November 2024

Rule 34 Permit
Sand Dunes RF & Containments
Section 7, T24S, R31E, Eddy County

Volume 3 In-Ground Containment

- ***C-147 Form***
- ***Stamped Design Drawings, Avian Hazing System & Liner Equivalency Demonstration***
- ***Recently Approved Plans for Design/Construction, O&M, Closure***

View south (upstream) from center of mapped watercourse at the southern boundary of the area planned for conversion of fresh water frac ponds to Rule 34 containments. The existing fresh water ponds cover the mapped watercourse. Engineered stormwater diversion to prevent damage to the proposed containments is the integral element of a request in Volume 1.

Prepared for:
Vaughan Operating, LLC
Carlsbad, NM

Prepared by:

R.T. Hicks Consultants, Ltd.
901 Rio Grande NW F-142
Albuquerque, New Mexico

District I
1625 N. French Dr., Hobbs, NM 88240
District II
811 S. First St., Artesia, NM 88210
District III
1000 Rio Brazos Road, Aztec, NM 87410
District IV
1220 S. St. Francis Dr., Santa Fe, NM 87505

State of New Mexico
Energy Minerals and Natural Resources
Department
Oil Conservation Division
1220 South St. Francis Dr.
Santa Fe, NM 87505

Form C-147
Revised October 11, 2022

Recycling Facility and/or Recycling Containment

Type of Facility: ☒ Recycling Facility ☒ Recycling Containment*

Type of action: ☐ Permit ☒ Registration
☐ Modification ☐ Extension
☐ Closure ☐ Other (explain) _____

*** At the time C-147 is submitted to the division for a Recycling Containment, a copy shall be provided to the surface owner.**

Be advised that approval of this request does not relieve the operator of liability should operations result in pollution of surface water, ground water or the environment. Nor does approval relieve the operator of its responsibility to comply with any other applicable governmental authority's rules, regulations or ordinances.

1.

Operator: Vaughan Operating,LLC OGRID #: 330307

Address: 1409 Verdel Ave, Carlsbad, NM 88220

Facility or well name (include API# if associated with a well): Sand Dunes Recycling Facility & Containments

OCD Permit Number: 2RF-214 (For new facilities the permit number will be assigned by the district office)

U/L or Qtr/Qtr: B Section: 7 Township: 24S Range: 31E County: Eddy

Surface Owner: ☐ Federal ☐ State ☒ Private ☐ Tribal Trust or Indian Allotment

2.

☒ **Recycling Facility:**

Location of (if applicable): Latitude: 32.236247 Longitude: -103.814293

Proposed Use: ☒ Drilling* ☒ Completion* ☒ Production* ☒ Plugging *

The re-use of produced water may NOT be used until fresh water zones are cased and cemented

☐ Other, ***requires permit for other uses. Describe use, process, testing, volume of produced water and ensure there will be no adverse impact on groundwater or surface water.***

☒ Fluid Storage

☒ Above ground tanks ☒ Recycling containment ☐ Activity permitted under 19.15.17 NMAC explain type _____

☐ Activity permitted under 19.15.36 NMAC explain type: _____ ☐ Other explain _____

☐ For multiple or additional recycling containments, attach design and location information of each containment

☐ **Closure Report (required within 60 days of closure completion):** ☐ Recycling Facility Closure Completion Date: _____

3.

☒ **Recycling Containment: North and South In-ground Containments**

☐ Annual Extension after initial 5 years (attach summary of monthly leak detection inspections for previous year)

Center of Recycling Containment (if applicable) Latitude: 32.236247 Longitude: -103.814293

-103.814293 ☐ For multiple or additional recycling containments, attach design and location information of each containment

☒ Lined ☐ Liner type: Thickness 60 mil pri. and 40 mil sec. See Attached Engineer Drawings ☐ LLDPE ☒ HDPE ☐ PVC ☐ Other

☐ String-Reinforced

Liner Seams: ☒ Welded ☐ Factory ☐ Other Volume: North = 956,830 BBLs South = 60,071 BBLs Dimensions See Attached Plans .

☐ Recycling Containment Closure Completion Date: _____

4.

Bonding:

☐ Covered under bonding pursuant to 19.15.8 NMAC per 19.15.34.15(A)(2) NMAC **(These containments are limited to only the wells owned or operated by the owners of the containment.)**

☒ Bonding in accordance with 19.15.34.15(A)(1). Amount of bond $ See Estimate **(work on these facilities cannot commence until bonding amounts are approved)**

☒ Attach closure cost estimate and documentation on how the closure cost was calculated. See Vol 1 attached closure estimate

5.

Fencing:

☐ Four foot height, four strands of barbed wire evenly spaced between one and four feet

☒ Alternate. Please specify Fixed knot woven wire, 8-foot height North, 6-ft high South Containment

6.

Signs:

☒ 12"x 24", 2" lettering, providing Operator's name, site location, and emergency telephone numbers

☐ Signed in compliance with 19.15.16.8 NMAC

7.

Variances:

Justifications and/or demonstrations that the proposed variance will afford reasonable protection against contamination of fresh water, human health, and the environment.

Check the below box only if a variance is requested:

☐ Variance(s): Requests must be submitted to the appropriate division district for consideration of approval. If a Variance is requested, include the variance information on a separate page and attach it to the C-147 as part of the application.

If a Variance is requested, it must be approved prior to implementation.

8.

Siting Criteria for Recycling Containment

Instructions: The applicant must provide attachments that demonstrate compliance for each siting criteria below as part of the application. Potential examples of the siting attachment source material are provided below under each criteria.

General siting

Ground water is less than 50 feet below the bottom of the Recycling Containment. NM Office of the State Engineer - iWATERS database search; USGS; Data obtained from nearby wells	☐ Yes ☒ No ☐ NA
Within incorporated municipal boundaries or within a defined municipal fresh water well field covered under a municipal ordinance adopted pursuant to NMSA 1978, Section 3-27-3, as amended. - Written confirmation or verification from the municipality; written approval obtained from the municipality	☐ Yes ☒ No ☐ NA
Within the area overlying a subsurface mine. - Written confirmation or verification or map from the NM EMNRD-Mining and Minerals Division	☐ Yes ☒ No
Within an unstable area. - Engineering measures incorporated into the design; NM Bureau of Geology & Mineral Resources; USGS; NM Geological Society; topographic map	☐ Yes ☒ No
Within a 100-year floodplain. FEMA map	☐ Yes ☒ No
Within 300 feet of a continuously flowing watercourse, or 200 feet of any other significant watercourse, or lakebed, sinkhole, or playa lake (measured from the ordinary high-water mark). - Topographic map; visual inspection (certification) of the proposed site	☐ Yes ☒ No
Within 1000 feet from a permanent residence, school, hospital, institution, or church in existence at the time of initial application. - Visual inspection (certification) of the proposed site; aerial photo; satellite image	☐ Yes ☒ No
Within 500 horizontal feet of a spring or a fresh water well used for domestic or stock watering purposes, in existence at the time of initial application. - NM Office of the State Engineer - iWATERS database search; visual inspection (certification) of the proposed site	☐ Yes ☒ No
Within 500 feet of a wetland. - US Fish and Wildlife Wetland Identification map; topographic map; visual inspection (certification) of the proposed site	☐ Yes ☒ No

9.
Recycling Facility and/or Containment Checklist:
Instructions: Each of the following items must be attached to the application. Indicate, by a check mark in the box, that the documents are attached.

- ☒ Design Plan - based upon the appropriate requirements.
- ☒ Operating and Maintenance Plan - based upon the appropriate requirements.
- ☒ Closure Plan - based upon the appropriate requirements.
- ☒ Site Specific Groundwater Data -
- ☒ Siting Criteria Compliance Demonstrations –
- ☒ **Certify that notice of the C-147 (only) has been sent to the surface owner(s)**

10.
Operator Application Certification:
I hereby certify that the information and attachments submitted with this application are true, accurate and complete to the best of my knowledge and belief.

Name (Print): Steven McCutcheon Title: Managing Partner

Signature: Date: 11/26/24

e-mail address: stevenm@mhatllc.com Telephone: 575 689-8620

11.
OCD Representative Signature: Victoria Venegas **Approval Date:** 12/16/2024

Title: Environmental Specialist **OCD Permit Number:** 2RF-214

- [x] OCD Conditions
- [x] Additional OCD Conditions on Attachment

RECYCLING CONTAINMENT DESIGN DRAWINGS

AVIAN DETERRENT SYSTEM

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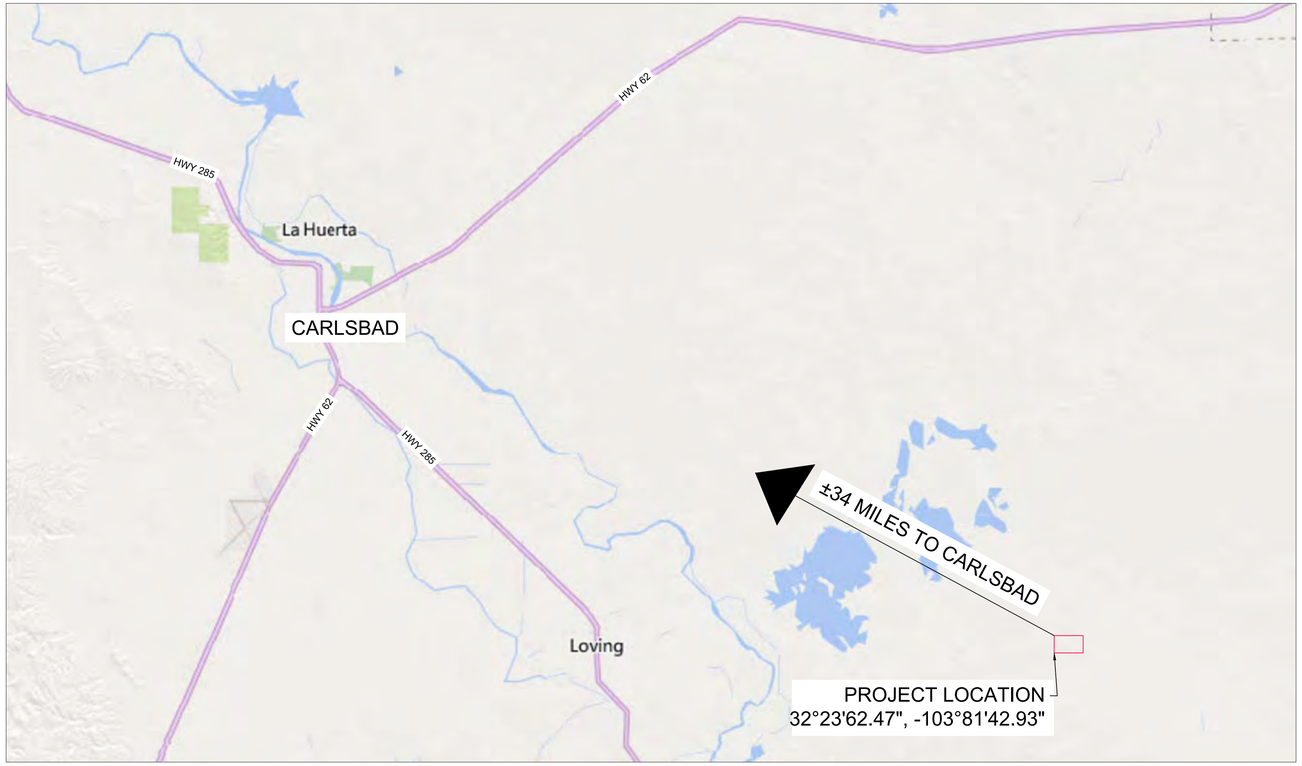
Hobbs, NM 88242
Squarerootservices.net
575-231-7347

CIVIL PLANS

VAUGHAN OPERATING

SAND DUNES

CITY OF CARLSBAD
SECTION 7, TOWNSHIP 24 SOUTH, RANGE 31 EAST
N.M.P.M., EDDY COUNTY, NEW MEXICO



INDEX OF SHEETS		
SHEET	NAME	DESCRIPTION
1	C-100	COVER SHEET
2	SU-101	TOPOGRAPHIC MAP
3	C-101	GENERAL NOTES
4	CS-101	CIVIL SITE PLAN
5	CS-102	NORTH-SOUTH & EAST-WEST CONTAINMENT PROFILES
6	CS-301	DIVERSION DITCH PLAN AND PROFILE STA:0+00 TO STA:9+00
7	CS-302	DIVERSION DITCH PLAN AND PROFILE STA:9+00 TO STA:17+22
8	CS-501	LEAK DETECTION DETAILS
9	CS-502	LINER DETAILS
10	CS-503	FENCE DETAILS
11	CS-504	DIVERSION DITCH DETAIL

EDDY COUNTY
NEW MEXICO

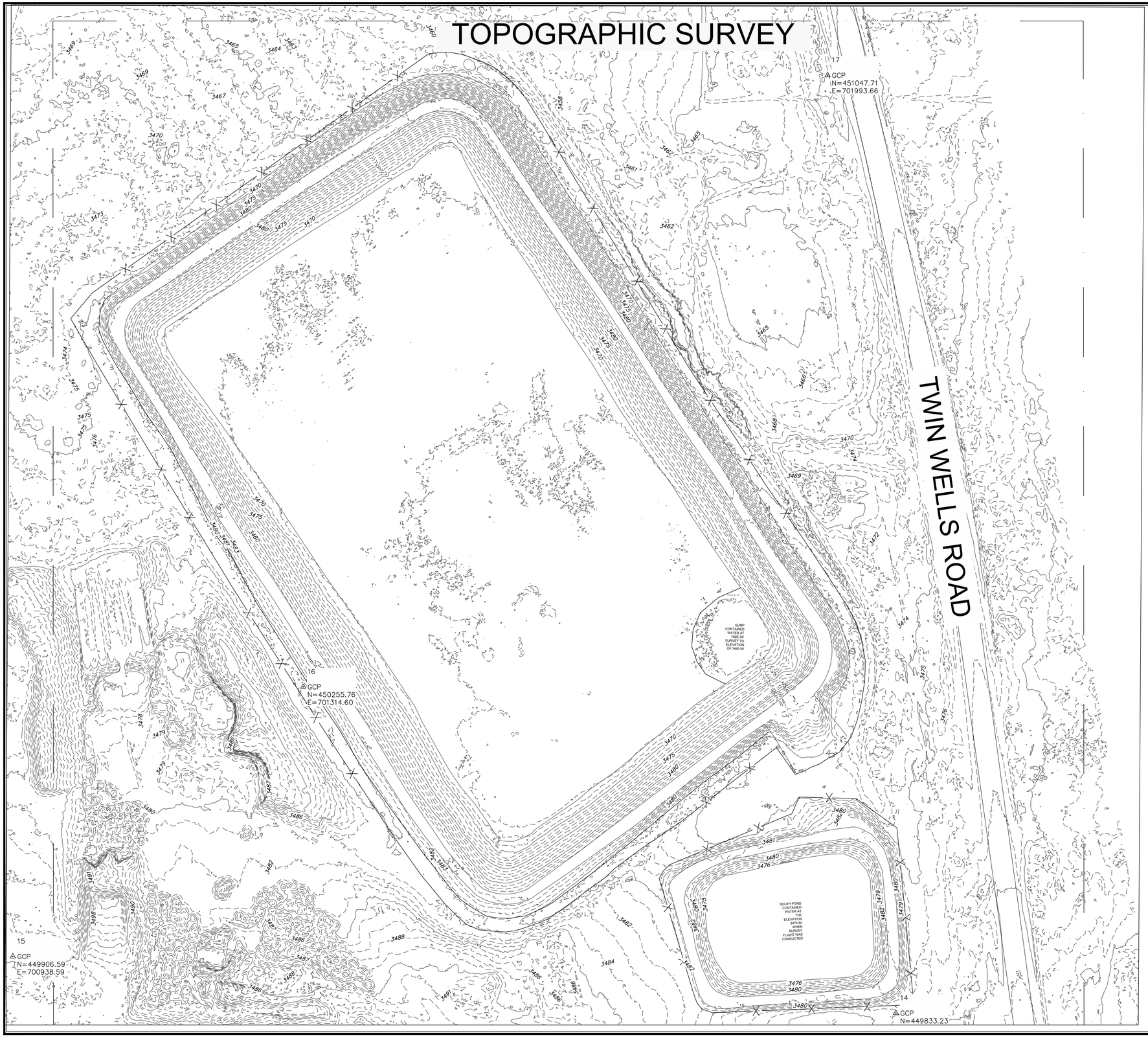
(505)-254-7310

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

JEREMY BAKER
NEW MEXICO
16207
LICENSED PROFESSIONAL ENGINEER

11/05/2024

TOPOGRAPHIC SURVEY



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Hobbs, NM 88242-9032
Squarerootservices.net
575-231-7347

TYPE OF SURVEY:

TOPOGRAPHIC SURVEY

OF

PROJECT NAME:

SAND DUNES

FOR

CLIENT:

Cascade

PROJECT NUMBER:

24198

PROJECT SURVEYOR:

Jeremy Baker, PS

DRAWN BY:

XAVIER CLARK

GRAPHIC SCALE

0 60' 120'

SCALE: 1" = 60'
(IN FEET)

LEGEND

- MAJOR CONTOUR LINE 5FT INTERVAL
- MINOR CONTOUR LINE 1FT INTERVAL
- FENCE
- BOUNDARY LINE

I, JEREMY BAKER, NEW MEXICO PROFESSIONAL SURVEYOR NO. 25773, DO HEREBY CERTIFY THAT THIS TOPOGRAPHIC SURVEY PLAT AND THE ACTUAL SURVEY ON THE GROUND UPON WHICH IT IS BASED WERE PERFORMED BY ME OR UNDER MY DIRECT SUPERVISION; THAT I AM RESPONSIBLE FOR THIS SURVEY; THAT THIS SURVEY MEETS THE MINIMUM STANDARDS FOR SURVEYING IN NEW MEXICO; AND THAT IT IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF. I FURTHER CERTIFY THAT THIS SURVEY IS NOT A LAND DIVISION OR SUBDIVISION AS DEFINED IN THE NEW MEXICO SUBDIVISION ACT AND THAT THIS INSTRUMENT IS A BOUNDARY SURVEY PLAT OF AN EXISTING TRACT OR TRACTS.

Jeremy Baker, N.M.P.S. 25773 — 11/05/2024 Date

JEREMY E. BAKER NEW MEXICO 25773 PROFESSIONAL SURVEYOR

TOPOGRAPHIC NOTE

THE TOPOGRAPHY SHOWN HEREIN IS A COMBINATION OF UAV DATA AND CONVENTIONAL/GPS DATA. THE UAV DATA WAS GENERATED USING INDUSTRY STANDARD QUALITY CHECKS AND IS **WITHIN** THE INDUSTRY RECOGNIZED GROUND SAMPLING DISTANCE (GSD) STANDARD OF BELOW 2.5 CM (1 IN / 0.08 FT). THE ABSOLUTE ACCURACY LEVEL IN STANDARD UAV DATA IS EQUAL TO 3 X GSD (3 X 0.08 FT = 0.24 FT). UAV DATA WAS USED FOR MEASUREMENTS ON NATURAL GROUND AND SUPPLEMENTAL FEATURES.

SHEET: 2 of 11

SU - 101

GENERAL NOTES

1. NEW MEXICO ADMINISTRATIVE CODE TITLE 19, CHAPTER 15, PART 34, DESIGN CRITERIA FOR RECYCLING CONTAINMENTS SHALL APPLY TO THIS PROJECT.
2. ALL BOUNDARY, TOPOGRAPHIC AND UTILITY INFORMATION SHOWN ARE BASED ON SURVEY INFORMATION FURNISHED BY TOPOGRAPHIC.
3. THE CONTRACTOR SHALL IDENTIFY AND LOCATE UTILITY LINES, MONITORING WELLS, SURVEY MONUMENTS, AND OTHER NEARBY STRUCTURES PRIOR TO PERFORMING WORK.
4. COORDINATE INFORMATION IS BASED ON STATE PLANE COORDINATES, NEW MEXICO EAST, NAD 83.
5. THE CONTRACTOR SHALL IDENTIFY ANY DISCREPANCIES PRIOR TO PROCEEDING WITH CONSTRUCTION AND CONTACT THE ENGINEER IN WRITING.
6. THE CONTRACTOR SHALL IMPLEMENT AND MAINTAIN BEST MANAGEMENT PRACTICES (BMPS) TO MINIMIZE EROSION AND CONTROL SEDIMENT TO PROTECT SURFACE WATER QUALITY DURING STORM EVENTS.

EARTHWORK NOTES

1. THE CONTRACTOR SHALL USE WATER FOR COMPACTION AT ALL TIMES. THE CONTRACTOR SHALL ENSURE THEIR BID INCLUDES CONSTRUCTION WATER. NO EARTHWORK OPERATIONS SHALL TAKE PLACE IF CONSTRUCTION WATER IS NOT AVAILABLE ONSITE.
2. THE CONTRACTOR SHALL BUILD THE LEVEES USING COMPACTED LAYERS. UNCONTROLLED AND INCONSISTENT PUSHING AND PILING OF MATERIAL FOR LEVEE CONSTRUCTION IS NOT ACCEPTABLE. THE CONTRACTOR SHALL DEVELOP A SUCCESSFUL COMPACTION PATTERN EARLY IN THE PROCESS, VERIFIED THROUGH NUCLEAR DENSITY OR SAND CONE TESTING, AND SHALL MAINTAIN CONSISTENCY IN THE COMPACTIVE EFFORT AS LONG AS THE MATERIALS ENCOUNTERED REMAINS CONSISTENT. IF ONSITE SOILS ENCOUNTERED CHANGE, THE CONTRACTOR SHALL DEVELOP A NEW COMPACTION PATTERN.
3. FILL FOR LEVEES SHALL BE PLACED AND COMPACTED IN HORIZONTAL LIFTS WITH MAXIMUM LOOSE LIFT THICKNESS OF 10 INCHES, OR AS DIRECTED BY ENGINEER. CONSTRUCT EACH LAYER CONTINUOUSLY AND APPROXIMATELY HORIZONTAL FOR THE WIDTH AND LENGTH OF THE LEVEE. FILL SHALL BE COMPACTED TO AT LEAST 95 PERCENT OF MAXIMUM DRY DENSITY DETERMINED BY THE ASTM D698 AND AT MOISTURE CONTENT WITHIN +2% TO -2% OF OPTIMUM MOISTURE CONTENT AS DETERMINED BY A STANDARD PROCTOR SOILS TEST ON SAMPLES FROM THE SOURCE AREA.
4. FILL SHALL NOT BE PLACED AND COMPACTED WHEN THE MATERIALS ARE TOO WET TO PROPERLY COMPACT. MATERIAL WHICH IS TOO WET SHALL BE SPREAD ON THE FILL AREA AND PERMITTED TO DRY, ASSISTED BY HARROWING IF NECESSARY, UNTIL THE MOISTURE CONTENT IS REDUCED TO ALLOWABLE LIMITS. IF THE ENGINEER DETERMINED THAT ADDED MOISTURE IS REQUIRED, WATER SHALL BE APPLIED UNIFORMLY OVER THE AREA TO BE TREATED, AND GIVE COMPLETE AND ACCURATE CONTROL OF THE AMOUNT OF WATER TO BE USED. IF TOO MUCH WATER IS ADDED, THAT AREA SHALL BE PERMITTED TO DRY BEFORE COMPACTION IS CONTINUED.
5. PERFORM ONE NUCLEAR DENSITY GAGE TEST PER 2500 CY MINIMUM OR AS DIRECTED BY THE ENGINEER.
6. EARTHWORK CONTRACTOR SHALL PERFORM A VISUAL INSPECTION OF THE FINISHED COMPACTED POND BOTTOM AND SIDE SLOPES BEFORE HDPE LINER INSTALLATION, REMOVING ALL DEBRIS, SHARP OBJECTS AND GRAVEL LARGER THAN 3/4 INCH.
7. EARTHWORK CONTRACTOR SHALL ROLL SURFACE WITH A SMOOTH ROLLER TO ELIMINATE RUTS.

LINER NOTES

1. LINER CONTRACTOR SHALL INSPECT GRADED SURFACE FOR DEBRIS, ROCKS OR OTHER MATERIAL THAT MAY DAMAGE THE LINER AND COORDINATE WITH OWNER IF ADDITIONAL SUBGRADE RESURFACING IS NEEDED PRIOR TO PERFORMING WORK.
2. LINER CONTRACTOR TO PROVIDE SUBMITTAL OF LINER PANEL LAYOUT.
3. LINER CONTRACTOR TO SIGN SUBGRADE ACCEPTANCE FORM (PROVIDED BY OWNER REPRESENTATIVE) DAILY PRIOR TO INSTALLATION.
4. LINER TO BE INSTALLED PER GRI SPECIFICATIONS, GUIDES AND PRACTICES.
5. CONTRACTOR SHALL PLACE SANDBAGS ON LINER DURING INSTALLATION AS REQUIRED TO PREVENT WIND UPLIFT UNTIL POND IS FILLED TO A DEPTH OF 3 FEET.
6. CONTRACTOR SHALL USE BLACK 60 MIL HDPE SMOOTH GEOMEMBRANE AS THE PRIMARY LINER AND BLACK 40 MIL HDPE SMOOTH GEOMEMBRANE AS THE SECONDARY LINER.
7. A 3' DIAMETER MINIMUM PIECE OF 40MIL LINER SHALL BE EXTRUDED WELDED WHERE THE PIE SHAPED CORNER SECTIONS MEET FOR SEAM REINFORCEMENT.
8. INSTALL A FULL DOUBLE WIDTH SECTION OF BLACK OR WHITE 60 MIL TEXTURED HDPE GEOMEMBRANE RUB SHEET. EXTRUDE WELD TO LINER. WELDS SHALL BE 2" LONG AND SPACED EVERY 12" ALONG BOTH SIDES OF THE SHEET. DO NOT WELD END EDGES. SECTION SHALL EXTEND FROM SUMP AND INSTALLED INTO LINER ANCHOR TRENCH AS SHOWN.
9. LINER SHALL BE PROTECTED WITH A 8 OZ. NONWOVEN GEOTEXTILE IF ROCK OR OTHER ANGULAR MATERIALS WITH A DIMENSION GREATER THAN 3/4 INCH ARE PRESENT.
10. SUMPS SHALL BE BACKFILLED WITH NON-ANGULAR MAXIMUM 3/8 INCH SIZED PEA GRAVEL.
11. ALL SEAMS MUST BE WELDED WITH A 6" MINIMUM OVERLAP.
12. CONTRACTOR SHALL NON-DESTRUCTIVELY TEST ALL SEAMS THEIR FULL LENGTH USING AN AIR PRESSURE OR VACUUM TEST, THE PURPOSE OF THIS TEST IS TO CHECK THE CONTINUITY OF THE SEAM.
13. FOR AIR PRESSURE TESTING (ASTM 5820), THE FOLLOWING PROCEDURES ARE APPLICABLE TO THE SEAMS WELD WITH DOUBLE SEAM FUSION WELDER.
    a. THE EQUIPMENT USED SHALL CONSIST OF AN AIR TANK OR PUMP CAPABLE OF PRODUCING A MINIMUM 35 PSI AND A SHARP NEEDLE WITH A PRESSURE GAUGE ATTACHED TO INSERT INTO THE AIR CHAMBER.
    b. SEAL BOTH ENDS OF THE SEAM BY HEATING AND SQUEEZING THEM TOGETHER. INSERT THE NEEDLE WITH THE GAUGE INTO THE AIR CHANNEL. PRESSURIZE THE AIR CHANNEL TO A MINIMUM OF 35 PSI. NOTE TIME STARTS AND WAIT A MINIMUM OF 5 MINUTES TO CHECK. IF PRESSURE AFTER 5 MINUTES HAD DROPPED LESS THAN 2 PSI THE TEST IS SUCCESSFUL (THICKNESS OF MATERIAL MAY CAUSE VARIANCE).
    c. CUT OPPOSITE SEAM END AND LISTEN FOR PRESSURE RELEASE TO VERIFY FULL SEAM HAS BEEN TESTED.
    d. IF THE TEST FAILS, FOLLOW THESE PROCEDURES.
        I. WHILE CHANNEL IS UNDER PRESSURE WALK THE LENGTH OF THE SEAM LISTENING FOR A LEAK.
        II. WHILE CHANNEL IS UNDER PRESSURE APPLY A SOAPY SOLUTION TO THE SEAM EDGE AND LOOK FOR BUBBLES FORMED BY AIR ESCAPING.
        III. RE-TEST THE SEAM IN SMALLER INCREMENTS UNTIL THE LEAK IS FOUND.
    e. ONCE LEAK IS FOUND USING ONE OF THE PROCEDURES ABOVE, CUT OUT THE AREA AND RETEST THE PORTIONS OF THE PORTIONS OF THE SEAMS BETWEEN THE LEAK AREAS PER 6A AND 6B ABOVE. CONTINUE THIS PROCEDURE UNTIL ALL SECTIONS OF THE SEAM PASS THE PRESSURE TEST.
    f. REPAIR THE LEAK WITH A PATCH AND VACUUM TEST.
14. ALL NON-DESTRUCTIVE TESTS WILL BE NOTED IN THE NON-DESTRUCTIVE LOGS.
15. LINER GAS VENTS SHALL BE SPACED ALONG THE INSIDE SLOPE AT APPROXIMATELY 100 FEET ON CENTER OR MINIMUM 2 VENTS PER SIDE.
16. WHEN ANY PIPING EQUIPMENT, INLET, OR OUTLET IS IN DIRECT CONTACT WITH THE LINER, AN APRON CONSISTING OF 60 MIL HDPE MATERIAL SHALL BE INSTALLED BENEATH THE EQUIPMENT OR STRUCTURE TO PROTECT THE PRIMARY LINER.
17. LAY BOTH LINERS IN ANCHOR TRENCH. BACKFILL ANCHOR TRENCH IN 2 LIFTS AND COMPACT.

SUGGESTED CONSTRUCTION SEQUENCE

1. CLEAR EXISTING VEGETATION.

2. STRIP AND STOCKPILE TOPSOIL AT THE LOCATION DESIGNATED ON THESE PLANS.

3. PERFORM EARTHWORK OPERATIONS:
    3.1. CONSTRUCT STORMWATER DIVERSION CHANNEL.
    3.2. PERFORM RIPPING/EXCAVATING OPERATIONS.
    3.3. REPLACE EXCAVATED MATERIAL IN COMPACTED LAYERS ON THE LEVEE/PAD IN ACCORDANCE WITH THE DETAILS AND SPECIFICATIONS.
    3.4. FINISH SLOPES USING A SMOOTH ROLLER.
    3.5. DIG ANCHOR TRENCH.

4. INSTALL NEW GAME FENCE AND GATES.

5. INSTALL GEOMEMBRANES:
    5.1. INSTALL GEOTEXTILE AS NEEDED, SECONDARY LINER, GEONET, LEAK DETECTION SYSTEM AND PRIMARY LINER.
    5.2. INSTALL RUB SHEETS AND WATER LEVEL GAGE/LADDER.
    5.3. BACKFILL AND COMPACT ANCHOR TRENCH.

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ENGINEERING SHEET:
GENERAL NOTES
OF
PROJECT NAME:
SAND DUNES
FOR
CLIENT:
VAUGHN OPERATING

PROJECT NUMBER:
24198

PROJECT ENGINEER:
JEREMY BAKER, PE
DRAWN BY:
XAVIER CLARK

REVISIONS

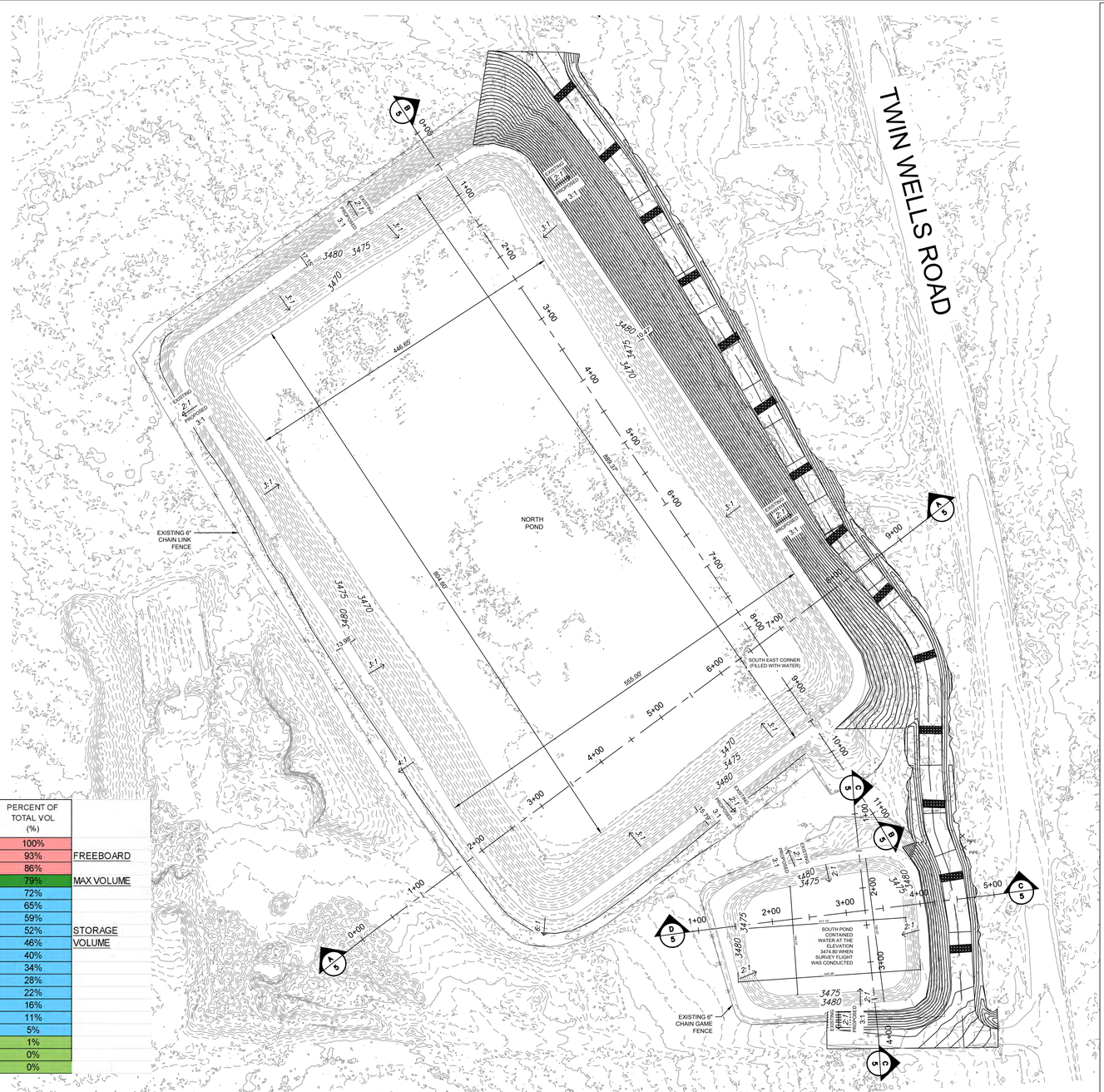
No.	DATE	DESCRIPTION

JEREMY BAKER
NEW MEXICO
16207
LICENSED PROFESSIONAL ENGINEER

11/05/2024

SHEET: 3 of 11

C-102



LARGE POND VOLUME

ELEVATION (FT)	CONTAINMENT DEPTH (FT)	REMAINING STORAGE (FT)	REMAINING STORAGE VOL (FT3)	REMAINING STORAGE VOL (GAL)	REMAINING STORAGE VOL (BBL)	PERCENT OF TOTAL VOL (%)	VOL IN CONTAINMENT (FT3)	VOL IN CONTAINMENT (GAL)	VOL IN CONTAINMENT (BBL)	VOL IN CONTAINMENT (AC-FT)	PERCENT OF TOTAL VOL (%)	
3,483.20	0	18	0	-	-	0%	6,805,341	50,910,757	1,211,993	156.23	100%	
3,482.20	1	17	485,142	3,629,349	86,401	7%	6,320,199	47,281,408	1,125,592	145.09	93%	FREEBOARD
3,481.20	2	16	962,565	7,200,950	171,427	14%	5,842,776	43,709,807	1,040,566	134.13	86%	
3,480.20	3	15	1,432,743	10,718,353	255,164	21%	5,372,598	40,192,403	956,830	123.34	79%	MAX VOLUME
3,479.20	4	14	1,895,432	14,179,728	337,566	28%	4,909,909	36,731,029	874,427	112.72	72%	
3,478.20	5	13	2,350,632	17,585,077	418,634	35%	4,454,709	33,325,680	793,359	102.27	65%	
3,477.20	6	12	2,797,918	20,931,224	498,293	41%	4,007,423	29,979,533	713,700	92.00	59%	
3,476.20	7	11	3,236,422	24,211,673	576,389	48%	3,568,919	26,699,084	635,604	81.93	52%	STORAGE
3,475.20	8	10	3,666,688	27,430,493	653,017	54%	3,138,653	23,480,264	558,977	72.05	46%	VOLUME
3,474.20	9	9	4,088,896	30,589,028	728,209	60%	2,716,445	20,321,728	483,784	62.36	40%	
3,473.20	10	8	4,503,188	33,688,347	801,992	66%	2,302,153	17,222,409	410,001	52.85	34%	
3,472.20	11	7	4,909,452	36,727,609	874,346	72%	1,895,889	14,183,147	337,647	43.52	28%	
3,471.20	12	6	5,307,198	39,703,150	945,182	78%	1,498,143	11,207,606	266,811	34.39	22%	
3,470.20	13	5	5,695,621	42,608,937	1,014,358	84%	1,109,721	8,301,819	197,635	25.48	16%	
3,469.20	14	4	6,074,389	45,442,504	1,081,815	89%	730,952	5,468,253	130,178	16.78	11%	
3,468.20	15	3	6,439,012	48,170,248	1,146,752	95%	366,329	2,740,509	65,241	8.41	5%	
3,467.20	16	2	6,712,478	50,216,045	1,195,455	99%	92,864	694,712	16,538	2.13	1%	
3,466.20	17.00	1.00	6,800,573	50,875,090	1,211,144	100%	4,768	35,667	849	0.11	0%	
3,465.20	18	0	6,805,341	50,910,757	1,211,993	100%	438	3,280	78	0.01	0%	

SMALL POND VOLUME

ELEVATION (FT)	CONTAINMENT DEPTH (FT)	REMAINING STORAGE (FT)	REMAINING STORAGE VOL (FT3)	REMAINING STORAGE VOL (GAL)	REMAINING STORAGE VOL (BBL)	PERCENT OF TOTAL VOL (%)	VOL IN CONTAINMENT (FT3)	VOL IN CONTAINMENT (GAL)	VOL IN CONTAINMENT (BBL)	VOL IN CONTAINMENT (AC-FT)	PERCENT OF TOTAL VOL (%)	
3,482.70	0	22	0	-	-	0%	462,800	3,462,207	82,422	10.62	100%	
3,481.70	1	21	44,237	330,940	7,878	10%	418,563	3,131,267	74,544	9.61	90%	FREEBOARD
3,480.70	2	20	85,649	640,743	15,254	19%	377,151	2,821,463	67,168	8.66	81%	
3,479.70	3	19	125,500	938,864	22,351	27%	337,300	2,523,343	60,071	7.74	73%	MAX VOLUME
3,478.70	4	18	163,754	1,225,045	29,164	35%	299,046	2,237,162	53,258	6.87	65%	
3,477.70	5	17	200,378	1,499,024	35,686	43%	262,422	1,963,182	46,736	6.02	57%	
3,476.70	6	16	235,321	1,760,440	41,909	51%	227,479	1,701,767	40,513	5.22	49%	
3,475.70	7	15	268,577	2,009,223	47,832	58%	194,223	1,452,983	34,590	4.46	42%	STORAGE
3,474.70	8	14	300,155	2,245,457	53,456	65%	162,645	1,216,749	28,966	3.73	35%	VOLUME

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ENGINEERING SHEET:

CIVIL SITE PLAN

OF

PROJECT NAME:

SAND DUNES

FOR

CLIENT:

VAUGHN OPERATING

PROJECT NUMBER:
24198

PROJECT ENGINEER: JEREMY BAKER, PE

DRAWN BY: XAVIER CLARK

GRAPHIC SCALE

0 80' 160'

SCALE: 1" = 80'
(IN FEET)

REVISIONS

No.	DATE	DESCRIPTION

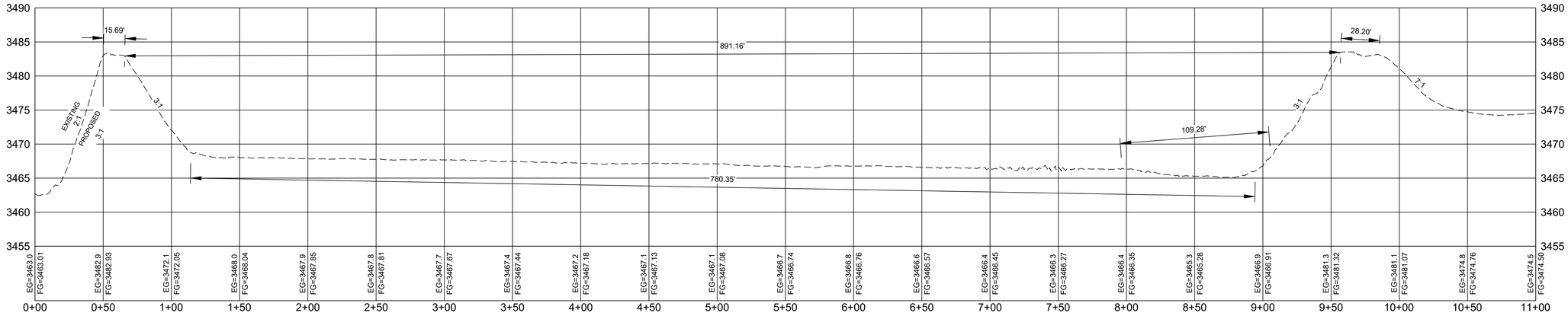
JEREMY BAKER NEW MEXICO 16207 LICENSED PROFESSIONAL ENGINEER

11/05/2024

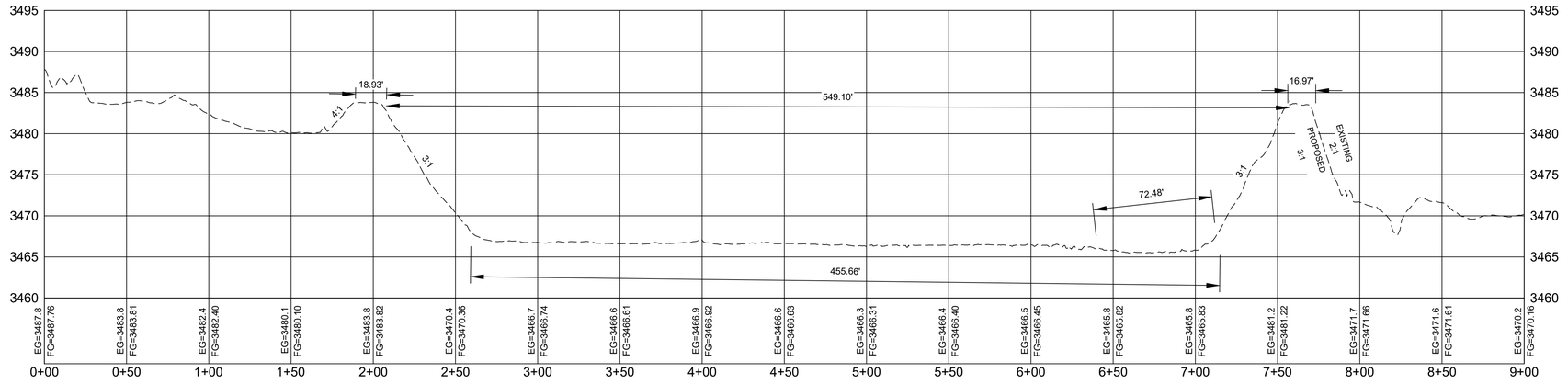
SHEET: 4 of 11

CS-102

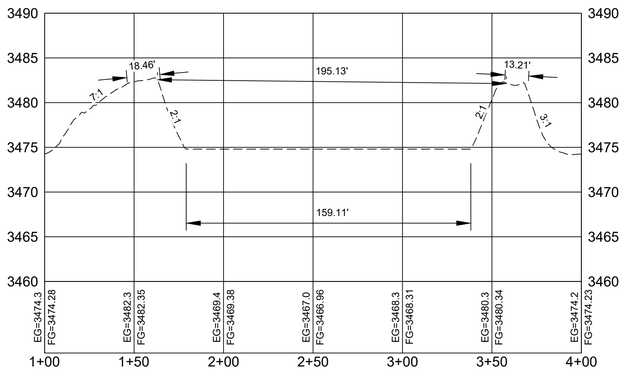
NORTH TO SOUTH ALIGNMENT B



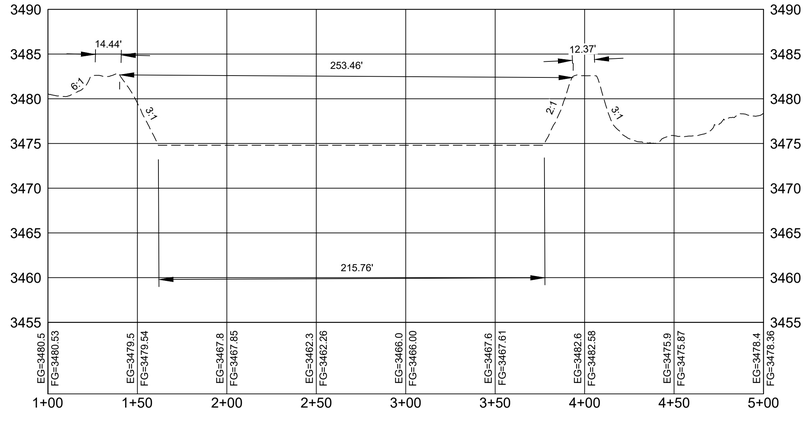
EAST TO WEST ALIGNMENT A



NORTH TO SOUTH ALIGNMENT C



EAST TO WEST ALIGNMENT D



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ENGINEERING SHEET:
NORTH-SOUTH & EAST-WEST CONTAINMENT PROFILES
OF
PROJECT NAME:

SAND DUNES

FOR
CLIENT:

VAUGHN OPERATING

PROJECT NUMBER:
24198

PROJECT ENGINEER:
JEREMY BAKER, PE
DRAWN BY:
XAVIER CLARK

GRAPHIC SCALE
HORIZONTAL
0 40' 80'
SCALE: 1" = 40'
(IN FEET)

GRAPHIC SCALE
VERTICAL
0 8' 16'
SCALE: 1" = 8'
(IN FEET)

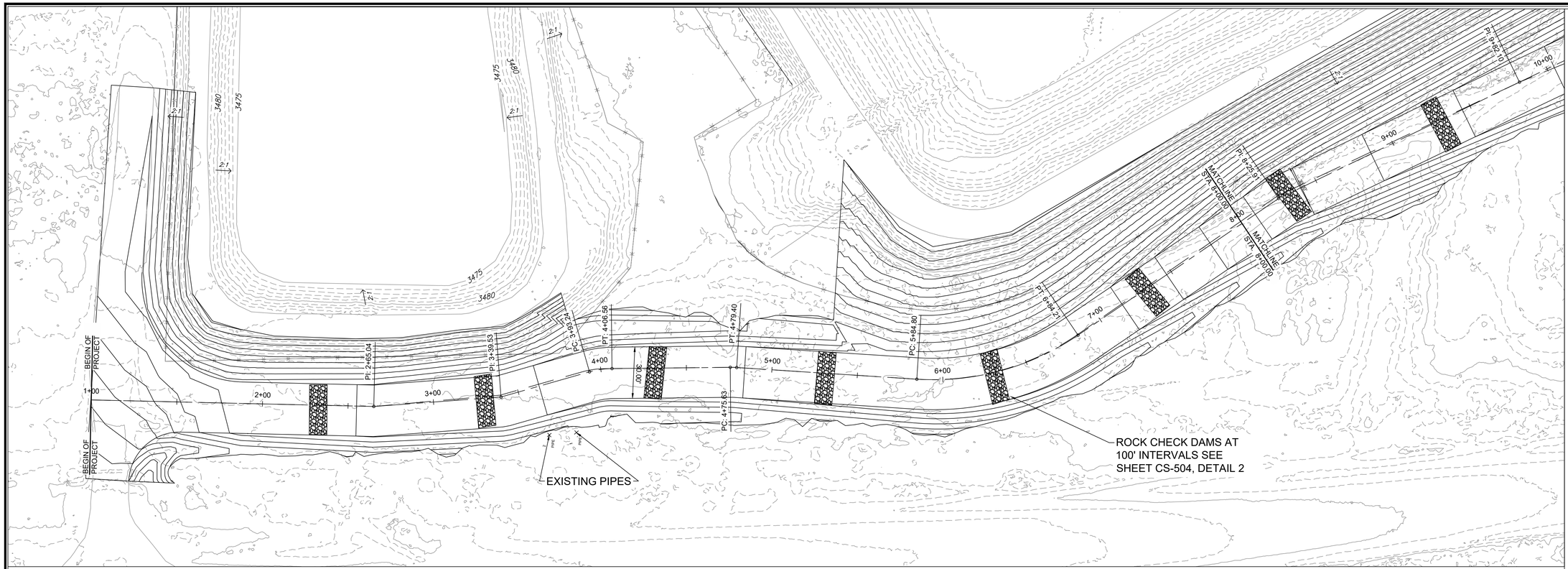
REVISIONS

No.	DATE	DESCRIPTION

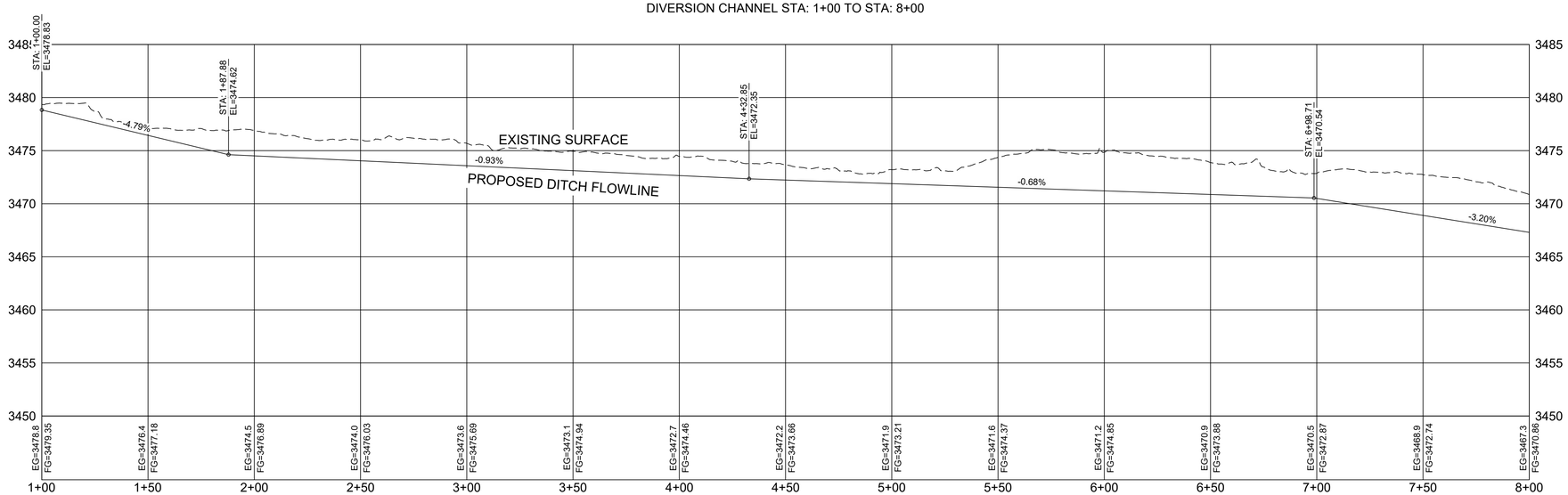
JEREMY BAKER NEW MEXICO 16207 REGISTERED PROFESSIONAL ENGINEER

11/05/2024

SHEET: 5 of 11
CS-102



DIVERSION CHANNEL STA: 1+00 TO STA: 8+00



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ENGINEERING SHEET:
DIVERSION DITCH
PLAN AND PROFILE
STA:0+00 TO STA:9+00
OF

PROJECT NAME:

SAND DUNES

FOR

CLIENT:

VAUGHN OPERATING

PROJECT NUMBER:
24198

PROJECT ENGINEER: JEREMY BAKER, PE

DRAWN BY: XAVIER CLARK

GRAPHIC SCALE
HORIZONTAL
0 30' 60'
SCALE: 1" = 30'
(IN FEET)

GRAPHIC SCALE
VERTICAL
0 6' 12'
SCALE: 1" = 12'
(IN FEET)

REVISIONS

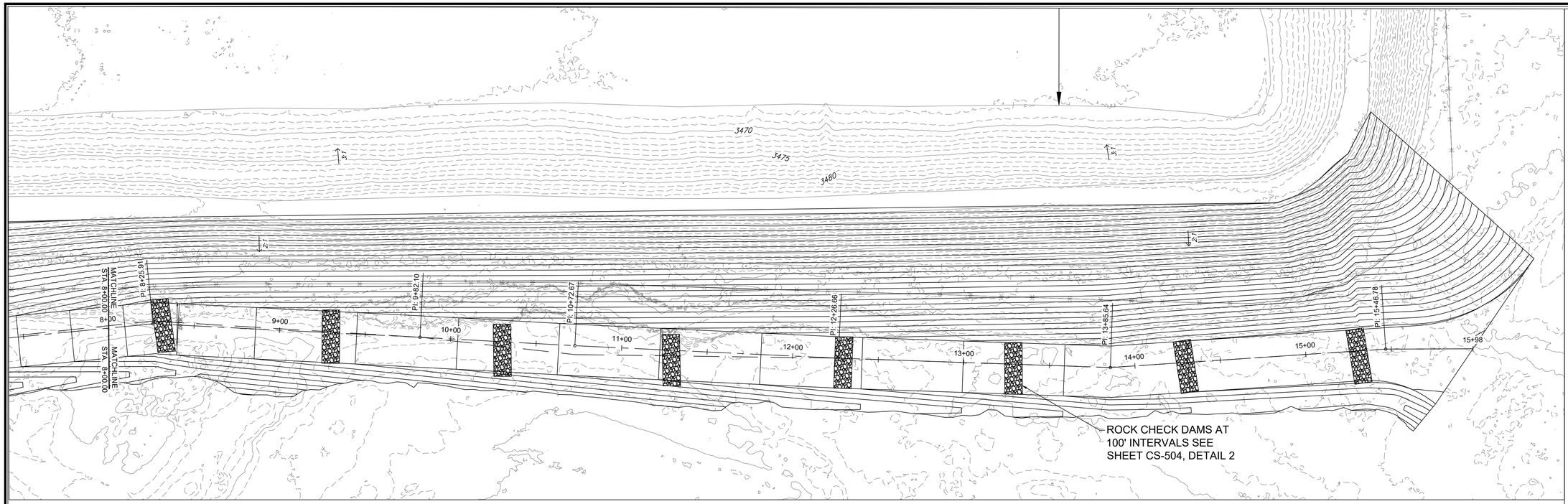
No.	DATE	DESCRIPTION

JEREMY BAKER NEW MEXICO 16207 LICENSED PROFESSIONAL ENGINEER

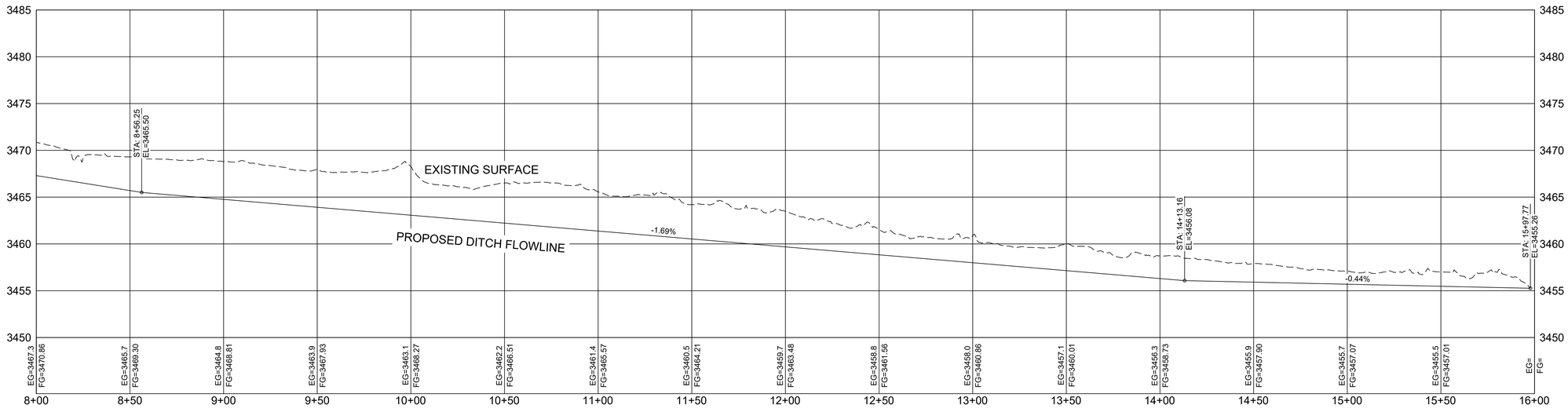
11/05/2024

SHEET: 6 of 11

CS-301



DIVERSION CHANNEL STA: 8+00 TO 16+00



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ENGINEERING SHEET:
DIVERSION DITCH
PLAN AND PROFILE
STA:9+00 TO STA:17+22
OF
PROJECT NAME:

SAND DUNES

FOR
CLIENT:

VAUGHN OPERATING

PROJECT NUMBER:
24198

PROJECT ENGINEER: JEREMY BAKER, PE
DRAWN BY: XAVIER CLARK

GRAPHIC SCALE
HORIZONTAL
0 30' 60'
SCALE: 1" = 30'
(IN FEET)

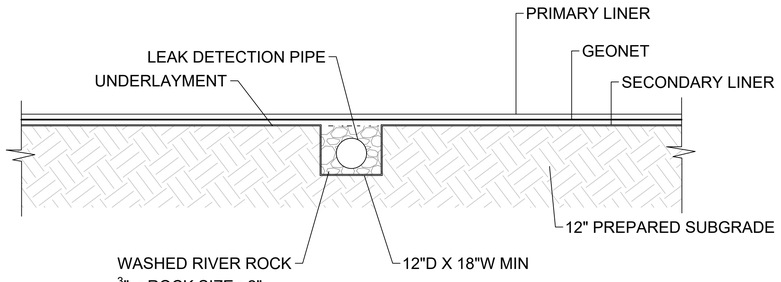
GRAPHIC SCALE
VERTICAL
0 6' 12'
SCALE: 1" = 12'
(IN FEET)

REVISIONS

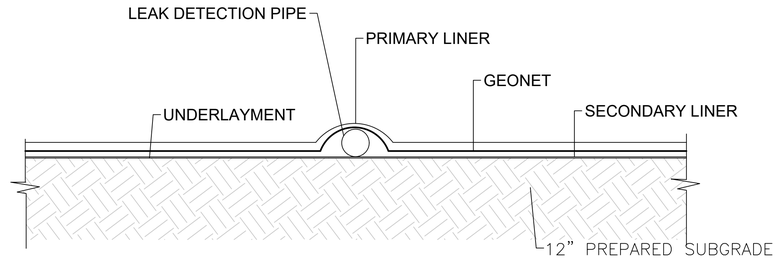
No.	DATE	DESCRIPTION

JEREMY BAKER
NEW MEXICO
16207
LICENSED PROFESSIONAL ENGINEER
11/05/2024

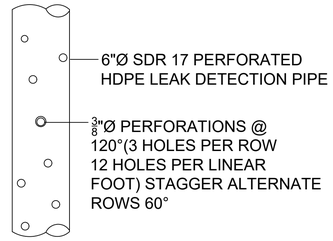
SHEET: 7 of 11
CS-302



1A SUMP DETECTION CROSS SECTION



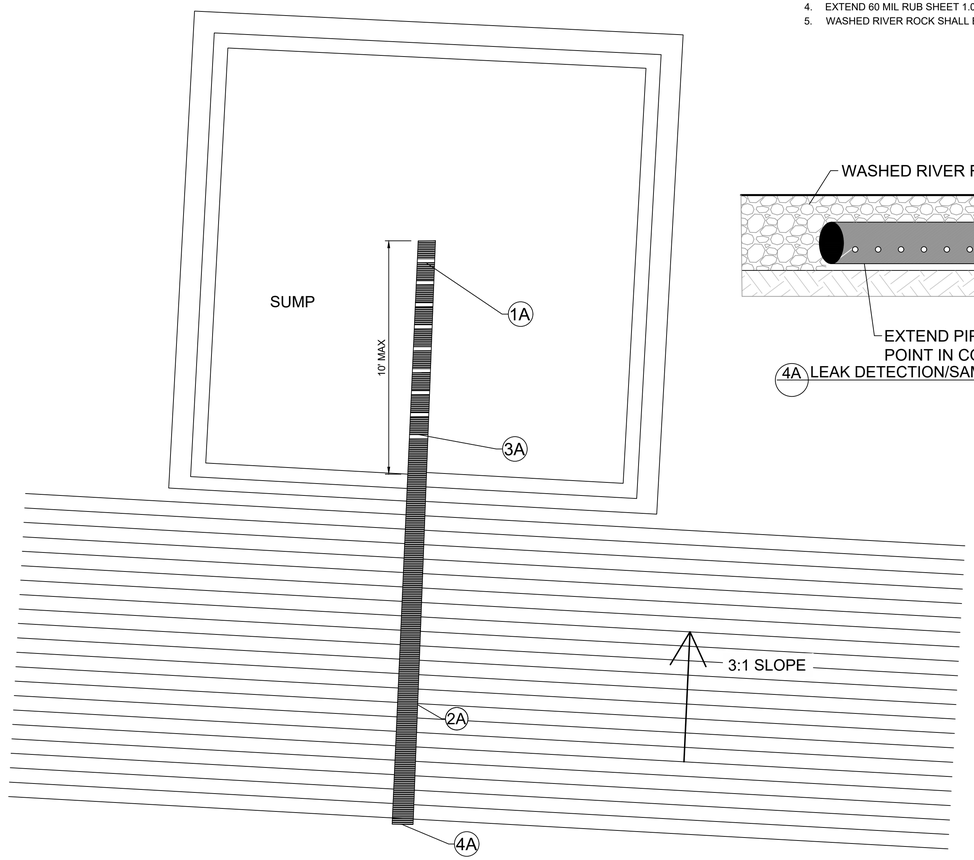
2A SIDE SLOPE LEAK DETECTION PIPE DETAIL



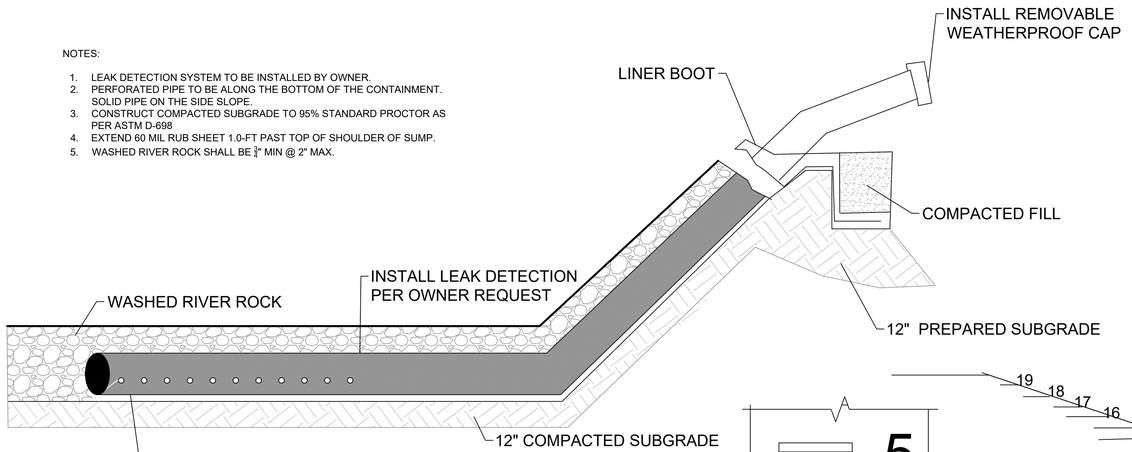
3A PERFORATED PIPE DETAIL

NOTES:

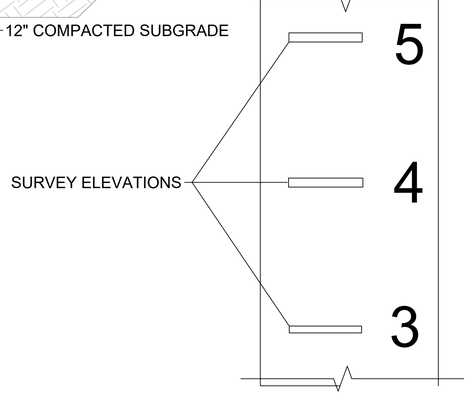
1. LEAK DETECTION SYSTEM TO BE INSTALLED BY OWNER.
2. PERFORATED PIPE TO BE ALONG THE BOTTOM OF THE CONTAINMENT. SOLID PIPE ON THE SIDE SLOPE.
3. CONSTRUCT COMPACTED SUBGRADE TO 95% STANDARD PROCTOR AS PER ASTM D-698
4. EXTEND 60 MIL RUB SHEET 1.0-FT PAST TOP OF SHOULDER OF SUMP.
5. WASHED RIVER ROCK SHALL BE 3/4" MIN @ 2" MAX.

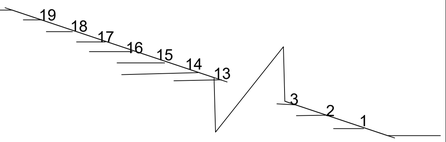


1 CONTAINMENT SUMP PLAN DETAIL



4A LEAK DETECTION/SAMPLING SYSTEM PROFILE





NOTE:

1. LEVEL MARKS TO BE LOCATED BY SURVEYOR
2. MARKS TO BE MADE BY AN EXTRUSION WELDER USING BLACK FILAMENT (OR WHITE FILAMENT ON BLACK LINER)
3. MARKS WILL BE DETERMINE ON THE FIELD BY THE OWNER AND CONTINUE TO THE TOP OF THE BERM.
4. REFERENCE PIT CAPACITY TABLES FOR ACCURATE ELEVATIONS.

2 WATER LEVEL MARKS

PROPOSED PIT REFERENCE TABLE

DETAIL	DESCRIPTION
PRIMARY LINER	60 MIL HDPE LINER
LEAK DETECTION	200 MIL GEONET
SECONDARY LINER	40 MIL HDPE LINER
UNDERLAYMENT	COMPACTED SUBGRADE/10 OZ GEOTEXTILE
BOTTOM OF POND	3465.20
BERM (ROAD CREST)	3483.20
LEAK DETECTION PIPING	8-IN DR11 X PERFORATED HEPE PIPE LEAK DETECTION PIPE

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ENGINEERING SHEET:
LEAK DETECTION DETAILS
OF
PROJECT NAME:
SAND DUNES
FOR
CLIENT:
VAUGHN OPERATING

PROJECT NUMBER:
24198

PROJECT ENGINEER:
JEREMY BAKER, PE
DRAWN BY:
XAVIER CLARK

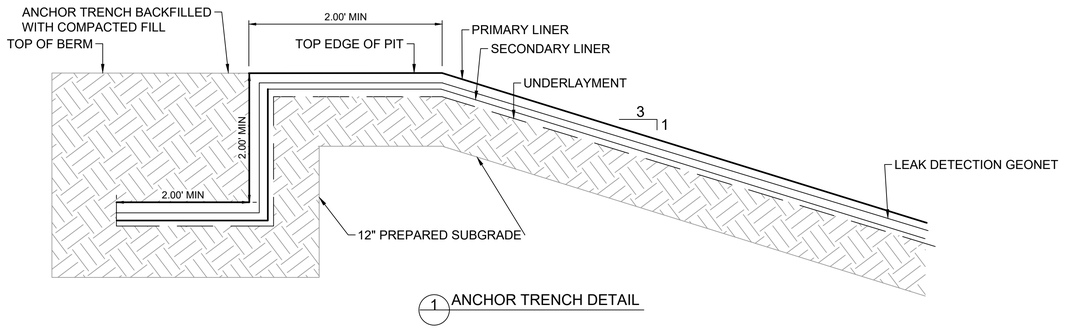
REVISIONS

No.	DATE	DESCRIPTION

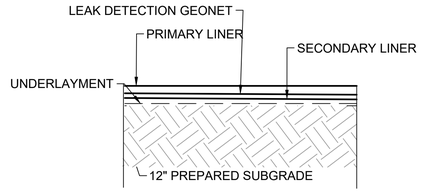
JEREMY BAKER NEW MEXICO 16207 LICENSED PROFESSIONAL ENGINEER

11/05/2024

SHEET: 8 of 11
CS-501



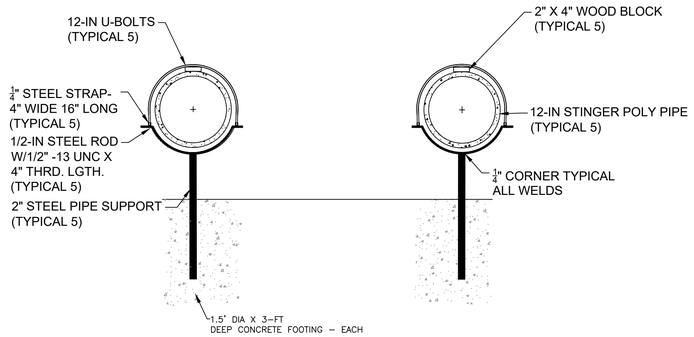
1 ANCHOR TRENCH DETAIL



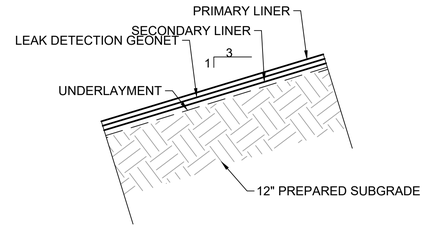
4 LINER SYSTEM FLOOR DETAIL

GENERAL NOTES:

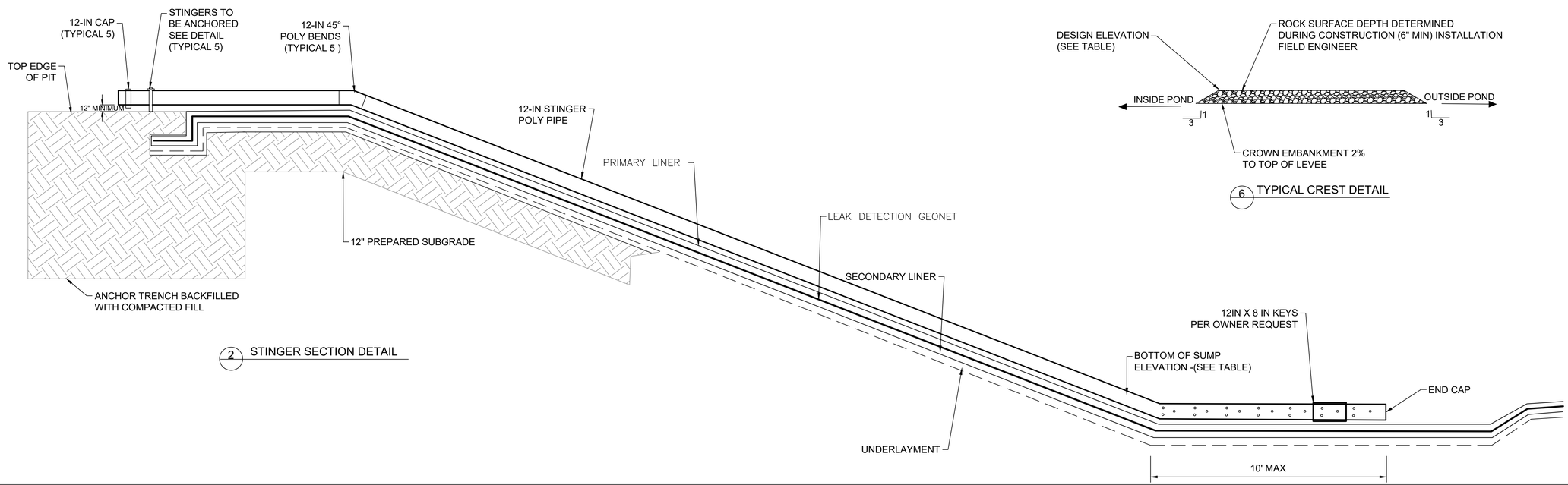
1. PREPARED SUBGRADE MEANS COMPACTED SMOOTH SUBGRADE FREE OF ROCK, ROOTS, WOOD DEBRIS, CONCRETE RUBBLE AND ANY SHARP OBJECTS THAT MAY PUNCTURE THE HDPE LINER, A MINIMUM COMPACTED DEPTH OF 12".
2. ALL INTERIOR SLOPES AND TOP OF BERMS TO BE SMOOTH DRUM ROLLED
3. ALL EMBANKMENT SLOPES SHALL HAVE A SLOPE (H:V RATIO) OF 3:1.
4. COMPACTED EARTH EMBANKMENTS TO BE CONSTRUCTED WITH 12 INCH (MAXIMUM LOOSE LIFTS, COMPACTED TO 95% STANDARD PROCTOR DENSITY)
5. PERFORM GEOTECHNICAL ANALYSIS ON EXISTING SOIL TO CONFIRM SOIL IS SUITABLE FOR USE IN THE LEVEE.
6. LINER SPECIFICATIONS PROVIDED ON SHEET CS - 501



3 STINGER SYSTEM ANCHOR DETAIL



5 LINER SYSTEM SIDE SLOPE



2 STINGER SECTION DETAIL

6 TYPICAL CREST DETAIL

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ENGINEERING SHEET:

LINER DETAILS

OF

PROJECT NAME:

SAND DUNES

FOR

CLIENT:

VAUGHN OPERATING

PROJECT NUMBER:
24198

PROJECT ENGINEER: JEREMY BAKER, PE

DRAWN BY: XAVIER CLARK

REVISIONS

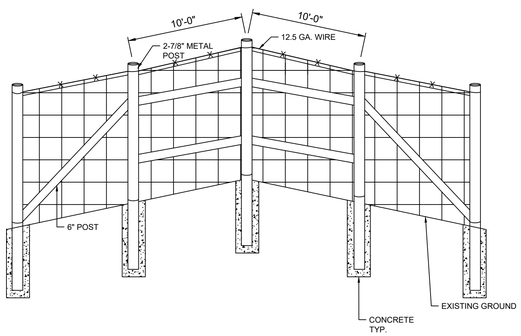
No.	DATE	DESCRIPTION

JEREMY BAKER NEW MEXICO 16207 LICENSED PROFESSIONAL ENGINEER

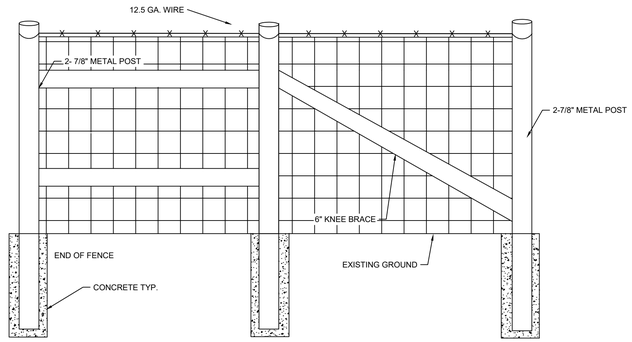
11/05/2024

SHEET: 9 of 11

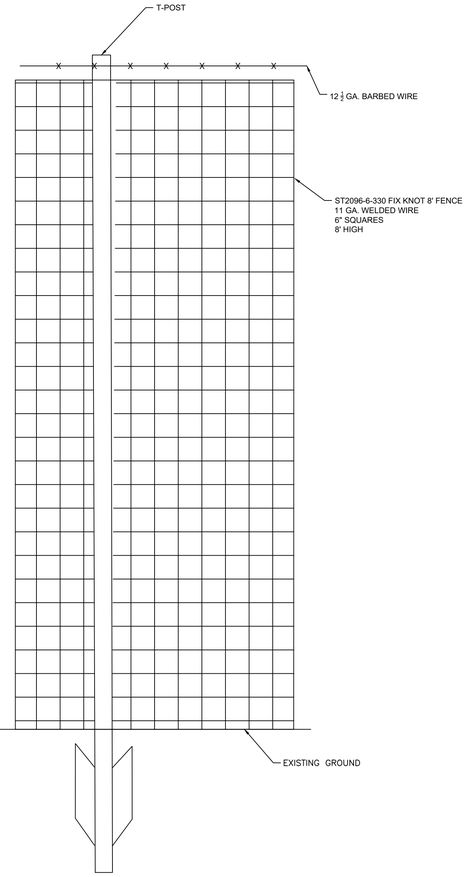
CS-502



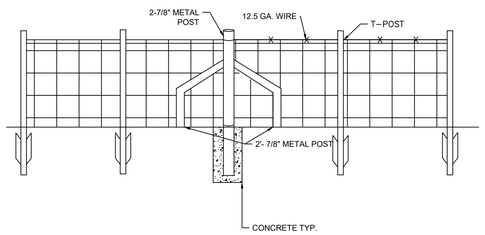
1 CORNER POST



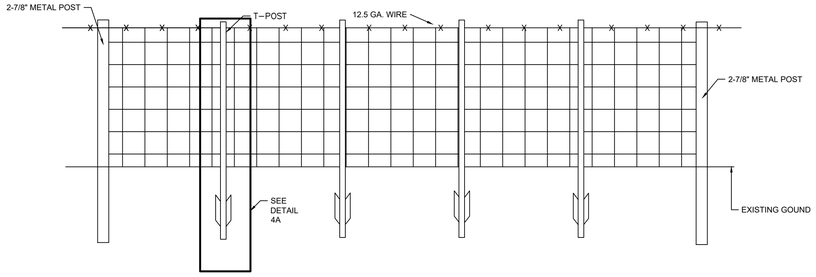
2 END POST



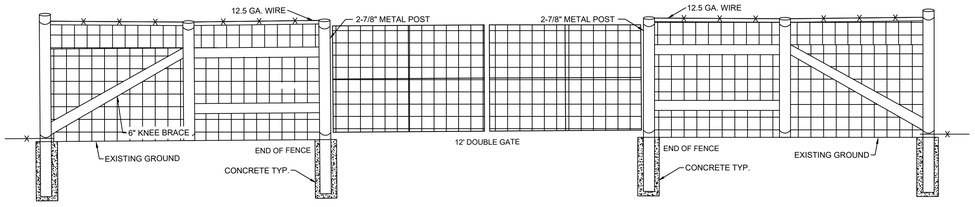
4A METAL POST



3 LINE BRACE POST



4 LINE POST



5 GATE POSTS

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ENGINEERING SHEET:

FENCE DETAILS

OF

PROJECT NAME:

SAND DUNES

FOR

CLIENT:

VAUGHN OPERATING

PROJECT NUMBER:
24198

PROJECT ENGINEER:
JEREMY BAKER, PE

DRAWN BY:
XAVIER CLARK

REVISIONS

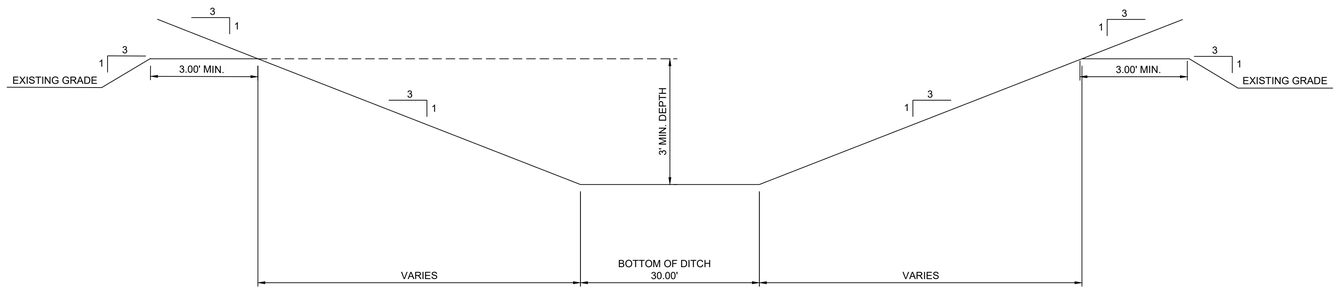
No.	DATE	DESCRIPTION

JEREMY BAKER NEW MEXICO 16207 REGISTERED PROFESSIONAL ENGINEER

11/05/2024

SHEET: 10 of 11

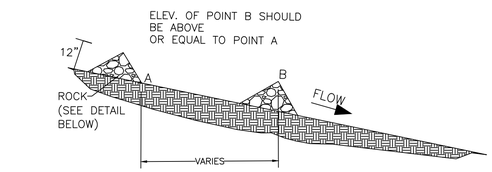
CS-503

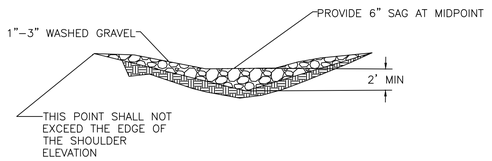


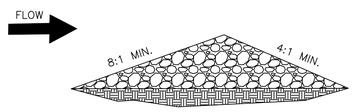
GENERAL NOTES:

1. PREPARED SUBGRADE MEANS COMPACTED SMOOTH SUBGRADE FREE OF ROCK, ROOTS, WOOD DEBRIS, CONCRETE RUBBLE AND ANY SHARP OBJECTS, A MINIMUM COMPACTED DEPTH OF 12".
2. ALL INTERIOR SLOPES AND TOP OF BERMS TO BE SMOOTH DRUM ROLLED
3. ALL EMBANKMENT SLOPES SHALL HAVE A SLOPE (H:V RATIO) OF 3:1.
4. COMPACTED EARTH EMBANKMENTS TO BE CONSTRUCTED WITH 12 INCH (MAXIMUM LOOSE LIFTS, COMPACTED TO 95% STANDARD PROCTOR DENSITY)
5. NO GEOTECHNICAL ANALYSIS WAS PERFORMED FOR THIS PROJECT
6. DIVERSION DITCH TO HAVE A BERM WHERE APPLICABLE. BERM SHALL BE CONSTRUCTED ON AREAS WHERE THE DITCH DOES NOT MEET THE 3 FOOT MINIMUM HEIGHT CRITERIA

1 DIVERSION DITCH DETAIL







GENERAL NOTES
1. ALL RIP RAP TO BE CLASS C PER NMDOT SECTIONS 602 OF THE 2019 NEW MEXICO DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR HIGHWAY AND BRIDGE CONSTRUCTION

2 CHECK DAM DETAIL

TYPE II
CHECK DAM

Table 602.2.1:1
Riprap Classifications and Gabion Requirements

Class	Description	Stone volume (ft^3) Minimum	Stone volume (ft^3) Maximum	Minimum dimension (in)[a]
A	Wire enclosed riprap	1/6	2/3	4
B[b]	Non-enclosed riprap	1	2	6
C[b]	Non-enclosed riprap	2	4	9
E	Grouted riprap	1/3	1	3
F	Grouted riprap	1	2	6
G	Rock plating	—	—	4–8[c]

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ENGINEERING SHEET:
DIVERSION DITCH DETAIL
OF
PROJECT NAME:
SAND DUNES
FOR
CLIENT:
VAUGHN OPERATING

PROJECT NUMBER:
24198

PROJECT ENGINEER:
JEREMY BAKER, PE
DRAWN BY:
XAVIER CLARK

REVISIONS

No.	DATE	DESCRIPTION

JEREMY BAKER NEW MEXICO 16207 REGISTERED PROFESSIONAL ENGINEER
11/05/2024

SHEET: 11 of 11
CS-504

EFFECTIVE WIDE-AREA BIRD CONTROL!

Mega Blaster PRO sonic bird repeller covers 30 acres!

- NEMA Rated Case
- Crystal-Clear Digital Sounds

Mega Blaster PRO uses intermittent distress calls to create a "danger zone" that frightens infesting birds away for good.

PREDATOR cries help scare all the birds.

- *Laughing Gull*
- *Ring-Billed Gull*
- *Herring Gull*
- *California Gull*
- *Black-Headed Gull*
- *Glaucous-Winged Gull*
- *Double Crested Cormorant*
- *Marsh Hawk*

Perfect for Landfills, Airfields, Fish Farms, Farm Fields or any multi-acre facility.

Our most powerful system features two high-output amplifiers that drive our specially-designed 20 speaker tower. The intense sound output covers up to 30 acres (12 hectares).

It features solid-state electronics mounted inside a NEMA-type control box, suitable for most any application.

The generating unit mounts easily to a post or pole using the included hardware. The unit comes pre-recorded in four different configurations for the most common bird infestations.

Choose any or all of the 8 sounds, including predators to give the birds even more of a sense of danger. Customize by choosing volume and silent time between sounds.

CONFIGURATIONS AVAILABLE:

- Agricultural
  # MEGA-AG
- Crow / Raven
  # MEGA-CROW
- Woodpecker
  # MEGA-WP
- Marine / Gull
  # MEGA-MAR

Mega Blaster PRO

Complete system includes the generating unit with two built-in high-output amplifiers, 20-speaker tower with audio cables, 40 watt solar panel, battery clips and all mounting hardware.

BIRD-X

The Bird Control 'X'-Perts

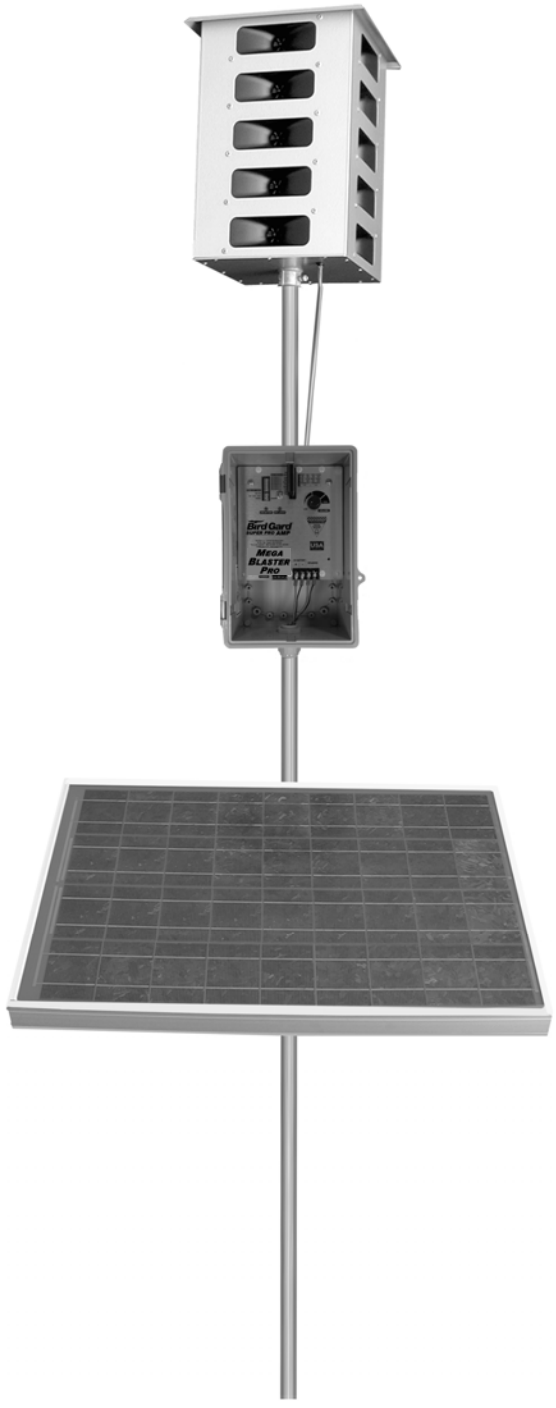
NOTE: This unit is capable of sound output up to 125 decibels. **HEARING PROTECTION IS RECOMMENDED.**

HEARING PROTECTION RECOMMENDED

MEGA BLASTER PRO

BIRD-X

User's Manual



Overview

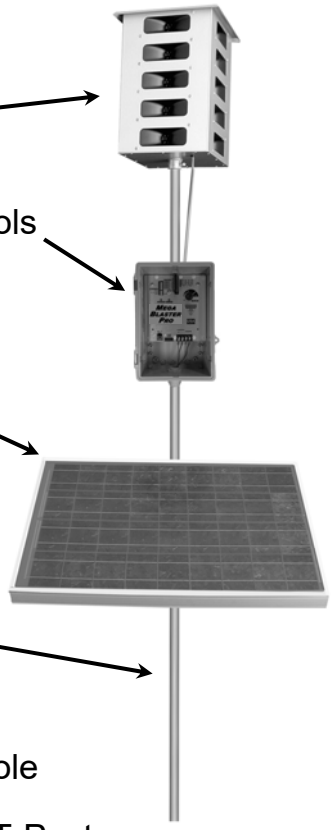
The Bird-X Mega Blaster Pro utilizes the innate power of the natural survival instincts of birds to effectively repel them. Digital recordings of distressed and alarmed birds, along with the sounds made by their natural predators are broadcast through high fidelity weather-resistant speakers over the top of areas. This action triggers a primal fear and flee response. Pest birds soon relocate to where they can feed without feeling threatened.

Your Bird-X Mega Blaster Pro system consists of:

20-Speaker Tower broadcasts the bird sounds

Control Unit produces the bird sounds and contains all operational controls

Solar Panel recharges the 12-volt deep cycle battery



Items needed but <u>not</u> included:

(1) **Mounting Pole** or **Mast** tall enough to raise the 20-Speaker Tower at least 5 feet above the top of the areas, trees or other obstructions

(1) **12-volt Deep Cycle Battery** (RV/Marine) Group 27 or larger wet cell

(1) **T-Post** or similar (Optional) may be needed to support the mounting pole

(1) **Bailing Wire or zip-tie** (Optional) to secure the Mounting Pole to the T-Post

CAUTION: THE MEGA BLASTER PRO IS CAPABLE OF PRODUCING SOUNDS UP TO 125 DECIBELS. PROPER HEARING PROTECTION MUST BE WORN ANYTIME THE UNIT IS TURNED ON.

