DRAINAGE REPORT

Winston Park

Project: 1607138

Prepared For

Jay Rice

Prepared October 31, 2017

Prepared By

BENCHMARK
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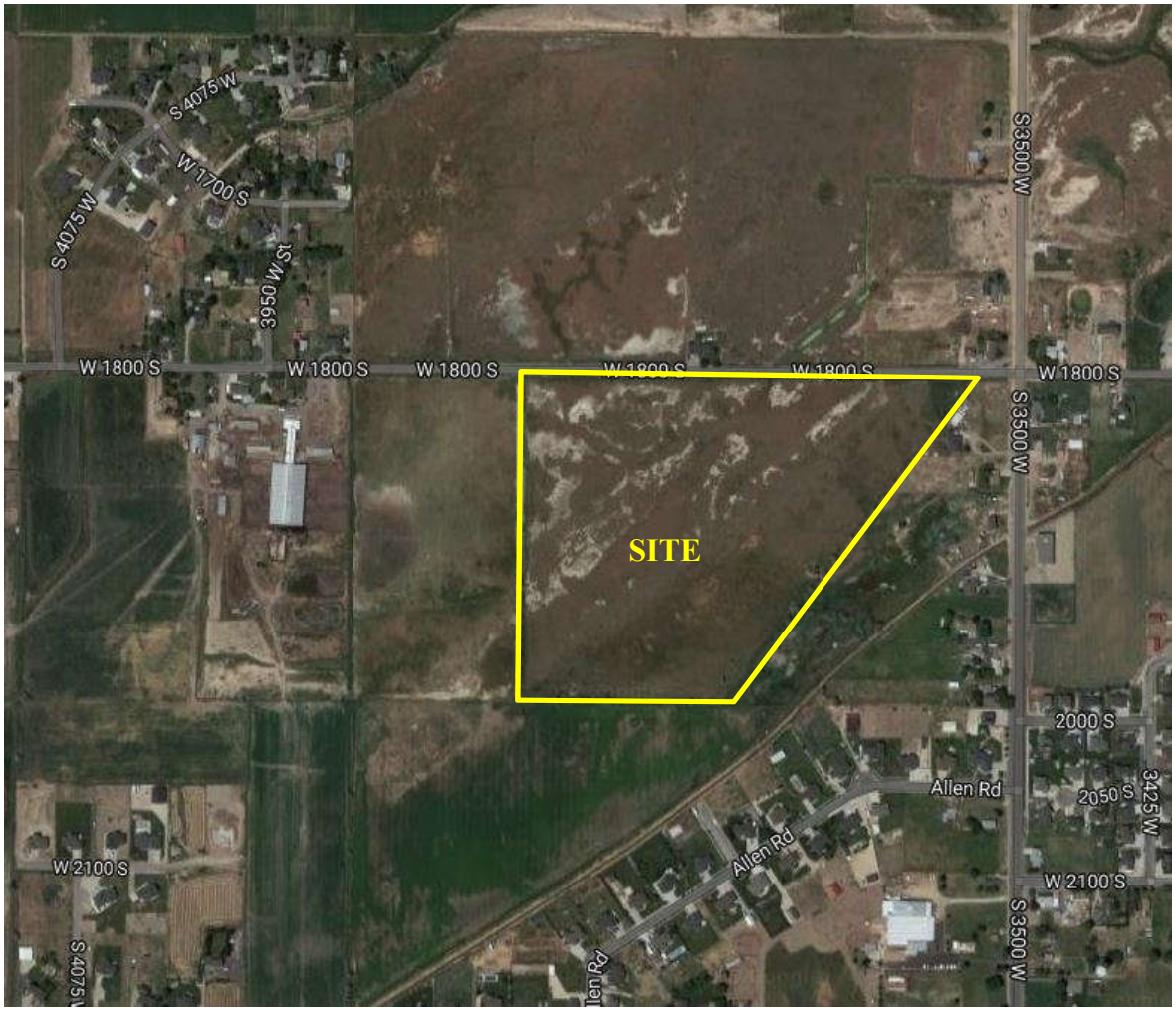
1. General Location and Description

The purpose of this report is to discuss the existing and proposed hydrologic and hydraulic conditions for the new Winston Park Subdivision and associated improvements. The site is located at 3908 West 1800 South in Weber County and consists of 38.88 acres. The intent of this report is to accompany the proposed civil plans for the subdivision by Benchmark Engineering for Weber County review and approval.

The project consists of two roads that both connect to 1800 south and stub off at the property line on the south and south-west. The site will be subdivided into 54 new residential lots and 18 new parcels for agricultural preservation. Improvements in the road and driveways will be constructed up to the buildable area for each lot. The site is bounded on the east by rural parcels with homes, the west and south by empty agricultural parcels, and the north by 1800 south.

Vicinity Map:



Currently, the projects site is a cleared parcel with natural vegetation and non-engineered fills. Runoff from the site generally travels to the north-west following the natural grade. The runoff then goes into the drainage ditch along 1800 south. Tailwater ditches along south and west property lines will be preserved and maintained by HOA.

According to the NRCS Web Soil Survey, the predominant native soils consist of Airport silt loam, Leland-Saltair complex, and Warm springs fine sandy loam. From the Geotech report provided,

the top 1.5-ft. of the site is top soil and approximately 13-ft. below that was found to be natural soil consisting of lean clay with silt and silty sand layers. The groundwater across the site ranged from 4.5-7 feet below the existing ground surface.

2. Drainage Basin

Runoff from the site generally travels to the north-west following the natural grade. The runoff then falls into a drainage ditch along the north boundary of the property, which flows west along 1800 south.

Benchmark Engineering does not have access to previous drainage studies.

