Simsboro Aquifer Well Permit Applications and Attachments

To Lost Pines Groundwater Conservation District

BASTROPTX
Heart of the Lost Pines / Est. 1832

July 2021

Table of Contents

Well 1

- Form 100
- Form 200A

Well 2

- Form 100
- Form 200A

Well 3

- Form 100
- Form 200A

Attachment A: Well Permit Applications Required Attachments

Attachment B: Letter of Authorization to Drill

Attachment C: Variance support letter from Mr. Sanchez

Attachment D: Simsboro Well Locations- May 2021

Attachment E: City of Bastrop Well J 36-Hour Pump Test Report

Attachment F: City of Bastrop Well TW2 Drilling Project

Attachment G: Water Conservation Plan

Attachment H: Drought Contingency Plan

Attachment I: City of Bastrop Additional GW Modeling TM

Well 1

FORM 100

Well Drilling Application

For District Use Only:

____
Application Date

____
Well Drilling Permit Number

Return this Form to: LPGCD, PO Box 1027 (908 Loop 230), Smithville, TX 78957
Phone: 512-360-5088 FAX: 512-360-5448 Email: lpgcd@lostpineswater.org

SECTION I – APPLICANT

Name Trey Job, CPM, Asst. City Manager of Community Development

Company (if applicable) City of Bastrop

Street (or PO Box) P.O. Box 427 - 1311 Chestnut Street

City Bastrop State TX Zip 78602

Phone Number (512) 332-8800

SECTION II – DRILLING SITE DESCRIPTION

Physical Description of Proposed Drilling Site (use GPS coordinates if known.)

Well 1 to be located within 100 feet of coordinates 30° 9'47.52"N, 97°19'29.54"W

County that the Drilling Site is Located in: Bastrop X Lee _____

Is the proposed well located within a neighborhood or subdivision? Yes_____ No X*

If Yes, which neighborhood or subdivsion? *A future subdivision is in planning stage

SECTION III – AUTHORIZATION TO DRILL

Is the Applicant the same as the Property Owner of the Proposed Drilling Site? Yes_____ No X

If Property Owner is different from Applicant shown in Section I, contact information and a notarized letter of authorization to drill from the property owner **must** be attached to this application. See Attachment B

SECTION V – WELL INFORMATION

What will be the primary use of the well (circle one)?

Domestic Livestock Irrigation Municipal Supply Mining Rig Supply Test Other ______________

What is the proposed aquifer that the well will produce from (if known)? Simsboro

What will be the approximate total depth of the well (if known)? 700 feet

Will the Applicant be requesting an exemption under LPGCD Rule 3.1? Yes____ No X

If Yes, type of exemption claimed:

______ A well that is solely for domestic or livestock use that is incapable of producing more than 25,000 gallons per day (gpd).

______ A well that uses less than 200 acre-feet/year solely for agricultural use.

______ A well that is used solely to supply water for a rig that is actively engaged in drilling or exploration operations for an oil or gas well permitted by the Railroad Commission of Texas.

______ A water well authorized under a permit issued by the Railroad Commission of Texas for mining activities.

______ A water well drilled and completed solely for the purposes of aquifer testing.

SECTION IV – AFFIRMATION

I certify that all statements and information in this application are true and correct.

Signature of Applicant

7-6-2021

Date

FORM 200
Operating/Transport Permit Application

For District Use Only:

____
Application Date

____
Temporary Permit Number

Return this Form to: LPGCD, PO Box 1027 (908 Loop 230), Smithville, TX 78957
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City Bastrop State TX Zip 78602

Phone Number (512) 332-8800

SECTION II – WELL INFORMATION

What aquifer will the well be producing from? Simsboro

What is the known or proposed total depth of the well? 700 feet

What is the known or proposed screened interval of the well? 500-650 feet

What is the known or proposed capacity of the well? 1,500 gpm

Is this Application for an existing well already registered with the LPGCD? Yes ______ No X

If Yes, what is the Well Number? ______________________

If No, has a Well Drilling Application (Form 100) or Well Registration Application (Form 300) been submitted? Yes X No ______

Well location (use GPS coordinates if known.) Well 1 to be located at coordinates 30° 9'47.52"N, 97°19'29.54"W

County that the well is located in: Bastrop X Lee _____

SECTION III – WITHDRAWAL AMOUNT REQUESTED

What is the total maximum withdrawal requested? ____1,333____acre-feet/year

Proposed maximum rate at which water will be withdrawn: _1,500_gpm

Is the Applicant requesting that the withdrawal be aggregated with another well? Yes_X__ No _____

If Yes, list other wells: City of Bastrop Well J and Proposed Wells 2 and 3 for a total of 6,000 acre-feet/year for all four

SECTION IV – PROPOSED USE

What is the proposed use of water from the well?

_X_ Municipal Supply ___ Mining ___ Irrigation ___ Other (describe) ___________________

List proposed usage of water produced from well and the amount of usage:

Use City of Bastrop municipal water demand____ Amount used ____1,333____acre-feet/year

Use ____ Amount used _____________acre-feet/year

Use ____ Amount used _____________acre-feet/year

SECTION V – TRANSPORT INFORMATION

Will this well be used to export water outside of the LPGCD? Yes ______ No __X___

If Yes, what is the maximum amount of water proposed to be exported: _____________acre-feet/year

If Yes, location of the use of the water: _________________________

SECTION VI – REQUIRED ATTACHMENTS

The following attachments are required with an Operating Permit Application:

__X__ Location map or property plat showing all registered or permitted wells within 5,000 feet of the proposed location

__X__ Results of a 36-hour pumping test (if the application is for more than 200 acre-feet/year)

__X__ Statement describing how the amount of water requested addresses an existing or projected need, including when that water supply need is projected to occur.

__X__ Statement describing how the amount of water requested will be dedicated to a beneficial use.

__X__ Statement identifying the End User of the requested water or that the End User has not been identified.

__X__ Applicant's or End User's Water Conservation Plan (if available)

__X__ Applicant's or End User's Drought Contingency Plan (if available)

__X__ Applicant's or End User's Well Closure Plan or declaration that the applicant will comply with well plugging guidelines and report closure to the TCEQ.

__X__ Any other information (describe) Smiley Well Variance Support Letter, 36-Hour Pump Test Reports from nearby wells

SECTION VII – DECLARATIONS

The Applicant agrees to the following conditions:

__X__ I agree to avoid waste and achieve water conservation.

__X__ I agree that reasonable diligence will be used to protect groundwater quality.

__X__ I agree that well plugging guidelines will be followed at the time of well closure.

[signature] 7-6-2021

Signature of Applicant Date

SECTION VIII – AFFIRMATION AND EXECUTION

I certify that all statements and information in this application are true and correct.

Signature of Applicant

7-6-2021
Date

THE STATE OF **TEXAS**

COUNTY OF Bastrop

I certify that the following person (s) personally appeared before me on this day, each acknowledging to me that he or she signed this Operating/Transport Permit Application.

Date: 7-6-21

Traci H Chavez
Signature of Notary

Traci H. Chavez
Printed Name of Notary

TRACI H CHAVEZ
Notary ID #1412377
My Commission Expires
October 14, 2021

My commission expires: 10-14-21

(seal)

Can be notarized by any Notary of your choice or at the LPGCD Office.

Well 2

FORM 100

Well Drilling Application

For District Use Only:

____
Application Date

____
Well Drilling Permit Number

Return this Form to: LPGCD, PO Box 1027 (908 Loop 230), Smithville, TX 78957
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Street (or PO Box) P.O. Box 427 - 1311 Chestnut Street

City Bastrop State TX Zip 78602

Phone Number (512) 332-8800

SECTION II – DRILLING SITE DESCRIPTION

Physical Description of Proposed Drilling Site (use GPS coordinates if known.)

Well 2 to be located within 100 feet of coordinates 30°10'7.66"N, 97°19'35.01"W

County that the Drilling Site is Located in: Bastrop X Lee _____

Is the proposed well located within a neighborhood or subdivision? Yes_____ No X*

If Yes, which neighborhood or subdivsion? *A future subdivision is in planning stage

SECTION III – AUTHORIZATION TO DRILL

Is the Applicant the same as the Property Owner of the Proposed Drilling Site? Yes_____ No X

If Property Owner is different from Applicant shown in Section I, contact information and a notarized letter of authorization to drill from the property owner **must** be attached to this application. See Attachment B

SECTION V – WELL INFORMATION

What will be the primary use of the well (circle one)?

Domestic Livestock Irrigation Municipal Supply Mining Rig Supply Test Other ______________

What is the proposed aquifer that the well will produce from (if known)? Simsboro

What will be the approximate total depth of the well (if known)? 700 feet

Will the Applicant be requesting an exemption under LPGCD Rule 3.1? Yes____ No X

If Yes, type of exemption claimed:

_____ A well that is solely for domestic or livestock use that is incapable of producing more than 25,000 gallons per day (gpd).

_____ A well that uses less than 200 acre-feet/year solely for agricultural use.

_____ A well that is used solely to supply water for a rig that is actively engaged in drilling or exploration operations for an oil or gas well permitted by the Railroad Commission of Texas.

_____ A water well authorized under a permit issued by the Railroad Commission of Texas for mining activities.

_____ A water well drilled and completed solely for the purposes of aquifer testing.

SECTION IV – AFFIRMATION

I certify that all statements and information in this application are true and correct.

Signature of Applicant

7-6-2021

Date

FORM 200

Operating/Transport Permit Application

For District Use Only:

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Application Date

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Temporary Permit Number

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SECTION II – WELL INFORMATION

What aquifer will the well be producing from? Simsboro

What is the known or proposed total depth of the well? 700 feet

What is the known or proposed screened interval of the well? 500-650 feet

What is the known or proposed capacity of the well? 1,500 gpm

Is this Application for an existing well already registered with the LPGCD? Yes ______ No X

If Yes, what is the Well Number? ____________________

If No, has a Well Drilling Application (Form 100) or Well Registration Application (Form 300) been submitted? Yes X No ______

Well location (use GPS coordinates if known.) Well 2 to be located within 100 feet of coordinates 30°10'7.66"N, 97°19'35.01"W

County that the well is located in: Bastrop X Lee _____

SECTION III – WITHDRAWAL AMOUNT REQUESTED

What is the total maximum withdrawal requested? ____1,333_____acre-feet/year

Proposed maximum rate at which water will be withdrawn: _1,500_gpm

Is the Applicant requesting that the withdrawal be aggregated with another well? Yes_X___ No _____

If Yes, list other wells: City of Bastrop Well J and Proposed Wells 1 and 3 for a total of 6,000 acre-feet/year for all four

SECTION IV – PROPOSED USE

What is the proposed use of water from the well?

_X_ Municipal Supply ___ Mining ___ Irrigation ___ Other (describe) ___________________

List proposed usage of water produced from well and the amount of usage:

Use City of Bastrop municipal water demand____ Amount used ____1,333_____acre-feet/year

Use ____ Amount used _____________acre-feet/year

Use ____ Amount used _____________acre-feet/year

SECTION V – TRANSPORT INFORMATION

Will this well be used to export water outside of the LPGCD? Yes ______ No __X___

If Yes, what is the maximum amount of water proposed to be exported: _____________acre-feet/year

If Yes, location of the use of the water: _________________________

SECTION VI – REQUIRED ATTACHMENTS

The following attachments are required with an Operating Permit Application:

__X__ Location map or property plat showing all registered or permitted wells within 5,000 feet of the proposed location

__X__ Results of a 36-hour pumping test (if the application is for more than 200 acre-feet/year)

__X__ Statement describing how the amount of water requested addresses an existing or projected need, including when that water supply need is projected to occur.

__X__ Statement describing how the amount of water requested will be dedicated to a beneficial use.

__X__ Statement identifying the End User of the requested water or that the End User has not been identified.

__X__ Applicant's or End User's Water Conservation Plan (if available)

__X__ Applicant's or End User's Drought Contingency Plan (if available)

__X__ Applicant's or End User's Well Closure Plan or declaration that the applicant will comply with well plugging guidelines and report closure to the TCEQ.

__X__ Any other information (describe) Smiley Well Variance Support Letter, 36-Hour Pump Test Reports from nearby wells

SECTION VII – DECLARATIONS

The Applicant agrees to the following conditions:

__X__ I agree to avoid waste and achieve water conservation.

__X__ I agree that reasonable diligence will be used to protect groundwater quality.

__X__ I agree that well plugging guidelines will be followed at the time of well closure.

Trey Job
Signature of Applicant

7-6-2021
Date

SECTION VIII – AFFIRMATION AND EXECUTION

I certify that all statements and information in this application are true and correct.

Trey Job
Signature of Applicant

7-6-2021
Date

THE STATE OF **TEXAS**

COUNTY OF Bastrop

I certify that the following person (s) personally appeared before me on this day, each acknowledging to me that he or she signed this Operating/Transport Permit Application.

Date: July 7, 2021

Traci H Chavez
Signature of Notary

Traci H. Chavez
Printed Name of Notary

My commission expires: 10-14-21

TRACI H CHAVEZ
Notary ID #1412377
My Commission Expires
October 14, 2021

NOTARY PUBLIC
STATE OF TEXAS

(seal)

Can be notarized by any Notary of your choice or at the LPGCD Office.

Well 3

FORM 100

Well Drilling Application

For District Use Only:

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Application Date

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Well Drilling Permit Number

Return this Form to: LPGCD, PO Box 1027 (908 Loop 230), Smithville, TX 78957
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City Bastrop State TX Zip 78602

Phone Number (512) 332-8800

SECTION II – DRILLING SITE DESCRIPTION

Physical Description of Proposed Drilling Site (use GPS coordinates if known.)

Well 3 to be located within 100 feet of coordinates 30°10'21.68"N, 97°19'18.04"W

County that the Drilling Site is Located in: Bastrop X Lee _____

Is the proposed well located within a neighborhood or subdivision? Yes_____ No X*

If Yes, which neighborhood or subdivsion?*A future subdivision is in planning stage

SECTION III – AUTHORIZATION TO DRILL

Is the Applicant the same as the Property Owner of the Proposed Drilling Site? Yes_____ No X

If Property Owner is different from Applicant shown in Section I, contact information and a notarized letter of authorization to drill from the property owner **must** be attached to this application. See Attachment B

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What will be the primary use of the well (circle one)?

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I certify that all statements and information in this application are true and correct.

Signature of Applicant

7-6-2021

Date

FORM 200
Operating/Transport Permit Application

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Temporary Permit Number

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Phone: 512-360-5088 FAX: 512-360-5448 Email: lpgcd@lostpineswater.org

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What is the known or proposed total depth of the well? 700 feet

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Is this Application for an existing well already registered with the LPGCD? Yes ______ No X

If Yes, what is the Well Number? ____________________

If No, has a Well Drilling Application (Form 100) or Well Registration Application (Form 300) been submitted? Yes X No ______

Well location (use GPS coordinates if known.) Well 3 to be located within 100 feet of coordinates 30°10'21.68"N, 97°19'18.04"W

County that the well is located in: Bastrop X Lee _____

SECTION III – WITHDRAWAL AMOUNT REQUESTED

What is the total maximum withdrawal requested? ____1,333____acre-feet/year

Proposed maximum rate at which water will be withdrawn: _1,500_gpm

Is the Applicant requesting that the withdrawal be aggregated with another well? Yes_X__ No _____

If Yes, list other wells: City of Bastrop Well J and Proposed Wells 1 and 2 for a total of 6,000 acre-feet/year for all four

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Use ____ Amount used _____________acre-feet/year

Use ____ Amount used _____________acre-feet/year

SECTION V – TRANSPORT INFORMATION

Will this well be used to export water outside of the LPGCD? Yes ______ No __X___

If Yes, what is the maximum amount of water proposed to be exported: _____________acre-feet/year

If Yes, location of the use of the water: __________________________

SECTION VI – REQUIRED ATTACHMENTS

The following attachments are required with an Operating Permit Application:

__X__ Location map or property plat showing all registered or permitted wells within 5,000 feet of the proposed location

__X__ Results of a 36-hour pumping test (if the application is for more than 200 acre-feet/year)

__X__ Statement describing how the amount of water requested addresses an existing or projected need, including when that water supply need is projected to occur.

__X__ Statement describing how the amount of water requested will be dedicated to a beneficial use.

__X__ Statement identifying the End User of the requested water or that the End User has not been identified.

__X__ Applicant's or End User's Water Conservation Plan (if available)

__X__ Applicant's or End User's Drought Contingency Plan (if available)

__X__ Applicant's or End User's Well Closure Plan or declaration that the applicant will comply with well plugging guidelines and report closure to the TCEQ.

__X__ Any other information (describe) Smiley Well Variance Support Letter, 36-Hour Pump Test Reports from nearby wells

SECTION VII – DECLARATIONS

The Applicant agrees to the following conditions:

__X__ I agree to avoid waste and achieve water conservation.

__X__ I agree that reasonable diligence will be used to protect groundwater quality.

__X__ I agree that well plugging guidelines will be followed at the time of well closure.

[signature] 7-6-2021

Signature of Applicant Date

SECTION VIII – AFFIRMATION AND EXECUTION

I certify that all statements and information in this application are true and correct.

Trey Job
Signature of Applicant

7-6-2021
Date

THE STATE OF **TEXAS**

COUNTY OF Bastrop

I certify that the following person (s) personally appeared before me on this day, each acknowledging to me that he or she signed this Operating/Transport Permit Application.

Date: July 7, 2021

Traci H Chavez
Signature of Notary

Traci H Chavez
Printed Name of Notary

My commission expires: 10-14-21

NOTARY PUBLIC STATE OF TEXAS
TRACI H CHAVEZ
Notary ID #1412377
My Commission Expires
October 14, 2021

(seal)

Can be notarized by any Notary of your choice or at the LPGCD Office.

Attachment A: Well Permit Applications Required Attachments

Lost Pines Groundwater Conservation District Well Permit Applications

City of Bastrop Wells 1, 2, and 3

Form 200 – Required Attachments

1) *Location map or property plat showing all registered or permitted wells within 5,000 feet of the proposed location*

   See Attachment D

2) *Results of a 36-hour pumping test (if the application is for more than 200 acre-feet/year)*

   The proposed wells have not been drilled yet, but 36-hour pump test reports are included from the City of Bastrop Wells J and Test Well 2 in the vicinity of the proposed wells. 36-hour pumping tests will be performed once the wells are drilled.

3) *Statement describing how the amount of water requested addresses an existing or projected need, including when that water supply need is projected to occur.*

   The City of Bastrop is in need of a new water supply to replace the existing system of shallow alluvial wells and provide additional supply to a growing demand from population increase. The existing system capacity is nearing the City's current peak summer demands. In addition, the existing wells are constrained because they are subject to the Groundwater Under the Influence of Surface Water rule. They are located in the floodplain of the Colorado River and nearing the end of their service life.

   Future water demand projections for the City of Bastrop were estimated based on historical population and water demand data. It is projected that the City will be in need of additional water supply by 2024.

   The new Simsboro wells water supply will provide the City with a reliable, long-term water source. The City is in the process of design for a new water treatment plant, pump station, and transmission main to treat the new water and distribute it to the customers in their service area.

4) *Statement describing how the amount of water requested will be dedicated to a beneficial use.*

   The water requested will be the source of the City of Bastrop's municipal water supply.

5) *Statement identifying the End User of the requested water or that the End User has not been identified.*

The End User of the requested water will be the City of Bastrop municipal water supply customers.

6) *Applicant's or End User's Water Conservation Plan (if available)*

   See Attachment G

7) *Applicant's or End User's Drought Contingency Plan (if available)*

   See Attachment H

8) *Applicant's or End User's Well Closure Plan or declaration that the applicant will comply with well plugging guidelines and report closure to the TCEQ.*

   The City of Bastrop declares that it will comply with well plugging guidelines and report well closures to TCEQ.

9) *Any other information (describe)*

   See Attachment C for Variance Support Letter from the Owner of the Smiley well, located within 5,000 feet of the proposed Well 3.

   See Attachment I for Technical Memorandum on results of groundwater modeling of the proposed wells.

In addition, please refer to the following additional attachments to the Well Permit Applications:

B – Notarized Letter of Authorization to drill wells from property owner

C – Variance Support Letter for Smiley Well

D – Well Location Map

E – Well J 36-hour Pump Test Report

F – Test Well 2 36-hour Pump Test Report

G – City of Bastrop Water Conservation Plan

H – City of Bastrop Drought Contingency Plan

I – Groundwater Modeling of Proposed Wells Technical Memorandum

Attachment B: Letter of Authorization to Drill

John Cochran
Crestline Investors, Inc.
201 Main Street, Suite 1900
Fort Worth, TX 76102
Office: (817) 339-7348

July 1, 2021

Paul Hofmann
City Manager
City of Bastrop
Bastrop City Hall
1311 Chestnut Street
Bastrop, TX 78602

Re: Bastrop Well Field - Authorization to Drill

Dear Mr. Hofmann:

I, John Cochran, attest that I am the Vice President of Crestline Investors, Inc., with registered offices at 201 Main Street, Suite 1900, Fort Worth, TX 76102. Crestline Investors, Inc. owns the property located in Bastrop, Texas described as the extreme eastern portion of Bastrop County Tax Parcels 22837 and 35216 located at the northwest corner of Sayers Road and Phelan Road, Bastrop, Texas 78602.

As Vice President of Crestline Investors, Inc., I hereby authorize the City of Bastrop to drill three new water production wells (Proposed Wells 1, 2, and 3) on the property described above. The drills will be located as shown on the enclosed Attachment A, Figure 1, and described below:

- Well 1 to be located within 100 feet of coordinates 30° 9'47.52"N, 97°19'29.54"W
- Well 2 to be located within 100 feet of coordinates 30°10'7.66"N, 97°19'35.01"W
- Well 3 to be located within 100 feet of coordinates 30°10'21.68"N, 97°19'18.04"W

Sincerely,

John Cochran
Vice President

Encl: Attachment A, Figure 1: City of Bastrop, Simsboro Aquifer Well Field Map

STATE OF TEXAS §
§
COUNTY OF TARRANT §

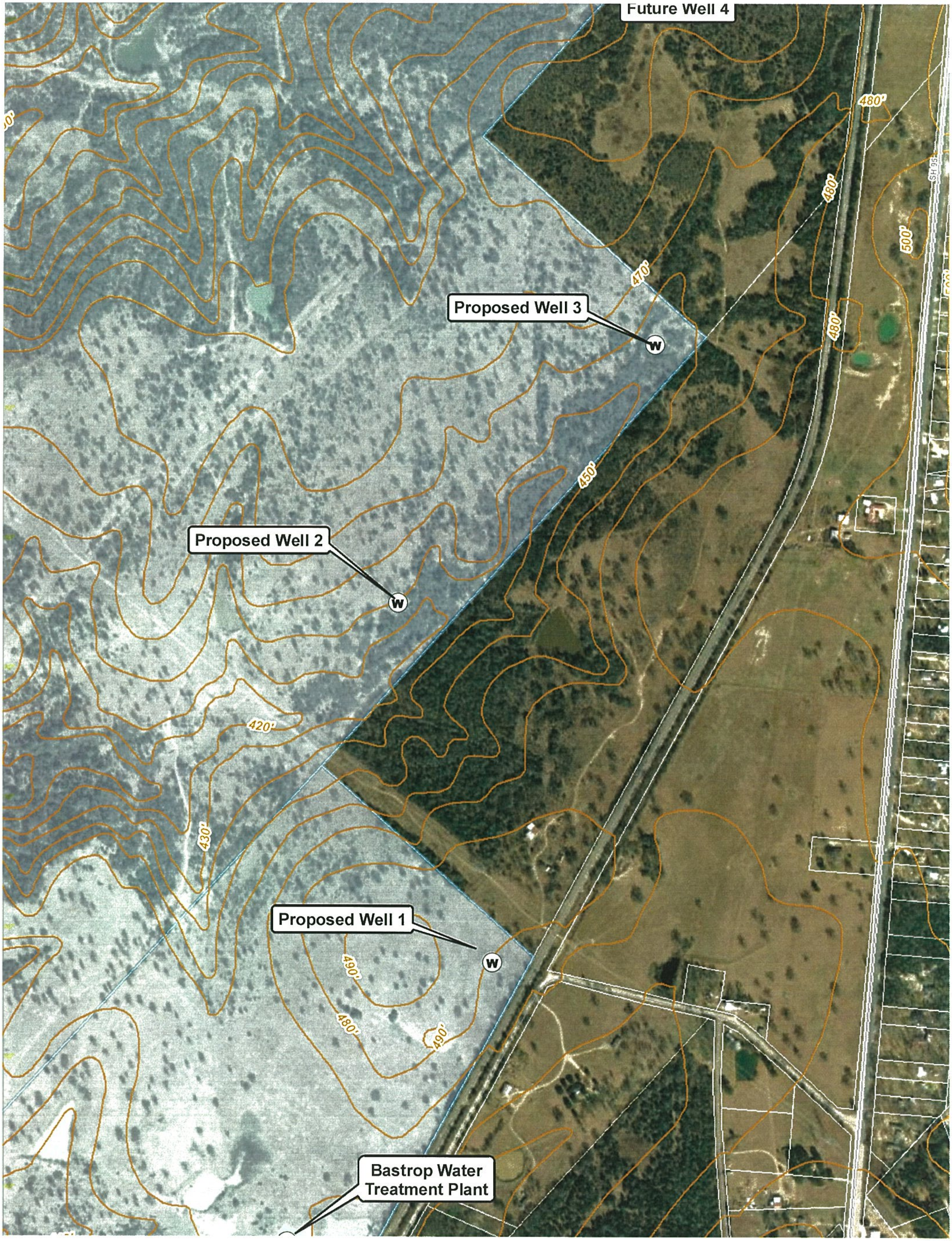
ACKNOWLEDGEMENT

Before me, the undersigned authority, on this day personally appeared **John Cochran**, proved to me through valid government issued identification, to be the person whose name is subscribed to the foregoing instrument and acknowledged to me that he executed the same for the purposes and consideration therein expressed.

Given under my hand and seal on this 1st day July, of 2021.

S. ANNA SASAKI
Notary Public, State of Texas
Comm. Expires 04-22-2022
Notary ID 128247949

[signature]
Notary Public, State of Texas


Future Well 4
Proposed Well 3
Proposed Well 2
Proposed Well 1
Bastrop Water Treatment Plant
480'
470'
450'
420'
430'
490'
500'

Attachment C: Variance support letter from Mr. Sanchez

BASTROPTX
City of Bastrop

February 10, 2021

Well Name: Bill Smiley Well
Well Location: 1029 Highway 95, Bastrop, TX 78602
Re: Letter Agreement for Support of Variance to Rule 8.2(b) of the Lost Pines Groundwater Conservation District

Agreement of Parties

WHEREIN, Oswald L. Sanchez, the owner of Lot 37, Block 8, Section 1, Lake Bastrop Acres, Bastrop County, Texas and located at 1029 Highway 95, Bastrop, Texas is not opposed to the City of Bastrop placing wells within 2,500 feet of the existing Smiley Well.

WHEREIN, the City agrees to replace the existing well, by drilling of a new well on Owner's property that produces as well or better, should the installation and/or operation of the new proposed City wells cause the pressure of the Smiley well, located on the Owner's property to drop in production by more than 25% of the current yield as described in Well Report Tracking Number 12282, report dated 9/22/2020 and attached hereto as Exhibit "A".

By: Oswald L. Sanchez

Date: 2021-02-11

Accepted by: CITY OF BASTROP

By: Trey Job, Assistant City Manager for Community Development

Date: 2-11-2021

Exhibit A

STATE OF TEXAS WELL REPORT for Tracking #12282

Owner:	**Bill Smiley**	Owner Well #:	**No Data**
Address:	**1029 Hwy 95 Bastrop, TX 78602**	Grid #:	**58-54-5**
Well Location:	**1029 Hwy 95 Bastrop, TX 78602**	Latitude:	**30° 10' 14" N**
		Longitude:	**097° 18' 57" W**
Well County:	**Bastrop**	Elevation:	**526 ft. above sea level**
Type of Work:	**New Well**	Proposed Use:	**Domestic**

Drilling Start Date: **8/28/2002** Drilling End Date: **8/30/2002**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**7.875**	**0**	**590**

Drilling Method: **Mud (Hydraulic) Rotary**

Borehole Completion: **Straight Wall**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
Annular Seal Data:	**0**	**10**	**4**

Seal Method: **hand**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **150**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **measured w/owner**

Surface Completion: **Surface Slab Installed**

Water Level: **No Data** on **2002-08-30** Measurement Method: **Unknown**

Packers: **1 rubber 10ft.**
1 rubber 430ft.

Type of Pump: **Submersible** Pump Depth (ft.): **240**

Well Tests: **Jetted** **Yield: 30 GPM with 294 ft. drawdown after 4 hours**

Water Quality:	Strata Depth (ft.)	Water Type
	No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

The driller did certify that while drilling, deepening or otherwise altering the above described well, injurious water or constituents was encountered and the landowner or person having the well drilled was informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Jimmy's Well Service**

P O Box 70
Bastrop, TX 78602

Driller Name: **2533WPL** License Number: **2533**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	4	sandy loam
4	92	tan clay
92	119	gray shale
119	120	rock
120	190	sandy shale
190	269	gray shale
269	420	sandy gray shale
420	575	sand-sandy shale
575	576	rock
576	583	sandy shale
583	590	gray shale

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia. (in.) New/Used Type Setting From/To (ft.)

4 1/2 n plastic 0 530

4 1/2 n slotted 530 570 .020

4 1/2 n plastic 570 590

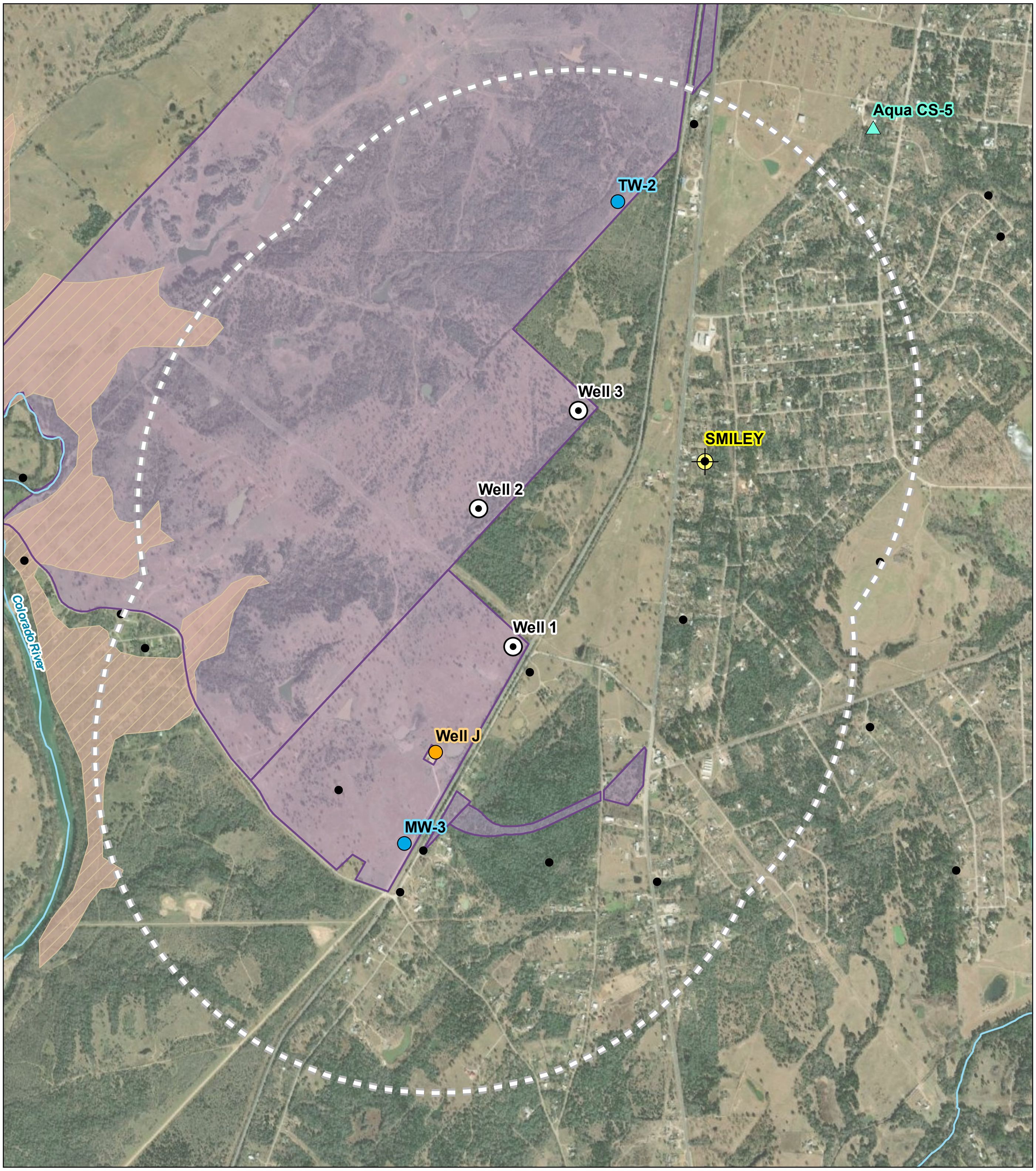
IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

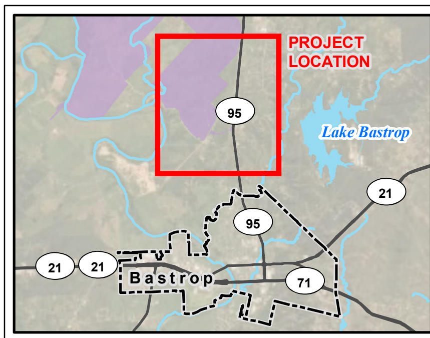
TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking Number on your written request.

Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

Attachment D: Simsboro Well Locations-May 2021





LEGEND

- Well
- Production Well
- Monitoring Well
- LPGCD Permitted Well
- LPGCD Exempt Well
- LPGCD Exempt Possible Simboro
- Well Buffer (5000')
- Former XS Ranch Property
- Simsboro Outcrop

All Other Features

- Watercourse
- Waterbody

FIGURE 1

Simsboro Well Locations May 2021

Bastrop, Texas

Date: May 26, 2021
Data Sources: TNRIS, TPWD, ESRI, USGS

N

0 0.2 0.4
Miles

GSI Water Solutions, Inc.

Document Path: Y:\0776_Freese_Nichols\Source_Figures\001_Bastrop_Prelim_Hydro_Rpt\FigureX_Simsboro_Well_Locations_May2021.mxd

Attachment E: City of Bastrop Well J 36-Hour Pump Test Report

March 29, 2018

Mr. Trey Job, CPM, Director
Public Works, Parks, & Utilities
City of Bastrop
1209 Linden Street
Bastrop, Texas 78602

Re: Summary of Pumping Test Results and Drawdown Assessment —
City of Bastrop Simsboro Well No. 1 (District Well: 5854819)
Bastrop County, Texas

Dear Mr. Job:

Thornhill Group, Inc. (TGI) provides to the City of Bastrop (City) this summary of work conducted and results pertaining to the monitoring plan, production testing and analyses associated with the City's Simsboro Well No. 1 (District Well: 5854819). The assessments herein are based on the proposed and permitted production from Simsboro Well No. 1 (primarily referenced herein as **Well "J"** as noted on the State Well Report and other documents) as follows:

- Maximum instantaneous pumping rate of 1,500 gallons per minute (gpm); and,
- Annual permit allocation of 2,000 acre-feet per year, which is equivalent to a continuous pumping rate of 1,240 gpm.

WORK CONDUCTED

The Work reported herein was conducted as outlined in TGI's Proposal to the City dated June 20, 2017, and in accordance with the provisions set forth by the Lost Pines Groundwater Conservation District (LPGCD) in the Special Conditions of the operating permit granted on October 12, 2016 for the subject well. Generally, TGI conducted the following:

- ✓ Compiling a list of water wells designated for monitoring per the Special Conditions of the Operation Permit granted by LPGCD and per all agreements between parties;
- ✓ Verifying local hydrogeologic conditions and completion details of proposed monitoring wells to delineate which wells are completed in the Simsboro aquifer as compared to other water-bearing zones;
- ✓ Conducting a field inventory of designated wells to assess access and suitability for monitoring, including needs for conducting any downhole video inspection and properly equipping the wells to enable sufficient monitoring before, during and after testing the required 36-hour production test;

- ✓ Implementing and executing an effective monitoring program to collect sufficient background (i.e., pre-testing) data, and to ensure comprehensive monitoring during the production test; and,
- ✓ Conducting hydraulic and hydrogeologic assessments based on the background and production testing monitoring to develop a scientific basis for determining "…proof of material impact caused by the pumping from Well No. 1…" per the terms in the Special Conditions of the Operating Permit.

TGI's entire proposed Scope of Services is provided in Appendix 1 and was intended to ensure that all work and information derived are in accordance with the Operating Permit, the subsequent Memorandum of Understanding (MOU), and any other applicable agreement relating to the monitoring and mitigation plan. The Scope of Services provided was based on the permit documentation provided by the City, on previous correspondence with the City, and on the meeting of June 14, 2017.

TGI has considerable experience in conducting monitoring programs and evaluating potential impacts due to pumping, and TGI professionals have conducted such assessments for wells completed in the Simsboro aquifer in Bastrop, Brazos, Burleson, Lee, Leon, Milam and Robertson counties, as well as in many aquifers across Texas. TGI is a licensed firm with the Texas Board of Professional Geoscientist and is comprised of licensed professional geoscientists specializing in groundwater and well evaluations.

RESULTS

TGI has reviewed numerous regional and local reports in conducting this work, including reports by experts and consultants employed on behalf of XS Ranch, the City of Bastrop and the LPGCD. This report will not reiterate the detailed findings of those previous studies but will provide summary information and comparisons as applicable to explain and illustrate the results of production testing and associated impacts assessments associated with Well "J". Supporting data, information and documentation for this assessment are provided in the following:

Appendix 1 – Scope of Services
Appendix 2 – Basic Groundwater Concepts
Appendix 3 – Reference Illustrations

Attachment 1 – Report Figures and Tables
Attachment 2 – Monitoring Well Information and Results (Packets)
Attachment 3 – Selected References

Well Location and Study Area

The City's new Well "J" is located on the XS Ranch approximately four (4) miles north of downtown Bastrop and about 0.6 mile west of State Highway 95. Figure 1 provides the location of the subject well and other wells permitted by LPGCD. The nearest large-capacity Simsboro wells are located in Aqua Water Supply Corporation's (AWSC) Camp Swift well field and the Lower Colorado River Authority's (LCRA) well field on the east side of Lake Bastrop. The wells monitored in this study include the City's monitoring well (MW-3) which is located approximately 1,400 feet south-southwestward from Well "J". Additionally, the City and TGI obtained permission and were able to access 17 private wells for monitoring before and during the 36-hour production testing. All of the private wells are exempt from permitting and are small-capacity wells used for domestic and stock purposes. The wells are located generally in three areas as follows:

- Area 1 – four (4) wells located within about 2,200 feet of Well "J", all along Phelan Road;
- Area 2 – nine (9) wells located near the Colorado River along the east side of Powell Bend, along and near Sayers Road. These wells are between 4,200 and 6,200 feet (approximately 0.8 to 1.2 miles) from the subject production well;
- Area 3 – four (4) wells reportedly located on the McCall Ranch property on the north side of the Colorado River near Powell Bend. These wells are approximately two (2) miles from the City's new Well "J".

Figure 2 provides the location of the Study Area, including the production well and wells monitored during testing.

Hydrogeology

The long-term availability of groundwater resources and impacts associated with pumping from aquifers depend on the following key factors:

- Thickness, rock type and character, and geometry (e.g., structure) of geologic units forming aquifers and confining units;
- Hydrologic and hydraulic characteristics of producing zones and confining units including primary porosity, secondary porosity, effective porosity, hydraulic conductivity (i.e., permeability), transmissivity and storage coefficient, as well as the presence of faults and other hydraulic boundaries;
- The storage characteristics of the aquifer;
- Sources, amounts, timing and distribution of recharge and other inflows;
- Amounts, locations, and duration of discharge and other outflows, including naturally via springs, seeps, underflow, leakage and evapotranspiration, as well as artificially due to pumping; and,
- Quality of water in water-bearing zones with respect to the quality of water needed;

Appendix 2 provides TGI's handout titled "Basic Groundwater Concepts" which provides fundamental terms, definitions and explanations regarding how aquifers function, and presents necessary insights to assess effects of pumping. Such definitions are not re-stated in this summary report. Appendix 3 includes pertinent miscellaneous illustrations from selected reference materials.

Aquifer Setting and Characteristics

The City's Well "J" is located atop the outcrop of the Calvert Bluff Formation and is completed in massive sand layers of the Simsboro aquifer, which is formed by saturated portions of the Eocene-age Simsboro Formation of the Wilcox Group. The Simsboro is part of the Major Aquifer identified by the TWDB as the Carrizo-Wilcox aquifer which is comprised, from shallower to deeper (i.e., younger to older), of the Carrizo Sands, the Calvert Bluff Formation, the Simsboro Formation and the Hooper Formation. The Carrizo is not present at the subject well site. Figure 3 provides a map illustration the Regional Surface Geology, and Figure 4 shows the Study Area Surface Geology (also see Appendix and USGS, 1984). The physical and hydraulic characteristics of each the geologic formations comprising the Wilcox Group are distinct from each other; therefore, each unit forms its own separate hydrostratigraphic unit. Figure 5 provides a summary Hydrostratigraphic Section.

The Calvert Bluff Formation is at land surface across most of the area between Well "J" and the Colorado River, and is characterized primarily by thin, alternating and interbedded layers of fine-grained sediments including mudstones, siltstones, lignite seams. Some significant sand channels ranging up to 100 feet in thickness occur in the Calvert Bluff, however, such channels are typically discontinuous and isolated laterally. The Calvert Bluff is up to 300 feet thick near Well "J" (see Appendix 3). Typical horizontal hydraulic conductivity values in Calvert Bluff sand channels range from four (4) to 18 feet per day (ft/d), which is equivalent to 30 to 135 gallons per day per square foot (gpd/ft^2) (TWDB 1991). The modeled hydraulic conductivity locally is between one (1) and three (3) gpd/ft^2 (see Appendix 3 and Dutton, Harden, Nicot and O'Rourke, 2008). Vertical hydraulic conductivity values in relatively uniform sand layers are generally one-tenth of the horizontal values, or less. The vertical hydraulic conductivity in the many clay layers within the Calvert Bluff likely ranges from 10^{-6} to 10^{-3} gpd/ft^2 (Driscoll, 1986). The Calvert Bluff is primarily considered an aquitard or confining unit, as horizontal and vertical groundwater flow through the Calvert Bluff is generally restricted across Bastrop County and the LPGCD. In some locations, the Calvert Bluff may yield sufficient quantities of water to wells for small industrial and municipal uses. While some interaquifer leakage always occurs as groundwater oozes from the Calvert Bluff into the Simsboro, the leakage is very slow and does not greatly affect the groundwater conditions in the Calvert Bluff due to low vertical hydraulic conductivity (i.e., permeability).

The Simsboro aquifer is the most prolific water-bearing unit in Bastrop and Lee counties and provides major water supplies across Groundwater Management Area 12 (GMA 12). The

Simsboro Formation is comprised of multistory, multilateral channel-fill sand complexes that are characteristic of fluvial-deltaic depositional systems (Ayers and Lewis, 1985). The Simsboro often contains two or more thick, massive sand units separated by clay layers. The Simsboro sands are characterized on geophysical logs by high formation resistivity. The sand units consist primarily of unconsolidated, medium- to coarse-grained sand, with some interbedded and stratified finer-grained sediments. Laterally, the thickness and character of the formation can vary considerably, but generally the sand layers are extensive and continuous. Locally, the Simsboro thickness reportedly ranges from 100 feet in its outcrop area near the Colorado River to more than 450 feet at the Well “J” site (see Appendix 3 and TGI, 2007). Appendix 3 provides maps from the Carrizo-Wilcox GAM showing the Simsboro sand channels to be between 100 and 300 feet thick in the study area (Dutton, Harden, Nicot and O’Rourke, 2003). The geophysical log for the City’s Well “J” and logs for other nearby sites indicate that the total aquifer thickness is approximately 380 feet, and the net sand thickness ranges from 160 to 200 feet locally. The horizontal hydraulic conductivity for Simsboro sands ranges from 2 to 84 ft/d, which is equivalent to 15 to 630 gpd/ft^2 (TWDB, 1991). The Carrizo-Wilcox GAM utilizes hydraulic conductivity values of between 10 and 20 ft/d, or 75 and 150 gpd/ft^2 within the Study Area (see Appendix 3 and Dutton, Harden, Nicot and O’Rourke, 2003). Locally, the transmissivity of the Simsboro aquifer generally ranges from 25,000 to more than 50,000 gpd/ft (LAN and TGI, 2005). The upper contact with the Calvert Bluff and the basal contact with the underlying Hooper Formation tend to be sharp, although locally the occurrence of some lower sand channels in the Calvert Bluff may make identifying the top of the Simsboro difficult.

The Hooper Formation underlies the Simsboro and is comprised of upward-coarsening sequences of delta-plain mudstone, lignite and channel fill (Ayers and Lewis, 1985). Locally, the Hooper is more than 1,000 feet thick (see Appendix 3 and Dutton, Harden, Nicot and O’Rourke, 2003). In some areas, the Hooper contains significant thicknesses of very fine- to medium-grained sands and has been tapped to provide relatively small municipal supplies, particularly in southeastern Williamson County and southwestern Milam County. The Hooper is tapped for small public water supplies in western Bastrop County (near Cedar Creek) and by Aqua WSC south and east of Elgin (see Figure 1). Locally, the Hooper is tapped near the Colorado River for domestic well uses. Typical horizontal hydraulic conductivity in the Hooper ranges from 0.1 to one (1) ft/d, or 0.75 to 7.5 gpd/ft^2 (see Appendix 3 and Dutton, Harden, Nicot and O’Rourke, 2003). Vertical hydraulic conductivity values are at least an order of magnitude less than the vertical values in sand layers, vertical permeabilities are orders of magnitude less in clay zones. Because of its stratification and lower hydraulic conductivity, the Hooper Formation is considered a confining layer with respect to the Simsboro aquifer.

The depth, thickness and lateral continuity of the Simsboro are determined by land-surface topography, depositional system and the geologic structure. The City’s Well “J” is completed to a total depth of 673 feet below ground level (BGL). The top of the Simsboro Formation occurs at a depth of 260 feet BGL, or an elevation of 201 feet above mean sea level (MSL). Some upper sands in the Simsboro were not screened, which allows for more favorable available drawdown. The top of the screened (i.e., producing) interval for the well is 450 feet BGL, an elevation of 11 feet above MSL. Figure 6 provides a diagram illustrating the well completion settings for Well "J" as related to the geophysical log and hydrostratigraphic layers for the site.

The geometry of the local Simsboro aquifer is controlled primarily by two structural features; the geologic dip and faulting. The Simsboro is mapped at land surface (i.e., crops out) in a narrow southwest-northeast trending band (see Appendix 3, Figure 3 and Figure 4). Along the ancient and present-day course of the Colorado River, the Simsboro subcrops beneath deposits of the Colorado River alluvium, which are typically less than 50 feet thick but locally may consist of gravel deposits that can yield significant water supplies to wells. The closest portion of the outcrop to Well "J" is mapped by the University of Texas Bureau of Economic Geology (BEG) to occur near Powell Bend on the Colorado River, approximately 3,500 feet (0.7 mile) from the subject production well (see Figure 4). However, due to faulting it is likely that the outcrop actually occurs slightly further to the west. Generally, the Simsboro dips (i.e., slopes) toward the east-southeast with an incline of between 100 and 200 feet per mile (see Appendix 3 and TWDB, 1991). However, the dip is probably on the order of 130 feet per mile in the shallow confined zone and is gentler (i.e., flatter) at less than 100 feet per mile nearer to the outcrop area (USGS, 1984). Faults associated with the Balcones Fault Zone have displaced the Simsboro within and near its outcrop area. Local studies have revealed at least three mappable faults within and near the Study Area (see Figure 4 and Appendix 3). The faults trend northeastward generally parallel to the outcrop, and are downthrown on the northwestern (i.e., updip) side (USGS, 1984). The "Bastrop Fault" occurs within 3,600 feet downdip from the Well "J". The "Powell Bend Fault" occurs within approximately 3,000 feet of the subject well in the updip direction and is likely between the subject production well and Powell Bend of the Colorado River. The "Powell Bend Fault" may be an extension of the previously mapped "Well-Field Fault" in the Camp Swift area (see Figure 4 and Appendix 3). The "Sayersville Fault" occurs between two (2) and three (3) miles updip from the "Powell Bend Fault" (see Figure 3 and Appendix 3). The net displacement along the trend of the faults varies from one end of the fault to the other and are sometimes called "scissor faults". Reportedly, the "Sayersville Fault", the most prominent fault, exhibits about 250 feet of throw in the northwestern part of Camp Swift, and has a reported displacement of about 500 feet several miles southwest of Camp Swift (USGS, 1984). Based on TGI's review of several geophysical logs within the Study Area, the fault displacement along the "Powell Bend Fault" is probably about 100 feet; therefore, the Simsboro Formation is not completely displaced across the fault line locally. Likely, there are numerous smaller faults associated with and parallel to the known or mapped faults. Figure 7 provides a Cross Section for the Study Area, showing the thickness and structure of the Simsboro aquifer and its relationships to overlying and underlying aquifers.

The geologic structure and depositional environments heavily influence the hydraulic characteristics and responses in the Simsboro aquifer. Faults in the Simsboro aquifer typically restrict or inhibit the flow of groundwater across the fault planes, due to the displacement (and saturated thickness change) across the fault and the associated low-permeability fault gouge along the fault plane. The amount of restriction varies, but typically results in more drawdown than anticipated on the pumping side of the fault, and less drawdown than anticipated on the side of the fault opposite of production. The close proximity to the outcrop area is also important with respect to the hydraulic setting and effects of pumping in the local Simsboro aquifer. Because the subject well is close to the water-table portions of the aquifer and the recharge area, the storage coefficient transitions from that of an artesian (i.e., confined) or leaky-artesian value (i.e., 10^{-4} to 10^{-3}) in the downdip areas to one equivalent to the specific yield (S_Y) in the unconfined or water-table areas (see discussion of aquifer storage coefficient in Appendix 2). Finally, all aquifers and aquitards (i.e., confining layers) leak. Because the Study Area is within the recharge zone of the Wilcox Group, groundwater continually moves laterally downgradient and attempts to leak vertically downward under non-pumping conditions. Modeled and measured water levels confirm that groundwater currently leaks downward from the Calvert Bluff to the Simsboro (see Appendix 3 and Dutton, Harden, Nicot and O'Rourke, 2003). Due to the stratified nature of the Simsboro aquifer and the overlying confining layers, the leakage from the Calvert Bluff into the Simsboro is quite slow. Modeled water levels indicate that artesian heads in the local Simsboro and Hooper formations are at similar elevations (see Appendix 3 and Dutton, Harden, Nicot and O'Rourke, 2003). Local water-level measurements indicate that Simsboro water level heads may be slightly higher than those in the Hooper, so groundwater is currently slowly leaking from the Simsboro to the Hooper. The confining layer between the Simsboro and Hooper greatly restrict the movement of water downward.

Wells Monitored During Testing

Additional to the City's production well (Well "J") and monitoring well (MW-3), twenty-six (26) property owners requested that their wells, a total of 32 domestic wells, be monitored during testing of the subject production well. TGI inspected all 32 of the domestic wells and found that 17 wells were constructed with sufficient access to allow for effective monitoring by electric line water-level indicators. Also, TGI obtained permission and installed continuous water-level recorders (i.e., pressure transducers) in five (5) of the private wells and one in the City's MW-3. Background water-level monitoring began in September of 2017.

TGI assessed land surface topography, available well completion records, information provided in the City's permit application and the associated contested-case hearing, and geologic conditions including formation thickness and geologic structure, and determined in which aquifer each well is completed. Table 1 provides a summary of the wells monitored per the permit conditions and agreement, including depths, elevations and completion zones. Figure 3 provides a map illustrating the locations of the wells and aquifer of completion. Generally, the accessible private monitoring wells are concentrated in three geographic areas, as summarized below:

Area 1 – Four (4) Wells Closest to the Production Well

- Distances from wells to the production well range from 460 to 1,160 feet;
- Well depths range from 240 to 285 feet below ground level, with elevations of total depth (TD) of the wells ranging from 164 to 211 feet above MSL; and,
- Wells are completed in the Calvert Bluff Formation.

Area 2 – Nine (9) Wells Within and Near Colorado Shores Subdivision

- Distances from wells to the production well range from 4,250 to 6,260 feet;
- Known well depths range from 165 to 400 feet below ground level, with elevations of tops of producing zones ranging from 112 to 233 feet above MSL; and,
- All wells with known settings, except two, are generally completed into the uppermost Simsboro sands (see Figure 7);
- Dr. Uliana noted that the Mr. Robert Martinez well is "most likely completed in the Simsboro Formation" (Uliana, 2015). However, TGI has concluded based on available geologic information and the lack of water-level response in the well due to pumping from Well "J" that the well does not produce from the Simsboro and likely produces from the overlying Calvert Bluff Formation;
- Previous reports stated that the Mr. Charles Tarket well is completed in the Hooper Formation (Uliana, 2015). However, TGI has concluded based on geologic information and measured water levels that the Tarket well is in the Simsboro aquifer. If the Tarket well taps the Hooper Formation, it does not penetrate much of the formation and likely produces only from the Simsboro.

Area 3 – Four (4) Wells Along Sayers Road

- Distances from wells to the production well range from 10,200 to 11,300 feet;
- Well depths range from 300 to 500 feet below ground level, with elevations of tops of producing intervals ranging from 131 feet below MSL to 98 feet above MSL; and,
- Wells are completed in the Hooper Formation.

Historical Water Levels and Pumping

The potentiometric surface in an aquifer determines the water levels in wells completed in the aquifer. Water levels below the top of the aquifer indicate unconfined or water-table conditions, while water levels above the top of the aquifer indicate that he well is completed in confined or artesian portions of the aquifer, and the water is under pressure greater than atmospheric pressure (see Appendix 2). Aquifer water levels change in response to changes in aquifer storage. Because storage coefficients in artesian aquifers are very small, large changes in water levels can occur with very small changes in storage. Conversely, the storage coefficient in water-table portions of aquifers is commonly three to five orders of magnitude larger than in artesian areas; therefore, water-level changes are typically slower and smaller in unconfined aquifers. The magnitude and rate of water-level changes in the Simsboro aquifer are primarily directly attributable to the aquifer transmissivity and the quantity, proximity and duration of pumping. Drawdown in artesian aquifers can extend for several miles from pumping centers. In fact, drawdown due to pumping in neighboring counties can affect water levels in Bastrop and Lee counties.

Historically, the amount of pumping in the Simsboro aquifer has been relatively small within Bastrop County and all of the LPGCD area. Prior to commencement of depressurization pumping associated with the Three Oaks Mine located partially within Lee County, total reported permitted pumping within LPGCD was between 11,000 and 12,000 acre-feet per year (LPGCD Database, 2012), with most of the pumping from Bastrop County and Aqua WSC being the largest producer from its Camp Swift well field. Since 2004, pumping from the mine and other smaller increases by existing users increased pumping from the Simsboro to as much as 25,000 acre-feet per year. (Note that Manville WSC purchased some of the water produced at the ALCOA/Three Oaks mine near Blue in Lee County). During the period from 2006 through 2014, Aqua WSC pumping increased slightly to as much as approximately 8,500 acre-feet per year in 2011, as Aqua WSC added some additional pumping in deeper portions of the aquifer near Paige. Recently, Heart of Texas (HOT) and the LCRA obtained permits and began pumping from the Simsboro aquifer in Lee County and from the east side of Lake Bastrop, respectively. Figure 8 shows reported pumping by entity for Bastrop and Lee counties and locations of permitted wells and mining areas. The TWDB modeled the 2010 pumping from the Calvert Bluff and Hooper formations in Bastrop County at 1,510 and 1,125 acre-feet, respectively.

Figure 9 is a regional map showing historical water levels (i.e., hydrographs) for wells completed in the Simsboro aquifer across GMA 12. Note that water levels have remained stable in the outcrop or recharge (i.e., water table or unconfined) portions of the aquifer. Water levels have declined by 150 feet or more over several decades in deeper, artesian portions of the aquifer that are near larger pumping centers. Figure 10 provides some of the limited historical water-level measurements for Simsboro aquifer wells within and near the Study Area. Generally, the hydrographs in Figure 10 show the steadier water-level behavior within and near outcrop areas, and more fluctuation due to pumping cycles in downdip areas. The chart for SWN 58-54-506, an Aqua WSC Camp Swift well, shows seasonal fluctuations of between 15 and 20 feet. Similarly, wells located near Bastrop State Park show large fluctuations in water levels due to pumping cycles. There are not sufficient data to determine local hydraulic gradients or long-term water-level trends.

TGI conducted background monitoring in 18 wells, including the City's MW-3, from September 2017 through the completion of the 36-hour pumping test on December 29, 2017. TGI installed automated data recorders in six (6) wells and collected periodic manual measurements in all wells utilizing electric line water-level indicators and/or calibrated steel tapes. Water-level elevations and behaviors, combined with the geologic information available, allow for determining the aquifer(s) in which each monitoring well is completed. Attachment 2 provides water-level charts for all monitored wells. Table 2 provides average static water level elevations and the overall water-level fluctuations for each of the monitored wells for the period between September 2017 and December 2017. Figure 11 provides representative static water level elevations for the monitored wells. The following provides a general summary of water levels per aquifer in the area near the City's Well "J":

- Calvert Bluff – static water elevations in the local Calvert Bluff wells varied from elevations of 294 feet to 386 feet above MSL indicating separate production intervals for several wells over a small area, which is indicative of the separate, isolated and small sand channels in the Calvert Bluff (see Figure 11). Water levels fluctuated by between two (2) and 21 feet over the three (3) months of monitoring prior to the production testing;
- Simsboro – static water level elevations in the Simsboro aquifer near the production well range from 298 feet to 305 feet above MSL, and the difference may be a function of the accuracy of land surface elevation datum (see Figure 11). Water-level elevations in Simsboro wells near the Colorado River, nearer to the outcrop area, ranged from 316 feet to 324 feet above MSL, with the differences potentially being due to accuracy of determination of land surface elevation datum due to relatively steep local topography. The Simsboro water levels indicate a uniform and interconnected aquifer between wells. The hydraulic gradient from the updip wells near Powell Bend to Well "J" is about 20 feet per mile, although sufficient data are not available to assess the effect of the faults on the hydraulic gradient. Static water levels fluctuated by about 0.5 to three (3) feet during the period from September 2017 until the production testing, indicating relatively uniform transmissivity and conditions. Some water levels may have been affected by development and short-term testing of Well "J" (see charts in Appendix 2);
- Hooper – Static water level elevations in wells likely completed in the Hooper Formation range from 316 feet to 332 feet above MSL, and land surface is relatively gently-sloping in the area of those wells (see Figure 11). Based on an estimated local hydraulic gradient in the overlying Simsboro aquifer and known water levels in the Simsboro monitoring wells, the water level elevation in the local Hooper is slightly deeper than that of the Simsboro, which is to be expected considering that groundwater moves downward within and near recharge zones. Measured static water levels fluctuated by 0.6 to almost six (6) feet during the three-month period prior to the production testing. Some of the fluctuation noted is due to pumping of the monitored wells, as indicated by the pattern of water levels (see Appendix 2).

Pumping Test

Pumping a water well causes an instantaneous change in aquifer storage resulting in water-level decline or drawdown in the well and causing movement of groundwater radially toward the well. The resistance to flow or friction produced by the water movement through the aquifer media causes a slope or gradient of the potentiometric surface to be created radially around the well, which is commonly referred to as the cone of depression. Due to the nature of the converging flow to the well and the mathematics of groundwater flow in an aquifer, the cone of depression is steeper near the well and slopes very gently at distance from the well. The magnitude of the drawdown and the slope of the cone of depression are primarily controlled by the friction of groundwater flow which is determined by aquifer transmissivity. Large aquifer transmissivity results in a shallow cone of depression with flat slopes and a large aerial extent, while low transmissivity results in a deep cone of depression with steep sides and a smaller radius. The rate of expansion of the cone of depression is primarily controlled by the aquifer storage coefficient (see Appendix 2). The extent of the cone of depression is a factor of both transmissivity and storage (see Appendix 3). Once the cone of depression expands sufficiently to supply flow to the well equal to its pumping rate, the drawdown ceases and the pumping reaches equilibrium (i.e., no more change in storage). Also, hydraulic boundaries such as faults or recharge areas can alter the shape or extent of the cone of depression. Generally, cones of depressions developing around wells completed in artesian (confined) aquifers extend for thousands of feet to miles from the pumping well, while drawdown typically extends out only hundreds to a couple thousand feet from wells completed in unconfined (i.e., water-table) aquifers. Drawdown is directly proportional to pumping rate and is additive if multiple wells are pumping (i.e., interference drawdown). Figure 12 and Figure 13 illustrate drawdown and interference drawdown in confined and unconfined aquifers, respectively.

Measurements

TGI monitored water levels during the 36-hour constant-rate production test conducted by Brien Water Wells (BWW) from December 27th to December 29th of 2017. The pumping rate for the City's Well "J" was 1,560 gpm throughout the duration of the test. Once pumping was turned off after 36 hours, TGI measured recovery water levels for 12 hours. Graphs and charts illustrating the pumping test results are provided in Attachment 2. Table 2 and Figure 14 provide a summary of measured drawdown at each of the monitored wells due to pumping of Well "J".

Hydraulic Parameters and Boundaries

Aquifer hydraulic parameters including transmissivity, hydraulic conductivity and storage coefficient (i.e., storativity) can be derived by analyzing measurements collected during pumping tests. Groundwater flow conforms to Darcy's Law, and C.V. Theis derived the mathematical equation for radial flow to a well taking into account the time of pumping (Theis, 1935). Theis' breakthrough allowed for solving pumping tests to determine hydraulic parameters before the pumping test reached a state of equilibrium, allowing for the effective use of shorter-term pumping tests. Additionally, the Theis "nonequilibrium well equation" allows for aquifer parameters to be determined utilizing observations in a single observation well, rather than at least two required by equilibrium well equations (Driscoll, 1986). The Theis nonequilibrium well equation is stated below:

$$s = \frac{114.6QW(u)}{T}$$

where;

s = drawdown, in feet
Q = pumping rate, in gpm
T = transmissivity, gpd/ft
W(u) = well function of *u* representing an exponential integral[1]

In the *W(u)* function, *u* is equal to:

$$u = \frac{1.87r^2S}{Tt}$$

where;

r = distance from center of pumped well to point drawdown is measured, in feet
S = storage coefficient, dimensionless
T = transmissivity, gpd/ft
t = time since pumping started, in days.

Due to the logarithmic relationship between drawdown, time and distance, graphical methods using log-log plots and a type curve can be utilized to analyze pumping tests and derive the various hydraulic parameters (see Attachment 2). Solutions using the Theis equation incorporate several assumptions including (see Driscoll, 1986):

- The aquifer is homogeneous and isotropic. That is, the water-bearing formation is uniform in character and the hydraulic conductivity is the same in all directions;
- The producing interval is uniform in thickness and is infinite in areal extent;
- The formation receives no recharge or leakage;
- The pumped well fully penetrates and producing water from the entire aquifer thickness;
- Water pumped from the well is removed from storage and discharged instantaneously when the head (i.e., water level) is lowered;
- The pumping well is 100-percent efficient;
- All water pumped from the well comes from aquifer storage;
- All flow in the aquifer and into the well is laminar; and,
- The potentiometric surface is flat (i.e., has no slope).

Commonly, a modified nonequilibrium well equation developed by Cooper and Jacob can be used when µ is sufficiently small, which commonly occurs when the pumping time is sufficiently long with respect to the distance to where drawdown is measured (Cooper and Jacob, 1946). Simplified graphical methods utilizing semi-log graphs and best-fit straight lines can be used to analyze the pumping tests. The Theis assumptions still apply. Most aquifers and pumping tests

[1] $\int_u^\infty \frac{e^{-x}}{x}dx = 0.577216 - \ln u + u - \frac{u^2}{2\cdot2!} + \frac{u^3}{3\cdot3!} - \frac{u^4}{4\cdot4!} + \cdots$

reasonably conform to the Theis equation assumptions, especially for wells very near the pumping well and for short-term or early portions of pumping tests (e.g., two days or less). Both the Theis and Cooper and Jacob methods allow for predicting drawdown at any time after pumping has started. However, when the assumptions in the aquifer vary from the Theis assumptions, the aquifer test results must be analyzed with care. Commonly, hydraulic boundaries such as faults and recharge areas are encountered by the cone of depression, requiring knowledgeable solutions of aquifer test data. Typically, the longer a well is pumped the more the Theis assumptions do not hold true. Therefore, while short-term pumping tests can allow for estimates and predictions of future drawdown, long-term drawdown can only be estimated from such testing results. Commonly, numerical models are utilized to assess multi-year to multi-decade aquifer responses to pumping.

Only the Simsboro monitoring wells exhibited definite water-level responses due to pumping Well "J" during the 36-hour test. Table 3 provides a summary of pumping test results and hydraulic parameters derived from the pumping test and recovery. The test analysis showed that the transmissivity of the aquifer at and near the pumped well is between 37,000 and 53,000 gpd/ft based on the early test data. The local storage coefficient is 2.5×10^{-4} during the period of pumping, which is reasonable for an artesian or slightly leaky artesian aquifer. Note that the storage coefficient will increase, probably by as much as an order of magnitude, as pumping continues due to recharge effects and leakage from overlying and underlying zones.

Calculated transmissivity values for the private Simsboro water wells range from 80,000 to 180,000 gpd/ft (see Table 3). These apparent transmissivity values are two (2) to five (5) times higher than known and estimated transmissivity based on geologic conditions (i.e., sand thickness and character), regional groundwater modeling, known values in other similar settings, and the calculated transmissivity values at Well "J" and MW-3. Based on the geologic setting, it is evident that the "Powell Bend Fault" disrupts the movement of groundwater between the private monitoring wells and the City's production well. Therefore, the Theis assumption of an infinite and uniform aquifer do not hold true, and the Theis analytical solutions result in "false" high transmissivity values. Also, the apparent storage coefficient values derived for the monitoring well areas are higher than for MW-3, ranging from 7.4×10^{-4} to 1.3×10^{-3}.

One way to assess variations in aquifer conditions and to identify hydraulic boundaries is to compare actual measured drawdown to the theoretical or expected drawdown assuming the aquifer and well conform to the Theis conditions. Representative hydraulic coefficients derived from the pumping test for the area near the pumped well are:

Transmissivity = 45,500 gpd/ft
Storage Coefficient = 0.00025

Figure 15 shows the actual measured drawdown in the local Simsboro aquifer versus expected drawdown calculated with the Theis equation. Drawdown in the pumped well is considerably more than calculated by Theis, which is potentially due to effects of nearby faults, partial penetration of the well into the aquifer, and slight inefficiency of the well. (Note that TGI assessed the well efficiency based on development testing and the 36-hour production test and estimated the well efficiency to be approximately 80 percent). It is possible that the actual hydraulic conductivity and transmissivity in the aquifer at the production location are higher than calculated; however, the proximity of the well to the "Powell Bend Fault" and the "Bastrop Fault" would cause the cone of depression to encounter those two "negative" hydraulic boundaries within the first 30 minutes of pumping. Drawdown in the nearby monitoring well (MW-3) is slightly less than calculated using Theis, which is likely due to an increase in aquifer transmissivity in the direction of MW-3. Measured drawdown in the Simsboro wells in Area 2 is between one (1) and two-and-one-half (2½) feet, while expected drawdown calculated using Theis is between six (6) and seven (7) feet. The primary cause for less drawdown occurring than expected is likely faulting associated with the "Powell Bend Fault", which forms a hydraulic boundary between the pumped well and the wells in Area 2. Other possible causes for less-than-expected drawdown occurring in Area 2 could be an increase in aquifer transmissivity and/or a higher storage coefficient due to proximity of the outcrop or recharge area (i.e., unconfined zone). There are currently no Simsboro wells in Area 3, so no aquifer test analyses are available for that area. While the anticipated drawdown based on Theis assumptions would be about one-and-a-half (1½) feet after 36 hours of pumping, it is probable that very little drawdown occurred in the Simsboro aquifer beneath Area 3 due to the hydraulic boundary conditions.

Impacts Assessment

Aquifers serve two primary functions; storing water and transmitting water. Impacts to aquifers due to pumping are related to the capabilities of aquifer to perform these two functions. The Simsboro aquifer has tremendous capacity as a groundwater storage reservoir. The TWDB reports that the Simsboro stores approximately 18,000,000 acre-feet of water beneath Bastrop County and 28,000,000 acre-feet within Lee County (Wade and Shi, 2014). Water levels in the outcrop area across the Simsboro show that storage in the aquifer has not diminished over time. Therefore, any impacts due to pumping Well "J" will not be related to aquifer storage. The amount of groundwater available in the aquifer will not be diminished due to pumping of the subject well.

The primary impact associated with pumping in the Simsboro aquifer is the reduction in artesian pressure. While the aquifer remains completely full, the reduction in pressure causes water levels in wells completed in the aquifer to decline in accordance with the pressure change (see Appendix 2). The pressure change is logarithmically related to time of pumping and distance from pumping centers, and the magnitude of decline is primarily determined by how much water will move through the aquifer (i.e., transmissivity) but is also influenced by the storativity of the producing zone. The rate of expansion of the cone of depression is primarily determined by the aquifer storage characteristics. The shape and areal extent of the pressure change is affected by the aquifer hydraulic coefficients and the occurrence of any hydraulic boundaries. Artesian pressure changes are directly related to pumping rates. Therefore, if pumping ceases the pressure and associated water levels in wells recover in essentially the same amount of time over which the drawdown had occurred.

Short-Term Drawdown

The effects of pumping Well "J" continuously for 36 hours at slightly more than the maximum permitted rate of 1,500 gpm have been measured. It is impossible to directly correlate drawdown for longer-duration pumping periods to the 36-hour testing results due to the effects of boundaries such as faults, recharge, and interaquifer leakage. Particularly, the storage coefficient increases with pumping duration as recharge and vertical leakage are induced. Based on the results from the 36-hour pumping test and using reasonable assumptions based on the local aquifer conditions, TGI calculated drawdown estimates for the following pumping scenarios:

- 30 days of continuous pumping at the maximum permitted rate of 1,500 gpm; and,
- One year of continuous pumping at the maximum permitted allocation of 2,000 acre-feet per year, which is equivalent to a constant pumping rate of 1,240 gpm.

Drawdown at the private wells (i.e., Area 2) with continuous pumping for 30 days at the maximum permitted pumping rate will likely range from four (4) to seven (7) feet. Because of the logarithmic relationship between time of pumping and drawdown and because of increased storage coefficient with pumping duration, most drawdown occurs early in the pumping cycle. Drawdown at the private water wells in Area 2 after one year of pumping 2,000 acre-feet (1,240 gpm) will likely range from five (5) to nine (9) feet. Table 4 provides estimated drawdown at the 18 monitoring wells under various pumping scenarios.

Long-Term Drawdown, Leakage and Storage Depletion

Long-term aquifer impacts due to pumping are best evaluated utilizing numerical groundwater flow modeling. Several experts including the LPGCD's hydrologist utilized the TWDB-approved groundwater availability model (GAM) to estimate impacts due to the permitted pumping from Simsboro wells on XS Ranch ranging from 2,000 to 6,000 acre-feet per year (see Appendix 3 and CH2MHill, 2014; Donnelly, 2014; Donnelly, 2013; R.W. Harden, 2013; and, Uliana, 2015). TGI also compared the impacts only due to Well "J" pumping to projected impacts based on all permitted pumping within LPGCD and other existing and projected regional pumping from neighboring counties (see Appendix 3 and Donnelly, 2013). LPGCD projects that pumping by 2060 will be as much as 40,400 acre-feet per year within the District, with the Aqua WSC, the City of Bastrop, Elgin, and Manville WSC all pumping at their maximum current permit amounts, and total pumping in Bastrop County increasing from 10,000 to 24,000 acre-feet. Based on current permits, long-term pumping within LPGCD could be 76,760 acre-feet per year or more, with notable new permits in Bastrop County granted to LCRA for their Lake Bastrop facilities. The largest pumping increases could occur in Lee County per Forestar's permits. Additionally, End Op had been issued permits in Lee and Bastrop counties. Figure 16 provides locations of wells and allocation amounts for existing Simsboro aquifer permits. Based on the TWDB-approved GAM, the following table summarizes the amount of estimated local drawdown due to only the City's Well "J" pumping 2,000 acre-feet per year (i.e., equivalent to continuous pumping of 1,240 gpm), and due to all projected local and regional pumping, except EndOp, from the Simsboro aquifer through 2060 (see Donnelly, 2013):

	Approximate Drawdown Due to Projected Pumping Through 2060		
Pumpage	**Area 1**	**Area 2**	**Area 3**
Well "J" Only	25 feet	15 feet	10 feet
All Other Pumping	150 feet	95 feet	55 feet
Total	175 feet	110 feet	65 feet

The drawdown amounts in the above table are rounded to the nearest five (5) feet. Based on current water levels and well completion details for the Simsboro wells monitored, pumping from the City of Bastrop's Well "J" will not disrupt the availability of groundwater from local well owners. Long-term increases in local and regional pumping will impact water levels in local wells much more than the City's pumping.

Pumping from Well "J" is small with respect to the existing and projected cumulative local and regional pumping in the aquifer. Additionally, the projected pumping is extremely small as compared to the amount of water available in aquifer storage. Increases in pumping induce additional recharge into the aquifer. GAM runs have shown that the even large increases in pumping in Bastrop and Lee counties will reduce local aquifer storage by less than two (2) percent after more than 50 years of pumping (R.W. Harden & Associates, Inc., 2013). Therefore, pumping from Well "J" will have no adverse effect on the amount of groundwater stored and available for use in the Simsboro aquifer.

Long-term pumping induces additional recharge into the aquifer, which may reduce the amount of natural discharge associated with evapotranspiration, seeps, springs and baseflow. The amount of such impacts due to the City of Bastrop's pumping from Well "J", particularly as compared to projected regional pumping from the aquifer, will be so small as to be undetectable. Any impacts to water levels in the overlying Calvert Bluff and underlying Hooper due to interaquifer leakage will be very small and likely undetectable. Based on vertical hydraulic conductivity of 10^{-5} gpd/ft^2, confining layer thickness of 50 feet, and an average decline in artesian pressure of 50 feet in the Simsboro aquifer, the amount of leakage from the Calvert Bluff Formation would increase by only about 280 gallons per day per square mile of area within the cone of depression.

CONCLUSIONS

Based on our assessment of the local hydrogeologic conditions and the results of the 36-hour production test for the City's Well "J", TGI provides the following conclusions:

- Eight (8) of the 17 private wells available and accessible for monitoring are completed in and produce from the Simsboro aquifer;
- Drawdown in the privately-owned monitoring wells completed in the Simsboro aquifer ranged from one (1) to 2.5 feet during the 36-hour production test for Well "J";
- Maximum drawdown in the private Simsboro wells monitored will likely be approximately eight (8) feet and 10 feet due to Well "J" pumping at maximum permitted rates for 30 days and one year, respectively;
- Hydraulic boundaries due to faulting cause drawdown in the private monitoring wells due to Well "J" pumping to be significantly less than would be expected in a uniform aquifer;
- Pumping from Well "J" will not decrease the amount of water stored in the Simsboro aquifer;
- The City's pumping from Well "J" will not disrupt local landowners' groundwater supplies;
- Pumping from Well "J" will not detectably affect water levels in the Calvert Bluff or Hooper Formations;
- Long-term artesian pressure declines due to other local and regional permitted and mining pumping could be as much as seven (7) times greater than drawdown caused by Well "J" pumping; and,
- As other local and projected regional pumping increases over several decades, it may be necessary for some landowners to lower pumps to maintain reliable supplies, depending on current pump settings. However, properly completed wells within the Study Area can be completed to maintain current supplies and increase local usage from the Simsboro aquifer.

We very much appreciate the opportunity to provide you this report and to serve you in our specialty. If you have any questions, please call.

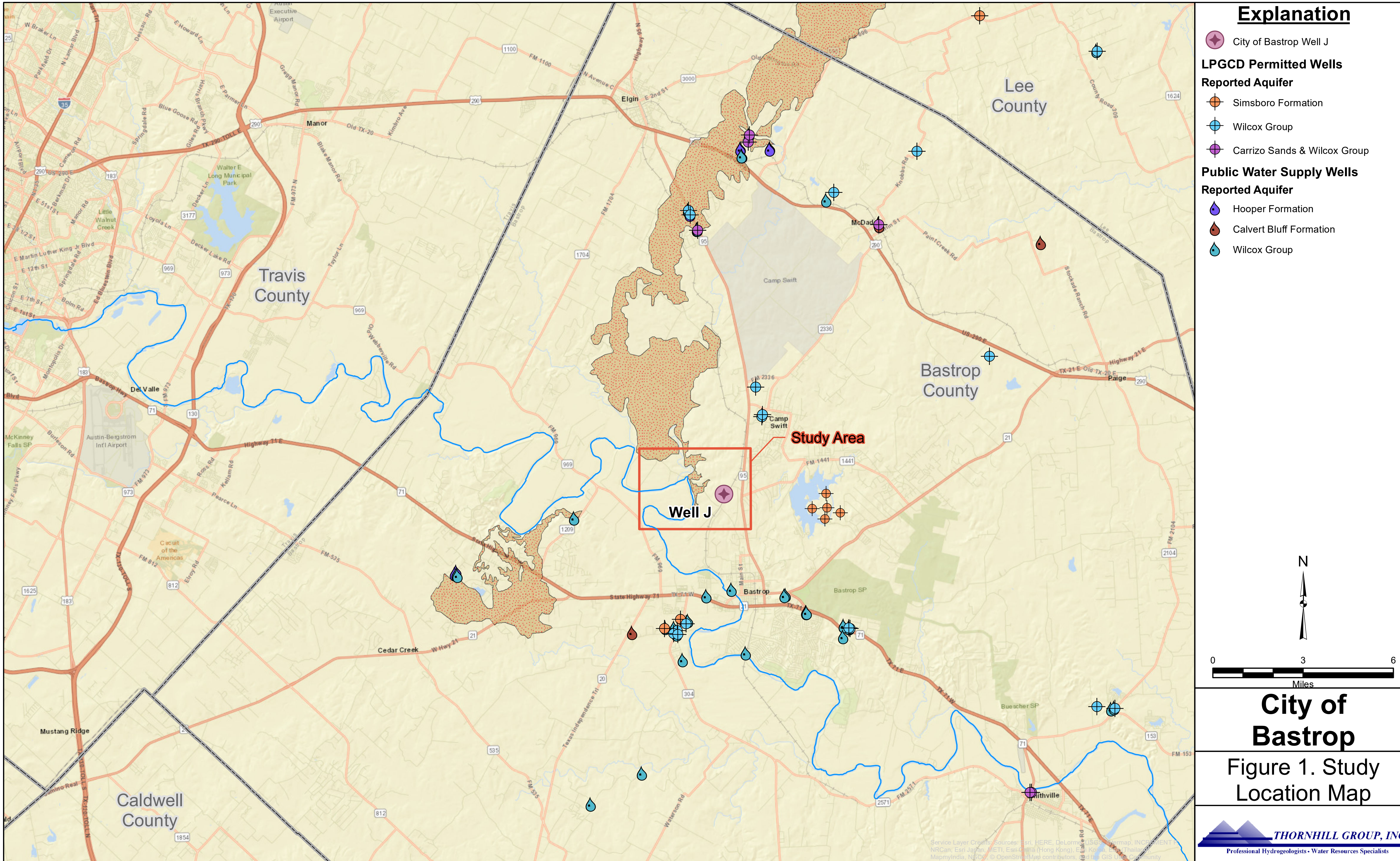
The seal appearing on this document was authorized by Michael R. Thornhill, P.G. on March 29, 2018.

Sincerely,
THORNHILL GROUP, INC.

Michael R. Thornhill, P.G.
President

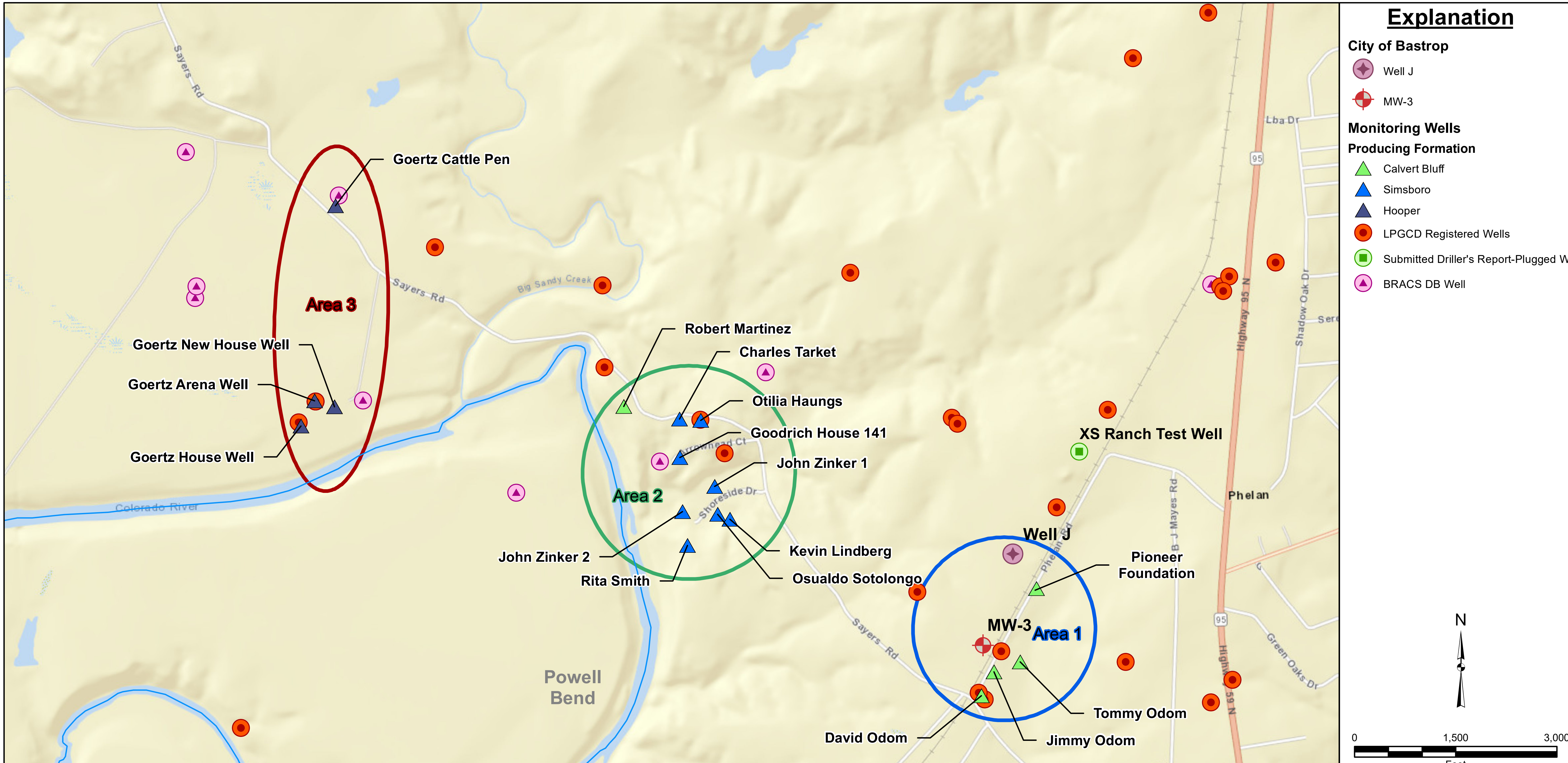
Attachments

Attachment 1 – Report Figures and Tables



City of Bastrop

Figure 1. Study Location Map



City of Bastrop

Figure 2. Study Area Map

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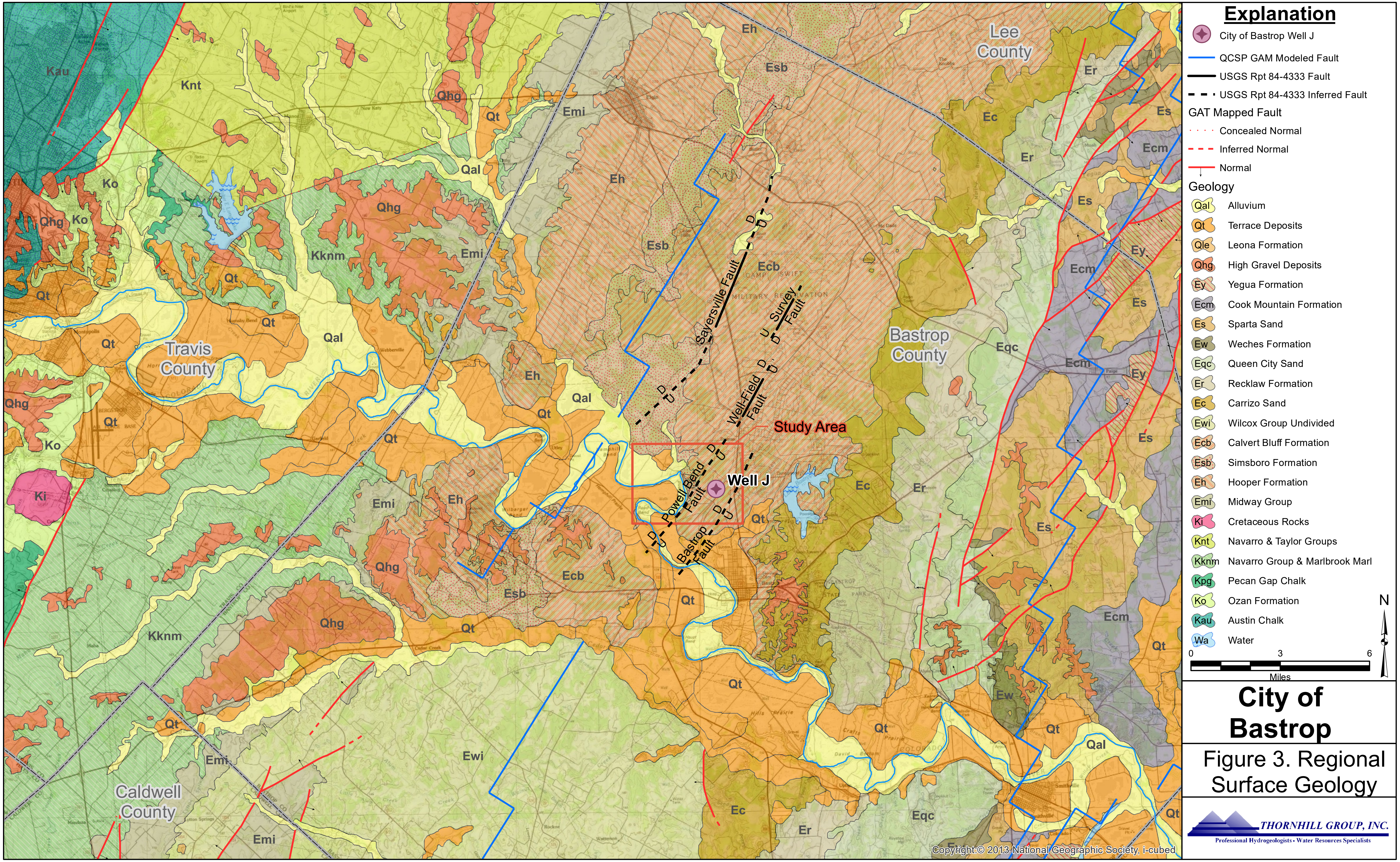
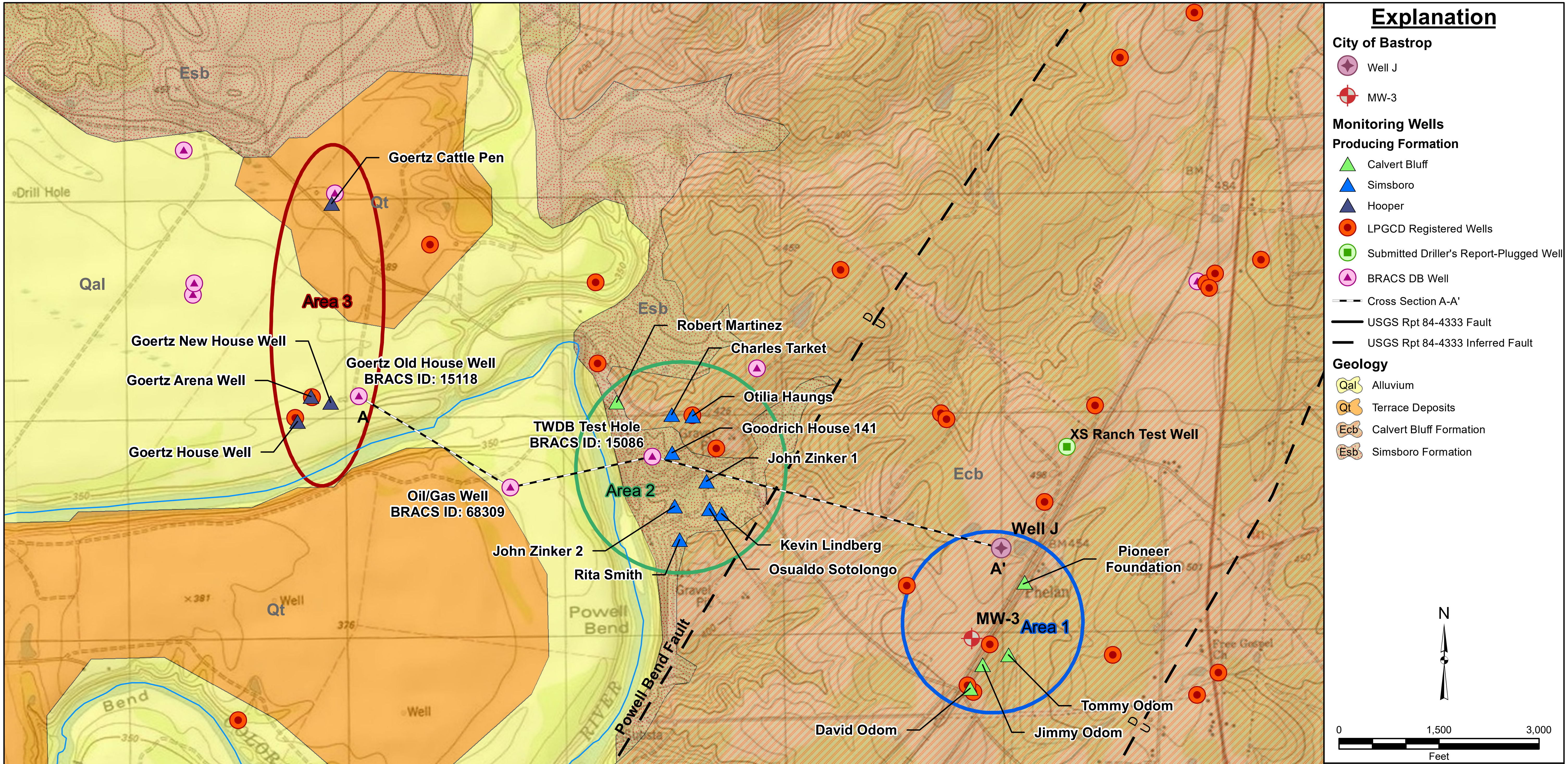


City of Bastrop

Figure 3. Regional Surface Geology



City of Bastrop

Figure 4. Study Area Geology Map

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Figure 5. Hydrostratigraphic Section

<table>
<tr><th>System</th><th>Series</th><th>Group</th><th>Formation</th><th>Abbreviation</th><th>Approximate Thickness</th><th>Geology</th><th>Hydrology</th></tr>
<tr><td>Quarternary</td><td>Holocene / Pleistocene</td><td>—</td><td>Alluvium and Terrace Deposits</td><td>Qal / Qt</td><td>60 feet</td><td>Sand, gravel, silt and clay. Gravel more prominent in older terraces.</td><td>Yields small to moderate quantities of water to shallow wells.</td></tr>
<tr><td rowspan="4">Tertiary</td><td rowspan="4">Ecocene</td><td>Claiborne</td><td colspan="5">Consists of seven distinct formations (from youngest to oldest): Yegua, Cook Mountain, Sparta, Weches, Queen City, Reklaw, and Carrizo. The formations formed as continental, marine, palustrine, and littoral facies. Formations are not encountered within study area.</td></tr>
<tr><td rowspan="3">Wilcox</td><td>Calvert Bluff</td><td>Ecb</td><td rowspan="3">2,600 feet</td><td>Mudstone, silt, fine to medium grained sandstone, light gray to yellowish brown, lignite mostly in lower part.</td><td rowspan="3">Yields moderate to large quantities of typically good quality water.</td></tr>
<tr><td>Simsboro</td><td>Esb</td><td>Mostly sand, some clay and silt, light gray.</td></tr>
<tr><td>Hooper</td><td>Eh</td><td>Mostly mudstone, medium to dark gray, some sandstone, minor lignite.</td></tr>
</table>

Modified from Follet 1970.

Figure 6. City of Bastrop Well No. 1

Well "J"

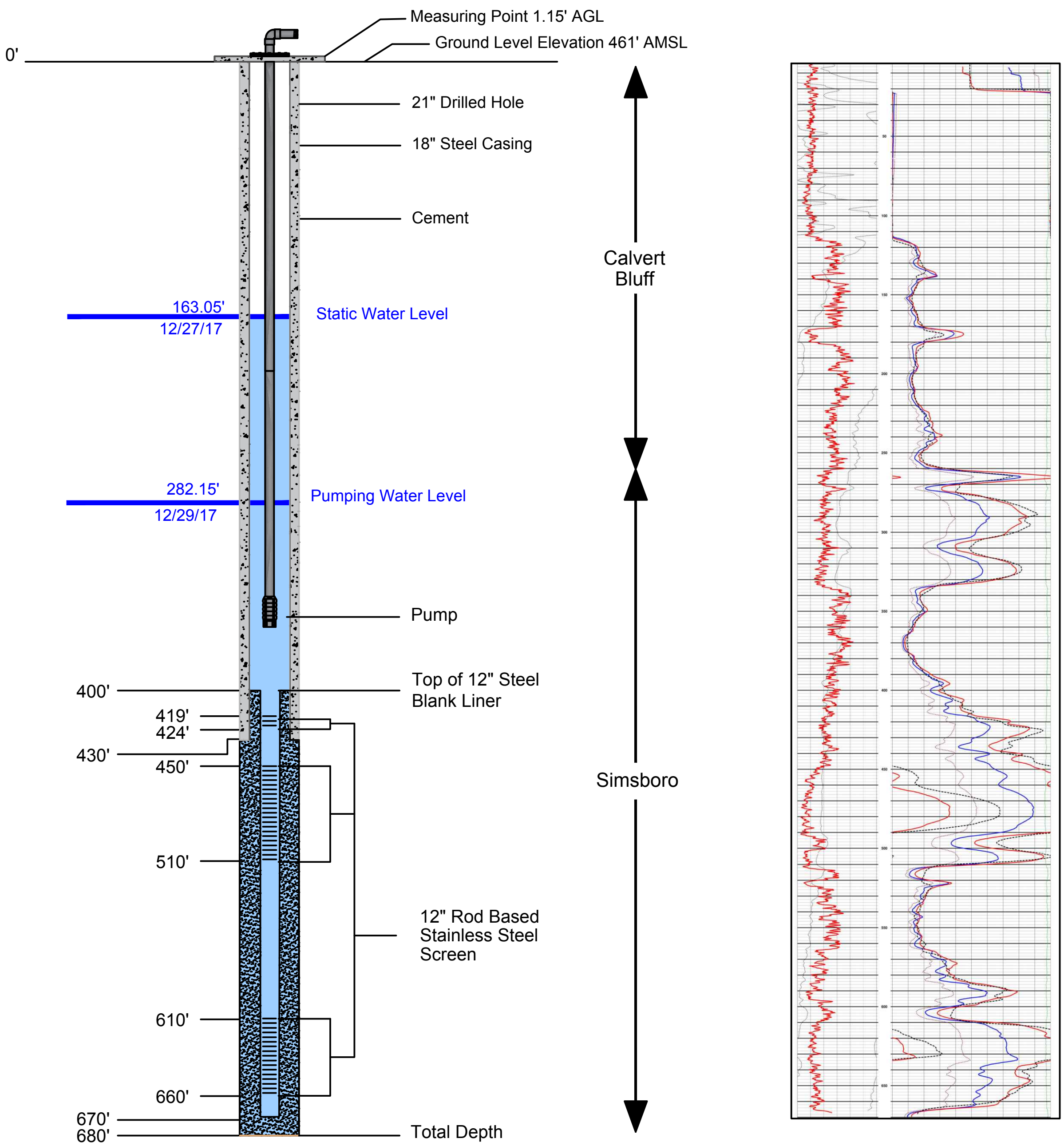
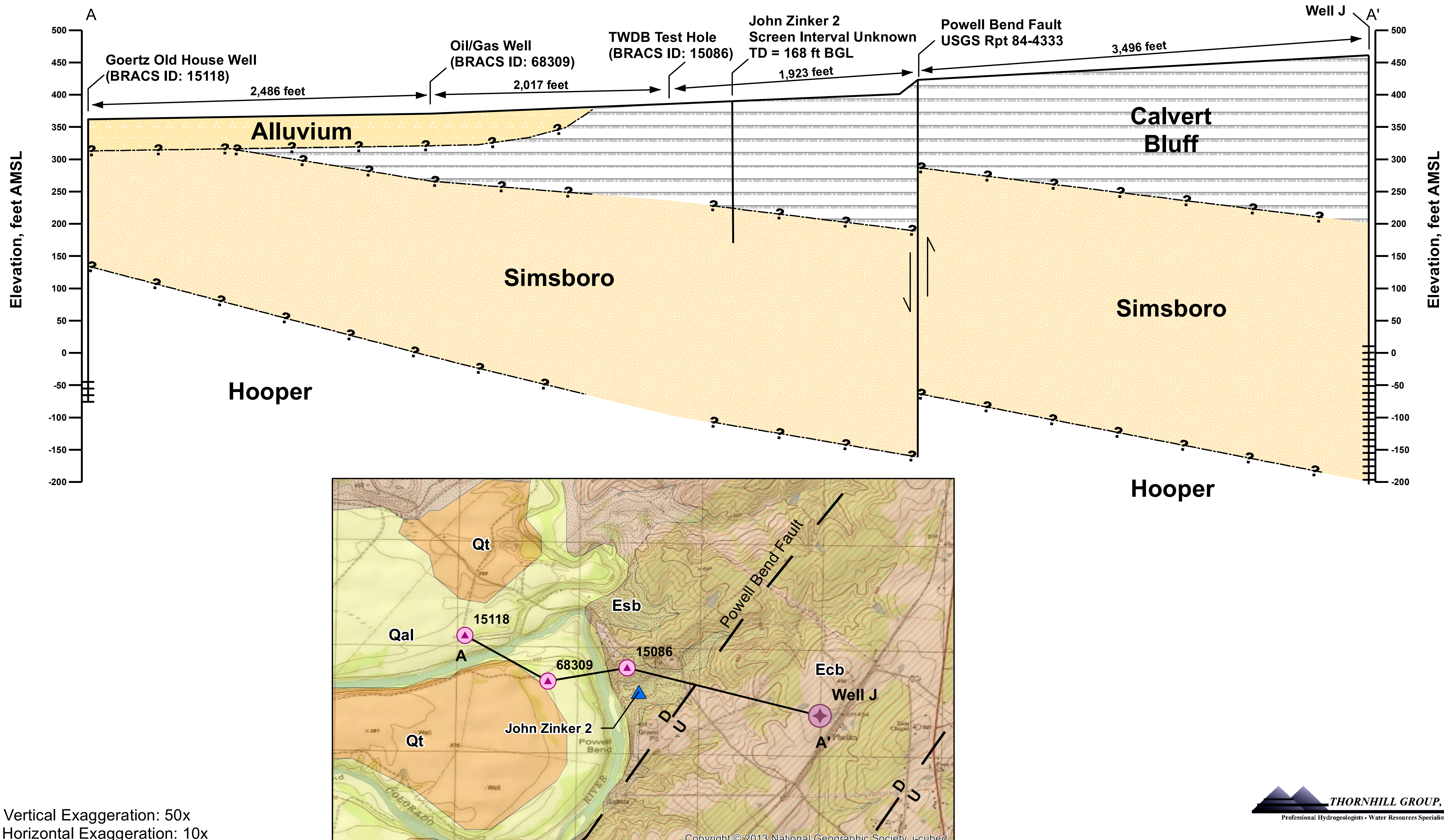


Figure 7. Schematic Cross Section A – A'



* Vertical Exaggeration: 50x
Horizontal Exaggeration: 10x

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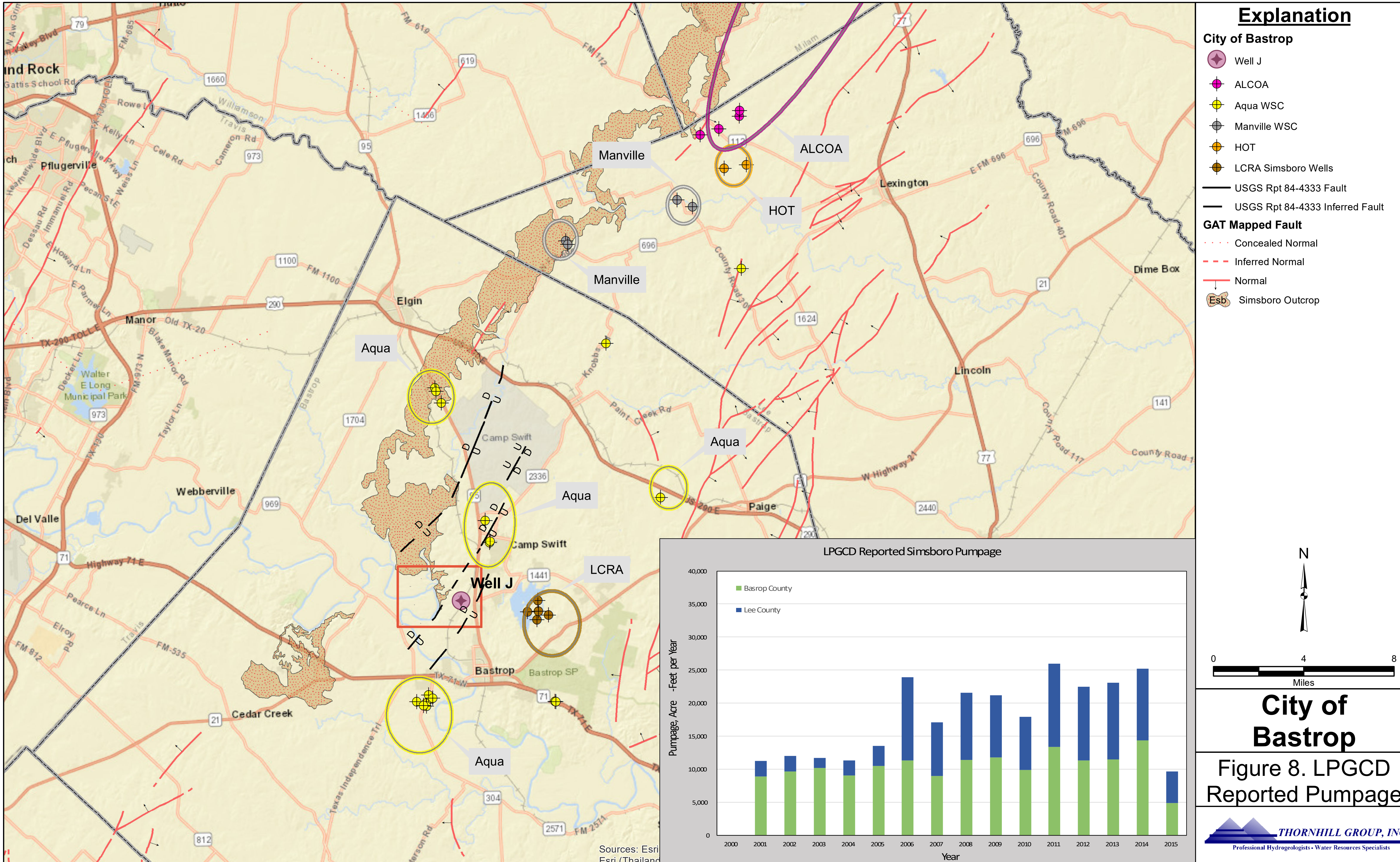


Figure 8. LPGCD Reported Pumpage

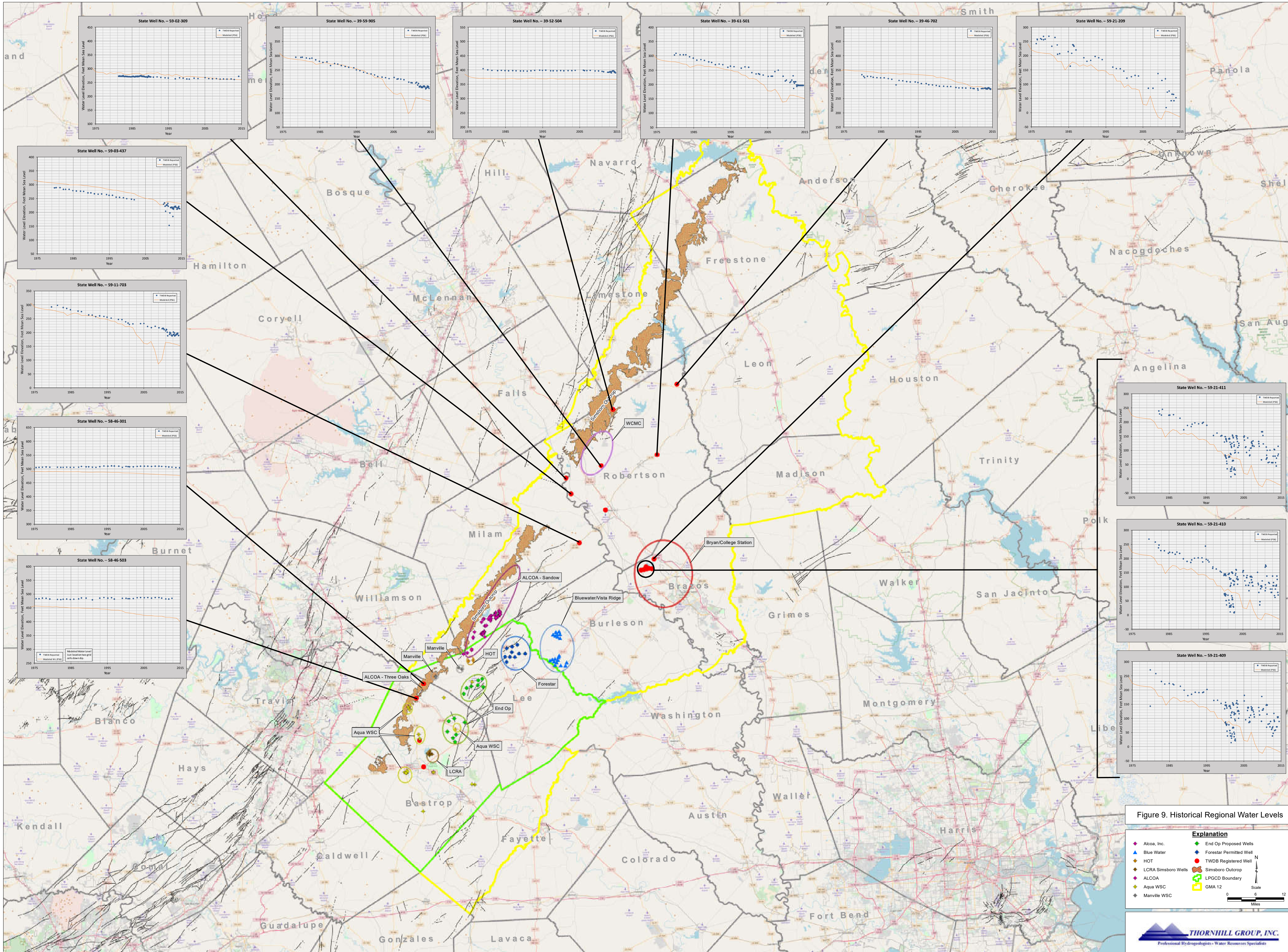
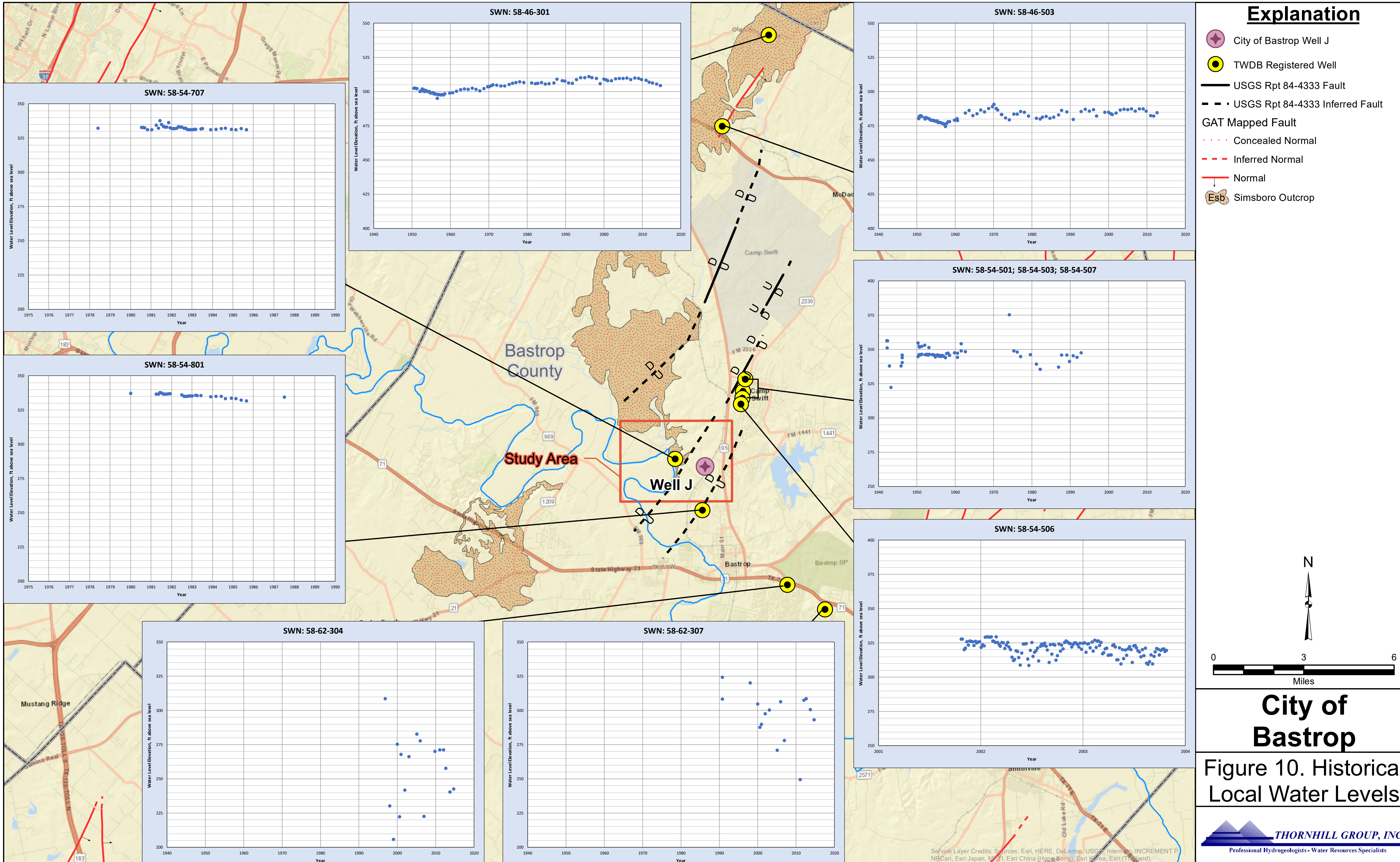
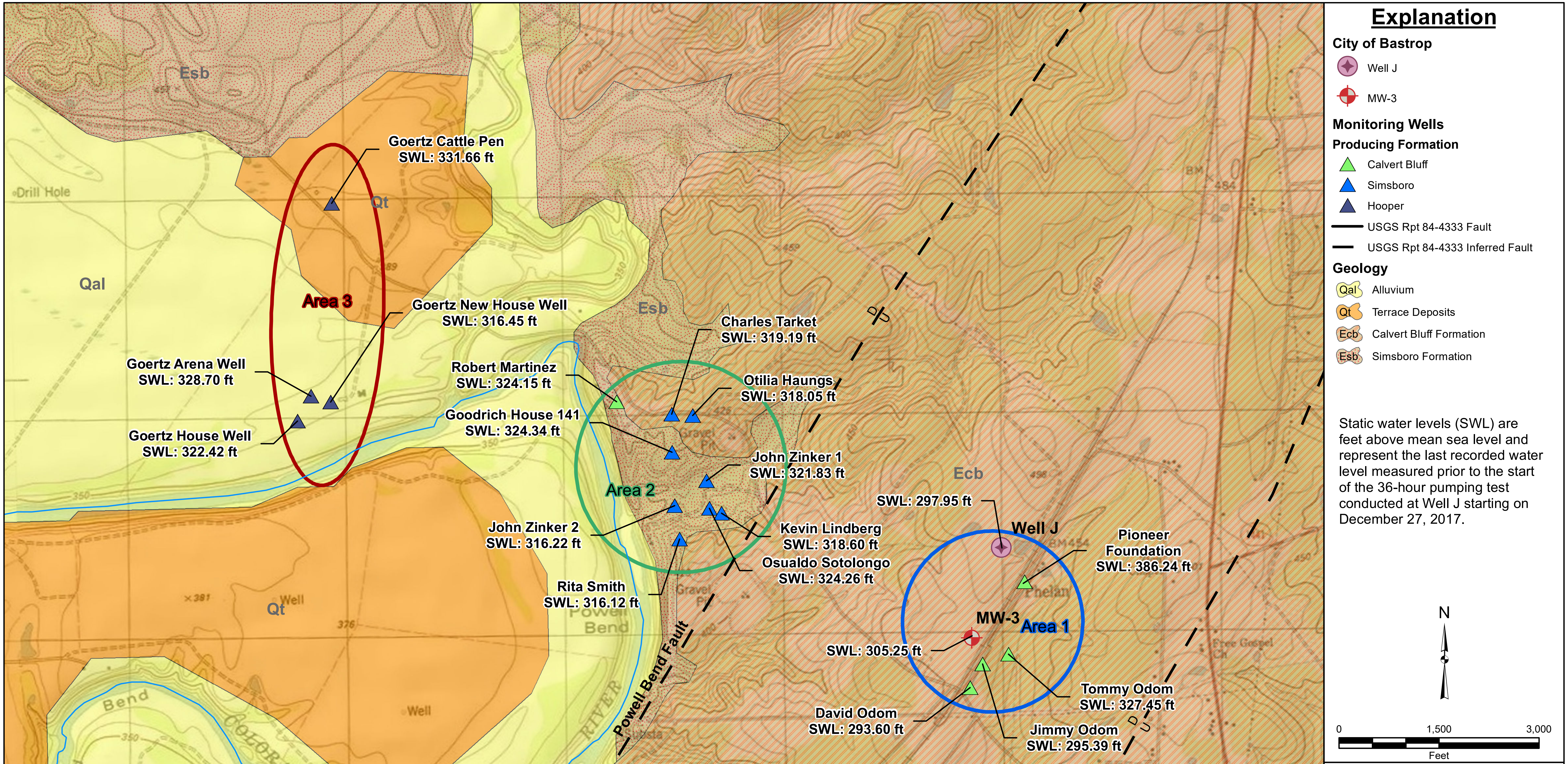


