WATER &
WASTEWATER
RECORD DRAWING / CAD /
GPS DELIVERABLES
SUBMISSION STANDARDS
AND REQUIREMENTS

NEW BRAUNFELS
UTILITIES

New Braunfels, TX 78130

PREFACE

In order to create a consistency and increase efficiency, Comal County, Comal Appraisal District, New Braunfels Utilities (NBU), the City of New Braunfels, and other government entities and utilities have created a set of standards for all digital master plan, plat, and construction deliverables. The creation of the standards has become necessary with the rapid growth of the area and the improving mapping capabilities of the entities.

Two major issues are addressed by creating the standards: uniform layer names and the use of control points to provide the proper georeferenced location of the development.

The layer names were adopted from the Bexar Appraisal District to enable the appraisal districts to share a standard and therefore easily transfer information. All deliverables must have the layer names as identified in the standards; layer names used in-house during construction may be changed prior to delivery. Obviously not all names will be needed. Use only the names appropriate for your project.

The use of control points in NAD 83 State Plane South Central Texas 4204 (survey feet) will permit the deliverable to insert properly and immediately into the existing database of the County, City or Utility.

NBU will not accept digital information that does not meet these standards. Before Final Acceptance is granted, the CAD Deliverables shall be reviewed for adherence to the Submission Standards.

Please begin to submit digital information using the new standards. We do appreciate your working with us toward the standardization of all our databases. We feel the long-term efficiency and accuracy that will be gained will be greatly beneficial.

Table of Contents

SECTION I PURPOSE

These standards were created and approved in an effort to create a consistency throughout the Cities, Counties, Appraisal Districts, and Utilities in the quality and compatibility of plats and other types of deliverables.

This set of standards will provide for the efficient incorporation of the deliverables into the entities' base files, especially that of the Comal Appraisal District who will maintain the parcel information for Comal County. The consistent layer naming will also provide the Comal, Bexar, and Guadalupe Appraisal Districts the ability to interchange files with ease and speed.

SECTION II REQUIREMENTS

1. FORMAT REQUIREMENTS

1.1. The digital format required for final plats, as-builts, and revisions shall be delivered in AutoCAD DWG format.

2. DATA LAYER REQUIREMENTS

2.1. **Appendix A** outlines what will be considered valid layer names and data objects for as-builts.
2.2. **Appendix B** outlines what will be considered valid layer symbols for as-builts.
2.3. Layer names – Use the layer names listed in **Appendix A** for submittal of plats and construction plans. Layer names are based on the Bexar Appraisal District for compatibility and should only include features appropriate to that layer.
2.4. The following feature types are acceptable: Lines, Polylines, Text, Insert/Blocks. The Leaders as feature types must not be used. Where there is a need for Leaders they shall be drawn using *Line* features and must be put on a text layer. For example, the leader for the diameter of a water pipe should be on the TEXT layer, not the MAIN layer.
2.5. One TEXT style to be used; style to be named "Standard."
2.6. Street Names to be in all capital letters
2.7. No three-dimensional objects.
2.8. NBU will provide a cad template (NBU CAD DELIVERABLES SUBMISSION STANDARDS. Dwg) for layer symbols (**Appendix B)**.
2.9. All layers must be created according to the geometry type and CAD feature type as specified in **Appendix A** for layer names and data objects for as-builts and **Appendix B** for layer symbols. The Geometric Feature type defines how the data will be represented in the "real world" model (e.g. Parcels look like polygons, fire hydrants look like points).

3. SUBMISSION REQUIREMENTS

3.1. NBU requires a complete original digital CAD drawing of the submitted paper document for as-builts.
3.2. All submitted CAD drawings will provide lines that are solid, continuous, and snapped at all intersections.
3.3. The completed CAD drawing must be in model space, not in paper space.
3.4. DIGITAL DRAWING REGISTRATION - For registration, all drawings of Major Subdivisions shall be shown in the Texas State Plane South Central Coordinate System: (**Appendix C**) (i.e. bearing and distance). The drawing shall have control points located by GPS (Global Positioning System).
3.5. DIGITAL DRAWING ORIENTATION AND GEOREFERENCE - A minimum three control points for georeferencing shall be required from the Developer's Contractor or Engineer. The control points selected are to be shown and dimensioned on the plan.
  3.5.1. For planning purposes, Engineer's scope of work will include delivery of three GPS control points: (**Appendix E Figures 4**).
  3.5.2. New Braunfels Utilities required survey monuments locations will be visible and referenced on CAD drawings.
  3.5.3. CAD Deliverable shall be georeferenced in the same coordinate system, datum, and increment of measure: (**Appendix C**).
  3.5.4. All drawings shall be North oriented in order to place drawing in State Plane Coordinates: (**Appendix C**).
  3.5.5. All references to bearing information shall be correct relative to other features on the drawing.

3.6. **NOTE: Survey points shall be taken for all utility features as provided in Appendix A column GPS Points (e.g. WT_BEND, WT_TEE, WW_LIFT_STATION, and WW_MAIN, etc.) along the complete utility route** .

3.6.1. In the event a survey point cannot be attained, three (3) reference dimensions must be provided from the point on the utility line to three (3) separate surrounding fixed points and the elevation change will be measured from top of grade.

3.6.2. The water and wastewater GPS points as indicated in column GPS Points in **Appendix A** shall be to survey grade.

3.7. DIGITAL DRAWING SCALE AND ACCURACY- All submissions must be to scale. The information is to be drawn in U.S. Survey Feet and at 1:1 scale. All standards of accuracy, which apply to plats submitted in hard copy format, also apply to plats in digital format. All boundaries submitted in digital format shall close. All graphic features shall be checked against textual descriptions to ensure proper representation of data.

3.8. CAD XREFS - Any CAD file with xrefs shall be submitted as separate individual DWG files. To eliminate imbedded or bundled files, no xrefs may be inserted into the file. Detach COGO files and other survey files and submit separately.