Bird Control Management Guidelines

An active bird control management program is a key to successfully repelling pest birds. Bird feeding patterns may take several days or weeks to break. Follow all suggestions for maximum effectiveness. Read all instructions prior to installation.

For best results:

- **It is extremely important to fully protect your entire area from birds.** Any areas not fully protected will allow birds to begin feeding at the fringes of the sound coverage. They will soon become bolder and learn the sounds are nothing to fear. This will cause the effectiveness to diminish. Complete Bird-X product coverage forces birds to leave the area entirely.
- Install the Mega Blaster Pro unit at least two weeks before birds are attracted to your area. It is much easier to keep birds away before they have found a food source than it is to repel them once they have developed a feeding pattern.
- Most birds begin feeding from the perimeter of an area. Place Mega Blaster Pro units so the sound protection covers past the edges of the area.
- Birds will often use tall trees for roosting and observation. If birds are in bordering trees it is necessary to position the units so the sound protection covers the trees as well.
- Mount the 20-Speaker Tower at least five feet above trees, areas and structures for maximum coverage. The higher the better. Sound will disperse or reflect off structures or foliage. Mount control unit out of direct sun, if possible.
- When first installed, run Mega Blaster Pro units at FULL volume and on SHORT time off periods. This ensures maximum “bird stress” and creates a hostile environment.
- Watch for changes in bird activity and adjust the location of your Mega Blaster Pro unit if needed.
- **Check the battery and unit settings often to insure continuous bird control. Be certain that the system is not turned down or has a dead battery. Field hands or harvesters may turn down the volume.**
- Changing settings and switches often helps to prevent bird habituation. Periodically change the switch settings of the eight sounds (turning them ON or OFF). NEVER turn OFF the distress calls of the target birds you are trying to repel and always keep at least one predator bird sound turned ON.
- If different bird species enter the protected area and begin causing damage contact us immediately for an updated Sound Recording Card designed to repel the new invading birds.
- Remember that the Mega Blaster Pro system is a management tool, and should be used as part of your overall bird control strategy, sometimes in conjunction with other bird control techniques and devices.

Be aware that under extreme drought or other adverse conditions, birds will disregard all deterrents and risks in order to survive

R.K. FROBEL & ASSOCIATES
Consulting Engineers

Technical Memorandum: 40-mil HDPE as Alternative Secondary Liner System for In Ground Recycling Containment Facilities

NMAC 19.15.34.12 A

I have investigated the suitability of application for 40 mil HDPE geomembrane as an equivalent secondary liner to 30 mil scrim reinforced LLDPE (LLDPEr) in the application for In Ground Recycling Containment facilities. *In summary, it is my professional opinion that the specified 40 mil HDPE geomembrane will provide a secondary liner system that is equal to or better than 30 mil scrim reinforced LLDPEr and will provide the requisite protection of fresh water, public health and the environment for many years when engineering design provides requisite site/soil/slope preparation and when used in concert with requisite primary liners and drainage layers.*

It is understood that the lining system under discussion is composed of a 60 mil HDPE Primary liner, geonet drainage layer and a 40 mil HDPE Secondary liner. *In consideration of the secondary lining system application, size of impoundment and depth, design details as well as the chemical nature of typical processed water, it is my professional opinion that the 40 mil HDPE geomembrane will provide the requisite barrier against processed water loss and will function effectively as a secondary liner.*

The following are discussion points that hopefully will exhibit the equivalency of a 40 mil HDPE secondary liner to that of a 30 mil LLDPEr.

The nature and formulation of the 40 mil HDPE resin is the same as the Primary 60 mil HDPE. The major difference is that the 40 mil HDPE is lower in thickness (more flexible and less puncture resistant). However, in covered conditions, HDPE will resist aging and degradation and remain intact for many decades. In fact, a secondary liner of 40 mil HDPE will outlast an exposed 60 mil HDPE liner. According to the Geosynthetic Research Institute (GRI) study on lifetime prediction (GRI Paper No. 6), the half life of HDPE (GRI GM 13) exposed is > 36 years and the half-life of HDPE covered or buried is greater than 100 years. It is understood that in order to ensure compliance of materials, the primary 60 mil HDPE to be used must meet or exceed GRI GM 13 Standards. Likewise, the secondary liner that is not exposed to the same environmental and chemical conditions must meet or exceed GRI GM 13 for non-reinforced HDPE. Adhering to the minimum requirements of the GRI Specifications, 40 mil HDPE when used as a secondary liner will be equally as protective as the primary 60 mil HDPE liner (reference: www.geosynthetic-institute.org/grispecs) and equally as protective as a 30 mil scrim reinforced LLDPEr liner.

Durability of Geomembranes is directly affected by exposure conditions. Buried or covered geomembranes are not affected by the same degradation mechanisms (UV, Ozone, Chemical, Stress, Temperature, etc) as are fully exposed geomembranes. In this regard, the secondary liner material and thickness can be much less robust than the fully exposed primary liner which in this case is 60 mil HDPE. This is also the case for

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landfill lining systems where the secondary geomembrane in a bottom landfill cell may be 40 mil HDPE.

Thermal Fusion Seaming Requirements. Thermal seaming and QC seam test requirements for geomembranes are product specific and usually prescribed by the sheet manufacturer. Dual wedge thermal fusion welding is commonly used on HDPE and QC testing by air channel (ASTM D 5820) is fully acceptable and recognized as an industry standard. In this regard, there should be no exception requirement for seaming and QC testing as both the Primary and Secondary geomembranes are HDPE. This is fully covered in comprehensive specifications for both the Primary and Secondary geomembranes (Reference: www.ASTM.org/Standards).

Potential for Leakage through the Primary and Secondary Liners. Leakage through geomembrane liners is directly a function of the height of liquid head above any hole or imperfection. The geonet drainage media provides immediate drainage to a low point or sump and thus no hydrostatic head or driving gradient is available to push leakage water through a hole in the secondary liner. In this regard, secondary geomembrane materials can be (and usually are) much less in thickness and also polymer type. Hydraulic Conductivity through the 40 mil HDPE liner material is extremely low due to the polymer type, structure and crystallinity and exceeds requirements of EPA SW-846 Method 9090A.

Chemical Attack. Chemical attack to polymeric geomembranes is directly a function of type of chemical, temperature and exposure time. Again, the HDPE Primary provides the chemically resistant liner and is QC tested to reduce potential defects or holes. If there is a small hole, the geonet drain takes any leakage water immediately to the sump for extraction. Thus, exposure time is very limited on a secondary liner in addition to low temperature, little volume and virtually no head pressure. In this regard, a chemically resistant geomembrane material such as 40 mil HDPE can be specified for the secondary and is a fully acceptable alternate to 30 mil scrim reinforced LLDPEr.

Mechanical Properties Characteristics. Geomembranes of different polymer and/or structure (i.e., reinforced vs non-reinforced) cannot be readily compared using such characteristics as tensile stress/strain, tear, puncture and polymer requirements. For a 40 mil HDPE liner material to function as a Secondary liner it should meet or exceed the manufacturers minimum requirements for Density, Tensile Properties, Tear, Puncture as well as other properties such as UV resistance. The sheet material must also meet or exceed GRI GM 13 minimum requirements. *In this regard, a 40 mil HDPE will be equivalent to a 30 mil LLDPEr as a secondary liner for the conditions listed below:*

- *The subgrade or compacted earth foundation will be smooth, free of debris or loose rocks, dry, unyielding and will support the lining system.*
- *The side slopes for the containment shall be equal to or less than 3H:1V.*
- *The physical properties and condition of the subgrade or liner foundation*

(i.e., density, slope, moisture) will be inspected and certified by a Professional Engineer that it meets or exceeds specification requirements.

- *Immediately prior to installation, the installation contractor shall inspect and sign off on the subgrade conditions that they meet or exceed the HDPE manufacturer and installers requirements.*
- *A protective geotextile will be placed on the finished and accepted subgrade between subgrade and the 40 mil HDPE Secondary liner.*
- *A 200 mil geonet will be placed over the 40 mil HDPE Secondary Liner.*
- *A 60 mil HDPE Primary liner will be placed over the 200 mil geonet drainage layer.*

If you have any questions on the above technical memorandum or require further information, give me a call at 720-289-0300 or email geosynthetics@msn.com

Sincerely Yours,

R K Frobel

Ronald K. Frobel, MSCE, PE

References:

NMAC 19.15.34.12 A DESIGN AND CONSTRUCTION SPECIFICATIONS FOR A RECYCLING CONTAINMENT

Geosynthetic Research Institute (GRI) Published Standards and Papers 2017
www.geosynthetic-institute.org

ASTM Geosynthetics Standards 2017
www.ASTM.org/Standards

DESIGN/CONSTRUCTION PLAN

Design and Construction Plan In Ground Containments

This plan addresses construction of the earthen containments.

Magrym Engineers is providing the design of the containment and their plans are presented in this submission.

Dike Protection and Structural Integrity

The design and operation provide for the confinement of produced water, prevention of releases and prevention of overtopping due to wave action or rainfall. Additionally, the design prevents run-on of surface water as the containment is surrounded by an above-grade levee (a berm) and/or diversion ditch (between the levee and the soil stockpile) to prevent run-on of surface water.

19.15.34.12 A Design and Construction Specifications
(1). The operator shall design and construct a recycling containment to ensure the confinement of produced water, to prevent releases and to prevent overtopping due to wave action or rainfall.
(8). The operator of a recycling containment shall design the containment to prevent run-on of surface water. The containment shall be surrounded by a berm, ditch or other diversion to prevent run-on of surface water

Stockpile Topsoil

Where topsoil is present, prior to constructing containment, the operator will strip and stockpile the topsoil for use as the final cover or fill at the time of closure.

19.15.34.12 B. Prior to constructing containment, the operator shall strip and stockpile the topsoil for use as the final cover or fill at the time of closure

Signage

The operator will place an upright sign no less than 12 inches by 24 inches with lettering not less than two inches in height in a conspicuous place on the fence surrounding the containment. The sign is posted in a manner and location such that a person can easily read the legend. The sign will provide the following information:

- the operator's name,
- the location of the site by quarter-quarter or unit letter, section, township and range, and
- emergency telephone numbers

19.15.34.12 C. Signs.
The operator shall post an upright sign no less than 12 inches by 24 inches with lettering not less than two inches in height in a conspicuous place on the fence surrounding the containment. The operator shall post the sign in a manner and location such that a person can easily read the legend. The sign shall provide the following information: the operator's name, the location of the site by quarter-quarter or unit letter, section, township and range, and emergency telephone numbers

Fencing

The operator will provide for a fence to enclose the recycling containment in a manner that deters unauthorized wildlife and human access. As specified in the design drawings, the operator will employ a chain-link or game fence. If required by the District Office, the operator will add four-strands of barbed wire to comply with the text of the Rule. Because feral pigs, javelina and deer are present in the area, a chain link or game fence is required in order to comply with Section 19.15.34.12 D.1 of the Rule because pigs will move beneath the lower strand of a 4-strand, 4-foot high barbed wire fence and deer will jump over. However, 19.15.34.12 D.2 requires "a four-foot fence that has at least four strands of barbed wire evenly spaced in the interval between one foot and four feet above ground level". Therefore, a barbed wire specification will be added to the game fence to avoid a variance if required by the OCD District Office.

19.15.34.12 D. Fencing
(1) The operator shall fence or enclose a recycling containment in a manner that deters unauthorized wildlife and human access and shall maintain the fences in good repair. The operator shall ensure that all gates associated with the fence are closed and locked when responsible personnel are not onsite.
(2) Recycling containments shall be fenced with a four-foot fence that has at least four strands of barbed wire evenly spaced in the interval between one foot and four feet above ground level.

As stated in the O&M plan, the operator will ensure that all gates associated with the fence are closed and locked when responsible personnel are not onsite.

Netting and Protection of Wildlife

The perimeter game/chain-link fence will be effective in excluding stock and most terrestrial wildlife. If requested by the surface owner, the game fence can include a fine mesh from the base to 1 foot above the ground to exclude the small reptiles (e.g. dune sagebrush lizard).

The recycling containment will be protective of wildlife, including migratory birds through the implementation of an Avian Protection Plan, routine inspections and the perimeter fence.

The avian protection plan includes the use of a Bird-X Mega Blaster Pro[1] as a primary hazing program for avian species. The device will be equipped with sounds suitable for the Permian Basin environment. In addition to this sonic device, staff will routinely inspect the containment for the presence of avian species and, if detected, will use a blank cartridge or shell in a handgun, starter pistol or shotgun as additional hazing. Decoys of birds of prey may be placed on the game fence and other roosts around the open water to provide additional hazing.

The O&M plan calls for the operator to inspect for and, within 30 days of discovery, report the discovery of dead migratory birds or other wildlife to the appropriate wildlife agency and to the division district office in order to facilitate assessment and implementation of measures to prevent incidents from reoccurring.

19.15.34.12 E Netting.
The operator shall ensure that a recycling containment is screened, netted or otherwise protective of wildlife, including migratory birds. The operator shall on a monthly basis inspect for and, within 30 days of discovery, report the discovery of dead migratory birds or other wildlife to the appropriate wildlife agency and to the division district office in order to facilitate assessment and implementation of measures to prevent incidents from reoccurring.

Earthwork

The containment will have a properly constructed foundation and interior slopes consisting of a firm, unyielding base, smooth and free of rocks, debris, sharp edges or irregularities to prevent the liner's rupture or tear. Geotextile is required under the liner when needed to reduce localized stress-strain or protuberances that otherwise may compromise the liner's integrity.

This volume provides the stamped drawings for the containment with the following design/construction specifications:

a) levee has inside grade no steeper than two horizontal feet to one vertical foot (2H: 1V).

19.15.34.12 A
(2) A recycling containment shall have a properly constructed foundation and interior slopes consisting of a firm, unyielding base, smooth and free of rocks, debris, sharp edges or irregularities to prevent the liner's rupture or tear. Geotextile is required under the liner when needed to reduce localized stress-strain or protuberances that otherwise may compromise the liner's integrity…

b) levee outside grade is no steeper than three horizontal feet to one vertical foot (3H: 1V)
c) top of the levee is wide enough to install an anchor trench and provide adequate room for inspection and maintenance.
d) The containment floor design calls for a slope toward the sump in the corner(s).

19.15.34.12 A
(2) …The operator shall construct the containment in a levee with an inside grade no steeper than two horizontal feet to one vertical foot (2H:1V). The levee shall have an outside grade no steeper than three horizontal feet to one vertical foot (3H:1V). The top of the levee shall be wide enough to install an anchor trench and provide adequate room for inspection and maintenance.

Liner and Drainage Geotextile Installation

The containment has a primary (upper) liner and a secondary (lower) liner with a leak detection system appropriate to the site's conditions.

19.15.34.12 A
(3) Each recycling containment shall incorporate, at a minimum, a primary (upper) liner and a secondary (lower) liner with a leak detection system appropriate to the site's conditions.

The primary (upper) liner is a geomembrane liner composed of an impervious, synthetic material that is resistant to ultraviolet light, petroleum hydrocarbons, salts and acidic and alkaline solutions. It is 60-mil HDPE. The secondary liner is specified in the design drawings and is 40-mil HDPE or thicker and is equivalent to 30-mil LLDPEr (in accordance with a previously approved variance) Liner compatibility meets or exceeds a subsequent relevant publication to EPA SW-846 method 9090A.

19.15.34.12 A
(4) All primary (upper) liners in a recycling containment shall be geomembrane liners composed of an impervious, synthetic material that is resistant to ultraviolet light, petroleum hydrocarbons, salts and acidic and alkaline solutions. All primary liners shall be 30-mil flexible PVC, 45-mil LLDPE string reinforced or 60-mil HDPE liners. Secondary liners shall be 30-mil LLDPE string reinforced or equivalent with a hydraulic conductivity no greater than 1 x 10-9 cm/sec. Liner compatibility shall meet or exceed the EPA SW-846 method 9090A or subsequent relevant publications.

The recycling containment design has a leak detection system between the upper and lower geomembrane liners of 200-mil geonet to facilitate drainage. The leak detection system consists of a properly designed drainage and collection and removal system placed above the lower geomembrane liner in depressions and sloped to facilitate the earliest possible leak detection. The containment floor design calls for a slope toward the sump in the corner(s) of the containment, as shown in the design drawings. This slope combined with the highly transmissive geonet drainage layer provide for rapid leak detection.

19.15.34.12 A
(7) The operator of a recycling containment shall place a leak detection system between the upper and lower geomembrane liners that shall consist of 200-mil geonet or two feet of compacted soil with a saturated hydraulic conductivity of 1 x 10-5 cm/sec or greater to facilitate drainage. The leak detection system shall consist of a properly designed drainage and collection and removal system placed above the lower geomembrane liner in depressions and sloped to facilitate the earliest possible leak detection.

The liners and drainage material will be installed consistent with the Manufacturer's specifications. In addition to any specifications of the Manufacturer, protocols for liner installation include measures to:

i. minimizing liner seams and orient them up and down, not across, a slope of the levee.
ii. use factory-welded seams where possible.
iii. use field seams in geosynthetic material that are thermally seamed and prior to field seaming, overlap liners four to six inches.
iv. minimize the number of field seams and comers and irregularly shaped areas.
v. provide for no horizontal seams within five feet of the

19.15.34.12 A
(5) The operator of a recycling containment shall minimize liner seams and orient them up and down, not across, a slope of the levee. Factory welded seams shall be used where possible. The operator shall ensure field seams in geosynthetic material are thermally seamed. Prior to field seaming, the operator shall overlap liners four to six inches…

slope's toe.

vi. use qualified personnel to perform field welding and testing.

vii. avoid excessive stress-strain on the liner

viii. The edges of all liners are anchored in the bottom of a compacted earth-filled trench that is at least 18 inches deep

19.15.34.12 A
(5) …The operator shall minimize the number of field seams and corners and irregularly shaped areas. There shall be no horizontal seams within five feet of the slope's toe. Qualified personnel shall perform field welding and testing.

At points of discharge into the lined earthen containment the pipe configuration effectively protects the liner from excessive hydrostatic force or mechanical damage during filling.

19.15.34.12 A
(3) The edges of all liners shall be anchored in the bottom of a compacted earth-filled trench. The anchor trench shall be at least 18 inches deep.

The design shows that at any point of discharge into or suction from the recycling containment, the liner is protected from excessive hydrostatic force or mechanical damage. External discharge or suction lines do not penetrate the liner.

19.15.34.12 A
(6) At a point of discharge into or suction from the recycling containment, the operator shall insure that the liner is protected from excessive hydrostatic force or mechanical damage. External discharge or suction lines shall not penetrate the liner.

Pumping from the containment to hydraulic fracturing operations is the responsibility of stimulation contractors. Typically, lines are permanently placed in the containment with floats attached to prevent damage to the liner system. The containment may be equipped with permanent HDPE stinger (supported by a sacrificial liner or geotextile) for withdrawal of fluid if the owner deems necessary during operations.

Leak Detection and Fluid Removal System Installation

The leak detection system, contains the following design elements

a. The 200-mil HyperNet Geonet drainage material between the primary and secondary liner that is sufficiently permeable to allow the transport of fluids to the observation ports .
b. The containment floor is sloped towards the monitoring riser pipe to facilitate the earliest possible leak detection of the containment bottom. A pump may be placed in the observation port to provide for fluid removal.
c. Piping will withstand chemical attack from any seepage, structural loading from stresses and disturbances from overlying water, cover materials, equipment operation or expansion or contraction .

OPERATIONS AND MAINTENANCE PLAN

CLOSURE PLAN

Operation and Maintenance Plan
In Ground Containments

Overview

The operator will operate and maintain the lined earthen containment to contain liquids and solids (blow sand and minimal precipitates from the produced water) and maintain the integrity of the liner system in a manner that prevents contamination of fresh water and protects public health and the environment as described below. The purpose of the lined earthen containment is to facilitate recycling, reuse and reclamation of produced water derived from oil and gas wells. During periods when water for E&P operations is not needed, produced water will discharge to injection wells or to a pipeline for transfer to another recycling facility. The containment will not be used for the disposal of produced water or other oilfield waste.

19.15.34.10 D
Recycling containments may not be used for the disposal of produced water or other oilfield wastes.

The operation of the containment is summarized below.

A. Produced water generated from nearby oil and gas wells is delivered to a treatment system located as indicated in the C-147.
B. Unless specified in the transmittal letter, after treatment, the produced water discharges into the containment.
C. When required, produced water is removed from the containment for E&P operations. At this time, produced water will be used for drilling beneath the freshwater zones (beneath surface casing), for well stimulation (e.g. hydraulic fracturing) and other E&P uses as approved by OCD.
D. Whenever the maximum fluid capacity of the containment is reached, treatment and discharge to the containment ceases (see Freeboard and Overtopping Plan, below).
E. The operator will keep accurate records and shall report monthly to the division the total volume of water received for recycling, with the amount of fresh water received listed separately, and the total volume of water leaving the facility for disposition by use on form C-148 (see attached example).
F. The operator will maintain accurate records that identify the sources and disposition of all recycled water that shall be made available for review by the division upon request.

19.15.34.9 E
The operator of a recycling facility shall keep accurate records and shall report monthly to the division the total volume of water received for recycling, with the amount of fresh water received listed separately, and the total volume of water leaving the facility for disposition by use on form C-148.

19.15.34.9 F
The operator of a recycling facility shall maintain accurate records that identify the sources and disposition of all recycled water that shall be made available for review by the division upon request.

G. The containment shall be deemed to have ceased operations if less than 20% of the total fluid capacity is used every six months following the first withdrawal of produced water for use. The operator will report cessation of operations to the appropriate division district office. The appropriate division district office may grant an extension to this determination of cessation of operations not to exceed six months.

19.15.34.13 C
A recycling containment shall be deemed to have ceased operations if less than 20% of the total fluid capacity is used every six months following the first withdrawal of produced water for use. The operator must report cessation of operations to the appropriate division district office. The appropriate division district office may grant an extension to this determination of cessation of operations not to exceed six months.

The operation of the lined earthen containment will follow the mandates listed below:

1. The operator will not discharge into or store any hazardous waste (as defined by 40 CFR 261 and NMAC 19.15.2.7.H.3) in the containments.
2. If the containment's primary liner is compromised above the fluid's surface, the operator will repair the damage or initiate replacement of the primary liner within 48 hours of discovery or seek an extension of time from the division district office.
3. If the primary liner is compromised below the fluid's surface, the operator will remove all fluid above the damage or leak within 48 hours of discovery, notify the division district office and repair the damage or replace the primary liner.
4. If any penetration of the containment liner is confirmed by sampling of fluid in the leak detection system (see Monitoring, Inspection, and Reporting Plan; below), the operator will:
    a. Begin and maintain fluid removal from the leak detection/pump-back system,
    b. Notify the district office within 48 hours (phone or email) of the discovery,
    c. Identify the location of the leak, and
    d. Repair the damage or, if necessary, replace the containment liner.
5. The operator will install, or maintain on site, an oil absorbent boom or other device to contain an unanticipated release and the operator will remove any visible layer of oil from the surface of the recycling containment.
6. The operator will report releases of fluid in a manner consistent with NMAC 19.15.29
7. The containment will be operated to prevent the collection of surface water run-on.

19.15.34.13 B
(4) If the containment's primary liner is compromised above the fluid's surface, the operator shall repair the damage or initiate replacement of the primary liner within 48 hours of discovery or seek an extension of time from the division district office.
(5) If the primary liner is compromised below the fluid's surface, the operator shall remove all fluid above the damage or leak within 48 hours of discovery, notify the division district office and repair the damage or replace the primary liner.

19.15.34.13 B
(7) The operator shall install, or maintain on site, an oil absorbent boom or other device to contain an unanticipated release.
(1) The operator shall remove any visible layer of oil from the surface of the recycling containment.
19.15.34.8 A

(6) All releases from the recycling and re-use of produced water shall be handled in accordance with 19.15.29 NMAC.

8. The operator will maintain the containment free of miscellaneous solid waste or debris.
9. The operator will maintain at least three feet of freeboard for the containment and will use a free-standing staff gauge to allow easy determination of the required 3-foot of freeboard.
10. As described in the design/construction plan, the injection or withdrawal of fluids from the containment is accomplished through hardware that prevents damage to the liner by erosion, fluid jets or impact from installation and removal of hoses or pipes.
11. The operator shall ensure that all gates associated with the fence are closed and locked when responsible personnel are not onsite.
12. The operator will maintain the fences in good repair.

19.15.34.13
(6) The containment shall be operated to prevent the collection of surface water run-on.

19.15.34.13 B
(2) The operator shall maintain at least three feet of freeboard at each containment.

19.15.34.13 B
(3) The injection or withdrawal of fluids from the containment shall be accomplished through a header, diverter or other hardware that prevents damage to the liner by erosion, fluid jets or impact from installation and removal of hoses or pipes.

19.15.34.12 D
(1) The operator shall fence or enclose a recycling containment in a manner that deters unauthorized wildlife and human access and shall maintain the fences in good repair. The operator shall ensure that all gates associated with the fence are closed and locked when responsible personnel are not onsite.

19.15.34.13 A
The operator shall inspect the recycling containment and associated leak detection systems weekly while it contains fluids. The operator shall maintain a current log of such inspections and make the log available for review by the division upon request.

Monitoring, Inspection, and Reporting Plan

The operator will inspect the recycling containment and associated leak detection systems weekly while it contains fluids. The operator shall maintain a current log of such inspections and make the log available for review by the division upon request.

Weekly inspections consist of:

- reading and recording the fluid height of staff gauges,
- recording any evidence that the pond surface shows visible oil,
- visually inspecting the containment's exposed liners
- checking the leak detection system for any evidence of a loss of integrity of the primary liner.
- inspect diversion ditches and berms around the containment to check for erosion and collection of surface water run-on.
- inspect the leak detection system for evidence of damage or malfunction and monitor for leakage.

As stated above, if a liner's integrity is compromised, or if any penetration of the liner occurs, then the operator will take appropriate action within 48 hours, based on if above or below water surface, as noted above.

Monthly, the operator will:

A. Inspect the containment for dead migratory birds and other wildlife. Within 30 days of discovery, report the discovery of dead migratory birds or other wildlife to the appropriate wildlife agency and to the division district office in order to facilitate assessment and implementation of measures to prevent incidents from reoccurring.
B. Report to the division the total volume of water received for recycling, with the amount of fresh water received listed separately, and the total volume of water leaving the facility for disposition by use on form C-148.
C. Record sources and disposition of all recycled water.

19.15.34.12 E
The operator shall on a monthly basis inspect for and, within 30 days of discovery, report the discovery of dead migratory birds or other wildlife to the appropriate wildlife agency and to the division district office in order to facilitate assessment and implementation of measures to prevent incidents from reoccurring.

19.15.34.9 E
The operator of a recycling facility shall keep accurate records and shall report monthly to the division the total volume of water received for recycling, with the amount of fresh water received listed separately, and the total volume of water leaving the facility for disposition by use on form C-148.

19.15.34.9 F
The operator of a recycling facility shall maintain accurate records that identify the sources and disposition of all recycled water that shall be made available for review by the division upon request.

The operator will maintain a log of all inspections and make the log available for the appropriate Division district office's review upon request. An example of the log is attached to this section of the permit application.

Freeboard and Overtopping Prevention Plan

The method of operation of the containment allows for maintaining freeboard with very few potential problems. When the capacity of the containment is reached (3-feet of freeboard), the discharge of produced water ceases and the produced water generated by nearby oil and gas wells is managed by an injection well(s).

If rising water levels suggest that 3-feet of freeboard will not be maintained, the operator will implement one or more of the following options:

I. Cease discharging produced water to the containment.

II.Accelerate re-use of the produced water for purposes approved by the Division.

III. Transfer produced water from the containment to injection wells.

The reading of the staff gauge typically occurs daily when treatment operations are ongoing and weekly when discharge to the containment is not occurring.

Protocol for Leak Detection Monitoring, Fluid Removal and Reporting

As shown in Appendix A, the leak detection system includes a monitoring system. Any fluid released from the primary liner will flow to the collection sump, where fluid level monitoring is possible at the monitoring riser pipe associated with the leak detection system.

Staff may employ a portable electronic water level meter to determine if fluid exists in the monitoring riser pipe. Obtaining accurate readings of water levels in a sloped pipe beneath a containment can be a challenge. An electrician's wire snake may be required to push the probe to the bottom of the port and the probe may be fixed in a 2-inch pipe "dry housing" to avoid false readings due to water condensation on the pipe. There are many techniques to determine the existence of water in the sumps – including low flow pumps and a simple small bailer affixed to an electrician's snake. The operator will use the method that works best for this containment.

If seepage from the containment into the leak detection system is suspected by a positive fluid level measurement, the operator will:

1. Re-measure fluid levels in the monitoring riser pipe on a daily basis for one week to determine the rate of seepage.
2. Collect a water sample from the monitoring riser pipe to confirm the seepage is produced water from the containment via electrical conductivity and chloride measurements.
3. Notify NMOCD of a confirmed positive detection in the system within 48 hours of sampling (initial notification).
4. Install a pump into the monitoring riser pipe sump to continually (manually on a daily basis or via automatic timers) remove fluids from the leak detection system into the containment until the liner is repaired or replaced.
5. Dispatch a liner professional to inspect the portion of the containment suspected of leakage during a "low water" monitoring event.
6. Provide NMOCD a second report describing the inspection and/or repair within 20 days of the initial notification.

If the point of release is obvious from a low water inspection, the liner professional will repair the loss of integrity. If the point of release cannot be determined by the inspection, the liner professional will develop a more robust plan to identify the point(s) of release. The inspection plan and schedule will be submitted to OCD with the second report. The operator will implement the plan upon OCD approval.

Closure Plan
In Ground Containments

Overview

After operations cease, the operator will remove all fluids within 60 days and close the containment within six months from the date the operator ceases operations from the containment for use.

19.15.34.14 A
Once the operator has ceased operations, the operator shall remove all fluids within 60 days and close the containment within six months from the date the operator ceases operations from the containment for use.

The operator shall substantially restore the impacted surface area to

a. the condition that existed prior to the construction of the recycling containment or
b. to a condition imposed by federal, state trust land or tribal agencies on lands managed by those agencies as these provisions govern the obligations of any operator subject to those provisions,

19.15.34.14 E
The operator shall substantially restore the impacted surface area to the condition that existed prior to the construction of the recycling containment.

19.15.34.14 G
The re-vegetation and reclamation obligations imposed by federal, state trust land or tribal agencies on lands managed by those agencies shall supersede these provisions and govern the obligations of any operator subject to those provisions, provided that the other requirements provide equal or better protection of fresh water, human health and the environment.

The surface owner will impose a closure design that conforms to their needs for the site. The operator understands that a variance will be submitted to OCD to allow for any alternative closure protocol.

Excavation and Removal Closure Plan – Protocols and Procedures

The containment is expected to hold a small volume of solids, the majority of which will be windblown sand and dust with some mineral precipitates from the water

1. The operator will remove all liquids from the containment and either:
    a. Dispose of the liquids in a division-approved facility, or
    b. Recycle, reuse or reclaim the water for reuse in drilling and stimulation.
2. The operator will close the recycling containment by first removing all fluids, contents and synthetic liners and transferring these materials to a division approved facility.
3. After the removal of the containment contents and liners, soils beneath the containment will be tested by collection of a five-point (minimum) composite sample which includes stained or wet soils, if any, and that sample shall be analyzed for the constituents listed in Table I of 19.15.34.14.
4. After review of the laboratory results:
    a. If any contaminant concentration is higher than the parameters listed in Table I, additional delineation may be required, and the operator must receive approval before proceeding with closure.

19.15.34.14 B
The operator shall close a recycling containment by first removing all fluids, contents and synthetic liners and transferring these materials to a division approved facility.

19.15.34.14 C
The operator shall test the soils beneath the containment for contamination with a five-point composite sample which includes stained or wet soils, if any, and that sample shall be analyzed for the constituents listed in Table I below.

19.15.34.14 C
(1) If any contaminant concentration is higher than the parameters listed in Table I, the division may require additional delineation upon review of the results and the operator must receive approval before proceeding with closure.

b. If all contaminant concentrations are less than or equal to the parameters listed in Table I, then the operator will proceed to
    i. backfill with non-waste containing, uncontaminated, earthen material - Or
    ii. undertake an alternative closure process pursuant to a variance request after approval by OCD.

19.15.34.14 C
(2) If all contaminant concentrations are less than or equal to the parameters listed in Table I, then the operator can proceed to backfill with non-waste containing, uncontaminated, earthen material.

Reclamation and Re-vegetation

a. The operator will reclaim the containment's location to a safe and stable condition that blends with the surrounding undisturbed area.
b. Topsoils and subsoils shall be replaced to their original relative positions and contoured so as to achieve erosion control, long-term stability and preservation of surface water flow patterns.
c. The disturbed area shall then be reseeded in the first favorable growing season following closure of a recycling containment.

19.15.34.14 E
Once the operator has closed the recycling containment, the operator shall reclaim the containment's location to a safe and stable condition that blends with the surrounding undisturbed area. Topsoils and subsoils shall be replaced to their original relative positions and contoured so as to achieve erosion control, long-term stability and preservation of surface water flow patterns. The disturbed area shall then be reseeded in the first favorable growing season following closure of a recycling containment.

Closure Documentation

Within 60 days of closure completion, the operator shall submit a closure report on form C-147, including required attachments, to document all closure activities including sampling results and the details on any backfilling, capping or covering, where applicable. The closure report shall certify that all information in the report and attachments is correct and that the operator has complied with all applicable closure requirements and conditions specified in division rules or directives.

19.15.34.14 D
Within 60 days of closure completion, the operator shall submit a closure report on form C-147, including required attachments, to document all closure activities including sampling results and the details on any backfilling, capping or covering, where applicable. The closure report shall certify that all information in the report and attachments is correct and that the operator has complied with all applicable closure requirements and conditions specified in division rules or directives.

The operator shall notify the division when reclamation and re-vegetation are complete. Specifically the notice will document that all ground surface disturbing activities at the site have been completed, and a uniform vegetative cover has been established that reflects a life-form ratio of plus or minus fifty percent (50%) of pre-disturbance levels and a total percent plant cover of at least seventy percent (70%) of pre-disturbance levels, excluding noxious weeds.

19.15.34.14 H
The operator shall notify the division when reclamation and re-vegetation are complete.

19.15.34.14 F
Reclamation of all disturbed areas no longer in use shall be considered complete when all ground surface disturbing activities at the site have been completed, and a uniform vegetative cover has been established that reflects a life-form ratio of plus or minus fifty percent (50%) of pre-disturbance levels and a total percent plant cover of at least seventy percent (70%) of pre-disturbance levels, excluding noxious weeds.

November 2024

Rule 34 Registration
Sand Dunes RF & Containments
Section 7, T24S, R31E, Eddy County

Volume 1-
- **Transmittal Letter & Closure Cost Estimate**
- **Siting Criteria Demonstration with Plates & Appendices**

View south (upstream) from center of mapped watercourse at the southern boundary of the area planned for conversion of fresh water frac ponds to Rule 34 containments. This mapped watercourse does not meet the OCD definition of a "significant watercourse".

Prepared for:
Vaughan Operating, LLC
Carlsbad, NM

Prepared by:

R.T. Hicks Consultants, Ltd.
Albuquerque, New Mexico

Cascade Services LLC
Midland, Texas

R. T. HICKS CONSULTANTS, LTD.

901 Rio Grande Blvd NW ▲ Suite F-142 ▲ Albuquerque, NM 87104 ▲ 505.266.5004 ▲ Since 1996

November 26, 2024

Ms. Leigh Barr
EMNRD - Oil Conservation Division
1220 S. St. Francis Drive
Santa Fe, NM 87505
Via E-Mail

Ms. Victoria Venegas
NMOCD - District 2
811 S. First St.
Artesia, NM 88210
Via E-Mail

RE: Vaughan Operating, LLC, Sand Dunes Recycling Facility and Containments
In-ground Containment Permit
Section 7, T24S, R31E, Eddy County

Dear Ms. Barr and Ms. Venegas:

On behalf Vaughan Operating, LLC, R.T. Hicks Consultants prepared a C-147 *permit* for the above-referenced project. Vaughan anticipates that construction will commence after OCD review and final approval.

This is a unique submission for the Cascade/Hicks Consultants team. For Box 8 of the C-147 Form, the team considered not checking yes or no relating to the setback distances for surface water. Our site inspection demonstrates that the drainage channel between Twin Wells Road and the Sand Dunes in-ground containments does not satisfy the OCD definition of a watercourse. Thus, the "blue line" on the 1968 USGS Topographic map does not create a defined watercourse for the 200-foot setback. However, beneath the existing fresh water frac pond is the footprint of a constructed stock tank and the earthen dam that caused this "water hole" for stock. USGS topographic maps and other databases show this feature as a lake/pond. For many decades, this stock tank captured water from the drainage, and it appears in the 1971 Eddy County Soil Survey (photos from 1960s). The stock pond was an artificial pond on private land, just as the fresh water frac pond is an artificial pond on private land. We elected to check the "no" box on the C-147 for surface water.

The Siting Demonstration also discusses the constructed stock tank relative to the OCD definition of a wetland. We conclude that the now-buried stock tank never met the definition of a wetland, and the checkbox is marked "no" as a result.

Although the drainage within 200+ feet of the proposed Rule 34 containment does not meet the criteria of a "significant watercourse", it will carry water near the containment during certain precipitation events. The Cascade/Square Root/Hicks team recommended that the operator incorporate engineering measures into the overall design to ensure that the integrity of the containment would not be compromised. This effort is described in Volume 2 of the submission.

We urge OCD to carefully read the Siting Criteria Demonstration as it relates to the surface water features discussed above.

Volume 1 of the package contains:

- This letter
- Closure cost estimates for the in-ground containment
- Siting criteria demonstration for both containments

Volume 2 includes engineering studies and the design that is an integral part of this submittal:

1. Statement of the Design Engineer
2. The Basin Drainage Study Report
3. The proposed design for the stormwater conveyance to manage flow from a 500-year precipitation event

Volume 3 includes:

- C-147 Form for the in-ground containment
- Stamped Design Drawings for the containment
- Recently Approved Plans for Design/Construction, O&M, Closure

The most important documents for OCD examination are in Volume 2. If you have questions regarding the study or design, please contact the design engineer, Mr. Jeremy Baker, PE, owner of Square Root Services.

This submission refers to the following elements that some OCD reviewers have considered variances for in-ground containments:

1. OCD has previously approved an equivalency demonstration written by experts for 40-mil HDPE secondary liner. We maintain that the language of the Rule is clear, and a variance is not required.
2. OCD has approved the proposed Avian Protection Plan (Bird-X Mega Blaster Pro) for other containments. Thus, the plan meets the requirement of the rule that the "otherwise protective of wildlife, including migratory birds" and a variance is not required.
3. Using the proposed deer fence in lieu of a 4-strand barbed wire fence is not a variance. Because feral pigs, javelina and deer are present in the area, a tall game fence is required to comply with Section 19.15.34.12 D.1 of the Rule. The specification for fencing provided in 19.15.34.12 D.2 contradicts D.1 because pigs will move beneath the lower strand of a 4-foot high barbed wire fence and deer will jump over. Thus, compliance with D.2 results in a violation of D.1. We maintain that compliance with D.1 is the critical component of the Rule and operators need not be required to submit a variance request to follow Best Management Practices and

comply with the Rule. Nevertheless, Vaughan Operating will attach 4 strands of barbed wire to the game fence if required by OCD.

Vaughan will transmit the registration package to OCD via the OCD.Online portal. In compliance with 19.15.34.10 of the Rule, Hicks Consultants provided this package to the surface owner. If you have any questions or concerns regarding this permit or the attached C-147, please contact me. As always, we appreciate your work ethic and diligence.

Sincerely,
R.T. Hicks Consultants

Randall T. Hicks PG
Principal

Copy: Vaughan Operating, LLC
Cascade Services, LLC

R. T. HICKS CONSULTANTS, LTD.
901 Rio Grande Blvd NW ▲ Suite F-142 ▲ Albuquerque, NM 87104 ▲ 505.266.5004 ▲ Since 1996

SAND DUNES IN-GROUND CONTAINMENTS

Financial Assurance Cost Estimate

Attached is the cost estimate for reclamation of the Sand Dunes recycling in-ground containments. As this facility is a conversion of an existing fresh water frac pond, reclamation will return the site to the original condition as discussed in the Variance Request.

The cost of closure sampling and analysis is estimated at $1725 (sampling) plus $2,700 (laboratory cost) to "test the soils beneath the containment for contamination with a five-point composite sample which includes stained or wet soils, if any, and that sample shall be analyzed for the constituents listed in Table I" of Rule 34.

RT Hicks Consultants will assist with the sampling as necessary and prepare the Closure Report for the site. Total closure costs associated with the sampling are estimated at $7500. The cost estimates from Cascade Services (attached) and from RT Hicks Consultants are presented below.

Cascade Services

All work elements required by Rule 34	
North Containment	*$745,025.00*
South Containment	*$71,007.00*

RT Hicks Consultants

Preparation of sampling results and closure report	7500.00
Total for all Closure Activities	**$823,532.00**

The reclamation must meet terms set forth in the surface lease agreement with the landowner, who received a copy of the registration.

Please contact Randall Hicks if you have any questions concerning this closure cost estimate.

Cascade Services, LLC
3403B E County Road 44
Midland, TX 79705
www.cascadeservicesllc.com

Estimate

ADDRESS	SHIP TO		
Steven McCutcheon Vaughn Operating, LLC 3021 Hepler Rd Carlsbad, NM 88220	Steven McCutcheon Vaughn Operating, LLC 3021 Hepler Rd Carlsbad, NM 88220	ESTIMATE DATE	1803 11/05/2024

CUSTOMER PROJECT NAME	PROJECT LOCATION COORDINATES
Sand Dunes 1.2mm bbl Closure	32.23691489, -103.814834587

DESCRIPTION	QTY	UNIT	RATE	AMOUNT
Remove and dispose of all four layers. Textile, 40 mil, net, and 60 mil	2,208,000		0.15	331,200.00
Fence removal and disposal. This includes 3,350' of fence and removal of all posts, braces, wire, fabric, gates, and hardware.	3,350		4.00	13,400.00
This is pricing a package to reclaim the Single 1.2 mm bbl pond. Mobilize equipment to site. Dirt reclaim of pond consist of- Bury all material (Caliche, Gypsum, Sand, ect.) below ground level, backfill pond area with uncontaminated soil from pond walls. Pond area will be reclaimed to natural elevations and water flow patterns. All stockpiled strippings will be put down last to ensure ground has been completely returned to native design.	1		393,000.00	393,000.00
Environmental soil sampling This will include digging 6 sample locations for each containment. One composite sample from 0-4 feet below surface and one discrete sample from each location at 4.25 feet Cost include trip, labor, materials, and laboratory testing	1		1,725.00	1,725.00
Environmental Soil testing Before earthwork can begin the soil must be tested for contamination in case of liner leakage. Cost include trip, labor, materials, and laboratory testing of 18 tests.	1		2,700.00	2,700.00

Broadcast seeding of pond area Seed will be a native mix for Eddy County NM Includes purchase of seed mix and placement	1	3,000.00	3,000.00

Preferred payment method: ACH/Wire
Email AR@cascadeservicesllc.com for ACH/Wire details.

Remit Checks To:
Cascade Services LLC
PO Box 200954
Dallas, TX 75320-0954
**THIS ESTIMATE IS SUBJECT TO THE TERMS & CONDITIONS ATTACHED.

**If pumping is needed due to weather conditions, a $350 daily fee will be charged on final invoice.

**Materials will be invoiced upon receipt of customer purchase order or job approval.

**This estimate may not include tax and may be added on invoice unless customer provides a valid tax exemption document.

Questions? Email AR@Cascadeservicesllc.com

SUBTOTAL	745,025.00
TAX	0.00
TOTAL	**$745,025.00**

Accepted By

Accepted Date

Cascade Services, LLC
3403B E County Road 44
Midland, TX 79705
www.cascadeservicesllc.com

Estimate

ADDRESS
Steven McCutcheon
Vaughn Operating, LLC
3021 Hepler Rd
Carlsbad, NM 88220

SHIP TO
Steven McCutcheon
Vaughn Operating, LLC
3021 Hepler Rd
Carlsbad, NM 88220

ESTIMATE 1803
DATE 11/05/2024

CUSTOMER PROJECT NAME
Sand Dunes 83,000 bbl Closure

PROJECT LOCATION COORDINATES
32.23691489, -103.814834587

DESCRIPTION	QTY	UNIT	RATE	AMOUNT
Remove and dispose of all four layers. Textile, 40 mil, net, and 60 mil	232,000		0.15	34,800.00
Fence removal and disposal. This includes 3,350' of fence and removal of all posts, braces, wire, fabric, gates, and hardware.	1,053		4.00	4,212.00
This is pricing a package to reclaim the Single 83,000 bbl pond. Mobilize equipment to site. Dirt reclaim of pond consist of- Bury all material (Caliche, Gypsum, Sand, ect.) below ground level, backfill pond area with uncontaminated soil from pond walls. Pond area will be reclaimed to natural elevations and water flow patterns. All stockpiled strippings will be put down last to ensure ground has been completely returned to native design.	1		26,770.00	26,770.00
Environmental soil sampling This will include digging 6 sample locations for each containment. One composite sample from 0-4 feet below surface and one discrete sample from each location at 4.25 feet Cost include trip, labor, materials, and laboratory testing	1		1,725.00	1,725.00
Environmental Soil testing Before earthwork can begin the soil must be tested for contamination in case of liner leakage. Cost include trip, labor, materials, and laboratory testing of 9 tests.	1		2,000.00	2,000.00

Broadcast seeding of pond area Seed will be a native mix for Eddy County NM Includes purchase of seed mix and placement	1	1,500.00	1,500.00

Preferred payment method: ACH/Wire
Email AR@cascadeservicesllc.com for ACH/Wire details.

