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November 26, 2018

Tracie M. White, P.E.  
Federal Facilities Remediation & Restoration Unit Leader  
Colorado Department of Public Health and Environment  
4300 Cherry Creek Drive South, Denver, CO 80246-1530

**Completion Report – FOSET Parcel 3  
Headquarters Area TCE Plume – Operable Unit 5  
Consent Agreement No. 01-08-07-02  
Former Lowry Air Force Base**

Dear Tracie:

Lowry Assumption, LLC (LAC), in accordance with Paragraph 50 of Consent Agreement No. 01-08-07-02 (Consent Agreement), as amended, is submitting this Completion Report for Finding of Suitability for Transfer (FOSET) Parcel 3. The parcel includes the Headquarters Area (HQ) TCE Plume as defined in Paragraph 23.c.iii of the Consent Agreement and presented in the *Final Transition Plan for Groundwater Cleanup and Landfill Closure at Lowry* (Transition Plan) (LAC, January 16, 2003). The Colorado Department of Public Health and Environment Hazardous Materials and Waste Management Division (Division) approved the Final Transition Plan for Privatization I on August 11, 2003. The legal description for FOSET Parcel 3 is defined in various documents including the *Finding of Suitability for Early Transfer – Former Lowry Air Force Base* (LAC, December 22, 2005) and Regulation 42.7(54) – Site-Specific Water Quality Classifications and Standards for Ground Water. Figures showing the location of FOSET Parcel 3 at the Former Lowry Air Force Base and a copy of the legal description from the FOSET document are included in **Exhibit 1**.

**Background**

Extensive discussions of the background and characterization of the Headquarters Area (HQ) TCE Plume can be found in the Operable Unit 5 Remedial Investigation Report (Versar, 2001) and the Transition Plan (LAC, 2003). Documentation of LAC's remediation and groundwater monitoring programs in Operable Unit 5 (OU5) and within the HQ TCE Plume is presented in numerous LAC technical documents and reports previously submitted to and approved by the Division beginning in 2003 and extending through July 2018. The following paragraphs provide a summary of those previously published discussions as they pertain to the HQ TCE Plume.

The HQ TCE Plume was sourced beneath the current Lowry Town Center near 2<sup>nd</sup> Avenue and Quebec Street and migrated to the northwest. See figures in **Exhibit 1**. The source of the HQ TCE Plume appears to have been leakage from an oil/water separator at a former Air Force building to a storm sewer that runs along the southeastern side of 1<sup>st</sup> Place. During the removal of the oil-water separator in 2001, TCE was detected in a sample of the separator contents but was not detected in the surrounding or underlying soil. It was concluded that leakage from junction vaults in the storm sewer system likely resulted in the release of TCE to the environment.

In the source area of the HQ TCE Plume, the highest dissolved-phase TCE concentrations occurred in groundwater within bedrock. The source area was over an erosional bedrock high where the water table has historically fluctuated above and below the bedrock-alluvium contact. North and west of the suspected source, the plume entered the Cherry Creek paleochannel, a major alluvial paleochannel incised in the top of the bedrock surface.

Remediation of the HQ TCE Plume was initiated in 2003. A field treatability study was conducted in the HQ source area to assess the efficacy of *in situ* chemical oxidation using potassium permanganate (KMnO<sub>4</sub>) to eliminate the chlorinated solvent impacts (predominantly TCE) in groundwater (LAC, October 2006). Based on the favorable results from the treatability study, full-scale remediation of the HQ source area and the HQ TCE Plume was implemented. Two separate rounds of KMnO<sub>4</sub> injections within the HQ TCE Plume were completed in 2004 and 2009 (LAC, August 2006, December 2006, and January 2010). Direct injections of KMnO<sub>4</sub> into the subsurface occurred in more than 100 points; over 27,000 pounds (by weight) of KMnO<sub>4</sub> were injected into the saturated alluvium and bedrock intervals within the HQ TCE Plume.