4. GPS and CAD ACCEPTANCE

4.1. All GPS points will be delivered in three dimensions (x, y and z coordinates). The CAD deliverables will include the following:

4.1.1. CAD Drawing with GPS survey points

4.1.2. GPS survey points in a separate file (DWG or Shapefile) format.

4.1.3. GPS survey points coordinate data in ASCII comma delimited or Excel file. (**Appendix E Figures 5A and 5B**).

4.2. GPS horizontal position accuracy (< 10 cm / 4 inch) accuracy

4.3. GPS vertical position accuracy (< 20 cm / 8 inch) accuracy

4.4. GPS coordinates will have no less than four decimal places (i.e. z value = 675.1234).

4.5. GPS Manhole submittal standards - (**Appendix E Figure 6**)

4.5.1. GPS top (rim) and bottom (flow line)

4.5.2. GPS additional inverts for mains to include both inverts for internal and external manhole drops

4.5.2.1. Correlate inverts with its elevation GPS point

4.6. GPS Fire Hydrant submittal standards - (**Appendix E Figure 6**)

4.6.1. GPS top of flange

4.6.2. OEM make and year as text in CAD deliverable

4.7. No seal required on electronic drawing file that has been modified with GPS points.

4.8. NOTE: An acceptance letter by NBU will not be released until NBU receives all correspondences required for acceptance including the final Record Drawing of the plans and the related GPS points, all in AutoCAD format, as stated in SECTION II Number 1;1.1.

5. DATA INTEGRITY REQUIREMENTS

5.1. All point features (e.g. manholes) will be inserted as blocks. All submitted CAD drawings with manhole point features will be geographically located in the same location as the GPS'ed manhole points. All line features should be digitized as continuous solid lines with the following exceptions:

5.1.1. Water lines should be split and snapped at all system valves, control valves, and fittings.

5.1.2. Sanitary sewer lines are straight two point lines that are split and snapped at Manholes: (**Appendix E Figures 3A and 3B**).

5.1.3. Sewer lines (sanitary and storm) are to be entered as a single line between structures, as opposed to double lines, or a continuous polyline running through structures. That is, each sewer or open channel section between structures must be a separate single-line entity. Avoid using polylines, except where turns in the line do not have structures, i.e., along force mains.

5.1.4. Sanitary, storm and open channel lines must be digitized in the direction of their physical flow. The beginning point of the line would be its upstream end and the ending point its downstream end.

5.1.5. Storm water pipes are straight two point lines that are split and snapped at catch basins, junction boxes/manholes, and headwalls.

5.2. Line/Polyline features that are modeling polygons (e.g. parcel boundaries) will be snapped closed at nodes or endpoints: (**Appendix E Figures 1 and 2**). Lines/Polylines may need to be duplicated on more than one layer.

5.3. Lot numbers and proposed address numbers text will be labeled inside of associated parcel. These text layers will include numbers only. No special character should be used (e.g. "#").

5.4. When displaying coordinates, the whole number for the coordinate will be shown (i.e. no constants will be applied).

6. REVIEW OF DIGITAL DATA

6.1. All digital data will be reviewed for the following criteria:

- 6.1.1. Correct and complete layering.
- 6.1.2. No duplicate linear or point elements.
- 6.1.3. Closure of the geometry of all logical areas.
- 6.1.4. Verification that digital and hardcopy maps are consistent.
- 6.1.5. Correct geographical position (i.e. correct coordinate values for final submissions).

7. FILE SUBMISSION PROCEDURE

7.1. The digital file for as-builts drawings will be submitted to NBU (**Appendix D**).

7.2. FILE NAMING CONVENTION - File names should correspond exactly to the subdivision or project name and should be consistent from one version to the next. The file name should contain the drawing revision date (in YYMMDD format) as part of the name. There should be no spaces in the name, only underscores. Example:

- 7.2.1. Subdivision Oak Run, Phase 1A dated March 22, 2011 will be
- 7.2.2. Oak_Run_Ph1A_110322.dwg

7.3. Digital Data may also be emailed before or on the day of paper submission.

7.4. All drawings and related files, including specifications, CAD drawings, and other materials generated by the contractor or engineer for the project shall be property of NBU upon their delivery to NBU. This applies to content as well as physical media. NBU will not accept disclaimers nullifying this requirement.

7.5. The submitting party will be responsible for correcting any errors and delivering the new correct digital file prior to final plat approval.

7.6. NOTE: The CAD Deliverable Submission Form (Appendix F) will need to be completed and submitted at the same time as the digital file.

7.7. ACCEPTABLE TRANSFER MEDIA REQUIREMENT- Digital data will be accepted on the following media:

- 7.7.1. CD/DVD-ROM
- 7.7.2. Electronic Mail (e-mail)
- 7.7.3. Other media acceptable to GIS staff (on a case-by case basis)
- 7.7.4. The submitted media will be labeled with the title of the project, type of drawing, project contact information, and a submittal date.
- **7.7.5. NOTE: No additional information will exist in the submission or on the media aside from data being specifically transmitted to Geographic Information Services.**

7.8. DIGITAL DATA FILE COMPRESSION - Files that are too large to copy onto one floppy may be compressed. The preferred compression utility is WinZip. If other compression utilities are used, a copy of the extraction utility must accompany the digital file submission.

7.9. MEDIA RETURN - Media will not be returned and becomes the property of New Braunfels Utilities.

7.10. The submitting party will be responsible for correcting any errors and delivering the new correct digital file prior to final plat approval.

