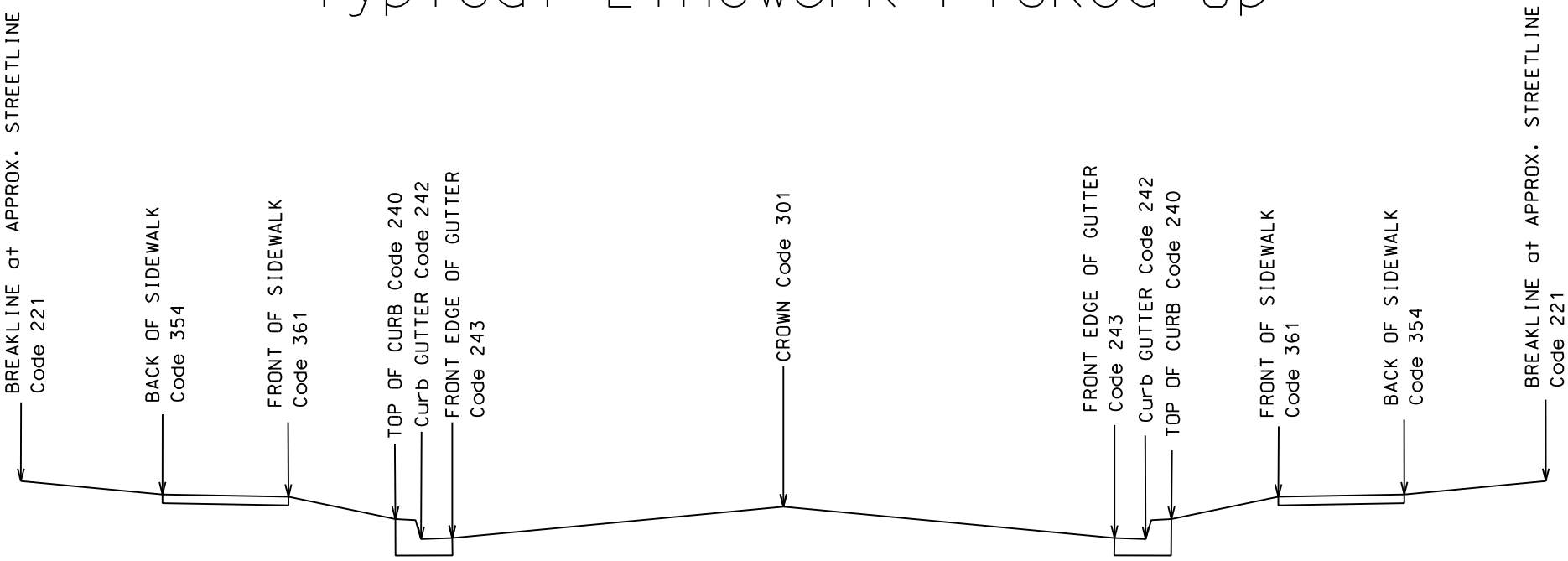


Catch Basin Pick-up Proceedure




Top of Curb (Back)
Code 240
Gutter
Code 242
Top of Curb (Back)
Code 240
Driveway and Curb Depression Shots
Gutter
Code 242
Top of Curb (Front)
Code 241
Top of Curb (Back)
Code 240
Gutter
Code 242
Top of Curb (Back)
Code 240

Typical Linework Picked Up



All linework shots are to be part of linestrings

Appendix E – As-Built Features Requirements

As-built drawings will show the accurate locations of construction features such as storm sewers, sanitary sewers, combined sewers, watermains and other water appurtenances, structures, conduits, power poles, light standards, vaults, width of streets, sidewalks, landscaping area, building footprints, channelization, pavement markings, property lines and easements.

The following minimum information is required and indicates who is responsible to provide it.

Storm Drainage

Storm drainage features are intended to move rainwater and groundwater. As-built drawings will indicate all necessary information about the storm drainage system to evaluate whether the constructed features will be able to function as intended by the design. Information will be field verified or surveyed or both as outlined in the following table. The following table indicates what features are required and by whom should provide the information.

Table: Storm drainage features

Storm drainage features	Field verify (contractor and inspector)	Survey (engineering surveys unit or consultants surveyors)	Indicate on as-built drawing (drawing preparer or engineer)
pipe	size, material, class of pipe, bedding type, drop pipe size	inverts, drop pipe inverts, location of end of stub or bulkhead	Redraw pipe on drawing if pipe has moved more than 300 mm horizontally or 150 mm or more vertically. Recalculate slope on record length and surveyed inverts. Indicate new information on plans such as slope, length, and diameter and so on.
catchbasins, manholes, outfalls, inlet structures	size, type, cover type, safety platforms, flow regulator, overflow, weir, grate type	rim elevation location of feature, overflow weir invert inlet /outlet inverts	Redraw structure on drawings if it moved 300 mm or more. Indicate new information on plans such as size, type and so on.
culverts	size, material, shape, seepage collars	location of ends of culverts and inverts	Redraw culvert on drawings if has moved more than 300 mm. Recalculate slope based on recorded length and surveyed inverts. Indicate new information on plans such as slope, length, and diameter and so on.
sub drains	pipe locations, material, cleanout locations		Redraw sub drains on drawings if it moved 300 mm or more.
laterals	size, material, class, bedding		Indicate locations on plan.
other drainage features			Redraw feature on drawings if it moved 300 mm or more.

Stormwater Management

Stormwater management features are intended to control the rate and quality of the rainwater runoff. As-built drawings will indicate all necessary information about the stormwater management system to evaluate whether the constructed features will be able to function as intended by the design. Information will be field verified or surveyed or both as outlined in the following table. The following table indicates what features are required and by whom should provide the information.