Long-term groundwater monitoring conducted prior to, during, and after the remedy implementation has demonstrated the effectiveness of the remedy as TCE concentrations in the majority of the HQ TCE Plume were reduced to levels at or below the applicable Colorado Basic Groundwater Standard (CBGWS) of 5 micrograms per liter (µg/l) (Regulation 41). By the time of the Second Five Year Review (AFCEC, October 2013), the overall lateral extent of the HQ TCE Plume greater than 5 µg/l had been reduced by approximately 81 percent from its maximum extent in 2001. However, as observed elsewhere within the Operable Unit 5 (OU5) groundwater plumes, there is a small but persistent remnant mass of TCE sorbed to the fine-grained alluvial matrix (e.g., interbedded silts and clays) throughout the dissolved-phase plumes. This physical limitation rendered further remediation of TCE technically impracticable for the purpose of achieving the CBGWS at every location. In recognition of these limiting conditions within OU5, an on-base site-specific groundwater standard for TCE of 11 µg/l was established in 2014 by Regulation 42.7(54). Since the site-specific standard was promulgated, the results of the groundwater monitoring program through July 2018 have demonstrated the continued attenuation of TCE concentrations in the HQ TCE Plume. As of July 2018, all monitoring wells within the HQ TCE Plume have achieved either the CBGWS of 5 µg/l (Regulation 41) or the on-base site-specific standard of 11 µg/l (Regulation 42.7(54)).

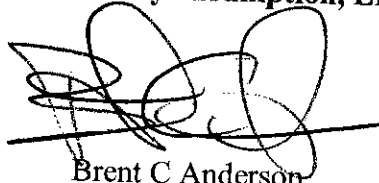
***Conclusion***

In its October 18, 2018 letter approving the *Results for the Biennial Operable Unit 5 Groundwater Monitoring Program – July 2018, Main TCE Plume, Headquarters Area TCE Plume, Fire Training Zone TCE Plumes, and the Carbon Tetrachloride Source Area* (LAC, September 27, 2018), the Division also approved the abandonment of on-base monitoring well MWHQ08 which is the sole remaining groundwater monitoring well located within FOSET Parcel 3. The well will be abandoned in accordance with applicable State of Colorado regulations, specifically the State Engineers Office Rule 16: Standards for Plugging, Sealing, and Abandoning Wells and Boreholes.

With well MWHQ08 having met the Division-approved criteria for monitoring well abandonment set forth in the *Addendum - Phase 2 Corrective Action Plan for Groundwater Cleanup at Lowry (Operable Unit 5)* (LAC, July 13, 2015), the Division's authorization to abandon well MWHQ08 represents the achievement of all applicable groundwater standards for groundwater (i.e., Regulation 41-Basic Standards for Ground Water and Regulation 42.7(54)) in FOSET Parcel 3. Thus, the remediation of the HQ TCE Plume is complete and with the submission of this Completion Report pursuant to Paragraph 50 of the Consent Agreement, LAC requests the Division's written final closure determination for FOSET Parcel 3.