Figure 9. Historical Regional Water Levels



City of Bastrop

Figure 10. Historical Local Water Levels



City of Bastrop

Figure 11. Static Water Level Elevation

Figure 12. Schematic Interference Drawdown - Water Table Aquifer Distance Between Wells, Hundreds of Feet

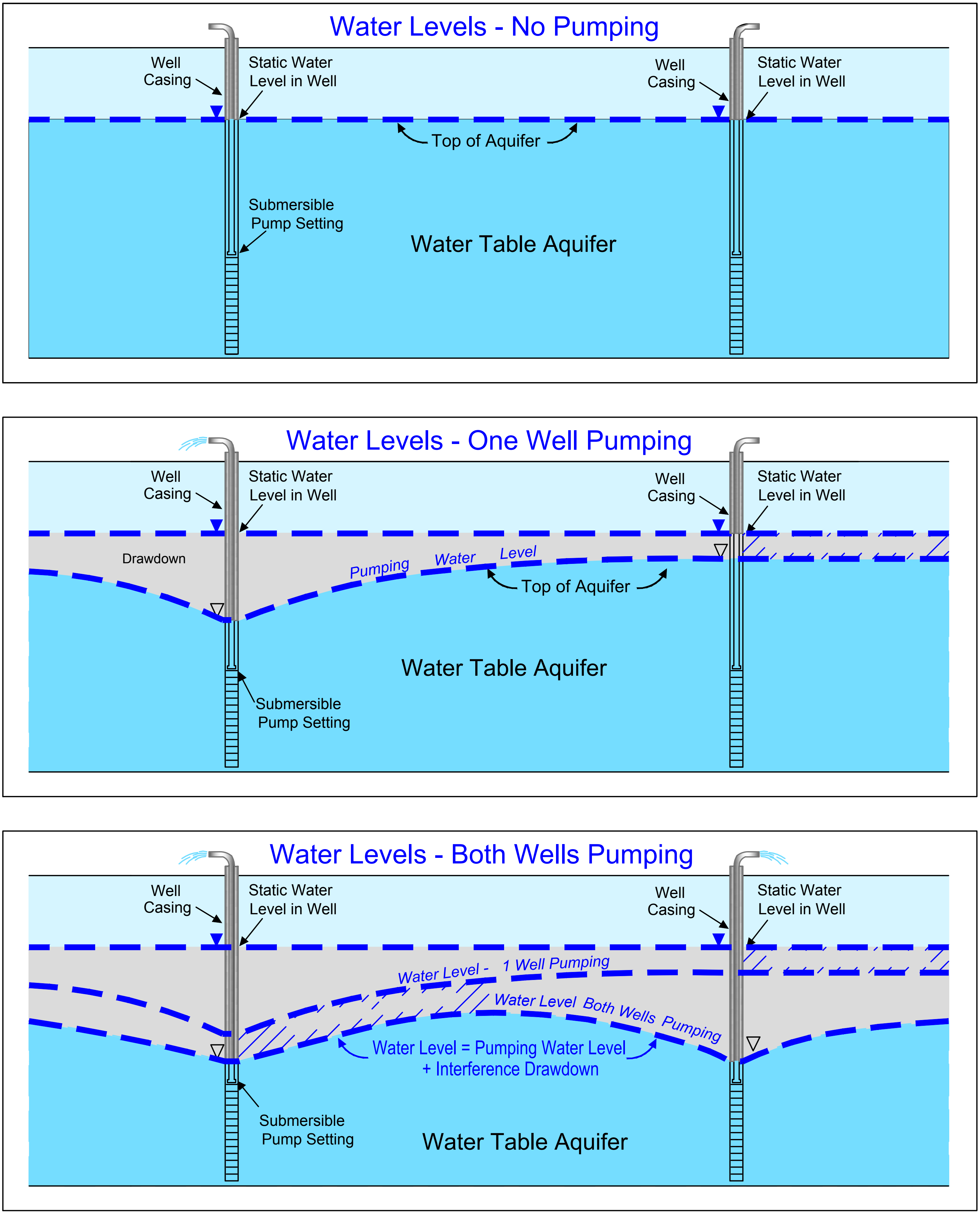
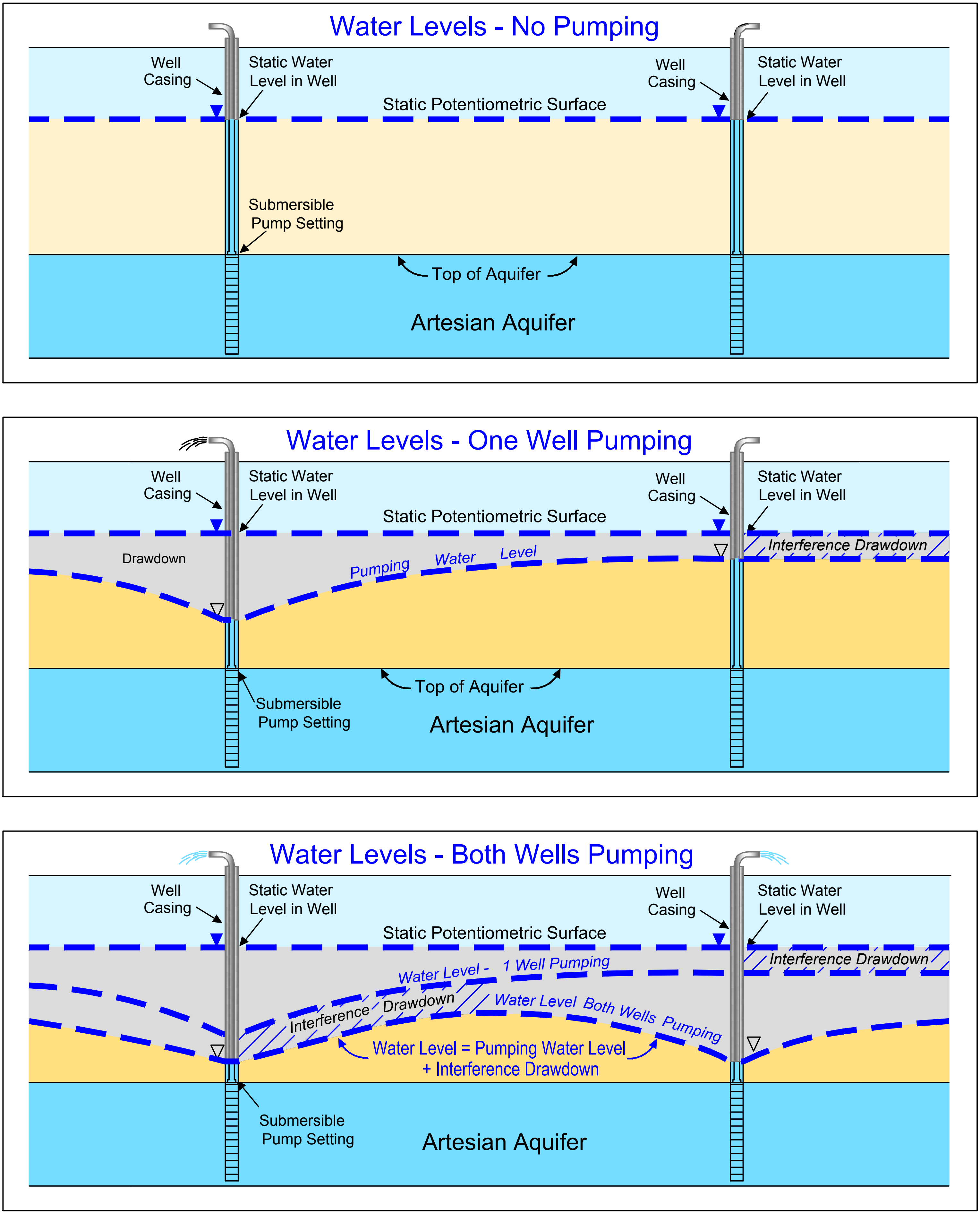


Figure 13. Schematic Interference Drawdown - Artesian Aquifer
Distance Between Wells, Thousands of Feet, or Miles



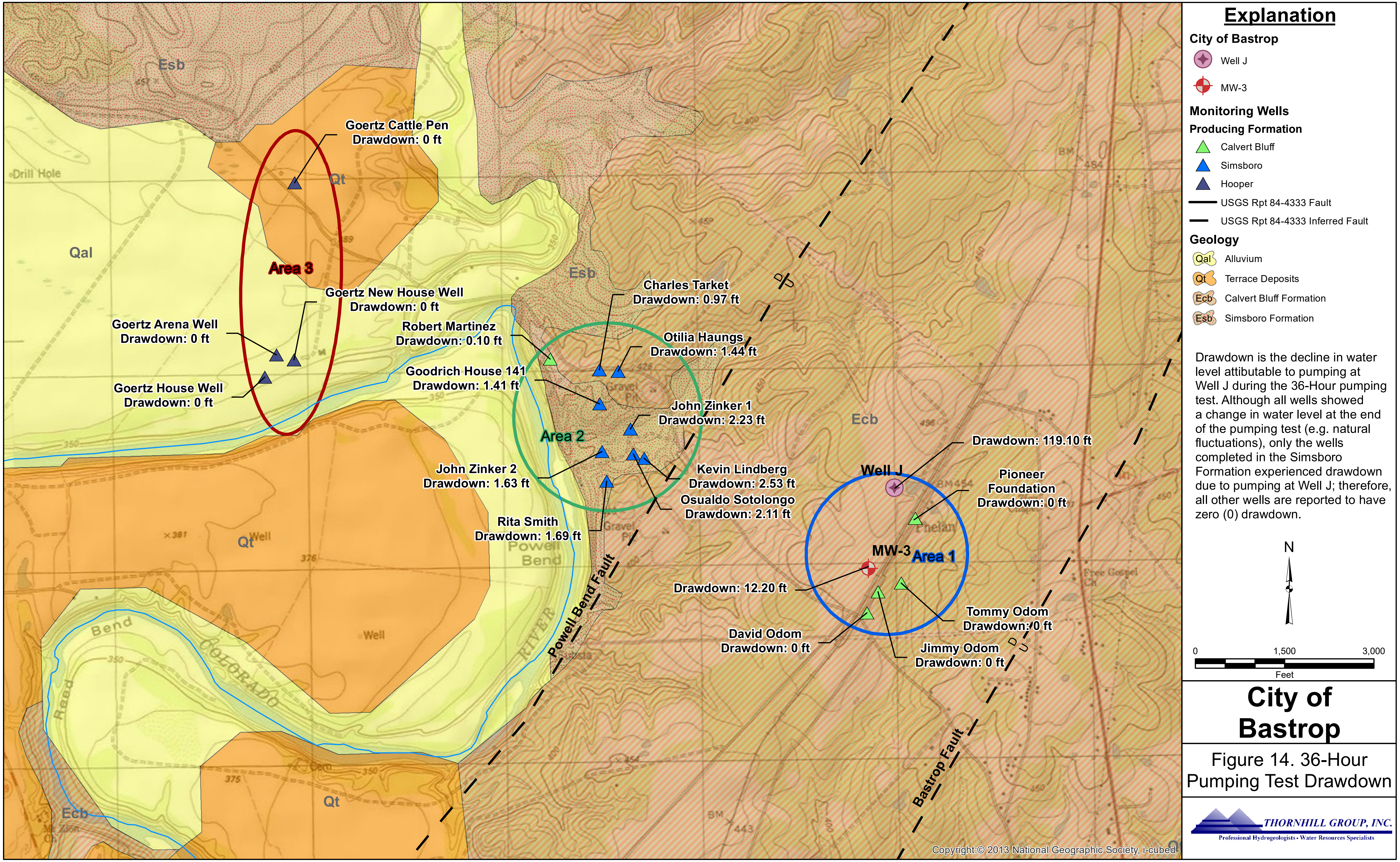


Figure 14. 36-Hour Pumping Test Drawdown

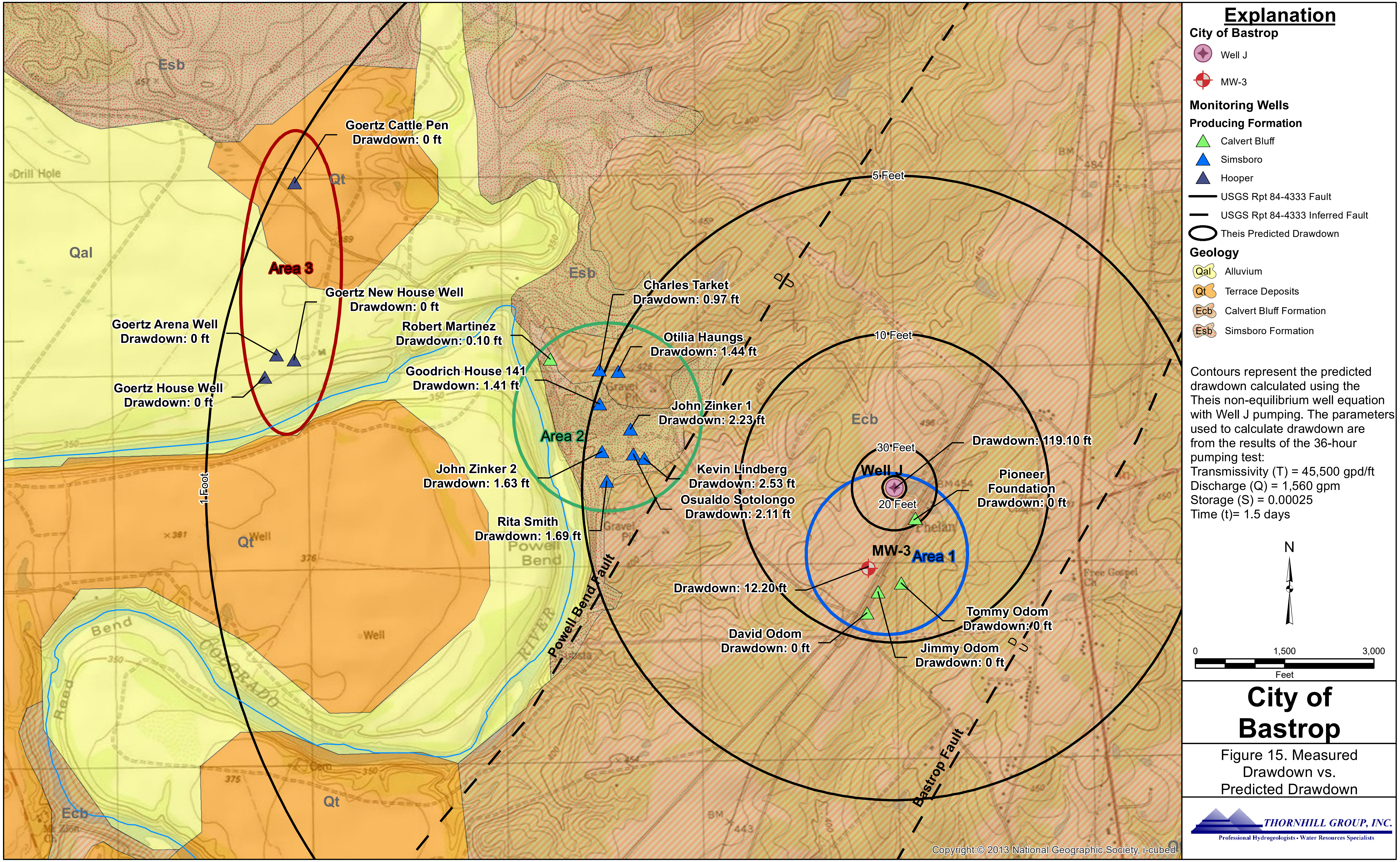
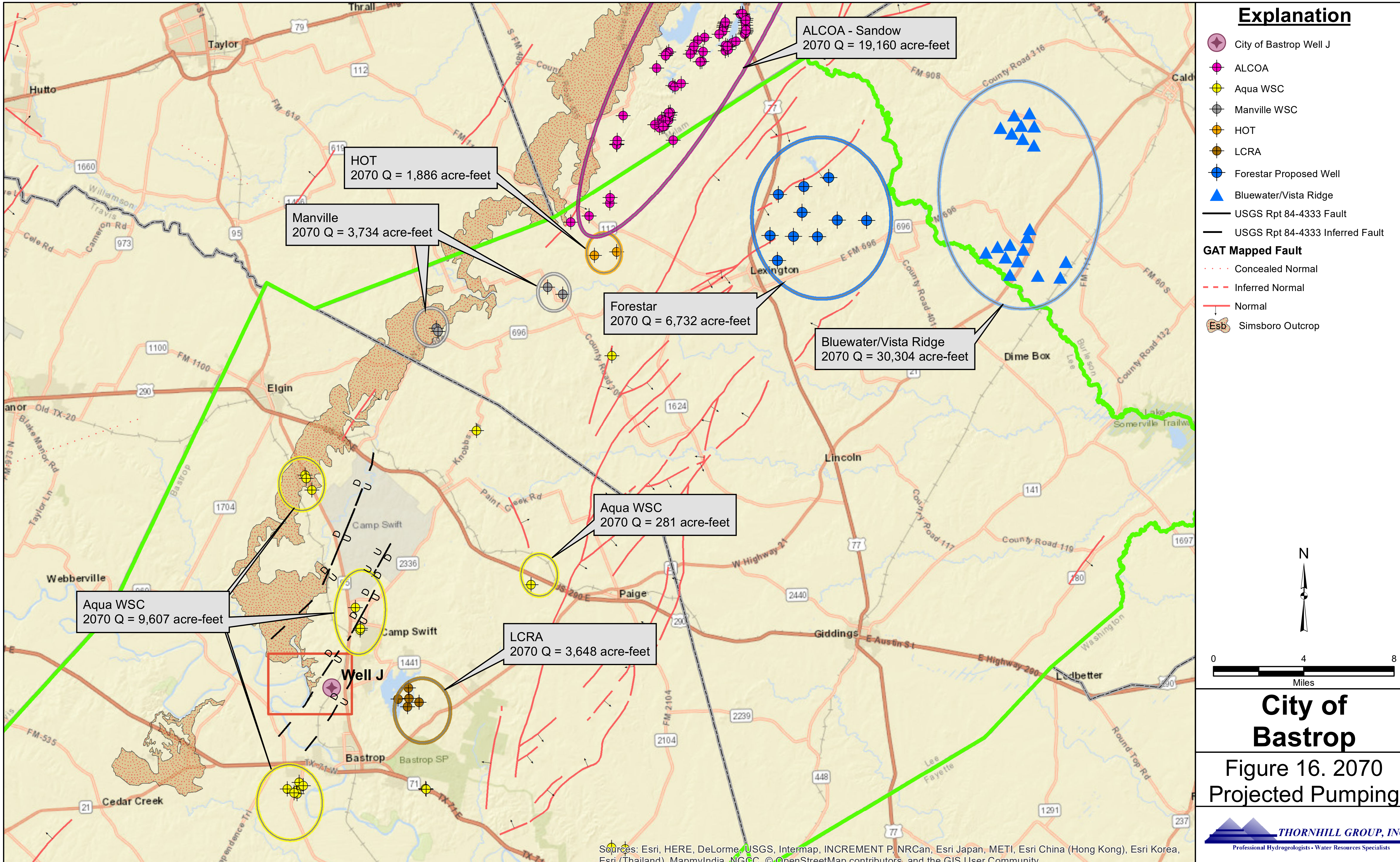


Figure 15. Measured Drawdown vs. Predicted Drawdown



City of Bastrop

Figure 16. 2070 Projected Pumping

Table 1. Summary of Pumping Well and Monitoring Wells

Well ID	Latitude	Longitude	Ground Level Elevation (Feet AMSL)	Total Depth (Feet BGL)	Producting Interval (Feet BGL)	Static Water Level (Feet BGL)	Static Water Level Elevation (Feet AMSL)	Producting Formation
Area 1								
Well J	30.155267	-97.330017	461	670	450 to 660	163.05	297.95	Simsboro
MW-3	30.158950	-97.328517	454	590	453 to 579	148.75	305.25	Simsboro
Pioneer Foundation	30.157521	-97.327447	451	240	200 to 240	64.76	386.24	Calvert Bluff
Tommy Odom	30.154545	-97.328288	433	250	210 to 250	105.55	327.45	Calvert Bluff
Jimmy Odom	30.154166	-97.329539	449	255	235 to 255	153.61	295.39	Calvert Bluff
David Odom	30.153218	-97.330151	449	285	240 to 280	155.40	293.60	Calvert Bluff
Area 2								
Kevin Lindberg	30.160635	-97.341770	369	193	160 to 180	50.40	318.60	Simsboro
Osualdo Sotolongo	30.160850	-97.342350	366	unknown	unknown	42.61	323.39	Simsboro
John Zinker 1	30.161996	-97.342462	361	unknown	unknown	39.17	321.83	Simsboro
Rita Smith	30.159620	-97.343797	403	unknown	unknown	86.88	316.12	Simsboro
John Zinker 2	30.160991	-97.344002	362	168	unknown	45.78	316.22	Simsboro
Otilia Haungs	30.164684	-97.343036	419	240	180 to 240	100.95	318.05	Simsboro
Goodrich 141	30.163201	-97.344059	398	unknown	unknown	76.66	321.34	Simsboro
Charles Tarket	30.164766	-97.344032	412	400	300 to unknown	92.81	319.19	Simsboro
Robert Martinez	30.165326	-97.346632	413	180	unknown	88.85	324.15	Simsboro
Area 3								
Goertz New House Well	30.165602	-97.360239	364	400	330 to 390	47.55	316.45	Hooper
Goertz Arena Well	30.165862	-97.361169	369	550	500 to 540	40.30	328.70	Hooper
Goertz House Well	30.164846	-97.361831	362	540	490 to 530	39.58	322.42	Hooper
Goertz Cattle Pen	30.173784	-97.359958	391	316	293 to 316	59.34	331.66	Hooper

Table 2. Summary of Water Level Fluctuations

Well ID	Elevation (feet AMSL)	Static Water Level Minimum (Feet AMSL)	Maximum (Feet AMSL)	Fluctuation (Feet)	Number of Observations
Area 1					
Well J	461	297.66	297.08	0.57	1,019*†
MW-3	454	305.48	296.42	9.06	4,678†
Pioneer Foundation	451	385.7	383.45	2.25	3
Tommy Odom	433	327.68	322.27	5.41	7
Jimmy Odom	449	295.45	290.37	5.09	6,078†
David Odom	449	293.6	272.47	21.13	7
Area 2					
Kevin Lindberg	369	319.26	316.42	2.84	7
Osualdo Sotolongo	366	324.21	321.53	2.68	5
John Zinker 1	361	322.7	321.83	0.87	2
Rita Smith	403	316.12	313.19	2.93	5
John Zinker 2	362	316.74	314.27	2.48	6,129†
Otilia Haungs	419	318.89	318.05	0.84	2
Goodrich 141	398	322.32	320.48	1.84	3
Charles Tarket	412	320.26	317.59	2.67	5
Robert Martinez	413	324.6	324.15	0.45	3
Area 3					
Goertz New House	364	317.47	311.78	5.69	4,912†
Goertz Arena Well	369	329.36	326.96	2.4	8**
Goertz House Well	362	323.02	319.12	3.9	5,509†
Goertz Cattle Pen	391	332.64	331.64	0.6	6

Table 3. Summary of Pumping Test Results

Well ID	Pumping Rate (GPM)	Static Water Level (Feet BGL)	36-Hr Water Level (Feet BGL)	Drawdown (Feet)	Transmissivity (gpd/ft)	Storage Coefficient
			Area 1			
Well J	1,500	163.05	282.15	119.1	37,000 to 43,000	N/A
MW-3	—	148.75	160.95	12.2	50,000 to 63,000	$1.8x10^{-4}$ to $3.3x10^{-4}$
Pioneer Foundation	—	64.76	65.76	N/A	N/A	N/A
Tommy Odom	—	105.55	106.1	N/A	N/A	N/A
Jimmy Odom	—	153.61	153.95	N/A	N/A	N/A
David Odom	—	155.4	160.1	N/A	N/A	N/A
			Area 2			
Kevin Lindberg	—	50.4	52.93	2.53	80,000	$7.4x10^{-4}$
Osualdo Sotolongo	—	41.74	44.72	2.05	90,000	$8.4x10^{-4}$
John Zinker 1	—	39.17	41.4	2.23	100,000	$7.7x10^{-4}$
Rita Smith	—	86.88	88.57	1.69	110,000	$9.1x10^{-4}$
John Zinker 2	—	45.78	47.41	1.63	125,000	$8.8x10^{-4}$
Otilia Haungs	—	100.95	102.39	1.44	130,000	$9.1x10^{-4}$
Goodrich 141	—	76.66	77.87	1.41	157,300	$9.3x10^{-4}$
Charles Tarket	—	92.81	93.78	0.97	180,000	$1.3x10^{-3}$
Robert Martinez	—	88.85	88.85	N/A	N/A	N/A
			Area 3			
Goertz New House Well	—	47.55	48.21	N/A	N/A	N/A
Goertz Arena Well	—	40.3	40.25	N/A	N/A	N/A
Goertz House Well	—	39.58	39.53	N/A	N/A	N/A
Goertz Cattle Pen	—	59.34	59.25	N/A	N/A	N/A

Table 4. Summary of Estimated Drawdown

Well ID	30 Day Predicted Drawdown, Feet*	1 Year Predicted Drawdown, Feet**
	Area 1	
Well J	75	68
MW-3	18	19
	Area 2	
Kevin Lindberg	8.0	9.8
Osualdo Sotolongo	7.1	8.7
John Zinker 1	6.5	7.9
Rita Smith	5.9	7.2
John Zinker 2	5.3	6.4
Otilia Haungs	5.1	6.2
Goodrich 141	4.4	5.2
Charles Tarket	3.9	4.6

Asterisk (*) Q=1,500 gpm, S=0.001

Double Asterisk (**) Q=1,240 gpm, S=0.002

Note that the calculated transmissivity from the pumping test workup for each monitoring well was used to calculate the predicted drawdown at each monitoring well site (see Table 3)

Attachment 2 – Monitoring Well Information and Results (Packets)

Area 1

City of Bastrop
Well J
36-Hour Continuous Pumping Test Results

Project: 10210
County: Bastrop County, Texas
Aquifer Tested: Simsboro Aquifer
Well Completion/Screen Interval: 450 to 510; 610 to 660 feet BGL
Well Casing Diameter: 12 inches
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

Date / Time	Pumping Rate, gpm	Depth to Water, Feet	Remarks
12/27/2017 12:30	0	163.05	Static Water
12/27/2017 12:31	1560	228.48	Pump On
12/27/2017 12:32	1560	246.98	
12/27/2017 12:33	1560	251.25	
12/27/2017 12:34	1560	253.84	
12/27/2017 12:35	1560	255.19	
12/27/2017 12:36	1560	256.18	
12/27/2017 12:37	1560	257.00	
12/27/2017 12:38	1560	258.26	
12/27/2017 12:39	1560	259.03	
12/27/2017 12:40	1560	259.50	
12/27/2017 12:41	1560	259.97	
12/27/2017 12:42	1560	260.35	
12/27/2017 12:43	1560	260.75	
12/27/2017 12:44	1560	260.98	
12/27/2017 12:45	1560	261.35	
12/27/2017 12:50	1560	262.51	
12/27/2017 12:55	1560	263.45	
12/27/2017 13:00	1560	264.08	
12/27/2017 13:05	1560	264.72	
12/27/2017 13:10	1560	265.33	
12/27/2017 13:15	1560	265.77	
12/27/2017 13:20	1560	266.25	
12/27/2017 13:25	1560	266.49	
12/27/2017 13:30	1560	266.89	
12/27/2017 13:40	1560	267.95	
12/27/2017 13:50	1560	268.35	
12/27/2017 14:00	1560	268.83	
12/27/2017 14:10	1560	269.14	
12/27/2017 14:20	1560	269.44	

City of Bastrop
Well J
36-Hour Continuous Pumping Test Results

Project: 10210
County: Bastrop County, Texas
Aquifer Tested: Simsboro Aquifer
Well Completion/Screen Interval: 450 to 510; 610 to 660 feet BGL
Well Casing Diameter: 12 inches
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

Date / Time	Pumping Rate, gpm	Depth to Water, Feet	Remarks
12/27/2017 14:30	1560	270.24	
12/27/2017 15:00	1560	273.19	
12/27/2017 15:30	1560	273.15	
12/27/2017 16:00	1560	274.23	
12/27/2017 16:30	1560	274.68	
12/27/2017 17:00	1560	274.98	
12/27/2017 17:30	1560	275.25	
12/27/2017 18:00	1560	275.65	
12/27/2017 18:30	1560	275.98	
12/27/2017 19:00	1560	276.15	
12/27/2017 19:30	1560	276.25	
12/27/2017 20:00	1560	276.41	
12/27/2017 20:30	1560	276.74	
12/27/2017 21:00	1560	276.95	
12/27/2017 21:30	1560	277.08	
12/27/2017 22:00	1560	277.61	
12/27/2017 22:30	1560	278.06	
12/27/2017 23:00	1560	278.53	
12/27/2017 23:30	1560	278.88	
12/28/2017 0:00	1560	279.33	
12/28/2017 0:30	1560	279.73	
12/28/2017 1:00	1560	280.08	
12/28/2017 1:30	1560	280.38	
12/28/2017 2:00	1560	280.55	
12/28/2017 2:30	1560	280.71	
12/28/2017 3:00	1560	280.85	
12/28/2017 3:30	1560	281.03	
12/28/2017 4:00	1560	281.15	
12/28/2017 4:30	1560	281.64	
12/28/2017 5:00	1560	282.04	

City of Bastrop
Well J
36-Hour Continuous Pumping Test Results

Project: 10210
County: Bastrop County, Texas
Aquifer Tested: Simsboro Aquifer
Well Completion/Screen Interval: 450 to 510; 610 to 660 feet BGL
Well Casing Diameter: 12 inches
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

Date / Time	Pumping Rate, gpm	Depth to Water, Feet	Remarks
12/28/2017 5:30	1560	282.14	
12/28/2017 6:00	1560	282.25	
12/28/2017 6:30	1560	281.41	
12/28/2017 7:00	1560	281.55	
12/28/2017 7:30	1560	281.44	
12/28/2017 8:00	1560	281.75	
12/28/2017 8:30	1560	281.84	
12/28/2017 9:00	1560	281.85	
12/28/2017 9:30	1560	282.35	
12/28/2017 10:00	1560	282.18	
12/28/2017 10:30	1560	282.35	
12/28/2017 11:00	1560	281.77	
12/28/2017 11:30	1560	281.44	
12/28/2017 12:00	1560	281.50	
12/28/2017 12:30	1560	281.56	
12/28/2017 13:00	1560	281.56	
12/28/2017 13:30	1560	281.59	
12/28/2017 14:00	1560	281.45	
12/28/2017 14:30	1560	281.53	
12/28/2017 15:00	1560	281.63	
12/28/2017 15:30	1560	281.65	
12/28/2017 16:00	1560	281.65	
12/28/2017 16:30	1560	281.79	
12/28/2017 17:00	1560	281.83	
12/28/2017 17:30	1560	281.85	
12/28/2017 18:00	1560	282.08	
12/28/2017 18:30	1560	282.05	
12/28/2017 19:00	1560	281.91	
12/28/2017 19:30	1560	281.98	
12/28/2017 20:00	1560	282.05	

City of Bastrop
Well J
36-Hour Continuous Pumping Test Results

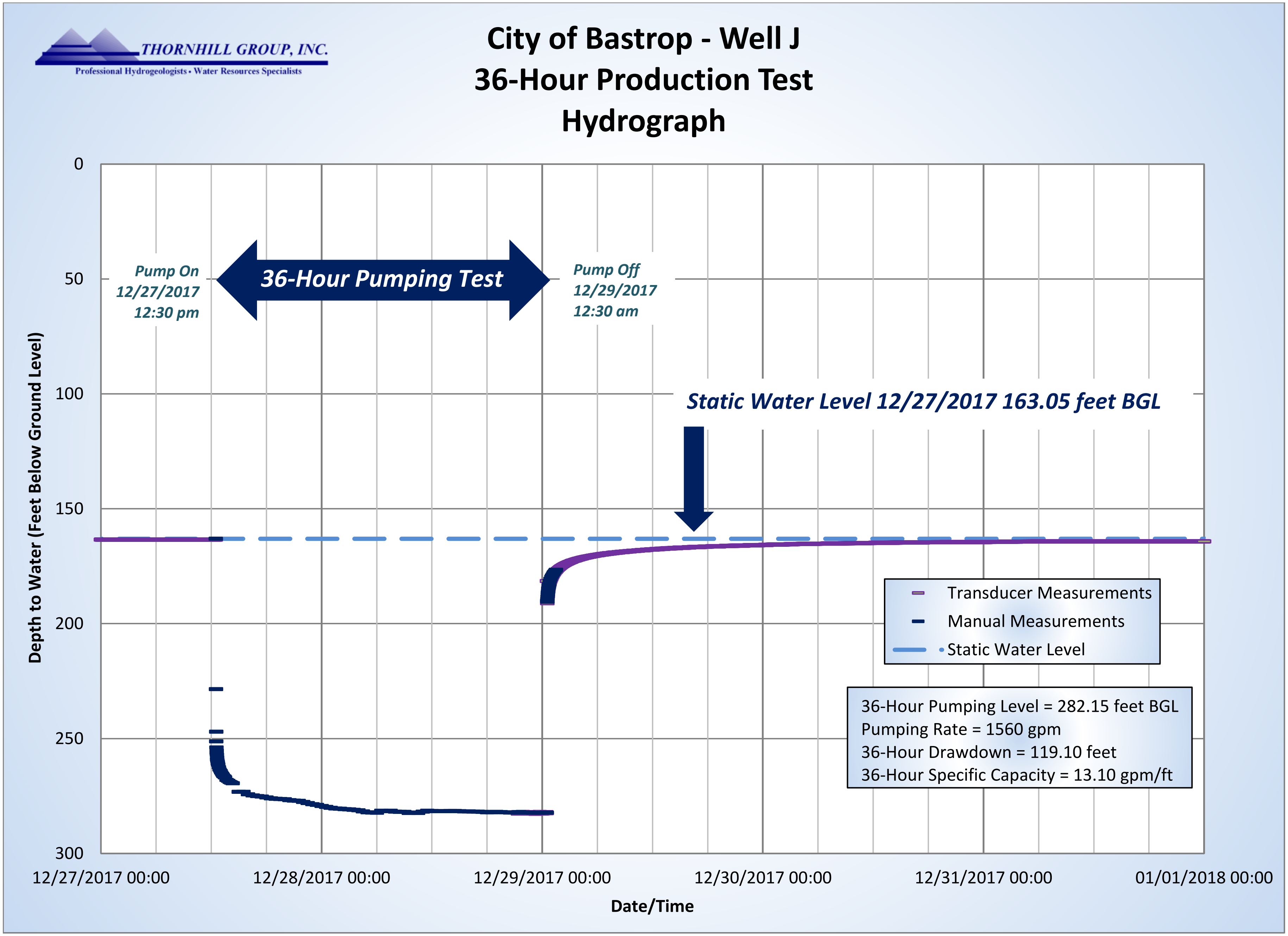
Project: 10210
County: Bastrop County, Texas
Aquifer Tested: Simsboro Aquifer
Well Completion/Screen Interval: 450 to 510; 610 to 660 feet BGL
Well Casing Diameter: 12 inches
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

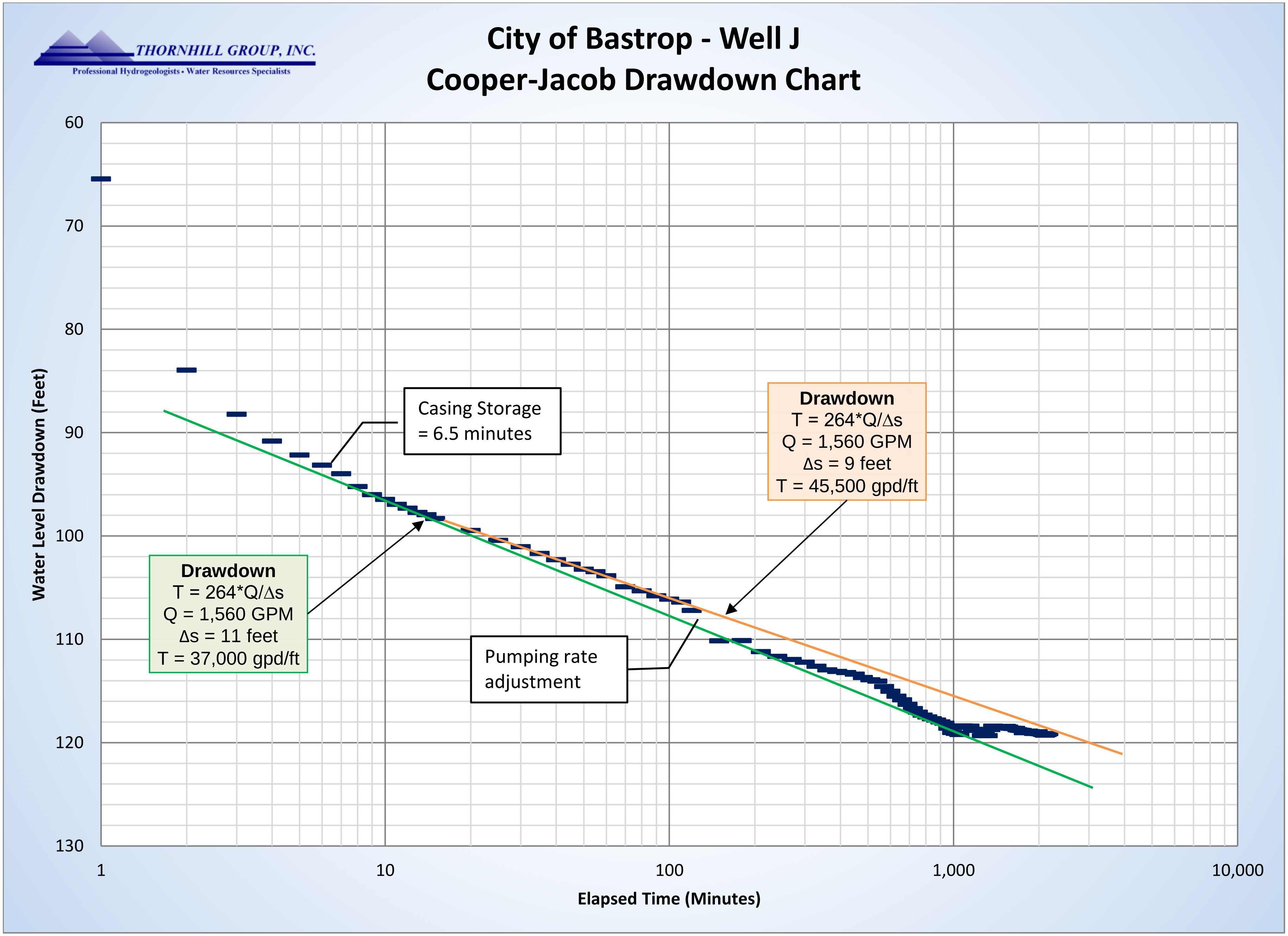
Date / Time	Pumping Rate, gpm	Depth to Water, Feet	Remarks
12/28/2017 20:30	1560	282.13	
12/28/2017 21:00	1560	282.13	
12/28/2017 21:30	1560	281.99	
12/28/2017 22:00	1560	282.15	
12/28/2017 22:30	1560	282.19	
12/28/2017 23:00	1560	282.25	
12/28/2017 23:30	1560	282.32	
12/29/2017 0:00	1560	282.25	
12/29/2017 0:30	1560	282.15	Pump Off
12/29/2017 0:31	0	–	Recovery
12/29/2017 0:32	0	190.11	
12/29/2017 0:33	0	190.44	
12/29/2017 0:34	0	189.31	
12/29/2017 0:35	0	188.23	
12/29/2017 0:36	0	187.30	
12/29/2017 0:37	0	186.50	
12/29/2017 0:38	0	185.82	
12/29/2017 0:39	0	185.47	
12/29/2017 0:40	0	184.69	
12/29/2017 0:41	0	184.33	
12/29/2017 0:42	0	184.02	
12/29/2017 0:43	0	183.37	
12/29/2017 0:44	0	183.18	
12/29/2017 0:45	0	182.85	
12/29/2017 0:50	0	181.30	
12/29/2017 0:55	0	180.45	
12/29/2017 1:00	0	179.60	
12/29/2017 1:05	0	178.95	
12/29/2017 1:10	0	178.39	
12/29/2017 1:15	0	177.85	

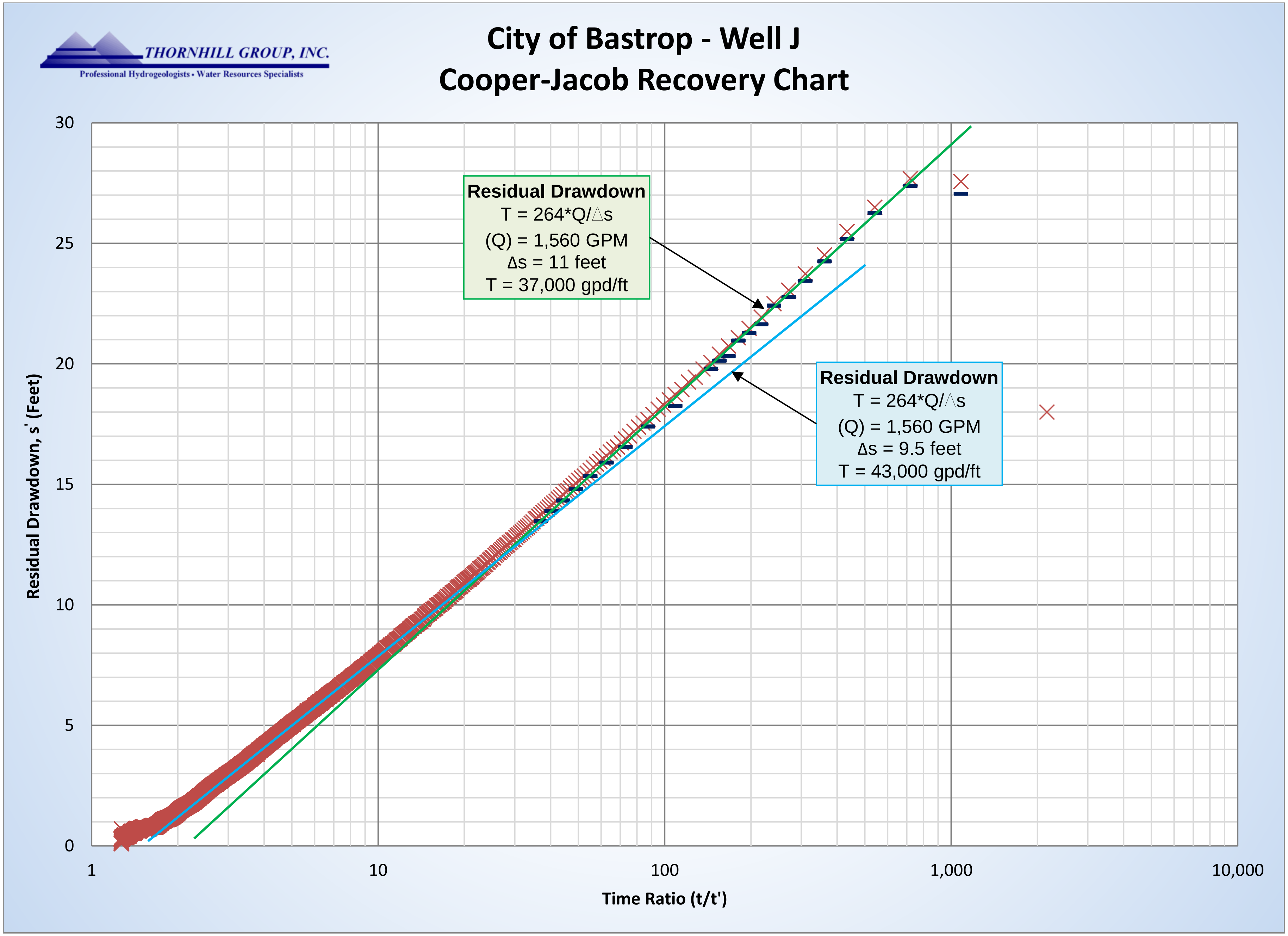
City of Bastrop
Well J
36-Hour Continuous Pumping Test Results

Project: 10210
County: Bastrop County, Texas
Aquifer Tested: Simsboro Aquifer
Well Completion/Screen Interval: 450 to 510; 610 to 660 feet BGL
Well Casing Diameter: 12 inches
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

Date / Time	Pumping Rate, gpm	Depth to Water, Feet	Remarks
12/29/2017 1:20	0	177.38	
12/29/2017 1:25	0	176.95	
12/29/2017 1:30	0	176.53	

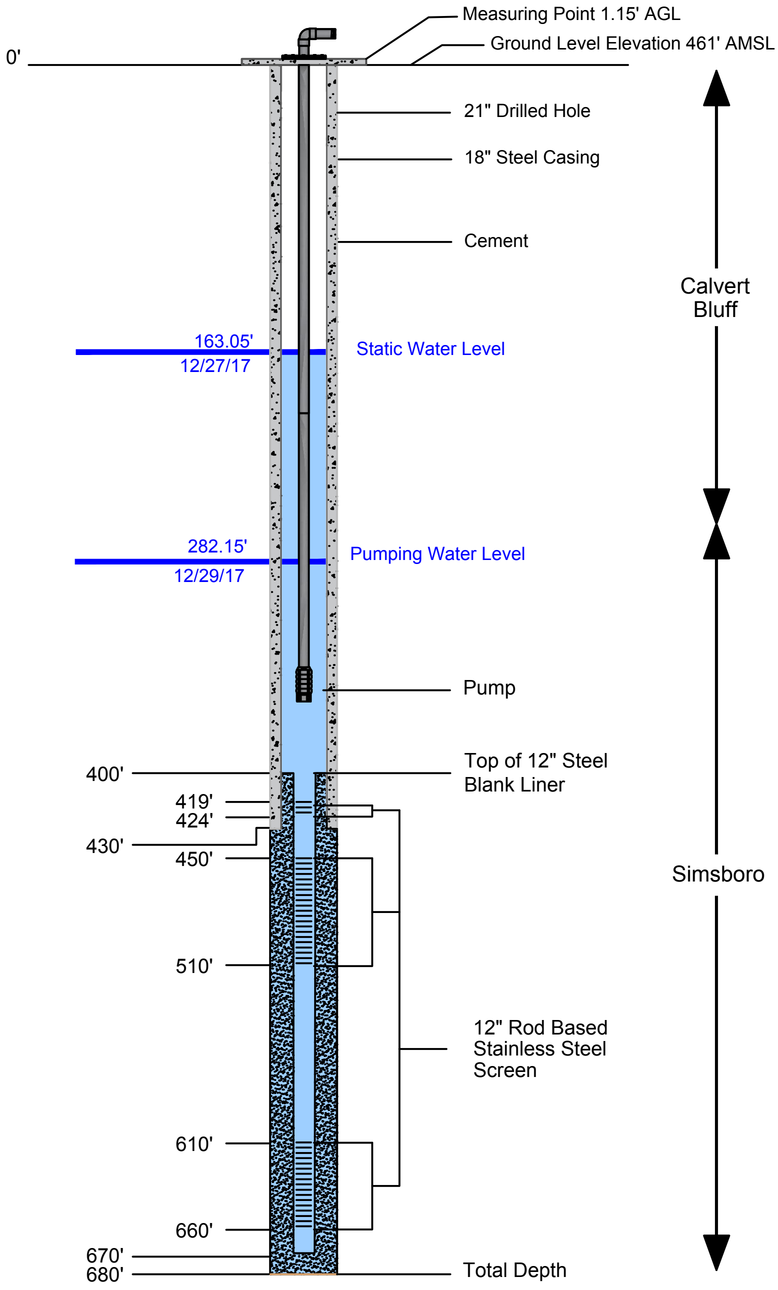

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop - Well J
36-Hour Production Test
Hydrograph
Pump On
12/27/2017
12:30 pm
36-Hour Pumping Test
Pump Off
12/29/2017
12:30 am
Static Water Level 12/27/2017 163.05 feet BGL
Transducer Measurements
Manual Measurements
Static Water Level
36-Hour Pumping Level = 282.15 feet BGL
Pumping Rate = 1560 gpm
36-Hour Drawdown = 119.10 feet
36-Hour Specific Capacity = 13.10 gpm/ft
Depth to Water (Feet Below Ground Level)
0
50
100
150
200
250
300
12/27/2017 00:00
12/28/2017 00:00
12/29/2017 00:00
12/30/2017 00:00
12/31/2017 00:00
01/01/2018 00:00
Date/Time

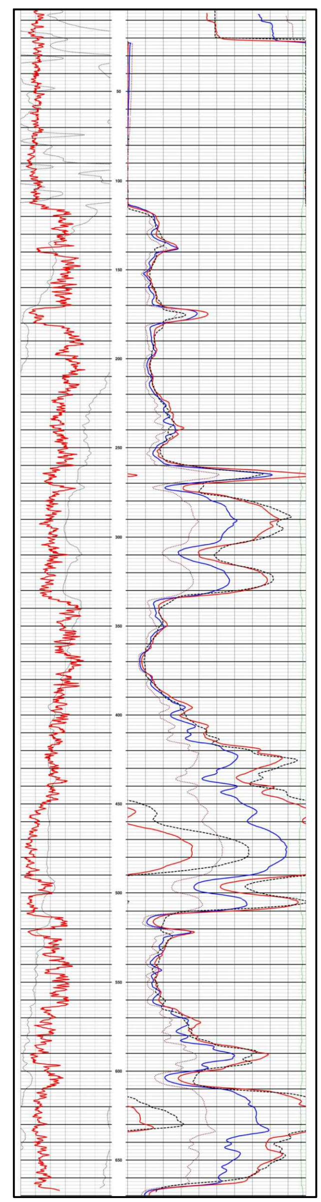

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop - Well J
Cooper-Jacob Drawdown Chart
Water Level Drawdown (Feet)
60
70
80
90
100
110
120
130
1
10
100
1,000
10,000
Elapsed Time (Minutes)
Casing Storage = 6.5 minutes
Drawdown
T = 264*Q/Δs
Q = 1,560 GPM
Δs = 9 feet
T = 45,500 gpd/ft
Drawdown
T = 264*Q/Δs
Q = 1,560 GPM
Δs = 11 feet
T = 37,000 gpd/ft
Pumping rate adjustment


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop - Well J
Cooper-Jacob Recovery Chart
Residual Drawdown
T = 264*Q/∆s
(Q) = 1,560 GPM
∆s = 11 feet
T = 37,000 gpd/ft
Residual Drawdown
T = 264*Q/∆s
(Q) = 1,560 GPM
∆s = 9.5 feet
T = 43,000 gpd/ft
Residual Drawdown, s' (Feet)
Time Ratio (t/t')
30
25
20
15
10
5
0
1
10
100
1,000
10,000

City of Bastrop Well No. 1

Well "J"





City of Bastrop
MW 3 Monitoring Well
36-Hour Drawdown and Recovery Results

Project: 10210
County: Bastrop
Aquifer Tested: Simsboro
Distance from Production Well: 1,423 feet
Production Well: Well J
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

Date / Time	Depth to Water (Feet Below Land Surface)	Remarks
11/10/2017 16:45	155.23	Background
11/13/2017 9:30	155.15	Background
12/22/2017 12:45	148.74	Background
12/27/2017 9:14	148.70	Background
12/27/2017 12:30	148.70	Static Water Level
12/27/2017 12:31	148.75	Production Well on: 12/27/2017 12:30
12/27/2017 12:32	148.75	
12/27/2017 12:33	148.75	
12/27/2017 12:34	148.75	
12/27/2017 12:35	148.75	
12/27/2017 12:36	148.75	
12/27/2017 12:37	148.75	
12/27/2017 12:38	148.77	
12/27/2017 12:39	148.77	
12/27/2017 12:40	148.80	
12/27/2017 12:41	148.81	
12/27/2017 12:42	148.82	
12/27/2017 12:43	148.84	
12/27/2017 12:44	148.86	
12/27/2017 12:45	148.88	
12/27/2017 12:46	148.92	
12/27/2017 12:47	148.94	
12/27/2017 12:48	148.97	
12/27/2017 12:49	149.00	
12/27/2017 12:50	149.03	
12/27/2017 12:55	149.19	
12/27/2017 13:00	149.35	
12/27/2017 13:05	149.53	
12/27/2017 13:10	149.70	

City of Bastrop
MW 3 Monitoring Well
36-Hour Drawdown and Recovery Results

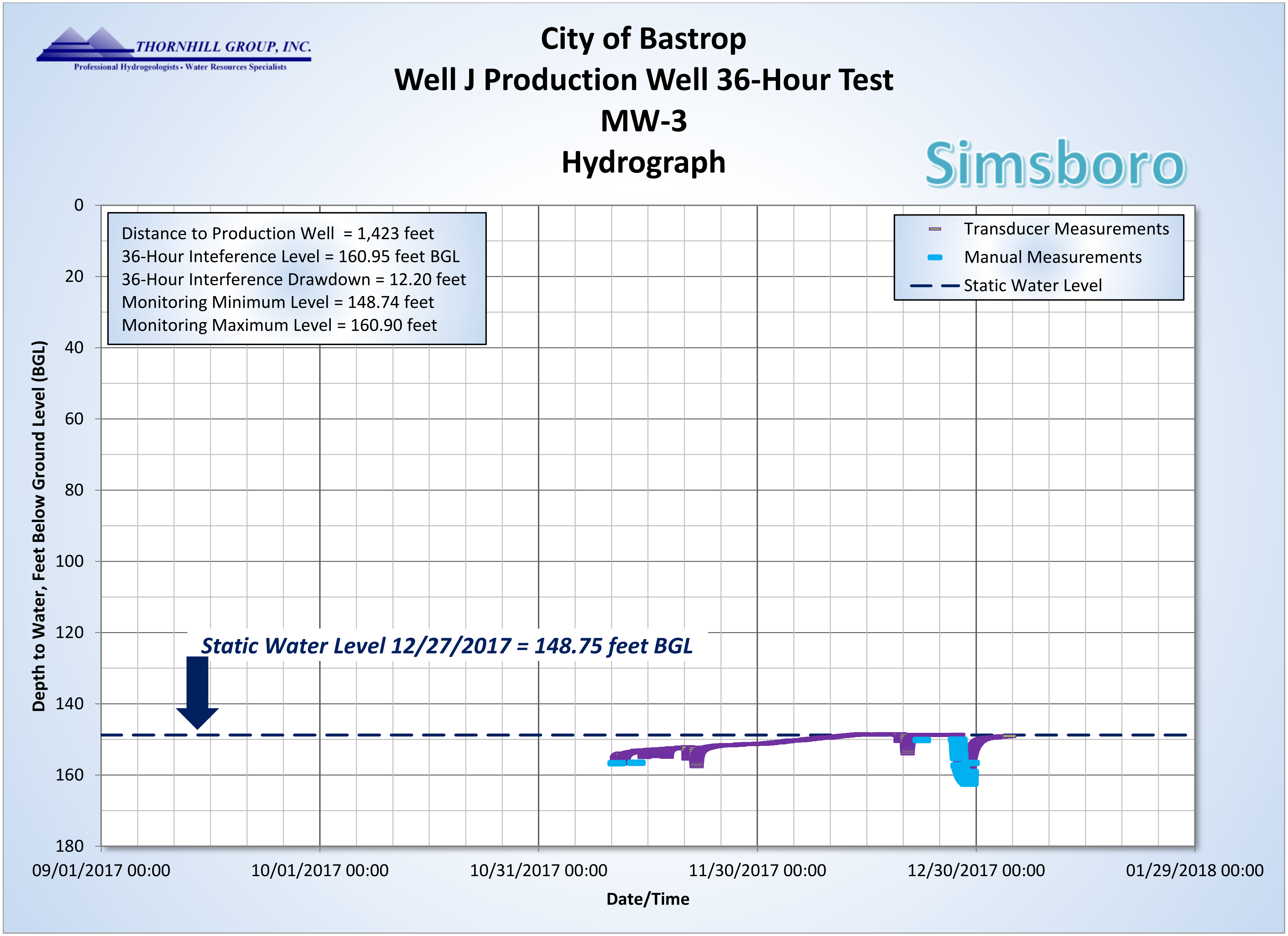
Project: 10210
County: Bastrop
Aquifer Tested: Simsboro
Distance from Production Well: 1,423 feet
Production Well: Well J
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

Date / Time	Depth to Water (Feet Below Land Surface)	Remarks
12/27/2017 13:15	149.88	
12/27/2017 13:25	150.21	
12/27/2017 13:30	150.37	
12/27/2017 13:40	150.65	
12/27/2017 13:50	150.95	
12/27/2017 14:00	151.29	
12/27/2017 14:10	151.50	
12/27/2017 14:20	151.73	
12/27/2017 14:30	151.95	
12/27/2017 14:40	152.21	
12/27/2017 14:50	152.37	
12/27/2017 15:00	152.62	
12/27/2017 15:10	152.75	
12/27/2017 15:20	152.90	
12/27/2017 15:30	153.08	
12/27/2017 15:45	153.31	
12/27/2017 16:00	153.55	
12/27/2017 16:17	153.80	
12/27/2017 17:54	155.97	
12/27/2017 19:31	155.80	
12/27/2017 21:35	156.62	
12/27/2017 23:24	157.30	
12/28/2017 1:35	157.87	
12/28/2017 3:05	158.25	
12/28/2017 4:55	158.62	
12/28/2017 6:53	158.90	
12/28/2017 8:30	159.25	
12/28/2017 11:20	159.68	
12/28/2017 13:30	159.90	

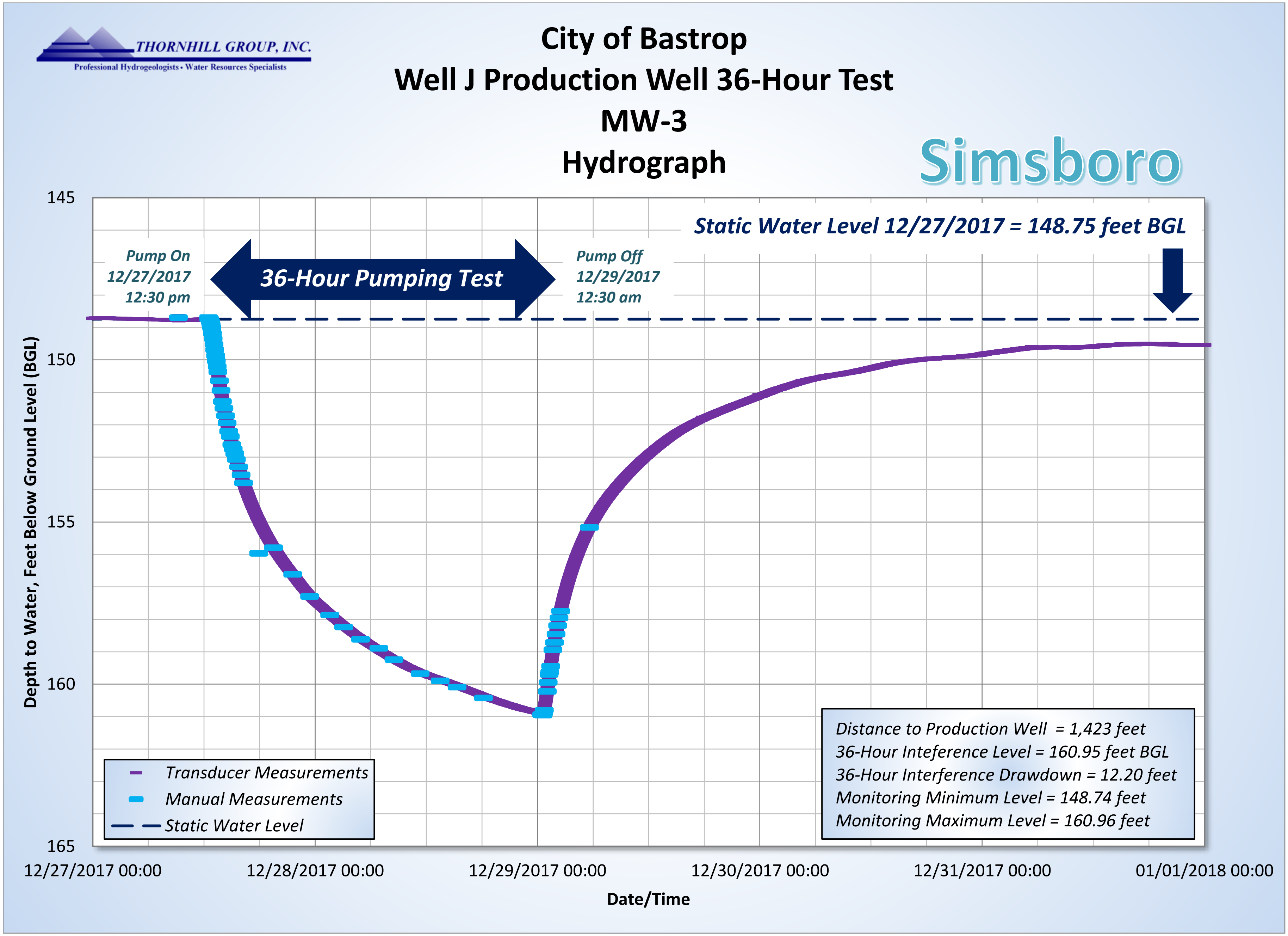
City of Bastrop
MW 3 Monitoring Well
36-Hour Drawdown and Recovery Results

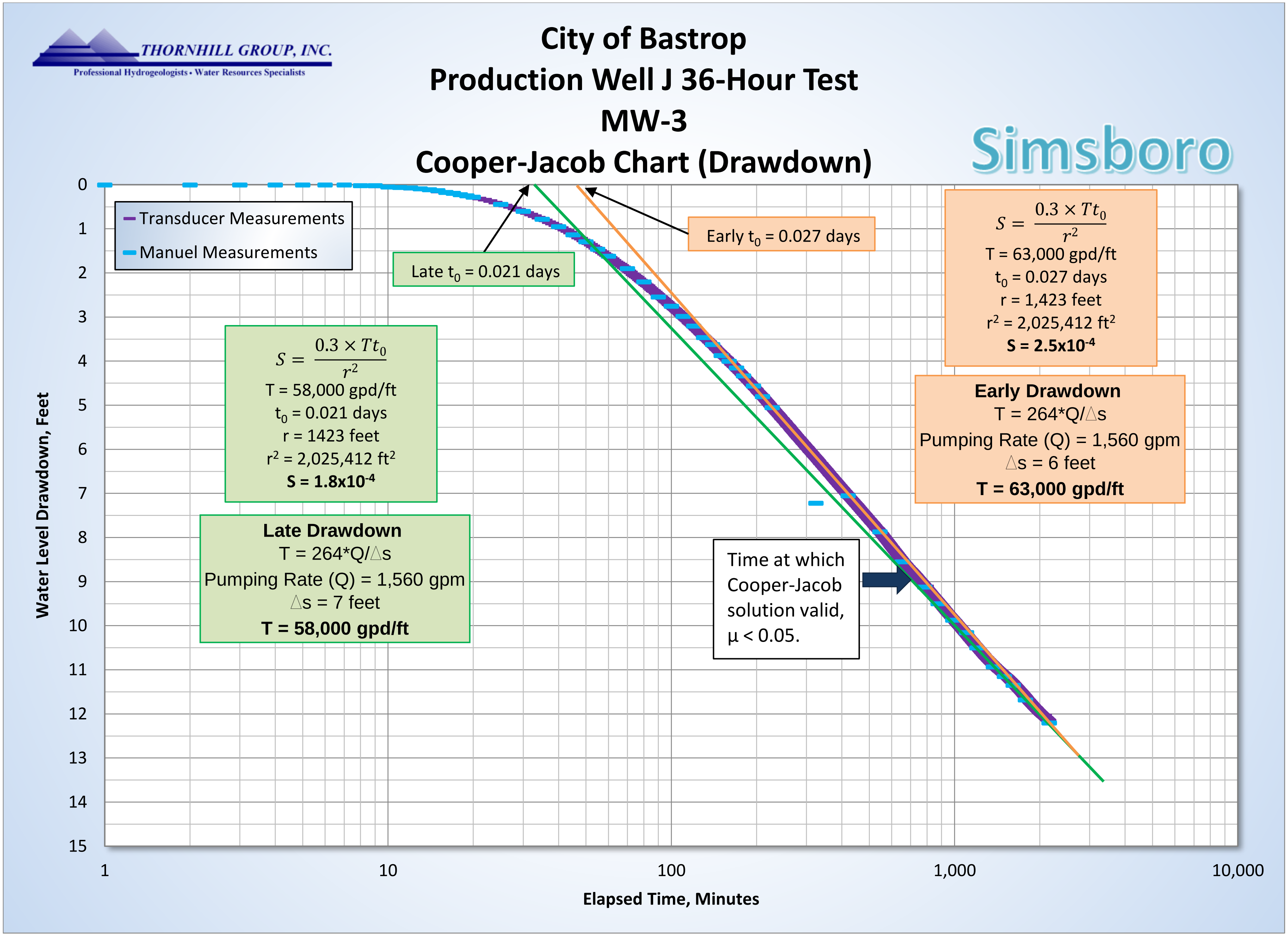
Project: 10210
County: Bastrop
Aquifer Tested: Simsboro
Distance from Production Well: 1,423 feet
Production Well: Well J
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

Date / Time	Depth to Water (Feet Below Land Surface)	Remarks
12/28/2017 15:20	160.10	
12/28/2017 18:10	160.43	
12/29/2017 0:27	160.95	
12/29/2017 0:29	160.95	
12/29/2017 0:30	160.95	Production Well off: 12/29/2017 0:30
12/29/2017 0:31	160.95	
12/29/2017 0:35	160.96	
12/29/2017 0:40	160.90	
12/29/2017 0:45	160.81	
12/29/2017 1:03	160.23	
12/29/2017 1:10	159.95	
12/29/2017 1:15	159.71	
12/29/2017 1:20	159.63	
12/29/2017 1:25	159.45	
12/29/2017 1:40	158.94	
12/29/2017 1:50	158.72	
12/29/2017 2:00	158.46	
12/29/2017 2:10	158.20	
12/29/2017 2:20	157.96	
12/29/2017 2:30	157.75	
12/29/2017 5:36	155.17	



THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
MW-3
Hydrograph
Simsboro
Distance to Production Well = 1,423 feet
36-Hour Inteference Level = 160.95 feet BGL
36-Hour Interference Drawdown = 12.20 feet
Monitoring Minimum Level = 148.74 feet
Monitoring Maximum Level = 160.90 feet
Transducer Measurements
Manual Measurements
Static Water Level
Static Water Level 12/27/2017 = 148.75 feet BGL
Depth to Water, Feet Below Ground Level (BGL)
0
20
40
60
80
100
120
140
160
180
09/01/2017 00:00
10/01/2017 00:00
10/31/2017 00:00
11/30/2017 00:00
12/30/2017 00:00
01/29/2018 00:00
Date/Time

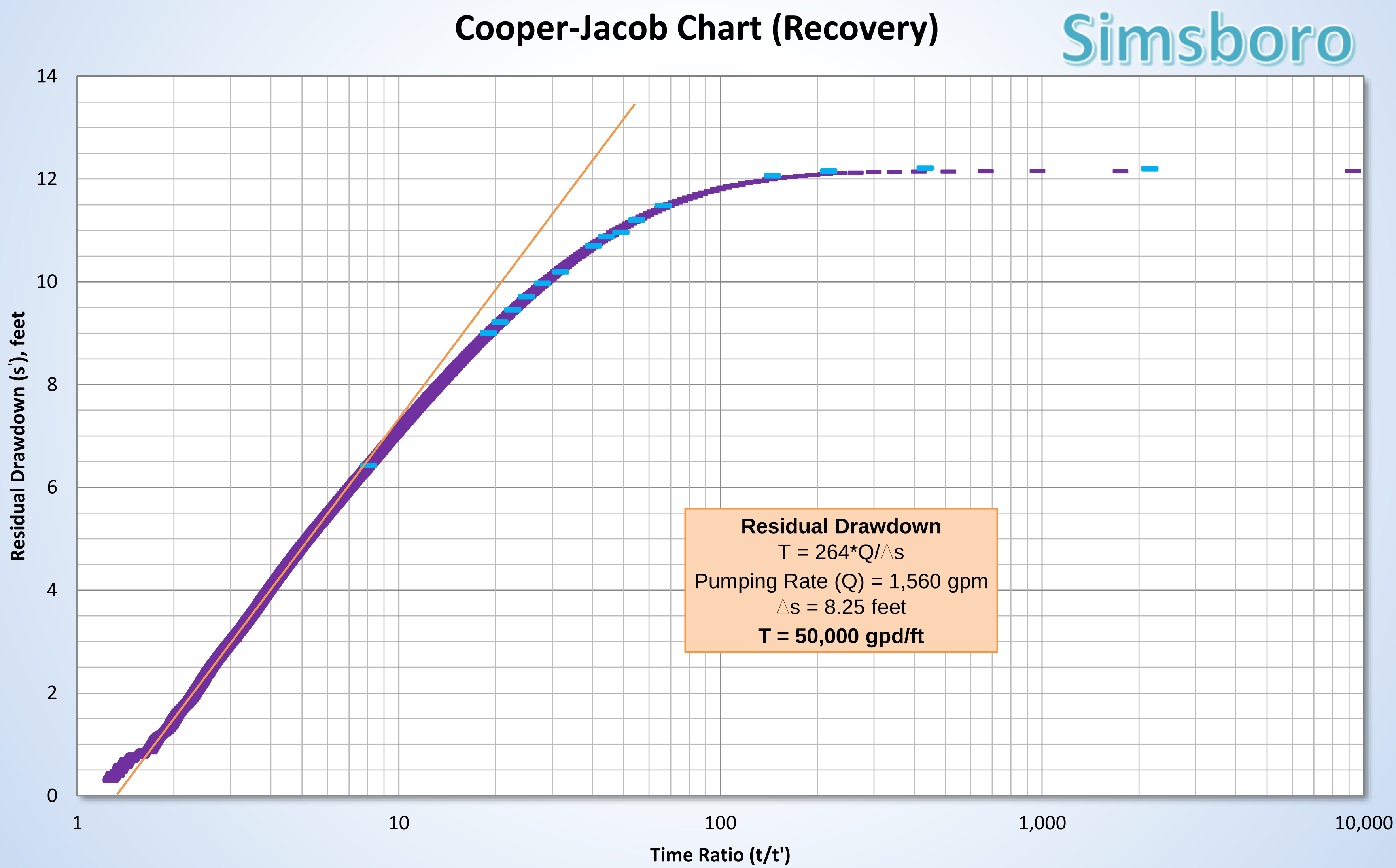

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
MW-3
Hydrograph
Simsboro
Static Water Level 12/27/2017 = 148.75 feet BGL
Pump On 12/27/2017 12:30 pm
36-Hour Pumping Test
Pump Off 12/29/2017 12:30 am
145
150
155
160
165
Depth to Water, Feet Below Ground Level (BGL)
12/27/2017 00:00
12/28/2017 00:00
12/29/2017 00:00
12/30/2017 00:00
12/31/2017 00:00
01/01/2018 00:00
Date/Time
Transducer Measurements
Manual Measurements
Static Water Level
Distance to Production Well = 1,423 feet
36-Hour Inteference Level = 160.95 feet BGL
36-Hour Interference Drawdown = 12.20 feet
Monitoring Minimum Level = 148.74 feet
Monitoring Maximum Level = 160.96 feet

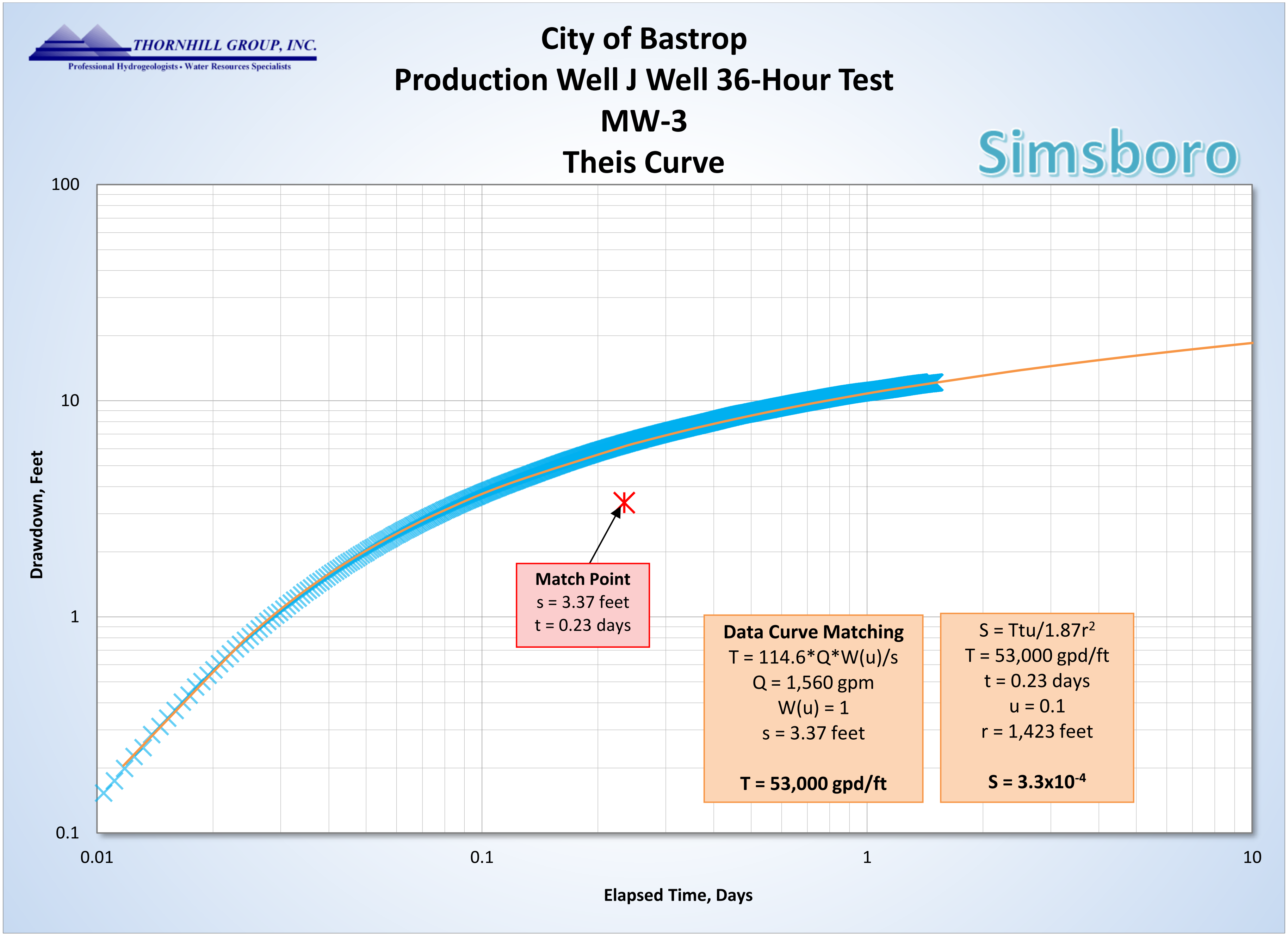


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Production Well J 36-Hour Test
MW-3
Cooper-Jacob Chart (Drawdown)
Simsboro
Transducer Measurements
Manuel Measurements
Late t_0 = 0.021 days
Early t_0 = 0.027 days
$S = \frac{0.3 \times Tt_0}{r^2}$
T = 63,000 gpd/ft
t_0 = 0.027 days
r = 1,423 feet
r^2 = 2,025,412 ft^2
S = 2.5x10^{-4}
Early Drawdown
T = 264*Q/△s
Pumping Rate (Q) = 1,560 gpm
△s = 6 feet
T = 63,000 gpd/ft
$S = \frac{0.3 \times Tt_0}{r^2}$
T = 58,000 gpd/ft
t_0 = 0.021 days
r = 1423 feet
r^2 = 2,025,412 ft^2
S = 1.8x10^{-4}
Late Drawdown
T = 264*Q/△s
Pumping Rate (Q) = 1,560 gpm
△s = 7 feet
T = 58,000 gpd/ft
Time at which Cooper-Jacob solution valid, μ < 0.05.
Water Level Drawdown, Feet
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
1
10
100
1,000
10,000
Elapsed Time, Minutes

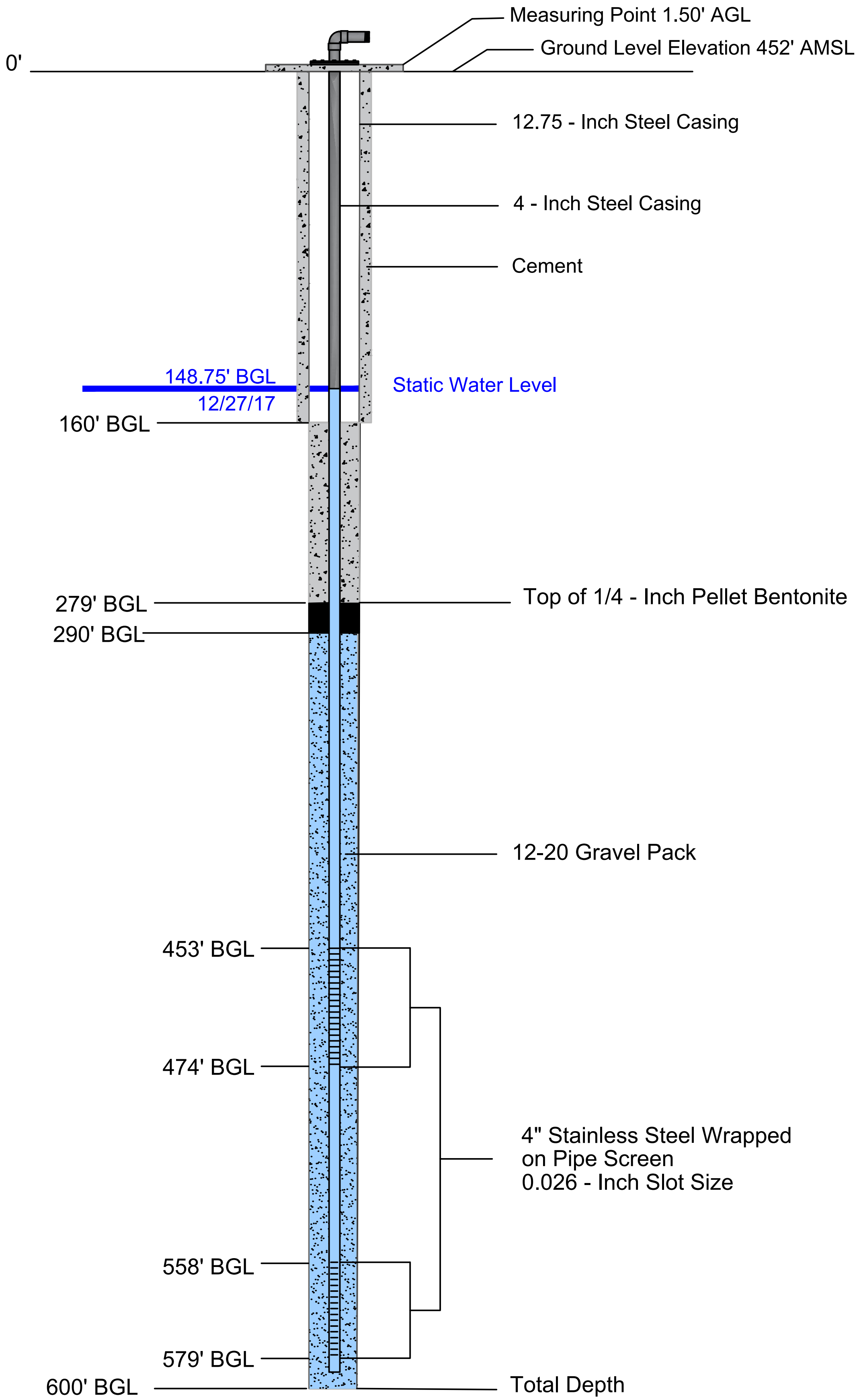
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists

City of Bastrop
Production Well J 36 Hour Test
MW-3
Cooper-Jacob Chart (Recovery)




THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Production Well J Well 36-Hour Test
MW-3
Theis Curve
Simsboro
100
10
1
0.1
0.01
0.1
1
10
Drawdown, Feet
Elapsed Time, Days
Match Point
s = 3.37 feet
t = 0.23 days
Data Curve Matching
T = 114.6*Q*W(u)/s
Q = 1,560 gpm
W(u) = 1
s = 3.37 feet
T = 53,000 gpd/ft
S = Ttu/1.87r²
T = 53,000 gpd/ft
t = 0.23 days
u = 0.1
r = 1,423 feet
S = 3.3x10⁻⁴

City of Bastrop MW-3

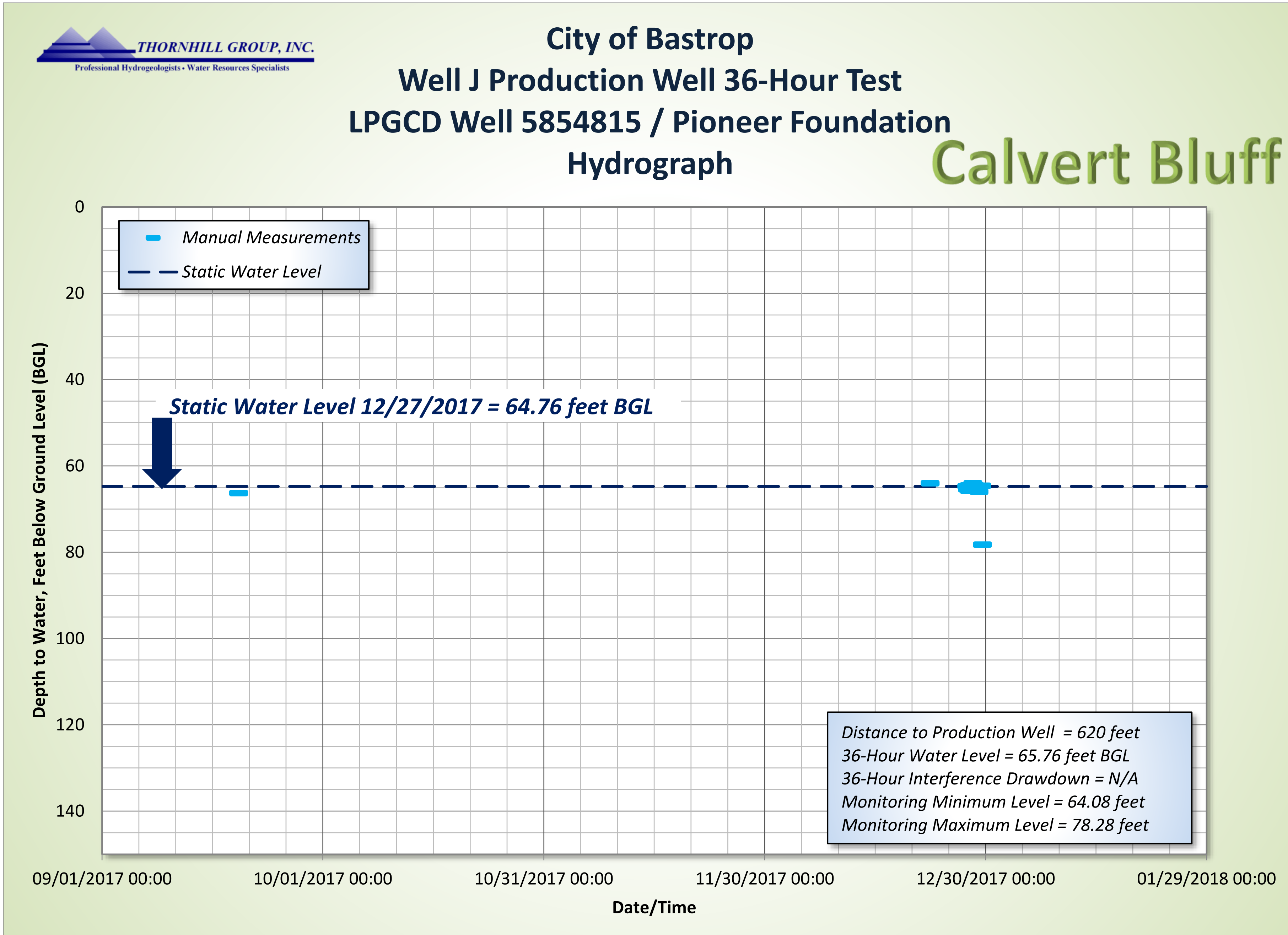



Arrowhead Ct
Shoreside Dr
Well J
Phelan Rd
Name: MW-3
Distance from Well J: 1,423.17 feet
Static Water Level 12/27/2017: 148.75 feet BGL
Sayers Rd
Old Perkins Rd
Smith Rd
Explanation
City of Bastrop
Well J
0 325 650 1,300
Feet
N
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors

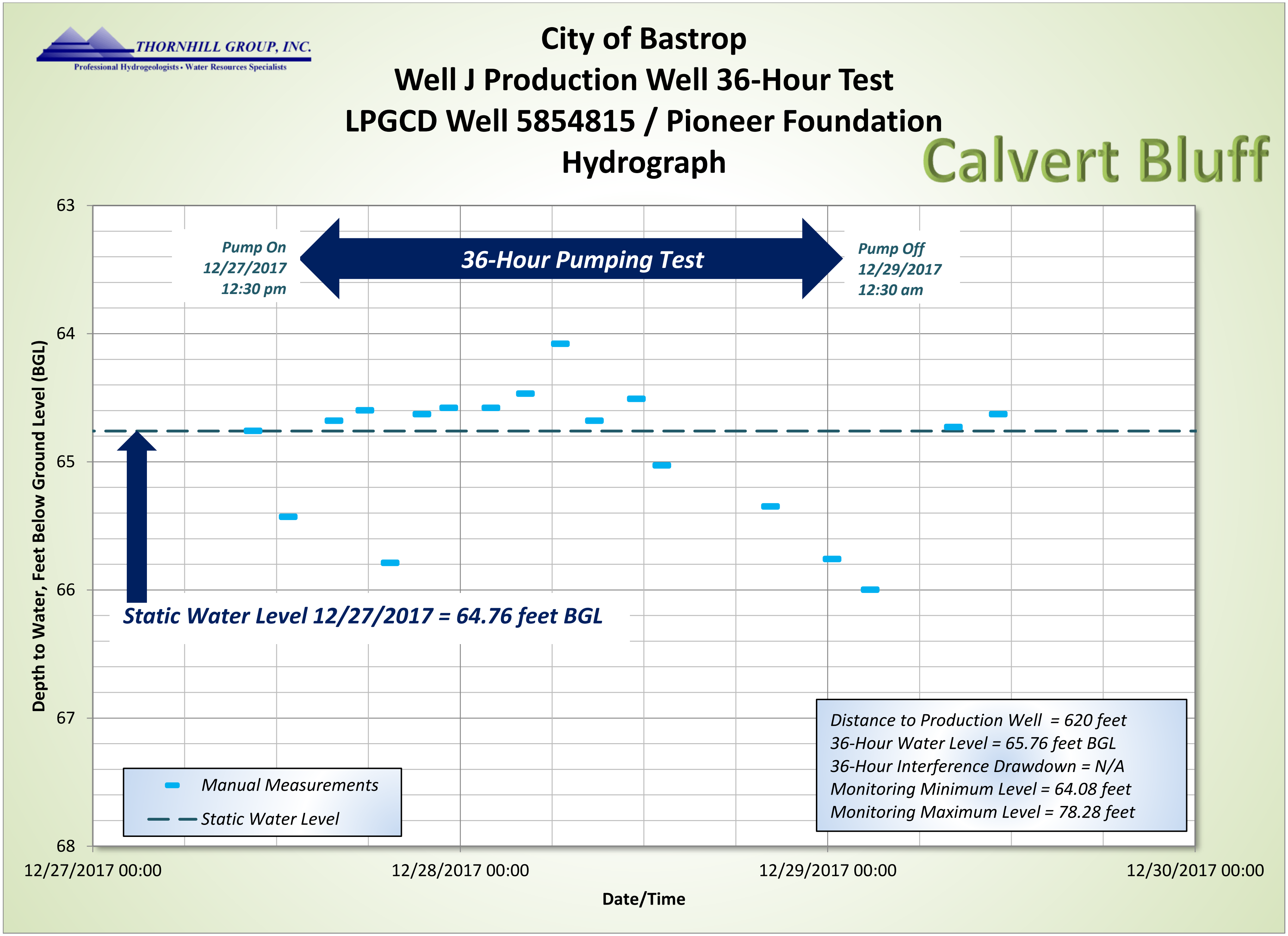
City of Bastrop
Pioneer Foundation Well
36-Hour Drawdown and Recovery Results

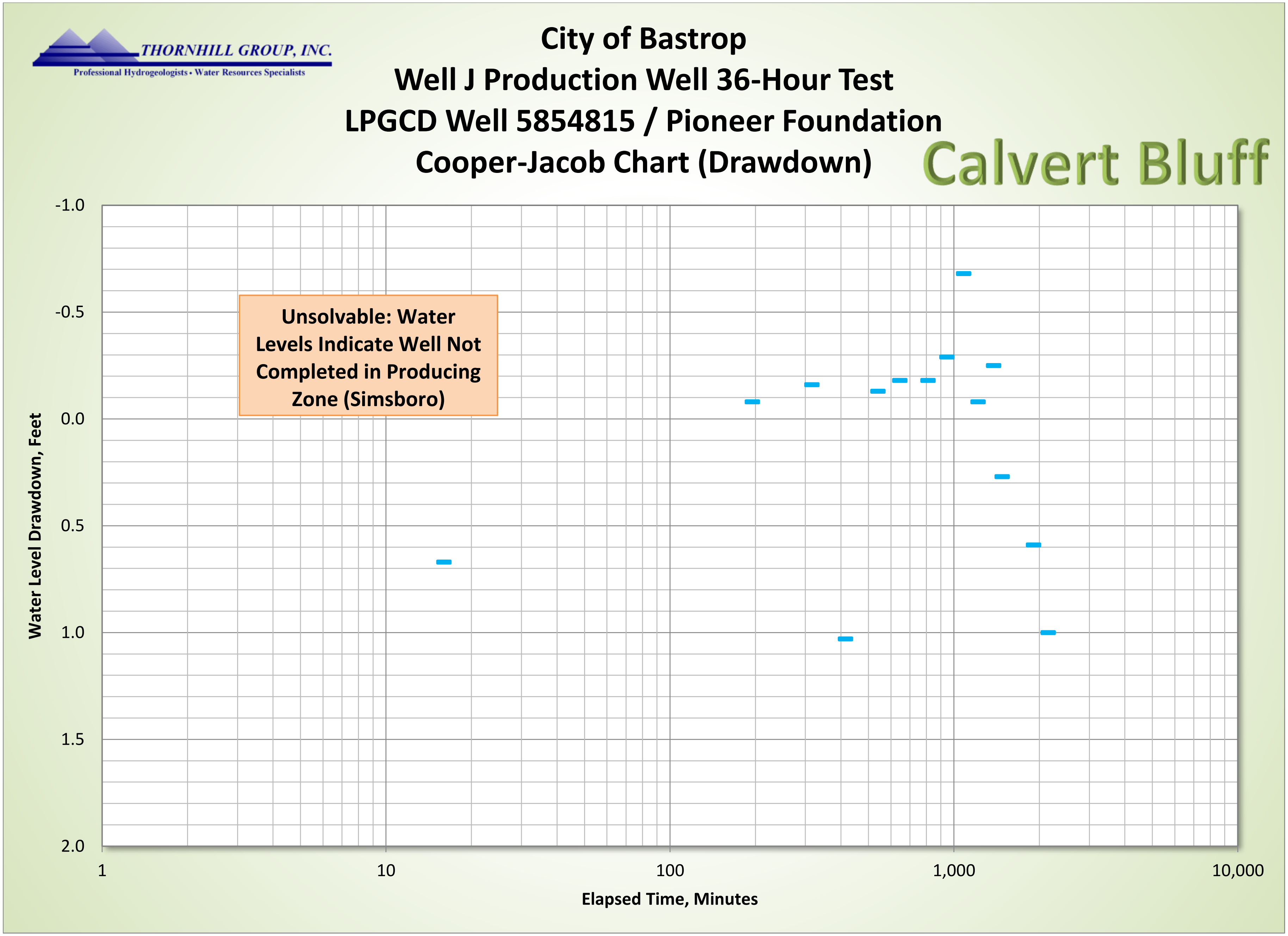
Project: 10210
County: Bastrop
Aquifer Tested: Simsboro
Distance from Production Well: 620 feet
Production Well: Well J
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

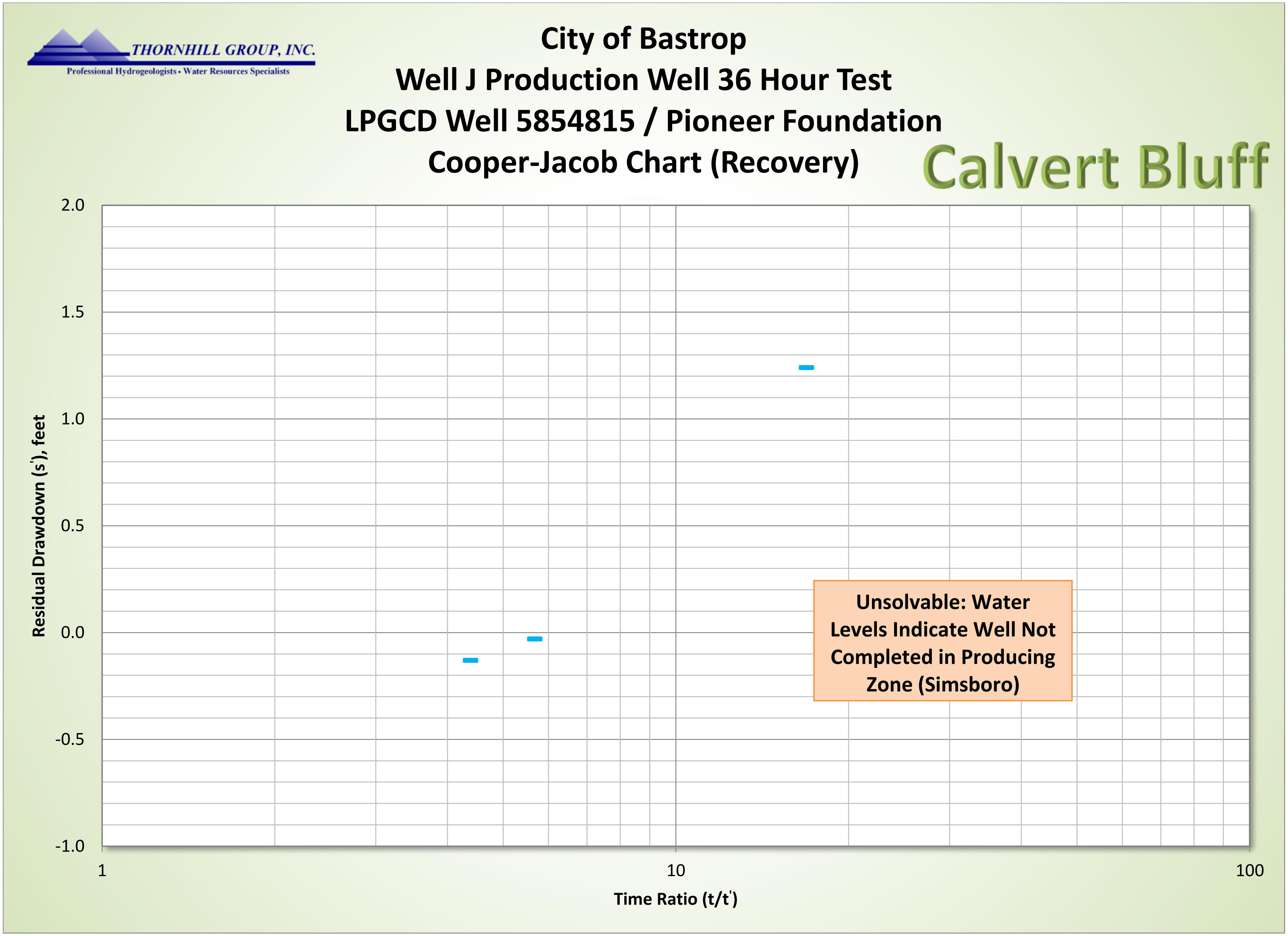
Date / Time	Depth to Water (Feet Below Land Surface)	Remarks
9/19/2017 13:21	66.33	Background
12/22/2017 10:45	64.08	Background
12/27/2017 10:28	64.76	Static Water Level
12/27/2017 12:46	65.43	Production Well on: 12/27/2017 12:30 pm
12/27/2017 15:45	64.68	
12/27/2017 17:46	64.60	
12/27/2017 19:25	65.79	
12/27/2017 21:30	64.63	
12/27/2017 23:15	64.58	
12/28/2017 2:00	64.58	
12/28/2017 4:15	64.47	
12/28/2017 6:32	64.08	
12/28/2017 8:46	64.68	
12/28/2017 11:30	64.51	
12/28/2017 13:10	65.03	
12/28/2017 20:16	65.35	
12/29/2017 0:17	65.76	Production Well off: 12/29/2017 12:30 am
12/29/2017 2:46	66.00	
12/29/2017 8:12	64.73	
12/29/2017 11:08	64.63	
12/29/2017 13:20	78.28	Pump might have kicked on.



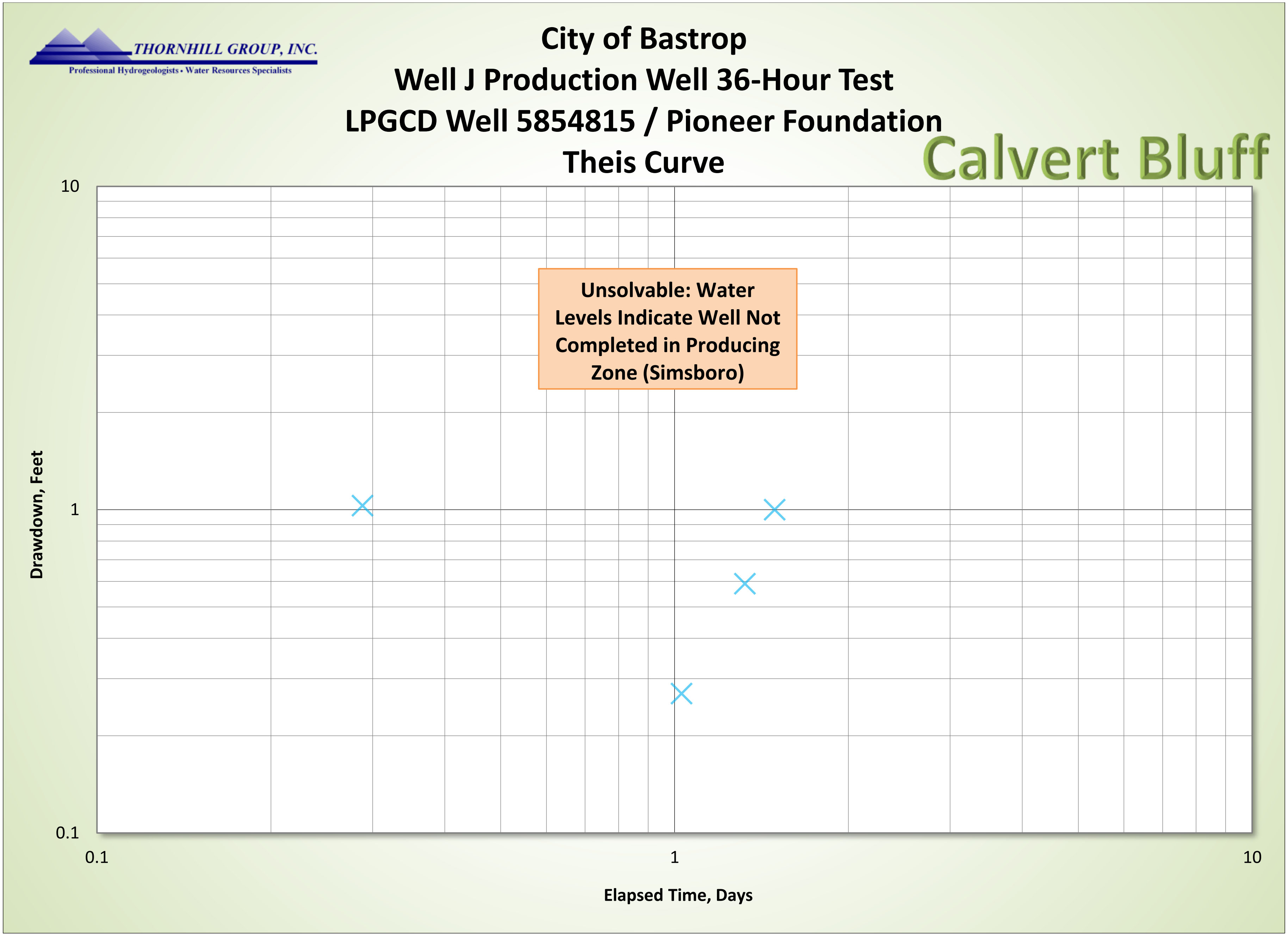
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854815 / Pioneer Foundation
Hydrograph
Calvert Bluff
Manual Measurements
Static Water Level
Static Water Level 12/27/2017 = 64.76 feet BGL
Distance to Production Well = 620 feet
36-Hour Water Level = 65.76 feet BGL
36-Hour Interference Drawdown = N/A
Monitoring Minimum Level = 64.08 feet
Monitoring Maximum Level = 78.28 feet
Depth to Water, Feet Below Ground Level (BGL)
0
20
40
60
80
100
120
140
09/01/2017 00:00
10/01/2017 00:00
10/31/2017 00:00
11/30/2017 00:00
12/30/2017 00:00
01/29/2018 00:00
Date/Time


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854815 / Pioneer Foundation
Hydrograph
Calvert Bluff
Pump On
12/27/2017
12:30 pm
36-Hour Pumping Test
Pump Off
12/29/2017
12:30 am
Static Water Level 12/27/2017 = 64.76 feet BGL
Distance to Production Well = 620 feet
36-Hour Water Level = 65.76 feet BGL
36-Hour Interference Drawdown = N/A
Monitoring Minimum Level = 64.08 feet
Monitoring Maximum Level = 78.28 feet
Manual Measurements
Static Water Level
Depth to Water, Feet Below Ground Level (BGL)
63
64
65
66
67
68
12/27/2017 00:00
12/28/2017 00:00
12/29/2017 00:00
12/30/2017 00:00
Date/Time

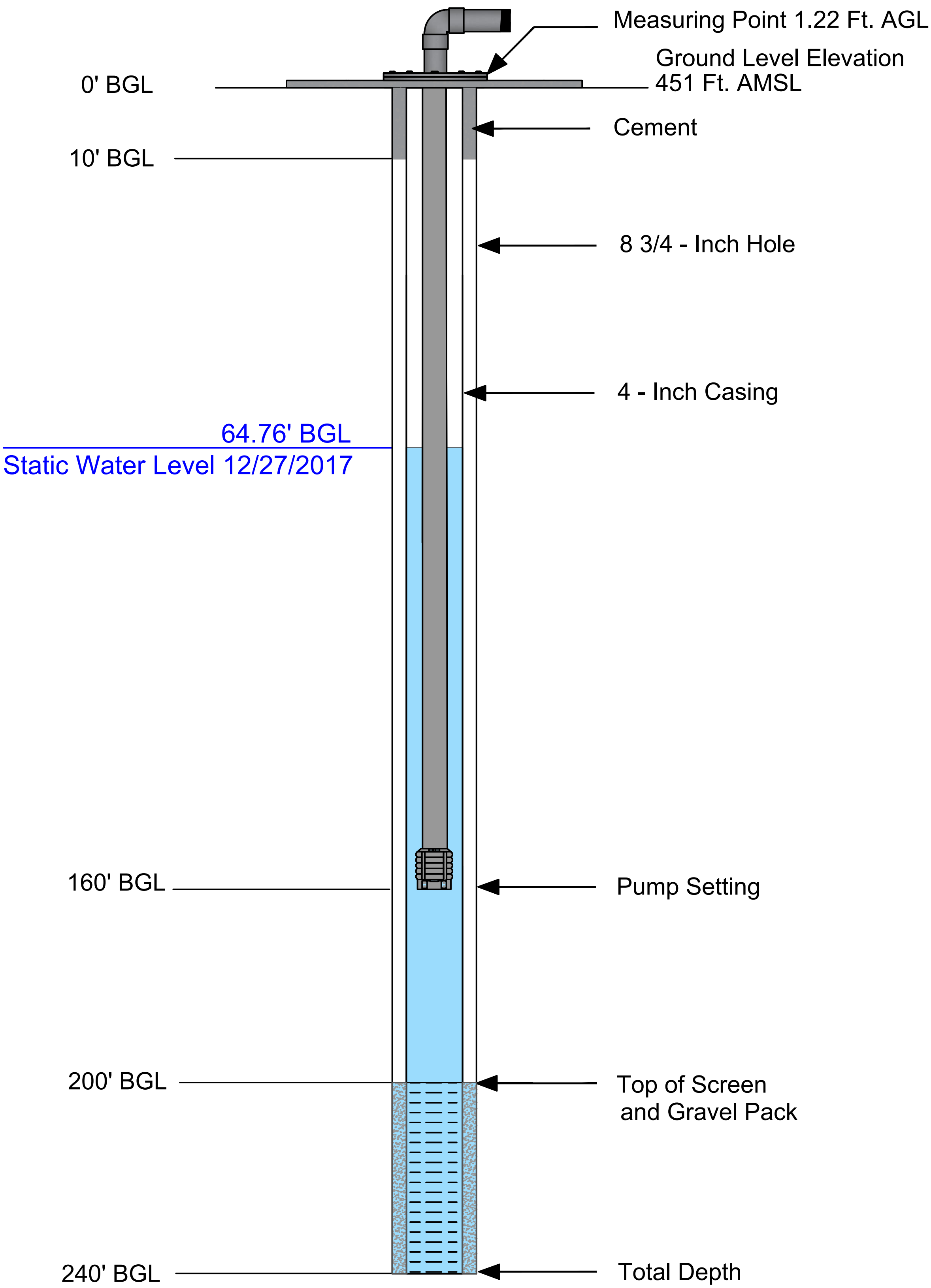

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854815 / Pioneer Foundation
Cooper-Jacob Chart (Drawdown)
Calvert Bluff
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)
Water Level Drawdown, Feet
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
1
10
100
1,000
10,000
Elapsed Time, Minutes



THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36 Hour Test
LPGCD Well 5854815 / Pioneer Foundation
Cooper-Jacob Chart (Recovery)
Calvert Bluff
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
Residual Drawdown (s'), feet
1
10
100
Time Ratio (t/t')
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854815 / Pioneer Foundation
Theis Curve
Calvert Bluff
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)
Drawdown, Feet
10
1
0.1
0.1
1
10
Elapsed Time, Days

LPGCD Well 5854815 / Pioneer Foundation



Well construction details compiled from State of Texas Well Report, LPGCD records, owner, and/or TGI field investigations.

