Texas Water Development Board

OLA ID 1546270
PIF No. 14190
Entity Name: Greenbelt MIWA
Project Name: Develop Additional Water Supplies from the Ogallala Aquifer

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General Information

Project Information

Funding Type SWIFT

Contact Information

County Donley

Entity Contact Information	Engineering Firm Contact Information
Name of Entity Greenbelt MIWA	Name of New Entity
Prefix Mr.	Prefix Mr.
First Name Bobbie	First Name Andrew
Last Name Kidd	Last Name Richardson, PE
Addr 1 P.O. Box 665	Addr 1 801 Cherry Street
Addr 2	Addr 2 Suite 2800
City Clarendon	City Fort Worth
State TX	State TX
Zip 79226-0000	Zip 76102-0000
Phone 806-874-3650	Phone (817) 735-7210
Fax 806-874-3223	Fax
Suffix	Suffix
OrgName	OrgName
DeptName	DeptName
Title General Manager	Title Project Manager
Email greenbeltwater@valornet.com	Email Andrew.Richardson@freese.com
	Firm Name Freese and Nichols, Inc.
Make Changes N	Make Changes Y
No Entity TxWISE Id	No Engineering TxWISE Id

Service Area

Population Served 21,422

Project Description

Project Name Develop Additional Water Supplies from the Ogallala Aquifer

Where can Project be found in the most recent Regional Water Plan?
The project is described on page #: 5C-25
The capital cost is listed on page #: 5C-26

Region A - PANHANDLE

Phase(s) Applied For
Planning N
Acquisition N
Design Y
Construction Y

Emergency
Applicant/entity's water supply will last less than 180 days. N
Applicant has received or applied for Federal emergency funding. N
None of the above. Y

Agricultural Efficiency Project? N

Estimated average annual residential water bill $860.89
Annual Median Household Income $39,842.09

Project will produce water Y
Project will conserve water N
Please provide the volume of water anticipated to be produced or conserved by the project per decade:

2020	2030	2040	2050	2060	2070
1000	2000	2000	2000	2000	2000

Project will address water loss Y

Description of Proposed Project Components The proposed project will install 3 proposed groundwater wells, well field piping, electrical distribution equipment and a 12-mile transmission line to transport the water to the existing Greenbelt Water Treatment Plant. The Greenbelt Water Authority has already negotiated water rights from this property, acquiring 2,780 ac-ft/yr of groundwater rights.

Water System Contacts

Type	Contact	Communication	
AC - Administrative Contact	WELCH, DON PO BOX 665 CLARENDON, TX 79226-0665	Electronic Type	Value
		EMAIL - Email	
		Phone Type	Value
		BUS - Business	806-874-3650

Annual Operating Period(s)

Eff. Begin Date	Eff. End Date	Start Month/Day	End Month/Day	Type	Population
03-30-2010	No End Date	1/1	12/31	W	22000

Service Connection(s)

Type	Count	Meter Type	Meter Size
CB	7311	ME	0

Service Area(s)

Code	Name
O	DISPENSER
O	WHOLESALER (SELLS WATER)

System Certification Requirements

Certification Name	Code	Begin Date

Water System Facilities

Fac. ID	Facility Name	Type Status Avail.	Unit Process Name Treatment Objective Name Treatment Process Name
CH14792	RAW-TAP	CH - A - P	
DS01	DISTRIBUTION SYSTEM	DS - A - P	
S0650013A	INTAKE 1	IN - A - P	
PF0001	CHILDRESS PS - 2000 GPM - SP	PF - A - P	
PF0002	PEASE RIVER PS - 1300 GPM - SP	PF - A - P	
PF0003	QUANAH PS - 650 GPM - SP	PF - A - P	
PF0004	CLARENDON PS - 1200 GPM - SP	PF - A - P	
PF0005	HEDLEY PS - 300 GPM - SP	PF - A - P	
PF0006	PLANT - 6300 GPM - SP	PF - A - P	
PF0007	QUANAH PS - 650 GPM - SP	PF - A - P	
PF0008	PEASE RIVER PS - 1300 GPM - SP	PF - A - P	
PF0009	HEDLEY PS - 150 GPM - SP	PF - A - P	
PF0010	CLARENDON PS - 500 GPM - SP	PF - A - P	
PF0011	PLANT - 8333 GPM - SP	PF - A - P	
PF0012	CHILDRESS PS - 2000 GPM - SP	PF - A - P	
PF0013	CHILDRESS PS - 1250 GPM - SP	PF - A - P	
PF0014	PLANT - 6300 GPM - SP	PF - A - P	
PF0015	CHILDRESS PS - 1250 - SP	PF - A - P	
PF0016	PLANT - 8333 GPM - SP	PF - A - P	
PF0017	PLANT (PRESSURE ONLY) - 400 GPM - SP	PF - A - P	
PF0018	CHILDRESS PS - 1250 GPM - SP	PF - A - P	
PF0019	CHILDRESS PS - 1250 GPM - SP	PF - A - P	
EP001	4610 TX 70 N, CLARENDON	SS - A - P	
PBCU001	4610 TX 70 N; CLARENDON	SS - A - P	
ST0001	6 MI S OF QUANAH - 1.000 MG - EL	ST - A - P	
ST0003	W OF CHILDRESS - 6.000 MG - GR	ST - A - P	
ST0004	1/2 M E OF HEDLEY - 2.000 MG - GR	ST - A - P	
ST0005	CONCRETE PLANT - 0.268 MG - GR	ST - A - P	
ST0002	N OF QUANAH - 1.2 MG GST	ST - I - O	
TP14792	PLANT - LK GREENBELT	TP - A - P	CHEMFEED1CL2 / DISINFECTION / GASEOUS CHLORINATION, PRE CHEMFEED2CL2 / DISINFECTION / GASEOUS CHLORINATION, PRE CHEMFEED3CL2 / DISINFECTION / GASEOUS CHLORINATION, PRE CHEMFEED4NH3 / DISINFECTION / CHLORAMINES (PRE) CHEMFEED5CL2 / DISINFECTION / GASEOUS CHLORINATION, POST CHEMFEED6NH3 / DISINFECTION / CHLORAMINES (POST) CLARIFIER(2) / PARTICULATE REMOVAL / CLARIFICATION (UPFLOW SOLIDSC) CLEARWELL / DISINFECTION / DETENTION TIME FLASHMIX(2) / PARTICULATE REMOVAL / RAPID MIX (HYRAULIC) FLOCBASIN(2) / PARTICULATE REMOVAL / FLOCCULATION (HYDRAULIC) GRAVFILTER(4) / PARTICULATE REMOVAL / FILTRATION (DUAL MEDIA)
G0650013A	KELLY CREEK 2	WL - A - P	
G0650013B	KELLY CREEK 4	WL - A - P	
G0650013C	CLARENDON 3	WL - A - P	
G0650013D	CLARENDON 4	WL - A - P	
G0650013E	CLARENDON 5	WL - A - E	
G0650013F	KELLY CREEK 1	WL - A - P	
G0650013G	KELLY CREEK 3	WL - A - P	
G0650013H	CLARENDON 1	WL - A - P	
G0650013I	CLARENDON 2	WL - A - P	

Water System Facility Flows

WL - G0650013C	CLARENDON 3	TP - TP14792	PLANT - LK GREENBELT
WL - G0650013D	CLARENDON 4	TP - TP14792	PLANT - LK GREENBELT
WL - G0650013E	CLARENDON 5	TP - TP14792	PLANT - LK GREENBELT
WL - G0650013F	KELLY CREEK 1	TP - TP14792	PLANT - LK GREENBELT
WL - G0650013G	KELLY CREEK 3	TP - TP14792	PLANT - LK GREENBELT
WL - G0650013H	CLARENDON 1	TP - TP14792	PLANT - LK GREENBELT
WL - G0650013I	CLARENDON 2	TP - TP14792	PLANT - LK GREENBELT
SS - PBCU001	4610 TX 70 N; CLARENDON	DS - DS01	DISTRIBUTION SYSTEM
IN - S0650013A	INTAKE 1	TP - TP14792	PLANT - LK GREENBELT
TP - TP14792	PLANT - LK GREENBELT	SS - EP001	4610 TX 70 N, CLARENDON

Water Purchases

Water System \ Treatment Status
No Water Purchases

Buyers of Water

Water System / Population / Availability (blank, (S)easonal, (E)mergency, (I)nterim, (P)ermanent, (O)ther
TX0650013 sells to RRA NEW GOODLETT WATER SYSTEM - TX0990003 / 20 / P
TX0650013 sells to RRA DONLEY COUNTY REST AREAS - TX0650018 / 400 / P
TX0650013 sells to CITY OF CHILLICOTHE - TX0990001 / 707 / P
TX0650013 sells to RRA GOODLETT WATER SYSTEM - TX0990012 / 66 / P
TX0650013 sells to RRA SOUTHWEST QUANAH WATER SYSTEM - TX0990044 / 129 / P
TX0650013 sells to RRA NORTHEAST QUANAH WATER SYSTEM - TX0990004 / 275 / P
TX0650013 sells to CITY OF CROWELL - TX0780001 / 948 / P
TX0780001 sells to THALIA WSC - TX0780013 / 125 / P
TX0650013 sells to RRA FOARD COUNTY WATER SYSTEM - TX0780014 / 120 / P
TX0650013 sells to RRA FARMERS VALLEY WATER SYSTEM - TX2440007 / 134 / P
TX0650013 sells to RRA ESTELLINE TURKEY WATER SYSTEM - TX0960001 / 250 / S
TX0650013 sells to RRA NEWLIN WATER SYSTEM - TX0960016 / 36 / P
TX0650013 sells to RRA GREENBELT LAKE LOTS - TX0650014 / 120 / P
TX0650013 sells to RRA CLUB LAKE WATER SYSTEM - TX0960019 / 50 / P
TX0650013 sells to CITY OF QUANAH - TX0990002 / 2474 / P
TX0650013 sells to RRA MEDICINE MOUND WATER SYSTEM - TX0990013 / 150 / P
TX0650013 sells to RRA TELL CEE VEE WS - TX0380013 / 534 / P
TX0650013 sells to CITY OF MEMPHIS - TX0960002 / 2290 / E
TX0650013 sells to CITY OF CLARENDON - TX0650001 / 2026 / P
TX0650013 sells to HEDLEY MUNICIPAL WATER SYSTEM - TX0650002 / 329 / P
TX0650013 sells to CITY OF CHILDRESS - TX0380001 / 6105 / P
TX0650013 sells to RRA CAREY NORTHFIELD WS - TX0380015 / 90 / P
TX0650013 sells to RRA NORTHEAST CHILDRESS - TX0380014 / 360 / P
TX0650013 sells to RRA SAIED WS - TX0380019 / 81 / P
TX0650013 sells to RRA KIRKLAND LAZARE WS - TX0380012 / 120 / P
TX0650013 sells to RRA GARDEN VALLEY WS - TX0380017 / 150 / P

Routine TCR Sample Schedules

Begin Date	End Date	Requirements
01-01-1991	Continuous	1 RT/MN

Repeat TCR Sample Schedules

Begin Date	End Date	Requirements	Original Sample ID/Date
No Repeat TCR Schedules			

Group Non-TCR Sample Schedules

Facility	Begin Date	End Date	Requirements	Analyte Group Code	Analyte Group Name
CH14792	07-01-2013	Continuous	1 RT/MN	TOC	RAW TOC
DS01	10-01-2013	Continuous	1 RT/YR	DBP2	DBP PHASE 2
EP001	01-01-2011	Continuous	1 RT/3Y	504	EDB/DBCP
EP001	01-01-2011	Continuous	1 RT/3Y	515	SOC METHOD 515.4
EP001	01-01-2011	Continuous	1 RT/3Y	531	SOC METHOD 531.1
EP001	01-01-2011	Continuous	1 RT/YR	MIN	MINERALS
EP001	01-01-2018	Continuous	1 RT/YR	MTL1	METALS REVISED
EP001	01-01-2010	Continuous	1 RT/6Y	RAD	RADIONUCLIDES
EP001	01-01-2016	Continuous	1 RT/YR	SOC5	SYNTHETIC ORGANICS
EP001	01-01-2011	Continuous	1 RT/YR	VOC	VOLATILE ORGANICS

Individual Non-TCR Sample Schedules

Facility	Begin/End Date	Init MP Begin Dt	Seasonal	Req.	Code	Analyte Name
TP14792	07-01-2013 Continuous	07-01-2013		1 RT/MN	2920	CARBON, TOTAL
EP001	01-01-2014 Continuous	01-01-2014		1 RT/YR	1024	CYANIDE
DS01	01-01-2004 Continuous	01-01-2004		1 RT/9Y	1094	ASBESTOS
EP001	01-01-2013 Continuous	01-01-2013		1 RT/YR	1040	NITRATE
EP001	01-01-2014 Continuous	01-01-2014		1 RT/9Y	1041	NITRITE

Group Violations

Fed.	Det. Date	Viol.	Viol. Name	An.	An. Group Name

Viol. No.	Det. Date	Viol. Type	Viol. Name	Viol. Code	An. Name
2018-1548	04-20-2018	38	MONITORING, ROUTINE (IESWTR/LT1), MAJOR	0100	TURBIDITY
2017-1546	05-24-2017	75	PUBLIC NOTICE RULE LINKED TO VIOLATION	7500	PUBLIC NOTICE
2017-1542	05-02-2017	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2017-1541	05-02-2017	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2017-1543	05-02-2017	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2017-1544	05-02-2017	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2017-1539	05-02-2017	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2017-1538	05-02-2017	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2017-1535	02-06-2017	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2017-1534	02-06-2017	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2017-1533	02-06-2017	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2017-1532	02-06-2017	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2017-1528	02-06-2017	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2017-1529	02-06-2017	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2017-1527	12-13-2016	75	PUBLIC NOTICE RULE LINKED TO VIOLATION	7500	PUBLIC NOTICE
2017-1510	11-08-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2017-1514	11-08-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2017-1525	11-08-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2017-1511	11-08-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2017-1513	11-08-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2017-1524	11-08-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2017-1519	10-21-2016	75	PUBLIC NOTICE RULE LINKED TO VIOLATION	7500	PUBLIC NOTICE
2017-1516	10-21-2016	75	PUBLIC NOTICE RULE LINKED TO VIOLATION	7500	PUBLIC NOTICE
2017-1517	10-21-2016	75	PUBLIC NOTICE RULE LINKED TO VIOLATION	7500	PUBLIC NOTICE
2017-1518	10-21-2016	75	PUBLIC NOTICE RULE LINKED TO VIOLATION	7500	PUBLIC NOTICE
2017-1520	10-21-2016	75	PUBLIC NOTICE RULE LINKED TO VIOLATION	7500	PUBLIC NOTICE
2017-1521	10-21-2016	75	PUBLIC NOTICE RULE LINKED TO VIOLATION	7500	PUBLIC NOTICE
2017-1522	10-21-2016	75	PUBLIC NOTICE RULE LINKED TO VIOLATION	7500	PUBLIC NOTICE
2017-1523	10-21-2016	75	PUBLIC NOTICE RULE LINKED TO VIOLATION	7500	PUBLIC NOTICE
2016-1501	08-11-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2016-1505	08-11-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2016-1506	08-11-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2016-1508	08-11-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2016-1509	08-11-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2016-1502	08-11-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1427	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1428	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1429	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1432	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1433	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1434	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1435	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1436	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1438	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1441	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1443	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1444	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1445	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1447	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1448	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1452	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1453	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1454	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1455	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1456	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1459	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1460	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1462	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1463	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1464	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2015-1465	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2016-1476	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2016-1477	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2016-1478	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2016-1480	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2016-1481	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2016-1482	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2016-1484	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL

2016-1493	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2016-1494	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2016-1497	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2016-1498	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2016-1499	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2016-1500	07-12-2016	27	MONITORING, ROUTINE (DBP), MAJOR	2920	CARBON, TOTAL
2016-1472	11-02-2015	38	MONITORING, ROUTINE (IESWTR/LT1), MINOR	0100	TURBIDITY
2015-1466	08-21-2015	75	PUBLIC NOTICE RULE LINKED TO VIOLATION	7500	PUBLIC NOTICE
2015-1469	08-21-2015	75	PUBLIC NOTICE RULE LINKED TO VIOLATION	7500	PUBLIC NOTICE
2015-1468	08-21-2015	75	PUBLIC NOTICE RULE LINKED TO VIOLATION	7500	PUBLIC NOTICE
2016-1473	06-20-2015	38	MONITORING, ROUTINE (IESWTR/LT1), MINOR	0100	TURBIDITY
2015-1426	06-01-2015	75	PUBLIC NOTICE RULE LINKED TO VIOLATION	7500	PUBLIC NOTICE
2015-1424	05-07-2015	38	MONITORING, ROUTINE (IESWTR/LT1), MAJOR	0100	TURBIDITY
2015-1423	05-07-2015	38	MONITORING, ROUTINE (IESWTR/LT1), MAJOR	0100	TURBIDITY
2015-1422	05-07-2015	38	MONITORING, ROUTINE (IESWTR/LT1), MAJOR	0100	TURBIDITY
2015-1421	05-07-2015	36	MONITORING, RTN/RPT MAJOR (SWTR-FILTER)	0999	CHLORINE
2015-1420	05-07-2015	36	MONITORING, RTN/RPT MAJOR (SWTR-FILTER)	0999	CHLORINE
2015-1419	05-07-2015	36	MONITORING, RTN/RPT MAJOR (SWTR-FILTER)	0999	CHLORINE
2015-1417	02-05-2015	36	MONITORING, RTN/RPT MAJOR (SWTR-FILTER)	0999	CHLORINE
2015-1418	02-05-2015	38	MONITORING, ROUTINE (IESWTR/LT1), MAJOR	0100	TURBIDITY
2012-1413	02-24-2012	39	FAILURE TO SUBMIT PLANT SCHEMATIC (FBR)	0500	FILTER BACKWASH RULE
2011-1410	01-31-2011	75	PUBLIC NOTICE RULE LINKED TO VIOLATION	7500	PUBLIC NOTICE
2011-1409	01-25-2011	75	PUBLIC NOTICE RULE LINKED TO VIOLATION	7500	PUBLIC NOTICE
2008-1408	04-25-2008	22	MCL (TCR), MONTHLY	3100	COLIFORM (TCR)
2008-1308	04-25-2008	25	MONITORING (TCR), REPEAT MAJOR	3100	COLIFORM (TCR)
2004-904	01-21-2004	38	MONITORING, ROUTINE (IESWTR/LT1), MAJOR	0300	IESWTR
2004-1004	12-21-2003	38	MONITORING, ROUTINE (IESWTR/LT1), MAJOR	0300	IESWTR
2003-303	02-21-2003	36	MONITORING, RTN/RPT MAJOR (SWTR-FILTER)	0200	SWTR
2003-203	01-21-2003	36	MONITORING, RTN/RPT MAJOR (SWTR-FILTER)	0200	SWTR
2002-102	10-21-2002	44	MONTHLY COMB FLTR EFFLUENT (IESWTR/LT1)	0300	IESWTR

Recent Positive TCR Sample Results

Type/ RP Loc	Sample No.	Date	Sample Point	Sample Pt. Description	Lab ID	Result / Analyte / Method / MP

PBCU Sample Summary Results

MP Begin Date	Type	# Samples	Measure	Units	Analyte Code/Name

Site Visits

Reason	Date	Deficiency(ies)/Recommendation(s)					
		Cat.	Sev.	Desc. Code Desc. Text	Freehand Desc.	Det. Date	Res. Date
SNSV	08-09-2021	No Deficiencies/Recommendations Entered					

Recent Primary/Secondary Sample Results

Fac./ Site	Sample No.	Date	An. Code	Analyte	Result	Unit	Method
EP001-TRT-TAP	Q2124834004	09-13-2021	1074	ANTIMONY, TOTAL	ND		200.8
EP001-TRT-TAP	Q2124834004	09-13-2021	1005	ARSENIC	0.003	MG/L	200.8
EP001-TRT-TAP	Q2124834004	09-13-2021	1010	BARIUM	0.21	MG/L	200.8
EP001-TRT-TAP	Q2124834004	09-13-2021	1075	BERYLLIUM, TOTAL	ND		200.8
EP001-TRT-TAP	Q2124834004	09-13-2021	1015	CADMIUM	ND		200.8
EP001-TRT-TAP	Q2124834004	09-13-2021	1020	CHROMIUM	ND		200.8
EP001-TRT-TAP	Q2124834006	09-13-2021	1024	CYANIDE	ND		335.4
EP001-TRT-TAP	Q2124834005	09-13-2021	1025	FLUORIDE	0.607	MG/L	300.0
EP001-TRT-TAP	Q2124834004	09-13-2021	1035	MERCURY	ND		245.1
EP001-TRT-TAP	Q2124834004	09-13-2021	1036	NICKEL	0.0011	MG/L	200.8
EP001-TRT-TAP	Q2124834004	09-13-2021	1045	SELENIUM	ND		200.8
EP001-TRT-TAP	Q2124834004	09-13-2021	1085	THALLIUM, TOTAL	ND		200.8

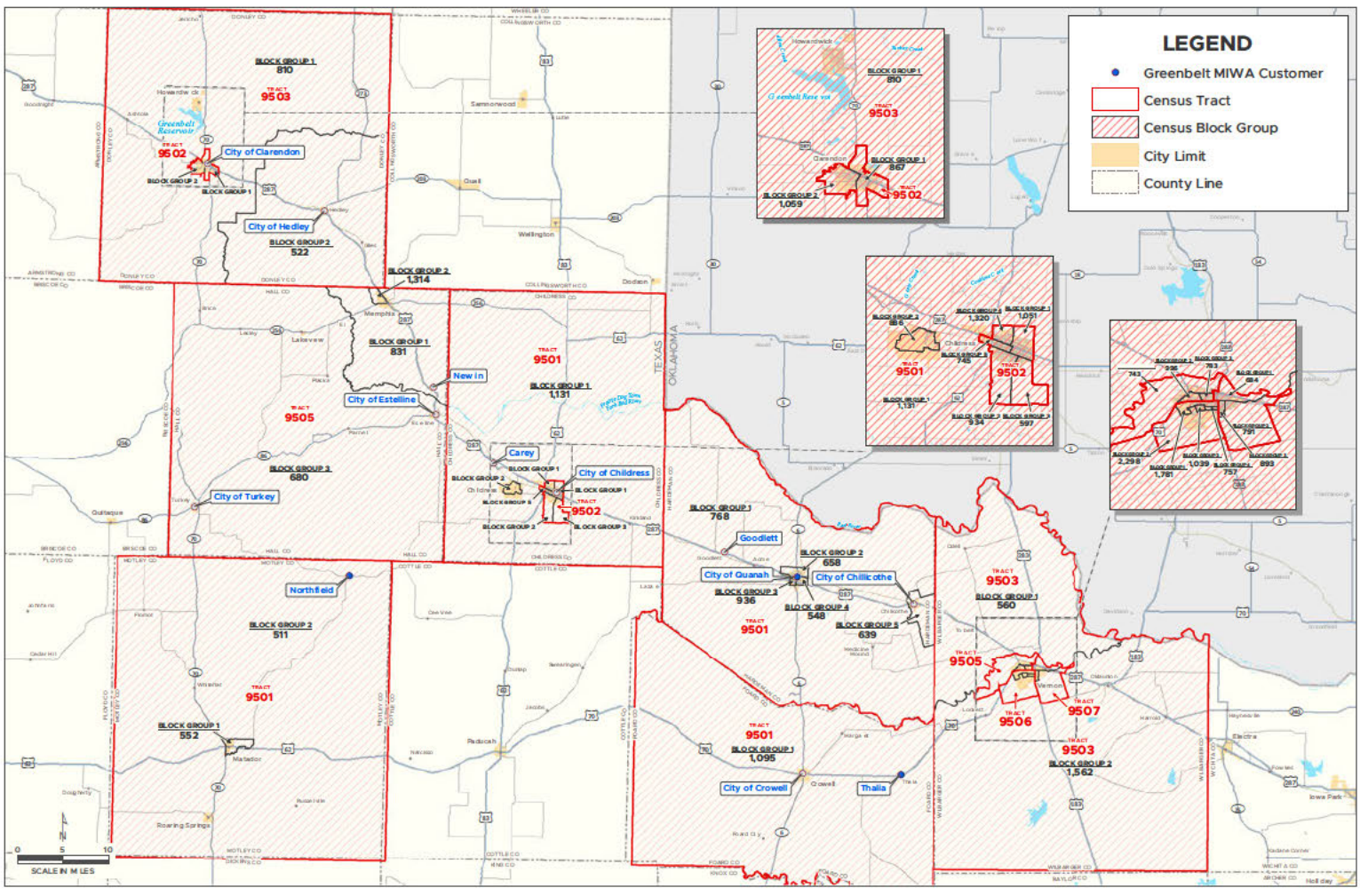
Recent SOC Sample Results

Fac./ Site	Sample No.	Date	An. Code	Analyte	Result	Unit	Method
EP001-TRT-TAP	Q1961475006	09-03-2019	2110	2,4,5-TP	ND		515.4
EP001-TRT-TAP	Q1961475006	09-03-2019	2105	2,4-D	ND		515.4
EP001-TRT-TAP	Q2124834001	09-13-2021	2051	ALACHLOR	ND		525.2
EP001-TRT-TAP	Q2124834001	09-13-2021	2050	ATRAZINE	ND		525.2
EP001-TRT-TAP	Q2124834001	09-13-2021	2010	BHC-GAMMA	ND		525.2
EP001-TRT-TAP	Q2124834001	09-13-2021	2959	CHLORDANE	ND		508.1
EP001-TRT-TAP	Q1961475006	09-03-2019	2031	DALAPON	ND		515.4
EP001-TRT-TAP	Q1961475006	09-03-2019	2041	DINOSEB	ND		515.4
EP001-TRT-TAP	Q2124834001	09-13-2021	2005	ENDRIN	ND		525.2
EP001-TRT-TAP	Q2124834001	09-13-2021	2065	HEPTACHLOR	ND		525.2

EP001-TRT-TAP	Q2124834001	09-13-2021	2020	TOXAPHENE	ND		508.1

Recent RVOC Sample Results

Fac./ Site	Sample No.	Date	An. Code	Analyte	Result	Unit	Method
EP001-TRT-TAP	Q2124834002	09-13-2021	2981	1,1,1-TRICHLOROETHANE	ND		524.2
EP001-TRT-TAP	Q2124834002	09-13-2021	2985	1,1,2-TRICHLOROETHANE	ND		524.2
EP001-TRT-TAP	Q2124834002	09-13-2021	2977	1,1-DICHLOROETHYLENE	ND		524.2
EP001-TRT-TAP	Q2124834002	09-13-2021	2378	1,2,4-TRICHLOROBENZENE	ND		524.2
EP001-TRT-TAP	Q2124834002	09-13-2021	2980	1,2-DICHLOROETHANE	ND		524.2
EP001-TRT-TAP	Q2124834002	09-13-2021	2983	1,2-DICHLOROPROPANE	ND		524.2
EP001-TRT-TAP	Q2124834002	09-13-2021	2990	BENZENE	ND		524.2
EP001-TRT-TAP	Q2124834002	09-13-2021	2982	CARBON TETRACHLORIDE	ND		524.2
EP001-TRT-TAP	Q2124834002	09-13-2021	2989	CHLOROBENZENE	ND		524.2
EP001-TRT-TAP	Q2124834002	09-13-2021	2380	CIS-1,2-DICHLOROETHYLENE	ND		524.2
EP001-TRT-TAP	Q2124834002	09-13-2021	2964	DICHLOROMETHANE	ND		524.2
EP001-TRT-TAP	Q2124834002	09-13-2021	2992	ETHYLBENZENE	ND		524.2
EP001-TRT-TAP	Q2124834002	09-13-2021	2968	O-DICHLOROBENZENE	ND		524.2
EP001-TRT-TAP	Q2124834002	09-13-2021	2969	P-DICHLOROBENZENE	ND		524.2
EP001-TRT-TAP	Q2124834002	09-13-2021	2996	STYRENE	ND		524.2
EP001-TRT-TAP	Q2124834002	09-13-2021	2987	TETRACHLOROETHYLENE	ND		524.2
EP001-TRT-TAP	Q2124834002	09-13-2021	2991	TOLUENE	ND		524.2
EP001-TRT-TAP	Q2124834002	09-13-2021	2979	TRANS-1,2-DICHLOROETHYLENE	ND		524.2
EP001-TRT-TAP	Q2124834002	09-13-2021	2984	TRICHLOROETHYLENE	ND		524.2
EP001-TRT-TAP	Q2124834002	09-13-2021	2976	VINYL CHLORIDE	ND		524.2
EP001-TRT-TAP	Q2124834002	09-13-2021	2955	XYLENES, TOTAL	ND		524.2


LEGEND
Greenbelt MIWA Customer
Census Tract
Census Block Group
City Limit
County Line
City of Clarendon
City of Hedley
City of Estelline
City of Turkey
City of Childress
Carey
New In
Northfield
Goodlett
City of Guanah
City of Chillicothe
City of Crowell
Thalia
TEXAS
OKLAHOMA
SCALE IN MILES

Readiness to Proceed to Construction

Preliminary planning or design work (30% of total project) has been completed or is not required. N

Applicant is prepared to begin implementation or construction within 18 months of application deadline. N

Applicant has acquired all water rights associated with the proposed project, or none will be required. Y

Estimated Costs

TWDB Requested Amount

Low-Interest Loan Amount $18110000.00

Deferred Loan Amount

Board Participation Amount $0.00

Local Contribution Amount

Other Amount
Other Desc

Total Estimated Project Costs $18110000.00
Anticipated Debt Service for 2018 Loan Closing is anticipated to be: LEVEL

Additional Attachments

The following documents are attached after this page:

Pages from Region A Water Plan -10302020.pdf
Region A Panhandle RWP Greenbelt MIWA Project.pdf
GMA PEFR for Additional Water Supply - Sealed.pdf

5C.5 Greenbelt Municipal and Industrial Water Authority

Greenbelt Municipal and Industrial Water Authority (Greenbelt MIWA) owns and operates Greenbelt Reservoir on the Salt Fork of the Red River. The MIWA also recently developed local groundwater supplies from the Ogallala aquifer. The Greenbelt MIWA is located in Donley County and provides water to local municipalities through an extensive delivery system, including a 121-mile aqueduct. There are five member cities, including Clarendon, Hedley, and Childress in the PWPA and Quanah and Crowell in the Region B planning area. The Red River Authority is a non-voting member of the Greenbelt MIWA.

Greenbelt MIWA's primary water source is Greenbelt Reservoir. The estimated reliable supply from the reservoir is about 3,112 acre-feet per year in 2020 and declining to 2,256 acre-feet per year over the planning period. Groundwater supplies are estimated 1,900 acre-feet per year and are expected to decline to about half of this amount by 2070. Current projected demands on the MIWA are shown in Table 5C-13 and are not expected to exceed 3,900 acre-feet per year over the planning period. Considering both the reservoir supplies and local groundwater supplies, Greenbelt MIWA is not expected to have water needs until 2060.

Table 5C-13: Summary of Demands, Supplies and Needs for the Greenbelt MIWA

Customers	Demands (Ac-Ft/Yr)					
	2020	2030	2040	2050	2060	2070
PWPA						
City of Childress	1,624	1,657	1,685	1,722	1,767	1,814
City of Clarendon	371	362	354	350	349	349
City of Hedley	56	56	56	56	56	56
City of Memphis	37	37	37	37	37	37
Red River Authority - Childress County	232	236	239	245	252	258
Red River Authority - Collingsworth County	16	16	16	16	16	16
Red River Authority - Donley County	30	30	30	30	30	30
Red River Authority - Hall County	100	100	100	100	100	100
Region B						
City of Chillicothe	40	40	40	40	40	40
City of Crowell	138	133	131	131	131	130
City of Quanah	396	391	387	394	397	400
Hardeman County Manufacturing	190	190	190	190	190	190
Red River Authority - Foard County	262	262	262	262	262	262
Red River Authority - Hardeman County	140	140	140	140	140	140
Total Demand	**3,631**	**3,649**	**3,666**	**3,712**	**3,766**	**3,821**

Sources	Current Water Supply (Ac-Ft/Yr)					
	2020	2030	2040	2050	2060	2070
Ogallala - Donley County	1,900	1,615	1,373	1,167	992	843
Greenbelt Reservoir	3,112	2,941	2,770	2,599	2,428	2,256
Total Current Water Supply	**5,012**	**4,556**	**4,143**	**3,766**	**3,420**	**3,099**
	Surplus or (Need) (Ac-Ft/Yr)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
	1,380	**907**	**477**	**54**	**(346)**	**(723)**

While the projections indicate Greenbelt MIWA can meet its projected demands until the 2060s, there are concerns regarding the reliability of the surface water supplies and the long-term reliability of the local groundwater. Greenbelt Reservoir is in current drought of record conditions. As the drought continues, the reliable supply may decrease. The on-going drought also increases the competition for local groundwater from nearby irrigators. With these uncertainties, Greenbelt is pursuing additional groundwater in northern Donley County. This additional supply will provide additional reliability to the Greenbelt MIWA's system. The recommended strategies for Greenbelt MIWA are shown below. Conservation measures and associated savings for the wholesale customers of the MIWA are discussed in Chapter 5B.

Recommended Strategies

- Conservation of wholesale customers
- Develop additional supplies from the Ogallala Aquifer in Donley County

Develop Additional Supplies from the Ogallala Aquifer in Donley County

In 2013, a feasibility study was developed for the Greenbelt MIWA. The recommended strategy included developing groundwater in North Donley County, transporting the water by a 16-inch pipeline approximately 16 miles to the Greenbelt Water Treatment Plant site. The strategy would include three 1000 gpm wells, a pump station and ground storage tank and associated electrical and instrumentation. The Greenbelt MIWA has purchased the groundwater rights necessary to provide 2,000 acre-feet annually. Greenbelt MIWA needs begin in 2060 and increase to 723 acre-feet per year in 2070.

Time Intended to Complete

The project is intended to be online by 2030. This project will supplement existing supplies for Greenbelt MIWA.

Quantity, Reliability and Cost

The quantity of water should be sufficient. Reliability of groundwater supply is moderate since there is competition for water from the Ogallala in Donley County. The capital cost is $17.9 million.

Environmental Issues

The environmental impacts from groundwater development are expected to be low. Once the specific locations of additional wells and alignments associated with infrastructure are identified, a detailed evaluation to determine environmental impacts, if any, will need to be performed.

Impact on Water Resources and Other Management Strategies

The proposed wells are located north of Greenbelt Reservoir in an area with some competition for groundwater for irrigation.

The strategy should not significantly impact other water resources or management strategies.

Impact on Agriculture and Natural Resources

The recommended strategy is expected to have low impact on the agriculture and other natural resources.

Other Relevant Factors

Greenbelt MIWA will need to seek a groundwater permit from the Panhandle GCD.

Summary of Recommended Strategies for Greenbelt MIWA

Water conservation and water audits and leak repair by Greenbelt MIWA customers will provide approximately 40 acre-feet per year in 2020 increasing to approximately 90 acre-feet per year by 2070. New wells in the Ogallala aquifer can provide an additional 2,000 acre-feet per year and could be completed by 2030. Table 5C-14 shows the amount of supply from the recommended strategies. The total capital costs for the recommended strategies is $17.9 million as shown in Table 5C-15.

Table 5C-14: Recommended Water Management Strategies for Greenbelt MIWA (Ac-Ft/Yr)

	2020	2030	2040	2050	2060	2070
Surplus or (Need)	**1,380**	**907**	**477**	**54**	**(346)**	**(723)**
Recommended Strategies	**Supply from Strategy**					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
PWPA Customer Conservation	34	36	37	38	39	41
Region B Customer Conservation	9	36	45	46	49	50
Donley County Groundwater	0	2,000	2,000	2,000	2,000	2,000
Total from Strategies	**43**	**2,072**	**2,082**	**2,084**	**2,088**	**2,091**

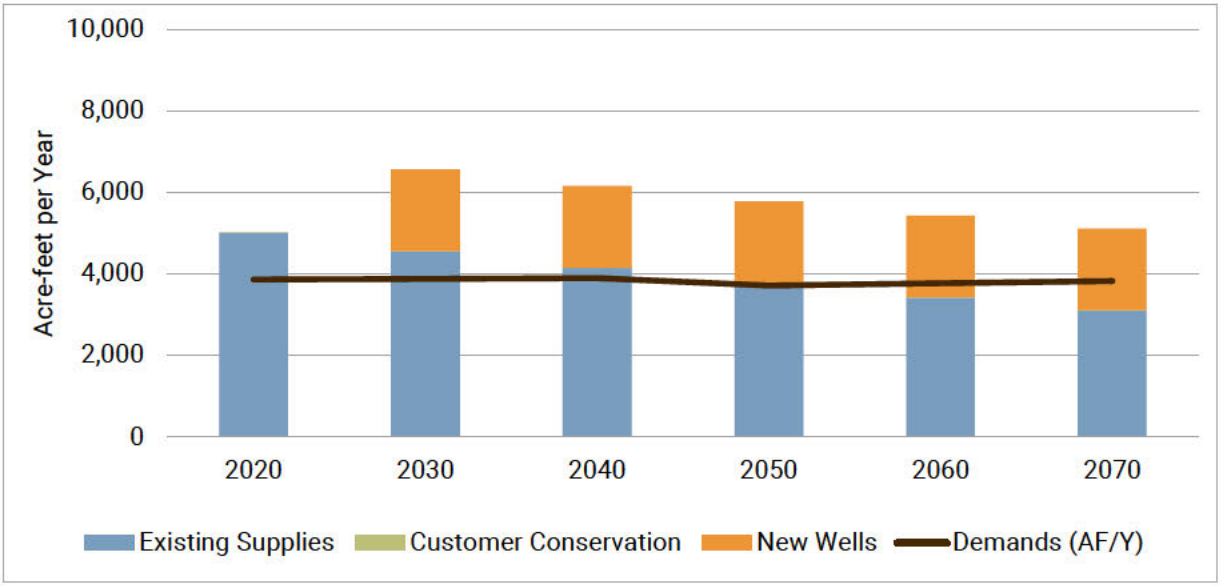
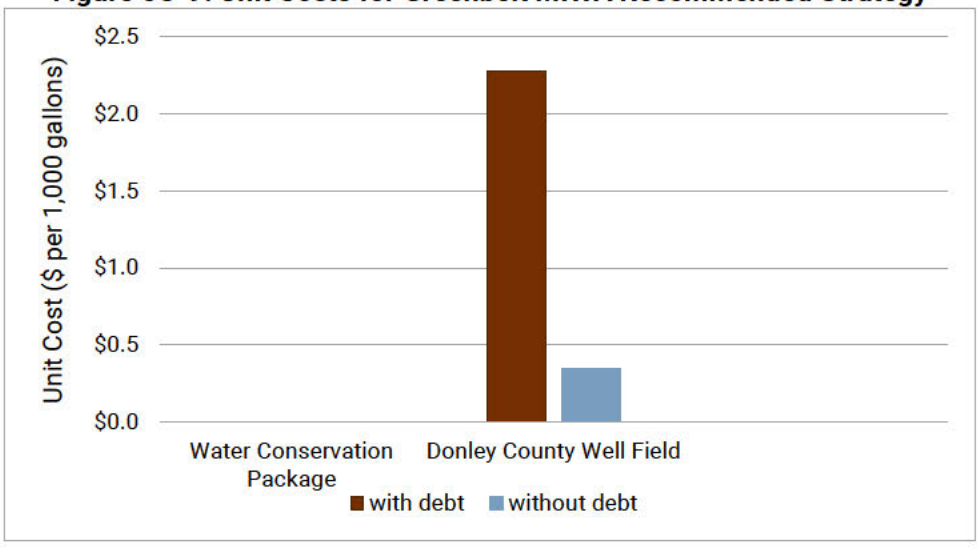


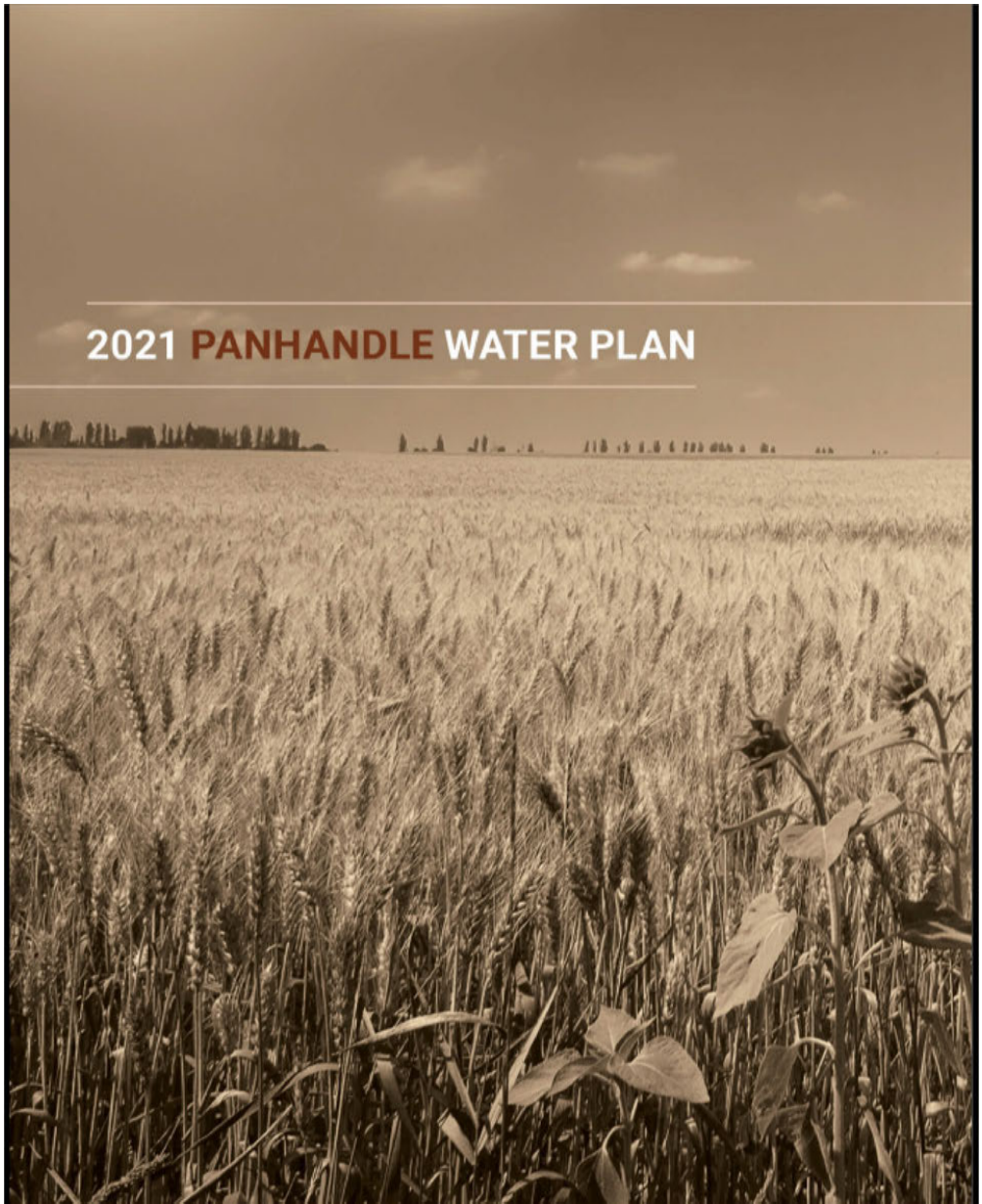
Figure 5C-8: Recommended Strategies for Greenbelt MIWA

Table 5C-15: Summary of Costs for Recommended Strategies for Greenbelt MIWA

Recommended Strategies	Capital Cost ($ million)	Annual Costs ($million)					
		2020	2030	2040	2050	2060	2070
Donley County Groundwater	$17.9	$0.00	$1.49	$1.49	$0.20	$0.20	$0.20
Total from Strategies	**$17.9**	**$0.00**	**$1.49**	**$1.49**	**$0.20**	**$0.20**	**$0.20**

Figure 5C-9: Unit Costs for Greenbelt MIWA Recommended Strategy




2021 PANHANDLE WATER PLAN

2021 PANHANDLE WATER PLAN. VOLUME II. APPENDICES.

Table D-25

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
Greenbelt Municipal and Industrial Water Authority - Develop Additional Supplies from the Ogallala Aquifer in Donley County

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
CAPITAL COST	
Transmission Pipeline (16 in dia., 16 miles)	$8,163,000
Primary Pump Stations (2.7 MGD)	$946,000
Transmission Pump Station(s) & Storage Tank(s)	$975,000
Well Fields (Wells, Pumps, and Piping)	$2,723,000
TOTAL COST OF FACILITIES	**$12,807,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$4,074,000
Environmental & Archaeology Studies and Mitigation	$425,000
Land Acquisition and Surveying (57 acres)	$94,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$479,000
TOTAL COST OF PROJECT	**$17,879,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,258,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$119,000
Pumping Energy Costs (1056710 kW-hr @ 0.08 $/kW-hr)	$85,000
TOTAL ANNUAL COST	**$1,486,000**
Available Project Yield (acft/yr)	2,000
Annual Cost of Water ($ per acft), based on PF=1.5	$743
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.5	$114
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$2.28
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$0.35

JSA *9/25/2019*

Innovative approaches
Practical results
Outstanding service

PRELIMINARY ENGINEERING FEASIBILITY REPORT FOR ADDITIONAL WATER SUPPLY

Prepared for:

Greenbelt Municipal and Industrial Water Authority

January 2022

Prepared by:

FREESE AND NICHOLS, INC.
801 Cherry Street, Suite 2800
Fort Worth, Texas 76102
817-735-7300

Innovative approaches
Practical results
Outstanding service

PRELIMINARY ENGINEERING FEASIBILITY REPORT FOR ADDITIONAL WATER SUPPLY

Prepared for:

Greenbelt Municipal and Industrial Water Authority

FREESE AND NICHOLS, INC.
TEXAS REGISTERED ENGINEERING FIRM F-2144
801 Cherry Street, Suite 2800
Fort Worth, Texas 76102
817-735-7300
GMA21554

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1.0 EXISTING WATER SUPPLY AND CORRESPONDING FACILITIES

1.1 WATER SOURCES AND EXISTING FACILITIES

Greenbelt Municipal and Industrial Water Authority (GMIWA) currently utilizes three different raw water sources in providing treated water for its customers: surface water from the Greenbelt Reservoir, groundwater from the Kelly Creek Wells, and additional groundwater from the Clarendon Wells.