This property is not part of any master plan.

Per FEMA, this site is located in Zone X, which is described as an area of minimal flood hazard.

3. Proposed Drainage Plan

The drainage of the site is composed of two drainage areas. All storm water falling on paved areas will be collected into the new storm drain system and piped to a baffled cleanout box with an orifice, and detention pond for its respective drainage area before being released, at a rate of 0.1 cfs/acre, into the existing drainage ditch along 1800 south that is to be piped. When developed, the runoff from the front yards of lots, portions of roofs sloped towards the road, and any other landscaped areas that direct water towards the road will be collected by these two systems. A minimal amount of storage will also be provided by some of the installed storm drain pipe and catch basins.

The site has been designed to detain a 100-year, 24-hour storm event with rainfall numbers provided by NOAA Atlas 14. A release rate of 0.1 cfs/acre was implemented, as required by Weber County.

The drainage area consists of several storm drain inlet boxes which collect surface water to be piped through 15", 18", and 21" RCP storm drain pipe into the new detention ponds located at the northern portion of the new subdivision. Before entering the new storm drain system along the south of 1800 south, the water will be cleaned with a snout. The detained water will release at the designate rate of 0.1cfs to the new storm drain system along the south of 1800 south. Storage volumes of 50,741 cf for the west drainage area and 14,765 cf for the east drainage area have been provided.

The details of the stormwater infrastructure, including the detention ponds and the piping of the existing drainage ditch along 1800 south, are shown on sheet CGD.01.

4. Stormwater Quality

The Utah Department of Environmental Quality (UTDEQ) is responsible for administering the state storm water management program. The Utah storm water program is closely modeled after the federal National Pollution Discharge Elimination System (NPDES) program, which requires storm water be treated to the maximum extent practicable (MEP). The UTDEQ water program establishes permitting requirements for construction sites disturbing more than one acre, industrial sites, and Municipal Separate Storm Sewer Systems (MS4s). All MS4s should currently be

permitted, or in the permit process. Each permitted MS4 will be responsible for establishing a Storm Water Management Program (SWMP).

Before entering the existing storm drain system, storm water will be treated with a snout. An orifice plate will maintain the rate of runoff released from the site at 0.1 cfs/acre.

5. Analysis

5.1. Hydrologic

As stated in Section 3, the site has been designed to detain a 100-year, 24-hour storm event with rainfall provided by NOAA Atlas 14. The rainfall intensities generated from this process produced the maximum volumes to detain listed in the attached drainage calculations.

Rational Method

The Rational method was used in determining the peak discharge from storm drains into the detention basins per the grading and drainage plan.

$$Q = CiA$$

Where:

Q = the peak discharge
C = the coefficient of runoff
i = rainfall intensity
A = tributary area

The maximum storm detention required for a 24 hour period is calculated by determining the time of concentration, which is the time it takes for runoff to travel from the hydraulically most distant part of the watershed sub-basin to its outfall point. It is computed by summing the time it takes water to travel through the different components of the drainage system. The soil type, ground cover, slope and flow lengths are used to determine the time of concentration for a specific detention basin area. Once the time of concentration is obtained, the rainfall intensity curves are used to determine the required storage.

Detention Location and Sizing

Detention for storm water is provided by two detention ponds that are located in the northern portion of the project site. The volumes of detention provided by the west and east ponds are 50,741 and 14,765 c.f., respectively. Minimal storage is provided by nearby pipes and catch basins.

The stormwater runoff routing is represented on sheet CGD.01.

5.2. Hydraulic

The Rational Method was used to determine the flow rate from the contributing areas. The intensity of rainfall was determined by referencing NOAA Atlas 14 Precipitation Frequency

Estimates for the surrounding area. The variable value of C was determined using a weighted average of the percentage of permeable and non-permeable surfaces.

The expected flow obtained by the rational method was then used in Manning's Equation, shown below, to solve for the required minimum pipe radius.

Manning's Equation:

$$Q = \frac{k}{n} * A * R_h^{\frac{2}{3}} * S^{\frac{1}{2}}$$

Q = the peak discharge
k = 1.49; conversion factor
R= hydraulic radius of the pipe
A = area of the pipe
S = slope of the pipe
n = coefficient of roughness for the pipe material

In the event that a 100-yr storm is exceeded, overflow from detention ponds will overtop the baffles in the 5' x 5' & 4' x 4' cleanout boxes adjacent to the detention ponds and flow unrestricted into the piped drainage ditch along 1800 south.

6. Conclusions

The drainage system for this site will consist of overland sheet flow, catch basins, cleanout boxes, RCP storm drain pipes, and two detention ponds. The increase in drainage requirements due to onsite improvements will be collected and routed through the above mentioned facilities to the new detention areas. The flow from the development will be restricted by orifice plates and treated for pollutants using snouts before flowing into the piped drainage ditch along 1800 south.

The storm water drainage and detention system designed for this site meets the requirements of a 100-year, 24-hour storm released at 0.1 cfs/acre as required by Weber County.

7. Appendix

STORM DRAINAGE CALCULATIONS
DRAINAGE AREA #1
Rational Method (Q=CIA)

Area Identification (A)		Rational Coefficient (C)	C*A	
*Roof =	117,500	0.9		105750 S.F.
**Pavement =	161,425	0.9		145283 S.F.
Landscaping =	355,828	0.2		71166 S.F.
Sum:	634753 S.F.		Sum:	322198 S.F.