Remit Checks To:
Cascade Services LLC
PO Box 200954
Dallas, TX 75320-0954
**THIS ESTIMATE IS SUBJECT TO THE TERMS & CONDITIONS ATTACHED.

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**Materials will be invoiced upon receipt of customer purchase order or job approval.

**This estimate may not include tax and may be added on invoice unless customer provides a valid tax exemption document.

Questions? Email AR@Cascadeservicesllc.com

SUBTOTAL	71,007.00
TAX	0.00
TOTAL	**$71,007.00**

Accepted By

Accepted Date

SITING CRITERIA DEMONSTRATION

PLATES

Distance to Groundwater

Plates 1 &2, the well logs referenced, and the discussion below demonstrates that groundwater (fresh water as defined by NMOCD Rules) at the location is greater than 50 feet beneath the lowest liner of the recycling containment.

Plate 1 is a topographic map that shows:

1. The Sand Dunes Containments lies within the blue striped rectangle with a yellow label.
2. Water wells from the OSE database as a blue triangle inside colored circles that indicate well depth. OSE wells are often miss-located in the WATERS database as older wells are plotted in the center of the quarter, quarter, quarter, of the Section-Township-Range. OSE wells showing no depth to water and no date are typically permits issued for wells that may or not be in existence at the time of writing this submission.
3. Two USGS wells with depth to water data.

Appendix-Well Logs & USGS Data has OSE drillers' logs of three wells/borings shown on Plate 1:

- C-4646 about 1 ½ miles north of the site
- C-4575 about 1 ¼ mile southwest and
- C-4499 about 2 miles southeast
- C-2783 and C-2784 are WIPP monitoring wells 1.5 miles northeast of the Sand Dunes site. We could find no lithologic data for these well after a 60-min Google Search

Plate 2 is a geologic and topographic map showing:

- Surface geology of the area surrounding the site
- Groundwater elevations of nearby wells in the USGS and MISC databases
- Potentiometric surface contours of groundwater (feet ASL)

Hydrogeology

A veneer of eolian and pediment deposits (Qe/Qp and Qp) cover all bedrock in the area shown by Plate 2. The driller's logs and USGS data (in appendix) provides the following information regarding near surface geology and groundwater zones.

- C-4575 (SW corner of Plate 1) is logged by Atkins Engineering, a competent contractor for generating lithologic logs. It describes 105 feet of dry sand that resembles Piedmont deposits. Note that page 2 of the document labels this well as C-4573 – which does not agree with OSE records.
- C-4646 (NW) is a reasonable driller's log that is typical of Piedmont deposits to 15-20 feet that are underlain by Chinle red beds to the depth of 110 feet. This is a dry boring.
- C-2440 (W) was drilled by air rotary in 1995 and is a reasonable driller's log for this period. The log suggests to us that the brown sandy shale at 45 feet is the top of the Chinle/Dockum that is 165 feet thick and dry. The dark brown sandstone from 210-350 feet is probably the Santa Rosa Sandstone. This unit may contain protectable

groundwater but at this location, the volume of water produced during air drilling was not sufficient to justify completion of a water supply well.

- C-4508 (SE) was logged by Atkins Engineering and describes the top of a red-brown dry siltstone at 25 feet below surface. This is a typical lithology of the Chinle/Dockum red beds. Underlying the siltstone is alternating red-brown claystone and white/off white sandstone, which is also typical of the Chinle/Dockum. The boring is dry to 111 feet.

The USGS database presents the following data from wells nearby the proposed Sand Dunes containment

- ✓ USGS 8924, the well at Poker Lake (SW), draws water from the Rustler Formation, which is probably at a depth of 400-500 feet.
- ✓ USGS-8899 (S) is at or near the Twin Wells Ranch and draws water from saturated alluvium overlying the Chinle red beds. This well lies within a closed depression.
- ✓ USGS-8847, due east of the Sand Dunes location draws water from the Rustler formation at a depth between 400-600 feet.
- ✓ USGS-9126, in the well cluster northwest of the Sand Dunes site, also draws water from the Rustler Formation at a depth of about 400-550 feet
- ✓ USGS-8820, about 4 miles southwest, draws water from the Pecos River Basin Alluvial Aquifer and/or the Rustler Formation. Publications and maps show the PRBA Aquifer in this area and this water table aquifer is hydraulically connected to bedrock aquifers, such as the Rustler and Chinle/Dockum.
- ✓ USGS-9014, in the southeast corner of Plate 2, yields water from the Rustler Formation

From these data we conclude:

1. Closed depressions, such as the area mapped around the Twin Wells Ranch headquarters, can exhibit adequate groundwater perched on the underlying red beds of the Dockum/Chinle. The data do not support any perched groundwater outside of the closed depression around Twin Wells Ranch.
2. The Poker Well (MISC-164/USGS-8924) does not exhibit shallow, alluvial groundwater at depth. This well is drilled to the Rustler Formation.
3. The Rustler Formation is the uppermost groundwater zone around the Sand Dunes containment.
4. The Dockum/Chinle does not yield water to wells in Plate 2.
5. Although the USGS wells shown on Plate 2 provide 1-5 measurements over the periods of record, two wells with a 40-year record of data illustrate a variation of groundwater elevation of less than 15 feet.

Groundwater Data

The data from nearby wells allow a professional hydrogeologist to present data and conclusions to demonstrate that depth to groundwater at this location exceeds 100 feet. We conclude with certainty that:

- The groundwater elevation of the Rustler Formation, the uppermost aquifer beneath the Sand Dunes site, is about 2975, plus or minus 15 feet.
- The Rustler Formation groundwater in this area is confined.
- Perched water does not exist beneath the Sand Dunes containment.
- The highest groundwater elevation at the site is no more than 3000 feet.

The distance from the base of the lowermost liner of the proposed Sand Dunes containment and the groundwater elevation in the Rustler Formation is (3475-25-3000=) 450 feet.

Distance to Municipal Boundaries and Fresh Water Fields

Plate 3 demonstrates that the Sand Dunes Containments is not within incorporated municipal boundaries or within defined municipal fresh water well fields covered under a municipal ordinance adopted pursuant to NMSA 1978, Section 3-27-3, as amended.

- The closest municipality is Malaga, NM approximately 16 miles west of the Sand Dunes Containments.
- The closest public wells are associated with the Malaga public water system that employs supply wells near Loving.

Distance to Subsurface Mines

Plate 4 and our general reconnaissance of the Sand Dunes Containments demonstrate that the nearest mines are caliche pits. This location is not within an area overlying a subsurface mine.

- Vaughan Operating owns the existing caliche pit that is adjacent to the southwest quadrant of the Sand Dunes Containments.
- Exclusive of the Sand Dunes Containments location, the closest caliche pit is about ½ mile north of the site and is not clearly visible in Google Earth images as it may have undergone restoration prior to 1996.
- The two pits mapped southeast of the Sand Dunes are not active and not well defined in Google Earth images.
- There are no subsurface mines in the area shown in Plate 4.

Distance to High or Critical Karst Areas

Plate 5 shows the Sand Dunes site is not within a mapped zone of high or critical with respect to BLM Karst areas.

- The proposed containment is located within a “low” potential karst area.
- The nearest “high” or “critical” potential karst area is located approximately 5 ½ miles northwest of the proposed containment.
- We observed no evidence of solution voids or unstable ground near the site during the field inspection.

Distance to 100-Year Floodplain

Plate 6 demonstrates that the Sand Dunes Containments is within Zone D as designated by the Federal Emergency Management Agency with respect to the Flood Insurance Rate 100-Year Floodplain.

- FEMA describes the location as an area with possible but undetermined flood hazards. No flood hazard analysis has been conducted.
- Our field inspection and examination of the topography permits a conclusion that the location is not within any floodplain and has low risk for flooding.
- The operator is incorporating engineering measures to prevent impact to the proposed Rule 34 containment caused by a heavy rainfall event within the drainage basin of the

watercourse that construction of the fresh water frac pond covered (see next section of this submission).

Distance to Surface Water

Plates 7a and 7b, Appendix Site Photos and the discussion below demonstrate that the proposed containment is not within 200 feet of a significant watercourse, lakebed, or playa lake. The data referenced in this section support the following conclusions:

A. The intermittent stream shown on the 1968 USGS Big Sinks topographic map and in the National Hydrography Dataset does not meet the OCD definition of a "significant watercourse" within 200-feet of the levee of the proposed containment. This definition is presented below with emphasis added:

> 19.15.17.7.P. "Significant watercourse" means a watercourse with a defined bed and bank either named or identified by a dashed blue line on a USGS 7.5 minute quadrangle map or the next lower order tributary with a defined bed and bank of such watercourse.

B. A significant watercourse does exist more than 750 feet down channel of the proposed containment levee.
C. Uphill from the levee of the proposed South containment, we found no evidence of a significant watercourse for at least 2000 feet.
D. A former surface owner constructed a stock tank/artificial pond within the footprint of the proposed recycling project area from before 1968.
E. Although the stock tank is mapped as a lake/pond by the National Hydrography Dataset and appears on the 1968 USGS topographic map, changes to the drainage caused by E&P development decreased the time that the tank held water and justified replacement with a fresh water frac pond prior to 2016 by the current surface owner.
F. Neither the former stock tank nor the existing fresh water frac pond is a surface water body subject to the setback requirements of Rule 34.

Plate 7a shows a mapped lake/pond on a 1968 USGS topographic map with the National Hydrography Dataset superimposed and Plate 7b is a larger scale Google Earth image showing the same data. Our review of historical aerial images demonstrate that this water body was a constructed stock tank (artificial pond) from at least the 1960s to about 2014-17. Google Earth images of the stock tank was dry more times than not, as shown in Table 1.

Water in Stock Tank	No Evidence of Water
• 6/3/05	• 10/21/96 • 5/8/09 • 7/24/11 • 3/12/12 • 2/13/14

Table 1 – Dates of Google Earth Images of Former Stock Tank with Records of Surface Water

The presence of a mapped Lake/Pond within the footprint of the proposed Rule 34 North containment is based upon the constructed stock tank that existed before publication of the 1968 USGS topographic map until before 2016. The stock tank was an artificial pond, and it held water (for stock) for days or weeks after a precipitation event. A former surface owner

constructed this artificial pond more than 50 years ago. The current surface owner replaced the constructed stock pond with the current fresh water frac ponds.

With respect to the Rule 34 setback requirement for the artificial pond that is the stock tank, the Rule states (emphasis added)

> **19.15.34.11.A.** An operator shall not locate a recycling containment:
> **(2)** within 300 feet of a continuously flowing watercourse, or 200 feet of any other significant watercourse or lakebed, sinkhole or playa lake (measured from the ordinary high-water mark);

The setback requirement in Rule 34 is the same as the setback requirement for a Multi-Well Fluid Management Pit of the 2013 Rule 17. After, participating as one of four authors of the 2013 Pit Rule, preparing exhibits for and participation in the 2013 revision to Rule 17 hearing, and working with Rule 17 and Rule 34 for 11 years, Mr. Hicks believes it highly unlikely that the Commission intended artificial lakes/ponds to be included in the setback requirement above. If that is the case, then Rule 34 forbids the conversion of fresh water frac ponds to recycling containments. OCD has rightly approved many such conversions.

With respect to intermittent stream mapped adjacent to and beneath the proposed containments, Plates 7a and 7b use data from the National Hydrography Dataset to show a watercourse. The 1996 Google Earth image shows what may be erosion associated with water flow in portions of the topographic channel but no evidence of a defined channel wherever the topographic grade decreases and vegetation is present. While the National Hydrography Dataset defines a continuous intermittent stream, the air photos show the watercourse present in some area and absent in others.

Google Earth images show significant oil and gas development uphill from the recycling project area after 1996 but before 2005. Google Earth images from 2017-2023, shows the referenced construction E&P infrastructure has modified the flow characteristics of the mapped channel as there is more vegetation and fewer erosional features within the topographic channel than observed in the 1996 image.

As demonstrated in the Appendix Site Photos, the mapped watercourse on the 1968 USGS topographic map does not meet the OCD definition of a significant water course, which is presented below with emphasis added:

> 19.15.17.7.P. “Significant watercourse” means a watercourse with a defined bed and bank either named or identified by a dashed blue line on a USGS 7.5 minute quadrangle map or the next lower order tributary with a defined bed and bank of such watercourse.

There is no bed and bank over most (perhaps all) of the drainage channel uphill and adjacent to the proposed Sand Dunes containments. Please examine the photographs taken by Ms. Pope, a degreed geologist with nearly 25 years of experience in the Permian Basin of New Mexico. Almost 800 feet downhill from the proposed Rule 34 containments, a bed and bank does exist. No bed and bank exist within the topographic change within our at the uphill edge of proposed recycling project area for more than 2000 feet uphill.

The mapped channel will contain stormwater flow during rare precipitation events. The team recognizes that a 100 year precipitation event could cause flooding that may compromise the integrity of the proposed containment levees in the absence of engineering measure to ensure their integrity. This concern caused the design of a robust stormwater conveyance and the basin analysis of a 500-year storm event that is the subject of Volume 2 of this submission.

We contend that the data and discussion above support the conclusions.

Distance to Permanent Residence or Structures

Plate 8 and the site visit demonstrates that the location is not within 1000 feet of an occupied permanent residence, school, hospital, institution, church, or other structure in existence at the time of initial application.

- The nearest structures are two existing fresh water frac ponds and a small caliche quarry.
- Lease roads, several working pads and pipelines are shown within the frame of Plate 8.
- No residences or other structures are in the area.

Distance to Non-Public Water Supply

Plates 1 and 7 demonstrate that the Sand Dunes Containments site is not within 500 horizontal feet of a spring or fresh water well used for domestic or stock watering purposes, in existence at the time of initial application.

- Plate 1 shows the locations of all area water wells, active or plugged.
- There are no domestic water wells located within 1,000 feet of the area of interest.
- No springs were identified within the mapping area (see Plate 8)

Distance to Wetlands

Plate 9 shows the former stock tank discussed above as a mapped wetland within 500 feet of the proposed containment. The discussion below permits a conclusion that the mapped wetland did not meet the OCD definition of a wetland.

The OCD definition is presented below.

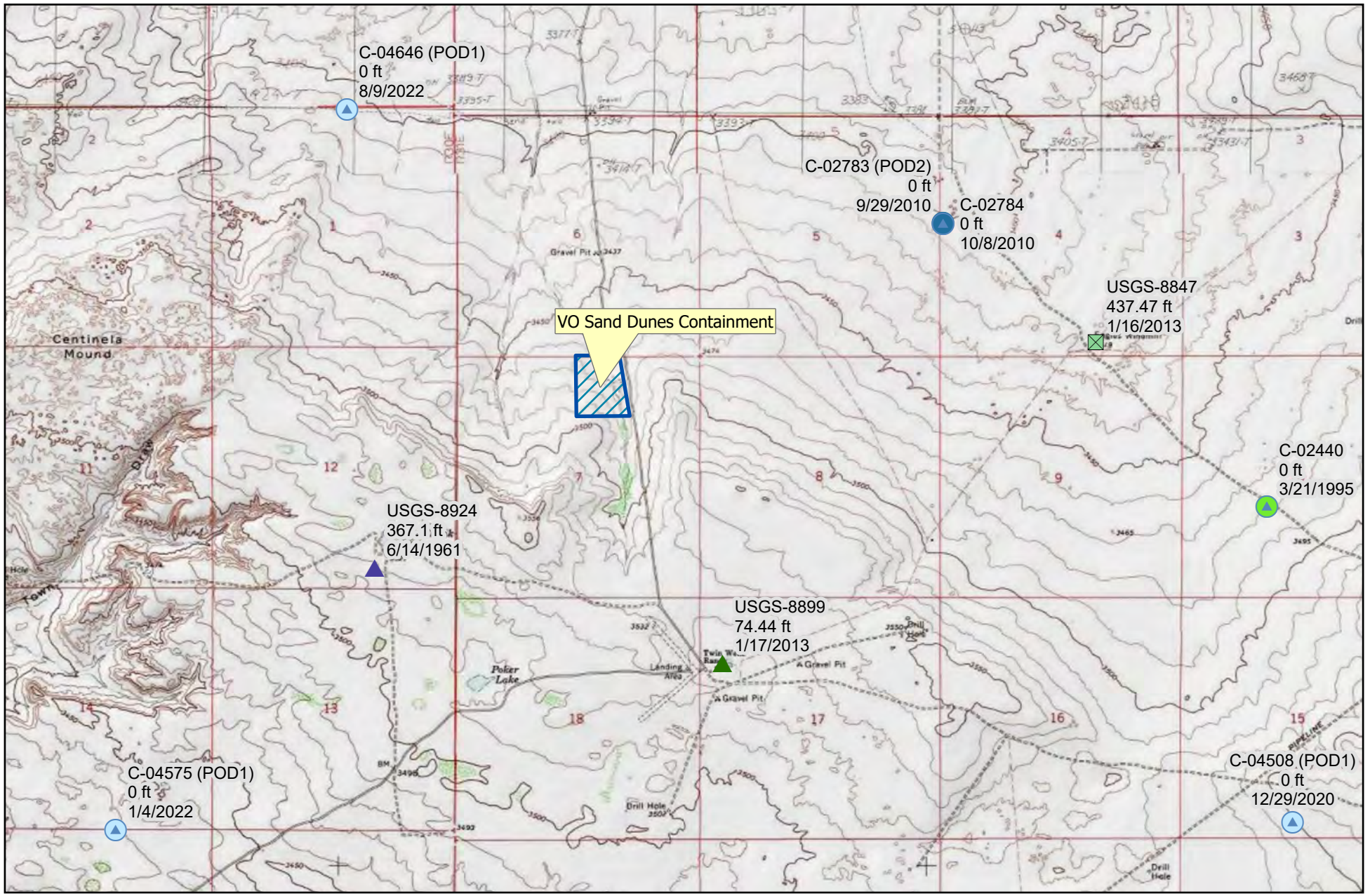
> ***19.15.2.7 DEFINITIONS: These definitions apply to 19.15.2 NMAC through 19.15.39 NMAC.***
> ***W. Definitions beginning with the letter "W"***
> ***. (9) "Wetlands"*** *means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions in New Mexico. This definition does not include constructed wetlands used for wastewater treatment purposes.*

We cannot attest to any characteristics of this stock tank as it lies beneath the liner of the fresh water frac pond. The three professional hydrogeologists currently working at Hicks Consultants have visited hundreds of stock tanks in Eddy and Lea Counties over our combined 80-years of working in the field of the Permian Basin. None of us can remember a stock tank that met the OCD definition that states *"under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions in New Mexico."* The discussion above about the mapping of the stock pond as a lake/pond applies to this mapped wetland. The

evidence of the aerial photos supports a conclusion that saturated soil conditions would not exist at the frequency or duration required by the definition. Moreover, there is no doubt that the former stock tank does not meet the definition of a wetland now, because it no longer exists.

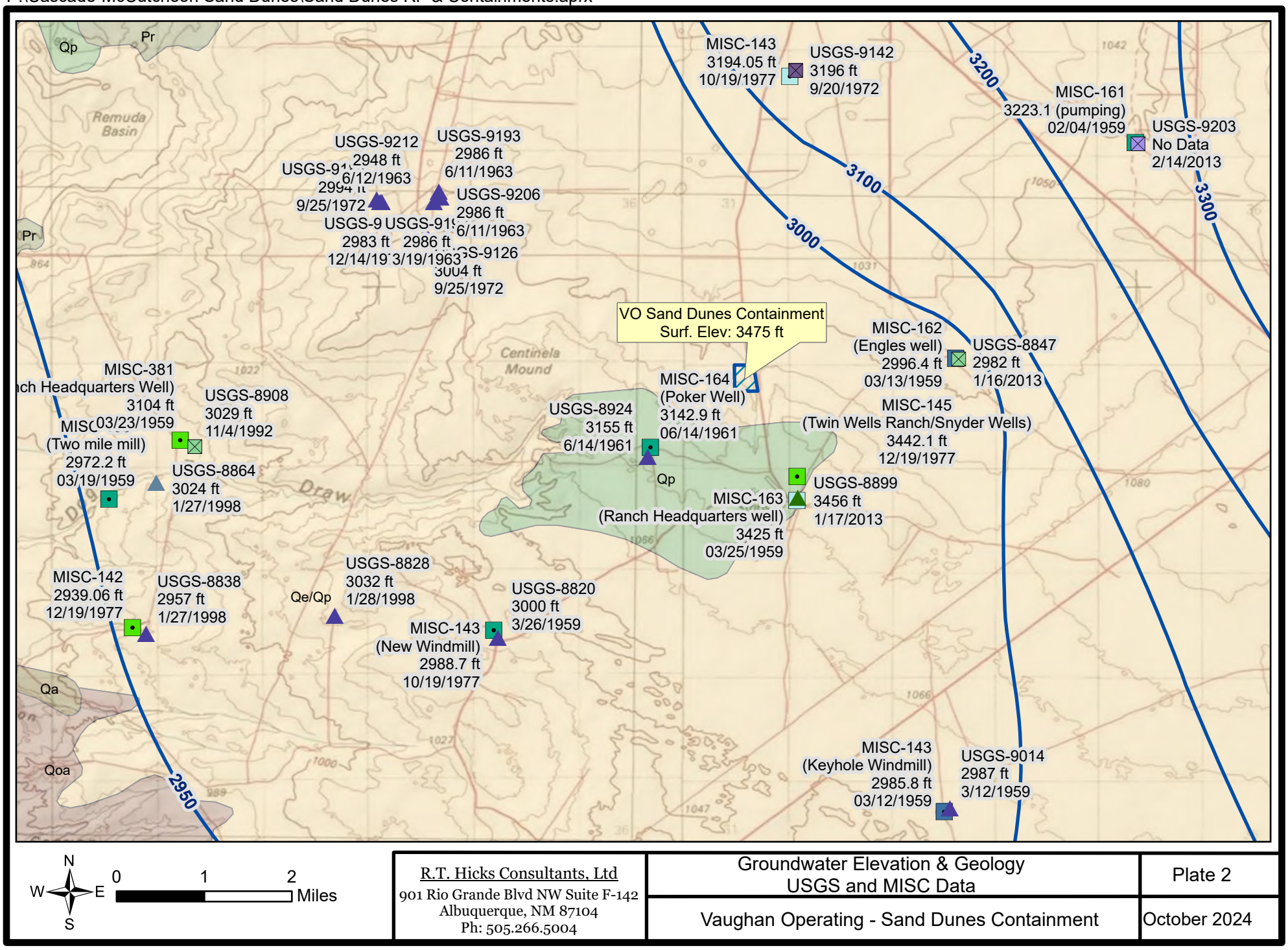
PLATES

P:\Cascade-McCutcheon Sand Dunes\Sand Dunes RF & Containments.aprx



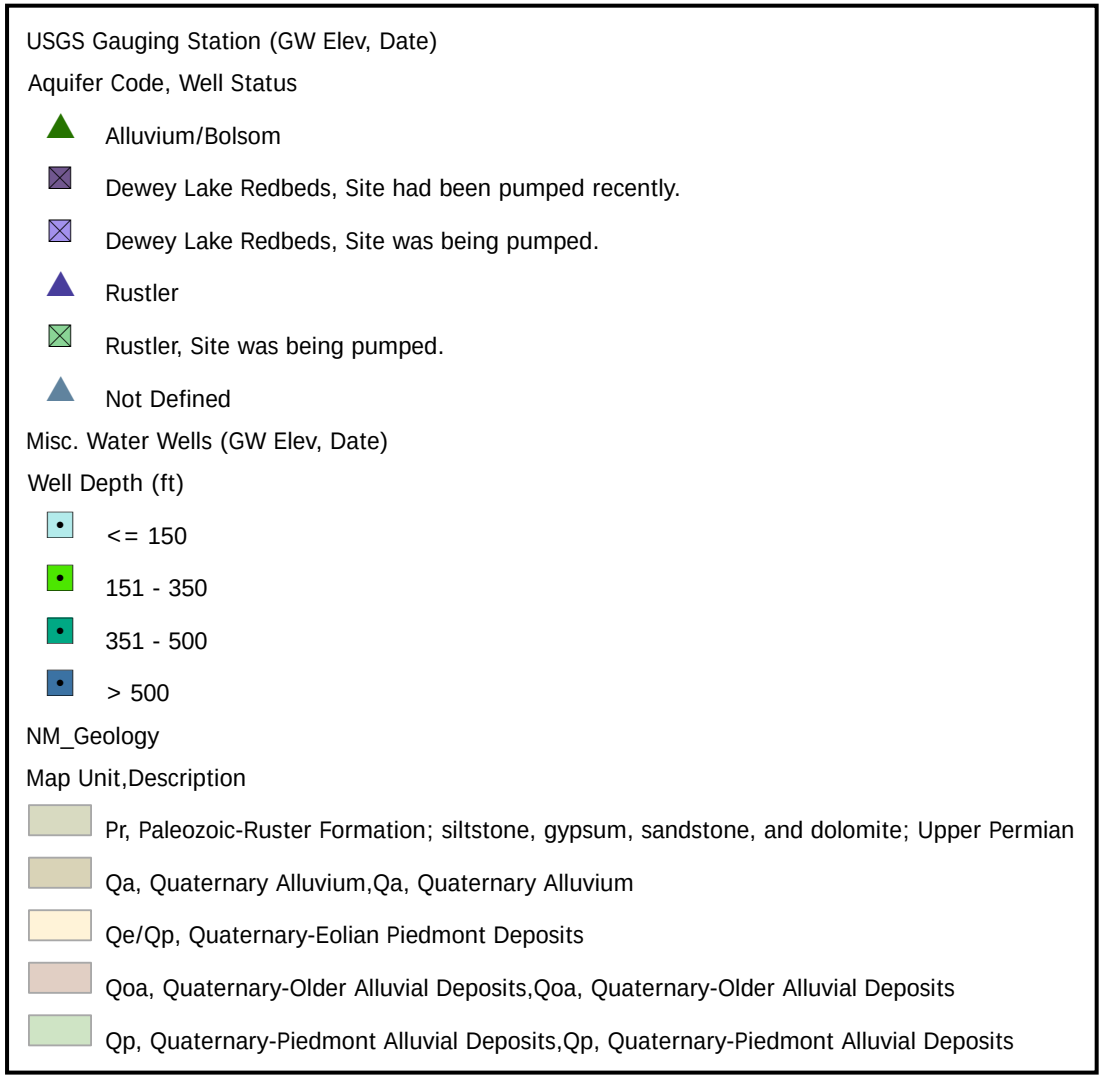
R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Nearby Wells and Borings with Depth to Water	Plate 1
	Vaughan Operating - Sand Dunes Containment	October 2024

P:\Cascade-McCutcheon Sand Dunes\Sand Dunes RF & Containments.aprx



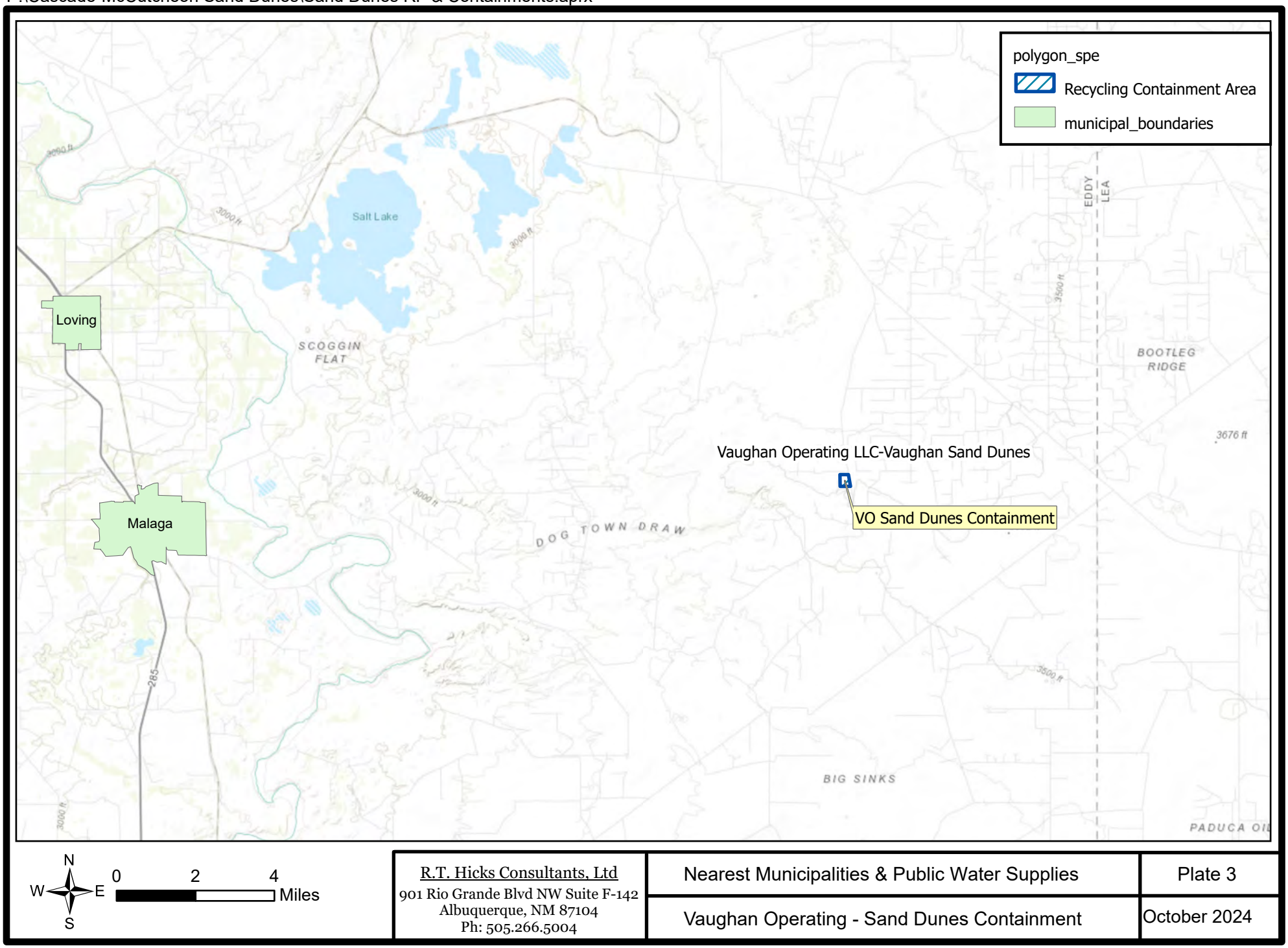
R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Groundwater Elevation & Geology USGS and MISC Data	Plate 2
	Vaughan Operating - Sand Dunes Containment	October 2024

P:\Cascade-McCutcheon Sand Dunes\Sand Dunes RF & Containments.aprx



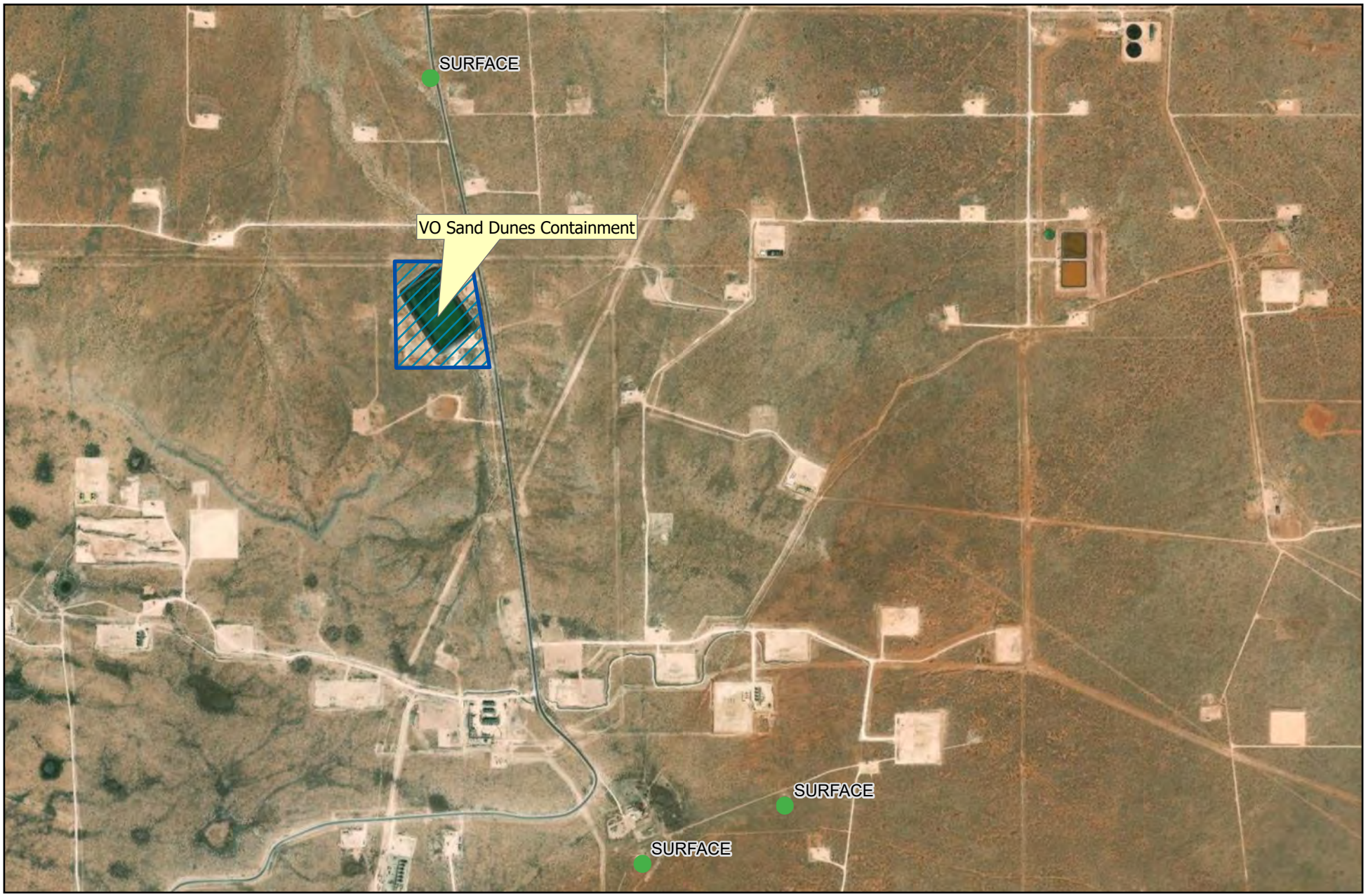
R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Legend Plates 1 & 2	
	Vaughan Operating - Sand Dunes Containment	October 2024

P:\Cascade-McCutcheon Sand Dunes\Sand Dunes RF & Containments.aprx



R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Nearest Municipalities & Public Water Supplies	Plate 3
	Vaughan Operating - Sand Dunes Containment	October 2024

P:\Cascade-McCutcheon Sand Dunes\Sand Dunes RF & Containments.aprx



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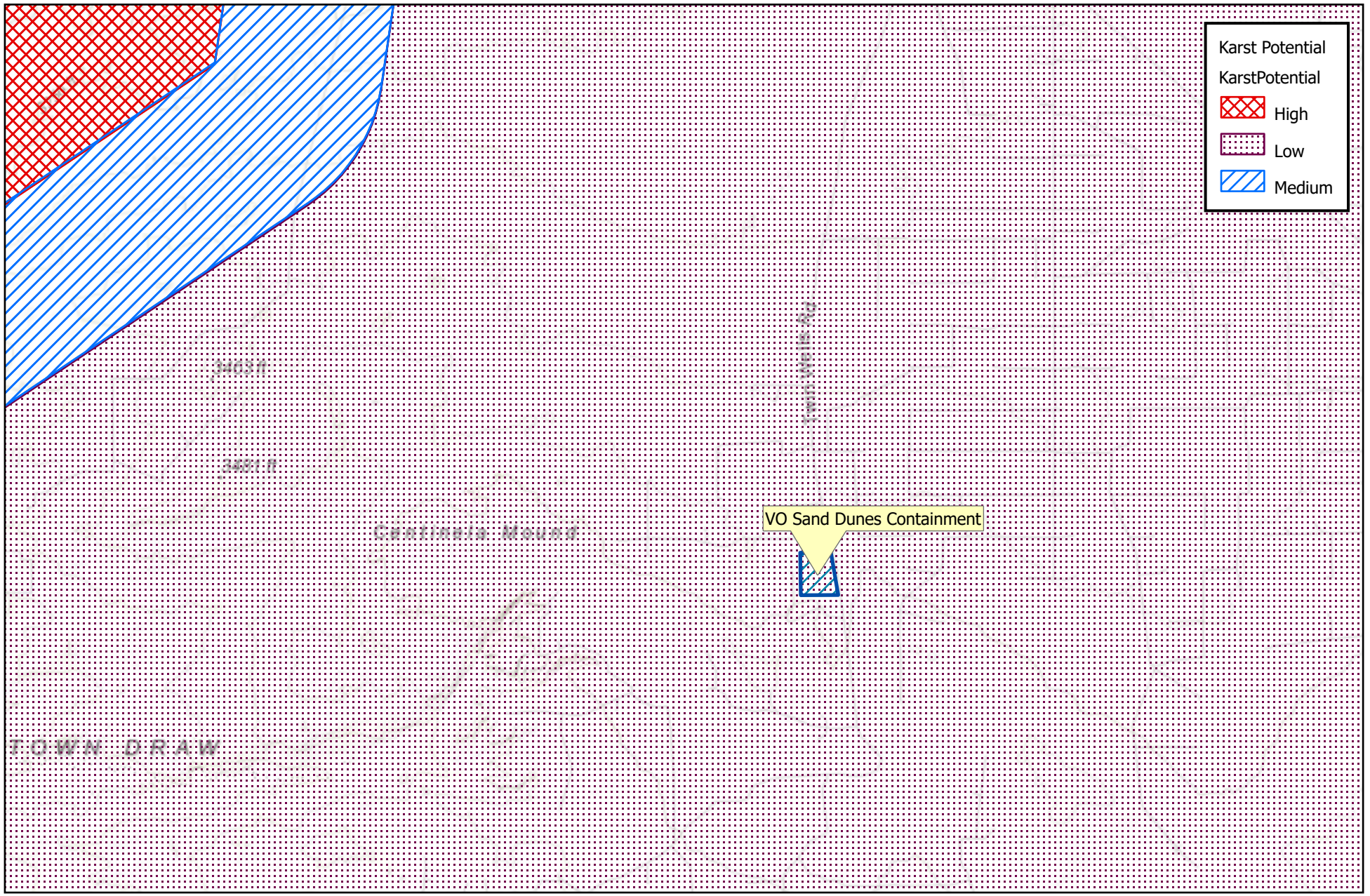
0 1,000 2,000 US Feet

R.T. Hicks Consultants, Ltd
901 Rio Grande Blvd NW Suite F-142
Albuquerque, NM 87104
Ph: 505.266.5004

Nearby Mines - Caliche Pits	Plate 4
Vaughan Operating - Sand Dunes Containment	October 2024

P:\Cascade-McCutcheon Sand Dunes\Sand Dunes RF & Containments.aprx



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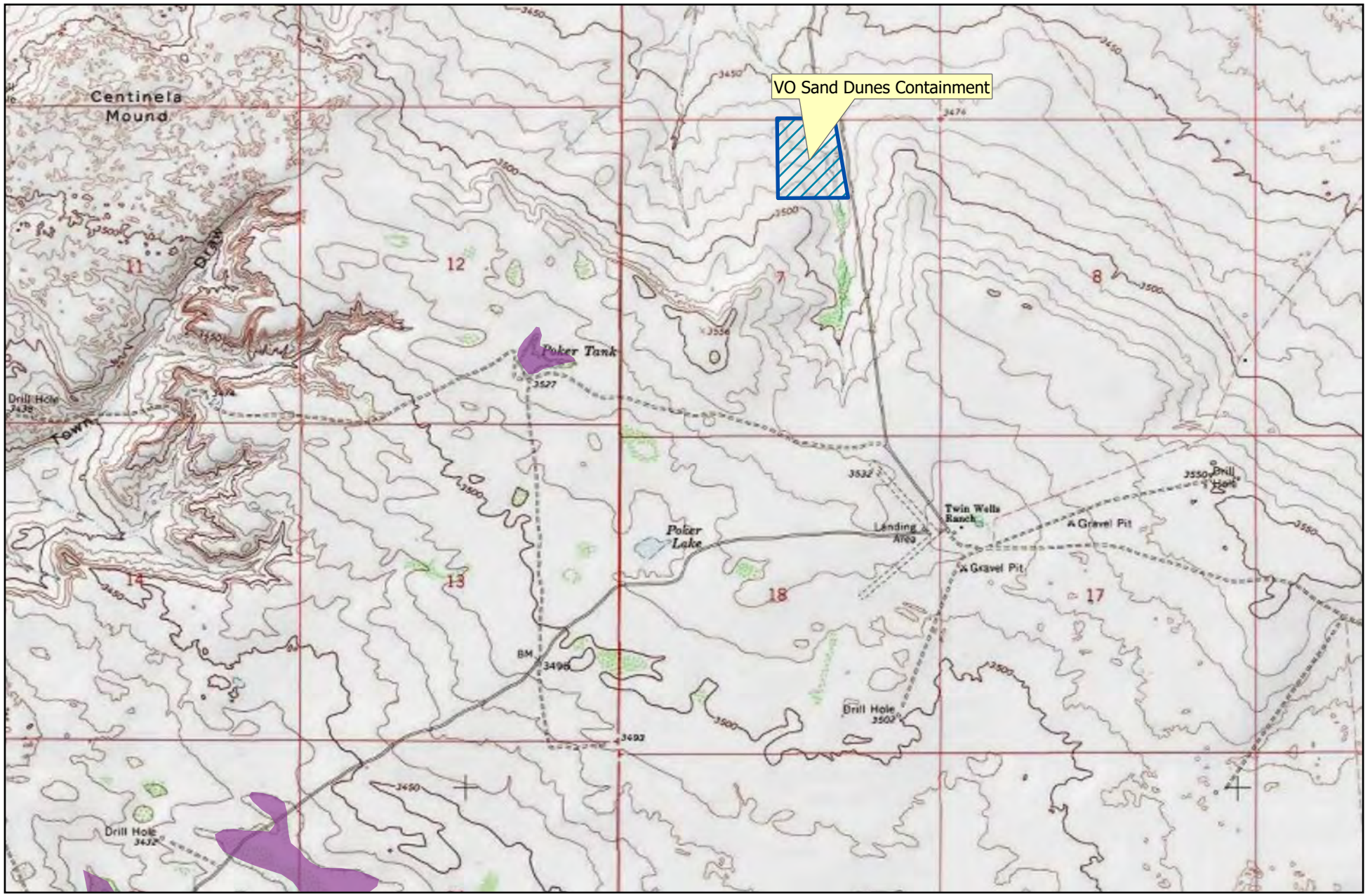
0 0.5 1 Miles

R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Nearest Municipalities & Public Water Supplies	Plate 5
	Vaughan Operating - Sand Dunes Containment	October 2024

P:\Cascade-McCutcheon Sand Dunes\Sand Dunes RF & Containments.aprx



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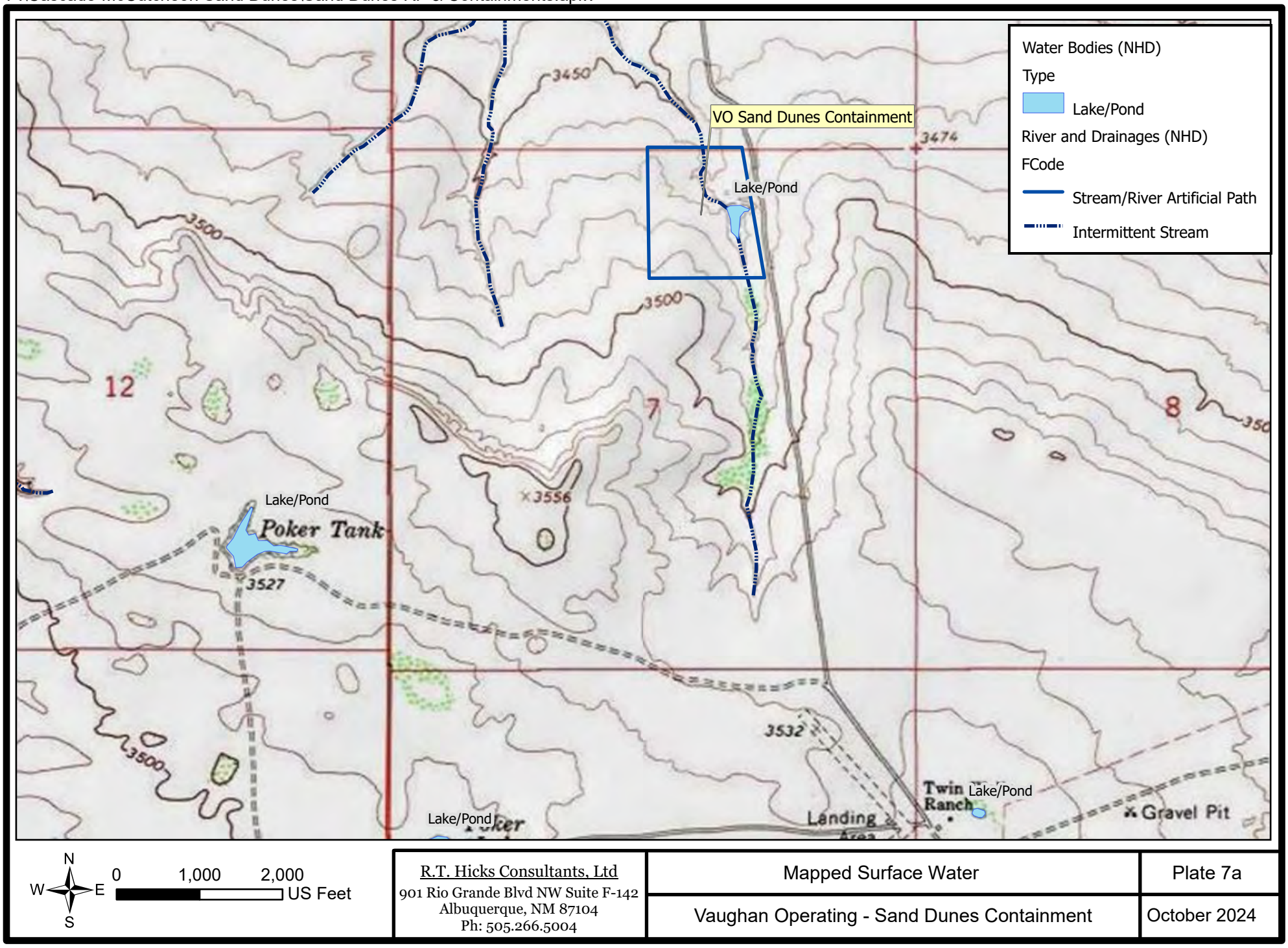
0 2,000 4,000 US Feet