Table: Stormwater management features

Stormwater management features	Field Verify (contractor and inspector)	Survey (engineering surveys unit or consultants surveyors)	Indicate on as-built drawing (drawing preparer or engineer)
storage tanks	material, type, size, control systems such as orifice size and weir dimensions	control structure location, control elevations such as orifice inverts, weir elevations bottom elevations and access locations	Redraw structure on drawing if moved more than 300 mm horizontally or 150 mm or more vertically. Indicate new information on plans such as size, type and so on.
ponds	size, shape	control structure location, control elevations such as orifice inverts and weir elevations overflow elevation topographic survey including bottom elevations final volumes	Redraw pond on drawing if moved more than 3.0 m or more. Recalculate volume based on water surface shape and depth. Indicate new information on plans such as size, type, volume and so on.
wetlands		boundary of created or modified wetlands	Redraw wetland on drawings if moved more than 3.0 m or more. Recalculate volume based on water surface shape and depth. Indicate new information on plans such as size, type, volume and so on.

Table: Stormwater management features (continued)

Stormwater management features	Field Verify (contractor and inspector)	Survey (engineering surveys unit or consultants surveyors)	Indicate on as-built drawing (drawing preparer or engineer)
grease interceptor oil/grit separation	size, material, vault, dimensions	horizontal location of four corners of vault where applicable	Indicate vault dimensions and size, inverts.
infiltration systems, French drains	material, size, pipe such as size, type and diameter	inlet invert outlet invert	Redraw feature on drawings if it moved 300 mm or more.

Water Distribution Systems

Water system features are intended to move or hold potable water. As-built drawings will indicate all necessary information about the water system to evaluate whether the constructed features will be able to function as intended by the design. Information will be field verified or surveyed or both as outlined in the following table. The following table indicates what features are required and by whom should provide the information.

Table: Water distribution systems features

Water distribution features	Field verify (contractor and inspector)	Survey (engineering surveys unit or consultants surveyors)	Indicate on as-built drawing (drawing preparer or engineer)
pipe and fittings	manufacture–material, size, class, bedding, joint type, fittings measure distance between fittings–centre of tees, crosses, bends crossing invert–location and invert of any utility crossings depth of pipes during installation at every fitting and appurtenances, vertical bends location where insulation used	inverts, drop pipe inverts, location of end of stub or bulkhead	Redraw pipe on drawing if pipe has moved more than 300 mm horizontally or 150 mm or more vertically. Recalculate slope on record length and surveyed inverts. Indicate new information on plans such as slope, length, and diameter and so on.
valves in chamber such as gate valve, air valve, and butterfly valve			Redraw structure on drawings if it moved 300 mm or more. Indicate new information on plans such as size, type and so on.

Table: Water distribution systems features (continued)

Water distribution features	Field verify (contractor and inspector)	Survey (engineering surveys unit or consultants surveyors)	Indicate on as-built drawing (drawing preparer or engineer)
hydrants	manufacturer hydrant bury depth	horizontal location of hydrant–centre of valve of stem	Redraw hydrant on drawings if it moved 300 mm or more. Indicate new information on plans.
water service lines	material, size, location		Redraw service line on drawings if it moved 300 mm or more. Indicate new information on plans, for example existing size, type, and so on.
mainline flow meters chambers	type, size, vault or box and size	horizontal location of centre of box, horizontal location of four corners of vault	Redraw vault or box on drawings if it moved 300 mm or more. Indicate new information on plans, for example, size, type, and so on.
pressure reducing valve chamber	size, vault size, vault drain data	horizontal location of four corners of vault	Redraw vault on drawings if it moved 300 mm or more. Indicate new information on plans, for example, size, type, and so on.
backflow devices at street line–exterior to building	device brand type, size, service line size, location of drain	horizontal location of four corners of vault or centre of box	Redraw vault or box on drawings if it moved 300 mm or more. Indicate new information on plans, for example, size, type, and so on.
backflow devices–interior to building	device brand, type, size, service line size, general location within building		

Sanitary or Combined Sewer

Sanitary or combined sewer system features are intended to transport sanitary waste into a collection system. As-built drawings will indicate all necessary information about the water system to evaluate whether the constructed features will be able to function as intended by the design. Information will be field verified or surveyed or both as outlined in the following table. The following table indicates what features are required and by whom should provide the information is shown in parentheses:

Table: Sanitary or combined sewer features

Sanitary combined sewer features	Field verify (contractor and inspector)	Survey (engineering surveys unit or consultants surveyors)	Indicate on as-built drawing (drawing preparer or engineer)
manholes	manhole diameter, type, manufacturer, safety platform, flow restrictors, overflow	horizontal location of centre of manhole, horizontal location of centre of lid, rim elevations and all invert elevations, overflow weir invert	Note all changes and correct elevations.
pipe–gravity sewer main	size, material, class of pipe, bedding type, drop pipe size	length–horizontal length of pipe form centre of manhole to centre of manhole. Inverts, drop pipe inverts, locations of end of stub/bulkhead inverts, drop pipe inverts, location of end of stub or bulkhead	Redraw pipe on drawing if pipe has moved more than 300 mm horizontally or 150 mm or more vertically. Recalculate slope on record length and surveyed inverts. Indicate new information on plans such as slope, length, and diameter and so on.