NOAA ATLAS 14 (100 YEAR STORM)				**Allowable Discharge =**	.10cfs/acre
Time *(min)*	Intensity *(in/hr)*	Rainfall *(inches)*	Rainfall Excess *(cu.ft.)*	Allowed Discharge *(cu.ft)*	Volume to Detain *(cu.ft)*
15	4.56	1.140	30609	1311	29297
30	3.07	1.535	41215	2623	38592
60	1.90	1.900	51015	5246	45769
120	1.09	2.180	58533	10492	**48041**
180	0.75	2.250	60412	15738	44674
360	0.41	2.484	66695	31475	35220
720	0.25	3.048	81838	62951	18888
1440	0.14	3.432	92149	125901	0

* Assumed 2,500 sq. ft. per home

** Assumed 400 sq. ft. per driveway

Detention Calculations

Pond Volume

Pond 1 Civil 3D = **48,766 cf**

Is there adequate storage? Storage Provided = **48,766 cf**

Req. Storage = **48,041 cf** **YES**

Orifice Design:

The storm runoff will be detained at 0.1 cfs/acre

$$Q = C_d A_0 \sqrt{2gh}$$

Total acreage of development:	14.57 acres
Allowable discharge:	0.1 cfs/acre
Max head:	0.93 ft
Design diameter for new orifice:	7.5 inch

STORM DRAINAGE CALCULATIONS
DRAINAGE AREA #2
Rational Method (Q=CIA)

Area Identification (A)		Rational Coefficient (C)		C*A
*Roof =	22,500	0.9		20250 S.F.
**Pavement =	47,439	0.9		42695 S.F.
Landscaping =	85,633	0.2		17127 S.F.
Sum:	2E+05 S.F.		Sum:	80072 S.F.

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Time *(min)*	Intensity *(in/hr)*	Rainfall *(inches)*	Rainfall Excess *(cu.ft.)*	Allowed Discharge *(cu.ft)*	Volume to Detain *(cu.ft)*
15	4.56	1.140	7607	321	7285
30	3.07	1.535	10243	643	9600
60	1.90	1.900	12678	1286	11392
120	1.09	2.180	14546	2571	**11975**
180	0.75	2.250	15013	3857	11156
360	0.41	2.484	16575	7714	8861
720	0.25	3.048	20338	15429	4910
1440	0.14	3.432	22901	30857	0

* Assumed 2,500 sq. ft. per home

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Detention Calculations

Pond Volume

Pond 1 Civil 3D = **12,085 cf**

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Req. Storage = **11,975 cf** **YES**

Orifice Design:

The storm runoff will be detained at 0.1 cfs/acre

$$Q = C_d A_0 \sqrt{2gh}$$

Total acreage of development:	3.57 acres
Allowable discharge:	0.1 cfs/acre
Max head:	0.86 ft
Design diameter for new orifice:	3.8 inch

GRADING AND DRAINAGE KEY NOTES REFERENCE

NO.	DESCRIPTION	DETAIL
1	GRADE SITE TO ELEVATIONS SHOWN ON PLAN	
2	7.5" ORIFICE PLATE (SEE DETAIL 'A')	5A/CDT.04
3	3.8" ORIFICE PLATE (SEE DETAIL 'B')	5B/CDT.04
4	STORM DRAIN INLET BOX	4/CDT.01
5	5'X5' SDCO W/ BAFFLE (SEE DETAIL 'A')	6A/CDT.04
6	STORM DRAIN CLEANOUT	4/CDT.01
7	STORM DRAIN COMBO BOX	3/CDT.04
8	FLARED END SECTION	4/CDT.04
9	REVERSED STORM DRAIN COMBO BOX	
10	SNOUT	3/CDT.03
11	4" PVC FOUNDATION DRAIN LATERAL PER WEBER COUNTY ENGINEERING STDS. (0.5% MIN. SLOPE)	
12	4'X4' SDCO W/ BAFFLE (SEE DETAIL 'B')	6B/CDT.04
13	BACKFLOW PREVENTER VALVE (J & S VALVE OR APPROVED EQUAL)	

NOTE:
CONTRACTOR IS RESPONSIBLE FOR POTHOLING TO IDENTIFY ANY CONFLICTS BEFORE ANY PIPE INSTALLATION. CONTACT ENGINEER IF ANY CONFLICTS ARE IDENTIFIED.

NOTE:
PRIOR TO FABRICATION OR CONSTRUCTION, CONTRACTOR IS TO BEGIN AT THE LOW END OF ALL GRAVITY UTILITY LINES AND VERIFY THE INVERT ELEVATION OF THE POINT OF CONNECTION AND NOTIFY ENGINEER IF THIS POINT IS HIGHER THAN SHOWN ON THE PLANS FOR A REDESIGN.

NOTE:
STORM DRAIN PIPES ARE TO BE LAID WITHOUT GASKETS AT JOINTS AND GRAVEL IS TO BE PLACED AROUND AT LEAST EVERY OTHER JOINT.

BENCHMARK:
WEBER COUNTY BENCHMARK 62121-2-5217
SURVEY BENCHMARK
ELEVATION NGVD 88 = 4241.87'
(FOUND 3" BRASS CAP SET IN 6" CONCRETE POST. SET IN 1954 BY BUREAU OF RECLAMATION. GOOD CONDITION)

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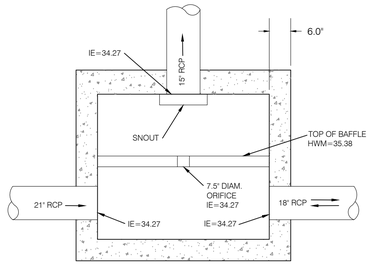
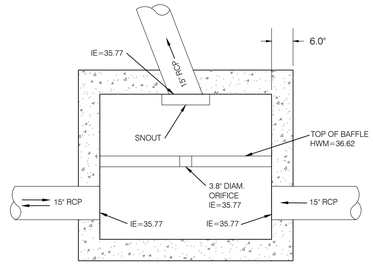