Sincerely,

**Lowry Assumption, LLC**

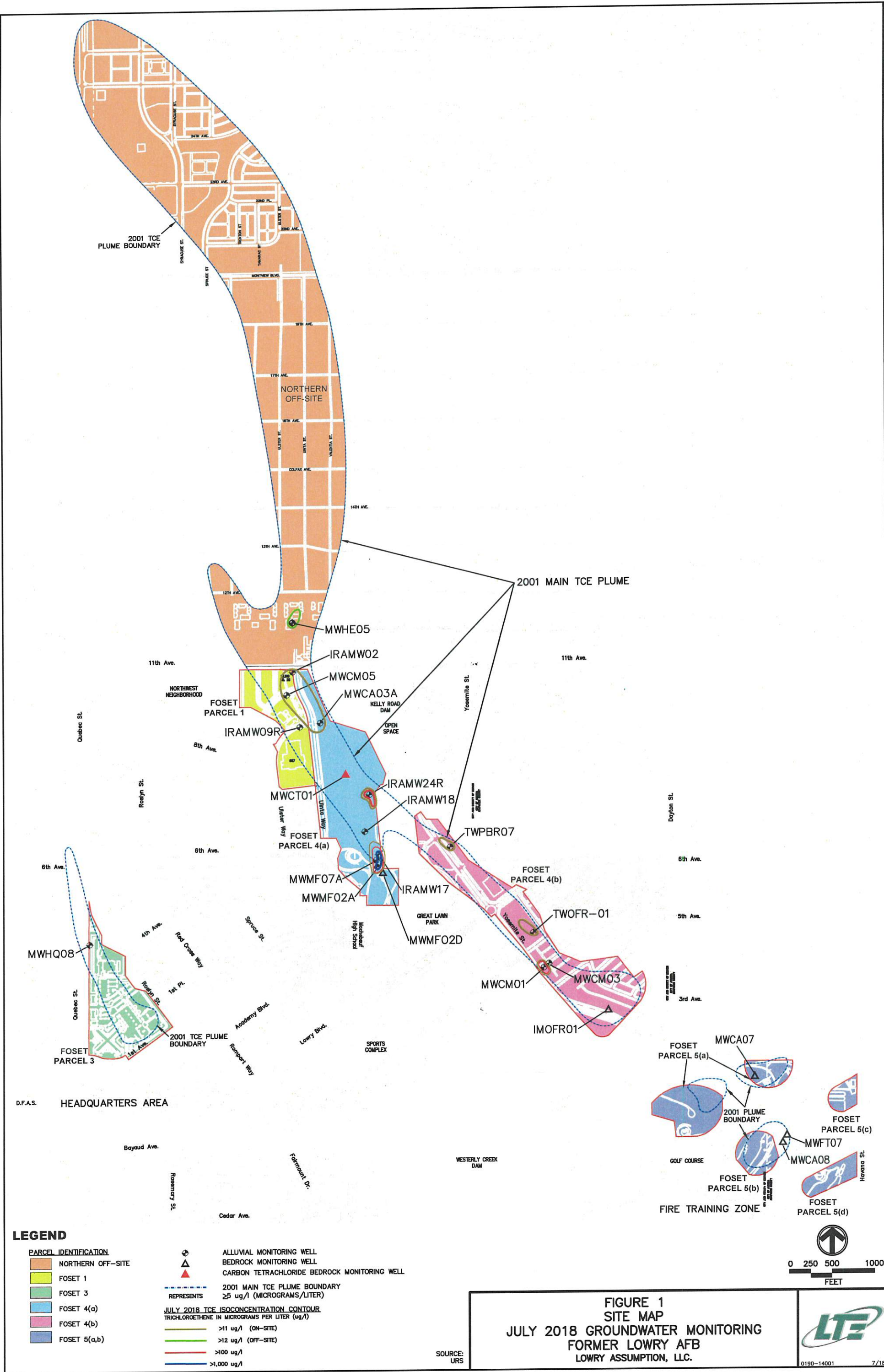


Brent C Anderson  
President

**Attachments**

cc: Tom Berger, LERA  
Paul Carroll, AFCEC  
David Erickson, DDPHE  
Monty Force, LERA  
Liia Koiv-Haus, Aurora  
Nate Owens, Aurora  
Lee Pivonka, CDPHE/HMWMD  
Jennifer Robbins, COAG  
Lowry Project File