Table: Sanitary or combined sewer features (continued)

Sanitary combined sewer features	Field verify (contractor and inspector)	Survey (engineering surveys unit or consultants surveyors)	Indicate on as-built drawing (drawing preparer or engineer)
pipe and fittings–force main	manufacturer–material, size, class, bedding, joint type, fittings measure distance between fittings–centre of tees, crosses, bends crossing invert–location and invert of any utility crossings depth of pipes during installations at every fitting and appurtenance.	horizontal location of main:	Redraw pipe on drawings if it moved 300 mm or more. Indicate new information on plans, for example, slope, length, size, and so on.
laterals	material, size, locations, backflow valve		Indicate location on plans.
cleanouts	size	rim elevations, centre of box, horizontal location of centre of box	Redraw structure on drawings if it moved 300 mm or more indicate new information on plans.
grease interceptor or oil grit separators	pipe materials, size, vault dimensions and size	horizontal location of four corners of the vault and inverts	Show vault dimensions and size. Show pipe elevations.

Transportation

Transportation system features are intended to transport vehicle and pedestrian traffic. As-built drawings will indicate all necessary information about the transportation system to evaluate whether the constructed features will be able to function as intended by the design. Information will be field verified or surveyed or both as outlined in the following table. The following table indicates what features are required and by whom should provide the information.

Table: Transportation features

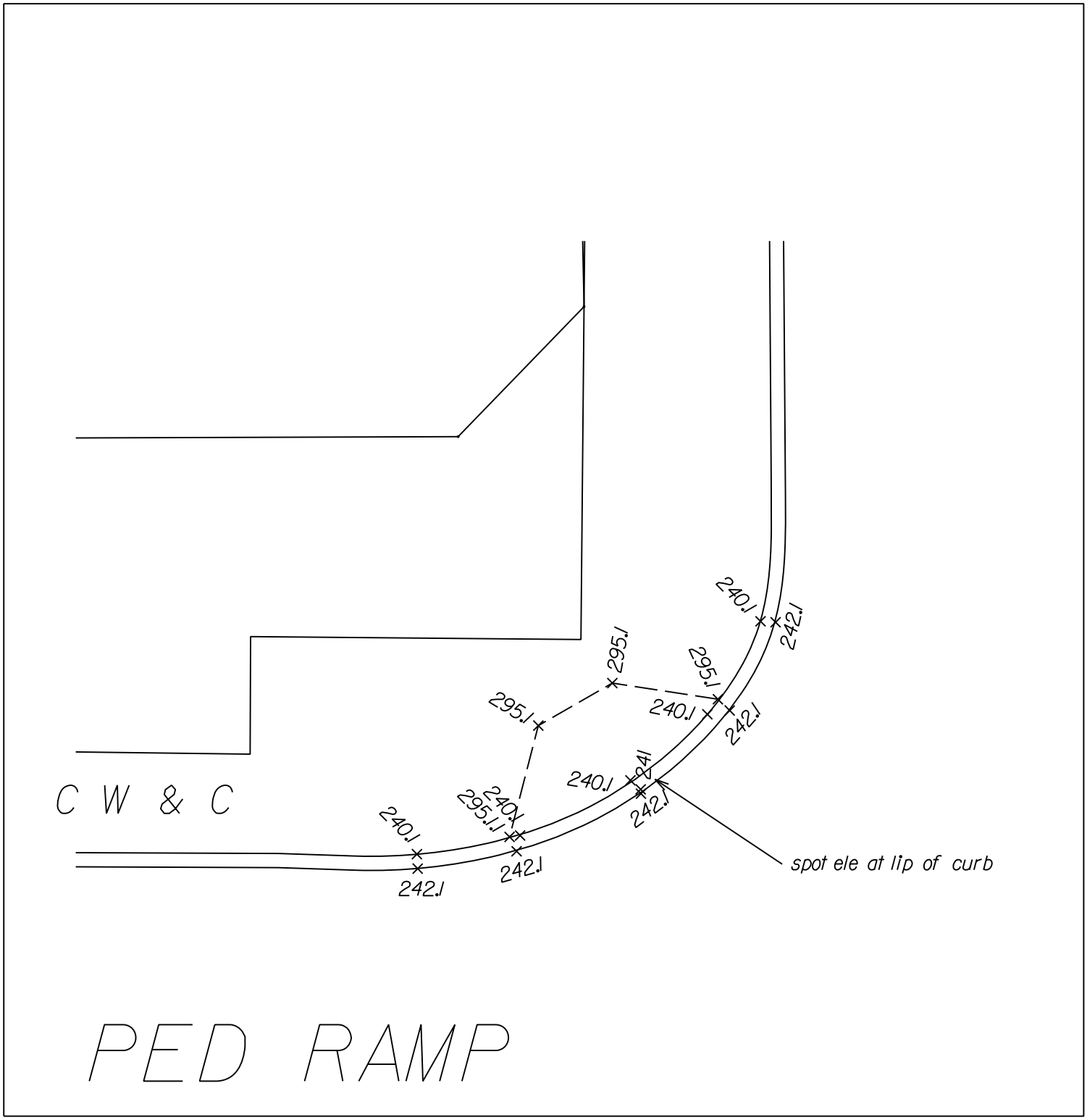
Trans-portation features	Field verify (contractor and inspector)	Survey (engineering surveys or consultants surveyors)	Indicate on as-built drawing (drawing preparer or engineer) Redraw on record drawing any and all transportation features listed if moved 300 mm or more.
pavement	material, depth, width		
curb and gutter	location of face curb, type		
driveways	location, width, type		
signage	location, size, type		
sidewalk	location, material, width		
street lighting	height, wattage, material		
traffic signals			
monument cases	location, materials		
conduit	location, depth, materials, size		
junction boxes	location, type, conduit entrance		

Other Utilities

As-built drawings will indicate all necessary information about other utilities to evaluate whether the constructed features will be able to function as intended by the design. Information will be field verified or surveyed or both as outlined in the following table. The following table indicates what features are required and by whom should provide the information.