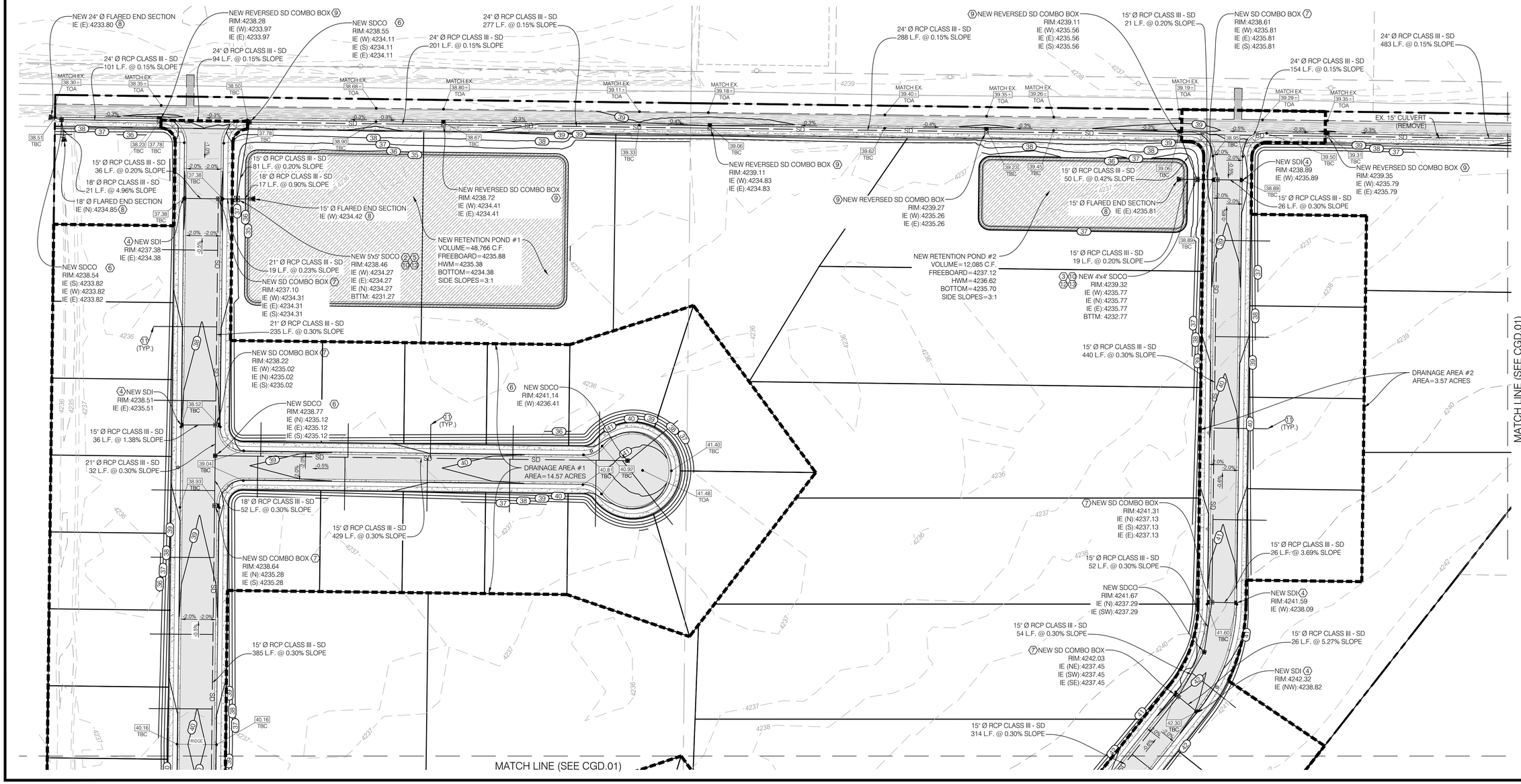
5'X5' SDCO W/ BAFFLE
PLAN VIEW
SCALE: N.T.S.
(A)



4'X4' SDCO W/ BAFFLE
PLAN VIEW
SCALE: N.T.S.
(B)

NORTH

GRAPHIC SCALE
50 0 25 50 100
(IN FEET)
1 inch = 50ft.



BENCHMARK ENGINEERING & LAND SURVEYING
9130 SOUTH STATE STREET SUITE # 100
SANDY, UTAH 84070 (801) 542-7192
www.benchmarkcivil.com