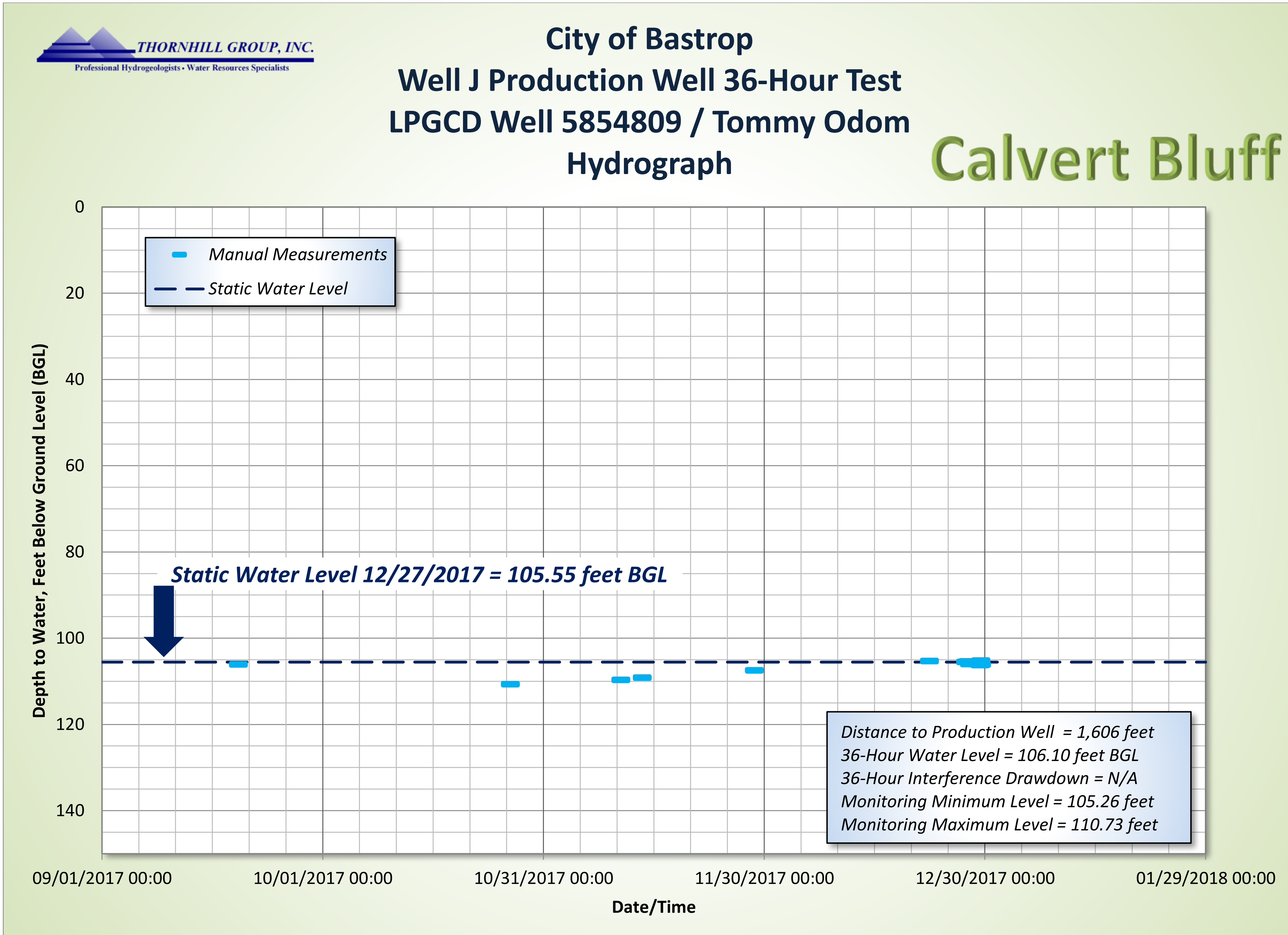
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists


Arrowhead Ct
Shoreside Dr
Well J
Phelan Rd
Name: Pioneer Foundation
Distance from Well J: 620.49 feet
Static Water Level 12/27/2017: 64.76 feet BGL
Sayers Rd
Old Perkins Rd
Smith Rd
Explanation
City of Bastrop
Well J
0 325 650 1,300
Feet
N
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors

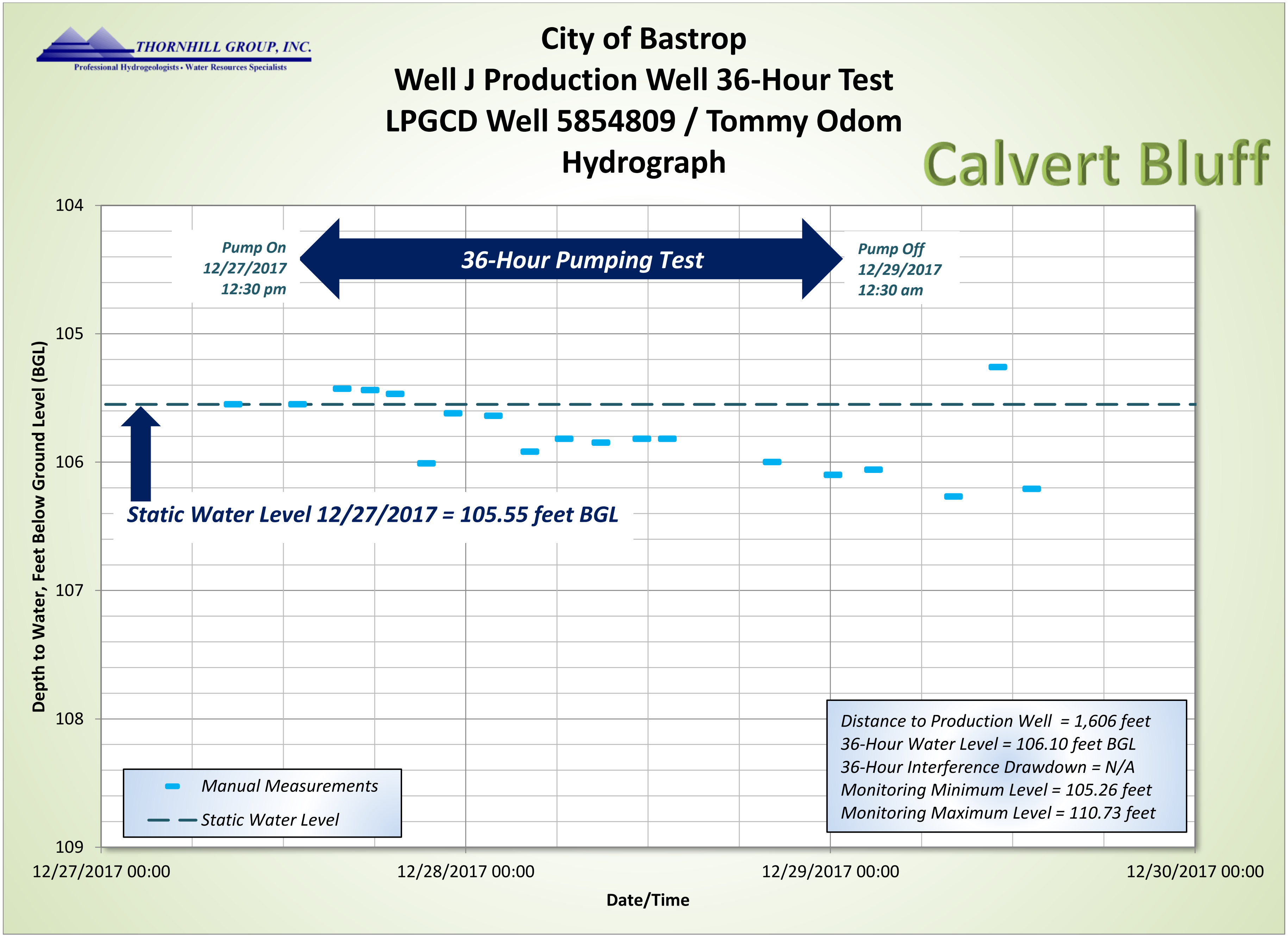
City of Bastrop
Tommy Odom Well
36-Hour Drawdown and Recovery Results

Project: 10210
County: Bastrop
Aquifer Tested: Simsboro
Distance from Production Well: 1,606 feet
Production Well: Well J
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

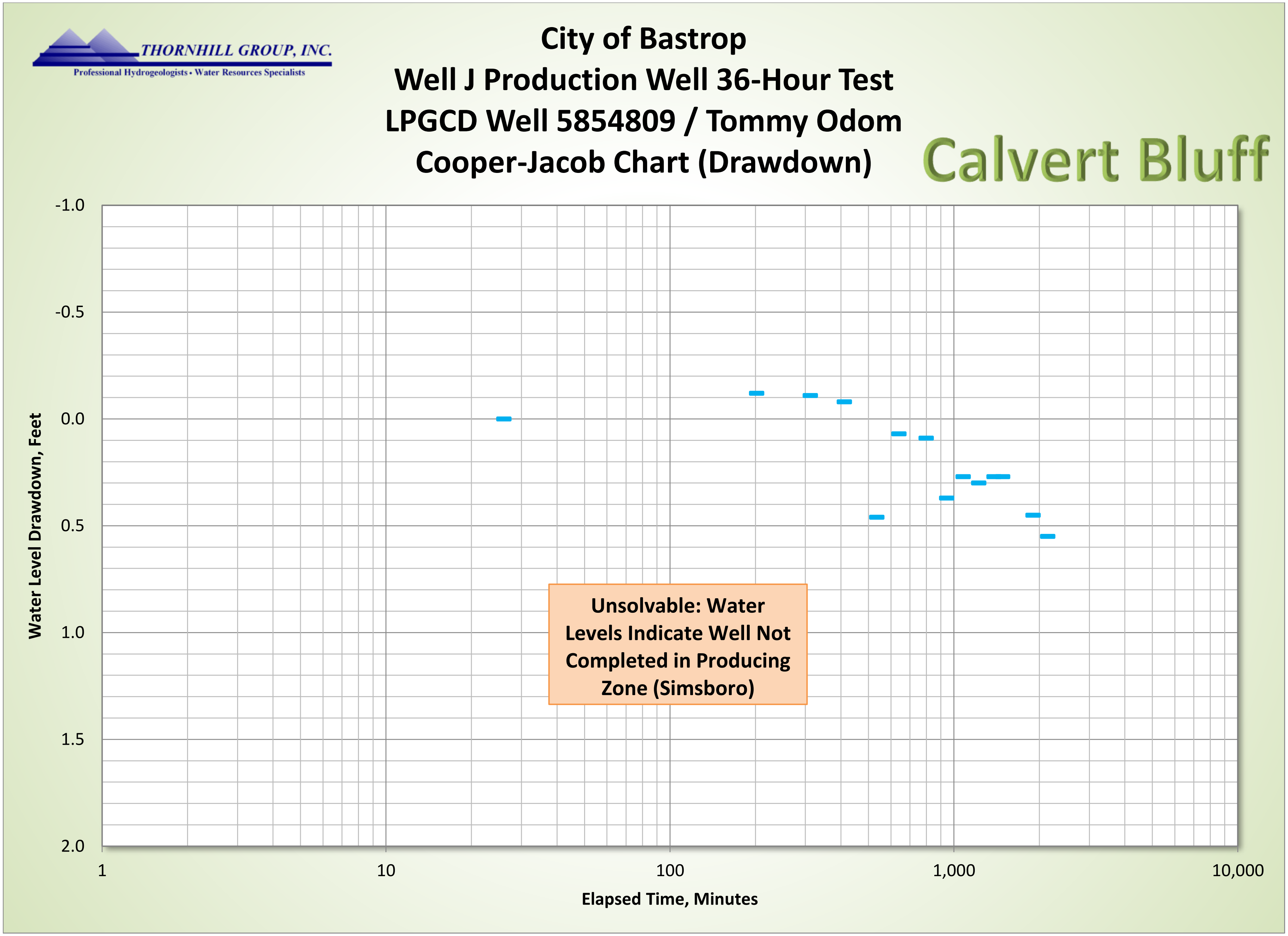
Date / Time	Depth to Water (Feet Below Land Surface)	Remarks
9/19/2017 12:35	106.15	Background
10/26/2017 12:09	110.73	Background
11/10/2017 12:48	109.70	Background
11/13/2017 10:03	109.20	Background
11/28/2017 15:48	107.52	Background
12/22/2017 11:03	105.32	Background
12/27/2017 8:41	105.55	Static Water Level
12/27/2017 12:56	105.55	Production Well on: 12/27/2017 12:30 pm
12/27/2017 15:52	105.43	
12/27/2017 17:42	105.44	
12/27/2017 19:21	105.47	
12/27/2017 21:25	106.01	
12/27/2017 23:10	105.62	
12/28/2017 1:49	105.64	
12/28/2017 4:13	105.92	
12/28/2017 6:28	105.82	
12/28/2017 8:53	105.85	
12/28/2017 11:35	105.82	
12/28/2017 13:16	105.82	
12/28/2017 20:10	106.00	
12/29/2017 0:10	106.10	
12/29/2017 2:50	106.06	Production Well off: 12/29/2017 12:30 am
12/29/2017 8:06	106.27	
12/29/2017 11:01	105.26	
12/29/2017 13:15	106.21	

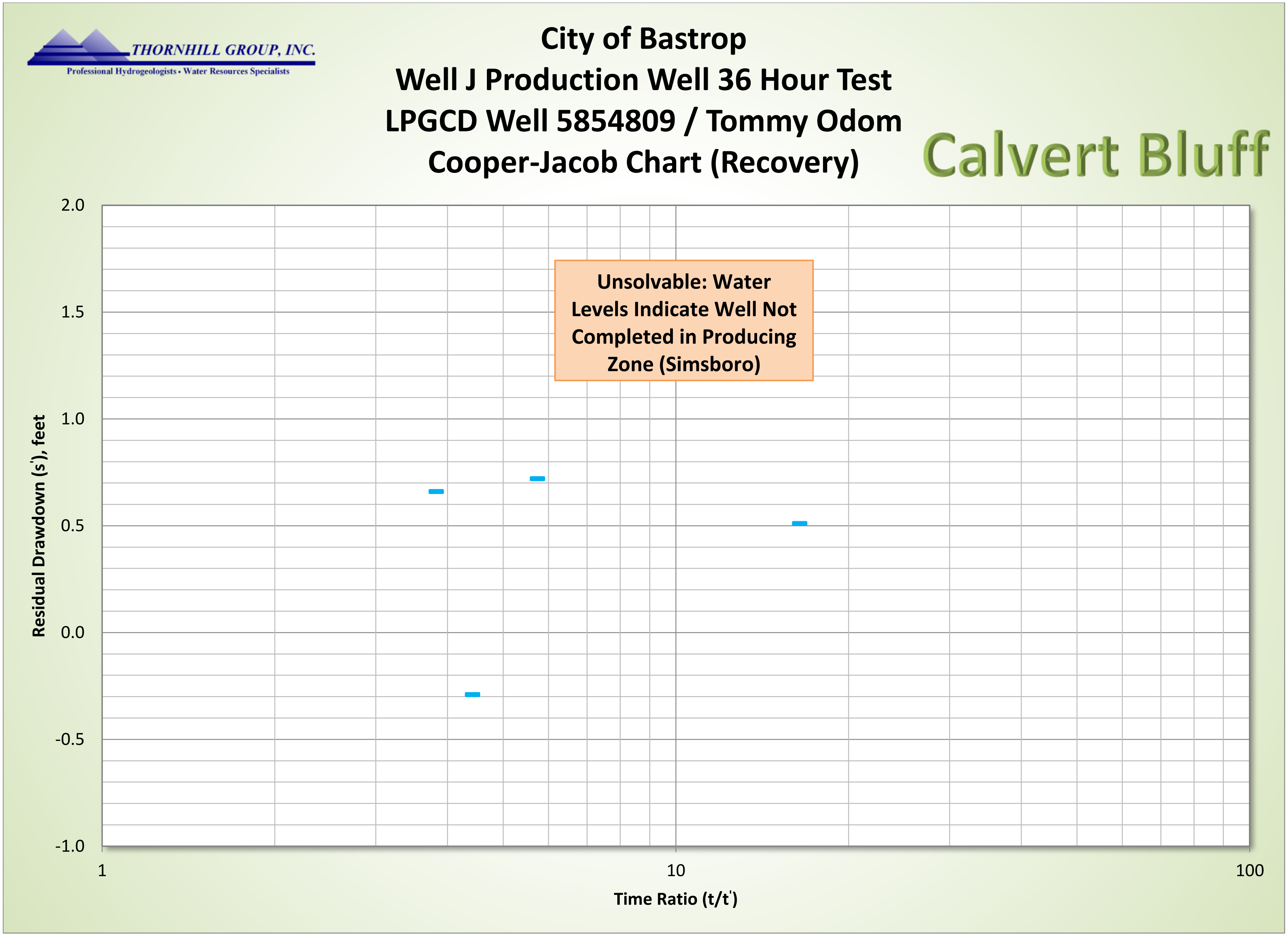


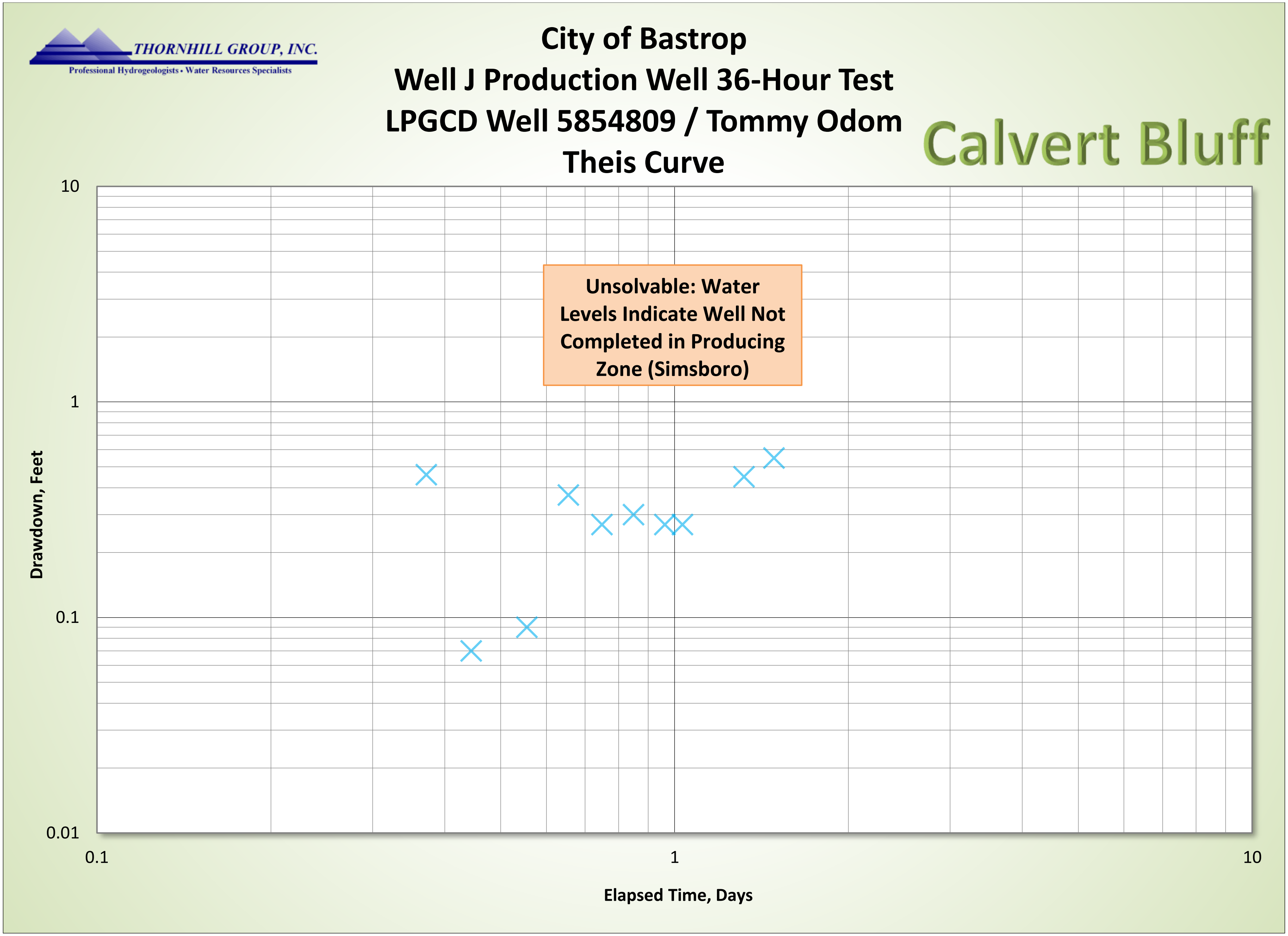
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854809 / Tommy Odom
Hydrograph
Calvert Bluff
Manual Measurements
Static Water Level
Static Water Level 12/27/2017 = 105.55 feet BGL
Depth to Water, Feet Below Ground Level (BGL)
0
20
40
60
80
100
120
140
Distance to Production Well = 1,606 feet
36-Hour Water Level = 106.10 feet BGL
36-Hour Interference Drawdown = N/A
Monitoring Minimum Level = 105.26 feet
Monitoring Maximum Level = 110.73 feet
09/01/2017 00:00
10/01/2017 00:00
10/31/2017 00:00
11/30/2017 00:00
12/30/2017 00:00
01/29/2018 00:00
Date/Time



THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854809 / Tommy Odom
Hydrograph
Calvert Bluff
Pump On
12/27/2017
12:30 pm
36-Hour Pumping Test
Pump Off
12/29/2017
12:30 am
Static Water Level 12/27/2017 = 105.55 feet BGL
Depth to Water, Feet Below Ground Level (BGL)
104
105
106
107
108
109
Manual Measurements
Static Water Level
Distance to Production Well = 1,606 feet
36-Hour Water Level = 106.10 feet BGL
36-Hour Interference Drawdown = N/A
Monitoring Minimum Level = 105.26 feet
Monitoring Maximum Level = 110.73 feet
12/27/2017 00:00
12/28/2017 00:00
12/29/2017 00:00
12/30/2017 00:00
Date/Time

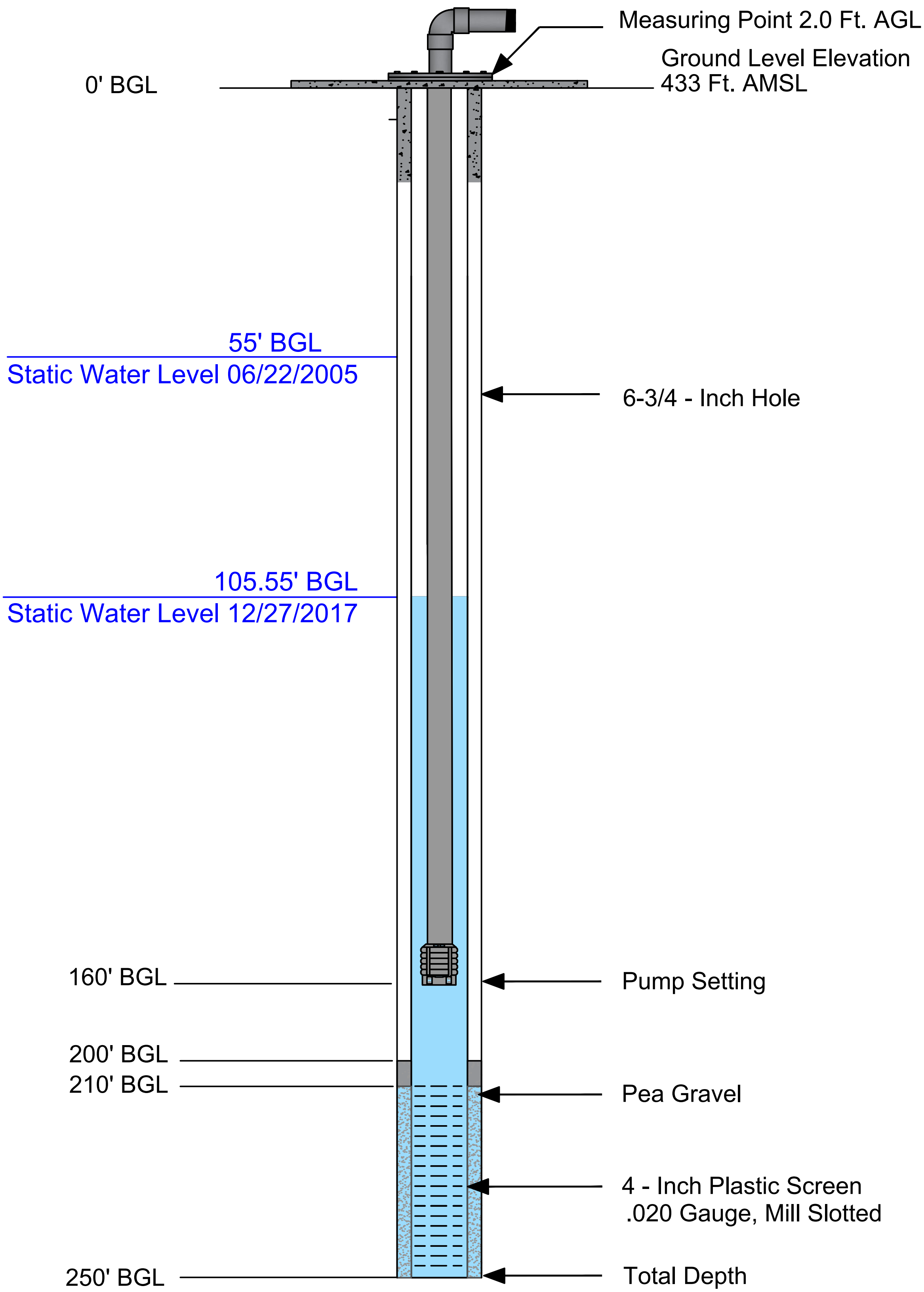

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854809 / Tommy Odom
Cooper-Jacob Chart (Drawdown)
Calvert Bluff
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
Water Level Drawdown, Feet
1
10
100
1,000
10,000
Elapsed Time, Minutes
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36 Hour Test
LPGCD Well 5854809 / Tommy Odom
Cooper-Jacob Chart (Recovery)
Calvert Bluff
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)
Residual Drawdown (s'), feet
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
1
10
100
Time Ratio (t/t')



THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854809 / Tommy Odom
Theis Curve
Calvert Bluff
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)
Drawdown, Feet
10
1
0.1
0.01
0.1
1
10
Elapsed Time, Days

LPGCD Well 5854809 / Tommy Odom



Well construction details compiled from State of Texas Well Report, LPGCD records, owner, and/or TGI field investigations.

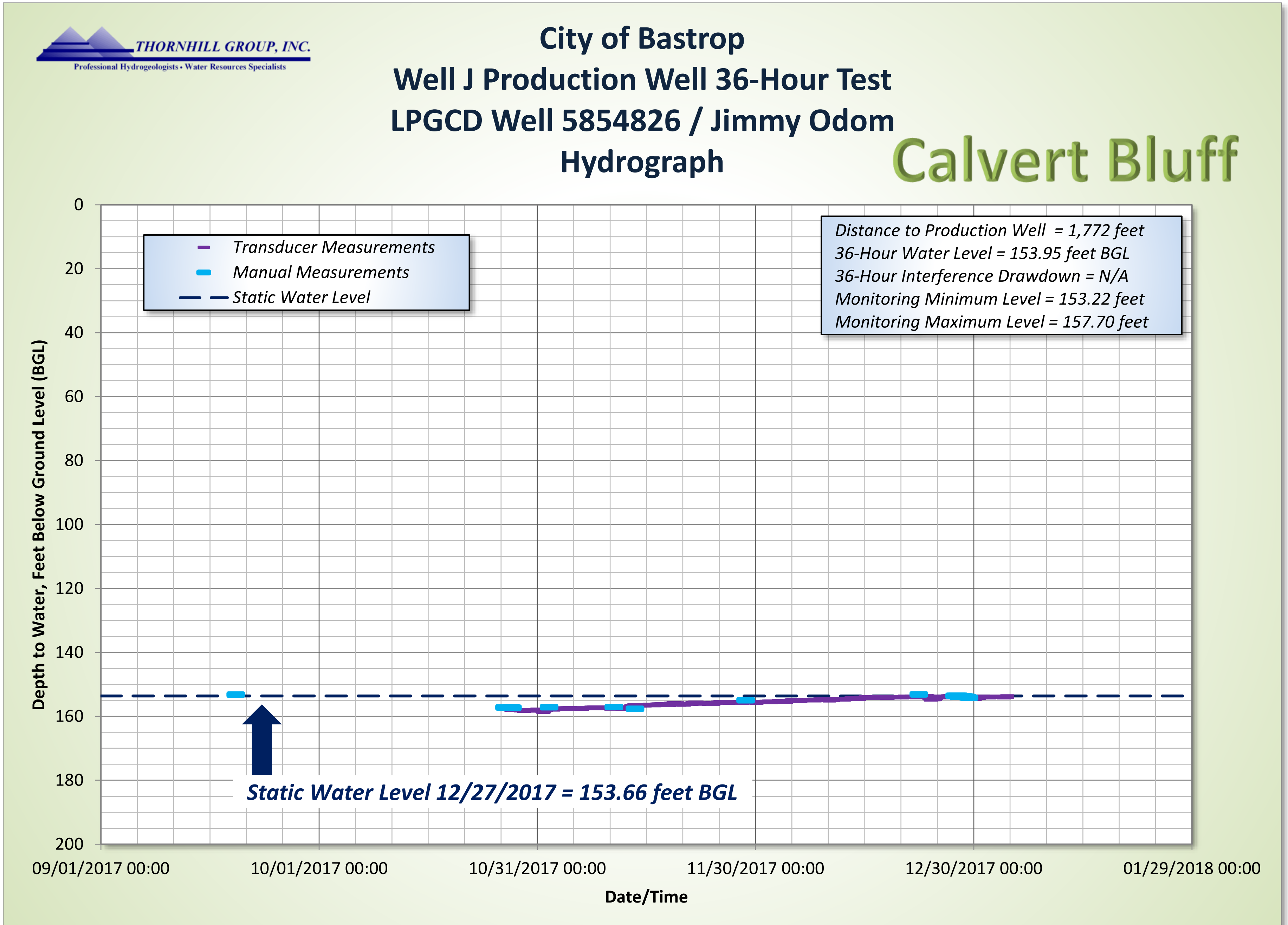
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists


Arrowhead Ct
Shoreside Dr
Well J
Phelan Rd
Name: Tommy Odom
Distance from Well J: 1,606.80 feet
Static Water Level 12/27/2017: 105.55 feet BGL
Sayers Rd
Old Perkins Rd
Smith Rd
Dorine
Explanation
City of Bastrop
Well J
0 325 650 1,300
Feet
N
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

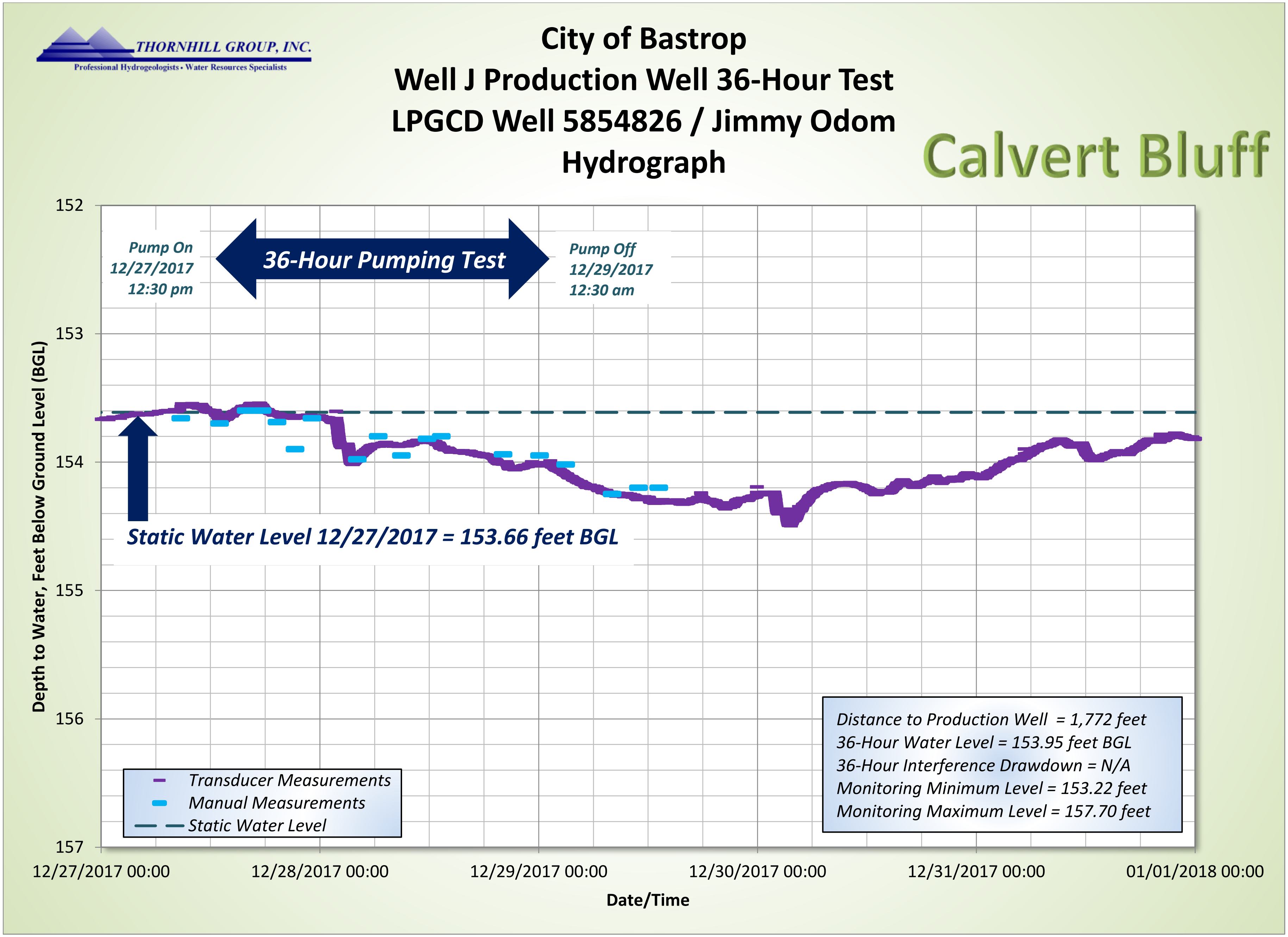
City of Bastrop
Jimmy Odom Well
36-Hour Drawdown and Recovery Results

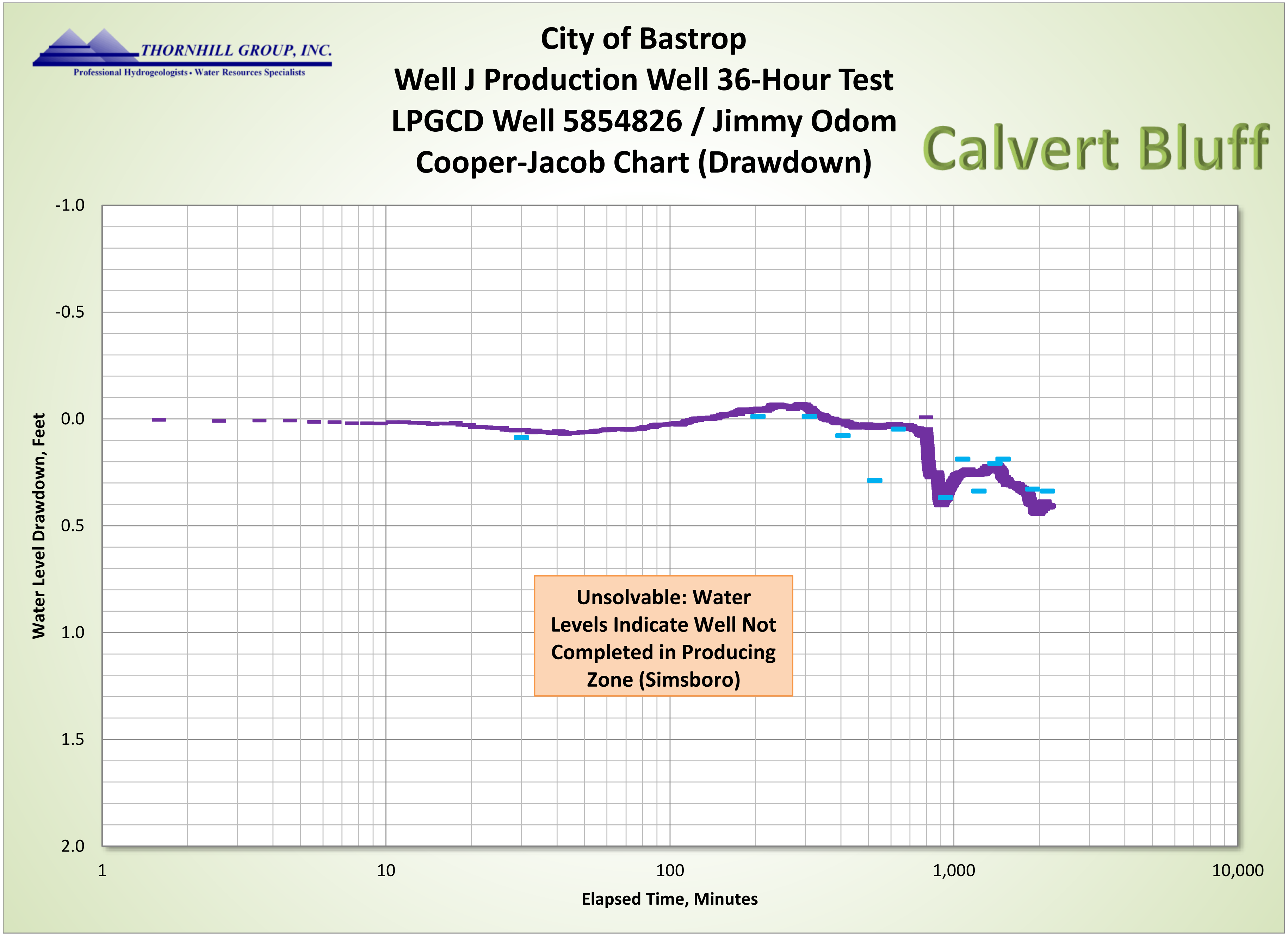
Project: 10210
County: Bastrop
Aquifer Tested: Simsboro
Distance from Production Well: 1,772 feet
Production Well: Well J
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

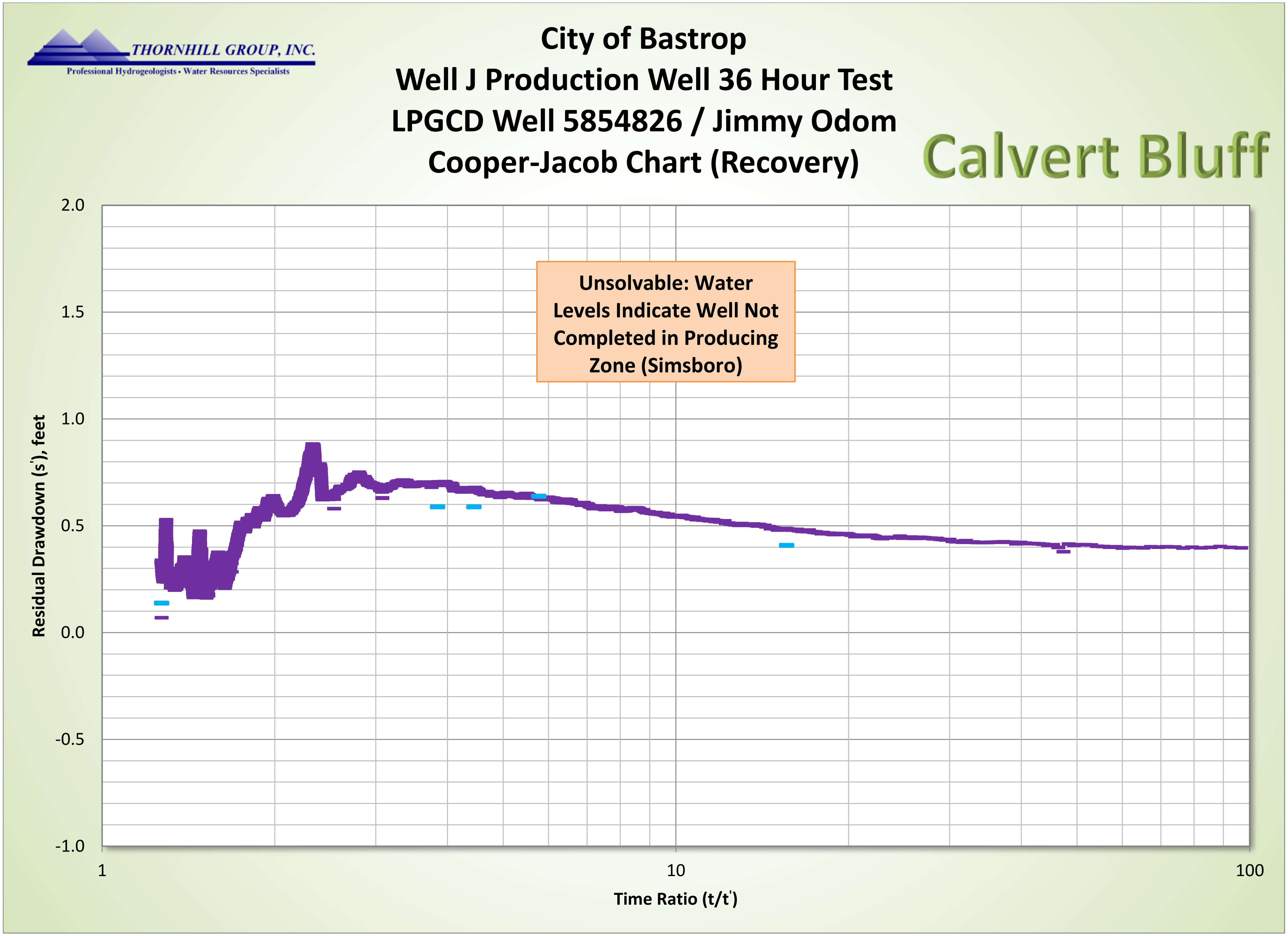
Date / Time	Depth to Water (Feet Below Land Surface)	Remarks
9/19/2017 12:48	153.31	Background
10/26/2017 11:56	157.30	Background
10/27/2017 13:55	157.35	Background
10/27/2017 9:25	157.25	Background
11/1/2017 14:30	157.24	Background
11/10/2017 12:35	157.15	Background
11/13/2017 10:00	157.70	Background
11/28/2017 15:43	155.05	Background
12/22/2017 10:52	153.22	Background
12/27/2017 8:44	153.66	Static Water Level
12/27/2017 13:00	153.70	Production Well on: 12/27/2017 12:30 pm
12/27/2017 15:54	153.60	
12/27/2017 17:40	153.60	
12/27/2017 19:17	153.69	
12/27/2017 21:16	153.90	
12/27/2017 23:08	154.66	
12/28/2017 4:05	153.98	
12/28/2017 6:24	153.80	
12/28/2017 8:56	153.95	
12/28/2017 11:45	153.82	
12/28/2017 13:19	153.80	
12/28/2017 20:05	153.94	
12/29/2017 0:06	153.95	
12/29/2017 2:58	154.02	Production Well off: 12/29/2017 12:30 am
12/29/2017 8:03	154.25	
12/29/2017 10:57	154.20	
12/29/2017 13:10	154.20	
1/3/2018 14:15	153.75	



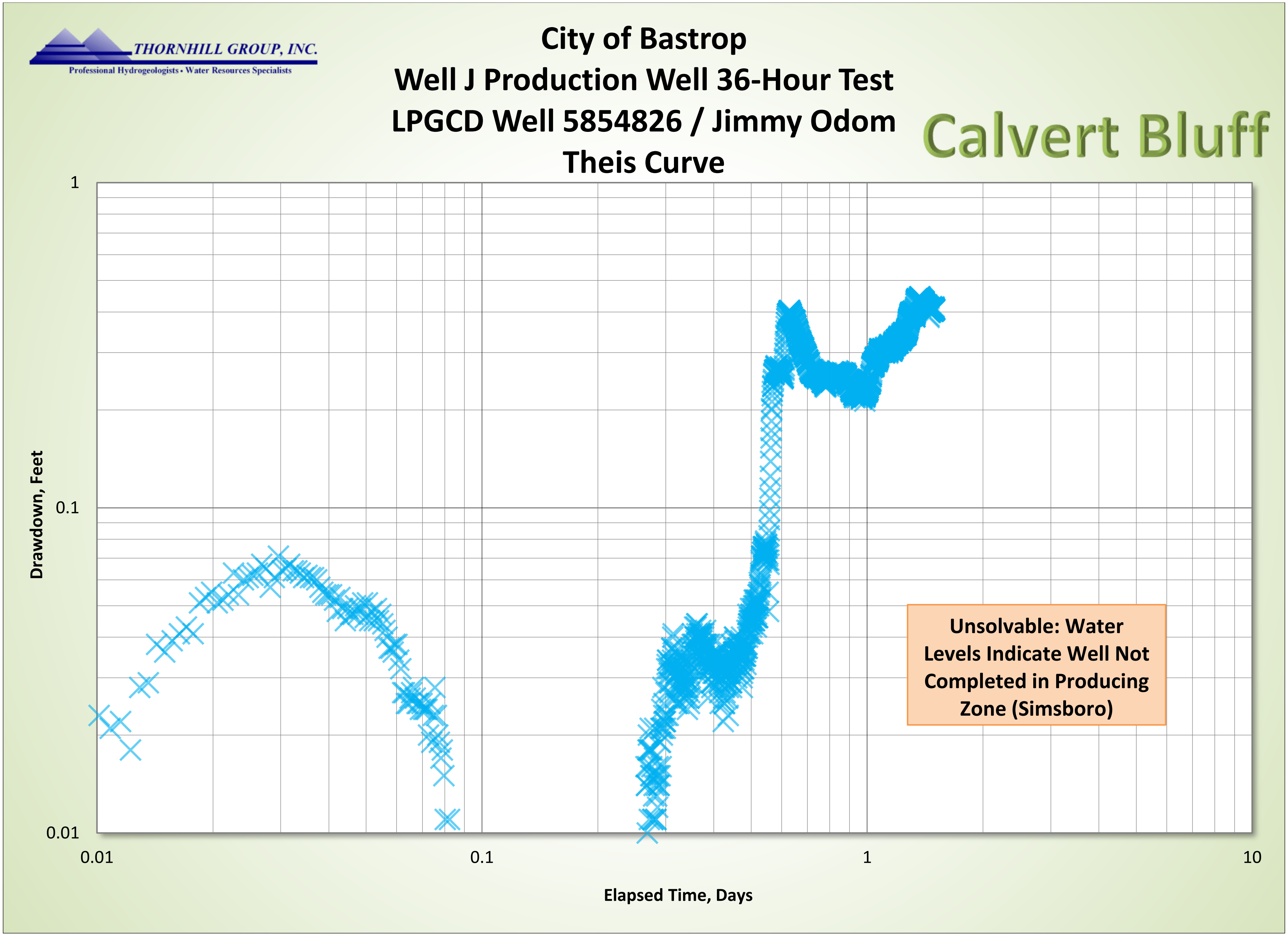
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854826 / Jimmy Odom
Hydrograph
Calvert Bluff
Transducer Measurements
Manual Measurements
Static Water Level
Distance to Production Well = 1,772 feet
36-Hour Water Level = 153.95 feet BGL
36-Hour Interference Drawdown = N/A
Monitoring Minimum Level = 153.22 feet
Monitoring Maximum Level = 157.70 feet
Depth to Water, Feet Below Ground Level (BGL)
0
20
40
60
80
100
120
140
160
180
200
Static Water Level 12/27/2017 = 153.66 feet BGL
09/01/2017 00:00
10/01/2017 00:00
10/31/2017 00:00
11/30/2017 00:00
12/30/2017 00:00
01/29/2018 00:00
Date/Time


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854826 / Jimmy Odom
Hydrograph
Calvert Bluff
Pump On
12/27/2017
12:30 pm
36-Hour Pumping Test
Pump Off
12/29/2017
12:30 am
Static Water Level 12/27/2017 = 153.66 feet BGL
Depth to Water, Feet Below Ground Level (BGL)
152
153
154
155
156
157
12/27/2017 00:00
12/28/2017 00:00
12/29/2017 00:00
12/30/2017 00:00
12/31/2017 00:00
01/01/2018 00:00
Date/Time
Transducer Measurements
Manual Measurements
Static Water Level
Distance to Production Well = 1,772 feet
36-Hour Water Level = 153.95 feet BGL
36-Hour Interference Drawdown = N/A
Monitoring Minimum Level = 153.22 feet
Monitoring Maximum Level = 157.70 feet

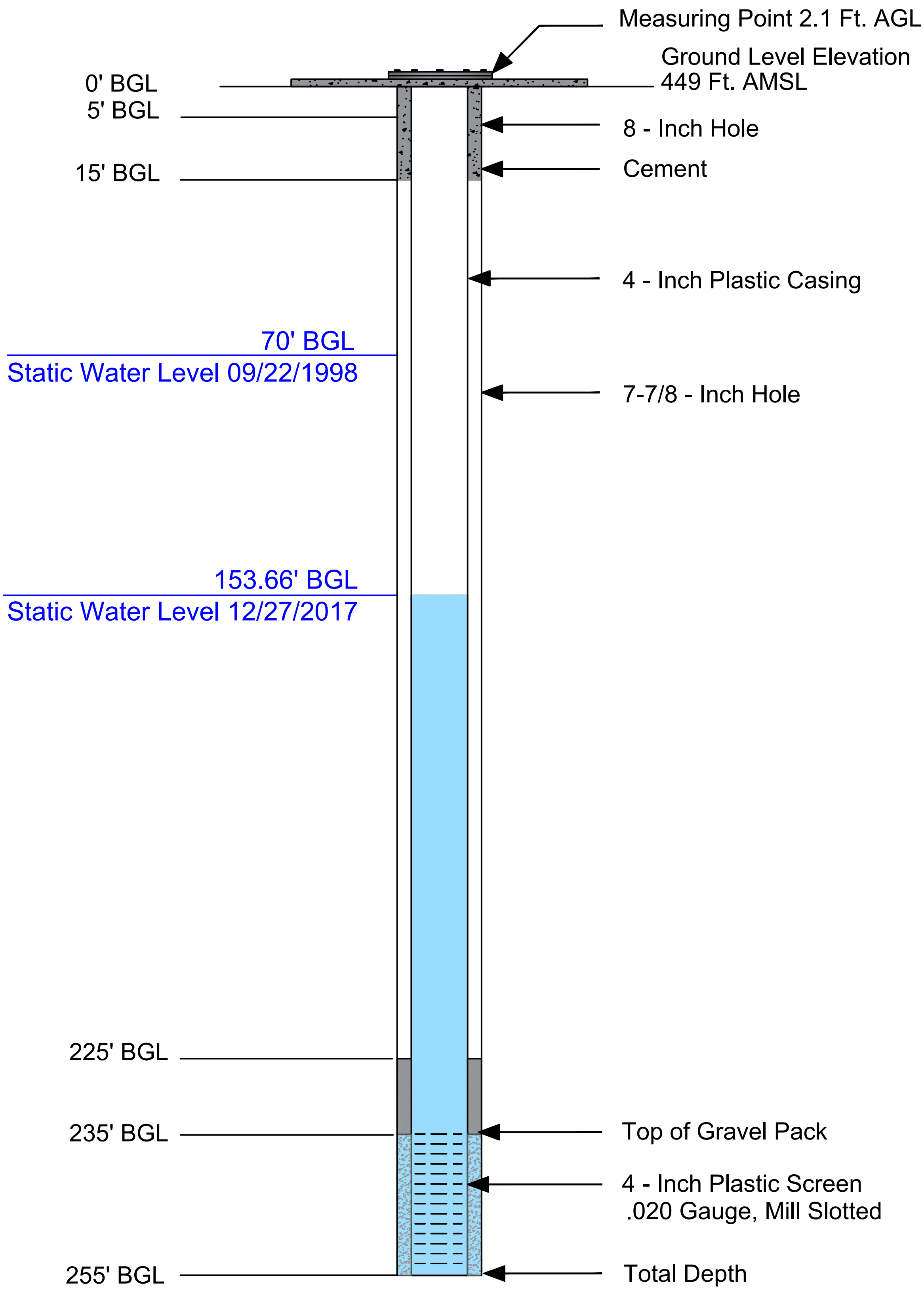

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854826 / Jimmy Odom
Cooper-Jacob Chart (Drawdown)
Calvert Bluff
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)
Water Level Drawdown, Feet
Elapsed Time, Minutes
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
1
10
100
1,000
10,000



THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36 Hour Test
LPGCD Well 5854826 / Jimmy Odom
Cooper-Jacob Chart (Recovery)
Calvert Bluff
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
Residual Drawdown (s'), feet
1
10
100
Time Ratio (t/t')


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854826 / Jimmy Odom
Theis Curve
Calvert Bluff
Drawdown, Feet
1
0.1
0.01
0.01
0.1
1
10
Elapsed Time, Days
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)

LPGCD Well 5854826 / Jimmy Odom



Well construction details compiled from State of Texas Well Report, LPGCD records, owner, and/or TGI field investigations.

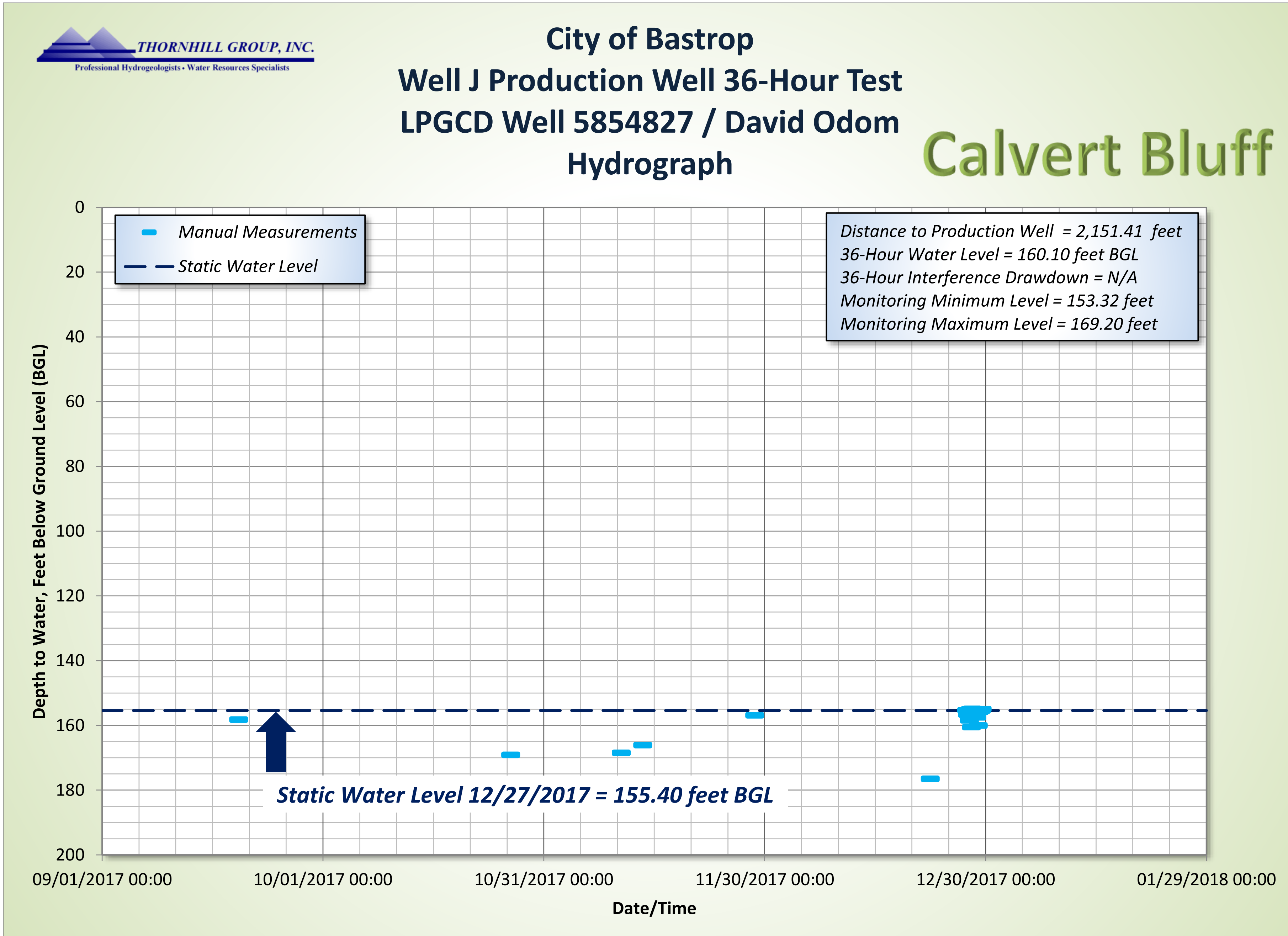
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists

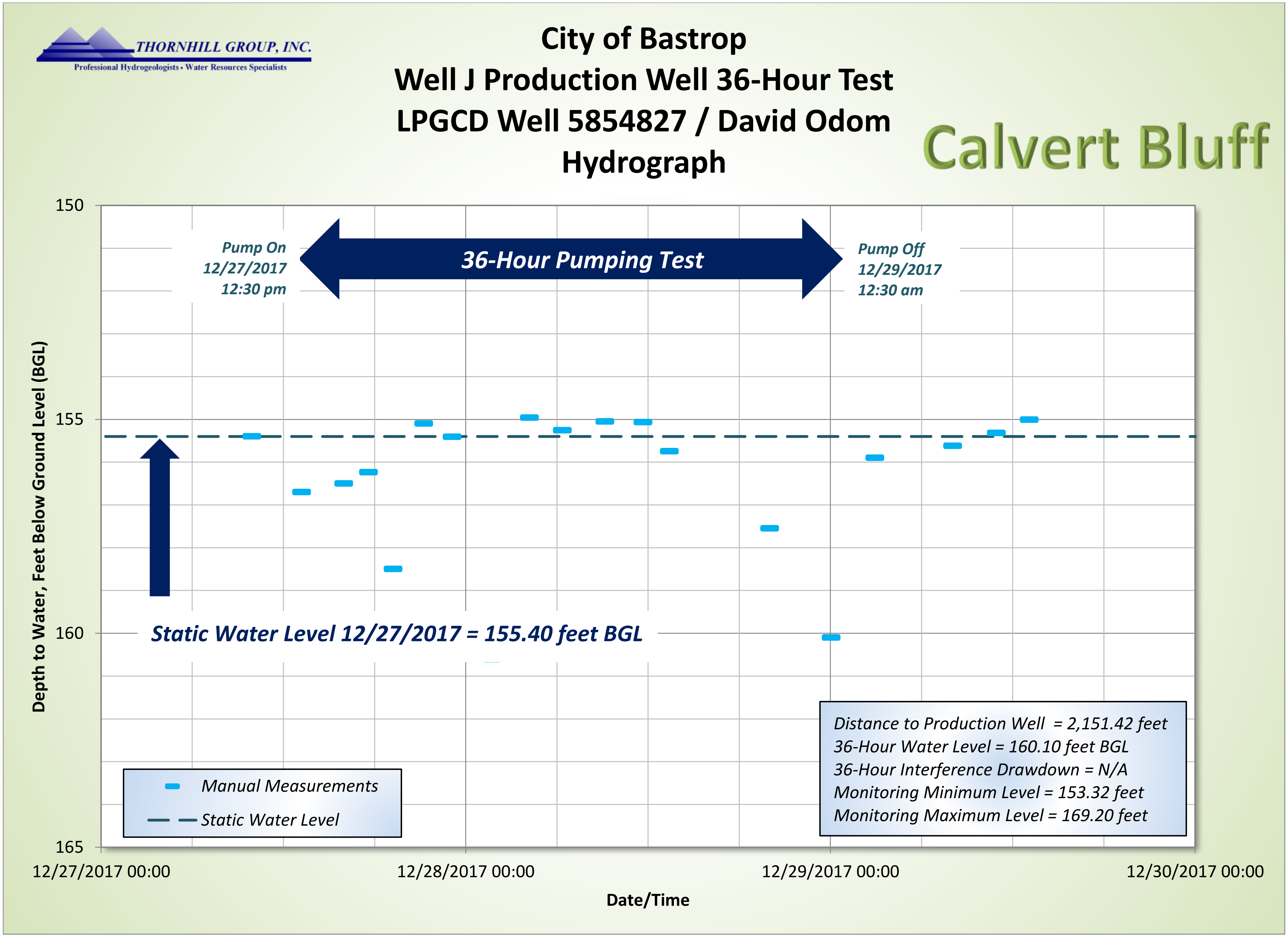

Arrowhead Ct
Shoreside Dr
Well J
Phelan Rd
Name: Jimmy Odom
Distance from Well J: 1,772.86 feet
Static Water Level 12/27/2017: 155.66 feet BGL
Sayers Rd
Old Perkins Rd
Smith Rd
Dorine Rd
Explanation
City of Bastrop
Well J
N
0 500 1,000 2,000
Feet
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

City of Bastrop
David Odom Well
36-Hour Drawdown and Recovery Results

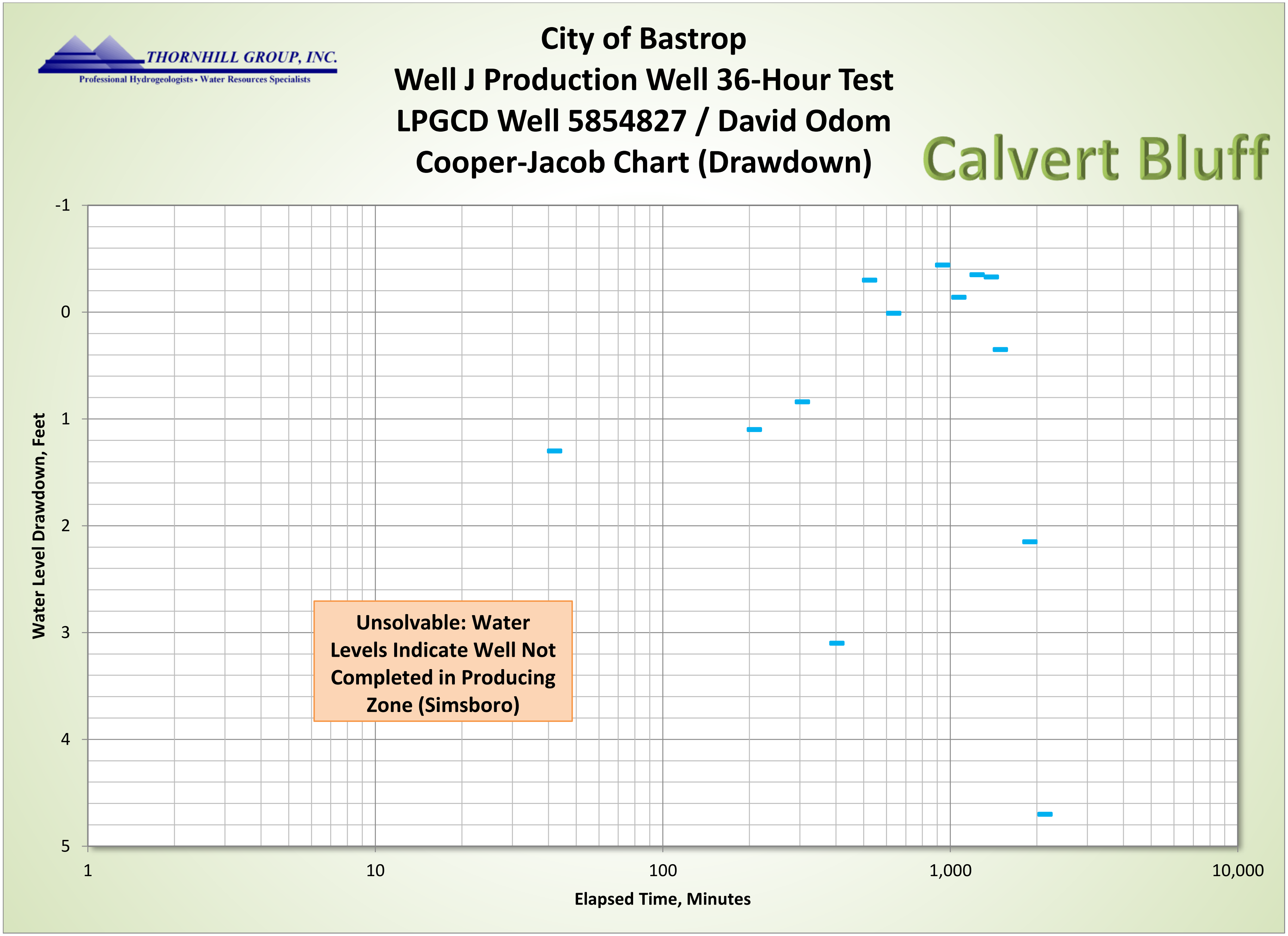
Project: 10210
County: Bastrop
Aquifer Tested: Simsboro
Distance from Production Well: 2,151.42 feet
Production Well: Well J
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

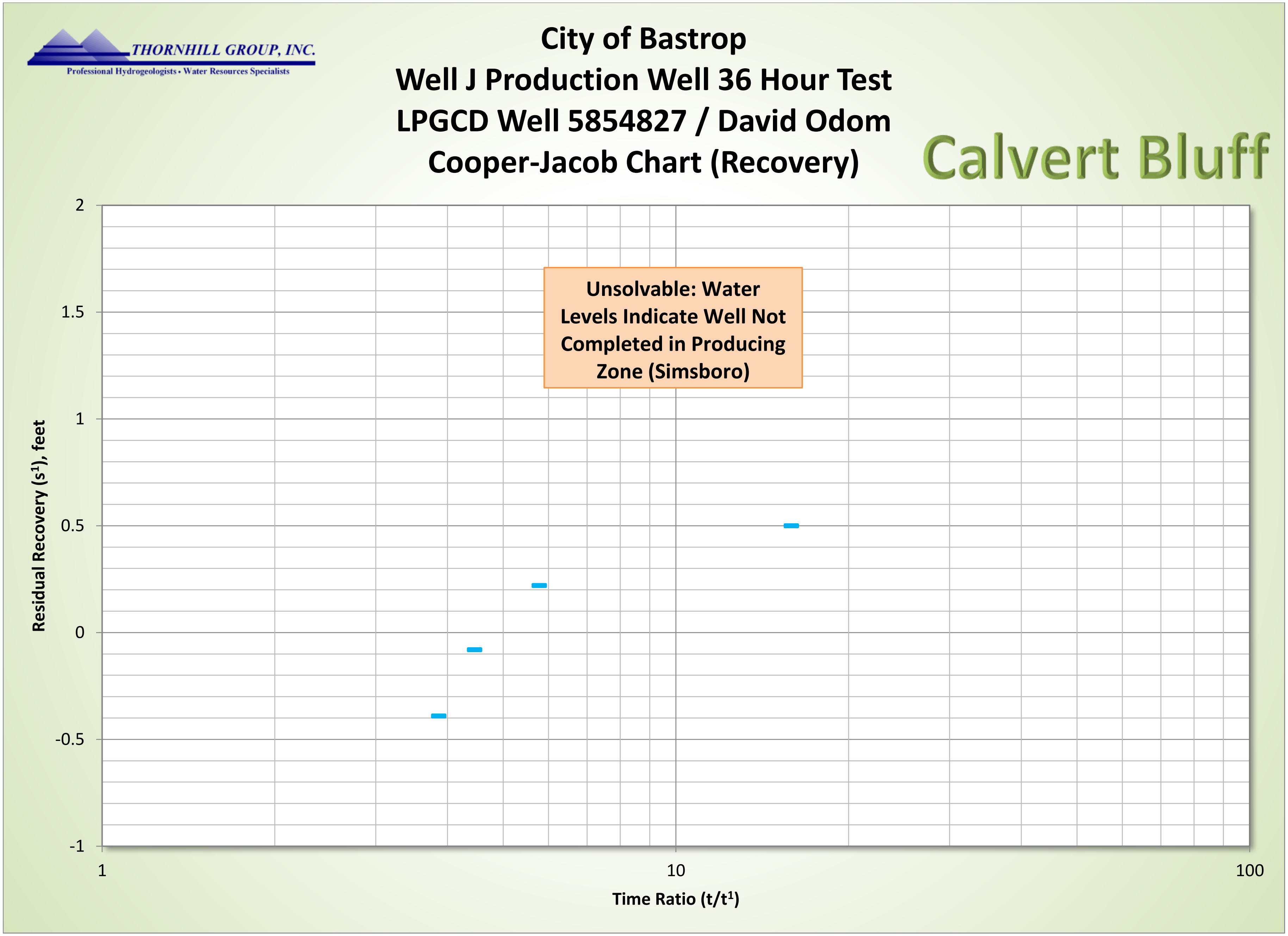
Date / Time	Depth to Water (Feet Below Land Surface)	Remarks
9/19/2017 12:45	158.30	Background
10/26/2017 11:49	169.20	Background
11/10/2017 12:43	168.55	Background
11/13/2017 9:54	166.13	Background
11/28/2017 15:37	156.91	Background
12/22/2017 11:11	176.53	Background
12/27/2017 9:55	155.40	Static Water Level
12/27/2017 13:12	156.70	Production Well on: 12/27/2017 12:30 pm
12/27/2017 15:58	156.50	
12/27/2017 17:36	156.24	
12/27/2017 19:13	158.50	
12/27/2017 21:14	155.10	
12/27/2017 23:06	155.41	
12/28/2017 1:42	160.61	
12/28/2017 4:11	154.96	
12/28/2017 6:21	155.26	
12/28/2017 9:09	155.05	
12/28/2017 11:40	155.07	
12/28/2017 13:24	155.75	
12/28/2017 20:00	157.55	
12/29/2017 0:03	160.10	
12/29/2017 2:55	155.90	Production Well off: 12/29/2017 12:30 am
12/29/2017 8:02	155.62	
12/29/2017 10:55	155.32	
12/29/2017 13:05	155.01	

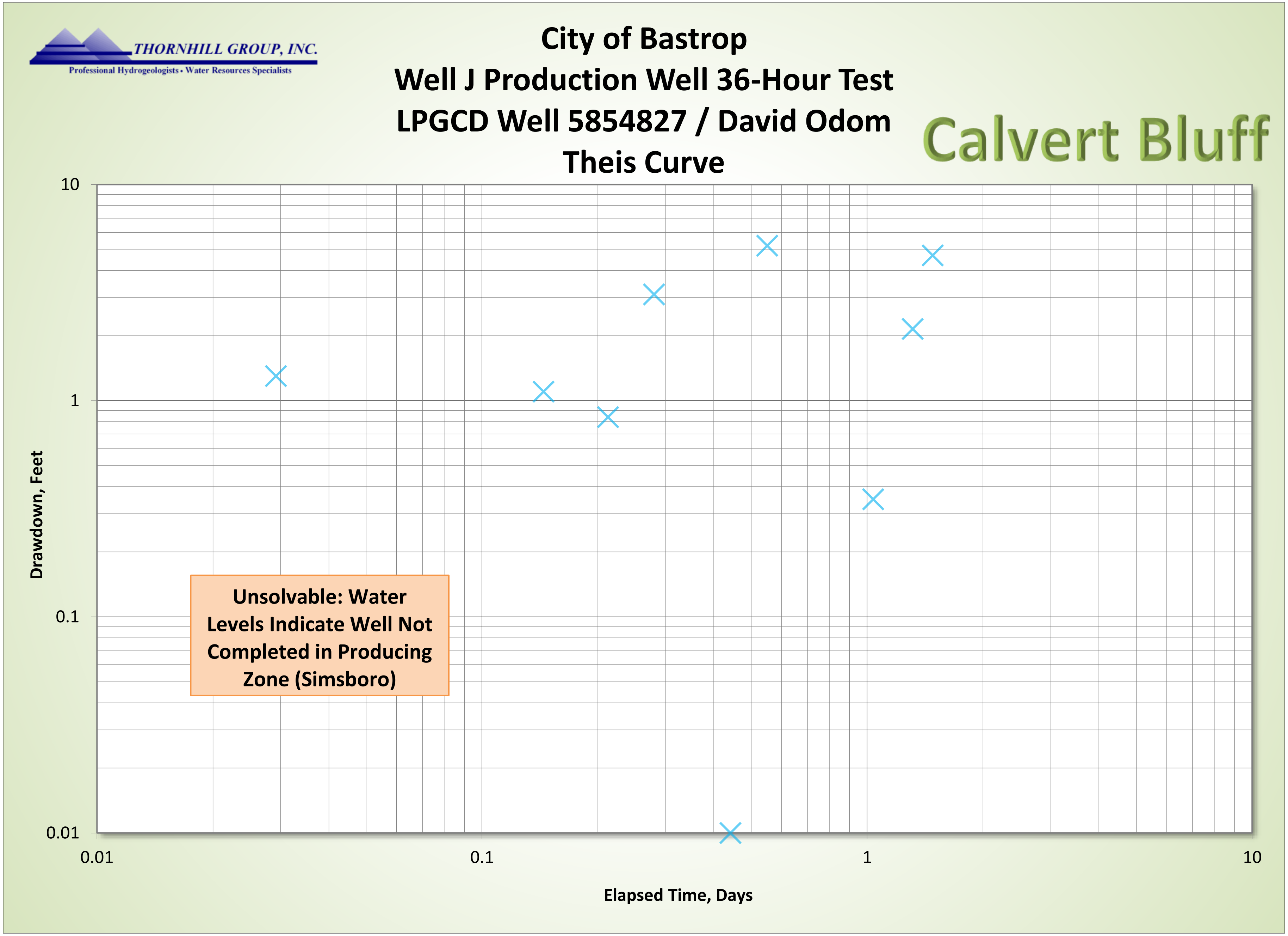

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854827 / David Odom
Hydrograph
Calvert Bluff
Manual Measurements
Static Water Level
Distance to Production Well = 2,151.41 feet
36-Hour Water Level = 160.10 feet BGL
36-Hour Interference Drawdown = N/A
Monitoring Minimum Level = 153.32 feet
Monitoring Maximum Level = 169.20 feet
Static Water Level 12/27/2017 = 155.40 feet BGL
Depth to Water, Feet Below Ground Level (BGL)
Date/Time
0
20
40
60
80
100
120
140
160
180
200
09/01/2017 00:00
10/01/2017 00:00
10/31/2017 00:00
11/30/2017 00:00
12/30/2017 00:00
01/29/2018 00:00



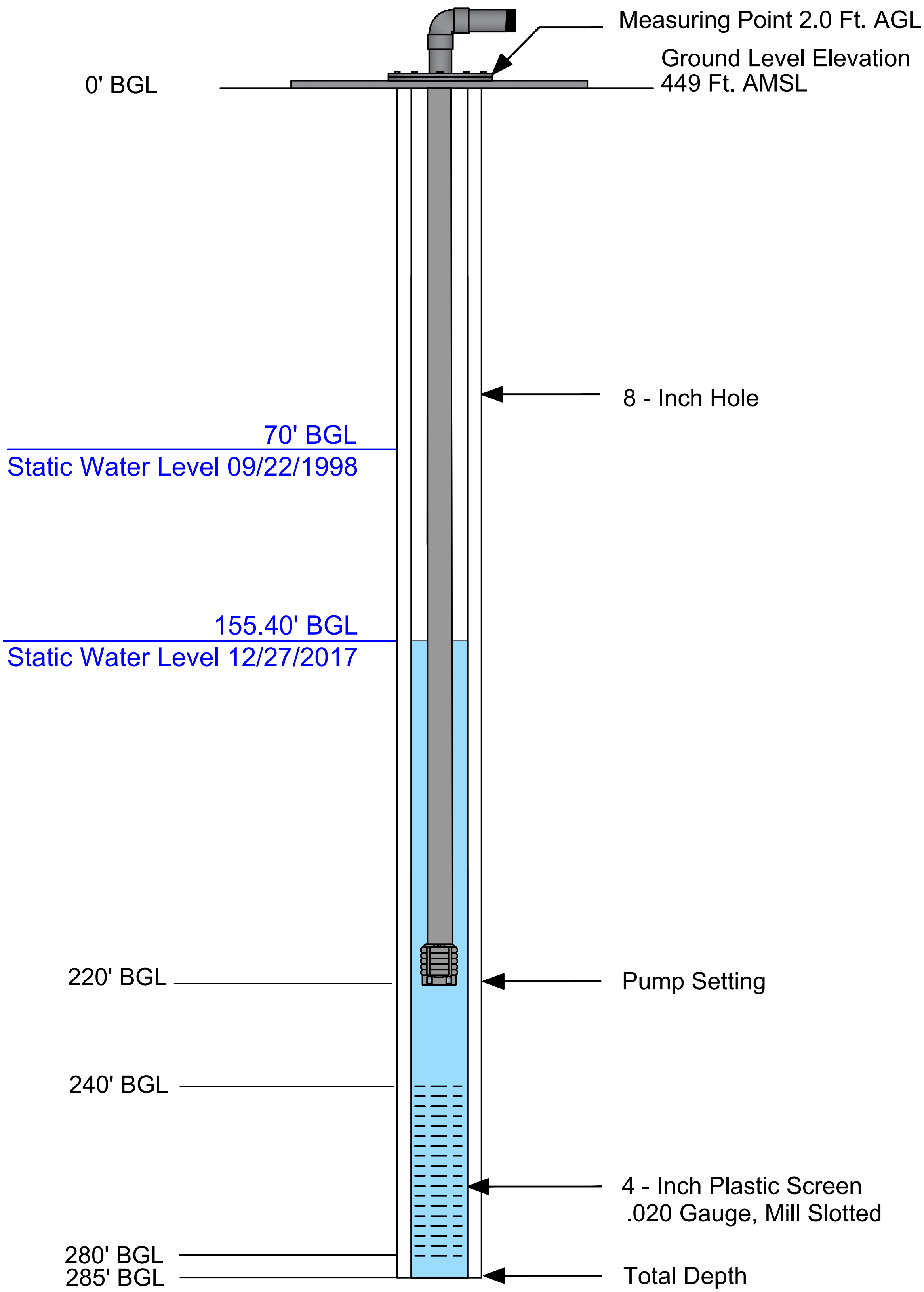
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854827 / David Odom
Hydrograph
Calvert Bluff
Pump On 12/27/2017 12:30 pm
36-Hour Pumping Test
Pump Off 12/29/2017 12:30 am
Static Water Level 12/27/2017 = 155.40 feet BGL
Distance to Production Well = 2,151.42 feet
36-Hour Water Level = 160.10 feet BGL
36-Hour Interference Drawdown = N/A
Monitoring Minimum Level = 153.32 feet
Monitoring Maximum Level = 169.20 feet
Manual Measurements
Static Water Level
Depth to Water, Feet Below Ground Level (BGL)
150
155
160
165
12/27/2017 00:00
12/28/2017 00:00
12/29/2017 00:00
12/30/2017 00:00
Date/Time


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854827 / David Odom
Cooper-Jacob Chart (Drawdown)
Calvert Bluff
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)
Water Level Drawdown, Feet
-1
0
1
2
3
4
5
1
10
100
1,000
10,000
Elapsed Time, Minutes


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36 Hour Test
LPGCD Well 5854827 / David Odom
Cooper-Jacob Chart (Recovery)
Calvert Bluff
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)
Residual Recovery (s1), feet
2
1.5
1
0.5
0
-0.5
-1
1
10
100
Time Ratio (t/t1)


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854827 / David Odom
Theis Curve
Calvert Bluff
10
1
0.1
0.01
Drawdown, Feet
0.01
0.1
1
10
Elapsed Time, Days
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)

LPGCD Well 5854827 / David Odom



Well construction details compiled from State of Texas Well Report, LPGCD records, owner, and/or TGI field investigations.

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists

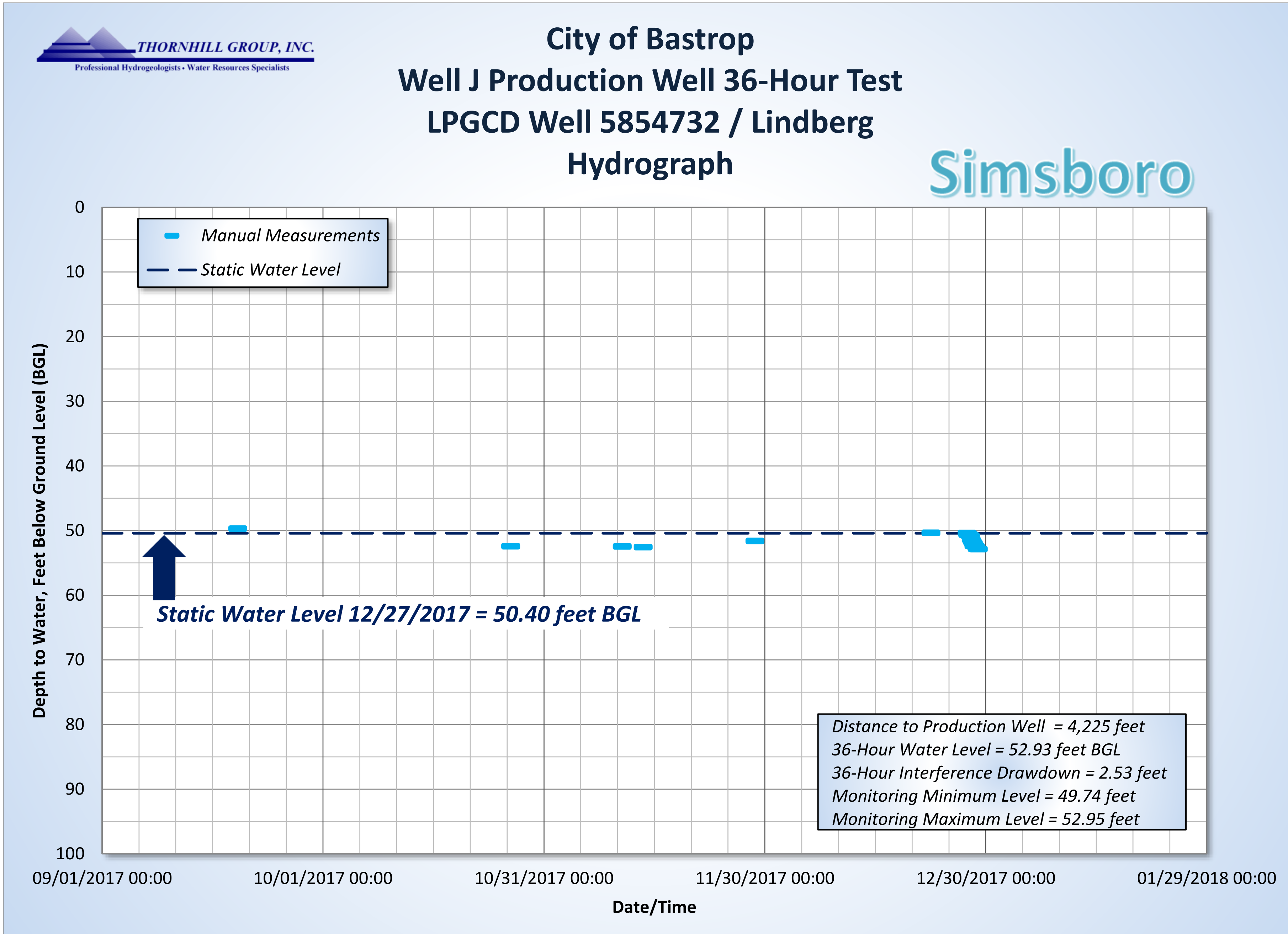
Rd
Arrowhead Ct
Shoreside Dr
Well J
Phelan Rd
Name: Odom, David
Distance from Well J: 2,151.42 feet
Static Water Level 12/27/2017: 155.40 feet BGL
Sayers Rd
Old Perkins Rd
Smith Rd
Explanation
City of Bastrop
Well J
0 325 650 1,300
Feet
N
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors

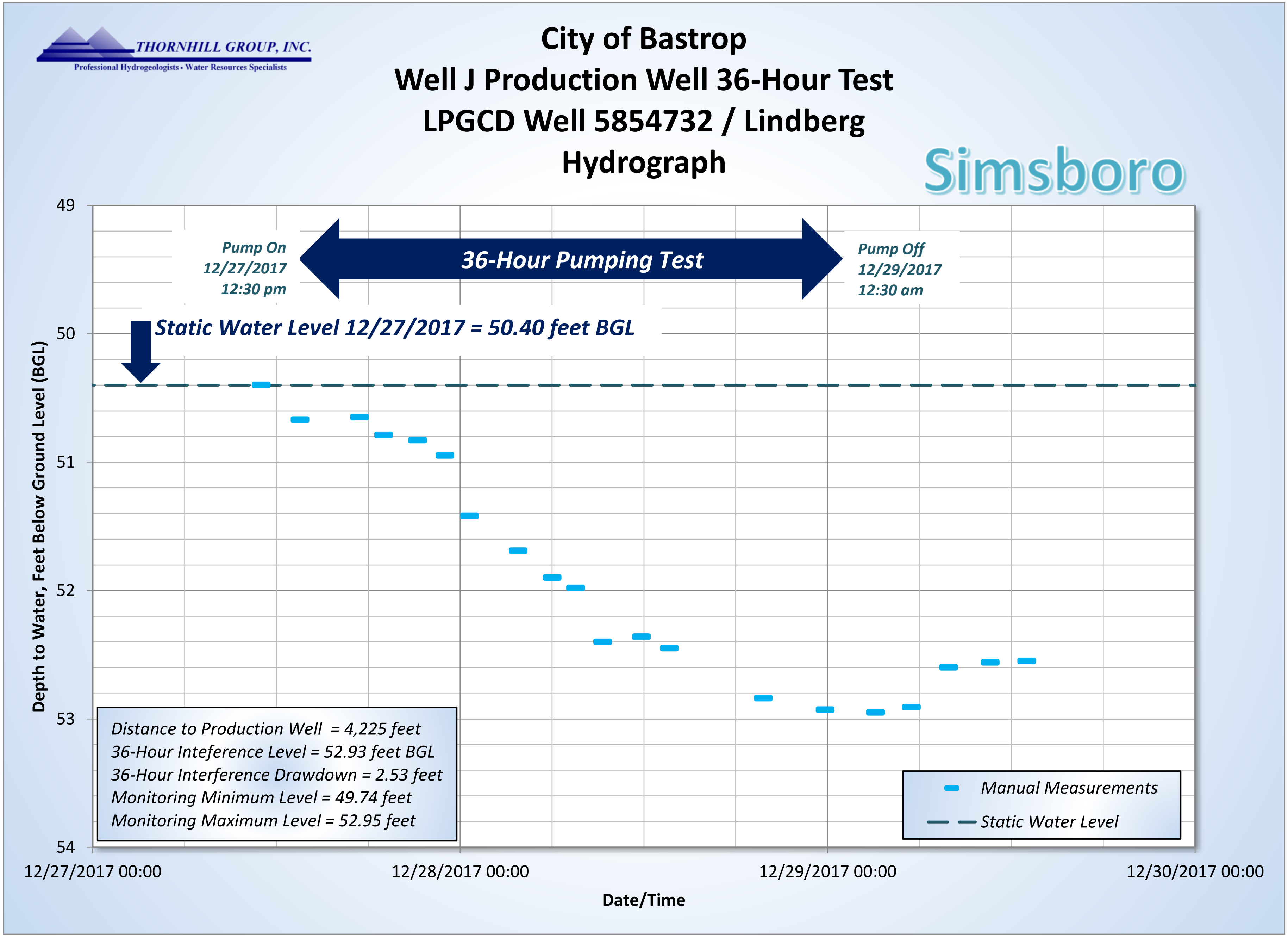
Area 2

City of Bastrop
Lindberg Well
36-Hour Drawdown and Recovery Results

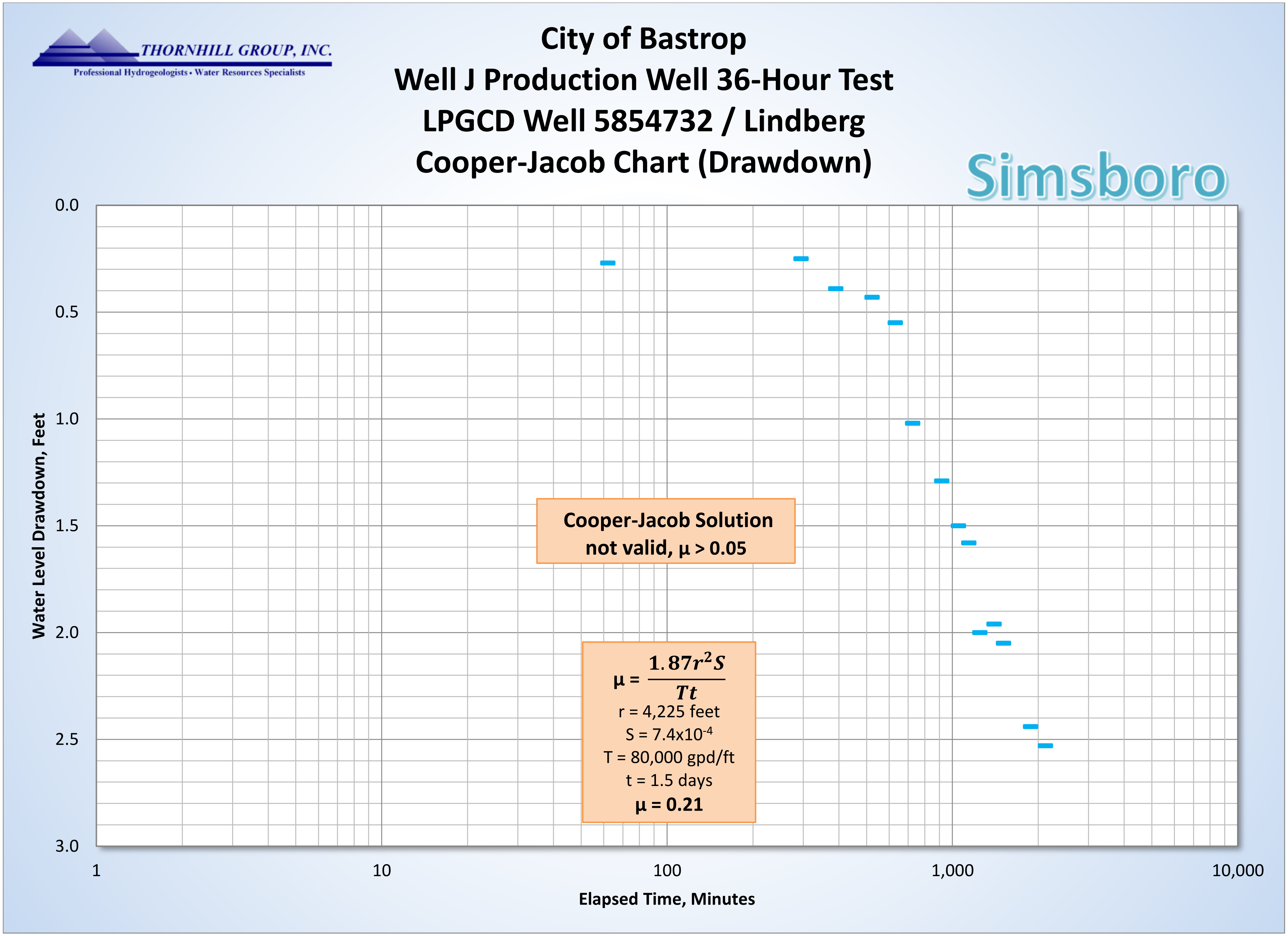
Project: 10210
County: Bastrop
Aquifer Tested: Simsboro
Distance from Production Well: 4,225 feet
Production Well: Well J
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

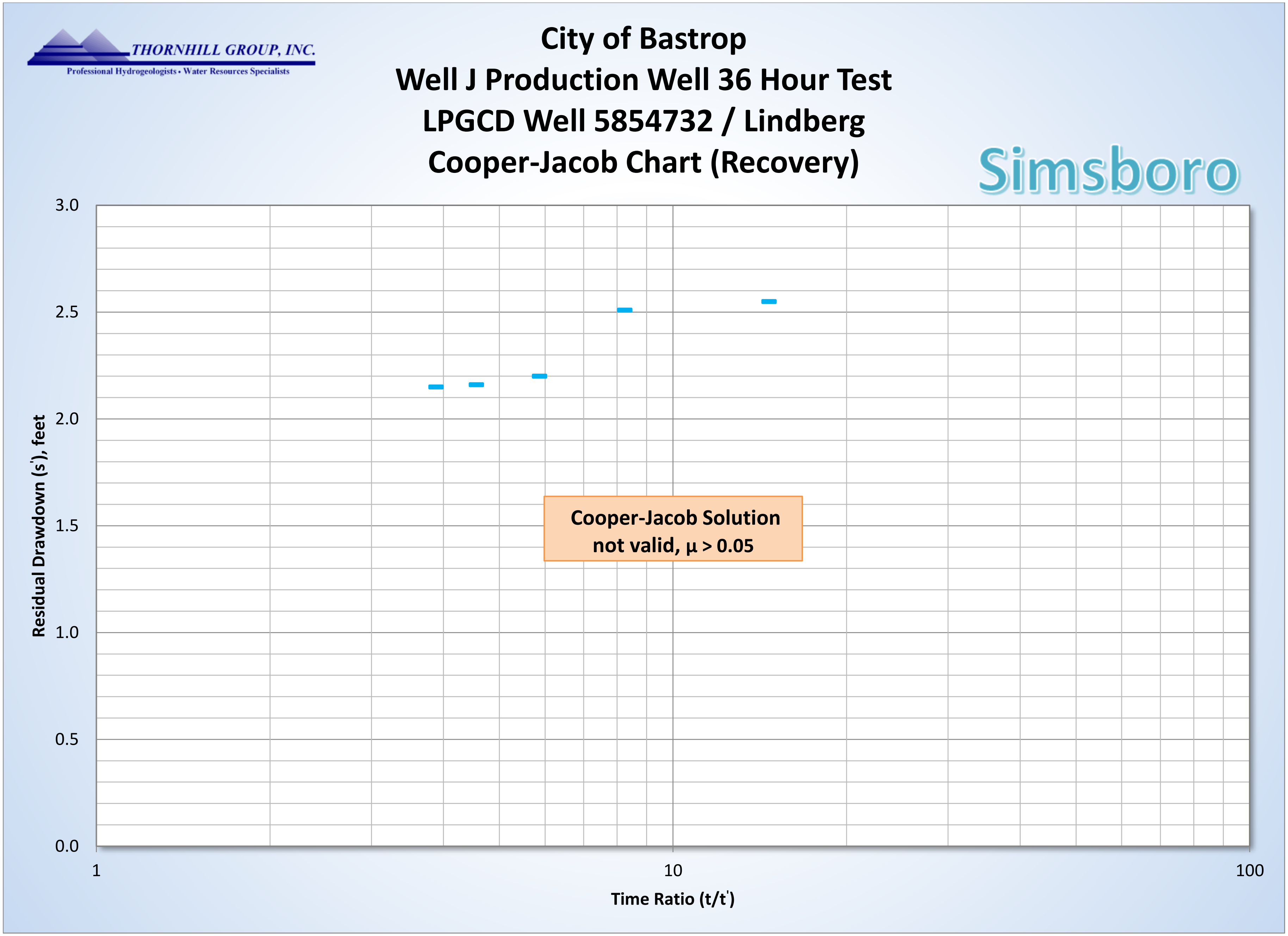
Date / Time	Depth to Water (Feet Below Land Surface)	Remarks
9/19/2017 10:10	49.74	Background
10/26/2017 11:26	52.45	Background
11/10/2017 15:05	52.50	Background
11/13/2017 11:05	52.58	Background
11/28/2017 16:00	51.63	Background
12/22/2017 12:55	50.39	Background
12/27/2017 11:00	50.40	Static Water Level
12/27/2017 13:32	50.67	Production Well on: 12/27/2017 12:30 pm
12/27/2017 17:25	50.65	
12/27/2017 19:00	50.79	
12/27/2017 21:13	50.83	
12/27/2017 23:00	50.95	
12/28/2017 0:36	51.42	
12/28/2017 3:47	51.69	
12/28/2017 6:00	51.90	
12/28/2017 7:32	51.98	
12/28/2017 9:18	52.40	
12/28/2017 11:50	52.36	
12/28/2017 13:40	52.45	
12/28/2017 19:48	52.84	
12/28/2017 23:50	52.93	
12/29/2017 3:08	52.95	Production Well off: 12/29/2017 12:30 am
12/29/2017 5:28	52.91	
12/29/2017 7:54	52.60	
12/29/2017 10:37	52.56	
12/29/2017 13:00	52.55	


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854732 / Lindberg
Hydrograph
Simsboro
Manual Measurements
Static Water Level
Static Water Level 12/27/2017 = 50.40 feet BGL
Distance to Production Well = 4,225 feet
36-Hour Water Level = 52.93 feet BGL
36-Hour Interference Drawdown = 2.53 feet
Monitoring Minimum Level = 49.74 feet
Monitoring Maximum Level = 52.95 feet
Depth to Water, Feet Below Ground Level (BGL)
0
10
20
30
40
50
60
70
80
90
100
09/01/2017 00:00
10/01/2017 00:00
10/31/2017 00:00
11/30/2017 00:00
12/30/2017 00:00
01/29/2018 00:00
Date/Time

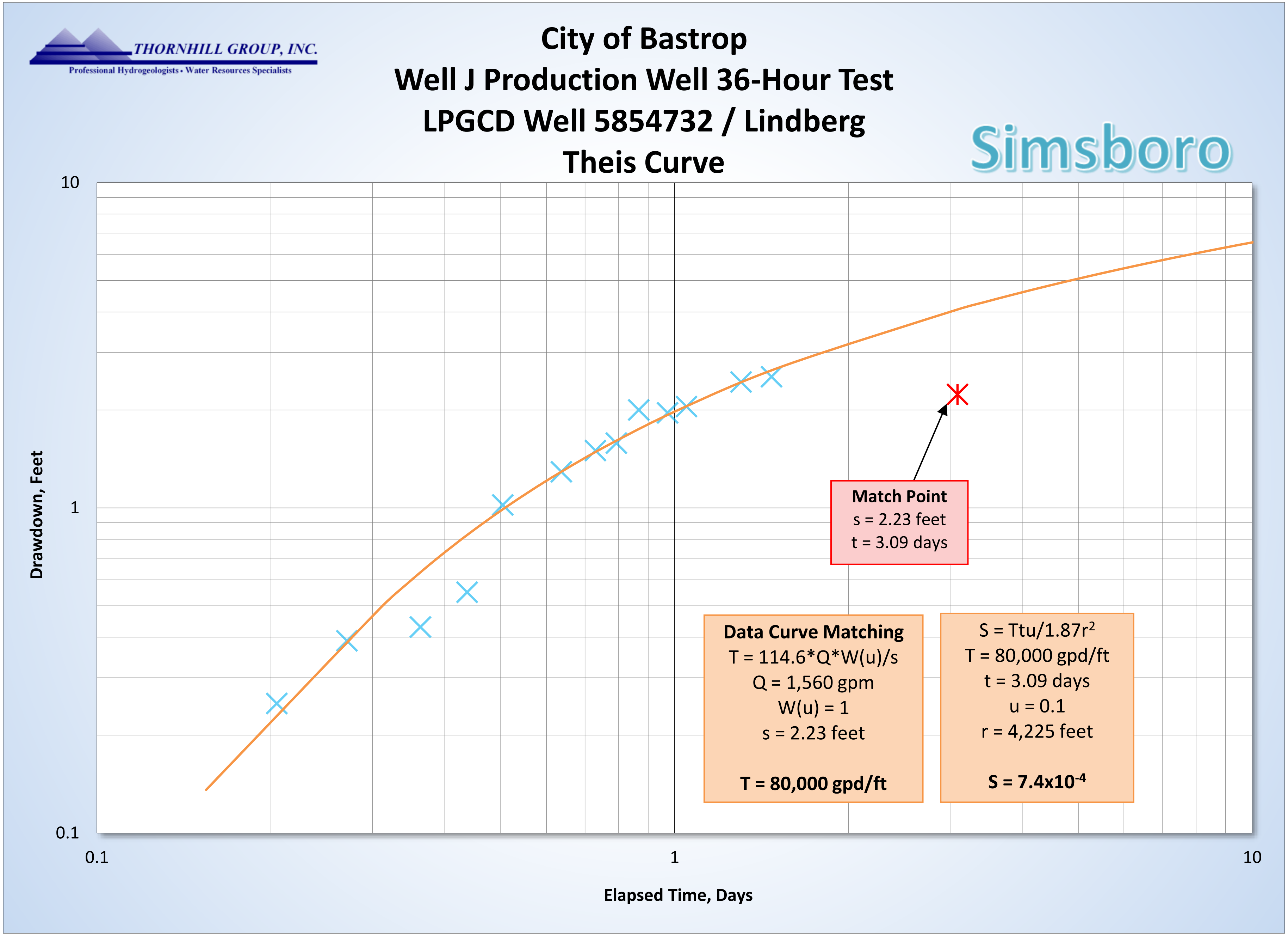


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854732 / Lindberg
Hydrograph
Simsboro
Pump On
12/27/2017
12:30 pm
36-Hour Pumping Test
Pump Off
12/29/2017
12:30 am
Static Water Level 12/27/2017 = 50.40 feet BGL
Depth to Water, Feet Below Ground Level (BGL)
49
50
51
52
53
54
Distance to Production Well = 4,225 feet
36-Hour Inteference Level = 52.93 feet BGL
36-Hour Interference Drawdown = 2.53 feet
Monitoring Minimum Level = 49.74 feet
Monitoring Maximum Level = 52.95 feet
Manual Measurements
Static Water Level
12/27/2017 00:00
12/28/2017 00:00
12/29/2017 00:00
12/30/2017 00:00
Date/Time

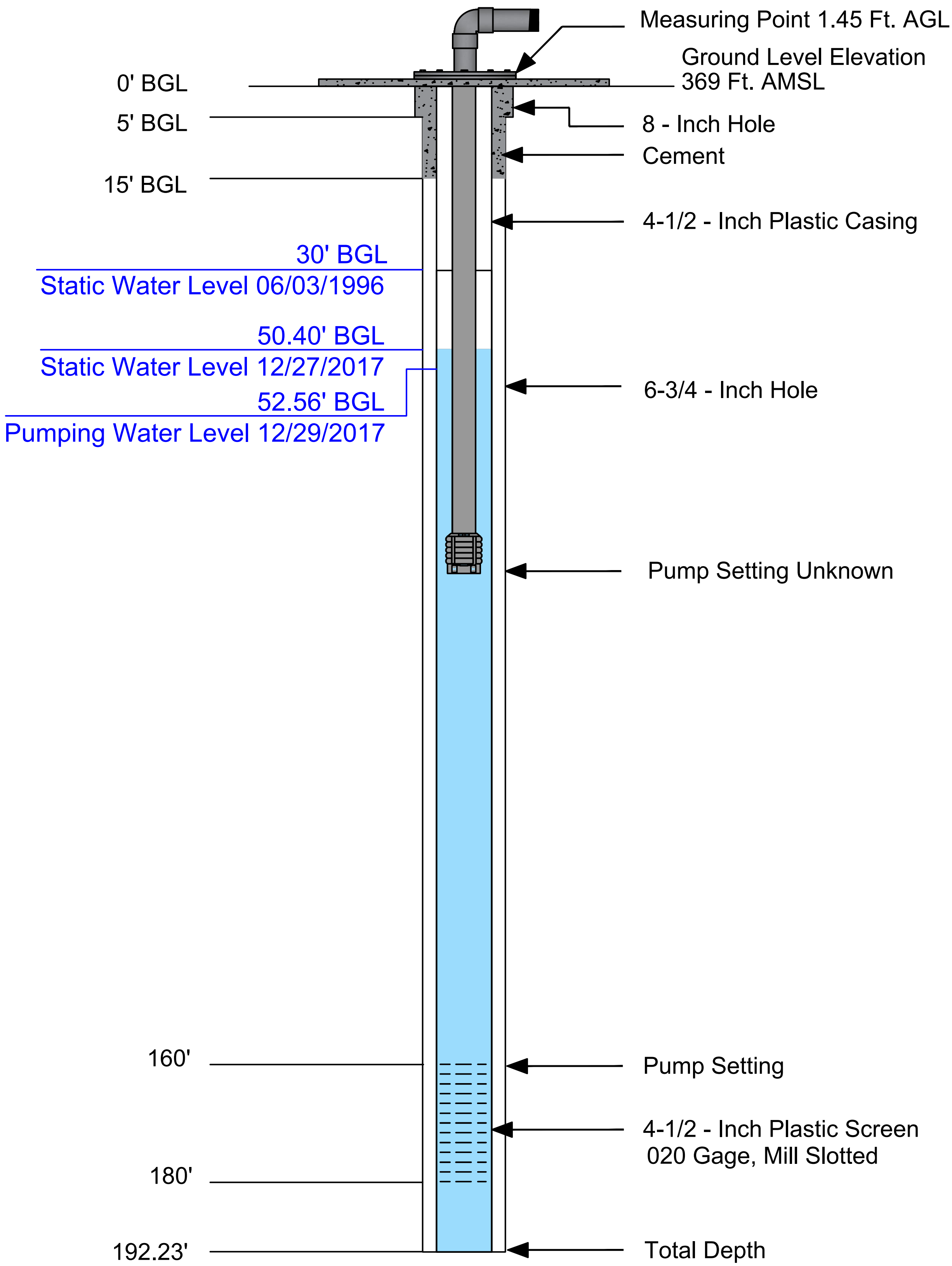

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854732 / Lindberg
Cooper-Jacob Chart (Drawdown)
Simsboro
Water Level Drawdown, Feet
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1
10
100
1,000
10,000
Elapsed Time, Minutes
Cooper-Jacob Solution not valid, μ > 0.05
$\mu = \frac{1.87r^2S}{Tt}$
r = 4,225 feet
S = 7.4×10^{-4}
T = 80,000 gpd/ft
t = 1.5 days
μ = 0.21



THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36 Hour Test
LPGCD Well 5854732 / Lindberg
Cooper-Jacob Chart (Recovery)
Simsboro
Residual Drawdown (s'), feet
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
10
100
Time Ratio (t/t')
Cooper-Jacob Solution
not valid, μ > 0.05


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854732 / Lindberg
Theis Curve
Simsboro
10
1
0.1
0.1
1
10
Drawdown, Feet
Elapsed Time, Days
Match Point
s = 2.23 feet
t = 3.09 days
Data Curve Matching
T = 114.6*Q*W(u)/s
Q = 1,560 gpm
W(u) = 1
s = 2.23 feet
T = 80,000 gpd/ft
S = Ttu/1.87r2
T = 80,000 gpd/ft
t = 3.09 days
u = 0.1
r = 4,225 feet
S = 7.4x10-4

LPGCD Well 5854732 / Lindberg



Well construction details compiled from State of Texas Well Report, LPGCD records, and/or TGI field investigations.