Table: Other utilities features

Other utilities features	Field verify (contractor and inspector)	Survey (engineering surveys unit or consultants surveyor)	Indicate on as-built drawing (drawing preparer or engineer)
other utilities	identify location and depth of all existing utilities encountered and new utilities constructed		Show utilities encountered and their depth.



PED RAMP

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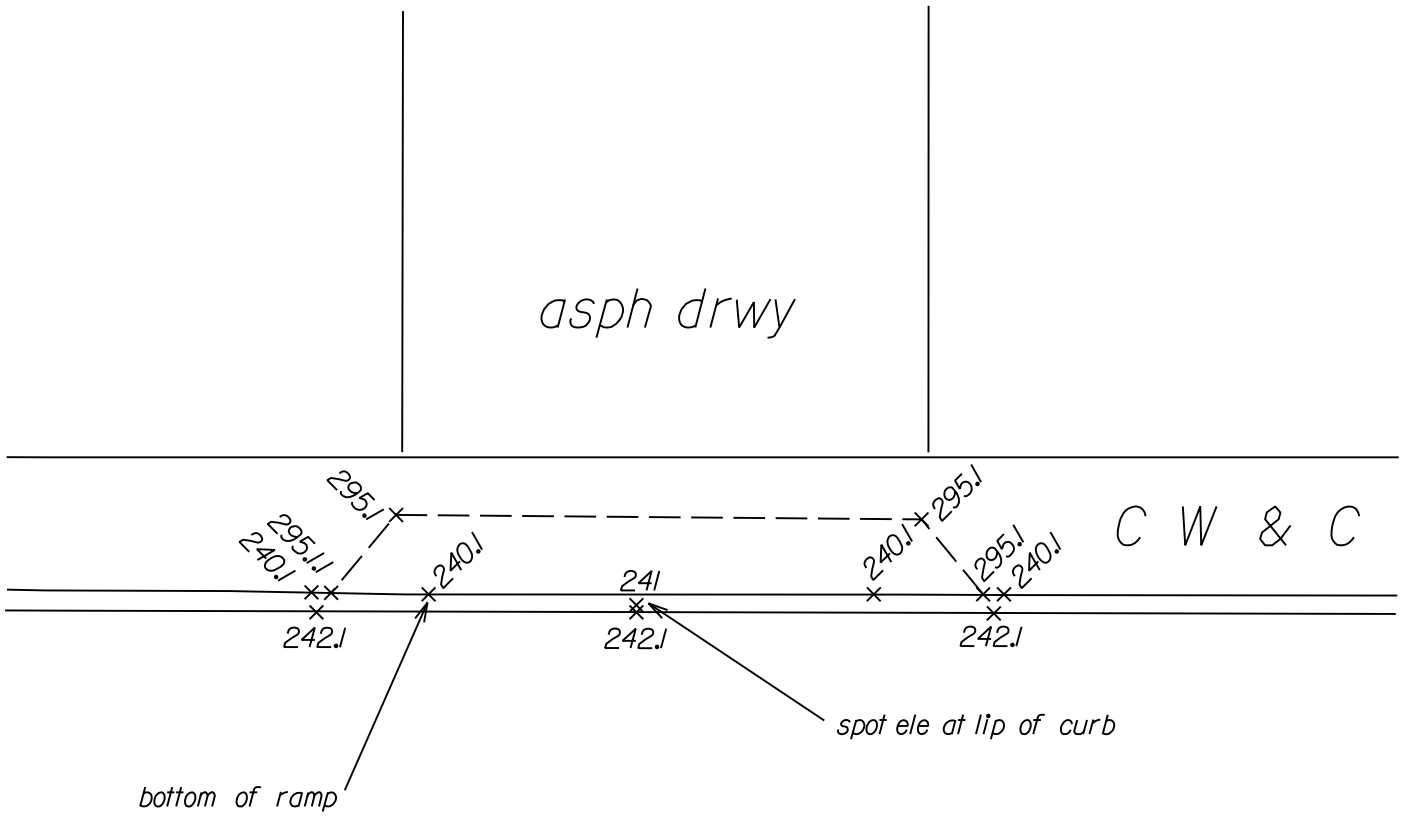

