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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 COntrol Survey INformation Exchange database (Ontario)
- HCM denotes HOrizontal COntrol MOnument as published by COSINE
- GBM denotes Gеodetic Bеnch Mаrk as published by COSINE
- SCM denotes Sub-Control Monument
- TBM denotes Temporary Bеnch Mаrk
- GPS denotes GGlobal Pозitioning System
- WM denotes Wаtermain

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
- Topographic 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’*:
  o Type/purpose of utility, ie. Storm, sanitary, hydro, etc.
  o Size/diameter of pipe and chamber
  o Depth to invert, top of pipe, top of spindle, etc.
  o Location of pipe inlet and outlet
  o 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:

- Top or invert of newly installed pipe, wherever possible;
- Utility nodes such as vertical and horizontal bends in the pipe;
- Exposed existing utilities (private and public);
- New and existing chambers, manholes or structures; and
- 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*
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.
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)
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.
APPENDIX ‘D’

FILE STRUCTURE

Refer to Appendix ‘M’

FOLDER STRUCTURE

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

- NewJob 201000000
  - Eng Survey Data
    - As-Built
      - Data
      - Download
      - Scanned Notes
  - Layout
    - Data
    - Download
    - Scanned Notes
    - Upload
  - Preliminary
    - Base Map
      - Data
      - Download
      - GPS
      - Scanned Notes
      - Traverse
  - TIMS Design
    - Month_Day_Year

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

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

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

APPENDIX ‘F’

See Engineering Surveys Microstation V8 Graphic Specification Manual for Feature Code Table
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 triangulated 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 LINWORK REQUIREMENT
**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 delimited (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 delimited (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

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

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<td>5000</td>
<td>840322.501</td>
<td>315161.355</td>
<td>145.505</td>
<td>V.C.</td>
<td>1.89</td>
<td>143.615</td>
<td>N/S</td>
<td>Dia.=150mm  Top of Pipe</td>
</tr>
<tr>
<td>1080</td>
<td>840316.042</td>
<td>315052.083</td>
<td>146.839</td>
<td>V.C.</td>
<td>2.53</td>
<td>144.309</td>
<td>E/W</td>
<td>Dia.=150mm  Top of Pipe</td>
</tr>
<tr>
<td>1081</td>
<td>840322.670</td>
<td>315056.581</td>
<td>146.661</td>
<td>V.C.</td>
<td>2.55</td>
<td>144.111</td>
<td>N/S</td>
<td>Dia.=150mm  Top of Pipe</td>
</tr>
<tr>
<td>1086</td>
<td>840321.389</td>
<td>315071.639</td>
<td>146.426</td>
<td>V.C.</td>
<td>2.16</td>
<td>144.266</td>
<td>E/W</td>
<td>Dia.=300mm  Top of Pipe</td>
</tr>
<tr>
<td>1087</td>
<td>840319.574</td>
<td>315072.605</td>
<td>146.524</td>
<td>V.C.</td>
<td>1.75</td>
<td>144.774</td>
<td>E/W</td>
<td>Dia.=300mm  Top of Pipe</td>
</tr>
</tbody>
</table>
Subsurface Utility Pickup

- Chamber
- Lid
- Center of Lid
- Invert Surface Reference
- Invert Surface Reference
Catch Basin Pick-up Procedure