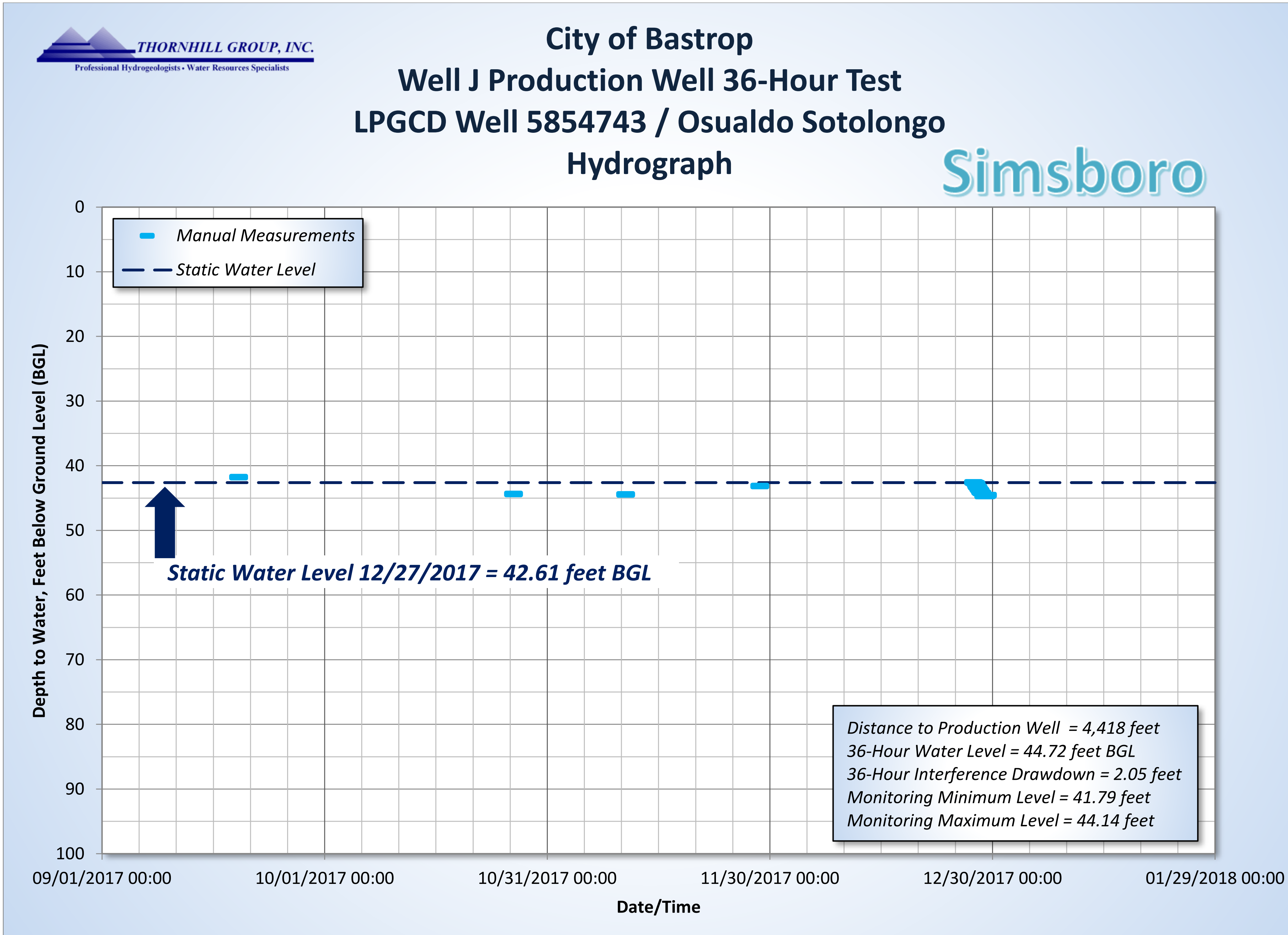
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists

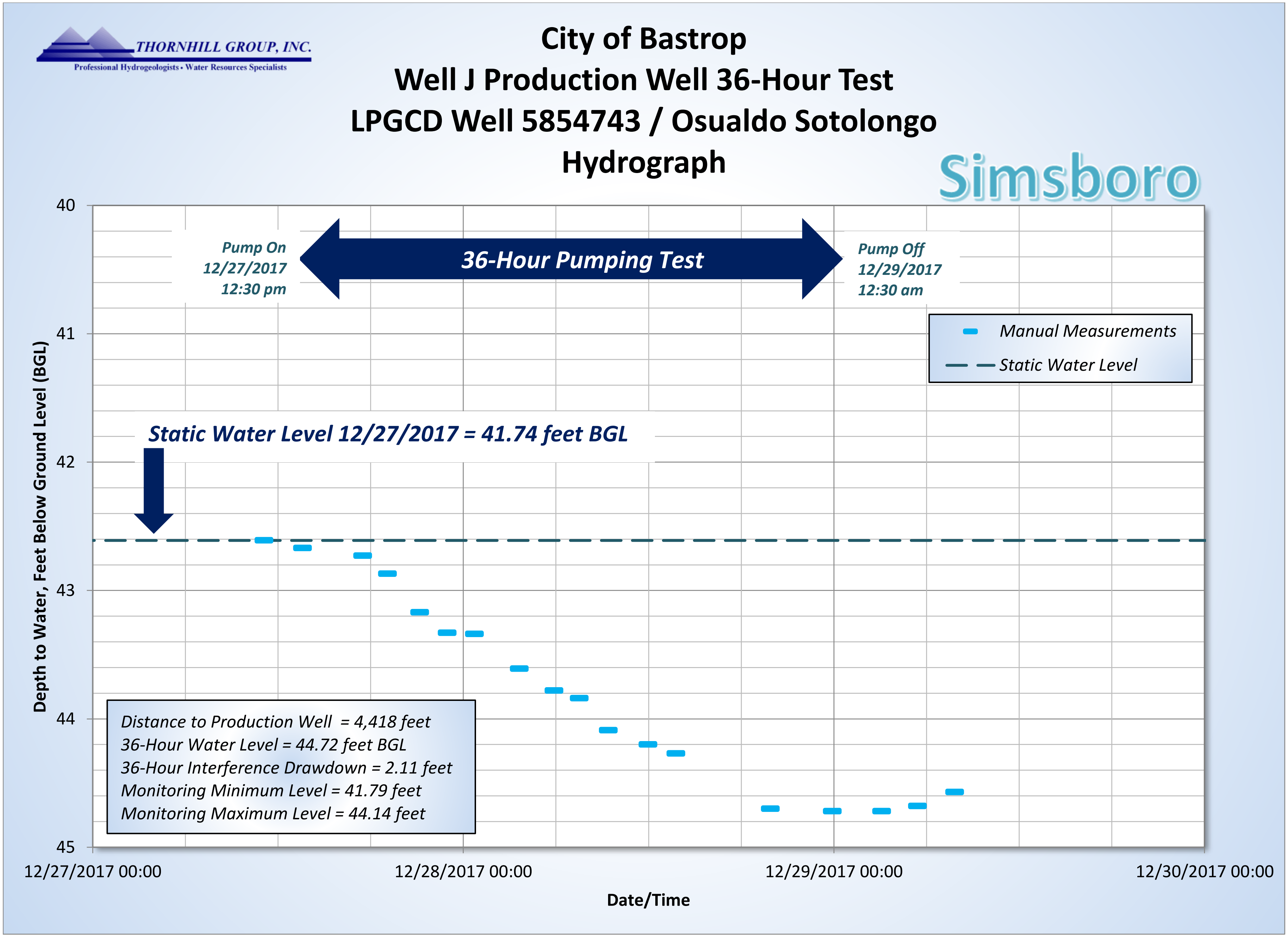

Name: Kevin Lindberg
Distance from Well J: 4,225.45 feet
Static Water Level 12/27/2017: 50.40 feet BGL
Arrowhead Ct
Shoreside Dr
Well J
Phelan Rd
Sayers Rd
Old Perkins Rd
Smith Rd
Dorine Rd
Explanation
City of Bastrop
Well J
0 325 650 1,300
Feet
N
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors,
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

City of Bastrop
Sotolongo Well
36-Hour Drawdown and Recovery Results

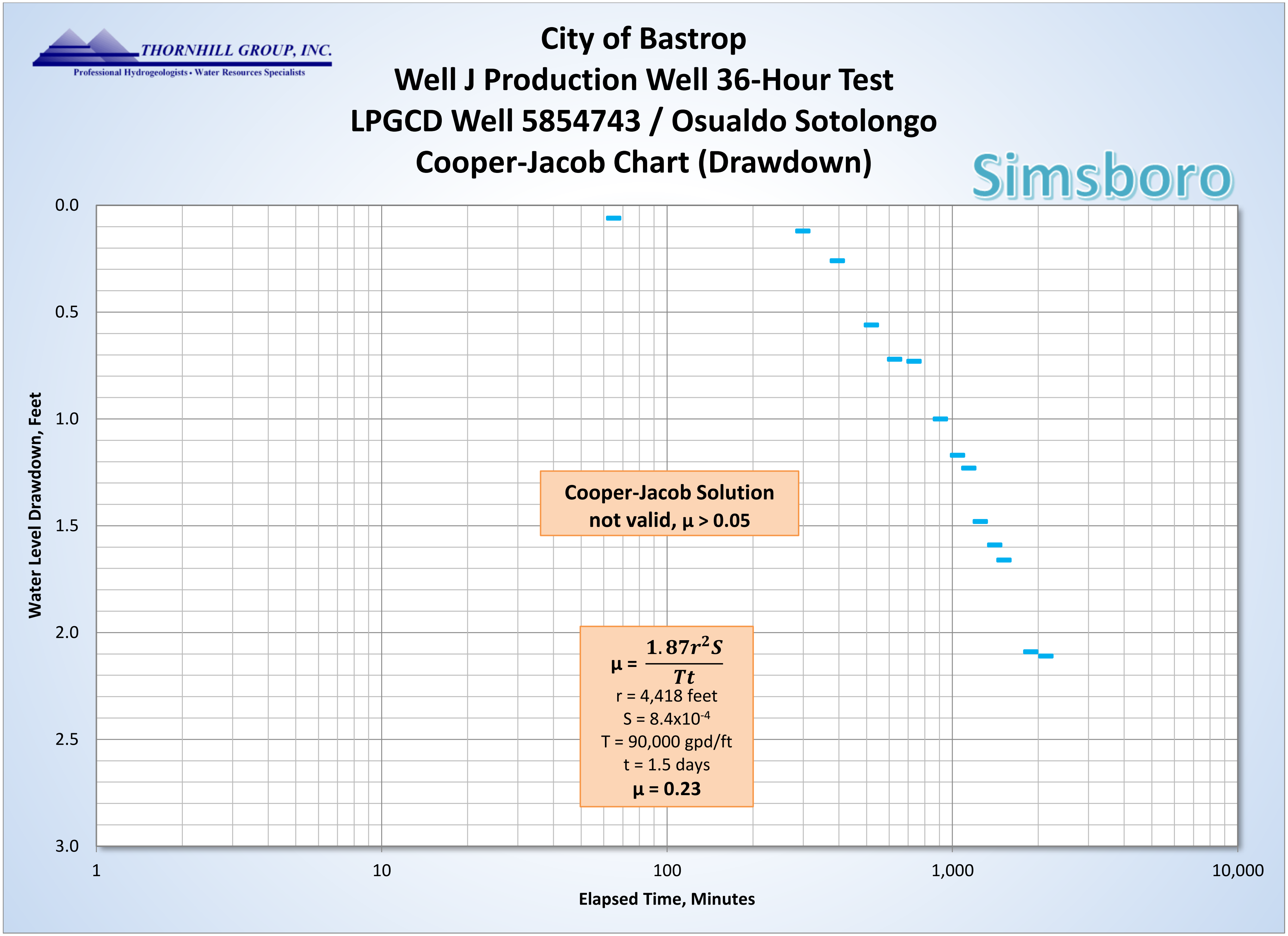
Project: 10210
County: Bastrop
Aquifer Tested: Simsboro
Distance from Production Well: 4,418 feet
Production Well: Well J
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

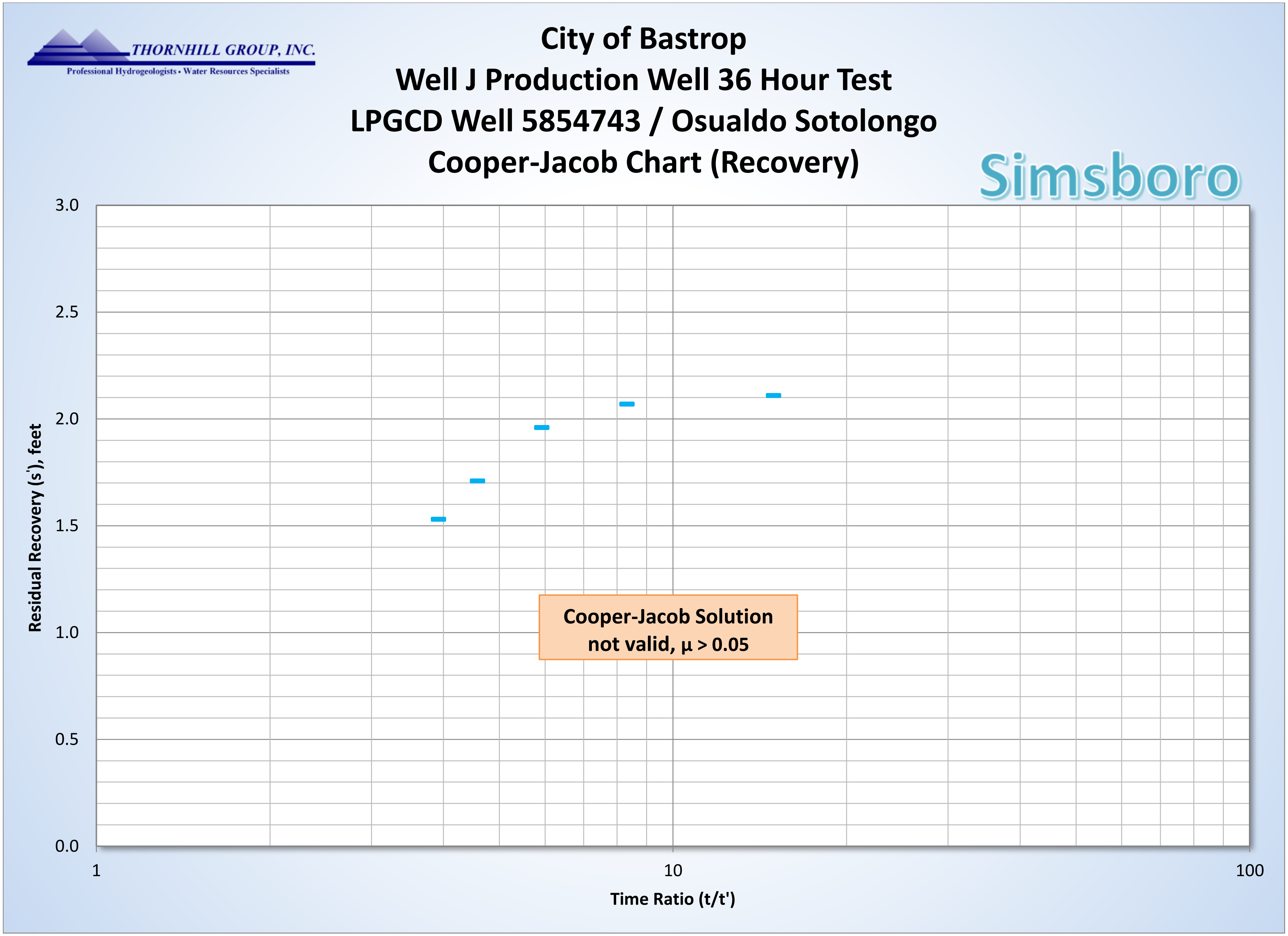
Date / Time	Depth to Water (Feet Below Land Surface)	Remarks
9/19/2017 9:25	41.79	Background
10/26/2017 10:35	44.39	Background
11/10/2017 13:15	44.47	Background
11/28/2017 15:25	43.18	Background
12/27/2017 11:05	42.61	Static Water Level
12/27/2017 13:35	42.67	Production Well on: 12/27/2017 12:30 pm
12/27/2017 17:29	42.73	
12/27/2017 19:05	42.87	
12/27/2017 21:10	43.17	
12/27/2017 22:57	43.33	
12/28/2017 0:43	43.34	
12/28/2017 3:37	43.61	
12/28/2017 5:52	43.78	
12/28/2017 7:30	43.84	
12/28/2017 9:23	44.09	
12/28/2017 11:57	44.20	
12/28/2017 13:46	44.27	
12/28/2017 19:53	44.70	
12/28/2017 23:54	44.72	
12/29/2017 3:05	44.72	Production Well off: 12/29/2017 12:30 am
12/29/2017 5:25	44.68	
12/29/2017 7:49	44.57	
12/29/2017 10:33	44.32	
12/29/2017 12:50	44.14	

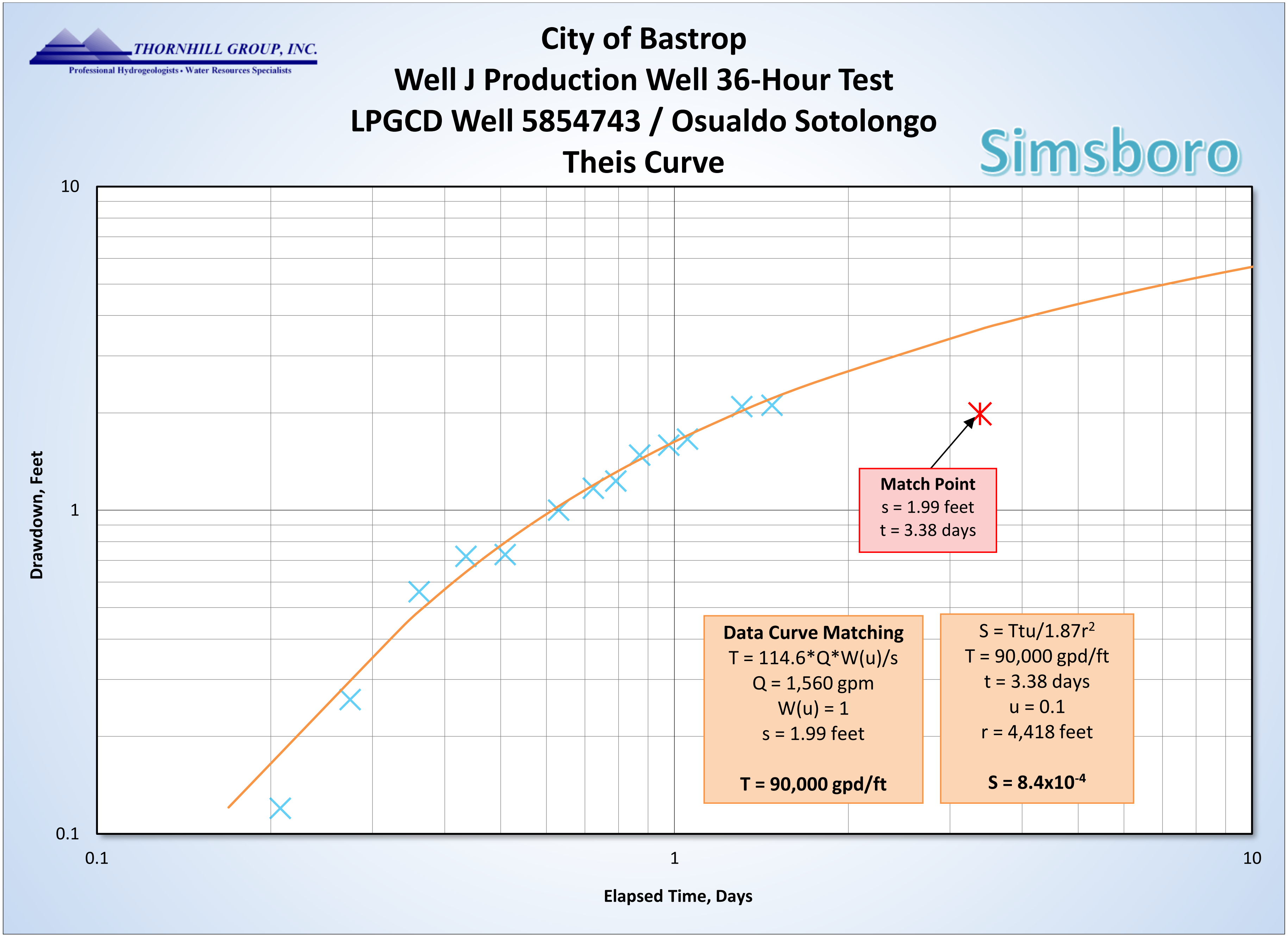

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854743 / Osualdo Sotolongo
Hydrograph
Simsboro
Manual Measurements
Static Water Level
Static Water Level 12/27/2017 = 42.61 feet BGL
Distance to Production Well = 4,418 feet
36-Hour Water Level = 44.72 feet BGL
36-Hour Interference Drawdown = 2.05 feet
Monitoring Minimum Level = 41.79 feet
Monitoring Maximum Level = 44.14 feet
Depth to Water, Feet Below Ground Level (BGL)
0
10
20
30
40
50
60
70
80
90
100
09/01/2017 00:00
10/01/2017 00:00
10/31/2017 00:00
11/30/2017 00:00
12/30/2017 00:00
01/29/2018 00:00
Date/Time



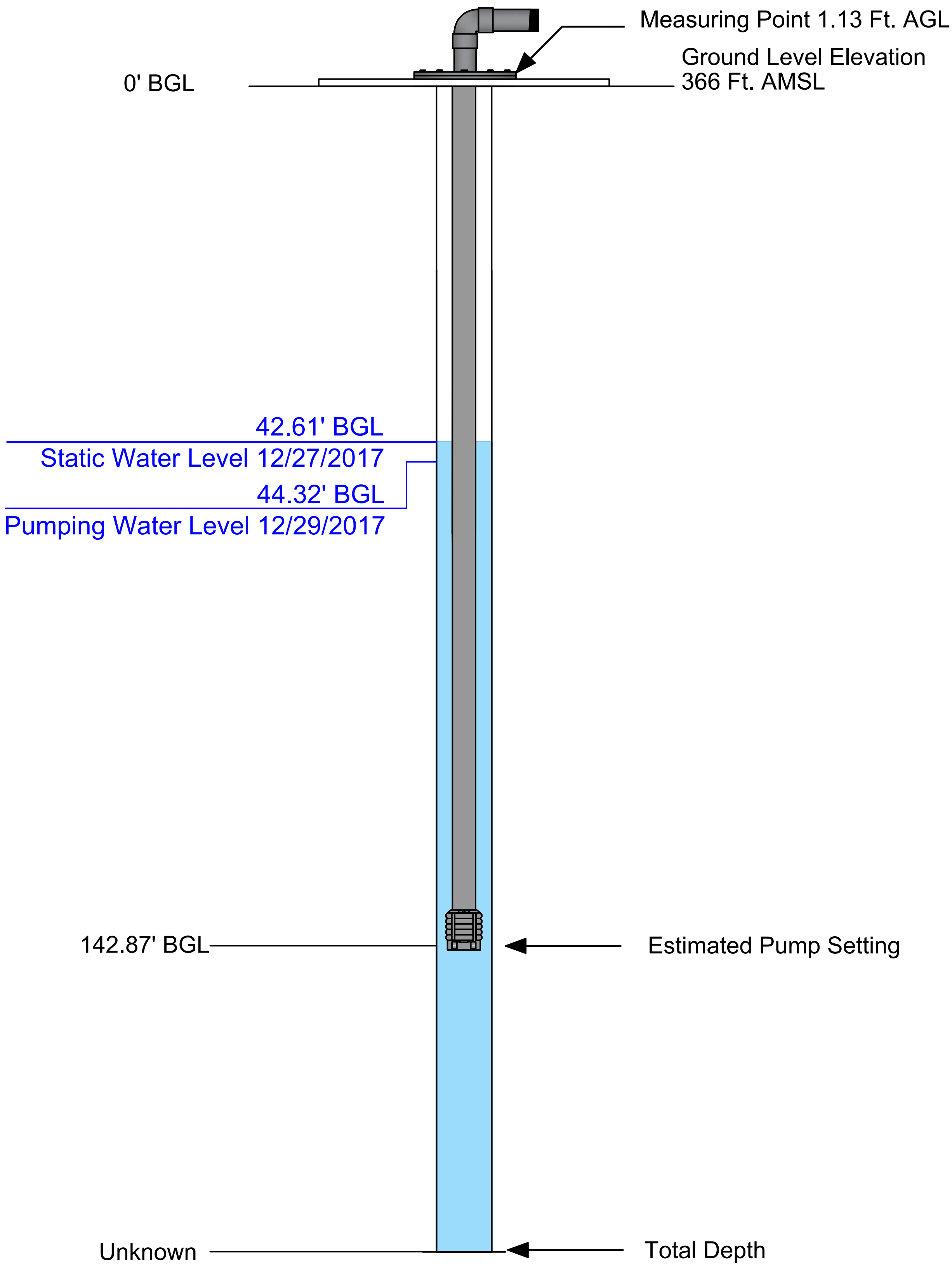
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854743 / Osualdo Sotolongo
Hydrograph
Simsboro
Pump On
12/27/2017
12:30 pm
36-Hour Pumping Test
Pump Off
12/29/2017
12:30 am
Manual Measurements
Static Water Level
Static Water Level 12/27/2017 = 41.74 feet BGL
Distance to Production Well = 4,418 feet
36-Hour Water Level = 44.72 feet BGL
36-Hour Interference Drawdown = 2.11 feet
Monitoring Minimum Level = 41.79 feet
Monitoring Maximum Level = 44.14 feet
Depth to Water, Feet Below Ground Level (BGL)
40
41
42
43
44
45
12/27/2017 00:00
12/28/2017 00:00
12/29/2017 00:00
12/30/2017 00:00
Date/Time


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854743 / Osualdo Sotolongo
Cooper-Jacob Chart (Drawdown)
Simsboro
Cooper-Jacob Solution not valid, μ > 0.05
μ = $\frac{1.87r^2S}{Tt}$
r = 4,418 feet
S = 8.4x10^{-4}
T = 90,000 gpd/ft
t = 1.5 days
μ = 0.23
Water Level Drawdown, Feet
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1
10
100
1,000
10,000
Elapsed Time, Minutes


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36 Hour Test
LPGCD Well 5854743 / Osualdo Sotolongo
Cooper-Jacob Chart (Recovery)
Simsboro
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Residual Recovery (s'), feet
Cooper-Jacob Solution
not valid, μ > 0.05
1
10
100
Time Ratio (t/t')


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854743 / Osualdo Sotolongo
Theis Curve
Simsboro
Match Point
s = 1.99 feet
t = 3.38 days
Data Curve Matching
T = 114.6*Q*W(u)/s
Q = 1,560 gpm
W(u) = 1
s = 1.99 feet
T = 90,000 gpd/ft
S = Ttu/1.87r^2
T = 90,000 gpd/ft
t = 3.38 days
u = 0.1
r = 4,418 feet
S = 8.4x10^-4
Drawdown, Feet
10
1
0.1
0.1
1
10
Elapsed Time, Days

LPGCD Well 5854743 / Sotolongo



Well construction details compiled from State of Texas Well Report, LPGCD records, and/or TGI field investigations.

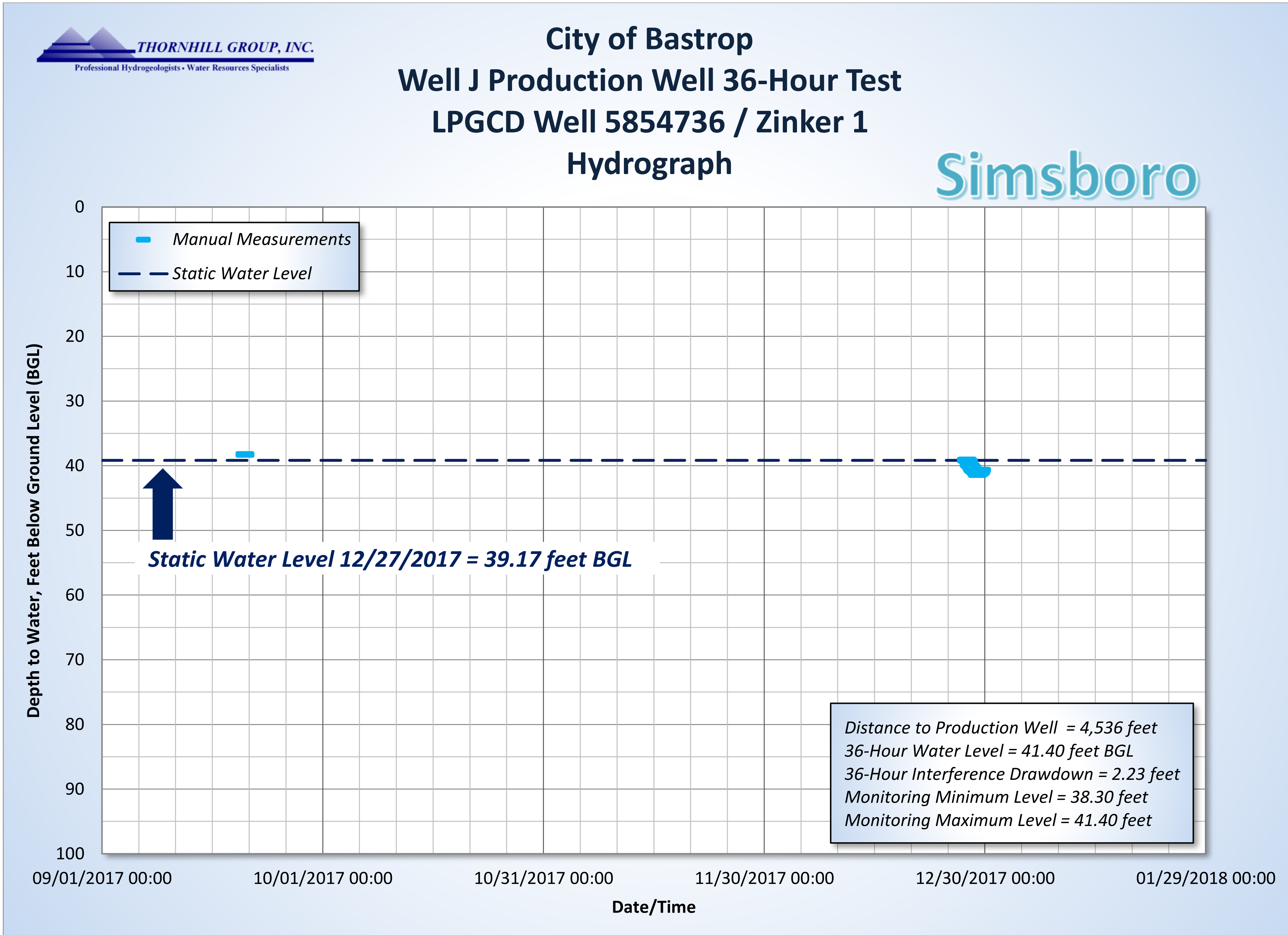
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists

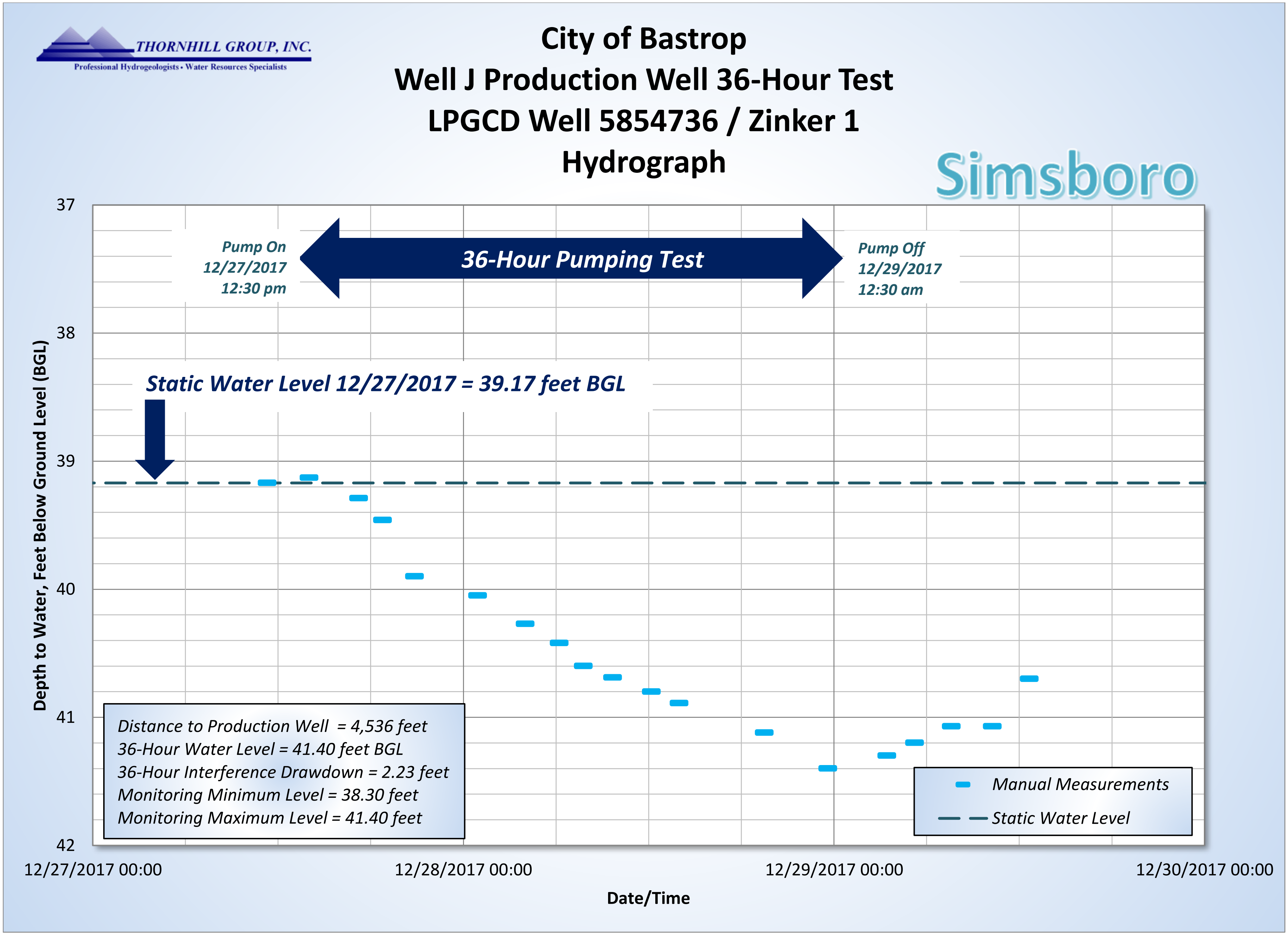

Name: Osualdo Sotolongo
Distance from Well J: 4,418.14 feet
Static Water Level 12/27/2017: 42.61 feet BGL
Arrowhead Ct
Shoreside Dr
Well J
Phelan Rd
Sayers Rd
Old Perkins Rd
Smith Rd
Explanation
City of Bastrop
Well J
0 325 650 1,300
Feet
N
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors,
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

City of Bastrop
Zinker 1 Well
36-Hour Drawdown and Recovery Results

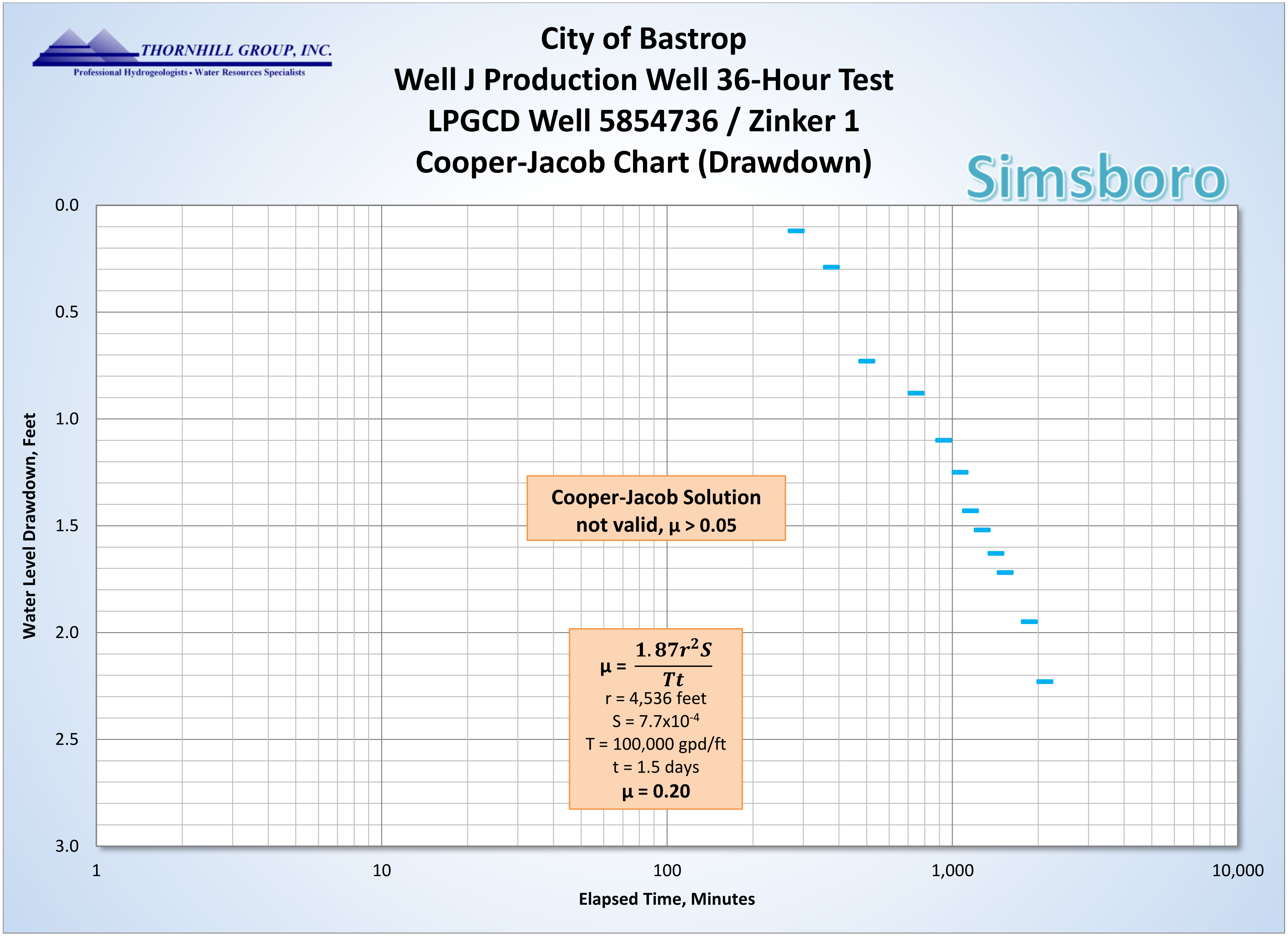
Project: 10210
County: Bastrop
Aquifer Tested: Simsboro
Distance from Production Well: 4,536 feet
Production Well: Well J
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

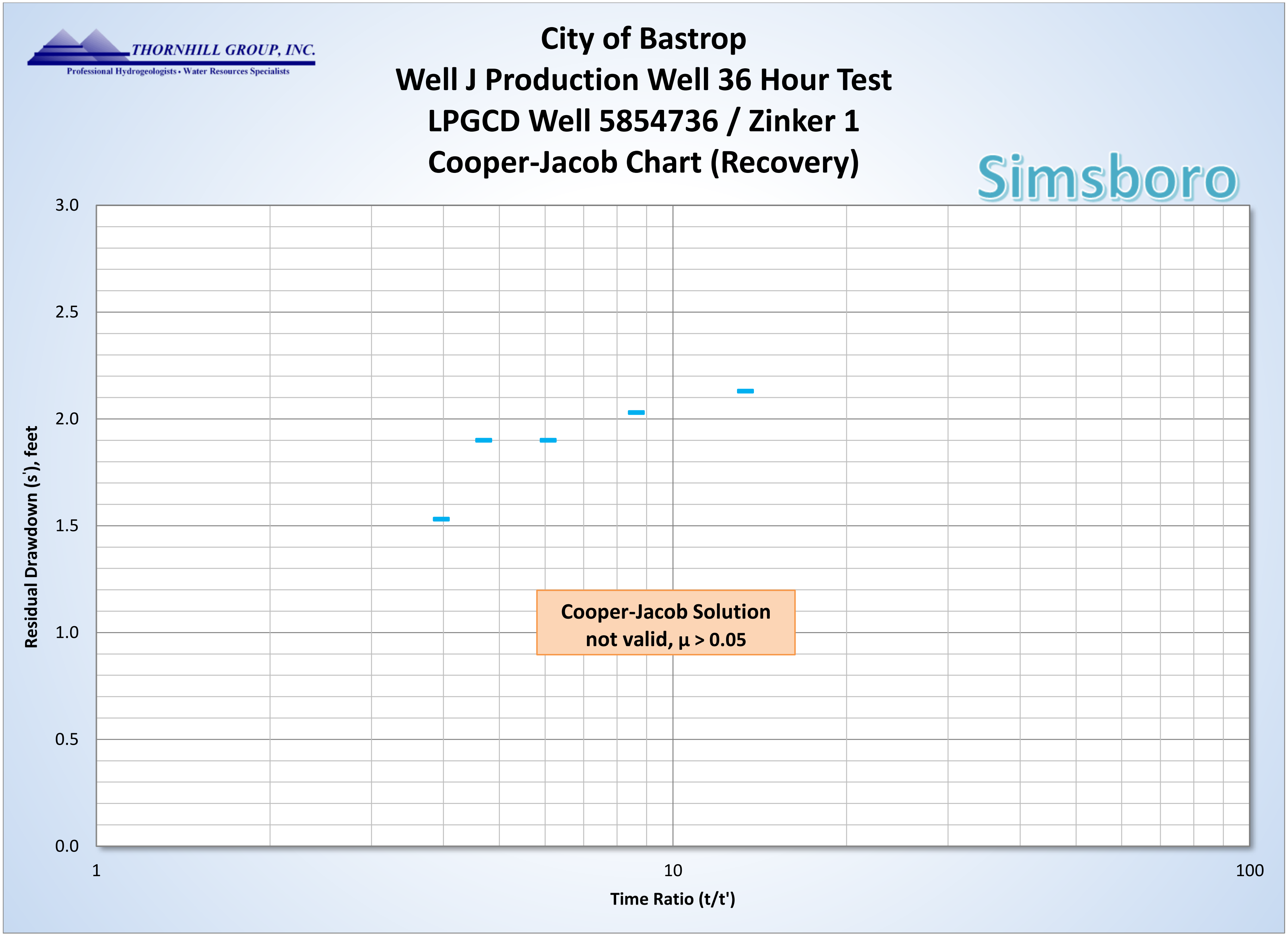
Date / Time	Depth to Water (Feet Below Land Surface)	Remarks
9/20/2017 10:35	38.30	Background
12/27/2017 11:17	39.17	Static Water Level
12/27/2017 14:00	39.13	Production Well on: 12/27/2017 12:30 pm
12/27/2017 17:13	39.29	
12/27/2017 18:46	39.46	
12/27/2017 20:50	39.90	
12/28/2017 0:55	40.05	
12/28/2017 4:00	40.27	
12/28/2017 6:12	40.42	
12/28/2017 7:46	40.60	
12/28/2017 9:40	40.69	
12/28/2017 12:10	40.80	
12/28/2017 13:58	40.89	
12/28/2017 19:29	41.12	
12/28/2017 23:36	41.40	
12/29/2017 3:25	41.30	Production Well off: 12/29/2017 12:30 am
12/29/2017 5:13	41.20	
12/29/2017 7:36	41.07	
12/29/2017 10:15	41.07	
12/29/2017 12:39	40.70	

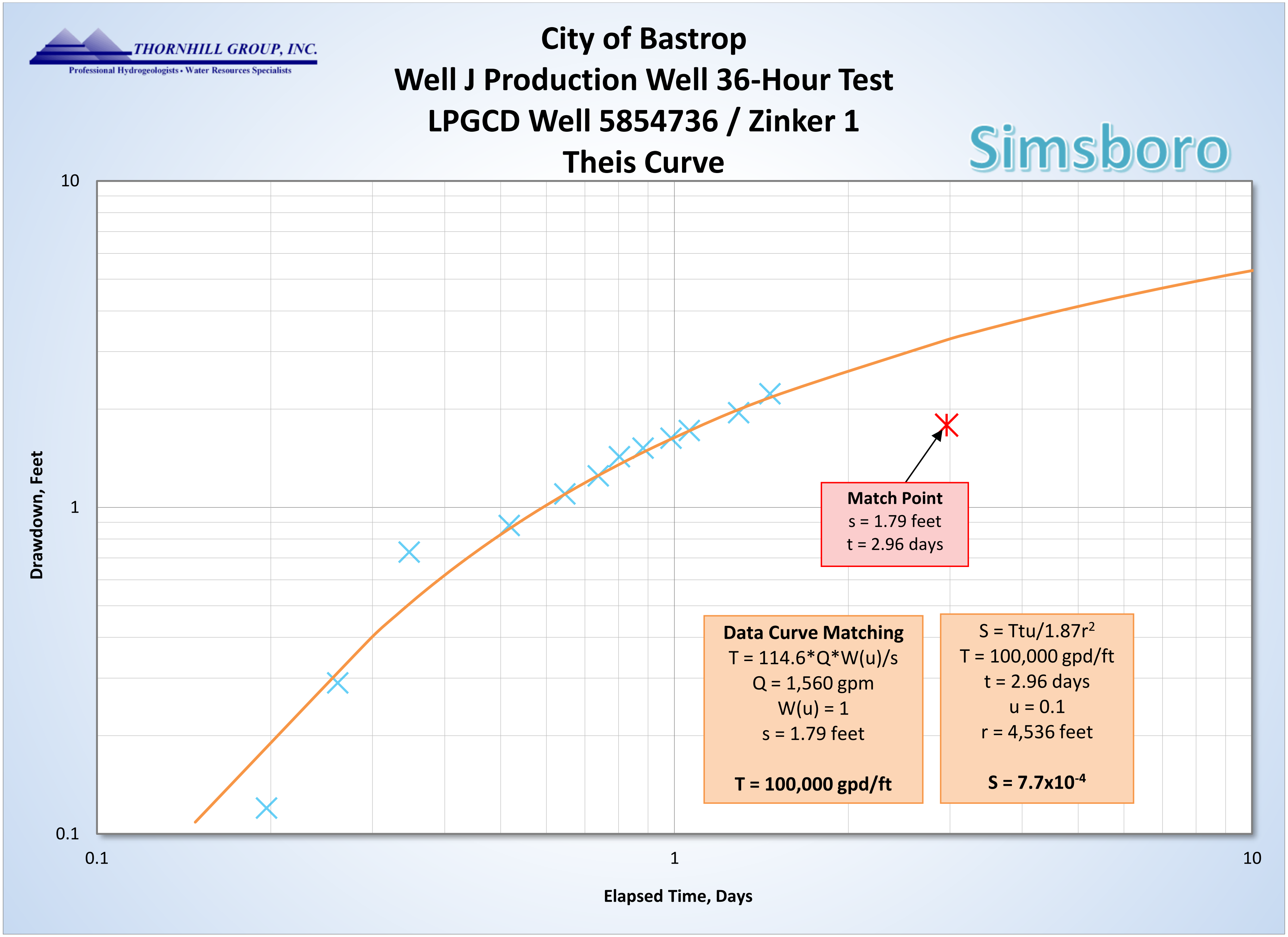

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854736 / Zinker 1
Hydrograph
Simsboro
Manual Measurements
Static Water Level
Static Water Level 12/27/2017 = 39.17 feet BGL
Depth to Water, Feet Below Ground Level (BGL)
0
10
20
30
40
50
60
70
80
90
100
09/01/2017 00:00
10/01/2017 00:00
10/31/2017 00:00
11/30/2017 00:00
12/30/2017 00:00
01/29/2018 00:00
Date/Time
Distance to Production Well = 4,536 feet
36-Hour Water Level = 41.40 feet BGL
36-Hour Interference Drawdown = 2.23 feet
Monitoring Minimum Level = 38.30 feet
Monitoring Maximum Level = 41.40 feet



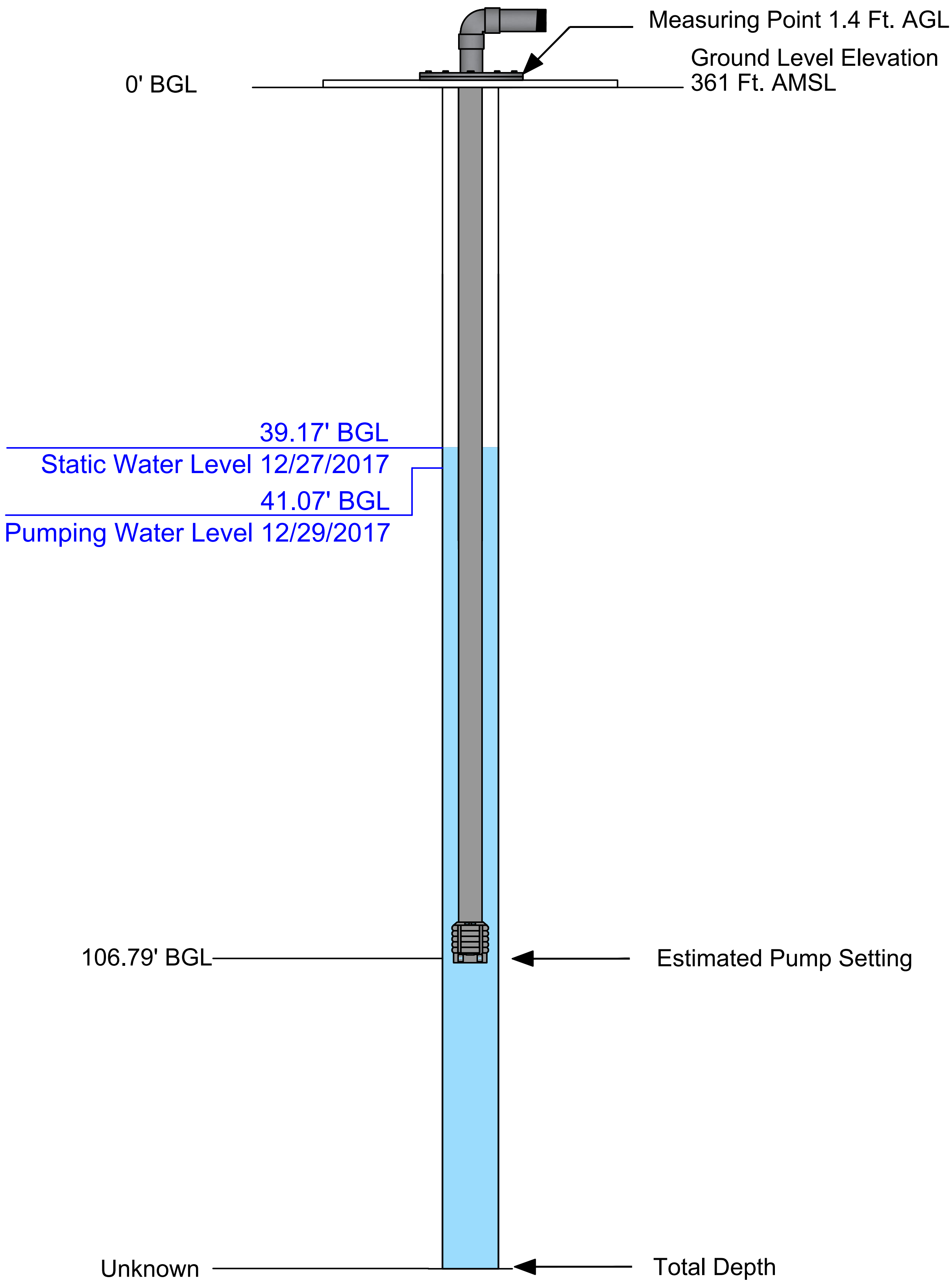
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854736 / Zinker 1
Hydrograph
Simsboro
Pump On
12/27/2017
12:30 pm
36-Hour Pumping Test
Pump Off
12/29/2017
12:30 am
Static Water Level 12/27/2017 = 39.17 feet BGL
Distance to Production Well = 4,536 feet
36-Hour Water Level = 41.40 feet BGL
36-Hour Interference Drawdown = 2.23 feet
Monitoring Minimum Level = 38.30 feet
Monitoring Maximum Level = 41.40 feet
Manual Measurements
Static Water Level
Depth to Water, Feet Below Ground Level (BGL)
37
38
39
40
41
42
12/27/2017 00:00
12/28/2017 00:00
12/29/2017 00:00
12/30/2017 00:00
Date/Time


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854736 / Zinker 1
Cooper-Jacob Chart (Drawdown)
Simsboro
Water Level Drawdown, Feet
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1
10
100
1,000
10,000
Elapsed Time, Minutes
Cooper-Jacob Solution
not valid, μ > 0.05
μ = $\frac{1.87r^2S}{Tt}$
r = 4,536 feet
S = 7.7x10^{-4}
T = 100,000 gpd/ft
t = 1.5 days
μ = 0.20


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36 Hour Test
LPGCD Well 5854736 / Zinker 1
Cooper-Jacob Chart (Recovery)
Simsboro
Residual Drawdown (s'), feet
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
10
100
Time Ratio (t/t')
Cooper-Jacob Solution
not valid, μ > 0.05


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854736 / Zinker 1
Theis Curve
Simsboro
10
1
0.1
Drawdown, Feet
0.1
1
10
Elapsed Time, Days
Match Point
s = 1.79 feet
t = 2.96 days
Data Curve Matching
T = 114.6*Q*W(u)/s
Q = 1,560 gpm
W(u) = 1
s = 1.79 feet
T = 100,000 gpd/ft
S = Ttu/1.87r²
T = 100,000 gpd/ft
t = 2.96 days
u = 0.1
r = 4,536 feet
S = 7.7x10⁻⁴

LPGCD Well 5854736 / Zinker 1



Well construction details compiled from State of Texas Well Report, LPGCD records, and/or TGI field investigations.

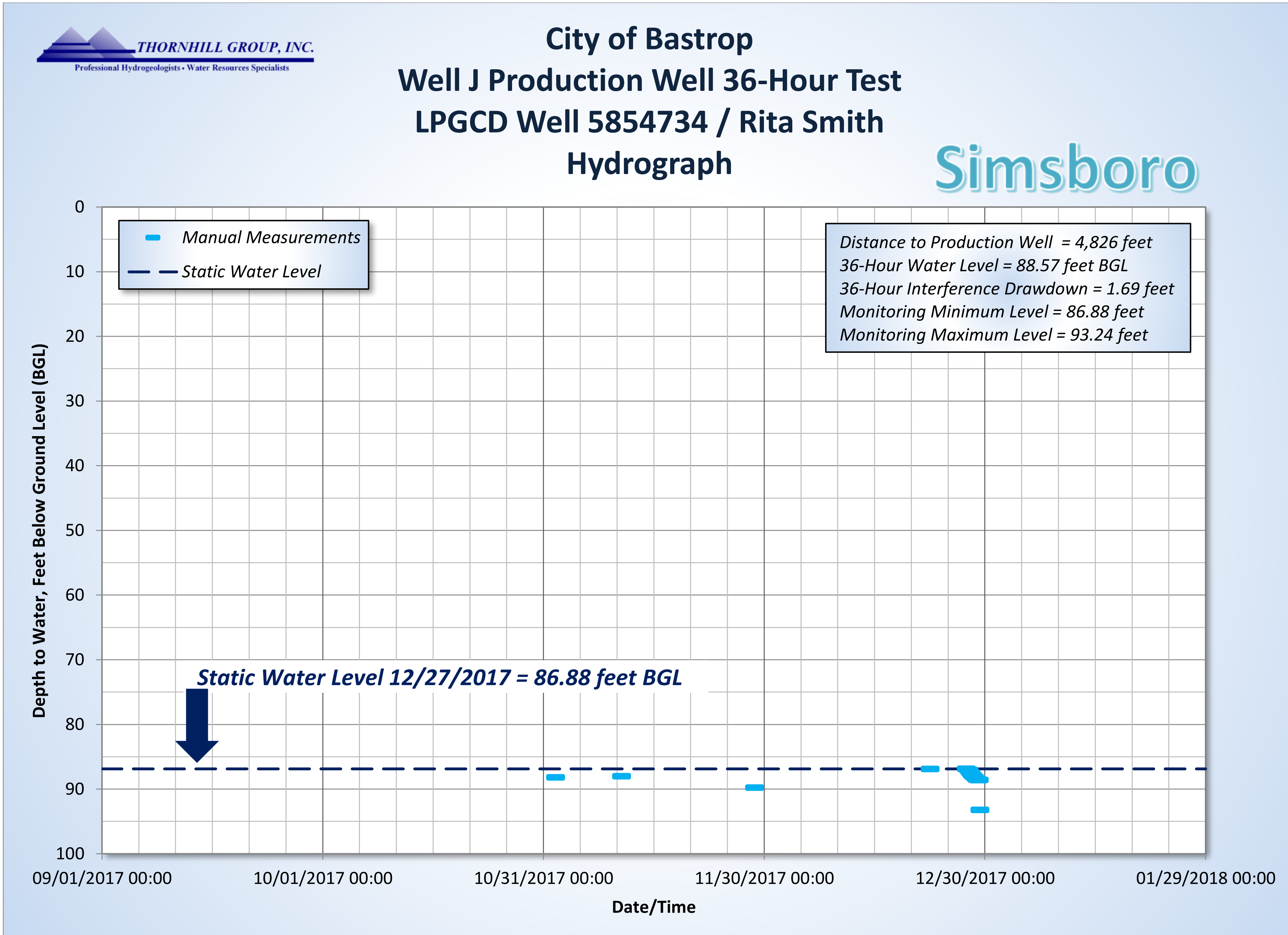
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists


Name: Zinker 1
Distance from Well J: 4,536.73 feet
Static Water Level 12/27/2017: 39.17 feet BGL
Arrowhead Ct
Shoreside Dr
Well J
Phelan Rd
Sayers Rd
Old Perkins Rd
Smith Rd
Explanation
City of Bastrop
Well J
0 325 650 1,300
Feet
N
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors

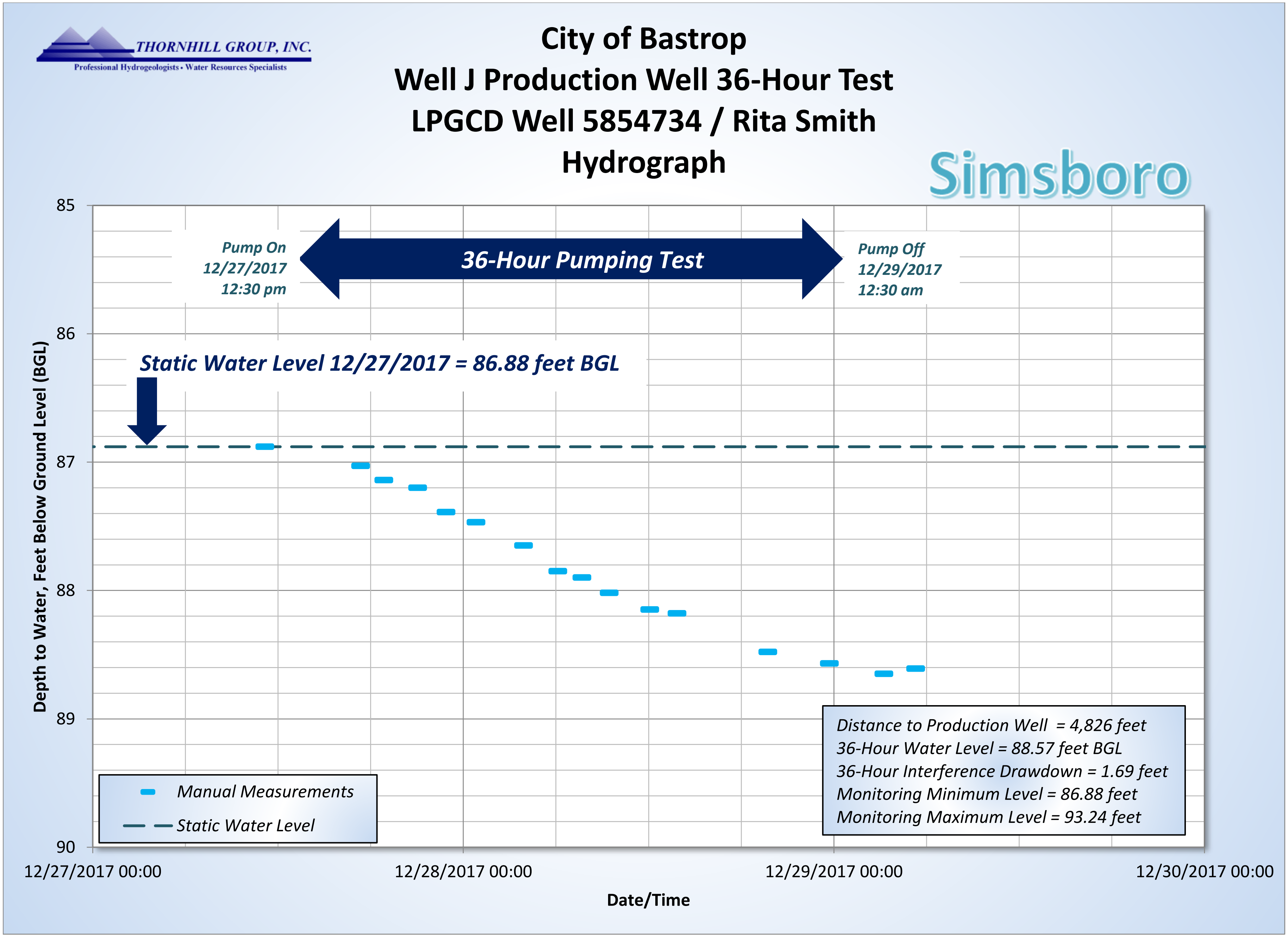
City of Bastrop
Smith Well
36-Hour Drawdown and Recovery Results

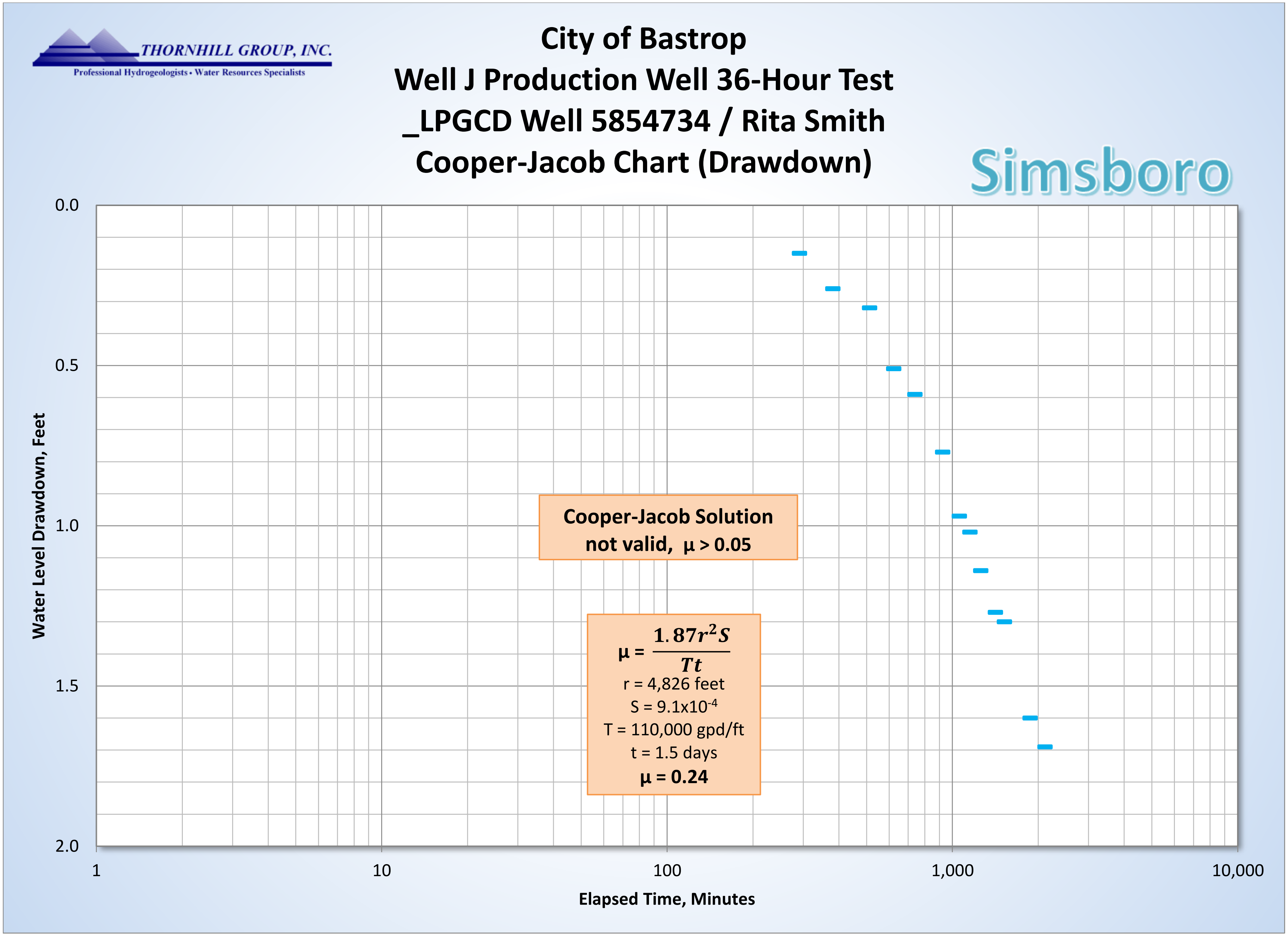
Project: 10210
County: Bastrop
Aquifer Tested: Simsboro
Distance from Production Well: 4,826 feet
Production Well: Well J
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

Date / Time	Depth to Water (Feet Below Land Surface)	Remarks
11/1/2017 15:41	88.22	Background
11/10/2017 14:50	88.05	Background
11/28/2017 16:30	89.81	Background
12/22/2017 13:08	86.91	Background
12/27/2017 11:09	86.88	Static Water Level
12/27/2017 17:21	87.03	Production Well on: 12/27/2017 12:30 pm
12/27/2017 18:51	87.14	
12/27/2017 21:02	87.20	
12/27/2017 22:53	87.39	
12/28/2017 0:49	87.47	
12/28/2017 3:54	87.65	
12/28/2017 6:07	87.85	
12/28/2017 7:41	87.90	
12/28/2017 9:27	88.02	
12/28/2017 12:04	88.15	
12/28/2017 13:50	88.18	
12/28/2017 19:43	88.48	
12/28/2017 23:42	88.57	
12/29/2017 3:14	88.65	Production Well off: 12/29/2017 12:30 am
12/29/2017 5:18	88.61	
12/29/2017 7:45	93.24	Pump On
12/29/2017 10:29	88.44	
12/29/2017 12:44	88.27	

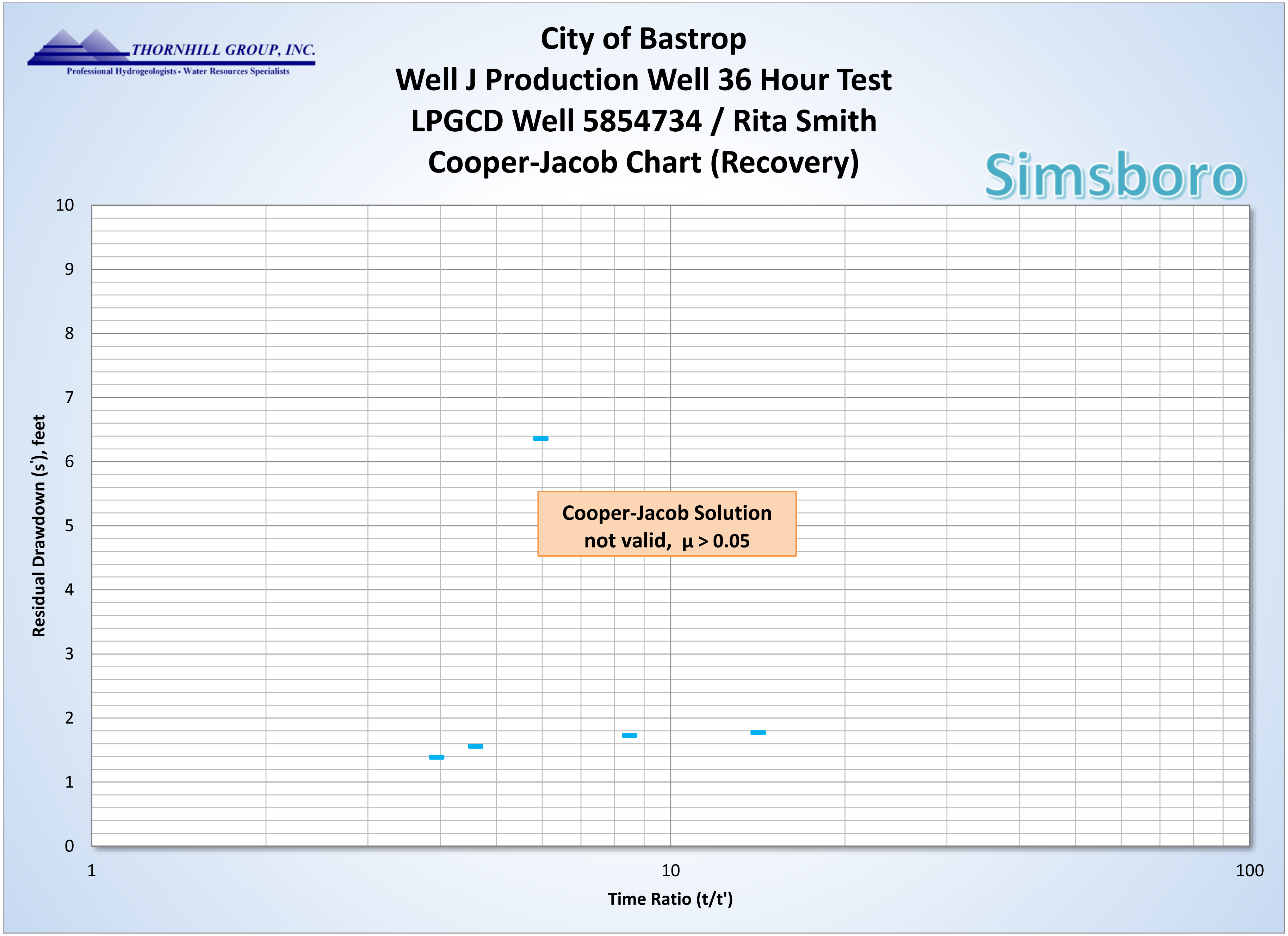


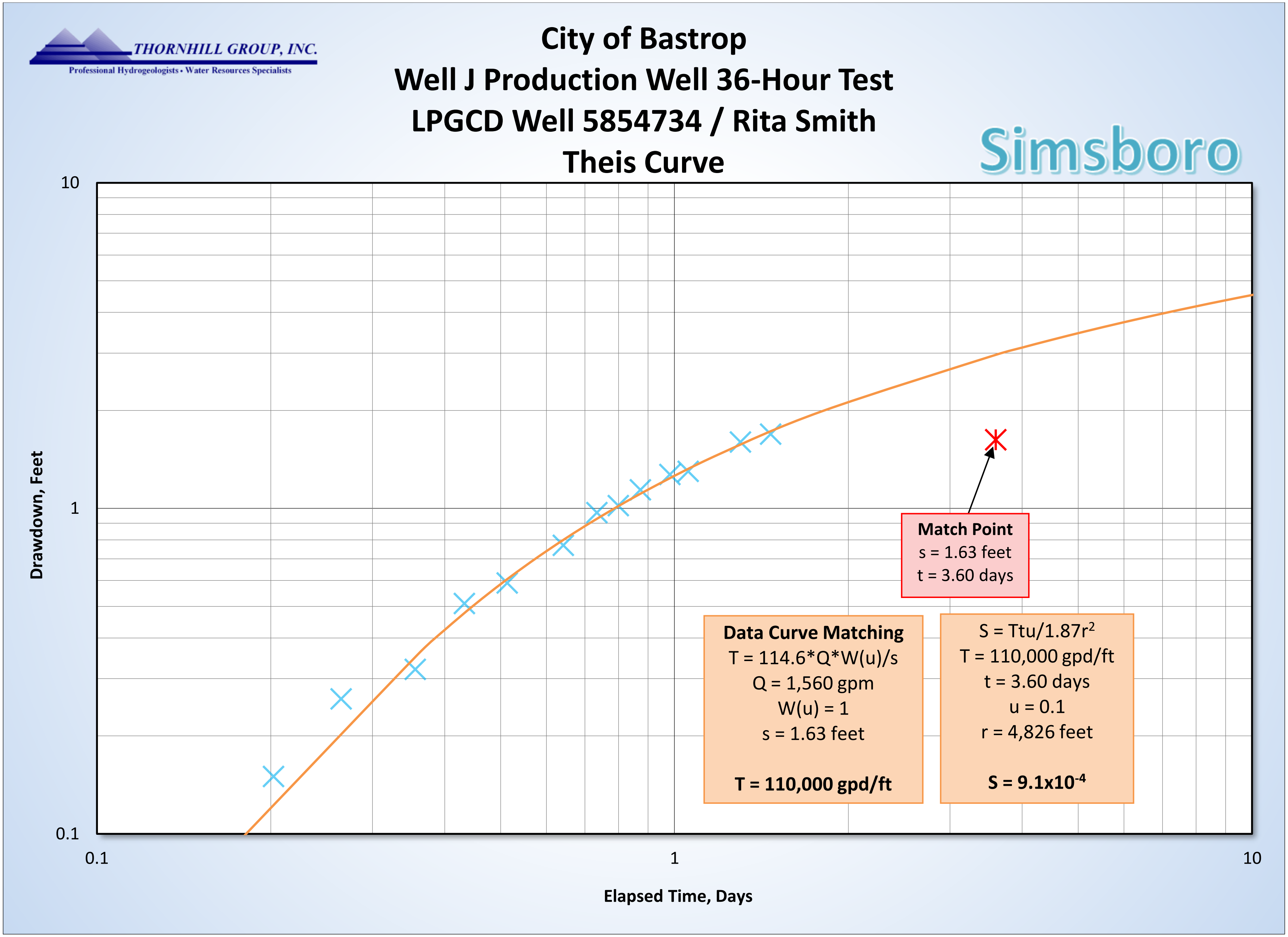
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854734 / Rita Smith
Hydrograph
Simsboro
Manual Measurements
Static Water Level
Distance to Production Well = 4,826 feet
36-Hour Water Level = 88.57 feet BGL
36-Hour Interference Drawdown = 1.69 feet
Monitoring Minimum Level = 86.88 feet
Monitoring Maximum Level = 93.24 feet
Static Water Level 12/27/2017 = 86.88 feet BGL
Depth to Water, Feet Below Ground Level (BGL)
0
10
20
30
40
50
60
70
80
90
100
09/01/2017 00:00
10/01/2017 00:00
10/31/2017 00:00
11/30/2017 00:00
12/30/2017 00:00
01/29/2018 00:00
Date/Time


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854734 / Rita Smith
Hydrograph
Simsboro
Pump On
12/27/2017
12:30 pm
36-Hour Pumping Test
Pump Off
12/29/2017
12:30 am
Static Water Level 12/27/2017 = 86.88 feet BGL
85
86
87
88
89
90
Depth to Water, Feet Below Ground Level (BGL)
Distance to Production Well = 4,826 feet
36-Hour Water Level = 88.57 feet BGL
36-Hour Interference Drawdown = 1.69 feet
Monitoring Minimum Level = 86.88 feet
Monitoring Maximum Level = 93.24 feet
Manual Measurements
Static Water Level
12/27/2017 00:00
12/28/2017 00:00
12/29/2017 00:00
12/30/2017 00:00
Date/Time



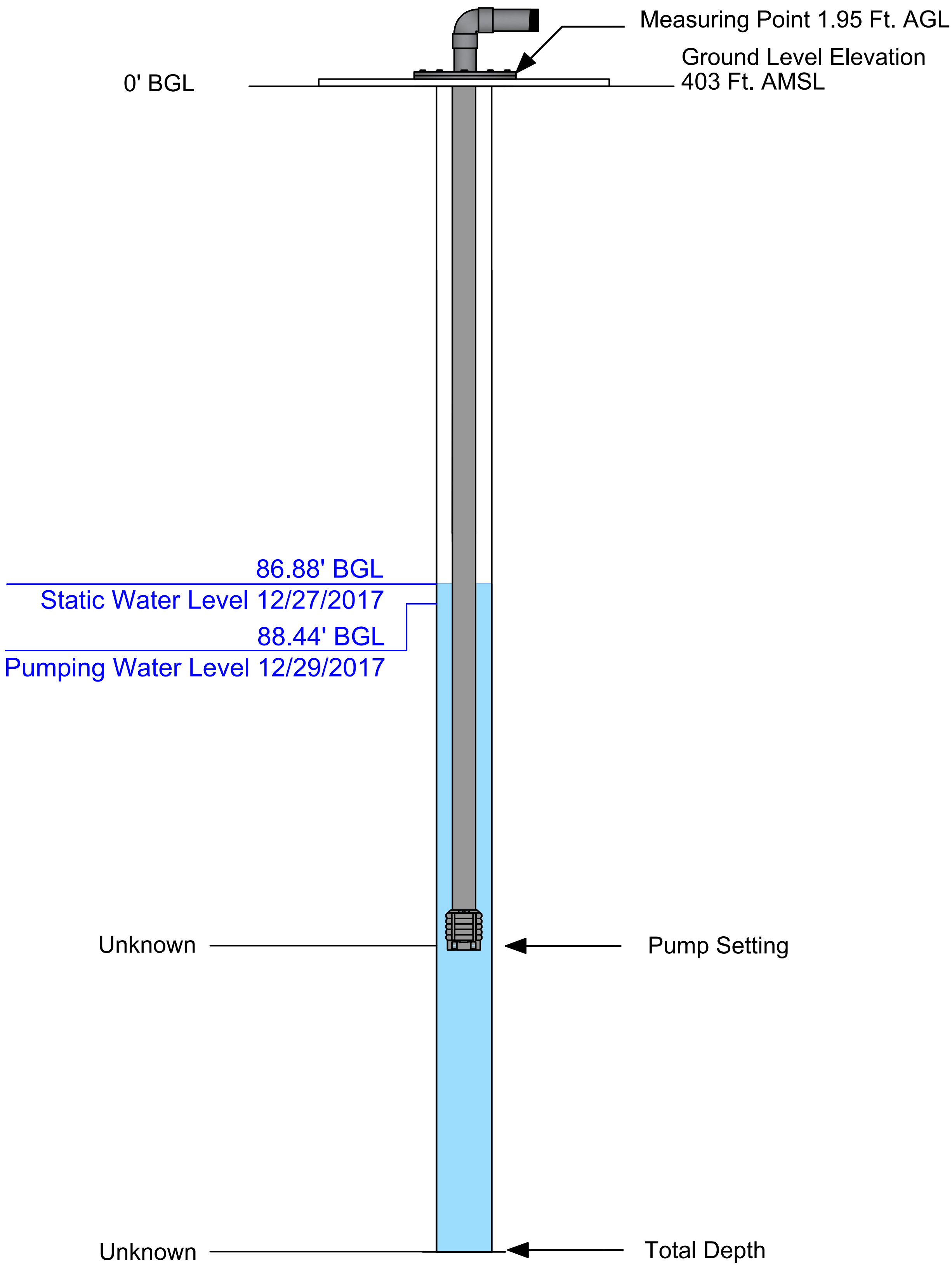
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
_LPGCD Well 5854734 / Rita Smith
Cooper-Jacob Chart (Drawdown)
Simsboro
Cooper-Jacob Solution not valid, μ > 0.05
$\mu = \frac{1.87r^2S}{Tt}$
r = 4,826 feet
S = 9.1x10^{-4}
T = 110,000 gpd/ft
t = 1.5 days
μ = 0.24
Water Level Drawdown, Feet
0.0
0.5
1.0
1.5
2.0
1
10
100
1,000
10,000
Elapsed Time, Minutes


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36 Hour Test
LPGCD Well 5854734 / Rita Smith
Cooper-Jacob Chart (Recovery)
Simsboro
Residual Drawdown (s'), feet
Time Ratio (t/t')
Cooper-Jacob Solution
not valid, μ > 0.05
0
1
2
3
4
5
6
7
8
9
10
1
10
100



THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854734 / Rita Smith
Theis Curve
Simsboro
10
1
0.1
0.1
1
10
Drawdown, Feet
Elapsed Time, Days
Match Point
s = 1.63 feet
t = 3.60 days
Data Curve Matching
T = 114.6*Q*W(u)/s
Q = 1,560 gpm
W(u) = 1
s = 1.63 feet
T = 110,000 gpd/ft
S = Ttu/1.87r2
T = 110,000 gpd/ft
t = 3.60 days
u = 0.1
r = 4,826 feet
S = 9.1x10-4

LPGCD Well 5854734 / Rita Smith



Well construction details compiled from State of Texas Well Report, LPGCD records, and/or TGI field investigations.

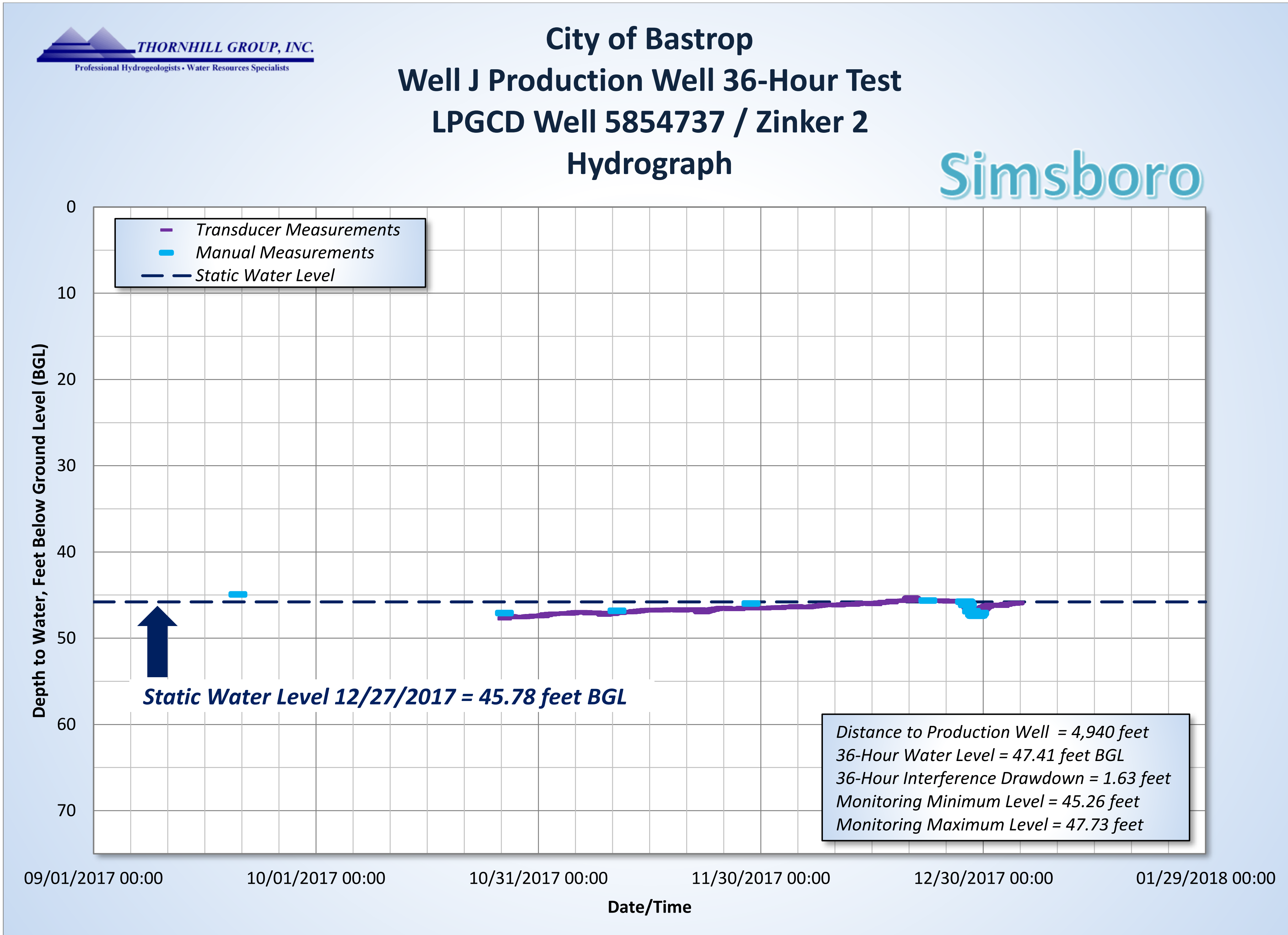
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists

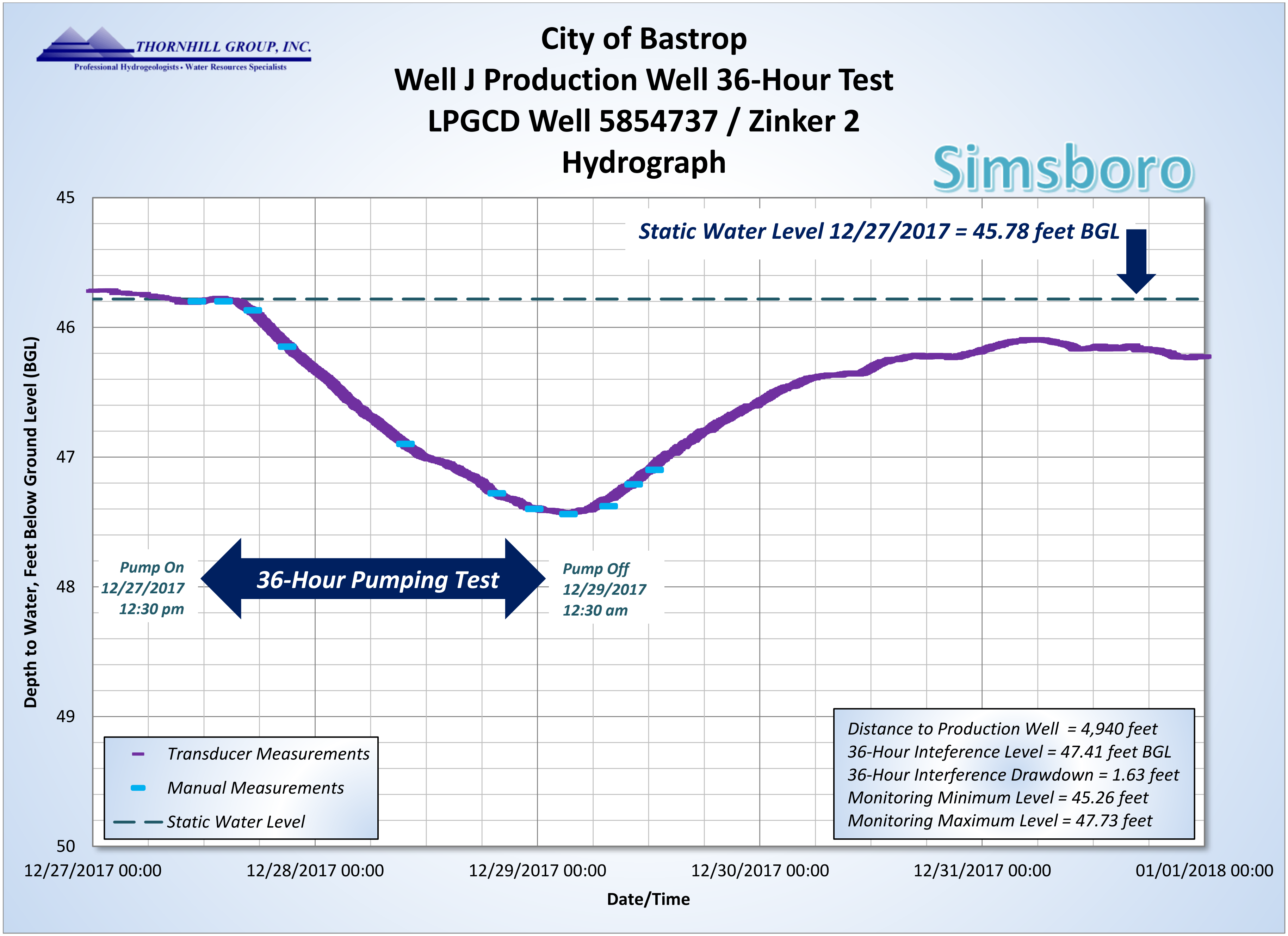

Name: Rita Smith
Distance from Well J: 4,826.12 feet
Static Water Level 12/27/2017: 86.88 feet BGL
Arrowhead Ct
Shoreside
Well J
Phelan Rd
Sayers Rd
Old Perkins Rd
Smith Rd
Explanation
City of Bastrop
Well J
N
0 325 650 1,300
Feet
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors,
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

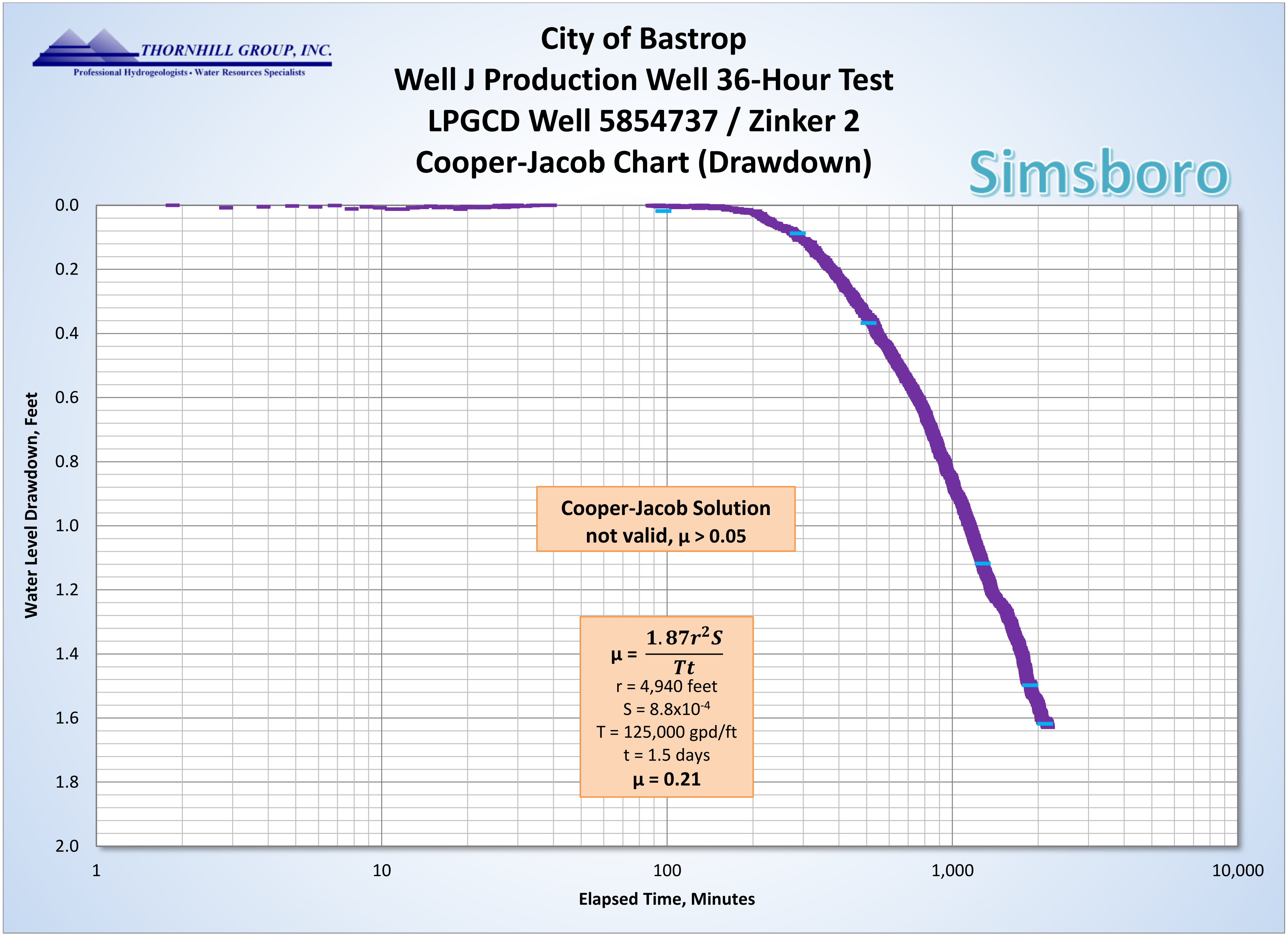
City of Bastrop
Zinker 2 Well
36-Hour Drawdown and Recovery Results

Project: 10210
County: Bastrop
Aquifer Tested: Simsboro
Distance from Production Well: 4,940 feet
Production Well: Well J
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

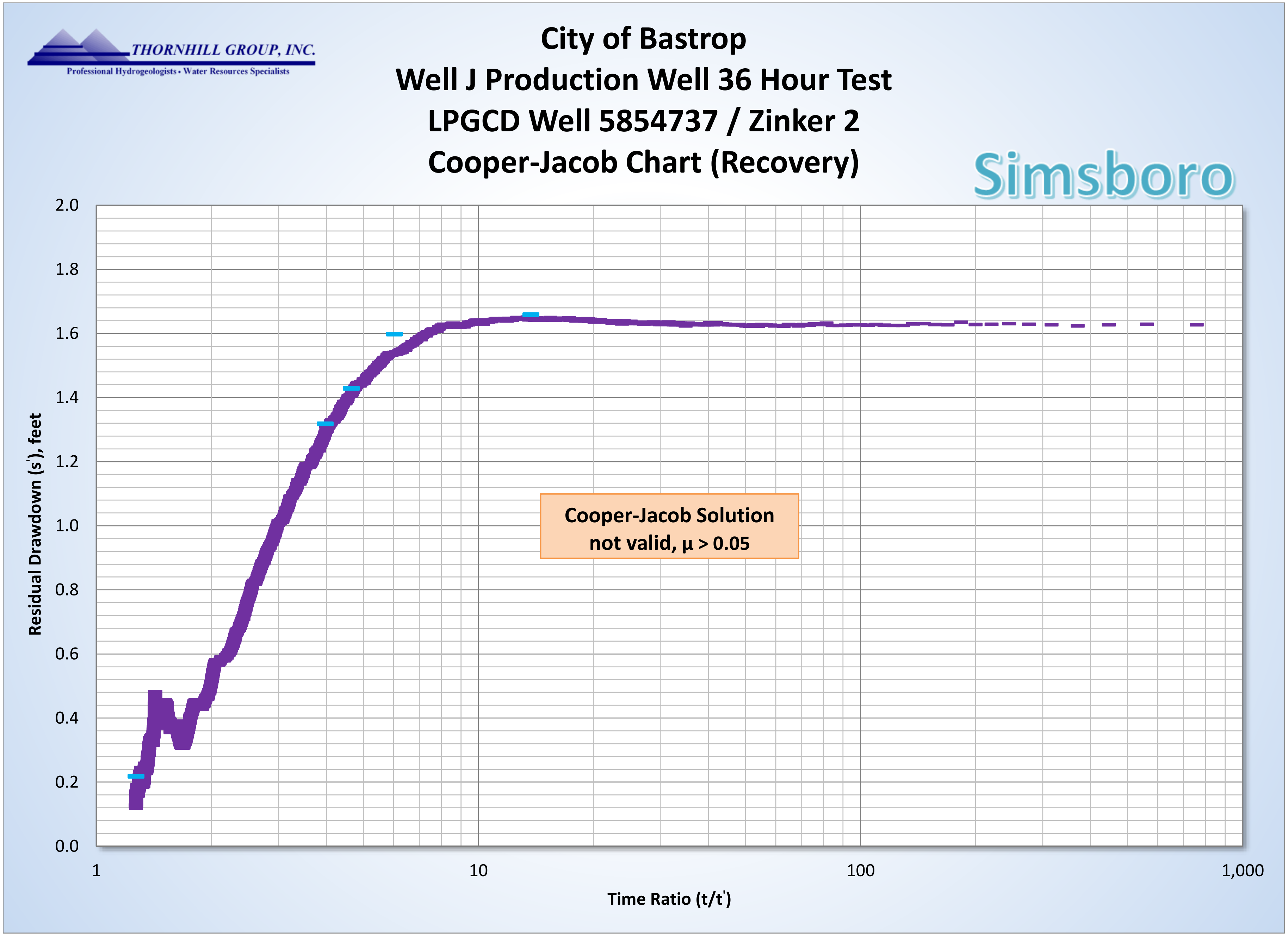
Date / Time	Depth to Water (Feet Below Land Surface)	Remarks
9/20/2017 10:50	44.95	Background
10/26/2017 10:00	47.10	Background
11/10/2017 14:40	46.85	Background
11/28/2017 16:13	46.00	Background
12/22/2017 13:03	45.67	Background
12/27/2017 11:15	45.80	Static Water Level
12/27/2017 14:07	45.80	Production Well on: 12/27/2017 12:30 pm
12/27/2017 17:17	45.87	
12/27/2017 20:58	46.15	
12/28/2017 9:45	46.90	
12/28/2017 19:37	47.28	
12/28/2017 23:39	47.40	
12/29/2017 3:20	47.44	Production Well off: 12/29/2017 12:30 am
12/29/2017 7:40	47.38	
12/29/2017 10:22	47.21	
12/29/2017 12:38	47.10	
1/3/2018 14:40	46.00	

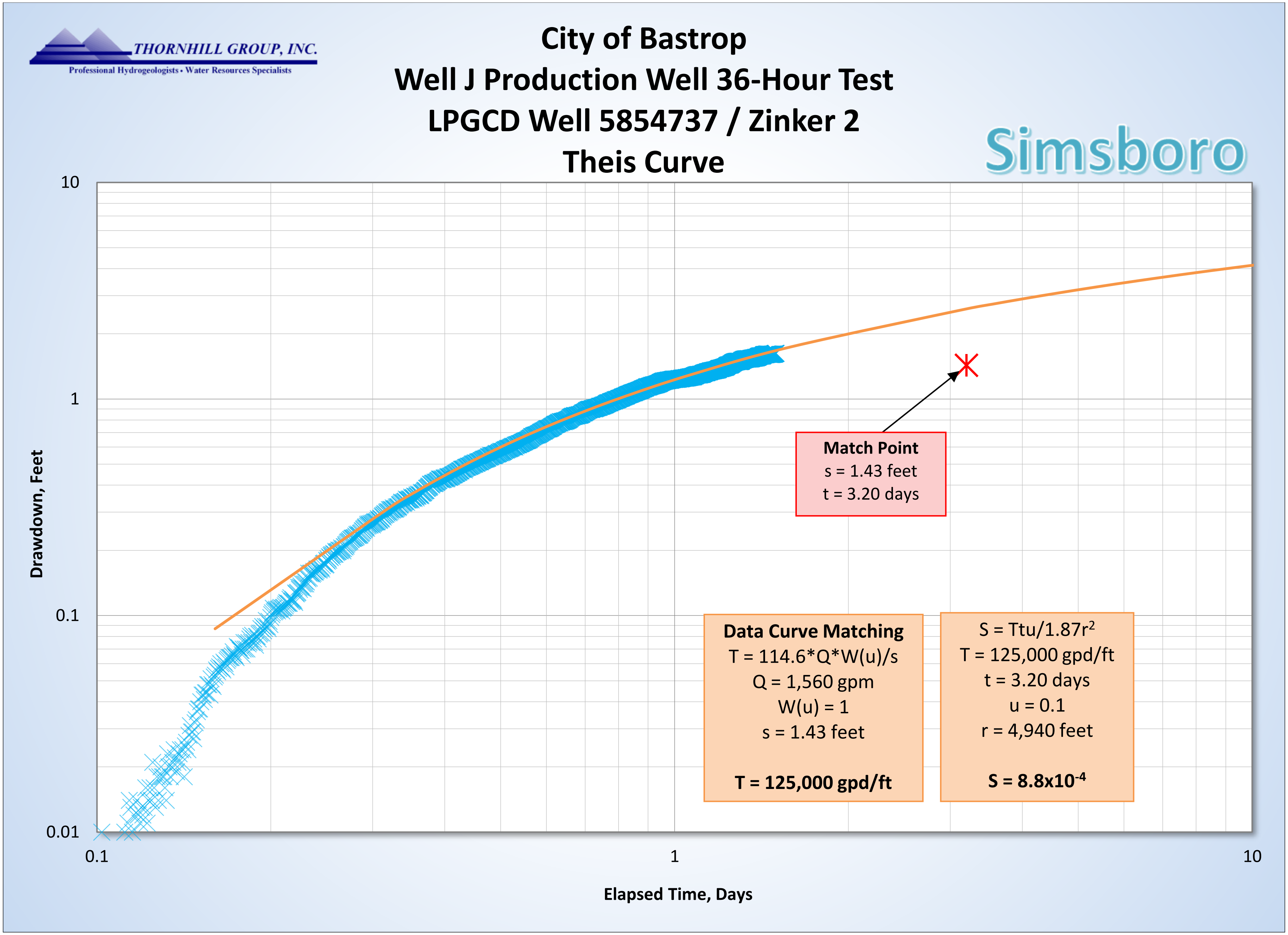

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854737 / Zinker 2
Hydrograph
Simsboro
Transducer Measurements
Manual Measurements
Static Water Level
Depth to Water, Feet Below Ground Level (BGL)
0
10
20
30
40
50
60
70
Static Water Level 12/27/2017 = 45.78 feet BGL
Distance to Production Well = 4,940 feet
36-Hour Water Level = 47.41 feet BGL
36-Hour Interference Drawdown = 1.63 feet
Monitoring Minimum Level = 45.26 feet
Monitoring Maximum Level = 47.73 feet
09/01/2017 00:00
10/01/2017 00:00
10/31/2017 00:00
11/30/2017 00:00
12/30/2017 00:00
01/29/2018 00:00
Date/Time


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854737 / Zinker 2
Hydrograph
Simsboro
Static Water Level 12/27/2017 = 45.78 feet BGL
Pump On
12/27/2017
12:30 pm
36-Hour Pumping Test
Pump Off
12/29/2017
12:30 am
Depth to Water, Feet Below Ground Level (BGL)
45
46
47
48
49
50
Transducer Measurements
Manual Measurements
Static Water Level
Distance to Production Well = 4,940 feet
36-Hour Inteference Level = 47.41 feet BGL
36-Hour Interference Drawdown = 1.63 feet
Monitoring Minimum Level = 45.26 feet
Monitoring Maximum Level = 47.73 feet
12/27/2017 00:00
12/28/2017 00:00
12/29/2017 00:00
12/30/2017 00:00
12/31/2017 00:00
01/01/2018 00:00
Date/Time

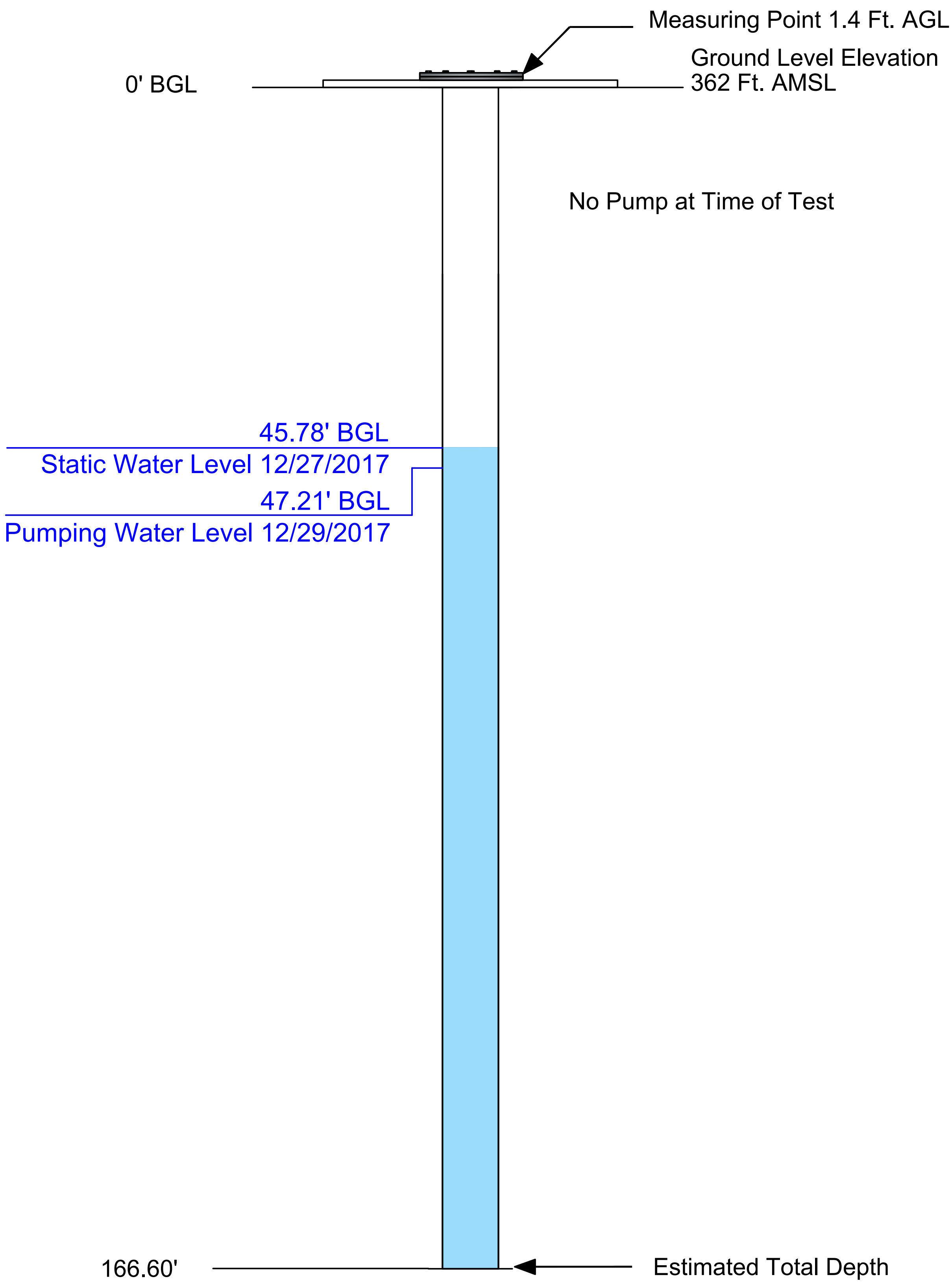


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854737 / Zinker 2
Cooper-Jacob Chart (Drawdown)
Simsboro
Water Level Drawdown, Feet
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1
10
100
1,000
10,000
Elapsed Time, Minutes
Cooper-Jacob Solution not valid, μ > 0.05
$\mu = \frac{1.87r^2S}{Tt}$
r = 4,940 feet
S = 8.8x10^{-4}
T = 125,000 gpd/ft
t = 1.5 days
μ = 0.21


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36 Hour Test
LPGCD Well 5854737 / Zinker 2
Cooper-Jacob Chart (Recovery)
Simsboro
Cooper-Jacob Solution
not valid, μ > 0.05
Residual Drawdown (s'), feet
Time Ratio (t/t')
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
10
100
1,000


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854737 / Zinker 2
Theis Curve
Simsboro
Drawdown, Feet
Elapsed Time, Days
10
1
0.1
0.01
0.1
1
10
Match Point
s = 1.43 feet
t = 3.20 days
Data Curve Matching
T = 114.6*Q*W(u)/s
Q = 1,560 gpm
W(u) = 1
s = 1.43 feet
T = 125,000 gpd/ft
S = Ttu/1.87r²
T = 125,000 gpd/ft
t = 3.20 days
u = 0.1
r = 4,940 feet
S = 8.8x10⁻⁴

LPGCD Well 5854737 / Zinker 2



Well construction details compiled from State of Texas Well Report, LPGCD records, and/or TGI field investigations.

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists

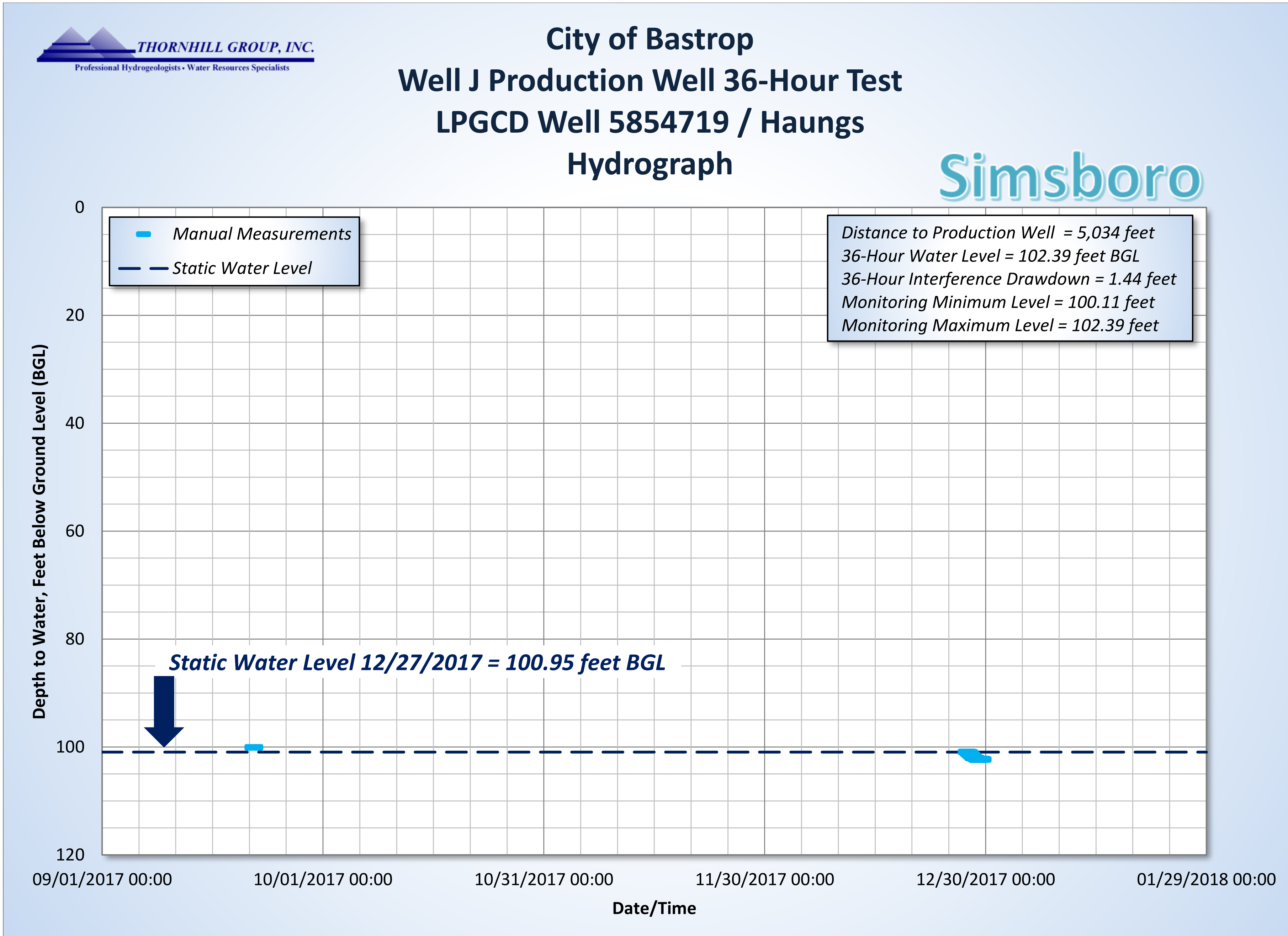
Name: Zinker 2
Distance from Well J: 4,940.95 feet
Static Water Level 12/27/2017: 45.78 feet BGL
Arrowhead Ct
Shoreside Dr
Well J
Phelan Rd
Sayers Rd
Old Perkins Rd
Smith Rd
Explanation
City of Bastrop
Well J
0 325 650 1,300
Feet
N
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors,
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

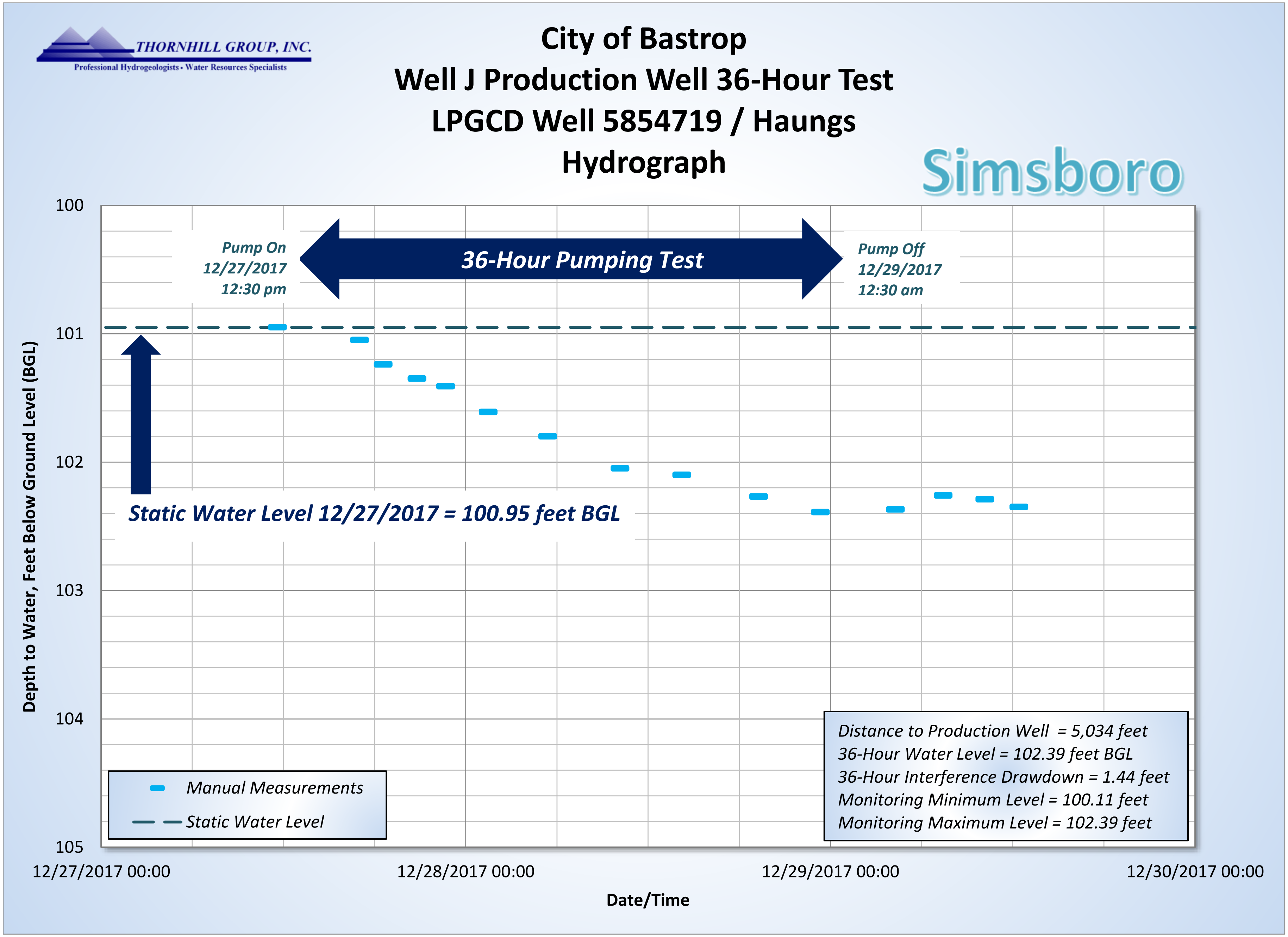
City of Bastrop
Haungs Well
36-Hour Drawdown and Recovery Results

Project: 10210
County: Bastrop
Aquifer Tested: Simsboro
Distance from Production Well: 5,034 feet
Production Well: Well J
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

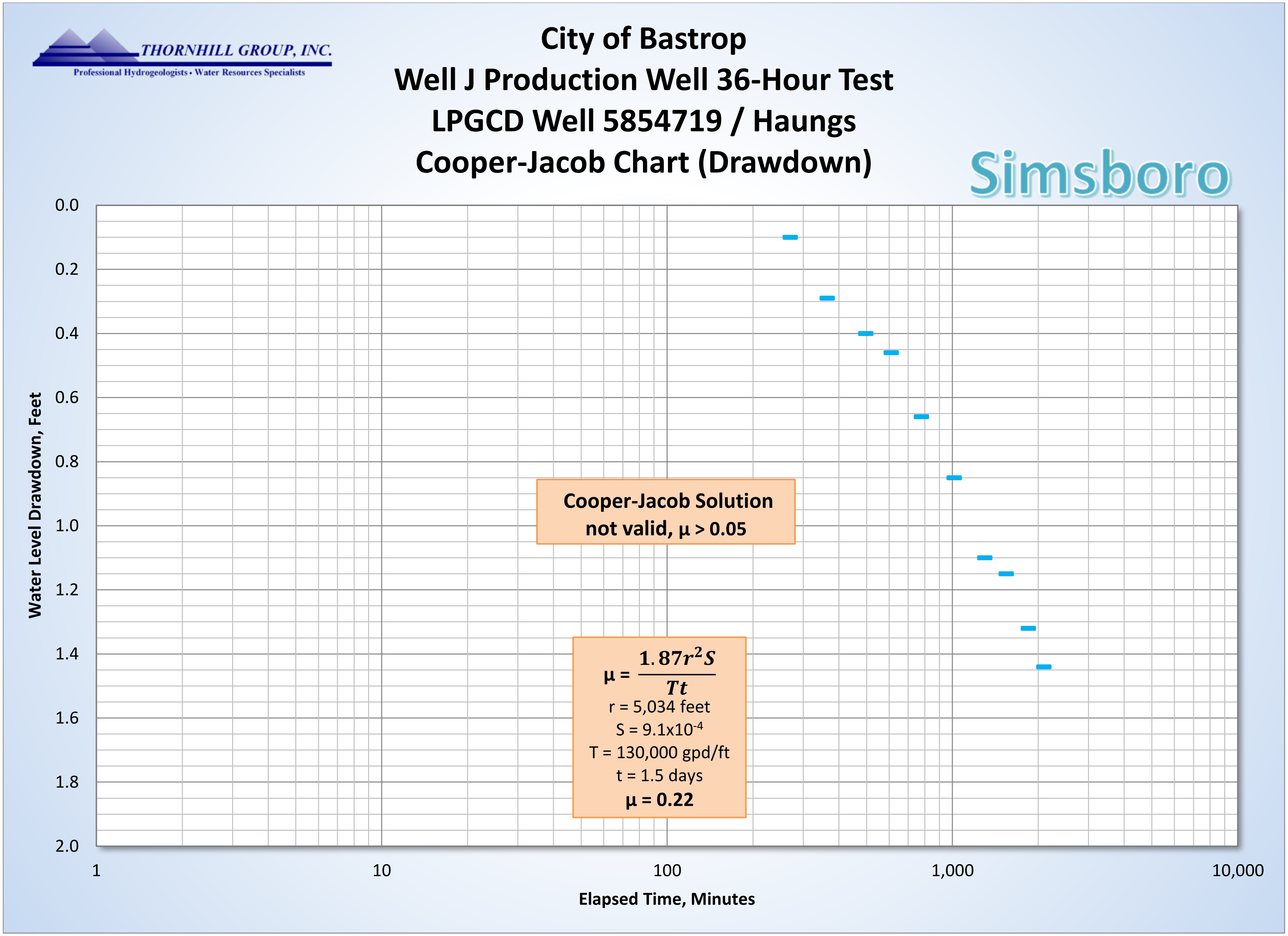
Date / Time	Depth to Water (Feet Below Land Surface)	Remarks
9/21/2017 14:31	100.11	Background
12/27/2017 11:36	100.95	Static Water Level
12/27/2017 17:00	101.05	Production Well on: 12/27/2017 12:30 pm
12/27/2017 18:34	101.24	
12/27/2017 20:47	101.35	
12/27/2017 22:40	101.41	
12/28/2017 1:28	101.61	
12/28/2017 5:23	101.80	
12/28/2017 10:09	102.05	
12/28/2017 14:13	102.10	
12/28/2017 19:16	102.27	
12/28/2017 23:20	102.39	
12/29/2017 4:16	102.37	Production Well off: 12/29/2017 12:30 am
12/29/2017 7:25	102.26	
12/29/2017 10:10	102.29	
12/29/2017 12:24	102.35	

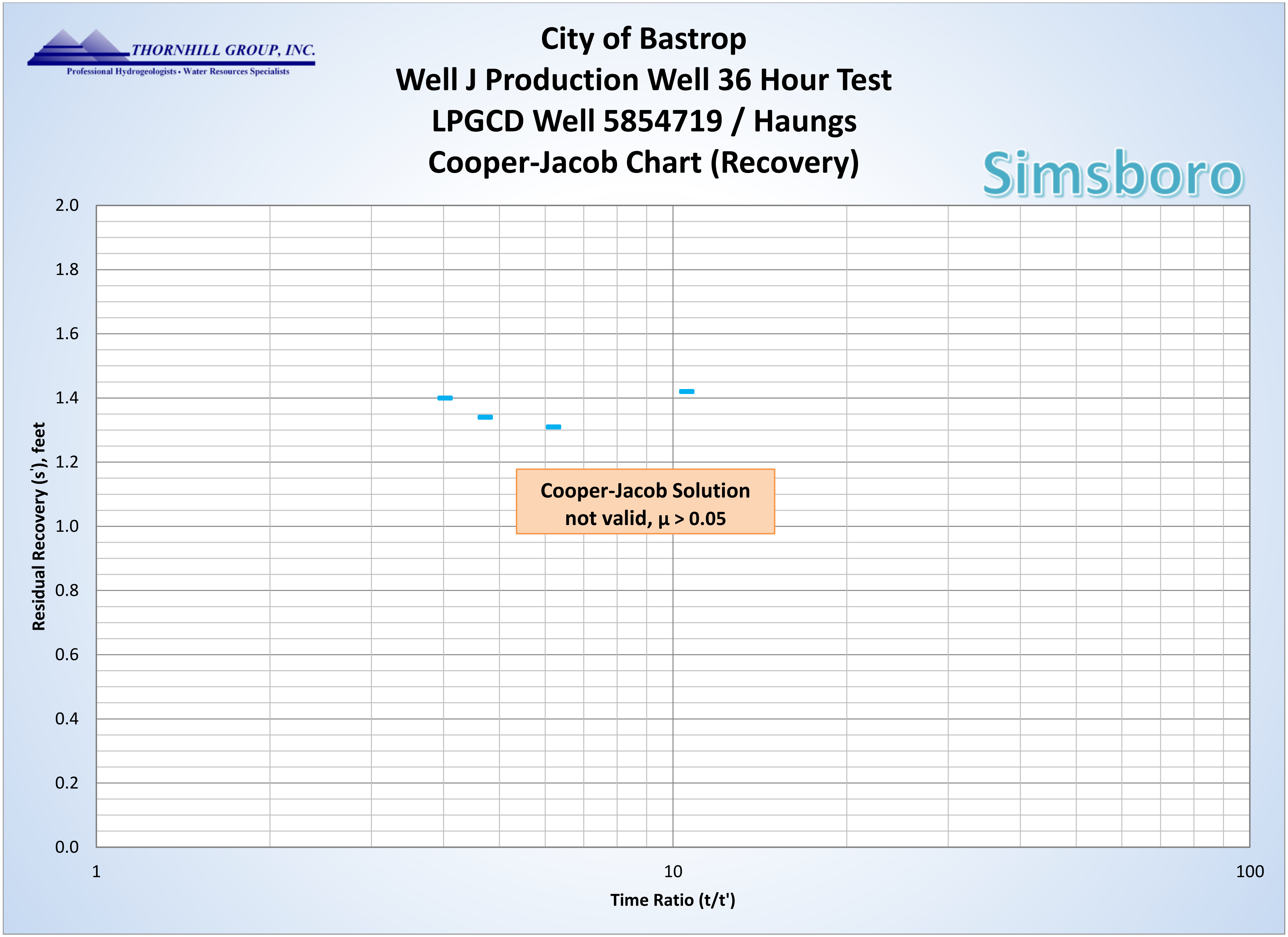
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854719 / Haungs
Hydrograph

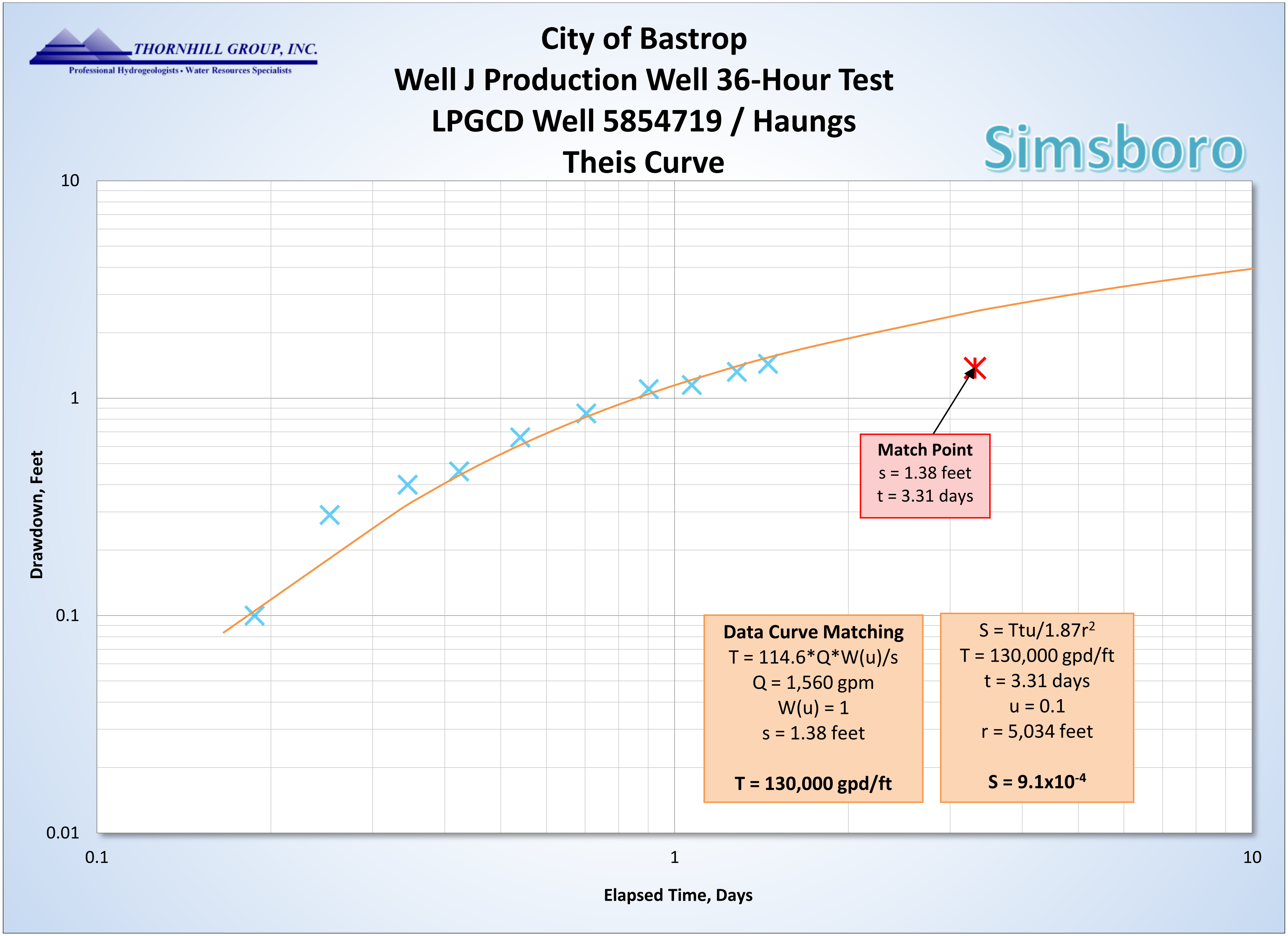




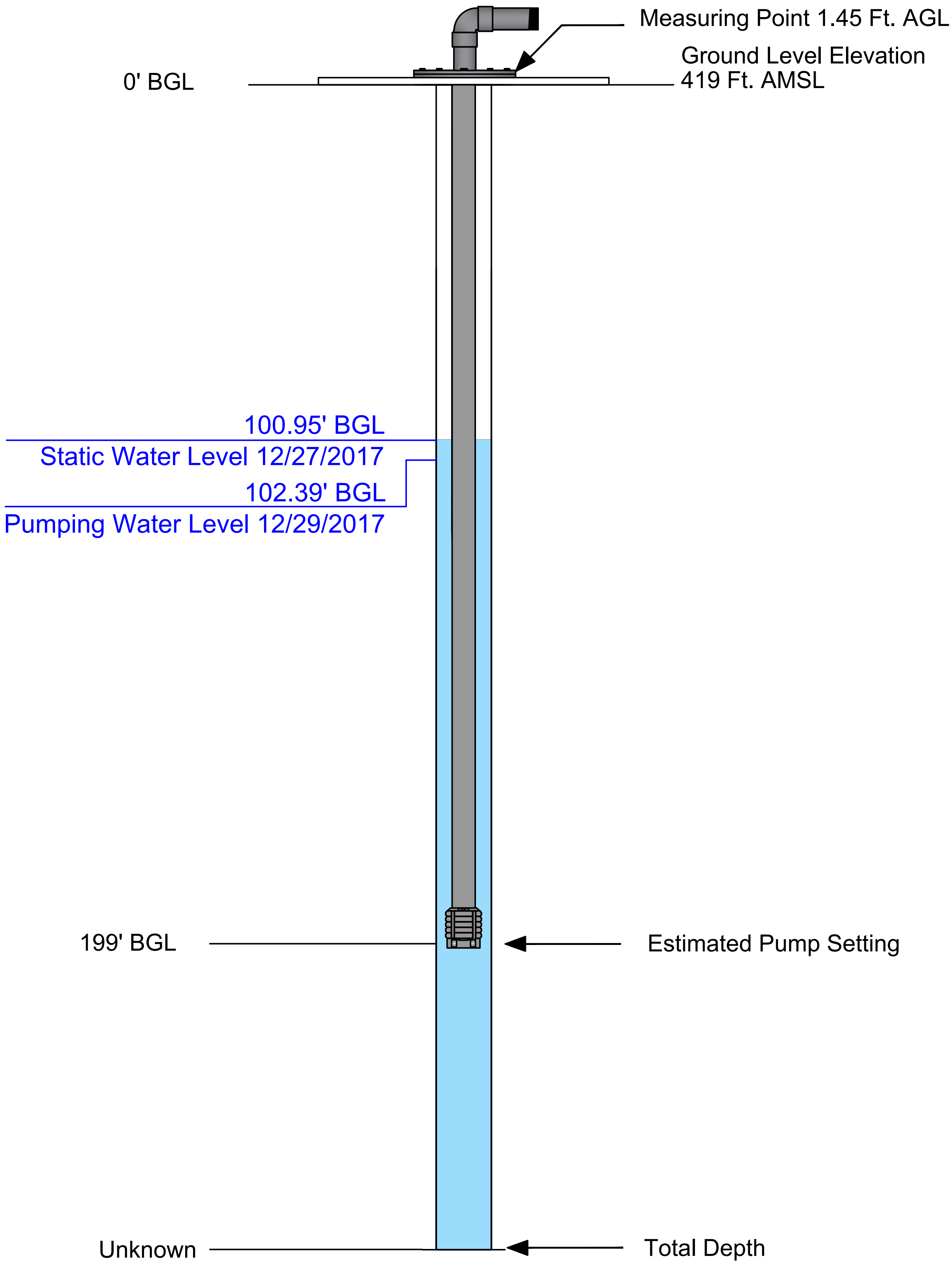
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854719 / Haungs
Hydrograph
Simsboro
Pump On
12/27/2017
12:30 pm
36-Hour Pumping Test
Pump Off
12/29/2017
12:30 am
Static Water Level 12/27/2017 = 100.95 feet BGL
Depth to Water, Feet Below Ground Level (BGL)
100
101
102
103
104
105
12/27/2017 00:00
12/28/2017 00:00
12/29/2017 00:00
12/30/2017 00:00
Date/Time
Manual Measurements
Static Water Level
Distance to Production Well = 5,034 feet
36-Hour Water Level = 102.39 feet BGL
36-Hour Interference Drawdown = 1.44 feet
Monitoring Minimum Level = 100.11 feet
Monitoring Maximum Level = 102.39 feet


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854719 / Haungs
Cooper-Jacob Chart (Drawdown)
Simsboro
Water Level Drawdown, Feet
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Cooper-Jacob Solution not valid, μ > 0.05
$\mu = \frac{1.87r^2S}{Tt}$
r = 5,034 feet
S = 9.1x10^{-4}
T = 130,000 gpd/ft
t = 1.5 days
μ = 0.22
1
10
100
1,000
10,000
Elapsed Time, Minutes


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36 Hour Test
LPGCD Well 5854719 / Haungs
Cooper-Jacob Chart (Recovery)
Simsboro
Residual Recovery (s'), feet
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
10
100
Time Ratio (t/t')
Cooper-Jacob Solution
not valid, μ > 0.05

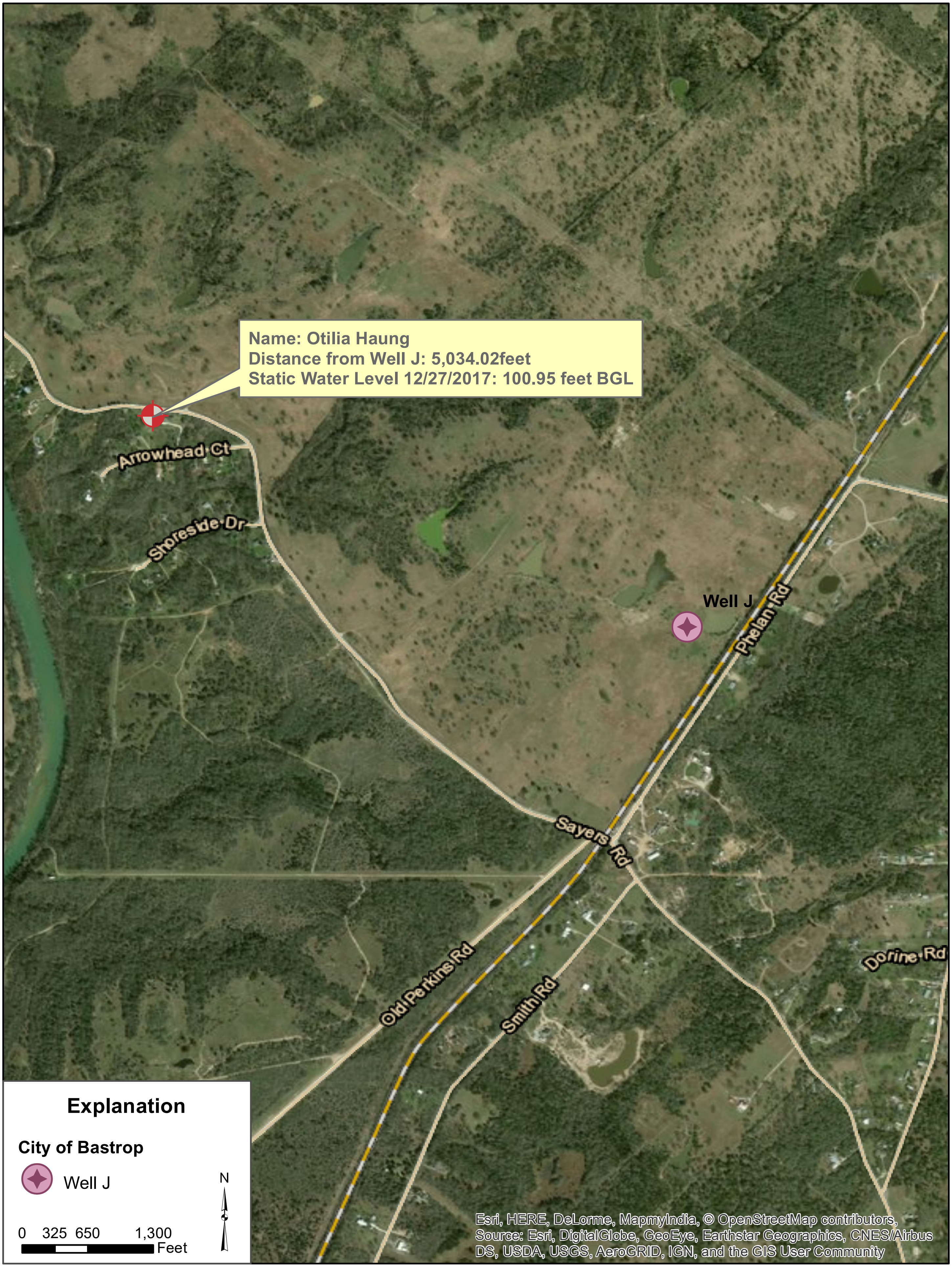

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854719 / Haungs
Theis Curve
Simsboro
Drawdown, Feet
10
1
0.1
0.01
0.1
1
10
Elapsed Time, Days
Match Point
s = 1.38 feet
t = 3.31 days
Data Curve Matching
T = 114.6*Q*W(u)/s
Q = 1,560 gpm
W(u) = 1
s = 1.38 feet
T = 130,000 gpd/ft
S = Ttu/1.87r²
T = 130,000 gpd/ft
t = 3.31 days
u = 0.1
r = 5,034 feet
S = 9.1x10⁻⁴

LPGCD Well 5854719 / Haungs



Well construction details compiled from State of Texas Well Report, LPGCD records, and/or TGI field investigations.