DRIVEWAY RAMP

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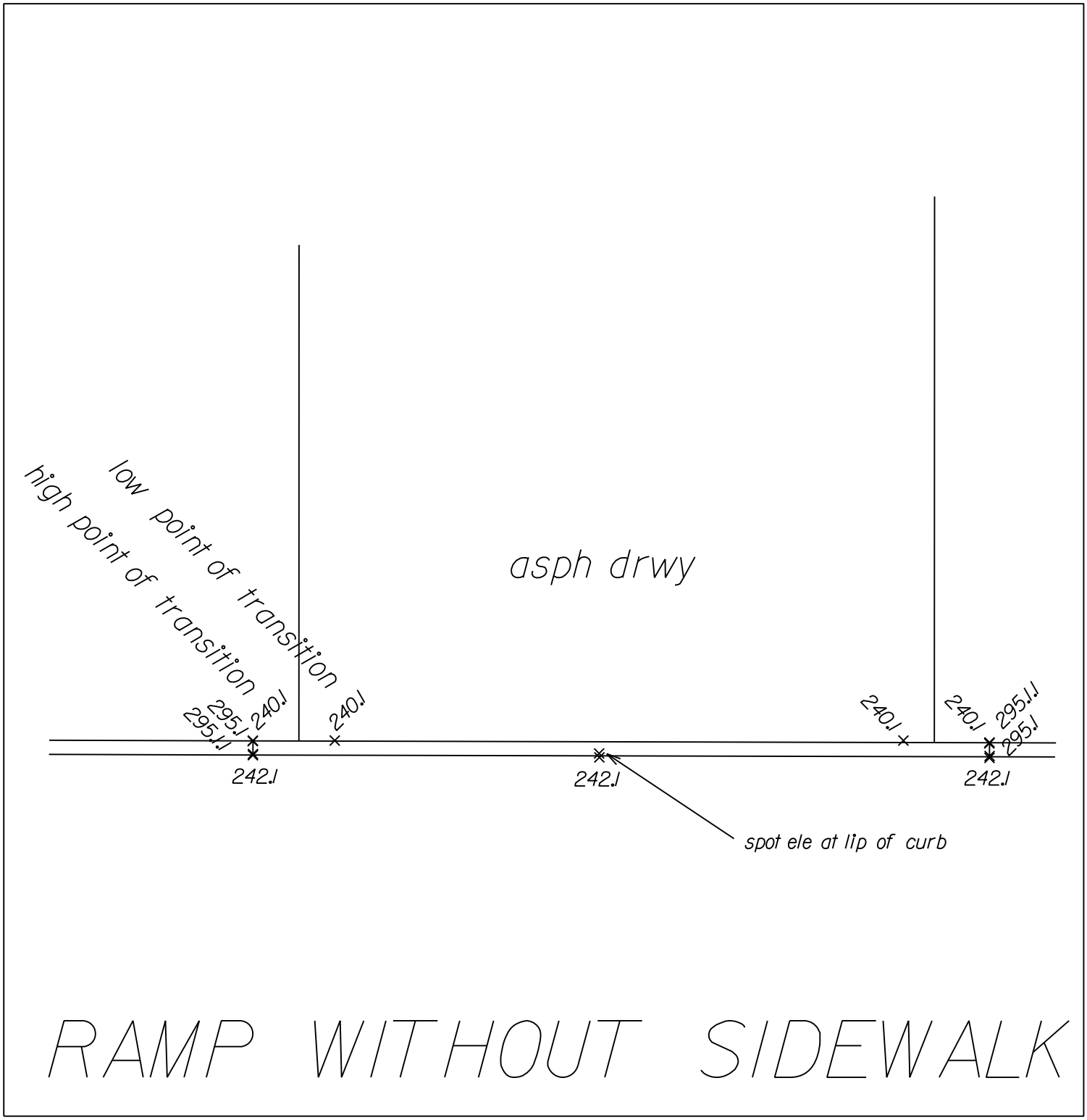
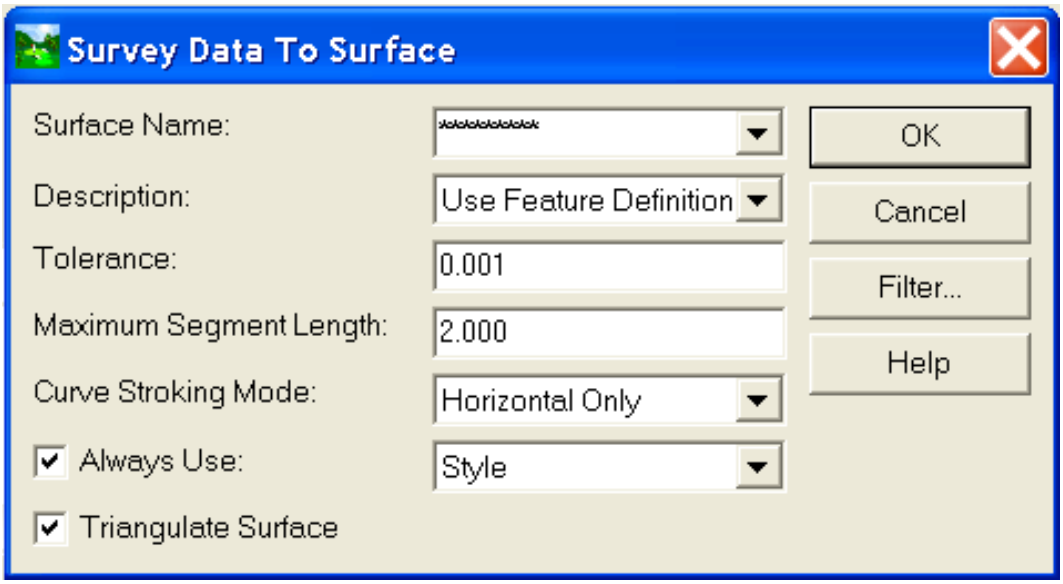
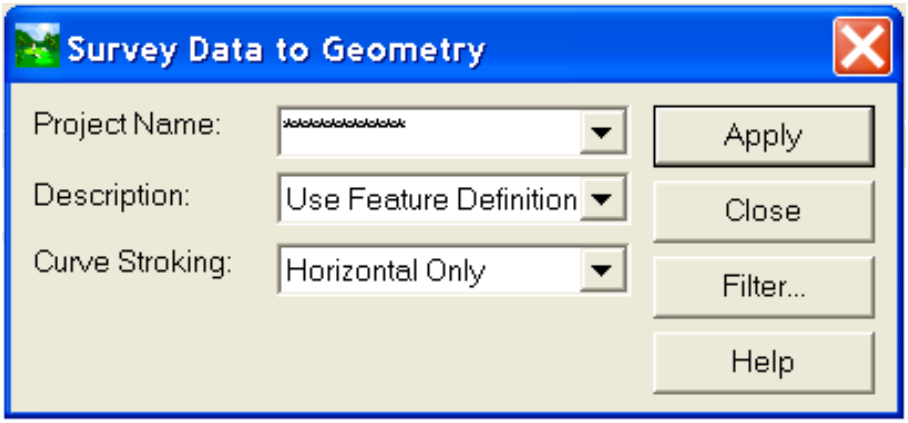