The Clarendon Well Field was installed in 2012 and consists of five (5) vertical turbine pump wells located just east of Clarendon, Texas. The four-year average production from the wells is approximately 372 ac-ft/yr, peaking in 2020 at 435 ac-ft/yr. While in continuous service since the installation date of 2012, the Clarendon Well Field was initially intended as a temporary solution to bolster water supply until a more permanent groundwater source was developed.

The Kelly Creek Well Field was installed in 2013 and consists of six (6) vertical turbine pump wells located along the alignment of Kelly Creek, the natural outfall of the Greenbelt Reservoir located northwest of Clarendon, Texas. The four-year average production from the wells is approximately 478 ac-ft/yr, peaking in 2020 at 728 ac-ft/yr.

The main raw water source for GMIWA is the Greenbelt Reservoir, a manmade lake impounded in 1968. The conservation storage of the lake is 59,968 ac-ft; however, the reservoir has not operated at this storage capacity at any time in its history, peaking at around 44,150 ac-ft in 1975. As of December 2021, the reservoir is operating at 16.6 percent capacity, or approximately 10,384 ac-ft. Figure 1 provides the historical storage from commissioning to October 1, 2021.

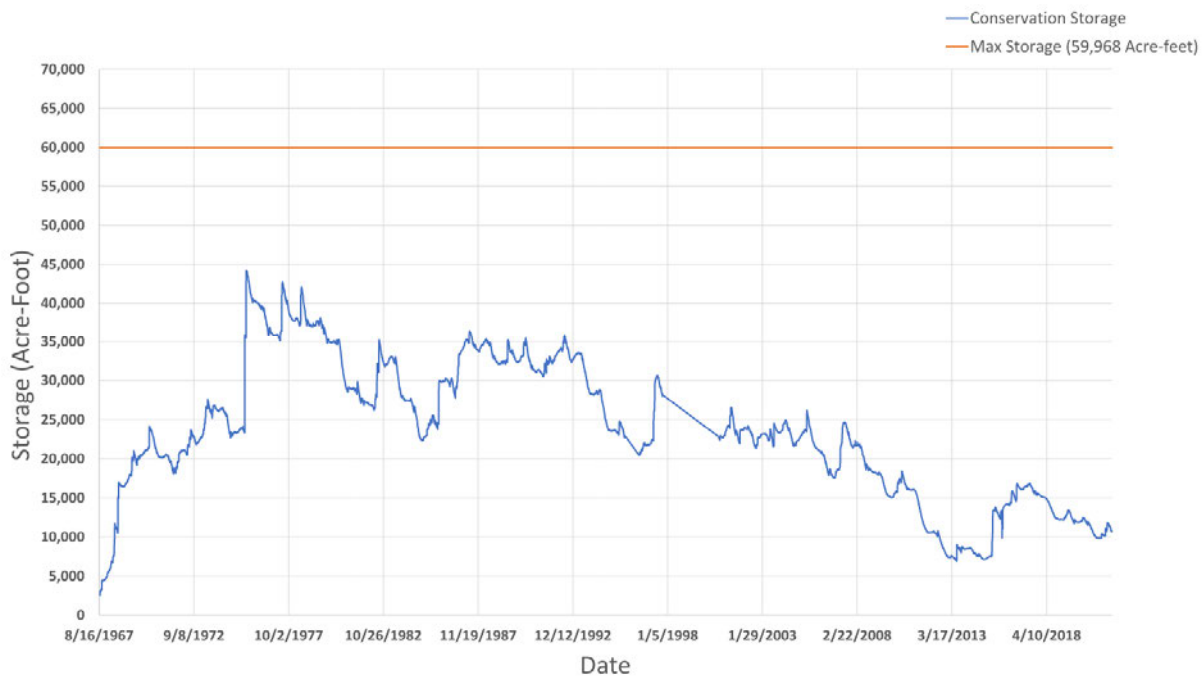

Figure 1 – Conservation Storage of Greenbelt Reservoir, Historical Storage[1]

Water is pumped from the reservoir to the GMIWA Water Treatment Plant (WTP) through the Raw Water Pump Station (RWPS) located on the southern border of the Greenbelt Reservoir. The RWPS was constructed in 1968, with three vertical turbine pumps. A fourth vertical turbine pump was installed in 1976. Due to the low reservoir volume, the pump station only operates its single small pump to deliver demand, averaging 1.55 million gallons per day (MGD) (1,737 ac-ft/yr) in 2020. The firm pumping capacity of the RWPS is 12 MGD.

All three existing water sources are routed to the Greenbelt WTP and treated prior to pumping into Greenbelt's finished water system. For discussions on water quality and corrosivity, refer to Section 2.2.

[1]Data Pulled from Texas Water Development Board (TWDB) Historical Data available at Water Data for Texas on October 1, 2021.

1.2 CURRENT AND FUTURE DEPENDENCIES

Data developed for the 2013 Preliminary Engineering Report (Appendix A) and the 2021 Panhandle Regional Water Plan (November 2020) are the basis for the assessment of GMIWA's projected water demands and need for the project.

GMIWA provides water to customers in Childress, Donley, Foard, Hall, Hardeman, and Wilbarger Counties, shown on the service map in Figure 2. These service areas lie in the Texas Water Development Board Regions A and B. At this time, GMIWA has no intent to significantly increase their service area or customer base outside of any population increases in the existing customer cities. Table 1-1 details the water demand projections for the GMIWA customers through 2070.

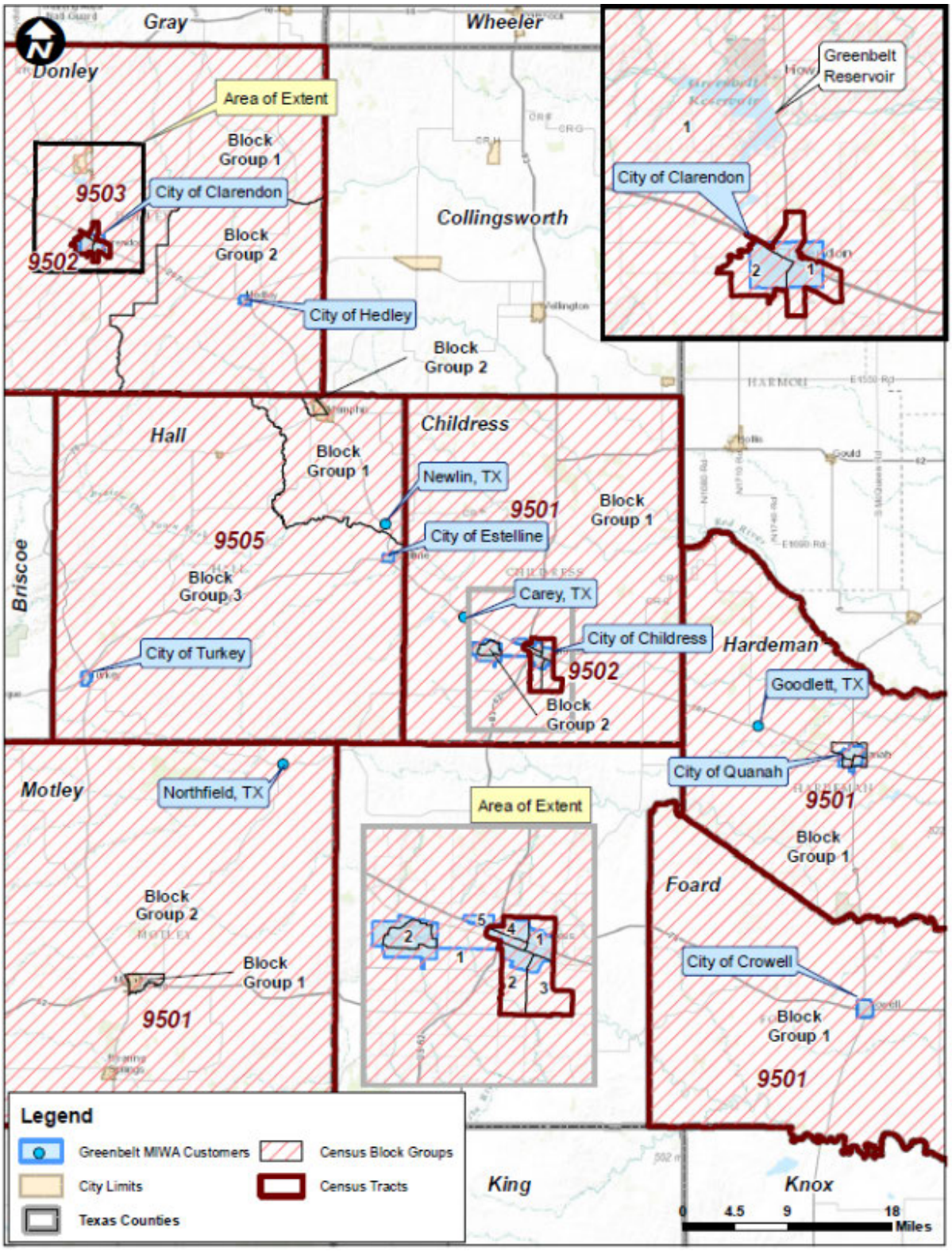

Figure 2 – GMIWA Service Map

1.2.1 Water Demand Needs

The table below provides water demand data for the customer cities and areas served by the GMIWA. This data is summarized from the 2021 Panhandle Water Plan, with relevant sections of the report provided in Appendix B. Included in the demand table is the main industrial demand for GMIWA, which is primarily the City of Quanah (labeled as Hardeman County Manufacturing).

Table 1-1 – Demand Projections for GMIWA Customers, 2020-2070

Customers	Demand (ac-ft/yr)					
	TWDB 2020 Projection	TWDB 2030 Projection	TWDB 2040 Projection	TWDB 2050 Projection	TWDB 2060 Projection	TWDB 2070 Projection
City of Childress	1,624	1,657	1,685	1,722	1,767	1,814
City of Clarendon	371	362	354	350	349	349
City of Hedley	56	56	56	56	56	56
City of Memphis*	37	37	37	37	37	37
City of Chillicothe	40	40	40	40	40	40
City of Crowell	138	133	131	131	131	130
City of Quanah	396	391	387	394	397	400
Red River Authority – Childress County	232	236	239	245	252	258
Red River Authority – Collingsworth County	16	16	16	16	16	16
Red River Authority – Donley County	30	30	30	30	30	30
Red River Authority – Hall County	100	100	100	100	100	100
Hardeman County Manufacturing	190	190	190	190	190	190
Red River Authority – Foard County	262	262	262	262	262	262
Red River Authority – Hardeman County	140	140	140	140	140	140
TOTAL	**3,631**	**3,649**	**3,666**	**3,712**	**3,766**	**3,821**

*GMIWA only provides a portion of the total demand for the City of Memphis.

Based on TWDB projections, GMIWA will be responsible for 3,821 ac-ft/yr of demand by 2070. Table 1-2 is an updated comparison of the supply and demands for GMIWA. The estimated available supply from the Greenbelt Reservoir will drop from 3,112 to 2,256 ac-ft/yr by 2070. Based on these projections, even with all of the existing GMIWA operated groundwater wells in operation to satisfy demand, the GMIWA will encounter a supply deficit.

Table 1-2 – Comparison of Supply and Demands for GMIWA

	Demand and Supply (ac-ft/yr)					
	2020	2030	2040	2050	2060	2070
Greenbelt Reservoir	3,112	2,941	2,770	2,559	2,428	2,256
Current Well Supply (Kelly Creek and Clarendon Well Field)	1,900	1,615	1,373	1,167	992	843
Total Existing Supply	**5,012**	**4,556**	**4,143**	**3,726**	**3,420**	**3,099**
Demand	**3,631**	**3,649**	**3,666**	**3,712**	**3,766**	**3,821**
Surplus (Need)	**1,381**	**907**	**447**	**14**	**(346)**	**(722)**

The overall comparison of supply and demand shows that the GMIWA, even when considering all current well fields, has limited available supply to fulfill future demand, especially with the declining yield in the Greenbelt Reservoir. As it stands, GMIWA is not resilient to any unforeseen issues with their water supply, especially any issues with the Greenbelt Reservoir. Due to declining supplies and increased demands, GMIWA will be unable to provide sufficient water to meet customers' demands by 2060. This need could be substantially sooner if the current drought continues, resulting in reduced supplies from Greenbelt Reservoir and decreased reliability of GMIWA's well fields. Table 1-3 displays the projected demands against the current groundwater, without the Greenbelt Reservoir.

Table 1-3 – Comparison of Existing Groundwater Supply Versus Average Day Demands

		2020	2030	2040	2050	2060	2070
Total Demand	ac-ft/yr	3,631	3,649	3,666	3,712	3,766	3,821
	gpm	2,251	2,262	2,273	2,301	2,335	2,369
Current Well Supply (Kelly Creek and Clarendon Well Field)	ac-ft/yr	1,900	1,615	1,373	1,167	992	843
	gpm	1178	1001	851	723	615	522
Difference	**ac-ft/yr**	**1731**	**2034**	**2293**	**2545**	**2774**	**2978**
	gpm	**1073**	**1261**	**1421**	**1577**	**1719**	**1846**

It is vital that new water supplies be introduced to add redundancy and reduce this risk. GMIWA recognized the current supply limitations and acquired additional water rights at a well site north of the Greenbelt Reservoir, allowing GMIWA to increase available supply with up to an additional 2,780 ac-ft/yr. This project is shown to be online by 2030 in the 2021 Panhandle Water Plan.

1.3 PROPOSED PROJECT DESCRIPTION

To increase the available groundwater supply, GMIWA purchased 2,780 ac-ft/yr in water rights from a private property 12 miles north of the Greenbelt Reservoir. To properly utilize said available supply, a well field, transmission line, and necessary electrical equipment will need to

be installed to transport water to either the Greenbelt Reservoir or the WTP. The proposed well field consists of three vertical turbine wells up to 625 feet in depth (detailed in Section 3.0), collection well field piping between 8-inch and 12-inch in diameter, and a transmission water line between 16-inch and 18-inch to transport the water from the well field, detailed in Section 4.0 and 5.0. Included in the project is the necessary electrical and instrumentation items to provide power and controls to the proposed well sites.

Using the six well layout shown in Figure 5 and Section 3.0, we recommend three wells to be installed initially. Based on the estimated range of 560 gpm to 1000 gpm per well, the estimated production of the well field is shown below in Table 1-4.

Table 1-4 – Estimated Well Capacity

# of Wells	Capacity per Well (gpm)	Total Capacity (gpm)	Total Capacity (ac-ft/yr)	Peaking Factor*
1	560	560	903	0.32
	1,000	1,000	1,612	0.58
2	560	1,120	1,806	0.65
	1,000	2,000	3,324	1.16
3	560	1,680	2,709	0.97
	1,000	3,000	4,836	1.74

*Peaking Factor = Maximum pumping rate divided by 2780 ac-ft/yr.

Note that 2,780 ac-ft/yr is used to determine the peaking factor. At the initial total demand of 3,631 ac-ft/yr, GMIWA could meet the demands with the Greenbelt Reservoir out of service. The three well layout provides a peaking factor of 0.97 to 1.74; depending on the actual well output. We recommend that either two wells or three wells be installed as needed to deliver 2780 ac-ft/yr with a peaking factor of 1.5. For recommendations on the exact well locations, see Section 3.0.

2.0 PROJECT SPECIFIC REQUIREMENTS

2.1 NEW SOURCES AND SITE

The proposed well field will utilize the Ogallala Aquifer within Donley County, an unconfined aquifer found in the Panhandle and the largest aquifer in the United States. The aquifer covers approximately 36,288 square miles within the Panhandle, with approximately 619 square miles residing in Donley County alone. Currently the two existing well fields, the Clarendon and Kelly Creek Well Fields, pull water from the Ogallala Aquifer. Additional technical information on the Ogallala Aquifer is provided in Appendix C.

The well field will be on an existing privately owned ranch property, referred to as the Carrol Creek Ranch, shown in Figure 3. The overall site is approximately 2,780 acres in Donley County and is bordered by County Road 9 to the west and State Highway 70 (SH 70) to the east. The site is mostly undeveloped, with deep ephemeral streams crossing the site.

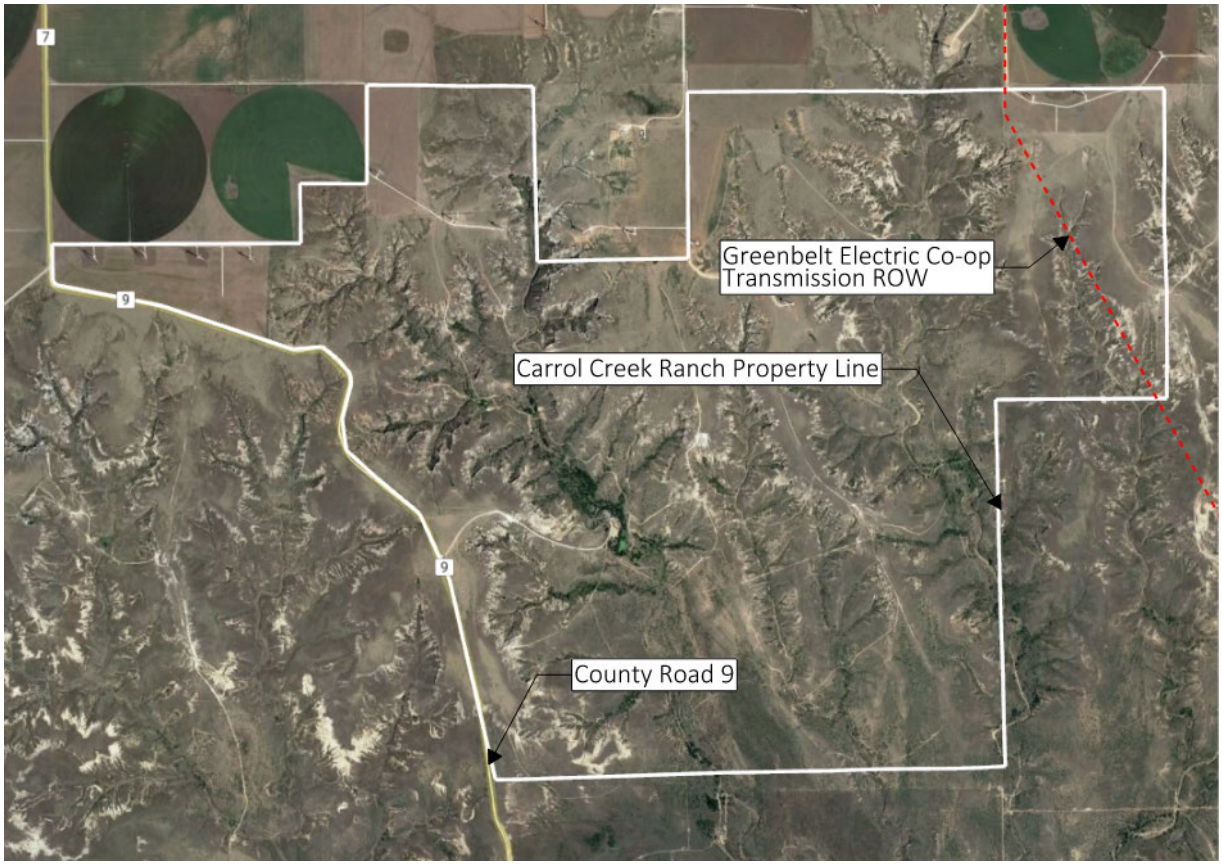

Figure 3 – Carrol Creek Ranch

2.1.1 Existing Infrastructure Conflicts

Along the northern border of the property, several existing wind turbine power generating stations are installed as a part of a larger wind power generating system in the adjacent properties. All proposed well sites are not in conflict with the turbine locations or associated electrical gear and electrical lines.

Crossing along the eastern side of the site is an existing electrical high voltage distribution line owned by Greenbelt Electric Cooperative, Inc. This distribution line does not interfere with any of the proposed well sites or the well field piping.

2.2 WATER QUALITY ANALYSIS

Water from the proposed new well field is being evaluated to mix with the GMIWA's existing water sources at two locations: (1) route the new pipeline either to the lake or the discharge of the RWPS at the front of the plant where the new groundwater source and existing surface water source from the Greenbelt Reservoir will go through the full treatment process or (2) convey the new groundwater source directly to the filters along with the Kelly Creek and Clarendon Well Field groundwater where these sources would mix with the surface water source and go through the final treatment steps. Total organic carbon (TOC) removal is required for surface water treatment, and the amount of removal required depends on the source water TOC and alkalinity. If the new groundwater source is combined with the reservoir water at the RWPS and goes through the full treatment process, the water treatment plant may experience difficulty meeting TOC removal requirements as groundwater generally has a lower TOC concentration than surface water. The existing groundwater sources are sent to the filters to remove any sediment such as sand from the groundwater before disinfection and distribution, and this approach may be a better option for the GMIWA to avoid treatment challenges commonly encountered in surface water treatment when treating a groundwater source.

The GMIWA is an existing public water system and is proposing a new water source, and the Texas Commission on Environmental Quality (TCEQ) requires the corrosiveness of the new water source be determined in order to understand what additional steps are required to utilize the new source (i.e., corrosion control treatment). FNI performed a water quality assessment of the

current treated water supply and the proposed well field at the Carrol Creek Ranch, focusing on potential corrosivity concerns that may be associated with both the new drinking water source and a blend of the current sources with the new source.

The TCEQ uses the Tetra Tech (RTW) Model to determine water corrosivity based on the following water quality indices at 10 and 25 degrees Celsius (°C):

- Langelier Saturation Index (LSI)
- Ryznar Stability Index (RSI)
- Aggressive Index (AI)
- Calcium Carbonate Precipitation Potential (CCPP)
- Chloride to Sulfate Mass Ratio (CSMR)

Table 2-1 provides the criteria used to assess water corrosivity according to each index.

Table 2-1 – TCEQ Corrosivity Definitions for Various Indices

Parameter	LSI	RSI	AI	CCPP	CSMR*
Not Corrosive (NC)	NC ≥ -0.25	NC < 7.0	NC > 12	NC > 0.0	NC < 0.2
Slightly Corrosive (SC)	-1.0 < SC < -0.25	7.0 < SC < 8.5	10 > SC < 12	-3 > SC < 0	> 0.2 SC < 0.5
Corrosive (C)	C < -1.0	C > 8.5	C <10	C < -3.0	C > 0.5 (TALK < 50)

**If the CSMR is greater than 0.5 and the total alkalinity (TALK) is greater than 50 mg/L (as $CaCO_3$), the water is classified as slightly corrosive.*

The TCEQ uses the results from each of the indices (at both temperatures) to determine the corrosive status of a water sample based on the following:

- The water is considered corrosive if three or more of the indices rate it as corrosive.
- The water is considered slightly corrosive if three indices rate it as slightly corrosive below 25°C.
- The water is also considered slightly corrosive if four of the indices indicate either corrosive or slightly corrosive.
- If none of the above conditions are met, the water is considered not to be corrosive.

2.2.1 Existing Water Quality

The GMIWA provided water quality data for the entry point to the distribution system sampled on May 30, 2018, from the treated water tap at the WTP clearwell. Table 2-2 summarizes the parameters provided and the number of data points.

Table 2-2 – Distribution System Water Quality Data

Parameter	Entry Point #1 Data Points	Value
Total Dissolved Solids	1	500 mg/L
pH	1	7.3 Standard Units (S.U.)
Alkalinity (as $CaCO_3$)	1	177 mg/L
Calcium (as $CaCO_3$)	1	186 mg/L
Calcium	1	74.6 mg/L
Chloride	1	77.8 mg/L
Sulfate	1	125 mg/L

2.2.2 Proposed Well Field Water Quality

Like the GMIWA's existing well fields, the proposed Carrol Creek Ranch well field would also pull water from the Ogallala Aquifer. While the site is generally undeveloped, there are several existing wells at the site, and water quality data from samples taken on July 6 and 20, 2016, were provided for the following locations:

- Carrol Creek Solar
- Carrol Creek WM
- Horse Pasture Well
- House Well
- Jericho WM
- Middle Jericho Solar
- North Carrol Creek Solar
- North Jericho Solar
- North Littlefield
- West Littlefield

The data set included temperature, pH, filtered solids, total dissolved solids (TDS), hardness, chloride, sulfate, calcium, magnesium, iron, potassium, and bi-carbonate. The West Littlefield sample did not include potassium; however, a duplicate sample for this well included this data and was used for the analysis. Carbonate data was not provided for any of the wells. Therefore, FNI performed an ion balance to determine the impact this anion has on the wells. The available ion data for each well was used to calculate the TDS for comparison to the TDS test results. Based on the ion balance performed, carbonate concentrations are expected to be minimal in the wells with data available.

For the Horse Pasture Well the calcium data result was recorded as 890 mg/L. Based on the ion balance performed by FNI, this data point was thought to be an error. As another method to verify the accuracy of this data point, the total hardness was calculated based on the concentrations of calcium and magnesium and compared to the total hardness test data provided for the well. Based on the TDS and total hardness calculations, the 890 mg/L data point was confirmed to be an error, which likely occurred when the data was recorded. At an estimated calcium value of 80 mg/L, which is similar to the other well data provided, the calculated TDS and total hardness are within 1.2% and 0.3%, respectively, of the TDS and total hardness data provided for the well. Therefore, 80 mg/L was used for the calcium concentration at the Horse Pasture Well. Water quality data associated with the sites is summarized in Table 2-3.

Table 2-3 – Existing Well Field Water Quality Data

Parameter	Carrol Creek Solar	Carrol Creek WM	Horse Pasture Well	House Well	Jericho WM	Middle Jericho Solar	North Carrol Creek Solar	North Jericho Solar	North Littlefield	West Littlefield (Sample | Duplicate)
Temperature (°F)	75	65	75	65	65	75	75	75	75	75 | 75
pH (S.U.)	6.78	7.56	6.56	7.76	7.64	6.73	6.78	6.27	6.78	6.78 | 6.74
Filtered Solids (mg/L)	294	156	326	592	156	306	266	314	294	318 | 263
TDS (mg/L)	827	841	907	879	874	846	827	860	827	896 | 896
Hardness (mg/L as $CaCO_3$)	500.4	400.4	603.3	599.2	400.4	509.5	500.4	500.4	500.4	500.4 | 500.4
Chloride (mg/L)	351	355	351	355	355	347	351	351	351	351 | 351
Sulfate (mg/L)	10	10	10	10	10	10	10	10	10	10 | 10
Sodium (mg/L)	62	120	44	46	129	64	62	71	62	83 | 83
Calcium (mg/L)	80	40	80*	80	40	82	80	80	80	80 | 80
Magnesium (mg/L)	73	73	98	97	73	74	73	73	73	73 | 73
Iron (mg/L)	11	11	11	11	11	11	11	11	11	11 | 11
Potassium (mg/L)	20	12	20	12	12	20	20	20	20	- | 20
Bi-Carbonate (mg/L)	220	220	293	268	244	238	220	244	220	268 | 268

*The recorded data provided for the wells listed 890 mg/L for the calcium concentration at the Horse Pasture Well. Based on an analysis of the TDS and total hardness provided and calculations performed by FNI, this number is believed to be an error and the value is estimated to be similar to the other wells at 80 mg/L.

Based on the ion data provided, the alkalinity was also calculated for each of the wells for use in the water quality analysis. The data provided for the wells suggests that the water quality is similar across the Carrol Creek Ranch. The locations of the existing and proposed wells are shown in Figure 4.

Figure 4 – GMIWA Wellfield

A blending analysis was performed for the ten existing wells using the Water!Pro™ Program (Water!Pro). For this analysis, it was assumed that the proposed GMIWA wells would have a similar water quality across the wellfield to the existing wells and that each proposed well would furnish an equal amount of the total supply (1,240 gallons per minute (gpm) total at the maximum water usage). The blended water quality data utilized for the corrosivity analysis from these ten wells are provided in Table 2-4.

Table 2-4 – Proposed Well Field Blended Water Quality

Parameter	Value
TDS (mg/L)	859
pH (S.U.)	7.1
Alkalinity (mg/Las $CaCO_3$)	200
Calcium (mg/L as $CaCO_3$)	72.2
Chloride (mg/L)	352
Sulfate (mg/L)	10.0

2.2.3 Blended Corrosivity Analysis

Based on the blended water quality from the proposed well field (Table 2-4), the RTW model was utilized to determine the corrosivity indices values of the proposed new water source. Table 2-5 presents the results of the analysis at both 10°C and 25°C. Based on this analysis, three of the indices are classified as corrosive resulting in a source water classification of corrosive.

Table 2-5 – Proposed Well Field Blended Water Corrosion Analysis

Index	Proposed Well Field 10°C	Proposed Well Field 25°C
LSI	-0.78 | SC | ●	-0.56 | SC | ●
RSI	8.63 | C | ●	8.18 | SC | ●
AI	11.23 | SC | ●	11.23 | SC | ●
CCPP	-45.73 | C | ●	-29.23 | C | ●
CSMR	35.20 | SC | ●	35.20 | SC | ●
Corrosivity Status per TCEQ Criteria	Corrosive | ●	

Only a portion of the total water treated at the GMIWA's WTP will come from the proposed well field. The GMIWA will continue utilizing their existing well fields and surface water from the Greenbelt Reservoir supplemented by the proposed well field at the Carrol Creek Ranch. Based on the current average annual amount of water treated at the WTP and the water rights purchased for the proposed well field, blending scenarios were selected to estimate the corrosivity of the treated water with the proposed new source. The average amount of water

treated at the WTP and the possible usage from the proposed well field are provided in Table 2-6.

Table 2-6 – Estimated Water Usage

Water Source	Water Usage
Existing Treated Water	Average Water Treated (Greenbelt Reservoir & Existing Well Fields) – 1,604 gpm (2,587 ac-ft/year)
Proposed Well Field	Estimated Maximum Water Usage – 1,240 gpm (2,000 ac-ft/year) Average Water Usage – 694.4 gpm (1,120 ac-ft/year)

Four scenarios were selected based on the amount of water required to be treated and the amount of water that can be utilized from the proposed well field. These scenarios are presented in Table 2-7.

Table 2-7 – Blending Scenarios of Existing and Proposed Water Sources

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Total Water Treated	1,604 gpm	1,604 gpm	1,604 gpm	1,604 gpm
Existing Water Sources Amount	364 gpm	910 gpm	1,203 gpm	802 gpm
Proposed Well Field Water Amount	1,240 gpm	694 gpm	401 gpm	802 gpm
Blend of Existing Sources to Proposed Well Field Water	1:3.8 (77% Proposed New Water Source)	1:0.8 (43% Proposed New Water Source)	1:0.3 (25% Proposed New Water Source)	1:1 (50% Proposed New Water Source)

Each of the four scenarios were analyzed using the RTW model, and the results are presented in Tables 2-8 through 2-11.

Table 2-8 – Scenario 1 (77% Proposed New Water Source) Corrosion Analysis

Index	Scenario 1 10°C	Scenario 1 25°C
LSI	-0.60 | SC | 🟡	-0.38 | SC | 🟡
RSI	8.32 | SC | 🟡	7.87 | SC | 🟡
AI	11.40 | SC | 🟡	11.40 | SC | 🟡
CCPP	-36.60 | C | 🔴	-20.81 | C | 🔴
CSMR	8.03 | SC | 🟡	8.03 | SC | 🟡
Corrosivity Status per TCEQ Criteria	Slightly Corrosive | 🟡	

Table 2-9 – Scenario 2 (43% Proposed New Water Source) Corrosion Analysis

Index	Scenario 2 10°C	Scenario 2 25°C
LSI	-0.39 | SC | 🟡	-0.16 | NC | 🟢
RSI	7.96 | SC | 🟡	7.52 | SC | 🟡
AI	11.60 | SC | 🟡	11.60 | SC | 🟡
CCPP	-23.32 | C | 🔴	-9.33 | C | 🔴
CSMR	2.58 | SC | 🟡	2.58 | SC | 🟡
Corrosivity Status per TCEQ Criteria	Slightly Corrosive | 🟡	

Table 2-10 – Scenario 3 (25% Proposed New Water Source) Corrosion Analysis

Index	Scenario 3 10°C	Scenario 3 25°C
LSI	-0.29 | SC | 🟡	-0.06 | NC | 🟢
RSI	7.81 | SC | 🟡	7.36 | SC | 🟡
AI	11.69 | SC | 🟡	11.69 | SC | 🟡
CCPP	-16.77 | C | 🔴	-3.66 | C | 🔴
CSMR	1.52 | SC | 🟡	1.52 | SC | 🟡
Corrosivity Status per TCEQ Criteria	Slightly Corrosive | 🟡	

Table 2-11 – Scenario 4 (50% Proposed New Water Source) Corrosion Analysis

Index	Scenario 4 10°C	Scenario 4 25°C
LSI	-0.43 | SC | 🟡	-0.21 | NC | 🟢
RSI	8.03 | SC | 🟡	7.59 | SC | 🟡
AI	11.56 | SC | 🟡	11.56 | SC | 🟡
CCPP	-25.93 | C | 🔴	-11.61 | C | 🔴
CSMR	3.16 | SC | 🟡	3.16 | SC | 🟡
Corrosivity Status per TCEQ Criteria	Slightly Corrosive | 🟡	

Based on the limited available water quality data for the existing treated water and the proposed well field, the calculated corrosion indices suggest that blending these sources will lead to a

slightly corrosive water designation. The current treated water status based on the water quality information provided for Entry Point #1 is also designated as slightly corrosive; however, the possible corrosive status of the new water source will require additional TCEQ coordination. For a noncorrosive or slightly corrosive new source, additional lead and copper sampling may be required if the system is currently performing reduced sampling. For a corrosive water source, the GMIWA may be required to submit a follow-up engineering corrosivity report as a condition of approval or be required to implement corrosion control treatment.

Based on available data from the TCEQ, the GMIWA does not have a Corrosion Control Plan on file with the TCEQ. Therefore, prior to proceeding with the new wells, it is recommended that the GMIWA perform additional water quality testing at the new well site and coordinate with the TCEQ regarding the slightly corrosive status of all blend scenarios and determine the compliance requirements for the new water source. If corrosion control treatment is required, FNI performed preliminary calculations using the RTW model on the amount of sodium hydroxide (NaOH – caustic) required for pH adjustment for the following scenarios to identify the maximum, average, and minimum possible caustic dosage requirements:

- Scenario 1 Adjusted – Adjust the pH of the maximum new source water blend by mixing 77% proposed new water source and 23% current water sources, to change the status from slightly corrosive to noncorrosive.
- Scenario 2 Adjusted – Adjust the pH of the average new source water blend by mixing 43% proposed new water source and 57% current water sources, to change the status from slightly corrosive to noncorrosive.
- Scenario 3 Adjusted – Adjust the pH of the lowest new source water blend by mixing 25% proposed new water source and 75% current water sources, to change the status from slightly corrosive to noncorrosive.

Scenario 4 (50% new source blend) was not included in this analysis because the caustic dosage for this scenario would be between the maximum dosage (Scenario 1 – 77% new source blend) and the average dosage (Scenario 2 – 43% new source blend) based on the blending percentage of the new source to the existing sources. Table 2-12 through Table 2-14 below present the required caustic dosage, adjusted pH, and value of the corrosivity indices for Scenarios A, B, and C.

Table 2-12 – Scenario 1 Adjusted (77% Proposed New Water Source) Corrosion Analysis with pH Adjustment for Corrosion Control

Index	Scenario 1 Adjusted 10°C	Scenario 1 Adjusted 25°C
LSI	0.05 | NC | ●	0.65 | NC | ●
RSI	7.61 | SC | ●	6.80 | NC | ●
AI	12.05 | NC | ●	12.42 | NC | ●
CCPP	1.62 | NC | ●	16.39 | NC | ●
CSMR	8.03 | SC | ●	8.03 | SC | ●
Corrosivity Status per TCEQ Criteria	Noncorrosive | ●	
Adjusted pH from Blended 7.12	7.72	8.09
Caustic Dosage	20 mg/L as NaOH	

Table 2-13 – Scenario 2 Adjusted (43% Proposed New Water Source) Corrosion Analysis with pH Adjustment for Corrosion Control

Index	Scenario 2 Adjusted 10°C	Scenario 2 Adjusted 25°C
LSI	0.04 | NC | ●	0.45 | NC | ●
RSI	7.50 | SC | ●	6.87 | NC | ●
AI	12.02 | NC | ●	12.21 | NC | ●
CCPP	1.56 | NC | ●	15.02 | NC | ●
CSMR	2.58 | SC | ●	2.58 | SC | ●
Corrosivity Status per TCEQ Criteria	Noncorrosive | ●	
Adjusted pH from Blended 7.19	7.58	7.77
Caustic Dosage	13 mg/L as NaOH	

Table 2-14 – Scenario 3 Adjusted (25% Proposed New Water Source) Corrosion Analysis with pH Adjustment for Corrosion Control

Index	Scenario 3 Adjusted 10°C	Scenario 3 Adjusted 25°C
LSI	0.06 | NC | ●	0.41 | NC | ●
RSI	7.43 | SC | ●	6.85 | NC | ●
AI	12.04 | NC | ●	12.17 | NC | ●
CCPP	2.43 | NC | ●	15.12 | NC | ●
CSMR	1.52 | SC | ●	1.52 | SC | ●
Corrosivity Status per TCEQ Criteria	Noncorrosive | ●	
Adjusted pH from Blended 7.23	7.55	7.68
Caustic Dosage	10 mg/L as NaOH	

2.2.4 Preliminary Corrosion Control System Sizing

The estimated flows to be accommodated for a caustic system at the GMIWA WTP based on the plant's design capacity and system demands are summarized in Table 2-15.

Table 2-15 – Raw Water Flow Basis of Caustic Chemical Feed Design

WTP Flow	
Minimum	1 MGD (694 gpm)
Average	2.3 MGD (1,604 gpm)
Maximum (WTP Design Capacity)	12 MGD (8,333 gpm)

The characteristics of caustic are shown in Table 2-16. Caustic is available for purchase in a range of concentrations; however, it was assumed that a 25% solution would be utilized at the GMIWA WTP due to its lower freezing temperature (~36°F). The following doses were evaluated based on the caustic dosages estimated in Tables 2-12 through 2-14:

- Minimum Dose = 10 mg/L as NaOH
- Average (Design) Dose = 13 mg/L as NaOH
- Maximum Dose = 20 mg/L as NaOH

Table 2-16 – 25% Caustic Characteristics

Parameter	Value
Chemical Formula	NaOH Sodium Hydroxide
Appearance	Colorless to Slightly Colored Liquid
Concentration	20 – 30%
pH	> 14 S.U.
Specific Gravity	1.22 – 1.33
Freezing Point	~36°F

The estimated daily caustic usage in gallons per day (gpd) based on the above dosages and GMIWA WTP flows are summarized in Table 2-17.