## **Exhibit 1**









# **Former Lowry Air Force Base**

**City & County of Denver, CO**

**And**


**City of Aurora, CO**

## **FINDING OF SUITABILITY FOR EARLY TRANSFER**

**December 22, 2005**



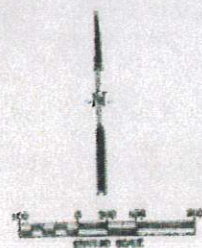
**Prepared by:**

 **Lowry Assumption, LLC**  
**7991 Shaffer Parkway, Suite 100**  
**Littleton, CO 80127**

**ATTACHMENT 1**

**SITE MAP AND LEGAL DESCRIPTIONS OF FOSET PARCELS**





LOWRY REDEVELOPMENT  
AUTHORITY

SITE MAP

Lot	Area
Lot 1	1.00
Lot 2	1.00

**SECRET**

CLASSIFIED BY [redacted]  
- EXCLUDED FROM AUTOMATIC DOWNGRADING AND DECLASSIFICATION  
DATE 10/19/2006 BY [redacted]

## Historical / Base Boundary

**URS**

1770 1730 ST. DATE 7  
MAY 1964 CO. 100  
1-100-1000. For 100-1000-1000



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**C. Parcel 3**

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## DESCRIPTION

### Parcel 3

A part of the West Half of Section 9, Township 4 South, Range 67 West of the Sixth Principal Meridian, City and County of Denver, State of Colorado being more particularly described as follows:

Commencing at the West Quarter Corner of said Section 9;  
thence North  $00^{\circ}10'10''$  East, along the west line of the Northwest Quarter of said Section 9, a distance of 37.00 feet;  
thence South  $89^{\circ}49'04''$  East, parallel with the south line of said Northwest Quarter, a distance of 30.00 feet to the easterly line of Quebec Street and the **POINT OF BEGINNING**;  
thence North  $00^{\circ}10'10''$  East, along said easterly line, a distance of 2,096.27 feet to a corner on the west line of Area 4 as described at Reception Number 9800174373 in the Clerk and Records Office of said City and County of Denver;

thence along the southwesterly line of said Area 4 the following seven (7) courses:

1. South  $09^{\circ}41'03''$  East a distance of 185.07 feet;
2. South  $26^{\circ}06'15''$  East a distance of 317.47 feet;
3. South  $00^{\circ}30'20''$  West a distance of 120.51 feet;
4. South  $61^{\circ}54'11''$  East a distance of 363.78 feet;
5. South  $00^{\circ}01'05''$  East a distance of 258.88 feet;
6. South  $36^{\circ}27'47''$  East a distance of 216.39 feet;
7. South  $74^{\circ}49'56''$  East a distance of 156.06 feet to the northwest corner of Area 9 as described at Reception Number 2000013500 in said Clerk and Records Office;

thence South  $36^{\circ}28'38''$  East, along the southwesterly line of said Area 9, a distance of 608.42 feet to a point on the northerly line of Area 2 as described at Reception Number 9800087078 in said Clerk and Records Office;

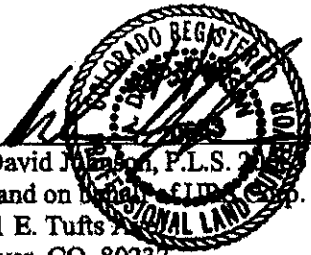
thence along said northerly line the following eight (8) courses:

1. South  $53^{\circ}32'18''$  West a distance of 744.29 feet;
2. North  $35^{\circ}20'40''$  West a distance of 74.00 feet to a point of non-tangent curvature;
3. along the arc of a curve to the right having a central angle of  $35^{\circ}31'36''$ , a radius of 263.00 feet, an arc length of 163.08 feet and whose chord bears South  $72^{\circ}25'08''$  West a distance of 160.48 feet;
4. North  $89^{\circ}49'04''$  West a distance of 81.42 feet to a point of curvature;
5. along the arc of a curve to the right having a central angle of  $20^{\circ}15'00''$ , a radius of 263.00 feet, an arc length of 92.95 feet and whose chord bears North  $79^{\circ}41'34''$  West a distance of 92.47 feet;
6. North  $69^{\circ}34'04''$  West a distance of 52.93 feet to a point of curvature;
7. along the arc of a curve to the left having a central angle of  $20^{\circ}15'00''$ , a radius of 337.00 feet, an arc length of 119.11 feet and whose chord bears North  $79^{\circ}41'34''$  West a distance of 118.49 feet;
8. North  $89^{\circ}49'04''$  West a distance of 4.92 feet to the **POINT OF BEGINNING**;