RAMP WITHOUT SIDEWALK

ramps.dgn 1/16/2009 2:48:18 PM


Survey Data To Surface
Surface Name:
Description:
Use Feature Definition
Tolerance:
0.001
Maximum Segment Length:
2.000
Curve Stroking Mode:
Horizontal Only
Always Use:
Style
Triangulate Surface
OK
Cancel
Filter...
Help

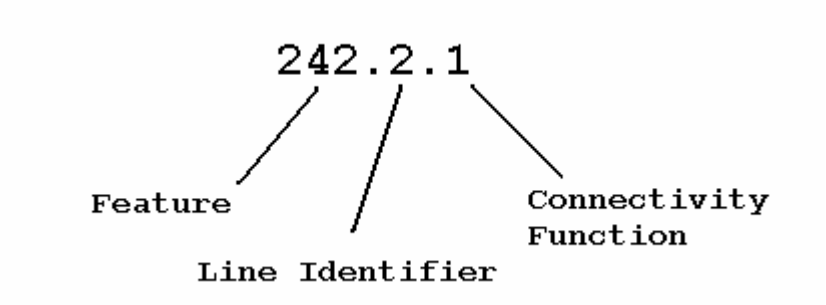

Survey Data to Geometry
Project Name:
Description:
Use Feature Definition
Curve Stroking:
Horizontal Only
Apply
Close
Filter...
Help

Line Connectivity:

Numeric coding is similar to Alpha coding with some differences. All of the coding components are numeric and they are separated by dots instead of spaces.

Coding for features are made up of three parts. First part being the feature shot, second being the line identifier, and the third being the connectivity function.

Eg. For a gutter shot on the right side of the road at the start of a breakline the code that would have been coded as GU2 ST would now be coded as.



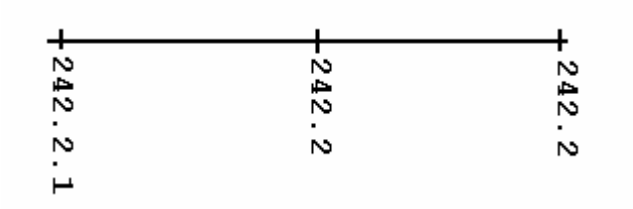
The Feature codes are found in the Feature Code Book provided to each crew either in the District 3 short list or the Toronto complete list.

The line identifier is in keeping with the Left side of the road being a 1 and the Right side of the road being a 2.

The connectivity functions are:

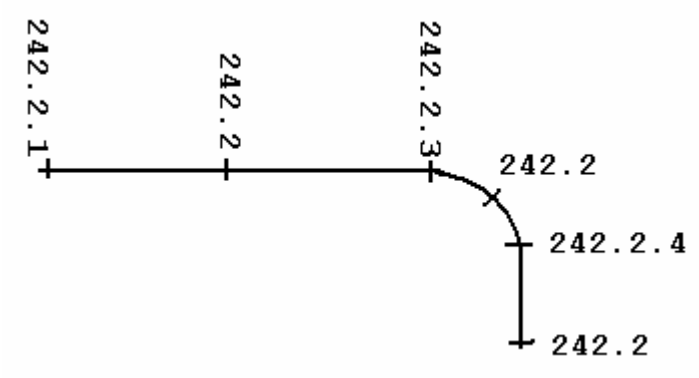
1	Start of a breakline
2	Close a shape
3	Start a curve
4	End a curve
5	Do not contour (not to be part of the model)
6	Not used
7	Close a rectangle using only 3 shots

For a set of Gutter shots the coding would be as follows:



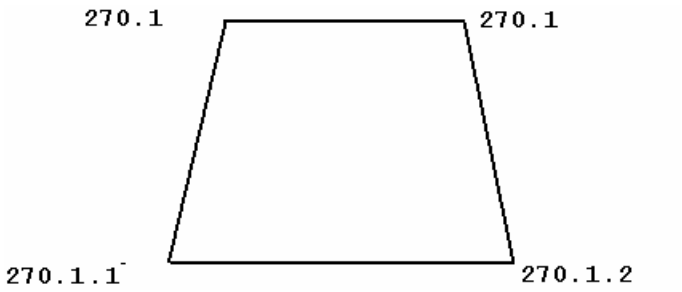
The first Gutter shot showing the code (242) that it is on the Right side of the road (2) and that it is the start of a breakline. The other shots along the line reflect the code and the side of road.

For a curving breakline it would look similar to this:



The code 242.2.3 is saying that this is the point of curve (PC) and the 242.2.4 is the end of the curve (PT)