Table 2-17 – 25% Caustic Daily Usage

Caustic Dose	Caustic Usage (gpd)		
	Minimum (1 MGD)	Average (2.3 MGD)	Maximum (12 MGD)
Minimum (10 mg/L)	31	72	376
Average (13 mg/L)	41	94	489
Maximum (20 mg/L)	63	144	752

The TCEQ requires that the chemical storage system provide 15 days of storage, as a minimum, at the average dose and maximum flow. Based on the TCEQ requirements it was determined that a bulk storage tank with a capacity of approximately 7,335 gallons would be required to support caustic storage for corrosion treatment at the GMIWA WTP. If the TCEQ requires a corrosion control system, the anticipated cost, assuming a new, outdoor containment area with a new bulk storage tank, day tank, and a small, fiber-reinforced plastic (FRP) enclosure for the new chemical feed pumps, is approximately $690,000. A conceptual opinion of probable construction cost (OPCC) is provided in Table 2-18.

Table 2-18 – Caustic Storage and Feed System OPCC

Item	Cost
Site Improvements and Yard Piping	$29,000
Bulk Containment and Storage	$160,000
Day Tank, Metering Pumps, and Enclosure	$138,000
Electrical, Instrumentation, and Control	$74,000
Subtotal	**$401,000**
Contingency (30%), Mobilization (5%), OH&P (15%), and Escalation (3.0%)	$286,000
Total OPCC (2022 Dollars)	**$687,000**

3.0 GROUNDWATER AND WELL ANALYSIS

RMBJ Geo, Inc. was tasked with determining location, estimated production, and number of wells available on the Carrol Creek Ranch property. The full report is provided in Appendix E, while the results are summarized below.

To determine well locations and quantities, several assumptions were made:

1. Wells must meet the Panhandle Groundwater Conservation District (PGCD) 12-inch well discharge spacing requirements to both wells inside and outside of the property.
2. Spacing between production wells should be maximized to prevent interference between wells.
3. Terrain must be considered for construction access.
4. Yearly average withdrawal is limited to 2,780 ac-ft/yr.

Based on these criteria two well layouts were prepared, a potential six well layout and a seven well layout. While the seven well layout can maximize production, the three wells located in the southern edge of the property would possibly be subject to interference and decrease the well yields prematurely. For this reason, the potential six well layout will be evaluated in this report. Maps of the six well and seven well layouts are provided in Appendix E with the full report. Figure 5 provides the well locations for the six well option, the ground elevation at the wells, and the proposed well piping to connect the wells to the proposed transmission line. Table 3-1 also provides the preliminary well depth, based on the surface elevation and the "Red Bed Elevation", or the bottom of the production zone of the Ogallala Reservoir. The difference in these values is the "Red Bed Depth", which is the assumed depth of well.

Table 3-1 – Preliminary Well Depths

Well Number	Red Bed Elevation (Ft-MSL)	Surface Elevation (Ft-MSL)	Red Bed Depth (Ft)
1	2,535	3,161	626
2	2,620	3,180	560
3	2,590	3,170	580
4	2,560	3,150	590
5	2,530	2,980	450
6	2,560	2,967	407

As mentioned previously, well locations are spaced to meet requirements for a 12-inch well discharge diameter, which, according to the PGCD, is classified as a 1300-2000 gpm well. RMBJ

Geo, based on the known well production in the area, expects the well production from each well to be more in line with an 8-inch discharge pipe, or a 560-1,000 gpm well. Based on this information and the known information of the Ogallala Aquifer in this area, RMBJ Geo recommends well locations 3, 4, and 5 for the first three wells, but to test all well locations to accurately determine the highest yield locations.

Based on samples extracted and tested in 2016, no significant water quality issues were discovered. The available data was used to perform the water blend analysis shown in Section 2.2.

4.0 PROPOSED PIPE AND ALIGNMENT REVIEW

4.1 PIPE MATERIAL OPTIONS

4.1.1 Polyvinyl Chloride (PVC)

PVC is the simplified term for AWWA C900 Polyvinyl Chloride pipe. PVC is comprised of a plastic matrix that is melted, mixed with additives for the desired material properties, and extruded into cylindrical shape in an extrusion machine. Each pipe section is a standard length (typically 20 feet) and can be joined together using plastic welding or bell and spigot joints.

Advantages:

- Lightweight, low-carbon plastic
- Excellent corrosion resistance (chemical and electrochemical)
- Standardized outside diameter dimension provides easier connections to existing utilities

Disadvantages:

- Can be more expensive in sizes larger than 24-inch diameter
- Vulnerable to environmental effects like temperature and UV light
- Loses ductility in freezing conditions or repeat stress/strain applications, which can cause cracking

4.1.2 High-Density Polyethylene (HDPE)

Polyethylene (PE) was first developed in 1933 as a flexible, low-density coating and insulating material for electrical cables. In general terms, the performance capability of PE in piping applications is determined by three main parameters: density, molecular weight, and molecular weight distribution. PE is a semicrystalline polymer composed of long, chain-like molecules of varying lengths and numbers of side branches. As the number of side branches increases, polymer crystallinity and hence, density decreases.

Advantages:

- Simple to install by open cut
- Easy/simple to install in jack/bore scenarios

Disadvantages:

- High thermal expansion

- Subject to stress cracking
- Poor weathering resistance
- Nonstandard joints make it difficult to connect to different pipe types

FNI recommends that PVC and HDPE be considered for the collection and transmission pipelines. Both pipe materials are commonly used for water pipelines.

4.2 ALIGNMENT OPTIONS

Three alignment options will be evaluated to determine the best alignment option. For reference, all alignment stationing will run from the proposed well field to their designated outfalls. Alignment Options #1 and #2 tie directly to the WTP. Alignment Option #3 delivers to the Greenbelt Reservoir. See Figure 6 for an overall view of all three alignments.

4.2.1 Alignment Option #1

Alignment Option #1, shown as the red alignment on Figure 6, begins near the location of Well No. 5. The alignment travels due east, traversing multiple creek crossings for approximately 10,000 linear feet (LF) before entering the west side of SH 70 Right-of-Way (ROW). SH 70 has a variable ROW width along the corridor, switching between a 120 feet and a 150 feet total width ROW. SH 70 along the proposed alignment has two lanes with a shoulder on each side. Figure 7 provides a typical cross-sectional view of SH 70 with the proposed water line. From a site walk of the corridor, existing underground telephone conduit and overhead electrical lines were noticed within the SH 70 ROW. At this time, it is believed that these conflicts will not be an issue due to the available space in the ROW ditch. While the pipeline will need to be moved if SH 70 is widened, the Texas Department of Transportation currently has no plans to widen SH 70. To ensure there are no problems in the future, the pipeline should be installed at least one lane width away from the existing asphalt.

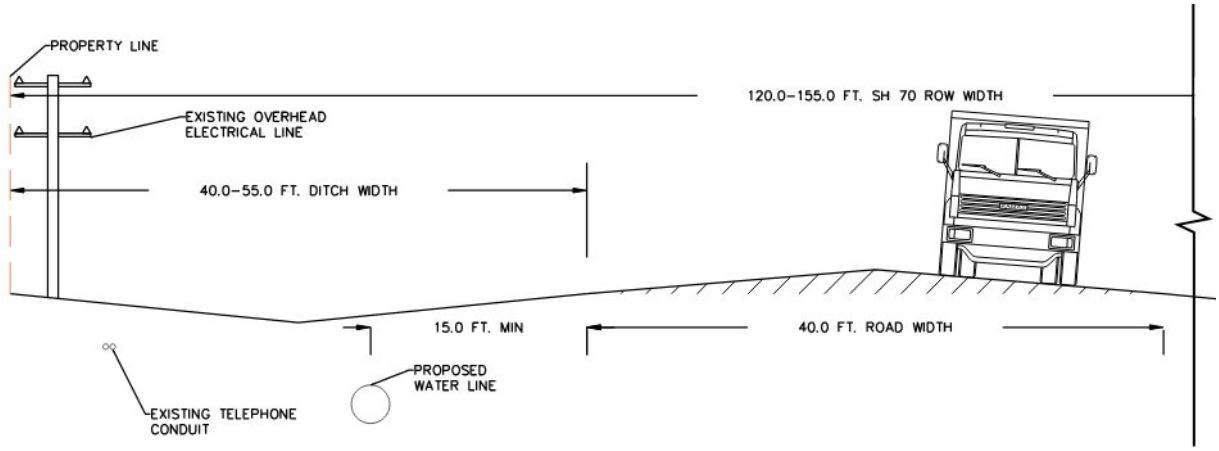

Figure 7 – Typical SH 70 Cross-Section, Facing North

The proposed alignment continues south along the west side of the existing SH 70 ROW for approximately ten miles (52,950 LF) to the existing WTP. Some minor conflicts were recognized along the alignment. These are further discussed below.

Approximately four miles along SH 70 a large guy-wire communications tower is located along the eastern edge of SH 70, shown in Figure 8. The proposed alignment travels along the western side of SH 70 to avoid conflict with this tower.

Figure 8 – Guy Wire Communication Tower, Facing North

All guy wires are anchored at least 45 feet off the property line. Special care must be made to ensure no construction or construction activities occur near the guy wires; however, it is not anticipated that construction would occur near the guy wires for the proposed water line.

Just south of the guy-wired tower, a free-standing communication tower owned and operated by the Federal Communications Commission (FCC) is located, shown in Figure 9. The tower is far enough away from the SH 70 ROW to not be impacted by construction; however, coordination with the FCC should be performed during construction to ensure no issues arise.

Figure 9 – FCC Free-Standing Communication Tower

The alignment continues south with no major conflicts, crossing drainage channels intermittently, with a typical channel shown in Figure 10. At the southern portion of the alignment the pipeline will need to be installed near the dam for the Greenbelt Reservoir. Care should be made to ensure the dam is not affected by the installation of the water line. A bridge/stream crossing will need to be made at the outlet for the Salt Fork of the Red River, shown in Figure 11. From there, the pipeline will cross SH 70 north of the dam and continue along the east side of SH 70 to the WTP.

Figure 10 – Typical Drainage Outlet Along SH 70

Figure 11 – Existing Bridge and Salt Fork River Crossing, Facing South

After crossing the Salt Fork, the alignment does not encounter any significant conflicts, traveling along the eastside of SH 70 to the existing GMIWA WTP. Depending on the results of the final water quality analysis, the proposed alignment will either connect directly to the 27-inch influent line to the treatment plant, or outfall directly to the existing filter beds, similar to the Clarendon Well Field connection, shown in Figure 12.

Figure 12 – Clarendon Well Field Outfall to Filters

4.2.2 Alignment Option #2

Alignment Option #2, shown as the blue alignment in Figure 6, begins at Well No. 5 similar to Alignment Option #1. The proposed alignment travels due east, crossing several creeks for approximately 7,500 LF before reaching an existing high-voltage overhead electric transmission line and easement, owned by the Greenbelt Electrical Co-op. The proposed alignment turns due south, following the existing transmission easement to the west of SH 70. For the next five miles, the proposed alignment will parallel the existing electric transmission line, staying within the overhead electrical (OHE) easement, where possible. A sample section is provided in Figure 13 of the typical alignment along the existing OHE easement. Further coordination with the Greenbelt Electric Co-op will be required to determine full ROW requirements; however, most electric companies require 25 feet offset from pole to utility. At this time, it is assumed that the proposed transmission line can be installed within the OHE easement. It is likely the water line will require a new easement, since the existing OHE easement may not have rights to install a water line in the easement.

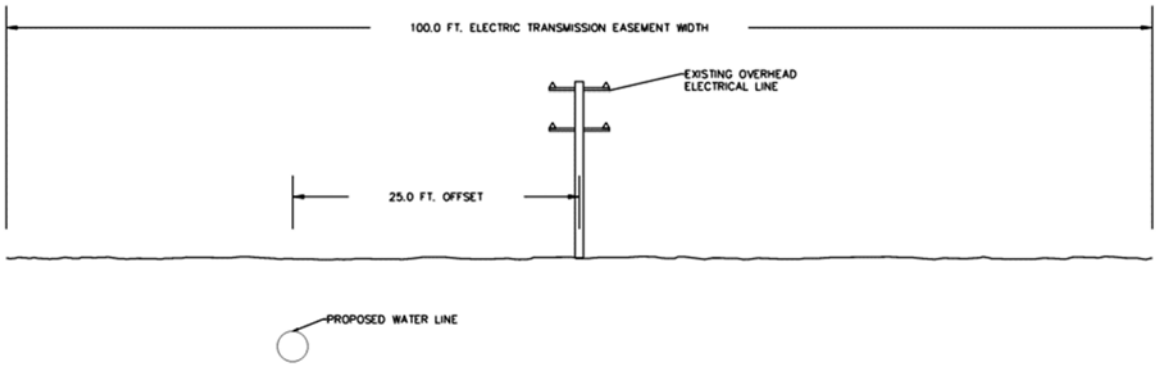

Figure 13 – Typical Electrical Transmission Easement Section View, Facing North

While following the electric easement, the proposed water line will cross seven ephemeral streams, requiring either open cut construction with stream and bank repair or boring the proposed water line underneath the crossing. Further effort is needed to determine the preferred installation method for each crossing. Open cut is preferred, when possible, to reduce cost. Tunneling, however, is sometimes necessary in large/difficult stream crossings. Tunneling also can be used to avoid environmental permitting triggers when installing via open cut. Eventually, the alignment re-enters public ROW, traveling along County Road I (Figure 14 for approximately 1,200 feet, before entering private property once again (Figure 15).

Figure 14 – Existing Electric Transmission Easement Along County Road I, Facing North

Figure 15 – Existing Electric Transmission Line Along County Road I, Facing South

The alignment continues due south along the OHE easement for approximately 5,000 LF before re-entering public ROW at Hereford Drive, shown in Figure 16. The alignment then makes a 90 degree turn to the east, paralleling along Hereford Drive.

Figure 16 – Photo Taken Along Hereford Drive, Facing North

The proposed alignment continues along the Hereford Drive ROW for approximately 2,850 LF before entering the ROW of SH 70. Once in the ROW of SH 70, the Alignment Option #2 follows the same alignment as Alignment Option #1, described in Section 4.2.1.

4.2.3 Alignment Option #3

Alignment Option #3, shown as the yellow alignment in Figure 6, begins at Well No. 6, the western well along the southern border of the Carrol Creek property. From Well No. 6, the proposed alignment continues southwest, across pastureland, for approximately 4,300 LF before turning due west towards County Road 9. The proposed alignment turns south towards the Greenbelt Reservoir, following the existing alignment of the County Road 9. County Road 9 is a caliche base 2-lane road, approximately 30-35 feet in width, shown in Figure 17.

Figure 17 – County Road 9

Alignment option #3 may be located within the fenced roadways or on the adjacent private land. The final location will be dependent on legal easement requirements and negotiations with the County Road official. Installing the alignment outside the road would also protect the water line during any road maintenance, which could expose and damage the water line. The proposed alignment follows County Road 9 south for approximately 27,750 feet. From the alignment walk performed, the only utility marker shown along County Road 9 is a gas line along the western edge of the road. With this information, a sample section view of the alignment along the County Road is shown in Figure 18 .

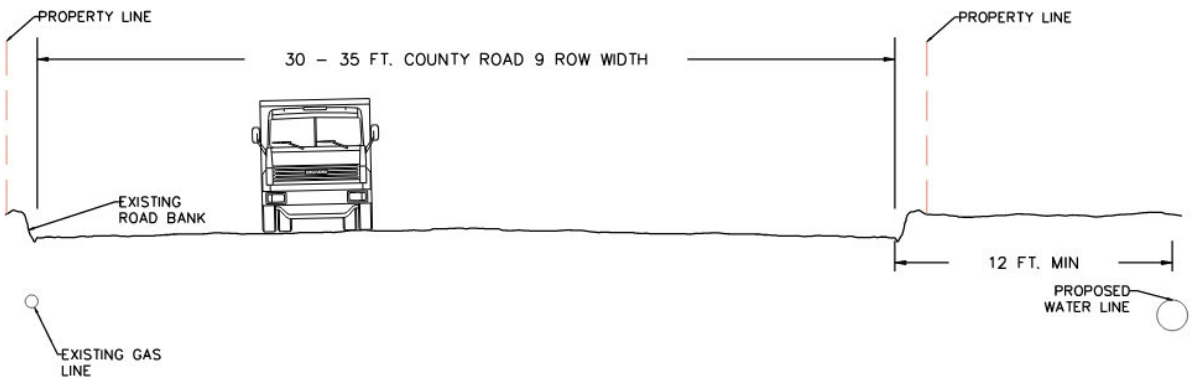

Figure 18 – Typical County Road Section View, Facing North

The proposed alignment is currently shown 12-ft outside the existing county road within the private land. A minimum of 12-ft from the property line would allow maintenance to access the water line without impact to existing property fences.

The proposed alignment continues along the existing county road, with no major deviations. The alignment continues to the intersection with County Road I, where the alignment follows County Road I south. Along County Road I, the proposed route travels through a heavily wooded area with a large tributary crossing for Carrol Creek. A photo of this area is shown in Figure 19. Underground electric markers were also found along the southern edge of County Road I in this area.

Figure 19 – Wooded Area Along County Road I, Facing East

The proposed alignment continues along the County Road I, traveling south until re-entering private property as County Road I dead-ends, shown in Figure 20. The proposed alignment continues south for approximately 9,500 LF before a proposed outfall at Greenbelt Reservoir.

Figure 20 – Dead-End County Road I, Facing South

5.0 HYDRAULIC ANALYSIS

Two of the pipeline routes, Alignment Option #1 and Alignment Option #2, start at the Well No. 5 site, located 1.75 miles west of SH 70 and 1.4 miles east of County Road 9, respectively. The Alignment Option #3 route starts at the potential future Well No. 6, located approximately 2.6 miles west of SH 70 and 0.55 miles east of County Road 9. Alignment Options #1 and #2 terminate at the GMIWA WTP located east of SH 70. Alignment Option #3 terminates at the Greenbelt Reservoir.

A desktop hydraulic analysis was performed on the three route options using GIS ground surface elevations. The proposed waterline has a projected average design flow rate of 1000 gpm (1.44 MGD) and a minimum peak design flow rate of 3000 gpm (4.28 MGD). Based on a Hazen Williams C-factor of 130, projected headloss was determined for all routes per 1000 feet.

Table 5-1 – Elevation Data for all Proposed Alignments

Alignment Option	Starting Elevation (ft-MSL)	Starting Point Station	High Point Elevation (ft-MSL)	High Point Station	Low Point Elevation (ft-MSL)	Low Point Station	End Point Elevation (ft-MSL)	End Point Station
1	2,981	1+00	3,070	103+00	2,590	543+00	2,780	629+00
2	2,980	1+00	3,004	92+00	2,590	544+00	2,780	629+00
3	2,966	1+00	3,067	72+00	2,630	461+00	2,630	461+00

Figure 21, Figure 22, and Figure 23 show the hydraulic grade lines (HGLs) for all route options. Per TCEQ, a minimum pipe pressure class of 150 psi is required for all routes to account for the working pressure. Each route has a high point near the well field that controls the well pump static head, and the flow will gravity flow from the high point to the delivery point. Along Alignment Options #1 and #2, from STA 527+00 to 557+00, there is a significant low point that requires class 235 psi pipe (DR-18 PVC pipe) for the crossing of the Salt Fork. A flow control valve will be required at the delivery point for all alignments to control flow pressure and surging in the pipeline.

In the hydraulic analysis, alternate pipe sizes were considered for the main transmission line. Pipe diameters of 16-inch and 18-inch were evaluated. While an 18-inch transmission line provides reduced headloss and less required head at the pumps in the 3,000-gpm scenario, the additional cost of installing an 18-inch pipeline versus a 16-inch line is not recouped in lower operating costs. Table 5-2 provides the difference in the required head of the pumps for a 16-inch and 18-inch transmission line.

Table 5-3 provides the velocity and headloss in the transmission line for various flow scenarios. To determine the pumping head shown in Table 5-2, the average pump depth is subtracted by the assumed well drawdown, which was calculated at 100 feet. This well draw down is half of the assumed static water level, which is 200 feet above the red bed layer. A 200-ft production zone is based on the currently available information, however once test wells are performed the exact production zone will be determined.

It should be noted that a 16-inch transmission line is adequate for the current supply available from the proposed well field, however, if GMIWA commissions any additional well fields within proximity of the proposed well field or transmission line, an 18-inch transmission line could handle the additional flow, depending on the specific flows from both well fields.

Table 5-2 – Pumping Head for 16-inch and 18-inch Water Lines, C = 130

Required Head (ft) of Pumps at 3,000 gpm	Alignment Option #1	Alignment Option #2	Alignment Option #3
16-inch	579	538	572
18-inch	561	488	557
Difference	18	50	15

Note that the 16-inch pipeline maximum capacity is 4,391 gpm, whereas the 18-inch maximum pipeline capacity is 5,515 gpm; however, the system capacity will be limited by the well field output.

Table 5-3 – Head and Velocity Summary of 16-inch and 18-inch Water Lines, C = 130

	1000 gpm		2000 gpm		3000 gpm		Max Flow (V = 7 ft/s)	
	V (ft/s)	HL/1000 ft	V (ft/s)	HL/1000 ft	V (ft/s)	HL/1000 ft	gpm	HL/1000 ft
16-inch	1.60	0.63	3.19	2.27	4.79	4.81	4,391	9.74
18-inch	1.26	0.36	2.54	1.31	3.81	2.76	5,515	8.53

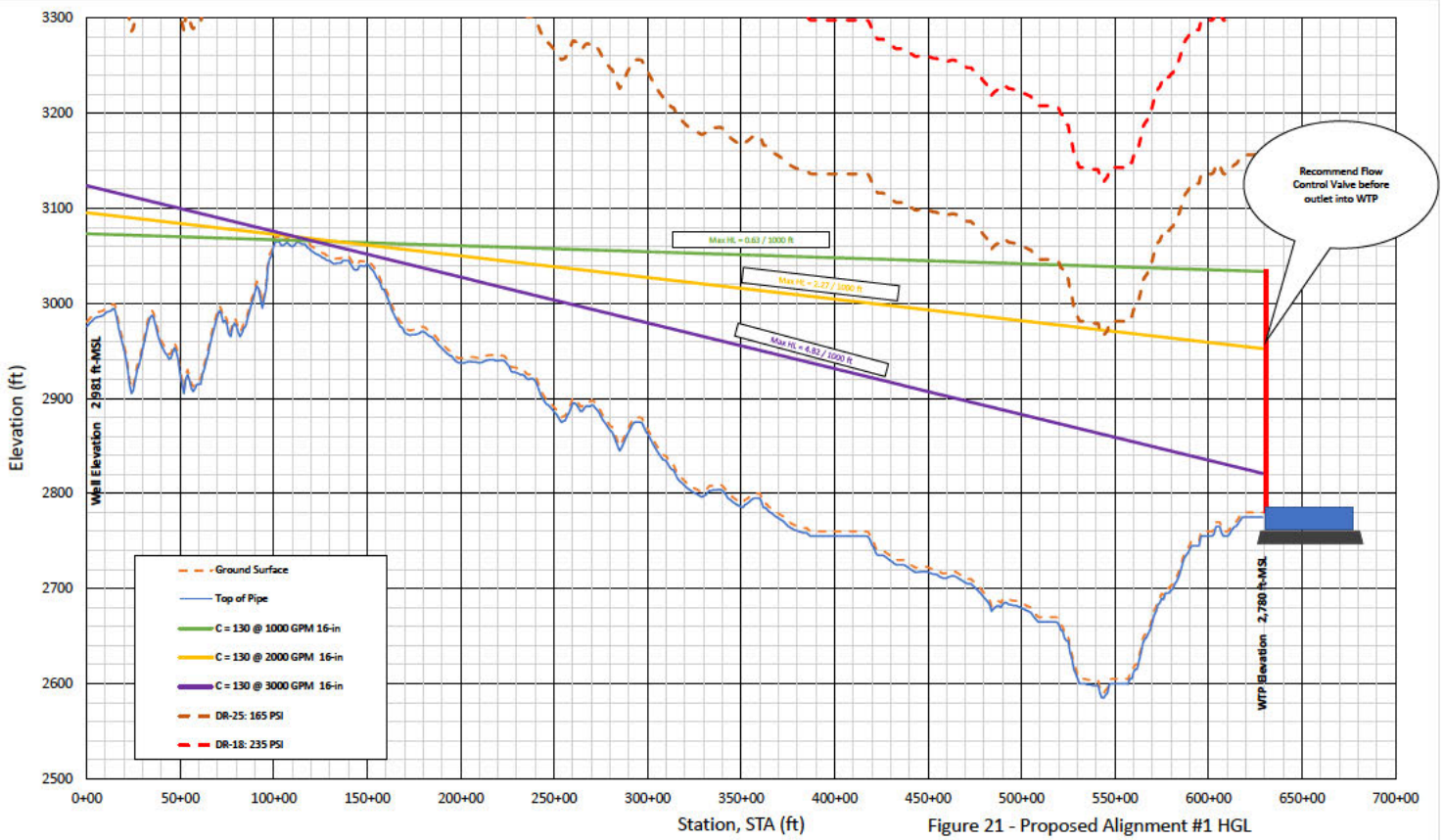

Figure 21 - Proposed Alignment #1 HGL

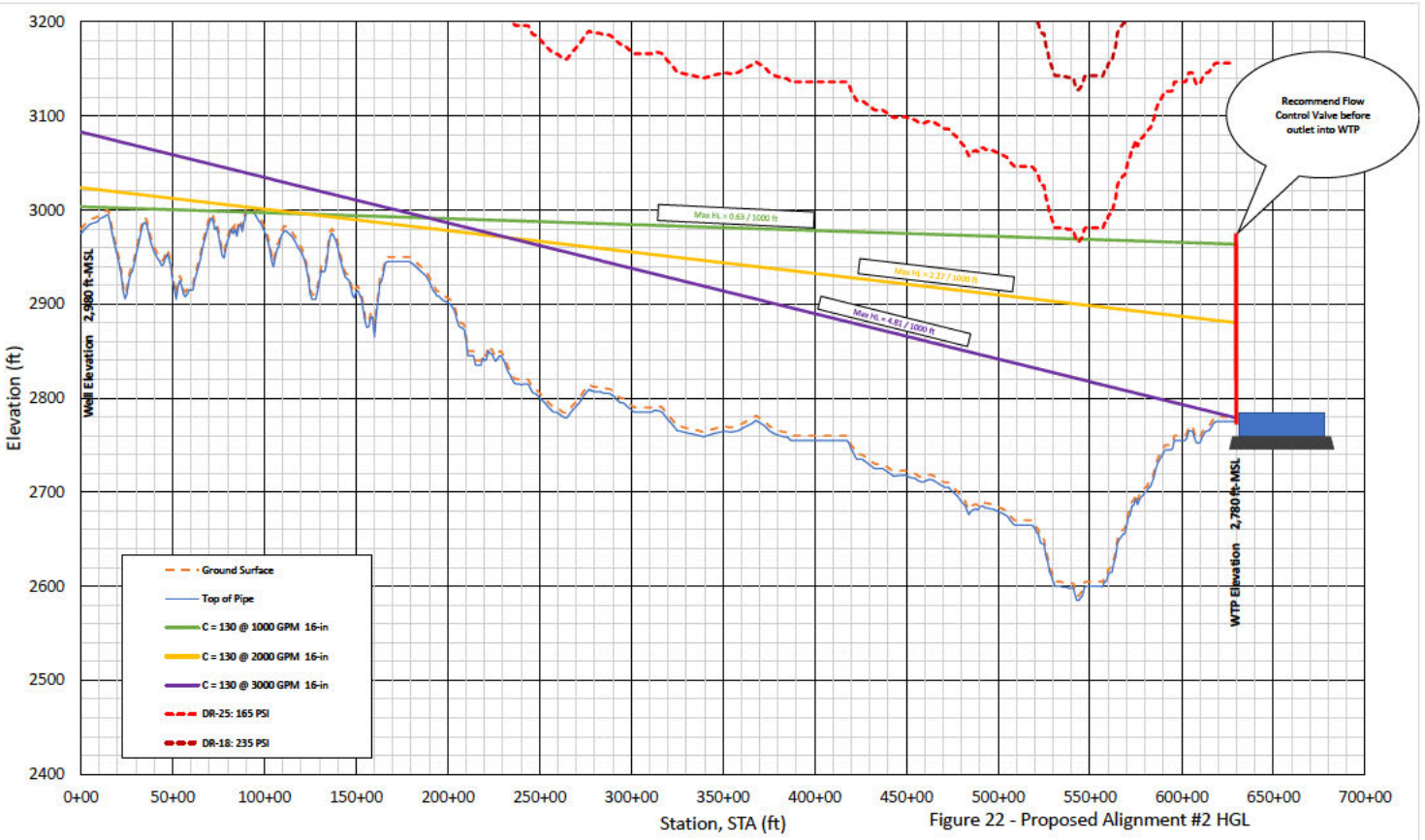

Figure 22 - Proposed Alignment #2 HGL

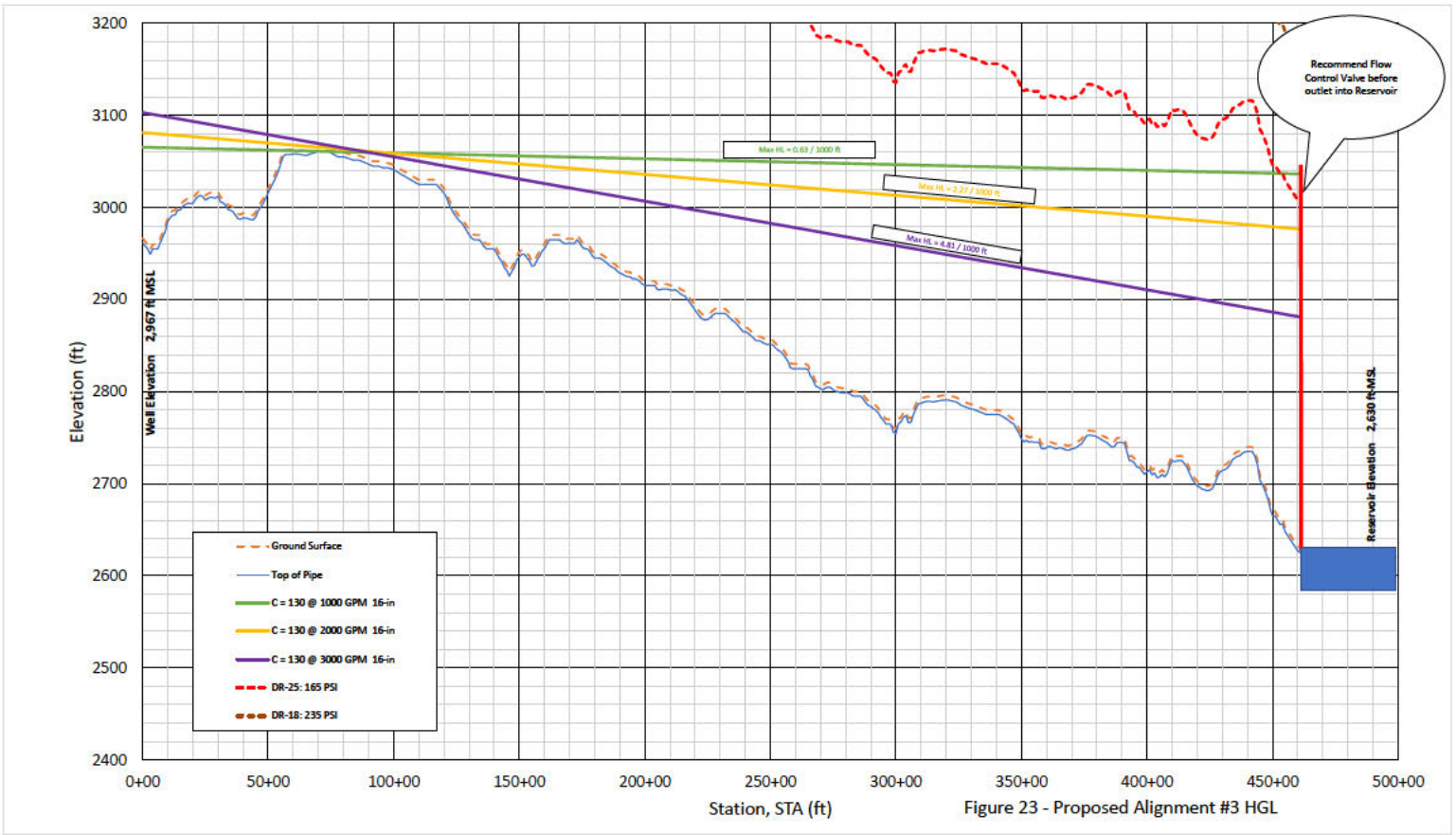

Figure 23 - Proposed Alignment #3 HGL

5.1 HYDRAULIC CONSIDERATIONS

There is a ground elevation gain observed from the well sites to the high points along the alignments of 160 ft-MSL, 94 ft-MSL, and 113 ft-MSL across Alignment Options #1, #2, and #3, respectively. This elevation gain and subsequent steep elevation decline are due to an existing hill in the area. Alignment Options #1 and #2 then encounter elevation gains once again before they reach the GMIWA WTP. The elevation variations are hydraulically significant for the water lines, as the pumps at the starting locations will have to produce enough total dynamic head (TDH) to push water over the hill, while the elevation losses result in excess head for all flow rates at the delivery point. A flow control valve is recommended at the end of each proposed alignment to reduce head at the delivery point.

5.2 PUMP HYDRAULIC POWER REQUIREMENTS

With the calculated HGLs from the previous section, the required horsepower for the pumps can be determined.

Hydraulic horsepower indicates the minimum power the pumps must output in order to move fluids through the system. Electric horsepower requirements, with consideration of pump and motor losses, will determine final pump and motor selection and electrical design, including utility coordination to ensure enough electricity (voltage) is reaching the pumps.

The equation below calculates electric horsepower.

$$HP = \frac{Q \times H \times S}{\eta_p \times \eta_m \times 3956}$$

where:

HP = Required Electric Horsepower (HP)
Q = Flow (gpm)
H = Head (ft)
S = Specific Gravity (S=1 for water)
η_p = Efficiency of the pump (Assume 0.7)
η_m = Efficiency of the motor (Assume 0.95)

The horsepower required for all six well sites was determined. See Table 5-4, Table 5-5, and Table 5-6 below for the required horsepower for Alignment Options #1, #2, and #3, respectively. The maximum dynamic head (the head at maximum intended flow rate of 3,000 gpm) and the average flow rate of 1,000 gpm were used to calculate the horsepower. These two values

represent the maximum horsepower needed. The pumping cost is calculated to provide 1,000 gpm 24/7, at a $/KWh of seven cents.

Table 5-4 – Horsepower Requirements per Well for Alignment Option #1

Wells	Red Bed Depth (ft)	Flow Rate, Q (gpm)	Head at 3,000 gpm	Total Head (ft)	Horsepower (HP)	Pumping Cost ($/yr)
1	626	1,000	143.36	769.36	292.45	$133,727
2	560	1,000	143.36	703.36	267.36	$122,254
3	580	1,000	143.36	723.36	274.96	$125,729
4	590	1,000	143.36	733.36	278.77	$127,471
5	450	1,000	143.36	593.36	225.55	$103,136
6	407	1,000	143.36	550.36	209.20	$95,659

Table 5-5 – Horsepower Requirements per Well for Alignment Option #2

Wells	Red Bed Depth (ft)	Flow Rate, Q (gpm)	Head at 3,000 gpm	Total Head (ft)	Horsepower (HP)	Pumping Cost ($/yr)
1	626	1,000	102.88	728.88	277.06	$126,689
2	560	1,000	102.88	662.88	251.97	$115,217
3	580	1,000	102.88	682.88	259.58	$118,696
4	590	1,000	102.88	692.88	263.38	$120,434
5	450	1,000	102.88	552.88	210.16	$96,098
6	407	1,000	102.88	509.88	193.82	$88,627

Table 5-6 – Horsepower Requirements per Well for Alignment Option #3

Wells	Red Bed Depth (ft)	Flow Rate, Q (gpm)	Head at 3,000 gpm	Total Head (ft)	Horsepower (HP)	Pumping Cost ($/yr)
1	626	1,000	136.62	762.62	289.89	$132,571
2	560	1,000	136.62	696.62	264.80	$121,098
3	580	1,000	136.62	716.62	272.40	$124,575
4	590	1,000	136.62	726.62	276.20	$126,313
5	450	1,000	136.62	586.62	222.99	$101,976
6	407	1,000	136.62	543.62	206.64	$94,501

Ultimately, regardless of the alignment option chosen the pumps will need to meet very similar delivery requirements.

6.0 ENVIRONMENTAL ASSESSMENT

A desktop level analysis was performed for the areas of the project that were not able to be accessed. The pedestrian survey and desktop analysis were conducted to identify potential Waters of the U.S. (WOTUS), including wetlands, within the proposed project area in accordance with Section 404 of the Clean Water Act (CWA), as well as habitat for federally listed threatened and endangered species.

Based on desktop analysis, each of the route options would cross intermittent channels which could be avoided by other-than-open-cut methods of installation, if required to avoid a Section 404 permit. Alignment Option #1 would cross nine potentially jurisdictional streams and one potential emergent wetland. One stream would be crossed at two separate locations. Alignment Option #2 would cross thirteen potentially jurisdictional waters. Three streams would be crossed at multiple locations with potential for parallel impacts. Alignment Option #3 would cross six potentially jurisdictional stream and one potential scrub-shrub wetland ahead of discharging into the Greenbelt Reservoir. If open-cut methods are proposed, then we recommend designing to meet the terms and conditions of NWP 58, which may require notification of the United States Army Corps of Engineers (USACE). There are environmental authorizations or permits that could be required, which will need to be considered during a more detailed design phase. Based on desktop level analysis, no potential habitat for threatened or endangered species was identified within the proposed project area; however, potential habitat for a candidate species is likely present. There is no designated critical habitat for a federally listed threatened or endangered species within the project area. A full site visit would be required to verify the desktop level analysis. Regarding cultural resources, all potential route options would likely require coordination with the THC, and a pedestrian survey by a professional archeologist may be required. From an environmental standpoint, there is no significant differences between the alternate routes which would change the alignment selection.

The full environmental memorandum can be found in Appendix D.

7.0 PROJECT COST

Project costs for the three proposed alignments and the associated well field work is shown in Appendix F, with a cost summary in Table 7-1. The overall project includes installing 3 wells (wells 3, 4, 5), necessary well field piping, and the full 16-inch transmission line. Detailed construction costs can be found in Appendix F.

Table 7-1 – Project Cost Summary

Costs	Alignment Option #1	Alignment Option #2	Alignment Option #3
Estimated Construction and Electrical Supply Cost	$14,044,988	$14,357,188	$12,915,488
Estimated Land Cost	$42,750	$138,600	$194,300
Estimated Engr/Admin/Legal/Contingency Cost (30%)	$3,823,200	$3,916,900	$3,484,400
Total OPCC	**$17,910,938**	**$18,412,688**	**$16,594,188**

8.0 PROJECT SCHEDULE

Table 8-1 provides a preliminary schedule of the major construction items required for the proposed well field. Construction is broken out between mobilization work and actual construction. The schedule assumes that the contractor or contractors that perform the effort can work concurrently on drilling, pump setting, and piping work.

Table 8-1 – Construction Schedule

Construction Tasks	Months Required to Complete Task												
	2	4	6	8	10	12	14	16	18	20	22	24	26
Engineering													
Design/Well Testing													
Bid/Award													
Construction													
Well 3, 4 & 5 Drilling													
Well 3, 4 & 5 Installation/Startup													
Well Field Piping													
Carrol Creek WL													

- Engineering Effort
- Construction
- Mobilization/Contractor Submittals

9.0 RECOMMENDATIONS

Table 9-1 provides an overall summary of the three alignments. The table provides the critical design elements of the three alignments; the length of the transmission line, permanent easements required, the capital cost, the annual pumping cost, the quantity of creek crossings, and a rating of the accessibility of the transmission line. Based on these elements, FNI recommends Alignment #1. While Alignment #1 is not the lowest cost option, it provides the easiest accessibility both for the initial installation and operation, requires the least amount of easements, and has no major conflicts with existing infrastructure.

Table 9-1 – Overall Summary of Potential Alignments

Alignments	Length of Transmission Line (LF)	Permanent Easements Required (ft^2)	Capital Cost*	Annual Pumping Cost ($/yr)**	Quantity of Creek Crossings	Access to Transmission Line Rating
1	62,764	251,825	$17,910,938	$118,779	9	1
2	62,822	816,700	$18,412,688	$111,743	13	2
3	46,111	1,144,829	$16,594,688	$117,621	6	3

*Capital Costs include the cost for three well pumps, well field piping, transmission line, land cost, electric power lines, WTP improvements, contingency, engineering, and all subsidiary costs.

**Annual Pumping Cost is the average power cost of wells 3, 4, and 5 to provide an average of 1000 gpm 24/7, at a rate of 0.07 $/KWh.

APPENDIX A

Preliminary Engineering Feasibility Report – Additional Water Supply - August 2013

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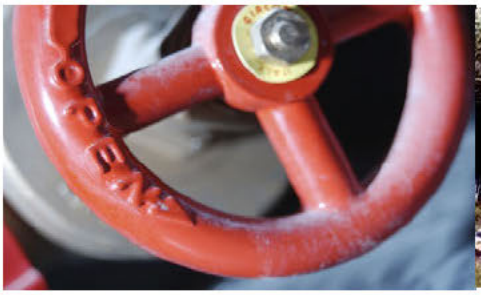


Preliminary Engineering Feasibility Report Additional Water Supply

Prepared for:

Greenbelt Municipal and Industrial Water Authority

August 2013

Prepared by:

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FREESE AND NICHOLS

Innovative approaches
Practical results
Outstanding service

Preliminary Engineering Feasibility Report
Additional Water Supply

Prepared for:

Greenbelt Municipal and Industrial Water Authority

August 2013

FREESE AND NICHOLS, INC.
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ENGINEERING FIRM
F-2144

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1.0 ENGINEERING FEASIBILITY REPORT

1.1 DESCRIPTION OF THE EXISTING SYSTEM

The Greenbelt Municipal and Industrial Water Authority (GMIWA or Authority) owns and operates the Greenbelt Reservoir for water supply. The reservoir is located in Donley County approximately three miles north of the City of Clarendon, Texas. The Authority provides water to the cities of Childress, Clarendon, Hedley, Crowell, and Quanah and to the Red River Authority.