SECTION III CONTACT INFORMATION

NBU GIS Department (830) 608-8942 gis@nbutexas.com

Appendix A: Layer Layout (*.dwg) Specifications

Water		
Feature Description	Layer Name	GPS Points
Main	WT_MAIN	
Bend	WT_BEND	Vertical and horizontal bends prior to backfill
Tee	WT_TEE	Center top prior to backfill
Fitting (reducers and couplings)	WT_FITTING	Center top prior to backfill
Casing	WT_CASING	Ends centerline top
Concrete Cap	WT_CAP_CONCRETE	Ends centerline top
Encasement	WT_ENCASEMENT	Ends centerline top
Hydrant	WT_HYDRANT	Top of flange
Valve (gate, butterfly, etc.)	WT_VALVE	Center top of valve lid
Blow-off	WT_BlOWOFF	Center top of blow-off lid
Valve Vault	WT_VLV_VAULT	Corners top
Meter Box	WT_METER_BOX	Top center of box
Storage Tank	WT_TANK	Corner slab and gate valve of water tank

Wastewater		
Feature Description	Layer Name	GPS Points
Lift Station	WW_LIFT_STATION	Slab Corners Top
Main	WW_MAIN	Ends Centerline Top
Cleanout (main)	WW_MAIN_CO	Center Top
Casing (pipe)	WW_MAIN_CASING	Ends Centerline Top
Concrete Cap	WW_MAIN_CAP_CONCRETE	Ends Centerline Top
Conduit Bridge (pipe support)	WW_MAIN_CONDUIT_BRIDGE	Ends Centerline Top
Encasement (concrete)	WW_MAIN_ENCASEMENT	Ends Centerline Top
Force Main	WW_MAIN_FORCE	End & Fitting Deviation Points
Fittings (main)	WW_MAIN_FITTING	Centerline Point Top
Manhole	WW_MANHOLE	Cover Final Grade Center
Meter	WW_METER	Center Top
Sample Site	WW_SAMPLE_SITE	Center Top
Service Lateral	WW_SERVICE_LATERAL	Main Fitting Centerline Top (couple with Service Cleanout GPS Point)
Service Cleanout	WW_SERVICE_LATERAL_CO	Center Top
Valve	WW_VALVE	Stem Center Top
Valve Vault	WW_VALVE	Corners Top

Parcel Base	
Feature Description	Layer Name
Survey / Abstract Lines	AbstractLines
Addresses	AddressPoint
Unit Number	UnitNum
Block Number	BlockNum
Lot Number	LotNum
New City Block Number	NCBNum
Coordinates	Dimensions
Subdivision / Unit Boundary	UnitBoundary
All lot lines / parcel lines	Parcel
Railroad	RailRoadCL
Railroad right-of-way	RailRoadROW
Streets / right-of-way – public	StreetROW
Streets / right-of-way – private	StreetROWPrivate
Streets / center line – public	StreetCL
Streets / center line – public	StreetCLPrivate
Streets / pavement – public	StreetPvmt
Streets / pavement – private	StreetPvmtPrivate
Streets names	StreetNames
Subdivision Names*	SubName

Taxing Units	
Feature Description	Layer Name
Appraisal District	Appraisal District
City	City
County	County
School District	SchoolDistricts
Special District	SpecialDistricts
Tax Increment	Financing Tiffs
Utility District	Utility District
Water District	Water District

Topo	
Feature Description	Layer Name
Waterways	Creek
Floodplain	FemaFlood
Easements	*
Contours	Contours
Contour	Text CountourText

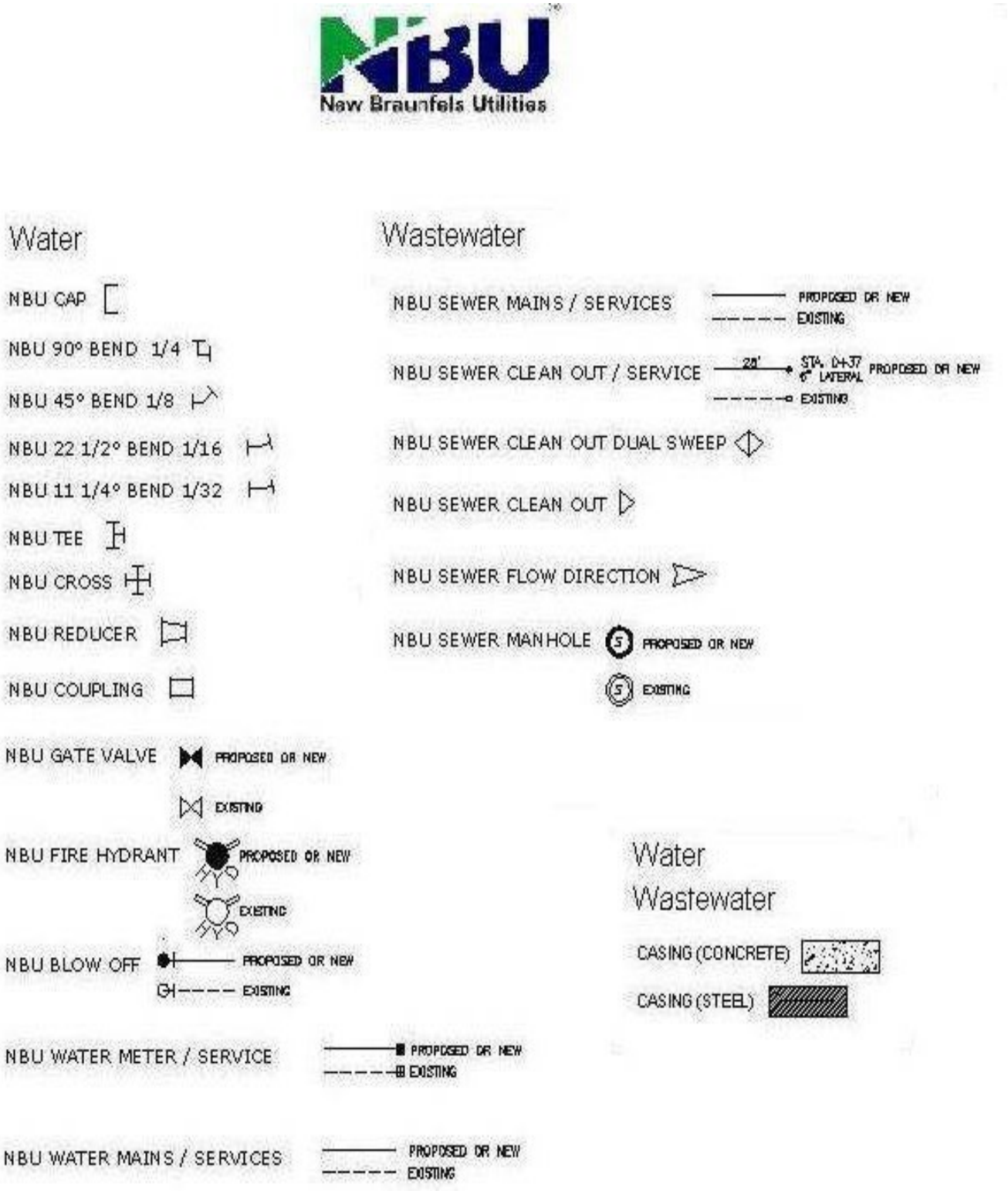
Other	
Feature Description	Layer Name
Peripheral information (title blocks,	Text
signature blocks, logos, borders,	
north arrow, scale and notes)	