No.	DATE	DESCRIPTION
1	10/31/17	REVISED PER COUNTY COMMENTS

SCALE MEASURES 1-INCH ON FULL SIZE SHEETS
ADJUST ACCORDINGLY FOR REDUCED SIZE SHEETS

DRAWN BY	KWS
CHECKED BY	MCP
FIELD CREW	SURVEY
DATE	8/28/2017
DWG. FILE	1607138site

0 0.5 1

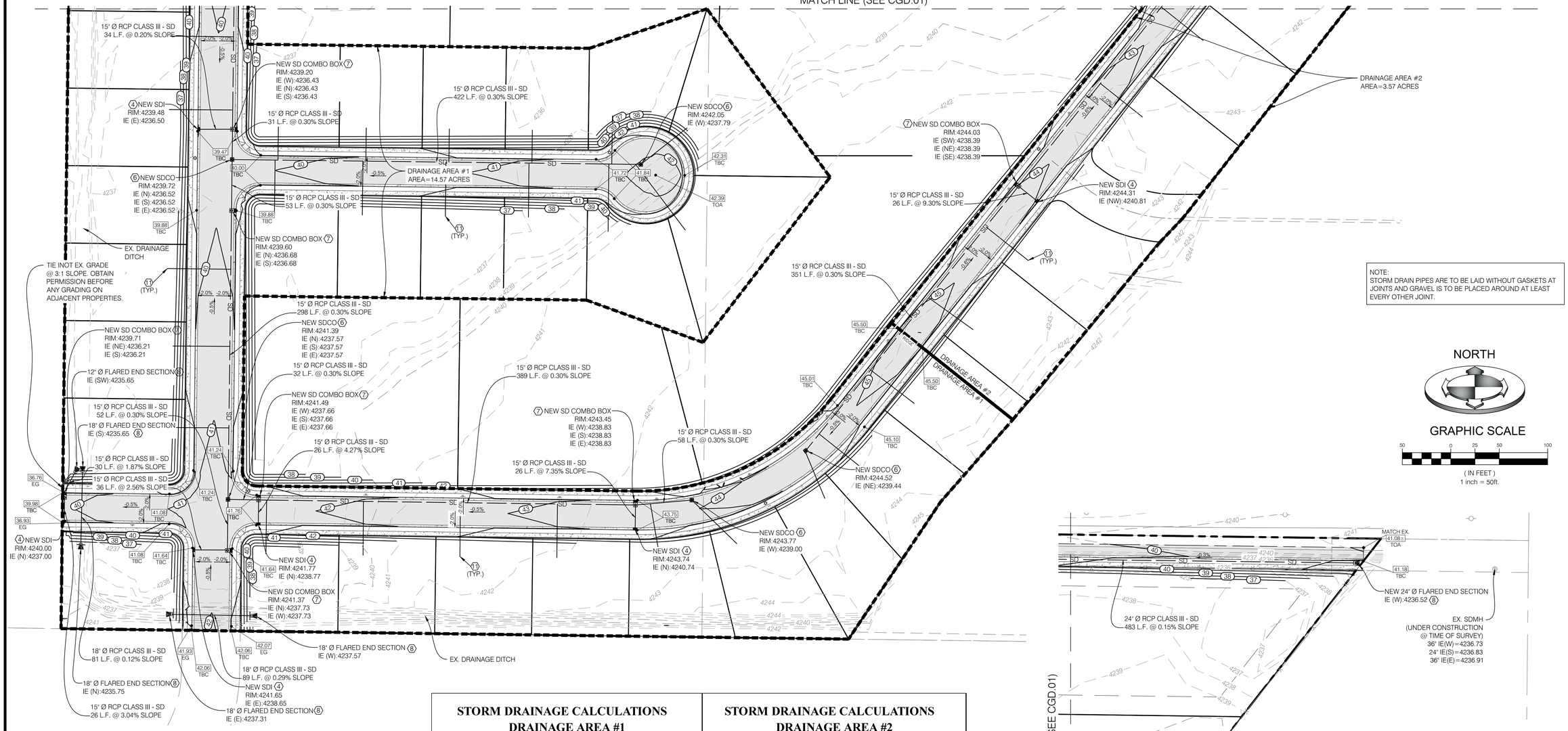
PROFESSIONAL ENGINEER
10/31/17
No. 10360773
M. CHRIS POULSEN
STATE OF UTAH

WINSTON PARK
3908 W 1800 S
WEBER COUNTY, UTAH

PROJECT NO. 1607138

GRADING & DRAINAGE PLAN

CGD.01
7 OF 24



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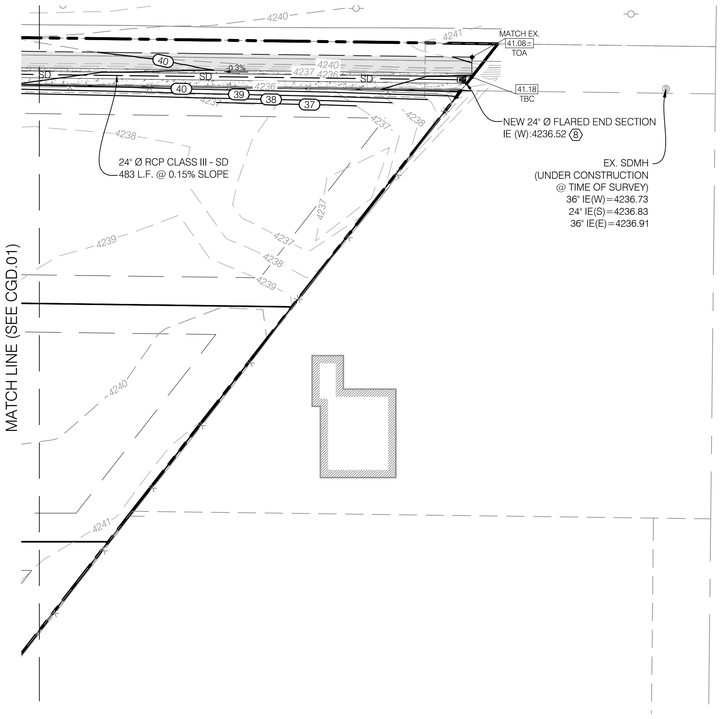

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DRAWN BY: KWS
CHECKED BY: MCP
FIELD CREW: SURVEY
DATE: 8/28/2017
DWG. FILE: 1607138site