Construction on Greenbelt Reservoir began on April 12, 1966, and the reservoir was completed in 1968, with impoundment beginning on December 5, 1966. The top of the conservation pool is 2,664 feet mean sea level (msl). The reservoir has never filled to the conservation pool elevation.

For much of the time since the reservoir was constructed, the water surface elevation has consistently fluctuated between elevations 2650 and 2640 feet msl, with occasional dips below elevation 2640 msl. In recent years the reservoir has shown an increasing decline in water elevation with a significant drop in elevation occurring over the last year (2011). The reservoir elevation is now the lowest since it began impounding water (elevation 2621.6 feet msl) and the Authority has entered Stage 3 of its Drought Contingency Plan (Severe Water Shortage). The yield analyses conducted in 2011 found the safe yield for Greenbelt Reservoir to be between 4,515 and 4,825 acre-feet per year, depending on downstream releases. The conditional reliability analyses show that this yield may be overstated if a drought continues. The minimum storage values of the yield analyses occur at the end of the simulation, indicating vulnerability to continued drought. Since the study was completed in December 2011 the reservoir has continued to decline.

The 2011 regional water plans show a demand on GMIWA of approximately 4,300 acre-feet per year through the planning period. This demand is consistent with historical dry year demands with no restrictions. Diversions over the last 5 years have averaged about 3,855 acre-feet per year. The maximum diversion from the reservoir was 5,035 acre-feet in 1983.

To maintain a safe level of supply in the reservoir, GMIWA could benefit from supplementing the surface water with an additional water source. The amount of additional water would vary depending upon the level of safe supply and risk the GMWIA is willing to assume.

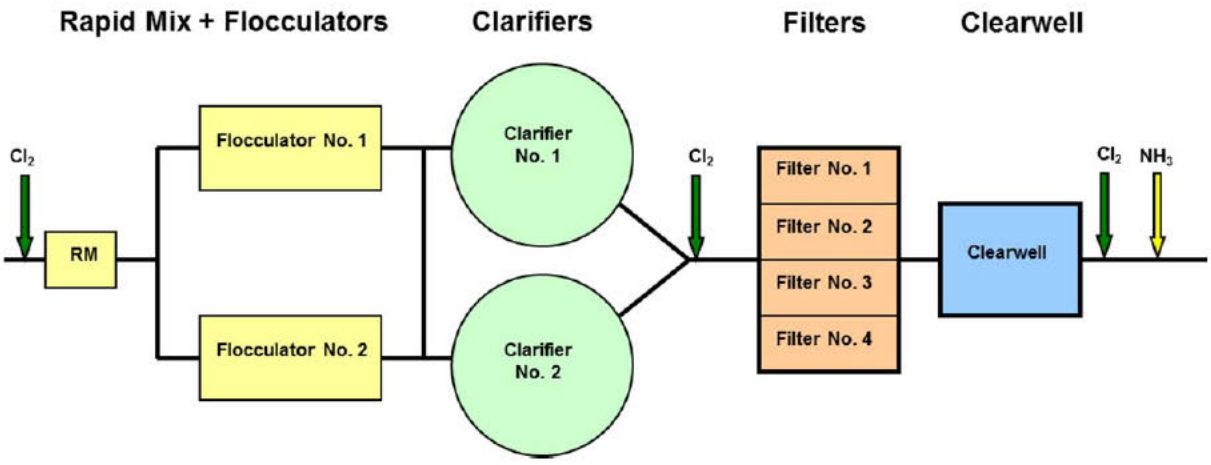
The existing water quality of the Greenbelt Reservoir is shown in Table 1.

Table 1 – Greenbelt Reservoir Water Quality Data

Parameter	Minimum	Maximum	Average
Total Alkalinity (mg/L as $CaCO_3$)	94	193	154
Calcium (mg/L as Ca)	29	50	43
Total Hardness (mg/L as $CaCO_3$)	190	214	206
Magnesium (mg/L as Mg)	13	28	23
Nitrite (mg/L as N)	0.002	0.05	0.02
Total Dissolved Solids (mg/L)	158	698	446

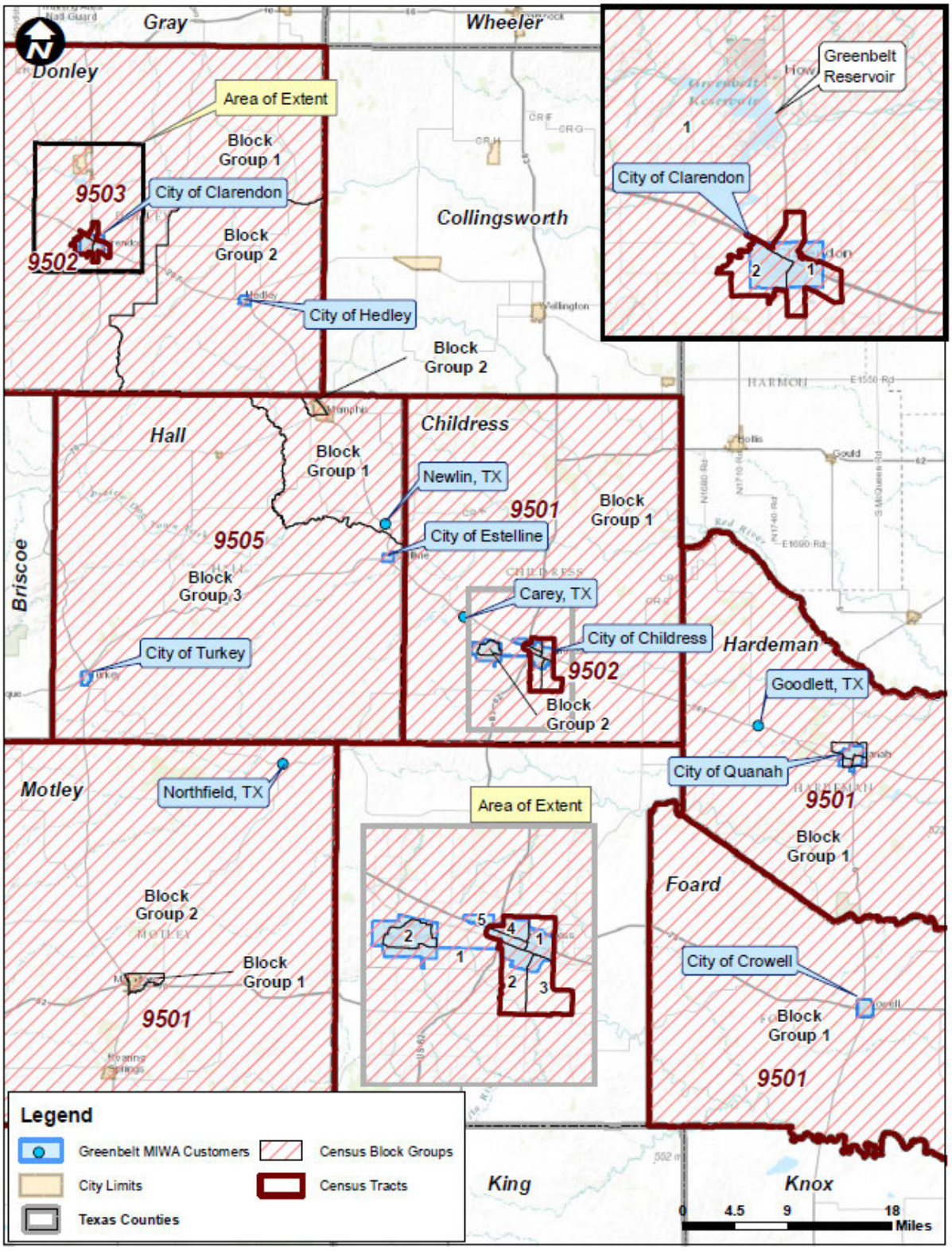
GMIWA pumps water from the Greenbelt Reservoir to existing water treatment plant via a 30-inch raw water pipeline. The water treatment plant consists of the following unit processes as illustrated in Figure 1.

Figure 1 – GMIWA Existing Water Treatment Plant Unit Processes



GMIWA's service area is illustrated on the following Figure 2.

Figure 2 – GMIWA's Service Area Map



1.2 PROJECTED NEEDS

The Authority provides water to customers in Childress, Donley, Foard, Hall, Hardeman, and Wilbarger Counties. A map of the GMIWA's service area is shown on Figure 2. The Authority's service area lies in both the Panhandle Region (Region A) and Region B. Most of their customers are smaller cities and rural municipal communities served by the Red River Authority. The City of Quanah is the only member city that provides a significant amount of water for manufacturing. The Authority also provides water directly to a country club and golf course. This demand is reflected as irrigation demand.

Table 2 shows the current and projected population, water demand and per capita water use for the GMIWA. The populations and demands for 2010 are based on the Census and historical water use reported to the Texas Water Development Board. The populations and demands for years 2020 through 2040 are based on the regional approved draft projections. The populations for the cities are taken directly from the TWDB draft projections. The populations served by the Red River Authority are shown as County-Other and are generally estimated by the number of connections. For Childress County, the GMIWA provides 90 percent of the water supplies to County-Other. The population and demands for Red River Authority systems in Childress County are estimated at 90 percent of the Panhandle Region-approved projections for Childress County-Other.

At this time, there are no plans to expand the GMIWA's service area or customer base. As such, the projections for the GMIWA's system generally remain constant over the planning horizon. The increase in total demands on the GMIWA between 2010 and 2040 is primarily due to projected increases in populations for Childress and reduced deliveries in 2010 due to the drought.

The historical per capita water use is calculated from the Census population data (or estimates developed for RRA) and the reported historical water use. Historical per capita demands in 2010 range from 103 to 210 gallons per person per day (gpcd). Projected per capita water demands are based on data from the TWDB and range from 86 to 223 gpcd in 2040.

Table 2 – Population and Demands for GMIWA

	Population			
	2010 Census	2020 TWDB	2030 TWDB	2040 TWDB
City of Childress	6,105	6,303	6,543	6,743
City of Chillicothe	707	731	749	755
City of Clarendon	2,026	2,088	2,088	2,088
City of Crowell	948	986	995	995
City of Memphis*	2,290	2,318	2,382	2,382
Childress County-Other	842	869	903	930
Donley County-Other	203	203	203	204
Foard County-Other	270	270	270	270
Hall County-Other	490	490	490	490
Hardeman County-Other	545	545	545	545
Hardeman County Manufacturing	-	-	-	-
City of Quanah	2,641	2,728	2,797	2,821
Wilbarger County-Other	94	94	94	94
Irrigation - Donley Co. Golf Course	-	-	-	-
Total	**17,161**	**17,625**	**18,059**	**18,317**
*Total population; GMIWA provides a portion of demands				
	Demand (Acre-feet per year)			
	2010 TWDB	2020 TWDB	2030 TWDB	2040 TWDB
City of Childress	1,385	1,624	1,658	1686
City of Chillicothe	82	76	74	73
City of Clarendon	314	378	369	361
City of Crowell	185	138	134	132
City of Memphis	50	50	100	100
Childress County-Other	178	184	189	194
Donley County-Other	33	33	33	33
Foard County-Other	42	42	42	42
Hall County-Other	92	92	92	92
Hardeman County-Other	128	128	128	128
Hardeman County Manufacturing	234	276	294	313
City of Quanah	390	397	391	388
Wilbarger County-Other	16	15	14	14
Irrigation - Donley Co. Golf Course	30	30	30	31
Total	**3,159**	**3,463**	**3,548**	**3,588**

Table 3 (continued) – Per Capita Water Use for GMIWA's Customers

	Demand (GPCD)			
	2010	2020	2030	2040
City of Childress	202	230	226	223
City of Chillicothe	103	93	88	86
City of Clarendon	138	162	158	154
City of Crowell	174	125	120	118
City of Memphis	157	148	143	144
Childress County-Other	189	188	187	187
Donley County-Other	145	145	145	144
Foard County-Other	139	139	139	139
Hall County-Other	168	168	168	168
Hardeman County-Other	210	210	210	210
Hardeman County Manufacturing				
City of Quanah	132	130	125	123
Wilbarger County-Other	152	142	137	137
Irrigation - Donley Co. Golf Course				
Average	**164**	**175**	**175**	**175**

The total demands on the GMIWA are estimated at 3,588 acre-feet per year in 2040. This is consistent with recent historical water use by the Authority. The need for additional water supplies is the result of declining surface water supplies in Lake Greenbelt.

Historical maximum day demands range from 1.5 to 2 times the average day demand. In 2011, the maximum day demand was 5.77 million gallons. Assuming a peaking factor of 2, the expected maximum day demands would be 6.4 MGD by 2040.

In response to the on-going drought the GMIWA has redeveloped groundwater supplies from wells in the City of Clarendon. This supply is interim gap measure to assist with the demands during drought. These wells provide approximately 1,800 acre-feet per year are not considered a long-term strategy for the Authority.

The 2011 study on the reliable supply of Lake Greenbelt shows under continued drought conditions the reservoir can support a demand of 3,850 acre-feet per year and maintain reservoir storage at about 5,000 acre-feet. Greater demands on the reservoir result in continued declining water levels. Since the 2011 study was completed, the reservoir water levels have continued to decline. Current storage in the

reservoir (based on 2011 capacity) is estimated at about 3,500 acre-feet. Based on these analyses and current storage, the reliable supply for Lake Greenbelt is estimated at 3,850 acre-feet per year. A comparison of supply and demand is shown in Table 4.

Table 4 – Comparison of Supply and Demands for GMIWA

	Acre-Feet per Year			
	2010	**2020**	**2030**	**2040**
Supply Lake Greenbelt	3,850	3,850	3,850	3,850
Demand	3,159	3,463	3,548	3,588
Surplus (Shortage)	691	387	302	262

The supply and demand comparison shows that the Authority has just enough supplies to meet current demands and no reserves should the drought continue and/or become worse. This analysis also does not take into account the decreased water quality associated with very low reservoir levels. Based on declining trend in available supplies from Lake Greenbelt, the GMIWA is seeking additional water supplies to meet its projected water demands.

To meet the regional water plan's projected demands on the Authority and have a reserve supply of about 2,000 acre-feet, it is recommended that GMWIA develop an additional source that could provide up to 2,000 acre-feet per year during drought. This additional supply may not be needed in all years but could supplement supplies during high demand periods.

1.3 ALTERNATIVES

1.3.1 Potential Groundwater Sources

Three potential groundwater sources were considered in this report: the Ogallala aquifer in Donley County, an alluvial aquifer north of Estelline, Texas in Hall County, and springs around the Greenbelt Reservoir.

1.3.1.1 Ogallala Aquifer

The extent of the Ogallala Aquifer in Donley County is shown in Figure 3. The Ogallala is present in the northwestern portion of the County and in much of the southern half. In order to identify the areas with the greatest potential for groundwater supply, LBG-Guyton Associates prepared an estimated saturated thickness map for the Ogallala Aquifer in Donley County (Figure 4). This saturated thickness map was estimated by subtracting current water level data (from the TWDB) from the base of aquifer information, which was determined from analyzing driller reports from the Texas Water Development Board (TWDB) and the Panhandle Groundwater Conservation District.

As can be seen on the saturated thickness map, the two most promising areas of production are located approximately four miles east of Clarendon, and in a large area approximately 9 to 13 miles north-northwest of Greenbelt Reservoir. Although the northern area is farthest from Greenbelt Reservoir and the treatment plant, the larger saturated thickness and reduced competition from current users may make this area more promising for developing relatively larger volumes over longer periods of time. On the other hand, for smaller demands over shorter periods of time, the area east of Clarendon may be more appealing because it is closer to the treatment plant.

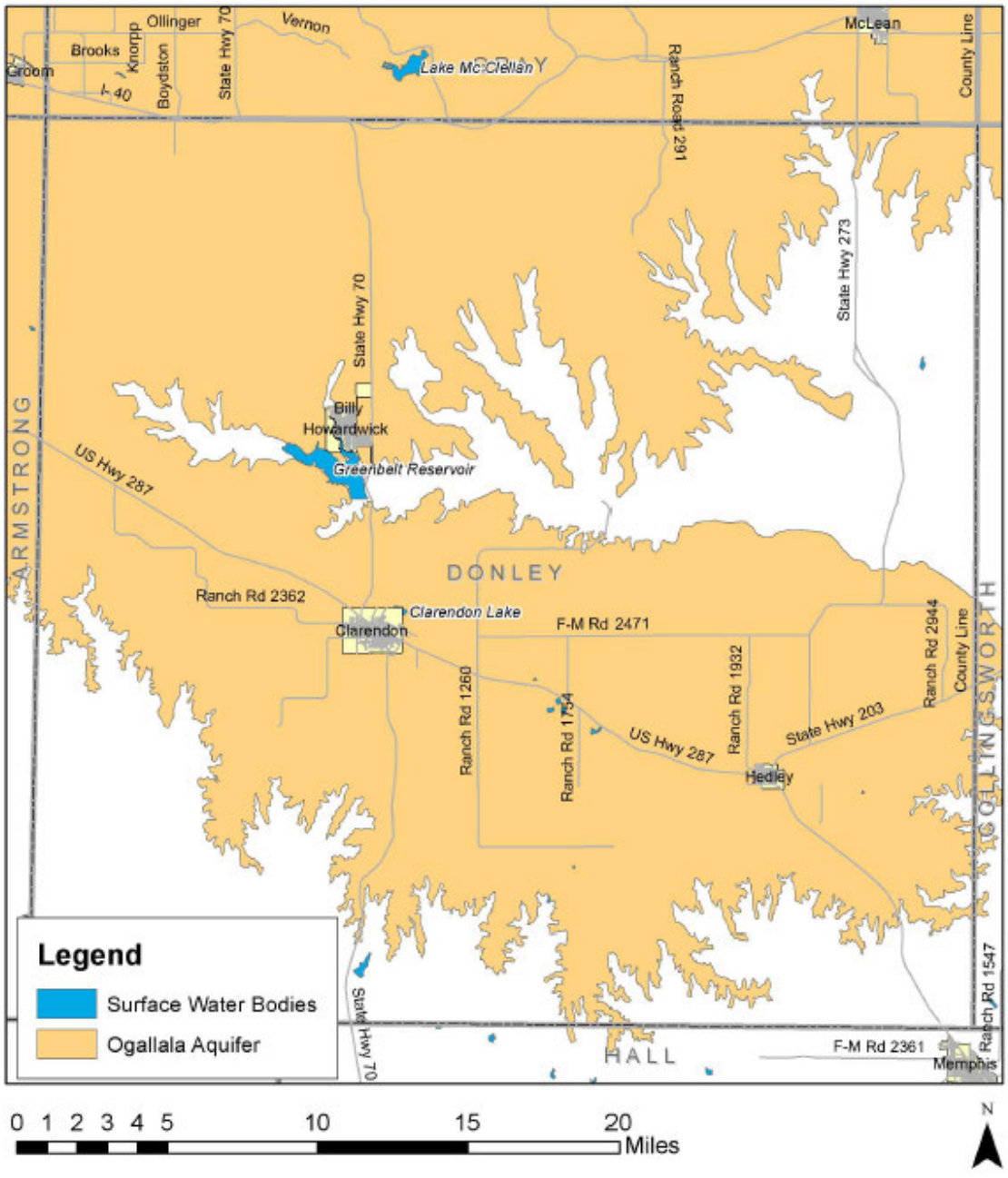
1.3.1.2 Alluvial Sands in Hall County

There are several wells near Estelline, Texas that reportedly produce a significant amount of water for irrigation purposes. The wells were completed for John Chandoin in 1968, and are shown in Figure 5.

The wells are completed in alluvial sands of the Prairie Dog Town Fork of the Red River. These alluvial sands appear to be extensive and are present along the river in much of Hall County.

The depths of the wells range from 12 to 138 feet. Yields are only available for three of the wells, wells #3 (300 gpm), #4 (1,200 gpm), and #6 (250 gpm). Specific capacities are reported to be in the range of 2-3 gpm per foot of drawdown for wells #3 and #6. Water quality data is not available, but wells #3, #4, and #6 are reported as fresh.

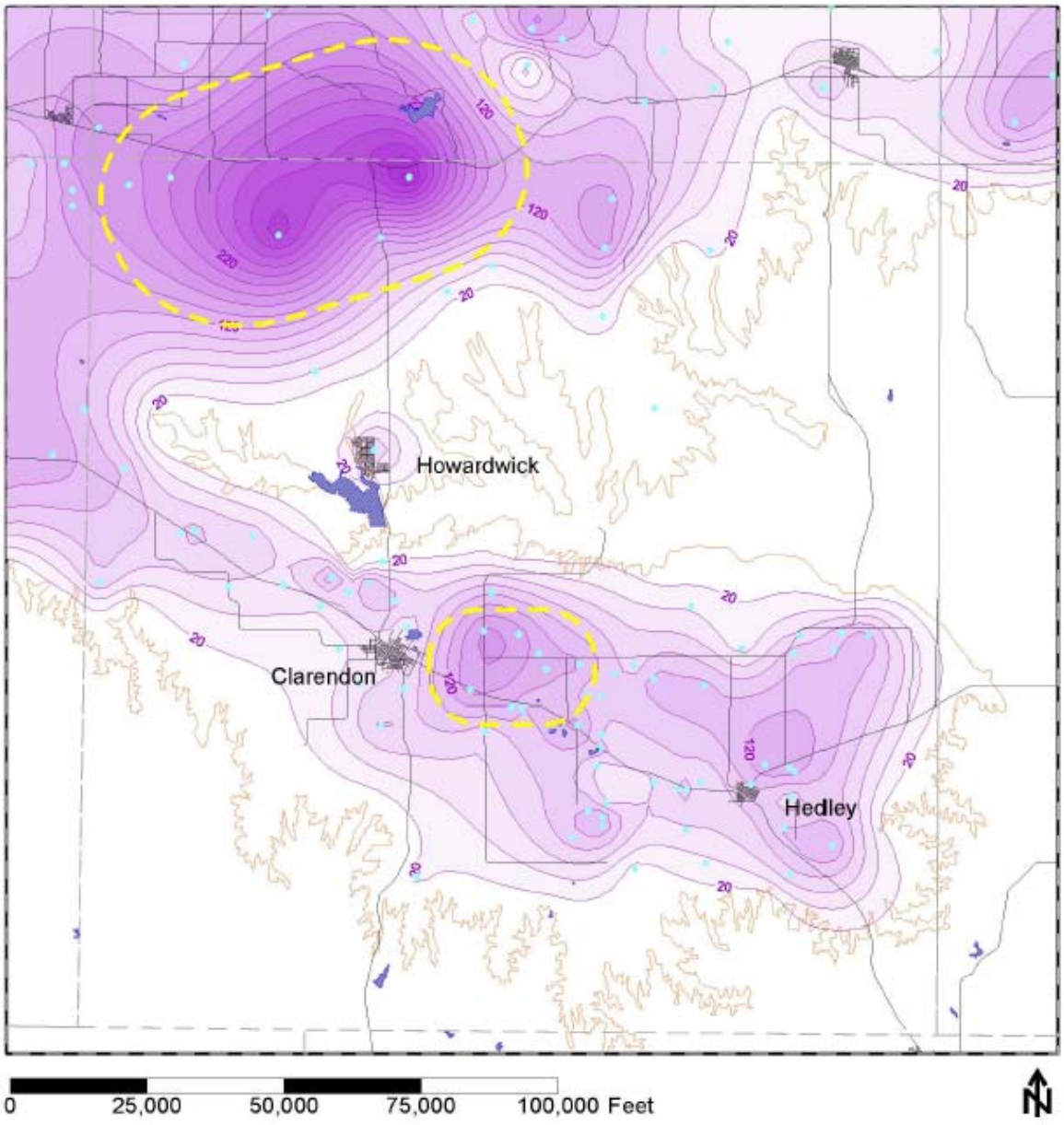
Figure 3 - Extent of Ogallala Aquifer in Donley County, Texas



Extent of Ogallala Aquifer in Donley County, Texas

LBG-GUYTON ASSOCIATES

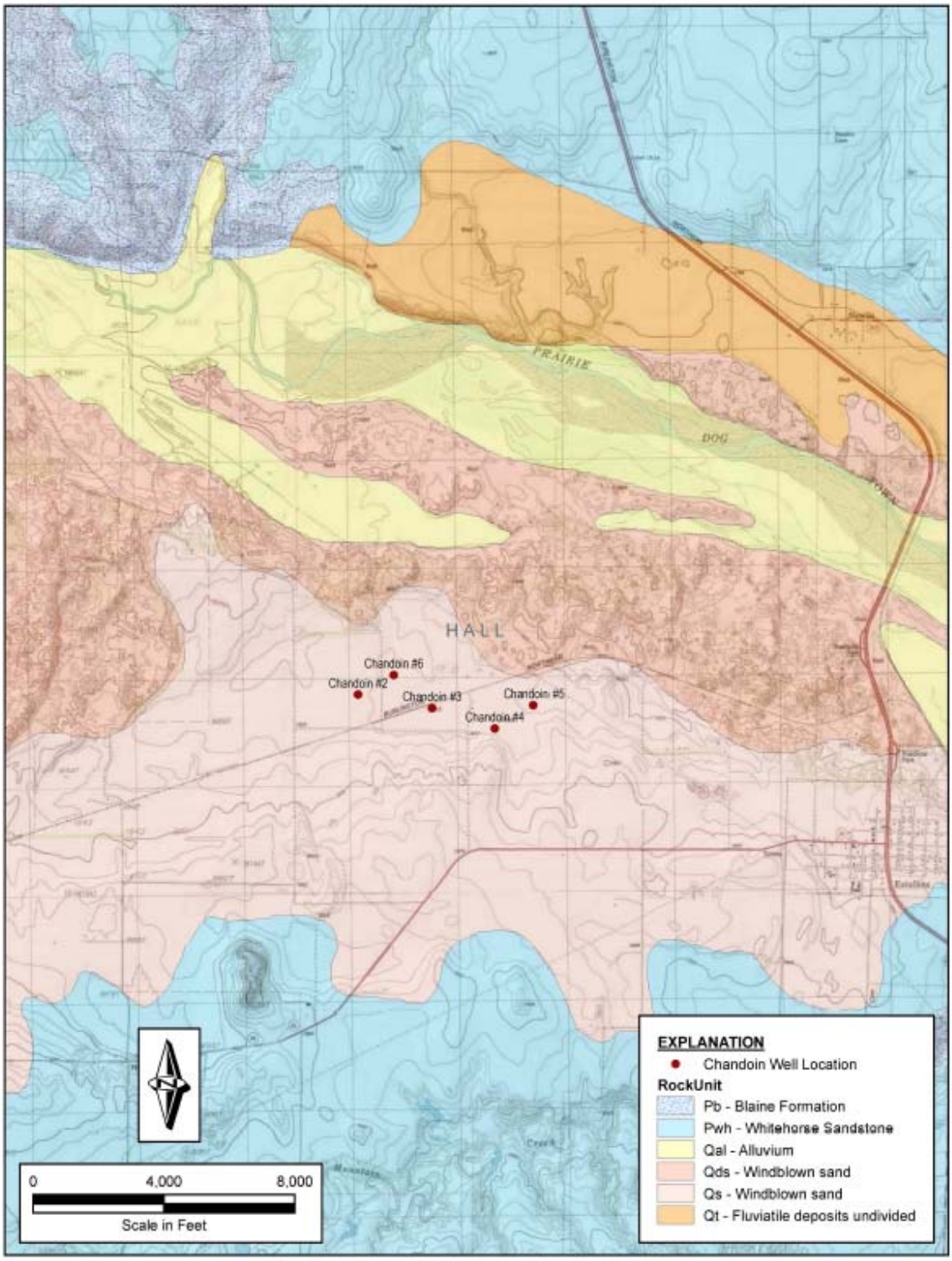
Figure 4 - Ogallala 2010 Estimated Saturated Thickness, Donley County



Ogallala 2010 Estimated Saturated Thickness, Donley County

LBG-GUYTON ASSOCIATES

Figure 5 – Estelline Springs



CHANDOIN WELLS WEST OF ESTELLINE
HALL COUNTY, TEXAS

LBG-GUYTON ASSOCIATES

Water levels in these wells ranged from 17 to 28 feet below land surface in 1968, but no other water level data is available so it is not clear how this alluvial aquifer responds to drought.

The limited data available suggests wells completed in this alluvial aquifer may provide a useful amount of water, although more study and field work would be required to accurately assess the potential of these alluvial sands to meet GMIWA's needs.

The rules of the local groundwater district, the Mesquite GCD, do appear to permit exporting of groundwater.

1.3.1.3 Local Springs

Greenbelt Reservoir is located in a valley along the fringe of the Ogallala Aquifer (see Figure 3). This area has known springs that contribute to the hydrology of Greenbelt Reservoir. These springs may be associated with the Ogallala Aquifer or local alluvium. Based on anecdotal reports from local well drillers and the GMIWA staff, the presence of local groundwater around the reservoir is very localized and the long-term reliability is unknown. Local alluvium groundwater may also be under the influence of the reservoir. While there is little long-term data on this source, local springs may provide interim supplies for the GMIWA.

It is uncertain whether spring flow is regulated by the local GCD or the state (TCEQ). If the spring discharges to a state water course, it would likely be classified as surface water and regulated by the TCEQ. If the spring is contained or accessed prior to surface discharge, it may be regulated by the local GCD.

1.3.2 Proposed Groundwater Alternatives

FNI and LBG-Guyton developed three water management alternatives to supplement the surface water supplies from Greenbelt Reservoir. These alternatives are based on available groundwater in Donley County as discussed above and local supplies identified by GMIWA staff. A brief description of each strategy is presented below.

1.3.2.1 Groundwater from the Ogallala Aquifer in North Donley County to Greenbelt Reservoir (Alternative 1A)

Saturated thickness in the northern Ogallala area ranges from about 100 feet at the edge to about 280 feet near the center. Well depths in the area of greatest saturated thickness would be approximately

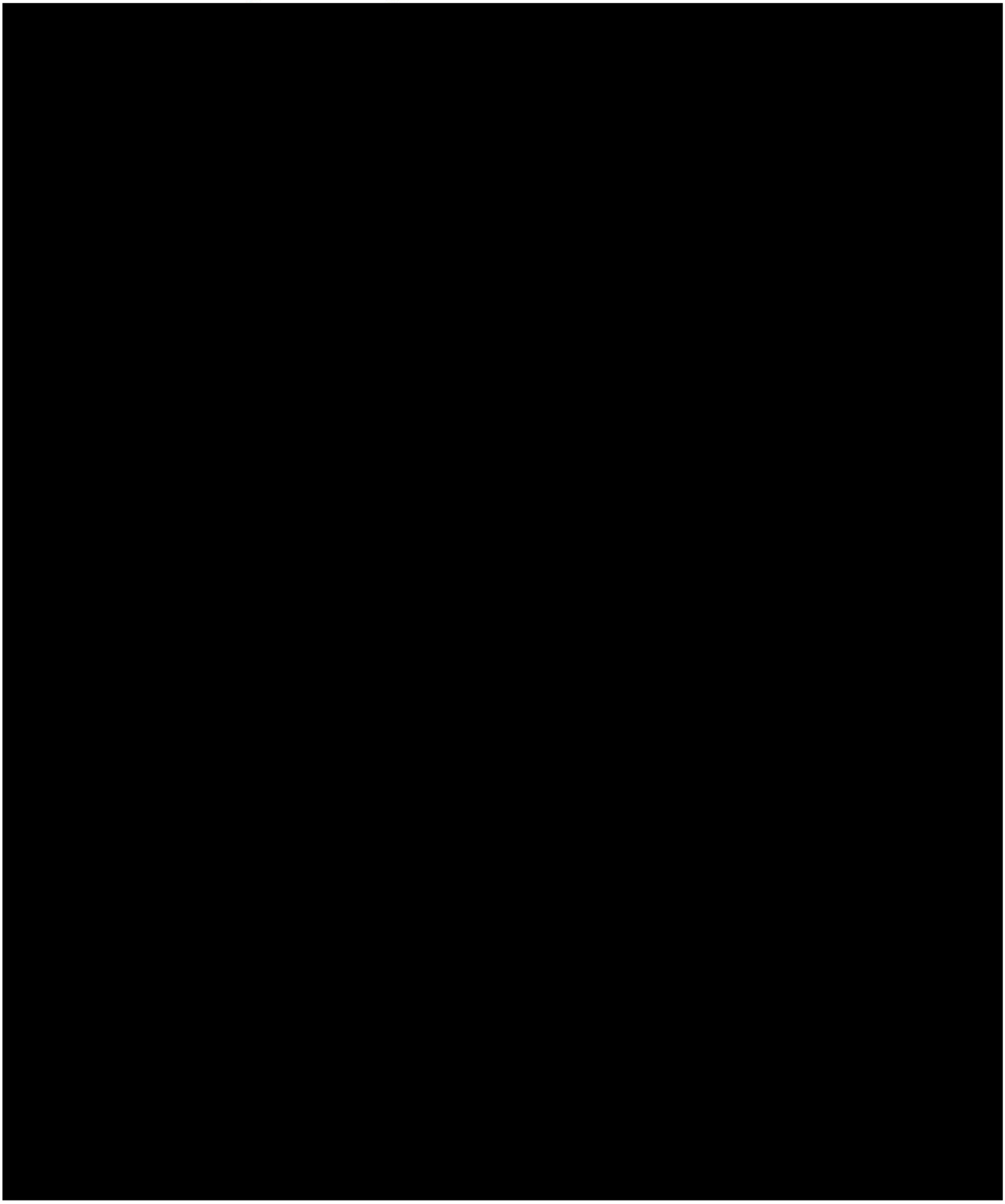
600 feet, with yields in the range of 900 - 1,500 gpm and a specific capacity of approximately 8 gpm per foot of drawdown.

Long-term water levels in this area appear to decline across the region (well hydrographs are included in Appendix A). Based on the hydrograph for well #656603 (see Appendix A), local water levels have been declining at a rate of approximately 1 foot per year since at least the 1970s. This well is located in an irrigated area. Declines in non-irrigated areas most likely will be less.

Considering the projected need for additional water supply, a peak production capacity requirement of 3 MGD could probably be met with two wells in the northern Ogallala area. Per district rules, the wells would need to be spaced at least 2,250 feet apart, and 1,125 feet from the property line.

As shown on Figure 6, the groundwater would be transported by a 16-inch pipe to a tributary of Greenbelt Reservoir (or directly to the lake, if desired). The location of this discharge was selected about six miles upstream of the reservoir. The discharge location should be sufficient to carry the amount of flow to be discharged. This location may need to be adjusted (either upstream or downstream) depending stream characteristics. Due to elevation differences, the groundwater could gravity flow from the well field to the discharge location. The water would then be diverted from Greenbelt Reservoir and treated at the Authority's existing surface water treatment facility. For this strategy, it was assumed that 5 percent of the discharged water would be lost to infiltration and evaporation during transport in the stream.

Figure 6 - North Ogallala to Greenbelt Reservoir Alternative 1A



Permits for groundwater production in this area are issued by the Panhandle Groundwater Conservation District (PGCD). This project would require a multiple well drilling permit and a multiple well production permit. These permit applications involve submission of several types of information such as well location, design details, production capacity, groundwater modeling, intended use, conservation measures, and drought contingency plans. A public meeting would be held regarding a multiple well drilling and production permit application before the permit is approved. If the permit application is approved, an initial permit will be issued based upon 1 acre-foot/acre of land controlled by the permittee.

This strategy would also require a bed and banks permit from the TCEQ to use the bed and banks of the Carrol Creek and Greenbelt Reservoir to transport the water. Other permitting requirements will likely include a Section 404 permit for the discharge structure (and possibly the pipeline), and an accounting plan for Greenbelt Reservoir to document withdrawals by source.

Long term groundwater projects in PGCD are subject to review to ascertain their compliance with various management strategies listed under Rule 15.1 of the GCD rules. These include:

- The 50/50 Standard, which ensures that at least 50% of the current saturated thickness remains after 50 years from 2010 or in 2060.
- Management Sub-Area Production Floor Rates, which define annual floor rates of production assuming all sections of the sub-area are producing, and
- Acceptable Annual Decline Rates presently established as 1.25% of the saturated thickness of the aquifer.

The GCD evaluates compliance with Rule 15 annually based on water level measurements in their monitoring well network. If excessive annual decline is observed, the area could be designated a Study Area. If after two years as a Study Area, excessive decline is still observed, the area could be designated a Conservation Area, at which time production permits could potentially be reduced at a rate of 0.1 ac-ft/ac every 2 years, and re-evaluated on the same schedule.

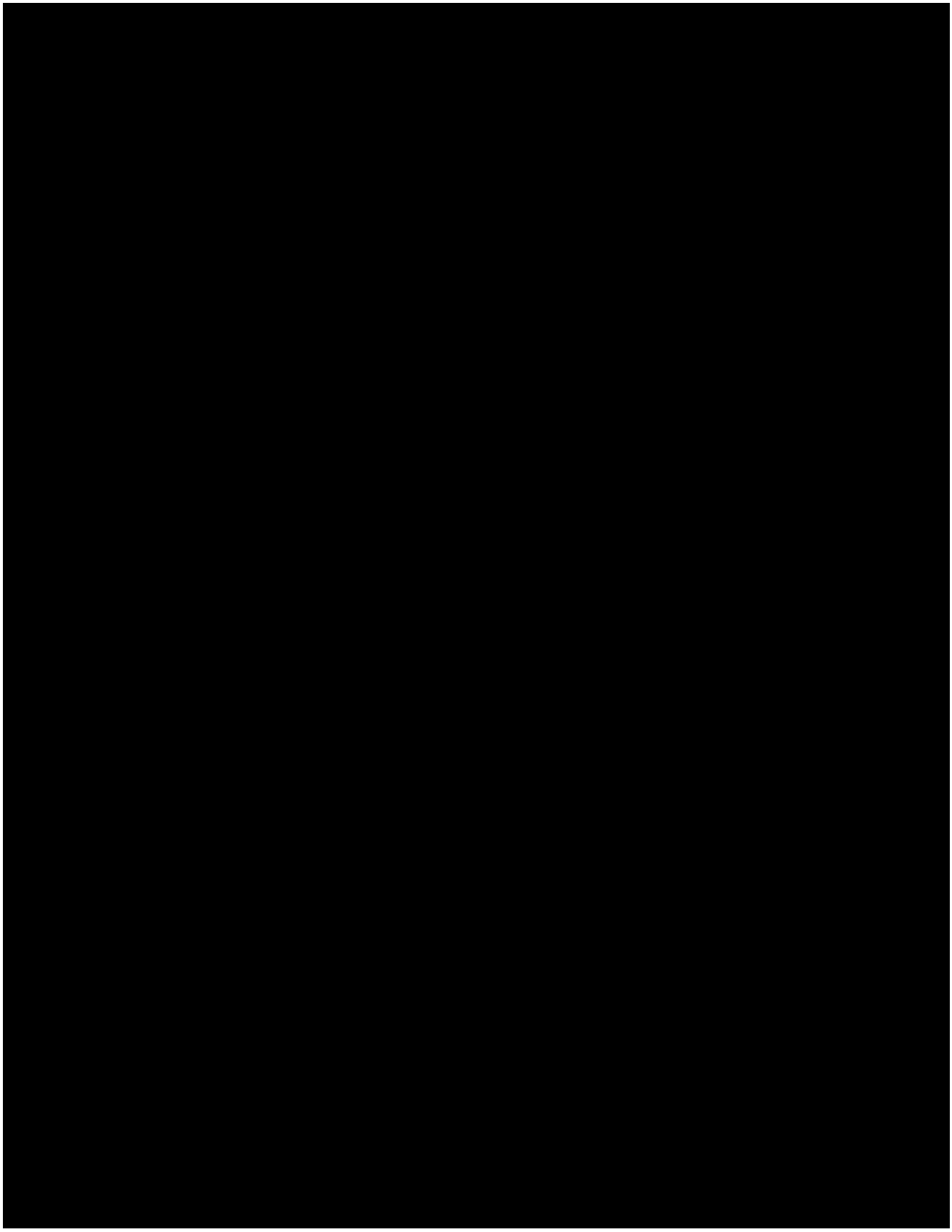
Under the initial permit conditions, a permit for 2,000 acre-feet per year (ac-ft/yr) of groundwater would require that the GMIWA control the groundwater rights for 2,000 acres of land (either through lease or purchase). Producing 2,000 ac-ft/yr for a 50-year period would equate to 100,000 acre-feet of total production. To adhere to the 50/50 standard, more acreage would be required over time or

average production would have to be curtailed. In the northern area, which has an average saturated thickness of about 190 feet, the GMIWA would need to obtain about 5,260 acres of groundwater rights to adhere to the 50/50 standard if 2,000 ac-ft/yr was produced each year. If the average annual production is less, the total acreage required would also be less. This calculation assumes that no groundwater will flow laterally into or out of the controlled acreage because the water level in adjacent properties will decline at a similar rate. A specific yield value of 0.2 was also assumed and is based on the value used in the TWDB Northern Ogallala GAM.

1.3.2.2 Groundwater from the Ogallala Aquifer in North Donley County to Greenbelt Water Treatment Plant (Alternative 1B)

As shown on Figure 7, the groundwater would be transported by a 16-inch pipeline approximately 13 miles to the Greenbelt Water Treatment Plant site. This would include a pump station and ground storage tank and associated electrical and instrumentation. This would be in-lieu of sending the groundwater to the existing Greenbelt Reservoir. This is the recommended alternative for providing additional groundwater to GMIWA.

Figure 7 - North Ogallala to Greenbelt Water Treatment Plant Alternative 1B



1.3.2.3 Groundwater from the Ogallala Aquifer, East of Clarendon (Alternative 2)

Saturated thickness in the eastern area is in an estimated range of 100 - 160 feet. Well depths in this area would probably average about 250 feet. A new well in this eastern area would likely produce in the range of 400 - 1,000 gpm, and have a specific capacity of 6 - 9 gpm per foot of drawdown.

A peak production capacity requirement of 3 MGD could probably be met with three wells in the eastern Ogallala area. Per district rules, the wells would need to be spaced at least 1,500 feet apart, and 750 feet from the property line.

The groundwater would be transported directly to the GMIWA's water treatment plant, where it would be disinfected and blended with treated surface water (Figure 8). To transport this water, approximately 6.5 miles of 16-inch pipeline and a new 150-HP pump station would be required.