* Specify Subdivision and easement names in appropriate layers as requested by City of New Braunfels and New Braunfels Utilities (examples in tables below).

Subd Name Res
Subd Name Comm
Esmt utility
Esmt drainage
Esmt non access
Esmt access
Esmt pipeline
Esmt LCRA

If not in utility easement separate into following layer names:

Esmt NBU Water
Esmt NBU Wastewater
ROW drainage utility
ROW drainage
Esmt drainage utility
Esmt phone
Esmt gas


NBU
New Braunfels Utilities
Water
NBU CAP
NBU 90° BEND 1/4
NBU 45° BEND 1/8
NBU 22 1/2° BEND 1/16
NBU 11 1/4° BEND 1/32
NBU TEE
NBU CROSS
NBU REDUCER
NBU COUPLING
NBU GATE VALVE
PROPOSED OR NEW
EXISTING
NBU FIRE HYDRANT
PROPOSED OR NEW
EXISTING
NBU BLOW OFF
PROPOSED OR NEW
EXISTING
NBU WATER METER / SERVICE
PROPOSED OR NEW
EXISTING
NBU WATER MAINS / SERVICES
PROPOSED OR NEW
EXISTING
Wastewater
NBU SEWER MAINS / SERVICES
PROPOSED OR NEW
EXISTING
NBU SEWER CLEAN OUT / SERVICE
20'
STA. 0+37
6" LATERAL
PROPOSED OR NEW
EXISTING
NBU SEWER CLEAN OUT DUAL SWEEP
NBU SEWER CLEAN OUT
NBU SEWER FLOW DIRECTION
NBU SEWER MANHOLE
PROPOSED OR NEW
EXISTING
Water
Wastewater
CASING (CONCRETE)
CASING (STEEL)

Appendix C: Coordinate System Specifications

Coordinate System:	State Plane
Projection:	Lambert Conformal Conic
Units:	US Survey Feet at grid coordinates
Zone Name:	Texas South Central Zone
FIPSZONE:	4204
ADSZone:	5401
UTM Zone:	14
Datum:	1983 (NAD83)
Spheriod:	GRS1980

Appendix D: NBU Service Address

New Braunfels Utilities NBU	
NBU Service Center	Phone: (830) 629-8400
Physical: 355 FM 306	Toll Free: (866) 629-8400
P.O.: P.O. Box 310289	Metro: 606-2074 (metro)
New Braunfels, TX 78131-0289	Fax: (830) 629-2119