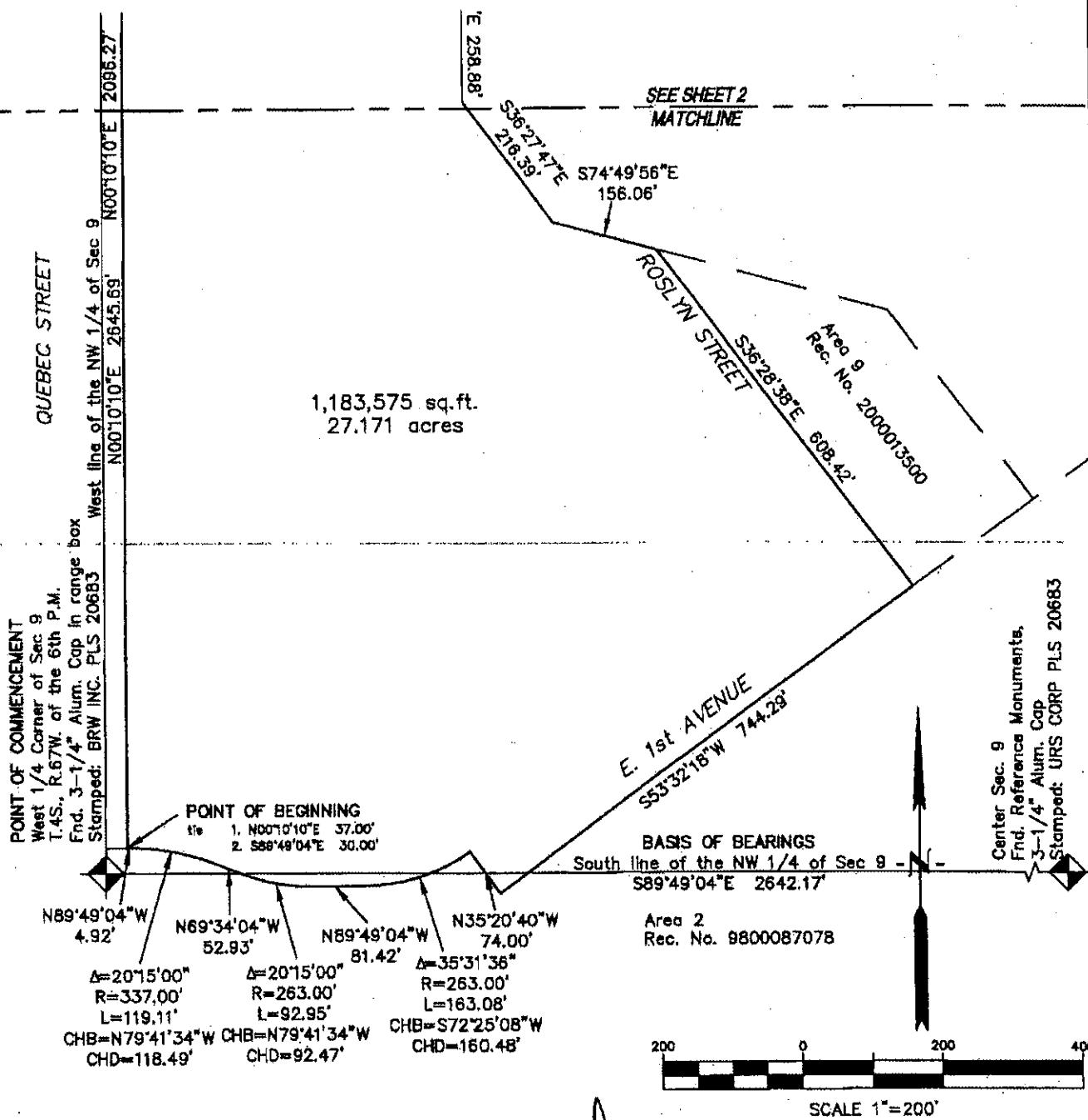


Containing 1,183,575 square feet or 27.171 acres, more or less.