R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	FEMA Mapped Flood Zones	Plate 6
	Example	October 2024

P:\Cascade-McCutcheon Sand Dunes\Sand Dunes RF & Containments.aprx



R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Mapped Surface Water	Plate 7a
	Vaughan Operating - Sand Dunes Containment	October 2024

P:\Cascade-McCutcheon Sand Dunes\Sand Dunes RF & Containments.aprx

N
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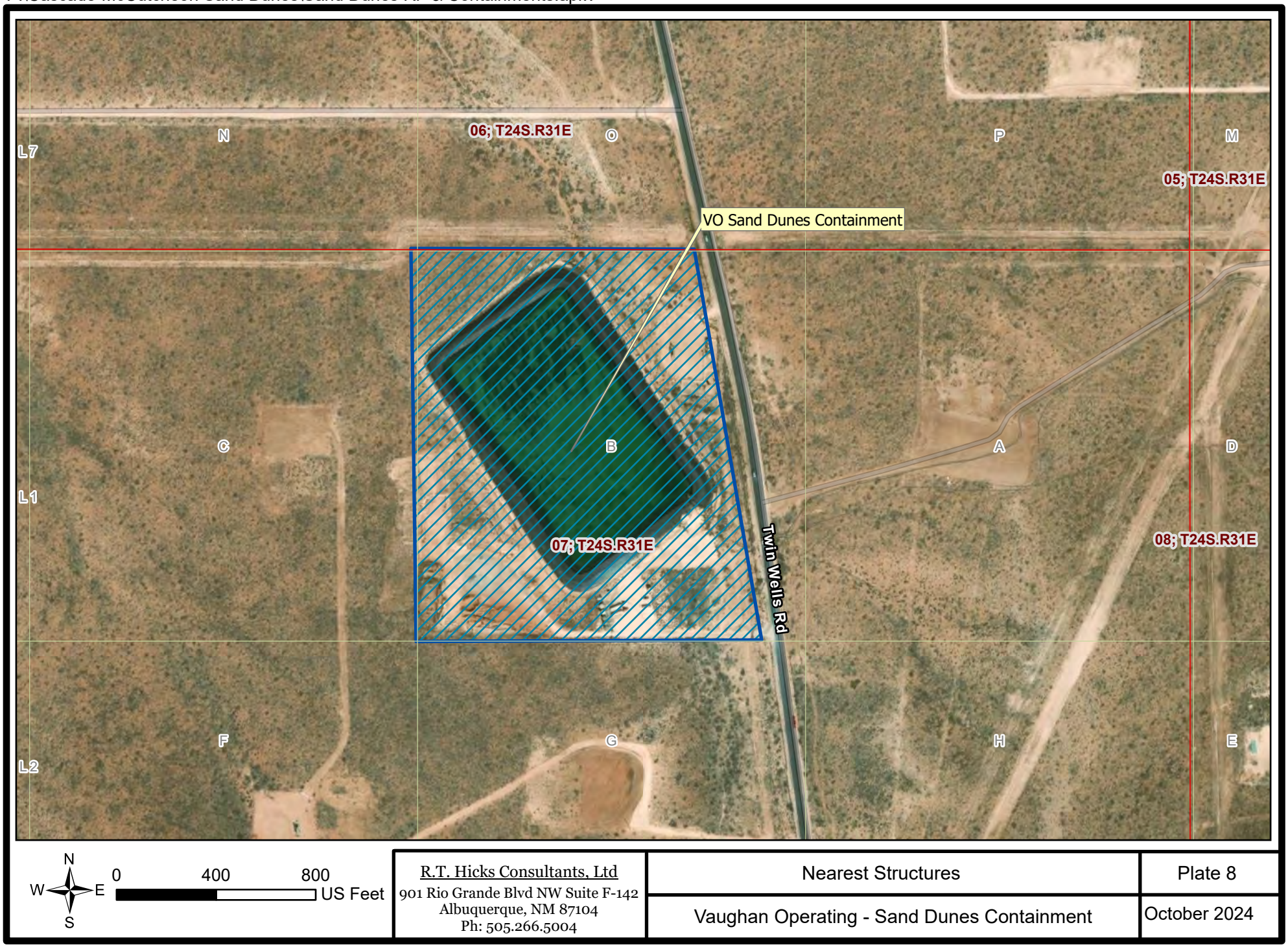
0 200 400 US Feet

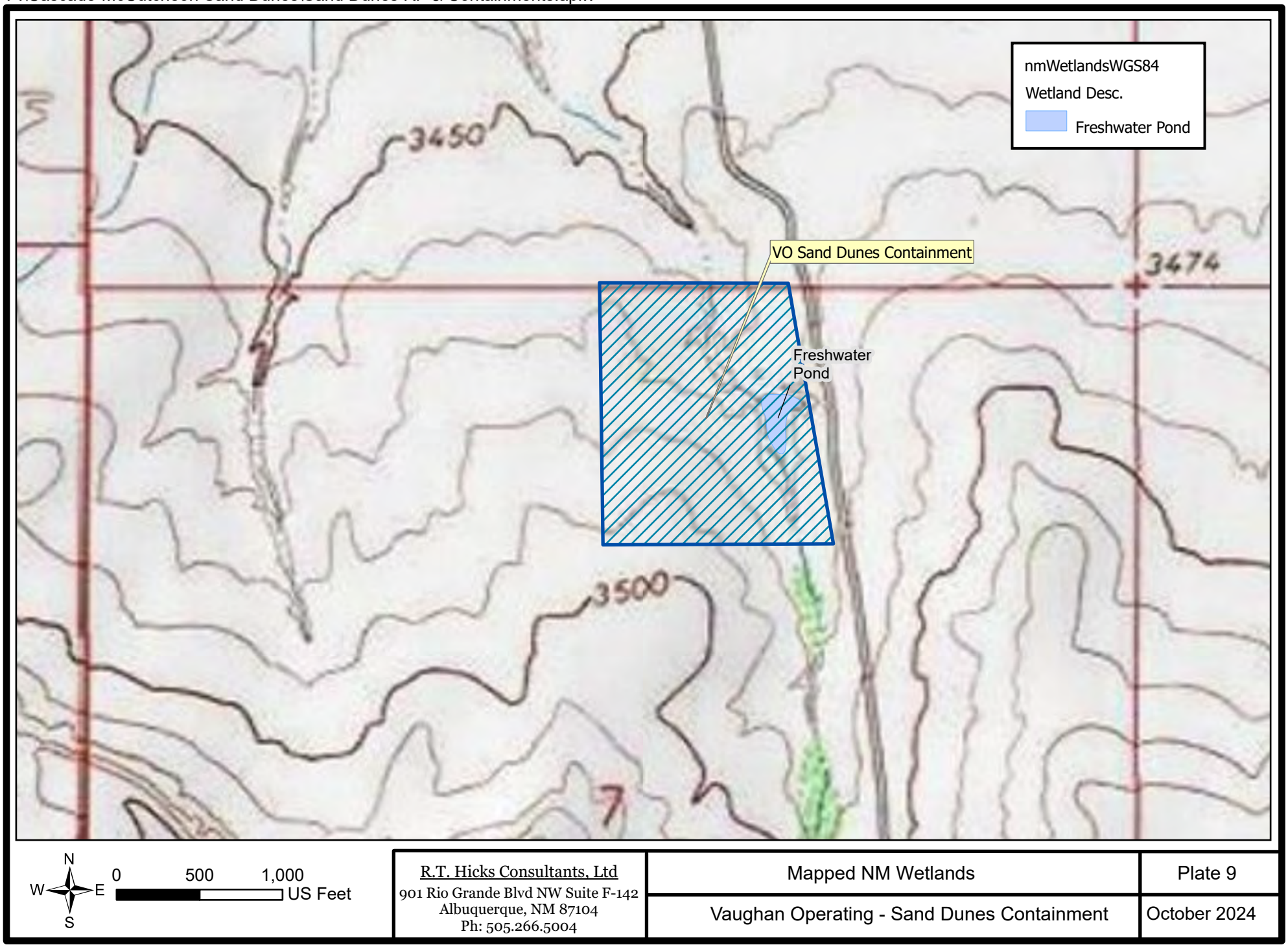
R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Mapped Surface Water	Plate 7b
	Vaughan Operating - Sand Dunes Containment	October 2024

P:\Cascade-McCutcheon Sand Dunes\Sand Dunes RF & Containments.aprx



R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Nearest Structures	Plate 8
	Vaughan Operating - Sand Dunes Containment	October 2024

P:\Cascade-McCutcheon Sand Dunes\Sand Dunes RF & Containments.aprx

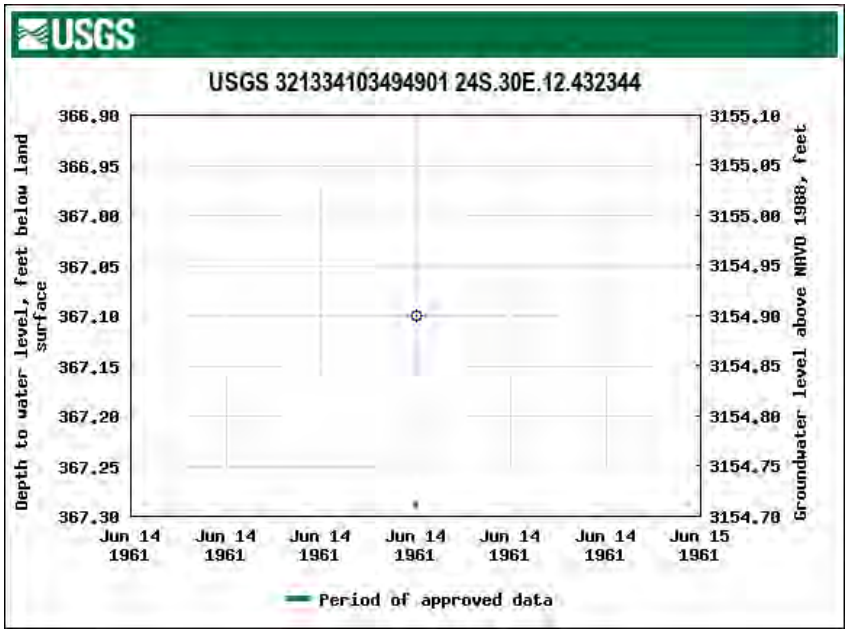


R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Mapped NM Wetlands	Plate 9
	Vaughan Operating - Sand Dunes Containment	October 2024

WELL LOGS AND USGS DATA

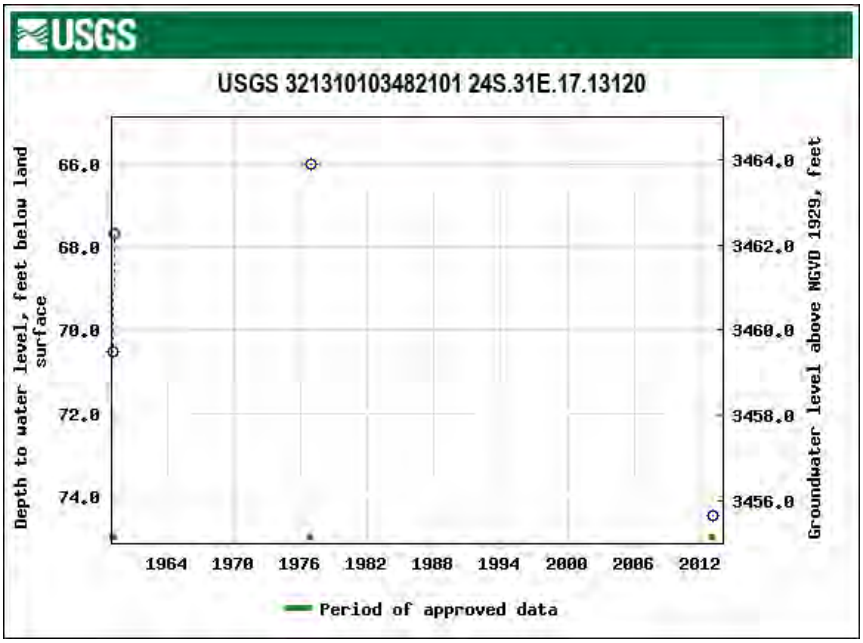
USGS 321334103494901 24S.30E.12.432344 AKA USGS-8924

Eddy County, New Mexico
Hydrologic Unit Code 13060011
Latitude 32°13'34",
Longitude 103°49'49" NAD27
Land-surface elevation 3,522 feet above NAVD88
The depth of the well is 500 feet below land surface.
This well is completed in the Other aquifers (N9999OTHER) national aquifer.
This well is completed in the Rustler Formation (312RSLR) local aquifer



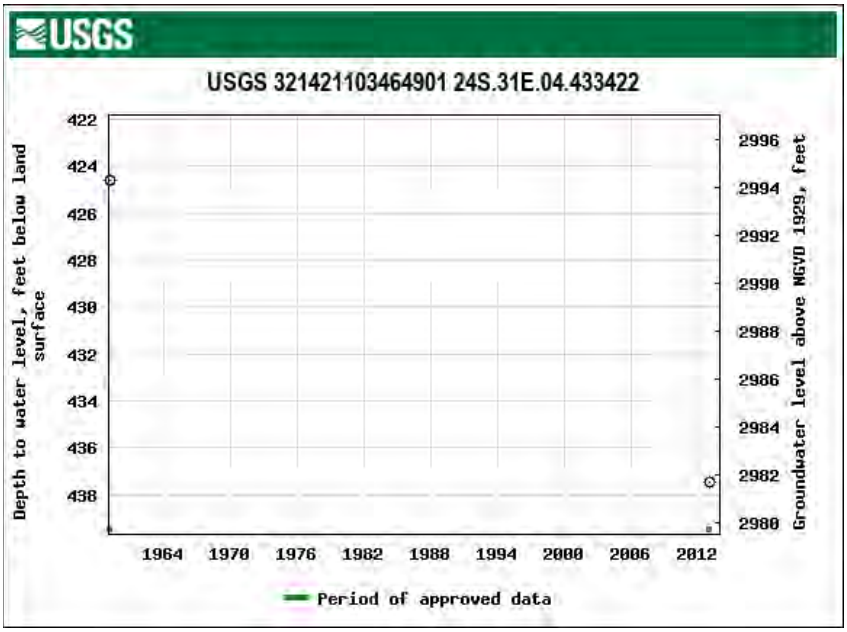
USGS 321310103482101 24S.31E.17.13120 AKA USGS-8899

Eddy County, New Mexico
Hydrologic Unit Code 13060011
Latitude 32°13'14.1",
Longitude 103°48'23.4" NAD83
Land-surface elevation 3,530.00 feet above NGVD29
This well is completed in the Other aquifers (N9999OTHER) national aquifer.
This well is completed in the Alluvium, Bolson Deposits and Other Surface Deposits (110AVMB) local aquifer.



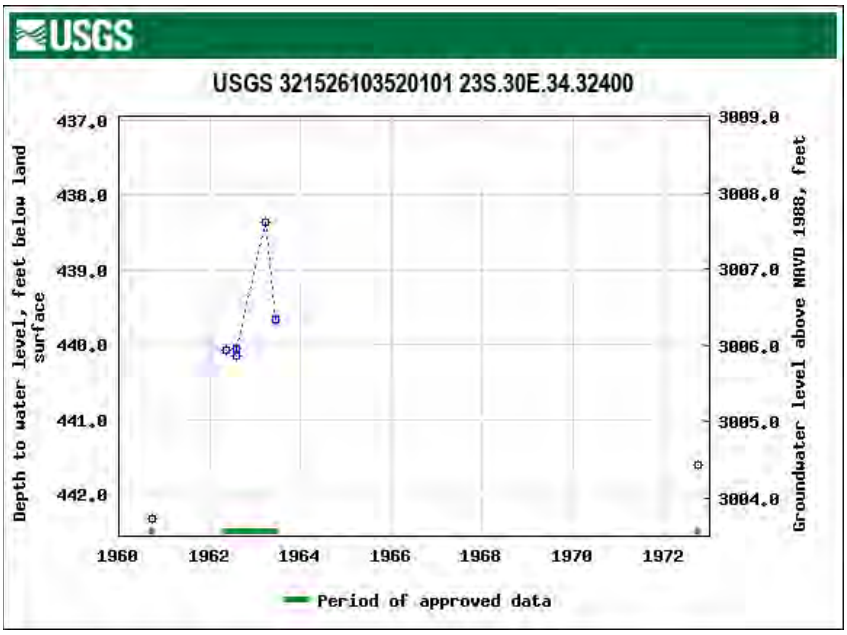
USGS 321421103464901 24S.31E.04.433422 AKA USGS-8847

Eddy County, New Mexico
Hydrologic Unit Code 13060011
Latitude 32°14'23.7",
Longitude 103°46'47.8" NAD83
Land-surface elevation 3,419.00 feet above NGVD29
The depth of the well is 627 feet below land surface.
This well is completed in the Other aquifers (N9999OTHER) national aquifer.
This well is completed in the Rustler Formation (312RSLR) local aquifer.



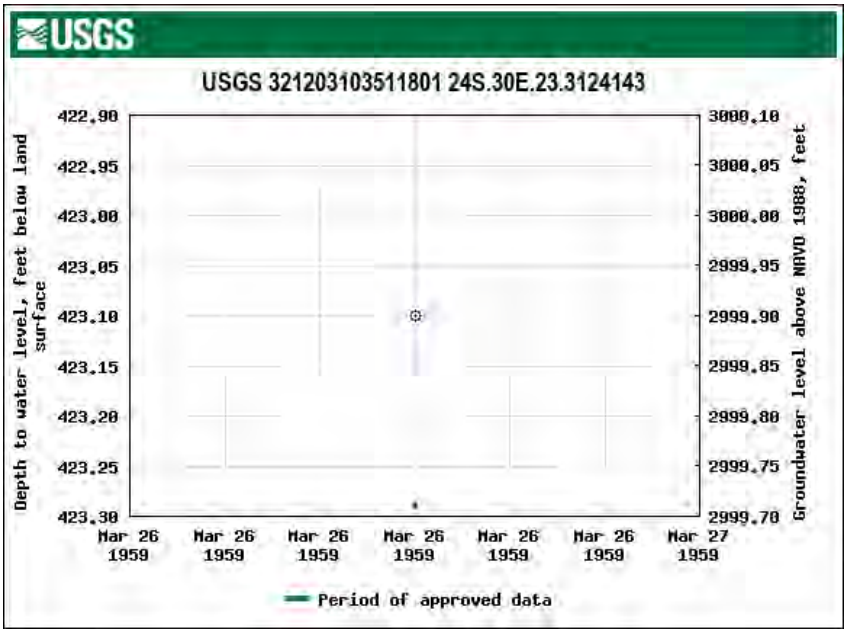
USGS 321526103520101 23S.30E.34.32400 AKA- USGS-9126

Eddy County, New Mexico
Hydrologic Unit Code 13060011
Latitude 32°15'26",
Longitude 103°52'01" NAD27
Land-surface elevation 3,446 feet above NAVD88
The depth of the well is 567 feet below land surface.
This well is completed in the Other aquifers (N9999OTHER) national aquifer.
This well is completed in the Rustler Formation (312RSLR) local aquifer.



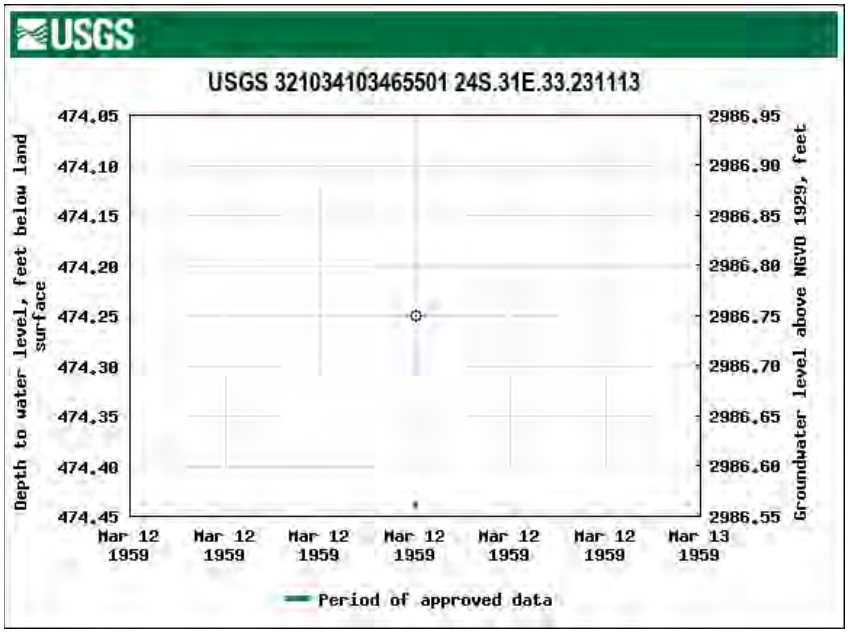
USGS 321203103511801 24S.30E.23.3124143 AKA USGS-8820

Eddy County, New Mexico
Hydrologic Unit Code 13060011
Latitude 32°12'03",
Longitude 103°51'18" NAD27
Land-surface elevation 3,423 feet above NAVD88
The depth of the well is 474 feet below land surface.
This well is completed in the Pecos River Basin alluvial aquifer (N100PCSRVR) national aquifer.
This well is completed in the Rustler Formation (312RSLR) local aquifer.



USGS 321034103465501 24S.31E.33.231113 AKA USGS-9014

Eddy County, New Mexico
Hydrologic Unit Code 13070001
Latitude 32°10'38.2",
Longitude 103°46'53.0" NAD83
Land-surface elevation 3,461.00 feet above NGVD29
The depth of the well is 740 feet below land surface.
This well is completed in the Other aquifers (N9999OTHER) national aquifer.
This well is completed in the Rustler Formation (312RSLR) local aquifer.



WELL RECORD & LOG

OFFICE OF THE STATE ENGINEER

www.ose.state.nm.us

OSE DIT JAN 24 2022 PM3:00

1. GENERAL AND WELL LOCATION

OSE POD NO. (WELL NO.)	WELL TAG ID NO.	OSE FILE NO(S).
POD1 (BH-01)	n/a	C-4575

WELL OWNER NAME(S)	PHONE (OPTIONAL)
XTO Energy (Kyle Littrell)	

WELL OWNER MAILING ADDRESS	CITY	STATE	ZIP
6401 Holiday Hill Dr.	Midland	TX	79707

WELL LOCATION (FROM GPS)		DEGREES	MINUTES	SECONDS	
	LATITUDE	32	12	38.03	N
	LONGITUDE	103	50	58.70	W

* ACCURACY REQUIRED: ONE TENTH OF A SECOND
* DATUM REQUIRED: WGS 84

DESCRIPTION RELATING WELL LOCATION TO STREET ADDRESS AND COMMON LANDMARKS – PLSS (SECTION, TOWNSHJIP, RANGE) WHERE AVAILABLE

NW NE Sec. 23 T24S R30E, NMPM

2. DRILLING & CASING INFORMATION

LICENSE NO.	NAME OF LICENSED DRILLER	NAME OF WELL DRILLING COMPANY
1249	Jackie D. Atkins	Atkins Engineering Associates, Inc.

DRILLING STARTED	DRILLING ENDED	DEPTH OF COMPLETED WELL (FT)	BORE HOLE DEPTH (FT)	DEPTH WATER FIRST ENCOUNTERED (FT)
1-4-2022	1-4-2022	temporary well material	105	n/a

COMPLETED WELL IS: ☐ ARTESIAN ☑ DRY HOLE ☐ SHALLOW (UNCONFINED)

STATIC WATER LEVEL IN COMPLETED WELL (FT): n/a

DRILLING FLUID: ☐ AIR ☐ MUD ADDITIVES – SPECIFY:

DRILLING METHOD: ☐ ROTARY ☐ HAMMER ☐ CABLE TOOL ☑ OTHER – SPECIFY: Hollow Stem Auger

DEPTH (feet bgl) FROM	DEPTH (feet bgl) TO	BORE HOLE DIAM (inches)	CASING MATERIAL AND/OR GRADE (include each casing string, and note sections of screen)	CASING CONNECTION TYPE (add coupling diameter)	CASING INSIDE DIAM. (inches)	CASING WALL THICKNESS (inches)	SLOT SIZE (inches)
0	105	±8.5	Boring- HSA	--	--	--	--

3. ANNULAR MATERIAL

DEPTH (feet bgl) FROM	DEPTH (feet bgl) TO	BORE HOLE DIAM. (inches)	LIST ANNULAR SEAL MATERIAL AND GRAVEL PACK SIZE-RANGE BY INTERVAL	AMOUNT (cubic feet)	METHOD OF PLACEMENT

FOR OSE INTERNAL USE

WR-20 WELL RECORD & LOG (Version 06/30/17)

FILE NO. C-4575	POD NO. 1	TRN NO. 709414	
LOCATION 2-1-1 24S-30E-23		WELL TAG ID NO. —	PAGE 1 OF 2

MON

OSE DII JAN 24 2022 PM 3:00

4. HYDROGEOLOGIC LOG OF WELL

DEPTH (feet bgl) FROM	DEPTH (feet bgl) TO	THICKNESS (feet)	COLOR AND TYPE OF MATERIAL ENCOUNTERED - INCLUDE WATER-BEARING CAVITIES OR FRACTURE ZONES (attach supplemental sheets to fully describe all units)	WATER BEARING? (YES / NO)	ESTIMATED YIELD FOR WATER-BEARING ZONES (gpm)
0	1	1	Caliche, White, Dry	Y ✓ N	
1	20	19	Sand, very fine grained, well graded, with caliche, Reddish Brown-Light Brown	Y N	
20	30	20	Caliche, consolidated with silt and some gravel, Off-White, Dry	Y ✓ N	
30	50	20	Sand, very fine grained, well graded, with gravel, Light Brown	Y ✓ N	
50	75	25	Sand, very fine grained, well graded, with gravel, Reddish Brown, slight moist	Y ✓ N	
75	105	30	Sand, very fine grained, poorly graded, Reddish Brown, slight moist	Y ✓ N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	

METHOD USED TO ESTIMATE YIELD OF WATER-BEARING STRATA:

☐ PUMP ☐ AIR LIFT ☐ BAILER ☐ OTHER – SPECIFY:

TOTAL ESTIMATED WELL YIELD (gpm): 0.00

5. TEST; RIG SUPERVISION

WELL TEST — TEST RESULTS - ATTACH A COPY OF DATA COLLECTED DURING WELL TESTING, INCLUDING DISCHARGE METHOD, START TIME, END TIME, AND A TABLE SHOWING DISCHARGE AND DRAWDOWN OVER THE TESTING PERIOD.

MISCELLANEOUS INFORMATION: Temporary well materials removed and the soil boring backfilled using drill cuttings from total depth to ten feet below ground surface, then hydrated bentonite chips from ten feet below ground surface to surface. Logs adapted from WSP on-site geologist.

PRINT NAME(S) OF DRILL RIG SUPERVISOR(S) THAT PROVIDED ONSITE SUPERVISION OF WELL CONSTRUCTION OTHER THAN LICENSEE:

Shane Eldridge, Cameron Pruitt, Carmelo Trevino

6. SIGNATURE

THE UNDERSIGNED HEREBY CERTIFIES THAT, TO THE BEST OF HIS OR HER KNOWLEDGE AND BELIEF, THE FOREGOING IS A TRUE AND CORRECT RECORD OF THE ABOVE DESCRIBED HOLE AND THAT HE OR SHE WILL FILE THIS WELL RECORD WITH THE STATE ENGINEER AND THE PERMIT HOLDER WITHIN 30 DAYS AFTER COMPLETION OF WELL DRILLING:

Jack Atkins — Jackie D. Atkins — 1/21/2022

SIGNATURE OF DRILLER / PRINT SIGNEE NAME — DATE

FOR OSE INTERNAL USE — WR-20 WELL RECORD & LOG (Version 06/30/2017)

FILE NO. C-4573	POD NO. 1	TRN NO. 709414	
LOCATION 2-1-1 24S-30E-23		WELL TAG ID NO.	PAGE 2 OF 2

MON

WELL RECORD & LOG

OFFICE OF THE STATE ENGINEER

www.ose.state.nm.us

1. GENERAL AND WELL LOCATION

OSE POD NO. (WELL NO.)	WELL TAG ID NO.	OSE FILE NO(S).
~~C-4646~~-POD1		C-4646

WELL OWNER NAME(S)	PHONE (OPTIONAL)
XTO ENERGY INC	575-200-0729

WELL OWNER MAILING ADDRESS	CITY	STATE	ZIP
3104 E GREENE ST	CARLSBAD	NM	88220

WELL LOCATION (FROM GPS)		DEGREES	MINUTES	SECONDS	
	LATITUDE	32	15	14.15	N
	LONGITUDE	-103	49	59.52	W

* ACCURACY REQUIRED: ONE TENTH OF A SECOND
* DATUM REQUIRED: WGS 84

DESCRIPTION RELATING WELL LOCATION TO STREET ADDRESS AND COMMON LANDMARKS – PLSS (SECTION, TOWNSHIP, RANGE) WHERE AVAILABLE

2. DRILLING & CASING INFORMATION

LICENSE NO.	NAME OF LICENSED DRILLER	NAME OF WELL DRILLING COMPANY
WD-1184	RUSSELL SOUTHERLAND	WEST TEXAS WATER WELL SERVICE

DRILLING STARTED	DRILLING ENDED	DEPTH OF COMPLETED WELL (FT)	BORE HOLE DEPTH (FT)	DEPTH WATER FIRST ENCOUNTERED (FT)
08/09/2022	08/09/2022	110		

COMPLETED WELL IS: ☐ ARTESIAN ☑ DRY HOLE ☐ SHALLOW (UNCONFINED)

STATIC WATER LEVEL IN COMPLETED WELL (FT): N/A

DRILLING FLUID: ☑ AIR ☐ MUD ADDITIVES – SPECIFY:

DRILLING METHOD: ☑ ROTARY ☐ HAMMER ☐ CABLE TOOL ☐ OTHER – SPECIFY:

DEPTH (feet bgl) FROM	DEPTH (feet bgl) TO	BORE HOLE DIAM (inches)	CASING MATERIAL AND/OR GRADE (include each casing string, and note sections of screen)	CASING CONNECTION TYPE (add coupling diameter)	CASING INSIDE DIAM. (inches)	CASING WALL THICKNESS (inches)	SLOT SIZE (inches)
			NO CASING IN HOLE				

3. ANNULAR MATERIAL

DEPTH (feet bgl) FROM	DEPTH (feet bgl) TO	BORE HOLE DIAM. (inches)	LIST ANNULAR SEAL MATERIAL AND GRAVEL PACK SIZE-RANGE BY INTERVAL	AMOUNT (cubic feet)	METHOD OF PLACEMENT
			N/A		

FOR OSE INTERNAL USE

WR-20 WELL RECORD & LOG (Version 04/30/19)

FILE NO. C-4646-POD1	POD NO. 1	TRN NO. 727924
LOCATION mon. 24.30.01.121	WELL TAG ID NO.	PAGE 1 OF 2

OSE DIT SEP 15 2022 PM1:36

4. HYDROGEOLOGIC LOG OF WELL

DEPTH (feet bgl) FROM	DEPTH (feet bgl) TO	THICKNESS (feet)	COLOR AND TYPE OF MATERIAL ENCOUNTERED - INCLUDE WATER-BEARING CAVITIES OR FRACTURE ZONES (attach supplemental sheets to fully describe all units)	WATER BEARING? (YES / NO)	ESTIMATED YIELD FOR WATER-BEARING ZONES (gpm)
0	10		RED SAND	Y ✔ N	
10	15		CALICHIE	Y ✔ N	
15	20		RED SANDSTONE	Y ✔ N	
20	50		RED CLAY	Y ✔ N	
50	90		RED CLAY W/SAND STREAKS	Y ✔ N	
90	110		RED SANDY CLAY	Y ✔ N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	

METHOD USED TO ESTIMATE YIELD OF WATER-BEARING STRATA:

☐ PUMP ☐ AIR LIFT ☐ BAILER ☑ OTHER – SPECIFY: DRY HOLE

TOTAL ESTIMATED WELL YIELD (gpm): 0.00

5. TEST; RIG SUPERVISION

WELL TEST — TEST RESULTS - ATTACH A COPY OF DATA COLLECTED DURING WELL TESTING, INCLUDING DISCHARGE METHOD, START TIME, END TIME, AND A TABLE SHOWING DISCHARGE AND DRAWDOWN OVER THE TESTING PERIOD.

MISCELLANEOUS INFORMATION:

PRINT NAME(S) OF DRILL RIG SUPERVISOR(S) THAT PROVIDED ONSITE SUPERVISION OF WELL CONSTRUCTION OTHER THAN LICENSEE:

RUSSELL SOUTHERLAND

6. SIGNATURE

BY SIGNING BELOW, I CERTIFY THAT TO THE BEST OF MY KNOWLEDGE AND BELIEF, THE FOREGOING IS A TRUE AND CORRECT RECORD OF THE ABOVE DESCRIBED WELL. I ALSO CERTIFY THAT THE WELL TAG, IF REQUIRED, HAS BEEN INSTALLED AND THAT THIS WELL RECORD WILL ALSO BE FILED WITH THE PERMIT HOLDER WITHIN 30 DAYS AFTER THE COMPLETION OF WELL DRILLING.

Russell Southerland — RUSSELL SOUTHERLAND — 08/09/2022

SIGNATURE OF DRILLER / PRINT SIGNEE NAME — DATE

FOR OSE INTERNAL USE — WR-20 WELL RECORD & LOG (Version 04/30/2019)

FILE NO. C-4646 POD 1	POD NO. 1	TRN NO. 727924	
LOCATION Mon 24.30.01.121		WELL TAG ID NO. —	PAGE 2 OF 2

OSE DII SEP 15 2022 PM 1:36

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

465596

Section 1. GENERAL INFORMATION

'95 MAY 23 AM 12:09

STATE ENGINEER OFFICE
SANTA FE NEW MEXICO

(A) Owner of well Sonat Exploration Owner's Well No. C-2440

Street or Post Office Address 110 W. Louisiana, Suite 500

City and State Midland, TX 79701

Well was drilled under Permit No. _____ and is located in the:

a. NE ¼ SW ¼ ____ ¼ ____ ¼ of Section 10 Township 24S Range 31E N.M.P.M.
Eddy Co.

b. Tract No. _____ of Map No. _____ of the _____

c. Lot No. _____ of Block No. _____ of the _____
Subdivision, recorded in _____ County.

d. X= _____ feet, Y= _____ feet, N.M. Coordinate System _____ Zone in the _____ Grant.

(B) Drilling Contractor West Texas Water Well Service License No. WD 1184

Address 3432 W. University Odessa, TX 79764

Drilling Began 03-20-95 Completed 03-21-95 Type tools air rotary Size of hole 8 3/4 in.

Elevation of land surface or _____ at well is _____ ft. Total depth of well 350 ft.

Completed well is ☐ shallow ☐ artesian. Depth to water upon completion of well _____ ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
			No water encountered formation log on back	

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

Section 5. PLUGGING RECORD

Plugging Contractor West Texas Water Well Service

Address 3432 W. University, Odessa, TX 79764

Plugging Method pumped cement slurry

Date Well Plugged 03-22-95

Plugging approved by:

_____
State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1	0	350	133
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received 04-25-95

Quad _____ FWL _____ FSL _____

File No. C-2440 Use "Dry Hole" OWD Location No. 24S.31E.10.32433

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	9	9	Sand
9	15	6	Caliche
15	38	23	Sand
38	45	7	Caliche
45	210	165	Brown sandy shale
210	350	140	Dark brown sandstone (hard - no water)

Section 7. REMARKS AND ADDITIONAL INFORMATION

STATE ENGINEER OFFICE
ROSWELL NEW MEXICO
'95 APR 25 AM 10 26

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Robert E. Chandler
Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

WELL RECORD & LOG

OFFICE OF THE STATE ENGINEER

www.ose.state.nm.us

1. GENERAL AND WELL LOCATION

OSE POD NO. (WELL NO.)	WELL TAG ID NO.	OSE FILE NO(S).
POD1 (BH-01)	n/a	C-4508

WELL OWNER NAME(S)	PHONE (OPTIONAL)
XTO Energy (Kyle Littrell)	

WELL OWNER MAILING ADDRESS	CITY	STATE	ZIP
6401 Holiday Hill Dr.	Midland	TX	79707

WELL LOCATION (FROM GPS)		DEGREES	MINUTES	SECONDS	
	LATITUDE	32°	12'	46.69"	N
	LONGITUDE	-103°	45'	55.29"	W

* ACCURACY REQUIRED: ONE TENTH OF A SECOND
* DATUM REQUIRED: WGS 84

DESCRIPTION RELATING WELL LOCATION TO STREET ADDRESS AND COMMON LANDMARKS – PLSS (SECTION, TOWNSHJIP, RANGE) WHERE AVAILABLE

SW SE Sec. 15 T24S R31E

2. DRILLING & CASING INFORMATION

LICENSE NO.	NAME OF LICENSED DRILLER	NAME OF WELL DRILLING COMPANY
1249	Jackie D. Atkins	Atkins Engineering Associates, Inc.

DRILLING STARTED	DRILLING ENDED	DEPTH OF COMPLETED WELL (FT)	BORE HOLE DEPTH (FT)	DEPTH WATER FIRST ENCOUNTERED (FT)
12/29/2020	12/29/2020	temporary well material	110	n/a

COMPLETED WELL IS: ☐ ARTESIAN ☑ DRY HOLE ☐ SHALLOW (UNCONFINED) — STATIC WATER LEVEL IN COMPLETED WELL (FT): n/a

DRILLING FLUID: ☐ AIR ☐ MUD ADDITIVES – SPECIFY:

DRILLING METHOD: ☐ ROTARY ☐ HAMMER ☐ CABLE TOOL ☑ OTHER – SPECIFY: Hollow Stem Auger

DEPTH (feet bgl) FROM	DEPTH (feet bgl) TO	BORE HOLE DIAM (inches)	CASING MATERIAL AND/OR GRADE (include each casing string, and note sections of screen)	CASING CONNECTION TYPE (add coupling diameter)	CASING INSIDE DIAM. (inches)	CASING WALL THICKNESS (inches)	SLOT SIZE (inches)
0	110	±8.5	Boring- HSA	--	--	--	--

3. ANNULAR MATERIAL

DEPTH (feet bgl) FROM	DEPTH (feet bgl) TO	BORE HOLE DIAM. (inches)	LIST ANNULAR SEAL MATERIAL AND GRAVEL PACK SIZE-RANGE BY INTERVAL	AMOUNT (cubic feet)	METHOD OF PLACEMENT

FOR OSE INTERNAL USE — WR-20 WELL RECORD & LOG (Version 06/30/17)

FILE NO. C-4508	POD NO. 1	TRN NO. 108665	
LOCATION Exp 1 24S.31E.15.344		WELL TAG ID NO. —	PAGE 1 OF 2

4. HYDROGEOLOGIC LOG OF WELL

DEPTH (feet bgl) FROM	DEPTH (feet bgl) TO	THICKNESS (feet)	COLOR AND TYPE OF MATERIAL ENCOUNTERED - INCLUDE WATER-BEARING CAVITIES OR FRACTURE ZONES (attach supplemental sheets to fully describe all units)	WATER BEARING? (YES / NO)	ESTIMATED YIELD FOR WATER-BEARING ZONES (gpm)
0	14	14	SAND, medium-fine grain, poorly graded,someclaiche, light-brown-tan,dry	Y ✓ N	
14	15	1	SAND, fine grain, poorly graded,someclaiche, light-brown-tan,dry	Y ✓ N	
15	25	5	CALICHE, moderately consolidated,silty, some gravel, off-white-tan, dry	Y ✓ N	
25	46	21	SILTSTONE, mod. consolidated, some sand, red-brown, dry	Y ✓ N	
46	64	18	CLAYSTONE, mod. consolidated, cohesive, few sand, red-brown, dry	Y ✓ N	
64	72	8	SANDSTONE, high consolidated, medium-grain, well graded,white/lightbrown	Y ✓ N	
72	90	18	CLAYSTONE, high consolidated, cohesive, medium plasticity, few sand, red-br	Y ✓ N	
90	101	11	SANDSTONE, high consolidated, fine grain, few silt,white/offwhite	Y ✓ N	
101	108	7	CLAYSTONE, high consolidated, cohesive, med.-low plasticity, few sand, red-b	Y ✓ N	
108	111	3	SANDSTONE, high consolidated, fine grain, few silt, white/offwhite, dry	Y ✓ N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	

METHOD USED TO ESTIMATE YIELD OF WATER-BEARING STRATA:

☐ PUMP ☐ AIR LIFT ☐ BAILER ☐ OTHER – SPECIFY:

TOTAL ESTIMATED WELL YIELD (gpm): 0.00

5. TEST; RIG SUPERVISION

WELL TEST — TEST RESULTS - ATTACH A COPY OF DATA COLLECTED DURING WELL TESTING, INCLUDING DISCHARGE METHOD, START TIME, END TIME, AND A TABLE SHOWING DISCHARGE AND DRAWDOWN OVER THE TESTING PERIOD.

MISCELLANEOUS INFORMATION: Temporary well materials removed and the soil boring backfilled using drill cuttings from total depth to ten feet below ground surface, then hydrated bentonite chips from ten feet below ground surface to surface. Logs adapted from WSP on-site geologist.

PRINT NAME(S) OF DRILL RIG SUPERVISOR(S) THAT PROVIDED ONSITE SUPERVISION OF WELL CONSTRUCTION OTHER THAN LICENSEE:

Shane Eldridge

6. SIGNATURE

THE UNDERSIGNED HEREBY CERTIFIES THAT, TO THE BEST OF HIS OR HER KNOWLEDGE AND BELIEF, THE FOREGOING IS A TRUE AND CORRECT RECORD OF THE ABOVE DESCRIBED HOLE AND THAT HE OR SHE WILL FILE THIS WELL RECORD WITH THE STATE ENGINEER AND THE PERMIT HOLDER WITHIN 30 DAYS AFTER COMPLETION OF WELL DRILLING:

Jack Atkins — Jackie D. Atkins — 02/11/2021

SIGNATURE OF DRILLER / PRINT SIGNEE NAME — DATE

FOR OSE INTERNAL USE — WR-20 WELL RECORD & LOG (Version 06/30/2017)

FILE NO. C-4508	POD NO. 1	TRN NO. 686651	
LOCATION		WELL TAG ID NO. —	PAGE 2 OF 2

OSE DII FEB 12 2021 PM3:10

SITE PHOTOGRAHS

Google Earth image showing location of all site photos. Not all are described below.

9WC on map - View north in center of mapped watercourse from the north boundary of proposed Sand Dunes F & Containments. Twin Wells Road and power lines are on left and western edge of drainage is on right. Deposition of sand is present in the drainage in the center, below the horizon. Patches of past deposition occurs within the channel. No stream bed or bank could be defined from walking the channel shown in this image.

11 SE – View south showing the South Containment levee on the left, Twin Wells road on the right, and the levee of the North Containment in the upper right of the image. The mapped watercourse lies between the road and the levees. There is no evidence of water flow in this image or a defined bed and bank. All these images of the mapped watercourse are from the center of the mapped channel.

15 WCn - View north (downhill). The eastern levee of the South Containment is visible in the center of the image and Twin Wells Road with the power lines is on the right. The sand deposition caused by water flow is evident in this image. There is no evidence of a defined bed and bank.

15 WCs - View south from same location as above showing nature of the mapped watercourse. The swale that is the watercourse is wider and appears to have a lower gradient at this location than the image above. There is no evidence of a defined bed and bank of an intermittent stream.