Stand Facing the Curb

Shoot Left Corner of CB 1st

Shoot Gutter and Top of Curb

Shoot Right Corner of CB 2nd

Stand Facing the Curb
Driveway and Curb Depression Shots

Top of Curb (Back)
Code 240

Top of Curb (Back)
Code 240

Top of Curb (Front)
Code 241

Top of Curb (Back)
Code 240

Gutter
Code 242

Gutter
Code 242

Gutter
Code 242

Gutter
Code 242
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>
<thead>
<tr>
<th>Storm drainage features</th>
<th>Field verify (contractor and inspector)</th>
<th>Survey (engineering surveys unit or consultants surveyors)</th>
<th>Indicate on as-built drawing (drawing preparer or engineer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pipe</td>
<td>size, material, class of pipe, bedding type, drop pipe size</td>
<td>inverts, drop pipe inverts, location of end of stub or bulkhead</td>
<td>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.</td>
</tr>
<tr>
<td>catchbasins, manholes, outfalls, inlet structures</td>
<td>size, type, cover type, safety platforms, flow regulator, overflow, weir, grate type</td>
<td>rim elevation location of feature, overflow weir invert inlet /outlet inverts</td>
<td>Redraw structure on drawings if it moved 300 mm or more. Indicate new information on plans such as size, type and so on.</td>
</tr>
<tr>
<td>culverts</td>
<td>size, material, shape, seepage collars</td>
<td>location of ends of culverts and inverts</td>
<td>Redraw culvert on drawings if it 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.</td>
</tr>
<tr>
<td>sub drains</td>
<td>pipe locations, material, cleanout locations</td>
<td></td>
<td>Redraw sub drains on drawings if it moved 300 mm or more.</td>
</tr>
<tr>
<td>laterals</td>
<td>size, material, class, bedding</td>
<td></td>
<td>Indicate locations on plan.</td>
</tr>
<tr>
<td>other drainage features</td>
<td></td>
<td></td>
<td>Redraw feature on drawings if it moved 300 mm or more.</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Stormwater management features</th>
<th>Field Verify (contractor and inspector)</th>
<th>Survey (engineering surveys unit or consultants surveyors)</th>
<th>Indicate on as-built drawing (drawing preparer or engineer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>storage tanks</td>
<td>material, type, size, control systems such as orifice size and weir dimensions</td>
<td>control structure location, control elevations such as orifice inverts, weir elevations bottom elevations and access locations</td>
<td>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.</td>
</tr>
<tr>
<td>ponds</td>
<td>size, shape</td>
<td>control structure location, control elevations such as orifice inverts and weir elevations overflow elevation topographic survey including bottom elevations final volumes</td>
<td>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.</td>
</tr>
<tr>
<td>wetlands</td>
<td>boundary of created or modified wetlands</td>
<td></td>
<td>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.</td>
</tr>
</tbody>
</table>
### Table: Stormwater management features (continued)

<table>
<thead>
<tr>
<th>Stormwater management features</th>
<th>Field Verify (contractor and inspector)</th>
<th>Survey (engineering surveys unit or consultants surveyors)</th>
<th>Indicate on as-built drawing (drawing preparer or engineer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>grease interceptor oil/grit separation</td>
<td>size, material, vault, dimensions</td>
<td>horizontal location of four corners of vault where applicable</td>
<td>Indicate vault dimensions and size, inverts.</td>
</tr>
<tr>
<td>infiltration systems, French drains</td>
<td>material, size, pipe such as size, type and diameter</td>
<td>inlet invert outlet invert</td>
<td>Redraw feature on drawings if it moved 300 mm or more.</td>
</tr>
</tbody>
</table>
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>
<thead>
<tr>
<th>Water distribution features</th>
<th>Field verify (contractor and inspector)</th>
<th>Survey (engineering surveys unit or consultants surveyors)</th>
<th>Indicate on as-built drawing (drawing preparer or engineer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pipe and fittings</td>
<td>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</td>
<td>inverts, drop pipe inverts, location of end of stub or bulkhead</td>
<td>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.</td>
</tr>
<tr>
<td>valves in chamber such as gate valve, air valve, and butterfly valve</td>
<td></td>
<td></td>
<td>Redraw structure on drawings if it moved 300 mm or more. Indicate new information on plans such as size, type and so on.</td>
</tr>
</tbody>
</table>
### Table: Water distribution systems features (continued)