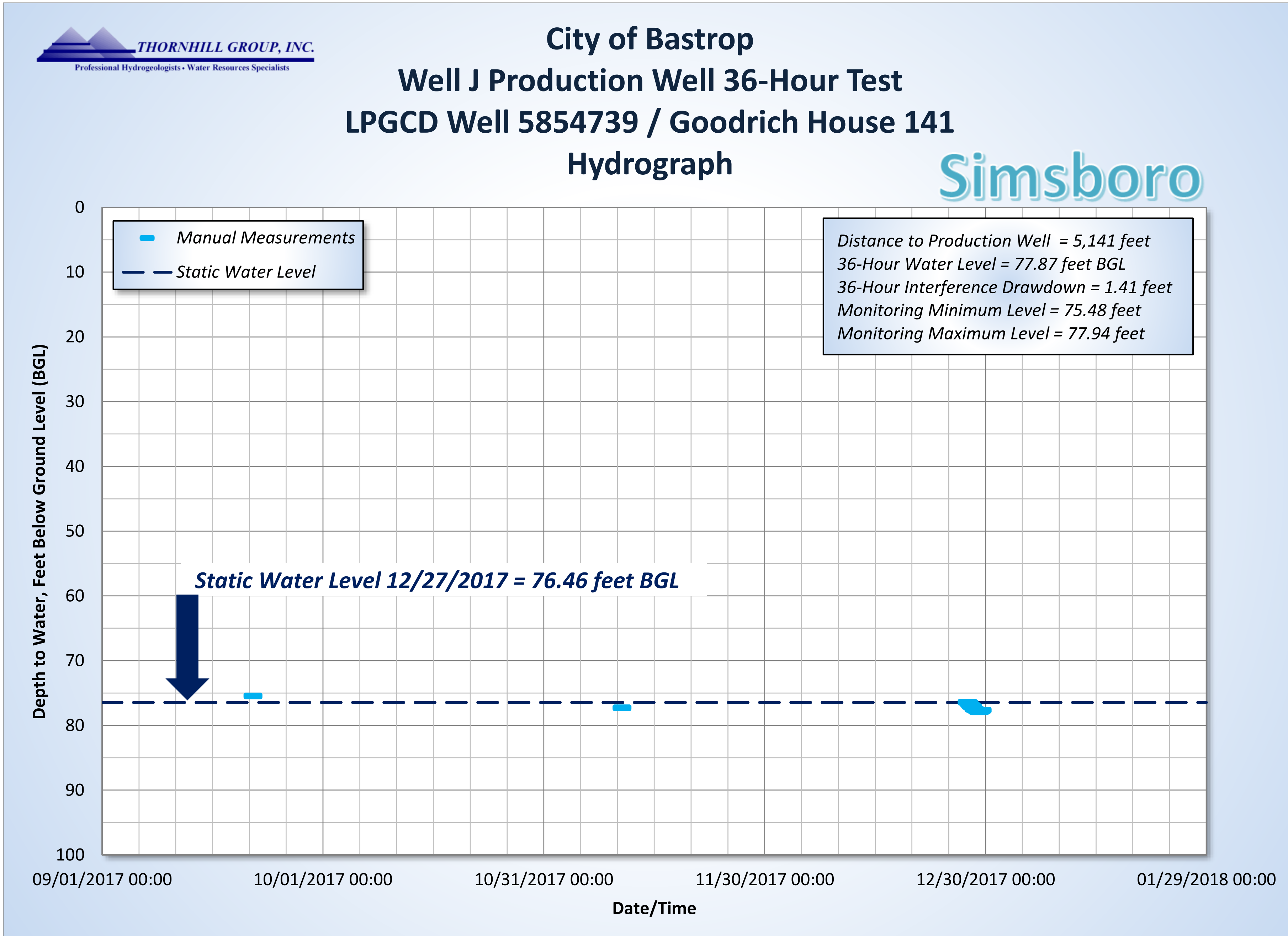
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists

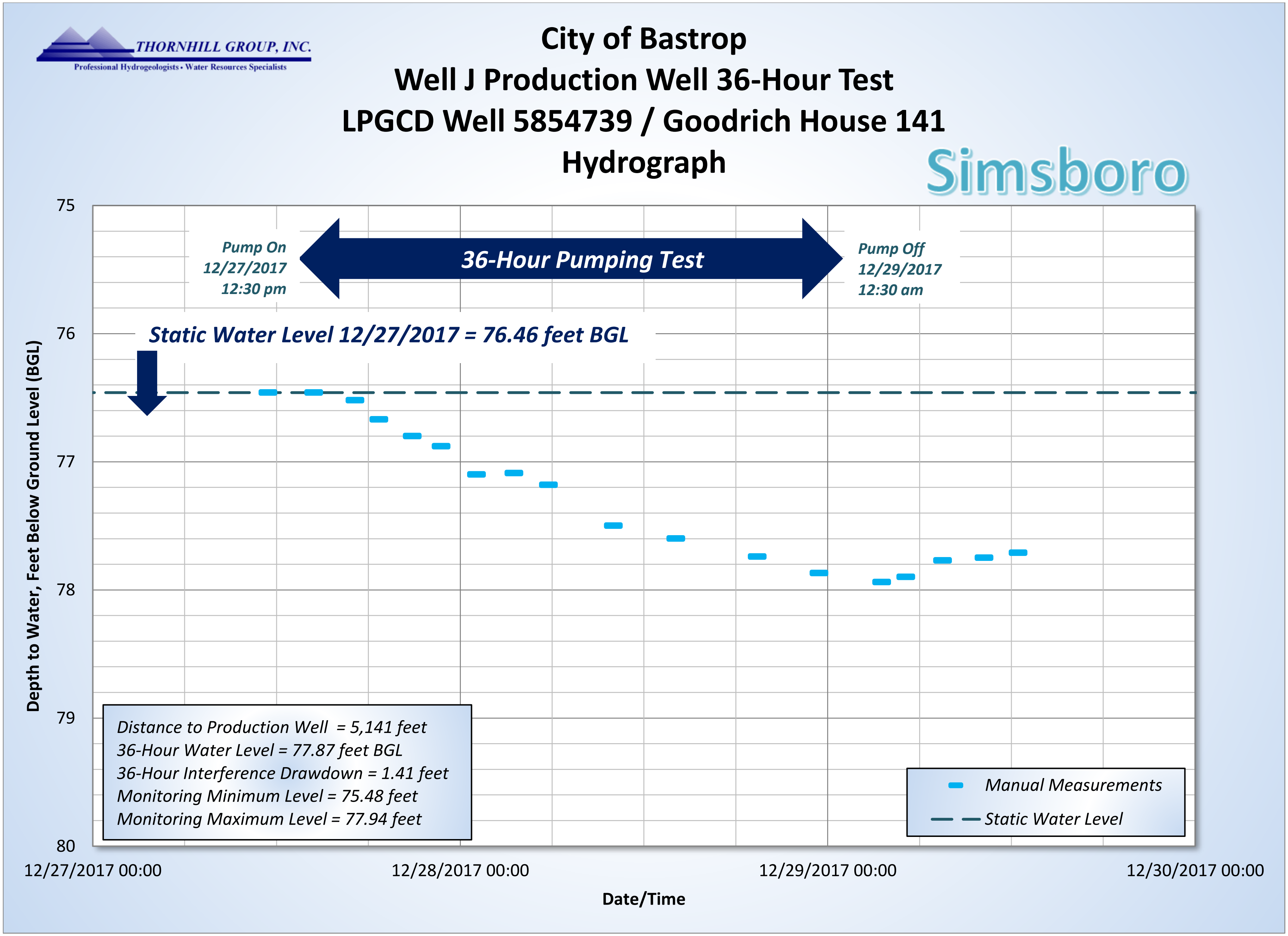

Name: Otilia Haung
Distance from Well J: 5,034.02feet
Static Water Level 12/27/2017: 100.95 feet BGL
Arrowhead Ct
Shoreside Dr
Well J
Phelan Rd
Sayers Rd
Old Perkins Rd
Smith Rd
Dorine Rd
Explanation
City of Bastrop
Well J
0 325 650 1,300
Feet
N
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors,
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

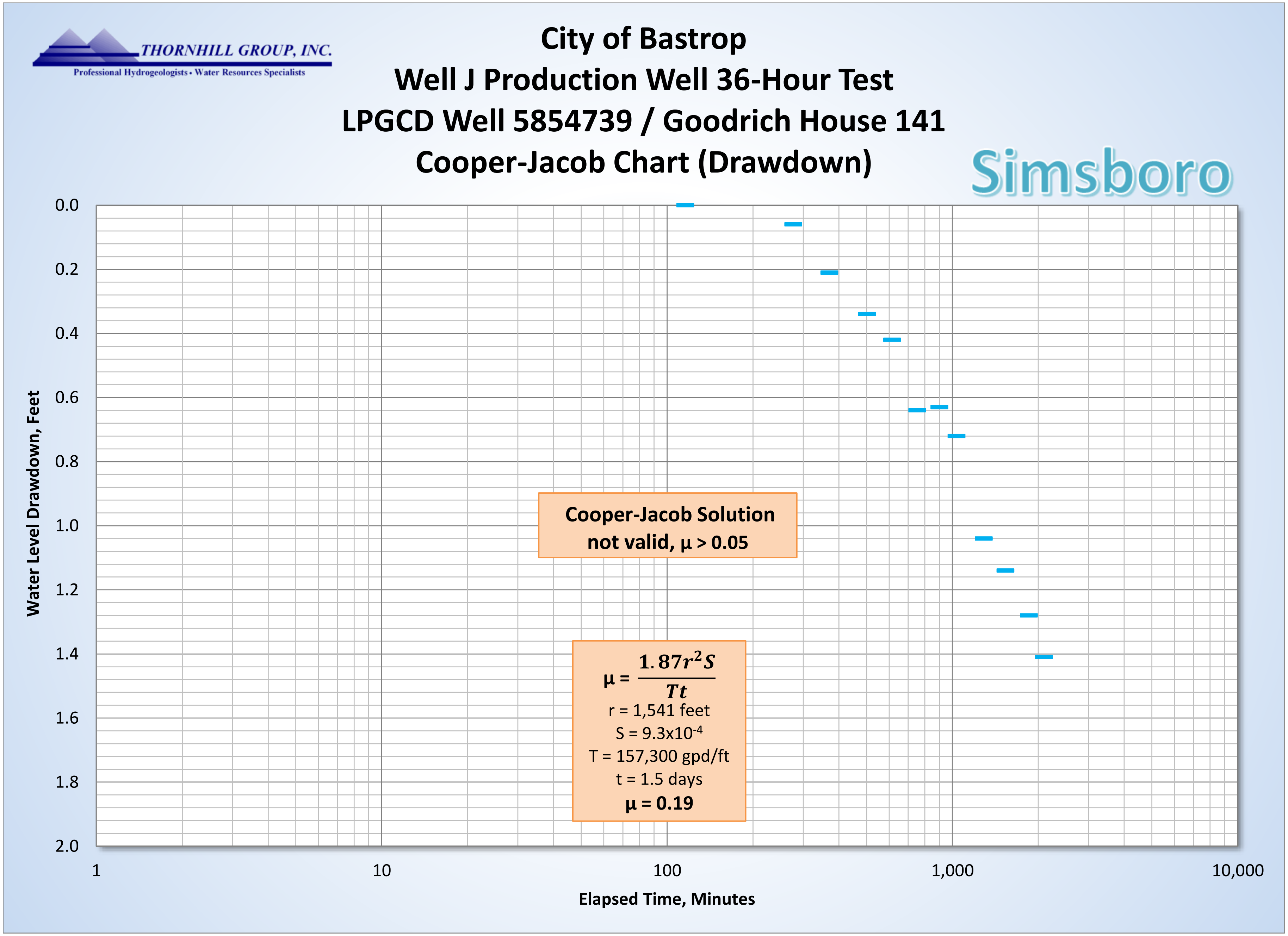
City of Bastrop
LPGCD Well 5854739 / Goodrich House 141
36-Hour Drawdown and Recovery Results

Project: 10210
County: Bastrop
Aquifer Tested: Simsboro
Distance from Production Well: 5,141 feet
Production Well: Well J
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

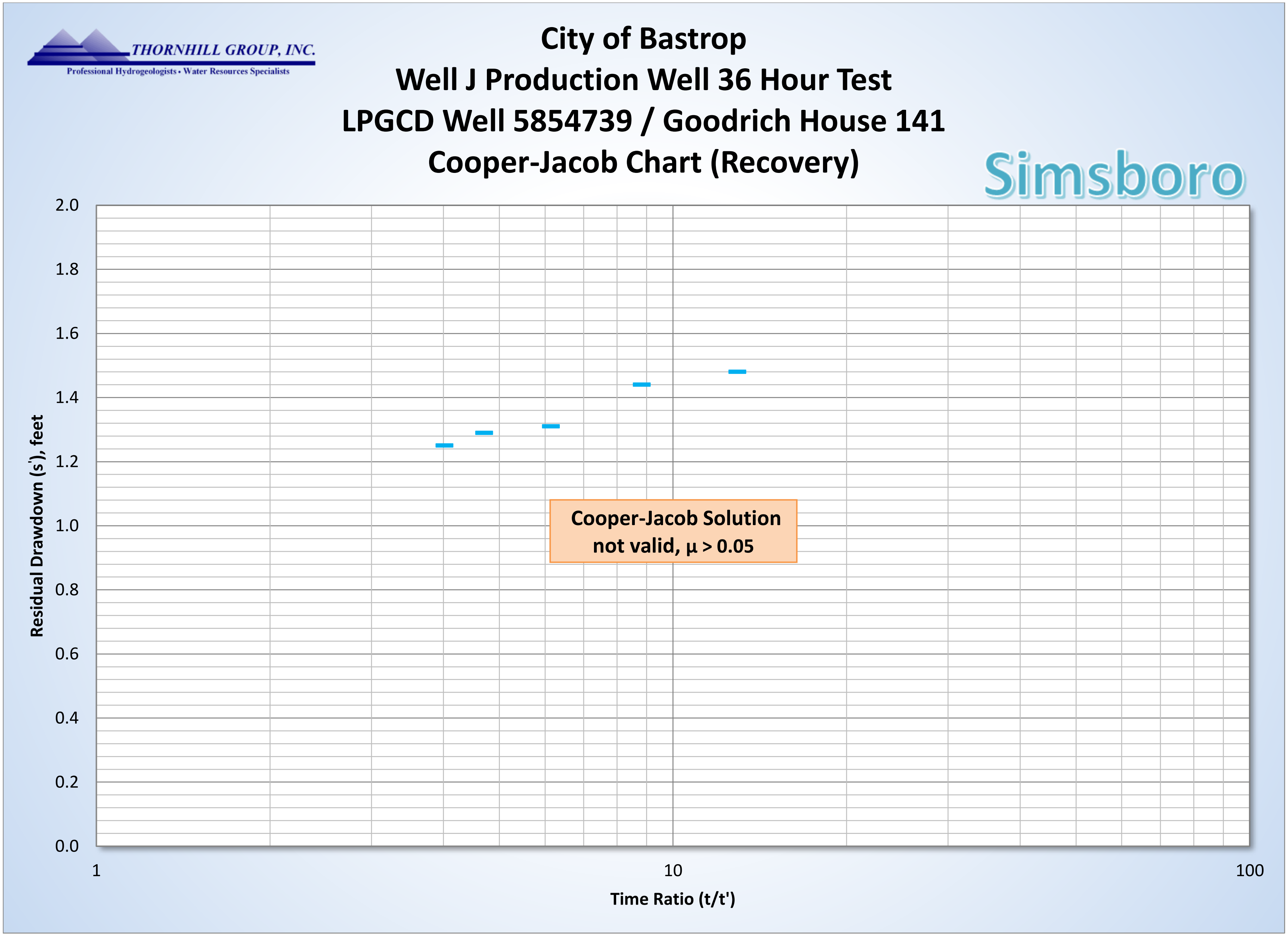
Date / Time	Depth to Water (Feet Below Land Surface)	Remarks
9/21/2017 11:35	75.48	Background
11/10/2017 14:29	77.32	Background
12/27/2017 11:26	76.46	Static Water Level
12/27/2017 14:26	76.46	Production Well on: 12/27/2017 12:30 pm
12/27/2017 17:07	76.52	
12/27/2017 18:41	76.67	
12/27/2017 20:52	76.80	
12/27/2017 22:45	76.88	
12/28/2017 1:04	77.10	
12/28/2017 3:30	77.09	
12/28/2017 5:45	77.18	
12/28/2017 10:00	77.50	
12/28/2017 14:05	77.60	
12/28/2017 19:24	77.74	
12/28/2017 23:26	77.87	
12/29/2017 3:31	77.94	Production Well off: 12/29/2017 12:30 am
12/29/2017 5:06	77.90	
12/29/2017 7:30	77.77	
12/29/2017 10:13	77.75	
12/29/2017 12:26	77.71	

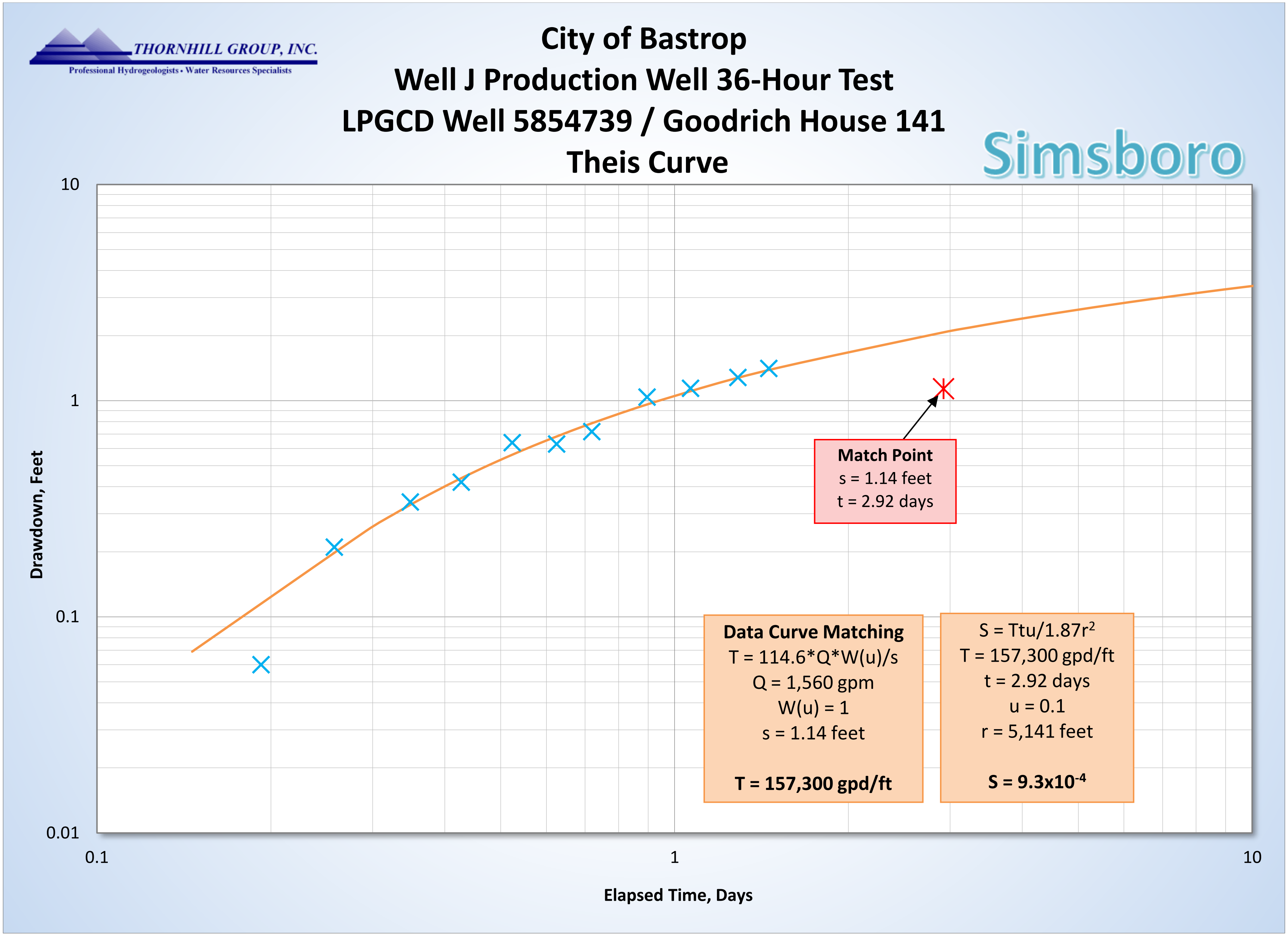

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854739 / Goodrich House 141
Hydrograph
Simsboro
Manual Measurements
Static Water Level
Distance to Production Well = 5,141 feet
36-Hour Water Level = 77.87 feet BGL
36-Hour Interference Drawdown = 1.41 feet
Monitoring Minimum Level = 75.48 feet
Monitoring Maximum Level = 77.94 feet
Static Water Level 12/27/2017 = 76.46 feet BGL
Depth to Water, Feet Below Ground Level (BGL)
0
10
20
30
40
50
60
70
80
90
100
09/01/2017 00:00
10/01/2017 00:00
10/31/2017 00:00
11/30/2017 00:00
12/30/2017 00:00
01/29/2018 00:00
Date/Time


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854739 / Goodrich House 141
Hydrograph
Simsboro
Pump On
12/27/2017
12:30 pm
36-Hour Pumping Test
Pump Off
12/29/2017
12:30 am
Static Water Level 12/27/2017 = 76.46 feet BGL
Depth to Water, Feet Below Ground Level (BGL)
75
76
77
78
79
80
Distance to Production Well = 5,141 feet
36-Hour Water Level = 77.87 feet BGL
36-Hour Interference Drawdown = 1.41 feet
Monitoring Minimum Level = 75.48 feet
Monitoring Maximum Level = 77.94 feet
Manual Measurements
Static Water Level
12/27/2017 00:00
12/28/2017 00:00
12/29/2017 00:00
12/30/2017 00:00
Date/Time



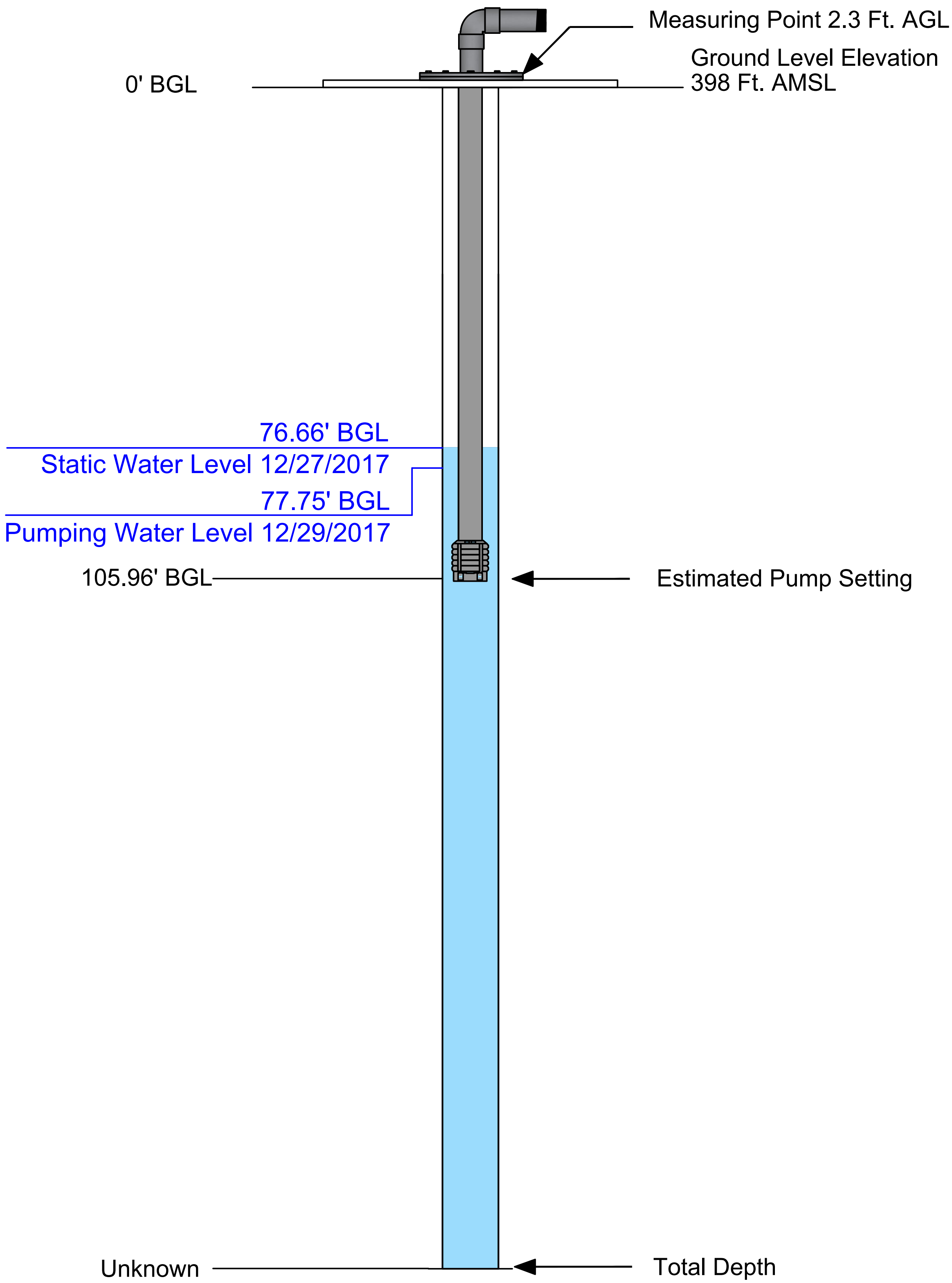
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854739 / Goodrich House 141
Cooper-Jacob Chart (Drawdown)
Simsboro
Water Level Drawdown, Feet
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1
10
100
1,000
10,000
Elapsed Time, Minutes
Cooper-Jacob Solution not valid, μ > 0.05
$\mu = \frac{1.87r^2S}{Tt}$
r = 1,541 feet
S = 9.3x10^{-4}
T = 157,300 gpd/ft
t = 1.5 days
μ = 0.19


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36 Hour Test
LPGCD Well 5854739 / Goodrich House 141
Cooper-Jacob Chart (Recovery)
Simsboro
Residual Drawdown (s'), feet
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
10
100
Time Ratio (t/t')
Cooper-Jacob Solution not valid, μ > 0.05



THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854739 / Goodrich House 141
Theis Curve
Simsboro
10
1
0.1
0.01
0.1
1
10
Drawdown, Feet
Elapsed Time, Days
Match Point
s = 1.14 feet
t = 2.92 days
Data Curve Matching
T = 114.6*Q*W(u)/s
Q = 1,560 gpm
W(u) = 1
s = 1.14 feet
T = 157,300 gpd/ft
S = Ttu/1.87r²
T = 157,300 gpd/ft
t = 2.92 days
u = 0.1
r = 5,141 feet
S = 9.3x10⁻⁴

LPGCD Well 5854739 / Goodrich House 141



Well construction details compiled from State of Texas Well Report, LPGCD records, and/or TGI field investigations.

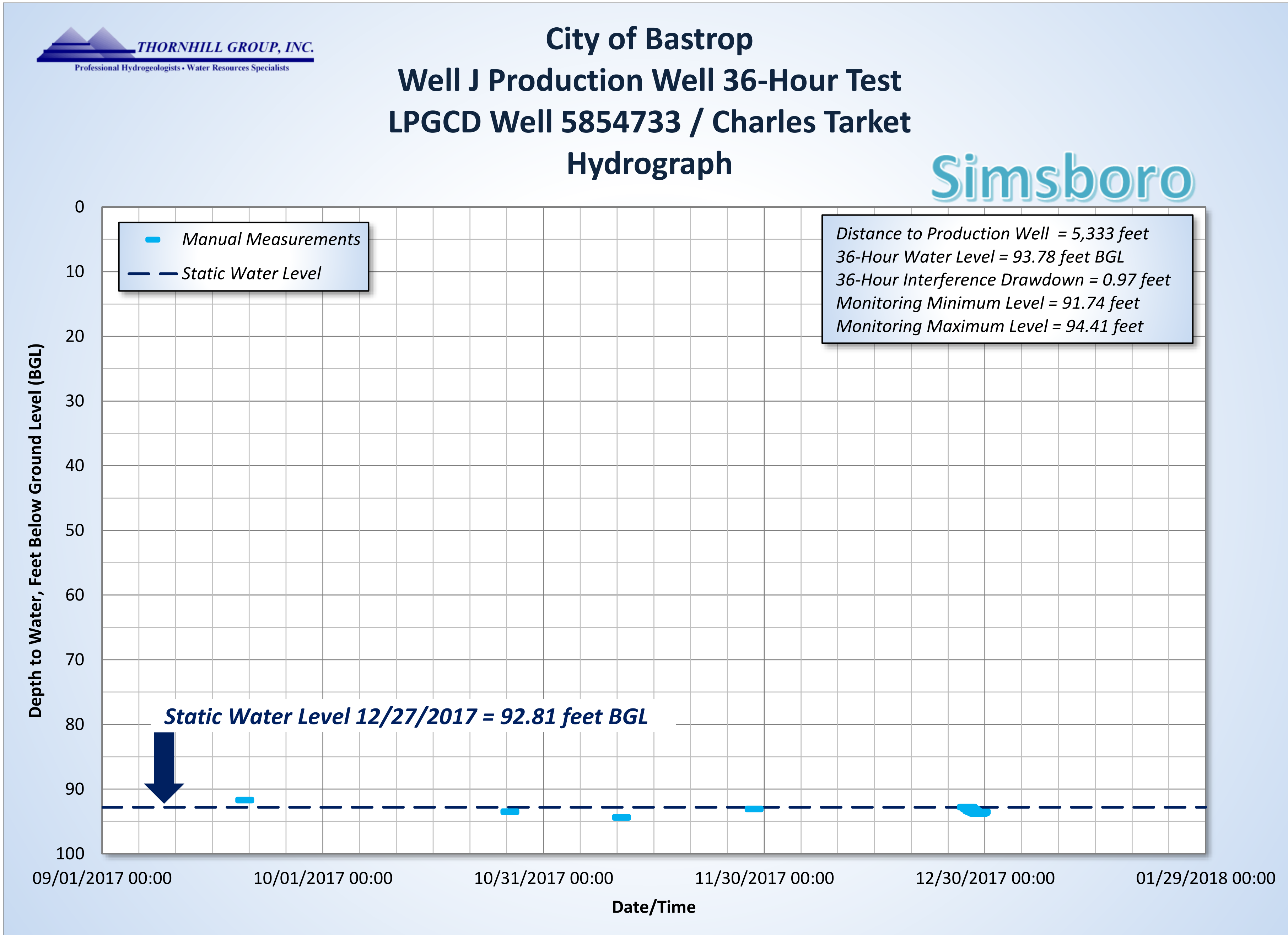
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists


Name: Goodrich House 141
Distance from Well J: 5,141.48 feet
Static Water Level 12/27/2017: 76.66 feet BGL
Rd
Arrowhead Ct
Shoreside Dr
Well J
Phelan Rd
Sayers Rd
Old Perkins Rd
Smith Rd
Explanation
City of Bastrop
Well J
N
0 325 650 1,300
Feet
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors

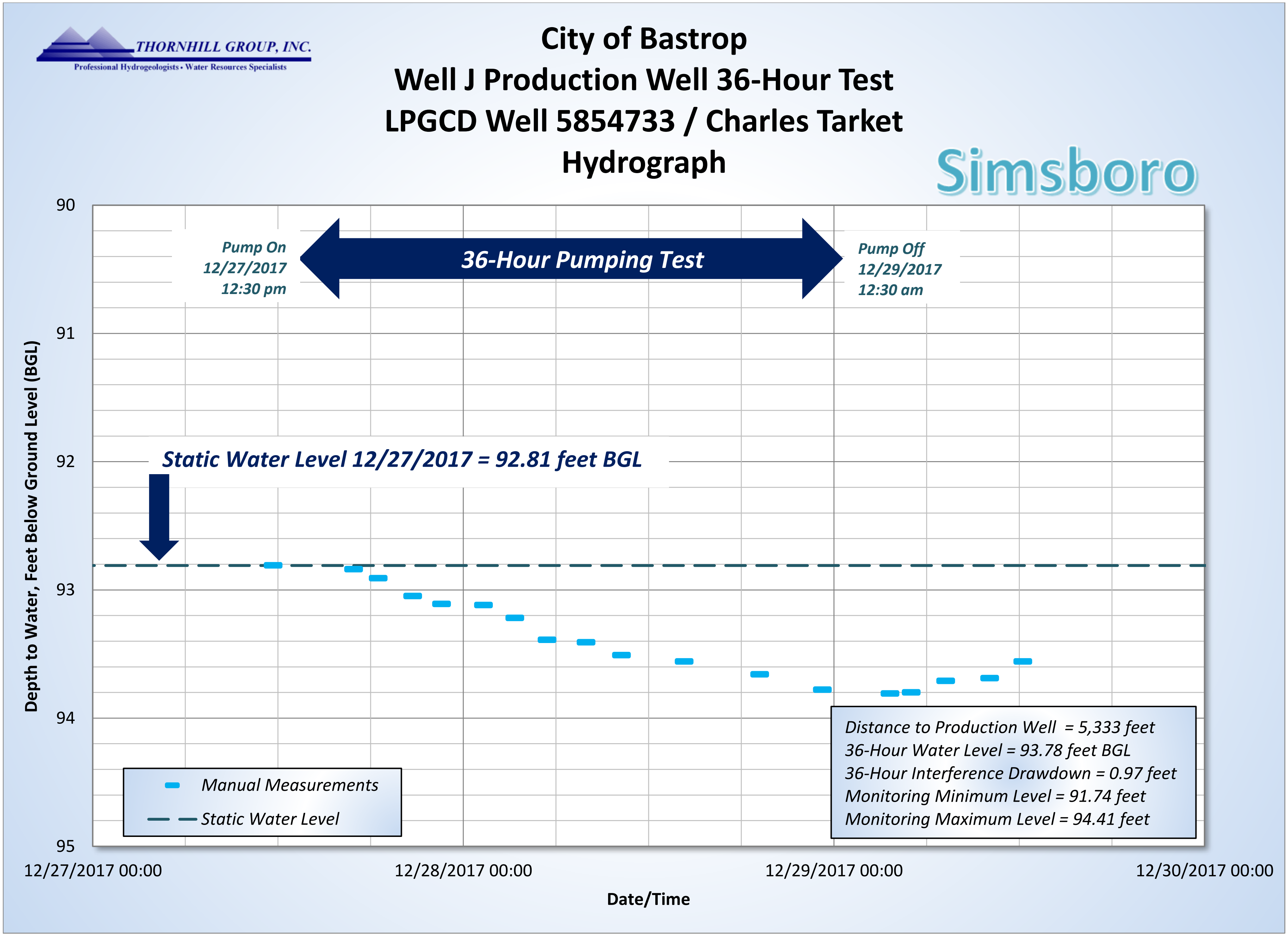
City of Bastrop
Tarket Well
36-Hour Drawdown and Recovery Results

Project: 10210
County: Bastrop
Aquifer Tested: Simsboro
Distance from Production Well: 5,333 feet
Production Well: Well J
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

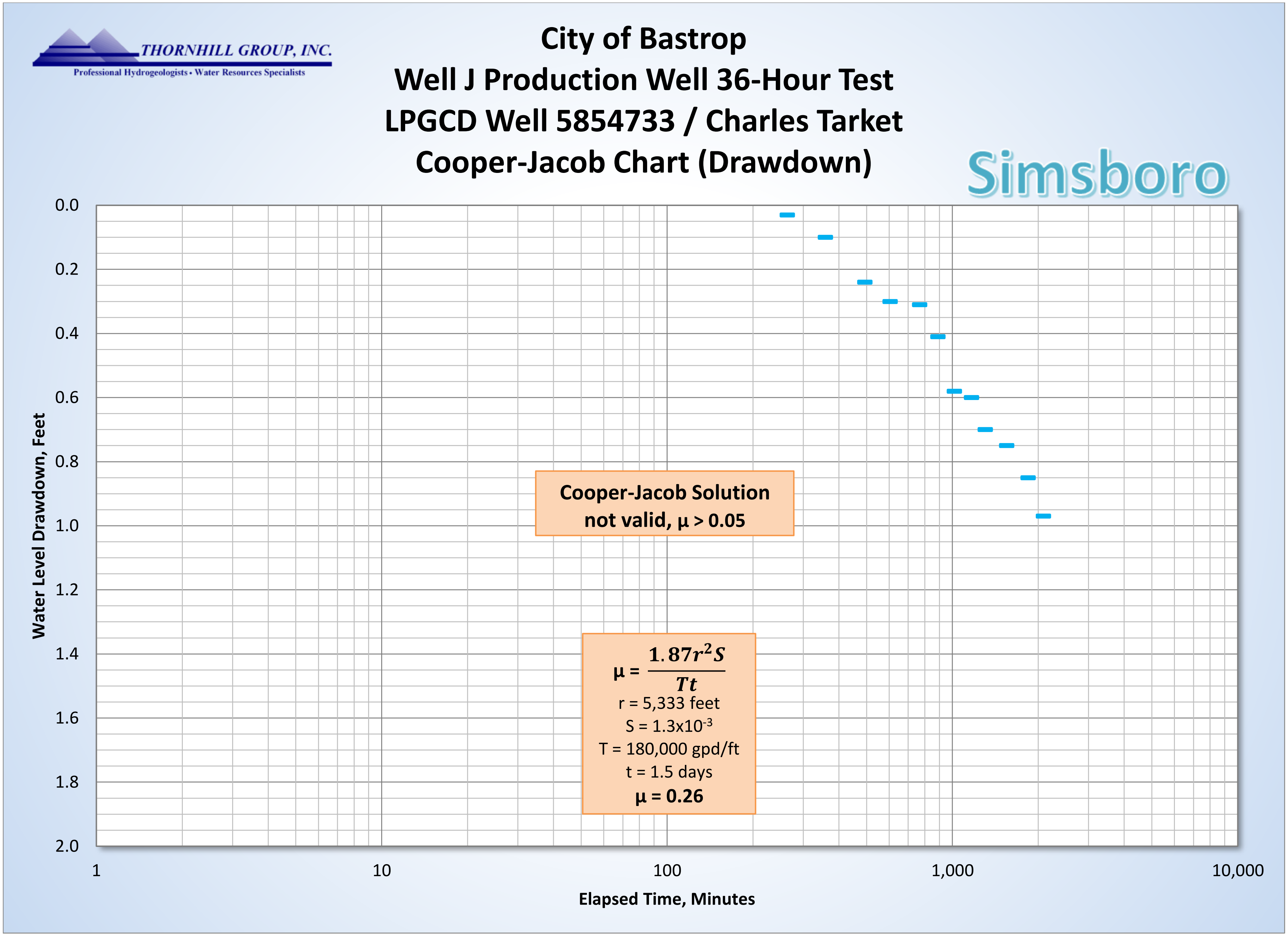
Date / Time	Depth to Water (Feet Below Land Surface)	Remarks
9/20/2017 9:35	91.74	Background
10/26/2017 10:48	93.54	Background
11/10/2017 14:20	94.41	Background
11/28/2017 15:20	93.11	Background
12/27/2017 11:41	92.81	Static Water Level
12/27/2017 16:54	92.84	Production Well on: 12/27/2017 12:30 pm
12/27/2017 18:29	92.91	
12/27/2017 20:43	93.05	
12/27/2017 22:35	93.11	
12/28/2017 1:18	93.12	
12/28/2017 3:20	93.22	
12/28/2017 5:25	93.39	
12/28/2017 7:57	93.41	
12/28/2017 10:14	93.51	
12/28/2017 14:18	93.56	
12/28/2017 19:11	93.66	
12/28/2017 23:15	93.78	
12/29/2017 3:38	93.81	Production Well off: 12/29/2017 12:30 am
12/29/2017 5:00	93.80	
12/29/2017 7:14	93.71	
12/29/2017 10:05	93.69	
12/29/2017 12:14	93.56	



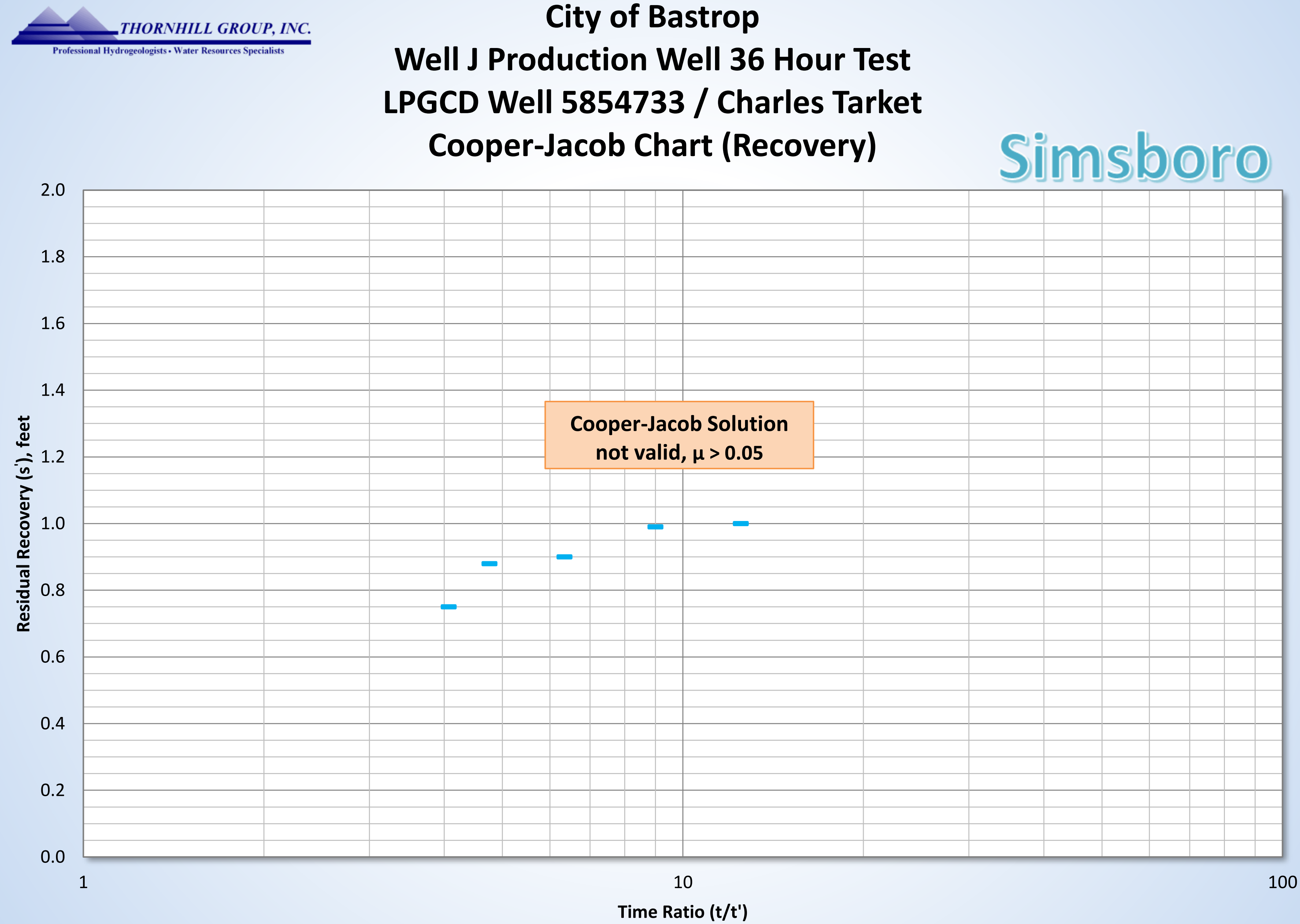
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854733 / Charles Tarket
Hydrograph
Simsboro
Manual Measurements
Static Water Level
Distance to Production Well = 5,333 feet
36-Hour Water Level = 93.78 feet BGL
36-Hour Interference Drawdown = 0.97 feet
Monitoring Minimum Level = 91.74 feet
Monitoring Maximum Level = 94.41 feet
Static Water Level 12/27/2017 = 92.81 feet BGL
Depth to Water, Feet Below Ground Level (BGL)
0
10
20
30
40
50
60
70
80
90
100
09/01/2017 00:00
10/01/2017 00:00
10/31/2017 00:00
11/30/2017 00:00
12/30/2017 00:00
01/29/2018 00:00
Date/Time

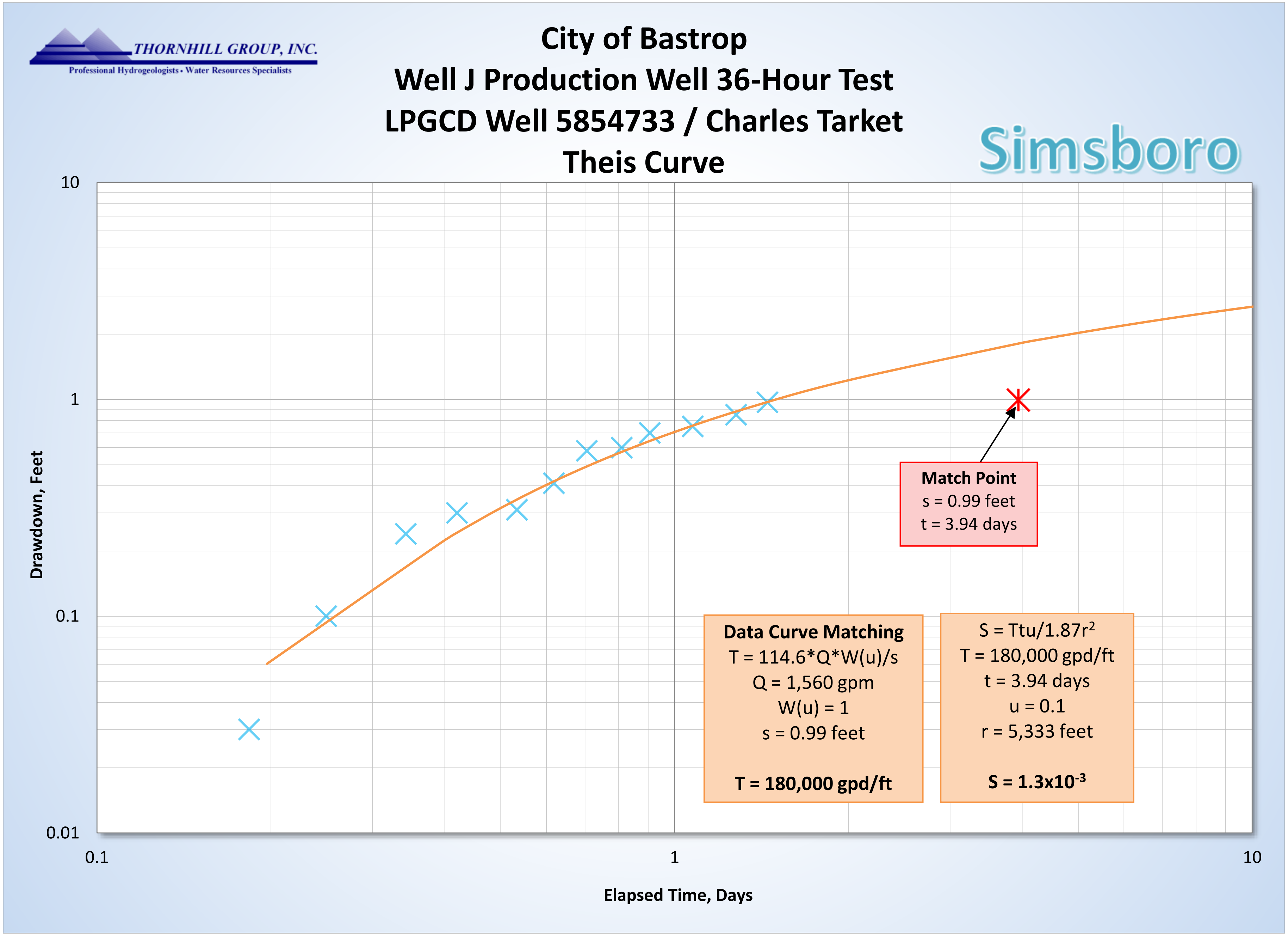


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854733 / Charles Tarket
Hydrograph
Simsboro
Pump On
12/27/2017
12:30 pm
36-Hour Pumping Test
Pump Off
12/29/2017
12:30 am
Static Water Level 12/27/2017 = 92.81 feet BGL
Depth to Water, Feet Below Ground Level (BGL)
90
91
92
93
94
95
Manual Measurements
Static Water Level
Distance to Production Well = 5,333 feet
36-Hour Water Level = 93.78 feet BGL
36-Hour Interference Drawdown = 0.97 feet
Monitoring Minimum Level = 91.74 feet
Monitoring Maximum Level = 94.41 feet
12/27/2017 00:00
12/28/2017 00:00
12/29/2017 00:00
12/30/2017 00:00
Date/Time

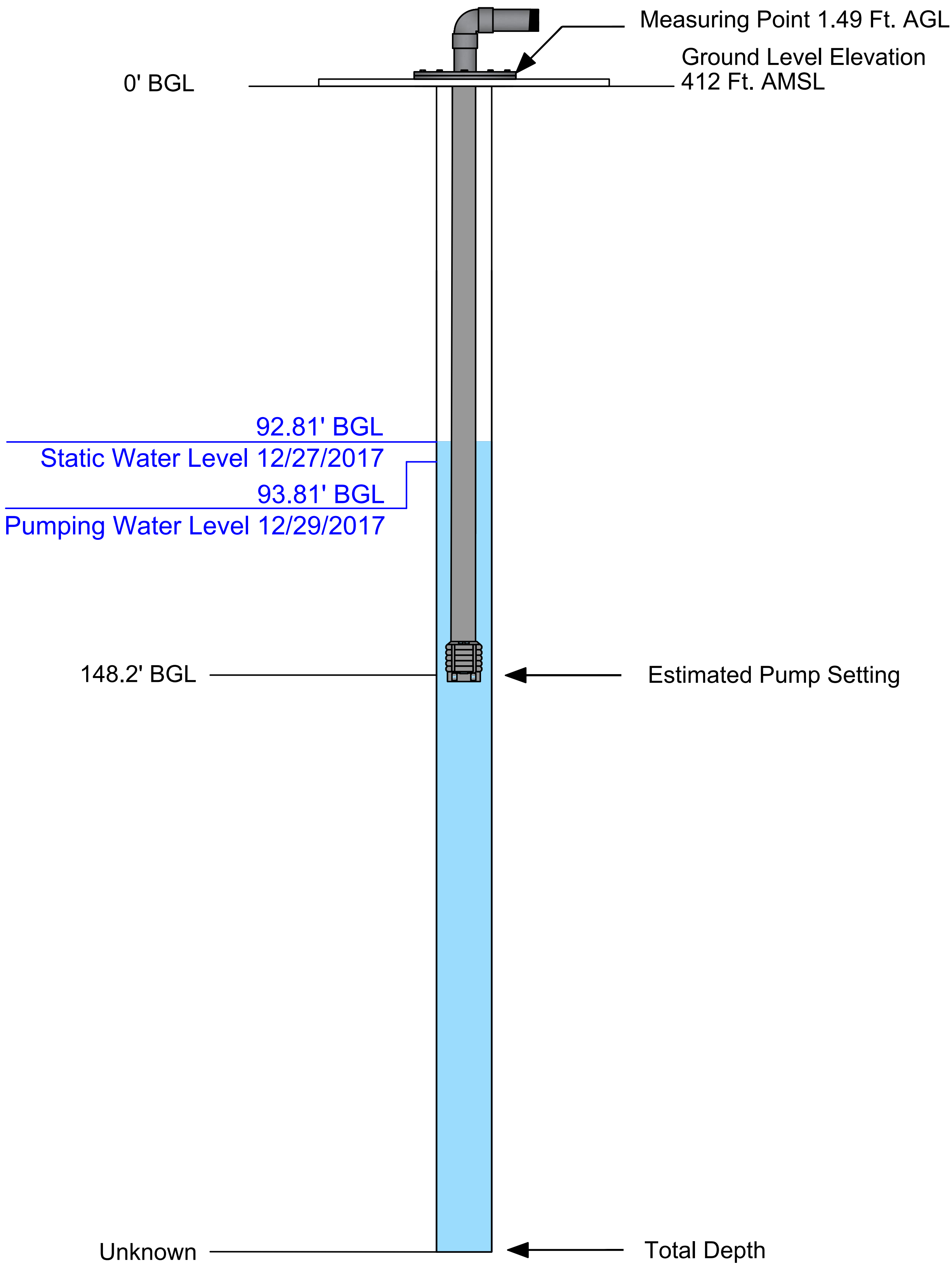

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854733 / Charles Tarket
Cooper-Jacob Chart (Drawdown)
Simsboro
Water Level Drawdown, Feet
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1
10
100
1,000
10,000
Elapsed Time, Minutes
Cooper-Jacob Solution not valid, μ > 0.05
μ = 1.87r²S / Tt
r = 5,333 feet
S = 1.3x10-3
T = 180,000 gpd/ft
t = 1.5 days
μ = 0.26

City of Bastrop
Well J Production Well 36 Hour Test
LPGCD Well 5854733 / Charles Tarket
Cooper-Jacob Chart (Recovery)




THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854733 / Charles Tarket
Theis Curve
Simsboro
Drawdown, Feet
10
1
0.1
0.01
0.1
1
10
Elapsed Time, Days
Match Point
s = 0.99 feet
t = 3.94 days
Data Curve Matching
T = 114.6*Q*W(u)/s
Q = 1,560 gpm
W(u) = 1
s = 0.99 feet
T = 180,000 gpd/ft
S = Ttu/1.87r²
T = 180,000 gpd/ft
t = 3.94 days
u = 0.1
r = 5,333 feet
S = 1.3x10⁻³

LPGCD Well 5854733 / Tarket



Well construction details compiled from State of Texas Well Report, LPGCD records, and/or TGI field investigations.

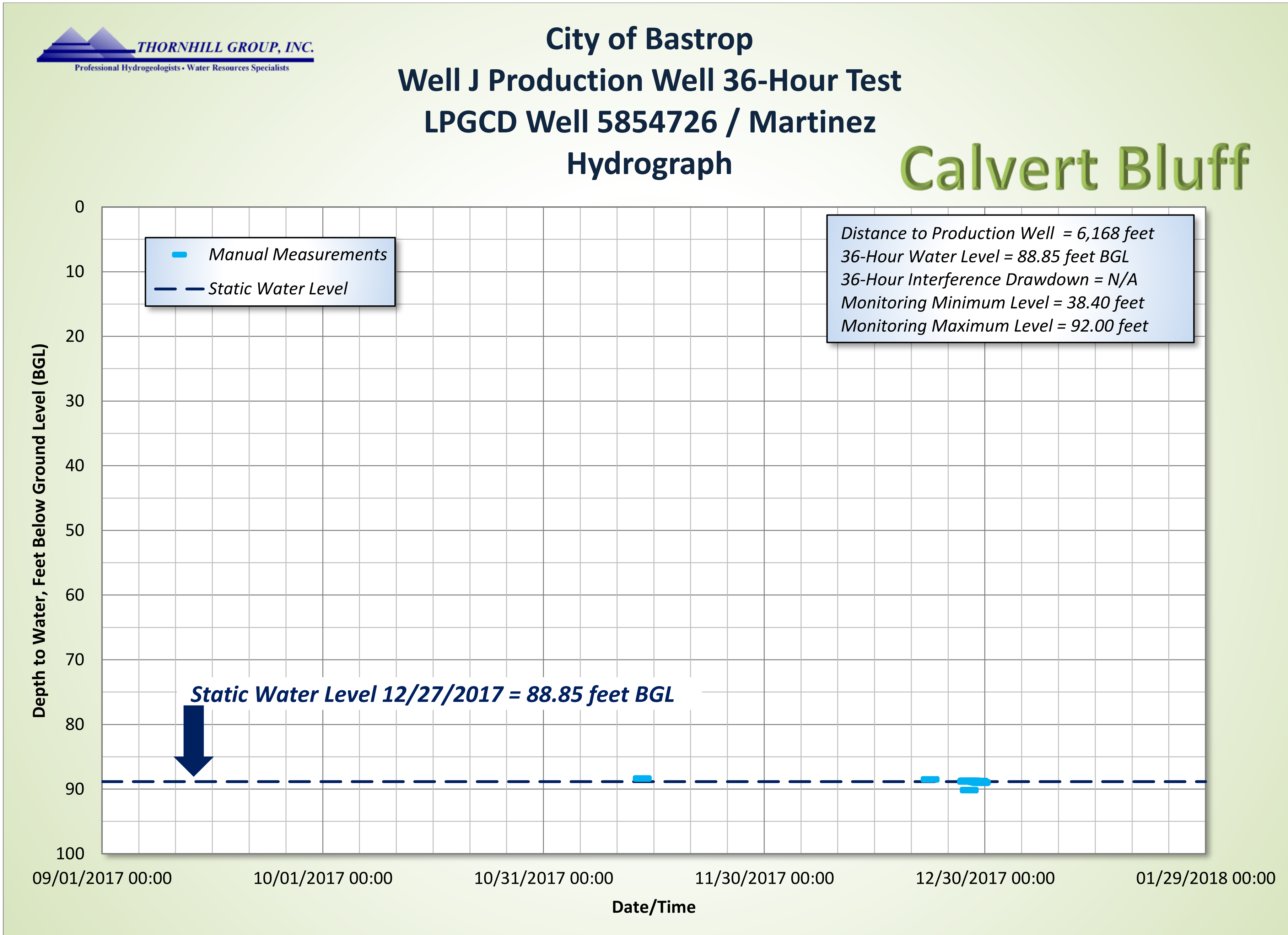
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists

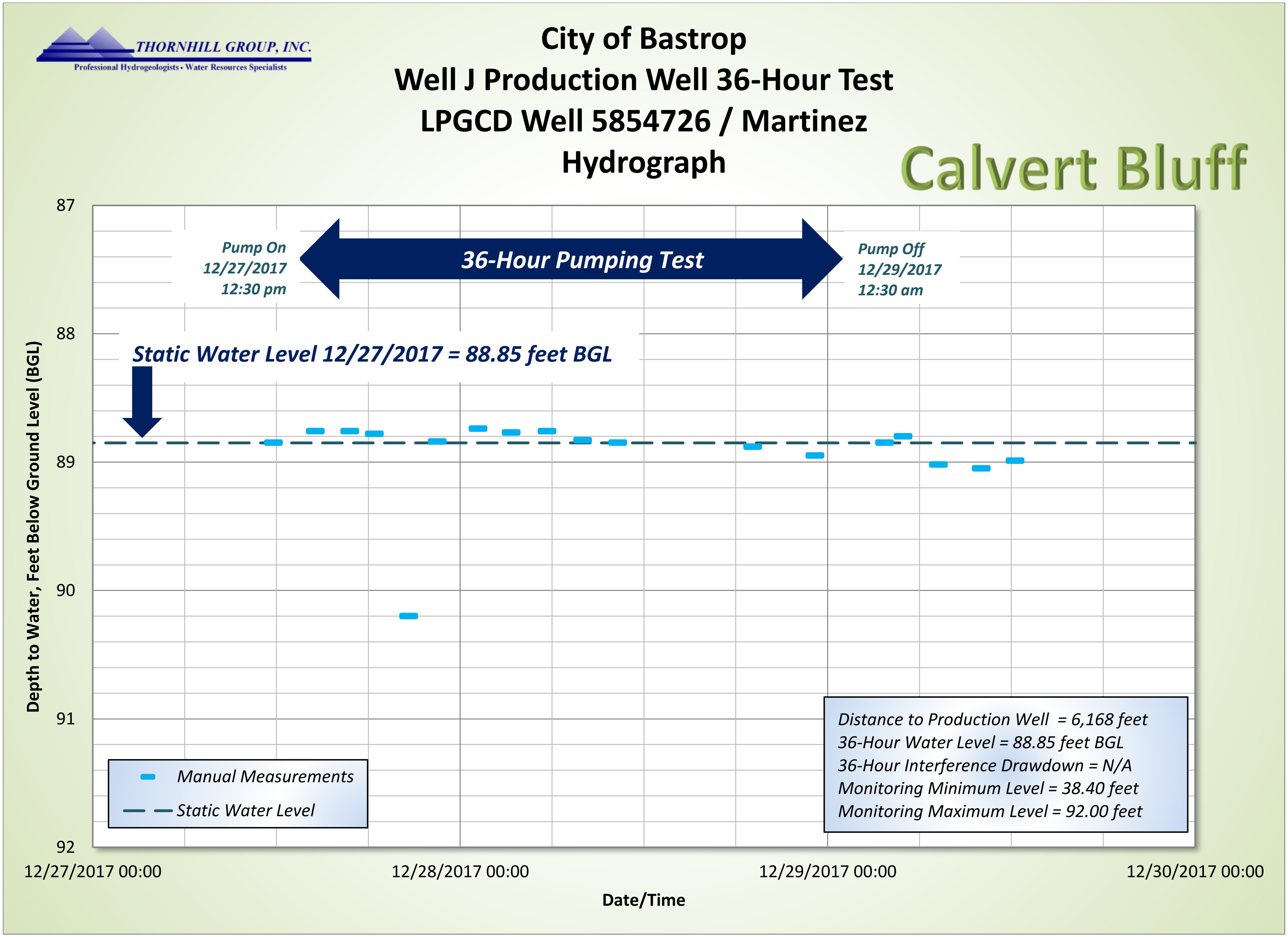
Name: Charles Tarket
Distance from Well J: 5,333.20 feet
Static Water Level 12/27/2017: 92.81 feet BGL
Arrowhead Ct
Shoreside Dr
Well J
Phelan Rd
Sayers Rd
Old Perkins Rd
Smith Rd
Explanation
City of Bastrop
Well J
N
0 325 650 1,300
Feet
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors,
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

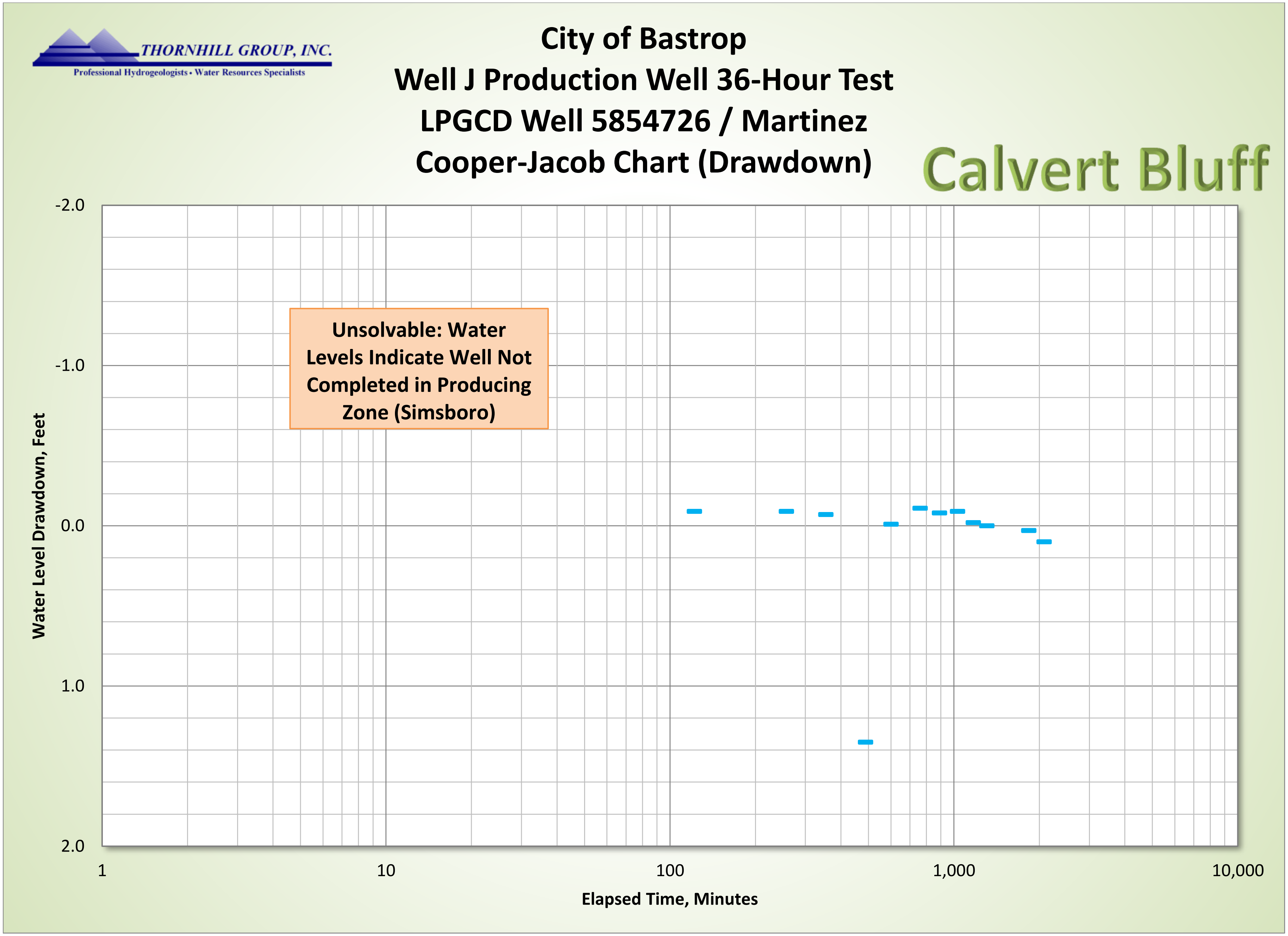
City of Bastrop
Martinez Well
36-Hour Drawdown and Recovery Results

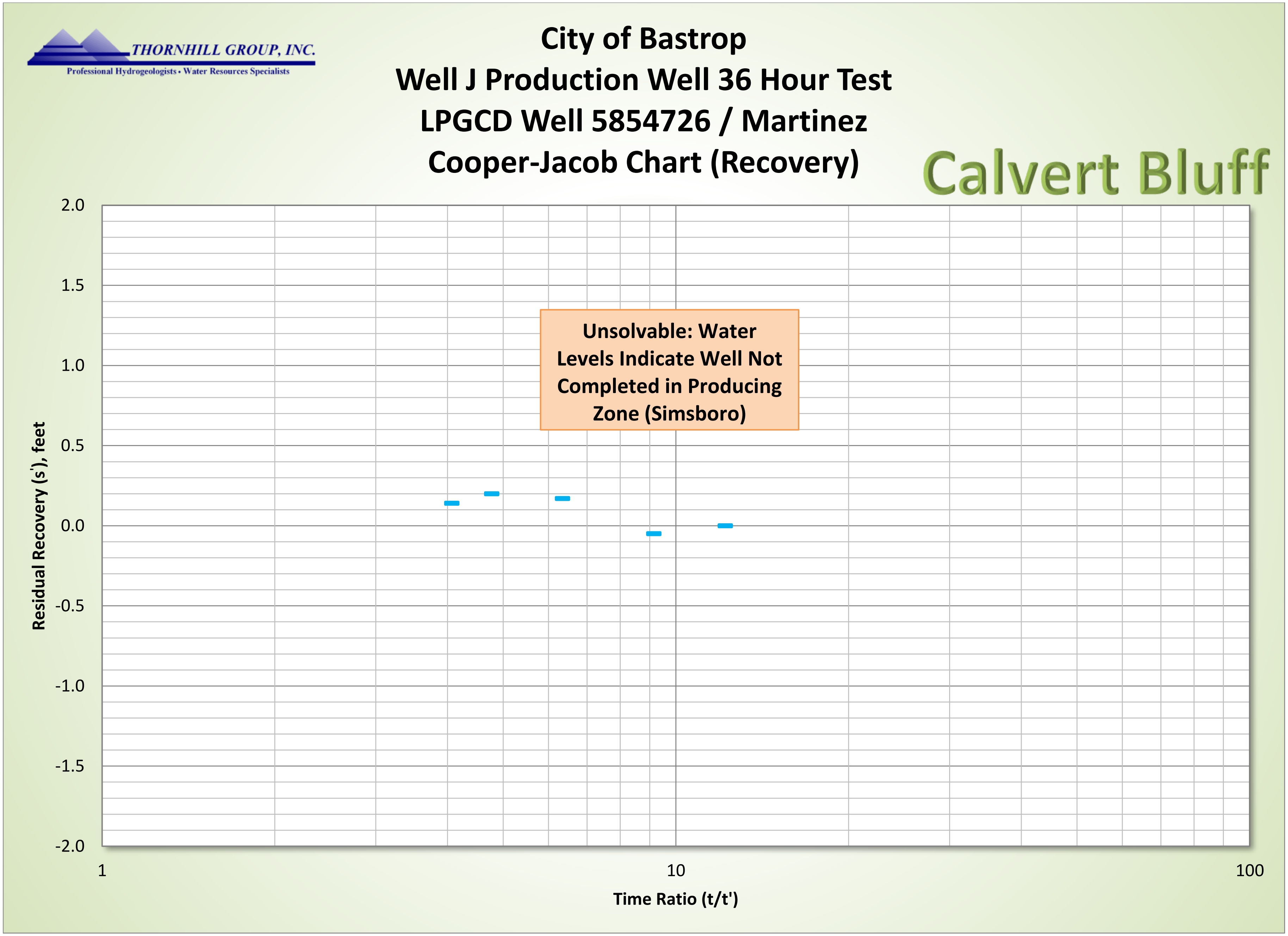
Project: 10210
County: Bastrop
Aquifer Tested: Simsboro
Distance from Production Well: 6,168 feet
Production Well: Well J
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

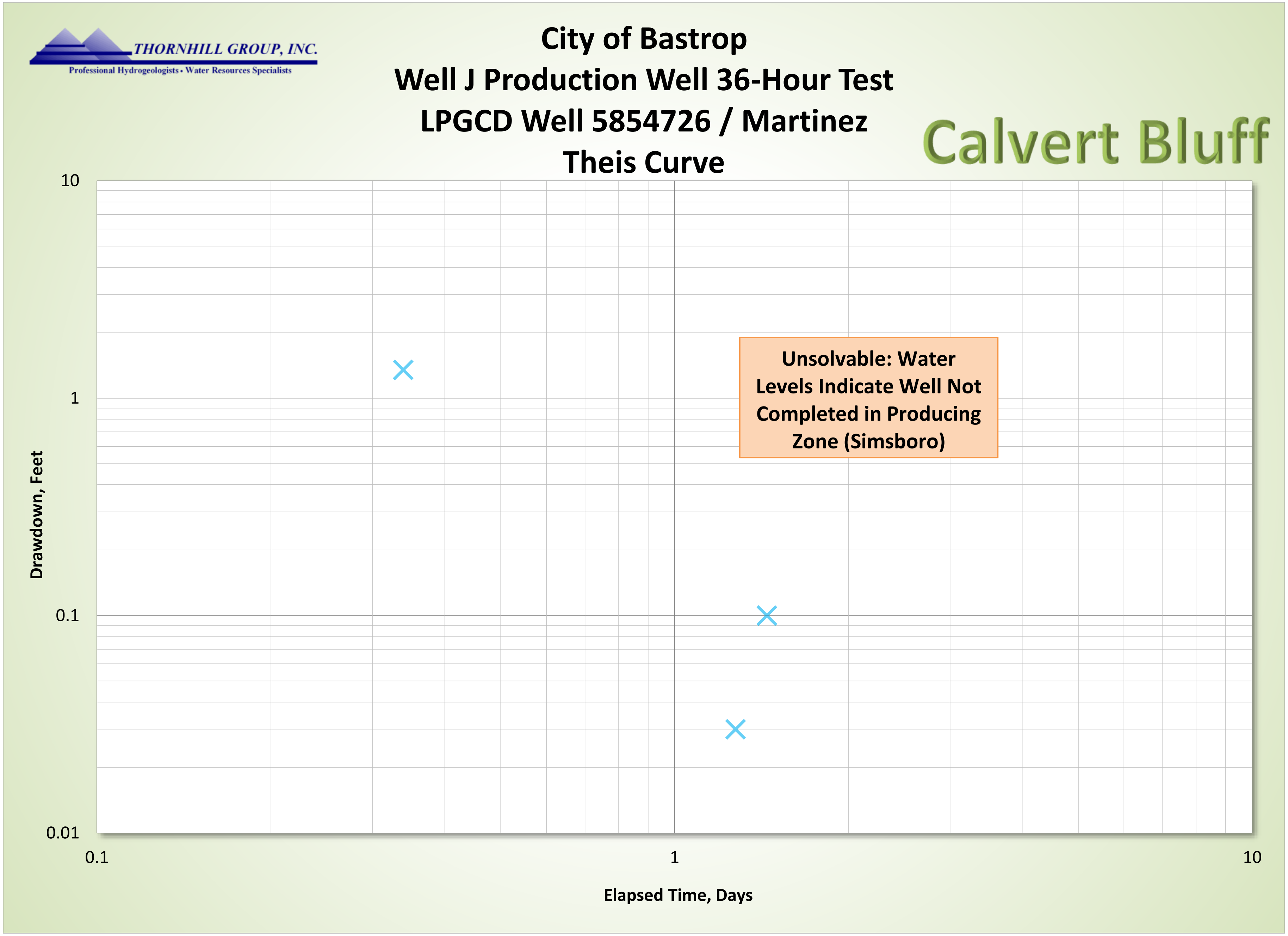
Date / Time	Depth to Water (Feet Below Land Surface)	Remarks
11/13/2017 10:16	88.40	Background
12/22/2017 13:31	88.55	Background
12/27/2017 11:48	88.85	Static Water Level
12/27/2017 14:32	88.76	Production Well on: 12/27/2017 12:30 pm
12/27/2017 16:47	88.76	
12/27/2017 18:24	88.78	
12/27/2017 20:38	90.20	
12/27/2017 22:30	88.84	
12/28/2017 1:10	88.74	
12/28/2017 3:20	88.77	
12/28/2017 5:40	88.76	
12/28/2017 8:00	88.83	
12/28/2017 10:17	88.85	
12/28/2017 19:06	88.88	
12/28/2017 23:10	88.95	
12/29/2017 3:43	88.85	Production Well off: 12/29/2017 12:30 am
12/29/2017 4:55	88.80	
12/29/2017 7:14	89.02	
12/29/2017 10:02	89.05	
12/29/2017 12:14	88.99	


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854726 / Martinez
Hydrograph
Calvert Bluff
Manual Measurements
Static Water Level
Distance to Production Well = 6,168 feet
36-Hour Water Level = 88.85 feet BGL
36-Hour Interference Drawdown = N/A
Monitoring Minimum Level = 38.40 feet
Monitoring Maximum Level = 92.00 feet
Static Water Level 12/27/2017 = 88.85 feet BGL
Depth to Water, Feet Below Ground Level (BGL)
0
10
20
30
40
50
60
70
80
90
100
09/01/2017 00:00
10/01/2017 00:00
10/31/2017 00:00
11/30/2017 00:00
12/30/2017 00:00
01/29/2018 00:00
Date/Time

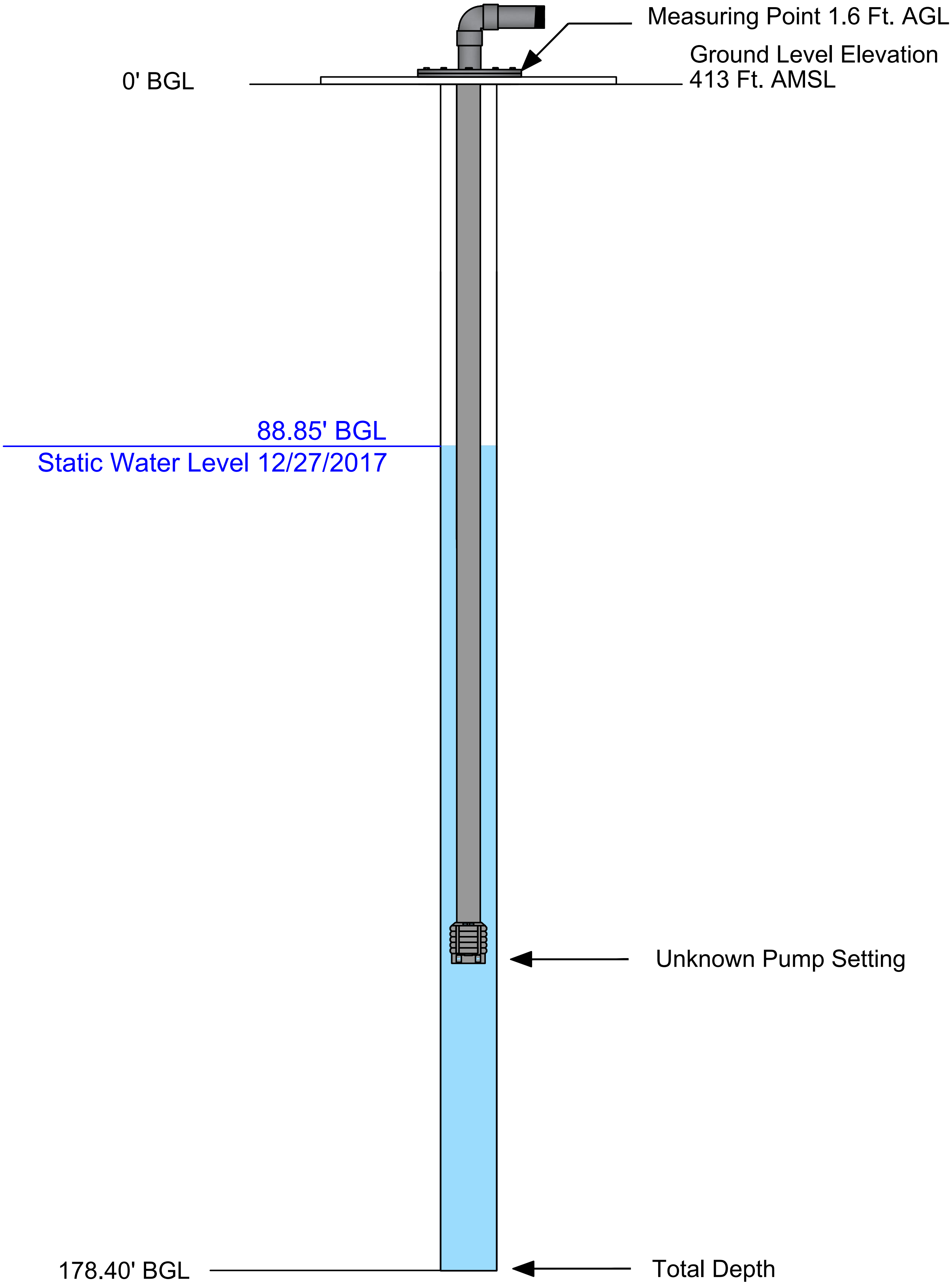

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854726 / Martinez
Hydrograph
Calvert Bluff
Pump On
12/27/2017
12:30 pm
36-Hour Pumping Test
Pump Off
12/29/2017
12:30 am
Static Water Level 12/27/2017 = 88.85 feet BGL
87
88
89
90
91
92
Depth to Water, Feet Below Ground Level (BGL)
12/27/2017 00:00
12/28/2017 00:00
12/29/2017 00:00
12/30/2017 00:00
Date/Time
Manual Measurements
Static Water Level
Distance to Production Well = 6,168 feet
36-Hour Water Level = 88.85 feet BGL
36-Hour Interference Drawdown = N/A
Monitoring Minimum Level = 38.40 feet
Monitoring Maximum Level = 92.00 feet


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854726 / Martinez
Cooper-Jacob Chart (Drawdown)
Calvert Bluff
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)
Water Level Drawdown, Feet
-2.0
-1.0
0.0
1.0
2.0
1
10
100
1,000
10,000
Elapsed Time, Minutes


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36 Hour Test
LPGCD Well 5854726 / Martinez
Cooper-Jacob Chart (Recovery)
Calvert Bluff
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)
Residual Recovery (s'), feet
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
1
10
100
Time Ratio (t/t')


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854726 / Martinez
Theis Curve
Calvert Bluff
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)
Drawdown, Feet
10
1
0.1
0.01
0.1
1
10
Elapsed Time, Days

LPGCD Well 5854726 / Martinez



Well construction details compiled from State of Texas Well Report, LPGCD records, and/or TGI field investigations.

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists

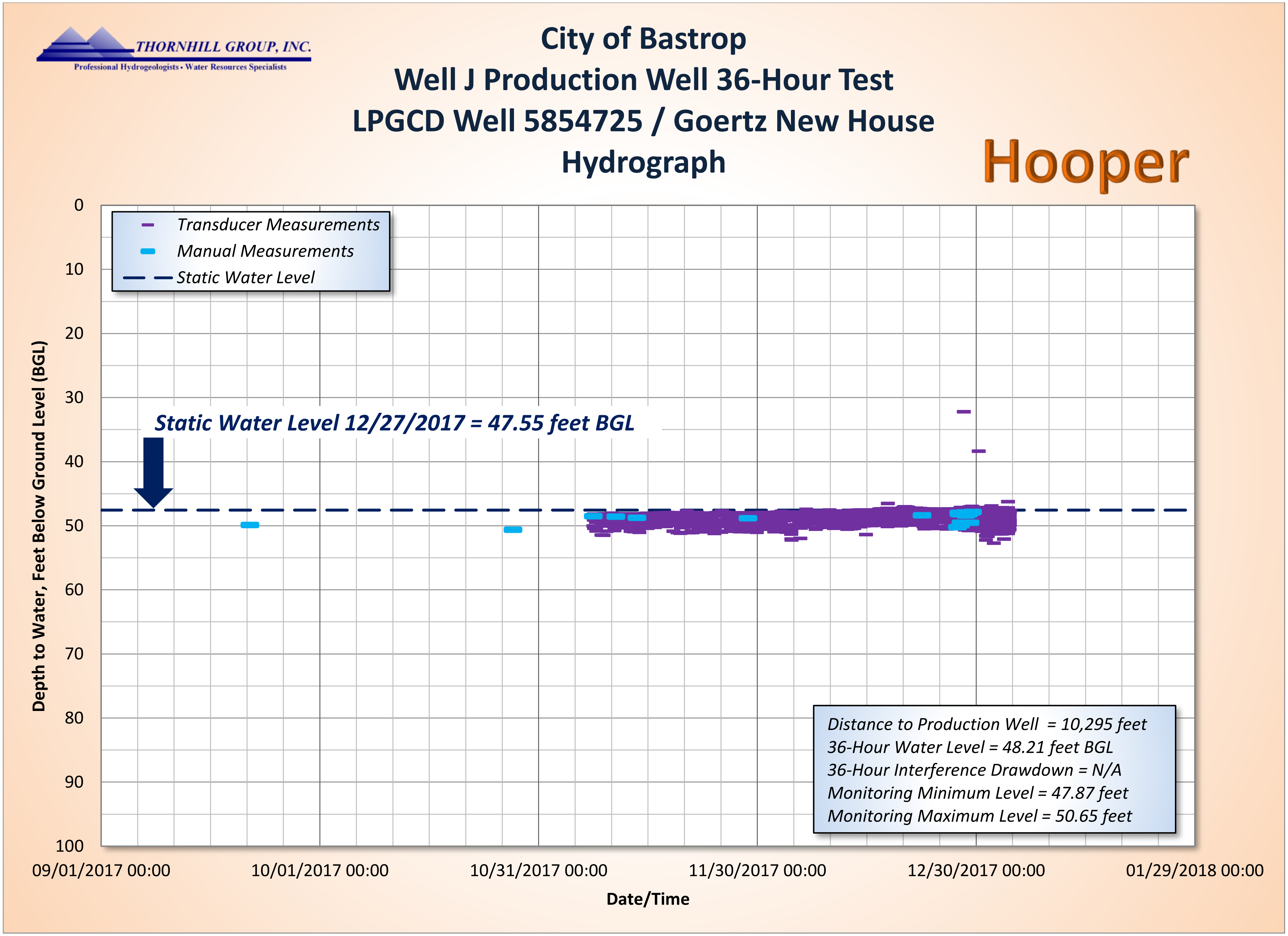
Name: Robert Martinez
Distance from Well J: 6,168.42 feet
Static Water Level 12/27/2017: 88.85 feet BGL
Arrowhead Ct
Shoreside Dr
Well J
Phelan Rd
Sayers Rd
Old Perkins Rd
Smith Rd
Explanation
City of Bastrop
Well J
0 325 650 1,300
Feet
N
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors,
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

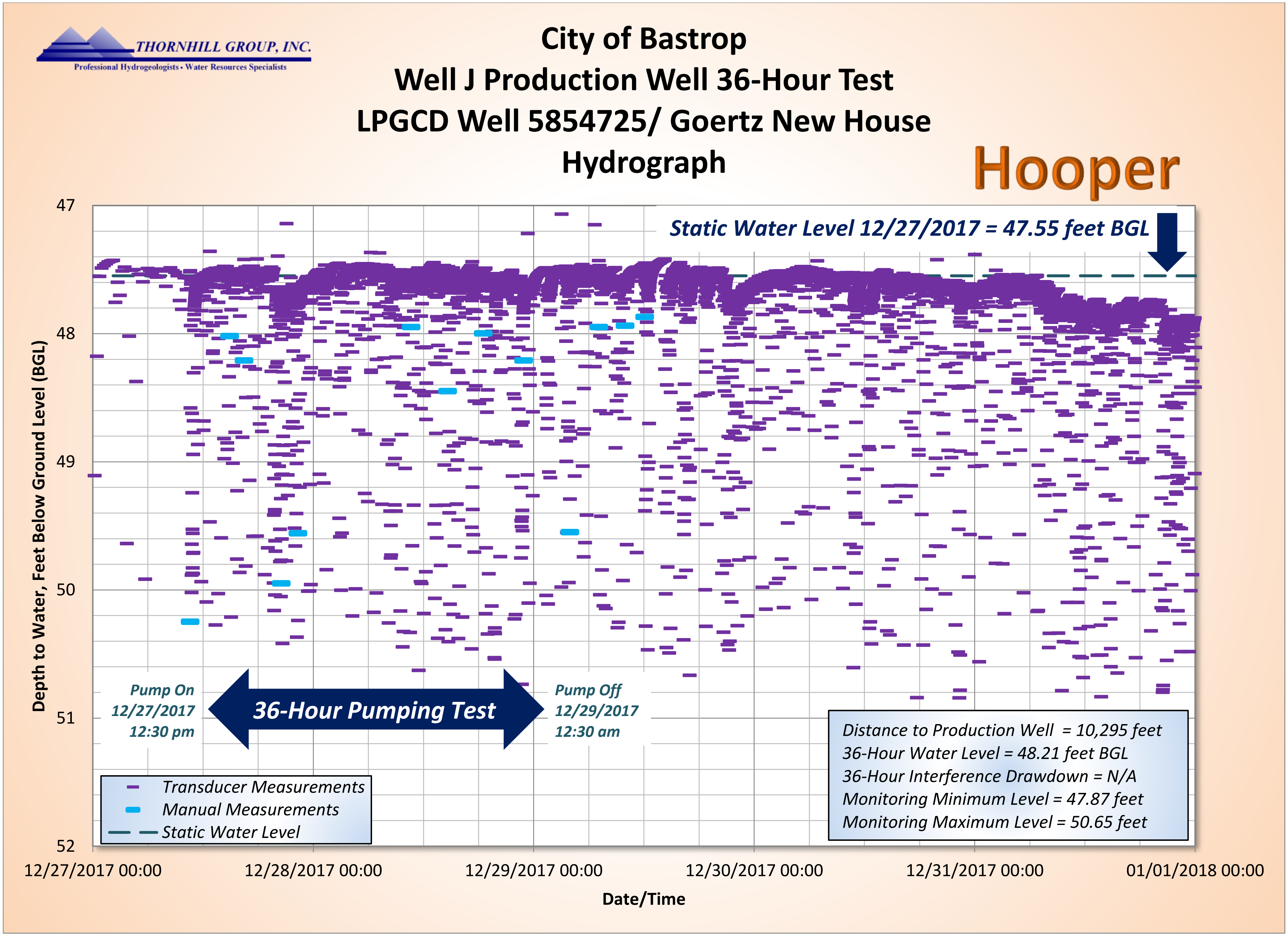
Area 3

City of Bastrop
Goertz New House Well
36-Hour Drawdown and Recovery Results

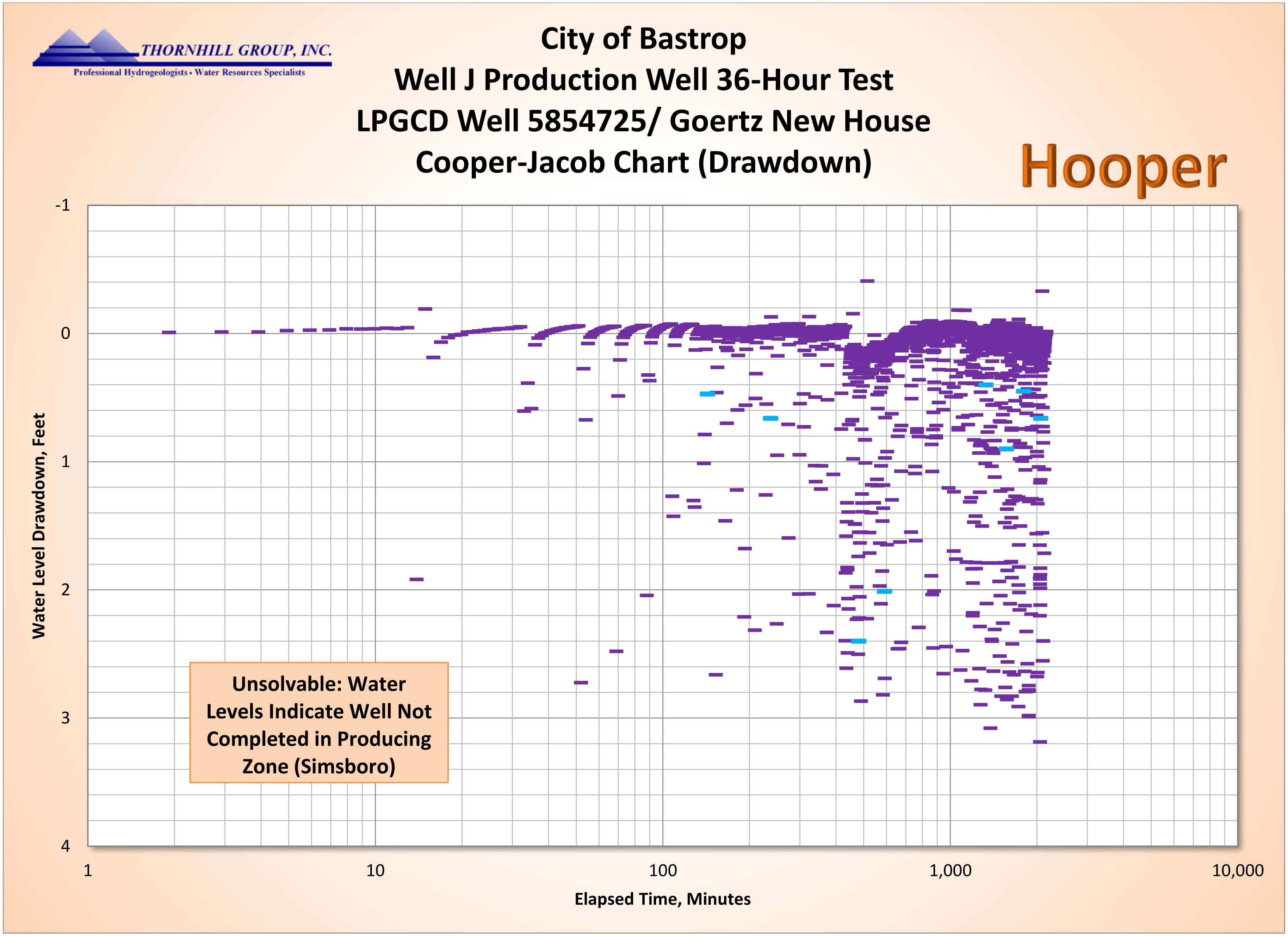
Project: 10210
County: Bastrop
Aquifer Tested: Simsboro
Distance from Production Well: 10,295 feet
Production Well: Well J
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

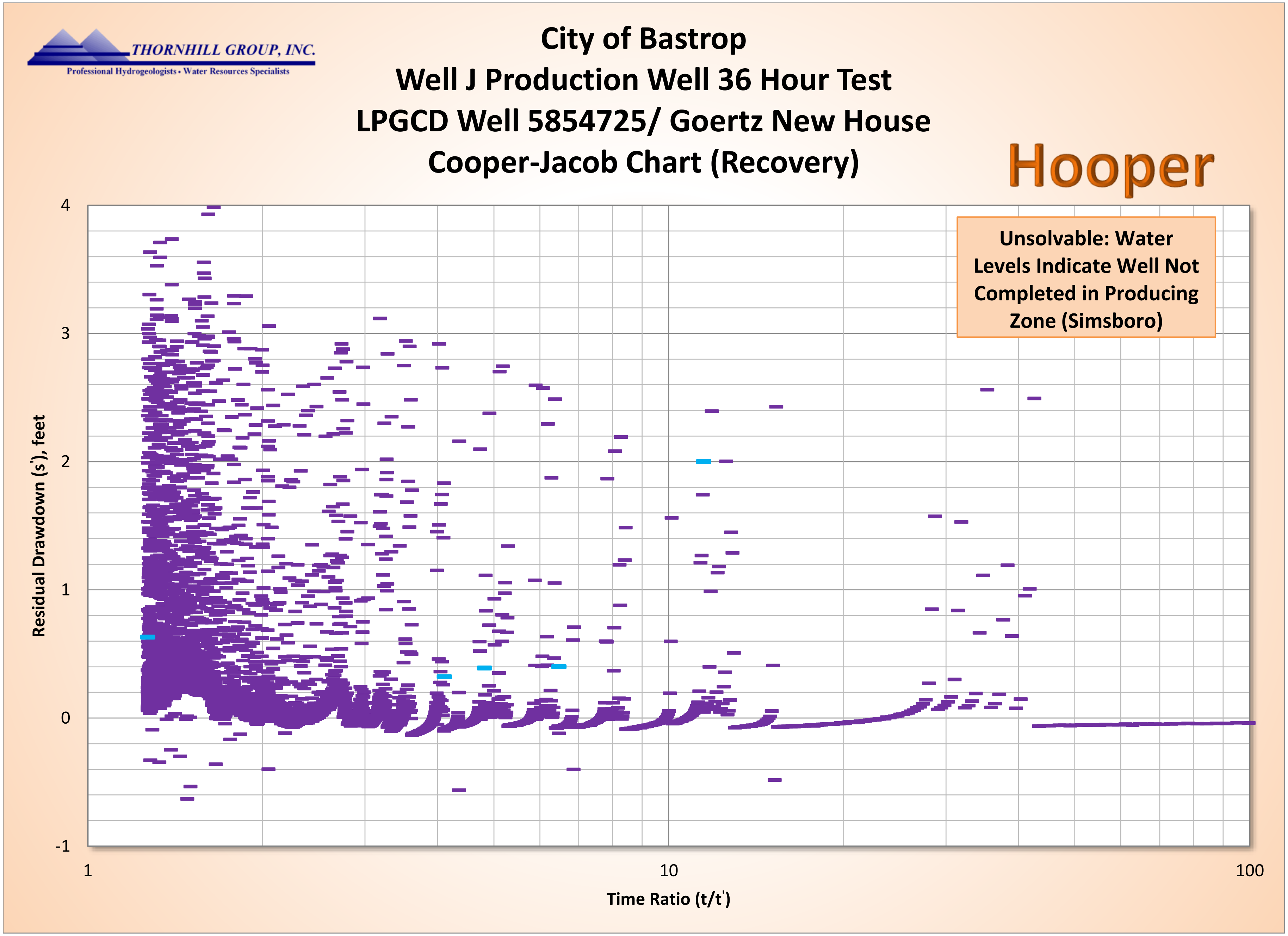
Date / Time	Depth to Water (Feet Below Land Surface)	Remarks
9/21/2017 9:40	49.90	Background
10/27/2017 11:11	50.65	Background
11/7/2017 11:47	48.55	Background
11/10/2017 13:57	48.61	Background
11/13/2017 11:42	48.80	Background
11/28/2017 16:40	48.86	Background
12/22/2017 13:49	48.40	Background
12/27/2017 10:36	50.25	Static Water Level
12/27/2017 14:53	48.02	Production Well on: 12/27/2017 12:30 pm
12/27/2017 16:27	48.21	
12/27/2017 20:30	49.95	
12/27/2017 22:20	49.56	
12/28/2017 10:39	47.95	
12/28/2017 14:38	48.45	
12/28/2017 18:30	48.00	
12/28/2017 22:54	48.21	
12/29/2017 3:56	49.55	Production Well off: 12/29/2017 12:30 am
12/29/2017 7:05	47.95	
12/29/2017 9:56	47.94	
12/29/2017 12:05	47.87	
1/3/2018 14:55	48.18	

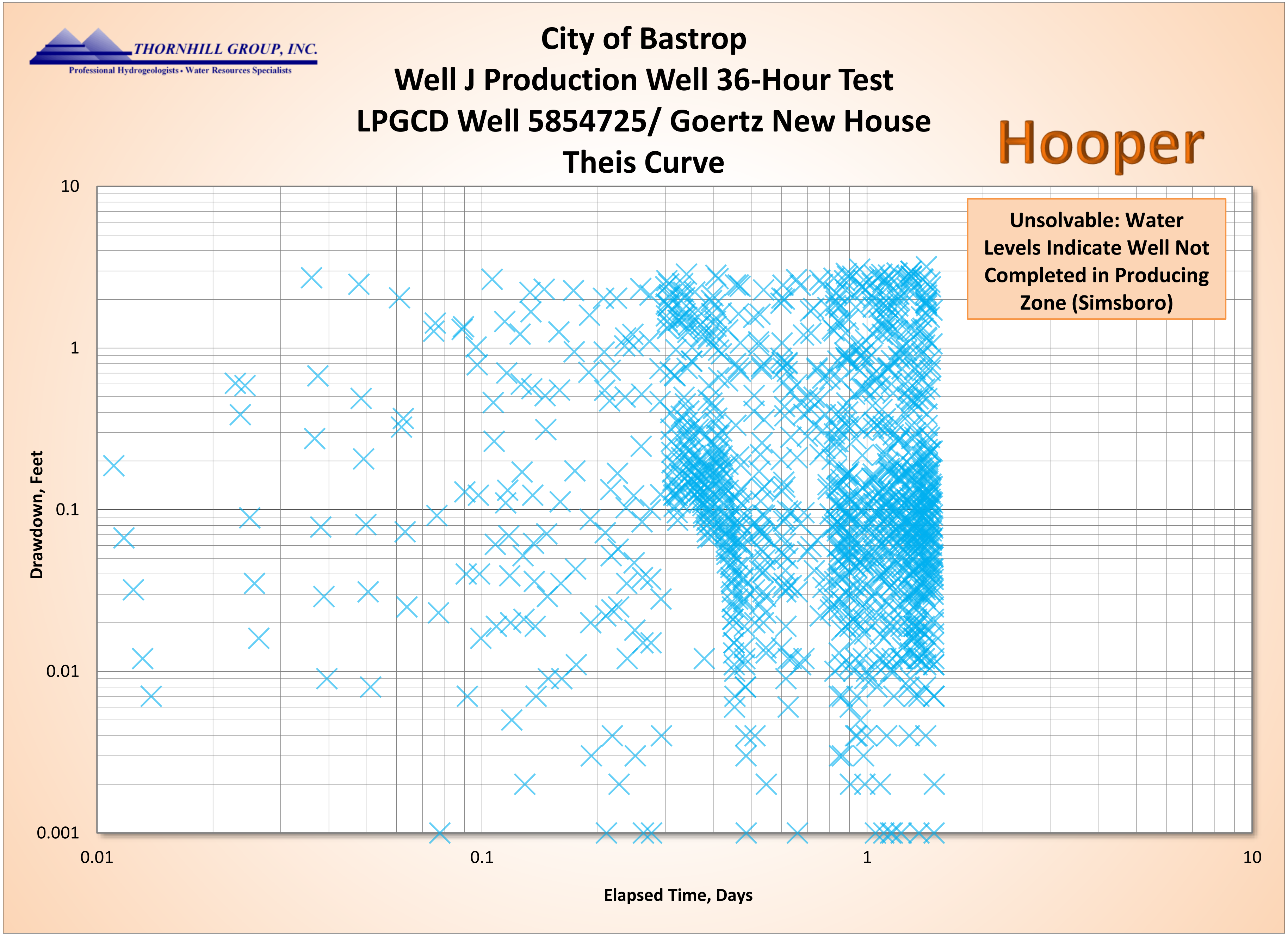

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854725 / Goertz New House
Hydrograph
Hooper
Transducer Measurements
Manual Measurements
Static Water Level
Static Water Level 12/27/2017 = 47.55 feet BGL
Depth to Water, Feet Below Ground Level (BGL)
0
10
20
30
40
50
60
70
80
90
100
09/01/2017 00:00
10/01/2017 00:00
10/31/2017 00:00
11/30/2017 00:00
12/30/2017 00:00
01/29/2018 00:00
Date/Time
Distance to Production Well = 10,295 feet
36-Hour Water Level = 48.21 feet BGL
36-Hour Interference Drawdown = N/A
Monitoring Minimum Level = 47.87 feet
Monitoring Maximum Level = 50.65 feet



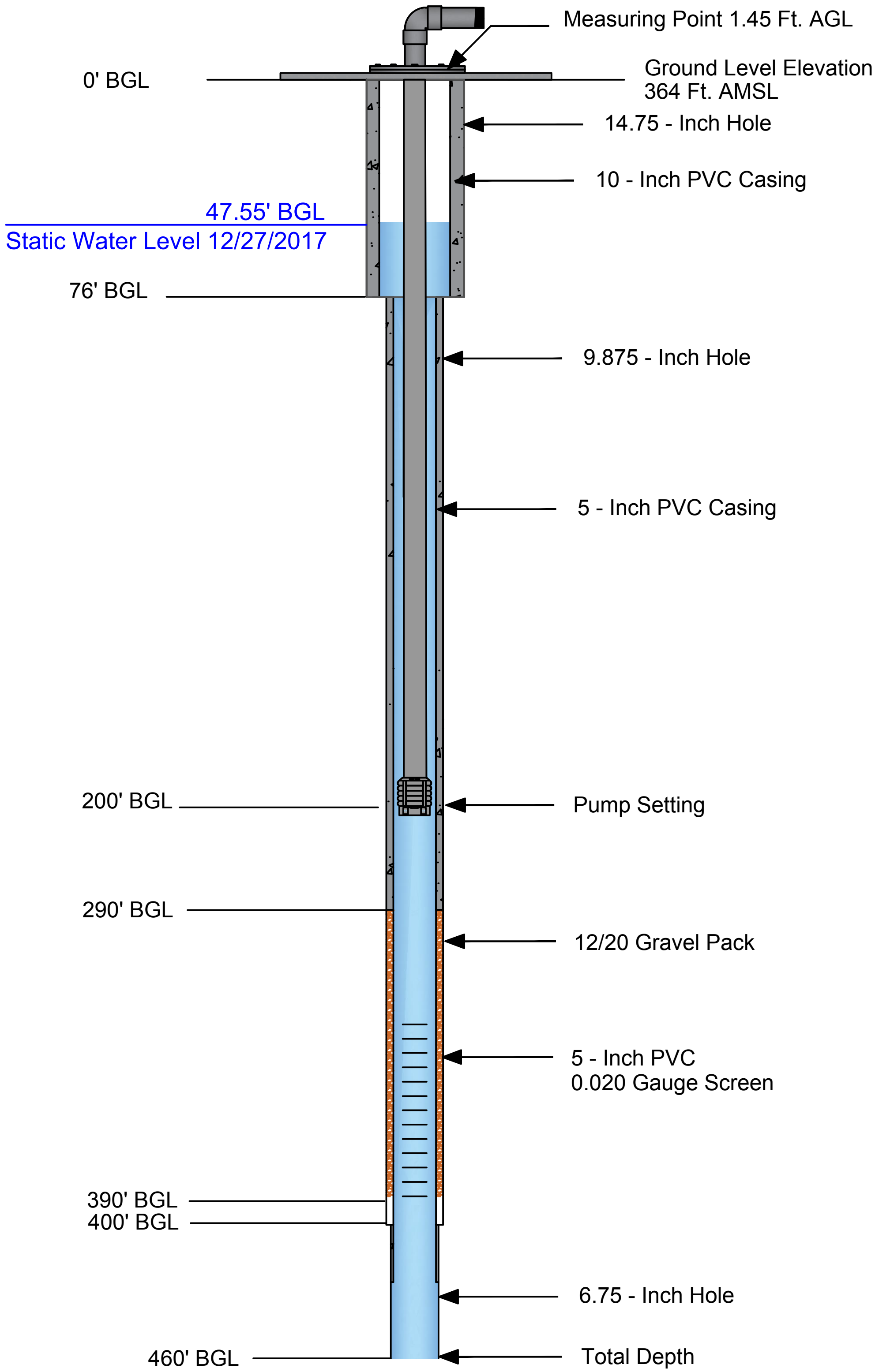
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854725/ Goertz New House
Hydrograph
Hooper
Static Water Level 12/27/2017 = 47.55 feet BGL
Depth to Water, Feet Below Ground Level (BGL)
47
48
49
50
51
52
Pump On
12/27/2017
12:30 pm
36-Hour Pumping Test
Pump Off
12/29/2017
12:30 am
Transducer Measurements
Manual Measurements
Static Water Level
Distance to Production Well = 10,295 feet
36-Hour Water Level = 48.21 feet BGL
36-Hour Interference Drawdown = N/A
Monitoring Minimum Level = 47.87 feet
Monitoring Maximum Level = 50.65 feet
12/27/2017 00:00
12/28/2017 00:00
12/29/2017 00:00
12/30/2017 00:00
12/31/2017 00:00
01/01/2018 00:00
Date/Time


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854725/ Goertz New House
Cooper-Jacob Chart (Drawdown)
Hooper
Water Level Drawdown, Feet
-1
0
1
2
3
4
1
10
100
1,000
10,000
Elapsed Time, Minutes
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36 Hour Test
LPGCD Well 5854725/ Goertz New House
Cooper-Jacob Chart (Recovery)
Hooper
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)
Residual Drawdown (s'), feet
Time Ratio (t/t')
4
3
2
1
0
-1
1
10
100

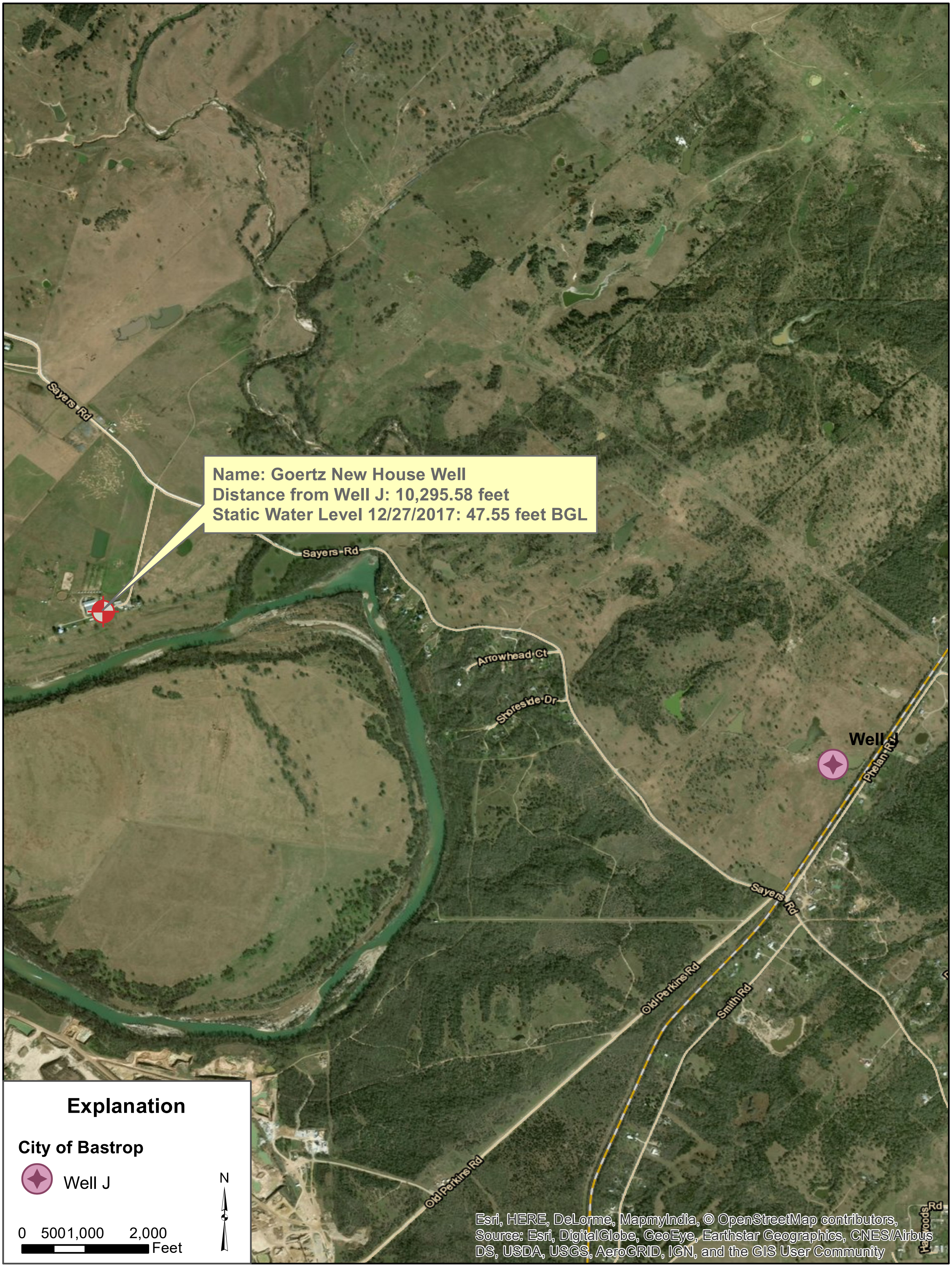

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well 5854725/ Goertz New House
Theis Curve
Hooper
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)
Drawdown, Feet
Elapsed Time, Days
10
1
0.1
0.01
0.001
0.01
0.1
1
10

LPGCD Well Unknown / Goertz New House Well



Well construction details compiled from State of Texas Well Report, LPGCD records, owner, and/or TGI field investigations.