16 WC View north. The more abundant vegetation within the channel testifies to differences in soil and water content due to occasional flow. This image show no erosion, deposition or any evidence of a defined bed and bank. The white truck in the NE corner is on Twin Wells Road.

15 WC View south. The difference of vegetation between the channel and the land east of the channel (right) is obvious in this image.

3-NEcorner - View south of mapped watercourse downstream from the containment area. The channel is shallow and wide in this area. Twin Wells Road is in the upper right corner of the image.

6-WC - View north-northwest downhill from a lease road from where this image was shot. The lease road was widened and improved between March 2022 and December 2023. The nature of the bed and banks of this watercourse are markedly different from earlier images. Looking at Google Earth images (2005-2023), there is no evidence of damage to this lease road due to stormwater flow. This may be evidence of an older event, but a defined bed and bank is evident.

15-Quarry - View east from the caliche pit quarry location with the western levee of the North frac pond in the background.

15-Quarry - View north from location above

12 PondFromQuarry - View north toward the North fresh water frac pond form the edge of the quarry.

7 New Pond - View east from tank batteries to the south fresh water frac pond at location.

November 2024

Rule 34 Permit
Sand Dunes RF & Containments
Section 7, T24S, R31E, Eddy County

Volume 2
Engineering Measures

- **Statement of Design Engineer**
- **Basin Stormwater Flow Analysis**
- **Stormwater Conveyance Design**

View south (upstream) from center of mapped watercourse at the southern boundary of the area planned for conversion of fresh water frac ponds to Rule 34 containments.

Prepared for:
Vaughan Operating, LLC
Carlsbad, NM

Prepared by:

R.T. Hicks Consultants, Ltd.
Albuquerque, New Mexico

Cascade Services LLC
Midland, Texas

squarerootservices.net
7921 N World Dr
Hobbs, NM 88242

November 7, 2024

To whom it may concern

RE: Sand Dunes RF & Containments

Square Root Services has conducted a Hydrology study of the Sand Dunes RF & Containments. The study consists of analyzing the 500-year stormwater event for the drainage basin associated with the watercourse that now flows east of the proposed containment as shown on the Civil plan set. Part of the study was to design a proposed channel that will protect the integrity of the levees in the event of the 500-year storm event. The conveyance channel will also reroute the runoff back to its original flowing path.

To reduce the damage caused by erosion, check dams were added to the design to be installed in the along the channel at 100 feet intervals. The check dams will act as small barriers to slow the velocity of the water and reduce erosion damage. Per the Civil Plan set shown, Riprap Class C is specified per New Mexico Department of Transportation standards. Class C was selected to help stabilize the channel by increasing the surface roughness and slowing the velocity of the water running through the channel.

For the purpose of this study, the Rational Method was used for the analysis as is traditionally accepted by many jurisdictions, including the New Mexico Department of Transportation. The Rational Method was selected due to the size of the watershed, less than 200 acres, as well as the terrain not having any diversions, detention basins or structures. The drainage channel releases the flow back into the original drainage path.

The design of the channel consisted of having capacity to convey the 500-year storm event with a geometry of a minimum depth of 3 feet, width of 30 feet and 3:1 side slopes. The design can withstand storm event with a flood depth of 2.44 feet, conveying 325 cubic feet per second. The channel has a maximum capacity of 325 cubic feet per second.

If the Oil Conservation Division has questions concerning the Drainage Study please feel free to contact with any additional questions.

Respectfully submitted,

Jeremy Baker

JEREMY BAKER NEW MEXICO 16207 LICENSED PROFESSIONAL ENGINEER

Jeremy Baker, P.E.
President/CEO

BASIN STORMWATER FLOW ANALYSIS

SAND DUNES RECYCLE FACILITY

DRAINAGE STUDY

EDDY COUNTY, NEW MEXICO
OCTOBER 30, 2024

SquareRoot services
Engineering | Surveying
Materials Testing

7921 N World Dr, Hobbs, NM 88242
Office: (575) 631-6943
squarerootservices.net

DRAINAGE STUDY

SAND DUNES RECYCLE FACILITY

EDDY COUNTY, NEW MEXICO

Prepare for

VAUGHAN OPERATING, LLC

October 18, 2024

This document was prepared under the supervision and direction of the undersigned whose seal as a Professional Engineer, licensed to practice as such in the State of New Mexico, is affixed below.

Jeremy Baker, P.E.
President/CEO

16207
NMPE Number

11/05/2024
Date

Introduction

A drainage investigation was completed for an area containing +/- 161.62 acres, which includes the recycle facility that was built on top of a riverine and wetland area, that has been identified by the New Mexico Environmental Department. Location of existing riverine and wetland area can be seen on Appendix A. This report will address all findings obtained during the drainage investigation and identify drainage characteristics pertaining to the project site.

Scope

The intend of this investigation is to identify the run-off produced in the existing conditions before the recycle facility was constructed and re-routing it to its original path.

Methodology

This drainage analysis was completed using the Standard Rational Method. The calculations for the hydrologic analysis were computed using the Hydrology Studio Software. The calculations for the hydraulic analysis were computed using Hydraflow Express Extension for Autodesk.

Site Characteristics

Rainfall

Precipitation information was obtained from the environmental data services record by National Oceanic and Atmospheric Administration (N.O.A.A.). Utilizing N.O.A.A.'s Precipitation Frequency Data Server (Atlas 14, Volume 1, Version 5), the precipitation frequency estimates for the project area were obtained. The geographical coordinates for the project area are Eddy County, New Mexico, USA, Latitude 32.2373° N and Longitude -103.8148° W. The local NOAA rainfall determination summary for this development is provided in Appendix B. The 24-hour duration rainfall totals for this development are as follows:

Table 1

Eddy County, NM Rainfall Summary		
Duration	Average Recurrence Interval	
	100 Year	500 Year
24- Hour	0.243 in/hr	.324 in/hr

Terrain

The project area is comprised of undeveloped land consisting of dessert brush vegetation. Twin Wells Road runs North to South and parallel to the East boundary of the watershed. The surrounding terrain is similar as the project area, with some development areas that are utilized in the oil and gas industry.

Level of Flood Risk

Per Federal Emergency Management Agency (FEMA), the project area is located within Flood Zone Designation X. Zone X designation is used where there is a minimal flood hazard. The corresponding FIS map number for the project location is Map #35015C1650D, effective June 04, 2010. The FEMA Flood Insurance Rate FIRMette Map is included in Appendix A for the project area.

Hydrology

Hydraulic Soil Classification

The hydrologic soil classification was determined from soil survey information available from the local Natural Resources Conservation Services field office. The Soil Survey of Eddy Area, New Mexico was accessed on-line via the United States Department of Agriculture Web Soil Survey at http://websoilsurvey.sc.egov.usda.gov/app/WebSoilSurvey.aspx . This information was used to determine the soil classification and run-off potential properties within the project area. A map showing the locations of the individual soils used in this drainage report is found in Appendix B. Due to the sites HSG classification being homogenous HSG D, a soil group break down is not provided in this report. The HSG classification will be used in calculating weighted C coefficient.

Existing Drainage Characteristics

The existing condition of basin consists of drainage patterns that generally sheets flows in shallow concentrated flow, South to North, through a series of draws and are conveyed to a discharge point north of the recycle facility. The land consists of mildly flat slopes, 0.5-1.5%. The cover of the land generally has exposed cobbles with a desert shrub landscape. The C coefficient is estimated to be approximately .3 for the whole watershed.

Hydrology Calculations

Based on the various physical characteristics defining soil type, land use, and land covers detailed in the previous sections, weighted composite C coefficient for each contributory drainage area were estimated. Tables for the project's hydrologic data are included in Appendix B.

The input values for the hydrograph calculations in Appendix C were determined with the following input data and are included in Appendix B in detail:

- The 100- and 500-year, 24-hour precipitations were determined from the NOAA web site.

- Time of concentration (Tc) values were estimated using the TR-55 method (shallow concentrated flow). Equation 3-1 and 3-2 of Urban Hydrology for Small Watersheds TR-55 Manual are shown below:

Travel time (T_t) is the ratio of flow length to flow velocity:

$$T_t = \frac{L}{3600V} \quad \text{[eq. 3-1]}$$

where:

T_t = travel time (hr)
L = flow length (ft)
V = average velocity (ft/s)
3600 = conversion factor from seconds to hours.

Time of concentration (T_c) is the sum of T_t values for the various consecutive flow segments:

$$T_c = T_{t1} + T_{t2} + \ldots T_{tm} \quad \text{[eq. 3-2]}$$

where:

T_c = time of concentration (hr)
m = number of flow segments

L = 5606.29 ft
V = 1.8 ft/s
Tt = .865 Hr.
Tt = 51.91 Min.

Figure 1

- The peak discharge hydrographs for the storm water routing are enclosed within Appendix C of this report.

Storm Frequency Event Results

The table listed below outlines the hydrologic summary of the project site sub-basin(s) pre-development calculations for the 100- and 500- year storm frequency event. The data includes the total area, the calculated TLag, the hydraulic basin length which is also known as the longest flow path, and the C coefficient.

Table 2

Basin Conditions					
Area (Acres)	Tc (Min.)	Hydraulic Basin Length (ft.)	C coefficient	Peak Discharge 100-year (cfs)	Peak Discharge 500-year (cfs)
162.62	50.60	5,606.29	.3	175.3	223.8

Hydraulics

The main conveyance channel path that is disrupted by a Recycle Facility that was constructed between 2014 and 2017. The path is partially mapped as an unnamed stream (an arroyo) that includes an intermittent pond that is mapped on a USGS topographic map. With the construction, the existing path was disturbed, and the wetland no longer exists. No re-routing alternative was implemented to convey the runoff back to its natural path.

To mitigate the issue, a diversion channel was designed using the peak flow of the 500-year storm event. The proposed channel starts at the South end of the project where the current stream ends and is routed to the East of the Recycle Facility until it discharges North, continuing its original path. The proposed location of the channel can be seen in Appendix A.

Channel Characteristics

The proposed channel is composed of 25 feet bottom with a minimum depth of 3 feet. The side slopes are to be daylighted at a 3:1 (V:H) slope. Characteristics of the proposed channel are shown in the figure below:

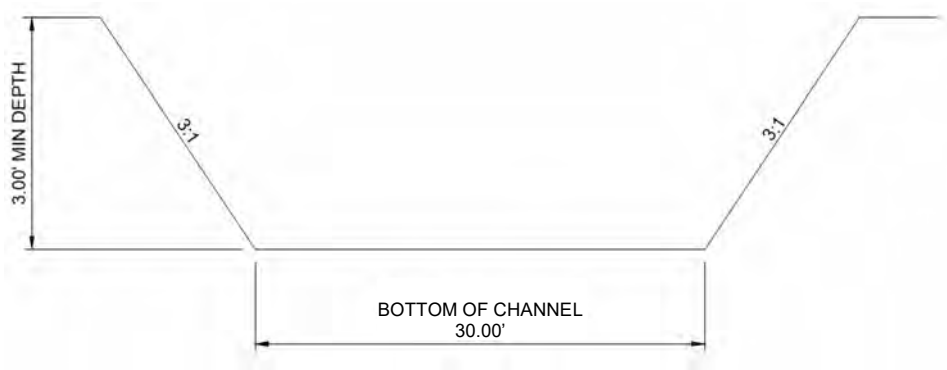


Figure 2

Manning's n Value

The Mannings coefficient was determined using the table Manning's n for Channels (Chow, 1959). The channel is going to be excavated with check dams added throughout. For the purpose of this study, a value of .120 was used to portrait the channel being used after multiple rain events and not being maintained. The coefficient reflects the channel having dense weeds that are as high as the flow depth.

Proposed Terrain

The proposed channel follows the existing terrain, to stay at least 3 ft below existing grade. Throughout the length of the channel, the slopes vary from .44% at the flattest section to 3.21% at the steepest. Due to the change in slope, the average slope of 1.58% was used.

Results

The table listed below outlines the hydraulic summary of the proposed channel during peak discharge for the 100 and 500-year storm event. The data includes Mannings n value, slope and water depth at the channel.

Table 3

	Hydraulic Results			
Storm Event	Slope (%)	n-value	Qpeak (cfs)	Depth (ft)
100 Year	1.58	.120	175.30	2.12
500 Year	1.58	.120	223.80	2.44
Max Depth	1.58	.120	325.56	3.00

Conclusion

From the previously outlined analysis, this drainage report details the current hydrologic and hydraulic conditions of the project site and includes recommended drainage improvements based on the post-development condition. Square Root Services concludes the following estimated conditions occur on the project site during a major storm.

- The existing runoff starting at the South of the project site needs to be re-routed and discharged at the original location before the construction of the Recycle Facility with a proposed channel.
- The proposed channel can convey a 500-year storm event with its proposed characteristics.
- The 500-year storm event creates a depth of 2.44 feet of depth at the channel, leaving over 6 inches of freeboard and can convey an extra 101.76 cfs of flow.

APPENDIX A

Watershed & Drainage Information

Location

Existing Watercourse

Proposed Diversion Ditch

FEMA 500-Year Flood Map

LEGEND

EXISTING STORM WATER FLOW LINE

BASIN BOUNDARY

RUN-OFF DIRECTION

DRAINAGE

BASIN AREA = 161.62 ACRES

LONGEST PATH = 5,506.29 FEET

WATERCOURSE SLOPE = 1.31%

TIME OF CONCENTRATION (FAA) = 51.91 MINUTES

C COEFFICIENT = .3

Q (100 YEAR STORM) = 175.3 cfs

Q (500 YEAR STORM) = 223.8 cfs

SquareRoot services
Engineering | Surveying
Materials Testing

7921 N World Dr.
Hobbs, NM 88242-9032
Squarerootservices.net
575-231-7347

ENGINEERING SHEET:

WATERSHED & DRAINAGE INFORMATION

OF

PROJECT NAME:

SAND DUNES RECYCLE FACILITY

FOR

CLIENT:

VAUGHAN OPERATING, LLC

PROJECT NUMBER: 24198

PROJECT ENGINEER: JEREMY BAKER, PE

DRAWN BY: JCD

GRAPHIC SCALE

0 250' 500'

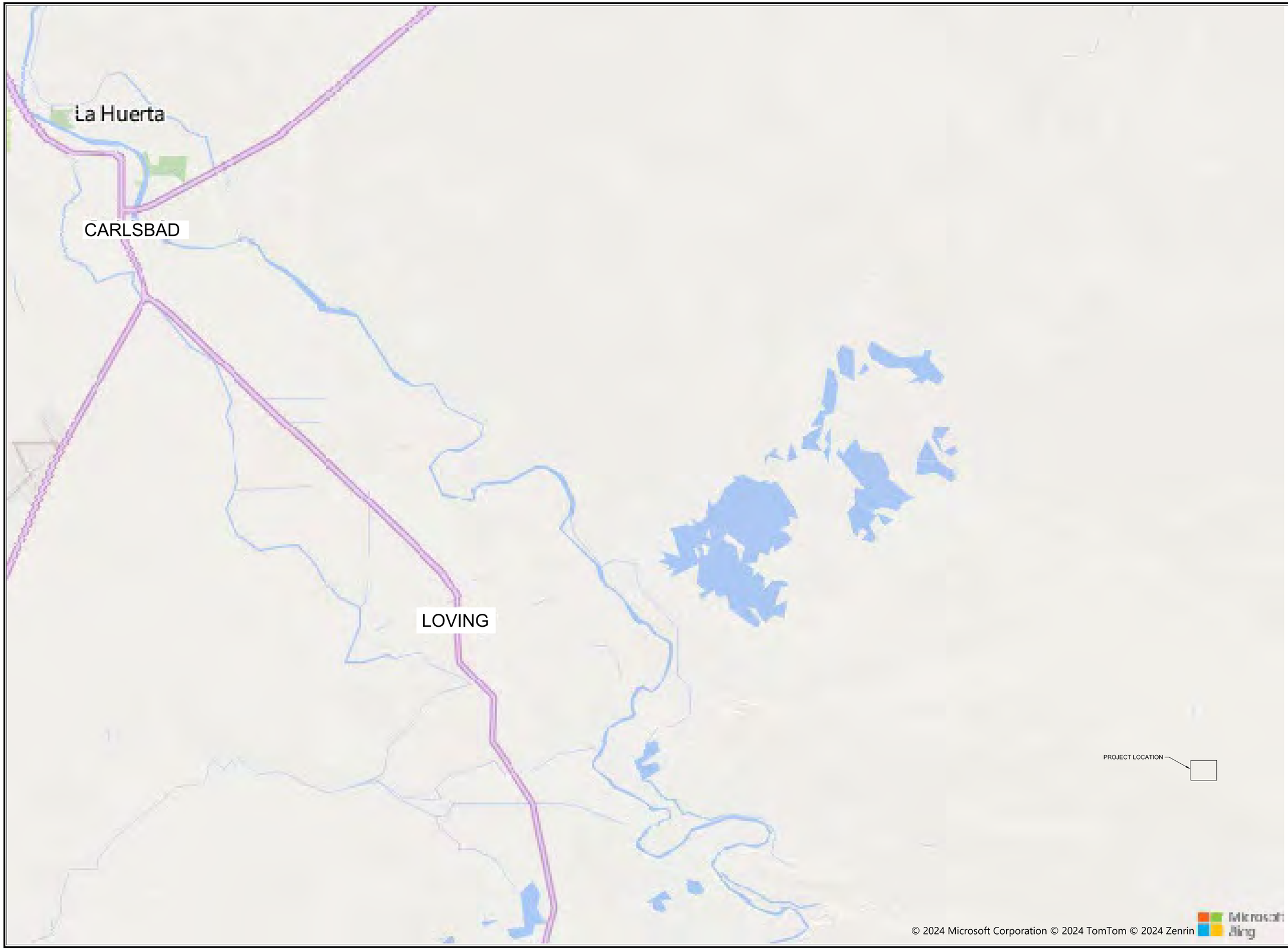
SCALE: 1" = 250'
(IN FEET)

REVISIONS

No.	DATE	DESCRIPTION

PRELIMINARY

SHEET: of C-101



SquareRoot services

Engineering | Surveying
Materials Testing

7921 N World Dr.
Hobbs, NM 88242-9032
Squarerootservices.net
575-231-7347

ENGINEERING SHEET:

PROJECT LOCATION

OF

PROJECT NAME:

SAND DUNES
RECYCLE FACILITY

FOR

CLIENT:

VAUGHAN OPERATING, LLC

PROJECT NUMBER:
24198

PROJECT ENGINEER:
JEREMY BAKER, PE

DRAWN BY:
JCD

GRAPHIC SCALE

0 5000' 10000'

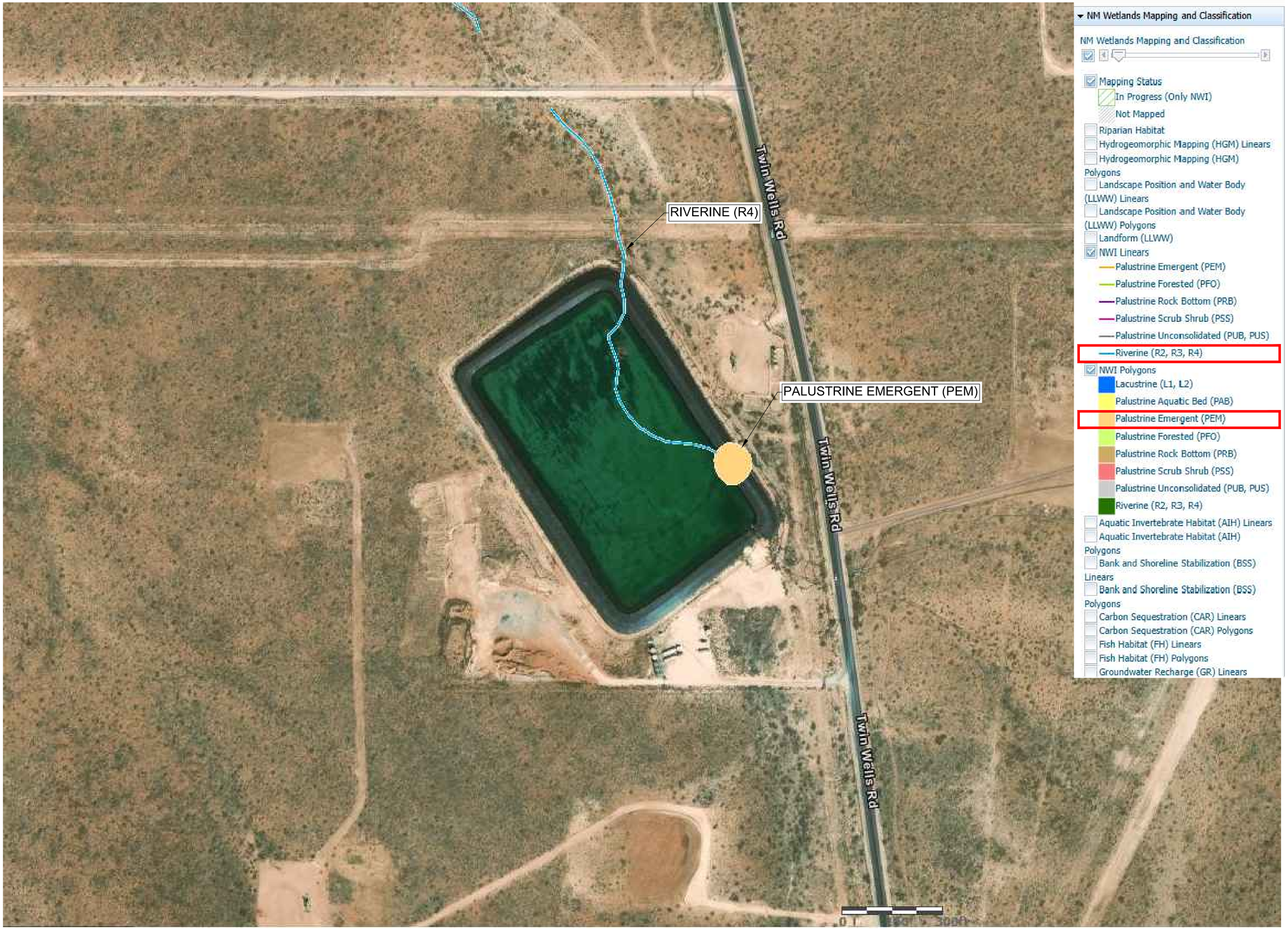
SCALE: 1" = 5000'
(IN FEET)

REVISIONS

No.	DATE	DESCRIPTION

PRELIMINARY

SHEET:
of
C-102



NM Wetlands Mapping and Classification

NM Wetlands Mapping and Classification

- Mapping Status
  - In Progress (Only NWI)
  - Not Mapped
- Riparian Habitat
- Hydrogeomorphic Mapping (HGM) Linears
- Hydrogeomorphic Mapping (HGM) Polygons
- Landscape Position and Water Body (LLWW) Linears
- Landscape Position and Water Body (LLWW) Polygons
- Landform (LLWW)
- NWI Linears
  - Palustrine Emergent (PEM)
  - Palustrine Forested (PFO)
  - Palustrine Rock Bottom (PRB)
  - Palustrine Scrub Shrub (PSS)
  - Palustrine Unconsolidated (PUB, PUS)
  - Riverine (R2, R3, R4)
- NWI Polygons
  - Lacustrine (L1, L2)
  - Palustrine Aquatic Bed (PAB)
  - Palustrine Emergent (PEM)
  - Palustrine Forested (PFO)
  - Palustrine Rock Bottom (PRB)
  - Palustrine Scrub Shrub (PSS)
  - Palustrine Unconsolidated (PUB, PUS)
  - Riverine (R2, R3, R4)
- Aquatic Invertebrate Habitat (AIH) Linears
- Aquatic Invertebrate Habitat (AIH) Polygons
- Bank and Shoreline Stabilization (BSS) Linears
- Bank and Shoreline Stabilization (BSS) Polygons
- Carbon Sequestration (CAR) Linears
- Carbon Sequestration (CAR) Polygons
- Fish Habitat (FH) Linears
- Fish Habitat (FH) Polygons
- Groundwater Recharge (GR) Linears

SquareRoot services
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Materials Testing

7921 N World Dr.
Hobbs, NM 88242-9032
Squarerootservices.net
575-231-7347

ENGINEERING SHEET:
EXISTING WATERCOURSE
OF
PROJECT NAME:
SAND DUNES RECYCLE FACILITY
FOR
CLIENT:
VAUGHAN OPERATING, LLC

PROJECT NUMBER: 24198

PROJECT ENGINEER: JEREMY BAKER, PE
DRAWN BY: JCD

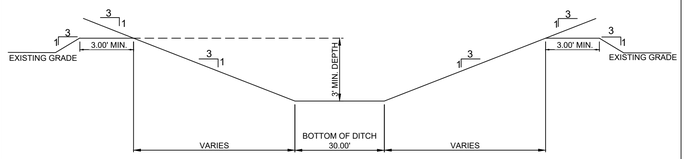
GRAPHIC SCALE
0 250' 500'
SCALE: 1" = 250'
(IN FEET)

REVISIONS

No.	DATE	DESCRIPTION

PRELIMINARY

SHEET: of
C-103



DIVERSION CHANNEL DETAIL

SquareRoot services
Engineering | Surveying
Materials Testing

7921 N World Dr.
Hobbs, NM 88242-9032
Squarerootservices.net
575-231-7347

ENGINEERING SHEET:

PROPOSED DIVERSION CHANNEL

OF

PROJECT NAME:

SAND DUNES RECYCLE FACILITY

FOR

CLIENT:

VAUGHAN OPERATING, LLC

PROJECT NUMBER:

24198

PROJECT ENGINEER:

JEREMY BAKER, PE

DRAWN BY:

JCD

GRAPHIC SCALE

0 80' 160'

SCALE: 1" = 80'
(IN FEET)

REVISIONS

No.	DATE	DESCRIPTION

PRELIMINARY

SHEET: of

C-104

National Flood Hazard Layer FIRMette

FEMA

103°49'16"W 32°14'32"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

103°48'38"W 32°14'2"N

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 10/18/2024 at 1:01 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX B

NOAA ATLAS RAINFALL DATA

NRCS Soil Survey Data

C Coefficient Table

Manning's n for Channels (Chow, 1959)

NOAA Atlas 14, Volume 1, Version 5
Location name: Loving, New Mexico, USA*
Latitude: 32.2373°, Longitude: -103.8148°
Elevation: 3470 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**3.86** (3.42-4.37)	**5.00** (4.42-5.65)	**6.67** (5.87-7.51)	**7.96** (6.98-8.95)	**9.68** (8.46-10.9)	**11.0** (9.58-12.4)	**12.5** (10.8-14.0)	**13.9** (12.0-15.6)	**15.9** (13.5-17.8)	**17.5** (14.7-19.6)
10-min	**2.94** (2.60-3.32)	**3.81** (3.36-4.30)	**5.08** (4.47-5.72)	**6.05** (5.32-6.81)	**7.37** (6.44-8.29)	**8.40** (7.29-9.43)	**9.48** (8.19-10.6)	**10.6** (9.10-11.9)	**12.1** (10.3-13.6)	**13.3** (11.2-14.9)
15-min	**2.43** (2.15-2.75)	**3.14** (2.78-3.56)	**4.20** (3.69-4.73)	**5.00** (4.39-5.63)	**6.09** (5.32-6.85)	**6.94** (6.02-7.79)	**7.83** (6.77-8.79)	**8.74** (7.52-9.82)	**10.0** (8.51-11.2)	**11.0** (9.27-12.3)
30-min	**1.64** (1.45-1.85)	**2.12** (1.87-2.39)	**2.82** (2.49-3.18)	**3.37** (2.96-3.79)	**4.10** (3.58-4.61)	**4.67** (4.06-5.25)	**5.27** (4.56-5.92)	**5.89** (5.06-6.61)	**6.73** (5.73-7.56)	**7.39** (6.24-8.31)
60-min	**1.01** (0.897-1.14)	**1.31** (1.16-1.48)	**1.75** (1.54-1.97)	**2.08** (1.83-2.35)	**2.54** (2.22-2.85)	**2.89** (2.51-3.25)	**3.26** (2.82-3.66)	**3.64** (3.13-4.09)	**4.16** (3.55-4.68)	**4.57** (3.86-5.14)
2-hr	**0.587** (0.519-0.666)	**0.761** (0.673-0.863)	**1.03** (0.910-1.17)	**1.24** (1.09-1.40)	**1.54** (1.34-1.73)	**1.77** (1.54-1.99)	**2.02** (1.74-2.26)	**2.28** (1.95-2.56)	**2.64** (2.24-2.96)	**2.93** (2.46-3.30)
3-hr	**0.417** (0.368-0.471)	**0.539** (0.478-0.610)	**0.725** (0.640-0.819)	**0.874** (0.769-0.985)	**1.08** (0.946-1.22)	**1.25** (1.08-1.40)	**1.42** (1.23-1.60)	**1.61** (1.38-1.81)	**1.87** (1.59-2.10)	**2.08** (1.75-2.35)
6-hr	**0.238** (0.211-0.269)	**0.306** (0.272-0.347)	**0.409** (0.362-0.462)	**0.491** (0.433-0.554)	**0.608** (0.533-0.684)	**0.703** (0.612-0.789)	**0.803** (0.695-0.901)	**0.910** (0.781-1.02)	**1.06** (0.900-1.19)	**1.18** (0.993-1.33)
12-hr	**0.131** (0.116-0.148)	**0.168** (0.149-0.191)	**0.224** (0.197-0.253)	**0.269** (0.236-0.304)	**0.332** (0.289-0.374)	**0.383** (0.331-0.431)	**0.438** (0.376-0.492)	**0.495** (0.422-0.556)	**0.577** (0.486-0.649)	**0.644** (0.536-0.725)
24-hr	**0.070** (0.062-0.079)	**0.090** (0.081-0.102)	**0.121** (0.108-0.137)	**0.147** (0.130-0.165)	**0.183** (0.161-0.205)	**0.212** (0.185-0.237)	**0.243** (0.211-0.272)	**0.276** (0.238-0.310)	**0.324** (0.275-0.365)	**0.363** (0.305-0.411)
2-day	**0.038** (0.033-0.043)	**0.049** (0.043-0.055)	**0.066** (0.058-0.075)	**0.080** (0.070-0.090)	**0.100** (0.087-0.113)	**0.117** (0.101-0.132)	**0.135** (0.116-0.153)	**0.155** (0.131-0.175)	**0.183** (0.153-0.208)	**0.207** (0.170-0.236)
3-day	**0.026** (0.023-0.030)	**0.034** (0.030-0.039)	**0.046** (0.041-0.053)	**0.056** (0.049-0.064)	**0.071** (0.062-0.080)	**0.083** (0.072-0.094)	**0.097** (0.083-0.109)	**0.111** (0.094-0.126)	**0.132** (0.110-0.151)	**0.150** (0.123-0.172)
4-day	**0.021** (0.018-0.024)	**0.027** (0.024-0.031)	**0.037** (0.032-0.042)	**0.045** (0.039-0.051)	**0.057** (0.049-0.064)	**0.066** (0.057-0.075)	**0.077** (0.066-0.088)	**0.089** (0.075-0.101)	**0.106** (0.088-0.122)	**0.121** (0.099-0.139)
7-day	**0.013** (0.011-0.015)	**0.017** (0.015-0.019)	**0.023** (0.021-0.027)	**0.029** (0.025-0.033)	**0.036** (0.031-0.041)	**0.042** (0.036-0.048)	**0.049** (0.042-0.056)	**0.057** (0.048-0.065)	**0.068** (0.056-0.078)	**0.077** (0.063-0.089)
10-day	**0.010** (0.009-0.011)	**0.013** (0.012-0.015)	**0.018** (0.016-0.021)	**0.022** (0.019-0.025)	**0.028** (0.024-0.032)	**0.033** (0.028-0.037)	**0.038** (0.033-0.043)	**0.044** (0.037-0.050)	**0.053** (0.044-0.060)	**0.060** (0.049-0.069)
20-day	**0.006** (0.005-0.007)	**0.008** (0.007-0.009)	**0.011** (0.010-0.012)	**0.013** (0.012-0.015)	**0.016** (0.014-0.018)	**0.019** (0.016-0.021)	**0.021** (0.018-0.024)	**0.024** (0.021-0.027)	**0.028** (0.024-0.032)	**0.031** (0.026-0.035)
30-day	**0.005** (0.004-0.005)	**0.006** (0.005-0.007)	**0.008** (0.007-0.009)	**0.010** (0.009-0.011)	**0.012** (0.011-0.014)	**0.014** (0.012-0.015)	**0.016** (0.014-0.018)	**0.018** (0.015-0.020)	**0.020** (0.017-0.023)	**0.022** (0.019-0.025)
45-day	**0.004** (0.003-0.004)	**0.005** (0.004-0.005)	**0.006** (0.006-0.007)	**0.008** (0.007-0.009)	**0.009** (0.008-0.010)	**0.011** (0.009-0.012)	**0.012** (0.010-0.014)	**0.014** (0.012-0.015)	**0.015** (0.013-0.018)	**0.017** (0.014-0.019)
60-day	**0.003** (0.003-0.003)	**0.004** (0.004-0.004)	**0.005** (0.005-0.006)	**0.006** (0.006-0.007)	**0.008** (0.007-0.009)	**0.009** (0.008-0.010)	**0.010** (0.008-0.011)	**0.011** (0.009-0.012)	**0.012** (0.010-0.014)	**0.013** (0.011-0.015)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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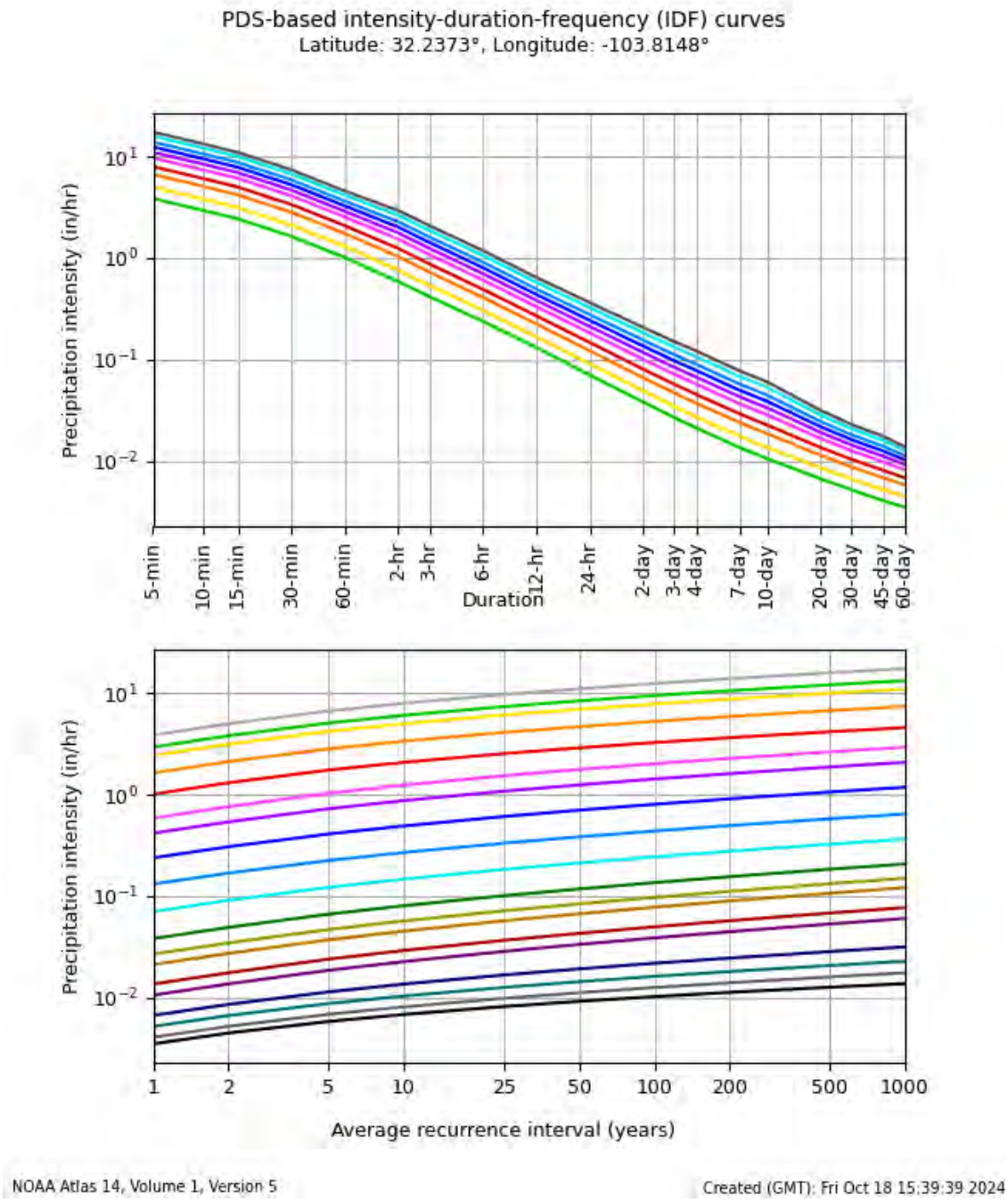
PF graphical



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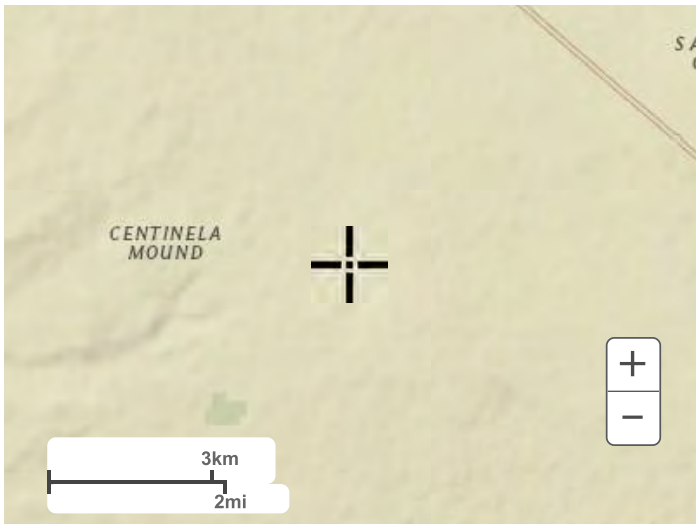
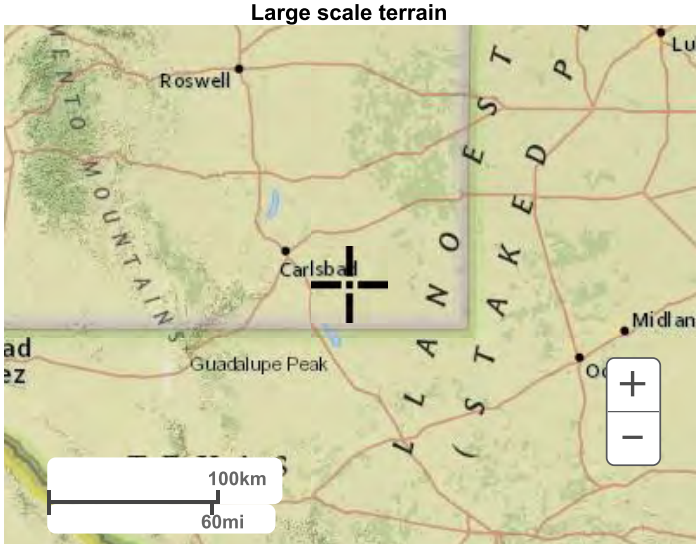
Maps & aerials

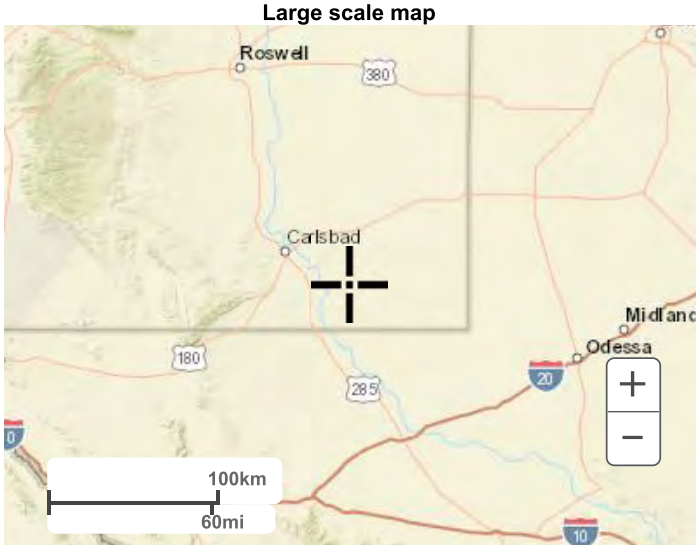
Small scale terrain



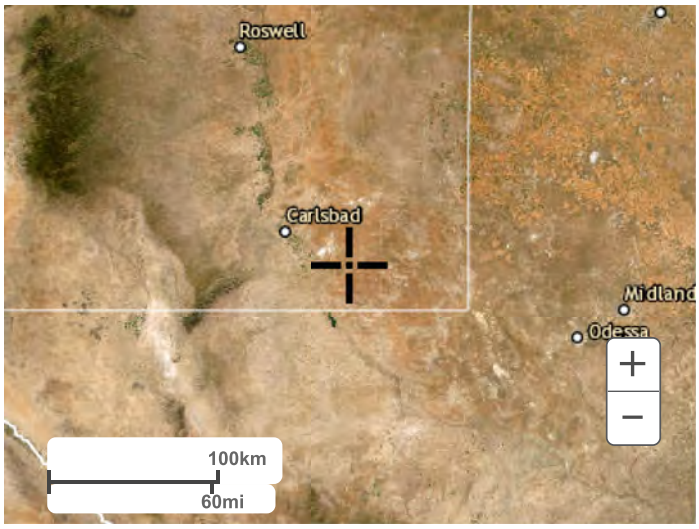
Large scale terrain



Large scale map



Large scale aerial



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National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Eddy Area, New Mexico

October 18, 2024

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

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 1:20,000.

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: Eddy Area, New Mexico
Survey Area Data: Version 20, Sep 3, 2024

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

Date(s) aerial images were photographed: Feb 7, 2020—May 12, 2020

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
SM	Simona-Bippus complex, 0 to 5 percent slopes	144.5	89.4%
TF	Tonuco loamy fine sand, 0 to 3 percent slopes	17.1	10.6%
Totals for Area of Interest		**161.6**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however,

onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Eddy Area, New Mexico

SM—Simona-Bippus complex, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 1w5x
Elevation: 1,800 to 5,000 feet
Mean annual precipitation: 8 to 24 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 230 days
Farmland classification: Not prime farmland

Map Unit Composition

Simona and similar soils: 55 percent
Bippus and similar soils: 30 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Simona

Setting

Landform: Plains, alluvial fans
Landform position (three-dimensional): Rise
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Mixed alluvium and/or eolian sands

Typical profile

H1 - 0 to 19 inches: gravelly fine sandy loam
H2 - 19 to 23 inches: indurated

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 7 to 20 inches to petrocalcic
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water supply, 0 to 60 inches: Very low (about 2.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: R070BD002NM - Shallow Sandy
Hydric soil rating: No

Description of Bippus

Setting

Landform: Flood plains, alluvial fans
Landform position (three-dimensional): Talf, rise
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 37 inches: silty clay loam
H2 - 37 to 60 inches: clay loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water supply, 0 to 60 inches: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R070BC017NM - Bottomland
Hydric soil rating: No

Minor Components

Simona

Percent of map unit: 8 percent
Ecological site: R070BD002NM - Shallow Sandy
Hydric soil rating: No

Bippus

Percent of map unit: 7 percent
Ecological site: R070BC017NM - Bottomland
Hydric soil rating: No

TF—Tonuco loamy fine sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 1w61
Elevation: 3,000 to 4,100 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 60 to 64 degrees F
Frost-free period: 200 to 217 days
Farmland classification: Not prime farmland

Map Unit Composition

Tonuco and similar soils: 98 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tonuco

Setting

Landform: Plains, alluvial fans
Landform position (three-dimensional): Rise
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Mixed alluvium and/or eolian sands

Typical profile

H1 - 0 to 5 inches: loamy fine sand
H2 - 5 to 15 inches: loamy fine sand
H3 - 15 to 19 inches: indurated

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 6 to 20 inches to petrocalcic
Drainage class: Excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water supply, 0 to 60 inches: Very low (about 1.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: R070BD004NM - Sandy
Hydric soil rating: No

Minor Components

Tonuco

Percent of map unit: 1 percent
Ecological site: R070BD004NM - Sandy
Hydric soil rating: No

Dune land

Percent of map unit: 1 percent
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

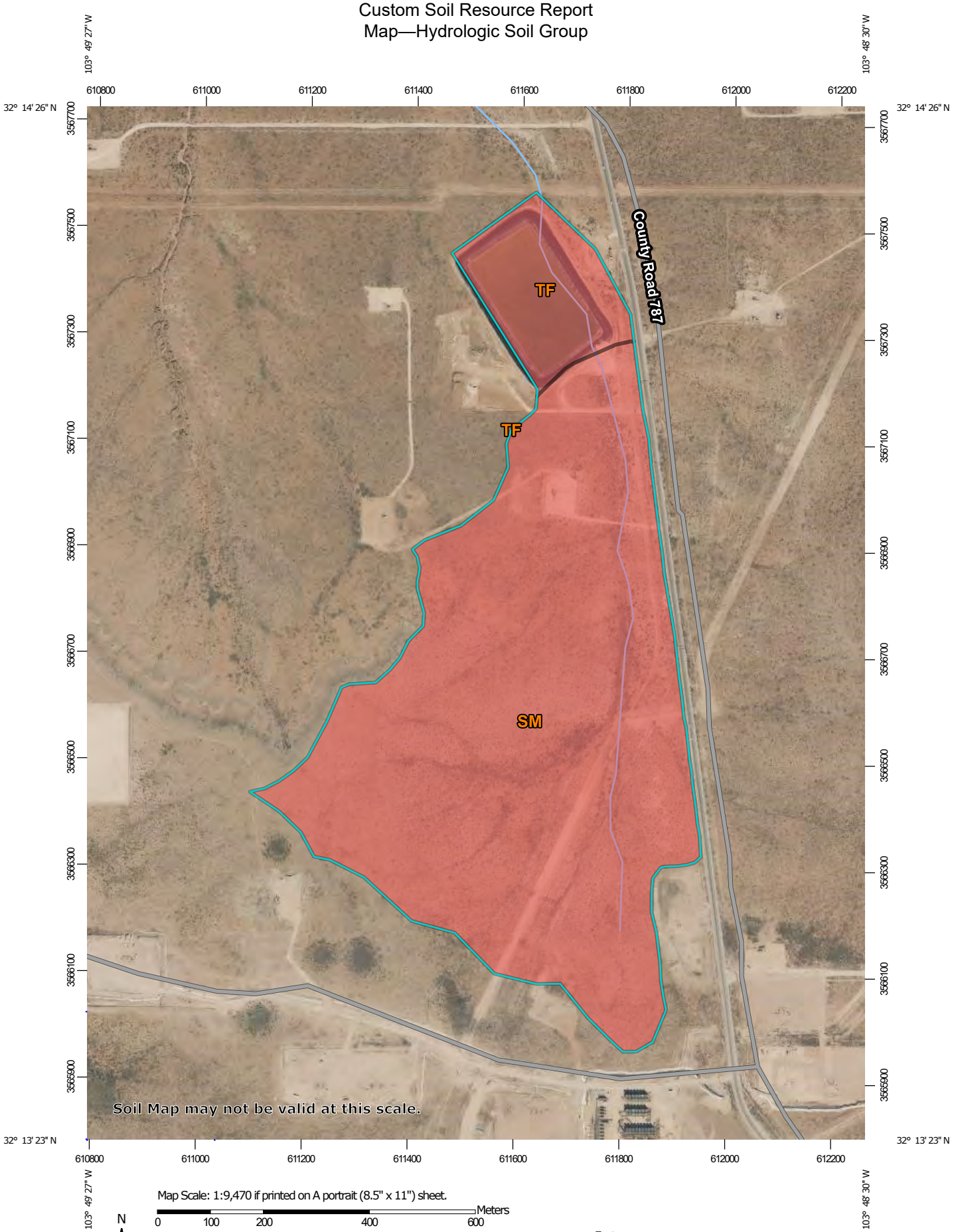
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Custom Soil Resource Report
Map—Hydrologic Soil Group



MAP LEGEND

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

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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 1:20,000.