Water levels in the Clarendon area appear to have stabilized or are declining at a lower rate (see hydrograph for well #1201501 in Appendix A). Areas that are designated as "Study Areas" by the PGCD are shown in Appendix B and may be subject to more stringent pumping limitations based on ongoing monitoring of water levels in these areas. If excessive declines are documented for two years in a Study Area, the area may then be designated as a "Conservation Area", and more restrictive pumping limitations imposed. The area east of Clarendon is currently designated as a study area.

Permit requirements for the Eastern Ogallala area are the same as in the case of the northern Ogallala area. Under the initial permit conditions, a permit for 2,000 ac-ft/yr of groundwater would require that Greenbelt control the groundwater rights for 2,000 acres of land. To adhere to the 50/50 standard, more acreage would be required. In the Eastern Ogallala area, which has an average saturated thickness of about 130 feet, the GMIWA would need to obtain the groundwater rights for about 10,260 acres to adhere to the 50/50 standard with an average annual production of 2,000 ac-ft/yr. As with the northern Ogallala area, this acreage would be less if the average annual production is less. This estimate assumes a specific yield value of 0.15 based on the TWDB Northern Ogallala GAM. The acreage requirement for the Eastern Ogallala area is significantly higher than the Northern Ogallala area because the saturated thickness and specific yield values are smaller.

1.3.2.4 Water from Gravel Pit Impoundment, East of Greenbelt Dam (Alternative 3)

Directly east of the Greenbelt Reservoir dam is a gravel operations as shown on Figure 9. These operations have created a relatively large excavation that appears to fill with local groundwater and possibly spring flow. The owner of the gravel operations has offered to sell this water to the GMIWA.

The water has been tested for quality parameters by the GMIWA and the quality is good. The site also has had limited pumping tests conducted. Anecdotal reports indicate that this water source could produce over 1500 gpm (Appendix A).

There is no long-term history of using this water and its response during drought. Long-term pumping tests should be initiated prior to use. However, the proximity to the Authority's existing water supply makes this a possible attractive interim supply.

The water in the gravel pit excavation does not appear to be under the influence of surface water and could possibly be classified as groundwater. It is uncertain as to whether the PGCD rules would apply to pumping of this water. Since it is proposed as a purchase of water from the existing owner, any permits required by regulatory agencies would be the responsibility of the owner.

This strategy proposes to pump water from the gravel pit impoundment to the GMIWA's existing raw water pipeline for transport to the water treatment plant. The project is sized for a maximum capacity of 2.5 MGD, and would require approximately 2 miles of 16-inch pipeline and 120-HP pump station.

Figure 8 - East Ogallala Alternative

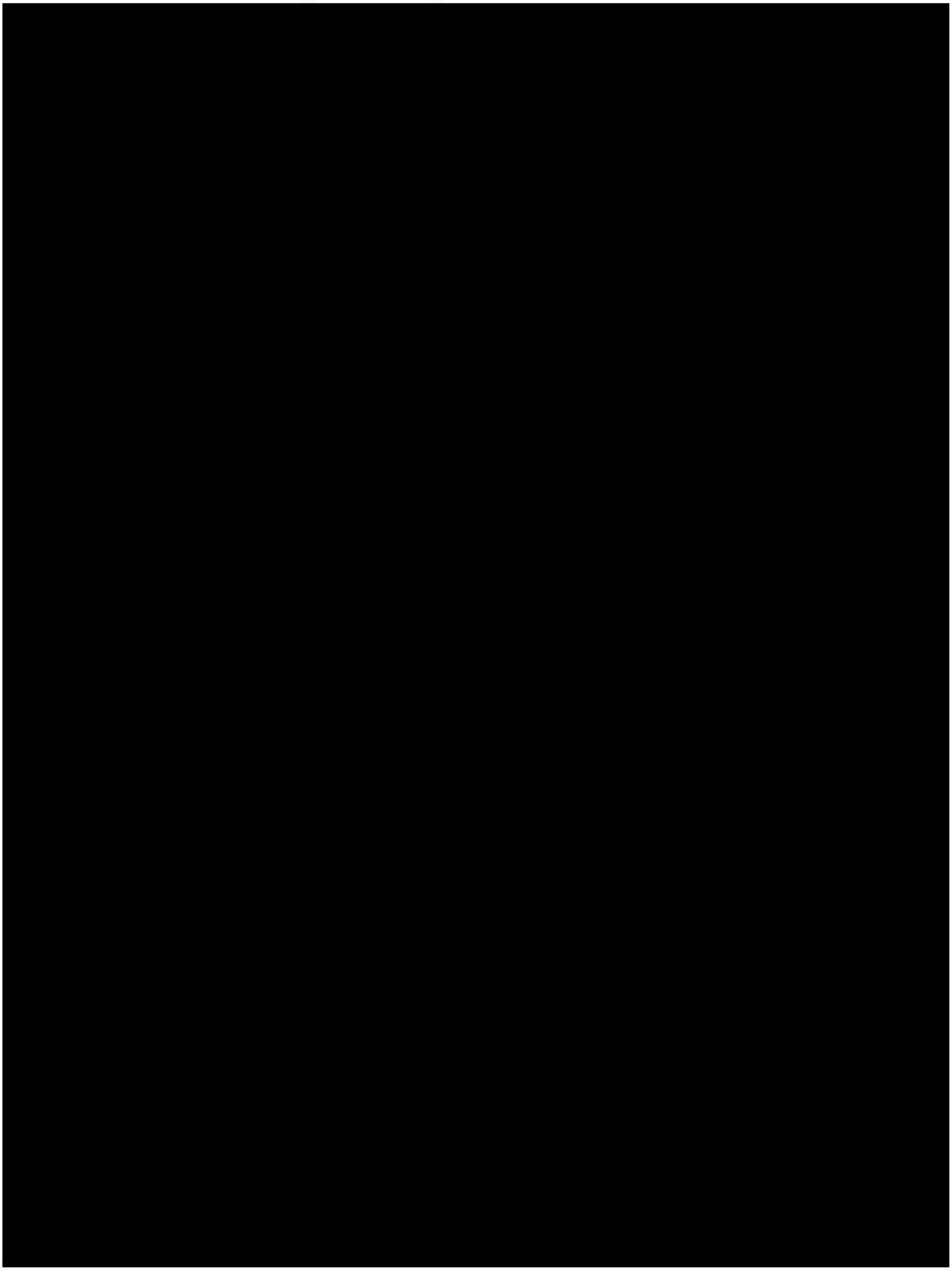
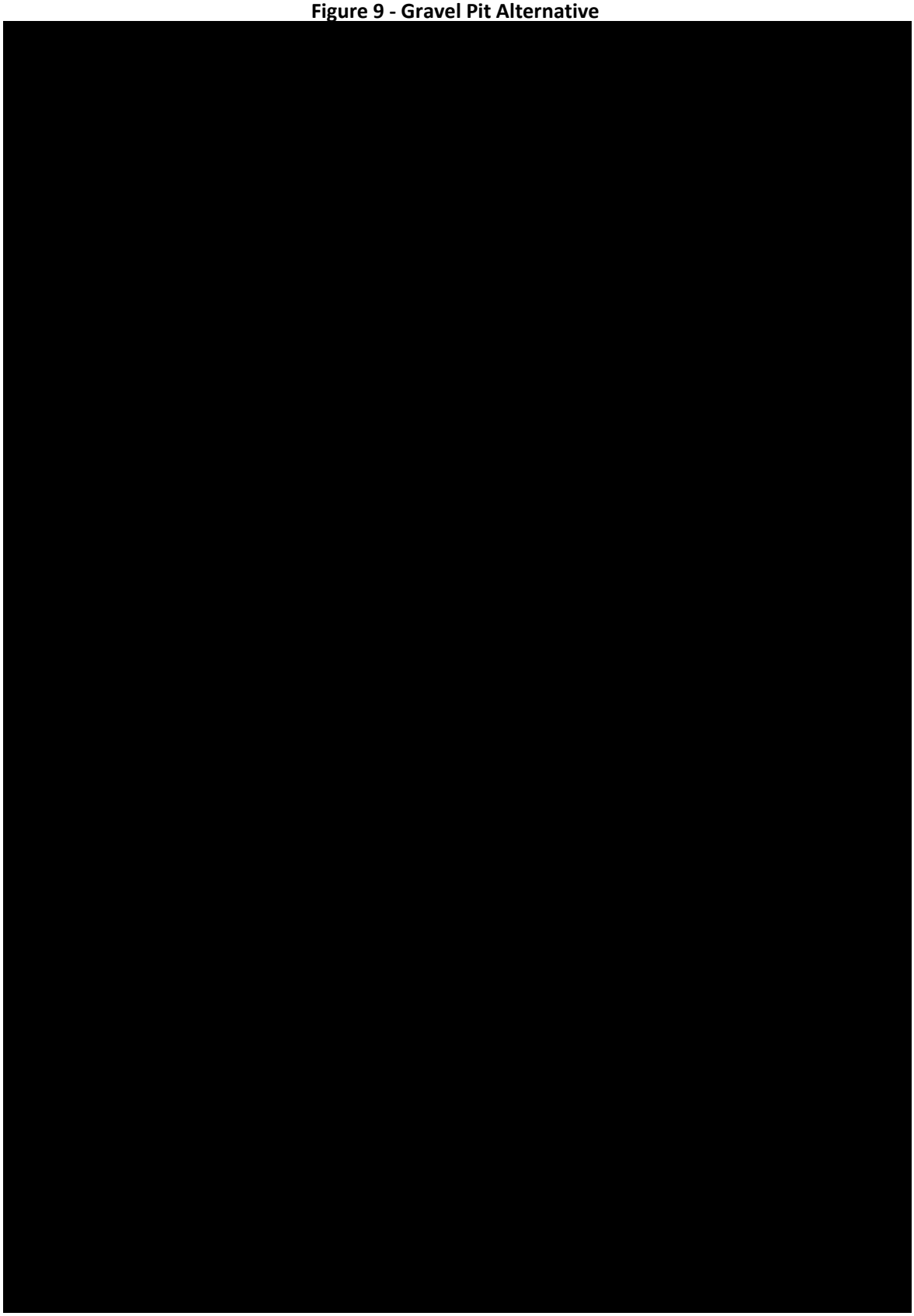


Figure 9 - Gravel Pit Alternative



1.3.3 Cost Development

Costs for the projects' infrastructures were generally developed using unit costs developed for regional water planning. These costs may be high for rural west Texas and will need to be refined during design. Groundwater rights were assumed to be purchased initially for the minimum acreage required by the PGCD or to provide water for a minimum of 20 years. The costs for groundwater rights, electric service connection and other well field infrastructure are highly variable and dependent upon the well field location. These costs are included in the cost estimates, but could vary considerably.

An approximate cost for wells completed in the northern Ogallala area is based on a 1,200 gpm well at a depth of 600 feet, complete with pumping equipment and testing. Costs for wells completed to non-public water supply (PWS) standards are about 30% less than a PWS well. A PWS well would be used if the intention is to use the groundwater production directly, but a non-PWS well would be less expensive option if the intention is to transport the produced groundwater through the reservoir. For the north Ogallala area (Alt 1A) strategy, a non-PWS well cost was used. For the eastern Ogallala area estimated well costs are based on a 700 gpm PWS well at a depth of 250 feet, complete with pumping equipment and testing.

Both capital and annual costs were developed for each potential water supply strategy. Detailed cost tables are included in Appendix C. A summary of the costs is presented in Table 2.

Table 5 - Cost Summary

Strategy	Capacity (MGD)	Capital Cost	Annual Cost With Debt ($/1,000 gal)	Annual Cost After Debt ($/1,000 gal)
North Ogallala (Alt. 1A)	3.0	$5,500,000	$1.03	$0.26
North Ogallala (Alt. 1B)	**3.0**	**$10,000,000**	**$1.65**	**$0.33**
East Ogallala (Alt. 2)	3.0	$7,600,000	$1.22	$0.22
Gravel Pit (Alt. 3)	2.5	$2,500,000	$0.86	$0.46

1.3.4 Recommended Groundwater Alternative

The recommended groundwater alternative is Alternative 1B, which includes the development of a well field in the North Ogallala Aquifer and a 16-inch pipeline to the GMIWA Water Treatment Plant. This alternative was selected because Alternative 1B allows the GMIWA to reduce treatment requirements if the groundwater is taken directly to the treatment plant, and there are additional permitting requirements (bed and banks) and potential concerns with losses from stream infiltration and evaporation associated with Alternative 1A. Alternative 1B provides a reliable backup for GMIWA and can be implemented in a timely manner.

1.4 NEW SOURCES

1.4.1 Ogallala Aquifer

Saturated thickness in the northern Ogallala area ranges from about 100 feet at the edge to about 280 feet near the center. Well depths in the area of greatest saturated thickness would be approximately 600 feet, with yields in the range of 900 - 1,500 gpm and a specific capacity of approximately 8 gpm per foot of drawdown.

Long-term water levels in this area appear to decline across the region (well hydrographs are included in Appendix A). Based on the hydrograph for well #656603 (see Appendix A), local water levels have been declining at a rate of approximately 1 foot per year since at least the 1970s. This well is located in an irrigated area. Declines in non-irrigated areas most likely will be less.

Considering the projected need for additional water supply, a peak production capacity requirement of 3 MGD could probably be met with two wells in the northern Ogallala area. To provide backup capacity, any additional well is proposed for a total of three wells. Per district rules, the wells would need to be spaced at least 2,250 feet apart, and 1,125 feet from the property line.

The water quality of the North Ogallala is very comparable to the existing treated surface water supply and blending the two water sources should not be an issue. This strategy allows the GMIWA to continue its current operations with supplementing the reservoir supply with groundwater.

1.5 SITE

1.5.1 Existing Infrastructure Conflicts

The recommended supplement water supply is Alternative 1B, which is shown in Figure 7 above. The pipeline will be routed parallel to County Road 70. The pipeline will be crossing an abandoned railroad track, existing GMIWA raw water pump station, existing raw water pipeline and at least two creek crossings. More detailed information will be provided during the preliminary design phase.

1.5.2 Floodplain and Easements

The pipeline route will run along the County Road, Farm-to-Market road easements, which have already been agreed upon between GMIWA and County Officials. Additional easement information will be generated during the design. There may be a potential easement due to the abandoned railroad track which originally crossed County Road 70.

1.6 TREATMENT

One of the characteristics of groundwater is the limited exposure to pathogens and organic material. Typically, groundwater supplies won't require treatment unless there are known pollutants exceeding the drinking water quality standards. The ground water supply form the Ogallala aquifer has a good water quality. The proposed Water Supply Project will mix the groundwater with surface water at the filter water channel at the Water Treatment Plant to continue the conventional treatment process. The blended supply after it is filtered is disinfected prior to distribution. During the groundwater production study, water quality samples will be collected. Figure 10 below illustrates the layout of how the new groundwater supply will be introduced into the GMIWA's water treatment plant.

1.7 DESIGN DATA

The well field will consist of three wells with downhole pumps, each rated at 1,200 gpm. The three well field pumps will pump water to 0.5-MG ground storage tank. The water will then travel by gravity through a 16-inch pipeline along County Road 70 and will discharge to the existing filter channel at the Water Treatment Plant. This new groundwater source will be used 100% of the time until the surface water reservoir levels get above the water conservation levels.

Design Data	
Design Flow	3.0-MGD
Well Field Storage Tank Capacity	0.5-MG
Length of 16-Inch Pipeline	12-Miles
Approximate Design Pressure	120-psi

The approximate elevation of the groundwater storage tank is elevation 3220 feet msl and the water treatment plant is located at elevation 2780 feet msl. This is a difference in elevation of 440-feet. The pipeline will be designed to account for surge and also it will have orifice plates in addition to a flow control valve to help maintain adequate pressure once the water reaches the water treatment plant. This information will be finalized during the design phase of the project.

1.8 ADEQUACY

This project is not modifying the existing distribution treated water distribution system, we are only adding an additional groundwater supply to supplement the Greenbelt Lake Surface Water Supply.

1.9 OPERATIONS AND MAINTENANCE

GMIWA will need to operate and maintain a pump station at the well field, a new pipeline and two new ground storage tanks. The additional annual costs associated with this project are provided in Table 6:

Table 6 - Cost Summary

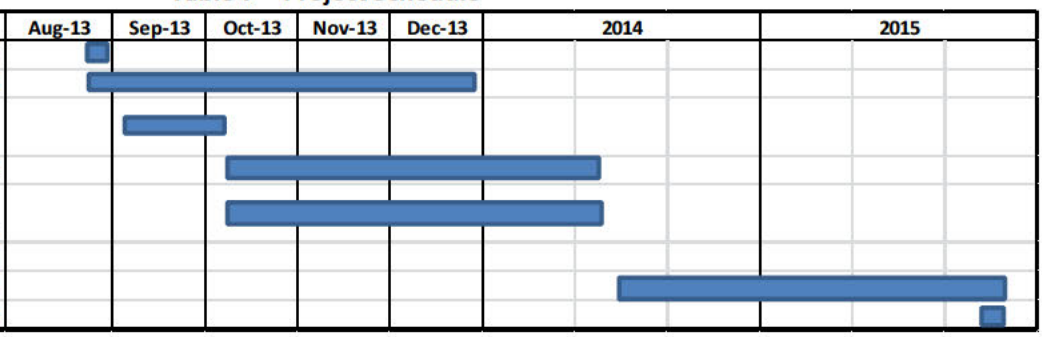
Annual Cost Items	Cost
Debt Service (6% for 30 years)	$726,000
Electricity ($0.09 kWh)	$92,844
Operation and Maintenance	$85,400
Total Annual Cost =	**$904,244**

1.10 SCHEDULE

The schedule for the entire project, from loan closing to end of construction is shown in Table 7

Table 7 – Project Schedule

Task	Date
Loan Application	8/31/2013
Loan Review and Closing	12/31/2013
DBE Advertising for Engineering Design Services	9/1/2013
Begin Design Engineering	10/1/2013
Environmental Information Document/Design End Date	6/30/2014
Advertising and Bid	7/31/2014
Construction Start Date	8/25/2014
Construction End Date	8/20/2015



1.11 PERMITS APPROVALS, AND CONTRACTS

The water authority is in the process of securing the North Ogallala water rights. A letter of intent of the purchase is provided as an attachment. In regards to other permits necessary for this project, a brief description of each permit is provided below.

Storm water discharges from construction activities would be authorized by a Texas Pollutant Discharge Elimination System (TPDES) General Permit for Construction Activity (Permit No. TXR150000) and the implementation of a Storm Water Pollution Prevention Plan (SW3P) as required by the Texas Commission on Environmental Quality (TCEQ). A Notice of Intent must also be submitted by the construction site operator to the operator (City, County, etc.) of the storm sewer system that receives

storm water runoff from the construction site. Once the construction site has reached final stabilization, a Notice of Termination should be submitted.

Construction of the pipeline across waters of the U.S. would require a U.S. Army Corps of Engineers (USACE) Section 404 permit. The construction may be authorized by Nationwide Permit (NWP) #12 for Utility Line Activities provided conditions in the permit are followed during construction. A General Land Office (GLO) easement would be required if construction associated with the project occurs on any state-owned riverbeds, which are determined on a case- by-case basis by GLO. A TPWD Marl, Sand, Gravel, Shell or Mudshell Permit would also be required for disturbance to a state stream bed.

The Antiquities Code of Texas requires that the Texas Historical Commission (THC) staff review any action that has the potential to disturb historic and archeological sites on public land. An Antiquities Permit would be required from the THC prior to an archeological field survey. Compliance with the National Historic Preservation Act is also required as a condition of a USACE Section 404 permit. No activity that may affect historic properties listed or eligible for listing in the National Register of Historic Places can be authorized until the USACE District Engineer has complied with the provisions of 33 CFR part 325, Appendix C.

Potential impacts to Threatened and Endangered Species or designated critical habitat will be evaluated during preparation of the Environmental Information Document (EID), which will be reviewed by the Texas Parks and Wildlife Division (TPWD) and the U.S. Fish and Wildlife Service (USFWS). Any activity which may affect or jeopardize the continued existence of a federally-listed threatened or endangered species or destroy or adversely modify a critical habitat requires a formal consultation process with the USFWS.

The proposed 16-inch pipeline will also cross an abandoned railroad tracks, which would require coordination with the Texas Railroad Commission in determining which entity currently owns the right of way in that area.

1.12 PROJECT BUDGET

The current estimated cost and allocation of costs to each project element including engineering, legal and other fees is shown in the attached TWDB-1201 Budget Form.

2.0 COST OF THE PROJECT

2.1 COST DEVELOPMENT

Costs for the projects' infrastructures were generally developed using unit costs developed for regional water planning. These costs may be high for rural west Texas and will need to be refined during design. Groundwater rights were assumed to be purchased initially for the minimum acreage required by the PGCD or to provide water for a minimum of 20 years. The costs for groundwater rights, electric service connection and other well field infrastructure are highly variable and dependent upon the well field location. These costs are included in the cost estimates, but could vary considerably.

An approximate cost for wells completed in the northern Ogallala area is based on a 1,200 gpm well at a depth of 600 feet, complete with pumping equipment and testing. Costs for wells completed to non-public water supply (PWS) standards are about 30% less than a PWS well. A PWS well would be used if the intention is to use the groundwater production directly, but a non-PWS well would be less expensive option if the intention is to transport the produced groundwater through the reservoir. For the north Ogallala area strategy, a non-PWS well cost was used. For the eastern Ogallala area estimated well costs are based on a 700 gpm PWS well at a depth of 250 feet, complete with pumping equipment and testing.

Both capital and annual costs were developed for each potential water supply strategy. Detailed cost tables are included in Appendix A.

APPENDIX B

Pages from 2021 Panhandle Water Plan – References to GMIWA – November 2020

2021 PANHANDLE WATER PLAN

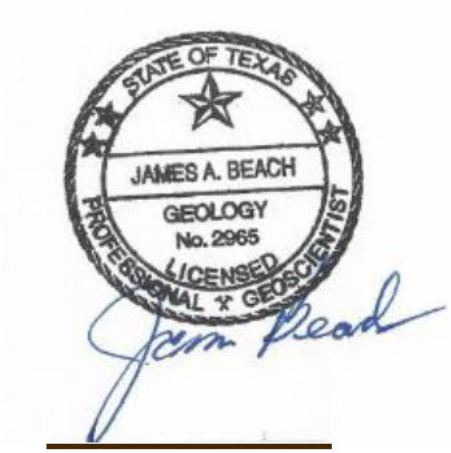
2021 PANHANDLE WATER PLAN

NOVEMBER 2020

Prepared for:

PANHANDLE WATER PLANNING GROUP

FREESE AND NICHOLS, INC.
TEXAS REGISTERED
ENGINEERING FIRM
F-2144



James Beach, P.G.
WSP U.S.A., Inc

Steve Amosson, PhD
Texas A&M AgriLife

Prepared by:

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WSP USA, INC.

TEXAS A&M AGRILIFE RESEARCH AND EXTENSION CENTER AT AMARILLO

Preface

In 1997, the 75th Texas Legislature passed Senate Bill One, legislation designed to address Texas water issues. Senate Bill One put in place a grass-roots regional process to plan for the future water needs of all Texans. To implement this process, the Texas Water Development Board created 16 regional water planning groups across the state and established regulations governing regional planning efforts. This plan presents the results of this process for the Panhandle Water Planning Area that represents 21 counties in the Texas Panhandle.

In accordance with the State planning guidelines, the regional water plan includes eleven specific chapters. In addition to the eleven required sections, this report also includes appendices providing more detailed information on the planning efforts. The elements contained in this plan meet Texas Water Development Board regional planning requirements and guidelines.

2021 Panhandle Water Plan Chapters

1. Planning Area Description
2. Current and Projected Population and Water Demand
3. Evaluation of Regional Water Supplies
4. Identification of Water Needs
5. Water Management Strategies
6. Impacts of the Regional Water Plan
7. Drought Response Information, Activities and Recommendations
8. Regulatory, Administrative and Legislative Recommendations
9. Water Infrastructure Funding Recommendations
10. Plan Adoption and Public Participation
11. Implementation and Comparison to Previous Regional Water Plan

The *2021 Panhandle Water Plan* represents the culmination of five years of working together with the PWPG, regional and local water providers, and the public. As you read this water plan, the PWPG would like you to keep in mind the following points:

- The *2021 Panhandle Water Plan* presents a comprehensive overview of the water supply issues in the region. It does not predict or forecast future water droughts or floods.
- This plan is a living document that will change as new data become available that better represent the demands on our water resources, available supplies from these resources, and the water supply projects that are being pursued.
- The report presents planning level analyses of the recommended water management strategies. Additional engineering studies and design will be needed prior to the implementation of the strategies.
- The specific surpluses and needs shown in the plan should be treated with caution because their development requires certain assumptions that may or may not come to fruition.
- The PWPG has no authority to regulate water supplies or implement water management strategies. The identified water management strategies are assumed to be implemented by the respective water user.

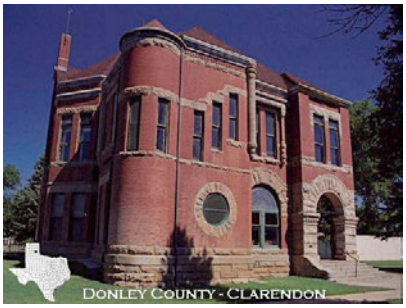
ATTACHMENT ES-1

RECOMMENDED AND ALTERNATE WATER MANAGEMENT STRATEGIES FOR PWPA

Summary of Recommended Water Management Strategies in the PWPA

Entity	County Used	Expected Online	Capital Cost	First Decade Unit Cost ($/af/y)	Total Supply 2020	2030	2040	2050	2060	2070	Last Decade Unit Cost ($/af/y)
Advanced Metering Infrastructure											
Amarillo	Potter/Randall	2020	$31,000,000	$1,062	1,485	1,655	1,831	2,008	2,198	2,398	$0
Aquifer Storage and Recovery											
Amarillo	Potter/Randall	2030	$11,472,000	$260	0	5,000	6,500	6,500	6,500	6,500	$419
CRMWA	Multiple	2030	$27,815,000	$355	0	12,000	11,500	11,500	11,500	11,500	$159
Pampa	Gray	2030	$2,183,000	$340	0	0	500	500	500	500	$32
Brush Control											
CRMWA	Multiple	2020	N/A	$60	2,500	2,500	2,500	2,500	2,500	2,500	$60
Develop Dockum/Ogallala Aquifer Supplies											
Canyon	Randall	2030	$9,565,000	$270	0	1,500	1,500	1,500	3,000	3,000	$354
Moore County Manufacturing	Moore	2050	$3,620,000	$145	0	0	0	3,000	3,000	3,000	$60
Develop Ogallala Aquifer in Donley County											
Greenbelt MIWA	Multiple	2030	$17,879,000	$743	0	2,000	2,000	2,000	2,000	2,000	$114
Develop Ogallala Aquifer Supplies											
Booker	Lipscomb/ Ochiltree	2040	$1,796,000	$1,268	0	0	400	400	400	400	$953
Cactus	Randall	2020	$16,598,000	$363	5,000	5,000	5,000	5,000	5,000	5,000	$129
Da hart	Hartley/Dallam	2020	$7,279,000	$507	3,140	3,140	3,140	3,140	3,140	3,140	$113
Dumas	Moore	2030	$5,560,000	$134	0	5,000	5,000	5,000	5,000	5,000	$56
Gruver	Hansford	2030	$891,000	$286	0	280	280	280	280	280	$61
McLean	Gray	2030	$414,000	$213	0	150	150	150	150	150	$20
Memphis	Hall	2020	$1,128,000	$1,107	0	150	150	150	150	150	$580
Pampa	Gray	2040	$4,091,000	$354	0	0	1,100	1,100	1,100	1,100	$92
Panhandle	Carson	2030	$1,814,000	$390	0	600	600	600	600	600	$177
Perryton	Ochiltree	2050	$9,097,000	$955	0	0	0	820	820	820	$174

DONLEY COUNTY SUMMARY PAGE



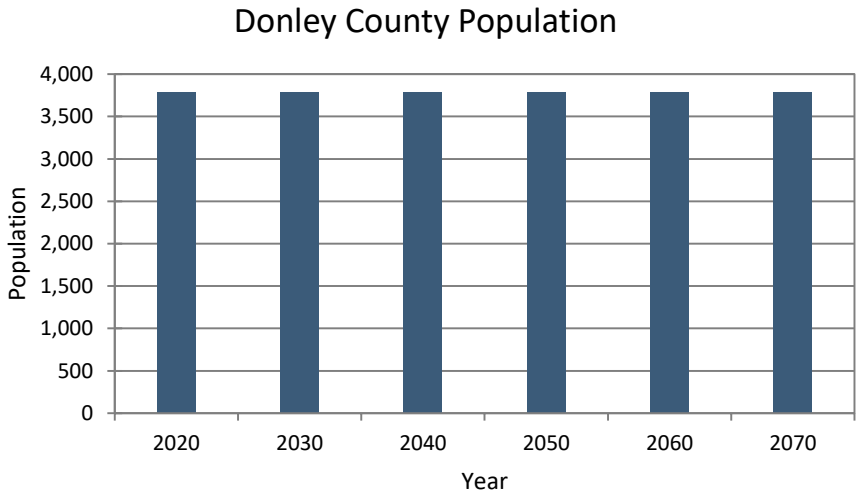
Who are my representatives?

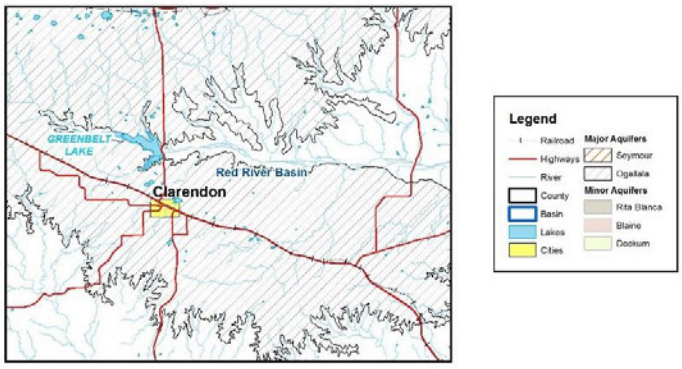
Dr. Nolan Clark	- Retired (USDA-ARS)
Ben Weinheimer	- Texas Cattle Feeders Association
Brent Auvermann	- Texas A&M AgriLife
Glen Green	- Xcel Energy
Rick Gibson	- Environmental Consultant
Bobbie Kidd	- Greenbelt MIWA
C.E. Williams	- Panhandle GCD
Danny Krienke	- GMA #1

County Seat: City of Clarendon

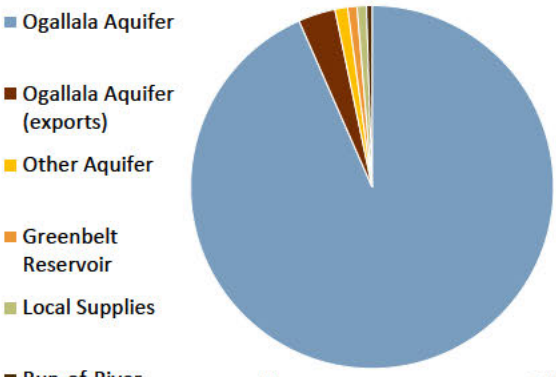
Economy: Agribusiness, Tourism

What is the source of my water? Ogallala Aquifer, Greenbelt Reservoir



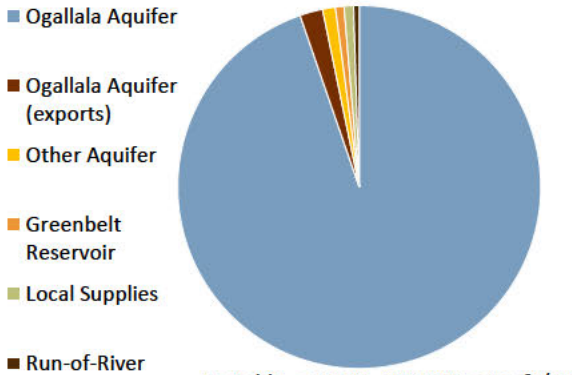


2020 Donley County Water Sources



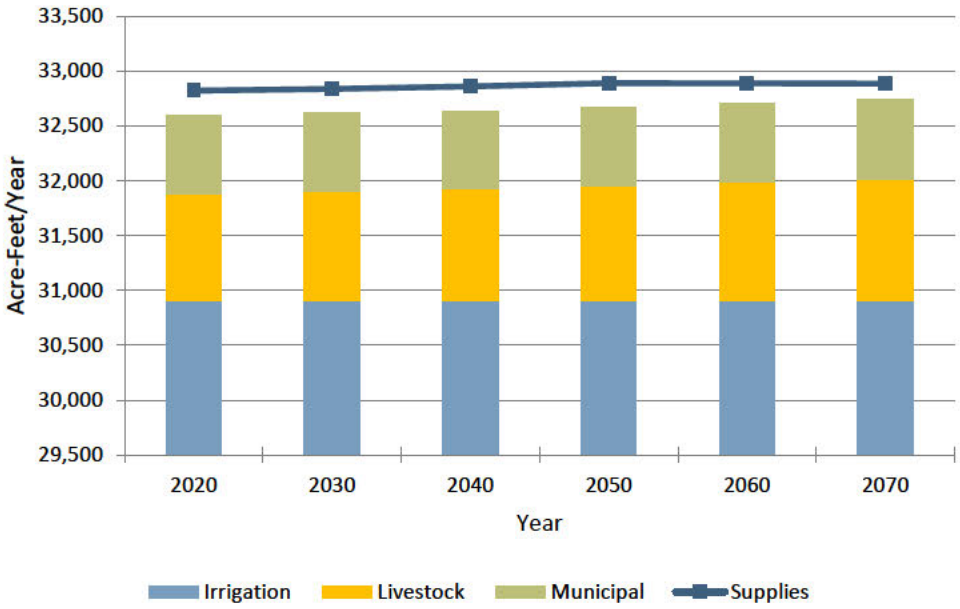
Total in county=32,821 acre-ft/yr
Total exports=1,121 acre-ft/yr

2070 Donley County Water Sources



Total in county=32,884 acre-ft/yr
Total exports=686 acre-ft/yr

Donley County Supplies and Demands



WATER USER GROUP	STRATEGY
Clarendon	Conservation
Red River Authority of Texas	No Water Need Identified
County-Other	No Water Need Identified
Irrigation	Conservation
Manufacturing	No Demands in this Category
Livestock	No Water Need Identified
Mining	No Water Need Identified
Steam Electric Power	No Demands in this Category

2.6.2 Greenbelt Municipal and Industrial Water Authority (Greenbelt MIWA)

Greenbelt MIWA provides water to four cities in the PWPA, three cities in Region B, and to the Red River Authority (RRA) for subsequent sales in both regions. Approximately 70 percent of the current demand on Greenbelt MIWA is from the cities of Childress, Clarendon, Hedley, and Memphis, and to the RRA for sales in the PWPA. The remaining sales are to the cities of Chillicothe, Crowell, and Quanah, and to the RRA in Region B. Demand projections for Greenbelt MIWA were developed based on each recipient's projected water demand and the percentage of the historical water demands that the Greenbelt MIWA had supplied. The demand on Greenbelt MIWA is expected to remain about the same through the planning period.

Table 2-4: Projected Water Demands for Greenbelt MIWA

Customers	Demands (ac ft/yr)					
	2020	2030	2040	2050	2060	2070
PWPA						
City of Childress	1,624	1,657	1,685	1,722	1,767	1,814
City of Clarendon	371	362	354	350	349	349
City of Hedley	56	56	56	56	56	56
City of Memphis	37	37	37	37	37	37
Red River Authority - Childress County	232	236	239	245	252	258
Red River Authority - Collingsworth County	16	16	16	16	16	16
Red River Authority - Donley County	30	30	30	30	30	30
Red River Authority - Hall County	100	100	100	100	100	100
Region B						
City of Chillicothe	40	40	40	40	40	40
City of Crowell	138	133	131	131	131	130
City of Quanah	396	391	387	394	397	400
Hardeman County Manufacturing	190	190	190	190	190	190
Red River Authority - Foard County	262	262	262	262	262	262
Red River Authority - Hardeman County	140	140	140	140	140	140
Total Demand	**3,631**	**3,649**	**3,666**	**3,712**	**3,766**	**3,821**

2.6.3 Canadian River Municipal Water Authority (CRMWA)

CRMWA is the largest wholesale water provider in the PWPA. In 2020, CRMWA is projected to supply over 101,000 acre-feet of water to customers in the PWPA and Llano Estacado Region. CRMWA delivers water to Amarillo, Borger, and Pampa in the PWPA and to eight cities in the Llano Estacado Region, including Lubbock. Projected water demands on CRMWA through the planning period are anticipated to increase to approximately 121,600 acre-feet per year.

5C.5 Greenbelt Municipal and Industrial Water Authority

Greenbelt Municipal and Industrial Water Authority (Greenbelt MIWA) owns and operates Greenbelt Reservoir on the Salt Fork of the Red River. The MIWA also recently developed local groundwater supplies from the Ogallala aquifer. The Greenbelt MIWA is located in Donley County and provides water to local municipalities through an extensive delivery system, including a 121-mile aqueduct. There are five member cities, including Clarendon, Hedley, and Childress in the PWPA and Quanah and Crowell in the Region B planning area. The Red River Authority is a non-voting member of the Greenbelt MIWA.

Greenbelt MIWA's primary water source is Greenbelt Reservoir. The estimated reliable supply from the reservoir is about 3,112 acre-feet per year in 2020 and declining to 2,256 acre-feet per year over the planning period. Groundwater supplies are estimated 1,900 acre-feet per year and are expected to decline to about half of this amount by 2070. Current projected demands on the MIWA are shown in Table 5C-13 and are not expected to exceed 3,900 acre-feet per year over the planning period. Considering both the reservoir supplies and local groundwater supplies, Greenbelt MIWA is not expected to have water needs until 2060.

Table 5C-13: Summary of Demands, Supplies and Needs for the Greenbelt MIWA

Customers	Demands (Ac Ft/Yr)					
	2020	2030	2040	2050	2060	2070
PWPA						
City of Childress	1,624	1,657	1,685	1,722	1,767	1,814
City of Clarendon	371	362	354	350	349	349
City of Hedley	56	56	56	56	56	56
City of Memphis	37	37	37	37	37	37
Red River Authority - Childress County	232	236	239	245	252	258
Red River Authority - Collingsworth County	16	16	16	16	16	16
Red River Authority - Donley County	30	30	30	30	30	30
Red River Authority - Hall County	100	100	100	100	100	100
Region B						
City of Chillicothe	40	40	40	40	40	40
City of Crowell	138	133	131	131	131	130
City of Quanah	396	391	387	394	397	400
Hardeman County Manufacturing	190	190	190	190	190	190
Red River Authority - Foard County	262	262	262	262	262	262
Red River Authority - Hardeman County	140	140	140	140	140	140
Total Demand	**3,631**	**3,649**	**3,666**	**3,712**	**3,766**	**3,821**

Sources	Current Water Supply (Ac Ft/Yr)					
	2020	2030	2040	2050	2060	2070
Ogallala - Donley County	1,900	1,615	1,373	1,167	992	843
Greenbelt Reservoir	3,112	2,941	2,770	2,599	2,428	2,256
Total Current Water Supply	**5,012**	**4,556**	**4,143**	**3,766**	**3,420**	**3,099**
	Surplus or (Need) (Ac Ft/Yr)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
	1,380	**907**	**477**	**54**	**(346)**	**(723)**

While the projections indicate Greenbelt MIWA can meet its projected demands until the 2060s, there are concerns regarding the reliability of the surface water supplies and the long-term reliability of the local groundwater. Greenbelt Reservoir is in current drought of record conditions. As the drought continues, the reliable supply may decrease. The on-going drought also increases the competition for local groundwater from nearby irrigators. With these uncertainties, Greenbelt is pursuing additional groundwater in northern Donley County. This additional supply will provide additional reliability to the Greenbelt MIWA's system. The recommended strategies for Greenbelt MIWA are shown below. Conservation measures and associated savings for the wholesale customers of the MIWA are discussed in Chapter 5B.

Recommended Strategies

- Conservation of wholesale customers
- Develop additional supplies from the Ogallala Aquifer in Donley County

Develop Additional Supplies from the Ogallala Aquifer in Donley County

In 2013, a feasibility study was developed for the Greenbelt MIWA. The recommended strategy included developing groundwater in North Donley County, transporting the water by a 16-inch pipeline approximately 16 miles to the Greenbelt Water Treatment Plant site. The strategy would include three 1000 gpm wells, a pump station and ground storage tank and associated electrical and instrumentation. The Greenbelt MIWA has purchased the groundwater rights necessary to provide 2,000 acre-feet annually. Greenbelt MIWA needs begin in 2060 and increase to 723 acre-feet per year in 2070.

Time Intended to Complete

The project is intended to be online by 2030. This project will supplement existing supplies for Greenbelt MIWA.

Quantity, Reliability and Cost

The quantity of water should be sufficient. Reliability of groundwater supply is moderate since there is competition for water from the Ogallala in Donley County. The capital cost is $17.9 million.

Environmental Issues

The environmental impacts from groundwater development are expected to be low. Once the specific locations of additional wells and alignments associated with infrastructure are identified, a detailed evaluation to determine environmental impacts, if any, will need to be performed.

Impact on Water Resources and Other Management Strategies

The proposed wells are located north of Greenbelt Reservoir in an area with some competition for groundwater for irrigation.

The strategy should not significantly impact other water resources or management strategies.

Impact on Agriculture and Natural Resources

The recommended strategy is expected to have low impact on the agriculture and other natural resources.

Other Relevant Factors

Greenbelt MIWA will need to seek a groundwater permit from the Panhandle GCD.

Summary of Recommended Strategies for Greenbelt MIWA

Water conservation and water audits and leak repair by Greenbelt MIWA customers will provide approximately 40 acre-feet per year in 2020 increasing to approximately 90 acre-feet per year by 2070. New wells in the Ogallala aquifer can provide an additional 2,000 acre-feet per year and could be completed by 2030. Table 5C-14 shows the amount of supply from the recommended strategies. The total capital costs for the recommended strategies is $17.9 million as shown in Table 5C-15.