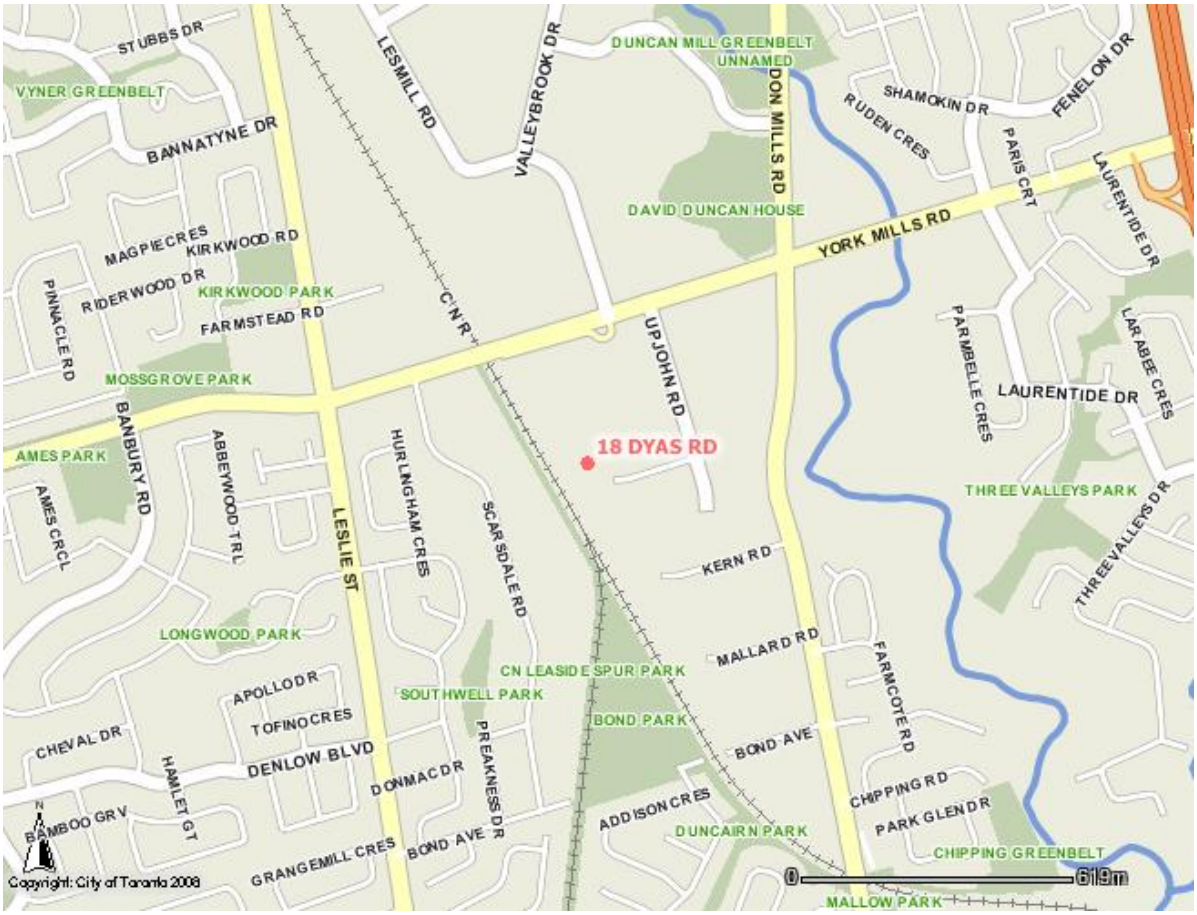
Similarly driveways they would look like this:



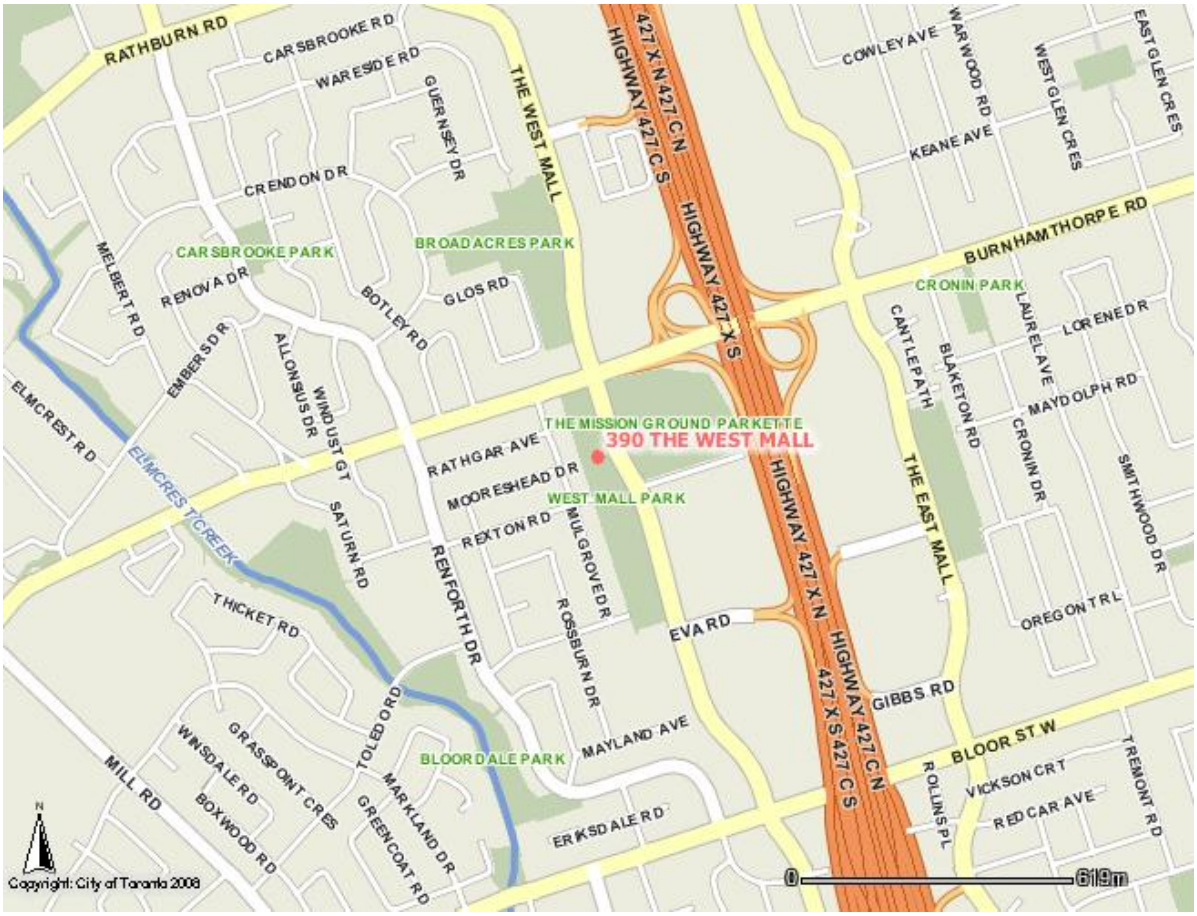
The code 270.1.1 says to start the line here and the 270.1.2 says to close the shape.