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0 0.5 1

PROFESSIONAL ENGINEER
10/31/17
No. 10360773
M. CHRIS POULSEN
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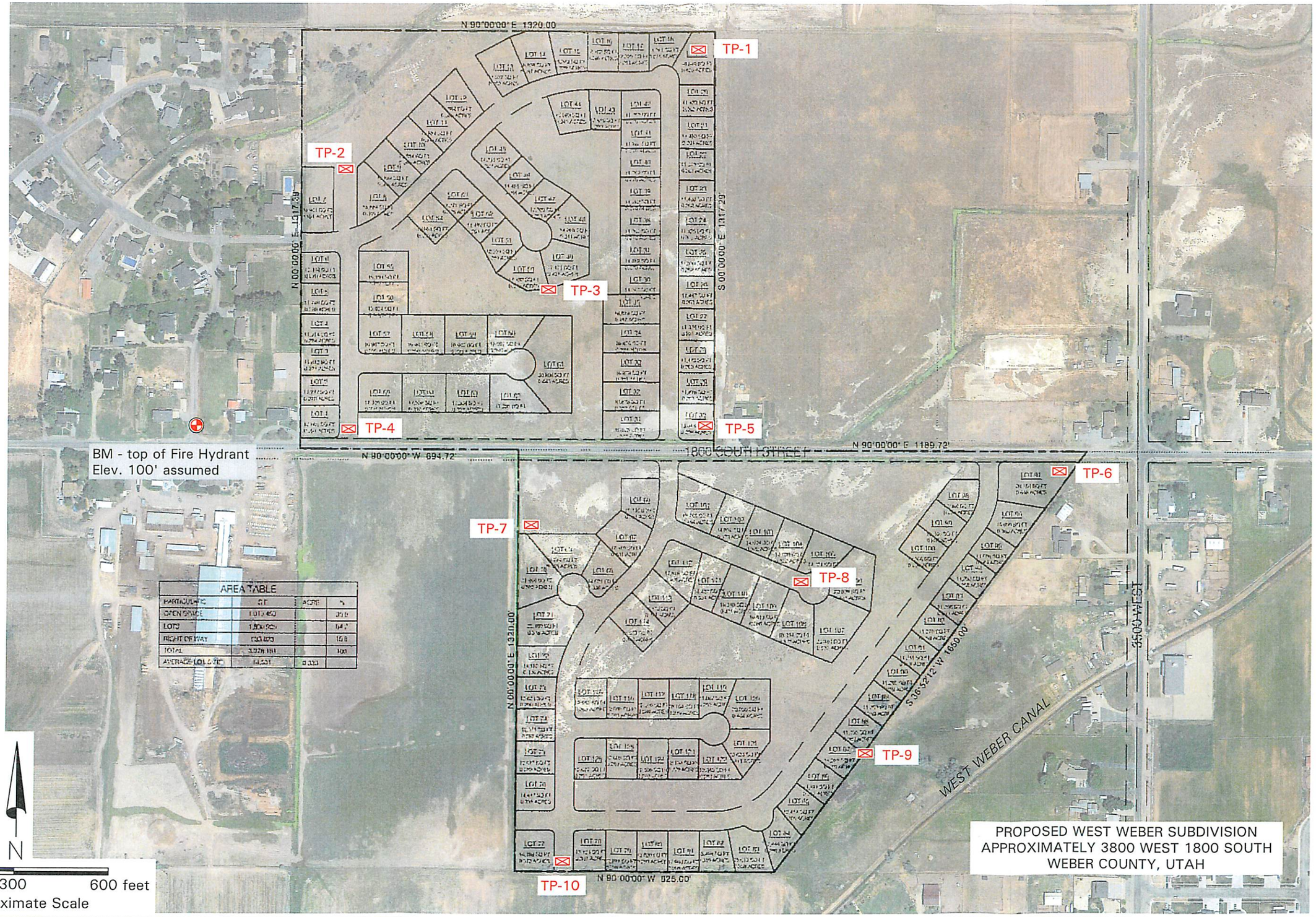
WINSTON PARK
3908 W 1800 S
WEBER COUNTY, UTAH