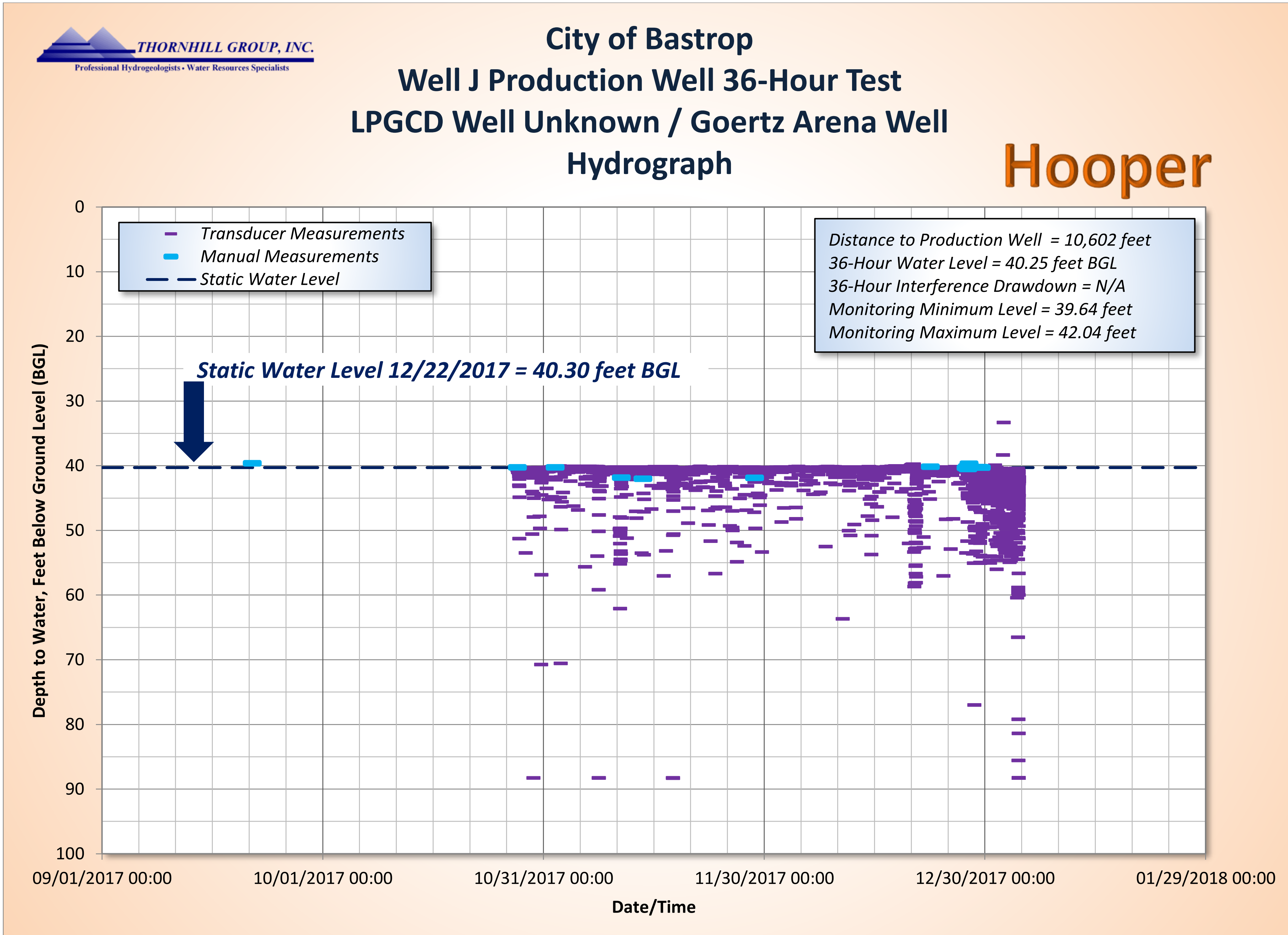
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists

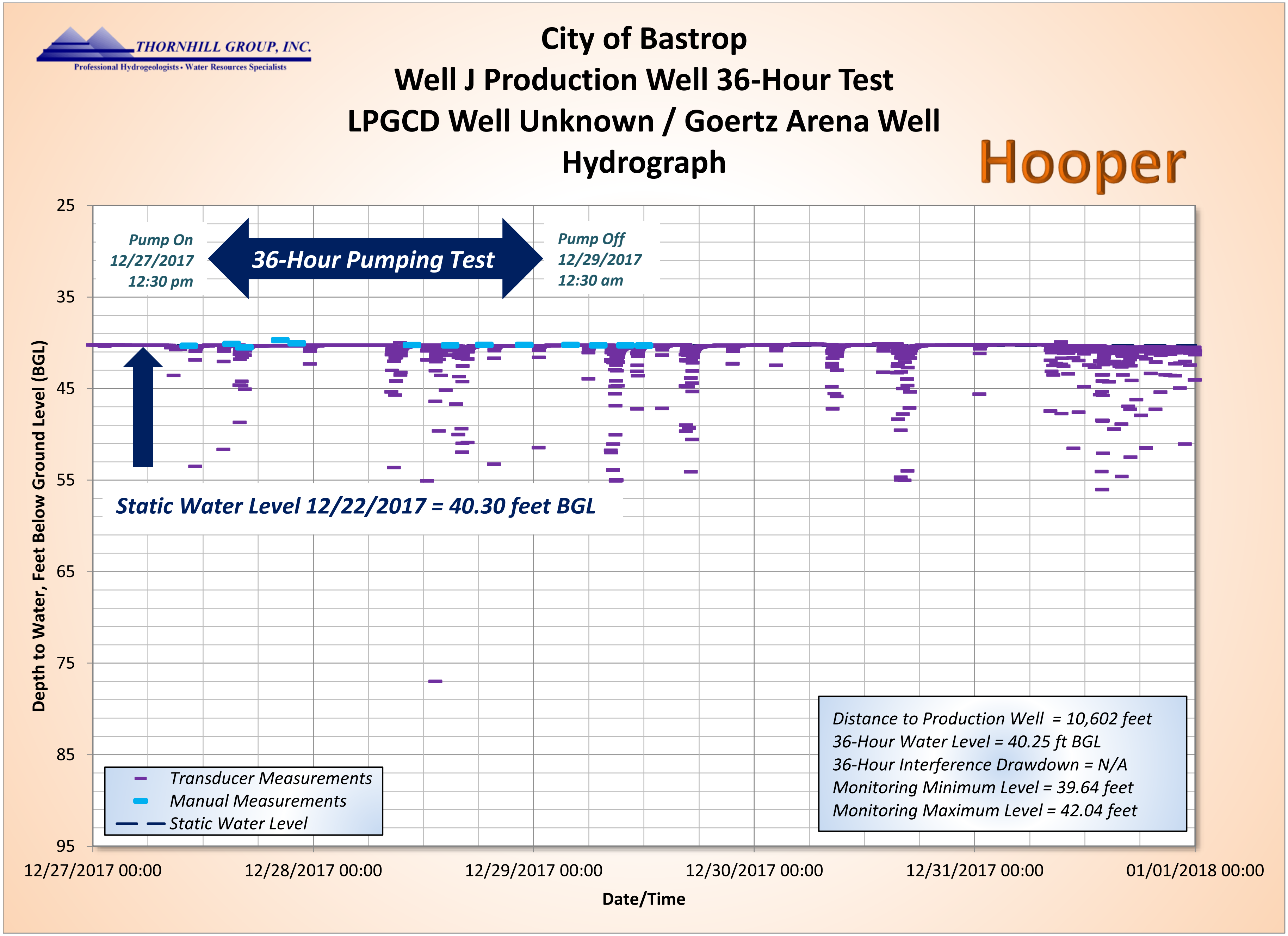

Name: Goertz New House Well
Distance from Well J: 10,295.58 feet
Static Water Level 12/27/2017: 47.55 feet BGL
Well J
Sayers Rd
Sayers Rd
Sayers Rd
Arrowhead Ct
Shoreside Dr
Phelan Rd
Old Perkins Rd
Old Perkins Rd
Smith Rd
Explanation
City of Bastrop
Well J
0 500 1,000 2,000
Feet
N
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors,
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

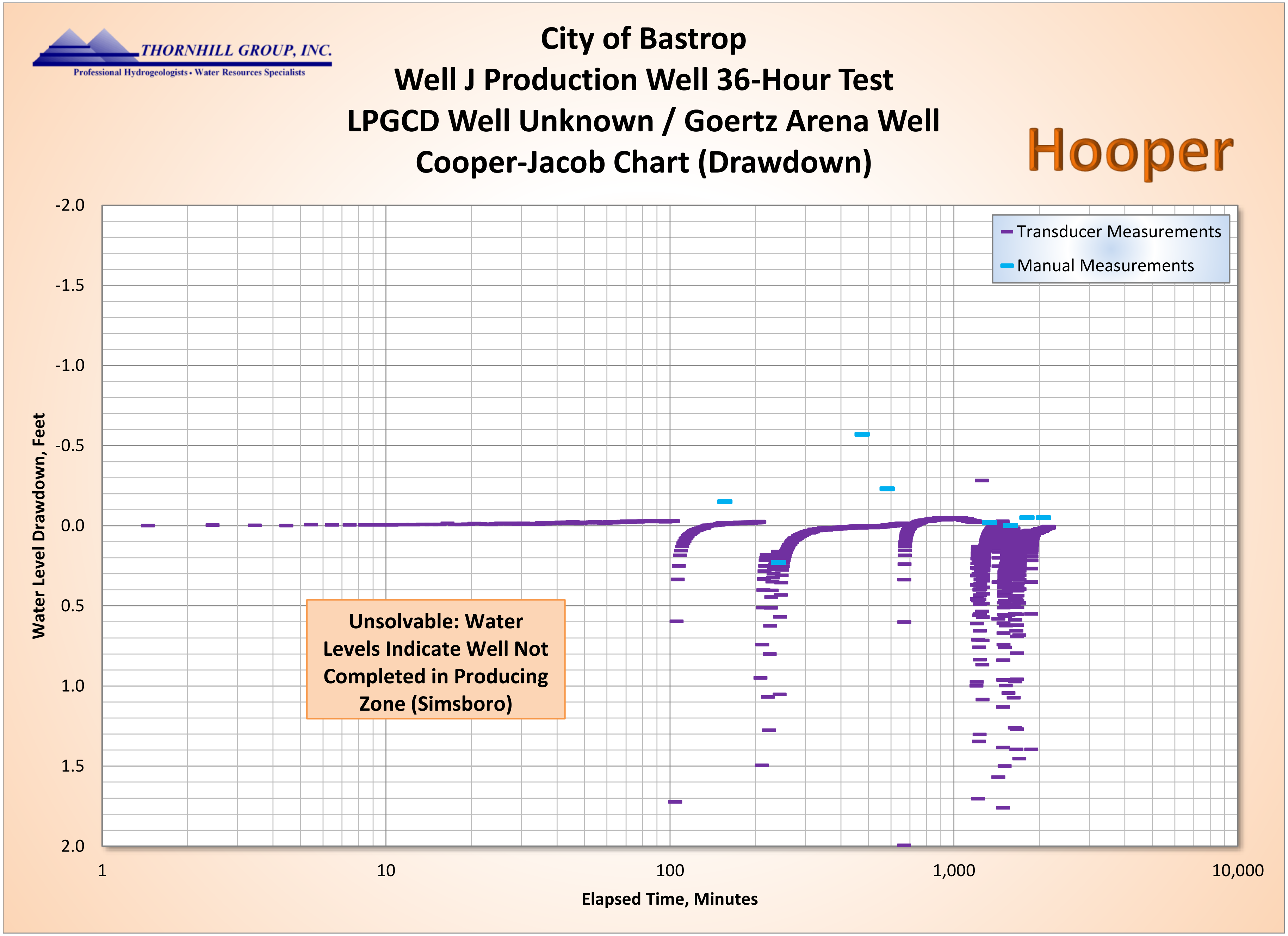
City of Bastrop
Goertz Arena Well
36-Hour Drawdown and Recovery Results

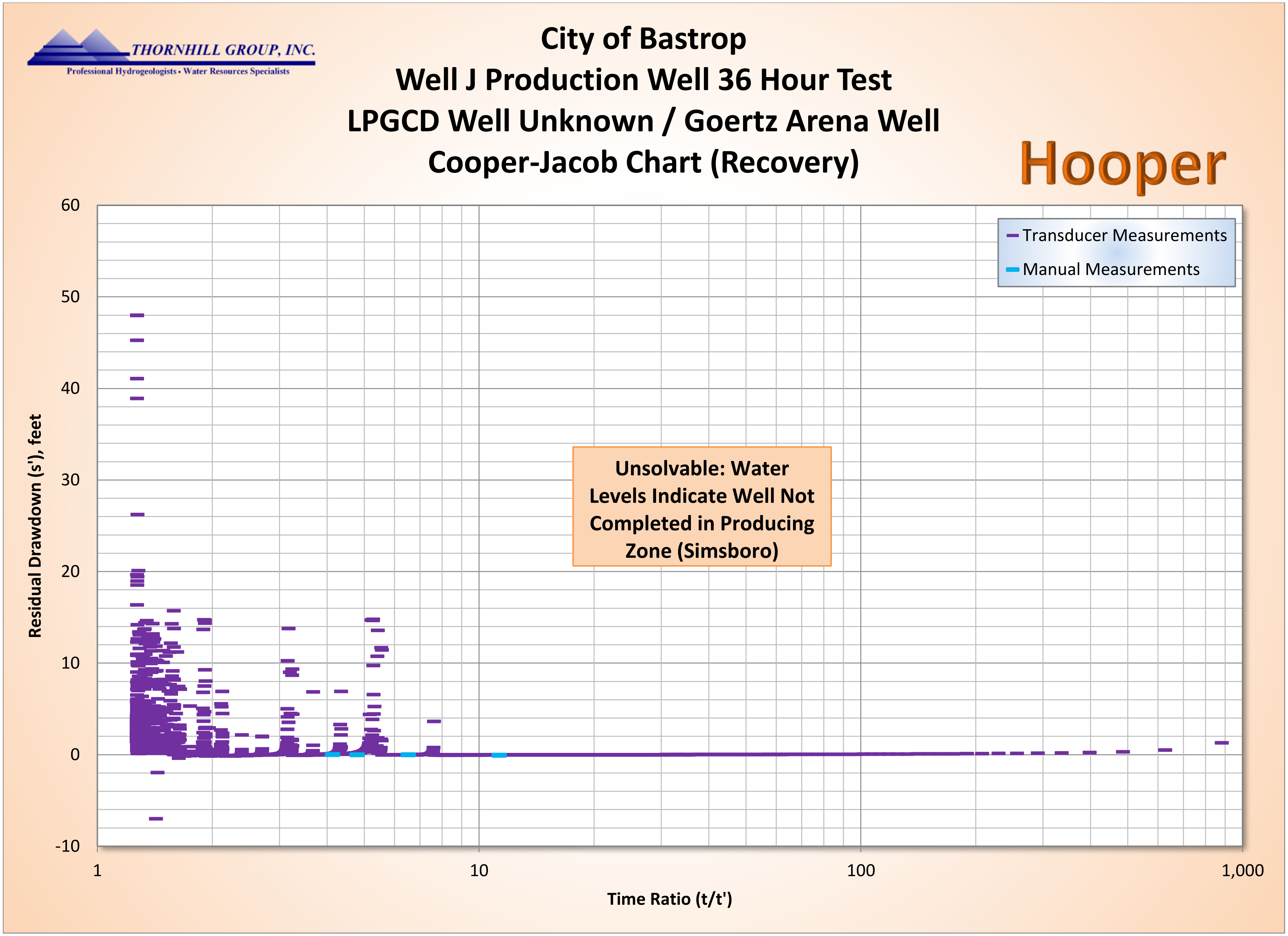
Project: 10210
County: Bastrop
Aquifer Tested: Simsboro
Distance from Production Well: 10,602 feet
Production Well: Well J
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

Date / Time	Depth to Water (Feet Below Land Surface)	Remarks
9/21/2017 10:00	39.64	Background
10/27/2017 10:52	40.30	Background
11/1/2017 13:56	40.30	Background
11/10/2017 13:47	41.86	Background
11/13/2017 12:05	42.04	Background
11/28/2017 16:55	41.89	Background
12/22/2017 13:53	40.20	Background
12/27/2017 10:27	40.35	Static Water Level
12/27/2017 15:06	40.15	Production Well on: 12/27/2017 12:30 pm
12/27/2017 16:31	40.53	
12/27/2017 20:25	39.73	
12/27/2017 22:12	40.07	
12/28/2017 10:45	40.28	
12/28/2017 14:54	40.30	
12/28/2017 18:38	40.25	
12/28/2017 22:58	40.25	
12/29/2017 4:00	40.25	Production Well off: 12/29/2017 12:30 am
12/29/2017 7:01	40.29	
12/29/2017 10:00	40.29	
12/29/2017 12:00	40.32	

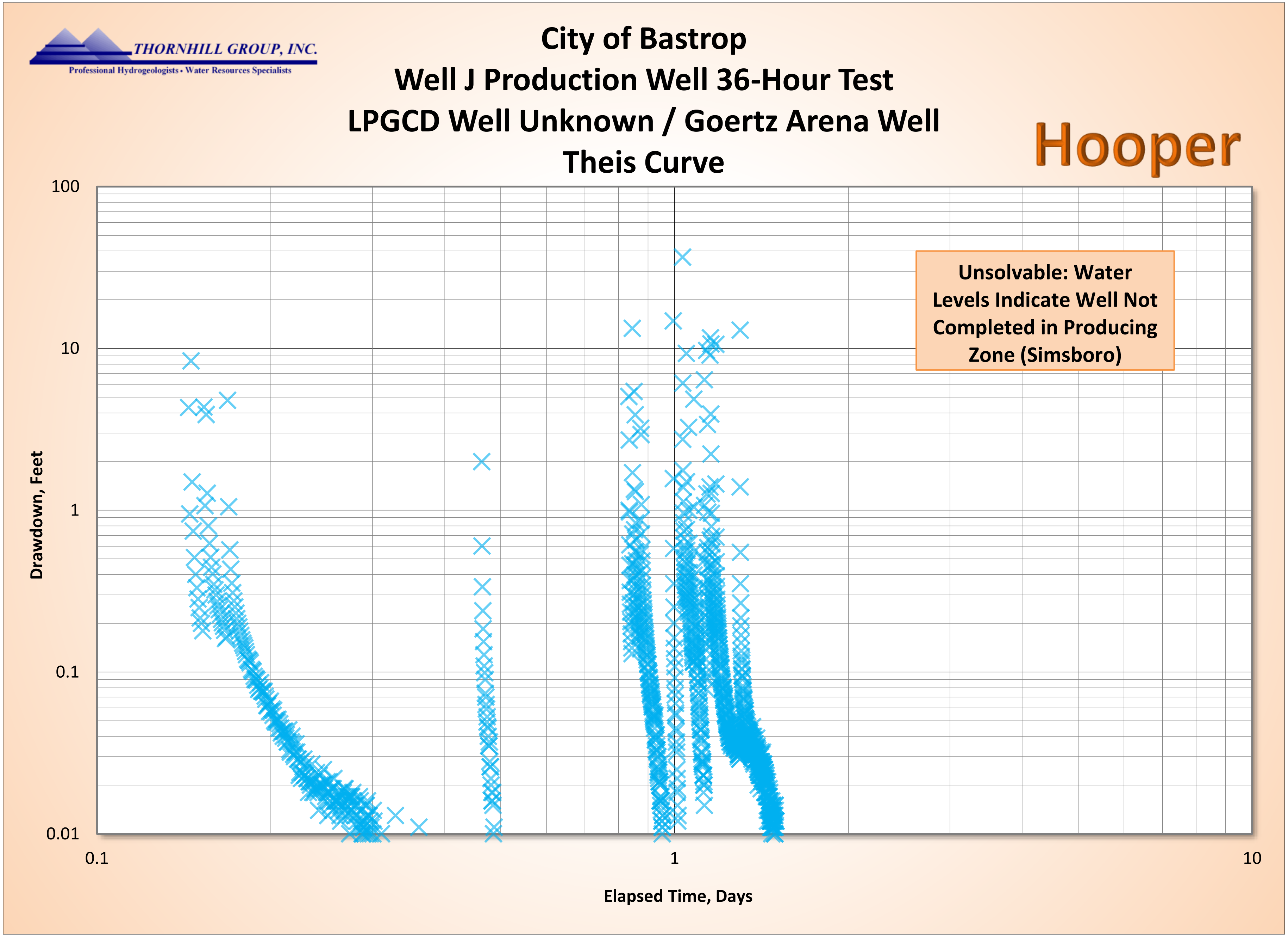

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well Unknown / Goertz Arena Well
Hydrograph
Hooper
Transducer Measurements
Manual Measurements
Static Water Level
Distance to Production Well = 10,602 feet
36-Hour Water Level = 40.25 feet BGL
36-Hour Interference Drawdown = N/A
Monitoring Minimum Level = 39.64 feet
Monitoring Maximum Level = 42.04 feet
Static Water Level 12/22/2017 = 40.30 feet BGL
Depth to Water, Feet Below Ground Level (BGL)
0
10
20
30
40
50
60
70
80
90
100
09/01/2017 00:00
10/01/2017 00:00
10/31/2017 00:00
11/30/2017 00:00
12/30/2017 00:00
01/29/2018 00:00
Date/Time


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well Unknown / Goertz Arena Well
Hydrograph
Hooper
Pump On
12/27/2017
12:30 pm
36-Hour Pumping Test
Pump Off
12/29/2017
12:30 am
Static Water Level 12/22/2017 = 40.30 feet BGL
Depth to Water, Feet Below Ground Level (BGL)
25
35
45
55
65
75
85
95
Transducer Measurements
Manual Measurements
Static Water Level
Distance to Production Well = 10,602 feet
36-Hour Water Level = 40.25 ft BGL
36-Hour Interference Drawdown = N/A
Monitoring Minimum Level = 39.64 feet
Monitoring Maximum Level = 42.04 feet
12/27/2017 00:00
12/28/2017 00:00
12/29/2017 00:00
12/30/2017 00:00
12/31/2017 00:00
01/01/2018 00:00
Date/Time


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well Unknown / Goertz Arena Well
Cooper-Jacob Chart (Drawdown)
Hooper
Transducer Measurements
Manual Measurements
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)
Water Level Drawdown, Feet
Elapsed Time, Minutes
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
1
10
100
1,000
10,000

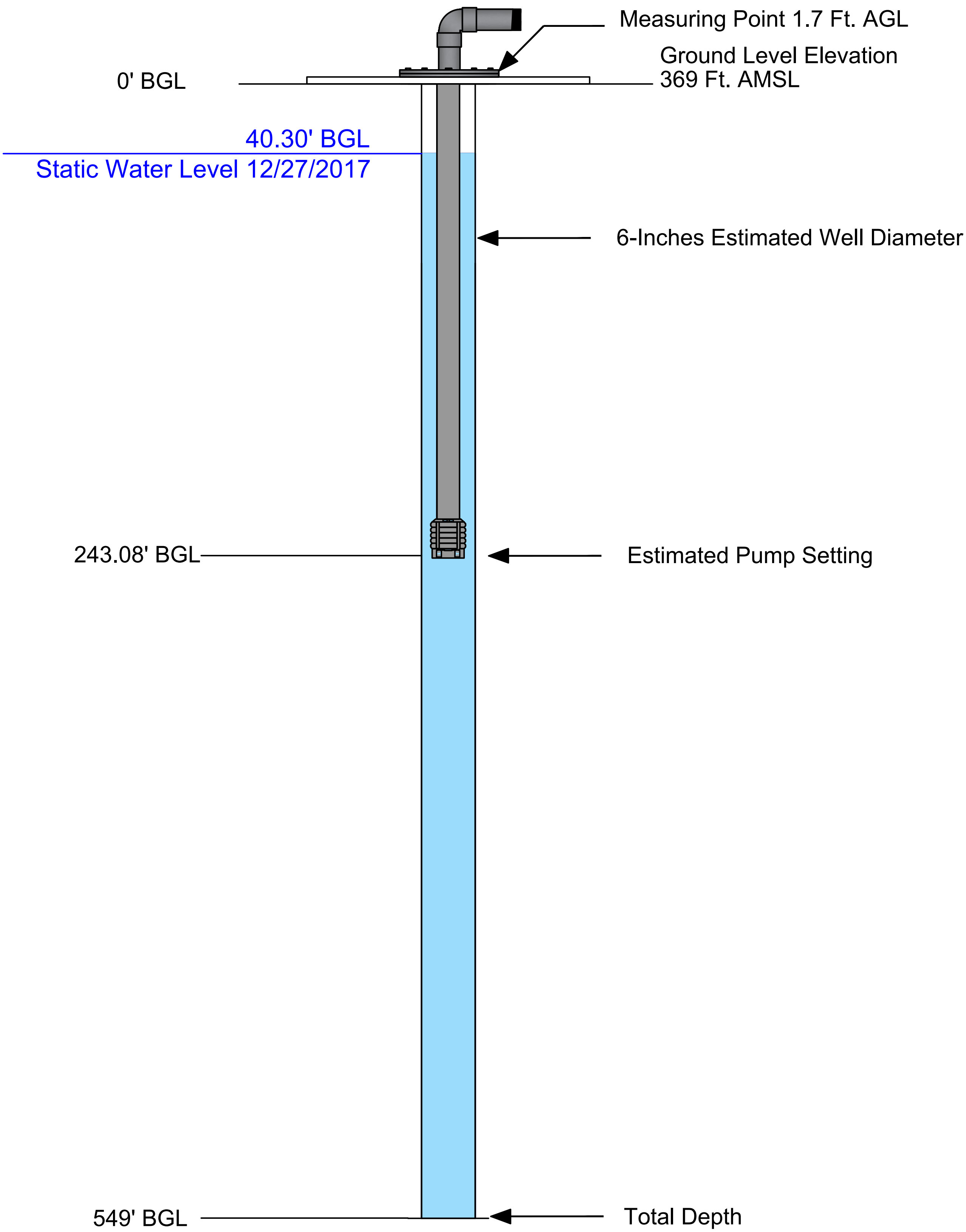


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36 Hour Test
LPGCD Well Unknown / Goertz Arena Well
Cooper-Jacob Chart (Recovery)
Hooper
Transducer Measurements
Manual Measurements
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)
Residual Drawdown (s'), feet
Time Ratio (t/t')
60
50
40
30
20
10
0
-10
1
10
100
1,000



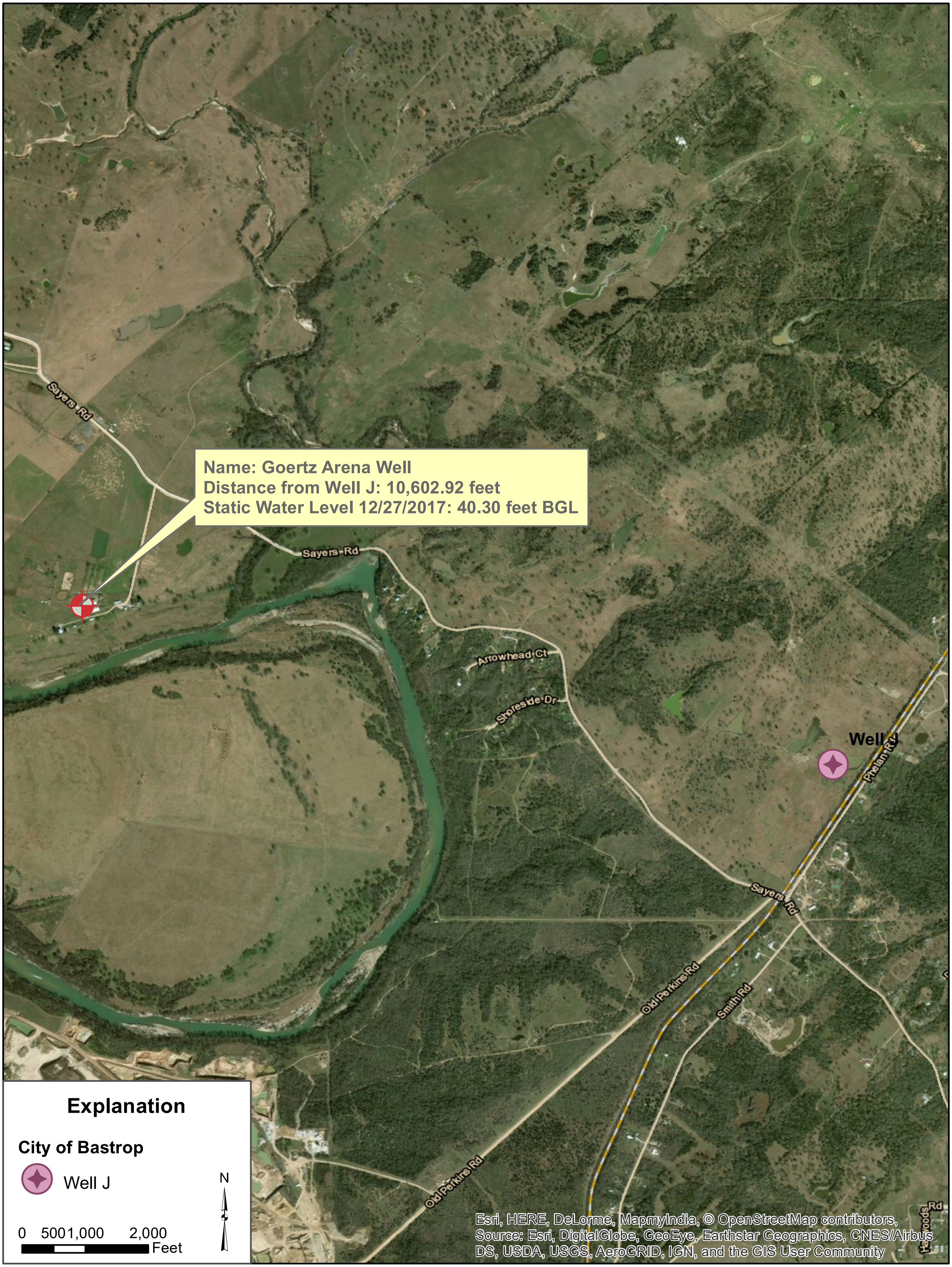
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well Unknown / Goertz Arena Well
Theis Curve
Hooper
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)
Drawdown, Feet
100
10
1
0.1
0.01
0.1
1
10
Elapsed Time, Days

LPGCD Unknown / Goertz Arena Well



Well construction details compiled from State of Texas Well Report, LPGCD records, and/or TGI field investigations.

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists


Name: Goertz Arena Well
Distance from Well J: 10,602.92 feet
Static Water Level 12/27/2017: 40.30 feet BGL
Sayers Rd
Sayers Rd
Arrowhead Ct
Shoreside Dr
Well J
Phelan Rd
Sayers Rd
Old Perkins Rd
Smith Rd
Old Perkins Rd
Explanation
City of Bastrop
Well J
N
0 5001,000 2,000
Feet
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors,
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus
DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

City of Bastrop
Goertz House Well
36-Hour Drawdown and Recovery Results

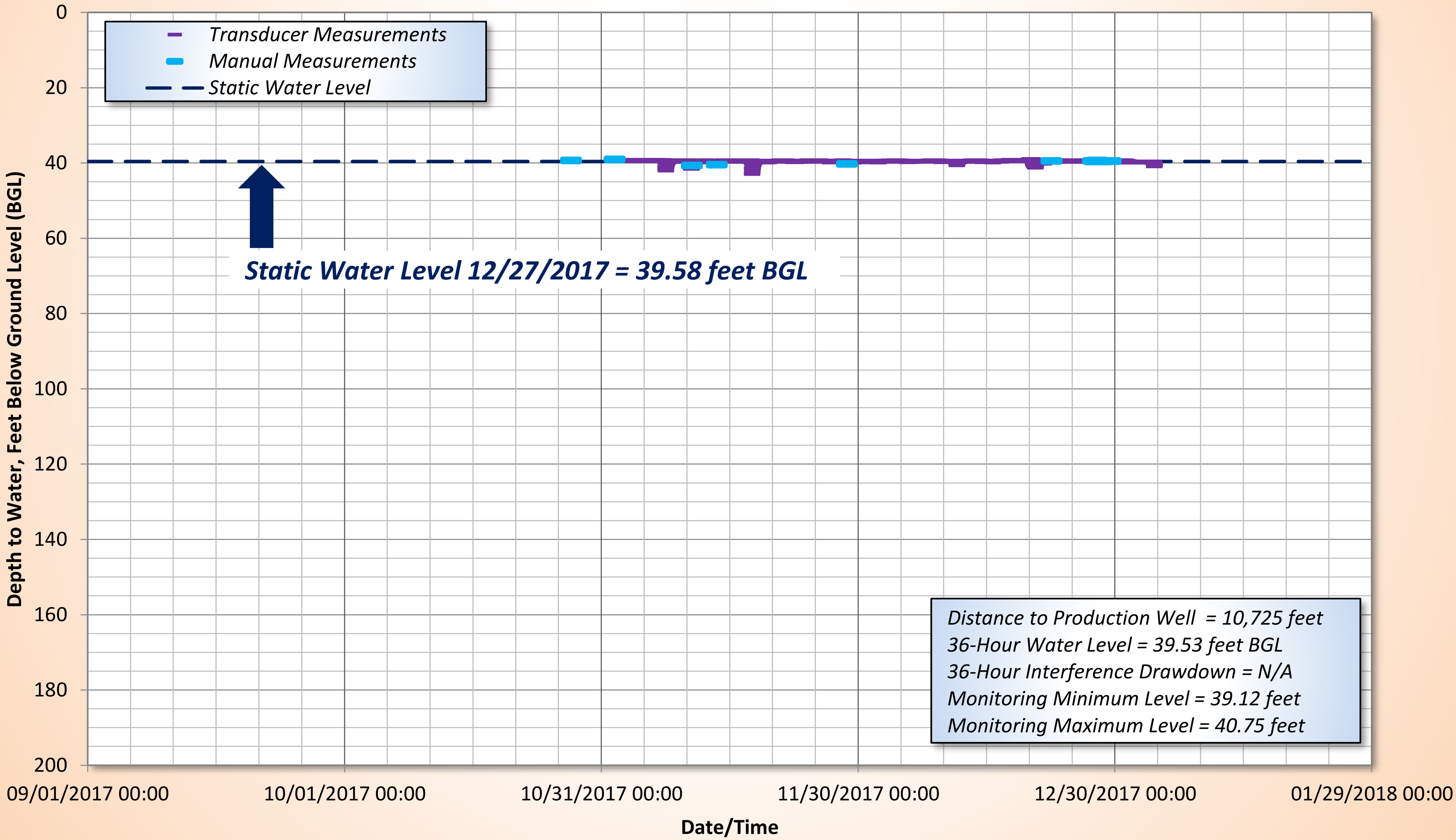
Project: 10210
County: Bastrop
Aquifer Tested: Simsboro
Distance from Production Well: 10,725 feet
Production Well: Well J
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

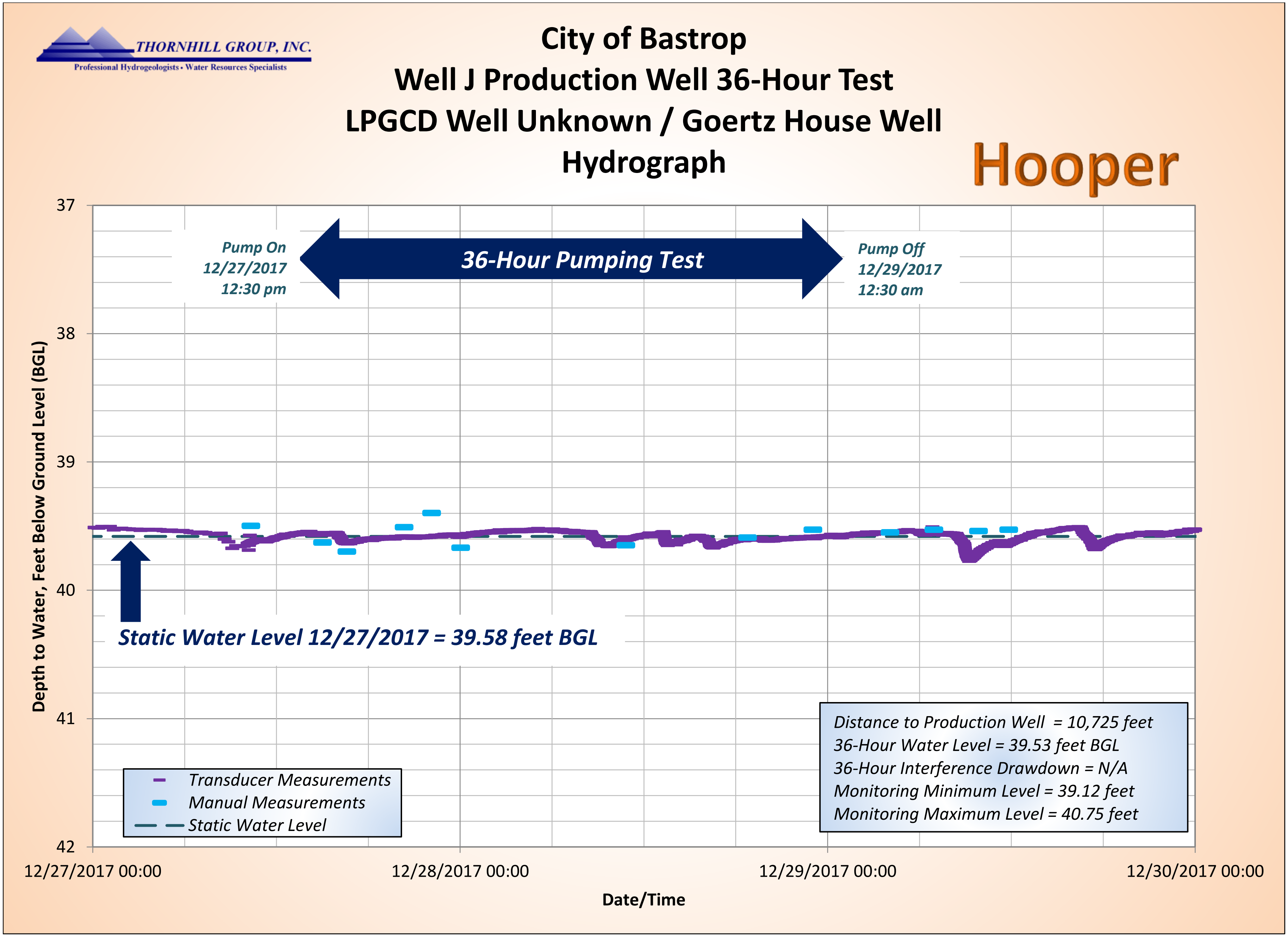
Date / Time	Depth to Water (Feet Below Land Surface)	Remarks
10/27/2017 10:45	39.37	Background
11/1/2017 13:20	39.12	Background
11/10/2017 13:42	40.75	Background
11/13/2017 11:52	40.50	Background
11/28/2017 16:32	40.34	Background
12/22/2017 13:53	39.56	Background
12/27/2017 10:20	39.50	Static Water Level
12/27/2017 15:00	39.63	Production Well on: 12/27/2017 12:30 pm
12/27/2017 16:36	39.70	
12/27/2017 20:20	39.51	
12/27/2017 22:08	39.40	
12/28/2017 0:02	39.67	
12/28/2017 10:49	39.65	
12/28/2017 18:46	39.59	
12/28/2017 23:02	39.53	
12/29/2017 4:04	39.55	Production Well off: 12/29/2017 12:30 am
12/29/2017 6:56	39.53	
12/29/2017 9:51	39.54	
12/29/2017 11:50	39.53	
1/3/2018 15:13	40.30	

City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well Unknown / Goertz House Well
Hydrograph

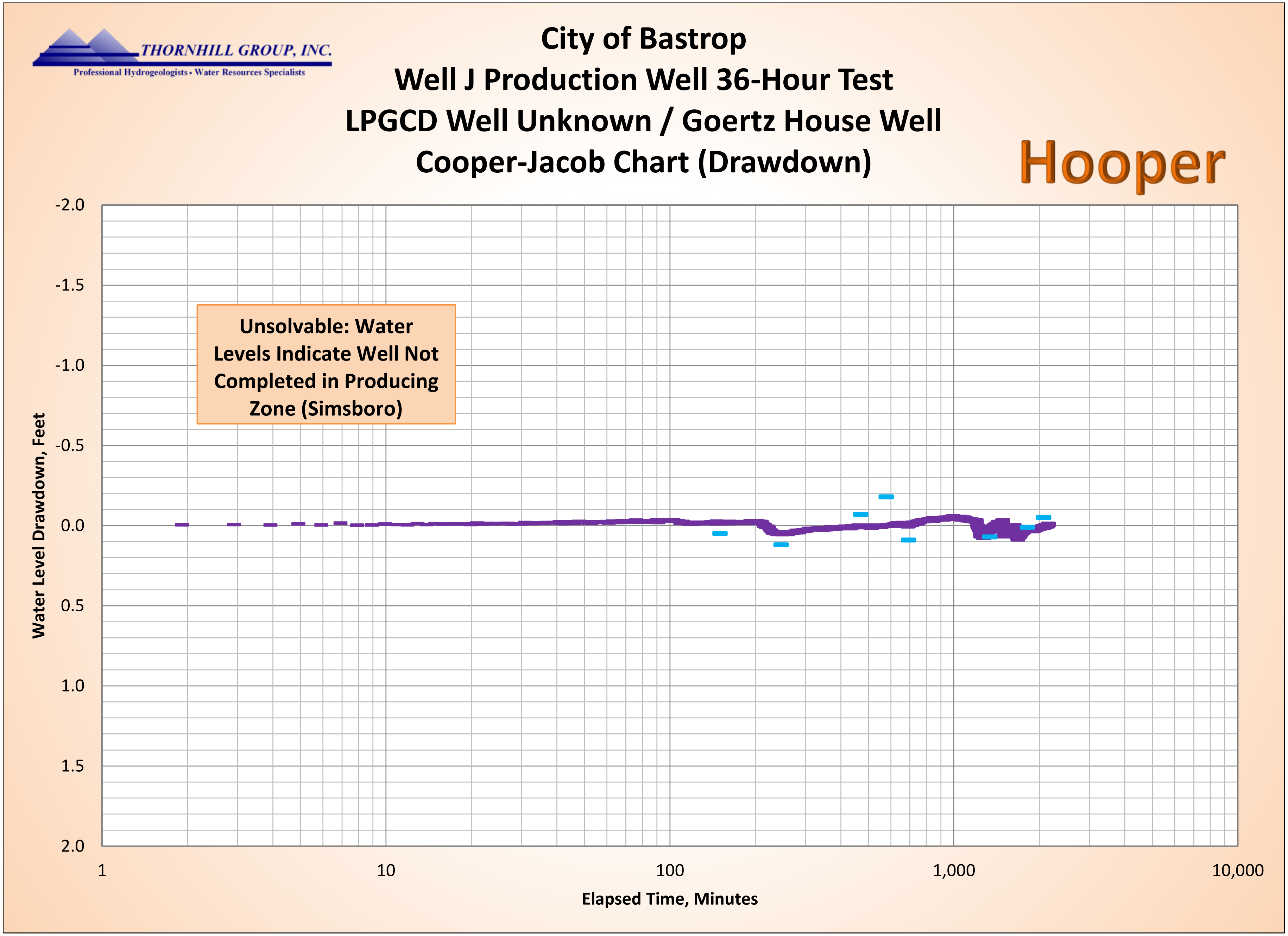
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists

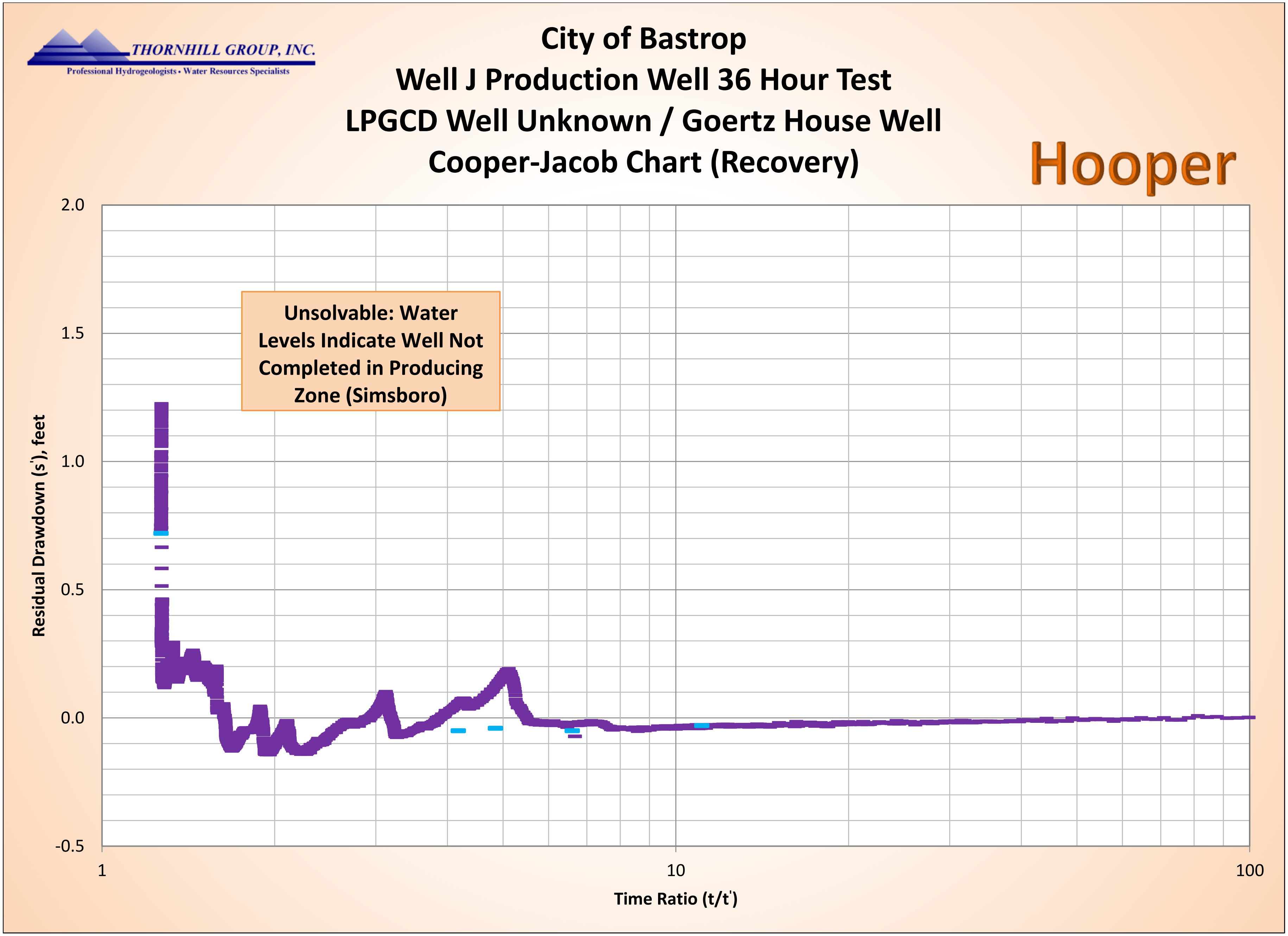
Hooper



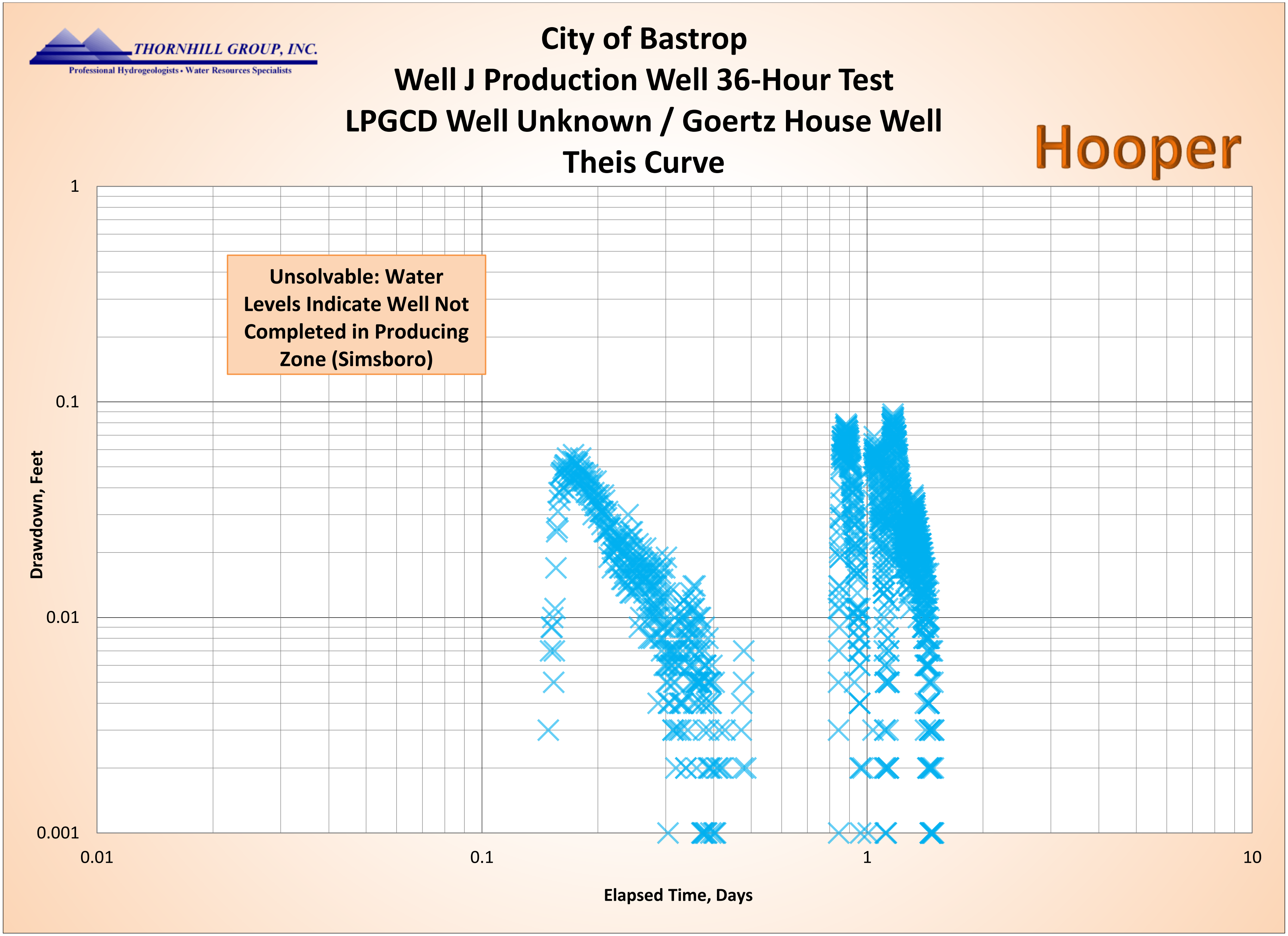


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well Unknown / Goertz House Well
Hydrograph
Hooper
Pump On 12/27/2017 12:30 pm
36-Hour Pumping Test
Pump Off 12/29/2017 12:30 am
Static Water Level 12/27/2017 = 39.58 feet BGL
Distance to Production Well = 10,725 feet
36-Hour Water Level = 39.53 feet BGL
36-Hour Interference Drawdown = N/A
Monitoring Minimum Level = 39.12 feet
Monitoring Maximum Level = 40.75 feet
Transducer Measurements
Manual Measurements
Static Water Level
Depth to Water, Feet Below Ground Level (BGL)
37
38
39
40
41
42
12/27/2017 00:00
12/28/2017 00:00
12/29/2017 00:00
12/30/2017 00:00
Date/Time

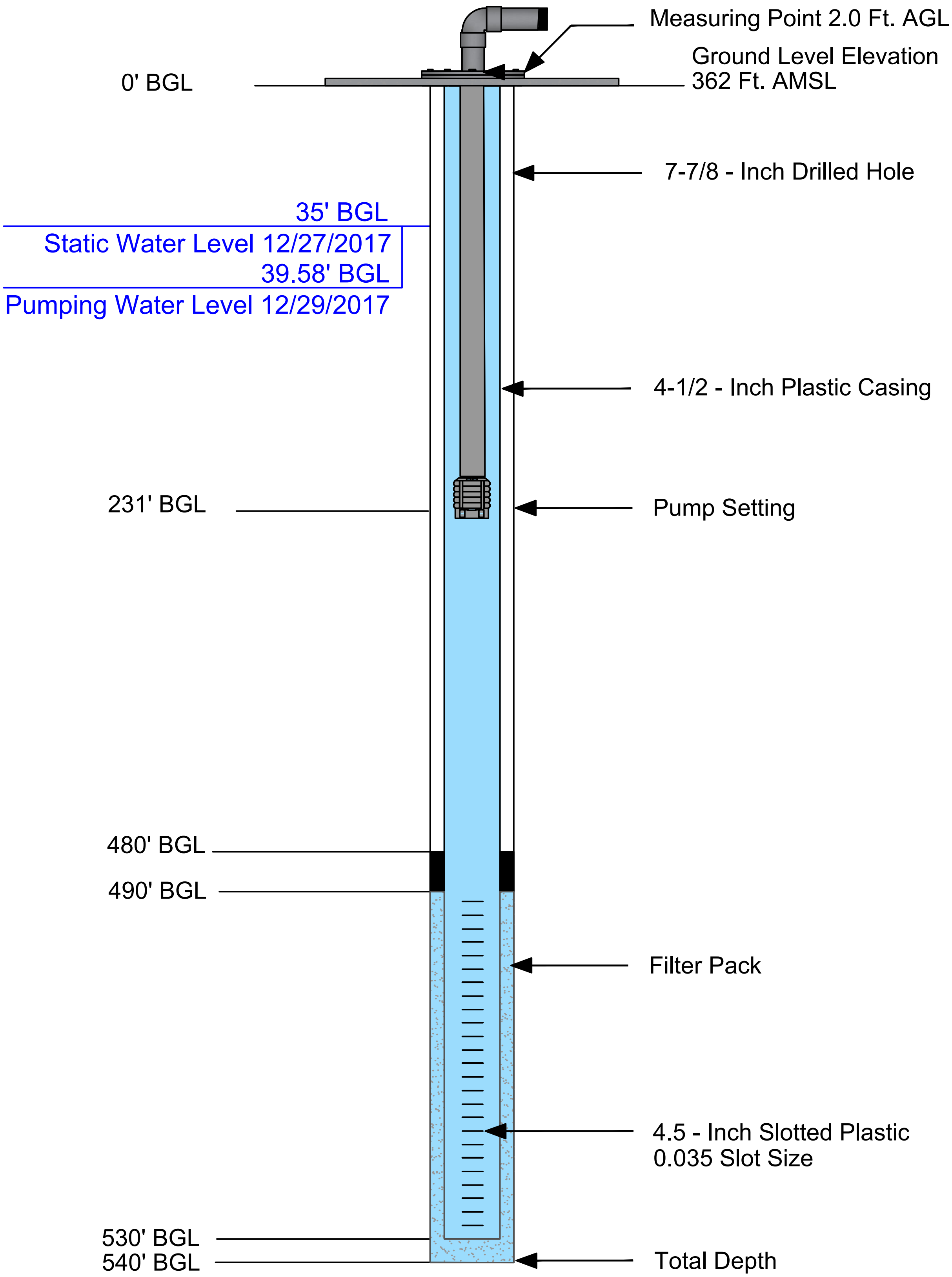

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well Unknown / Goertz House Well
Cooper-Jacob Chart (Drawdown)
Hooper
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)
Water Level Drawdown, Feet
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
1
10
100
1,000
10,000
Elapsed Time, Minutes



THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36 Hour Test
LPGCD Well Unknown / Goertz House Well
Cooper-Jacob Chart (Recovery)
Hooper
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)
Residual Drawdown (s'), feet
2.0
1.5
1.0
0.5
0.0
-0.5
1
10
100
Time Ratio (t/t')


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well Unknown / Goertz House Well
Theis Curve
Hooper
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)
Drawdown, Feet
1
0.1
0.01
0.001
0.01
0.1
1
10
Elapsed Time, Days

LPGCD Well Unknown / Goertz House Well



Well construction details compiled from State of Texas Well Report, LPGCD records, owner, and/or TGI field investigations.

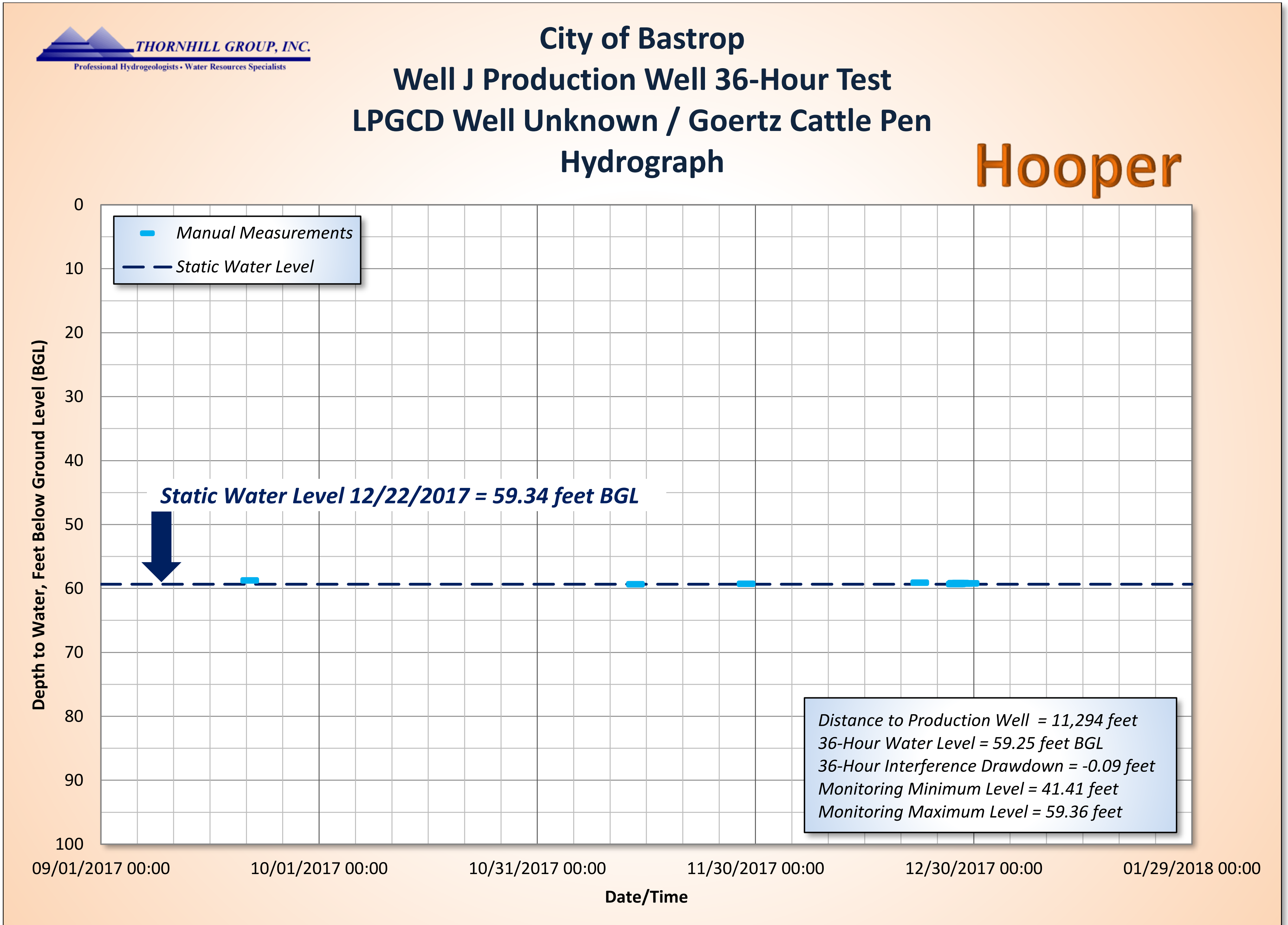
THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists

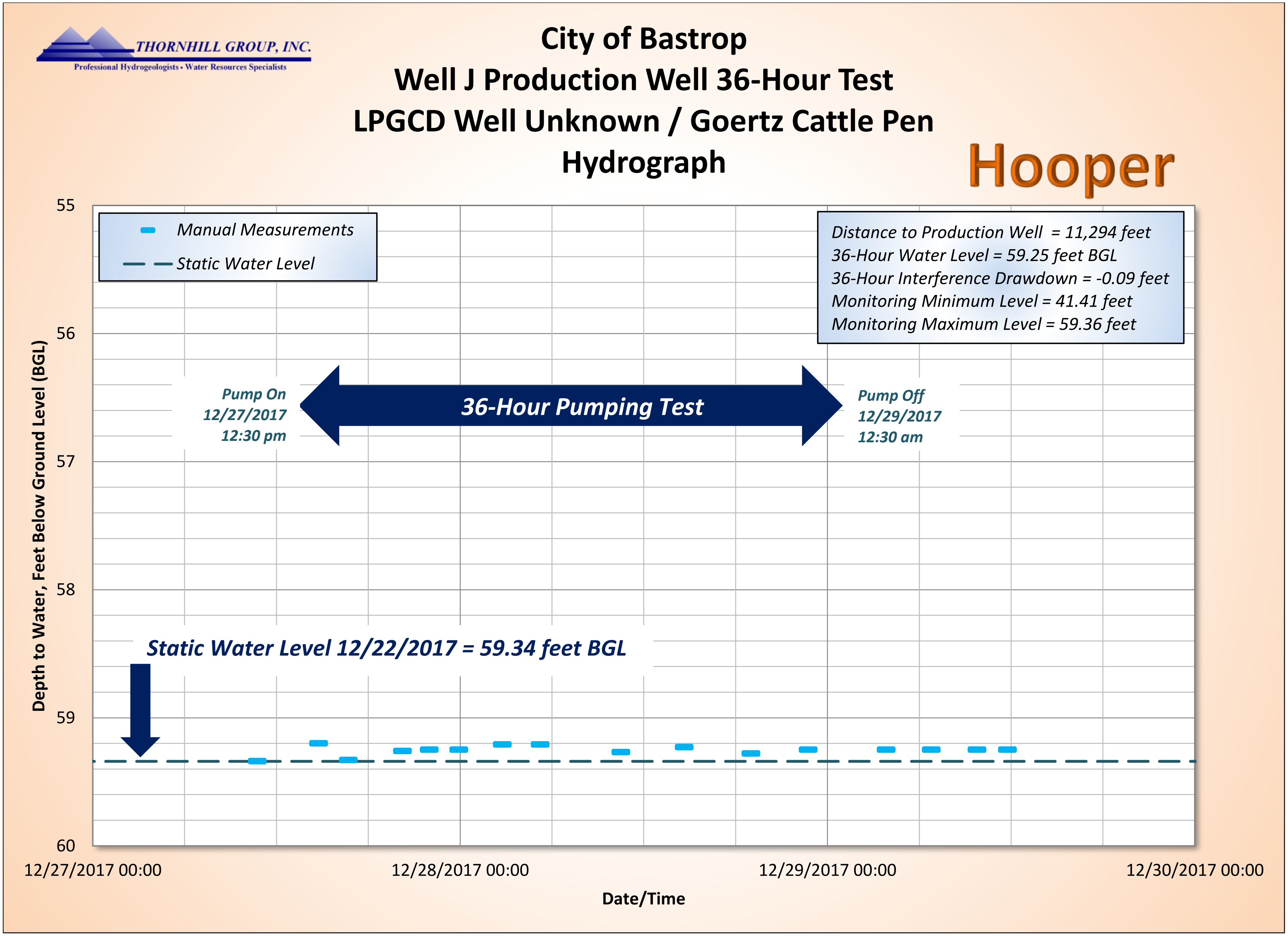
Name: Goertz House Well
Distance from Well J: 10,725.79 feet
Static Water Level 12/27/2017: 39.58 feet BGL
Sayers Rd
Sayers Rd
Arrowhead Ct
Shoreside Dr
Well J
Phelan Rd
Sayers Rd
Old Perkins Rd
Smith Rd
Explanation
City of Bastrop
Well J
N
0 500 1,000 2,000
Feet
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors,
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

City of Bastrop
Goertz Cattle Pen Well
36-Hour Drawdown and Recovery Results

Project: 10210
County: Bastrop
Aquifer Tested: Simsboro
Distance from Production Well: 11,294 feet
Production Well: Well J
Test Conducted By: Brien Water Wells & Thornhill Group, Inc.

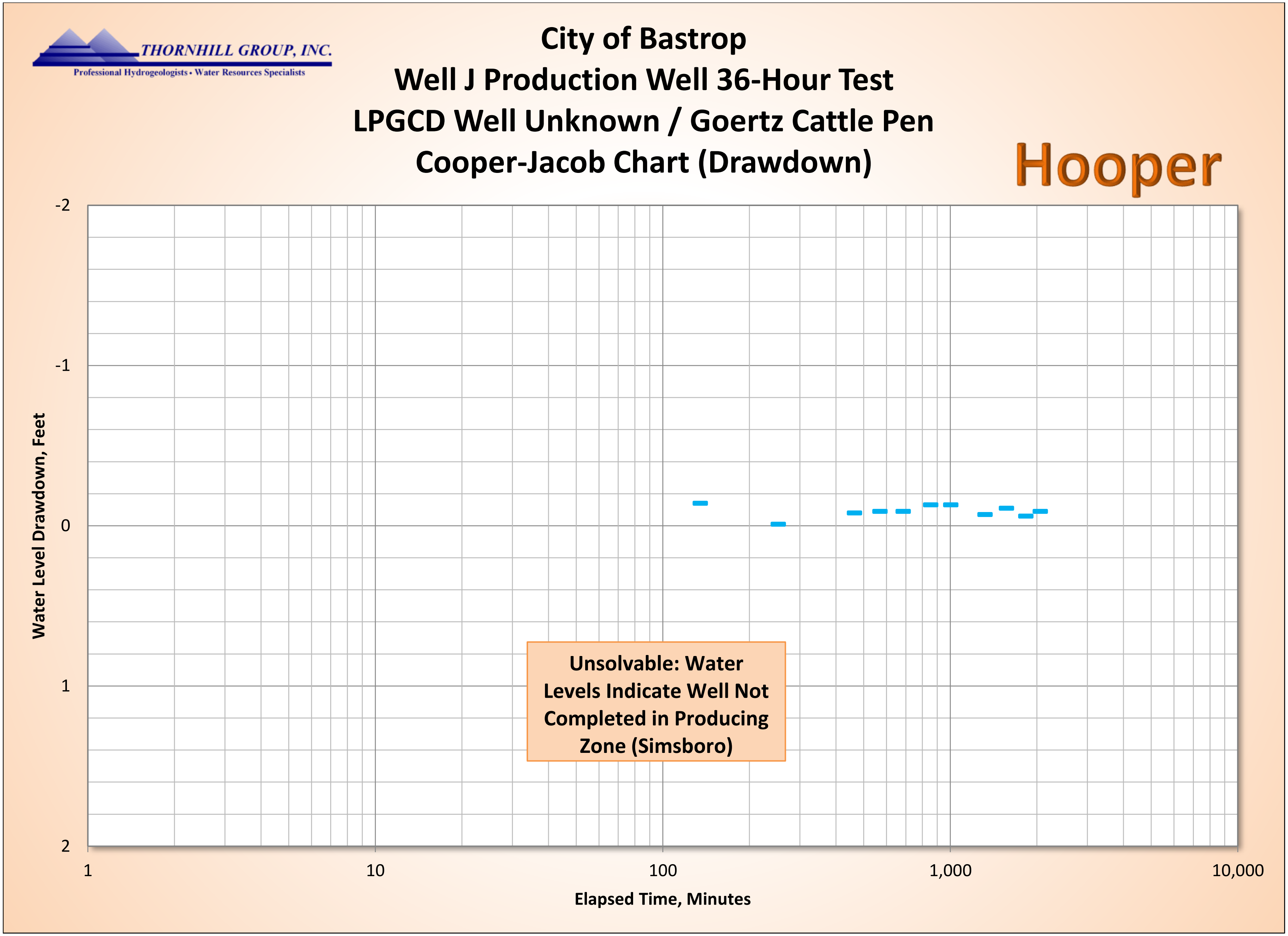
Date / Time	Depth to Water (Feet Below Land Surface)	Remarks
9/21/2017 10:39	58.76	Background
2/12/1900 13:47	59.35	Background
11/13/2017 11:31	59.36	Background
11/28/2017 17:02	59.32	Background
12/22/2017 13:36	59.13	Background
12/27/2017 10:45	59.34	Static Water Level
12/27/2017 14:45	59.20	Production Well on: 12/27/2017 12:30 pm
12/27/2017 16:42	59.33	
12/27/2017 20:14	59.26	
12/27/2017 21:59	59.25	
12/27/2017 23:55	59.25	
12/28/2017 2:45	59.21	
12/28/2017 5:14	59.21	
12/28/2017 10:30	59.27	
12/28/2017 14:38	59.23	
12/28/2017 19:00	59.28	
12/28/2017 22:44	59.25	
12/29/2017 3:50	59.25	Production Well off: 12/29/2017 12:30 am
12/29/2017 6:47	59.25	
12/29/2017 9:46	59.25	
12/29/2017 11:45	59.25	

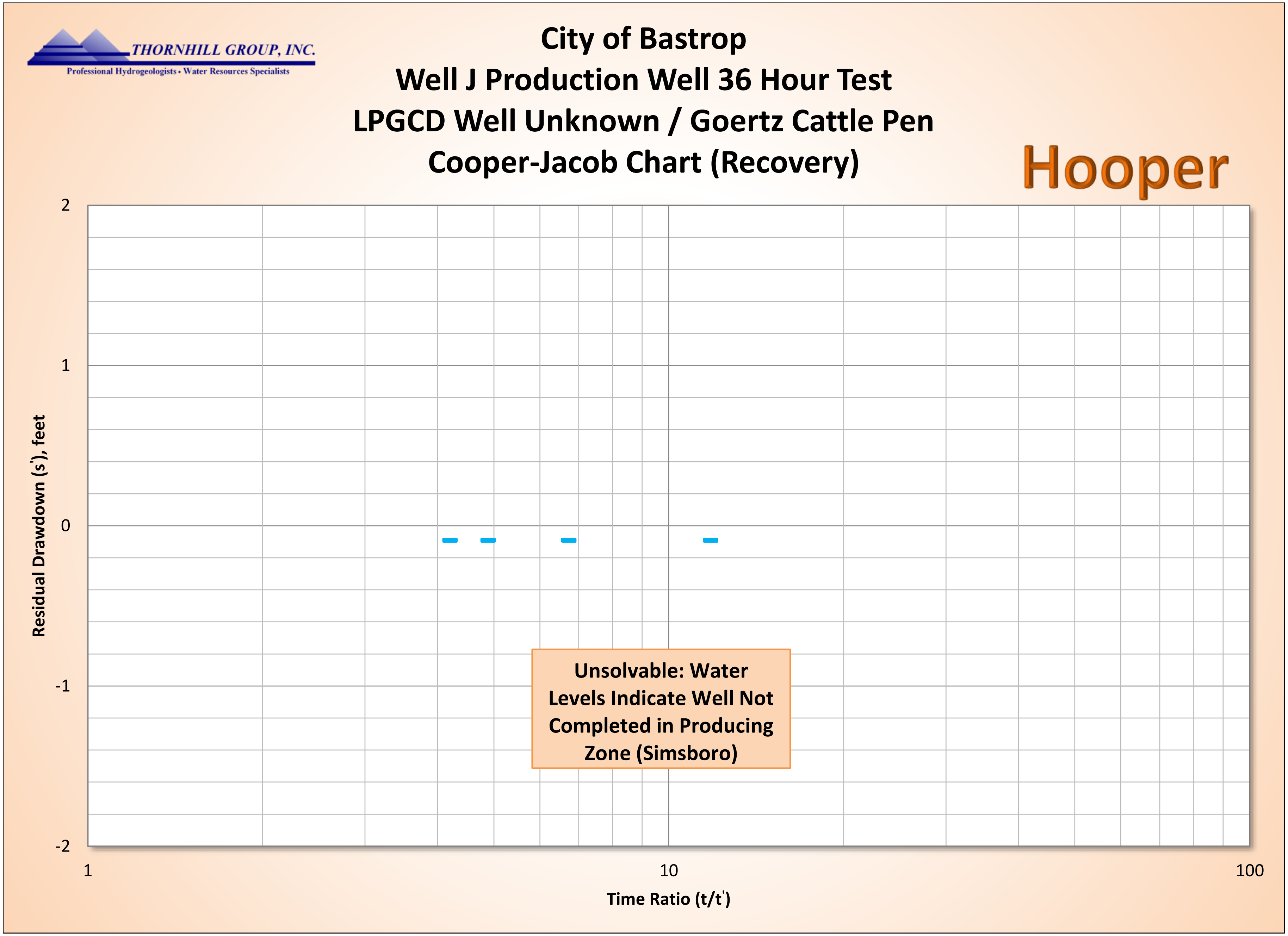

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well Unknown / Goertz Cattle Pen
Hydrograph
Hooper
Manual Measurements
Static Water Level
Static Water Level 12/22/2017 = 59.34 feet BGL
Depth to Water, Feet Below Ground Level (BGL)
0
10
20
30
40
50
60
70
80
90
100
09/01/2017 00:00
10/01/2017 00:00
10/31/2017 00:00
11/30/2017 00:00
12/30/2017 00:00
01/29/2018 00:00
Date/Time
Distance to Production Well = 11,294 feet
36-Hour Water Level = 59.25 feet BGL
36-Hour Interference Drawdown = -0.09 feet
Monitoring Minimum Level = 41.41 feet
Monitoring Maximum Level = 59.36 feet

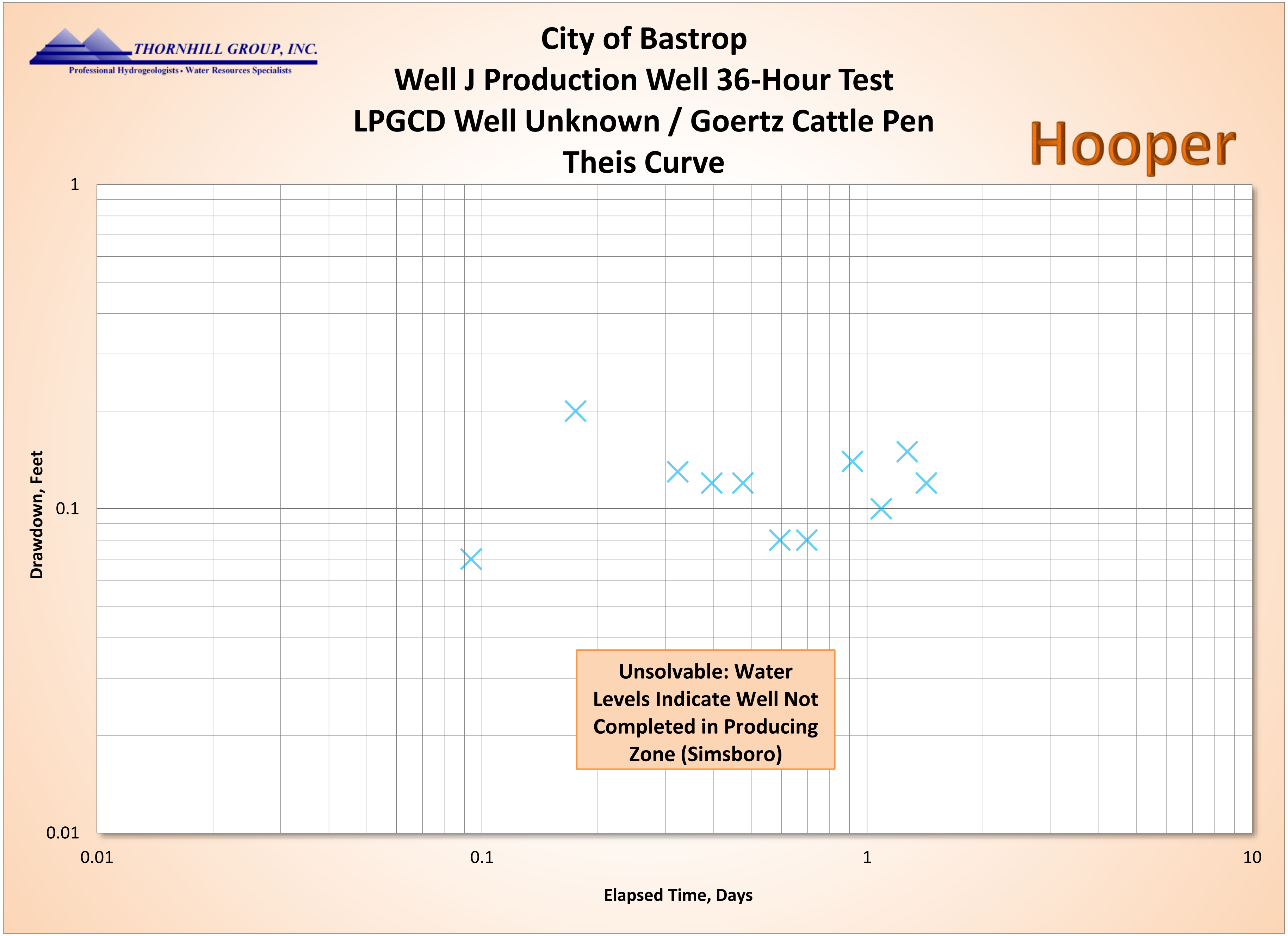


THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well Unknown / Goertz Cattle Pen
Hydrograph
Hooper
Manual Measurements
Static Water Level
Distance to Production Well = 11,294 feet
36-Hour Water Level = 59.25 feet BGL
36-Hour Interference Drawdown = -0.09 feet
Monitoring Minimum Level = 41.41 feet
Monitoring Maximum Level = 59.36 feet
Pump On 12/27/2017 12:30 pm
36-Hour Pumping Test
Pump Off 12/29/2017 12:30 am
Static Water Level 12/22/2017 = 59.34 feet BGL
Depth to Water, Feet Below Ground Level (BGL)
55
56
57
58
59
60
12/27/2017 00:00
12/28/2017 00:00
12/29/2017 00:00
12/30/2017 00:00
Date/Time

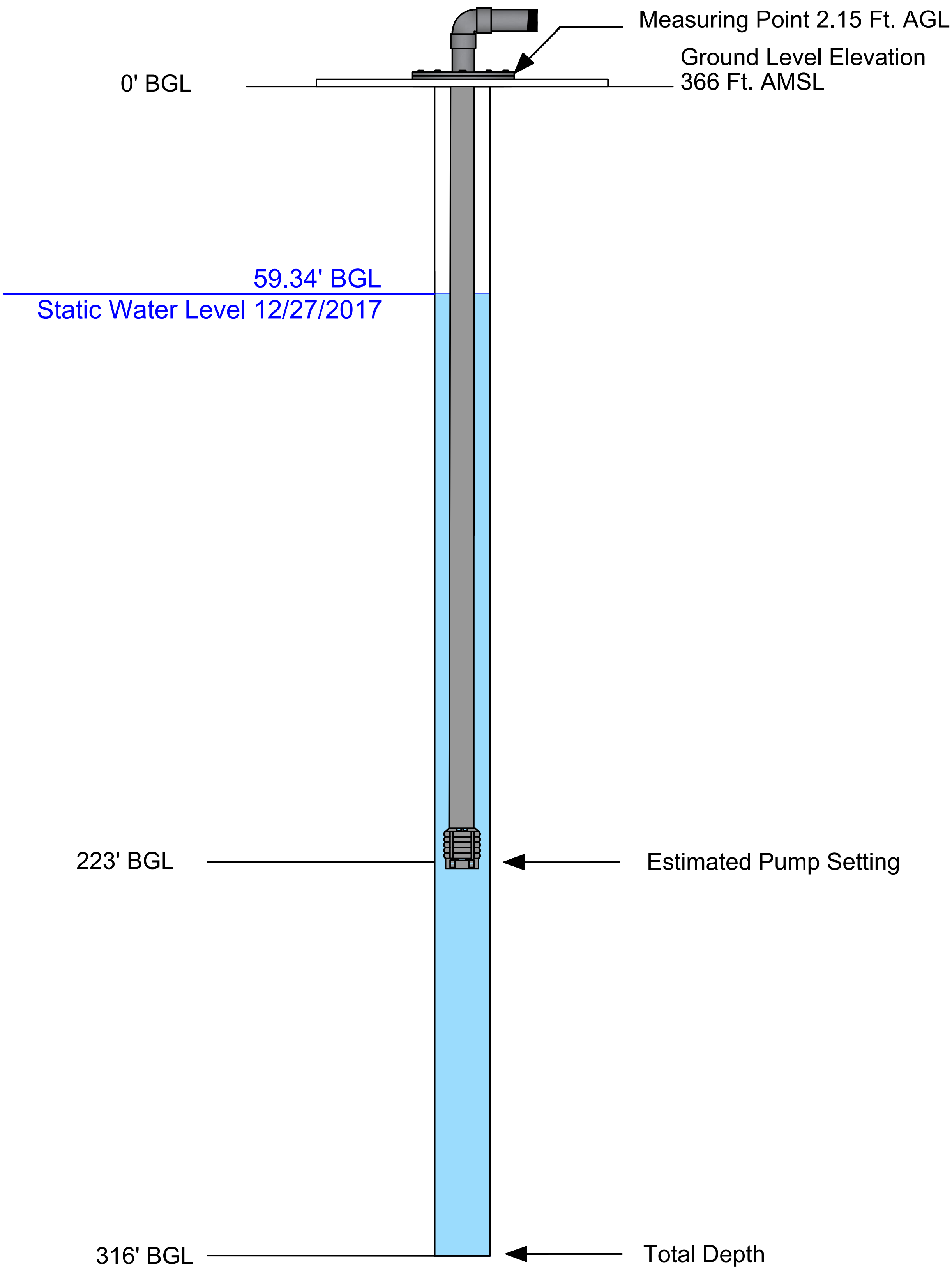
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well Unknown / Goertz Cattle Pen
Cooper-Jacob Chart (Drawdown)




THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36 Hour Test
LPGCD Well Unknown / Goertz Cattle Pen
Cooper-Jacob Chart (Recovery)
Hooper
Residual Drawdown (s'), feet
2
1
0
-1
-2
1
10
100
Time Ratio (t/t')
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)

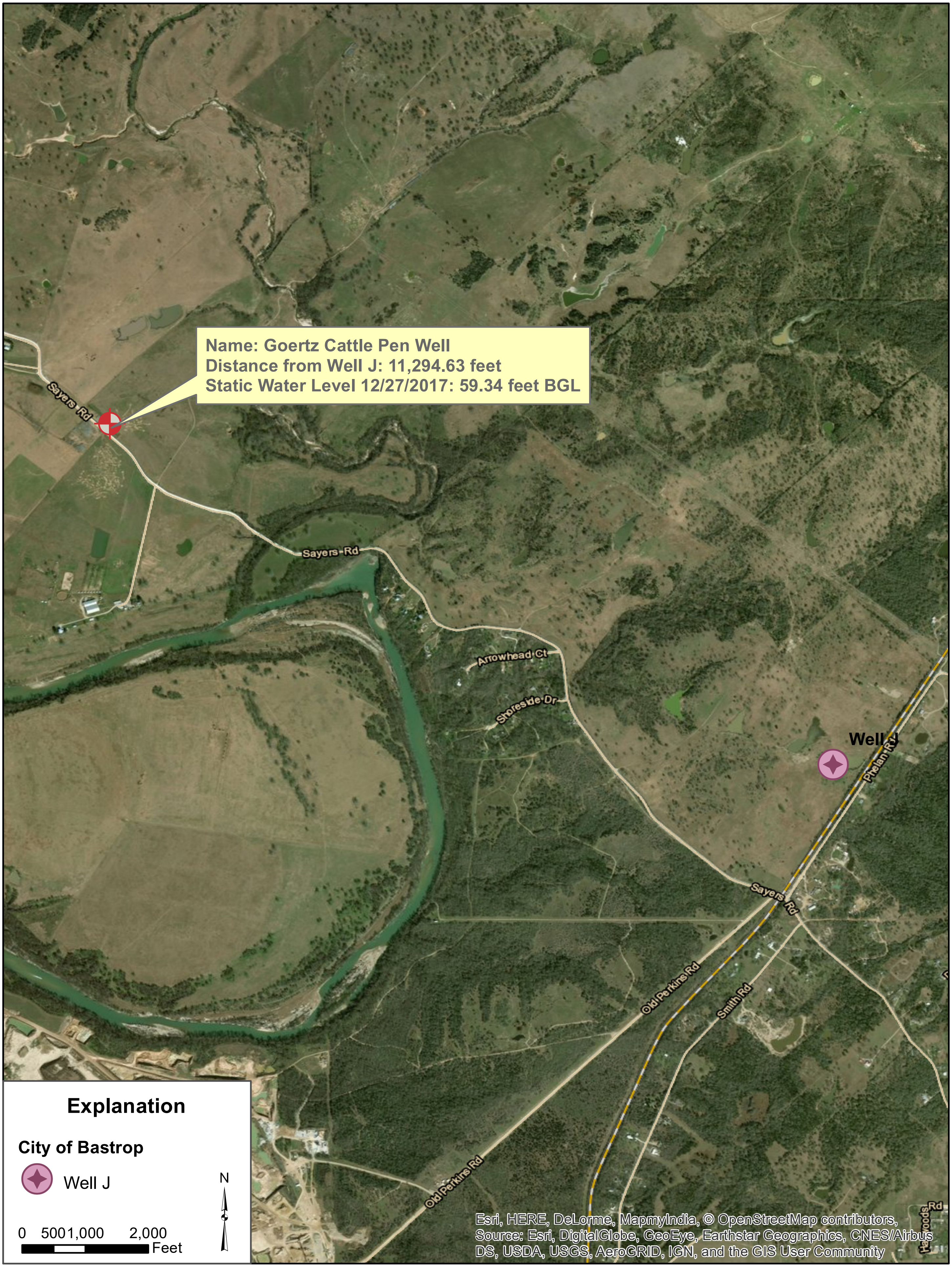

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists
City of Bastrop
Well J Production Well 36-Hour Test
LPGCD Well Unknown / Goertz Cattle Pen
Theis Curve
Hooper
Drawdown, Feet
1
0.1
0.01
0.01
0.1
1
10
Elapsed Time, Days
Unsolvable: Water Levels Indicate Well Not Completed in Producing Zone (Simsboro)

LPGCD Well Unknown / Goertz Cattle Pen Well



Well construction details compiled from State of Texas Well Report, LPGCD records, and/or TGI field investigations.

THORNHILL GROUP, INC.
Professional Hydrogeologists • Water Resources Specialists


Name: Goertz Cattle Pen Well
Distance from Well J: 11,294.63 feet
Static Water Level 12/27/2017: 59.34 feet BGL
Sayers Rd
Sayers Rd
Arrowhead Ct
Shoreside Dr
Well J
Phelan Rd
Sayers Rd
Old Perkins Rd
Smith Rd
Old Perkins Rd
Explanation
City of Bastrop
Well J
0 500 1,000 2,000
Feet
N
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Attachment F: City of Bastrop Well TW2 Drilling Project

Construction Report

City of Bastrop
Well TW2 Drilling Project

Prepared for

City of Bastrop

JANUARY 2015

STATE OF TEXAS
DAVID O'ROURKE
96829
LICENSED
PROFESSIONAL ENGINEER

1/9/15

CH2M HILL ENGINEERS, INC.,
TBPE NUMBER 3699

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Building 4, Suite 250
Austin, Texas 78759

Contents

Section	Page
Acronyms and Abbreviations	**v**
Executive Summary	**vii**
Introduction	**3**
1.1 Background	3
1.2 Hydrogeologic Definitions	4
1.3 Hydrogeologic Setting	5
Well Construction and Development	**6**
2.1 Sequence of Construction	6
2.1.1 Chronology	6
2.2 Construction Details	7
2.2.1 Drilling Methods	7
2.2.2 Pilot Holes	7
2.2.3 Well Construction	7
2.2.4 Well Development	9
Testing and Analysis	**11**
3.1 Lithology	11
3.1.1 Sampling Procedures	11
3.1.2 Description Methodology	11
3.2 Borehole Geophysics	11
3.2.1 Purpose and Methodology	11
3.2.2 Geophysical Logging	11
3.3 Aquifer Performance Testing	12
3.3.1 Purpose and Methodology	12
3.3.2 Results	13
3.4 Groundwater Quality	15
3.4.1 Purpose and Sampling Procedures	15
3.4.2 Field Parameter Summary	15
3.4.3 Laboratory Analysis Summary	15
Future Considerations	**17**
4.1 Water Quality	17
4.2 Yield Potential	17
References	19

Section **Page**

Tables

2-1 TW2 Well Construction Chronology 6
2-2 Tubulars Detail 9
2-3 Cementing and Filter Pack Detail 9
3-1 Constant-Rate Summary 13
3-2 Field Water Quality Parameters 15
3-3 Laboratory Analytical Results 15

Figures

1-1 Bastrop TW2 Location 4
3-1 Cooper-Jacob Drawdown Graph 14
3-2 Cooper-Jacob Recovery Graph 14

Appendixes

A Daily Field Logs
B Geophysical Logs
C Lithologic Logs and Well Construction
D Sieve Analyses
E Aquifer Test Data
F Analytical Laboratory Reports

Acronyms and Abbreviations

µs/cm	microsiemens per centimeter
ASTM	American Society for Testing and Materials
BEG	Bureau of Economic Geology
bgs	below ground surface
DO	dissolved oxygen
ft	feet
GAM	groundwater availability model
gpd	gallons per day
gpm	gallons per minute
GR	gamma ray
MCL	maximum contaminant levels
mg/L	milligram per liter
mV	millivolt
NGS	natural gamma ray spectroscopy
pCi/L	picocuries per liter
SP	spontaneous potential
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TDLR	Texas Department of Licensing and Regulation
TDS	total dissolved solids
TWDB	Texas Water Development Board
USCS	Unified Soil Classification System

Executive Summary

The City of Bastrop has negotiated a partial purchase of groundwater rights from the XS Ranch property in Bastrop County. In order to assess water quality and aquifer productivity in the northern part of the property, a test well was installed into the Simsboro Aquifer beneath the site to collect water quality samples and to perform an aquifer test. The well will also be used to monitor conditions in the Simsboro Aquifer at the site before and after production wells are installed and operated.

The drilling contractor worked at the site from September 4 through November 27, 2014. The first well that was installed had to be abandoned due to the presence of cement inside the well. The contractor demobilized after abandoning the first well.

The contractor re-mobilized to the site in late October 2014 and successfully installed well TW2. The well was installed to a total depth of 660 feet below ground surface (bgs), with 100 feet of 0.030 inch continuous slotted screen placed in two sections from 510 to 570 feet bgs, and 610 to 650 feet bgs. Sand pack of grade #12/20 was placed from the base of the sump to 450 feet bgs, and the remaining annulus from ground surface to 450 feet bgs was filled with a cement-bentonite grout.

Water quality analyses indicate that the produced water is suitable for public consumption with minor treatment or blending to reduce iron and manganese concentrations below the secondary drinking water standard for these parameters. When disinfecting the water with chlorine, ammonia detected in the water will increase demands on the chlorine and reaction products can cause noticeable taste and odor. As this water is to be used for public drinking water, the ammonia levels will need to be reduced through treatment, or a combination of treatment and blending.

The TW2 water is slightly scale-forming based upon general corrosion indices and has dissolved carbon dioxide gas and dissolved iron and manganese. When introduced into the existing Bastrop piping system, preliminary water quality results indicate that this water should not cause any significant changes in pipe scale. While these results are promising, no guarantees can be made with regards to the water quality of additional wells, because fluvial and deltaic aquifers similar to the Carrizo-Wilcox system have inherent variability.

A 37-hour constant-rate aquifer test was performed on the newly-installed well, followed by a 12-hour recovery period. The well was pumped at 408 gallons per minute. Transmissivity estimates based on data collected ranged from approximately 36,000 gallons per day per foot (gpd/ft) to 53,000 gpd/ft, with an expected value of approximately 50,000 gpd/ft. Since the tested transmissivity at TW2 was significantly higher than the value used in the assessment of long-term yield conducted by CH2M HILL in 2013, it is possible that the total sustainable yield of the XS Ranch wells may be higher than the 6,000 ac-ft/yr predicted by the previous assessment..

SECTION 1

Introduction

This document provides a detailed account of well construction, testing activities, and results as well as the as-built condition of test well TW2 located on the XS Ranch property (Figure 1-1) north of the City of Bastrop (the City). Activities performed during well construction included:

- Collection of lithologic samples
- Geophysical logging
- Documentation of well installation procedures and materials
- Aquifer performance testing
- Water quality sampling and analysis

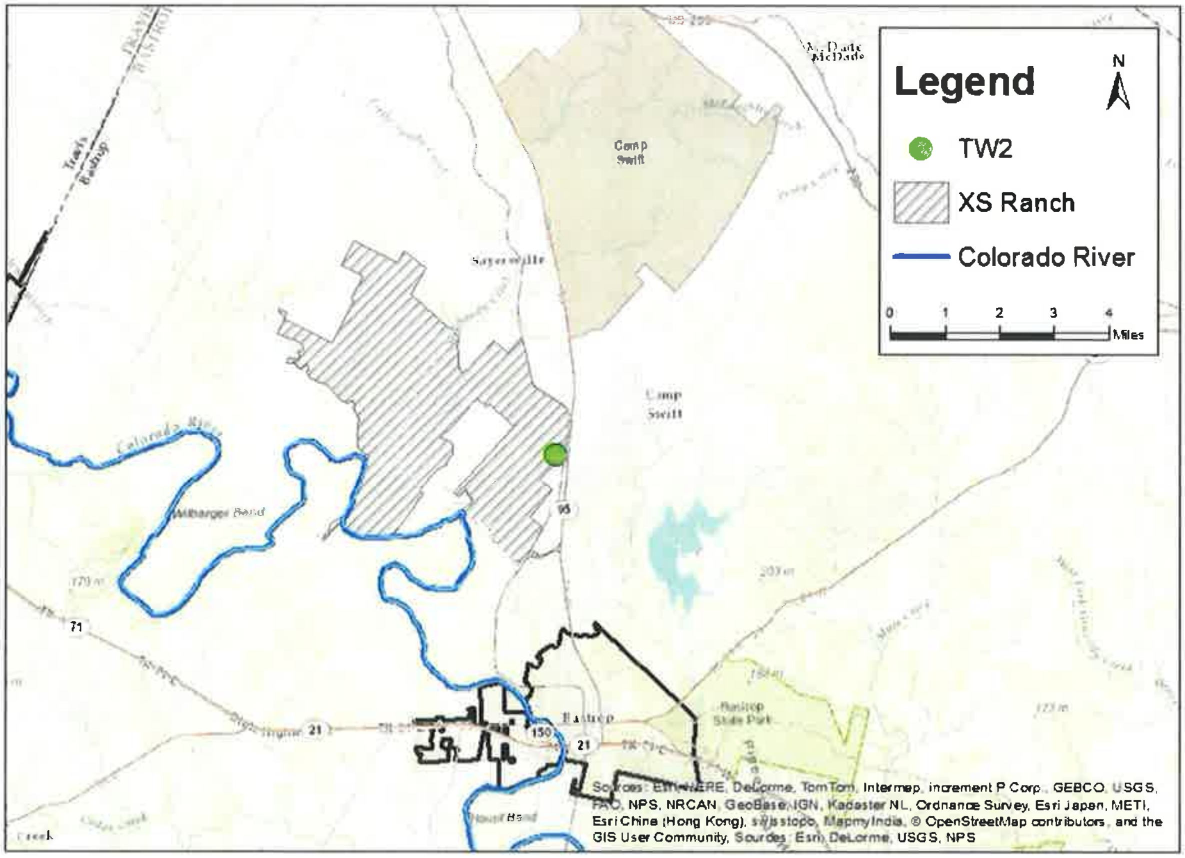
Information is presented documenting the locations, installation sequence, material descriptions and quantities, and methods used during well construction and testing.

The drilling and well construction were organized and funded by the landowner, Mr. John Landwehr (Landowner), and his consultant, R.W. Harden Associates (Harden), with the understanding that the City would reimburse the Landowner for costs incurred on the well. Under this arrangement, preparation of drilling specifications and the selection of the drilling contractor were performed by Harden. CH2M HILL provided technical expertise and limited construction oversight during well construction operations. Well construction operations were performed by Andrews & Foster Drilling Company, from Athens, Texas (Contractor). Originally well TW2 was specified as a temporary well to be removed after aquifer performance testing and collection of a water quality sample. However, after discussion with the Landowner and the Lost Pines Groundwater Conservation District (the District), it was decided to retain the well as a permanent monitoring well.

1.1 Background

The XS Ranch is a property owned by the Landowner of over 8,700 acres located north of the City (Figure 1-1). The City has entered into an agreement with the Landowner to complete a limited purchase of the Landowner's water rights associated with the property for the purpose of completing municipal supply wells to augment the current water supply for the City. The XS Ranch TW2 was constructed for two primary purposes; to characterize the water quality and yield potential of the Simsboro Aquifer at the northern limits of the proposed XS Ranch Wellfield and to allow monitoring of aquifer conditions before and after development of the production wells at the site. This project supplements and augments the data collected during the installation of Test Well 1 (TW1), completed in March 2013.

FIGURE 1-1
Bastrop TW2 Location



1.2 Hydrogeologic Definitions

The purpose of this project was to install a test well to collect water quality and aquifer hydraulic data in the northern extent of the XS Ranch property. Subsequent hydraulic testing provided site-specific aquifer properties, thus reducing design uncertainty moving forward. The following paragraphs provide a brief explanation of the hydrogeologic terminology used in this report.

Aquifer – Any saturated rock or sediment with sufficient permeability to transmit water. A confined aquifer is overlain by a geologic unit of significantly lower permeability thus inhibiting fluid flow vertically. Unconfined aquifers are not under pressure and can be recharged directly from fluid flow from the surface.

Hydraulic Conductivity – A measure of the speed (e.g. meters per second or feet (ft) per day) at which a fluid can flow through a porous media; is directly proportional to permeability. Hydraulic conductivity is dependent on the density and viscosity of the fluid passing through the porous media.

Permeability – A measure of how easily a fluid can to move through a porous media. It is related to connectivity of the void spaces within a rock. Permeability is independent of the type of fluid flowing through the porous media.

Porosity – A unitless measure of the void space in a material. It is calculated by dividing the volume of void space divided by the total volume of material.

Saturated Thickness - For a confined aquifer containing groundwater under positive pressure, the saturated thickness is equal to the aquifer thickness. For an unconfined aquifer, the saturated thickness is the distance from the top of the water table to the base of the aquifer.

Transmissivity – An intrinsic measurement of how much fluid can flow through a unit width of the aquifer under a unit hydraulic gradient. Transmissivity is dependent upon the hydraulic conductivity and saturated thickness of the aquifer. Transmissivity is the most important parameter in determining the sustainable yield of a well.

1.3 Hydrogeologic Setting

The Carrizo-Wilcox Aquifer, one of the nine major aquifers in Texas designated by the Texas Water Development Board, occurs throughout Bastrop County. Test well TW2 was installed into the Simsboro Formation, locally acknowledged to be the most productive member of the Wilcox Group. According to TWDB Report 1090 (Follett, 1972), the Wilcox consists chiefly of fine to coarse sand and lesser amounts of clay, sandy clay, sandstone, and silty shale with a few lenses of limestone and lignite. The sand, which constitutes about 40 percent of the Wilcox, is typically gray, fine to medium-grained, and is mostly quartz. In many places the Wilcox has an upper, middle, and lower sand zone. In Bastrop County east of the Colorado River, the middle zone is recognizable as the Simsboro Sand Member, and contains more and generally coarser sand than the other two zones. Some typical thicknesses of the Simsboro are about 650 feet in well AT-58-63-601 and about 850 feet in wells AT-58-47-901, AT-58-48-704, and AT-58-56-702. West of the Colorado the Simsboro becomes less massive and may be divided into two or more sand zones. Except for the Simsboro east of the Colorado, individual sand beds in the Wilcox Group are not continuous over long distances.

SECTION 2

Well Construction and Development

2.1 Sequence of Construction

2.1.1 Chronology

The contract between the Landowner and the Contractor was executed July 25, 2014. Wellfield construction began at TW2 on September 4, 2014, and concluded on November 27, 2014, with completion of the wellhead. **Table 2-1** presents the chronology of the test well construction and testing completed at the site. The following sections provide a brief account of delays and problems encountered during construction and testing. The Contractor encountered numerous delays related to loss of circulation of drilling fluid at shallow depths (less than 130 ft bgs), and moved the location of the borehole several times. CH2M HILL and Harden speculated that the circulation losses may be associated with loose bedding planes associated with lignite beds, or possibly historical mining in the area. **Appendix A** contains copies of CH2M HILL staff's daily field logs for the project. Testing procedures, analytical methods, and results are presented in **Section 3**.

TABLE 2-1
Well Construction Chronology[A]

Item	Period
Pilot hole drilling, two initial locations abandoned due to lost circulation of drilling muds, even after attempts to grout hole to plug off conduits causing loss. [B,C]	9/4/2014-9/15/2014
Complete pilot hole to TD at third location. Geophysical logging[D]	9/16/2014
Reaming of pilot hole.	9/17/2014-9/21/2014
Attempt well Installation. Tremie pipe would not fit down hole.	9/22/2014
Pull well casing from hole.	9/23/2014
Re-condition bore hole to straighten.	9/24/2014
Re-install well screen casing, gravel pack, and cement.	9/25/2014
Cement is discovered inside well at 84 ft bgs. Drill out interior of well and document presence of cement to 510 ft bgs. Well is abandoned. Contractor demobilizes.	9/26/2014
Contractor re-mobilize to site with new well materials.	10/25/2014
Pilot hole drilling, two initial locations abandoned due to lost circulation of drilling muds, even after attempts to grout hole to plug off conduits causing loss. [B,C]	10/26/2014-10/28/2014
Complete pilot hole to 690 feet bgs without loss of circulation w/ 7-7/8" drill bit.	10/30/2014
Ream to 660 feet bgs w/ 12-1/4" drill bit.	10/31/2014-11/1/2014
Ream with 14-3/4" drill bit and lose circulation at 65 ft bgs.	11/3/2014
Attempt to salvage hole through grouting, etc. Unsuccessful.	11/4/2014-11/6/2014
Start pilot holes at new locations. Two locations are abandoned due to shallow circulation loss.	11/7/2014-11/10/2014
Successfully complete pilot hole to 680 feet bgs w/ 7-7/8" drill bit.	11/11/2014
Ream borehole.	11/12/2014-11/15/2014
Install well screen, casing, and gravel pack.	11/17/2014

Item	Period
Well development.	11/18/2014-11/19/2014
Initial Cementing (35 sks).	11/20/2014
Final Cementing (162 sks 6%).	11/21/2014
Constant-rate test[E].	11/23/2014-11/25/2014
Water sampling[F].	11/25/2014
Site cleanup and de-mobilize	11/26-27/2014

Notes:
[A]All events performed by the Contractor unless otherwise noted
[B]Pilot hole start begins at hole "spud"
[C]End date is when total depth (TD) was reached
[D]Performed by Geo Cam, Inc
[E]Includes 12 hour recovery period
[F]Includes laboratory water quality sampling. Bacteriological samples were taken after the video survey.

2.2 Construction Details

2.2.1 Drilling Methods

The test well was drilled using a direct circulation mud rotary drill rig with tri-cone rotary bits to advance the boreholes. These bits were chosen because of the previous success using the bits in the Carrizo-Wilcox aquifer. The Contractor used a drilling fluid composed primarily of premium-grade, high-yielding Wyoming sodium bentonite. The reduced fluid weight and increased viscosity provides better fluid loss control and gelling characteristics. Excessive fluid loss and subsequent formation invasion can negatively affect geophysical logging quality and inhibit well development. Effective solids control was provided with excavated settling pits.

2.2.2 Pilot Holes

Pilot holes were installed for the purpose of collecting geophysical and lithologic data prior to reaming and construction of the test well. Each pilot hole was drilled with a 7-7/8-inch diameter tri-cone bit and was advanced to predetermined depths at the locations of the test wells. The first pilot hole was completed to a depth of 700 feet bgs. Geophysical and lithologic data collected from the pilot holes were used to select screen intervals, appropriate gradation for filter pack, and to calculate an acceptable screen slot size for the final wells. Lithologic grab samples were collected by the Contractor at 10-foot intervals immediately after discharge from the borehole. The samples were evaluated in the field by CH2M HILL using the Unified Soil Classification System (USCS; ASTM 1989). Geophysical logs are contained in **Appendix B** and a lithologic log is provided in **Appendix C**.

In order to save costs after the initial well location and borehole were abandoned, CH2M HILL did not request new geophysical or caliper logging of the new locations. Lithologic samples from the new location were compared to the boring log completed from the original location. It was determined that the lithology was effectively similar enough to maintain the original well design and screen intervals without the need for confirmatory geophysical or caliper logging.

2.2.3 Well Construction

After the pilot hole data were evaluated and a final well design was agreed to by the Contractor and CH2M HILL, the following general construction sequence was followed for well installation and testing.

- Ream the pilot hole to a 14-3/4-inch diameter down to the minimum depth determined by Engineer.
- Install 6-5/8" diameter 0.030-inch slot pipe-base, continuous 304 stainless steel wire-wrap well screen and 6-5/8" diameter steel casing, install a steel swedge, and 8-5/8" diameter upper casing in place.
- Install #12/20 gravel pack in annulus.
- Perform well development.
- Install cement in well annulus above the gravel pack.
- Perform preliminary rate test and constant rate aquifer test.
- Collect water samples.
- Secure and seal well casing.

CH2M HILL staff members were onsite to document the installed quantities and types of casing, screen, cement, and gravel pack. Well-specific construction activities are outlined in the following paragraphs for each site. Tubular quantities and quantities of cement and gravel pack are presented in **Tables 2-2 and 2-3,** respectively. CH2M HILL also documented the aquifer performance testing and water sampling, as presented in **Section 3**.

Well TW2

Pilot hole drilling commenced on September 4, 2014. As mentioned previously in Table 2-1, two initial locations were abandoned due to circulation losses in the borehole, and the drilling location was moved to a location within a few hundred feet of the original, along the dirt access road (to minimize clearing), and maintaining a minimum 50 foot distance from the property line as per District rules. The first successful pilot hole was competed to a depth of 690 feet below ground surface (bgs) on September 16, 2014. Lithologic samples were collected from this borehole, and a geophysical log was run on September 16, 2014, by GeoCam, Inc. The pilot hole was reamed between September 17 and September 21, 2014 to a depth of approximately 660 ft bgs. Casing and screen were installed on September 22, 2014. During the gravel pack installation, the Contractor was unable to place the tremie pipe to the desired depth, likely due to crooked screen or casing. On September 23-24, 2014, the casing was pulled from the borehole, and the borehole was re-conditioned. On September 25, 2014 the well was re-installed. Two intervals of 0.030-inch screen were installed (a 40-foot section from 610 to 650 feet bgs, and a 60-ft section from 510 to 570 ft bgs). A #12/20 grade gravel pack was emplaced in the annular space between well screen and borehole wall via a tremie pipe on from the total depth of the borehole to a depth of 20 feet above the top of the well screen. In general, the Contractor emplaced the gravel back to a depth shallower than the base of the upper casing.