Appendix E: CAD Deliverables Submission Figures – Figure 1

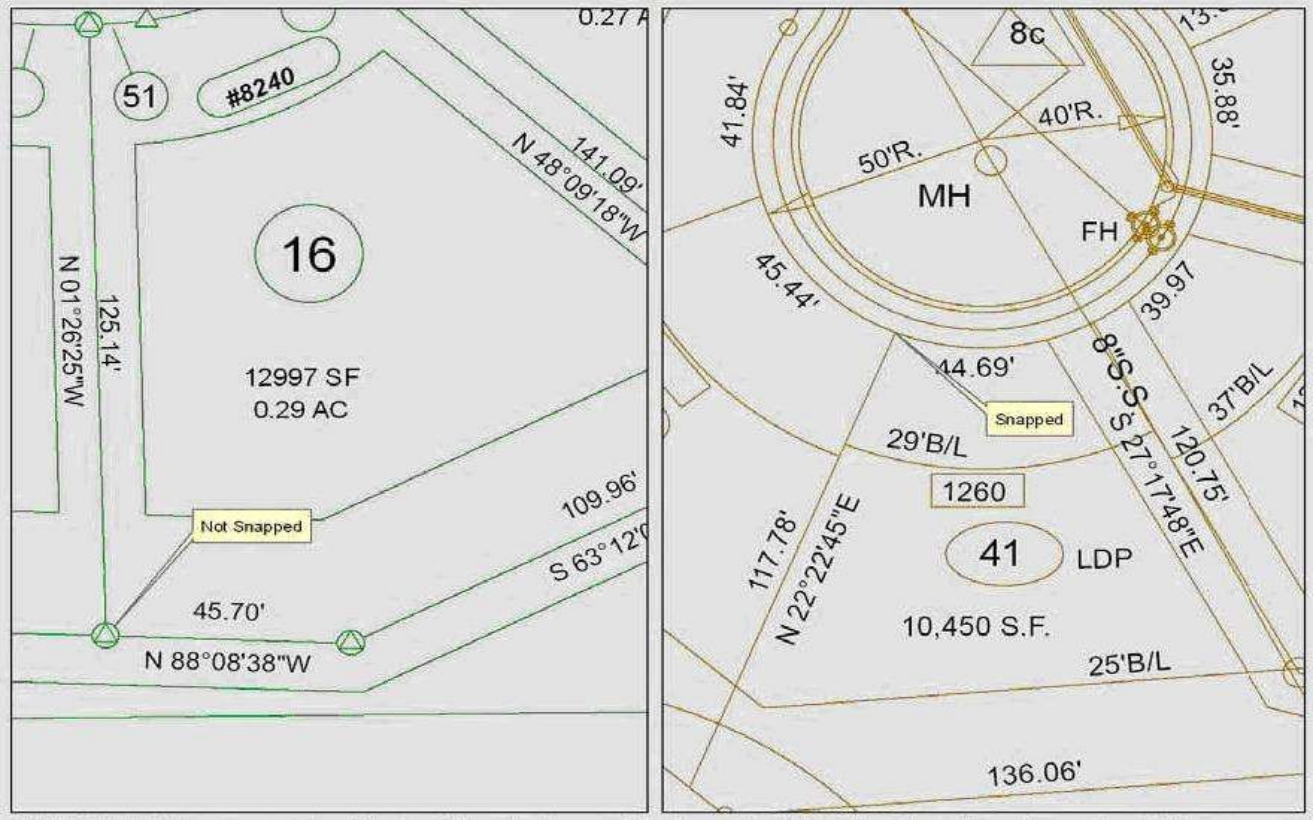


FIGURE 1. When snapping line/polyline features, it is important that the boundary lines should be snapped closed to the center of each vertex. Please note that the incorrect example has the line snapped to the edge rather that the center.

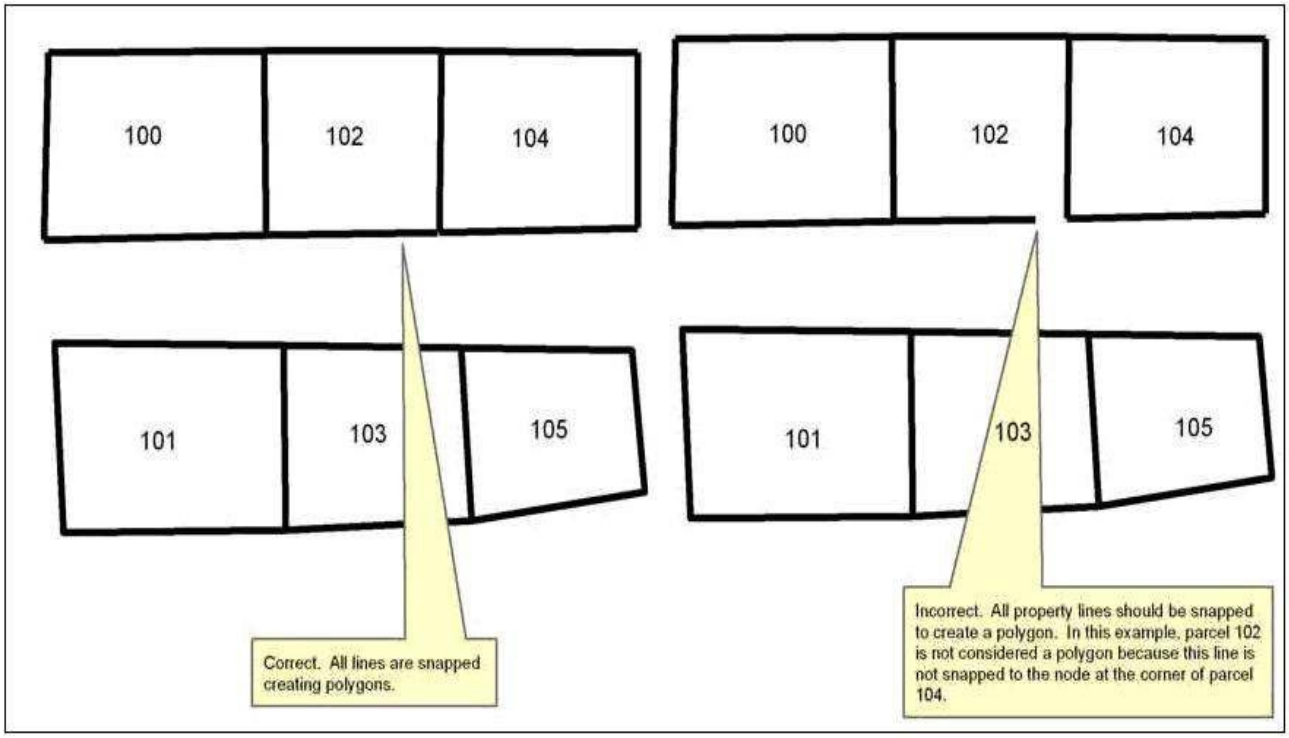


FIGURE 2. This example shows a property line that has been closed, which is correct (left) and the same property line drawn incorrectly (right).