<table>
<thead>
<tr>
<th>Water distribution features</th>
<th>Field verify (contractor and inspector)</th>
<th>Survey (engineering surveys unit or consultants surveyors)</th>
<th>Indicate on as-built drawing (drawing preparer or engineer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>hydrants</td>
<td>manufacturer hydrant bury depth</td>
<td>horizontal location of hydrant–centre of valve of stem</td>
<td>Redraw hydrant on drawings if it moved 300 mm or more. Indicate new information on plans.</td>
</tr>
<tr>
<td>water service lines</td>
<td>material, size, location</td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>mainline flow meters chambers</td>
<td>type, size, vault or box and size</td>
<td>horizontal location of centre of box, horizontal location of four corners of vault</td>
<td>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.</td>
</tr>
<tr>
<td>pressure reducing valve chamber</td>
<td>size, vault size, vault drain data</td>
<td>horizontal location of four corners of vault</td>
<td>Redraw vault on drawings if it moved 300 mm or more. Indicate new information on plans, for example, size, type, and so on.</td>
</tr>
<tr>
<td>backflow devices at street line–exterior to building</td>
<td>device brand type, size, service line size, location of drain</td>
<td>horizontal location of four corners of vault or centre of box</td>
<td>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.</td>
</tr>
<tr>
<td>backflow devices–interior to building</td>
<td>device brand, type, size, service line size, general location within building</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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>
<thead>
<tr>
<th>Sanitary combined sewer features</th>
<th>Field verify (contractor and inspector)</th>
<th>Survey (engineering surveys unit or consultants surveyors)</th>
<th>Indicate on as-built drawing (drawing preparer or engineer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>manholes</td>
<td>manhole diameter, type, manufacturer, safety platform, flow restrictors, overflow</td>
<td>horizontal location of centre of manhole, horizontal location of centre of lid, rim elevations and all invert elevations, overflow weir invert</td>
<td>Note all changes and correct elevations.</td>
</tr>
<tr>
<td>pipe–gravity sewer main</td>
<td>size, material, class of pipe, bedding type, drop pipe size</td>
<td>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</td>
<td>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.</td>
</tr>
</tbody>
</table>
## Table: Sanitary or combined sewer features (continued)

<table>
<thead>
<tr>
<th>Sanitary combined sewer features</th>
<th>Field verify (contractor and inspector)</th>
<th>Survey (engineering surveys unit or consultants surveyors)</th>
<th>Indicate on as-built drawing (drawing preparer or engineer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pipe and fittings–force main</td>
<td>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.</td>
<td>horizontal location of main:</td>
<td>Redraw pipe on drawings if it moved 300 mm or more. Indicate new information on plans, for example, slope, length, size, and so on.</td>
</tr>
<tr>
<td>laterals</td>
<td>material, size, locations, backflow valve</td>
<td></td>
<td>Indicate location on plans.</td>
</tr>
<tr>
<td>cleanouts</td>
<td>size</td>
<td>rim elevations, centre of box, horizontal location of centre of box</td>
<td>Redraw structure on drawings if it moved 300 mm or more indicate new information on plans.</td>
</tr>
<tr>
<td>grease interceptor or oil grit separators</td>
<td>pipe materials, size, vault dimensions and size</td>
<td>horizontal location of four corners of the vault and inverts</td>
<td>Show vault dimensions and size. Show pipe elevations.</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Transportation features</th>
<th>Field verify (contractor and inspector)</th>
<th>Survey (engineering surveys or consultants surveyors)</th>
<th>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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>pavement</td>
<td>material, depth, width</td>
<td></td>
<td></td>
</tr>
<tr>
<td>curb and gutter</td>
<td>location of face curb, type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>driveways</td>
<td>location, width, type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>signage</td>
<td>location, size, type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sidewalk</td>
<td>location, material, width</td>
<td></td>
<td></td>
</tr>
<tr>
<td>street lighting</td>
<td>height, wattage, material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>traffic signals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>monument cases</td>
<td>location, materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>conduit</td>
<td>location, depth, materials, size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>junction boxes</td>
<td>location, type, conduit entrance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Other utilities features</th>
<th>Field verify (contractor and inspector)</th>
<th>Survey (engineering surveys unit or consultants surveyor)</th>
<th>Indicate on as-built drawing (drawing preparer or engineer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>other utilities</td>
<td>identify location and depth of all existing utilities encountered and new utilities constructed</td>
<td>Show utilities encountered and their depth.</td>
<td></td>
</tr>
</tbody>
</table>
DRIVEWAY RAMP

asph drwy

bottom of ramp

spot ele at lip of curb

C W & C
RAMP WITHOUT SIDEWALK

low point of transition
2421
2401
2401
2421
2421
2421
2421
2421

high point of transition
2951
2951

asph drwy

spot ele at lip of curb
Survey Data To Surface

- Surface Name: [Input]
- Description: [Input]
- Tolerance: 0.001
- Maximum Segment Length: 2.000
- Curve Stroking Mode: Horizontal Only
- Always Use: Style
- Triangulate Surface: [Check box]

[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.

\[ 242.2.1 \]

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:

\[ 242.2.1 \]

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.
433 Eastern Ave.,
Toronto, ON,
M4M 1B7
Survey Standards for Consultants

Updates

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