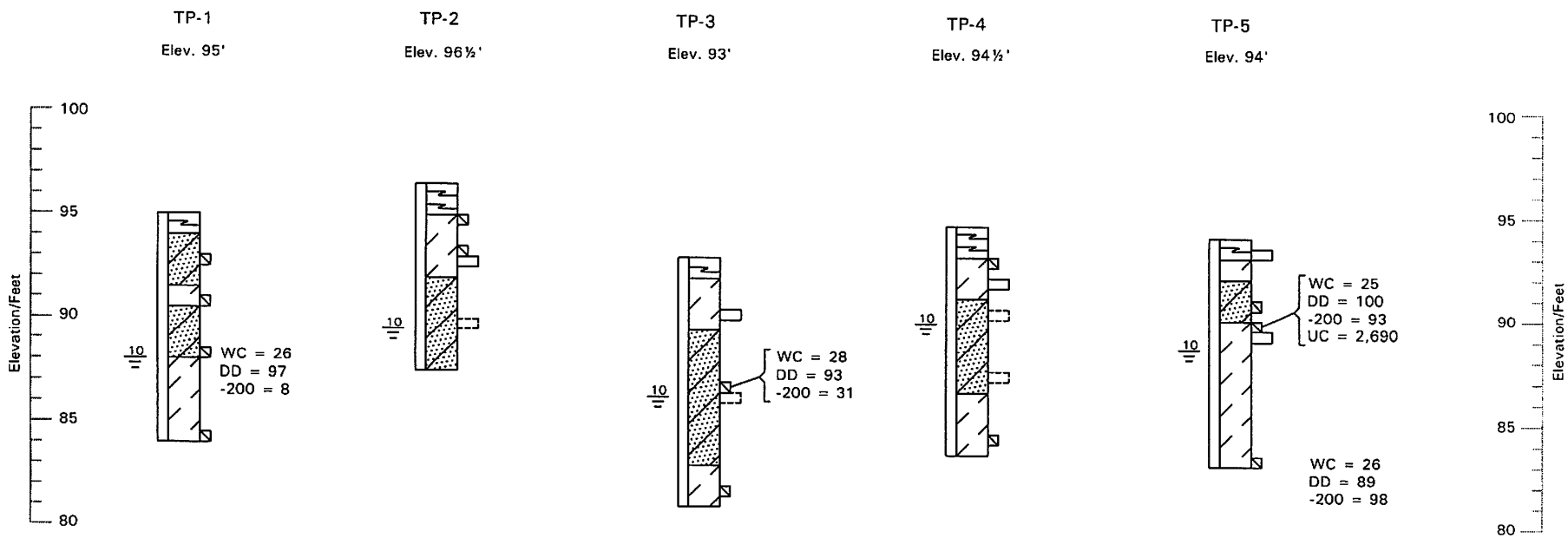
PROJECT NO. 1607138

GRADING & DRAINAGE PLAN

CGD.02
8 OF 24



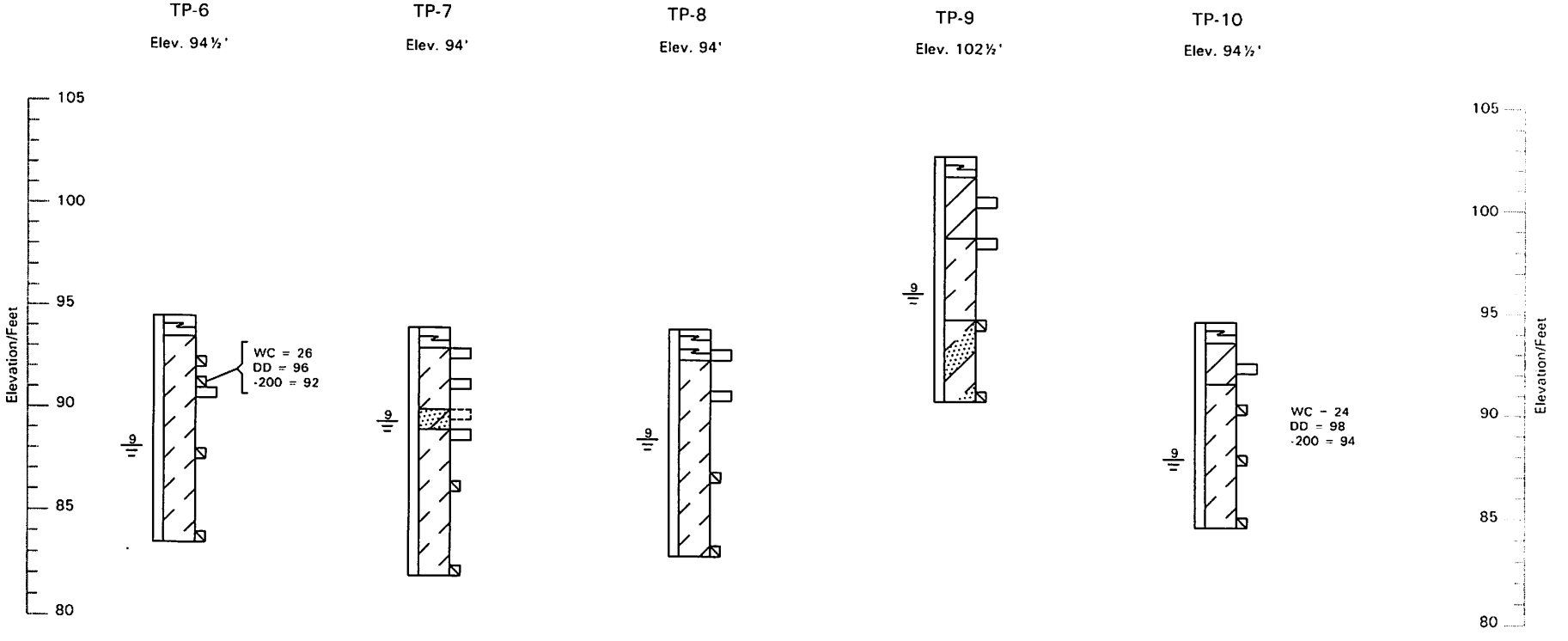
1160708	AGEC	Test Pit Locations	Figure 1



Approximate Vertical Scale 1" = 8'

See Figure 4 for Legend and Notes

1160708	AGEC	Test Pit Logs - North Parcel	Figure 2



Approximate Vertical Scale 1" = 8'

See Figure 4 for Legend and Notes

1160708	AGEC	Test Pit Logs - South Parcel	Figure 3

LEGEND:

Topsoil; lean clay to silty sand, slightly moist to moist, brown to gray, roots and organics.

Lean Clay (CL); small to moderate amounts of sand, soft to stiff, moist to wet, brown to gray.

Silt (ML); small amounts of sand, slightly porous, stiff, slightly moist, light brown to light gray.

Silty Sand (SM); small to moderate amounts of silt, occasional poorly-graded sand with silt, occasional thin lean clay layers, medium dense, moist to wet, brown.

Interlayered Lean Clay and Silty Sand (CL/SM); medium stiff/medium dense, wet, brown.

Poorly-graded Sand with Silt (SP-SM); medium dense, moist to wet, brown.

Indicates relatively undisturbed hand drive sample taken.

Indicates disturbed sample taken.

Indicates relatively undisturbed block sample taken.

Indicates slotted 1 ½ inch PVC pipe installed in the test pit to the depth shown.

Indicates the depth to free water and the number of days after excavation the measurement was taken.