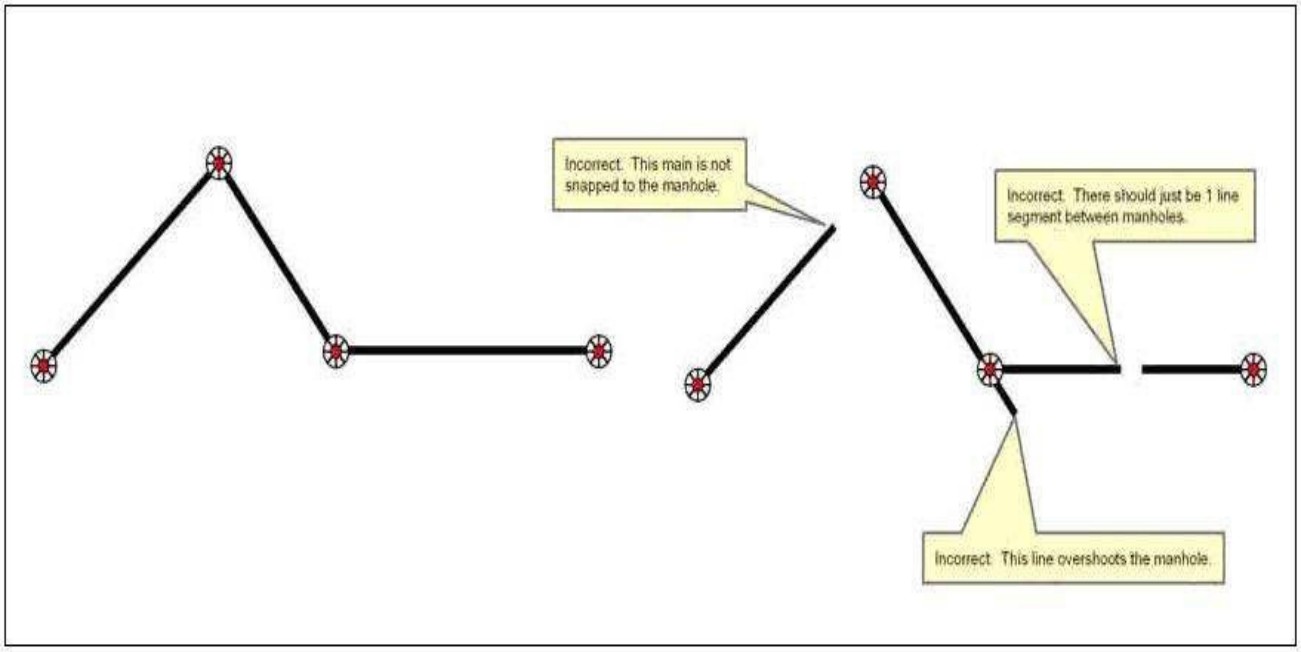


FIGURE 3A LEFT. CORRECT – The example on the left of sanitary sewer gravity mains is correct. The mains are single lines snapped to the pick point of the manholes.

FIGURE 3B RIGHT. INCORRECT - The example on the right has sanitary sewer not snapped to manhole and a short section of the sanitary sewer polyline past the manhole and the sanitary serer line in two short sections instead of one complete polyline.

Appendix E: CAD Deliverables Submission Figures – Figure 4

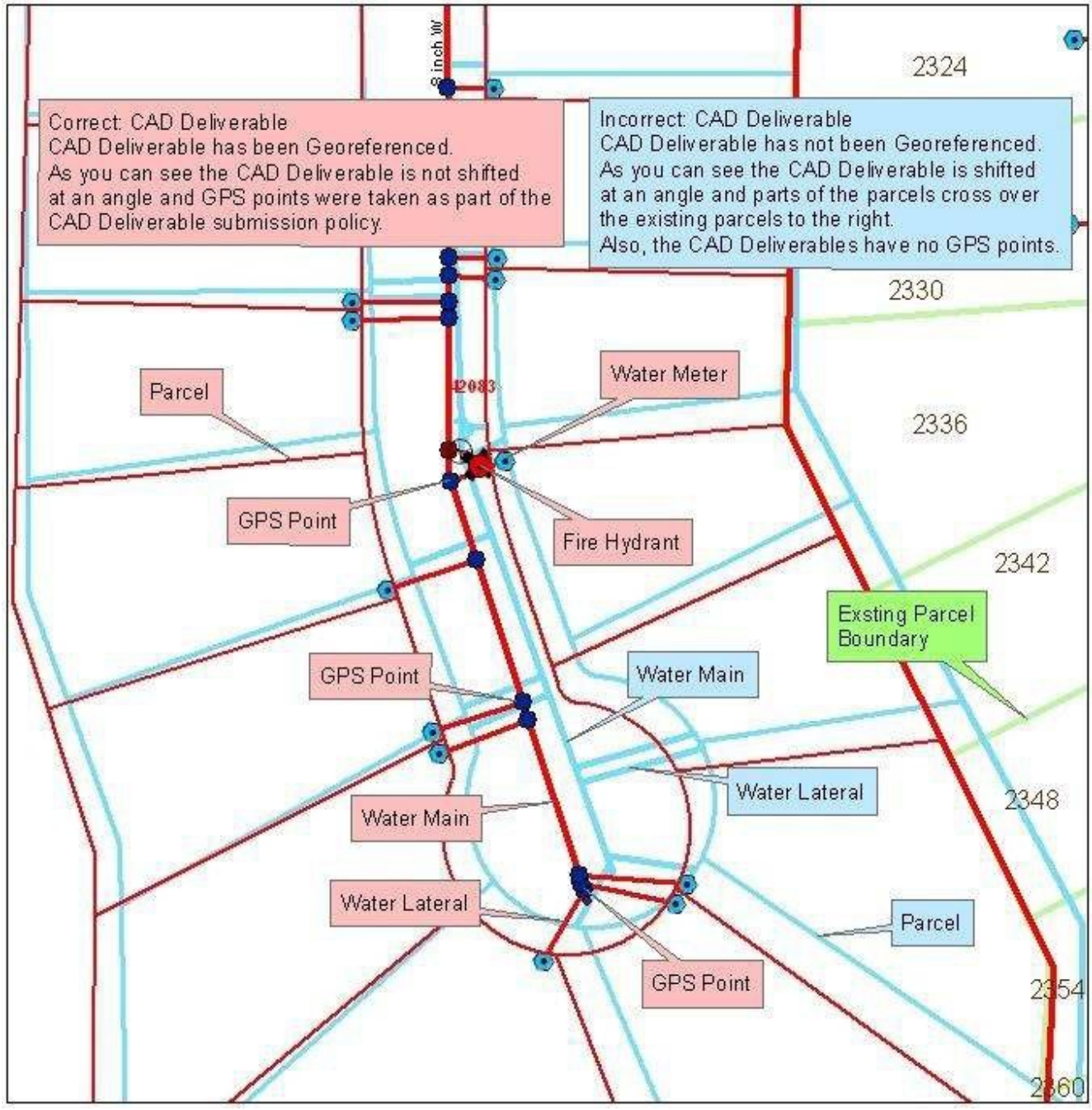


FIGURE 4. This example shows an addition to an existing subdivision. The GIS data in green is the existing parcel boundary and the CAD data in red is a CAD Deliverable submitted correctly following the CAD Deliverable Submission Standards and the CAD data in cyan is CAD Deliverable submitted incorrectly.