**Basis of Bearings:** Bearings are based on the south line of the Northwest Quarter of Section 9, Township 4 South, Range 67 West of the 6th Principal Meridian as being S89°49'04"E. The bearing of said south line is shown on the City and County of Denver Lowry Air Force Base Boundary Survey under Project No. 94-576, dated 04/09/96 and recorded in Book 23 of the County Surveyor's Land Survey/Right of Way Surveys at Pages 102-103. The Center Quarter Corner of Section 9 is marked by reference monuments, found 3-1/4" aluminum caps stamped URS CORP PLS 20683. The West Quarter Corner of Section 9 is a found 3-1/4" aluminum cap in range box stamped BRW INC. PLS 20683.

  
A. David Johnson, P.L.S. No. 12345  
For and on behalf of FID  
8181 E. Tufts  
Denver, CO 80237  
Ph: 303.740.2600  
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# EXHIBIT



*This exhibit does not represent a monumented survey. It is intended only to depict the attached description.*

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**URS**  
8181 E. TUFTS AVENUE  
DENVER, CO 80237  
PH: 303-740-2500  
FAX: 303-294-3046

EXHIBIT	ACCOMPANYING DESCRIPTION
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**PARCEL 3  
EXHIBIT**

DENVER

**COLORADO**

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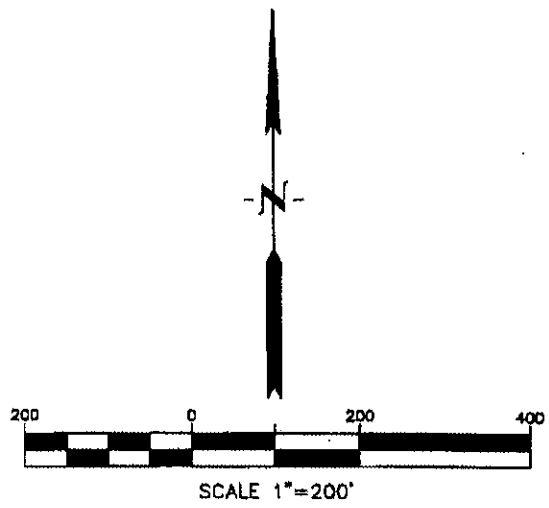
# EXHIBIT

NW Corner of Sec 9  
T.4S., R.67W. of the 6th P.M.  
Fnd. 3-1/4" Alum. Cap in range box  
Stamped: BRW INC. PLS 20683

S09°41'03"E  
185.07'

S26°06'15"E 317.47'

E. 5th AVENUE



QUEBEC STREET

S00°30'20"W  
120.51'

S61°34'11"E 363.78'

E. 4th AVENUE

Area 4  
Rec. No. 9800174373

Sec 9  
N00°10'10"E 2086.27'

MATCHLINE  
SEE SHEET 1

S00°01'05"E 258.88'

S36°27'47"E 216.39'

S74°49'56"E 156.06'



**URS**

5151 E. TUFTS AVENUE  
DENVER, CO 80237  
Pte 303-746-2600  
Fax: 303-694-3846

EXHIBIT ACCOMPANYING DESCRIPTION

**PARCEL 3  
EXHIBIT**

DENVER COLORADO  
Drawn by: JCB Checked by: ADJ Sheet No. 2 of 2 Sheet(s)

This exhibit does not represent a monumented survey. It is intended only to depict the attached description.

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