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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)

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Soil Survey Area: Eddy Area, New Mexico
Survey Area Data: Version 20, Sep 3, 2024

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

Date(s) aerial images were photographed: Feb 7, 2020—May 12, 2020

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.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
SM	Simona-Bippus complex, 0 to 5 percent slopes	D	144.5	89.4%
TF	Tonuco loamy fine sand, 0 to 3 percent slopes	D	17.1	10.6%
Totals for Area of Interest			**161.6**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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Show

Manning's n Values

Reference tables for Manning's n values for Channels, Closed Conduits Flowing Partially Full, and Corrugated Metal Pipes.

Manning's n for Channels (Chow, 1959).

Type of Channel and Description	Minimum	Normal	Maximum
Natural streams - minor streams (top width at floodstage < 100 ft)			
1. Main Channels			
a. clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
b. same as above, but more stones and weeds	0.030	0.035	0.040
c. clean, winding, some pools and shoals	0.033	0.040	0.045
d. same as above, but some weeds and stones	0.035	0.045	0.050
e. same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
f. same as "d" with more stones	0.045	0.050	0.060
g. sluggish reaches, weedy, deep pools	0.050	0.070	0.080
h. very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075	0.100	0.150
2. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages			
a. bottom: gravels, cobbles, and few boulders	0.030	0.040	0.050
b. bottom: cobbles with large boulders	0.040	0.050	0.070
3. Floodplains			
a. Pasture, no brush			
1.short grass	0.025	0.030	0.035
2. high grass	0.030	0.035	0.050
b. Cultivated areas			
1. no crop	0.020	0.030	0.040
2. mature row crops	0.025	0.035	0.045
3. mature field crops	0.030	0.040	0.050
c. Brush			
1. scattered brush, heavy weeds	0.035	0.050	0.070
2. light brush and trees, in winter	0.035	0.050	0.060
3. light brush and trees, in summer	0.040	0.060	0.080
4. medium to dense brush, in winter	0.045	0.070	0.110
5. medium to dense brush, in summer	0.070	0.100	0.160
d. Trees			
1. dense willows, summer, straight	0.110	0.150	0.200
2. cleared land with tree stumps, no sprouts	0.030	0.040	0.050
3. same as above, but with heavy growth of sprouts	0.050	0.060	0.080

4. heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	0.080	0.100	0.120
5. same as 4. with flood stage reaching branches	0.100	0.120	0.160
4. Excavated or Dredged Channels			
a. Earth, straight, and uniform			
1. clean, recently completed	0.016	0.018	0.020
2. clean, after weathering	0.018	0.022	0.025
3. gravel, uniform section, clean	0.022	0.025	0.030
4. with short grass, few weeds	0.022	0.027	0.033
b. Earth winding and sluggish			
1. no vegetation	0.023	0.025	0.030
2. grass, some weeds	0.025	0.030	0.033
3. dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
4. earth bottom and rubble sides	0.028	0.030	0.035
5. stony bottom and weedy banks	0.025	0.035	0.040
6. cobble bottom and clean sides	0.030	0.040	0.050
c. Dragline-excavated or dredged			
1. no vegetation	0.025	0.028	0.033
2. light brush on banks	0.035	0.050	0.060
d. Rock cuts			
1. smooth and uniform	0.025	0.035	0.040
2. jagged and irregular	0.035	0.040	0.050
e. Channels not maintained, weeds and brush uncut			
1. dense weeds, high as flow depth	0.050	0.080	0.120
2. clean bottom, brush on sides	0.040	0.050	0.080
3. same as above, highest stage of flow	0.045	0.070	0.110
4. dense brush, high stage	0.080	0.100	0.140
5. Lined or Constructed Channels			
a. Cement			
1. neat surface	0.010	0.011	0.013
2. mortar	0.011	0.013	0.015
b. Wood			
1. planed, untreated	0.010	0.012	0.014
2. planed, creosoted	0.011	0.012	0.015
3. unplaned	0.011	0.013	0.015
4. plank with battens	0.012	0.015	0.018
5. lined with roofing paper	0.010	0.014	0.017
c. Concrete			
1. trowel finish	0.011	0.013	0.015
2. float finish	0.013	0.015	0.016
3. finished, with gravel on bottom	0.015	0.017	0.020
4. unfinished	0.014	0.017	0.020
5. gunite, good section	0.016	0.019	0.023
6. gunite, wavy section	0.018	0.022	0.025

7. on good excavated rock	0.017	0.020	
8. on irregular excavated rock	0.022	0.027	
d. Concrete bottom float finish with sides of:			
1. dressed stone in mortar	0.015	0.017	0.020
2. random stone in mortar	0.017	0.020	0.024
3. cement rubble masonry, plastered	0.016	0.020	0.024
4. cement rubble masonry	0.020	0.025	0.030
5. dry rubble or riprap	0.020	0.030	0.035
e. Gravel bottom with sides of:			
1. formed concrete	0.017	0.020	0.025
2. random stone mortar	0.020	0.023	0.026
3. dry rubble or riprap	0.023	0.033	0.036
f. Brick			
1. glazed	0.011	0.013	0.015
2. in cement mortar	0.012	0.015	0.018
g. Masonry			
1. cemented rubble	0.017	0.025	0.030
2. dry rubble	0.023	0.032	0.035
h. Dressed ashlar/stone paving	0.013	0.015	0.017
i. Asphalt			
1. smooth	0.013	0.013	
2. rough	0.016	0.016	
j. Vegetal lining	0.030		0.500

Manning's n for Closed Conduits Flowing Partly Full (Chow, 1959).

Type of Conduit and Description	Minimum	Normal	Maximum
1. Brass, smooth:	0.009	0.010	0.013
2. Steel:			
Lockbar and welded	0.010	0.012	0.014
Riveted and spiral	0.013	0.016	0.017
3. Cast Iron:			
Coated	0.010	0.013	0.014
Uncoated	0.011	0.014	0.016
4. Wrought Iron:			
Black	0.012	0.014	0.015
Galvanized	0.013	0.016	0.017
5. Corrugated Metal:			
Subdrain	0.017	0.019	0.021
Stormdrain	0.021	0.024	0.030
6. Cement:			
Neat Surface	0.010	0.011	0.013
Mortar	0.011	0.013	0.015
7. Concrete:			
Culvert, straight and free of debris	0.010	0.011	0.013
Culvert with bends, connections, and some debris	0.011	0.013	0.014
Finished	0.011	0.012	0.014
Sewer with manholes, inlet, etc., straight	0.013	0.015	0.017

Unfinished, steel form	0.012	0.013	0.014
Unfinished, smooth wood form	0.012	0.014	0.016
Unfinished, rough wood form	0.015	0.017	0.020
8. Wood:			
Stave	0.010	0.012	0.014
Laminated, treated	0.015	0.017	0.020
9. Clay:			
Common drainage tile	0.011	0.013	0.017
Vitrified sewer	0.011	0.014	0.017
Vitrified sewer with manholes, inlet, etc.	0.013	0.015	0.017
Vitrified Subdrain with open joint	0.014	0.016	0.018
10. Brickwork:			
Glazed	0.011	0.013	0.015
Lined with cement mortar	0.012	0.015	0.017
Sanitary sewers coated with sewage slime with bends and connections	0.012	0.013	0.016
Paved invert, sewer, smooth bottom	0.016	0.019	0.020
Rubble masonry, cemented	0.018	0.025	0.030

Manning's n for Corrugated Metal Pipe (AISI, 1980).

Type of Pipe, Diameter and Corrugation Dimension	n
1. Annular 2.67 x 1/2 inch (all diameters)	0.024
2. Helical 1.50 x 1/4 inch	
8" diameter	0.012
10" diameter	0.014
3. Helical 2.67 x 1/2 inch	
12" diameter	0.011
18" diameter	0.014
24" diameter	0.016
36" diameter	0.019
48" diameter	0.020
60" diameter	0.021
4. Annular 3x1 inch (all diameters)	0.027
5. Helical 3x1 inch	
48" diameter	0.023
54" diameter	0.023
60" diameter	0.024
66" diameter	0.025
72" diameter	0.026
78" diameter and larger	0.027
6. Corrugations 6x2 inches	
60" diameter	0.033
72" diameter	0.032
120" diameter	0.030
180" diameter	0.028

FishXing Version 3.0 Beta, 2006

	Runoff Coefficient, C					
	Soil Group C			Soil Group D		
Slope :	< 2%	2-6%	> 6%	< 2%	2-6%	> 6%
Forest	0.12	0.16	0.20	0.15	0.20	0.25
Meadow	0.26	0.35	0.44	0.30	0.40	0.50
Pasture	0.30	0.42	0.52	0.37	0.50	0.62
Farmland	0.20	0.25	0.34	0.24	0.29	0.41
Res. 1 acre	0.28	0.32	0.40	0.31	0.35	0.46
Res. 1/2 acre	0.31	0.35	0.42	0.34	0.38	0.46
Res. 1/3 acre	0.33	0.38	0.45	0.36	0.40	0.50
Res. 1/4 acre	0.36	0.40	0.47	0.38	0.42	0.52
Res. 1/8 acre	0.38	0.42	0.49	0.41	0.45	0.54
Industrial	0.86	0.86	0.87	0.86	0.86	0.88
Commercial	0.89	0.89	0.90	0.89	0.89	0.90
Streets: ROW	0.84	0.85	0.89	0.89	0.91	0.95
Parking	0.95	0.96	0.97	0.95	0.96	0.97
Disturbed Area	0.68	0.70	0.72	0.69	0.72	0.75

Rational Method Runoff Coefficients - Part II

APPENDIX C

Hydrologic Analysis

Table of Contents

Project Name:

Hydrology Studio v 3.0.0.33 10-18-2024

Hydrograph by Return Period

Project Name:

10-18-2024

Hydrology Studio v 3.0.0.33

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Outflow (cfs)							
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	100-yr	500-yr
1	Rational	SAND DUNES		70.49			111.9		175.3	223.8

Hydrograph 100-yr Summary

Project Name:

10-18-2024

Hydrology Studio v 3.0.0.33

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	Rational	SAND DUNES	175.3	0.87	547,070	----		

Hydrograph Report

Project Name:

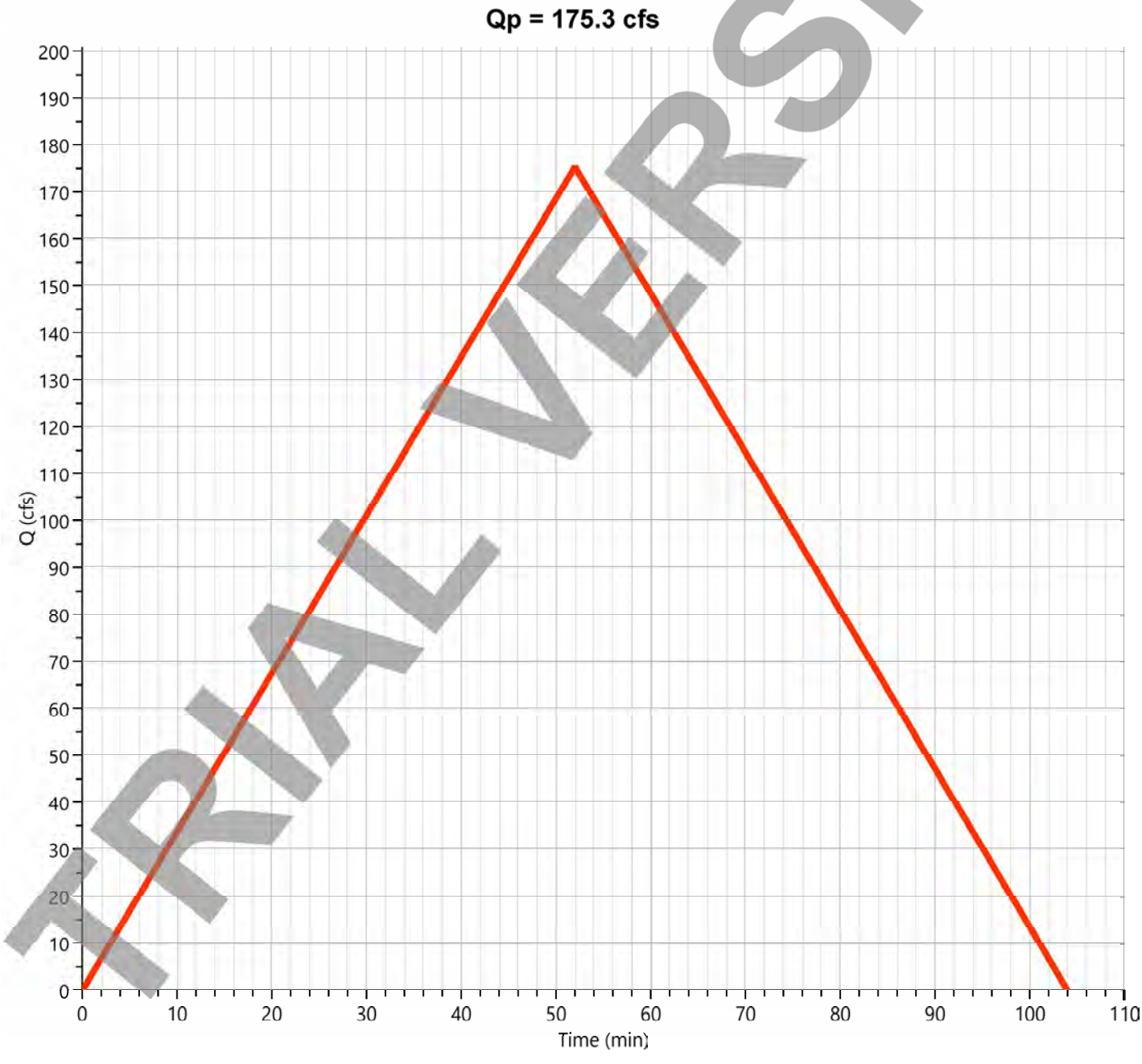
Hydrology Studio v 3.0.0.33

10-18-2024

SAND DUNES

Hyd. No. 1

Hydrograph Type	= Rational	Peak Flow	= 175.3 cfs
Storm Frequency	= 100-yr	Time to Peak	= 0.87 hrs
Time Interval	= 2 min	Runoff Volume	= 547,070 cuft
Drainage Area	= 161.62 ac	Runoff Coeff.	= 0.3
Tc Method	= TR55 (See Worksheet)	Time of Conc. (Tc)	= 52.0 min
IDF Curve	= 500-updated.IDF	Intensity	= 3.62 in/hr
Freq. Corr. Factor	= 1.00	Asc/Rec Limb Factors	= 1/1



Hydrograph Discharge Table

SAND DUNES

Time (min)	Outflow (cfs)	Time (min)	Outflow (cfs)	Time (min)	Outflow (cfs)	Time (min)	Outflow (cfs)	Time (min)	Outflow (cfs)
2	6.744	74	101.2						
4	13.49	76	94.42						
6	20.23	78	87.67						
8	26.98	80	80.93						
10	33.72	82	74.18						
12	40.46	84	67.44						
14	47.21	86	60.70						
16	53.95	88	53.95						
18	60.70	90	47.21						
20	67.44	92	40.46						
22	74.18	94	33.72						
24	80.93	96	26.98						
26	87.67	98	20.23						
28	94.42	100	13.49						
30	101.2	102	6.744						
32	107.9	104	0.000						
34	114.6	*...end*	*...end*						
36	121.4								
38	128.1								
40	134.9								
42	141.6								
44	148.4								
46	155.1								
48	161.9								
50	168.6								
52	**175.3**								
54	168.6								
56	161.9								
58	155.1								
60	148.4								
62	141.6								
64	134.9								
66	128.1								
68	121.4								
70	114.6								
72	107.9								

Printed values > 1% of Qpeak. nth-point print interval = 1

Tc by TR55 Worksheet

Project Name:

Hydrology Studio v 3.0.0.33 10-18-2024

SAND DUNES

Rational

Hyd. No. 1

Description	Segments			
	A	B	C	Tc (min)
Sheet Flow				
Description				
Manning's n	0.013	0.013	0.013	
Flow Length (ft)				
2-yr, 24-hr Precip. (in)	2.28	2.28	2.28	
Land Slope (%)				
Travel Time (min)	**0.00**	**0.00**	**0.00**	**0.00**
Shallow Concentrated Flow				
Flow Length (ft)	5606.29			
Watercourse Slope (%)	1.31	0.00	0.00	
Surface Description	Unpaved	Paved	Paved	
Average Velocity (ft/s)	1.85			
Travel Time (min)	**50.60**	**0.00**	**0.00**	**50.60**
Channel Flow				
X-sectional Flow Area (sqft)				
Wetted Perimeter (ft)				
Channel Slope (%)				
Manning's n	0.013	0.013	0.013	
Velocity (ft/s)				
Flow Length (ft)				
Travel Time (min)	**0.00**	**0.00**	**0.00**	**0.00**
Total Travel Time				**52 min**

Design Storm Report

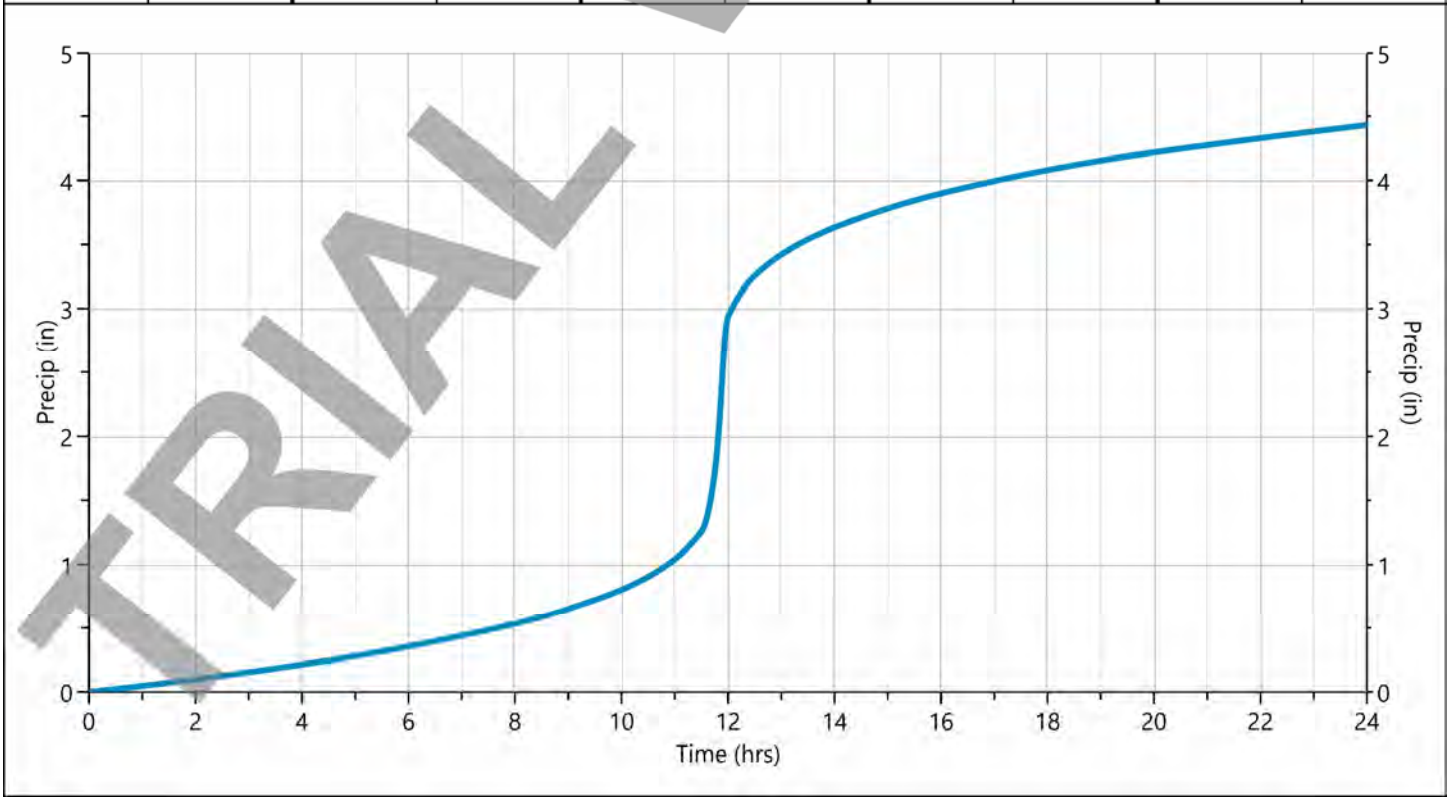
Custom Storm filename:

Hydrology Studio v 3.0.0.33 10-18-2024

Storm Distribution: NRCS/SCS - Type II, 24-hr

Storm Duration	Total Rainfall Volume (in)								
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	✔ 100-yr	500-yr	
24 hrs	1.82	2.28	0.00	2.85	3.31	3.94	4.43	4.94	

Incremental Rainfall Distribution, 100-yr									
Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)
10.90	0.009943	11.27	0.014176	11.63	0.058516	12.00	0.066573	12.37	0.017897
10.93	0.010140	11.30	0.014649	11.67	0.070171	12.03	0.029616	12.40	0.016775
10.97	0.010337	11.33	0.015121	11.70	0.081827	12.07	0.027998	12.43	0.015653
11.00	0.010534	11.37	0.015594	11.73	0.093483	12.10	0.026875	12.47	0.014530
11.03	0.010867	11.40	0.016066	11.77	0.107303	12.13	0.025753	12.50	0.013408
11.07	0.011341	11.43	0.016539	11.80	0.137553	12.17	0.024631	12.53	0.012720
11.10	0.011813	11.47	0.017011	11.83	0.169974	12.20	0.023509	12.57	0.012463
11.13	0.012286	11.50	0.017484	11.87	0.202395	12.23	0.022386	12.60	0.012207
11.17	0.012758	11.53	0.023581	11.90	0.234816	12.27	0.021264	12.63	0.011951
11.20	0.013231	11.57	0.035204	11.93	0.214291	12.30	0.020142	12.67	0.011695
11.23	0.013703	11.60	0.046860	11.97	0.140357	12.33	0.019020	12.70	0.011439



Hydrograph 500-yr Summary

Project Name:

10-18-2024

Hydrology Studio v 3.0.0.33

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	Rational	SAND DUNES	223.8	0.87	698,275	----		

Hydrograph Report

Project Name:

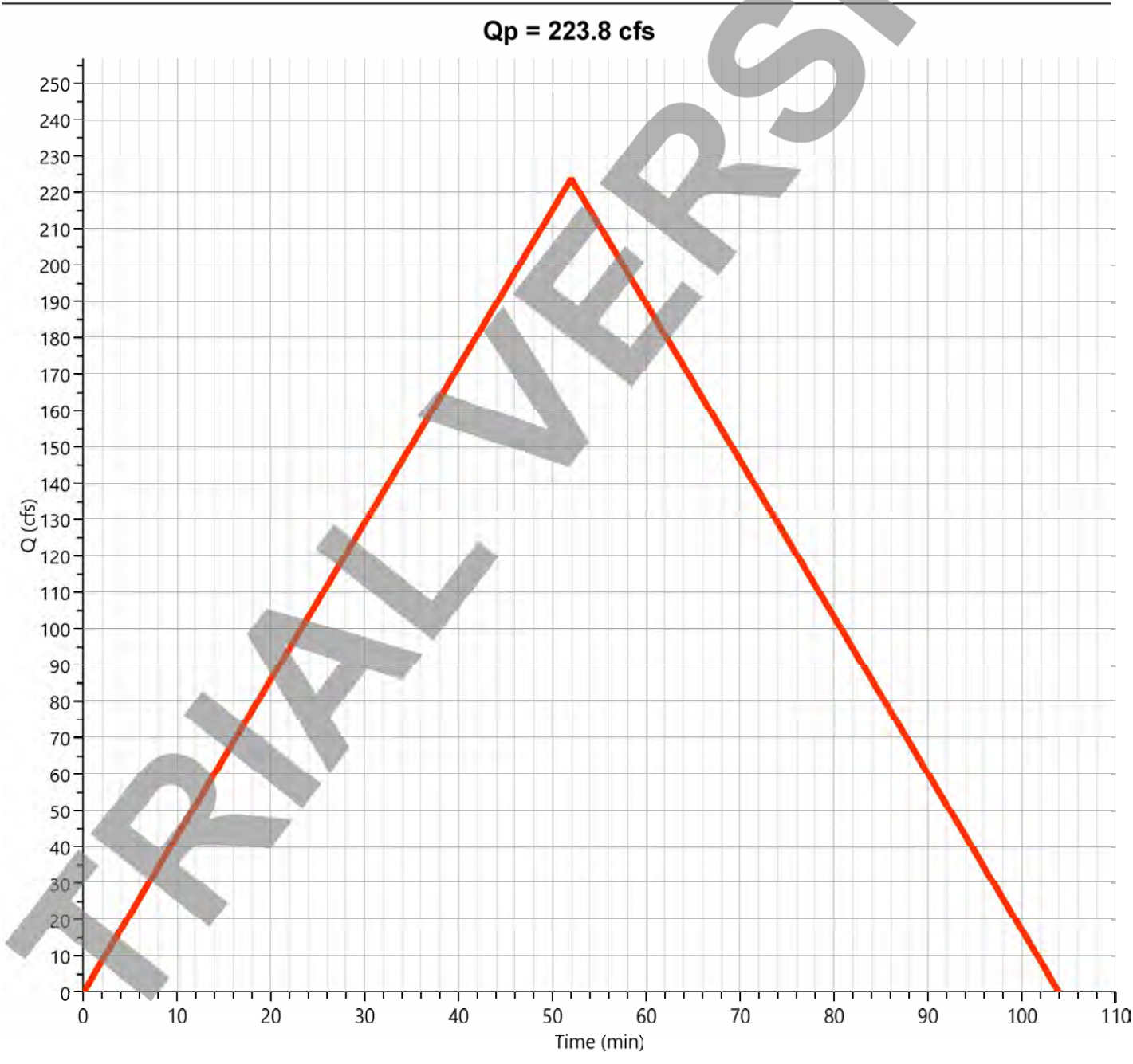
Hydrology Studio v 3.0.0.33

10-18-2024

SAND DUNES

Hyd. No. 1

Hydrograph Type	= Rational	Peak Flow	= 223.8 cfs
Storm Frequency	= 500-yr	Time to Peak	= 0.87 hrs
Time Interval	= 2 min	Runoff Volume	= 698,275 cuft
Drainage Area	= 161.62 ac	Runoff Coeff.	= 0.3
Tc Method	= TR55 (See Worksheet)	Time of Conc. (Tc)	= 52.0 min
IDF Curve	= 500-updated.IDF	Intensity	= 4.62 in/hr
Freq. Corr. Factor	= 1.00	Asc/Rec Limb Factors	= 1/1



Hydrograph Discharge Table

SAND DUNES

Time (min)	Outflow (cfs)	Time (min)	Outflow (cfs)	Time (min)	Outflow (cfs)	Time (min)	Outflow (cfs)	Time (min)	Outflow (cfs)
2	8.608	74	129.1						
4	17.22	76	120.5						
6	25.82	78	111.9						
8	34.43	80	103.3						
10	43.04	82	94.69						
12	51.65	84	86.08						
14	60.26	86	77.47						
16	68.86	88	68.86						
18	77.47	90	60.26						
20	86.08	92	51.65						
22	94.69	94	43.04						
24	103.3	96	34.43						
26	111.9	98	25.82						
28	120.5	100	17.22						
30	129.1	102	8.608						
32	137.7	104	0.000						
34	146.3	*...end*	*...end*						
36	154.9								
38	163.6								
40	172.2								
42	180.8								
44	189.4								
46	198.0								
48	206.6								
50	215.2								
52	**223.8**								
54	215.2								
56	206.6								
58	198.0								
60	189.4								
62	180.8								
64	172.2								
66	163.6								
68	154.9								
70	146.3								
72	137.7								

Printed values > 1% of Qpeak. nth-point print interval = 1

Design Storm Report

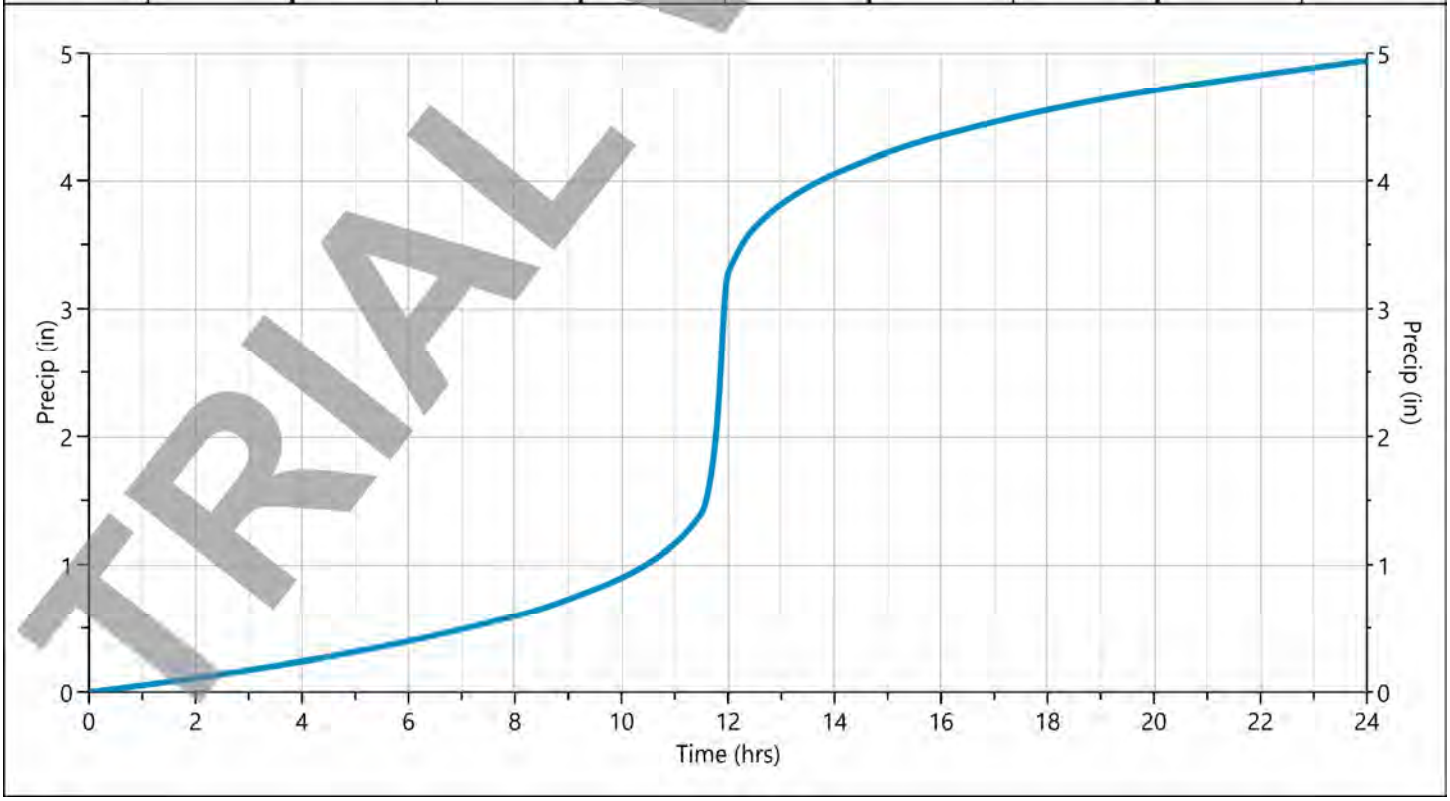
Custom Storm filename:

Hydrology Studio v 3.0.0.33 10-18-2024

Storm Distribution: NRCS/SCS - Type II, 24-hr

Storm Duration	Total Rainfall Volume (in)								
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	100-yr	✔ 500-yr	
24 hrs	1.82	2.28	0.00	2.85	3.31	3.94	4.43	4.94	

Incremental Rainfall Distribution, 500-yr									
Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)
10.90	0.011088	11.27	0.015808	11.63	0.065252	12.00	0.074237	12.37	0.019958
10.93	0.011307	11.30	0.016335	11.67	0.078250	12.03	0.033025	12.40	0.018706
10.97	0.011527	11.33	0.016862	11.70	0.091247	12.07	0.031221	12.43	0.017455
11.00	0.011746	11.37	0.017389	11.73	0.104245	12.10	0.029969	12.47	0.016203
11.03	0.012118	11.40	0.017916	11.77	0.119656	12.13	0.028718	12.50	0.014952
11.07	0.012646	11.43	0.018443	11.80	0.153389	12.17	0.027466	12.53	0.014185
11.10	0.013173	11.47	0.018970	11.83	0.189542	12.20	0.026215	12.57	0.013898
11.13	0.013700	11.50	0.019497	11.87	0.225696	12.23	0.024964	12.60	0.013612
11.17	0.014227	11.53	0.026296	11.90	0.261849	12.27	0.023712	12.63	0.013327
11.20	0.014754	11.57	0.039257	11.93	0.238961	12.30	0.022460	12.67	0.013042
11.23	0.015281	11.60	0.052254	11.97	0.156515	12.33	0.021209	12.70	0.012756



IDF Report

IDF filename: 500-updated.IDF

Hydrology Studio v 3.0.0.33

10-18-2024

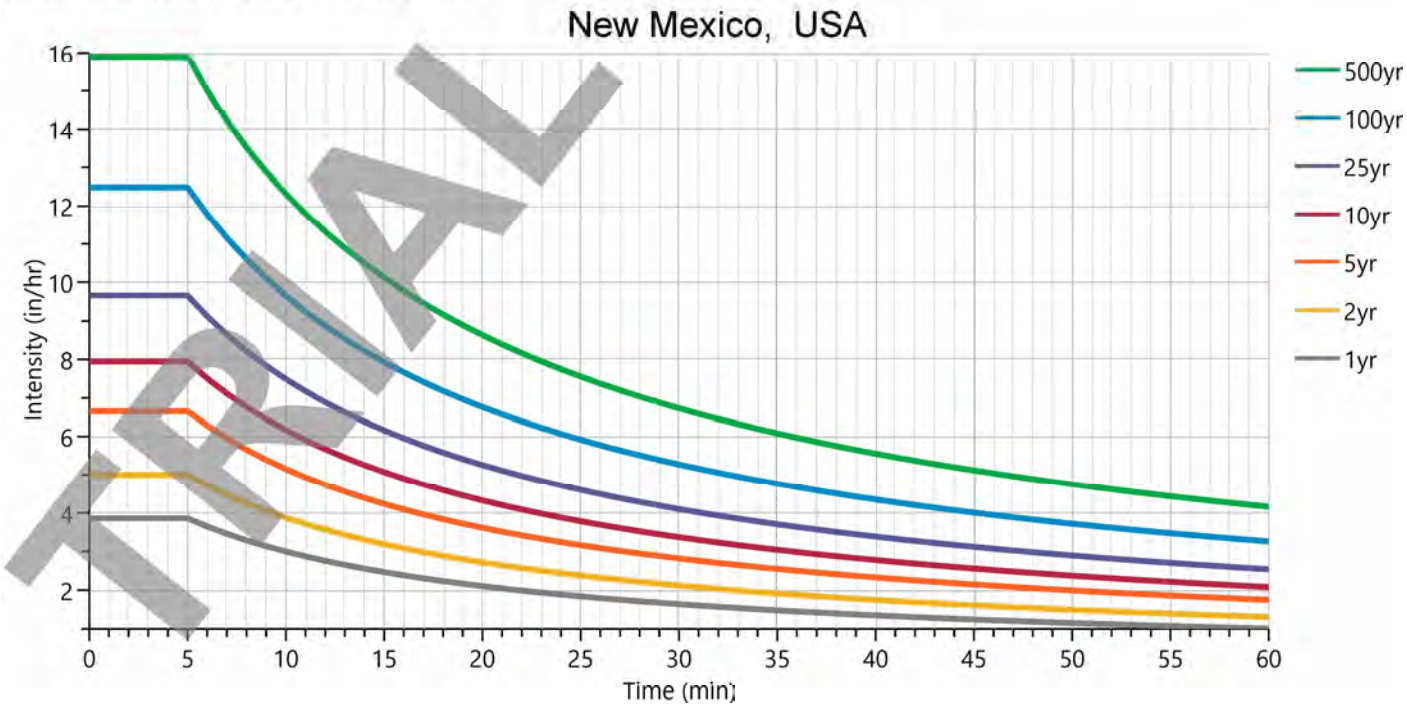
Intensity = B / (Tc + D)^E (in/hr)

Equation Coefficients	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	100-yr	500-yr
B	39.0643	47.8042	0.0000	59.8763	77.1941	89.4560	115.1384	150.1958
D	9.7000	9.3000	0.0000	8.9000	9.4000	9.1000	9.0000	9.2000
E	0.8612	0.8487	0.0000	0.8346	0.8524	0.8409	0.8418	0.8465

Minimum Tc= 5 minutes

Tc (min)	Intensity Values (in/hr)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	100-yr	500-yr
Cf	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	3.86	5.00	0	6.66	7.95	9.67	12.48	15.90
10	3.00	3.88	0	5.15	6.16	7.49	9.65	12.31
15	2.47	3.19	0	4.23	5.07	6.16	7.93	10.12
20	2.11	2.72	0	3.61	4.33	5.26	6.76	8.64
25	1.84	2.38	0	3.16	3.78	4.60	5.92	7.55
30	1.64	2.12	0	2.82	3.37	4.10	5.27	6.73
35	1.48	1.92	0	2.55	3.04	3.71	4.76	6.08
40	1.35	1.75	0	2.33	2.78	3.39	4.35	5.55
45	1.24	1.61	0	2.15	2.56	3.12	4.01	5.12
50	1.15	1.50	0	1.99	2.37	2.90	3.72	4.75
55	1.08	1.40	0	1.86	2.22	2.71	3.47	4.43
60	1.01	1.31	0	1.75	2.08	2.54	3.26	4.16

Cf = Correction Factor applied to Rational Method runoff coefficient



APPENDIX D

Hydraulic Analysis

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Oct 30 2024

500-Year Event

Trapezoidal

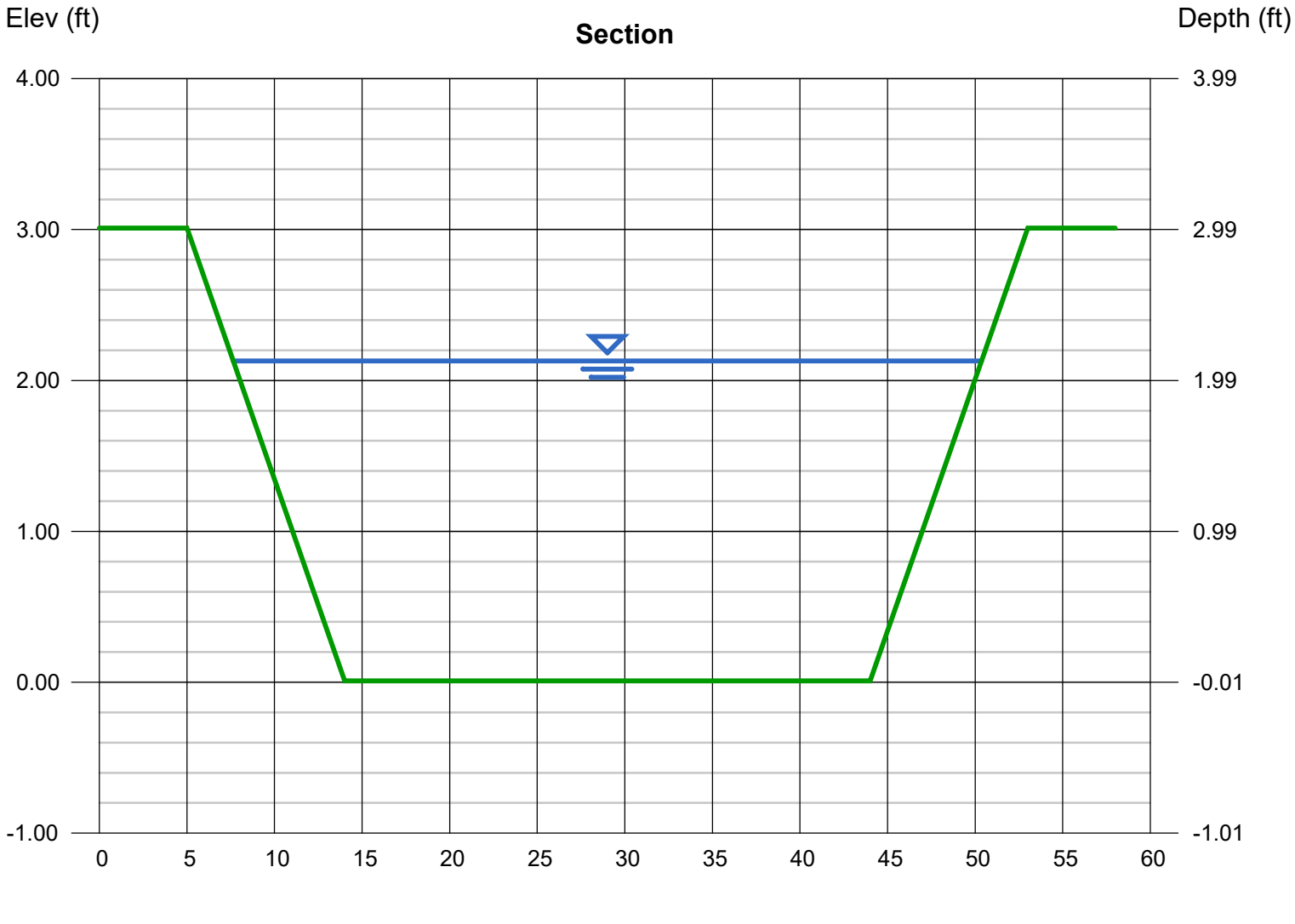
Bottom Width (ft)	= 30.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 0.01
Slope (%)	= 1.58
N-Value	= 0.120

Calculations

Compute by:	Known Q
Known Q (cfs)	= 175.30

Highlighted

Depth (ft)	= 2.12
Q (cfs)	= 175.30
Area (sqft)	= 77.08
Velocity (ft/s)	= 2.27
Wetted Perim (ft)	= 43.41
Crit Depth, Yc (ft)	= 0.99
Top Width (ft)	= 42.72
EGL (ft)	= 2.20