Table 5C-14: Recommended Water Management Strategies for Greenbelt MIWA (Ac-Ft/Yr)

	2020	2030	2040	2050	2060	2070
Surplus or (Need)	**1,380**	**907**	**477**	**54**	**(346)**	**(723)**
Recommended Strategies	**Supply from Strategy**					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
PWPA Customer Conservation	34	36	37	38	39	41
Region B Customer Conservation	9	36	45	46	49	50
Donley County Groundwater	0	2,000	2,000	2,000	2,000	2,000
Total from Strategies	**43**	**2,072**	**2,082**	**2,084**	**2,088**	**2,091**

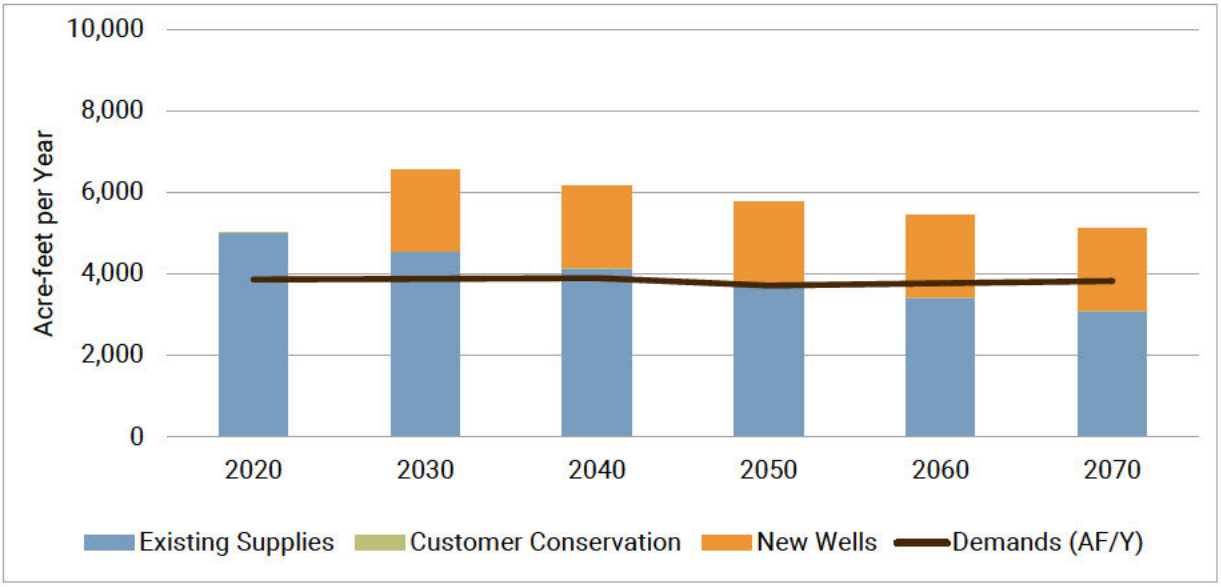
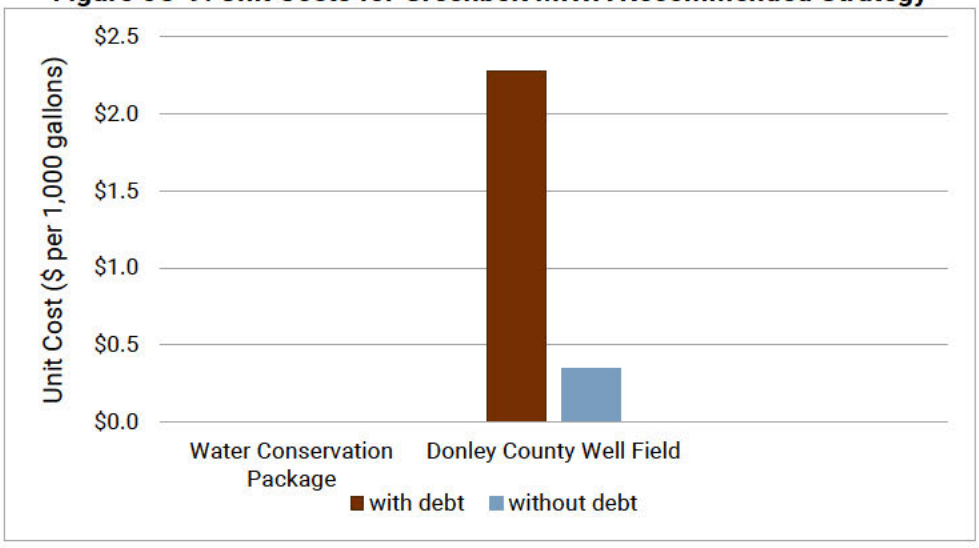


Figure 5C-8: Recommended Strategies for Greenbelt MIWA

Table 5C-15: Summary of Costs for Recommended Strategies for Greenbelt MIWA

Recommended Strategies	Capital Cost ($ million)	Annual Costs ($million)					
		2020	2030	2040	2050	2060	2070
Donley County Groundwater	$17.9	$0.00	$1.49	$1.49	$0.20	$0.20	$0.20
Total from Strategies	**$17.9**	**$0.00**	**$1.49**	**$1.49**	**$0.20**	**$0.20**	**$0.20**

Figure 5C-9: Unit Costs for Greenbelt MIWA Recommended Strategy



APPENDIX C

Pages from TWDB Texas Aquifers Study – References to Ogallala Aquifer – December 2016

Texas Aquifers Study

Groundwater Quantity, Quality, Flow, and Contributions to Surface Water

Bech Bruun, Chairman
Kathleen Jackson, Member
Peter Lake, Member
Jeff Walker, Executive Administrator

December 31, 2016

Geoscientists Seal

The contents of this report (including figures and tables) document the work of the following licensed Texas geoscientists:

Roberto Anaya, P.G. 480

Mr. Anaya was responsible for evaluating the statewide baseflow analysis. The seal appearing on this document was authorized on 11/21/2016 by

Roberto Anaya

Radu Boghici, P.G. No. 482

Mr. Boghici was responsible for evaluating groundwater flows between aquifers. The seal appearing on this document was authorized on 11/21/2016 by

Radu Boghici

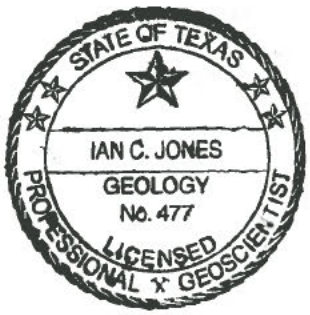
Lawrence N. French, P.G. No. 1288

Mr. French was responsible for general oversight of the project and editing the report. The seal appearing on this document was authorized on 11-21-16 by

Lawrence N. French

Ian Jones, P.G. No. 477

Mr. Jones was responsible for evaluating inter-aquifer groundwater flows involving the San Antonio and Barton Springs segments of the Edwards (Balcones Fault Zone) Aquifer, the Pecos Valley Aquifer, the Edwards-Trinity (Plateau) Aquifer, and the Hill Country portion of the Trinity Aquifer. The seal appearing on this document was authorized on by 12/1/16



Ian Jones

Rima Petrossian, P.G. No. 467

Ms. Petrossian was responsible for project oversight. The seal appearing on this document was authorized on 12/01/2016 by

Rima Petrossian

Cynthia K. Ridgeway, P.G. No. 471

Ms. Ridgeway was responsible for directing the evaluation of groundwater flows between aquifers. The seal appearing on this document was authorized on 12/1/2016 by

Cynthia K. Ridgeway

Jianyou Shi, Ph.D., P.G. No. 11113

Dr. Shi was responsible for evaluating inter-aquifer groundwater flows involving the High Plains Aquifer System, the Edwards-Trinity (Plateau) and Edwards (Balcones Fault Zone) aquifer in Kinney County, the Llano Uplift minor aquifers (Marble Falls, Ellenburger-San Saba, and Hickory aquifers), the Rustler Aquifer, and the Trinity and Woodbine aquifers. The seal appearing on this document was authorized on 11/21/2016 by

Jianyou Shi

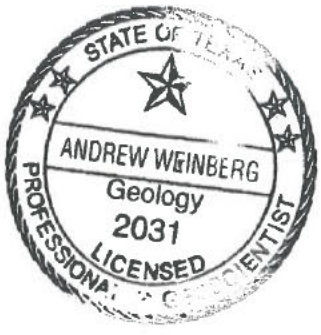
Shirley Wade, Ph.D., P.G. No. 525

Dr. Wade was responsible for evaluating groundwater flows between the Carrizo-Wilcox Aquifer and the Brazos River Alluvium Aquifer based on the groundwater availability model for the central portion of the Carrizo-Wilcox Aquifer Version 1.01. The seal appearing on this document was authorized on 11/21/16 by

Shirley Wade

Andrew Weinberg, P.G. No. 2031

Mr. Weinberg was responsible for working on all aspects of the project and preparing the report. The seal appearing on this document was authorized on 11.30.16 by



Andrew Weinberg

6.6 Ogallala Aquifer

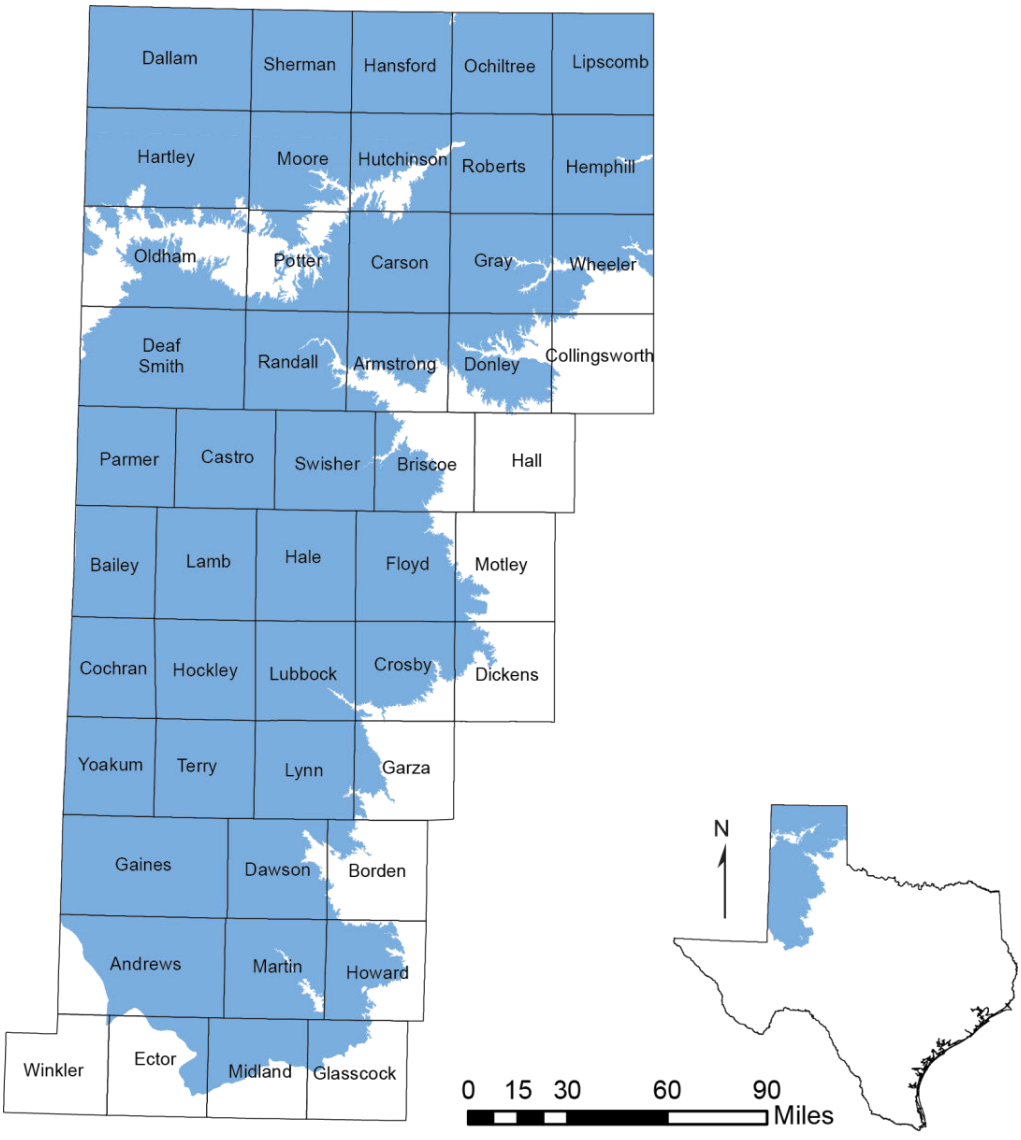


Figure 6-24. Extent of the Ogallala Aquifer in Texas.

Aquifer characteristics

- Aquifer type: unconfined
- Area of aquifer: 36,293 square miles
- Proportion of aquifer with groundwater conservation districts: 86 percent
- Number of counties containing the aquifer: 49

Geology and hydrogeology

The Ogallala Aquifer, an unconfined aquifer, is the largest aquifer in the United States and is a major aquifer of Texas, underlying much of the High Plains region (Figure 6-24). The aquifer consists of sand, gravel, clay, and silt and has a maximum thickness of 800 feet. Freshwater saturated thickness in the aquifer averages 95 feet but is significantly greater in several paleovalleys that were eroded into the Permian- to Cretaceous-aged surfaces before deposition of the Ogallala Formation.

The Ogallala Formation was deposited as alluvial outwash from the Rocky Mountains. The thickest and coarsest grained sediments are fluvial channel facies in alluvial fan lobes deposited in paleovalleys (Seni, 1980; Gustavson, 1996), where pebble- to boulder-size gravel lenses are common along the basal surface. Three major paleovalleys are located north of the Canadian River, and a smaller paleovalley stretches from near Clovis to southeast of Plainview. Most sediment in the preserved extent of the Ogallala Formation are sands and gravels that were deposited in braided stream channels (Seni, 1980). The Ogallala Formation becomes finer-grained with increased distance from the mountains. The Ogallala Formation is overlain by the Blackwater Draw Formation, which forms a layer of Quaternary eolian fine sand, silt, clay, and caliche that covers the Ogallala Formation except along breaks and draws.

The hydraulic conductivity of the Southern Ogallala Aquifer ranges from 0.01 to 2,600 feet per day with a mean of about 6.8 feet per day (Blandford, 2003). The geometric mean of hydraulic conductivity in the Northern Ogallala Aquifer is about 14.8 feet per day with a standard deviation of 5 to 44 feet per day (Dutton, 2001). The specific yield of the Ogallala Aquifer ranges from 15 to 22 percent, with an average of 16 percent (Blandford, 2003).

Studies indicate that recharge represents a small fraction of current water usage. Most recently, Deeds and Hamlin (2015) developed detailed maps of present-day recharge, dividing the Ogallala into two regions. Recharge in the southern region has been affected by agricultural development and ranges from 0.007 to over 3 inches per year, with the most recharge in areas where irrigated crops are raised on relatively permeable soils. In the northern region, relatively clayey soils limit agricultural influence on recharge, and the pre-development distribution of recharge remains in place, with rates ranging from 0.1 to 0.8 inches per year.

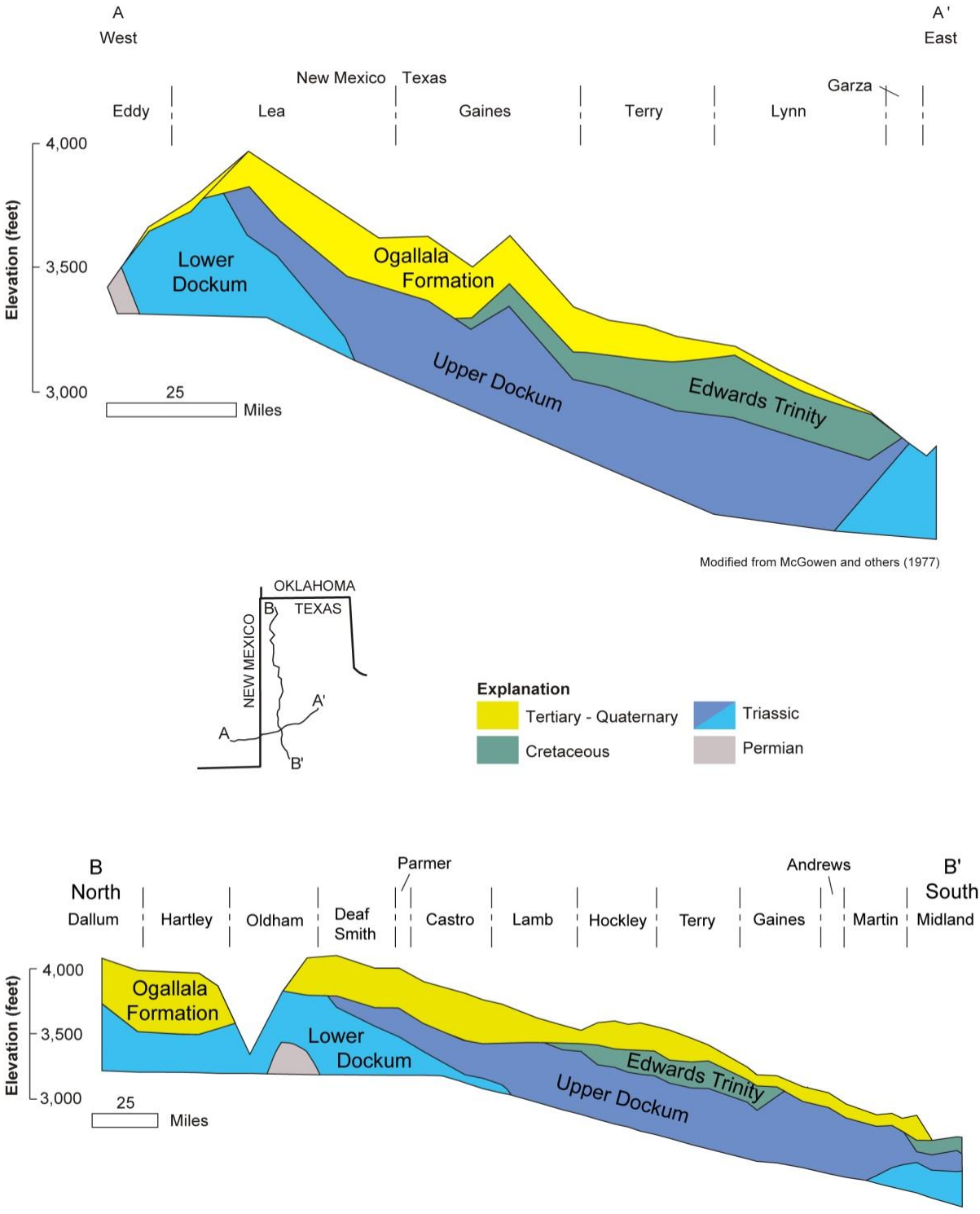


Figure 6-25. Geologic cross-sections showing the relationship of the Ogallala Formation to underlying strata (modified from McGowen and others, 1977).

Flows to surface water and other aquifers

Baseflow from springs or aquifer discharge has diminished due to the large volume of pumping for irrigation from the Ogallala Aquifer, resulting in low to no flow in streams that originally depended on aquifer discharge (Deeds and Hamlin, 2015). Table 6-15 summarizes groundwater flow from the Ogallala Aquifer to surface water.

The Ogallala Aquifer is in hydraulic communication with the underlying Cretaceous Edwards-Trinity (Plateau) Aquifer in the south, the Rita Blanca Aquifer in the northwest, and the Triassic Dockum Aquifer in the central region. Table 6-16 shows groundwater availability model estimates of total flow and average annual flow between the Ogallala Aquifer and other aquifers.

Table 6-15. Summary of groundwater flow from the Ogallala Aquifer to surface water by county.

County	Area of aquifer outcrop in county (square miles)	Sum of average annual baseflow (cubic feet per second)	Sum of median annual baseflow (cubic feet per second)
Andrews	1,215	4.3	3.1
Armstrong	620	1.6	1.1
Bailey	820	2.4	1.4
Borden	105	0.4	0.3
Briscoe	404	1.6	1.2
Carson	912	3.4	2.5
Castro	900	1.1	0.1
Cochran	775	2	1.4
Collingsworth	16	0.1	0
Crosby	696	5.3	5
Dallam	1,505	13.1	5.1
Dawson	846	2.9	1.8
Deaf Smith	1,439	3.1	0.8
Dickens	123	1	0.6
Donley	619	4.2	1.9
Ector	207	0.8	0.6
Floyd	924	7.7	6.6
Gaines	1,501	4.4	3.8
Garza	158	0.9	0.8
Glasscock	199	1	0.3

Table 6-15. Summary of groundwater flow from the Ogallala Aquifer to surface water by county.

County	Area of aquifer outcrop in county (square miles)	Sum of average annual baseflow (cubic feet per second)	Sum of median annual baseflow (cubic feet per second)
Gray	903	8.5	5.4
Hale	1,005	2.4	2.2
Hall	1	0	0
Hansford	917	3	1.7
Hartley	1,424	3.7	2.5
Hemphill	902	11	7
Hockley	910	1.1	1
Howard	548	1.8	0.7
Hutchinson	717	2.6	1.5
Lamb	1,018	2	1.5
Lipscomb	932	8.5	4.4
Lubbock	893	2.7	2.6
Lynn	889	3.8	4.4
Martin	884	3.6	1.7
Midland	496	2.2	1.2
Moore	842	2.7	0.9
Motley	100	1.2	0.9
Ochiltree	914	6.7	2.9
Oldham	733	3.9	1.6
Parmer	879	2	0.8
Potter	497	1.6	0.8
Randall	889	1.5	0.7
Roberts	917	6	4.5
Sherman	921	4.1	1.6
Swisher	900	1.7	0.9
Terry	890	1.9	1.3
Wheeler	581	13	8
Winkler	3	0	0
Yoakum	799	2.3	1.8
Total	**36,288**	**167**	**103**

Table 6-16. Model estimates of inter-aquifer flows between the Ogallala Aquifer and other major and minor aquifers.

Flow from	Flow to	Total flow (acre-feet per year)
Ogallala Aquifer	Dockum Aquifer	27,497
Ogallala Aquifer	Edwards-Trinity (High Plains) Aquifer	13,812
Ogallala Aquifer	Edwards-Trinity (Plateau) Aquifer	3,014
Ogallala Aquifer	Pecos Valley Aquifer	220
Ogallala Aquifer	Rita Blanca Aquifer	1,670
Dockum Aquifer	Ogallala Aquifer	2,241
Edwards-Trinity (High Plains) Aquifer	Ogallala Aquifer	5,544
Edwards-Trinity (Plateau) Aquifer	Ogallala Aquifer	7,341

Water quantity

Total storage in the Ogallala Aquifer is estimated to be more than 380 million acre feet. Recoverable storage is estimated to be between 25 and 75 percent of the total, about 95.1 million to 285.4 million acre-feet (Table 6-17). Throughout much of the Ogallala Aquifer, groundwater withdrawals exceed the amount of recharge, and water levels have declined over time. Although water-level declines in excess of 300 feet have occurred in several areas over the last 50 to 60 years, the rate of decline has slowed, and water levels have risen in a few areas. Figure 6-26 shows changes in water levels in the Ogallala Aquifer.

Table 6-17. Total estimated recoverable storage in the Ogallala Aquifer, by groundwater management area, in acre-feet

Groundwater management area	Total storage	25 percent of storage	75 percent of storage
1	232,700,000	58,175,000	174,525,000
2	139,210,000	34,802,500	104,407,500
3	9,600	2,400	7,200
6	2,285,000	571,250	1,713,750
7	6,340,000	1,585,000	4,755,000
Total	**380,544,600**	**95,136,150**	**285,408,450**

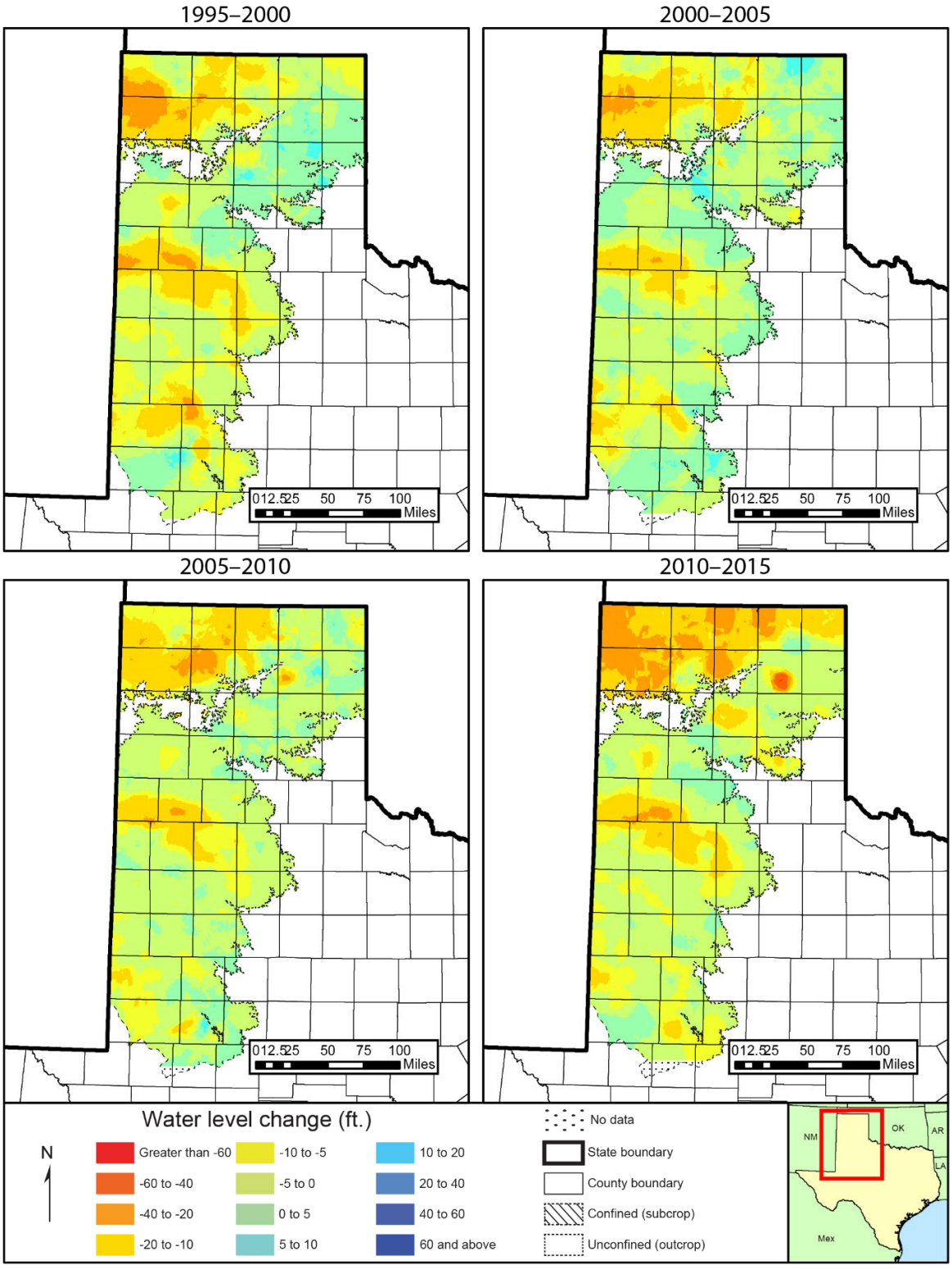


Figure 6-26. Water-level changes in the Ogallala Aquifer, 1995 to 2015.

Water quality

Water to the north of the Canadian River is generally fresh, with total dissolved solids concentrations typically less than 400 milligrams per liter. However, water quality diminishes to the south, where large areas contain total dissolved solids concentrations greater than 1,000 milligrams per liter (Figure 6-27). Increased salinity may be associated with evaporative concentration of groundwater in saline playa lakes in the southern portion of the aquifer, upflow of more saline groundwater from the underlying Dockum Aquifer, and other sources (Reedy and others, 2011).

Arsenic, fluoride, nitrate, radionuclides, and selenium levels have been known to be in excess of primary drinking water standards, primarily in the southern portion of the aquifer. Volcanic ash leaching in the aquifer is likely the source of arsenic, fluoride, selenium, and radionuclides. Sources of nitrate may come from agricultural activity in the area (Reedy and others, 2011).

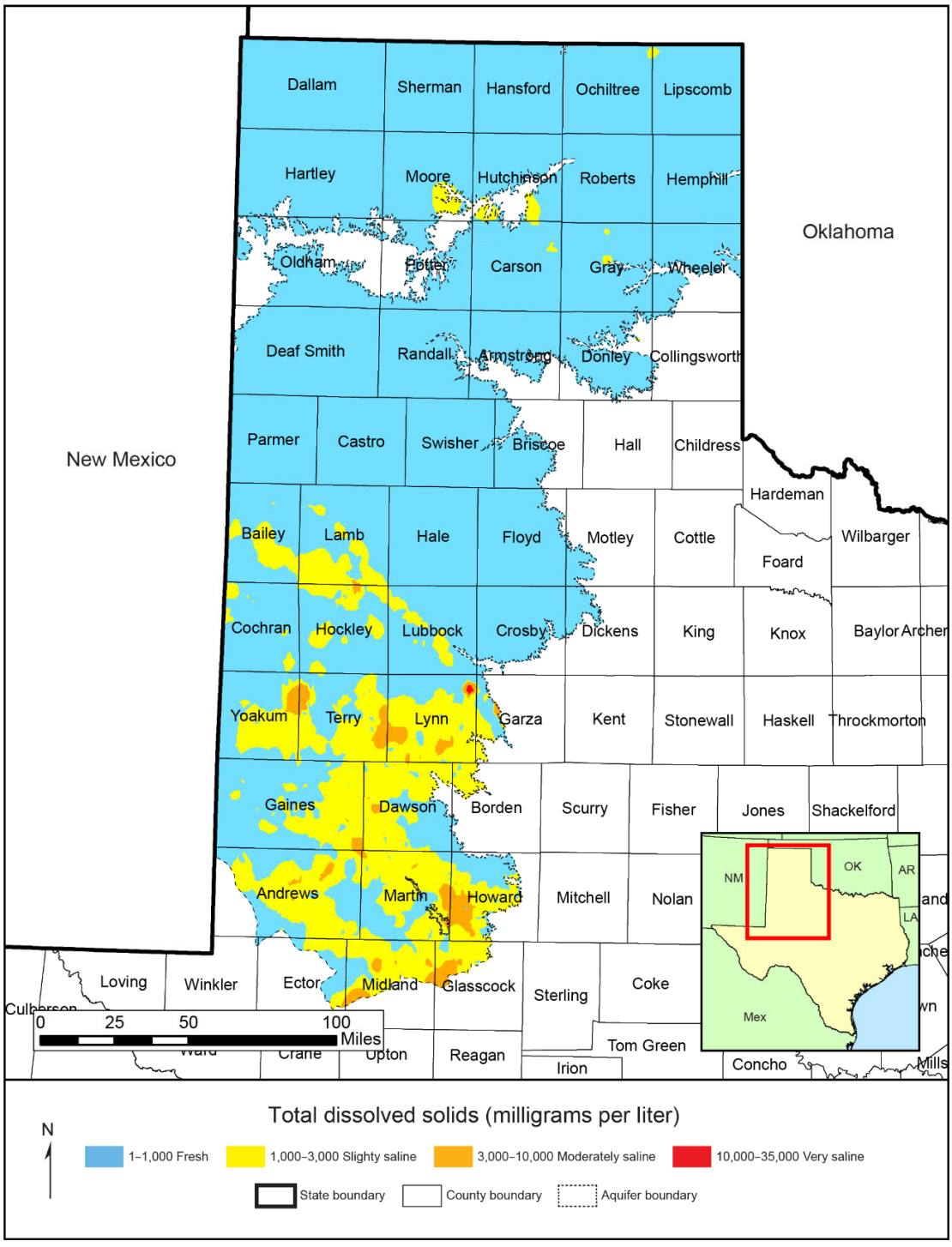


Figure 6-27. Total dissolved solids in the Ogallala Aquifer.

APPENDIX D

Biological Desktop/Field Survey and Permitting Evaluation – October 2021

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TO: File: GMA21554

FROM: Eli Ellis

SUBJECT: Biological Desktop/Field Survey and Permitting Evaluation

DATE: October 19, 2021

PROJECT: GMA21554 – Greenbelt Water Line Route Study

Introduction

Freese and Nichols, Inc. (FNI) personnel conducted a limited pedestrian survey in Donley County, Texas, on September 9, 2021, for the Greenbelt Water Authority's Water Line Route Study. A desktop level analysis was performed for the areas of the project where access was not available. The pedestrian survey and desktop analysis were conducted to identify potential waters of the U.S. (WOTUS), including wetlands, within the proposed project area in accordance with Section 404 of the Clean Water Act (CWA), as well as habitat for federally listed threatened and endangered species. This memo was prepared to summarize the findings of the pedestrian survey and desktop analysis and to document how the proposed project can be designed to be constructed to meet the terms and conditions of Nationwide Permit (NWP) 58 *(Utility Line Activities for Water and Other Substances)*. The proposed project, including locations of waterbody crossings, is presented in Figure 1 (Appendix A).

Project Description

The proposed improvements include the construction of a new water line. The route of the proposed water line will be selected from three alternative route options, from proposed ground water well sites on the Carrol Creek Ranch to the existing Greenbelt Water Treatment Plant (WTP).

Route Option A

Route Option A begins at the Greenbelt Water Treatment Plant and travels north along SH-70 and west through grasslands, ending at proposed well sites on Carrol Creek Ranch. Route Option A is approximately 70,225 linear feet (LF) in length and was designed to follow previously disturbed or cleared areas, to the practicable extent. New easements would be required along sections of the proposed pipeline alignment.

Route Option B

Route Option B begins at the Greenbelt Water Treatment Plant and travels north along SH-70 and west through a residential area, before following an existing powerline right-of-way north. It continues west through grasslands, ending at proposed well sites on Carrol Creek Ranch. Route Option B is approximately 70, 350 LF in length and was designed to follow previously disturbed or cleared areas, to the practicable extent. New easements would be required along sections of the proposed pipeline alignment.

Route Option C

Route Option C begins at Greenbelt Reservoir, travels north through grasslands, wooded riparian areas, and along county roads, ending at proposed well sites on Carrol Creek Ranch. Route Option C is approximately 53,890 LF in length. The proposed alignment was designed to follow previously disturbed or cleared areas, to the practicable extent. New easements would be required along sections of the proposed pipeline alignment.

Site Description

The proposed project lies within the Southwestern Tablelands Ecoregion. Vegetation observed during the pedestrian survey included Bermudagrass (*Cynodon dactylon*), buffalograss (*Bouteloua dactyloides*), hairy grama (*B. hirsuita*), blue grama (*B. gracilis*), sideoats grama (*B. curtipendula*), Johnsongrass (*Sorghum halepense*), big bluestem (*Andropogon gerardi*), Indiangrass (*Sorghastrum nutans*), silver bluestem (*Bothriochloa laguroides*), American elm (*Ulmus americana*), black willow (*Salix nigra*), cottonwood (*Populus deltoides),* redberry juniper (*Juniperus pinchotii*), shin oak (*Quercus havardii*), honey mesquite (*Prosopis glandulosa*), prickly pear (*Opuntia* spp.), sand sagebrush (*Artemisia filifolia*), western soapberry (*Sapindus saponaria*), and yucca (*Yucca glauca*).

Waters of the U.S.

The United States Army Corps of Engineers (USACE) regulates the discharge of dredged and fill material into waters of the U.S. (WOTUS), including wetlands, under Section 404 of the Clean Water Act (Section 404).WOTUS (i.e., jurisdictional waters) typically include streams that display continuous ordinary high water marks (OHWMs) and have a direct hydrologic connection with traditional navigable waters (TNW) of the U.S., impoundments of such streams, and wetlands adjacent to these jurisdictional waters. The term OHWM means “that line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural lines impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas” (33 CFR 328.3). Official determination of the presence or absence of waters of the U.S. can only be obtained by requesting an approved jurisdictional determination (AJD) from the USACE. A site visit would be required to delineate potential WOTUS.

Geographic information system (GIS) spatial data were used to develop a map of potential WOTUS spanning the project study area using ArcGIS Desktop version 10.5. Data used in the desktop analysis to identify potential WOTUS within the project area included the following: Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps; Google Earth 2021 Image Landsat (current and historical); Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO); NRCS National Hydric Soils List; United States Fish and Wildlife Service (USFWS) National Wetlands Inventory maps; United States Geological Survey (USGS) 1:24,000 topographic maps, 7.5- by 7.5-minute quadrangles; and USGS National Hydrography Dataset (NHD) 1:24,000-scale.

Route Option A

Based on desktop analysis, nine (9) streams are located within or adjacent to the proposed route option (Figures 1.1-1.09; Appendix A). One (1) NWI mapped emergent wetland was identified within or adjacent to the proposed route option.

A summary of the Potential WOTUS within or adjacent to Route Option A can be found in Table 1.

Table 1. Potential WOTUS within or adjacent to Route Option A.

Feature Name	Feature Classification
S1 – A	Intermittent
S2– A (Salt Fork Red River)	Intermittent
S2 – A	Intermittent
S3 – A	Intermittent
S4 – A	Intermittent
S5 – A	Intermittent
EW1 – A	Emergent Wetland
S6 – A	Intermittent
S7 – A	Intermittent
S8 – A	Intermittent
S9-A	Intermittent

Route Option B
Based on desktop analysis, 13 streams are located within or adjacent to the proposed route option (Figures 1.1-1.09). No wetlands, ponds or impoundments were identified within or adjacent to the proposed route option.

A summary of the Potential WOTUS within or adjacent to Route Option B can be found in Table 2.

Table 2. Potential WOTUS within or adjacent to Route Option B.

Feature Name	Feature Classification
S1 – B	Intermittent
S2 – B (Salt Fork Red River)	Intermittent
S3 – B	Intermittent
S4 – B	Intermittent
S5 – B	Intermittent
S6 – B	Intermittent
S7 – B	Intermittent
S8 – B	Intermittent
S9 – B	Intermittent
S10 – B	Intermittent
S11 – B	Intermittent
S12 – B	Intermittent
S13 – B	Intermittent

Route Option C
Based on desktop analysis, six (6) streams are located within or adjacent to the proposed route option (Figures 1.10-1.15). The Greenbelt Reservoir and one (1) associated NWI mapped scrub-shrub wetland are located within or adjacent to the proposed route option.

A summary of the Potential WOTUS within or adjacent to Route Option C can be found in Table 3.

Table 3. Potential WOTUS within or adjacent to Route Option C.

Feature Name	Feature Classification
Greenbelt Reservoir	Reservoir
SSW1 – C	Scrub-Shrub Wetland
S1 – C	Intermittent
S2 – C	Ephemeral
S3 – C	Intermittent
S4 – C	Intermittent
S5 – C	Intermittent
S6 – C	Intermittent

Section 404 Permitting

An example of a regulated discharge of fill material in a regulated stream is open-cut trenching across a stream. Boring or utilizing other-than-open-cut construction methods under a stream is not regulated by Section 404. If a proposed route were to cross a regulated stream with open-cut construction methods, Nationwide Permit (NWP) 58, *Utility Line Activities for Water and Other Substances,* could likely authorize the construction activities, assuming all terms and conditions of NWP 58, including NWP General Conditions and NWP Regional Conditions for the State of Texas were met. Design details and field surveys would be needed to determine if the terms and conditions of NWP 58 could be met and if pre-construction notification (PCN) to the USACE would be required.

Section 401 Water Quality Certification

Construction of the proposed Project must comply with the Section 401 Water Quality Certification Conditions for NWPs that have been issued by the Texas Commission on Environmental Quality (TCEQ). The TCEQ conditionally certifies that work authorized by NWP 58 would not result in a violation of established Texas Surface Water Quality Standards as required under the authority of Section 401 of the CWA as long as NWP General Conditions 12 and 25 are met. For General Condition 12 to be met for soil erosion and sediment controls, at least one construction best management practice (BMP) must be implemented for erosion control and at least one construction BMP for sedimentation control. For General Condition 25 to be met for water quality, at least one post-construction BMP must be implemented to control total suspended solids (TSS).

TPDES Stormwater Permit

Projects that disturb over one (1) acre of land or are part of a larger common plan of development that will disturb over one acre of land must comply with the Texas Pollution Discharge Elimination System (TPDES) Construction General Permit (CGP) TXR150000. Among other requirements, such projects must develop and implement a Storm Water Pollution Prevention Plan (SWPPP) and conduct periodic inspections of erosion and sedimentation controls. A Notice of Intent (NOI) must be submitted to the TCEQ prior to commencing construction activities for projects that will disturb five (5) or more acres. Operators of smaller projects that disturb between one and five acres of land must comply with TXR150000 but are not required to submit an NOI. As designed, the proposed project would disturb more than 5 acres of land and would therefore be subject to TPDES CGP TXR150000 and the submittal of an NOI would be required prior to construction.

Floodplains

According to the Federal Emergency Management Agency (FEMA) Flood Map Service Center, the proposed project is located in an area that is classified as unmapped. As such, no floodplain coordination is required.

Soils

Soil types within the proposed route options include loams, clay loams, sandy loams, fine sandy loams, loamy fine sands. Soils map units present within the proposed route options can be found in Table 4. Figure 2 (Appendix A) depicts soil map units within the proposed project area.

Table 4. Soil Series within the proposed Route Options.

Soil Series	Hydric Soil
2 - Acuff loam, 1 to 3 percent slopes	No
3 - Acuff loam, 3 to 5 percent slopes	No
4 - Altus fine sandy loam, dry, 0 to 1 percent slopes	No
7 - Berda-Pep-Potter association	No
8 - Berda-Potter-Rock outcrop association	No
11 - Burson-Aspermont association	No
19 - Guadalupe fine sandy loam, 0 to 2 percent slopes, occasionally flooded	Yes
20 - Likes loamy fine sand, 1 to 8 percent slopes	No
21 - Lincoln loamy fine sand, dry, 0 to 1 percent slopes, frequently flooded	No
22 - Miles loamy fine sand, 0 to 3 percent slopes	No
25 - Miles fine sandy loam, 0 to 1 percent slopes	No
26 - Miles fine sandy loam, 1 to 3 percent slopes	No
27 - Miles fine sandy loam, 3 to 5 percent slopes	No
29 - Mobeetie fine sandy loam, 1 to 3 percent slopes	No
30 - Mobeetie fine sandy loam, 3 to 5 percent slopes	No
31 - Mobeetie fine sandy loam, 5 to 12 percent slopes	No
33 - Mobeetie-Polar association, hilly	No
34 - Mobeetie-Veal-Potter association, rolling	No
37 - Olton clay loam, 0 to 1 percent slopes	No
38 - Olton clay loam, 1 to 3 percent slopes	No
41 - Potter loam, 1 to 8 percent slopes	No
46 - Springer loamy fine sand, 3 to 8 percent slopes	No
48 - Springer loamy fine sand, 5 to 8 percent slopes	No
52 - Veal fine sandy loam, 1 to 3 percent slopes	No
53 - Veal fine sandy loam, 3 to 5 percent slopes	No
SPY - Spillway	No

Threatened and Endangered Species

According to the U.S. Fish and Wildlife Service's (USFWS's) Information for Planning and Consultation (IPaC) resource list, received on October 8, 2021 (Appendix D), the following three federally listed threatened, endangered, or candidate species may occur within Donley County, Texas:

- The piping plover (*Charadrius melodus*) is listed as threatened in Donley County with the condition that in this area it only needs to be considered for wind energy projects. Based on desktop analysis, no potential habitat was observed within the project area and the proposed project is not a wind energy project.
- The red knot (*Calidris canutus rufa*) is listed as threatened in Donley County with the condition that in this area it only needs to be considered for wind energy projects. Based on desktop analysis, no potential habitat was observed within the project area and the proposed project is not a wind energy project.
- The monarch butterfly (*Danaus plexippus*) is listed as a candidate species in Donley County. Based on desktop analysis, there is potential habitat within the project area.