The original well installed (Lost Pines Groundwater Conservation District Drilling Registration No. 5854535) was found to have cement grout on the interior of the well on September 26, 2014. It was therefore necessary for the Contractor to abandon this well. The location of this well was latitude 30° 10' 50.81", longitude 97° 19' 11.0". A plugging report, Form a004WWD, was filed with the Texas Department of License and Regulation.

The Contractor returned to the site and began drilling a replacement well on October 25, 2014. Two initial pilot holes were abandoned due to circulation loss. At a third site, the pilot hole was completed to 690 feet bgs. This borehole was reamed to total depth with a 12-1/4-inch diameter bit. Then the borehole was reamed with a 14-3/4-inch diameter bit, and circulation was lost at 65 feet bgs. After various attempts to salvage this hole were unsuccessful, the location was moved again.

The next two borehole locations encountered circulation loss at shallow depths (less than 100 feet bgs). At the third location, the pilot hole and reamed hole were completed to total depth of 680 ft bgs without loss of circulation. Well TW2 was installed as originally designed on November 17, 2014. An initial cement stage was pumped (35 sacks Class A with 6% bentonite) on November 20, followed by 5 feet of bentonite grout (no cement). The final stage (162 sacks Class A with 6% bentonite) was pumped November 21, 2014. The location of TW2 latitude 30° 10' 49.08", longitude 97° 19' 12.76".

TABLE 2-2
Tubulars Detail

Item	Top (ft bls)	Bottom	Outside Dia. (in)	Wall Thickness (in)	Material
Base of Upper Casing	Land Surface	510 [A]	8 5/8	0.322	Mild Steel
Screened Interval 1	510	570	6 5/8	0.375	pipe-base, continuous 304 stainless steel wire-wrap
Blank Interval 1	570	610	6 5/8	0.375	Mild Steel
Screened Interval 2	610	650	6 5/8	0.375	pipe-base, continuous 304 stainless steel wire-wrap
Sump	650	660	6 5/8	0.375	Mild Steel

[A] Includes swedge

TABLE 2-3
Cement and Filter Pack Detail

Item	Top (ft bls)	Bottom	Hole Dia. (in)	Volume	Material
Cement	Land Surface	450	14 3/4	197 SK	Class A with 6% bent.
Gravel Pack	450	660	14 3/4	4.6 CY	12/20

WT2 CONSTR. AT DIFFERENT LOCATION

2.2.4 Well Development

Well development activities improve well yield by removing drilling fluid and formation fines introduced during drilling and construction activities from the gravel pack and adjacent aquifer matrix. Following installation of the casing and screen, the Contractor thinned the drilling fluid (i.e., density and viscosity reduced) using fresh water to prepare for gravel packing. Gravel pack was then installed using a tremie pipe to approximately 60 feet above the top of the well screen (450 feet bgs). When installing the gravel pack, the Contractor was required to keep the maximum free fall distance between the top of the gravel and the bottom of the tremie less than 20 ft.

SECTION 3

Testing and Analysis

3.1 Lithology

3.1.1 Sampling Procedures

During drilling at the first well site, extensive sampling was conducted to characterize the lithology of the production zone and overlying strata at the first well site. The Contractor collected representative grab samples that were separated from drilling fluids upon exit from the borehole. Formation samples were collected every 10 feet for inspection by CH2M HILL staff. The lithology of each sample was described by a CH2M HILL engineer and recorded on a lithologic log (**Appendix C**). Samples were considered to be representative of the lithology over each 10-foot interval drilled.

Representative samples were selected from the production interval for a particle size analysis. Results will be useful in determining the appropriate screen slot size and corresponding gravel pack design for the future production wells. Sieve analyses were performed by Johnson Well Screen, the well screen manufacturer. Johnson's recommendations based on the sieve analysis results suggested 0.030-inch slot screen, and #12/20 grade sand pack. These are the screen and sand sizes used in TW2. **Appendix D** contains the results of the sieve analyses.

3.1.2 Description Methodology

Lithologic samples were described using the United Soil Classification System (USCS) (ASTM 1989). An individual sample was first classified based upon its particle size distribution and relative percentage of clay, silt, and sand. Samples were further described using a Munsell Rock Color chart. Also noted were grading and occurrence of trace constituents such as lignite, muscovite, or shale fragments, if present.

3.2 Borehole Geophysics

3.2.1 Purpose and Methodology

Borehole geophysical logging was performed to the total depth of the pilot borehole at the first well site. Various logging tools were passed through the borehole to measure different properties of the formations penetrated. Correlation of the recorded properties with the physical properties of geologic materials provided an accurate and cost-effective representation of the type and in-situ structure of the formations and general water chemistry present. Geo Cam, Inc., was the geophysical subcontractor for well TW2.

3.2.2 Geophysical Logging

Because different geophysical logs respond to the same formation materials in unique ways, logs are often run in suites to define key characteristics more accurately. This section describes the various logs run in the pilot hole at the first well site. Objectives of the geophysical logging program included:

- Identification of lithologic and mineral composition of formations
- Positive and accurate depth control
- Indication of relative permeability

3.2.2.1 Caliper Log

The caliper log measures the diameter of the borehole. Spring-loaded arms record borehole diameter variations as the tool is retrieved from the borehole. Diameter variations can be associated with the relative hardness of sequential strata, the degree of fracturing in hard rock, or the occurrence of significant voids or can be related to rotational speed of the drill bit and mud circulation rate.

3.2.2.2 Natural Gamma Ray Log

The natural gamma ray (GR) log records the native radioactivity of the geologic strata. Radioactive elements tend to concentrate in clay and shale deposits. However, volcanic ash or granite sand can also produce detectable radioactivity.

3.2.2.3 Spontaneous Potential Log

The spontaneous potential (SP) log works by measuring small electric potentials (measured in millivolts) between depths in the borehole and a grounded voltage at the surface. The change in voltage through the borehole wall is caused by a buildup of charge on the well bore walls. Clays and shales will generate one charge and permeable formations such as sandstone will generate an opposite one. This buildup of charge is, in turn, caused by differences in the salt content of the well bore fluid (drilling mud) and the formation water (connate water). These potential differences are represented on the geophysical log by the SP curve. The "flat" shape of the SP curve noted for shale intervals indicates the limited ion exchange in low permeability formations. This is called the shale baseline, and typically shifts only slowly over the depth of the borehole. Whether the mud contains more or less salt than the connate water will determine which way the SP curve will deflect opposite a permeable formation. The amplitude of the response line will vary from formation to formation and will not give a definitive answer as to the permeability or the porosity of the formation that it is logging.

3.2.2.4 Resistivity

The resistivity log records the electrical resistivity of the borehole environment and surrounding rocks and water as measured by variably spaced potential electrodes on the logging probe. Typical spacing for potential electrodes are 16 inches for short-normal resistivity and 64 inches for long-normal resistivity. Normal-resistivity logs are affected by bed thickness, borehole diameter, and borehole fluid and can only be collected in water- or mud-filled open holes (without casing).

Processed log presentations are provided in Appendix B for the logs performed.

Inspection of the geophysical logs indicated two significant sections of sand separated by a shale member approximately 20 feet thick (Appendix C). Based on this observation, CH2M HILL decided to construct the well with two separate screened intervals: from 510 to 570 feet bgs, and from 610 to 650 feet bgs.

3.3 Aquifer Performance Testing

3.3.1 Purpose and Methodology

The constant-rate test was preformed primarily to collect a representative water sample. The upper casing diameter of 8 5/8 inches limited the pump capacity and did not allow the aquifer to pumped at the rate planned production wells at the site (up to 1,500 gpm). The well was also not screened over all the available sand in the target production zone to limit construction cost. Therefore, estimates of aquifer transmissivity from TW2 likely lower than the actual value for the production zone.

The Theis equation (1935) describes drawdown in a well at any time after pumping has started and was used to estimate the theoretical drawdown in the pumping well assuming no well losses. The equation depends on the following assumptions adapted from Driscoll (1986):

- The pumping well is 100 percent efficient.
- The aquifer is uniform in character and the hydraulic conductivity is the same in all directions.
- The formation is uniform in thickness and infinite in a real extent.
- The formation receives no recharge from any source.
- The pumped well penetrates, and receives water from, the full thickness of the aquifer.
- The water removed from storage is discharged instantaneously when the head is lowered.
- All water removed from the well comes from aquifer storage.

- Laminar flow exists throughout the well and aquifer.
- The water table or potentiometric surface has no slope.

The simplest form of the Theis (1935) equation is:

$$s = \frac{114.6Q}{T} W(u);$$

where:

s = drawdown, in ft, at any point in the vicinity of a well discharging at a constant rate
Q = pumping rate, in gpm
T = coefficient of transmissivity of the aquifer, gpd/ft
W(u) = the well function of u, which represents an exponential integral with u, calculated as follows:

$$u = \frac{1.87r^2 S}{Tt};$$

where:

r = distance, in ft, from the center of a pumped well to a point where the drawdown is measured
S = coefficient of storage (dimensionless)
t = time since pumping started, in days

For our analysis, a modified version of the Theis equation presented by Cooper and Jacob (1946) was used. This method is valid for values of u less than about 0.05. The transmissivity of the formation near the well can be calculated based on the slope of the drawdown versus elapsed time on a semi-log plot as follows:

$$T = \frac{2.3Q}{4\pi\Delta s};$$

where:

Δs = slope of the drawdown graph expressed as the change in drawdown over one log cycle.

3.3.2 Results

A summary of data collected during aquifer performance testing is provided in **Table 3-1**. **Appendix E** provides the observed water level response at the pumped well.

TABLE 3-1
Constant-Rate Summary

Well	Constant-Rate Start Date	Static Depth to Water (ft)	Rate (gpm)	Depth to Water at end of Pumping (ft)	Est. Trans. (gpd/ft)
TW2	11/23/2014	195.9	408	265.5	50,000

Inspection of the drawdown graph (**Figure 3-1**) and the recovery graph (**Figure 3-2**) appears to indicate a break in slope in the data over the period of the test. In Figure 3-1, the slope appears to flatten out, or become less steep, after about 500-600 minutes of pumping. Transmissivity estimates were calculated separately for each portion of the curve. For the first portion of the curve (zero to 600 minutes) the transmissivity is estimated at 36,000 gallons per day/foot (gpd/ft). For the second part of the curve (600 to 2100 minutes), the transmissivity is estimated at 53,000 gpd/ft.

The recovery graph (Figure 3-2) displays similar trends to Figure 3-1, with a break in slope after approximately 600 minutes of pumping. Based on the first part of the curve, transmissivity is estimated at 45,000 gpd/ft. Based on the longer second part of the curve, the transmissivity is estimated at 53,850 gpd/ft.

The second part of the curve represents the time after initial conditions immediately surrounding the well dominate the dynamics of the aquifer response, when the pumped well is engaging a larger vertical section of the aquifer; these conditions are more representative of the conditions characteristic of the aquifer during long-term operation for production. As such, the higher transmissivity estimate may be more representative of what the aquifer will produce over the long term.

Figure 3-1
Cooper-Jacob Drawdown Graph

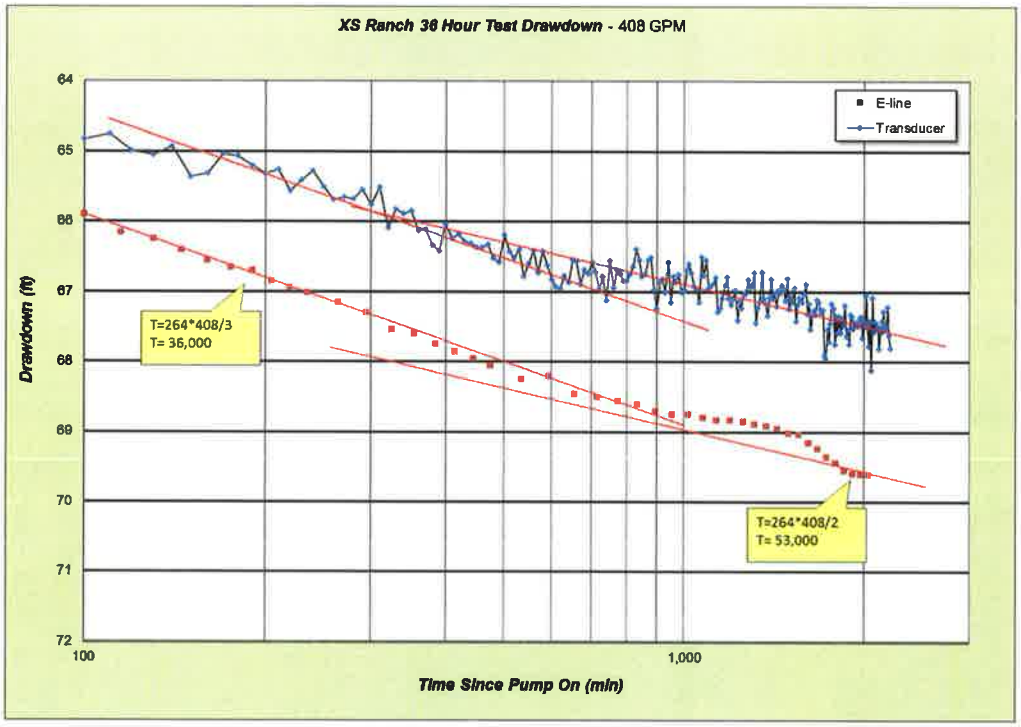
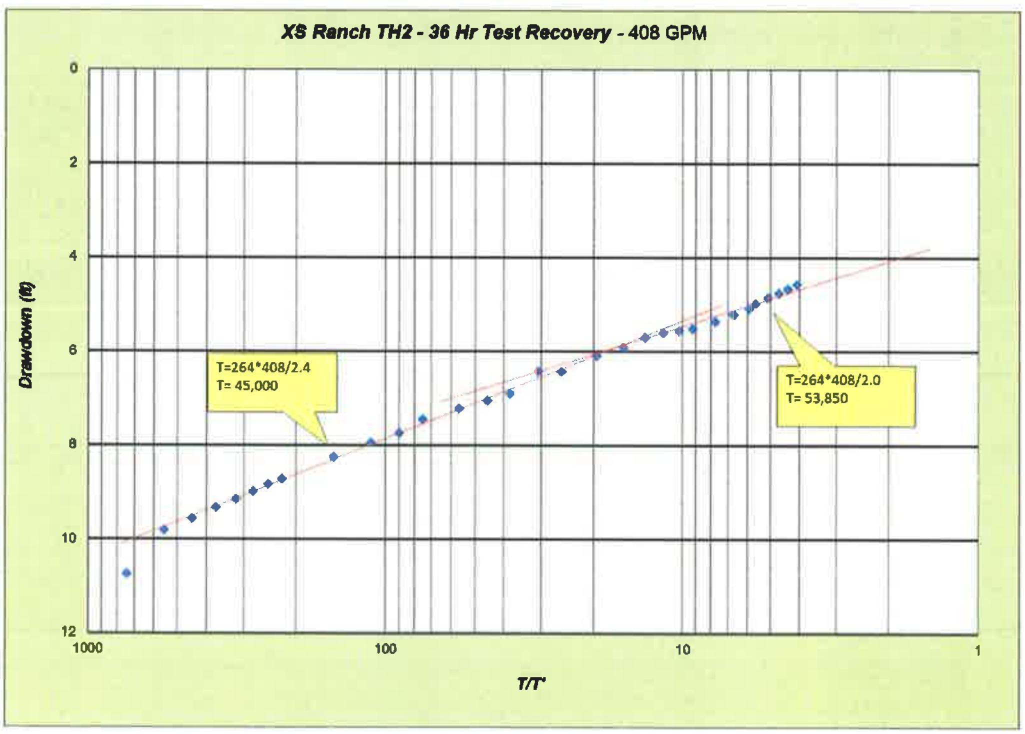


Figure 3-1
Cooper-Jacob Recovery Graph



3.4 Groundwater Quality

3.4.1 Purpose and Sampling Procedures

Groundwater samples were collected to characterize water quality in the northern part of the XS Ranch property, to augment data collected previously in the southern part of the property during the installation of TW1. This data will help the City assess any treatment or blending requirements that may be necessary to meet public drinking water standards. All the required constituents for Texas public supply wells were measured.

Two sampling events were conducted:

1) Field parameter sampling - Samples were collected from Bastrop Well TW2 near the end of the 37-hour aquifer performance tests. A summary of field parameters is provided in Section 3.4.2.

2) Sampling for laboratory analysis - Analab Laboratories Inc. provided the appropriate sample bottles and staff trained in proper water sampling techniques. Groundwater was collected through a silicon tube out of a sample tap located on the outlet piping. CH2M HILL representatives observed and assisted with sample collection and ensured that the lab maintained proper chain-of-custody requirements. A summary of the laboratory analyses is provided in Section 3.4.3.

3.4.2 Field Parameter Summary

Field water quality parameters were monitored and recorded prior to the collection of groundwater samples during the constant rate aquifer test. Water quality parameters were recorded on a Dissolved Oxygen meter provided by Harden and a combined meter used by the Analab field technician during sample collection, and the pressure/temperature/conductivity transducer used during the aquifer performance test. Field parameters were taken during the final hour of the constant-rate test, prior to sample collection but before the recovery phase of the hydraulic test.

Parameters included temperature, specific conductivity, dissolved oxygen (DO), and pH. **Table 3-2** presents the field water quality parameters recorded prior to the collection of the groundwater samples. The volume of groundwater purged prior to sampling was approximately 880,000 gallons.

TABLE 3-2
Field Water Quality Parameters

Parameter	Units	TW2 (Simsboro)
Temperature	°F	81.1
Specific Conductivity	µs/cm	0.387
Dissolved Oxygen	mg/L	0.85 – 1.3
pH	Std Units	7.3

3.4.3 Laboratory Analysis Summary

Analytical sample results are presented in **Table 3-3,** along with TCEQ maximum contaminant levels (MCL) for the applicable analytes. These samples were taken after the well was pumped for approximately 36 hours. Analytical Laboratory reports are provided in **Appendix F**. Parameters analyzed meet current primary drinking water standards. Iron and manganese, secondary drinking water standards, exceed the maximum allowable concentration. Water quality in well TW2 is typical of that from other wells in the Simsboro aquifers in the test areas.

TABLE 3-3
Laboratory Analytical Results

	Unit	TCEQ MCL	Results		Unit	TCEQ MCL	Results
Primary Drinking Water Standards							
Antimony, Total	mg/L	0.006	0.00297	Dissolved Aluminum	ug/L	50-200	2.05

	Unit	TCEQ MCL	Results		Unit	TCEQ MCL	Results
Dissolved Antimony	ug/L	6.00	<1.00	Chloride	mg/L	300	53.7
Dissolved Arsenic	ug/L	10.0	0.262	Dissolved Copper	ug/L	1,000	<1.00
Dissolved Barium	ug/L	2,000	174	Fluoride	mg/L	2.0	0.254
Dissolved Beryllium	ug/L	4.00	<0.500	Total Iron	mg/L	0.3	0.661
Cadmium, Total	mg/L	0.005	<0.0005	Dissolved Iron	ug/L	300	519
Dissolved Cadmium	ug/L	5.00	<0.500	Manganese, Total	mg/L	0.05	0.211
Dissolved Chromium	ug/L	100	1.34	Dissolved Manganese	ug/L	50	209
Cyanide	mg/L	0.200	0.0019	Dissolved Silver	ug/L	100	0.0769
Dissolved Lead	ug/L	15.0	<0.500	Sulfate	mg/L	300	72.3
Dissolved Mercury	ug/L	2.00	<0.200	Total Dissolved Solids	mg/L	1,000	412
Nitrate-Nitrite Nitrogen	mg/L	10	<0.100	Dissolved Zinc	ug/L	5,000	101
Dissolved Selenium	ug/L	50.0	0.791	pH	SU	6.5-8.5	7.3
Dissolved Thallium	ug/L	2.00	<0.500	Laboratory pH	SU	6.5-8.5	7.7
General Chemistry							
Hydroxide	mg/L	NL	<0.5	Sulfide	mg/L	NL	<0.015
Bicarbonate (as CaCO3)/Calc	mg/L	NL	195	Sulfide as Hydrogen Sulfide	mg/L	NL	<0.0159
Carbonate (as CaCO3)/Calc	mg/L	NL	<0.5	Total Alkalinity (as CaCO3)	mg/L	NL	195
Free Carbon Dioxide (Calc)	mg/L	NL	19.5	Acidity (as CaCO3, Calc)	mg/L	NL	12.2
Carbon Dioxide (Calc)	mg/L	NL	191	Acidity (as CaCO3)	uEq/L	NL	245
Methane	ug/L	NL	<0.965	Sodium Hydrosulfide (NASH)	mg/L	NL	<0.036
Calcium	mg/L	NL	88.9	Silicon Recoverable	mg/L	NL	12.5
Potassium	mg/L	NL	3.32	Silicon (as SIO2)	mg/L	NL	26.8
Magnesium, Total	mg/L	NL	11.6	Ammonia Nitrogen	mg/L	NL	0.207
Sodium	mg/L	NL	28.1	Total Hardness Ca/Mg Eq. CaCO3	mg/L	NL	270
Radiologicals							
Gross Alpha Particle Activity	pCi/L	15	4	Radium-226	pCi/L	NL	<0.98
Uranium	ug/L	30	ND	Radium-228	pCi/L	NL	1.10
				Combined Radium	pCi/L	5	<2.1

Notes:

MCL = maximum contaminant limit

pCi/L = picocuries per liter

Gross Alpha Compliance Level = Gross alpha results - U-234 result - U-238 result - U-235 result

SU = standard units

NL = Not Listed

uEq/L = microequivalents per liter

ug/L = micrograms per liter

Combined Radium Compliance Level = Ra-226 result + Ra-228 result

mg/L = milligrams per liter

ND = non-detect

SECTION 4

Future Considerations

4.1 Water Quality

As presented previously, TW2 was constructed for two primary purposes; characterize the water quality and yield potential at the northern limits of the proposed XS Ranch Wellfield. The well will also be used to monitor aquifer conditions before and after development of the production wells at the site. Results of field and laboratory analyses of samples collected from TW2, as summarized in Table 3-2 and Table 3-3, respectively, indicate that groundwater in the Simsboro Formation at the TW2 site meets all Texas Commission on Environmental Quality's (TCEQ's) primary drinking water standards. To be an approved water source, the secondary standards for iron and manganese levels would have to be met by treating the water to reduce the levels or by blending this well water with another source that has lower levels of iron and manganese.

When disinfecting the water with chlorine, iron, manganese, and ammonia will cause increased demands on the chlorine. The ammonia can react with the chlorine to form chloramines. Chloramine compounds are disinfectants, but can cause noticeable taste and odor and can elevated levels of disinfection residual when combined with free chlorinated waters. As this water is to be used for public drinking water, the ammonia levels will need to be reduced through treatment, or a combination of treatment and blending.

Groundwater from TW2 can be characterized as being hard, with a slightly elevated temperature (81.1 degrees F) and is generally compatible with the City of Bastrop's existing water sources. The TW2 water is slightly scale-forming based upon general corrosion indices and has dissolved carbon dioxide gas and dissolved iron and manganese, as noted previously. When introduced into the existing Bastrop piping system, these preliminary water quality results indicate that this water should not cause any significant changes in pipe scale.

4.2 Yield Potential

Although the primary purpose of the testing at TW2 was to characterize the quality of the groundwater, testing at TW2 did provide useful information regarding potential well yield at the site. Of particular interest was comparison of the tested value of transmissivity with the transmissivity assumed in the long-term simulation performed using the Texas Water Development Board Groundwater Availability Model (GAM), as summarized in the technical memorandum, "Final XS Ranch Groundwater Evaluation Review Comments", CH2M HILL, October 2, 2013. This simulation was performed to assess the sustainability of the proposed 6,000 acre-feet per year (ac-ft/yr) pumping rate proposed for the XS Ranch Wellfield.

Drill cutting analysis and geophysical logs of the open borehole at TW2 indicated a net sand thickness of approximately 140 feet versus approximately 75 feet of sand at TW1. While there was more sand in the proposed production zone at TW-2, the sand is apparently not as permeable as the sand at TW1 since the aquifer test at TW1 indicated a transmissivity value of 35,000 gallon per day per foot (gpd/ft) versus a tested value approximately 50,000 gpd/ft at TW2. Most importantly, the transmissivity at TW2 was approximately 2.9 times the value assumed in the GAM for that same location. Since the tested transmissivity at TW1 closely approximated the corresponding value in the GAM, and the tested value of transmissivity at TW2 was significantly higher than the GAM value, it is possible that the sustainable yield of the four proposed production wells on the XS Ranch may be higher than the 6,000 ac-ft/yr predicted by the GAM.

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Attachment G: Water Conservation Plan

CITY OF BASTROP

WATER CONSERVATION PLAN

Adopted: March 24, 2020

City Ordinance No. 2020-07

Prepared by:

Table of Contents

1. Introduction and Objectives 1

2. Regulatory Considerations 1

3. Utility Profile 2

4. Specification of Water Conservation Targets and Goals 3

5. Water Conservation Plan Efficiency / Effectiveness Monitoring 4

6. Water Conservation Management and Strategies 4

7. Wholesale Water Contracts 9

8. Coordination with Regional Water Planning Group 9

9. Water Conservation Plan Adoption and Enforcement 9

10. Reporting Requirements 9

11. Plan Review and Update 9

APPENDICES

Appendix A – City of Bastrop Utility Profile (TWDB Form No. 1965-R) 2

Appendix B – City of Bastrop Water CCN Map 3

Appendix C – 5-year and 10-year Goals for Water Savings (TWDB Form No. 1964) 4

Appendix D – City of Bastrop Drought Contingency Plan 5

Appendix E – Regional Water Planning Group – Region K – Notification Letter 6

Appendix F - City Council Ordinance of Adoption 7

1. Introduction and Objectives

1.1 Purpose

Water supply has always been a key issue in the development of Texas. In recent years, the increasing population and economic development within the Texas Water Development Board (TWDB) Lower Colorado Water Planning Region (Region K) have led to growing demands for water supplies. Additional supplies to meet future demands can be expensive and difficult to secure. Extending current supplies will delay the need for new supplies, minimize environmental impacts associated with developing new supplies, and delay the relatively high cost of additional water supply development. Therefore, it is imperative that we make efficient use of existing supplies in order to make them last as long as possible.

The City of Bastrop has developed this Water Conservation Plan (WCP) in accordance with the requirements provided in 31 Texas Administrative Code (TAC) §363 and guidance provided by the Texas Water Development Board (TWDB). This plan supersedes the previous plan adopted in August 2016. The objectives of this Water Conservation Plan are to:

- Reduce water consumption from the levels that would prevail without conservation efforts;
- Reduce loss and waste of water;
- Improve efficiency in the use of water;
- Encourage efficient outdoor water use;
- Document the level of recycling and reuse in the water supply; and
- Extend the life of current water supplies/facilities by reducing the rate of growth in demand.

2. Regulatory Considerations

2.1 Rules Governing Water Conservation Plans and Applicability

Rules and requirements pertaining to WCPs are published by the Texas Commission on Environmental Quality (TCEQ) and the TWDB under 30 TAC §288 and 31 TAC §363, respectively.

The TCEQ requires that a WCP be prepared and submitted for entities holding a surface water right of 1,000 acre-feet or more for municipal, industrial, and other non-irrigation uses, or entities holding a surface water right of 10,000 acre-feet or more for irrigation uses.

The TWDB requires that each retail public utility that provides potable water service to 3,300 or more connections submit a WCP to the TWDB.

The City of Bastrop is not a surface water right holder but does have more than 3,300 connections. As such, this plan is being submitted to satisfy the requirements by the TWDB as outlined in 31 TAC §363.

2.2 Minimum Plan Requirements

The minimum requirements in the Texas Administrative Code for Water Conservation Plans for Public Water Suppliers are covered in this plan as follows:

- Utility Profile
- Specific, Quantifiable Targets and Goals
- Schedule for Plan Implementation to Achieve Targets
- Monitoring Plan Effectiveness
- Record Management System
- Accurate Master Metering for Production
- Universal Metering
- Determination and Control of Water Loss
- Leak Detection, Repair, and Water Loss Accounting
- Public Education and Information Program
- Drought Contingency Plan
- Non-Promotional Water Rate Structure
- Requirement for Water Conservation Plans by Wholesale Customers
- Coordination with Regional Water Planning Groups
- Means of Implementation and Enforcement
- Reporting Requirements
- Provisions Review and Update of Plan

In addition to these minimum plan requirements, a WCP may also include any other water conservation practice, method, or technique that the applicant deems appropriate.

3. Utility Profile

The following is a brief summary of the City of Bastrop's Utility Profile. A detailed summary of the utility profile is provided in Appendix A.

3.1 Water System

The City of Bastrop's Water and Wastewater Department manages a water distribution service area covering an extent of approximately 11 square miles in area and serving a population of approximately 8,510 people. The city has approximately 4,100 retail connections. A map depicting the boundaries of the City's Water Certificate of Convenience and Necessity (CCN) is included in Appendix B. Connections within the system are categorized and broken out by percentage of the total water usage as follows: single family residential (66%), multi-family residential (18%), and commercial (17%). The City provides drinking water to its customers from groundwater produced from the City's seven (7) active groundwater wells, capable of producing up to 6.91 million gallons per day (MGD). This groundwater is treated at the City's two (2) water treatment plant facilities before entering the distribution system. Customers are served through a network of approximately 70 miles of transmission and distribution lines, ranging in diameter from 2 through 16 inches.

The City is currently in the planning and design phase for a new groundwater treatment plant facility utilizing Carrizo Aquifer groundwater. The new treatment plant facility is being designed for a phased build-out approach to cover the City's projected water demands for the future. Once completed, the new plant will replace the existing water treatment plant facility.

3.2 Wastewater System

Raw wastewater in the City is conveyed through a network of over 54 miles of wastewater collection lines and numerous lift stations to the City's wastewater treatment plant facility. The facility is located on the south end of Water Street and is comprised of two (2) treatment plant units which discharge treated effluent to the Colorado River under TPDES permit WQ0011076001. The City is also under contractual obligations to treat up to 200,000 gallons per day (GPD) of wastewater flows from Bastrop County Water Control and Improvement District #2 (BCWCID #2). In total for 2018, the wastewater treatment plant facility treated an average daily flow of approximately 0.97 MGD; the design capacity of the wastewater treatment facility is 1.4 MGD. The City is currently in the planning and design phase for a new wastewater treatment plant facility. The new wastewater treatment plant facility is being designed for a phased build-out approach to cover the City's projected wastewater demands for the future. Once completed, the new plant will replace the existing wastewater treatment plant facility.

The City has received authorization from the TCEQ for reuse of Type I and Type II wastewater effluent from the City's wastewater treatment plant facility. Historically under this authorization, the City has provided reuse water to support local construction activities and operations at the City's wastewater treatment facility.

4. Specification of Water Conservation Targets and Goals

The purpose of this Water Conservation Plan is to provide a framework to reduce long-term demand on limited water resources by encouraging more efficient water use practices in the City of Bastrop. TWDB rules require that the plan contain specific, quantified 5-year and 10-year targets for water savings which are to include goals for water loss programs and goals for municipal use in total and residential gallons per capita per day (GPCD).

The City is situated in a high-growth corridor and anticipates experiencing continued economic growth. The primary goals of this plan are to reduce total and residential GPCD demand. The City's 2016 Water Conservation Plan noted the historic 5-year average for total GPCD and residential GPCD use at that time was 178 and 95 GPCD, respectively. Additionally, the plan included the 5-year and 10-year goals for total GPCD and residential GPCD by 2020 and by 2025 as shown in Table 4.1.

Table 4.1
City of Bastrop 2016 Water Conservation Plan – Historic and Target GPCD Use

	Historic 5-Year Average	**5-Year Goal (2020)**	**10-Year Goal (2025)**
Total GPCD	178	169	161
Residential GPCD	95	94	93
Water Loss GPCD	21	18	16
Water Loss %	12%	11%	10%

Current water use data show that the historic 5-year averages for total GPCD, residential GPCD, and water loss are at or below the 5-year goals established in the City's 2016 Water Conservation Plan.

The City is planning to continue reducing their total GPCD to align with the guidance provided in the 2016 Region K Regional Water Plan whereby long-term total GPCD demand is reduced to less than 140 gallons per capita per day. The current 5-year averages for each component are used as a new baseline for projecting revised 5-year and 10-year goals under this current plan. Targets for future total GPCD are developed using the same methodology incorporated into the 2016 Region K Regional Water Plan for municipal conservation, whereby total GPCD is reduced by 5% for each coming decade until a total GPCD of 140 is achieved. Similarly, targets for future residential GPCD are also developed based on a goal of achieving a 5% reduction each decade. Future water loss targets are developed to achieve a water loss percentage of 10% or less.

Table 4.2
City of Bastrop 2019 Water Conservation Plan – Historic and Target GPCD Use

	Historic 5-Year Average	**Baseline**	**5-Year Goal (2024)**	**10-Year Goal (2029)**
Total GPCD	169	169	165	161
Residential GPCD	80	80	78	76
Water Loss GPCD	19	19	17	16
Water Loss %	11%	11%	10%	10%

**Table also provided in Appendix C.

5. Water Conservation Plan Efficiency / Effectiveness Monitoring

The City will evaluate the efficiency and effectiveness of this plan's 5-year and 10-year goals for water use reductions on an annual basis. As the City completes its annual Texas Water Development Board Water Use Survey and water loss audit, the data used will be compared against the targets for total and residential GCPD and water losses.

6. Water Conservation Management and Strategies

6.1 Records Management System

The City administers a comprehensive records management system which accounts for water use and use characteristics throughout the water system. It also allows for the separation of aggregate water sales and water usage characteristics into customer-specific categories.

In 2015, the City of Bastrop completed a city-wide upgrade to an Advanced Metering Infrastructure (AMI) system. This system has allowed the city to begin tracking information in real-time and has increased the accuracy of reporting data. The pumpage and meter readings are compiled daily, monthly, and annually on spreadsheets which are reviewed by City representatives and are used to compile annual reports required by state agencies. These water records include:

- Raw water pumpage
- Backwash recycle waters
- Treated water pumped to the distribution system (total and by pressure zone)

- Water sold by user classifications
    - Single family residential
    - Multi-family residential
    - Commercial
    - Industrial
    - Institutional
    - Wholesale water
- Total water sold
- Water metered but not billed
- Miscellaneous accounted for water

Miscellaneous accounted for water includes such categories as tank overflows, pump testing, water leak repair summary reports, fire hydrant flushing, flush valve usage, fire department usage, etc. The non-revenue water and water loss is compiled and reviewed on a monthly and annual basis.

6.2 Accurate Master Metering for Production

Raw water produced from the City's seven (7) groundwater wells are individually metered at the wellhead. Treated water entering distribution is monitored through flow meters at each of the water treatment plants. Flow meter calibrations are performed, at a minimum, on an annual basis, and more frequently if needed. Calibrations of these meters are performed by a qualified firm specializing in this work, and copies of the calibration log sheets are maintained by the Water and Wastewater Department. All meters monitoring diversion and production flows are in accordance with American Water Works Association (AWWA) standards and calibrated to maintain a minimum accuracy of +/- 2.0%.

6.3 Universal Metering

The ability to meter all water distribution and consumption uses allows the City to closely account for all water use and water losses, and to prevent unauthorized use. All service connections in the City are metered via an Advanced Metering Infrastructure (AMI) as of 2015. All residential, commercial, and municipal structures; swimming pools; and parks operated by the City are metered via AMI.

AMI allows for much more accurate accounting data which reduces non-revenue water issues. The following are some of the advantages of the AMI system:

- Instant meter reading allows for concurrent pumped volumes versus retail water record data, which reduces accounting inaccuracies
- Allows for identification of potential water leaks on the customer side of each meter
- Increased availability of data allows for additional customer support options

The City will continue to provide a preventative maintenance program for its water meters, wherein regular scheduled testing, repairs, and replacement are performed as follows:

- A representative number of 2-inch and smaller residential meters are tested annually to ensure continued accuracy
- Water meters 3-inch and larger are tested once per year;

- Residential water meters shall be tested in accordance with the AWWA recommendations found in Standard C700 and AWWA M6, *Water Meters – Selection, Installation, Testing, and Maintenance Manual*

6.4 Tracking and Controlling Water Loss

6.4.1 Water Loss Control Measures

The goal of the City's water loss control program is to limit system water losses to not exceed 15% of total annual treated water entering distribution and to ultimately reduce unaccounted-for water to a level of 10% or less. Unaccounted-for water includes unbilled authorized usage and unbilled unauthorized usage. Unbilled authorized usage includes water used for fighting fires, flushing water lines, etc. Unbilled unauthorized usage includes water lost to leaks, theft, etc.

In some cases, the age of water lines and associated degradation due to age may be contributing to both unbilled authorized and unauthorized usages. Due to age of certain water lines within the system, these lines are typically scheduled for more frequent flushing; these lines generally have a higher probability of leakage due to their age as well. In order to meet the goals set forth in this plan, the City has implemented programs including routine water audits, a program of leak detection and repair, and meter testing and accuracy calibration.

The Water and Wastewater Department generates a monthly water loss report that compares metered production with metered consumption as well as accounted-for and unaccounted-for losses. This report provides an effective tracking system of water loss. The City also completes a detailed water system audit conforming to TWDB guidelines each year. The water system audit determines the volume of actual water loss, the identification of water loss sources, the status and condition of primary water meters, an analysis of water line breaks, an evaluation of underground leakage potential, and provides recommendation for meter replacement.

6.4.2 Leak Detection and Repair

The City administers leak detection and repair programs for its water distribution system. Approximately 175 acoustic magnetic leak detection units, which monitor the system nightly, are installed throughout the City's distribution system. The City runs reports to evaluate the data collected from the leak detection units and identify potential locations for leaks; when leaks are apparent, the City dispatches repair crews as needed.

Additionally, the City has a program that features a work order prioritization system for leaks needing repair as well as an inventory of equipment and materials needed to promptly repair all detected or reported leaks. The City has also implemented a rehabilitation program to upgrade its aging water distribution system and address areas of the system with a high volume of leaks. This program relies on findings identified in monthly loss reports as well as the leak detection programs described above.

6.5 Public Education and Information Program

The City's public education program makes thousands of contacts, both direct and indirect, every year through presentations, community fairs, plant tours, utility bill inserts, newspaper and radio ads, and the City's website. The City promotes water conservation issues by informing the public in the following ways:

- Making water conservation information available to new customers

- Making residential water audits available to all customers upon request
- Providing water conservation information to all customers upon request, through the City's website, and through social media outlets
- Coordinating educational presentations, lectures, and demonstrations for schools, civic groups, and the general public
- Providing exhibits at public events held throughout the year
- Publishing water conservation information on a regular basis in the City's utility bill insert or other written form
- Participating in community environmental education activities with local organizations to promote water conservation education
- Supporting annual events and demonstrations relating to water conservation and environmental issues that affect water supply and quality

6.6 Plumbing Code and Retrofit Program

The City has adopted the International Plumbing Code, which requires the use of water-saving, Ultra-Low Flow (ULF) fixtures to be installed in new construction and in the replacement of plumbing in existing structures.

The City educates the residents, plumbers, and contractors on the benefits of retrofitting existing facilities with water-saving devices through its public education program.

6.7 Landscape Water Management

The City provides information about the methods and benefits of water-conserving landscaping practices and devices through public education to homeowners, business owners, landscape architects and designers, and irrigation professionals. The following methods are encouraged:

- The use of Xeriscape™ and "Water Wise" landscaping techniques, including drought-tolerant plants and grasses, for landscaping new homes and commercial areas
- The use of drip irrigation systems, when possible, or other water-conserving irrigation systems that utilize efficient sprinklers and considerations for prevailing winds
- Ensuring that ornamental fountains, and other similar water features, are designed to recycle water and use minimal amounts of water
- Working with area landscape supply businesses and nurseries to encourage the sale of locally-adapted, drought-tolerant plants and grasses along with efficient irrigation systems, and to promote the use of these types of water conserving strategies mentioned through demonstrations and advertisements

6.8 Water Use Restrictions

The City has implemented, through its Drought Contingency Plan (August 2019), permanent water use restrictions that apply year-round, regardless of drought stage. Refer to the Drought Contingency Plan in Appendix D for detailed information regarding permanent water use restrictions.

6.9 Water Pressure Reduction

As dictated by location within the water distribution system, each service connection incorporates a pressure-reducing valve to limit service connection pressure where system pressure exceeds 85 psig.

6.10 Reuse Water

The City of Bastrop has received authorization from the TCEQ for reuse of Type I and Type II wastewater effluent from the City's wastewater treatment plant facility. Historically under this authorization, the City has provided reuse water to support local construction activities and operations at the City's wastewater treatment facility.

6.11 Non-Promotional Water Rate Structure

The City utilizes an inclining water rate structure to encourage customers to reduce both peak and overall water usage, while at the same time fairly allocating cost of service to each customer class. Under an inclining rate structure, the rate per thousand gallon increases as the amount of water used increases. The current rate structure charges a minimum monthly service charge based on meter size, plus a fee based on consumption. Table 6.11.1 provides the rate structure for the minimum monthly service charge, inside and outside the city limits, based on a customer's meter size. Table 6.11.2 provides the rate structure for the consumption fee, inside and outside the city limits, based on every 1,000 gallons of the total number of gallons a customer consumes each month.

Table 6.11.1
Minimum Base Charge by Meter Size

Meter Size	**Residential and Commercial**	
	Inside City Limits	**Outside City Limits**
3/4"	$ 27.72	$ 41.59
1"	$ 47.13	$ 70.69
1-1/2"	$ 79.47	$ 119.22
2"	$ 118.28	$ 177.43
3"	$ 221.78	$ 332.68
4"	$ 255.07	$ 507.34
6"	$ 661.68	$ 992.48

Table 6.11.2
Consumption Fee per 1,000 gallons Used

Consumption (gallons)	**Residential and Commercial**	
	Charge ($/1,000 gallons)	
	Inside City Limits	**Outside City Limits**
0 - 3,000	$ 2.85	$ 4.13
3,001 - 5,000	$ 3.04	$ 4.42
5,001 - 10,000	$ 3.22	$ 4.70
10,001 - 20,000	$ 3.42	$ 4.98
20,001 - 50,000	$ 3.69	$ 5.39
> 50,000	$ 3.87	$ 5.66

This rate structure will be reviewed on a regular basis to ensure that the rates adequately recover cost of service and conform to the goals of this plan. In order to meet critical needs of the City's water system, it is the City's intention to increase the rates for minimum and volume charges each year as outlined by separate ordinances.

7. Wholesale Water Contracts

The City, as part of contracts for sale of water, will require any other entity re-selling water to adopt applicable provisions of the City's WCP or have a plan in effect, previously adopted, meeting the basic requirements of 30 TAC §288. These provisions will be through contractual agreement prior to the sale of any water to the water re-seller. It should be noted that at this time, the City does not have any wholesale water contracts.

8. Coordination with Regional Water Planning Group

The City's water service area is located within the Region K (Lower Colorado Region) planning area. The City has provided a copy of this plan to the Region K Group. A copy of the submission letter is provided in Appendix E of this plan.

9. Water Conservation Plan Adoption and Enforcement

This Water Conservation Plan was adopted by the Bastrop City Council; a copy of the corresponding ordinance is included in Appendix F of this plan. The City Manager, or designee thereof, will be responsible for the implementation and enforcement of the plan and educating all City staff personnel. Implementation of the plan by City staff shall begin immediately in 2020 upon adoption.

10. Reporting Requirements

Each entity required to submit a WCP to the TWDB shall file a report annually, no later than May 1st, on the entity's progress in implementing each of the minimum requirements of the WCP. The annual report is to be submitted electronically to the TWDB, as described at:

http://www.twdb.texas.gov/conservation/municipal/plans/ARs.asp

11. Plan Review and Update

The City will review and update this Water Conservation Plan based on an assessment of the 5-year and 10-year targets and any other new or updated information. The City will review and update the next revision of its WCP every five (5) years to coincide with the regional water planning group.

APPENDIX A

City of Bastrop Utility Profile
TWDB Form No. 1965-R

Texas Water Development Board

UTILITY PROFILE FOR RETAIL WATER SUPPLIER

Fill out this form as completely as possible.
If a field does not apply to your entity, leave it blank.

CONTACT INFORMATION

Name of Utility: City of Bastrop

Public Water Supply Identification Number (PWS ID): TX0110001

Certificate of Convenience and Necessity (CCN) Number: Water - 11198; Sewer - 20466

Surface Water Right ID Number: N/A

Wastewater ID Number: WQ0011076001

Completed By: Curtis Hancock Title: Assistant Director Public Works

Address: Physical: 300 Water Street Mailing: P.O. Box 427 City: Bastrop Zip Code: 78602

Email: chancock@cityofbastrop.org Telephone Number: 512-332-8960

Date: 12/16/2019

Regional Water Planning Group: Region K Map

Groundwater Conservation District: Lost Pines GCD Map

Check all that apply:

- [ ] Received financial assistance of $500,000 or more from TWDB
- [x] Have 3,300 or more retail connections
- [ ] Have a surface water right with TCEQ

Section I: Utility Data

A. Population and Service Area Data

1. Current service area size in square miles: 11
(Attach or email a copy of the service area map.)

2. Provide historical service area population for the previous five years, starting with the most current year.

Year	Historical Population Served By Retail Water Service	Historical Population Served By Wholesale Water Service	Historical Population Served By Wastewater Service
2014	7,716	0	7,092
2015	7,834	0	7,228
2016	8,080	0	7,363
2017	8,391	0	7,714
2018	8,508	0	7,841

3. Provide the projected service area population for the following decades.

Year	Projected Population Served By Retail Water Service	Projected Population Served By Wholesale Water Service	Projected Population Served By Wastewater Service
2020	9,653	0	10,540
2030	13,088	0	15,210
2040	17,553	0	22,320
2050	23,603	0	27,466
2060	31,775	0	33,108

4. Describe the source(s)/method(s) for estimating current and projected populations.

Historical Population Served by Retail Water Service - based on the reported population served in the City's annual TWDB Water Use Surveys.

Projected Population Served by Retail Water Service - equal to the population projections provided in the Region K 2016 Regional Water Plan.

Historical Population Served by Wastewater Service - calculated by using internal billing reports that show number of sewer connections; added multi-family units; and then multiplied by 2.49 (population equivalent provided by TCEQ). For example: Dec. 2014 residential sewer customers is 2,130. Multi-family units are 718. So, (2130+718) * 2.49 = 7,092.

Projected Population Served by Wastewater Service - based on design info. for new WWTP.

B. System Input

Provide system input data for the previous five years.

Total System Input = Self-supplied + Imported – Exported

Year	Self-supplied Water in Gallons	Purchased/Imported Water in Gallons	Exported Water in Gallons	Total System Input	Total GPCD
2014	485,759,635	0	0	485,759,635	172
2015	467,373,992	0	0	467,373,992	163
2016	485,676,056	0	0	485,676,056	165
2017	519,172,553	0	0	519,172,553	170
2018	542,252,000	0	0	542,252,000	175
Historic 5-year Average	500,046,847	0	0	500,046,847	169

C. Water Supply System (Attach description of water system)

1. Designed daily capacity of system 8,496,000 **gallons** per day.
2. Storage Capacity:
   Elevated 1,250,000 **gallons**
   Ground 1,510,000 **gallons**

3. List all current water supply sources in gallons.

Water Supply Source	Source Type*	Total Gallons
Alluvial aquifer	Ground	6,331,700
Simsboro aquifer	Ground	576,000
	Choose One	
	Choose One	
	Choose One	
	Choose One	

*Select one of the following source types: *Surface water, Groundwater, or Contract*

4. If surface water is a source type, do you recycle backwash to the head of the plant?
   ○ Yes ________________ estimated **gallons** per day
   ○ No

Texas Water Development Board

D. Projected Demands

1. Estimate the water supply requirements for the next ten years using population trends, historical water use, economic growth, etc.

Year	Population	Water Demands (gallons)
2020	9,653	595,261,662
2021	9,997	616,474,758
2022	10,341	637,687,853
2023	10,685	658,900,949
2024	11,029	680,114,045
2025	11,373	701,327,140
2026	11,717	722,540,236
2027	12,061	743,753,331
2028	12,405	764,966,427
2029	12,749	786,179,523

2. Describe sources of data and how projected water demands were determined. Attach additional sheets if necessary.

Population - The current Region K data for population projections (current planning cycle) for the City of Bastrop was used to determine population growth over the next decade. An annual average growth rate of 344 people per year was calculated based on the projected 2020 and 2030 populations.

Water Demand - estimated using the historic 5-year average for Total GPCD. Projected water demands do not account for/incorporate water conservation goals provided in subsequent sections of this Utility Profile.

Texas Water Development Board

E. High Volume Customers

1. List the annual water use, in gallons, for the five highest volume **RETAIL customers**. Select one of the following water use categories to describe the customer; choose Residential, Industrial, Commercial, Institutional, or Agricultural.

Retail Customer	Water Use Category*	Annual Water Use	Treated or Raw
Bastrop County Law Center	Commercial	111,250	Treated
Bastrop Walnut Ridge	Commercial	86,714	Treated
Bucees	Commercial	63,890	Treated
Texas Parks and Wildlife	Commercial	51,988	Treated
Brite and Shiny Carwash	Commercial	42,564	Treated

*For definitions on recommended customer categories for classifying customer water use, refer to the online Guidance and Methodology for Reporting on Water Conservation and Water Use.

2. If applicable, list the annual water use for the five highest volume **WHOLESALE customers**. Select one of the following water use categories to describe the customer; choose Municipal, Industrial, Commercial, Institutional, or Agricultural.

Wholesale Customer	Water Use Category*	Annual Water Use	Treated or Raw
	Choose One		Choose One
	Choose One		Choose One
	Choose One		Choose One
	Choose One		Choose One
	Choose One		Choose One

*For definitions on recommended customer categories for classifying customer water use, refer to the online Guidance and Methodology for Reporting on Water Conservation and Water Use.

F. Utility Data Comment Section

Provide additional comments about utility data below.

Water System Description - The City of Bastrop's Water and Wastewater Department manages a water distribution service area covering an extent of approximately 11 square miles in area and serving a population of approximately 8,510 people. The city has approximately 4,100 retail connections. Connections within the system are categorized and broken out by percentage of the total water usage as follows: single family residential (66%), multi-family residential (18%), and commercial (17%). The City provides drinking water to its customers from groundwater produced from the City's seven (7) active groundwater wells capable of producing up to 6.91 million gallons per day (MGD). This groundwater is treated at the City's two (2) water treatment plant facilities before entering the distribution system. Customers are served through a network of approximately 70 miles of transmission and distribution lines ranging in size from 2-inch through 16-inch in diameter.

Section II: System Data

A. Retail Connections

1. List the active retail connections by major water use category.

Water Use Category*	Active Retail Connections			
	Metered	Unmetered	Total Connections	Percent of Total Connections
Residential – Single Family	2,699		2,699	66%
Residential – Multi-family (units)	718		718	18%
Industrial	0		0	0%
Commercial	680		680	17%
Institutional	0		0	0%
Agricultural	0		0	0%
TOTAL	4,097	0	4,097	

*For definitions on recommended customer categories for classifying customer water use, refer to the online Guidance and Methodology for Reporting on Water Conservation and Water Use.

2. List the net number of new retail connections by water use category for the previous five years.

Water Use Category*	Net Number of New Retail Connections				
	2014	2015	2016	2017	2018
Residential – Single Family	73	47	99	125	47
Residential – Multi-family (units)	-80	0	0	0	0
Industrial					
Commercial	50	-36	-13	22	21
Institutional					
Agricultural					
TOTAL	43	11	86	147	68

*For definitions on recommended customer categories for classifying customer water use, refer to the online Guidance and Methodology for Reporting on Water Conservation and Water Use.

B. Accounting Data

For the previous five years, enter the number of gallons of RETAIL water provided in each major water use category.

Water Use Category*	Total Gallons of Retail Water				
	2014	2015	2016	2017	2018
Residential - Single Family	145,211,834	209,761,800	183,589,000	203,218,100	201,295,300
Residential – Multi-family	43,788,666	43,790,500	51,989,727	53,658,627	47,980,915
Industrial					
Commercial	209,547,600	184,368,600	201,496,773	193,500,273	205,569,685
Institutional					
Agricultural					
TOTAL	398,548,100	437,920,900	437,075,500	450,377,000	454,845,900

*For definitions on recommended customer categories for classifying customer water use, refer to the online Guidance and Methodology for Reporting on Water Conservation and Water Use.

C. Residential Water Use

For the previous five years, enter the residential GPCD for single family and multi-family units.

Water Use Category*	Residential GPCD				
	2014	2015	2016	2017	2018
Residential - Single Family	52	73	62	66	65
Residential – Multi-family	16	15	18	18	15

D. Annual and Seasonal Water Use

1. For the previous five years, enter the gallons of treated water provided to RETAIL customers.

Month	Total Gallons of Treated Retail Water				
	2014	2015	2016	2017	2018
January	28,658,100	36,296,100	29,038,500	31,328,200	32,522,100
February	27,614,200	23,927,220	30,748,800	27,855,500	27,539,900
March	28,000,100	24,531,200	31,783,300	32,633,500	31,856,300
April	28,308,000	25,865,900	30,188,500	35,023,200	36,241,700
May	37,542,200	26,702,700	33,474,500	45,815,500	39,369,700
June	36,101,900	33,075,000	36,932,000	30,454,500	46,267,600
July	34,453,000	39,079,800	50,794,800	54,157,100	52,789,600
August	43,701,800	62,474,300	42,431,700	49,259,800	53,586,500
September	43,595,200	49,677,400	40,760,500	43,596,400	41,221,500
October	31,453,500	53,865,700	38,730,100	48,277,000	31,964,300
November	32,102,500	30,874,100	33,607,300	33,510,700	31,748,900
December	26,117,300	27,767,500	28,557,000	29,501,500	29,147,800
TOTAL	397,647,800	434,136,920	427,047,000	461,412,900	454,255,900

2. For the previous five years, enter the gallons of raw water provided to RETAIL customers.

Month	Total Gallons of Raw Retail Water				
	2014	2015	2016	2017	2018
January					
February					
March					
April					
May					
June					
July					
August					
September					
October					
November					
December					
TOTAL	0	0	0	0	0

3. Summary of seasonal and annual water use.

Water Use	Seasonal and Annual Water Use					Average in Gallons
	2014	2015	2016	2017	2018	
Summer Retail (Treated + Raw)	114,256,700	134,629,100	130,158,500	133,871,400	152,643,700	133,111,880 5yr Average
TOTAL Retail (Treated + Raw)	397,647,800	434,136,920	427,047,000	461,412,900	454,255,900	434,900,104 5yr Average

E. Water Loss

Provide Water Loss data for the previous five years.

Water Loss GPCD = [Total Water Loss in Gallons ÷ Permanent Population Served] ÷ 365

Water Loss Percentage = [Total Water Loss ÷ Total System Input] x 100

Year	Total Water Loss in Gallons	Water Loss in GPCD	Water Loss as a Percentage
2014	81,758,785	29	17%
2015	23,610,917	8	5%
2016	36,023,508	12	7%
2017	56,537,525	18	11%
2018	80,627,950	26	15%
5-year average	55,711,737	19	11%

F. Peak Water Use

Provide the Average Daily Water Use and Peak Day Water Use for the previous five years.

Year	Average Daily Use (gal)	Peak Day Use (gal)	Ratio (peak/avg)
2014	1,234,000	1,714,000	1.39
2015	1,271,000	2,323,000	1.83
2016	1,315,000	2,314,000	1.76
2017	1,411,000	2,817,000	2.00
2018	1,484,000	2,546,000	1.72

G. Summary of Historic Water Use

Water Use Category	Historic 5-year Average	Percent of Connections	Percent of Water Use
Residential SF	188,615,207	66%	0%
Residential MF	48,241,687	18%	0%
Industrial	0	0%	0%
Commercial	198,896,586	17%	0%
Institutional	0	0%	0%
Agricultural	0	0%	0%

H. System Data Comment Section

Provide additional comments about system data below.

Section III: Wastewater System Data

If you do not provide wastewater system services then you have completed the Utility Profile. Save and Print this form to submit with your Plan. Continue with the Water Conservation Plan Checklist to complete your Water Conservation Plan.

A. **Wastewater System Data** (Attach a description of your wastewater system.)

1. Design capacity of wastewater treatment plant(s): 1,400,000 **gallons** per day.

2. List the active wastewater connections by major water use category.

Water Use Category*	Active Wastewater Connections			
	Metered	Unmetered	Total Connections	Percent of Total Connections
Municipal	2,431		2,431	81%
Industrial			0	0%
Commercial	561		561	19%
Institutional			0	0%
Agricultural			0	0%
TOTAL	2,992	0	2,992	

2. What percent of water is serviced by the wastewater system? 96 %

3. For the previous five years, enter the number of gallons of wastewater that was treated by the utility.

Month	Total Gallons of Treated Wastewater				
	2014	2015	2016	2017	2018
January	22,612,000	26,056,000	25,286,000	27,621,000	26,793,000
February	21,223,000	21,857,000	23,675,000	25,593,000	24,615,000
March	24,298,000	26,743,000	27,901,000	29,760,000	28,826,000
April	23,662,000	27,420,000	31,428,000	28,458,000	27,507,000
May	27,146,000	34,613,000	34,914,000	30,297,000	30,642,000
June	26,962,000	29,418,000	29,105,000	28,541,000	30,204,000
July	25,623,000	29,701,000	29,646,000	28,679,000	30,830,000
August	26,275,000	28,918,000	34,353,000	34,656,000	31,679,000
September	26,446,000	26,346,000	29,156,000	28,344,000	30,748,000
October	26,243,000	29,864,000	27,969,000	28,158,000	31,608,000
November	24,195,000	28,349,000	26,256,000	26,679,000	28,878,000
December	24,227,000	26,958,000	29,076,000	27,090,000	30,244,000
TOTAL	298,912,000	336,243,000	348,765,000	343,876,000	352,574,000

4. Can treated wastewater be substituted for potable water?

○ Yes ● No

B. Reuse Data

1. Provide data on the types of recycling and reuse activities implemented during the current reporting period.

Type of Reuse	Total Annual Volume (in gallons)
On-site irrigation	
Plant wash down	Minimal
Chlorination/de-chlorination	
Industrial	
Landscape irrigation (parks, golf courses)	
Agricultural	
Discharge to surface water	
Evaporation pond	
Other	
TOTAL	0

C. Wastewater System Data Comment

Provide additional comments about wastewater system data below.

Wastewater System Description - Raw wastewater in the City is conveyed through a network of over 54 miles of wastewater collection lines and numerous lift stations to the City's wastewater treatment plant facility. The facility is located on the south end of Water Street and is comprised of two (2) treatment plant units which discharge treated effluent to the Colorado River under TPDES permit WQ0011076001. The City is also under contractual obligations to treat up to 200,000 gallons per day (GPD) of wastewater flows from Bastrop County Water Control and Improvement District #2 (BCWCID #2). In total for 2018, the wastewater treatment plant facility treated an average daily flow of approximately 0.97 MGD; the design capacity of the wastewater treatment facility is 1.4 MGD. The City is currently in the planning and design phase for a new wastewater treatment plant facility. The new wastewater treatment plant facility is being designed for a phased build-out approach to cover the City's projected wastewater demands for the future. Once completed, the new plant will replace the existing wastewater treatment plant facility.

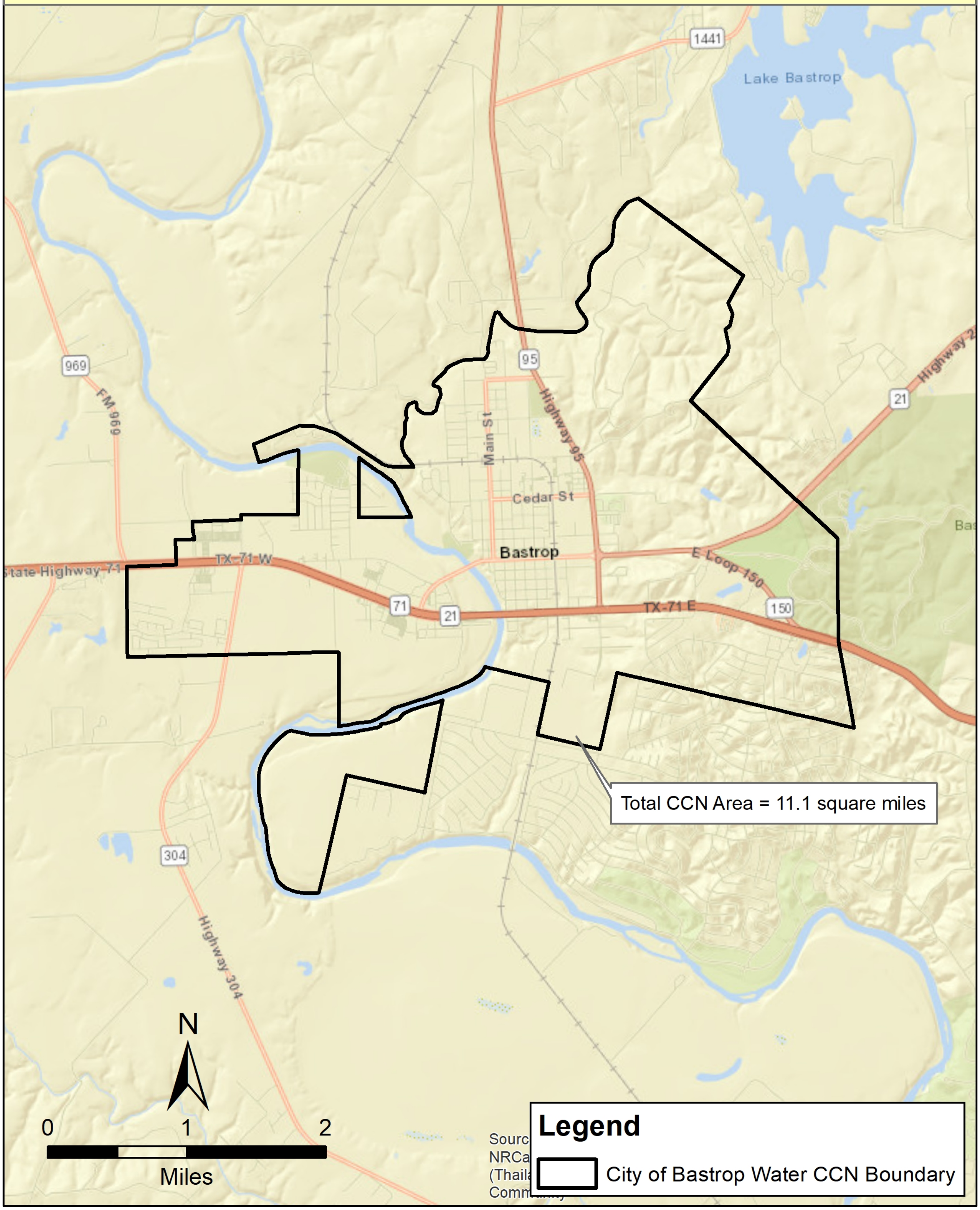
The City has received authorization from the TCEQ for reuse of Type I and Type II wastewater effluent from the City's wastewater treatment plant facility. Historically under this authorization, the City has provided reuse water to support local construction activities and operations at the City's wastewater treatment facility. Currently, the City is not utilizing reuse water as additional capital improvements to supporting pumping and storage facilities are needed before the system can be brought back online.

You have completed the Utility Profile. Save and Print this form to submit with your Plan. Continue with the [Water Conservation Plan Checklist] to complete your Water Conservation Plan.

APPENDIX B

City of Bastrop Water CCN Map

City of Bastrop
Water CCN No. 11198



APPENDIX C

5-year and 10-year Goals for Water Savings
TWDB Form No. 1964

WATER CONSERVATION PLAN
5- AND 10-YR GOALS FOR WATER SAVINGS

Facility Name: CITY OF BASTROP

Water Conservation Plan Year: 2019

	Historic 5yr Average	Baseline	5-yr Goal for year 2024	10-yr Goal for year 2029
Total GPCD[1]	169	169	165	161
Residential GPCD[2]	80	80	78	76
Water Loss (GPCD)[3]	19	19	17	16
Water Loss (Percentage)[4]	11 %	11 %	10 %	10 %

1. Total GPCD = (Total Gallons in System ÷ Permanent Population) ÷ 365
2. Residential GPCD = (Gallons Used for Residential Use ÷ Residential Population) ÷ 365
3. Water Loss GPCD = (Total Water Loss ÷ Permanent Population) ÷ 365
4. Water Loss Percentage = (Total Water Loss ÷ Total Gallons in System) x 100; or (Water Loss GPCD ÷ Total GPCD) x 100

APPENDIX D

City of Bastrop Drought Contingency Plan

Walker Partners
engineers ★ surveyors

804 Las Cimas Pkwy., Suite 150
Austin, Texas 78746

9/5/2019

Texas Commission on Environmental Quality
P.O. Box 13087
Resource Protection Team
MC-160
Austin, TX 78711-3087

Attn: Resource Protection Team

Re: Updated Drought Contingency Plan for the City of Bastrop, TX

To the Resources Protection Team

The City of Bastrop (City) has recently revised and updated their Drought Contingency Plan (DPC) in accordance with the rules and requirements provided by the Texas Commission on Environmental Quality (TCEQ). The current plan, which was adopted by Bastrop City Council on August 27, 2019, replaces the previous DCP for the City dated May 2012.

The updated DCP is provided as an attachment to this letter. Also included as attachments are the following:

- Summary log of revisions to current plan from previous plan;
- Cover letter for the DCP submittal to the Region K Regional Water Planning Group; and
- Copy of the signed City of Bastrop City Council resolution adopting the updated DCP.

The TCEQ previously provided a notice dated July 24, 2019 to the City reminding the City of the deadlines for the DCP and the City's Water Conservation Plan. After further discussion with TCEQ staff, it was clarified that the City is not required to submit a Water Conservation Plan to the TCEQ as the City is not a surface water right holder. The City is in the process of updating their Water Conservation Plan for submission to the Texas Water Development Board pursuant to the rules and requirements under 31 TAC 363.

Please feel free to contact me directly should you have any questions concerning these items.

Sincerely,

Daniel Frazier

DANIEL M. FRAZIER, P.E.
PROJECT MANAGER

W 512.382.0021 **M** 512.960.0081

DF

Attachments: City of Bastrop Drought Contingency Plan (August 2019); Summary Log of DCP Revisions, Cover Letter for DCP Submittal to the Region K Regional Water Planning Group; Bastrop City Council Resolution Adopting Current DCP

Electronic Delivery

Cc: Project File

Attachment 1 – Updated Drought Contingency Plan for the City of Bastrop (August 2019)

CITY OF BASTROP

DROUGHT CONTINGENCY PLAN

Adopted: August 27, 2019

Prepared by:

Walker Partners
engineers ★ surveyors

AMENDED DROUGHT CONTINGENCY PLAN
FOR THE
CITY OF BASTROP, TEXAS

Introduction and Background

The City of Bastrop provides utility services which includes providing treated water to its residents. Refer to the information below concerning general details for the city's water utility.

- Name of Utility: City of Bastrop
- Address: 300 Water Street., Bastrop, TX 78602
- Water CCN#: 11198
- PWS #: TX0110001

Safe, high quality drinking water is a precious resource in the Bastrop region. This Drought Contingency Plan (Plan) requires that the available resources of the City of Bastrop be put to the most beneficial use possible. The Plan also requires that the waste, unreasonable use, or unreasonable method of use of water be prevented and that conservation of water be extended with a view to reasonable and beneficial use in the interests of public health and welfare of the Bastrop community.

Section I: Declaration of Policy, Purpose, and Intent

In order to conserve the available water supply and protect the integrity of water supply facilities, with particular regard for domestic water use, sanitation, and fire protection, and to protect and preserve public health, welfare, and safety and minimize the adverse impacts of water supply shortage or other water supply emergency conditions, the City of Bastrop hereby adopts the following regulations and restrictions on the delivery and consumption of water by ordinance.

Water uses regulated or prohibited under this Plan are considered to be non-essential and continuation of such uses during times of water shortage or other emergency water supply conditions are deemed to constitute a waste of water which subjects the offender(s) to penalties as defined in Section XI of this Plan.

Section II: Public Involvement

Opportunity for the public to provide input into the preparation of the Plan was provided by the City of Bastrop by means of public hearing during a City Council meeting on August 27, 2019.

Section III: Public Education

The City of Bastrop will periodically provide the public with information about the Plan as well as water conservation and drought conditions, including information about the conditions under which each stage of the Plan is to be initiated or terminated and the drought response measures to be implemented in each stage. This information will be provided by means of paid advertisements, public notices, press releases, publication through City social media account(s), and/or utility bill inserts.

Section IV: Coordination with the Lower Colorado Regional Water Planning Group

The service area of the City of Bastrop is located within the Lower Colorado Regional Water Planning Region (Region K) and the City of Bastrop has provided a copy of this plan to the Lower Colorado Regional Water Planning Group.

Section V: Authorization

The City Manager, or his/her designee is hereby authorized and directed to implement the applicable provisions of this Plan upon determination that such implementation is necessary to protect public health, safety, and welfare. The City Manager, or his/her designee shall have authority to initiate or terminate drought or other water supply emergency response measures as described in this Plan. This Plan shall also be referenced in, and become an Appendix to, the City of Bastrop Emergency Management Plan, Annex L; Utilities.

Section VI: Application

The provisions of this Plan shall apply to all persons, customers, and property utilizing water provided by the City of Bastrop. The terms “person” and “ customer” as used in the Plan include individuals, corporations, partnerships, associations, and all other legal entities. Utilization of a water source other than City potable water is exempt from the provisions of this Plan.

Section VII: Permanent Water Restrictions

This section establishes permanent water conservation regulations and applies year-round regardless of Drought stage.

(a) Landscape irrigation using automatic in-ground or hose-end sprinkler systems is prohibited between the hours of 9:30 a.m. and 6:30 p.m.
   1. The time restrictions do not apply to:
      i. The irrigation of commercial plant nurseries.
      ii. Irrigation using reclaimed water or other non-potable water sources.
      iii. New landscape installation during planting and the first ten (10) days after planting.
      iv. The testing of new irrigation systems or systems that are under repair.
      v. Irrigation using a hand-held bucket or hose equipped with a positive shut-off valve, pressure washer system, or other device that automatically shut off water flow when the hose is not being held by the water user.
      vi. Irrigation by drip irrigation or soaker hoses.

(b) The following constitute a waste of water and are prohibited:
   1. Washing sidewalks, walkways, driveways, parking lots, tennis courts, patios, or other hard-surfaced areas except with a pressure-washing system or to alleviate immediate health or safety hazards.
   2. Allowing water to run off a property or allowing water to pond or pool in the street, parking lot, or sidewalk.
   3. Operating an irrigation system with sprinkler heads that are broken or out of adjustment.
   4. Failure to repair a controllable leak(s) within a reasonable time period after having been given notice directing the repair of such leak(s).

(c) Ornamental fountains or ponds for aesthetic or scenic purposes must be equipped with a recirculation device. This restriction does not apply to ornamental fountains or ponds that use reclaimed water, non-potable water, or water provided by sources other than the City.

(d) Use of water for irrigation of golf course greens, tees, and fairways is permitted only on designated watering days as outlined in Section X of this plan. Such irrigation shall only occur from 1:00 a.m. to 7:00 a.m.and from 8:00 p.m. to midnight. These restrictions do not apply to irrigation of any golf course that uses reclaimed water or other non-potable sources.

Section VIII: Definitions

For the purposes of this Plan, the following definitions shall apply:

Aesthetic water use: water used for ornamental or decorative purposes such as fountains, reflecting pools, and water gardens.

Commercial and institutional water use: water use which is integral to the operations of commercial and non-profit establishments and governmental entities such as retail establishments, hotels and motels, restaurants, and office buildings.

Conservation: those practices, techniques, and technologies that reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water or increase the recycling and reuse of water so that a supply is conserved and made available for future or alternative uses.

Customer: any person, company, or organization using water supplied by the City of Bastrop.

Daily water demand: the total amount of water pumped or otherwise released into distribution system(s) for customer use. Expressed in gallons, which are metered in a given 24-hour period (gallons per day).

Declaration of disaster: that action taken by the Mayor, as authorized by the City of Bastrop Emergency management Basic Plan and the Texas Disaster Act of 1975, when the Mayor determines that the public health, safety, and welfare may be threatened by a disastrous event, or the imminent threat of such an event.

Director: the director of water and wastewater, City of Bastrop, Texas.

Domestic water use: water use for personal needs or for household or sanitary purposes such as drinking, bathing, heating, cooking, sanitation, or for cleaning a residence, business, industry, or institution.

Drip irrigation: also known as *trickle irrigation* or *micro-irrigation* is an irrigation method which minimizes the use of water and fertilizer by allowing water to drip slowly to the roots of plants through a network of valves, pipes, tubing, and emitters.

Even number address: street addresses, box numbers, or rural postal route numbers ending in 0, 2, 4, 6, or 8 and locations without addresses.

Hose-end sprinkler: designed to screw into a standard hose and rest on the ground wherever you drag it and set it down; it then delivers water in a spray pattern in the immediate area.

Industrial water use: the use of water in processes designed to convert materials of lower value into forms having greater usability and value.

Landscape irrigation use: water used for the irrigation and maintenance of landscaped areas, whether publicly or privately owned, including residential and commercial lawns, gardens, golf courses, parks, and rights-of-way and medians.

Non-essential water use: water uses that are neither essential nor required for the protection of public, health, safety, and welfare, including:

(a) irrigation of landscape areas, including parks, athletic fields, and gold courses, except otherwise provided under this Plan;

(b) use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle;

(c) use of water to wash down any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;

(d) use of water to wash down buildings or structures for purposes other than immediate fire protection;

(e) flushing gutters or permitting water to run or accumulate in any gutter or street;

(f) use of water to fill, refill, or add indoor or outdoor swimming pools or Jacuzzi-type pools;

(g) use of water in a fountain or pond for aesthetic water use or scenic purposes except where necessary to support aquatic life;

(h) failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s); and

(i) use of water from hydrants for construction purposes or any other purposes other than firefighting.

Odd numbered address: street addresses, box numbers, or rural postal route numbers ending in 1, 3, 5, 7, or 9.

Total production capability: the total net aggregate amount of water that can be produced from all water wells capable of supplying water to the system in any given 16-hour period.

Trigger: a threshold level to be used as an initiation or termination point for actions based on certain mathematical criteria, or as per the authority granted by Section 13.06.013 of the Bastrop City Code of Ordinances.

Section IX: Criteria for Initiation and Termination of Drought Response Stages

Daily water demand will be monitored for emergency conditions by the City Manager or his/her designee. Trigger conditions will be based on an emergency situation caused by a natural disaster, equipment or system failure, natural or manmade contamination, high daily average water demand, or any other condition that substantially and negatively affects the City's potable water supply. The City Manager, on either the recommendations of the Director or pursuant to their sole discretion and authority, shall determine when conditions warrant initiation or termination of each stage of the Plan.

The triggering criteria described below are based on a statistical analysis of the vulnerability of the water source under drought of record condition, and on known system capacity limits.

Stage 1 Trigger -- MILD Water Shortage Conditions / Water Awareness

Requirements for initiation
Customers shall be requested to voluntarily conserve water and adhere to the prescribed restrictions on certain non-essential water uses, as provided in Section X of this Plan, when daily water demand exceeds 85% of Total Production Capability for three (3) consecutive days or water demand approaches a reduced delivery capacity for all or parts of the system, and the City Manager determines that no circumstances exist that will decrease the demand except conservation by customers.

Requirements for termination
Stage 1 of the Plan may be terminated or rescinded when all of the conditions listed as triggering events have ceased to exist for a period of (3) consecutive days and would be unlikely to recur upon termination, or until such time as determined by the City Manager.

Stage 2 Trigger -- MODERATE Water Shortage Conditions / Water Watch

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses, as provided in Section X of this Plan, when the daily water demand exceeds 90 % of Total Production Capability for three (3) consecutive days, and that response measures required by Stage 1 trigger – MILD Water Shortage Conditions / Water Awareness have been implemented, and the City Manager determines that no circumstances exist that will decrease the demand below the Stage 2 Trigger except conservation by customers.

Requirements for Termination
Stage 2 of the Plan may be terminated or rescinded when all of the conditions listed as triggering events have ceased to exist for a period of (3) consecutive days and would be unlikely to recur upon termination, as determined by the City Manager. Upon termination of Stage 2, Stage 1 becomes operative.

Stage 3 Trigger -- CRITICAL Water Shortage Conditions

Requirements for Initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses, as provided in Section X of this Plan, when the daily water demand exceeds 95 % of Total Production Capability for three (3) consecutive days, and that response measures required by Stage 2 trigger – MODERATE Water Shortage Conditions / Water Watch have been implemented, and the City Manager determines that no circumstances exist that will decrease the demand below the Stage 3 Trigger except conservation by customers.

Requirements for Termination
Stage 3 of the Plan may be terminated or rescinded when all of the conditions listed as triggering events have ceased to exist for a period of (3) consecutive days. Upon termination of Stage 3, Stage 2 becomes operative.

Stage 4 Trigger –– EMERGENCY Water Shortage Conditions / Water Emergency

Requirements for Initiation
Customers shall be required to comply with the requirements and restrictions for Stage 4 of this Plan when the City Manager determines that a water supply emergency exists based on:

1. Major water line breaks, or pump or system failures occur, which cause substantially significant threat of a loss of capability to provide water service; or
2. Natural or man-made contamination of the water supply sources(s); or
3. Daily water demand equals or exceeds 100 % of the Total Production Capability for three (3) consecutive days.

Requirements for Termination
Stage 4 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of three (3) consecutive days and would be unlikely to recur upon termination, as determined by the City Manager. Upon termination of Stage 4, the City Manager may impose requirements of Stage 1, 2, or 3 of the Plan if circumstances exist that require continued abatement to the effects of the emergency water shortage condition.

Stage 5 Trigger — WATER ALLOCATION

Requirements for Initiation
Customers shall be required to comply with the water allocation plan prescribed in Section IX of this Plan if the City Manager makes the determination that water shortage conditions threated public health, safety, and welfare due to the type, effect, or magnitude of such conditions.

Requirements for Termination
Stage 5 of the plan may be rescinded when the City Manager makes a determination that the triggering conditions no longer threaten public health, safety, and welfare of the City of Bastrop water utility customers.

Section X: Drought Response Stages

The City Manager, or his/her designee, shall monitor water supply and/or demand conditions on a daily basis and, in accordance with the triggering criteria set forth in Section IX of this Plan, and the City Manager will determine if conditions exist that would trigger any of the designated drought stages, and if so, shall implement the following notification protocol:

Notification of the Public:
The City Manager or his/her designee shall notify the public by means of:

(a) Publication in a newspaper of general circulation, and/or direct mail to customers, or
(b) Public service announcements, or signs posted in public places, or

(c) Notice posted on the City of Bastrop's website at https://www.cityofbastrop.org

Additional Notification:
The City Manager or his/her designee shall notify directly, or cause to be notified directly, the following individuals and entities:

(a) Mayor / Members of the City Council

(b) Fire Chief

(c) City and/or County Emergency Management Coordinator(s)

(d) County Judge

(e) State Disaster District / Department of Public Safety

(f) TNRCC (required when mandatory restrictions are imposed) Major water users

(g) Critical water users; i.e. hospitals, clinics and nursing homes

(h) City of Bastrop Department Heads

Stage 1 Response -- MILD Water Shortage Conditions

Target: Raise public awareness of water demand conditions and achieve a voluntary reduction such that daily water demand is equal to 85 % or less of Total Production Capability.

Best Management Practices for Supply Management:

The City Manager shall implement supply management measures that include reduction in flushing of water mains, visually inspect lines and repair leaks on a daily basis, monthly review of customer use/consumption records and follow-up on any that have unusually high usage, as well as conservation of incidental water usage at water and wastewater plants. Activities shall be implemented which include increased monitoring of meters, gauges, water levels in tanks, and water well production data.

Voluntary Water Use Restrictions for Reducing Demand:

Water customers are requested to voluntarily limit the use of water for nonessential purposes and to practice water conservation.

(a) Restricted Days/Hours: Water customers are requested to voluntarily limit the irrigation of landscaped areas to Sundays and Thursdays for customers with a street address ending in an even number (0, 2, 4, 6 or 8), and Saturdays and Wednesdays for water customers with a street address ending in an odd number (1, 3, 5, 7 or 9), and to irrigate landscapes only between the hours of 12:00 a.m. (midnight) and 7:00 a.m., and between the hours of 6:00 p.m. to 9:00 p.m. on designated watering days. However, irrigation of landscaped areas is permitted at any time if it is by means of a hand-held hose, a faucet-filled bucket or watering can of five (5) gallons or less, or drip irrigation system.

(b) All general operations of the City of Bastrop shall adhere to mandatory water use restrictions prescribed for Stage 2 of the Plan.

(c) Water customers are requested to practice water conservation and to minimize or discontinue water use for non-essential purposes.

Stage 2 Response --MODERATE Water Shortage Conditions

<u>Target:</u> Achieve a reduction in water use such that daily water demand is equal to 90% or less of Total Production Capability.

<u>Best Management Practices for Supply Management:</u>

The City Manager shall implement supply management measures that discontinue flushing of water mains, irrigation of public landscaped areas and all water usage at water and wastewater plants not required for direct operations of the facilities.

<u>Mandatory Water Use Restrictions for Demand Reduction</u>:

Under threat of penalty for violation, the following water use restrictions shall apply to all City of Bastrop water utility customers.

(a) Irrigation of landscaped areas with hose-end sprinklers or automatic irrigation systems shall be limited to Sundays and Thursdays for customers with a street address ending in an even number (0, 2, 4, 6 or 8), and Saturdays and Wednesdays for water customers with a street address ending in an odd number (1, 3, 5, 7 or 9), and irrigate landscapes only between the hours of 4:00 a.m. and 8:00 a.m. and between the hours of 8:00 p.m. and 12:00 a.m. (midnight) on designated watering days. However, irrigation of landscaped areas is permitted at any time if it is by means of a hand-held hose, a faucet-filled bucket or watering can of five (5) gallons or less, or drip irrigation system.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle is prohibited except on designated watering days between the hours of 7:00 p.m. until 11:00 p.m. Such washing, when allowed, shall be done with a faucet-filled bucket or a hand-held hose equipped with a positive shut-off nozzle. Vehicle washing may be done at any time on the immediate premises of a commercial car wash or commercial service station. Further, such washing may be exempted from these regulations if the health, safety, and welfare of the public is contingent upon frequent vehicle cleansing, such as garbage trucks and vehicles used to transport food and perishables.

(c) Use of water to fill, refill, or add to any indoor or outdoor swimming pools, wading pools, or Jacuzzi-type pools is prohibited except on designated watering days during the hours prior to 8:00 a.m. and the hours after 8:00 p.m.

(d) Use of water from hydrants shall be limited to firefighting, related activities, or other activities necessary to maintain public health, safety, and welfare, except that use of water from designated fire hydrants for construction purposes may be allowed under special permit from the City Manager.

(e) Use of water for the irrigation of athletic fields or golf course greens, tees, and fairways is prohibited except on designated watering days between the hours of 4:00 a.m. and 8:00 a.m. and the hours of 8:00 p.m. and 12:00 a.m. (midnight). However, if the athletic field or golf course utilizes a water source other than that provided by the City of Bastrop, the facility shall not be subject to these regulations.

(f) The following uses of water are defined as non-essential and are prohibited:
1. Use of water to wash down any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;
2. Use of water to wash down buildings or structures for purposes other than immediate fire protection;
3. Use of water for dust control;
4. Flushing gutters or permitting water to run or accumulate in any gutter or street; and
5. Failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s).

Stage 3 Response - CRITICAL Water Shortage Conditions

Target: Achieve a reduction in water use such that daily water demand is equal to 95% or less of Total Production Capability.

Best Management Practices for Supply Management:

The City Manager shall implement supply management measures that discontinue flushing of water mains, irrigation of public landscaped areas and all water usage at water and wastewater plants not required for direct operations of the facilities. Water usage at all City buildings shall be restricted to health, sanitation, cleanliness or firefighting purposes.

Mandatory Water Use Restrictions:

Under threat of penalty for violation, the following water use restrictions shall apply to all City of Bastrop water utility customers:

(a) Irrigation of landscaped areas by means of hand-held hoses, hand-held buckets or drip irrigation shall be limited to designated watering days, as outlined in Stage 2 of this Plan and between the hours of 6:00 a.m. and 8:00 a.m. and between 8:00 p.m. and 12:00 a.m. (midnight). The use of hose-end sprinklers or automatic sprinkler systems are prohibited at all times.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle not occurring on the premises of a commercial car wash and commercial service stations and not in the immediate interest of public health, safety and welfare is prohibited. Further, such vehicle washing at commercial car washes and commercial service stations shall occur only between the hours of 8:00 and 6:00 p.m.

(c) The filling, refilling, or adding of water to indoor or outdoor swimming pools, wading pools, and Jacuzzi-type pools is prohibited.

(d) Operation of any ornamental fountain or pond for aesthetic or scenic purposes is prohibited except where necessary to support aquatic life or where such fountains or ponds are equipped with a re-circulation system.

(e) No new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind shall be approved or installed for such time as this drought response stage or a higher-numbered stage shall be in effect.

(f) Use of water from hydrants shall be limited to firefighting, related activities, or other activities necessary to maintain public health, safety, and welfare. Use of water from fire hydrants for construction purposes is prohibited.

(g) Use of water for the irrigation of athletic fields or golf course greens, tees, and fairways is prohibited. However, if the athletic field or golf course utilizes a water source other than that provided by the City of Bastrop, the facility shall not be subject to these regulations.

(h) All non-essential uses of water as listed in Stage 2 of this plan are prohibited.

Stage 4 Response – EMERGENCY Water Shortage Conditions

Target: Achieve reduction in daily water demand sufficient to assure protection of public health, safety, and welfare of the City of Bastrop water utility customers.

Best Management Practices for Supply Management:

The City Manager shall implement supply management measures that discontinue flushing of water mains, irrigation of public landscaped areas and all water usage at water and wastewater plants not required for direct operations of the facilities. Water usage at all City buildings shall be restricted to health, sanitation, cleanliness or firefighting purposes.

Mandatory Water Use Restrictions:

Under threat of penalty for violation, all requirements of Stage 3 shall remain in effect during Stage 4 except:

(a) Irrigation of landscaped areas is absolutely prohibited.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle is absolutely prohibited.

(c) Curtailment of service to persons shown to be of violation of prohibited uses of water may be ordered by the City Manager, if the City Manager determines that such curtailment would not be detrimental to the public health, safety, and welfare, and determines that such curtailment would benefit the mitigation of Stage 4 conditions.

Stage 5 Response - WATER ALLOCATION

In the event that water shortage conditions threaten public health, safety, and welfare due to the duration, type, effect or magnitude of such conditions, and a Declaration of Disaster has been issued relating to such conditions, the City Manager is hereby authorized to allocate water according to the following plan. In addition to other restrictions required in Stage 2, 3, or 4 Response, a monthly water allocation may be established by the City Manager for single family residentiall water customers.

Single-Family Residential Customers

The allocation to residential water customers residing in a single-family dwelling shall be as follows:

Persons per Household	Gallons per Month
1 or 2	4,500
3 or 4	5,500
5 or 6	6,500
7 or 8	7,500
9 or 10	8,500
11 or more	10,000

"Household" means the residential premises served by the customer's meter. "Persons per household" includes only those persons currently physically residing at the premises and expected to reside there for the entire billing period. It shall be assumed that a particular customer's household is comprised of two (2) persons unless the customer notifies the City of Bastrop of a greater number of persons per household on a form prescribed by the City Manager. It shall be the customer's responsibility to go to the City of Bastrop offices to complete and sign the form claiming more than two (2) persons per household. When the number of persons per household increases so as to place the customer in a different allocation category, the customer may notify the City of Bastrop on such form and the change will be implemented in the next practicable billing period. If the number of persons in a household is reduced, the customer shall notify the City of Bastrop in writing. Any person who knowingly, recklessly, or with criminal negligence falsely reports the number of persons in a household or fails to timely notify the City of Bastrop of a reduction in the number of persons in a household shall be subject to penalties set forth in Section XI of this Plan.

Residential water customers shall pay the following surcharge: 125 % of the normal and routine charge for water billed in excess of allocation.

Master-Metered Multi-Family Residential Customers

In addition to other restrictions in Stage 2, 3 or 4 Responses, a monthly water allocation may be established by the City Manager for master-metered multi-family water customers. The allocation to a customer billed from a master meter which jointly measures water to multiple permanent residential dwelling units (e.g., apartments, mobile homes) shall be allocated 6,ooo gallons per month for each dwelling unit. A dwelling unit may be claimed under this provision whether it is occupied or not. Any person who knowingly, recklessly, or with criminal negligence falsely reports the number of dwelling units served by a master meter shall be subject to penalties set forth in Section XI of this Plan.

Customers billed from a master meter under this provision shall pay the following monthly surcharge: 125 % of the normal and routine charges for water billed in excess of allocation.

Commercial Customers

In addition to other restrictions in Stage 2, 3 or 4 Responses, a monthly water allocation may be established by the City Manager for each commercial customer. The commercial customer's allocation shall be no less than 75 percent of the customer's usage for corresponding month's billing period for the previous 12 months. If the customer's billing history is shorter than 12 months, the monthly average for the period for which there is a record shall be used for any monthly period for which no history exists. However, a customer for which 75 percent of the monthly usage is less than 6,ooo gallons, shall be allocated 6,ooo gallons. Upon request of a customer or at the initiative of the City Manager, the allocation may be reduced or increased if, (1) the designated period does not accurately reflect the customer's normal water usage or (2) other objective evidence demonstrates that the designated allocation is inaccurate under present conditions. A customer may appeal an allocation established hereunder to the Bastrop City Council.

Non-residential commercial customers shall pay the following surcharges: 150 % of the normal and routine charges for water billed in excess of allocation.

Industrial Customers

In addition to other restrictions in Stage 2, 3 or 4 Responses, a monthly water allocation may be established by the City Manager for each industrial customer, which uses water for processing purposes. The industrial customer's allocation shall be no less than 85 percent of the customer's water usage baseline. However, a customer of which 85 percent of the monthly usage is less than 6,ooo gallons, shall be allocated 6,ooo gallons. The industrial customer's water use baseline will be computed on the average water use for the three month period ending prior to the date of implementation of Stage 2 of the Plan. If the industrial water customer's billing history is shorter than 3 months, the monthly average for the period for which there is a record shall be used. Upon request of the customer or at the initiative of the City Manager, the allocation may be reduced or increased if, (1) the designated period for baseline calculation does not accurately reflect the customer's normal water usage, (2) the customer has added or is in the process of adding significant additional processing capacity, (3) the customer has shut down or significantly reduced the production of a major processing unit, (4) the customer has previously implemented significant permanent water conservation measures such that the ability to further reduce water use is limited, or (5) if other objective evidence demonstrates that the designated allocation is inaccurate under present conditions. A customer may appeal an allocation established hereunder to the Bastrop City Council.

Industrial customers shall pay the following surcharges: 150 % of the normal and routine charges for water billed in excess of allocation.

Section XI: Enforcement

(a) No person shall knowingly or intentionally allow the use of water from the City of Bastrop for residential, commercial, industrial, agricultural, governmental, or any other purpose in a manner contrary to any provision of this Plan, or in an amount in excess of that permitted by the drought response stage in effect at the time pursuant to action taken by in accordance with provisions of this plan.

(b) Any person who violates this Plan is guilty of a Class C misdemeanor and, upon conviction shall be punished by a fine of not less than FIFTY DOLLARS ($50.00) and not more than FIVE HUNDRED DOLLARS ($500.00). Each day that one or more of the provisions in this Plan is violated shall constitute a separate offense. If a person is convicted of two or more distinct violations of this Plan, the City Manager shall, upon due notice to the customer, be authorized to discontinue water service to the premises where such violations occur. Services discontinued under such circumstances shall be restored only upon payment of a re-connection charge, hereby established at $25.00, and any other costs incurred by the City of Bastrop in discontinuing service. In addition, suitable assurance must be given to the City Manager that the same action shall not be repeated while the Plan is in effect. Compliance with this Plan may also be sought through injunctive relief in the District Court.

(c) Any person, including a person classified as a water customer of the City of Bastrop, in apparent control of the property where a violation occurs or originates shall be presumed to be the violator, and proof that the violation occurred on the person's property shall constitute a rebuttable presumption that the person in apparent control of the property committed the violation, but any such person shall have the right to show the he/she did not commit the violation. Parents shall be presumed to be responsible for violations of their minor children and proof that violation, committed by a child, occurred on property within the parents' control shall constitute a rebuttable presumption that the parent committed the violation, but any such parent may be excused if he/she proves that he/she had previously directed the child not to use the water as it was used in violation of this Plan and that the parent could not have reasonably known of the violation.

(d) Any police officer, Code Compliance Official, building official or other City of Bastrop employee designated by the City Manager, may issue a citation to a person he/she reasonably believes to be in violation of this Ordinance. The citation shall be prepared in duplicate and shall contain the name and address of the alleged violator, if known, the offense charged, and shall direct him/her to appear in the Municipal Court on the date shown on the citation for which the date shall not be less than three (3) days nor more than five (5) days from the date the citation was issued. The alleged violator shall be served a copy of the citation. Service of the citation shall be complete upon delivery of the citation to the alleged violator, to an agent or employee of a violator, or to a person over fourteen (14) years of age who is a member of the violator's immediate family or is a resident of the violator's residence. The alleged violator shall appear in Municipal Court to enter a plea of guilty or not guilty for the violation of this Plan. If the alleged violator fails to appear in Municipal Court, a warrant for his/her arrest may be issued. A summons to appear may be issued in lieu of an arrest warrant. These cases shall be expedited and given preferential setting in Municipal Court before all other cases.

Section XII: Variances

The City Manager may, in writing, grant temporary variance for existing water uses otherwise prohibited under this Plan if it is determined that failure to grant such variance would cause an emergency condition adversely affecting the health, sanitation, or fire protection for the public or the person requesting such variance and if one or more of the following conditions are met:

(a) Compliance with this Plan cannot be technically accomplished during the duration of the water supply shortage or other condition for which the Plan is in effect.

(b) Alternative methods can be implemented which will achieve the same level of reduction in water use.

Persons requesting an exemption from the provisions of this Ordinance shall file a petition for variance with the City of Bastrop within five (5) days after the Plan or particular drought response stage has been invoked. All petitions for variances shall be reviewed by the City Manager, or his/her designee, and shall include the following:

(a) Name and address of the petitioner(s).

(b) Purpose of water use.

(c) Specific provision(s) of the Plan from which the petitioner is requesting relief.

(d) Detailed statement as to how the specific provision of the Plan adversely affects the petitioner or what damage or harm will occur to the petitioner or others if the petitioner complies with this Ordinance.

(e) Description of the relief requested.

(f) Period of time for which the variance is sought.

(g) Alternative water use restrictions or other measures the petitioner is taking or proposes to take to meet the intent of this Plan and the compliance date.

(h) Other pertinent information.

Variances granted by the City Manager shall be subject to the following conditions, unless waived or modified:

(a) Variances granted shall include a timetable for compliance.

(b) Variances granted in a particular stage shall expire upon advancing to a more restrictive stage of the Plan.

(c) Petitioners shall promptly display the variance granted where it can be read by the general public at all location(s) for which the variance applies, and make said variance available to the public.

(d) Variances granted may be rescinded or revoked by the City Manager if the Petitioner fails to meet specific requirements set forth in the variance. The variance will automatically expire when the Plan is no longer in effect.

(e) No variance shall be retroactive or otherwise justify any violation of this Plan occurring prior to the issuance of the variance.

Section XIII: City Manager's Authority to Impose Additional Restrictions

(a) The City Manager may, in his/her sole discretion, implement mandatory water restrictions in addition to those previously described in this Drought Contingency Plan, to protect the public health and safety in the event of an unusual water system operation event, equipment failure, catastrophic occurrence, or severe weather event.

(b) The City Manager may implement mandatory restrictions, immediately effective, by public announcement.

Attachment 2 – Summary Log of Revisions from Previous Drought Contingency Plan

2019 Bastrop Drought Contingency Plan
Change Log

Edits	Section	Description
1	General	Renumbered plan sections to be consistent with model template provided by Lower Colorado Planning Group
2	Introduction and Background	Added utility information including name of utility, address, Water CCN #, and Public Water Supply System #
2.1	Introduction and Background	Removed reference to coordination with Regiona K as this is provided in its own dedicated section further down in the Plan
3	Section 1	Added "by ordinance" to the end of first paragraph
4	Section 2	Added in new Section 2 to address public involvement provisions
5	Section 3	Revised paragraph to include the Plan in the first sentence
6	Section 3	Added reference to City social media account
7	Section 4	Modified references to Lower Colorado Regional Water Planning Group to align with how it's referenced in the model template from LCRPG
8	Section 5	Added 'his/her designee' after mentions of City Manager
8.1	Section 7	Reformatted sub-listing to include the 'Time Restrictions do not apply' bullet within the heading bullet of landscape irrigation.
9	Section 9	Replaced 'their' with 'his/her' after reference to City Manager
10	Section 9	Revised Water/Wastewater Director to be Director to match Definitions reference
11	Section 9, Stage 1	Replaced 'Stage 1 conditions' with 'all of the conditions listed as triggering events have ceased to exist' to standardize to language provided in LCRPG model
12	Section 9, Stage 2	Replaced 'Stage 1 conditions' with 'all of the conditions listed as triggering events have ceased to exist' to standardize to language provided in LCRPG model
13	Section 9, Stage 3	Replaced 'Stage 1 conditions' with 'all of the conditions listed as triggering events have ceased to exist' to standardize to language provided in LCRPG model
14	Section 9, Stage 4	Update Item 3 under requirements for initiation to read 'equals or exceeds' in liue of just 'equal'
15	Section 9, Stage 4	Replaced 'Stage 1 conditions' with 'all of the conditions listed as triggering events have ceased to exist' to standardize to language provided in LCRPG model
16	Section 9, Stage 5	Added Stage 5 Trigger Water Allocation to Section IX;
17	Section 10	First paragraph, added reference to City Manager to clarify only City Manager can make determination
18	Section 10	Added 'his/her designee' after mentions of City Manager, for notifications
19	Section 10	Added 'his/her designee' after mentions of City Manager, for additional notifications
20	Section 10	Included URL to city's website under notifications
21	Section10, Stage 1	Changed Goal to Target to align with LCPRPG model template; reworded target statement to indicate demand equal to % of target production in liue of providing mandated decrease. Previous version read as if the % given is the target reduction vs a reduction to get below the %
22	Section10, Stage 1	Changed 'Supply Management Measures' to 'Best Management Practices for Supply Management' in heading to align with language in LCRPG model template
23	Section10, Stage 1	Revised irrigation water times to be 12:00 am; previous version incorrectly listed 12:00 pm as midnight.
24	Section10, Stage 1	changed 'permananent' to 'mandatory'.

25	Section 10, Stage 2	Changed Goal to Target to align with LCPRPG model template; reworded target statement to indicate demand equal to % of target production in liue of providing mandated decrease. Previous version read as if the % given is the target reduction vs a reduction to get below the %
26	Section 10, Stage 2	Changed 'Supply Management Measures' to 'Best Management Practices for Supply Management' in heading to align with language in LCRPG model template
27	Section10, Stage 2	Revised times to be 12:00 am; previous version incorrectly listed 12:00 pm as midnight.
28	Section 10, Stage 3	Changed Goal to Target to align with LCPRPG model template; reworded target statement to indicate demand equal to % of target production in liue of providing mandated decrease. Previous version read as if the % given is the target reduction vs a reduction to get below the %
29	Section 10, Stage 3	Changed 'Supply Management Measures' to 'Best Management Practices for Supply Management' in heading to align with language in LCRPG model template
30	Section 10, Stage 3	Deleted Restricted Days/Hours as this heading is applicable to multiple subitems, not just the one it was included for. Deleted for consitency
31	Section 10, Stage 3	Added 12:00 a.m. to be consistent with time callouts in used elsewhere in document.
32	Section 10, Stage 4	Changed Goal to Target to align with LCPRPG model template
33	Section 10, Stage 4	Changed 'Supply Management Measures' to 'Best Management Practices for Supply Management' in heading to align with language in LCRPG model template

Attachment 3 – Cover Letter for Drought Contingency Plan Submittal to the Region K Regional Water Planning Group

Walker Partners
engineers ★ surveyors

804 Las Cimas Pkwy., Suite 150
Austin, Texas 78746

9/3/2019

Lower Colorado River Authority
P.O. Box 220
Austin, TX 78767-0220

Attn: Stacy Pandey

Re: Drought Contingency Plan for the City of Bastrop, Texas

Dear Ms. Pandey:

The City of Bastrop is submitting the enclosed Drought Contingency Plan to the Region K – Lower Colorado Regional Water Planning Group as prescribed by the Texas Commission on Environmental Quality (TCEQ) in 30 TAC §288. This plan is an update to the City's previous drought contingency plan prepared in May 2012, and it was adopted by the City of Bastrop through a council resolution on August 27, 2019. Updates to the current plan have been incorporated based on a review of the Region K 2016 Regional Water Plan and sample model plan guidance provided by the regional planning group.

Please feel free to contact me should you have any questions or comments concerning the information in the enclosed Drought Contingency Plan.

Sincerely,

Daniel Frazier

DANIEL M. FRAZIER, P.E.
PROJECT MANAGER
M 512.960.0081

DF

Attachments: 2019 City of Bastrop Drought Contingency Plan

Postal Delivery

Cc: Project File

Attachment 4 – City Council Resolution Adopting Current Drought Contingency Plan for the City of Bastrop

RESOLUTION NO. R-2019-76

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF BASTROP, TEXAS APPROVING THE ADOPTION OF A DROUGHT CONTINGENCY; REPEALING CONFLICTING PROVISIONS; AND ESTABLISHING AN EFFECTIVE DATE.

WHEREAS, the City Council of the City of Bastrop, Texas recognizes that the amount of water available to the City of Bastrop and its water utility customers are limited and subject to depletion during periods of extended drought; and

WHEREAS, the City Council of the City of Bastrop, Texas recognizes that natural limitations due to drought conditions and other acts of God cannot guarantee an uninterrupted water supply for all purposes; and

WHEREAS, Section 11.1272 of the Texas Water Code and applicable rules of the Texas Commission on Environmental Quality require all public water supply systems in Texas to prepare a drought contingency plan; and

WHEREAS, as authorized under law, and in the best interests of the customers of the City of Bastrop, the City Council of the City of Bastrop, Texas deems it expedient and necessary to establish certain rules and policies for the orderly and efficient management of limited water supplies during drought and other water supply emergencies; and

WHEREAS, the City of Bastrop previously adopted a Drought Contingency Plan and requires it be amended or revised and resubmitted to the Texas Commission on Environmental Quality.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF BASTROP, TEXAS:

SECTION 1. That the amended Drought Contingency Plan attached hereto as Exhibit "A" and made part hereof for all purposes be, and the same is hereby, adopted as the official policy of the City of Bastrop.

SECTION 2. That the City Manager is hereby directed to implement, administer, and enforce the Drought Contingency Plan.

SECTION 3. That this resolution shall take effect immediately upon its passage.

DULY RESOLVED AND ADOPTED by the City Council of the City of Bastrop, Texas this 27th day of August 2019.

APPROVED:

Connie B. Schroeder

Connie B. Schroeder, Mayor

ATTEST:

Ann Franklin

Ann Franklin, City Secretary

APPROVED AS TO FORM:

Alan Bojorquez

Alan Bojorquez, City Attorney

APPENDIX E

Regional Water Planning Group – Region K Notification Letter

804 Las Cimas Pkwy., Suite 150
Austin, Texas 78746

March XX, 2020

Lower Colorado River Authority
P.O. Box 220
Austin, TX 78767-0220

Attn: Stacy Pandey

Re: Water Conservation Plan for the City of Bastrop, Texas

Dear Ms. Pandey:

The City of Bastrop is submitting the enclosed Water Conservation Plan to the Region K – Lower Colorado Regional Water Planning Group as prescribed by the Texas Water Development Board (TWDB) in 31 TAC §363. This plan is an update to the City's previous water conservation plan (adopted August 2016). The updated plan was adopted by the City of Bastrop by passing Ordinance No. 2020-07 on March 24, 2020. Updates to the current plan have been incorporated based on a review of the City's most recent water use data; these plan updates primarily include revisions to the City's 5-year and 10-year water conservation targets, as well as an updated water utility profile. The City's current Water Conservation Plan is not required to be updated until 2021; however, the City has gone ahead and incorporated the updates in the enclosed plan as this was prepared in conjunction with an update to the City's Drought Contingency Plan.

Please feel free to contact me should you have any questions or comments concerning the information in the enclosed Water Conservation Plan.

Sincerely,

S. **JARED** NIERMANN, P.E.
PROJECT MANAGER
O 512.382.0021

SJN

Attachments: 2019 City of Bastrop Water Conservation Plan

Postal Delivery

Cc: Project File

APPENDIX F

City of Bastrop City Council Ordinance of Adoption

Attachment H: Drought Contingency Plan

Walker Partners
engineers ★ surveyors

804 Las Cimas Pkwy., Suite 150
Austin, Texas 78746

9/5/2019

Texas Commission on Environmental Quality
P.O. Box 13087
Resource Protection Team
MC-160
Austin, TX 78711-3087

Attn: Resource Protection Team

Re: Updated Drought Contingency Plan for the City of Bastrop, TX

To the Resources Protection Team

The City of Bastrop (City) has recently revised and updated their Drought Contingency Plan (DPC) in accordance with the rules and requirements provided by the Texas Commission on Environmental Quality (TCEQ). The current plan, which was adopted by Bastrop City Council on August 27, 2019, replaces the previous DCP for the City dated May 2012.

The updated DCP is provided as an attachment to this letter. Also included as attachments are the following:

- Summary log of revisions to current plan from previous plan;
- Cover letter for the DCP submittal to the Region K Regional Water Planning Group; and
- Copy of the signed City of Bastrop City Council resolution adopting the updated DCP.

The TCEQ previously provided a notice dated July 24, 2019 to the City reminding the City of the deadlines for the DCP and the City's Water Conservation Plan. After further discussion with TCEQ staff, it was clarified that the City is not required to submit a Water Conservation Plan to the TCEQ as the City is not a surface water right holder. The City is in the process of updating their Water Conservation Plan for submission to the Texas Water Development Board pursuant to the rules and requirements under 31 TAC 363.

Please feel free to contact me directly should you have any questions concerning these items.

Sincerely,

Daniel Frazier

DANIEL M. FRAZIER, P.E.
PROJECT MANAGER

W 512.382.0021 **M** 512.960.0081

DF

Attachments: City of Bastrop Drought Contingency Plan (August 2019); Summary Log of DCP Revisions, Cover Letter for DCP Submittal to the Region K Regional Water Planning Group; Bastrop City Council Resolution Adopting Current DCP

Electronic Delivery

Cc: Project File

Attachment 1 – Updated Drought Contingency Plan for the City of Bastrop (August 2019)

CITY OF BASTROP

DROUGHT CONTINGENCY PLAN

Adopted: August 27, 2019

Prepared by:

Walker Partners
engineers ★ surveyors

AMENDED DROUGHT CONTINGENCY PLAN
FOR THE
CITY OF BASTROP, TEXAS

Introduction and Background

The City of Bastrop provides utility services which includes providing treated water to its residents. Refer to the information below concerning general details for the city's water utility.

- Name of Utility: City of Bastrop
- Address: 300 Water Street., Bastrop, TX 78602
- Water CCN#: 11198
- PWS #: TX0110001

Safe, high quality drinking water is a precious resource in the Bastrop region. This Drought Contingency Plan (Plan) requires that the available resources of the City of Bastrop be put to the most beneficial use possible. The Plan also requires that the waste, unreasonable use, or unreasonable method of use of water be prevented and that conservation of water be extended with a view to reasonable and beneficial use in the interests of public health and welfare of the Bastrop community.

Section I: Declaration of Policy, Purpose, and Intent

In order to conserve the available water supply and protect the integrity of water supply facilities, with particular regard for domestic water use, sanitation, and fire protection, and to protect and preserve public health, welfare, and safety and minimize the adverse impacts of water supply shortage or other water supply emergency conditions, the City of Bastrop hereby adopts the following regulations and restrictions on the delivery and consumption of water by ordinance.

Water uses regulated or prohibited under this Plan are considered to be non-essential and continuation of such uses during times of water shortage or other emergency water supply conditions are deemed to constitute a waste of water which subjects the offender(s) to penalties as defined in Section XI of this Plan.

Section II: Public Involvement

Opportunity for the public to provide input into the preparation of the Plan was provided by the City of Bastrop by means of public hearing during a City Council meeting on August 27, 2019.

Section III: Public Education

The City of Bastrop will periodically provide the public with information about the Plan as well as water conservation and drought conditions, including information about the conditions under which each stage of the Plan is to be initiated or terminated and the drought response measures to be implemented in each stage. This information will be provided by means of paid advertisements, public notices, press releases, publication through City social media account(s), and/or utility bill inserts.

Section IV: Coordination with the Lower Colorado Regional Water Planning Group

The service area of the City of Bastrop is located within the Lower Colorado Regional Water Planning Region (Region K) and the City of Bastrop has provided a copy of this plan to the Lower Colorado Regional Water Planning Group.

Section V: Authorization

The City Manager, or his/her designee is hereby authorized and directed to implement the applicable provisions of this Plan upon determination that such implementation is necessary to protect public health, safety, and welfare. The City Manager, or his/her designee shall have authority to initiate or terminate drought or other water supply emergency response measures as described in this Plan. This Plan shall also be referenced in, and become an Appendix to, the City of Bastrop Emergency Management Plan, Annex L; Utilities.

Section VI: Application

The provisions of this Plan shall apply to all persons, customers, and property utilizing water provided by the City of Bastrop. The terms "person" and " customer" as used in the Plan include individuals, corporations, partnerships, associations, and all other legal entities. Utilization of a water source other than City potable water is exempt from the provisions of this Plan.

Section VII: Permanent Water Restrictions

This section establishes permanent water conservation regulations and applies year-round regardless of Drought stage.

(a) Landscape irrigation using automatic in-ground or hose-end sprinkler systems is prohibited between the hours of 9:30 a.m. and 6:30 p.m.

1. The time restrictions do not apply to:
    i. The irrigation of commercial plant nurseries.
    ii. Irrigation using reclaimed water or other non-potable water sources.
    iii. New landscape installation during planting and the first ten (10) days after planting.
    iv. The testing of new irrigation systems or systems that are under repair.
    v. Irrigation using a hand-held bucket or hose equipped with a positive shut-off valve, pressure washer system, or other device that automatically shut off water flow when the hose is not being held by the water user.
    vi. Irrigation by drip irrigation or soaker hoses.

(b) The following constitute a waste of water and are prohibited:

1. Washing sidewalks, walkways, driveways, parking lots, tennis courts, patios, or other hard-surfaced areas except with a pressure-washing system or to alleviate immediate health or safety hazards.
2. Allowing water to run off a property or allowing water to pond or pool in the street, parking lot, or sidewalk.
3. Operating an irrigation system with sprinkler heads that are broken or out of adjustment.
4. Failure to repair a controllable leak(s) within a reasonable time period after having been given notice directing the repair of such leak(s).

(c) Ornamental fountains or ponds for aesthetic or scenic purposes must be equipped with a recirculation device. This restriction does not apply to ornamental fountains or ponds that use reclaimed water, non-potable water, or water provided by sources other than the City.

(d) Use of water for irrigation of golf course greens, tees, and fairways is permitted only on designated watering days as outlined in Section X of this plan. Such irrigation shall only occur from 1:00 a.m. to 7:00 a.m.and from 8:00 p.m. to midnight. These restrictions do not apply to irrigation of any golf course that uses reclaimed water or other non-potable sources.

Section VIII: Definitions

For the purposes of this Plan, the following definitions shall apply:

Aesthetic water use: water used for ornamental or decorative purposes such as fountains, reflecting pools, and water gardens.

Commercial and institutional water use: water use which is integral to the operations of commercial and non-profit establishments and governmental entities such as retail establishments, hotels and motels, restaurants, and office buildings.

Conservation: those practices, techniques, and technologies that reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water or increase the recycling and reuse of water so that a supply is conserved and made available for future or alternative uses.

Customer: any person, company, or organization using water supplied by the City of Bastrop.

Daily water demand: the total amount of water pumped or otherwise released into distribution system(s) for customer use. Expressed in gallons, which are metered in a given 24-hour period (gallons per day).

Declaration of disaster: that action taken by the Mayor, as authorized by the City of Bastrop Emergency management Basic Plan and the Texas Disaster Act of 1975, when the Mayor determines that the public health, safety, and welfare may be threatened by a disastrous event, or the imminent threat of such an event.

Director: the director of water and wastewater, City of Bastrop, Texas.

Domestic water use: water use for personal needs or for household or sanitary purposes such as drinking, bathing, heating, cooking, sanitation, or for cleaning a residence, business, industry, or institution.

Drip irrigation: also known as *trickle irrigation* or *micro-irrigation* is an irrigation method which minimizes the use of water and fertilizer by allowing water to drip slowly to the roots of plants through a network of valves, pipes, tubing, and emitters.

Even number address: street addresses, box numbers, or rural postal route numbers ending in 0, 2, 4, 6, or 8 and locations without addresses.

Hose-end sprinkler: designed to screw into a standard hose and rest on the ground wherever you drag it and set it down; it then delivers water in a spray pattern in the immediate area.

Industrial water use: the use of water in processes designed to convert materials of lower value into forms having greater usability and value.

Landscape irrigation use: water used for the irrigation and maintenance of landscaped areas, whether publicly or privately owned, including residential and commercial lawns, gardens, golf courses, parks, and rights-of-way and medians.