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Oct 30 2024

100-Year Event

Trapezoidal

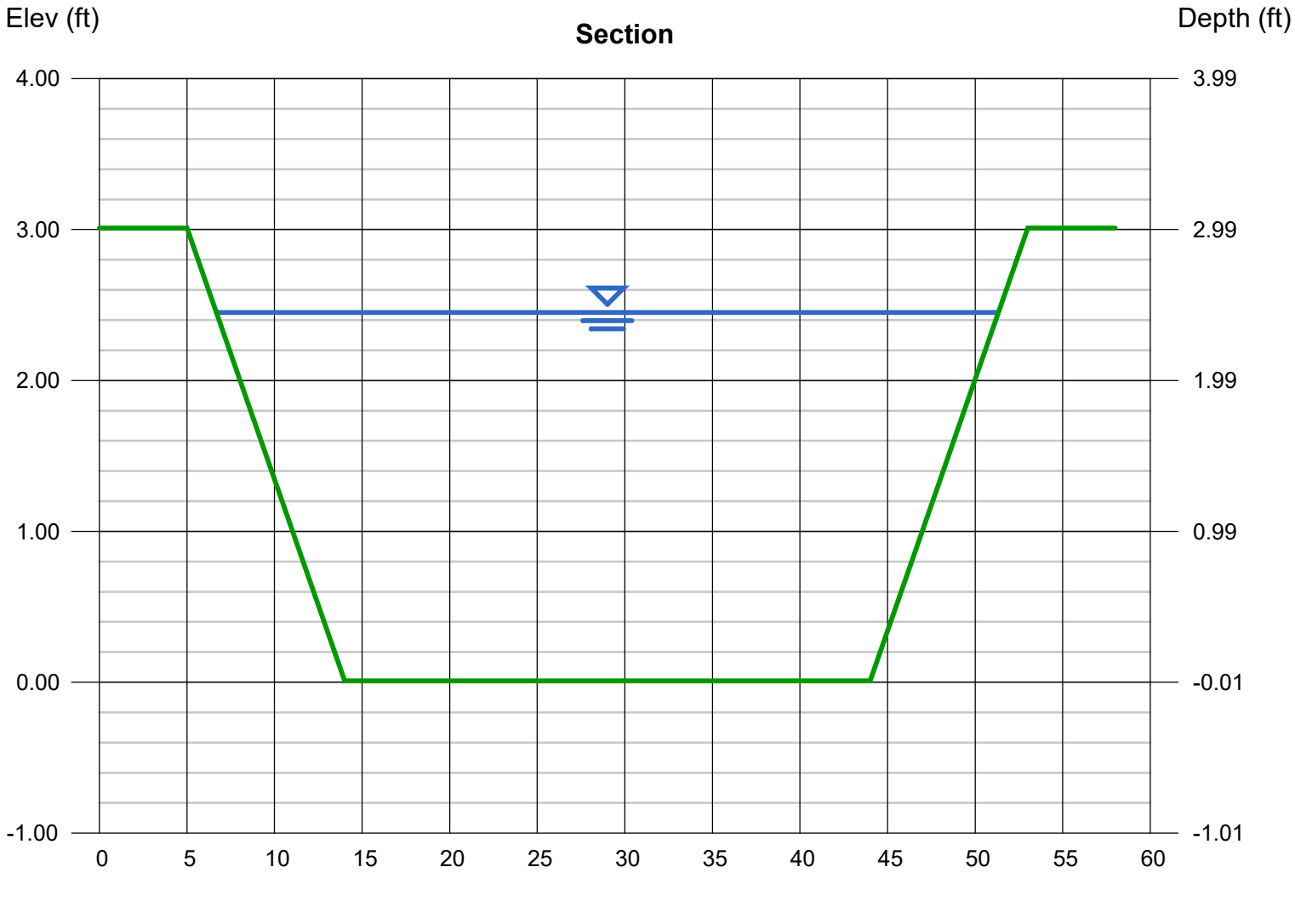
Bottom Width (ft)	= 30.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 0.01
Slope (%)	= 1.58
N-Value	= 0.120

Calculations

Compute by:	Known Q
Known Q (cfs)	= 223.80

Highlighted

Depth (ft)	= 2.44
Q (cfs)	= 223.80
Area (sqft)	= 91.06
Velocity (ft/s)	= 2.46
Wetted Perim (ft)	= 45.43
Crit Depth, Yc (ft)	= 1.16
Top Width (ft)	= 44.64
EGL (ft)	= 2.53



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Oct 30 2024

Maximum Capacity

Trapezoidal

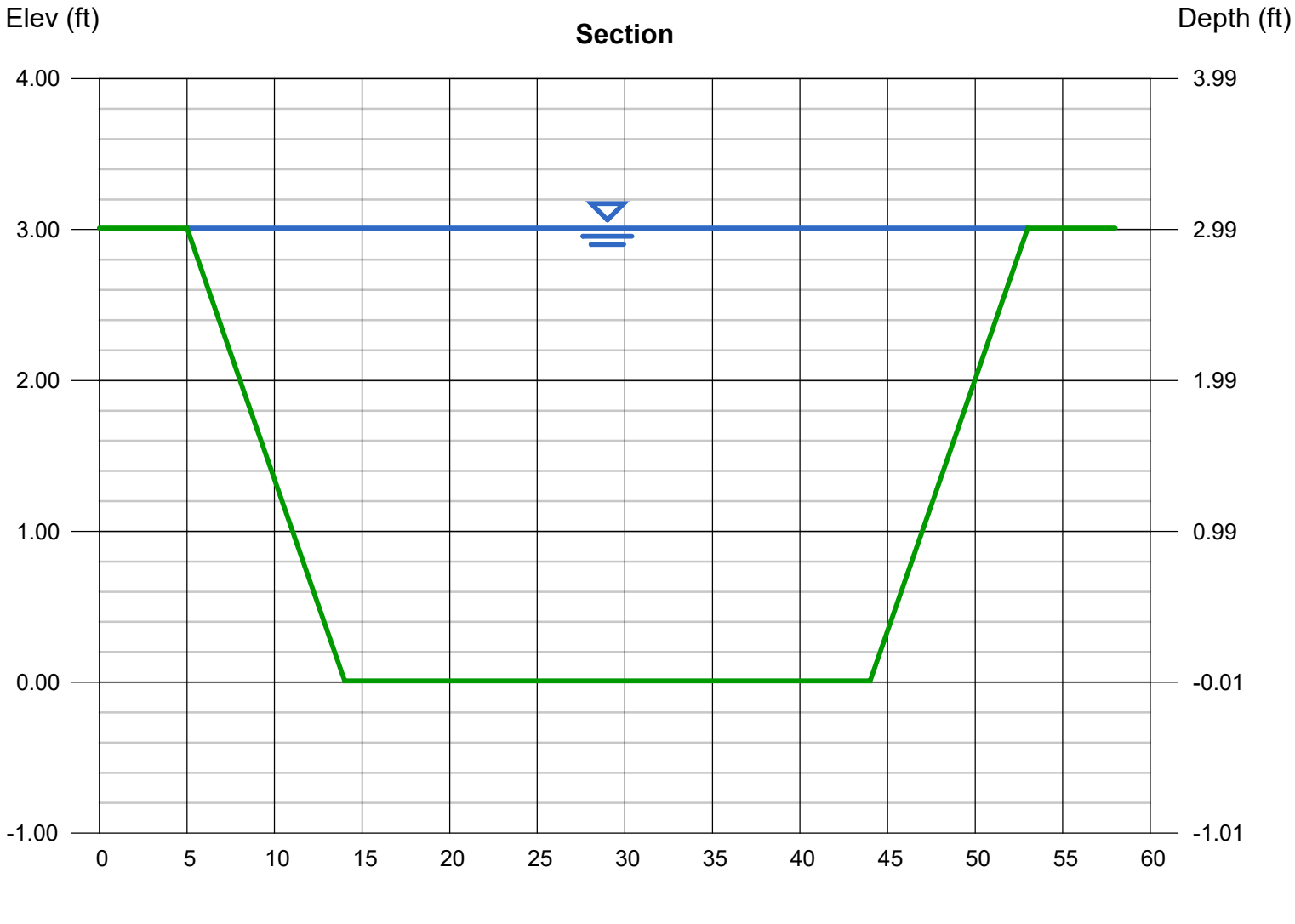
Bottom Width (ft)	= 30.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 0.01
Slope (%)	= 1.58
N-Value	= 0.120

Calculations

Compute by:	Known Depth
Known Depth (ft)	= 3.00

Highlighted

Depth (ft)	= 3.00
Q (cfs)	= 325.56
Area (sqft)	= 117.00
Velocity (ft/s)	= 2.78
Wetted Perim (ft)	= 48.97
Crit Depth, Yc (ft)	= 1.47
Top Width (ft)	= 48.00
EGL (ft)	= 3.12



STORMWATER CONVEYANCE DESIGN

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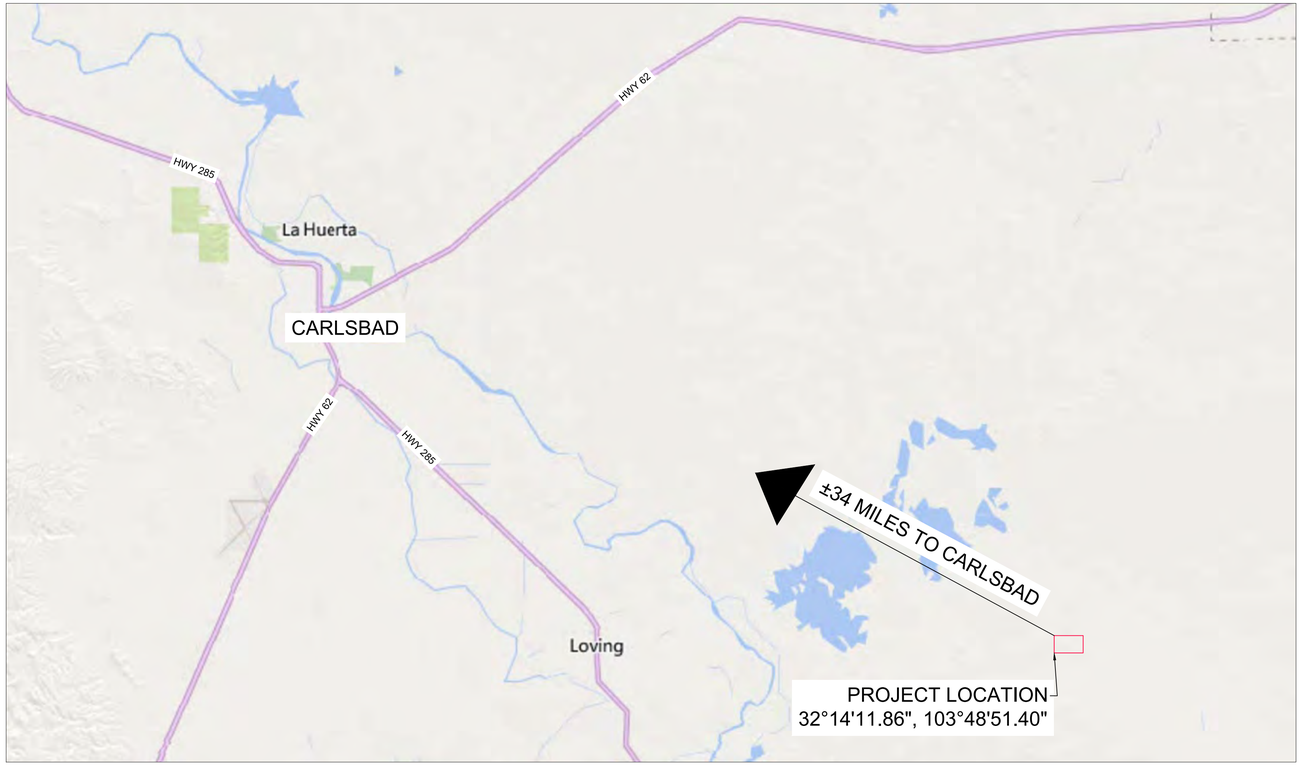
CIVIL PLANS

VAUGHAN OPERATING

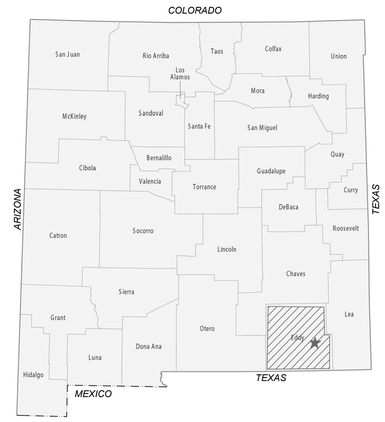
SAND DUNES

CITY OF CARLSBAD
SECTION 7, TOWNSHIP 24 SOUTH, RANGE 31 EAST
N.M.P.M., EDDY COUNTY, NEW MEXICO



INDEX OF SHEETS		
SHEET	NAME	DESCRIPTION
1	C-100	COVER SHEET
2	SU-101	~~TOPOGRAPHIC MAP~~
3	C-101	~~GENERAL NOTES~~
4	CS-101	CIVIL SITE PLAN
5	CS-102	~~NORTH-SOUTH & EAST-WEST CONTAINMENT PROFILES~~
6	CS-301	DIVERSION DITCH PLAN AND PROFILE STA:0+00 TO STA:9+00
7	CS-302	DIVERSION DITCH PLAN AND PROFILE STA:9+00 TO STA:17+22
8	CS-501	~~LEAK DETECTION DETAILS~~
9	CS-502	~~LINER DETAILS~~
10	CS-503	~~FENCE DETAILS~~
11	CS-504	DIVERSION DITCH DETAIL

EDDY COUNTY
NEW MEXICO



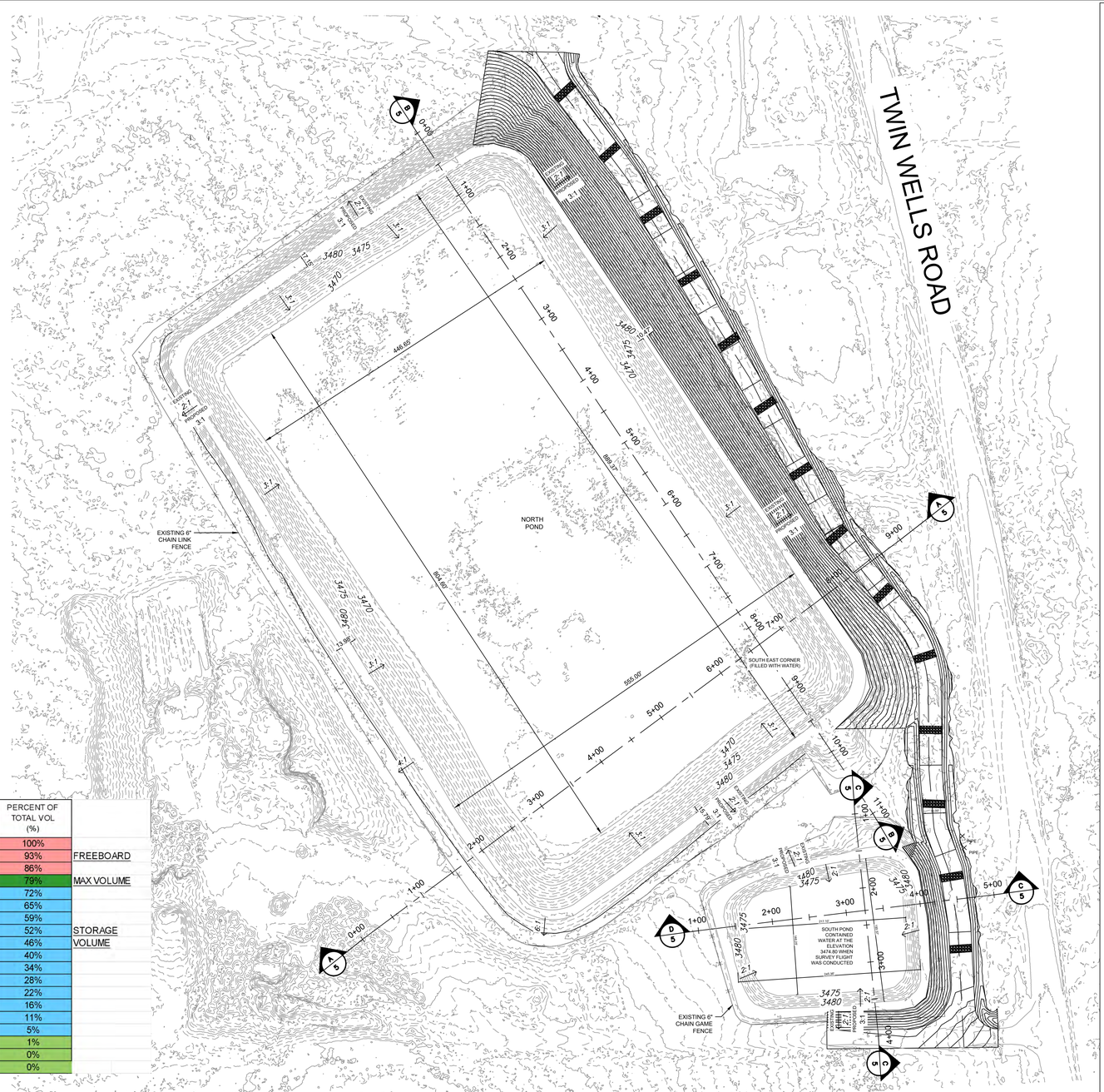
nm811
Know what's below.
Call before you dig.

(505)-254-7310

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

JEREMY BAKER
NEW MEXICO
16207
LICENSED PROFESSIONAL ENGINEER

11/05/2024



LARGE POND VOLUME

ELEVATION (FT)	CONTAINMENT DEPTH (FT)	REMAINING STORAGE (FT)	REMAINING STORAGE VOL (FT3)	REMAINING STORAGE VOL (GAL)	REMAINING STORAGE VOL (BBL)	PERCENT OF TOTAL VOL (%)	VOL IN CONTAINMENT (FT3)	VOL IN CONTAINMENT (GAL)	VOL IN CONTAINMENT (BBL)	VOL IN CONTAINMENT (AC-FT)	PERCENT OF TOTAL VOL (%)	
3,483.20	0	18	0	-	-	0%	6,805,341	50,910,757	1,211,993	156.23	100%	
3,482.20	1	17	485,142	3,629,349	86,401	7%	6,320,199	47,281,408	1,125,592	145.09	93%	FREEBOARD
3,481.20	2	16	962,565	7,200,950	171,427	14%	5,842,776	43,709,807	1,040,566	134.13	86%	
3,480.20	3	15	1,432,743	10,718,353	255,164	21%	5,372,598	40,192,403	956,830	123.34	79%	MAX VOLUME
3,479.20	4	14	1,895,432	14,179,728	337,566	28%	4,909,909	36,731,029	874,427	112.72	72%	
3,478.20	5	13	2,350,632	17,585,077	418,634	35%	4,454,709	33,325,680	793,359	102.27	65%	
3,477.20	6	12	2,797,918	20,931,224	498,293	41%	4,007,423	29,979,533	713,700	92.00	59%	
3,476.20	7	11	3,236,422	24,211,673	576,389	48%	3,568,919	26,699,084	635,604	81.93	52%	STORAGE
3,475.20	8	10	3,666,688	27,430,493	653,017	54%	3,138,653	23,480,264	558,977	72.05	46%	VOLUME
3,474.20	9	9	4,088,896	30,589,028	728,209	60%	2,716,445	20,321,728	483,784	62.36	40%	
3,473.20	10	8	4,503,188	33,688,347	801,992	66%	2,302,153	17,222,409	410,001	52.85	34%	
3,472.20	11	7	4,909,452	36,727,609	874,346	72%	1,895,889	14,183,147	337,647	43.52	28%	
3,471.20	12	6	5,307,198	39,703,150	945,182	78%	1,498,143	11,207,606	266,811	34.39	22%	
3,470.20	13	5	5,695,621	42,608,937	1,014,358	84%	1,109,721	8,301,819	197,635	25.48	16%	
3,469.20	14	4	6,074,389	45,442,504	1,081,815	89%	730,952	5,468,253	130,178	16.78	11%	
3,468.20	15	3	6,439,012	48,170,248	1,146,752	95%	366,329	2,740,509	65,241	8.41	5%	
3,467.20	16	2	6,712,478	50,216,045	1,195,455	99%	92,864	694,712	16,538	2.13	1%	
3,466.20	17.00	1.00	6,800,573	50,875,090	1,211,144	100%	4,768	35,667	849	0.11	0%	
3,465.20	18	0	6,805,341	50,910,757	1,211,993	100%	438	3,280	78	0.01	0%	

SMALL POND VOLUME

ELEVATION (FT)	CONTAINMENT DEPTH (FT)	REMAINING STORAGE (FT)	REMAINING STORAGE VOL (FT3)	REMAINING STORAGE VOL (GAL)	REMAINING STORAGE VOL (BBL)	PERCENT OF TOTAL VOL (%)	VOL IN CONTAINMENT (FT3)	VOL IN CONTAINMENT (GAL)	VOL IN CONTAINMENT (BBL)	VOL IN CONTAINMENT (AC-FT)	PERCENT OF TOTAL VOL (%)	
3,482.70	0	22	0	-	-	0%	462,800	3,462,207	82,422	10.62	100%	
3,481.70	1	21	44,237	330,940	7,878	10%	418,563	3,131,267	74,544	9.61	90%	FREEBOARD
3,480.70	2	20	85,649	640,743	15,254	19%	377,151	2,821,463	67,168	8.66	81%	
3,479.70	3	19	125,500	938,864	22,351	27%	337,300	2,523,343	60,071	7.74	73%	MAX VOLUME
3,478.70	4	18	163,754	1,225,045	29,164	35%	299,046	2,237,162	53,258	6.87	65%	
3,477.70	5	17	200,378	1,499,024	35,686	43%	262,422	1,963,182	46,736	6.02	57%	
3,476.70	6	16	235,321	1,760,440	41,909	51%	227,479	1,701,767	40,513	5.22	49%	
3,475.70	7	15	268,577	2,009,223	47,832	58%	194,223	1,452,983	34,590	4.46	42%	STORAGE
3,474.70	8	14	300,155	2,245,457	53,456	65%	162,645	1,216,749	28,966	3.73	35%	VOLUME

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ENGINEERING SHEET:

CIVIL SITE PLAN

OF

PROJECT NAME:

SAND DUNES

FOR

CLIENT:

VAUGHN OPERATING

PROJECT NUMBER:
24198

PROJECT ENGINEER: JEREMY BAKER, PE

DRAWN BY: XAVIER CLARK

GRAPHIC SCALE

0 80' 160'

SCALE: 1" = 80'
(IN FEET)

REVISIONS

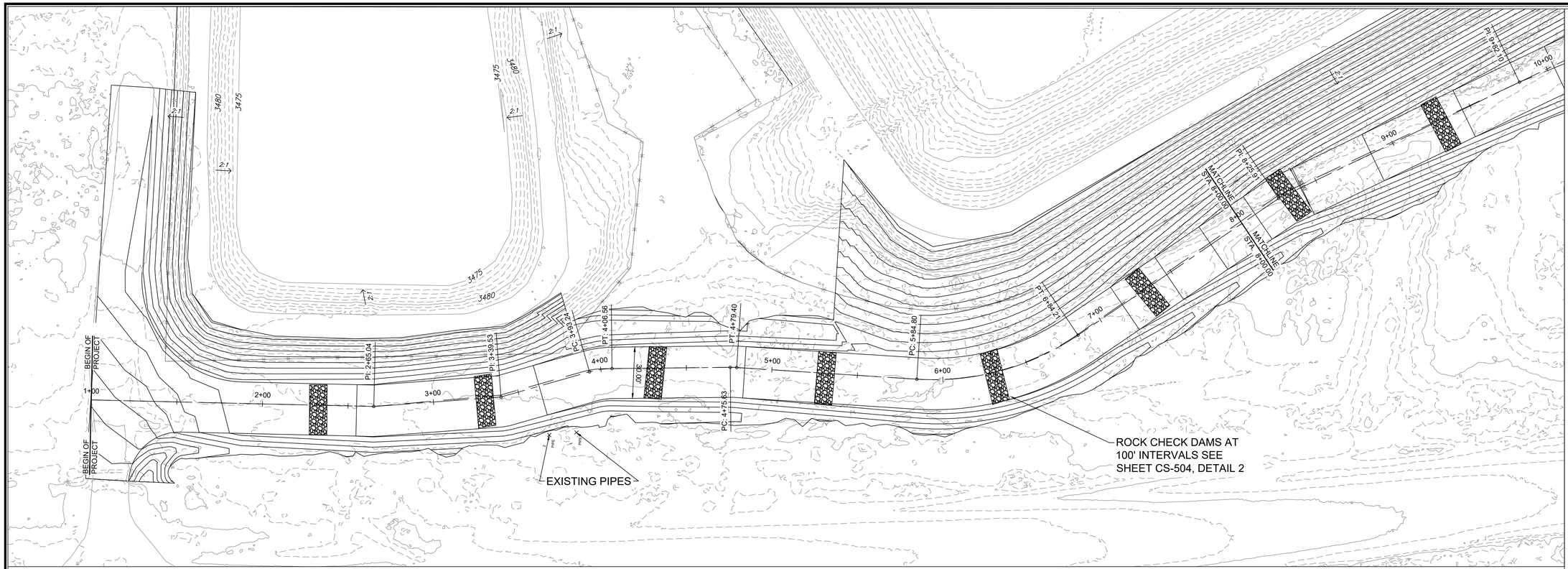
No.	DATE	DESCRIPTION

JEREMY BAKER NEW MEXICO 16207 LICENSED PROFESSIONAL ENGINEER

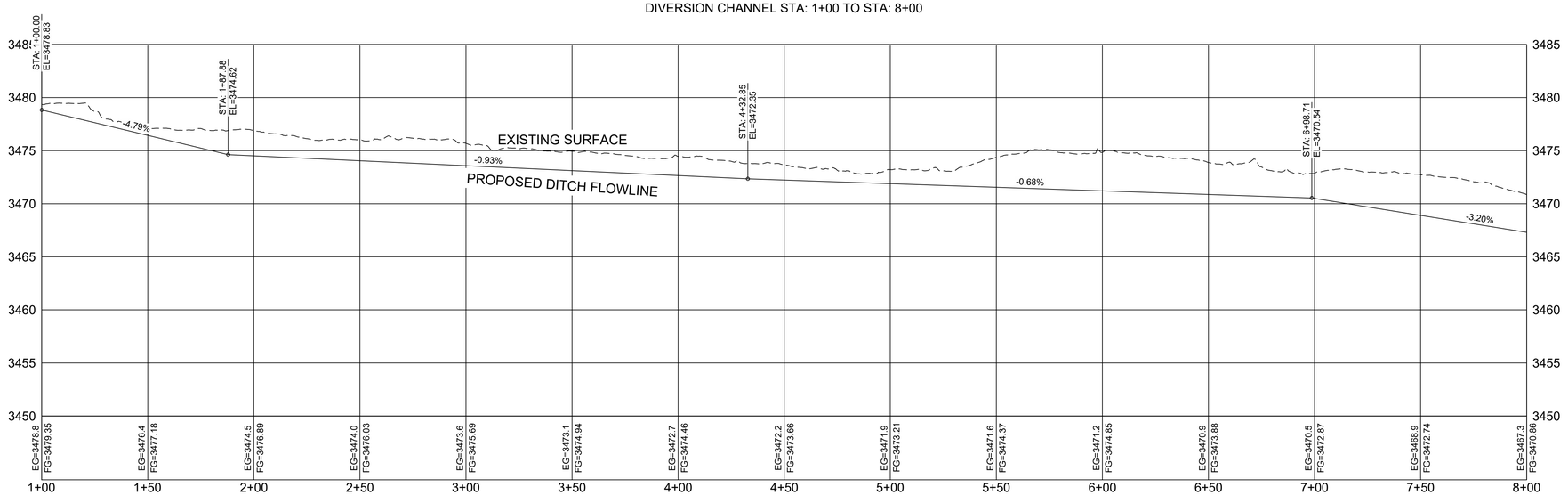
11/05/2024

SHEET: 4 of 11

CS-102



DIVERSION CHANNEL STA: 1+00 TO STA: 8+00



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ENGINEERING SHEET:
DIVERSION DITCH
PLAN AND PROFILE
STA:0+00 TO STA:9+00
OF

PROJECT NAME:

SAND DUNES

FOR

CLIENT:

VAUGHN OPERATING

PROJECT NUMBER:
24198

PROJECT ENGINEER: JEREMY BAKER, PE

DRAWN BY: XAVIER CLARK

GRAPHIC SCALE
HORIZONTAL
0 30' 60'
SCALE: 1" = 30'
(IN FEET)

GRAPHIC SCALE
VERTICAL
0 6' 12'
SCALE: 1" = 12'
(IN FEET)

REVISIONS

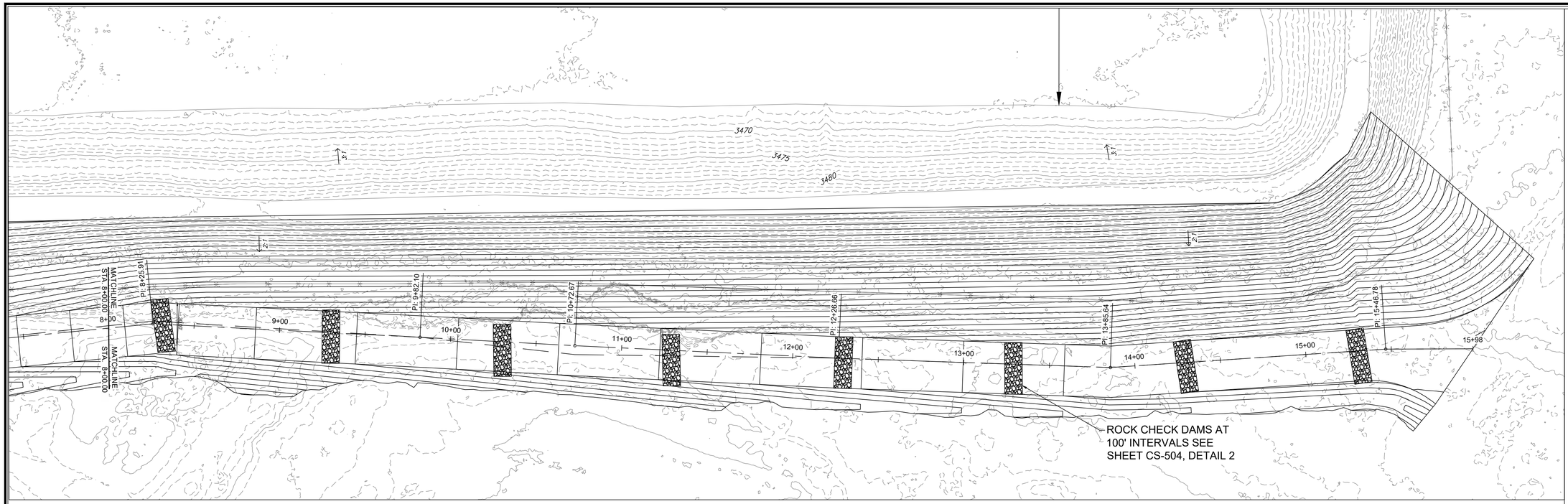
No.	DATE	DESCRIPTION

JEREMY BAKER NEW MEXICO 16207 LICENSED PROFESSIONAL ENGINEER

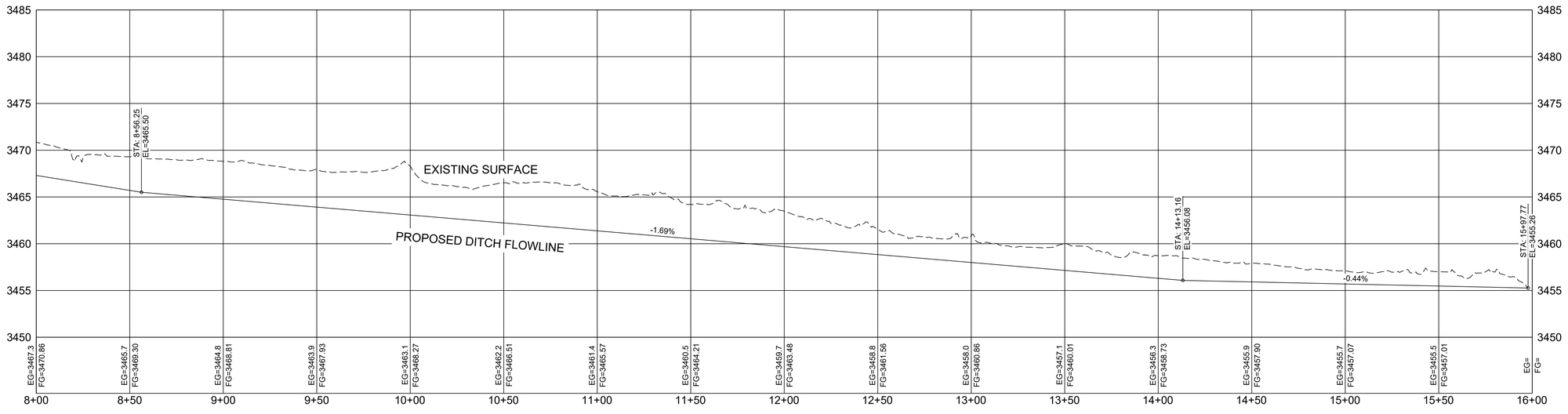
11/05/2024

SHEET: 6 of 11

CS-301



DIVERSION CHANNEL STA: 8+00 TO 16+00



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ENGINEERING SHEET:
DIVERSION DITCH
PLAN AND PROFILE
STA:9+00 TO STA:17+22
OF
PROJECT NAME:

SAND DUNES

FOR
CLIENT:

VAUGHN OPERATING

PROJECT NUMBER:
24198

PROJECT ENGINEER: JEREMY BAKER, PE
DRAWN BY: XAVIER CLARK

GRAPHIC SCALE
HORIZONTAL
0 30' 60'
SCALE: 1" = 30'
(IN FEET)

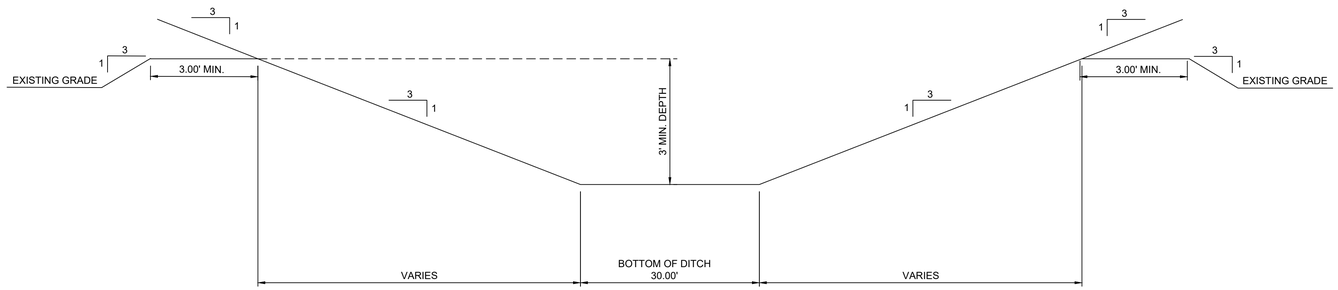
GRAPHIC SCALE
VERTICAL
0 6' 12'
SCALE: 1" = 12'
(IN FEET)

REVISIONS

No.	DATE	DESCRIPTION

JEREMY BAKER
NEW MEXICO
16207
LICENSED PROFESSIONAL ENGINEER
11/05/2024

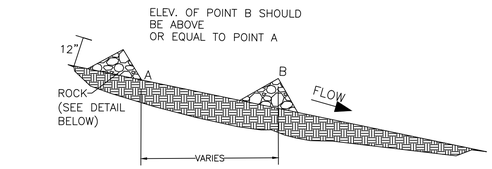
SHEET: 7 of 11
CS-302

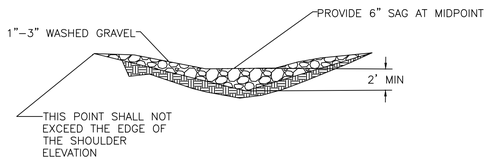


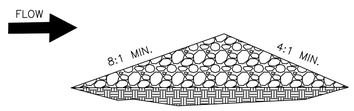
GENERAL NOTES:

1. PREPARED SUBGRADE MEANS COMPACTED SMOOTH SUBGRADE FREE OF ROCK, ROOTS, WOOD DEBRIS, CONCRETE RUBBLE AND ANY SHARP OBJECTS, A MINIMUM COMPACTED DEPTH OF 12".
2. ALL INTERIOR SLOPES AND TOP OF BERMS TO BE SMOOTH DRUM ROLLED
3. ALL EMBANKMENT SLOPES SHALL HAVE A SLOPE (H:V RATIO) OF 3:1.
4. COMPACTED EARTH EMBANKMENTS TO BE CONSTRUCTED WITH 12 INCH (MAXIMUM LOOSE LIFTS, COMPACTED TO 95% STANDARD PROCTOR DENSITY)
5. NO GEOTECHNICAL ANALYSIS WAS PERFORMED FOR THIS PROJECT
6. DIVERSION DITCH TO HAVE A BERM WHERE APPLICABLE. BERM SHALL BE CONSTRUCTED ON AREAS WHERE THE DITCH DOES NOT MEET THE 3 FOOT MINIMUM HEIGHT CRITERIA

1 DIVERSION DITCH DETAIL







GENERAL NOTES
1. ALL RIP RAP TO BE CLASS C PER NMDOT SECTIONS 602 OF THE 2019 NEW MEXICO DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR HIGHWAY AND BRIDGE CONSTRUCTION

2 CHECK DAM DETAIL

TYPE II
CHECK DAM

Table 602.2.1:1
Riprap Classifications and Gabion Requirements

Class	Description	Stone volume (ft^3) Minimum	Stone volume (ft^3) Maximum	Minimum dimension (in)[a]
A	Wire enclosed riprap	1/6	2/3	4
B[b]	Non-enclosed riprap	1	2	6
C[b]	Non-enclosed riprap	2	4	9
E	Grouted riprap	1/3	1	3
F	Grouted riprap	1	2	6
G	Rock plating	—	—	4–8[c]

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DIVERSION DITCH DETAIL
OF
PROJECT NAME:
SAND DUNES
FOR
CLIENT:
VAUGHN OPERATING

PROJECT NUMBER:
24198

PROJECT ENGINEER:
JEREMY BAKER, PE
DRAWN BY:
XAVIER CLARK

REVISIONS

No.	DATE	DESCRIPTION

JEREMY BAKER NEW MEXICO 16207 REGISTERED PROFESSIONAL ENGINEER
11/05/2024

SHEET: 11 of 11
CS-504

Venegas, Victoria, EMNRD

From: Venegas, Victoria, EMNRD
Sent: Monday, December 16, 2024 2:51 PM
To: Bobbi Settle
Subject: 2RF-214 - SAND DUNES RECYCLING FACILITY & CONTAINMENTS [fVV2435134912]
Attachments: C-147 2RF-214 - SAND DUNES RECYCLING FACILITY & CONTAINMENTS [fVV2435134912].pdf

2RF-214 - SAND DUNES RECYCLING FACILITY & CONTAINMENTS [fVV2435134912]

Good afternoon Ms. Settle,
NMOCD has reviewed the recycling containment permit application and related documents, submitted by [330307] Vaughan Operating LLC on 11/27/2024, Application ID 406972, for 2RF-214 - SAND DUNES RECYCLING FACILITY & CONTAINMENTS [fVV2435134912] in B-07-24S-31E, Eddy County, New Mexico. The form C-147 and related documents for 2RF-214 - SAND DUNES RECYCLING FACILITY & CONTAINMENTS [fVV2435134912] are approved with the following conditions of approval:

- The purpose of this permit is for oil and gas activities regulated under the NMAC 19.15.34.3 STATUTORY AUTHORITY: 19.15.34 NMAC is adopted pursuant to the Oil and Gas Act, Paragraph (15) of Section 70-2-12(B) NMSA 1978, which authorizes the division to regulate the disposition of water produced or used in connection with the drilling for or producing of oil and gas or both and Paragraph (21) of Section 70-2-12(B) NMSA 1978 which authorizes the regulation of the disposition of nondomestic wastes from the exploration, development, production or storage of crude oil or natural gas.
- 2RF-214 - SAND DUNES RECYCLING FACILITY & CONTAINMENTS [fVV2435134912] is approved for five years of operation from the date of permit application of 11/27/2024. 2RF-214 - SAND DUNES RECYCLING FACILITY & CONTAINMENTS [fVV2435134912] permit expires on 11/27/2029. If [330307] Vaughan Operating LLC wishes to extend operations past five years, an annual extension request must be submitted using on form C-147 Long through OCD Permitting by 10/27/2029.
- 2RF-214 - SAND DUNES RECYCLING FACILITY & CONTAINMENTS [fVV2435134912] consists of two (2) inground containments with a fluid capacity of 1,016,901.00 barrels.
- The total closure cost estimated of 2RF-214 - SAND DUNES RECYCLING FACILITY & CONTAINMENTS [fVV2435134912] in the amount of $823,532.00, meets the requirements of NMAC 19.15.34.15.A. The financial assurance should be mailed to: **EMNRD - Oil Conservation Division, Administration & Compliance Bureau Attn: Bond Administrator 1220 S. St. Francis Drive | Santa Fe, NM 87505**.
- [330307] Vaughan Operating LLC shall construct, operate, maintain, close, and reclaim 2RF-214 - SAND DUNES RECYCLING FACILITY & CONTAINMENTS [fVV2435134912] in compliance with NMAC 19.15.34 NMAC.
- [330307] Vaughan Operating LLC shall notify OCD, through OCD Permitting, when construction of 2RF-214 - SAND DUNES RECYCLING FACILITY & CONTAINMENTS [fVV2435134912] commences.
- [330307] Vaughan Operating LLC shall notify NMOCD through OCD Permitting when recycling operations commence and cease at 2RF-214 - SAND DUNES RECYCLING FACILITY & CONTAINMENTS [fVV2435134912].
- A minimum of 3-feet freeboard must be maintained at 2RF-214 - SAND DUNES RECYCLING FACILITY & CONTAINMENTS [fVV2435134912] at all times during operations.
- If less than 20% of the total fluid capacity is utilized every six months, beginning from the first withdrawal, operations of the 2RF-214 - SAND DUNES RECYCLING FACILITY & CONTAINMENTS [fVV2435134912] are considered ceased and a notification of cessation of operations should be sent electronically to OCD Permitting. A request to extend the cessation of operations, not to exceed six months, may be submitted using a C-147 form through OCD Permitting. If after that 6-month extension period, the 2RF-214 - SAND

DUNES RECYCLING FACILITY & CONTAINMENTS [fVV2435134912] is not utilized at a minimum of 20% fluid capacity, no additional extensions would be granted, and the operator would be directed to remove all fluids and proceed with the closure requirements.

- [330307] Vaughan Operating LLC shall submit monthly reports of recycling and reuse of produced water, drilling fluids, and liquid oil field waste on OCD form C-148 via OCD Permitting even if there is zero activity.
- [330307] Vaughan Operating LLC shall inspect the recycling containment and associated leak detection systems weekly while it contains fluids. The operator shall maintain a current log of such inspections and make the logs available for review by the division upon request according to 19.15.34.13.A.
- [330307] Vaughan Operating LLC shall comply with 19.15.29 NMAC Releases in the event of any release of produced water or other oil field waste at 2RF-214 - SAND DUNES RECYCLING FACILITY & CONTAINMENTS [fVV2435134912].

Please reference number 2RF-214 - SAND DUNES RECYCLING FACILITY & CONTAINMENTS [fVV2435134912] in all future communications.
Regards,

Victoria Venegas ● Environmental Specialist Advanced
EMNRD - Oil Conservation Division
506 W. Texas Ave. Artesia, NM 88210
575.909.0269 | Victoria.Venegas@emnrd.nm.gov

Sante Fe Main Office
Phone: (505) 476-3441

General Information
Phone: (505) 629-6116

Online Phone Directory
https://www.emnrd.nm.gov/ocd/contact-us

State of New Mexico
Energy, Minerals and Natural Resources
Oil Conservation Division
1220 S. St Francis Dr.
Santa Fe, NM 87505

CONDITIONS

Operator:	OGRID:
Vaughan Operating LLC 3021 Hepler Rd. Carlsbad, NM 88220	330307
	Action Number: 406972
	Action Type: [C-147] Water Recycle Long (C-147L)

CONDITIONS

Created By	Condition	Condition Date
vvenegas	2RF-214 - SAND DUNES RECYCLING FACILITY & CONTAINMENTS [fVV2435134912] permit expires on 11/27/2029. If [330307] Vaughan Operating LLC wishes to extend operations past five years, an annual extension request must be submitted using on form C-147 Long through OCD Permitting by 10/27/2029. • [330307] Vaughan Operating LLC shall construct, operate, maintain, close, and reclaim 2RF-214 - SAND DUNES RECYCLING FACILITY & CONTAINMENTS [fVV2435134912] in compliance with NMAC 19.15.34 NMAC. • [330307] Vaughan Operating LLC shall comply with 19.15.29 NMAC Releases in the event of any release of produced water or other oil field waste at 2RF-214 - SAND DUNES RECYCLING FACILITY & CONTAINMENTS [fVV2435134912].	12/16/2024