Based on desktop level analysis, no potential habitat for threatened or endangered species was identified within the proposed project area; however, potential habitat for a candidate species is likely present. There is no designated critical habitat for a federally listed threatened or endangered species within the project area. A full site visit would be required to verify the desktop level analysis.

Migratory Bird Treaty/Bald and Golden Eagle Protection Acts

Coordination with the USFWS would be required by the Migratory Bird Treaty Act of 1918 if the proposed project activities would result in the intentional "take" (e.g., pursue, hunt, shoot, wound, kill, trap, capture, or collect) or possession of a migratory bird, or the parts, nests, or eggs of migratory bird. The proposed project is not expected to cause an intentional take of migratory birds.

Based on a desktop level analysis, bald eagle could potentially utilize Greenbelt Reservoir as suitable nesting and feeding habitat. A site visit would be required to verify the desktop level analysis.

Cultural Resources/Archaeology

Projects sponsored by public entities in the State of Texas that affect a cumulative area greater than five acres or that disturb more than 5,000 cubic yards require advance consultation with the Texas Historical Commission (THC) according to Section 191.0525 (d) of the Antiquities Code of Texas (ACT). Furthermore, under Section 106 of the National Historic Preservation Act (Section 106), a federal undertaking (like the USACE issuing a Section 404 permit) requires archeological coordination if an undertaking has the potential to affect historic places. If the proposed project's area of disturbance would exceed five (5) acres, or the volume of disturbance would exceed 5,000 cubic yards, then THC coordination would be required under the ACT.

Conclusions and Recommendations

Based on desktop analysis, each of the route options would cross intermittent channels which could likely be avoided by other-than-open-cut methods of installation. Route Option A would cross nine (9) potentially jurisdictional streams and one (1) potential emergent wetland. One stream would be crossed at two (2) sperate locations. Route Option B would cross 13 potentially jurisdictional waters. Three streams would be crossed at multiple locations with potential for parallel impacts. Route Option C would cross six (6) potentially jurisdictional

streams, one (1) potential scrub-shrub wetland, and would impact the Greenbelt Reservoir. If open-cut methods are proposed, then we recommend that the project should be designed to meet the terms and conditions of NWP 58, which may require notification to the USACE. There are additional environmental authorizations or permits that could be required, which would need to be considered during a more detailed design phase. Regarding cultural resources, all potential route options would likely require coordination with the THC and a pedestrian survey by a professional archeologist may be required.

References

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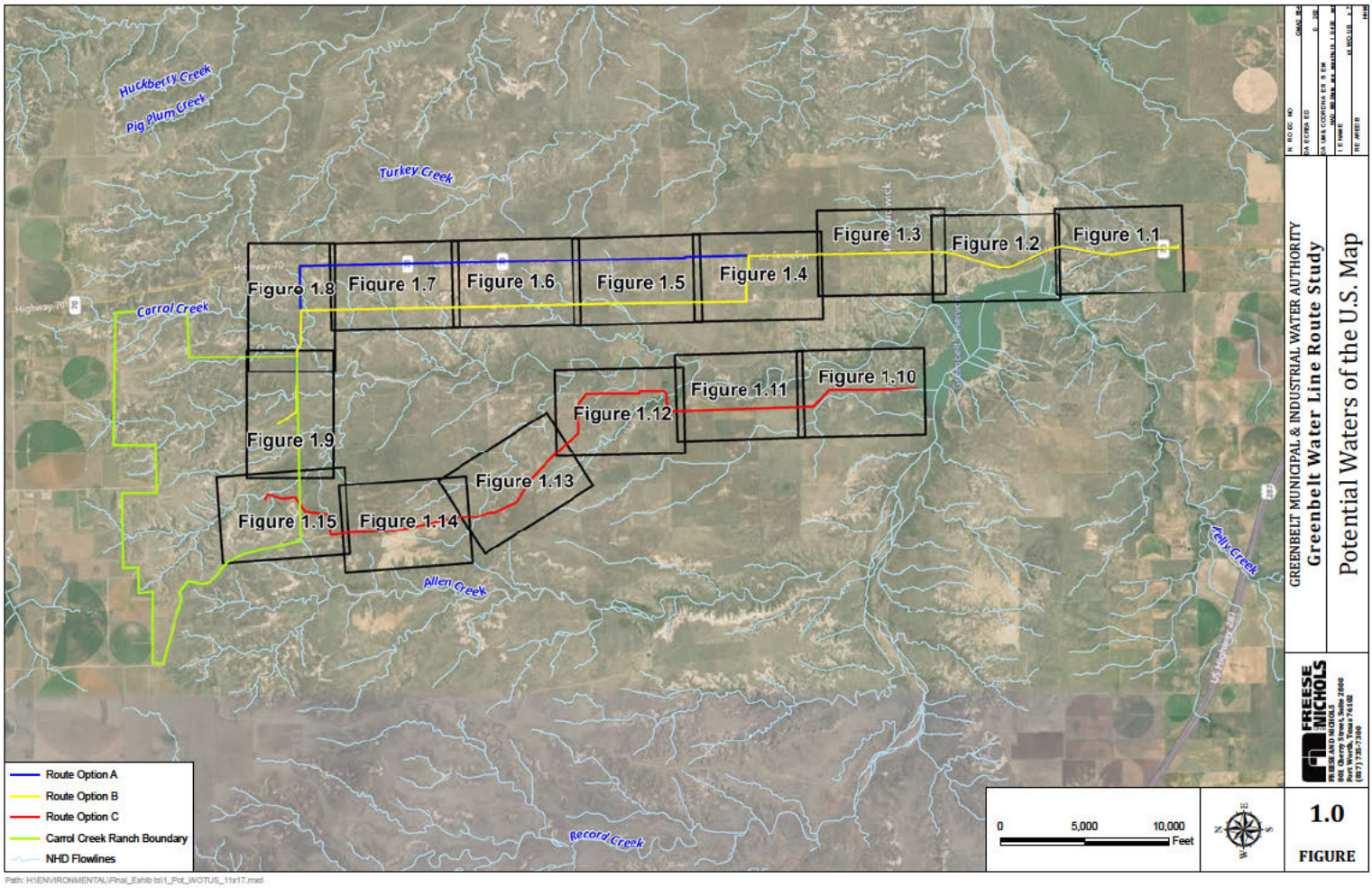
U.S. Fish and Wildlife Service (USFWS). 2021. Ecological Services. Endangered Species Lists. [Online] (September 2021). Available URL: http://www.fws.gov/endangered/

Appendix A

Figures


Huckberry Creek
Pig Plum Creek
Turkey Creek
Carrol Creek
Allen Creek
Record Creek
Kelly Creek
Highway 70
US Highway 287
Figure 1.1
Figure 1.2
Figure 1.3
Figure 1.4
Figure 1.5
Figure 1.6
Figure 1.7
Figure 1.8
Figure 1.9
Figure 1.10
Figure 1.11
Figure 1.12
Figure 1.13
Figure 1.14
Figure 1.15
Route Option A
Route Option B
Route Option C
Carrol Creek Ranch Boundary
NHD Flowlines
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Greenbelt Water Line Route Study
Potential Waters of the U.S. Map
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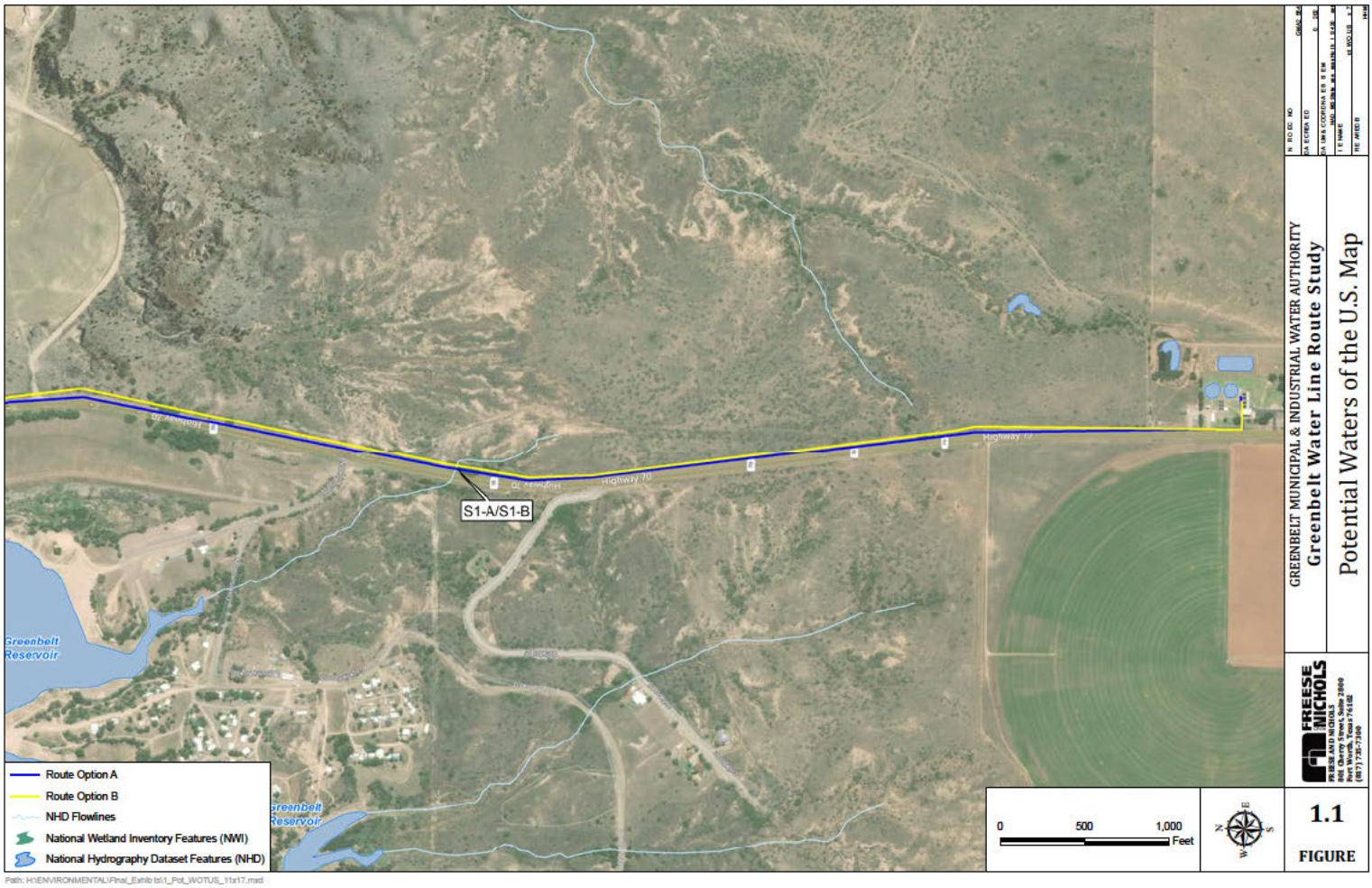
FIGURE


S1-A/S1-B
Highway 70
Greenbelt Reservoir
Route Option A
Route Option B
NHD Flowlines
National Wetland Inventory Features (NWI)
National Hydrography Dataset Features (NHD)
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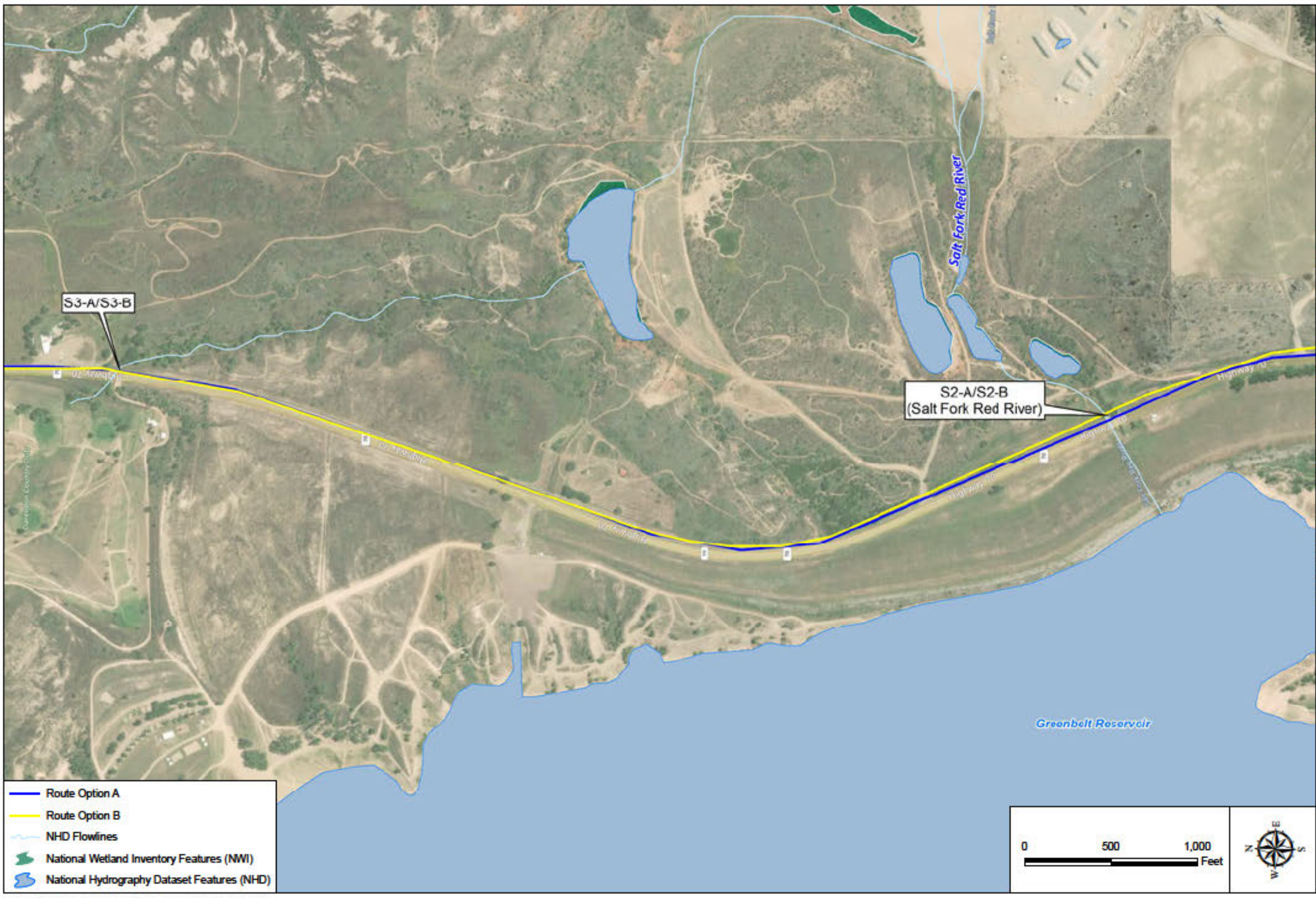

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FIGURE

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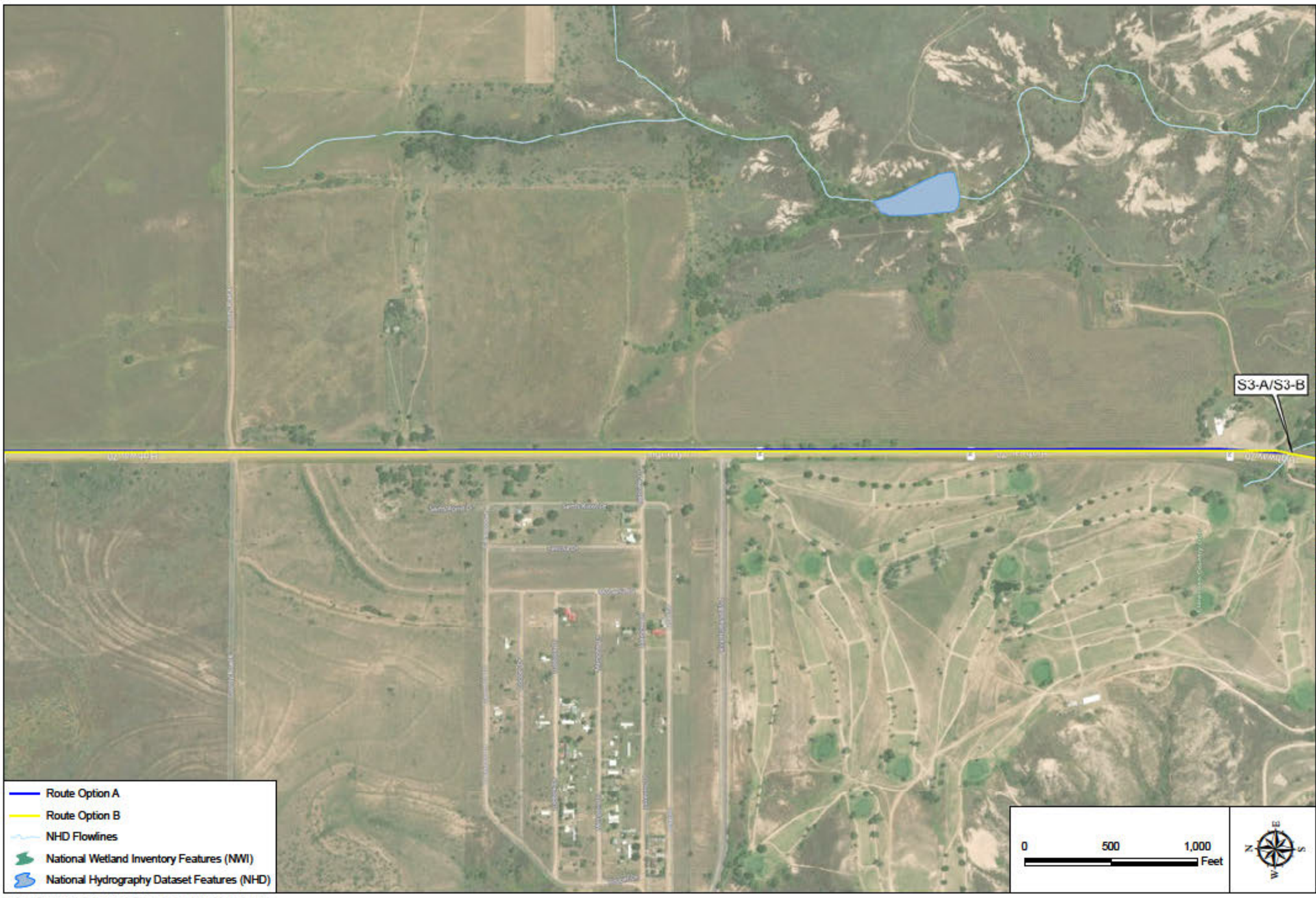

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FIGURE 1.3

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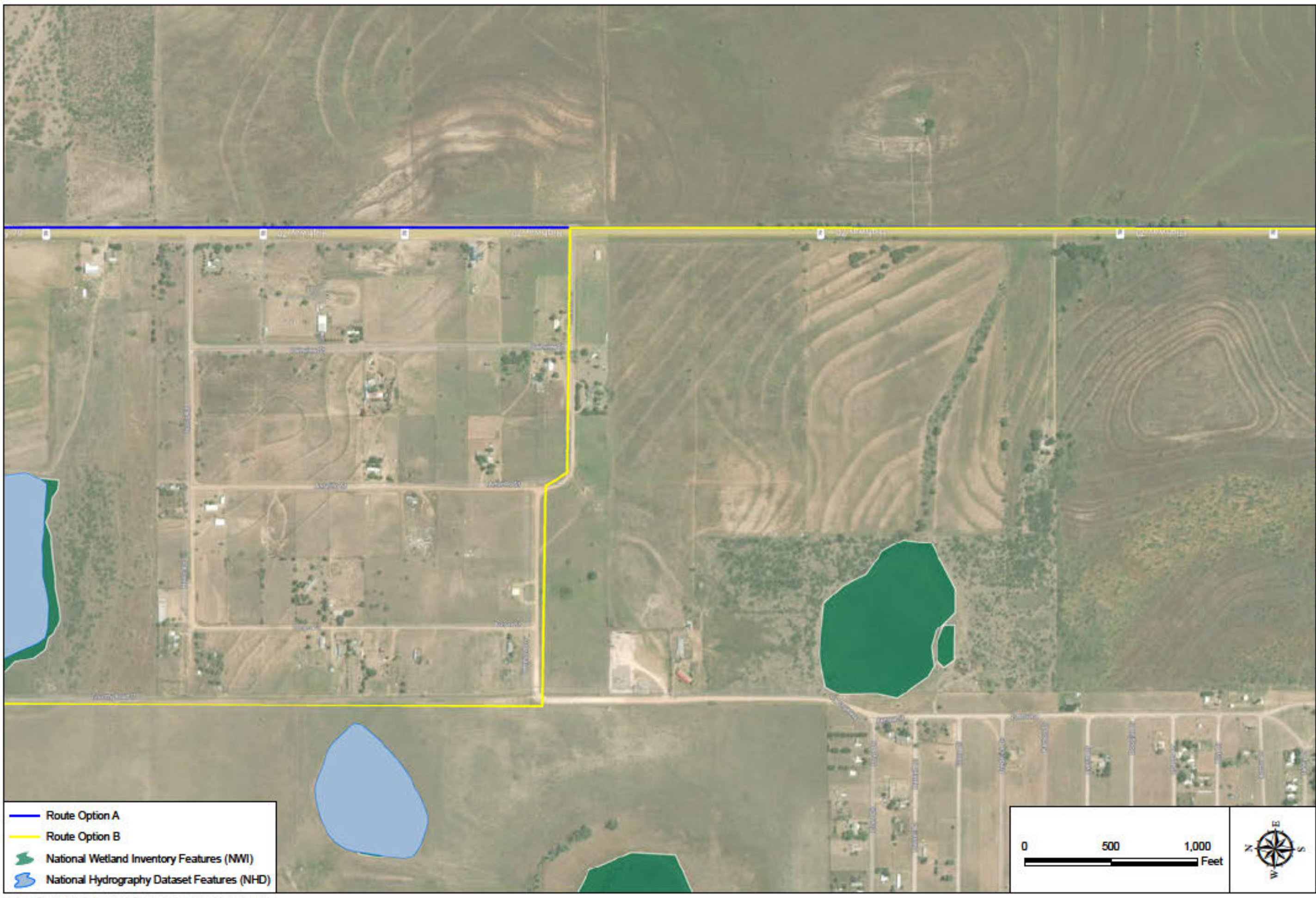

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FIGURE 1.4

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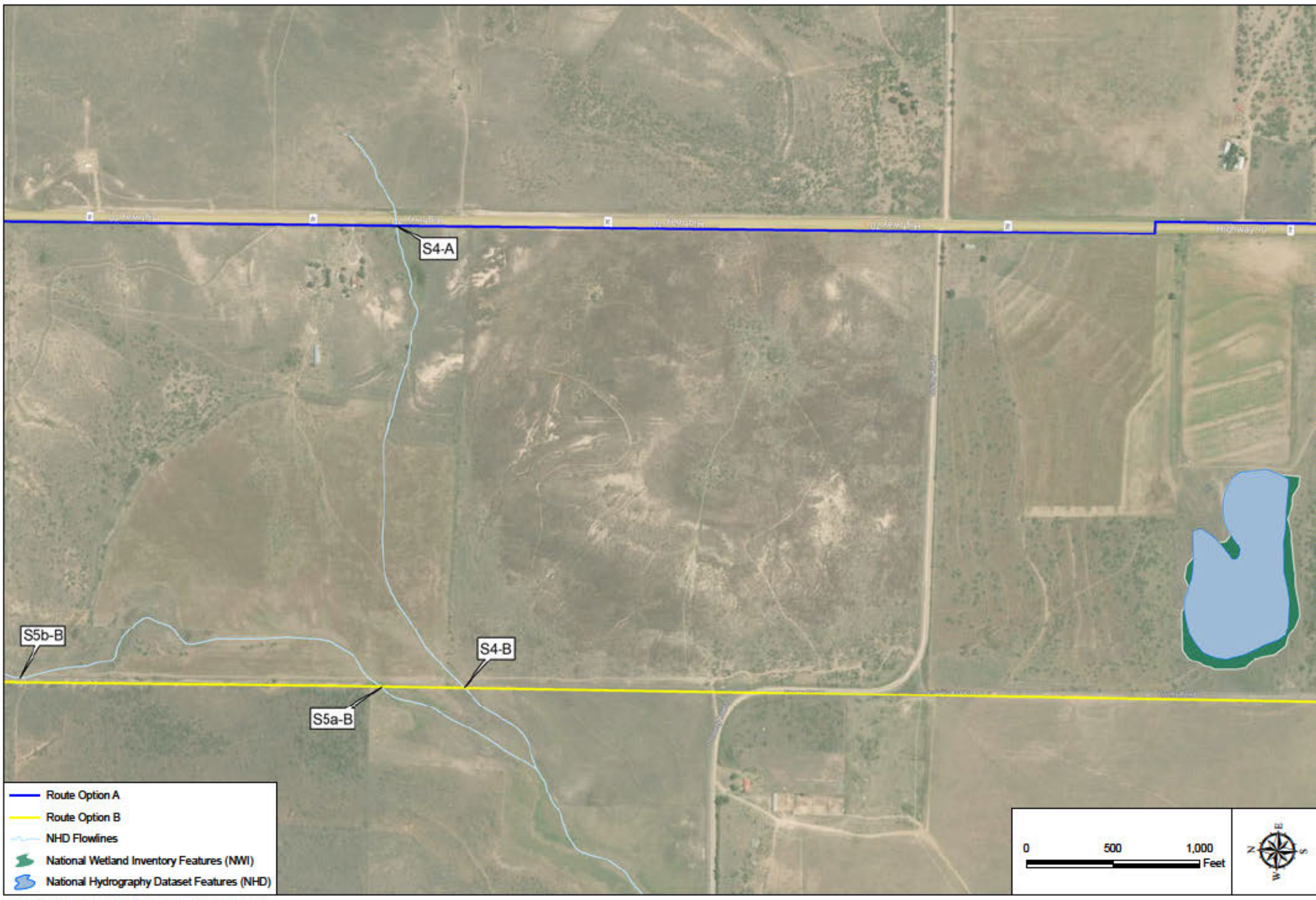

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FIGURE 1.5

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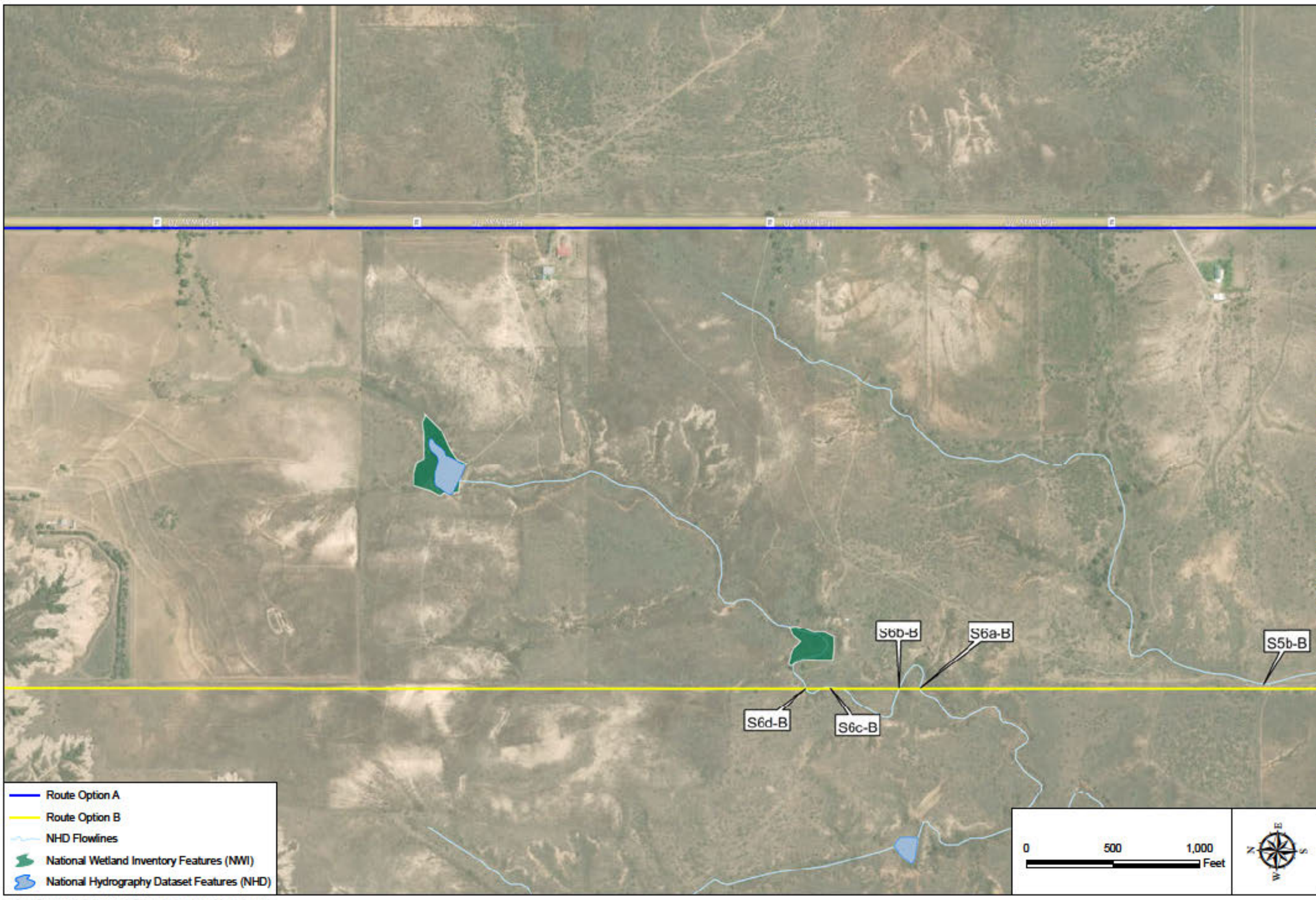

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FIGURE

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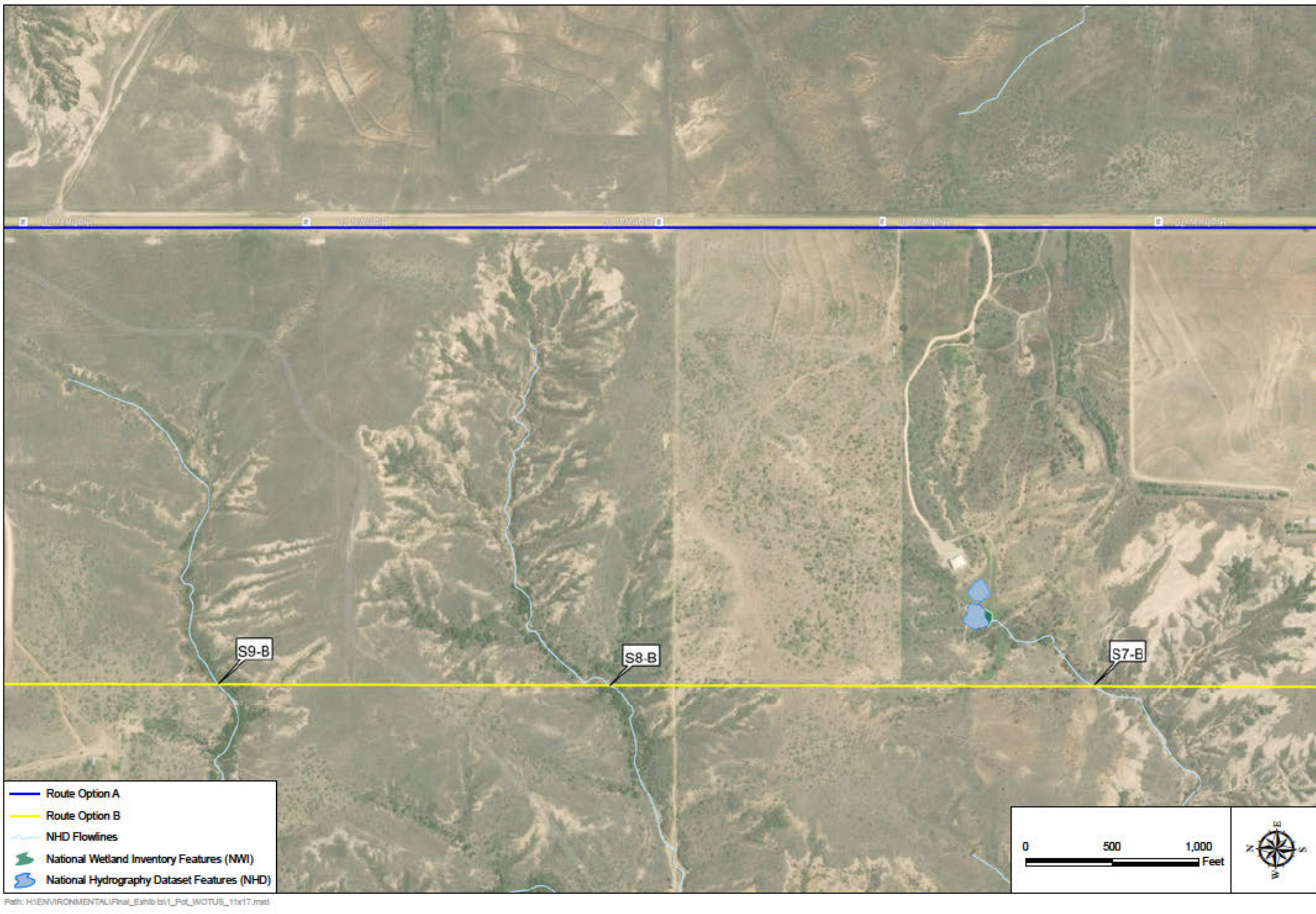

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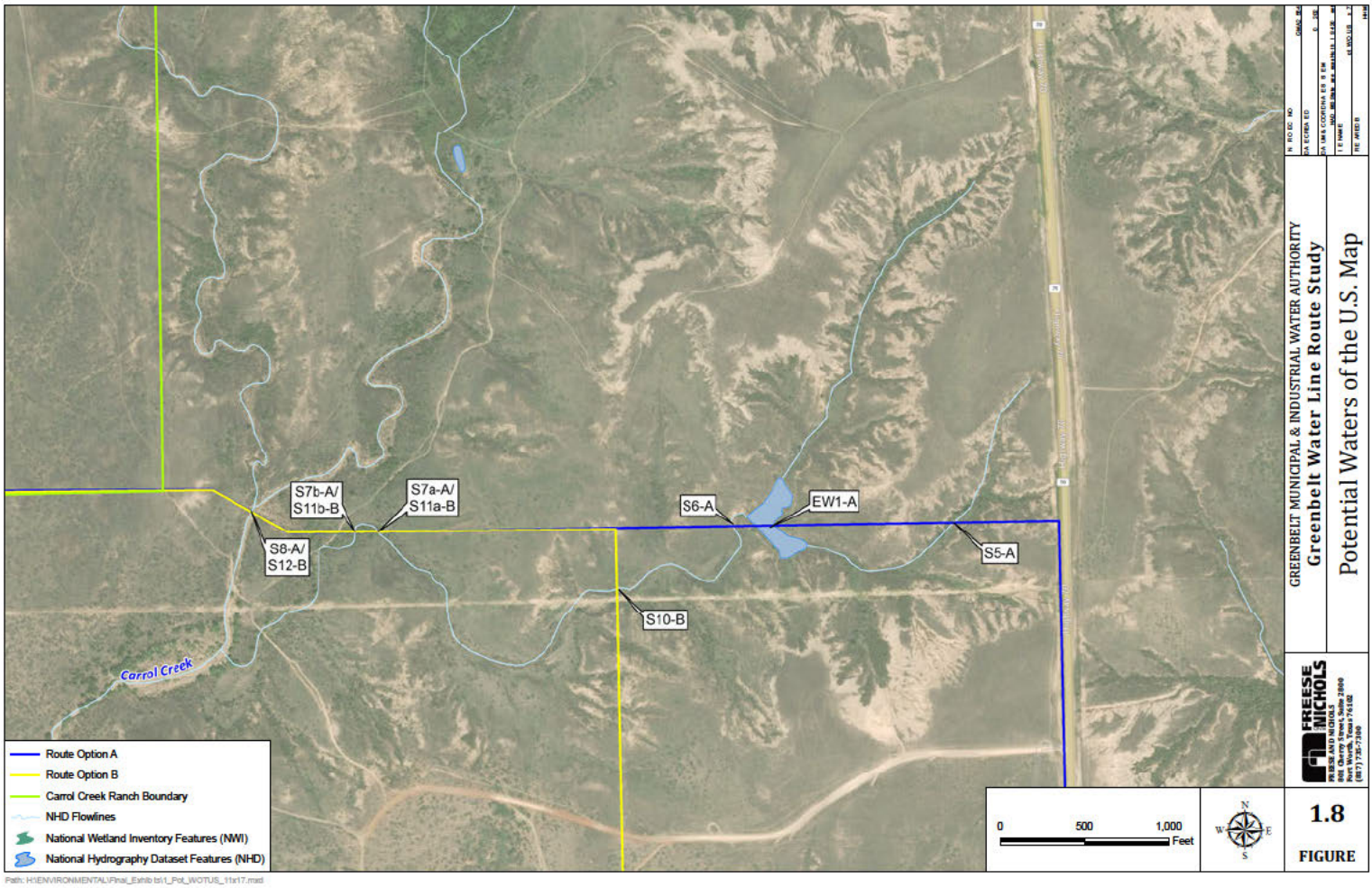
FIGURE 1.7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S11a-B
S8-A/
S12-B
S6-A
EW1-A
S5-A
S10-B
Carrol Creek
Route Option A
Route Option B
Carrol Creek Ranch Boundary
NHD Flowlines
National Wetland Inventory Features (NWI)
National Hydrography Dataset Features (NHD)
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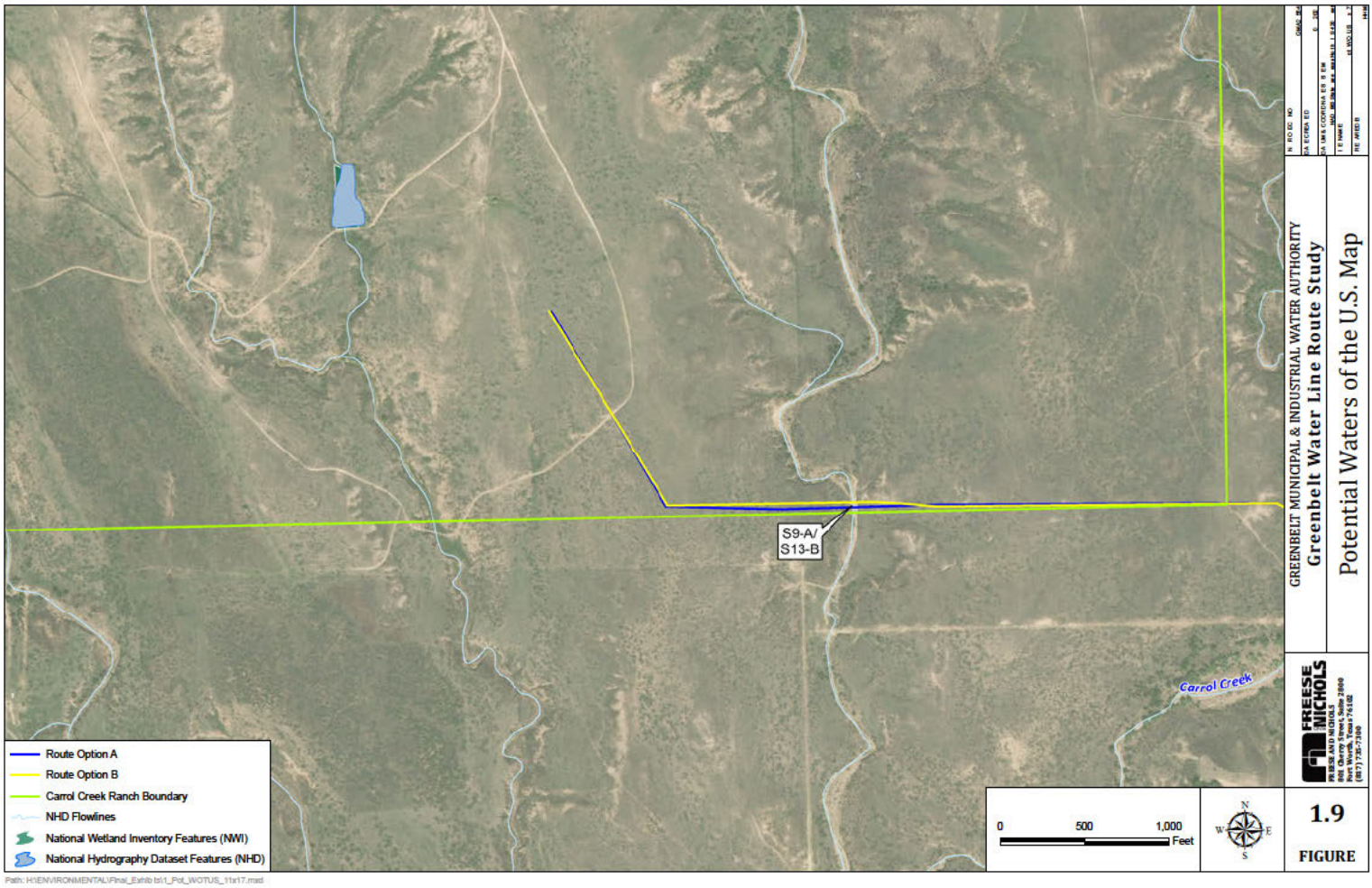
GREENBELT MUNICIPAL & INDUSTRIAL WATER AUTHORITY
Greenbelt Water Line Route Study
Potential Waters of the U.S. Map
FREESE NICHOLS
1.8
FIGURE