Non-essential water use: water uses that are neither essential nor required for the protection of public, health, safety, and welfare, including:

(a) irrigation of landscape areas, including parks, athletic fields, and gold courses, except otherwise provided under this Plan;

(b) use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle;

(c) use of water to wash down any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;

(d) use of water to wash down buildings or structures for purposes other than immediate fire protection;

(e) flushing gutters or permitting water to run or accumulate in any gutter or street;

(f) use of water to fill, refill, or add indoor or outdoor swimming pools or Jacuzzi-type pools;

(g) use of water in a fountain or pond for aesthetic water use or scenic purposes except where necessary to support aquatic life;

(h) failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s); and

(i) use of water from hydrants for construction purposes or any other purposes other than firefighting.

Odd numbered address: street addresses, box numbers, or rural postal route numbers ending in 1, 3, 5, 7, or 9.

Total production capability: the total net aggregate amount of water that can be produced from all water wells capable of supplying water to the system in any given 16-hour period.

Trigger: a threshold level to be used as an initiation or termination point for actions based on certain mathematical criteria, or as per the authority granted by Section 13.06.013 of the Bastrop City Code of Ordinances.

Section IX: Criteria for Initiation and Termination of Drought Response Stages

Daily water demand will be monitored for emergency conditions by the City Manager or his/her designee. Trigger conditions will be based on an emergency situation caused by a natural disaster, equipment or system failure, natural or manmade contamination, high daily average water demand, or any other condition that substantially and negatively affects the City's potable water supply. The City Manager, on either the recommendations of the Director or pursuant to their sole discretion and authority, shall determine when conditions warrant initiation or termination of each stage of the Plan.

The triggering criteria described below are based on a statistical analysis of the vulnerability of the water source under drought of record condition, and on known system capacity limits.

Stage 1 Trigger -- MILD Water Shortage Conditions / Water Awareness

Requirements for initiation
Customers shall be requested to voluntarily conserve water and adhere to the prescribed restrictions on certain non-essential water uses, as provided in Section X of this Plan, when daily water demand exceeds 85% of Total Production Capability for three (3) consecutive days or water demand approaches a reduced delivery capacity for all or parts of the system, and the City Manager determines that no circumstances exist that will decrease the demand except conservation by customers.

Requirements for termination
Stage 1 of the Plan may be terminated or rescinded when all of the conditions listed as triggering events have ceased to exist for a period of (3) consecutive days and would be unlikely to recur upon termination, or until such time as determined by the City Manager.

Stage 2 Trigger -- MODERATE Water Shortage Conditions / Water Watch

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses, as provided in Section X of this Plan, when the daily water demand exceeds 90 % of Total Production Capability for three (3) consecutive days, and that response measures required by Stage 1 trigger – MILD Water Shortage Conditions / Water Awareness have been implemented, and the City Manager determines that no circumstances exist that will decrease the demand below the Stage 2 Trigger except conservation by customers.

Requirements for Termination
Stage 2 of the Plan may be terminated or rescinded when all of the conditions listed as triggering events have ceased to exist for a period of (3) consecutive days and would be unlikely to recur upon termination, as determined by the City Manager. Upon termination of Stage 2, Stage 1 becomes operative.

Stage 3 Trigger -- CRITICAL Water Shortage Conditions

Requirements for Initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses, as provided in Section X of this Plan, when the daily water demand exceeds 95 % of Total Production Capability for three (3) consecutive days, and that response measures required by Stage 2 trigger – MODERATE Water Shortage Conditions / Water Watch have been implemented, and the City Manager determines that no circumstances exist that will decrease the demand below the Stage 3 Trigger except conservation by customers.

Requirements for Termination
Stage 3 of the Plan may be terminated or rescinded when all of the conditions listed as triggering events have ceased to exist for a period of (3) consecutive days. Upon termination of Stage 3, Stage 2 becomes operative.

Stage 4 Trigger –– EMERGENCY Water Shortage Conditions / Water Emergency

Requirements for Initiation
Customers shall be required to comply with the requirements and restrictions for Stage 4 of this Plan when the City Manager determines that a water supply emergency exists based on:

1. Major water line breaks, or pump or system failures occur, which cause substantially significant threat of a loss of capability to provide water service; or
2. Natural or man-made contamination of the water supply sources(s); or
3. Daily water demand equals or exceeds 100 % of the Total Production Capability for three (3) consecutive days.

Requirements for Termination
Stage 4 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of three (3) consecutive days and would be unlikely to recur upon termination, as determined by the City Manager. Upon termination of Stage 4, the City Manager may impose requirements of Stage 1, 2, or 3 of the Plan if circumstances exist that require continued abatement to the effects of the emergency water shortage condition.

Stage 5 Trigger — WATER ALLOCATION

Requirements for Initiation
Customers shall be required to comply with the water allocation plan prescribed in Section IX of this Plan if the City Manager makes the determination that water shortage conditions threated public health, safety, and welfare due to the type, effect, or magnitude of such conditions.

Requirements for Termination
Stage 5 of the plan may be rescinded when the City Manager makes a determination that the triggering conditions no longer threaten public health, safety, and welfare of the City of Bastrop water utility customers.

Section X: Drought Response Stages

The City Manager, or his/her designee, shall monitor water supply and/or demand conditions on a daily basis and, in accordance with the triggering criteria set forth in Section IX of this Plan, and the City Manager will determine if conditions exist that would trigger any of the designated drought stages, and if so, shall implement the following notification protocol:

Notification of the Public:
The City Manager or his/her designee shall notify the public by means of:

(a) Publication in a newspaper of general circulation, and/or direct mail to customers, or
(b) Public service announcements, or signs posted in public places, or

(c) Notice posted on the City of Bastrop's website at https://www.cityofbastrop.org

Additional Notification:
The City Manager or his/her designee shall notify directly, or cause to be notified directly, the following individuals and entities:

(a) Mayor / Members of the City Council

(b) Fire Chief

(c) City and/or County Emergency Management Coordinator(s)

(d) County Judge

(e) State Disaster District / Department of Public Safety

(f) TNRCC (required when mandatory restrictions are imposed) Major water users

(g) Critical water users; i.e. hospitals, clinics and nursing homes

(h) City of Bastrop Department Heads

Stage 1 Response -- MILD Water Shortage Conditions

Target: Raise public awareness of water demand conditions and achieve a voluntary reduction such that daily water demand is equal to 85 % or less of Total Production Capability.

Best Management Practices for Supply Management:

The City Manager shall implement supply management measures that include reduction in flushing of water mains, visually inspect lines and repair leaks on a daily basis, monthly review of customer use/consumption records and follow-up on any that have unusually high usage, as well as conservation of incidental water usage at water and wastewater plants. Activities shall be implemented which include increased monitoring of meters, gauges, water levels in tanks, and water well production data.

Voluntary Water Use Restrictions for Reducing Demand:

Water customers are requested to voluntarily limit the use of water for nonessential purposes and to practice water conservation.

(a) Restricted Days/Hours: Water customers are requested to voluntarily limit the irrigation of landscaped areas to Sundays and Thursdays for customers with a street address ending in an even number (0, 2, 4, 6 or 8), and Saturdays and Wednesdays for water customers with a street address ending in an odd number (1, 3, 5, 7 or 9), and to irrigate landscapes only between the hours of 12:00 a.m. (midnight) and 7:00 a.m., and between the hours of 6:00 p.m. to 9:00 p.m. on designated watering days. However, irrigation of landscaped areas is permitted at any time if it is by means of a hand-held hose, a faucet-filled bucket or watering can of five (5) gallons or less, or drip irrigation system.

(b) All general operations of the City of Bastrop shall adhere to mandatory water use restrictions prescribed for Stage 2 of the Plan.

(c) Water customers are requested to practice water conservation and to minimize or discontinue water use for non-essential purposes.

Stage 2 Response --MODERATE Water Shortage Conditions

<u>Target:</u> Achieve a reduction in water use such that daily water demand is equal to 90% or less of Total Production Capability.

<u>Best Management Practices for Supply Management:</u>

The City Manager shall implement supply management measures that discontinue flushing of water mains, irrigation of public landscaped areas and all water usage at water and wastewater plants not required for direct operations of the facilities.

<u>Mandatory Water Use Restrictions for Demand Reduction</u>:

Under threat of penalty for violation, the following water use restrictions shall apply to all City of Bastrop water utility customers.

(a) Irrigation of landscaped areas with hose-end sprinklers or automatic irrigation systems shall be limited to Sundays and Thursdays for customers with a street address ending in an even number (0, 2, 4, 6 or 8), and Saturdays and Wednesdays for water customers with a street address ending in an odd number (1, 3, 5, 7 or 9), and irrigate landscapes only between the hours of 4:00 a.m. and 8:00 a.m. and between the hours of 8:00 p.m. and 12:00 a.m. (midnight) on designated watering days. However, irrigation of landscaped areas is permitted at any time if it is by means of a hand-held hose, a faucet-filled bucket or watering can of five (5) gallons or less, or drip irrigation system.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle is prohibited except on designated watering days between the hours of 7:00 p.m. until 11:00 p.m. Such washing, when allowed, shall be done with a faucet-filled bucket or a hand-held hose equipped with a positive shut-off nozzle. Vehicle washing may be done at any time on the immediate premises of a commercial car wash or commercial service station. Further, such washing may be exempted from these regulations if the health, safety, and welfare of the public is contingent upon frequent vehicle cleansing, such as garbage trucks and vehicles used to transport food and perishables.

(c) Use of water to fill, refill, or add to any indoor or outdoor swimming pools, wading pools, or Jacuzzi-type pools is prohibited except on designated watering days during the hours prior to 8:00 a.m. and the hours after 8:00 p.m.

(d) Use of water from hydrants shall be limited to firefighting, related activities, or other activities necessary to maintain public health, safety, and welfare, except that use of water from designated fire hydrants for construction purposes may be allowed under special permit from the City Manager.

(e) Use of water for the irrigation of athletic fields or golf course greens, tees, and fairways is prohibited except on designated watering days between the hours of 4:00 a.m. and 8:00 a.m. and the hours of 8:00 p.m. and 12:00 a.m. (midnight). However, if the athletic field or golf course utilizes a water source other than that provided by the City of Bastrop, the facility shall not be subject to these regulations.

(f) The following uses of water are defined as non-essential and are prohibited:

1. Use of water to wash down any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;
2. Use of water to wash down buildings or structures for purposes other than immediate fire protection;
3. Use of water for dust control;
4. Flushing gutters or permitting water to run or accumulate in any gutter or street; and
5. Failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s).

Stage 3 Response - CRITICAL Water Shortage Conditions

<u>Target:</u> Achieve a reduction in water use such that daily water demand is equal to 95% or less of Total Production Capability.

<u>Best Management Practices for Supply Management:</u>

The City Manager shall implement supply management measures that discontinue flushing of water mains, irrigation of public landscaped areas and all water usage at water and wastewater plants not required for direct operations of the facilities. Water usage at all City buildings shall be restricted to health, sanitation, cleanliness or firefighting purposes.

<u>Mandatory Water Use Restrictions:</u>

Under threat of penalty for violation, the following water use restrictions shall apply to all City of Bastrop water utility customers:

(a) Irrigation of landscaped areas by means of hand-held hoses, hand-held buckets or drip irrigation shall be limited to designated watering days, as outlined in Stage 2 of this Plan and between the hours of 6:00 a.m. and 8:00 a.m. and between 8:00 p.m. and 12:00 a.m. (midnight). The use of hose-end sprinklers or automatic sprinkler systems are prohibited at all times.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle not occurring on the premises of a commercial car wash and commercial service stations and not in the immediate interest of public health, safety and welfare is prohibited. Further, such vehicle washing at commercial car washes and commercial service stations shall occur only between the hours of 8:00 and 6:00 p.m.

(c) The filling, refilling, or adding of water to indoor or outdoor swimming pools, wading pools, and Jacuzzi-type pools is prohibited.

(d) Operation of any ornamental fountain or pond for aesthetic or scenic purposes is prohibited except where necessary to support aquatic life or where such fountains or ponds are equipped with a re-circulation system.

(e) No new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind shall be approved or installed for such time as this drought response stage or a higher-numbered stage shall be in effect.

(f) Use of water from hydrants shall be limited to firefighting, related activities, or other activities necessary to maintain public health, safety, and welfare. Use of water from fire hydrants for construction purposes is prohibited.

(g) Use of water for the irrigation of athletic fields or golf course greens, tees, and fairways is prohibited. However, if the athletic field or golf course utilizes a water source other than that provided by the City of Bastrop, the facility shall not be subject to these regulations.

(h) All <u>non-essential</u> uses of water as listed in Stage 2 of this plan are prohibited.

Stage 4 Response – EMERGENCY Water Shortage Conditions

<u>Target:</u> Achieve reduction in daily water demand sufficient to assure protection of public health, safety, and welfare of the City of Bastrop water utility customers.

<u>Best Management Practices for Supply Management:</u>

The City Manager shall implement supply management measures that discontinue flushing of water mains, irrigation of public landscaped areas and all water usage at water and wastewater plants not required for direct operations of the facilities. Water usage at all City buildings shall be restricted to health, sanitation, cleanliness or firefighting purposes.

Mandatory Water Use Restrictions:

Under threat of penalty for violation, all requirements of Stage 3 shall remain in effect during Stage 4 except:

(a) Irrigation of landscaped areas is absolutely prohibited.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle is absolutely prohibited.

(c) Curtailment of service to persons shown to be of violation of prohibited uses of water may be ordered by the City Manager, if the City Manager determines that such curtailment would not be detrimental to the public health, safety, and welfare, and determines that such curtailment would benefit the mitigation of Stage 4 conditions.

Stage 5 Response - WATER ALLOCATION

In the event that water shortage conditions threaten public health, safety, and welfare due to the duration, type, effect or magnitude of such conditions, and a Declaration of Disaster has been issued relating to such conditions, the City Manager is hereby authorized to allocate water according to the following plan. In addition to other restrictions required in Stage 2, 3, or 4 Response, a monthly water allocation may be established by the City Manager for single family residentiall water customers.

Single-Family Residential Customers

The allocation to residential water customers residing in a single-family dwelling shall be as follows:

Persons per Household	Gallons per Month
1 or 2	4,500
3 or 4	5,500
5 or 6	6,500
7 or 8	7,500
9 or 10	8,500
11 or more	10,000

"Household" means the residential premises served by the customer's meter. "Persons per household" includes only those persons currently physically residing at the premises and expected to reside there for the entire billing period. It shall be assumed that a particular customer's household is comprised of two (2) persons unless the customer notifies the City of Bastrop of a greater number of persons per household on a form prescribed by the City Manager. It shall be the customer's responsibility to go to the City of Bastrop offices to complete and sign the form claiming more than two (2) persons per household. When the number of persons per household increases so as to place the customer in a different allocation category, the customer may notify the City of Bastrop on such form and the change will be implemented in the next practicable billing period. If the number of persons in a household is reduced, the customer shall notify the City of Bastrop in writing. Any person who knowingly, recklessly, or with criminal negligence falsely reports the number of persons in a household or fails to timely notify the City of Bastrop of a reduction in the number of persons in a household shall be subject to penalties set forth in Section XI of this Plan.

Residential water customers shall pay the following surcharge: 125 % of the normal and routine charge for water billed in excess of allocation.

Master-Metered Multi-Family Residential Customers

In addition to other restrictions in Stage 2, 3 or 4 Responses, a monthly water allocation may be established by the City Manager for master-metered multi-family water customers. The allocation to a customer billed from a master meter which jointly measures water to multiple permanent residential dwelling units (e.g., apartments, mobile homes) shall be allocated 6,ooo gallons per month for each dwelling unit. A dwelling unit may be claimed under this provision whether it is occupied or not. Any person who knowingly, recklessly, or with criminal negligence falsely reports the number of dwelling units served by a master meter shall be subject to penalties set forth in Section XI of this Plan.

Customers billed from a master meter under this provision shall pay the following monthly surcharge: 125 % of the normal and routine charges for water billed in excess of allocation.

Commercial Customers

In addition to other restrictions in Stage 2, 3 or 4 Responses, a monthly water allocation may be established by the City Manager for each commercial customer. The commercial customer's allocation shall be no less than 75 percent of the customer's usage for corresponding month's billing period for the previous 12 months. If the customer's billing history is shorter than 12 months, the monthly average for the period for which there is a record shall be used for any monthly period for which no history exists. However, a customer for which 75 percent of the monthly usage is less than 6,ooo gallons, shall be allocated 6,ooo gallons. Upon request of a customer or at the initiative of the City Manager, the allocation may be reduced or increased if, (1) the designated period does not accurately reflect the customer's normal water usage or (2) other objective evidence demonstrates that the designated allocation is inaccurate under present conditions. A customer may appeal an allocation established hereunder to the Bastrop City Council.

Non-residential commercial customers shall pay the following surcharges: 150 % of the normal and routine charges for water billed in excess of allocation.

Industrial Customers

In addition to other restrictions in Stage 2, 3 or 4 Responses, a monthly water allocation may be established by the City Manager for each industrial customer, which uses water for processing purposes. The industrial customer's allocation shall be no less than 85 percent of the customer's water usage baseline. However, a customer of which 85 percent of the monthly usage is less than 6,ooo gallons, shall be allocated 6,ooo gallons. The industrial customer's water use baseline will be computed on the average water use for the three month period ending prior to the date of implementation of Stage 2 of the Plan. If the industrial water customer's billing history is shorter than 3 months, the monthly average for the period for which there is a record shall be used. Upon request of the customer or at the initiative of the City Manager, the allocation may be reduced or increased if, (1) the designated period for baseline calculation does not accurately reflect the customer's normal water usage, (2) the customer has added or is in the process of adding significant additional processing capacity, (3) the customer has shut down or significantly reduced the production of a major processing unit, (4) the customer has previously implemented significant permanent water conservation measures such that the ability to further reduce water use is limited, or (5) if other objective evidence demonstrates that the designated allocation is inaccurate under present conditions. A customer may appeal an allocation established hereunder to the Bastrop City Council.

Industrial customers shall pay the following surcharges: 150 % of the normal and routine charges for water billed in excess of allocation.

Section XI: Enforcement

(a) No person shall knowingly or intentionally allow the use of water from the City of Bastrop for residential, commercial, industrial, agricultural, governmental, or any other purpose in a manner contrary to any provision of this Plan, or in an amount in excess of that permitted by the drought response stage in effect at the time pursuant to action taken by in accordance with provisions of this plan.

(b) Any person who violates this Plan is guilty of a Class C misdemeanor and, upon conviction shall be punished by a fine of not less than FIFTY DOLLARS ($50.00) and not more than FIVE HUNDRED DOLLARS ($500.00). Each day that one or more of the provisions in this Plan is violated shall constitute a separate offense. If a person is convicted of two or more distinct violations of this Plan, the City Manager shall, upon due notice to the customer, be authorized to discontinue water service to the premises where such violations occur. Services discontinued under such circumstances shall be restored only upon payment of a re-connection charge, hereby established at $25.00, and any other costs incurred by the City of Bastrop in discontinuing service. In addition, suitable assurance must be given to the City Manager that the same action shall not be repeated while the Plan is in effect. Compliance with this Plan may also be sought through injunctive relief in the District Court.

(c) Any person, including a person classified as a water customer of the City of Bastrop, in apparent control of the property where a violation occurs or originates shall be presumed to be the violator, and proof that the violation occurred on the person's property shall constitute a rebuttable presumption that the person in apparent control of the property committed the violation, but any such person shall have the right to show the he/she did not commit the violation. Parents shall be presumed to be responsible for violations of their minor children and proof that violation, committed by a child, occurred on property within the parents' control shall constitute a rebuttable presumption that the parent committed the violation, but any such parent may be excused if he/she proves that he/she had previously directed the child not to use the water as it was used in violation of this Plan and that the parent could not have reasonably known of the violation.

(d) Any police officer, Code Compliance Official, building official or other City of Bastrop employee designated by the City Manager, may issue a citation to a person he/she reasonably believes to be in violation of this Ordinance. The citation shall be prepared in duplicate and shall contain the name and address of the alleged violator, if known, the offense charged, and shall direct him/her to appear in the Municipal Court on the date shown on the citation for which the date shall not be less than three (3) days nor more than five (5) days from the date the citation was issued. The alleged violator shall be served a copy of the citation. Service of the citation shall be complete upon delivery of the citation to the alleged violator, to an agent or employee of a violator, or to a person over fourteen (14) years of age who is a member of the violator's immediate family or is a resident of the violator's residence. The alleged violator shall appear in Municipal Court to enter a plea of guilty or not guilty for the violation of this Plan. If the alleged violator fails to appear in Municipal Court, a warrant for his/her arrest may be issued. A summons to appear may be issued in lieu of an arrest warrant. These cases shall be expedited and given preferential setting in Municipal Court before all other cases.

Section XII: Variances

The City Manager may, in writing, grant temporary variance for existing water uses otherwise prohibited under this Plan if it is determined that failure to grant such variance would cause an emergency condition adversely affecting the health, sanitation, or fire protection for the public or the person requesting such variance and if one or more of the following conditions are met:

(a) Compliance with this Plan cannot be technically accomplished during the duration of the water supply shortage or other condition for which the Plan is in effect.

(b) Alternative methods can be implemented which will achieve the same level of reduction in water use.

Persons requesting an exemption from the provisions of this Ordinance shall file a petition for variance with the City of Bastrop within five (5) days after the Plan or particular drought response stage has been invoked. All petitions for variances shall be reviewed by the City Manager, or his/her designee, and shall include the following:

(a) Name and address of the petitioner(s).

(b) Purpose of water use.

(c) Specific provision(s) of the Plan from which the petitioner is requesting relief.

(d) Detailed statement as to how the specific provision of the Plan adversely affects the petitioner or what damage or harm will occur to the petitioner or others if the petitioner complies with this Ordinance.

(e) Description of the relief requested.

(f) Period of time for which the variance is sought.

(g) Alternative water use restrictions or other measures the petitioner is taking or proposes to take to meet the intent of this Plan and the compliance date.

(h) Other pertinent information.

Variances granted by the City Manager shall be subject to the following conditions, unless waived or modified:

(a) Variances granted shall include a timetable for compliance.

(b) Variances granted in a particular stage shall expire upon advancing to a more restrictive stage of the Plan.

(c) Petitioners shall promptly display the variance granted where it can be read by the general public at all location(s) for which the variance applies, and make said variance available to the public.

(d) Variances granted may be rescinded or revoked by the City Manager if the Petitioner fails to meet specific requirements set forth in the variance. The variance will automatically expire when the Plan is no longer in effect.

(e) No variance shall be retroactive or otherwise justify any violation of this Plan occurring prior to the issuance of the variance.

Section XIII: City Manager's Authority to Impose Additional Restrictions

(a) The City Manager may, in his/her sole discretion, implement mandatory water restrictions in addition to those previously described in this Drought Contingency Plan, to protect the public health and safety in the event of an unusual water system operation event, equipment failure, catastrophic occurrence, or severe weather event.

(b) The City Manager may implement mandatory restrictions, immediately effective, by public announcement.

Attachment 2 – Summary Log of Revisions from Previous Drought Contingency Plan

2019 Bastrop Drought Contingency Plan
Change Log

Edits	Section	Description
1	General	Renumbered plan sections to be consistent with model template provided by Lower Colorado Planning Group
2	Introduction and Background	Added utility information including name of utility, address, Water CCN #, and Public Water Supply System #
2.1	Introduction and Background	Removed reference to coordination with Regiona K as this is provided in its own dedicated section further down in the Plan
3	Section 1	Added "by ordinance" to the end of first paragraph
4	Section 2	Added in new Section 2 to address public involvement provisions
5	Section 3	Revised paragraph to include the Plan in the first sentence
6	Section 3	Added reference to City social media account
7	Section 4	Modified references to Lower Colorado Regional Water Planning Group to align with how it's referenced in the model template from LCRPG
8	Section 5	Added 'his/her designee' after mentions of City Manager
8.1	Section 7	Reformatted sub-listing to include the 'Time Restrictions do not apply' bullet within the heading bullet of landscape irrigation.
9	Section 9	Replaced 'their' with 'his/her' after reference to City Manager
10	Section 9	Revised Water/Wastewater Director to be Director to match Definitions reference
11	Section 9, Stage 1	Replaced 'Stage 1 conditions' with 'all of the conditions listed as triggering events have ceased to exist' to standardize to language provided in LCRPG model
12	Section 9, Stage 2	Replaced 'Stage 1 conditions' with 'all of the conditions listed as triggering events have ceased to exist' to standardize to language provided in LCRPG model
13	Section 9, Stage 3	Replaced 'Stage 1 conditions' with 'all of the conditions listed as triggering events have ceased to exist' to standardize to language provided in LCRPG model
14	Section 9, Stage 4	Update Item 3 under requirements for initiation to read 'equals or exceeds' in liue of just 'equal'
15	Section 9, Stage 4	Replaced 'Stage 1 conditions' with 'all of the conditions listed as triggering events have ceased to exist' to standardize to language provided in LCRPG model
16	Section 9, Stage 5	Added Stage 5 Trigger Water Allocation to Section IX;
17	Section 10	First paragraph, added reference to City Manager to clarify only City Manager can make determination
18	Section 10	Added 'his/her designee' after mentions of City Manager, for notifications
19	Section 10	Added 'his/her designee' after mentions of City Manager, for additional notifications
20	Section 10	Included URL to city's website under notifications
21	Section10, Stage 1	Changed Goal to Target to align with LCPRPG model template; reworded target statement to indicate demand equal to % of target production in liue of providing mandated decrease. Previous version read as if the % given is the target reduction vs a reduction to get below the %
22	Section10, Stage 1	Changed 'Supply Management Measures' to 'Best Management Practices for Supply Management' in heading to align with language in LCRPG model template
23	Section10, Stage 1	Revised irrigation water times to be 12:00 am; previous version incorrectly listed 12:00 pm as midnight.
24	Section10, Stage 1	changed 'permananent' to 'mandatory'.

25	Section 10, Stage 2	Changed Goal to Target to align with LCPRPG model template; reworded target statement to indicate demand equal to % of target production in liue of providing mandated decrease. Previous version read as if the % given is the target reduction vs a reduction to get below the %
26	Section 10, Stage 2	Changed 'Supply Management Measures' to 'Best Management Practices for Supply Management' in heading to align with language in LCRPG model template
27	Section10, Stage 2	Revised times to be 12:00 am; previous version incorrectly listed 12:00 pm as midnight.
28	Section 10, Stage 3	Changed Goal to Target to align with LCPRPG model template; reworded target statement to indicate demand equal to % of target production in liue of providing mandated decrease. Previous version read as if the % given is the target reduction vs a reduction to get below the %
29	Section 10, Stage 3	Changed 'Supply Management Measures' to 'Best Management Practices for Supply Management' in heading to align with language in LCRPG model template
30	Section 10, Stage 3	Deleted Restricted Days/Hours as this heading is applicable to multiple subitems, not just the one it was included for. Deleted for consitency
31	Section 10, Stage 3	Added 12:00 a.m. to be consistent with time callouts in used elsewhere in document.
32	Section 10, Stage 4	Changed Goal to Target to align with LCPRPG model template
33	Section 10, Stage 4	Changed 'Supply Management Measures' to 'Best Management Practices for Supply Management' in heading to align with language in LCRPG model template

Attachment 3 – Cover Letter for Drought Contingency Plan Submittal to the Region K Regional Water Planning Group

Walker Partners
engineers ★ surveyors

804 Las Cimas Pkwy., Suite 150
Austin, Texas 78746

9/3/2019

Lower Colorado River Authority
P.O. Box 220
Austin, TX 78767-0220

Attn: Stacy Pandey

Re: Drought Contingency Plan for the City of Bastrop, Texas

Dear Ms. Pandey:

The City of Bastrop is submitting the enclosed Drought Contingency Plan to the Region K – Lower Colorado Regional Water Planning Group as prescribed by the Texas Commission on Environmental Quality (TCEQ) in 30 TAC §288. This plan is an update to the City's previous drought contingency plan prepared in May 2012, and it was adopted by the City of Bastrop through a council resolution on August 27, 2019. Updates to the current plan have been incorporated based on a review of the Region K 2016 Regional Water Plan and sample model plan guidance provided by the regional planning group.

Please feel free to contact me should you have any questions or comments concerning the information in the enclosed Drought Contingency Plan.

Sincerely,

David Frazier

DANIEL M. FRAZIER, P.E.
PROJECT MANAGER
M 512.960.0081

DF

Attachments: 2019 City of Bastrop Drought Contingency Plan

Postal Delivery

Cc: Project File

Attachment 4 – City Council Resolution Adopting Current Drought Contingency Plan for the City of Bastrop

RESOLUTION NO. R-2019-76

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF BASTROP, TEXAS APPROVING THE ADOPTION OF A DROUGHT CONTINGENCY; REPEALING CONFLICTING PROVISIONS; AND ESTABLISHING AN EFFECTIVE DATE.

WHEREAS, the City Council of the City of Bastrop, Texas recognizes that the amount of water available to the City of Bastrop and its water utility customers are limited and subject to depletion during periods of extended drought; and

WHEREAS, the City Council of the City of Bastrop, Texas recognizes that natural limitations due to drought conditions and other acts of God cannot guarantee an uninterrupted water supply for all purposes; and

WHEREAS, Section 11.1272 of the Texas Water Code and applicable rules of the Texas Commission on Environmental Quality require all public water supply systems in Texas to prepare a drought contingency plan; and

WHEREAS, as authorized under law, and in the best interests of the customers of the City of Bastrop, the City Council of the City of Bastrop, Texas deems it expedient and necessary to establish certain rules and policies for the orderly and efficient management of limited water supplies during drought and other water supply emergencies; and

WHEREAS, the City of Bastrop previously adopted a Drought Contingency Plan and requires it be amended or revised and resubmitted to the Texas Commission on Environmental Quality.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF BASTROP, TEXAS:

SECTION 1. That the amended Drought Contingency Plan attached hereto as Exhibit "A" and made part hereof for all purposes be, and the same is hereby, adopted as the official policy of the City of Bastrop.

SECTION 2. That the City Manager is hereby directed to implement, administer, and enforce the Drought Contingency Plan.

SECTION 3. That this resolution shall take effect immediately upon its passage.

DULY RESOLVED AND ADOPTED by the City Council of the City of Bastrop, Texas this 27th day of August 2019.

APPROVED:

Connie B. Schroeder

Connie B. Schroeder, Mayor

ATTEST:

Ann Franklin

Ann Franklin, City Secretary

APPROVED AS TO FORM:

Alan Bojorquez

Alan Bojorquez, City Attorney

Attachment I: City of Bastrop Additional GW Modeling TM

GSI Water Solutions, Inc.

DRAFT Technical Memorandum

To: **Freese and Nichols, Mark Graves, Kira Iles**

From: **GSI Water Solutions, Inc., Dave O'Rourke, PG, PE**

Date: **October 3, 2019**

Re: **Additional Groundwater Modeling and Updated Preliminary Engineering Report, City of Bastrop Proposed Simsboro well Field Expansion**

Introduction

GSI Water Solutions, Inc. (GSI), on behalf of Freese and Nichols (F&N) and the City of Bastrop, TX (City), has prepared this technical memorandum (TM) summarizing the results of requested additional groundwater modeling of the City's Simsboro Wellfield Expansion project. GSI previously prepared a preliminary engineering report (PER) (GSI, March 2019) that addressed well spacing, preliminary well design, recommended well locations, and regional groundwater modeling for the project. Since that time, two developments have occurred which prompted the City to request additional groundwater modeling simulations. First, a revised version of the Central Carrizo-Wilcox Groundwater Availability Model (GAM) was released by the Texas Water Development Board (TWDB), which has significant effects on modeling results. Additionally, the City wanted to evaluate the possible effects of pumping 7,600 AFY, a higher amount than was previously evaluated.

Scope of Work

As documented in GSI's Scope of Work dated July 29, 2019, GSI was authorized to perform the following tasks:

- Review the Central Carrizo-Wilcox GAM version 3.01 in the project area (Figure 1),
- Perform groundwater modeling using the revised GAM to perform the following simulations:
    - Scenario 1: A baseline simulation using regional pumpage files provided by TWDB,

- Scenario 2: A simulation which adds City project pumpage of 7,600 AFY to the baseline pumpage, and
- Scenario 3: A simulation which adds proposed Lower Colorado River Authority (LCRA) pumpage of 25,000 AFY to Scenario 2.

- Produce a TM summarizing the results.

Background

The City is the County seat of Bastrop County, located along the Colorado River approximately 20 miles southeast of Austin, Texas (Figure 1). Bastrop County and Lee County to the northeast comprise the Lost Pines Groundwater Conservation District (LPGCD or District), which has authority to regulate groundwater development within its boundaries. Bastrop County is also part of Groundwater Management Area 12 (GMA-12), which extends from the Colorado River northeast to Freestone and Leon Counties. The GMAs were formed to assist in coordinating regional groundwater planning at a higher organizational level than individual counties and districts.

The City has historically relied on water from alluvial wells located along the Colorado River as its source water to provide potable water to its service area. During the recent drought, water levels in these wells declined to a point that significant stress was placed on the City's water supply. As a result, during the past several years, the City has sponsored a variety of hydrogeologic and engineering studies to investigate the feasibility of converting all or part of its potable water supply sources from the Colorado River alluvial wells to deeper wells screened in the Simsboro Aquifer.

Well I was installed in a Bastrop City Park on the southwest side of the Colorado River in 2010. Well I is blended with other water supplies and treated with aeration because of poor water quality. Subsequently, the City has negotiated with the owners of XS Ranch, located north of the City (Figure 1), for a lease to locate new Simsboro wells on their property. After a series of hydrogeologic investigations (Thornhill, 2018; CH2M HILL, 2015) and after completing the State Office of Administrative Hearings (SOAH) process and associated contested case hearings, the City obtained permits from the District to develop municipal supply wells on the XS Ranch property. One test well (TW-2), one production well (Well J), and an associated monitoring well (MW-3) have been constructed on the XS Ranch property (Figure 1). Table 1 presents construction details of these wells. However, Well J has not yet been brought into service.

Table 1. XS Ranch Simsboro Well Construction Details

	Well J	Well MW-3	Well TW-2
Total Depth (ft)	670	590	660
Screened Intervals (ft BGS)	419-424 450-510 610-660	453-579	510-570 610-650
Screen Diameter	12 inch	4 inch	6-5/8 inch

Hydrogeologic Setting

The Carrizo-Wilcox Aquifer is one of the state's major aquifers, designated by the Texas Water Development Board (TWDB). It is composed of a thick series of sedimentary deposits that dip toward the coast. In different parts of the state, the component formations of the Carrizo-Wilcox Aquifer have differing hydrogeologic characteristics. In Bastrop County, there are four distinct geologic formations in the aquifer: (from top to bottom) Carrizo Sands, Calvert Bluff Formation, Simsboro Formation, and Hooper Formation. In Bastrop County, wells exist that draw from each of these formations, but the Simsboro Formation has the highest well yields and the most desirable water quality. Most municipal production wells in Bastrop County draw from the Simsboro Aquifer. The City's proposed wellfield will be in the Simsboro Aquifer. For additional detail on the geology and hydrogeologic setting, refer to Dutton et al. (2003) and Thornhill (2018).

The proposed wellfield is located 1 to 2 miles southeast (downdip) of the outcrop of the Simsboro Formation. The aquifer in this area is confined, with water levels under artesian pressure. The Simsboro Aquifer is approximately 400 to 600 feet thick in the proposed wellfield area, with the top of formation at 200 to 300 feet below ground surface (bgs) and the bottom of formation at about 600 to 700 feet bgs. Municipal wells screened in the Simsboro are capable of yields in excess of 1,500 gallons per minute (gpm), which is the maximum allowable yield by District rules. Well J was tested at 1,560 gpm.

Review of Revised (Version 3.01) Central Carrizo-Wilcox GAM

The original GAM released for this model area is referred to as version 2.01 (Dutton et al., 2003), and was a 6-layer model depicting formations from the River Alluvium down to the base of the Wilcox Group. Version 2.02 (Kelly et al., 2004) eliminated the alluvium layer, but maintained the rest of the model layers and parameters as version 2.01, and adds 2 layers (Sparta and Weches Formations) above the Queen City Formation, resulting in an 8-layer model. The newly revised model (version 3.01) is a 10-layer model, and incorporates several significant changes in the conceptual model and model parameters which are discussed herein.

A review of the documentation and model files for version 3.01 of the Central Carrizo-Wilcox GAM reveals that several significant changes have been made since the release of version 2.02 in 2004. The following text presents a brief summary of each significant topic, and are presented in the order which GSI judges to be most significant to potential changes in model results in the project area. These are:

1. Faults
2. Transmissivity
3. Unstructured Grid
4. Historical Calibration Expanded
5. Colorado and Brazos River Alluvium Model Layer
6. Shallow Groundwater System Layer

Faults

As part of the update to the GAM, the TWDB commissioned a study evaluating the effects of regional faulting on groundwater flow in the GAM model area (Intera, September 2018). Changes in the conceptualization and representation of faults in the model is one of the most significant model revisions with respect to having a significant effect on modeled water levels and drawdowns.

The original GAM had the faults of the Milano fault system represented as a series of laterally continuous “sealing faults” up to approximately 100 miles in length through Bastrop, Lee, Burleson, Milam, and Robertson counties. The fault study associated with the recent model update posited a different conceptual model of the faulting, with a series of disconnected fault zones (Figure 2). The re-assessment of the faults omits the long, continuous representation in favor of a series of shorter disconnected faults that provide for “windows” and “gates” through the fault system that allow groundwater to flow more freely through the fault system than was possible in version 2.02 of the GAM. The faults identified in the recent study cover significantly less area than the representation of faults in the original GAM. This implies that the regional aquifer area that may be affected by faulting is smaller than the area affected in the original GAM. In addition to the change in physical representation of the faults from the original GAM, the fault conductance terms have been revised. Conductance is the modeling parameter in MODFLOW that regulates the amount of flow; higher conductance values allow greater amount of groundwater flow across the fault boundaries, and lower conductance values allow a lesser amount of groundwater flow across the fault boundaries. In the original GAM, downgradient faults in the Simsboro were assigned conductance values of 0.0001. In the revised GAM, fault conductance is assigned according to the fault offset observed in geophysical logs, and varies from 0.001 to 0.0001, resulting in a higher average value of fault conductance in the new GAM. With higher conductance values, a greater amount of groundwater will be allowed to flow across the fault boundaries. All of the revisions to the representation of faults in the GAM (fault continuity, density, and conductance) would result in lesser drawdowns for equal pumping in a regional project in the vicinity of the faulting.

Transmissivity in Project Area

As documented in the PER (GSI, March 2019), modeled Simsboro transmissivity in the project area was approximately 30,000 gpd/ft (Figure 3a). GSI documented aquifer tests on Well J and Well TW-2 that indicated transmissivity of over 50,000 gpd/ft, and thus we changed the model to reflect this in the simulations for the PER. The new GAM uses transmissivity values of 70,000 to 80,000 gpd/ft for the full thickness of Simsboro (Figure 3b). A modeled transmissivity value higher than the aquifer test value is reasonable in our opinion, because the tested well's screen does not penetrate the full thickness of the aquifer. Higher transmissivity estimates in the model will lead to smaller amounts of drawdown given the same amount of pumping.

Historical Calibration Period

The original GAM was calibrated to a historical period of 1980-1999. The newly revised GAM extends this calibration period significantly, to 1930-2010. Successful calibration to a longer historical period provides greater confidence in the model's representation of the hydrogeologic system, particularly in areas where historical stresses are observed in the previously unmodeled period from 1930-1980. Forty wells in Bastrop County from many different model were used as calibration targets. (An attachment provided with this TM presents these calibration graphs for your inspection.) An expanded calibration period makes the model more robust overall. A comparison of the calibration statistics for versions 2.02 and 3.01 of the GAM indicate that the model revisions implemented have resulted in slightly improved calibration statistics for the overall model area. In Bastrop County, however, there were no significant groundwater declines during the expanded historical calibration period. Therefore this revision, by itself, will not significantly affect modeling results in the project area.

Unstructured Grid (MODFLOW-USG)

The USGS groundwater modeling code MODFLOW is the most commonly utilized groundwater modeling code used in the world, and is considered an industry standard. The USGS is constantly working to update and improve the MODFLOW suite of modelling codes. One of the most recent updates to

MODFLOW is MODFLOW-USG (USG is short for Unstructured Grid). In previous MODFLOW versions, the grid size needed to be uniform throughout the model domain. In MODFLOW-USG, it is possible to have non-uniform grid cells, allowing smaller grid cells in areas of greater interest. The revised GAM incorporates smaller grid cells in the vicinity of the Colorado River Alluvium and the Brazos River Alluvium and associated tributaries. Figure 4 presents the previous and revised MODFLOW model grids for the GAM in the project area. MODFLOW-USG gives the modeler greater flexibility when developing the model. However, the conversion of the GAM to MODFLOW-USG is unlikely to have a significant effect on model results in and of itself.

New Model Layers for Colorado River Alluvium and Brazos River Alluvium

Previous versions of the GAM do not have a model layer representing the alluvium of the Colorado and Brazos Rivers. Layer 1 of the new model represents these alluvial aquifers. Explicit representation in the GAM of the large alluvial deposits associated with the major rivers in the region is intended to improve simulation of surface water/groundwater interaction. However, it is unlikely to have a significant impact on model results in confined portion of the Simsboro Aquifer in the project area.

Shallow Groundwater System

The new GAM has implemented a revised conceptual model in which the combined outcrop area of all eight water-bearing geologic Formations (Sparta, Weches, Queen City, Reklaw, Carrizo, Calvert Bluff, Simsboro, Hooper) is combined as a single layer in an attempt to more accurately simulate the shallow hydrogeologic system in the vicinity of rivers and creeks in the model domain. This new layer of combined outcrop area is beneath the alluvium of Layer 1, but above the deeper portions of all the other model layers. Figure 5 displays the conceptual model layering approach for version 2.02 and 3.01 of the GAM. As previously discussed, MODFLOW-USG allows the use of smaller grid cells. Smaller cells were implemented in the vicinity of alluvium of rivers and streams, and the more detailed representation of streams and their surrounding alluvium is intended to provide improved simulation of groundwater/surface water interaction. This may result in better calibration for wells in the alluvium, or near the Colorado and/or Brazos Rivers, but it is unlikely to have a significant impact on model results in the confined portion of the Simsboro Aquifer in the project area.

Groundwater Modeling

To assess the long-term effect that operation of the proposed wellfield has on Simsboro Aquifer water levels, GSI used the following modeling approach. As previously discussed, the Central Carrizo-Wilcox GAM v. 3.01 (Intera, 2018) was used to perform model simulations for this analysis.

GSI performed model simulations of the following three scenarios:

- Scenario 1: Baseline pumpage only
- Scenario 2: Baseline + Bastrop 7,600 AFY
- Scenario 3: Baseline + Bastrop 7,600 AFY + LCRA 25,000 AFY

These scenarios are detailed in the following report sections.

Scenario 1: Baseline Pumpage

Scenario 1 was defined as a Baseline Scenario in which neither the Bastrop Simsboro wellfield nor the LCRA wellfield was explicitly represented. The purpose of this simulation is to create a baseline for comparison with results from other scenarios. The well pumpage files for this simulation were provided by the TWDB, as documented in the TM by D.B. Stephens (Stephens, October 2018). These well files represent available groundwater pumping estimates for Groundwater Management Area 12 (GMA 12) during the second round of joint water planning completed in 2016. This simulation had pumping in Bastrop County that was represented in the GAM. This transient simulation used 142 annual stress periods (recharge and pumping) to represent the period of time from 1929 to 2070, with the period from 1929 through 2010 being used for calibration and validation. Baseline Bastrop County pumpage in the Simsboro Aquifer in this simulation increases from approximately 10,000 AFY in 2011 to over 20,000 AFY in 2070. This baseline pumpage represents estimates of growth, development of new projects, and desired future conditions (DFCs) documented at the time of the joint water planning (Stephens, 2018). Specific additional project pumpage from the City and from LCRA are added to the baseline pumpage.

GSI is aware that numerous groundwater development projects have been proposed and discussed in the District to date, in both Bastrop and Lee Counties. However, for the purposes of evaluating the anticipated conditions in the proposed wellfield, GSI believes that the representation of future non-project District pumpage is appropriate for this analysis. As updated planning estimates become available, and District permitting of proposed projects proceeds, these runs may be revised if appropriate.

Modeled Baseline Simsboro groundwater elevations in the study area for year 2070 are presented in Figure 6. A groundwater elevation hydrograph for a modeled observation well at the eastern edge of the well field is included in Figure 11. The Scenario 1 hydrograph indicates that water levels will decline approximately 20 feet at this location between 2020 and 2070 under baseline pumping conditions.

Scenario 2: Baseline Pumpage + Bastrop 7,600 AFY

In Scenario 2, full pumpage of Bastrop's potential buildout pumpage of 7,600 AFY was simulated, using average annual pumping volumes evenly divided between modeled wells. Pumpage of 6,000 AFY was implemented in year 2021 (stress period 93) using four wells pumping 930 gpm each (one of which is Well J, installed in 2017), and was expanded to 7,600 AFY in year 2030 (stress period 102) with the addition of a new well, with pumping of 942 gpm in each of the five wells. (In MODFLOW, if multiple wells are located within the same model cell, the combined pumping is applied at the center of the grid cell. Therefore, minor changes of well location within the project area in the future will not significantly affect the model results.) This pumpage was added to the Baseline Scenario beginning in the year 2021 and continuing until 2070.

Modeled regional Simsboro groundwater elevations in the study area for year 2070 for Scenario 2 are presented in Figure 7. (It should be noted that Figure 7 represents regional groundwater model results, and not groundwater elevations at the specific pumping well location; this will be discussed further in a later section.)

To calculate the regional drawdown specifically attributable to the proposed City wellfield, groundwater elevations from Scenario 2 were subtracted from the baseline groundwater elevations of Scenario 1. Drawdown attributed to the Bastrop well field is presented in Figure 8. Drawdown in excess of 30 feet is evident in the pumping center, with a maximum additional regional modeled drawdown of 36 feet compared with the baseline condition. The Scenario 2 hydrograph in figure 11 indicates that drawdown on the eastern edge of the wellfield will be 26 feet greater than the baseline scenario.

Scenario 3: Baseline + Bastrop 7,600 + LCRA 25K

At the kickoff meeting with the City that was attended by Freese and Nichols and GSI, the City discussed a proposed groundwater project being contemplated by LCRA approximately 5 miles east of the study area, with requested permits for up to 25,000 AFY from eight wells. The City requested information on the possible effect that the LCRA project might have on the proposed XS Ranch wellfield. GSI performed the Scenario 3 simulation to evaluate that effect. It should be noted that the LCRA project is not yet permitted, and there are several variances requested in the application. However, Scenario 3 was developed under the assumption that full implementation of the project as proposed would occur.

GSI added the LCRA pumpage of 25,000 AFY to the Scenario 2 well files. Each of the eight LCRA wells was simulated as pumping 1,937 gpm continuously beginning in the year 2030 (stress period 102), with the locations indicated on their permit application.

Modeled regional Simsboro groundwater elevations in Bastrop County for the year 2070 with all Scenario 3 pumpage simulated is displayed in Figure 9. A significant cone of depression resulting from the LCRA project is apparent, with groundwater elevations predicted to be lower than 25 feet above sea level.

To calculate the drawdown specifically attributable to the proposed LCRA project, Scenario 3 groundwater elevations were subtracted from the Scenario 2 groundwater elevations. LCRA project-attributable drawdown in year 2070 is presented in Figure 10. A maximum modeled drawdown of more than 225 feet is specifically attributable to the LCRA project pumping. The predicted additional water level drawdown at the XS Ranch wells caused by LCRA-pumping is approximately 50 feet. Thus, the LCRA-attributed drawdown in the XS Ranch project area is greater than the modeled drawdown attributed to the City's own project pumping.

Figure 11 presents hydrographs of modeled water surface elevations from 1930 through 2070 for all three scenarios. This figure displays results from a modeled observation well on the east side of the well field, at the intersection of State Highway 95 and county Road 1441 (Figure 1). This figure indicates that under Baseline conditions, water levels in the Study area will decline about 20 feet between 2020 and 2070. Under Scenario 2 with 7,600 AFY of Bastrop pumpage added, an additional 26 feet of drawdown is indicated at this location. Under Scenario 3, with full LCRA pumpage simulated, an additional 55 feet of drawdown is indicated at the observation well.

Anticipated Operational Water Levels in Proposed Simsboro Wells

In the PER (GSI, March 2019), GSI discussed and explained the discrepancy between regional modeling results and anticipated operational water levels within the wells during operation, including the Trescott correction to convert from average head in the model cell to the expected head at the well, and well losses due to friction across the well screen. Changes in modeled transmissivity and expected average pumping rates per well result in a revised Trescott correction value, from about 44 feet to 25 feet. Well loss estimates remain the same (80 feet), since they are based on field observations during aquifer testing at Well J.

Figure 12 presents a conceptual well design for a "typical" City Simsboro well, displaying anticipated depths and projected water levels at and inside the well, based on the modeling analysis just described. Although these results indicate that there is adequate submergence of the pump under all proposed pumping, it is noteworthy that the LCRA pumpage significantly reduces the amount of water column above the pump, if the project is constructed and operated as outlined in the permit application. If this amount of drawdown is maintained over the project lifetime, it could impact operating conditions at the XS Ranch well field, possibly leading to reduced well yields over time.

Recommended Well Locations and District Spacing Rules

Lost Pines GCD rules mandate a 5,000-foot spacing for wells producing in excess of 1,000 gpm. In recent communications with the District's consultant (D.B. Stephens and Associates), it was conveyed that despite the literal text of the rule, it is the stance of the District that this spacing requirement does not apply to wells within a well field with a common owner. In essence, it was stated that if a well owner wants to install wells that "interfere" with their own wells, the District does not take issue with that. (This explains how LCRA could propose 2,000-foot spacing for wells anticipated to produce over 2,000 gpm.) The 5,000-foot spacing requirement is to be applied to 3rd party wells that draw from the same aquifer, not the applicant's own wells. GSI performed a drawdown interference analysis comparing the previous 5,000-foot spacing assumption between City wells with a new criteria of 2,500-foot spacing between City wells, assuming a transmissivity of 70,000 gpd/ft and a pumping rate of 1,000 gpm. The 2,500-foot well spacing results in only about 6-7 additional feet of drawdown due to interference between the City wells compared to the 5,000-foot spacing. This is not considered significant, so GSI proceeded with a new assumption of 2,500-foot spacing between City wells. Additionally, District rules mandate that no well may be located within 100 feet of a property boundary.

GSI obtained shape files of the District-permitted wells and exempt wells registered with the District. Aqua Water Supply Corporation has four permitted wells located northeast of the project site of Highway 95 that will affect XS Ranch well locations (only #CS5 is visible in the map area of Figure 13). Regarding exempt wells, it should be noted that the District consultant did not express a great deal of confidence in the locations documented in the exempt well file data; a detailed air photo review and field reconnaissance should be undertaken prior to final siting of the proposed Simsboro wells. Additionally, the exempt well file is a work in progress, and currently does not contain an aquifer assignment. GSI reviewed the data for exempt wells near XS Ranch, and selected those that may be Simsboro wells based on the reported total depth of the well. Any nearby exempt wells greater than 400 feet deep were identified as possible Simsboro wells. Only one exempt well (the Smiley well) was identified that could potentially impact City well locations (Figure 13).

Using geographic information system (GIS) mapping methods, a 100-foot buffer was placed around the inside of the XS Ranch property line, a 5,000-foot buffer was placed around District-permitted Simsboro wells and nearby exempt wells identified as possible Simsboro wells, and a 2,500-foot buffer was placed around proposed City well locations. Four new proposed well sites (in addition to existing Well J) were located so as not to violate the District's rules (Figure 13).

Examination of Figure 13 indicates that the 5,000-foot buffer around the Smiley well creates a significant constraint with respect to proposed City well locations. If subsequent information confirms that the Smiley well is a Simsboro well subject to the District's spacing rules, the proposed locations on Figure 13 are the most feasible option. If it is determined that the Smiley well is not a Simsboro well subject to District spacing rules, GSI would recommend moving locations 1, 2, and 3 farther east on the XS Ranch property, to increase the distance from the Simsboro outcrop, resulting in a greater depth of submergence of well screen and pump.

The proposed water treatment plant (WTP) is to be located at the southern end of the proposed wellfield area. To minimize pipe length runs from the wells to the WTP location, wells are assumed to be located as far south in the study area as practical. Well locations should also be selected to be as far downgradient from the Simsboro outcrop as feasible, in order to maintain confined aquifer conditions and maximize the well depth, and therefore the amount of available water for drawdown above the pump. Other considerations were physical constraints that should be avoided; features such as dense woods and existing water bodies. There are few roads on the XS Ranch property, but if an existing road can be used, the wells may be preferentially located near them.

Figure 13 displays GSI's recommended locations for four additional wells, in addition to Well J. Table 2 provides the latitude and longitude of these proposed locations.

Table 2. Proposed Well Locations

Proposed Location	Latitude	Longitude
1	30.16588477620	-97.33118610560
2	30.17314796980	-97.33179973810
3	30.17969311660	-97.32814347400
4	30.18590581790	-97.32387080860

Summary and Conclusions

Following is a summary of results and conclusions discussed in this report.

- Version 3.01 of the Central Carrizo-Wilcox GAM has several significant revisions. A revised representation of the regional faulting of the Milano Fault Zone allows groundwater to flow more freely when compared to version 2.02. Additionally, higher modeled transmissivity in the XS Ranch area will result in lesser amounts of drawdown in the project area given equal amounts of pumping when compared to version 2.02. Other model revisions (incorporation of MODFLOW-USG, representation of Colorado River and Brazos River Alluvium, a new conceptual model of the shallow flow system, and expanded calibration period), are not expected to significantly affect model results in the project area.

- New simulations using the Central Carrizo-Wilcox GAM version 3.01 confirms that the XS Ranch is capable of long-term production of up to 7,600 AFY of good quality groundwater with less than 30 feet of City-attributed regional drawdown on surrounding wells.

- Predicted water level drawdown in the Simsboro Aquifer as a result of the City project is estimated to be more than 30 feet in the immediate vicinity of the wellfield. It is noteworthy that although City pumping in these updated simulations (7,600 AFY) is greater than that simulated in the model runs for the draft PER (6,000 AFY), the updated modeled drawdown is less. This demonstrates the effect that the GAM version 3.01 revisions has on model results in the project area.

- The additional predicted drawdown in the XS Ranch wellfield resulting from full implementation of the LCRA Griffith League Ranch project currently under consideration is estimated to be approximately 50-55 feet. It is noteworthy that this is greater than the amount of drawdown predicted at XS Ranch due to the City's own project pumping at the site.

- Anticipated operational pumping levels in the proposed Bastrop Simsboro wells under Scenario 2 (Bastrop project pumping, but no LCRA pumping) will be approximately 155 feet below current static water levels when considering corrections to the regional modeling results and anticipated well losses. Data on seasonal water level fluctuation data in the Study Area should be collected and considered when determining the final pump depth setting. The final pump setting should maintain a minimum submergence of 20-30 feet under the lowest anticipated pumping levels.

- Anticipated operational pumping levels in the proposed Bastrop Simsboro wells under Scenario 3 (Bastrop and LCRA project pumping) will be approximately 210 feet below current static water levels when considering corrections to the regional modeling results and anticipated well losses. LCRA-attributed modeled drawdown at XS Ranch is greater than the drawdown due to the City's own proposed pumping at the site. If LCRA pumpage and drawdown is maintained at this level over the project lifetime, it may ultimately impact operating conditions at the XS Ranch well field, including potential reduction of City well yields, and/or the requirement of additional wells.

- A conceptual well design is submitted and is based on review of the hydrogeology in the area, well testing, and review of construction details for Well J and TW-2.

- Four locations have been proposed for future well sites in the XS Ranch wellfield using currently available District information, and based on the primary constraints of 5,000-foot spacing from offsite 3rd party Simsboro wells, and 2,500-foot spacing between proposed City wells. If the Smiley well is determined not to be a Simsboro well subject to District spacing rules, proposed locations 1, 2, and 3 could be moved farther east to be farther from the outcrop, resulting in greater depth of submergence of well screen and pumping equipment.

Limitations

GSI prepared this updated Preliminary Engineering Report for the City and Freese and Nichols in accordance with the scope of work outlined in the contract amendment executed in August 2019. The basis of our analysis and conclusions are limited to the available data and reports referenced. As such, the results of this analysis are not appropriate to be extrapolated to other properties.

References

Groundwater Availability Model for the Central Part of the Carrizo-Wilcox Aquifer in Texas (Dutton, Harden, Nicot, and O'Rourke, February 2003).

Groundwater Availability Models for the Queen City and Sparta Aquifers (Kelly et al., 2004).

City of Bastrop Well TW-2 Drilling Project (CH2M HILL, January 2015).

Summary of Pumping Test Results and Drawdown Assessment – City of Bastrop Simsboro Well No. 1 (District Well 5854819), Bastrop County, TX (Thornhill Group, Inc., March 29, 2018).

Lost Pines GCD Rules (LPGCD, April 20, 2016).

Texas Water Development Board Report ####. Final Report: Groundwater Availability for the Central Portion of the Sparta, Queen city, and Carrizo-Wilcox Aquifers, (Young et al., September 2018)

Summary of Pumping Test Results and Drawdown Assessment – City of Bastrop Simsboro Well No. 1 (District Well 5854819), Bastrop County, TX (Thornhill Group, Inc., March 29, 2018).

City of Bastrop Water Well Plans Submission (BEFCO, March 30, 2017).

Technical Specifications, City of Bastrop TX Simsboro Aquifer Production Well J and Monitoring Well MW-3 Project (CH2M HILL, March 29, 2017).

Technical Memo – City of Bastrop Water Demand Projections – Final (CH2M HILL, May 13, 2014).

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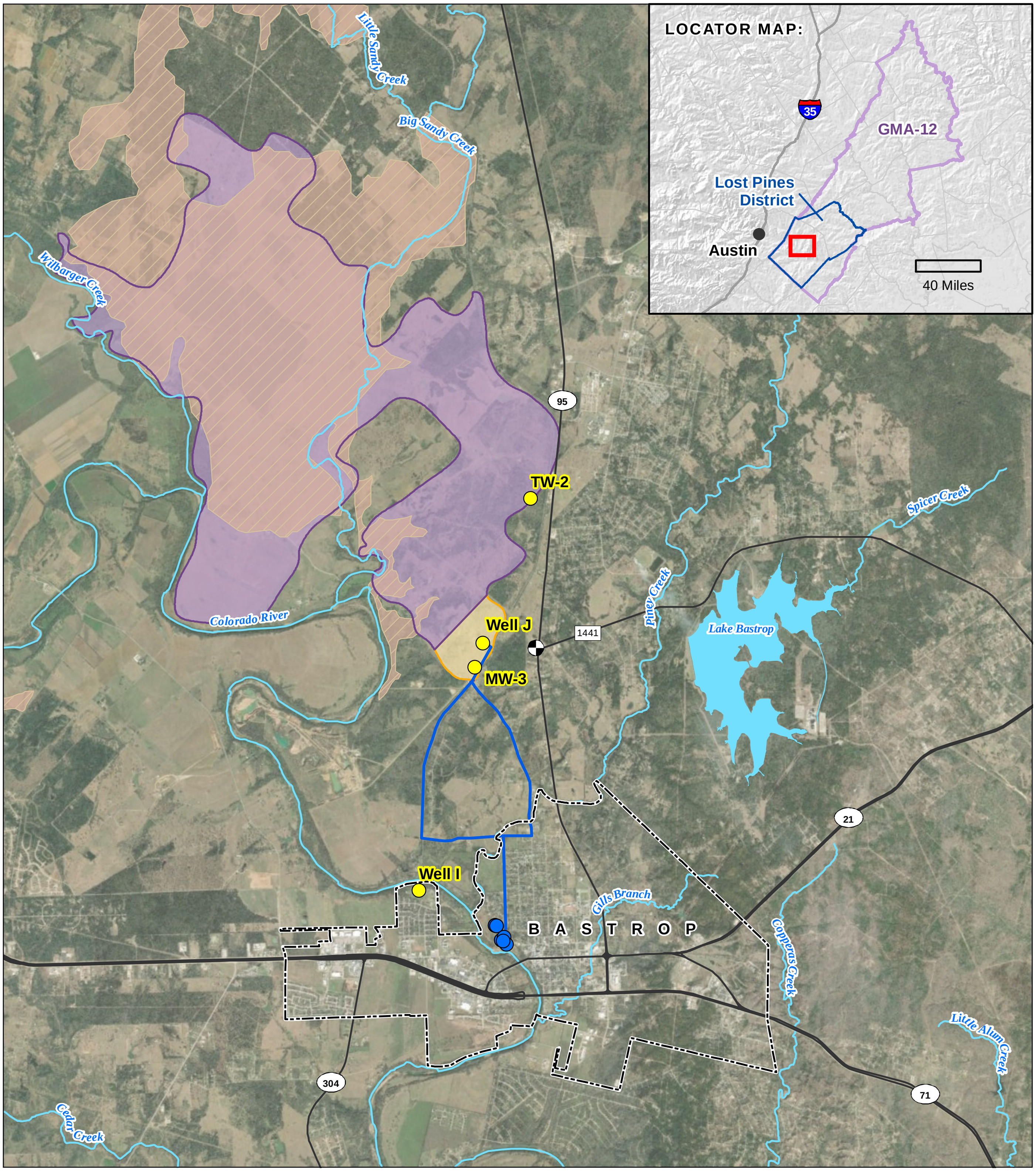
Lost Pines GCD Management Plan (LPGCD, September 20, 2017).



LEGEND

- Well
- Alluvial Well
- Modeled Monitoring Well
- Proposed Waterline
- XS Ranch
- Proposed WTP Area
- Simsboro Outcrop
- Groundwater Management Area
- Groundwater Conservation District

All Other Features

- County Boundary
- City Boundary
- Major Road
- Watercourse
- Waterbody

N

0 ¾ 1½
Miles

FIGURE 1

Site Vicinity Map

Bastrop, Texas

GSI Water Solutions, Inc.

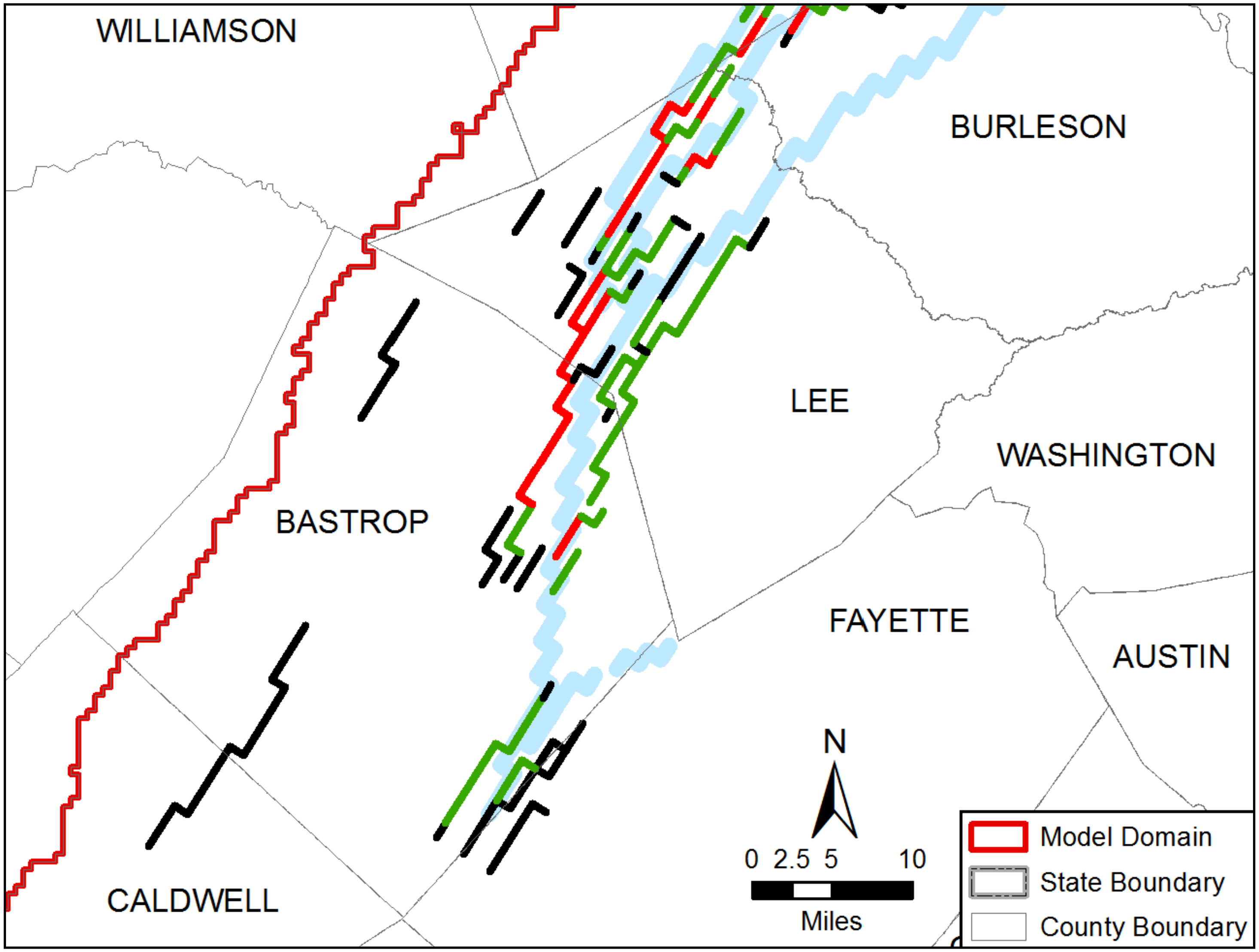
Date: October 3, 2019
Data Sources: TNRIS, TPWD, ESRI, DigiGlobe 2017

Document Path: Y:\0776_Freese_Nichols\Source_Figures\001_Bastrop_Prelim_Hydro_Rpt\Bastrop_Report_RevisedGAM\Figure1_Site_Vicinity_Map.mxd

FIGURE 2

GAM Fault Revisions

Bastrop, Texas



LEGEND

GAM Sealing Faults

Faults from Study

Offset < 200 ft

Offset 200 - 500 ft

Offset > 500 ft

Date: February 16, 2018
Data Sources: CWQCSP Vol. 1

GSI Water Solutions, Inc.

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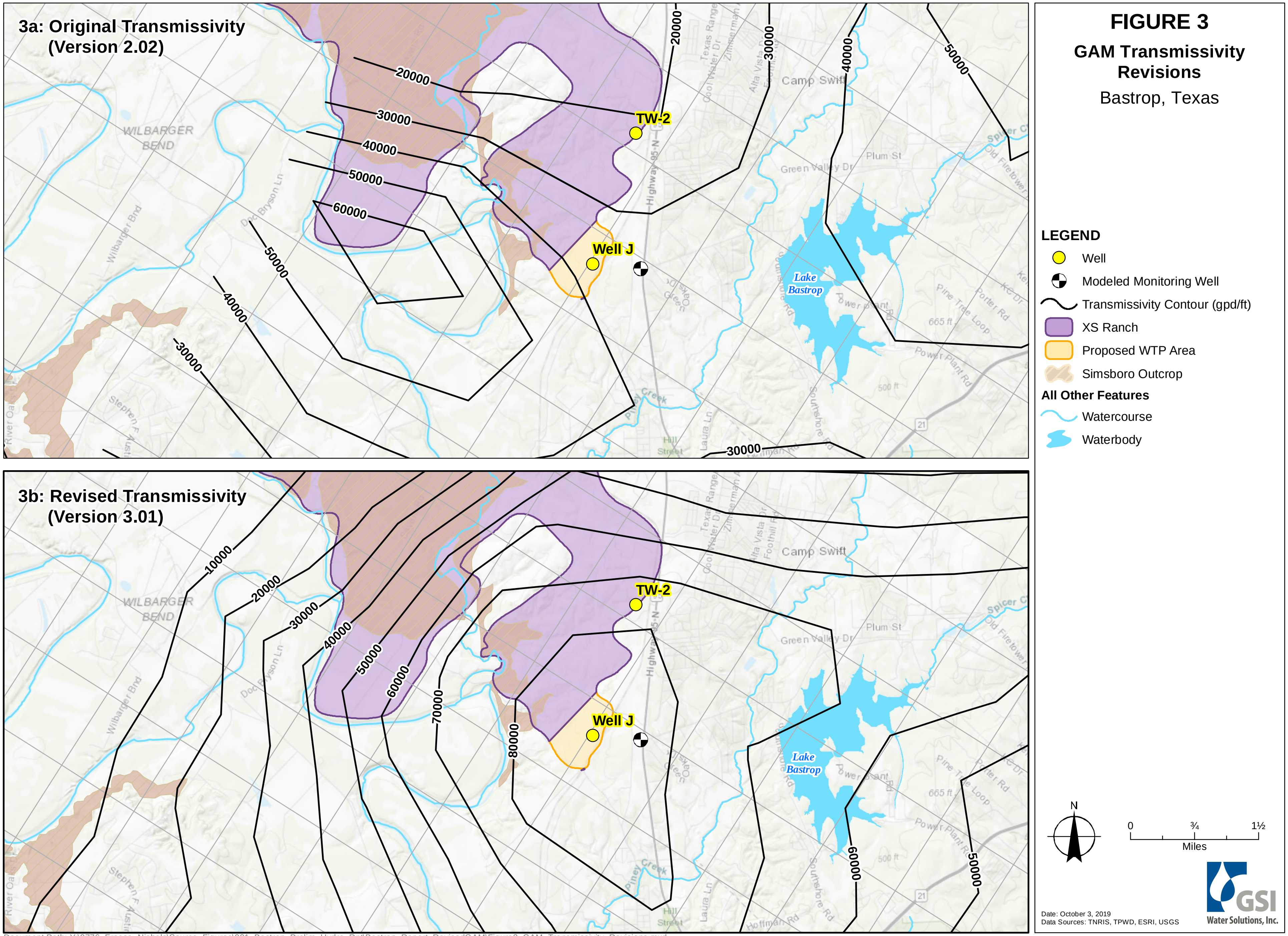

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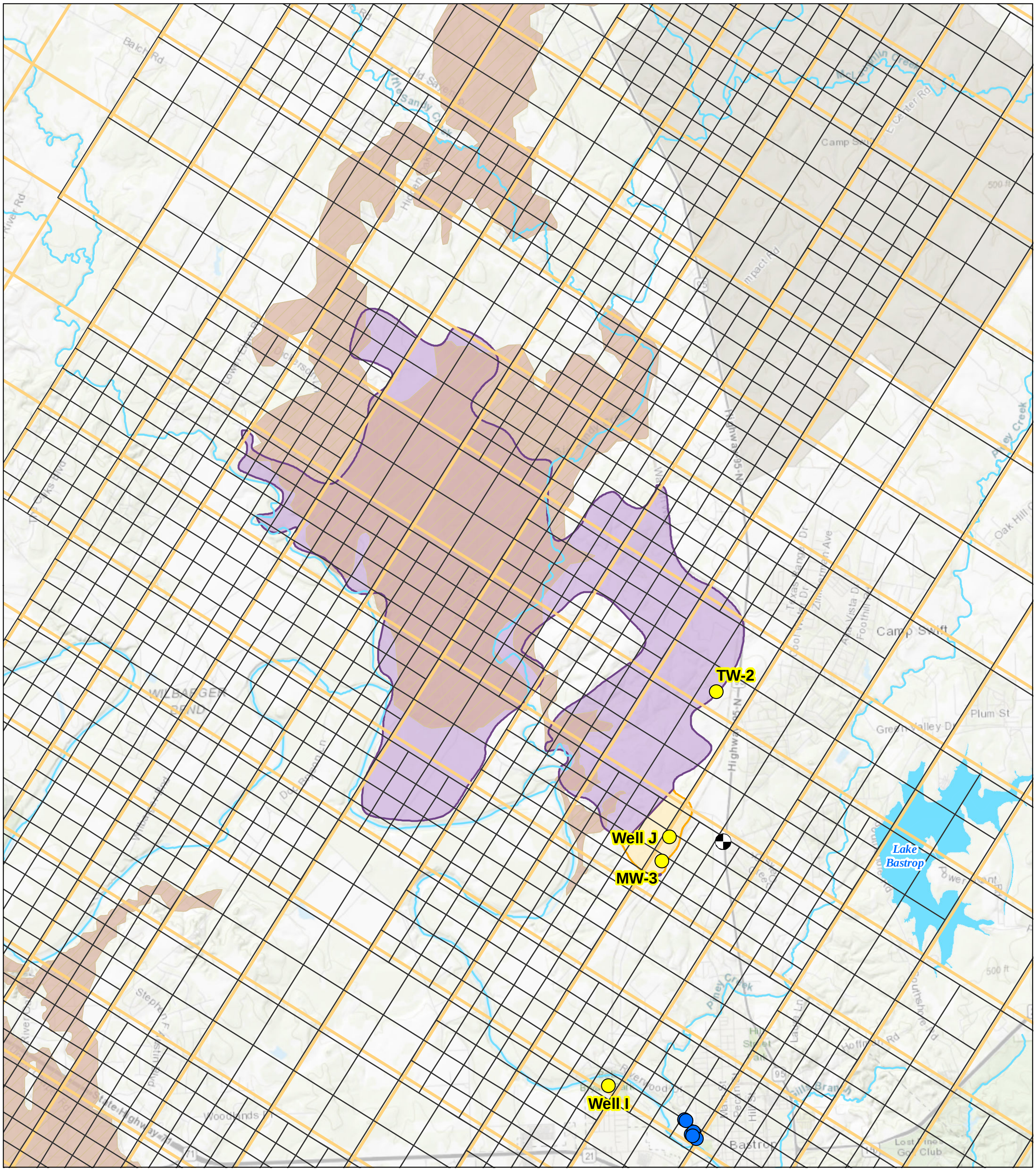

LEGEND

- Well
- Alluvial Well
- Modeled Monitoring Well
- v.3.01 GAM Grid
- v.2.02 GAM Grid
- XS Ranch
- Proposed WTP Area
- Simsboro Outcrop

All Other Features

- Watercourse
- Waterbody

FIGURE 4

GAM Grid Revisions

Bastrop, Texas

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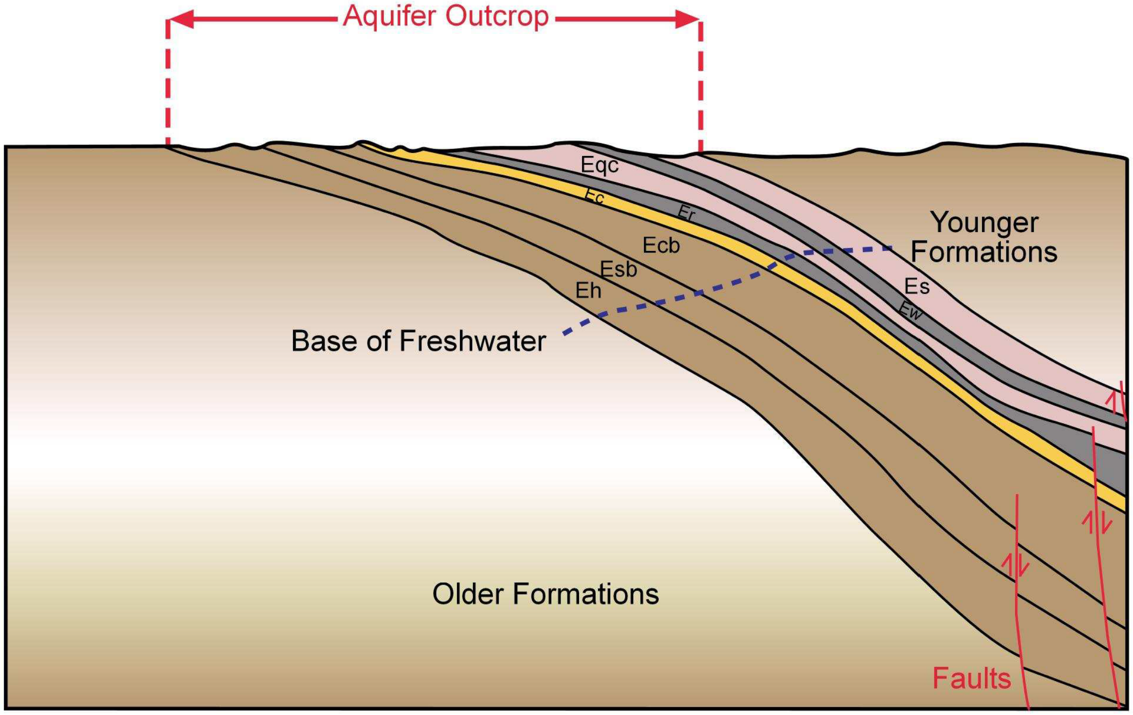
0 ¾ 1½
Miles

GSI Water Solutions, Inc.

Date: October 3, 2019
Data Sources: TNRIS, TPWD, ESRI, USGS

Document Path: Y:\0776_Freese_Nichols\Source_Figures\001_Bastrop_Prelim_Hydro_Rpt\Bastrop_Report_RevisedGAM\Figure4_GAM_GRID_Revisions.mxd

Conceptual Groundwater Flow Model
for Queen City and Sparta GAM (Version 2.02)



Groundwater Availability Model for the Central Portion
of the Carrizo-Wilcox, Queen City, and Sparta Aquifers (Version 3.01)

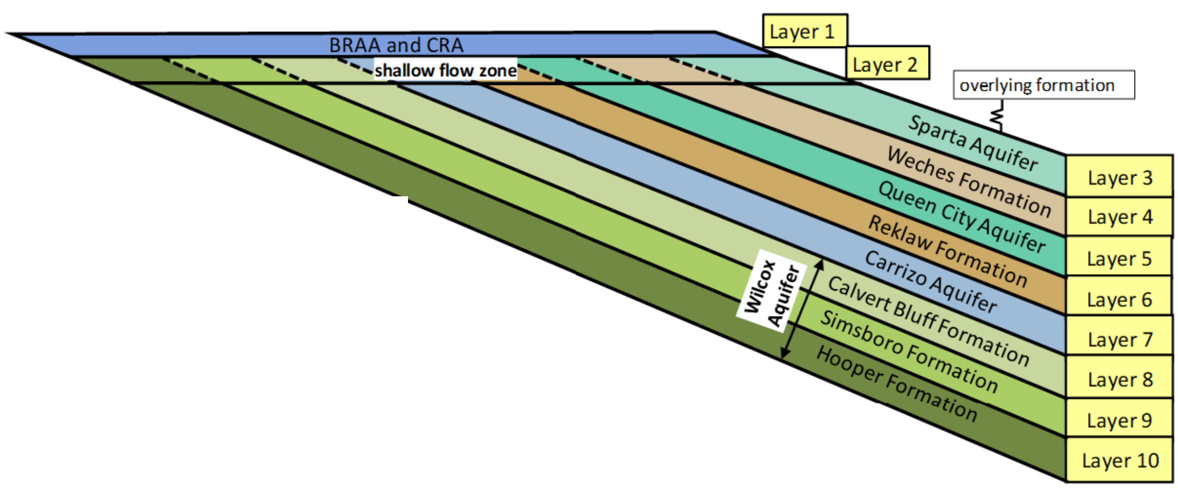


FIGURE 5

GAM Shallow Flow System Conceptual Layers

Bastrop, Texas

NOTES:

Date: February 16, 2018
Data Sources: CWQCSP Vol. 1

Water Solutions, Inc.

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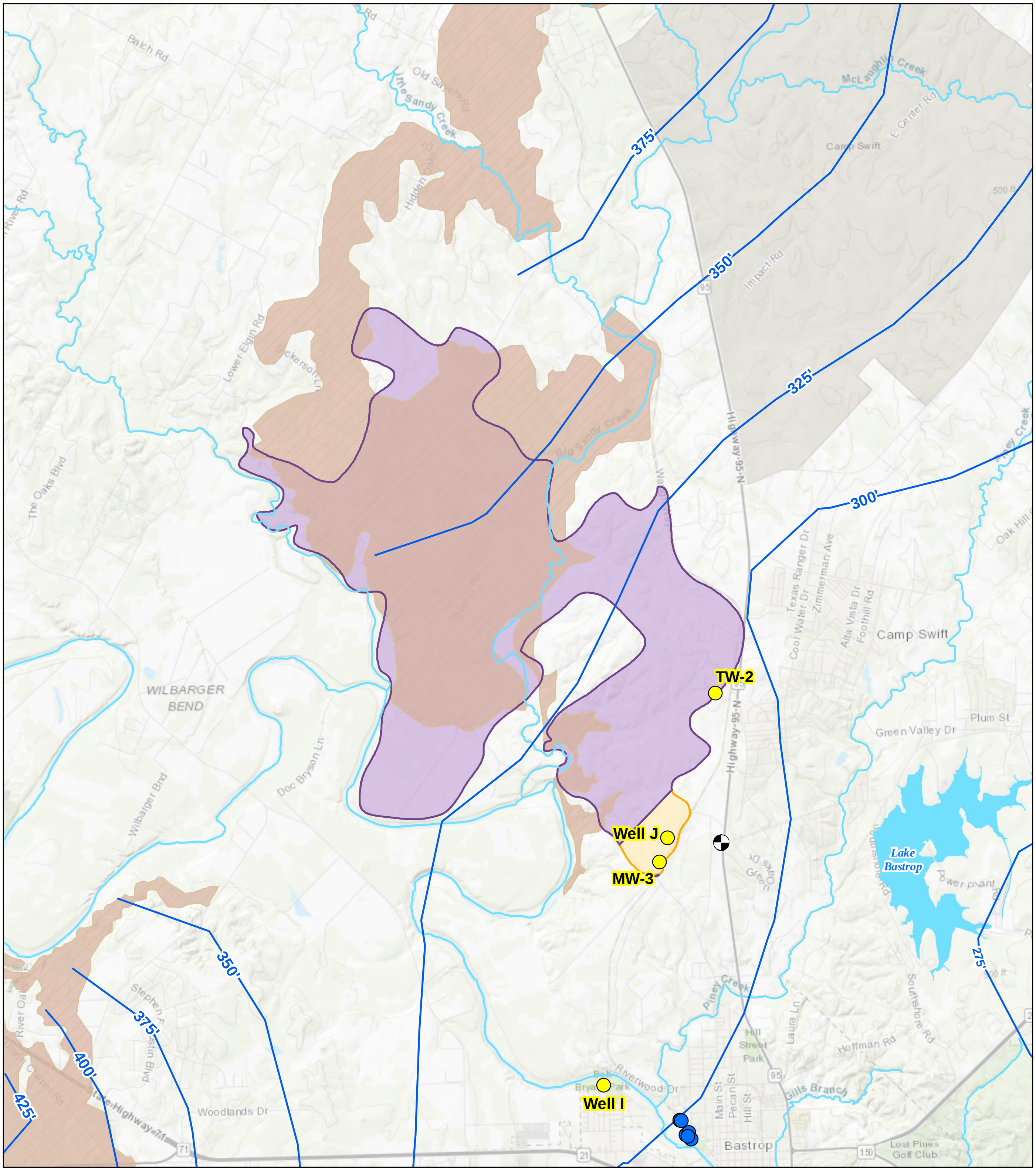


LEGEND

- Well
- Alluvial Well
- Modeled Monitoring Well
- Groundwater Elevation Contour (ft)
- XS Ranch
- Proposed WTP Area
- Simsboro Outcrop

All Other Features

- Watercourse
- Waterbody

FIGURE 6

Scenario 1 Modeled 2070 Groundwater Elevations

Bastrop, Texas

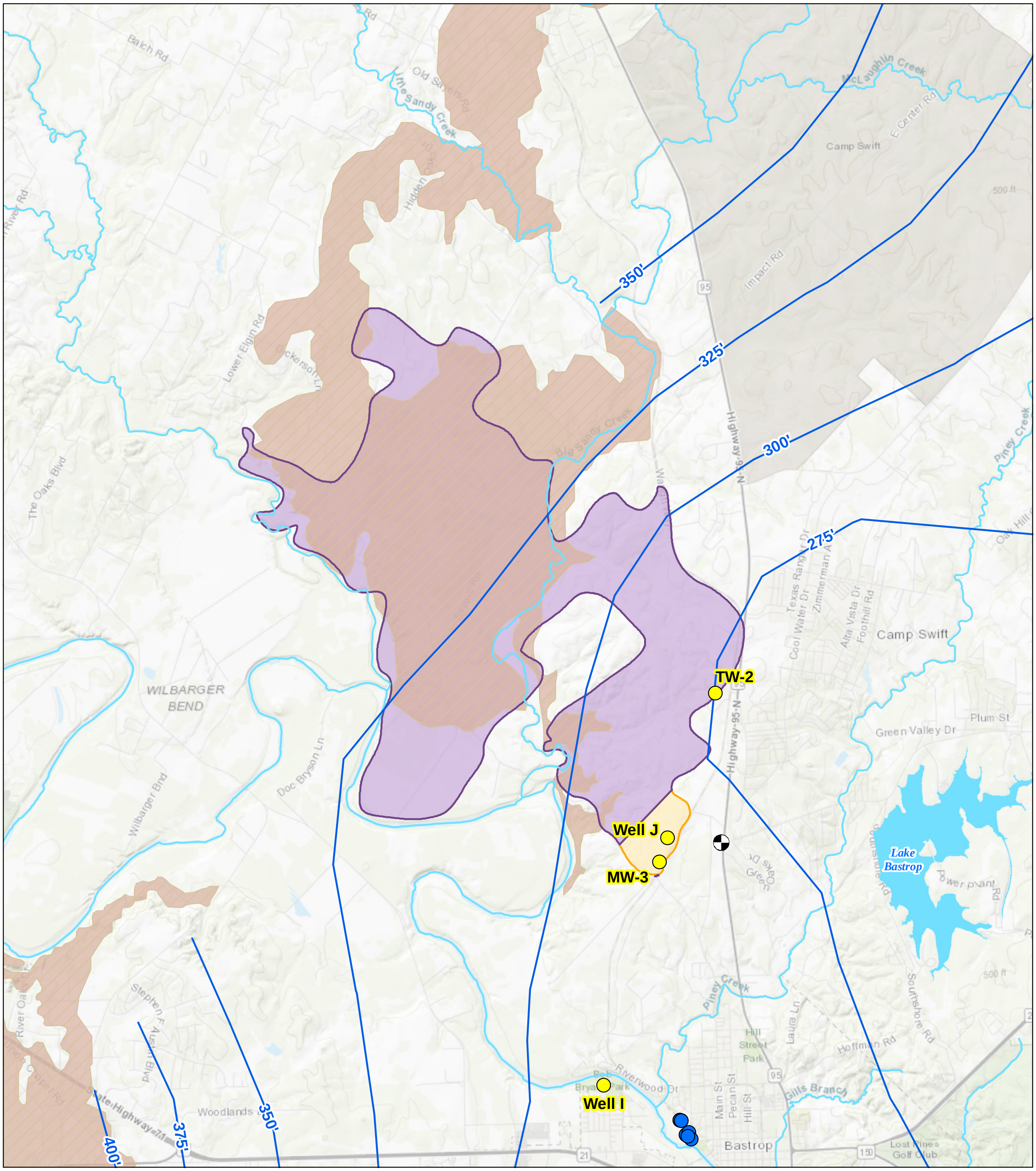
N

0 ¾ 1½
Miles

GSI Water Solutions, Inc.

Date: October 3, 2019
Data Sources: TNRIS, TPWD, ESRI, USGS

Document Path: Y:\0776_Freese_Nichols\Source_Figures\001_Bastrop_Prelim_Hydro_Rpt\Bastrop_Report_RevisedGAM\Figure6_Scenario1_Modeled_2070_Groundwater_Elevations.mxd



LEGEND

- Well
- Alluvial Well
- Modeled Monitoring Well
- Groundwater Elevation Contour (ft)
- XS Ranch
- Proposed WTP Area
- Simsboro Outcrop

All Other Features

- Watercourse
- Waterbody

FIGURE 7

Scenario 2 Modeled 2070 Groundwater Elevations

Bastrop, Texas

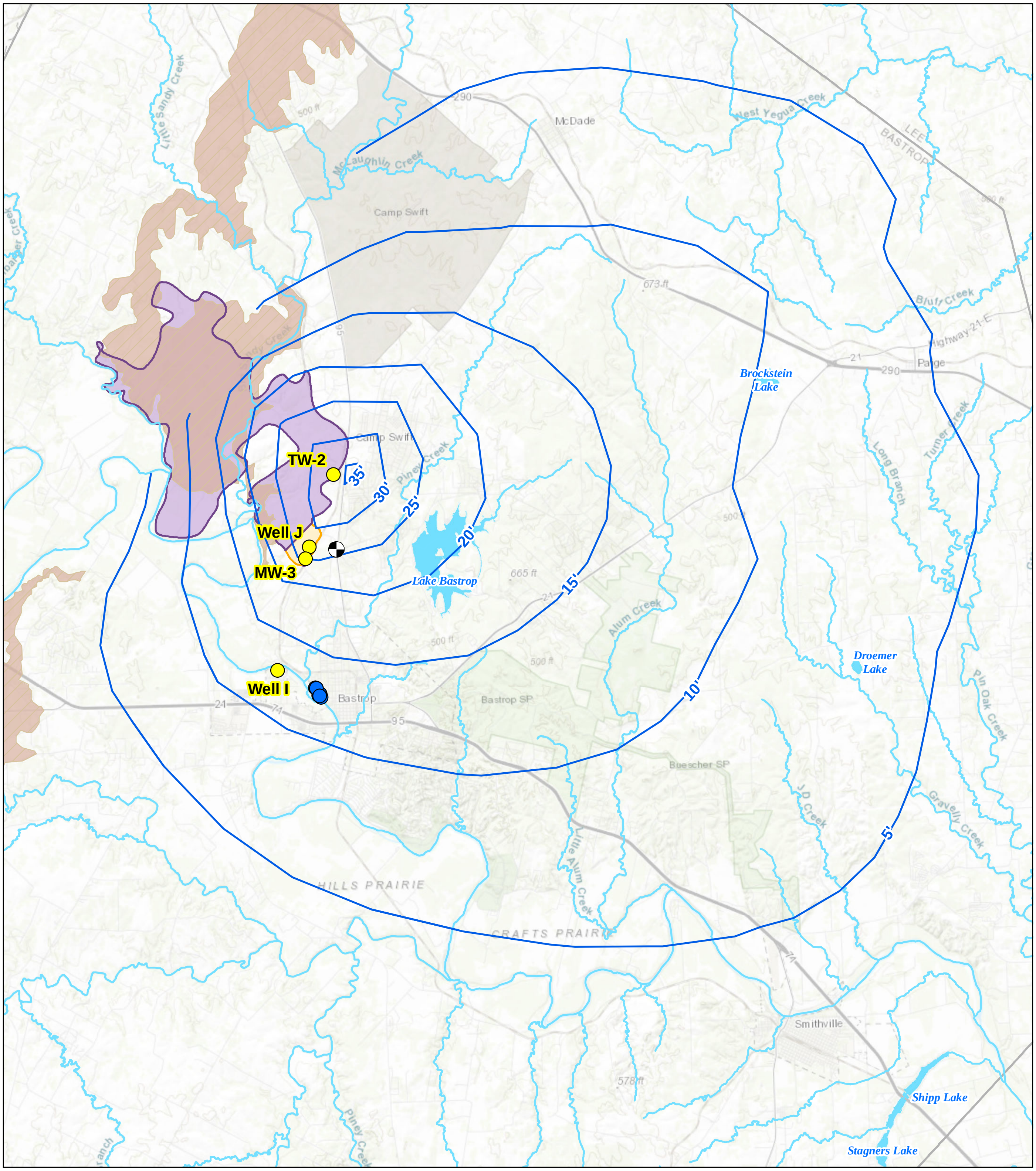
N

0 ¾ 1½
Miles

GSI Water Solutions, Inc.

Date: October 3, 2019
Data Sources: TNRIS, TPWD, ESRI, USGS

Document Path: Y:\0776_Freese_Nichols\Source_Figures\001_Bastrop_Prelim_Hydro_Rpt\Bastrop_Report_RevisedGAM\Figure7_Scenario2_Modeled_2070_Groundwater_Elevations.mxd



LEGEND

- Well
- Alluvial Well
- Modeled Monitoring Well
- Drawdown Contour (ft)
- XS Ranch
- Proposed WTP Area
- Simsboro Outcrop

All Other Features

- County Boundary
- Watercourse
- Waterbody

FIGURE 8

50-Year Drawdown Attributed to Bastrop Project Pumping (2021-2070)

Bastrop, Texas

N

0 1½ 3

Miles

GSI Water Solutions, Inc.

Date: October 3, 2019
Data Sources: TNRIS, TPWD, ESRI, USGS

Document Path: Y:\0776_Freese_Nichols\Source_Figures\001_Bastrop_Prelim_Hydro_Rpt\Bastrop_Report_RevisedGAM\Figure8_50yr_Drawdown_Attributed_to_Bastrop_Project_Pumping.mxd

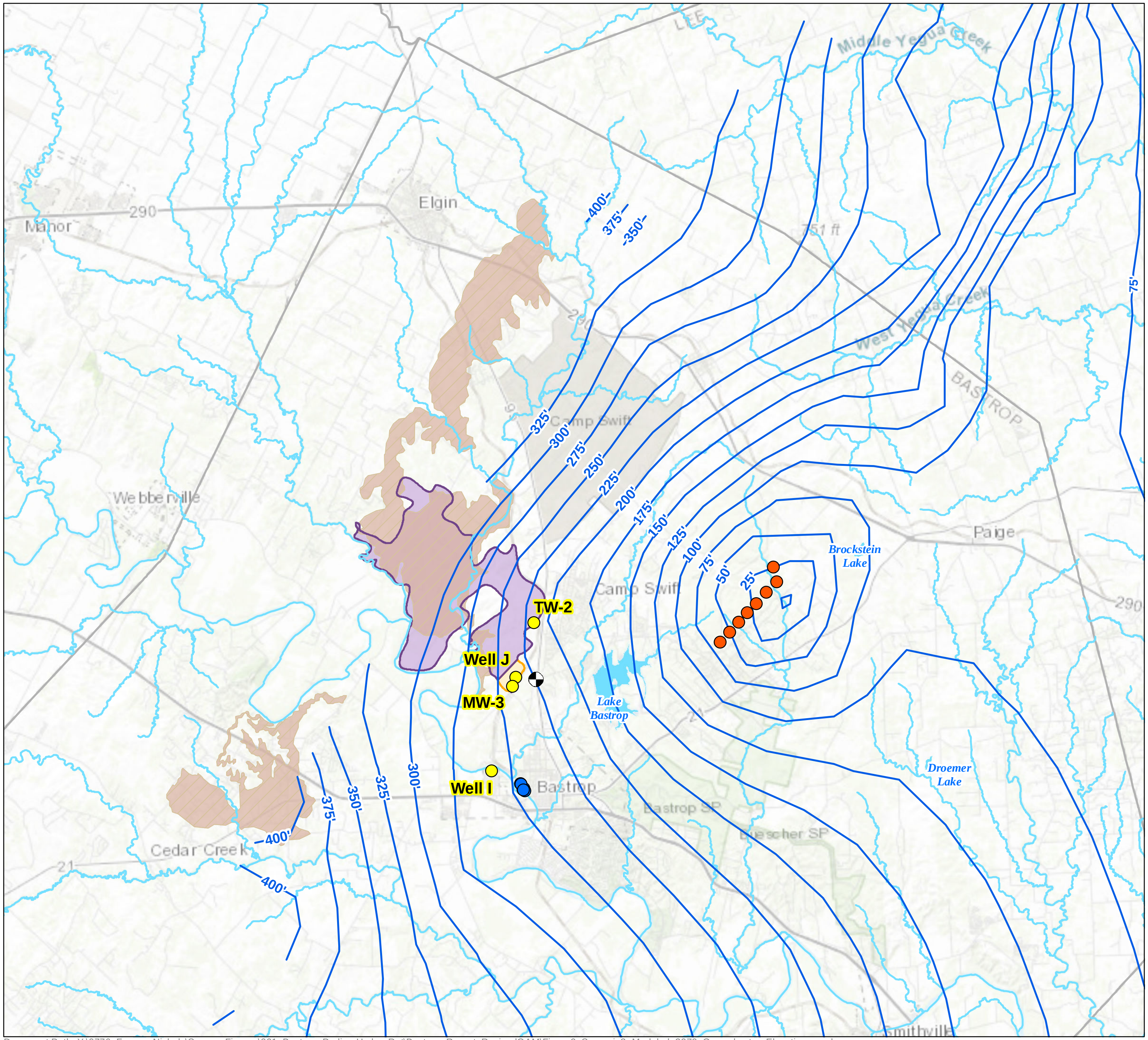


FIGURE 9

Scenario 3 Modeled 2070 Groundwater Elevations

Bastrop, Texas

LEGEND

- Well
- Proposed LCRA Production Well
- Alluvial Well
- Modeled Monitoring Well
- Groundwater Elevation Contour (ft)
- XS Ranch
- Proposed WTP Area
- Simsboro Outcrop

All Other Features

- County Boundary
- Watercourse
- Waterbody

N

0 2 4
Miles

Date: October 3, 2019
Data Sources: TNRIS, TPWD, ESRI, USGS

GSI Water Solutions, Inc.

Document Path: Y:\0776_Freese_Nichols\Source_Figures\001_Bastrop_Prelim_Hydro_Rpt\Bastrop_Report_RevisedGAM\Figure9_Scenario3_Modeled_2070_Groundwater_Elevations.mxd

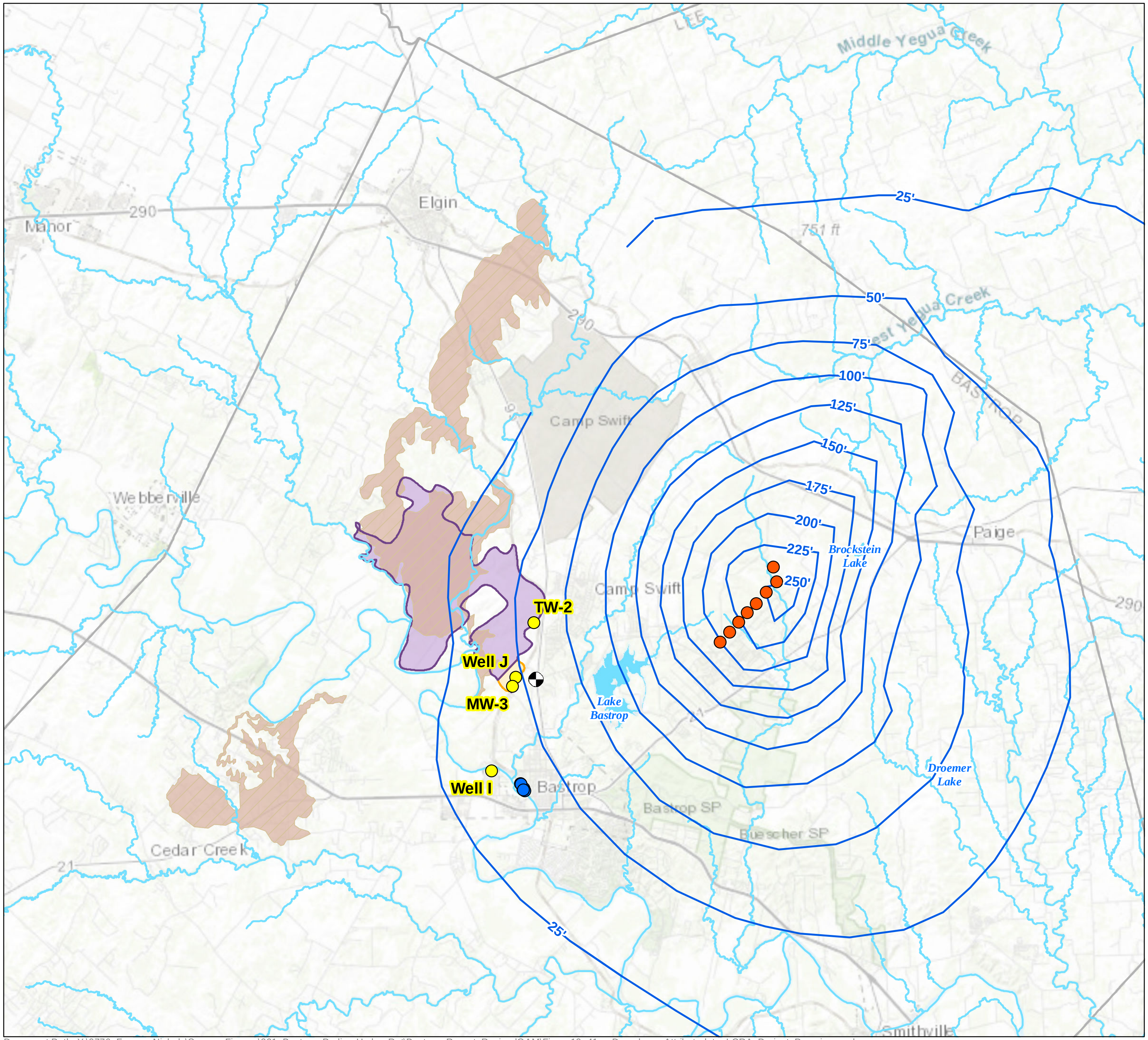


FIGURE 10

41-Year Drawdown Attributed to LCRA Project Pumpinig (2030-2070)

Bastrop, Texas

LEGEND

- Well
- Proposed LCRA Production Well
- Alluvial Well
- Modeled Monitoring Well
- Drawdown Contour (ft)
- XS Ranch
- Proposed WTP Area
- Simsboro Outcrop

All Other Features

- County Boundary
- Watercourse
- Waterbody

N

0 2 4
Miles

Date: October 3, 2019
Data Sources: TNRIS, TPWD, ESRI, USGS

GSI Water Solutions, Inc.

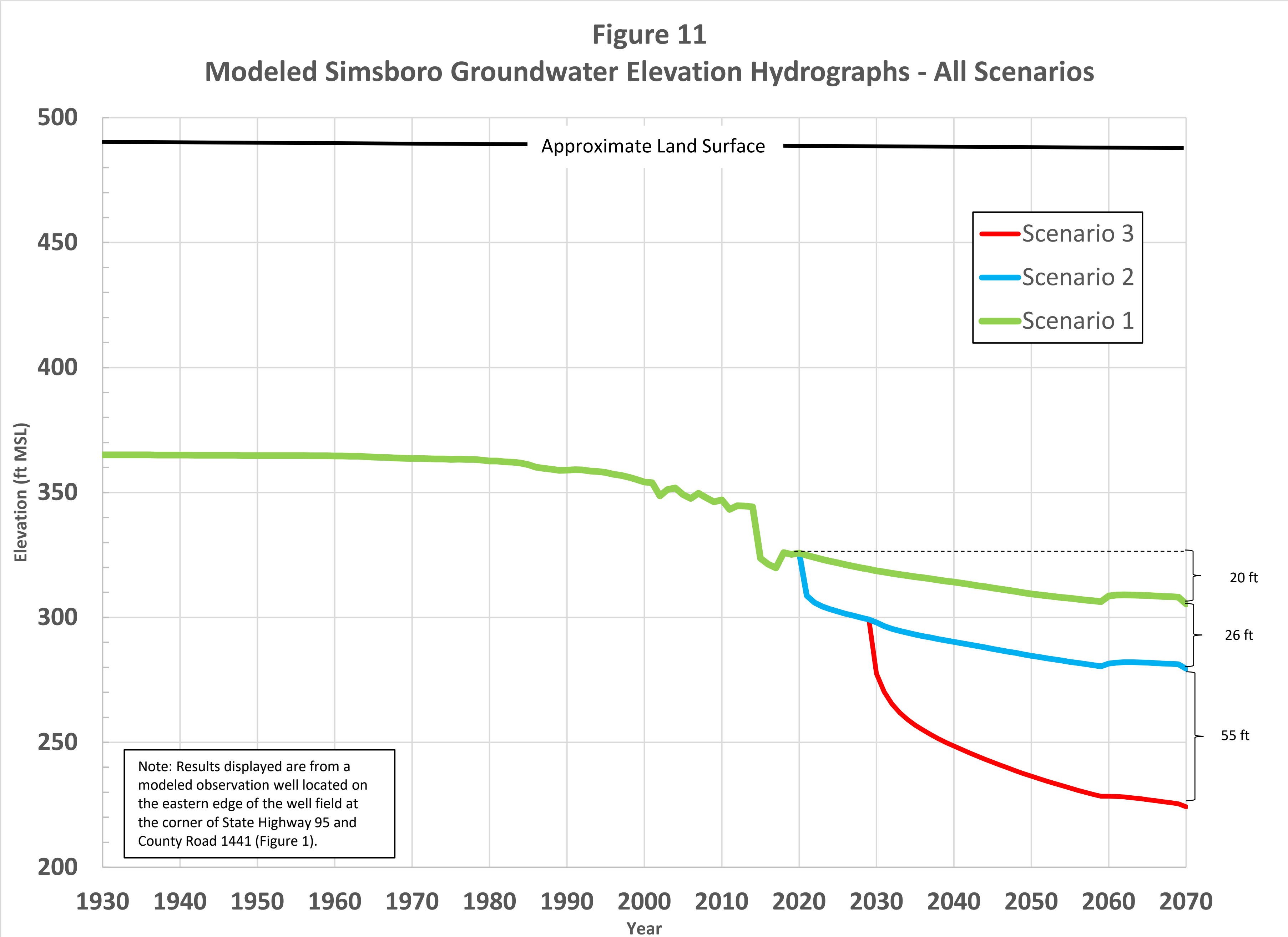


Figure 11
Modeled Simsboro Groundwater Elevation Hydrographs - All Scenarios
500
450
400
350
300
250
200
Elevation (ft MSL)
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
Year
Approximate Land Surface
Scenario 3
Scenario 2
Scenario 1
20 ft
26 ft
55 ft
Note: Results displayed are from a modeled observation well located on the eastern edge of the well field at the corner of State Highway 95 and County Road 1441 (Figure 1).

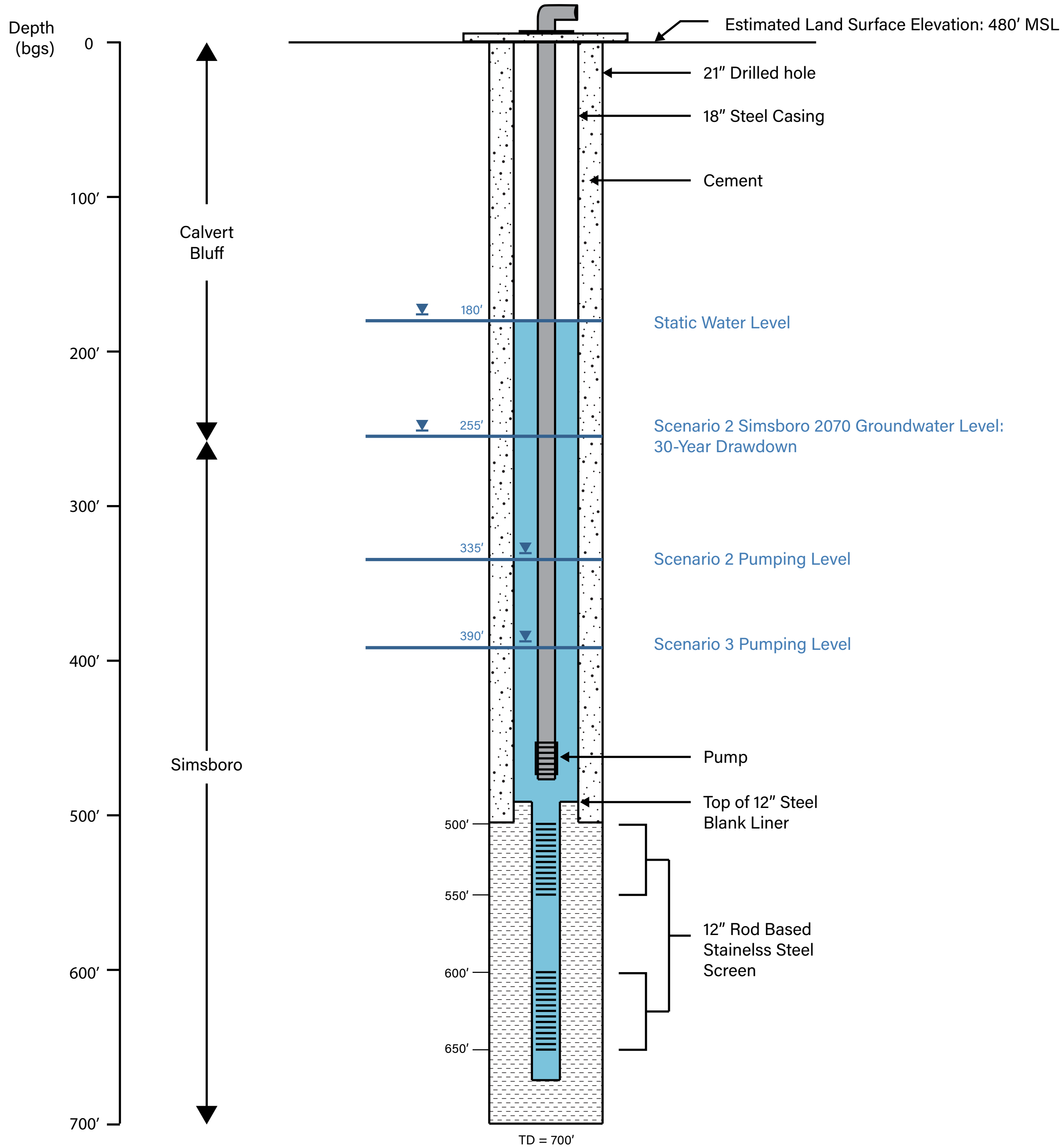


FIGURE 12

City of Bastrop
Simsboro Well Conceptual Design
Bastrop, Texas

NOTES:
bgs = Below ground surface
MSL = Mean sea level

Date: October 3, 2019

GSI Water Solutions, Inc.

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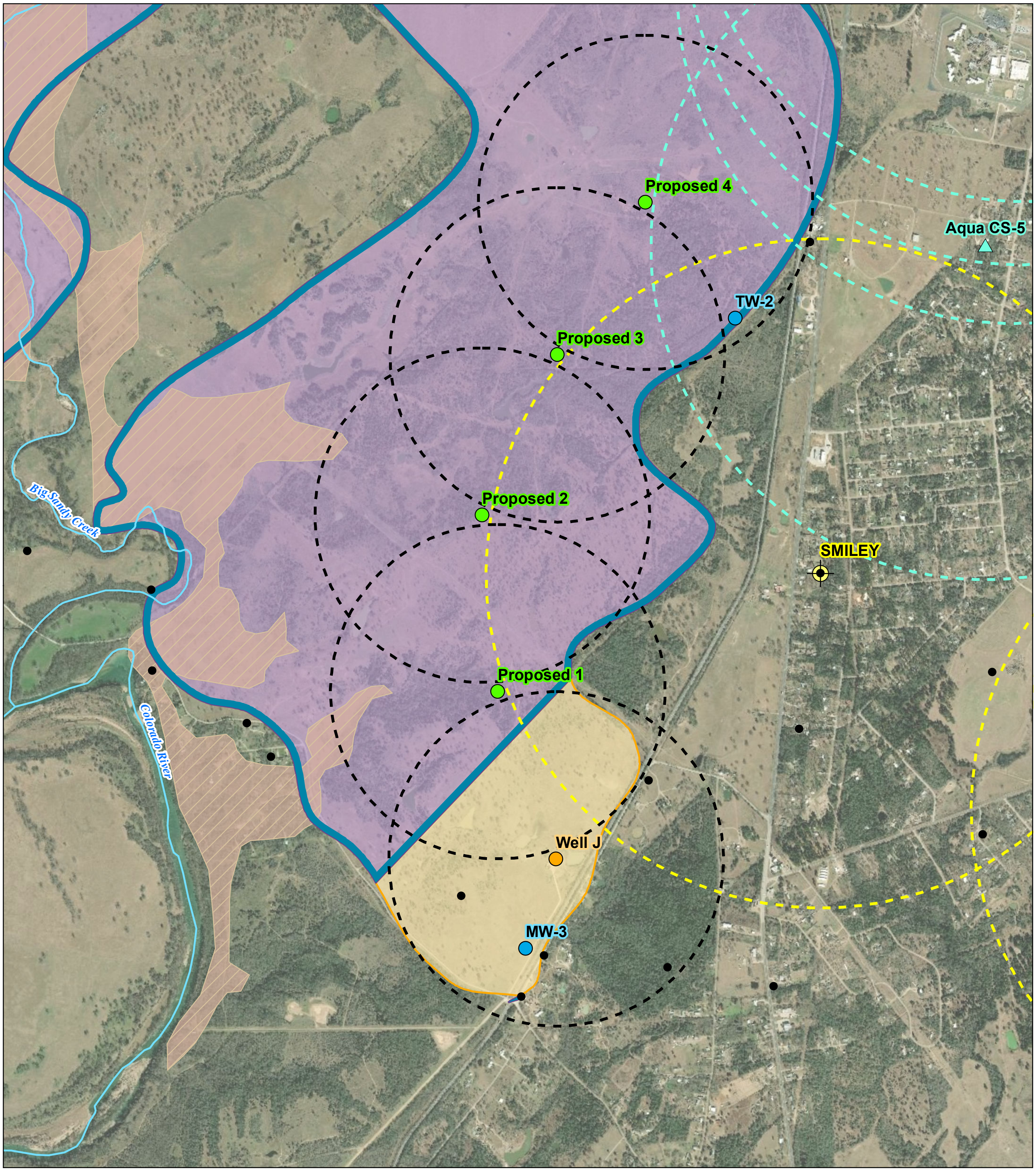

LEGEND

- Proposed Well Location
- Production Well
- Monitoring Well
- LPGCD Permitted Well
- LPGCD Exempt Well
- LPGCD Exempt Possible Simboro
- 2500' Buffer (City well)
- 5000' Buffer (LPGCD permitted)
- 5000' Buffer (LPGCD exempt)
- XS Ranch
- Proposed WTP Area
- 100' Buffer from Property Line
- Simsboro Outcrop

All Other Features

- Watercourse

Date: October 10, 2019
Data Sources: TNRIS, TPWD, ESRI, USGS

N

0 0.2 0.4
Miles

GSI Water Solutions, Inc.

FIGURE 13

Proposed Simsboro Well Locations

Bastrop, Texas

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