Appendix E: CAD Deliverables Submission Figures – Figure 5A

```
ID,NORTHING, EASTING, ELEVATION,DESC
1100,13813084.90000,2253608.35300,663.27500,wtr mtr top
1101,13813094.51000,2253726.00900,664.26800,wtr mtr top
1102,13813139.10000,2253855.31200,665.41300,wtr mtr top
1103,13813190.80000,2253925.86300,666.78100,wtr mtr top
1105,13813214.22399,2253904.83712,661.75000,cl ex h2o
1106,13813167.32189,2253839.01651,660.32000,cl ex h2o
1107,13813125.60070,2253720.18262,659.39000,cl ex h2o
1108,13813117.07145,2253604.91165,658.84000,cl ex h2o
1109,13813083.52000,2253513.28100,663.07500,ex elec
1110,13813070.95000,2253526.26600,663.22200,ex elec
```

FIGURE 5A. This example shows a typical ASCII comma delimited file of GPS points.

Appendix E: CAD Deliverables Submission Figures – Figure 5B

	A	B	C	D	E
1	ID	NORTHING	EASTING	ELEVATION	DESC
55	2026	13812887.431650	2254137.343660	661.910000	FL WW CO
56	2027	13812855.298110	2254089.969840	661.640000	FL WW CO
57	2028	13812857.171090	2254088.527610	661.860000	FL WW CO
58	2029	13812822.790320	2254037.321320	661.770000	FL WW CO
59	2030	13812821.097150	2254038.825210	661.530000	FL WW CO
60	2031	13812796.062370	2254015.033350	666.779100	CL TOP EXIST MH
61	2032	13812796.071020	2254015.220140	660.620000	FL EXIST MH
62	2033	13812789.371120	2253987.104010	661.410000	FL WW CO
63	2034	13812787.439480	2253988.517360	661.200000	FL WW CO
64	2035	13812756.233010	2253937.415580	661.150000	FL WW CO
65	2036	13812754.520560	2253938.716110	660.960000	FL WW CO
66	2037	13812722.296520	2253887.046750	661.070000	FL WW CO
67	2038	13812720.647060	2253888.186460	660.860000	FL WW CO
68	2039	13812680.663960	2253828.958020	660.570000	FL WW CO

FIGURE 5B. This example shows a typical Excel file of GPS points.

Appendix E: CAD Deliverables Submission Figure – Figure 6

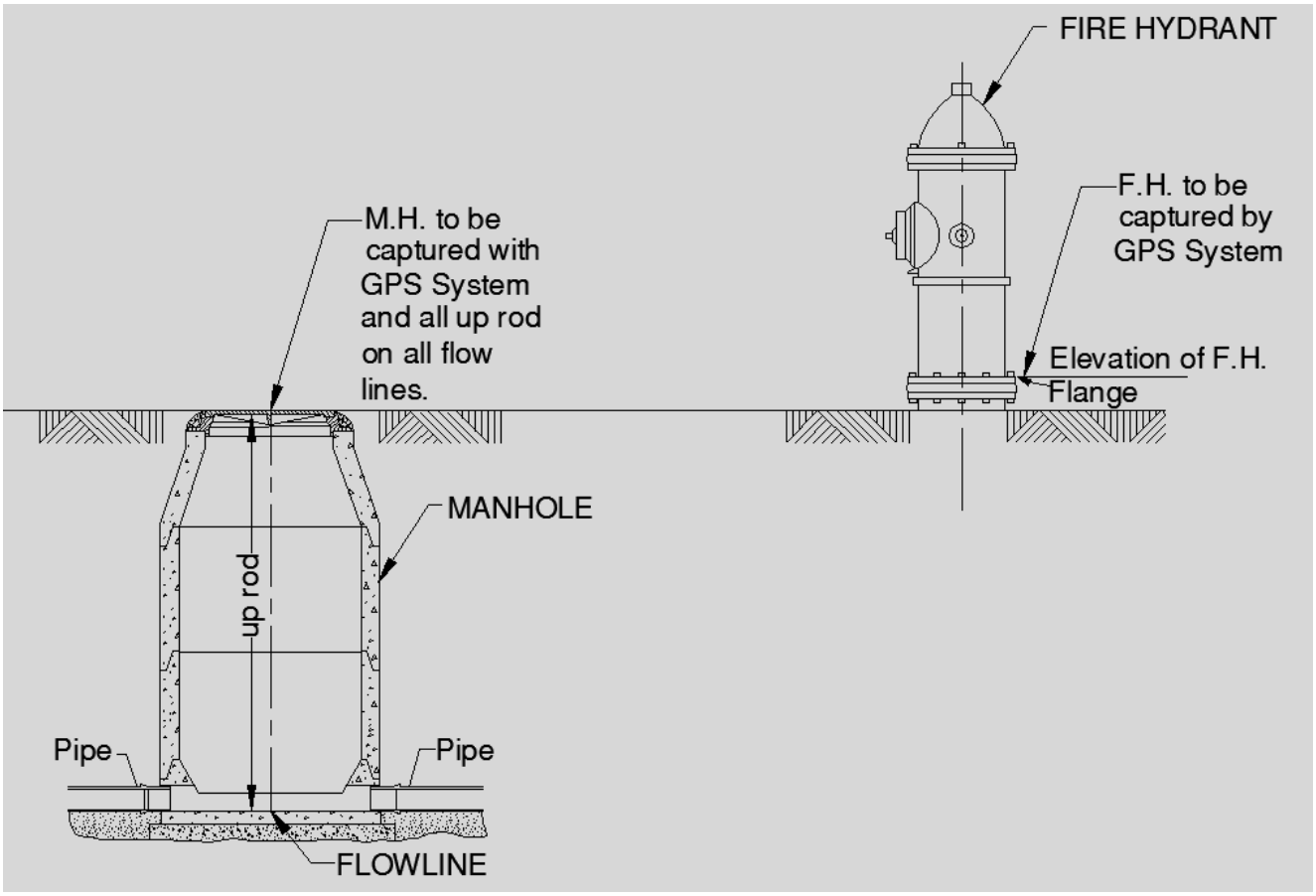


FIGURE 6. This example shows a typical Manhole and Fire Hydrant. GPS points will be taken as stated in section 2 GPS and CAD ACCEPTANCE.