NOTES:

1. The test pits were excavated on September 12 and 13, 2016 with a rubber-tired backhoe.
2. Locations of the test pits were measured approximately by pacing from features shown on the site plan provided.
3. Elevations of the test pits were measured by automatic level and refer to the bench mark shown on Figure 1.
4. The test pit locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between materials shown on the logs represent the approximate boundaries between material types and the transitions may be gradual.
6. Water level readings shown on the logs were made at the time and under the conditions indicated. Fluctuations in the water level will occur with time.
7. WC = Water Content (%);
   DD = Dry Density (pcf);
   -200 = Percent Passing the No. 200 Sieve;
   UC = Unconfined Compressive Strength (psf).

Map Scale: 1:3,340 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 45 90 180 270

Feet
0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Davis-Weber Area, Utah
Survey Area Data: Version 10, Sep 9, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

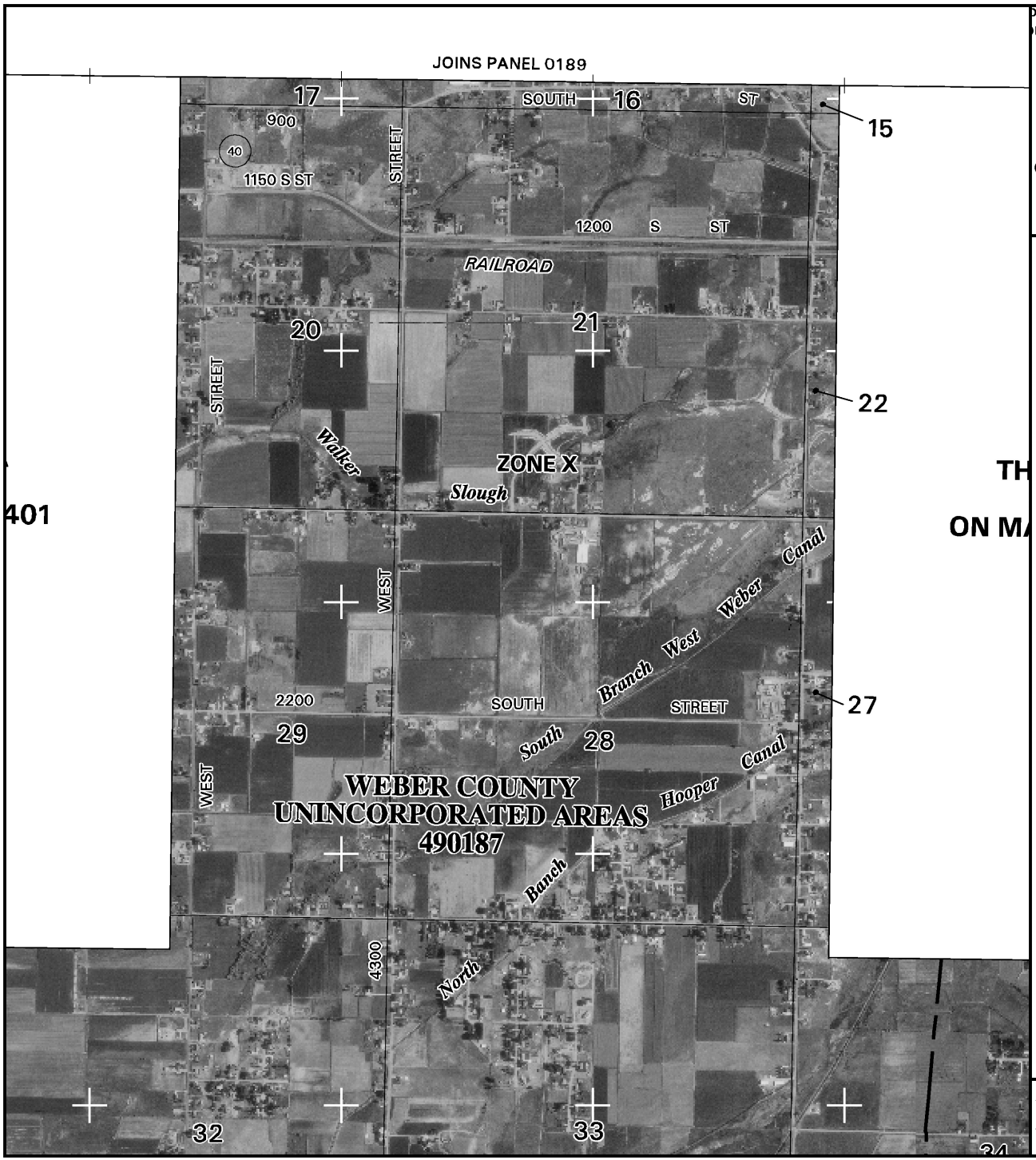
Date(s) aerial images were photographed: May 22, 2005—Nov 13, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Ac	Airport silt loam, 0 to 2 percent slopes	6.2	16.2%
LS	Leland-Saltair complex, 0 to 1 percent slopes	18.8	48.8%
WgA	Warm Springs fine sandy loam, saline, sodic, 0 to 1 percent slopes	13.5	35.0%
Totals for Area of Interest		**38.5**	**100.0%**

od insurance is available in this community, contact you
nal Flood Insurance Program at (800) 638-6620.



MAP SCALE 1" = 2000'

000 0 2000 4000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0425E

FIRM

FLOOD INSURANCE RATE MAP

WEBER COUNTY,
UTAH AND
INCORPORATED AREAS

PANEL 425 OF 600

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
WEBER COUNTY, UNINCORPORATED AREAS	490187	0425	E
WEST HAVEN, CITY OF	490249	0425	E
HOOPER, CITY OF	490256	0425	E
ROY, CITY OF	490223	0425	E
RIVERDALE, CITY OF	490190	0425	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
49057C0425E

EFFECTIVE DATE:
DECEMBER 16, 2005

Federal Emergency Management Agency