Because of limitations of the Data Pack no double coding will be done in the field. If a shot is to be double coded make a note of it and inform the processor. The note should contain the point number and the proper code.

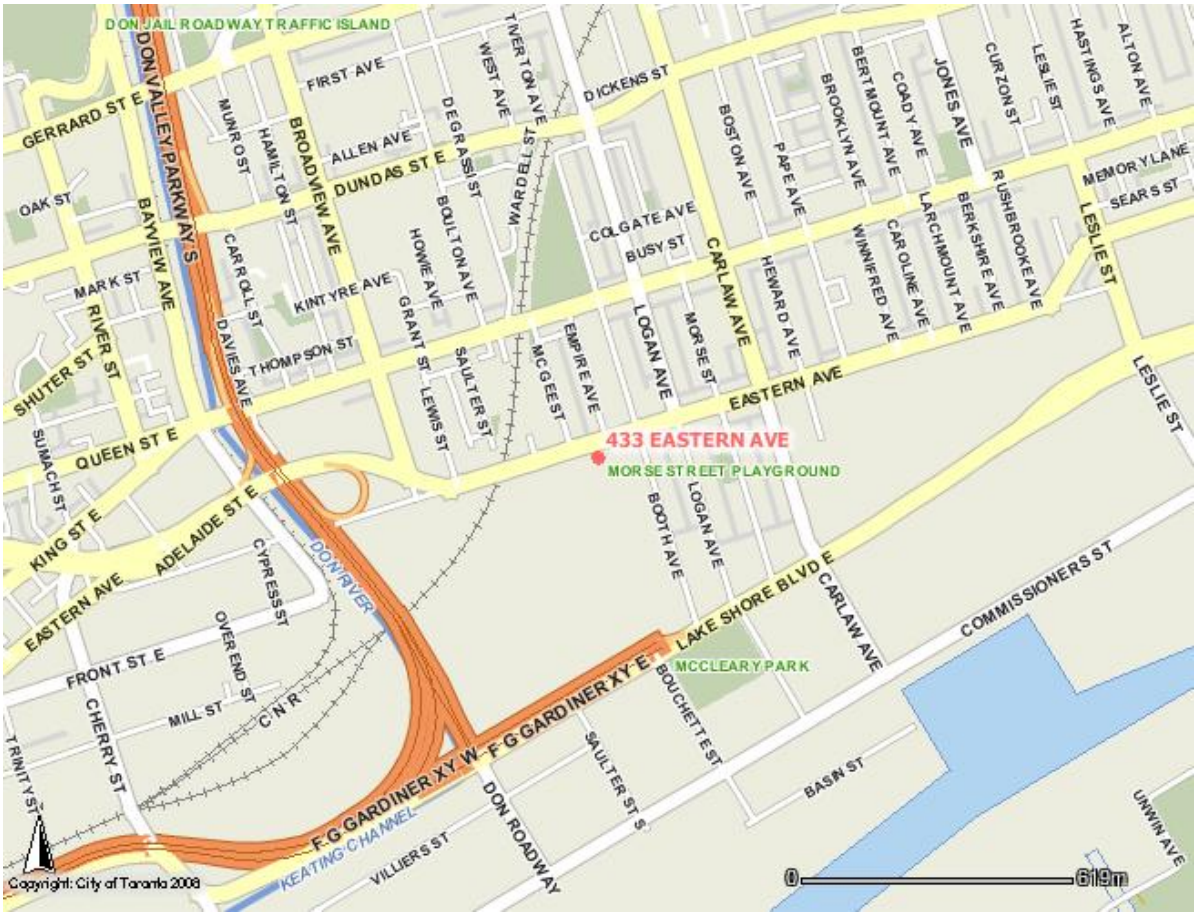
18 Dyas Rd.
Toronto, ON,
M3B 1V5



390 The West Mall,
Toronto, ON,
M9C 2Y2



433 Eastern Ave.,
Toronto, ON,
M4M 1B7



Survey Standards for Consultants

Updates

Date	Version	
January 23 2009	1.1	Addition of Sidewalk Ramping Pick-up Diagrams "Appendix O", "Appendix P", "Appendix Q"
February 9 2009	1.2	Addition of new revised Toronto Water As-Built Feature Requirements 'Appendix N' Dated January 2009
February 25 2009	1.3	Revised the contact person for the City of Toronto Control Surveys on page 3
		Repaired all broken links on pages 6,7 and 15
March 4 2009	2.0	Added Engineering Survey Microstation V8 Graphic Specification Reference on Page 13
		Ammended Page 9 to reflect Microstation V8 files
October 1 2010	2.5	Added G.P.S. Survey to page 4
		Amended "Appendix G" to include G.P.S. Raw File Deliverable
		Amended Folder Structure of "Appendix D"
		Amended "Typical Intersection" Drawing to include Point Code Numbers
		Amended "Catch Basin Pick-up Proceedure" Drawing to include Point Code Numbers
		Amended "Driveway and Curb Depression Shots" Drawing to include Point Code Numbers
		Amended "Typical Linework Picked Up" Drawing to include Point Code Numbers
		Addition of InRoads settings for "Survey Data to Surface" and "Survey Data to Geometry"
		Addition of revised Toronto Water As-Built Feature Requirements "Appendix N" Dated May 2009