Appendix F: CAD Deliverables Submission Form – Some of the fields in the form may not apply to every plan. Omit the fields that do not apply to a plan.

NEW BRAUNFELS UTILITIES
CAD Deliverables Submission Form

Contact Name, Date and Phone numbers:

Print:_____ Date:_____

Write:_____ Fax:_____

Office Phone:_____ Mobile: _____

Project Manager: _____

Company Name: _____

Address:_____

City: State: Zip: _____

Email: _____

Engineer of Record: _____

Drawing/File Name: _____

Software/Version Used: _____

Project Number: _____

Project Name: _____

Subdivision Name - Addition - Phase: _____

Project Location - Description: _____

Coordinate System / Projection: _____

Tied to Control Points: Y N

If yes identify the control: _____

CAD drawing was georeferenced using Control and GPS points: Y N

Point's of reference to local coordinates system: Y N

Data layer and symbol schema was followed: Y N

NBU Employee Name, Department and Phone Number: Date: _____

NBU Service Center
GIS Department - (830) 608-8942 - gis@nbutexas.com
Physical: 355 FM 306 - P.O. Box 310289 - New Braunfels, TX 78131-0289

NEW BRAUNFELS UTILITIES
Record Drawing / CAD / GPS
Submittal Requirements

1. As-Built Cad Utility File :
   Geo-Referenced "As- Built" File w/ GPS points
   (As Per Cad Deliverables Standards)

2. GPS Point File:
   Coordinate Data ASCII Comma Delimited or Excel File
   (As Per Cad Deliverables Standards)

3. Record Drawing Utility Stamped Set:
   Corrected with GPS points and Contractor "Redlines"
   PDF Format File to Include Utility Plan and Profiles

4. Copies of Contractor "Red Lines":
   PDF File Format

5. Fire Hydrant Flow Test Submittal:
   Flow Test for Each Newly Installed Fire Hydrant for Project
   Test Submittal PDF File on New Braunfels Utilities' Form
   Required for New Braunfels Fire Dept. Review and Approval

Submittal Info:

As-Builts Link - https://filecloud.nbutexas.com/url/3gw3gt355sy8y56f

1. Folders are only able to be dropped if it is zipped first (the system will not let them drop a whole folder if it is not zipped)
   a. Folders should be titled the project name
2. Documents within the folder should be titled: Project Name – Description of Document

FIRE HYDRANT FLOW TEST FORM

NEW BRAUNFELS UTILITIES

355 FM 306, NEW BRAUNFELS TX 78130

I. PROJECT INFORMATION (TO BE COMPLETED BY APPLICANT)

Name: _____ Phone: (_____) _____

Company Address: _____

Project Name: _____

Address (Lot / Block): _____

Nearest Cross Street / Distance (ft): _____

II. FLOW TEST DATA (TO BE COMPLETED BY APPLICANT)

FLOW HYDRANT:

Plan Sheet: _____ Hydrant #: _____ Outlet Diameter: 5"_____ 2-½"_____

Size and Material of Main:_____

Static PSI:_____ Residual PSI: _____ Pitot (PSI): _____ Pitot 2(PSI): _____

Observed Flow (GPM): _____

Calculated Fire Flow @ 20 PSI: _____ Duration of Flow: _____ Date and Time: _____

TEST (STATIC) HYDRANT:

Plan Sheet: _____ Hydrant #: _____

Size and Material of Main: _____Static PSI: _____ Residual PSI: _____

TEST (STATIC) HYDRANT:

Plan Sheet: _____ Hydrant #: _____

Size and Material of Main: _____Static PSI: _____ Residual PSI: _____

III. NBFD FIRE HYDRANT FLOW REQUIREMENTS (TO BE COMPLETED BY FIRE DEPARTMENT)

_____ _____

Signature of
FIRE DEPARTMENT REVIEWER

Please Print Name

Date: ____/____/____ Title: _____

Time: _____(am / pm) Accept: _____ Decline: _____

Comments (if applicable): _____

IV. TESTER / COMPANY INFORMATION (TO BE COMPLETED BY APPLICANT)

Flow Test Conducted by: _____Phone: (_____) _____

Company Name

Texas Dept. of Insurance State Fire Marshal's Office License #: _____

Company Address: _____

Date: ____/____/____ Signature: _____

FIRE HYDRANT FLOW TEST FORM

NEW BRAUNFELS UTILITIES

355 FM 306, NEW BRAUNFELS TX 78130

V. CALCULATIONS AND SKETCH (TO BE COMPLETED BY APPLICANT)

EQUATIONS:

Following equations should be used to determine the Residual and Fire Flows

Residual Flow	**Fire Flow**
$Q_r = 29.83 \times c_d \times D^2 \sqrt{P_p} \times H_f$ *Where* : Q_r = the residual flow at the pitot pressure measured in gpm c_d = the friction loss coefficient (usually 0.9 for a smooth 2-½" opening) D = the diameter of the opening in inches P_p = the pitot pressure in psi H_f = the number of hydrants flowed	$Q_f = Q_r \times ((P_s\text{-}20 / (P_s - P_r))^{0.54}$ *Where* : Q_f = the Fire Flow in gpm at 20 psi P_s = the static pressure in psi P_r = the residual pressure in psi

CALCULATIONS:

Residual Flow:	**Fire Flow:**

SKETCH (LOCATION OF RESIDUAL AND FIRE FLOW HYDRANTS):

Label Hydrant #'s and Street Name(s)

Indicate North