S9-A/
S13-B
Carrol Creek
Route Option A
Route Option B
Carrol Creek Ranch Boundary
NHD Flowlines
National Wetland Inventory Features (NWI)
National Hydrography Dataset Features (NHD)
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GREENBELT MUNICIPAL & INDUSTRIAL WATER AUTHORITY
Greenbelt Water Line Route Study
Potential Waters of the U.S. Map
FREESE NICHOLS
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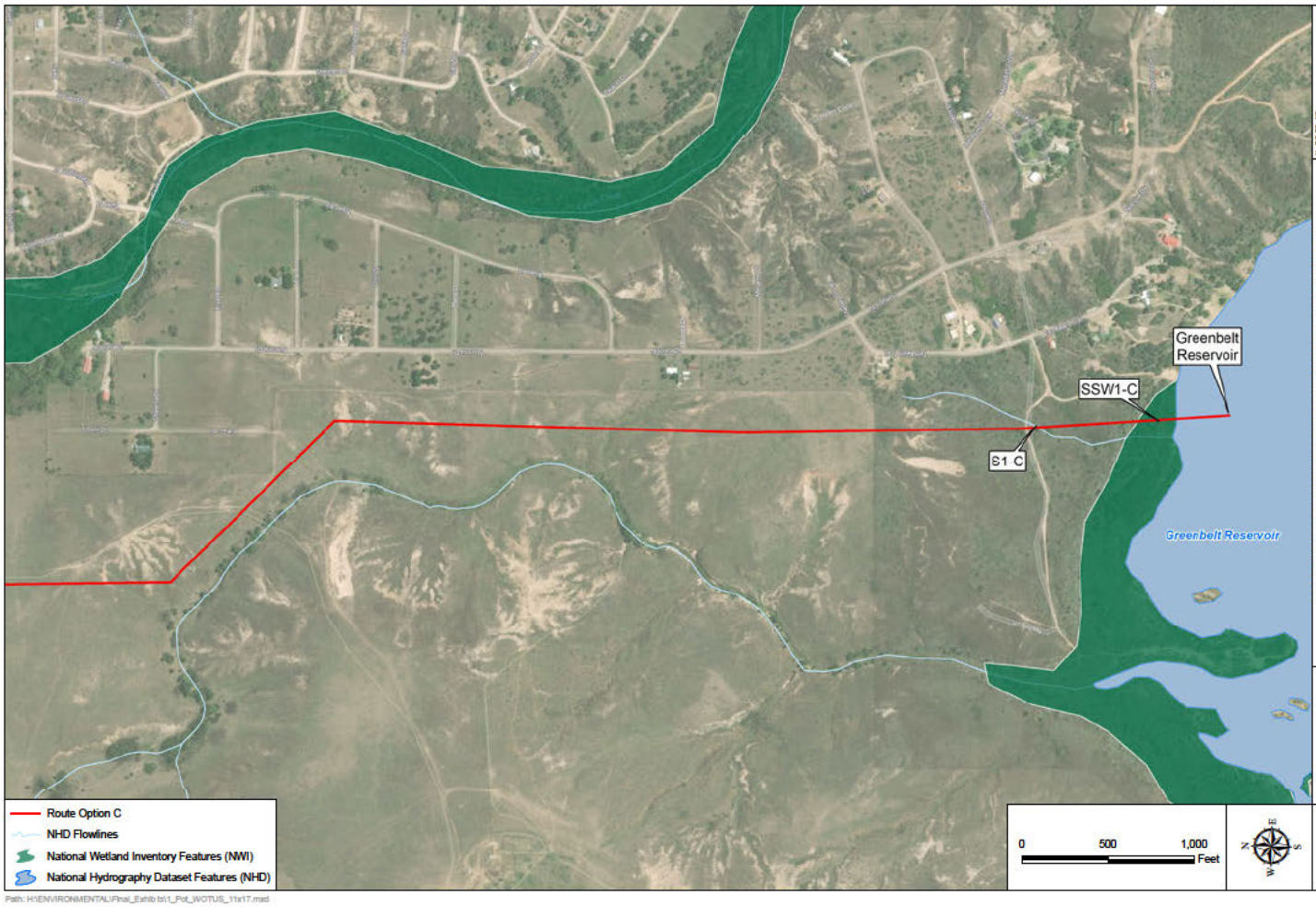
FIGURE



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Greenbelt Water Line Route Study

Potential Waters of the U.S. Map

FREESE NICHOLS

1.10

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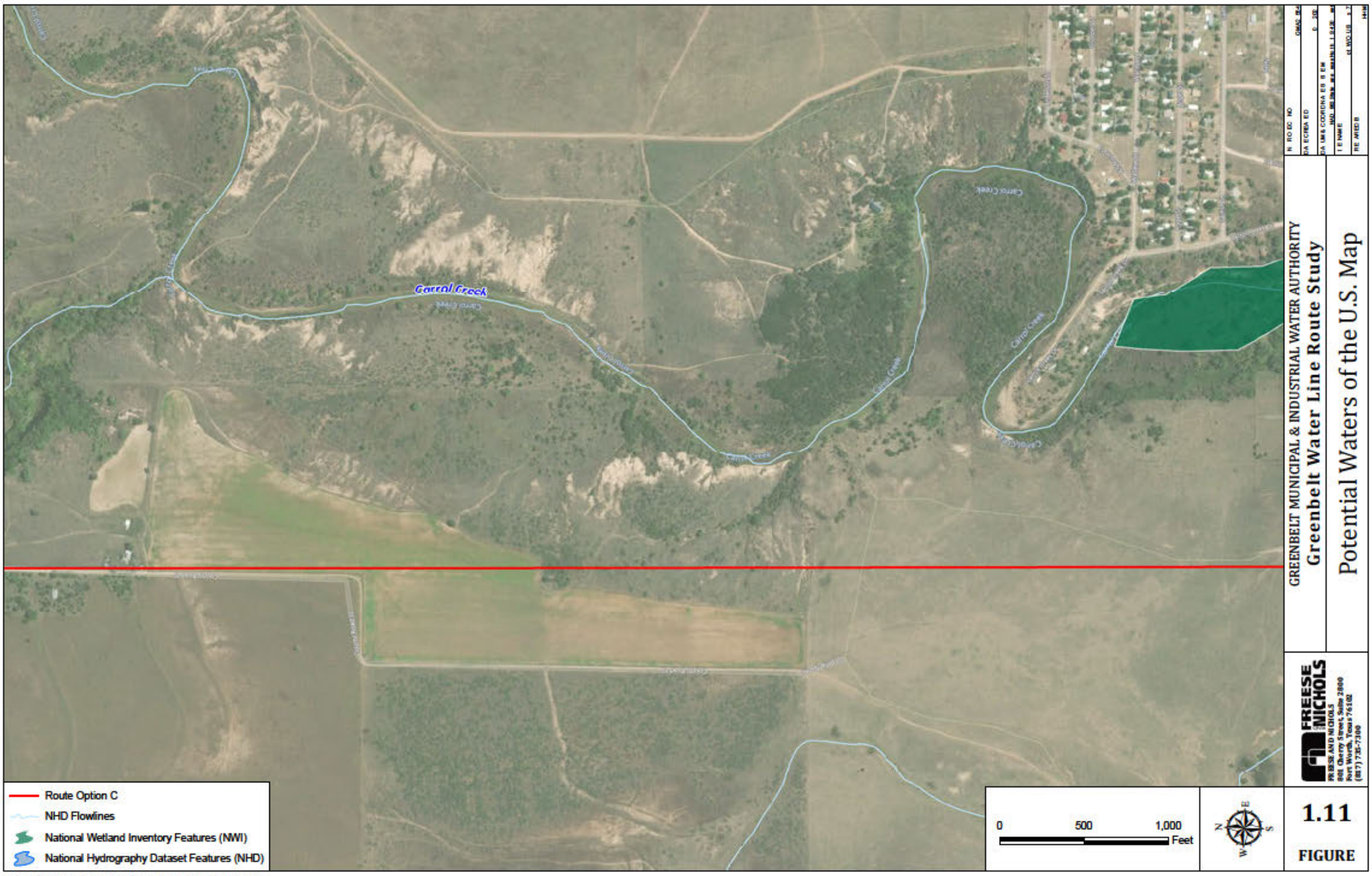

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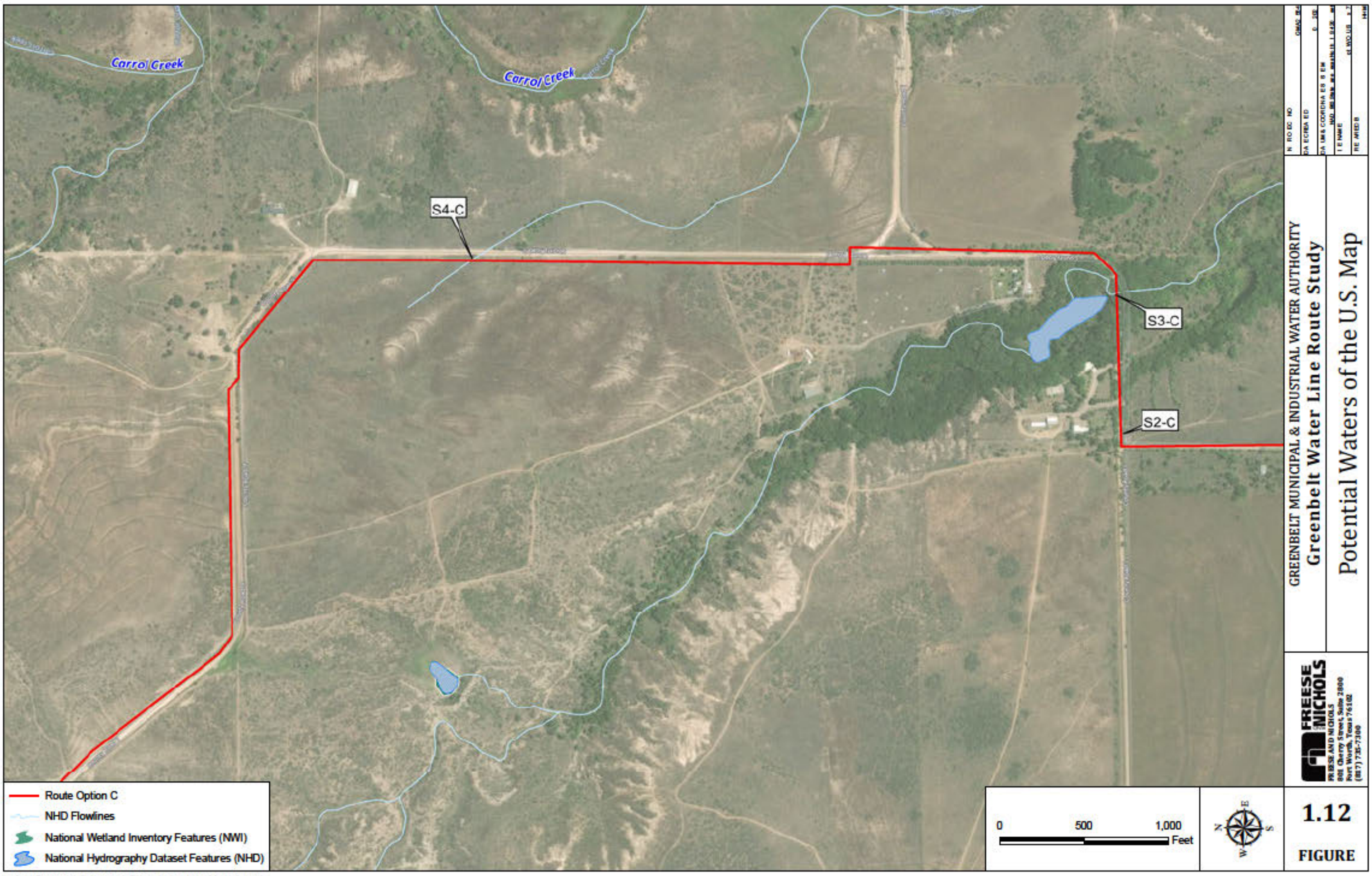

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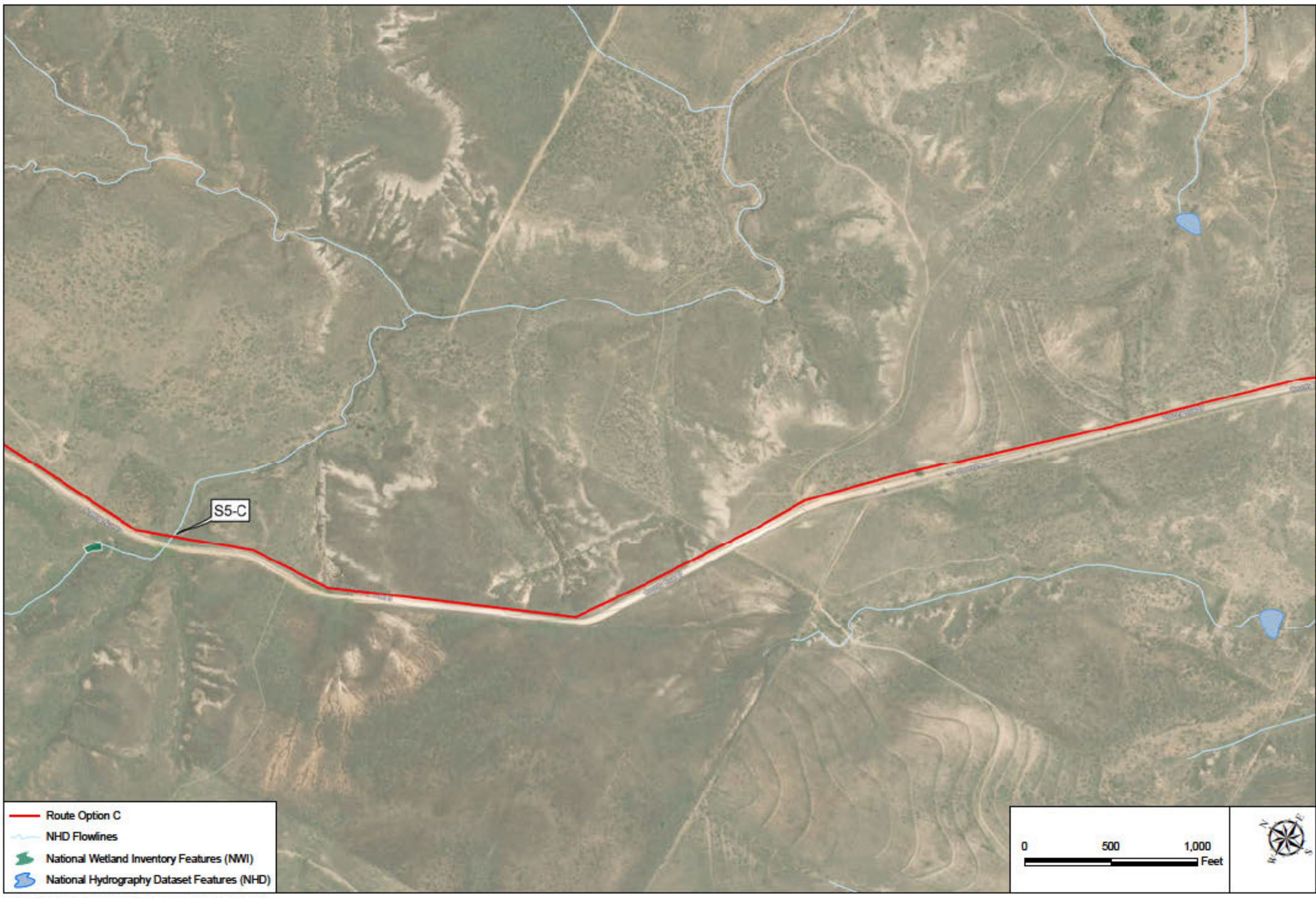

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1.13

FIGURE

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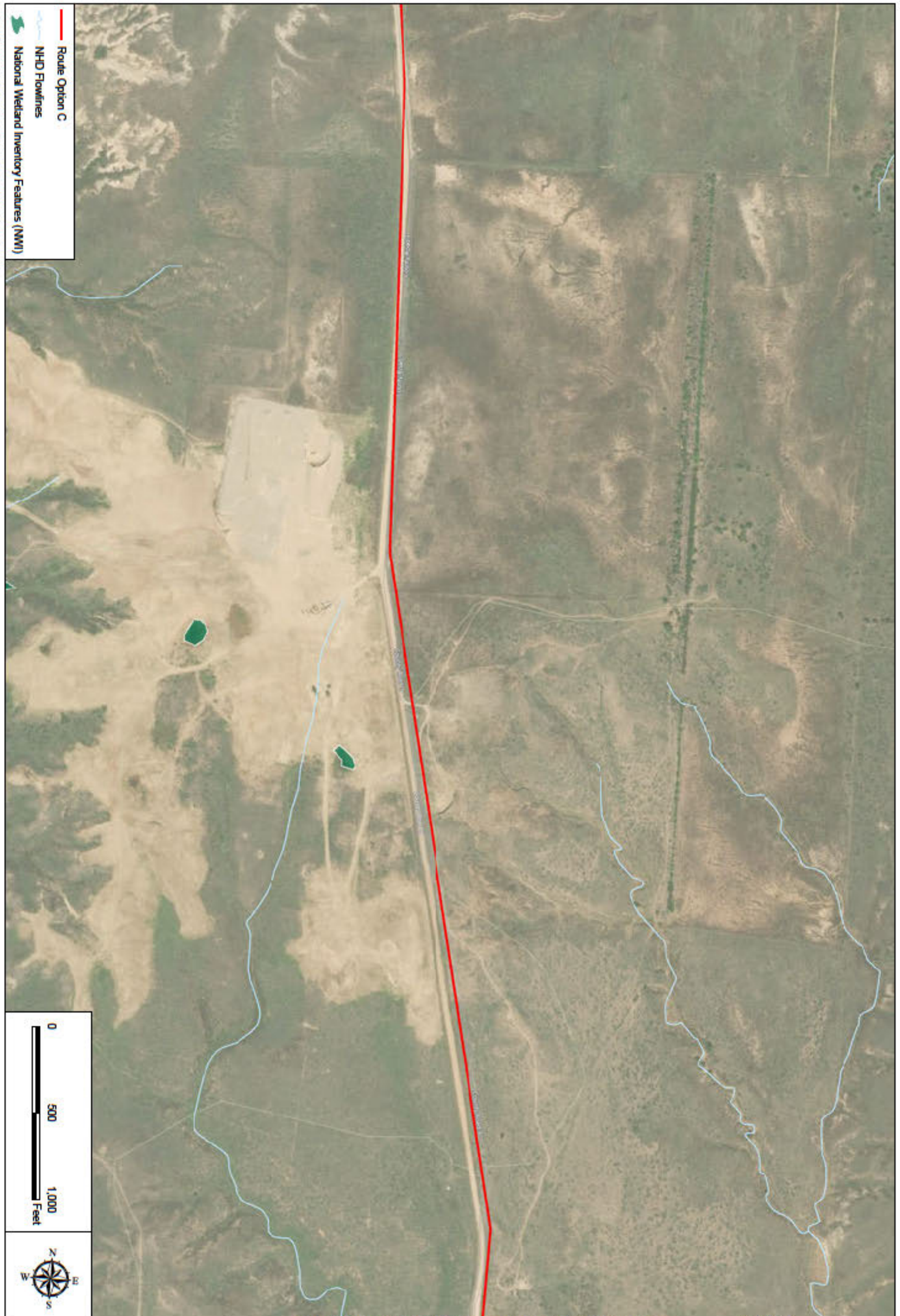

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FIGURE 1.14

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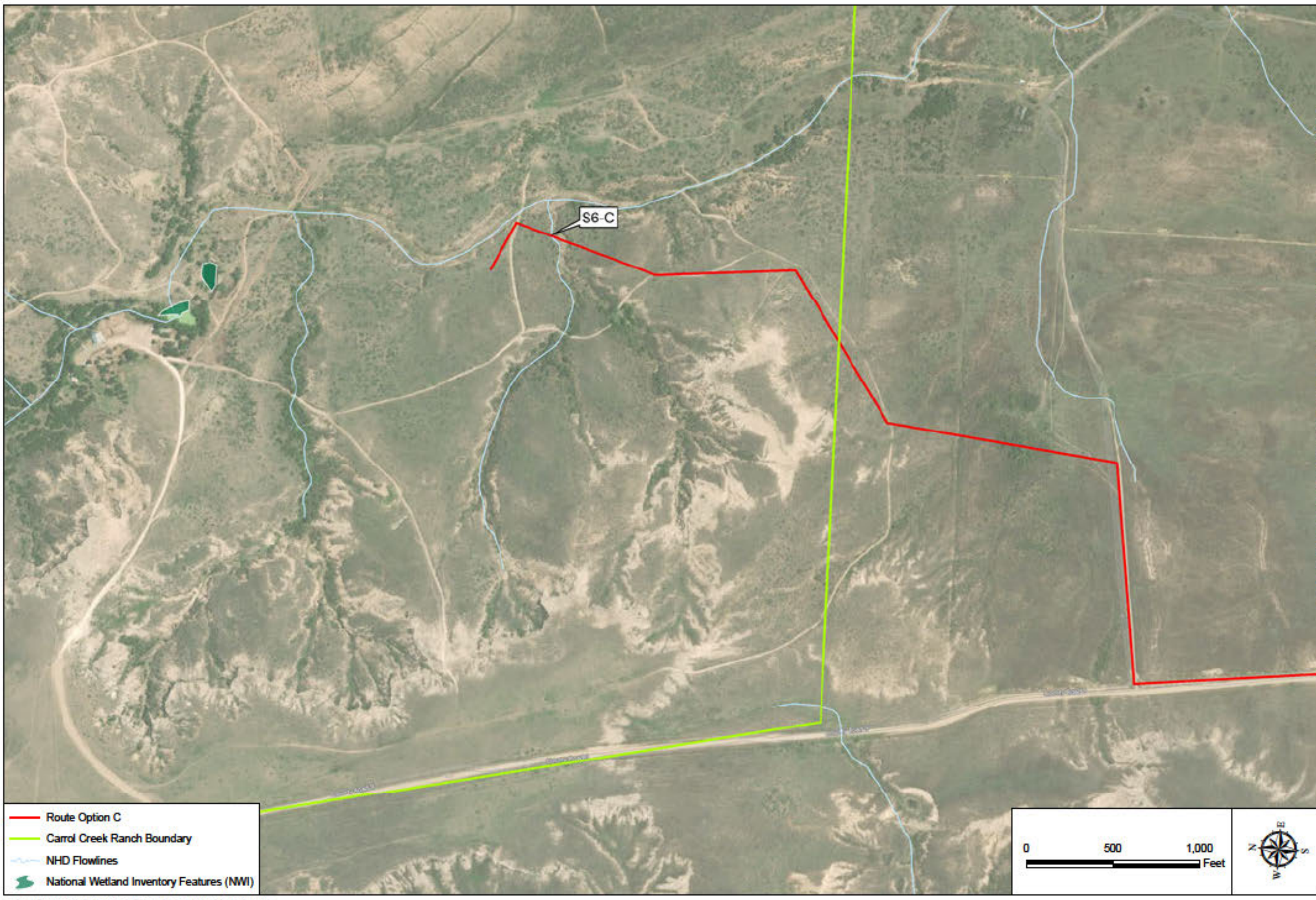

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Greenbelt Water Line Route Study

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1.15

FIGURE

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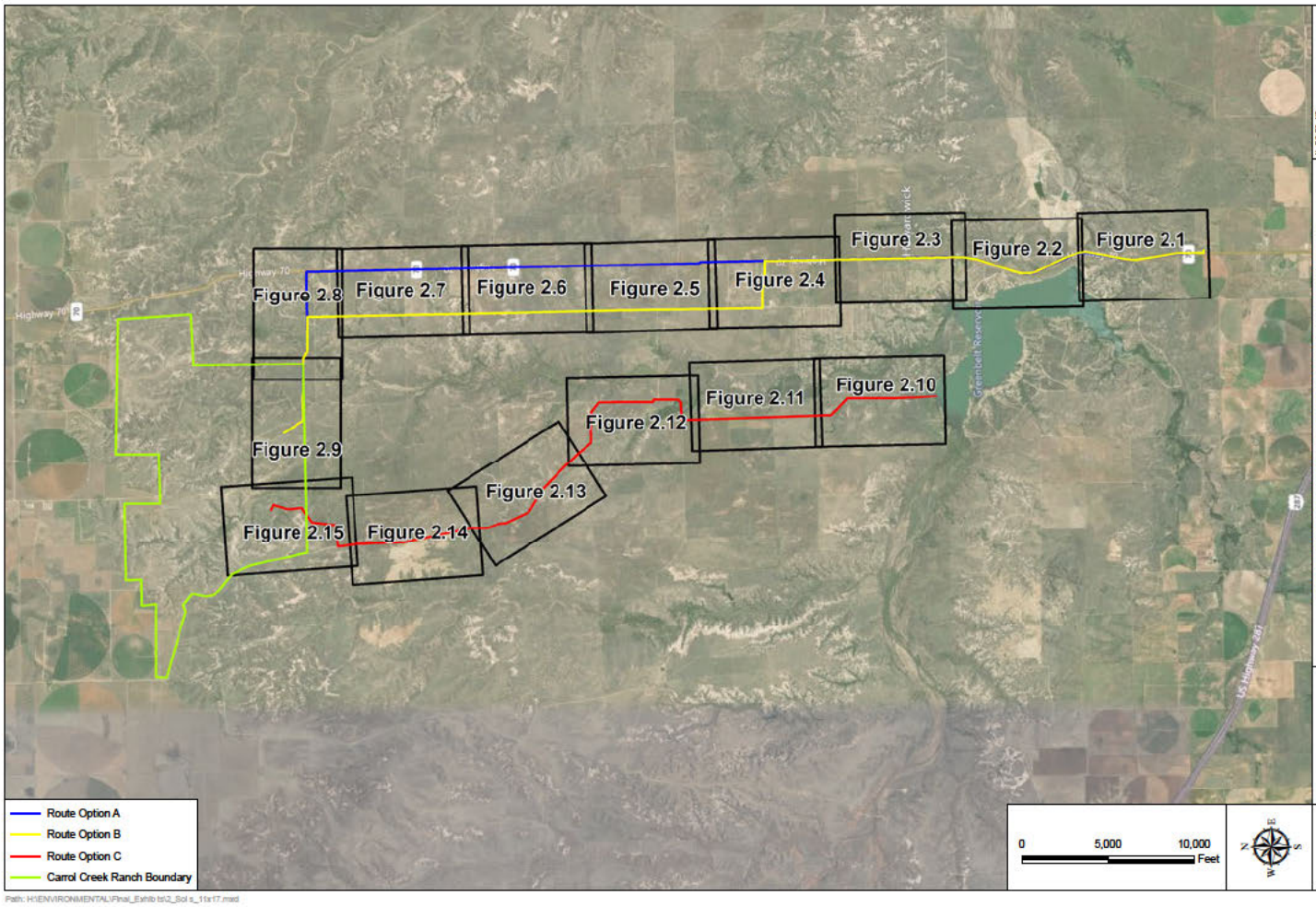


GREENBELT MUNICIPAL & INDUSTRIAL WATER AUTHORITY

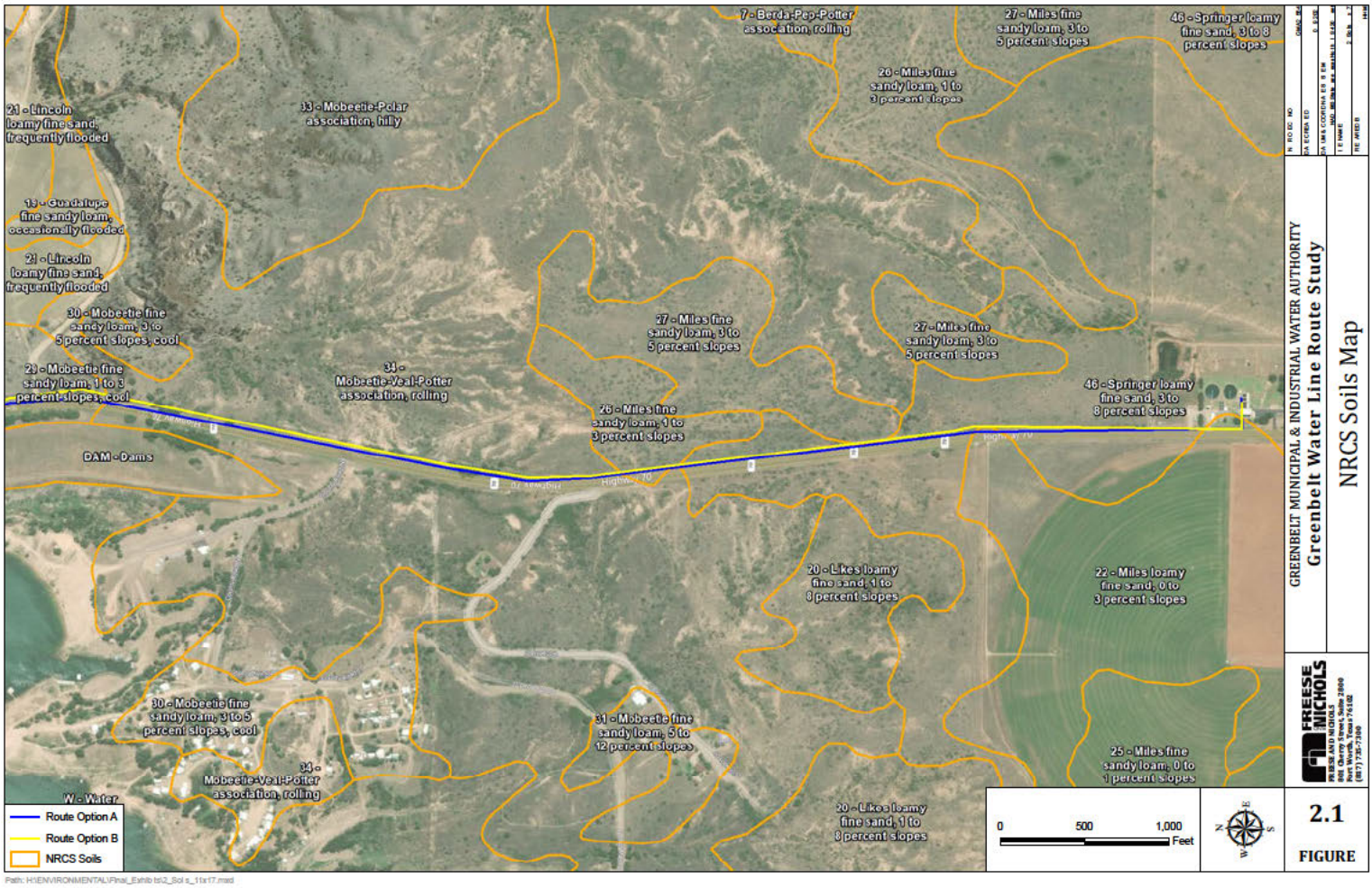
Greenbelt Water Line Route Study

NRCS Soils Map

FREESE NICHOLS

2.0

FIGURE



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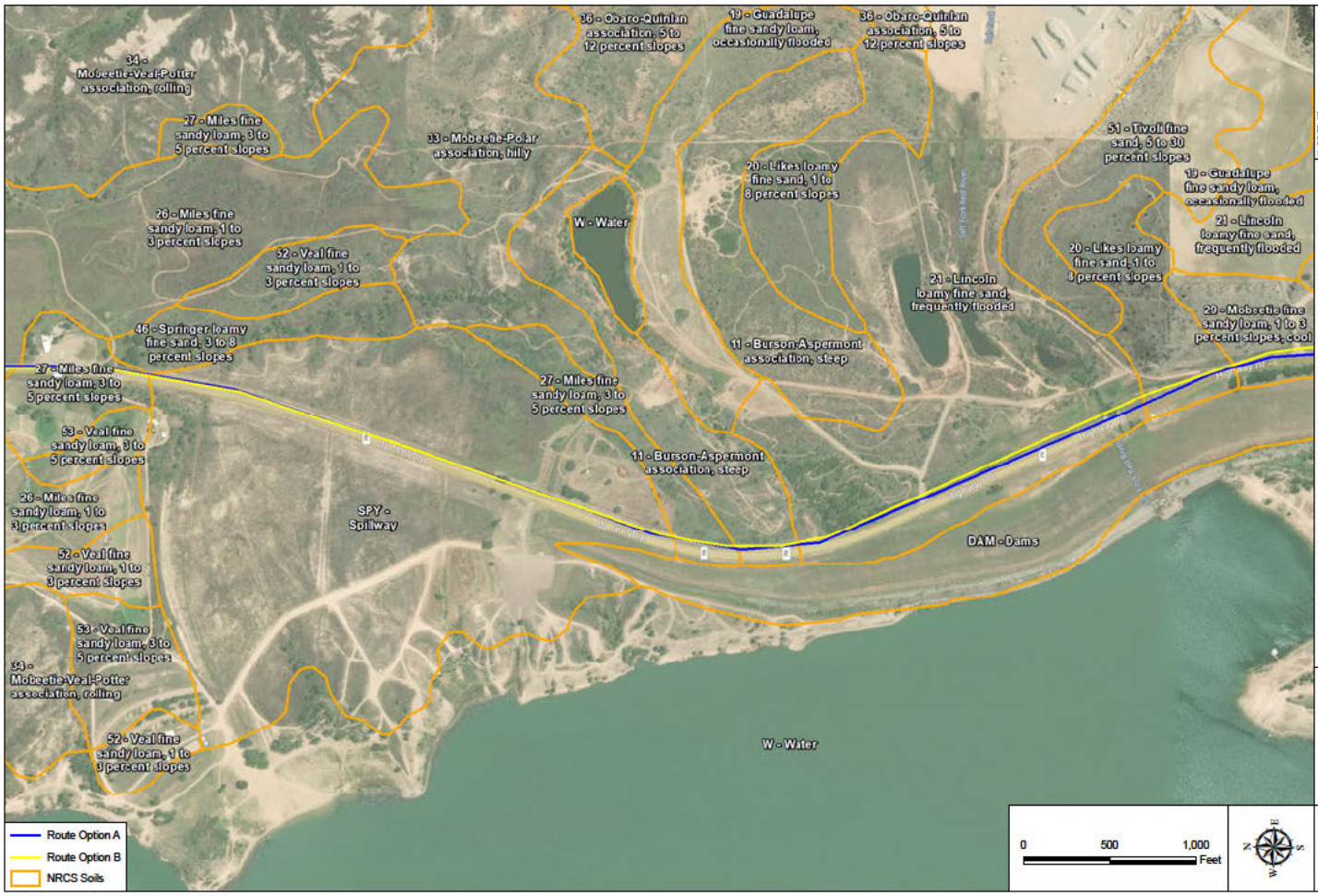

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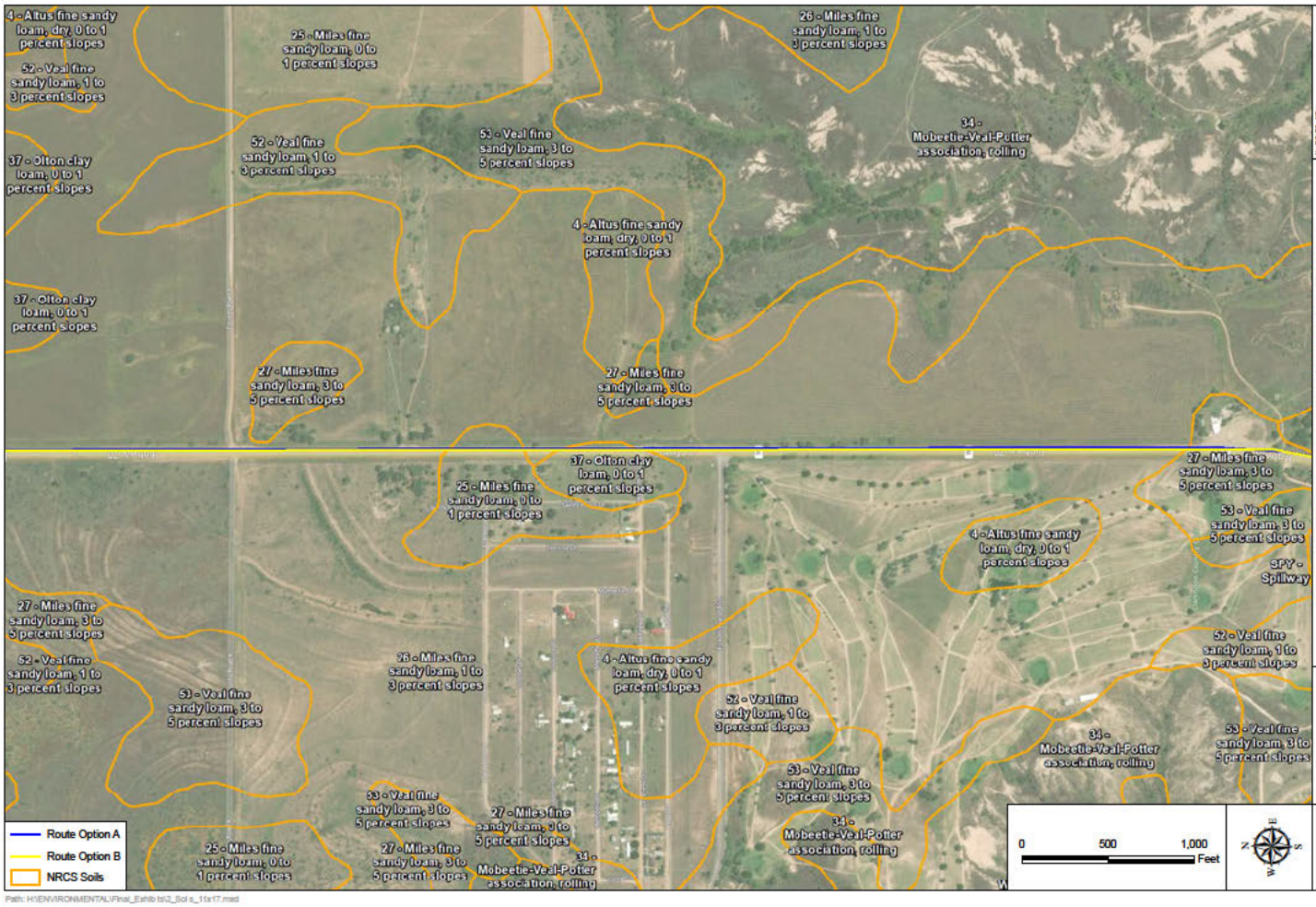

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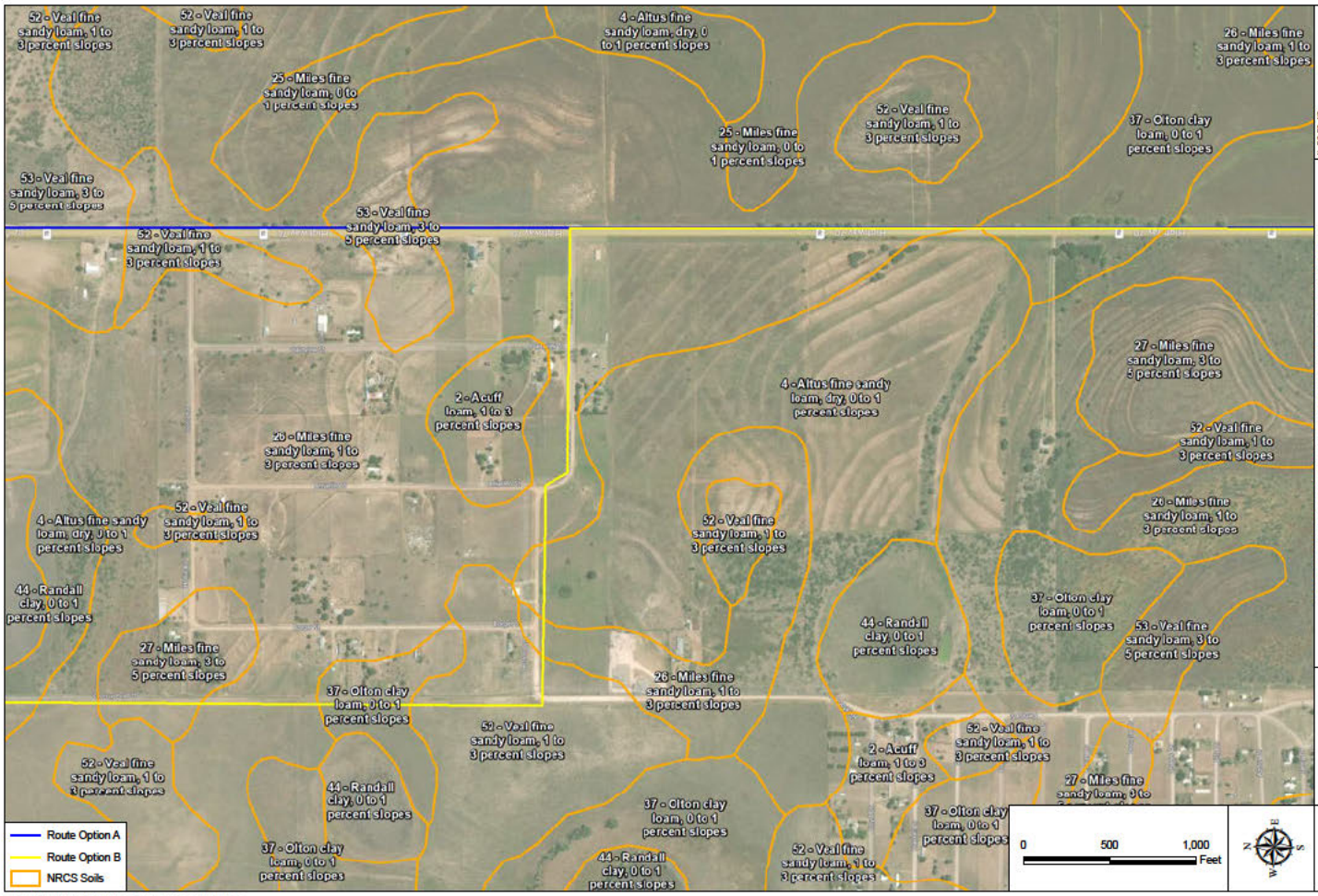

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Greenbelt Water Line Route Study

NRCS Soils Map

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2.4

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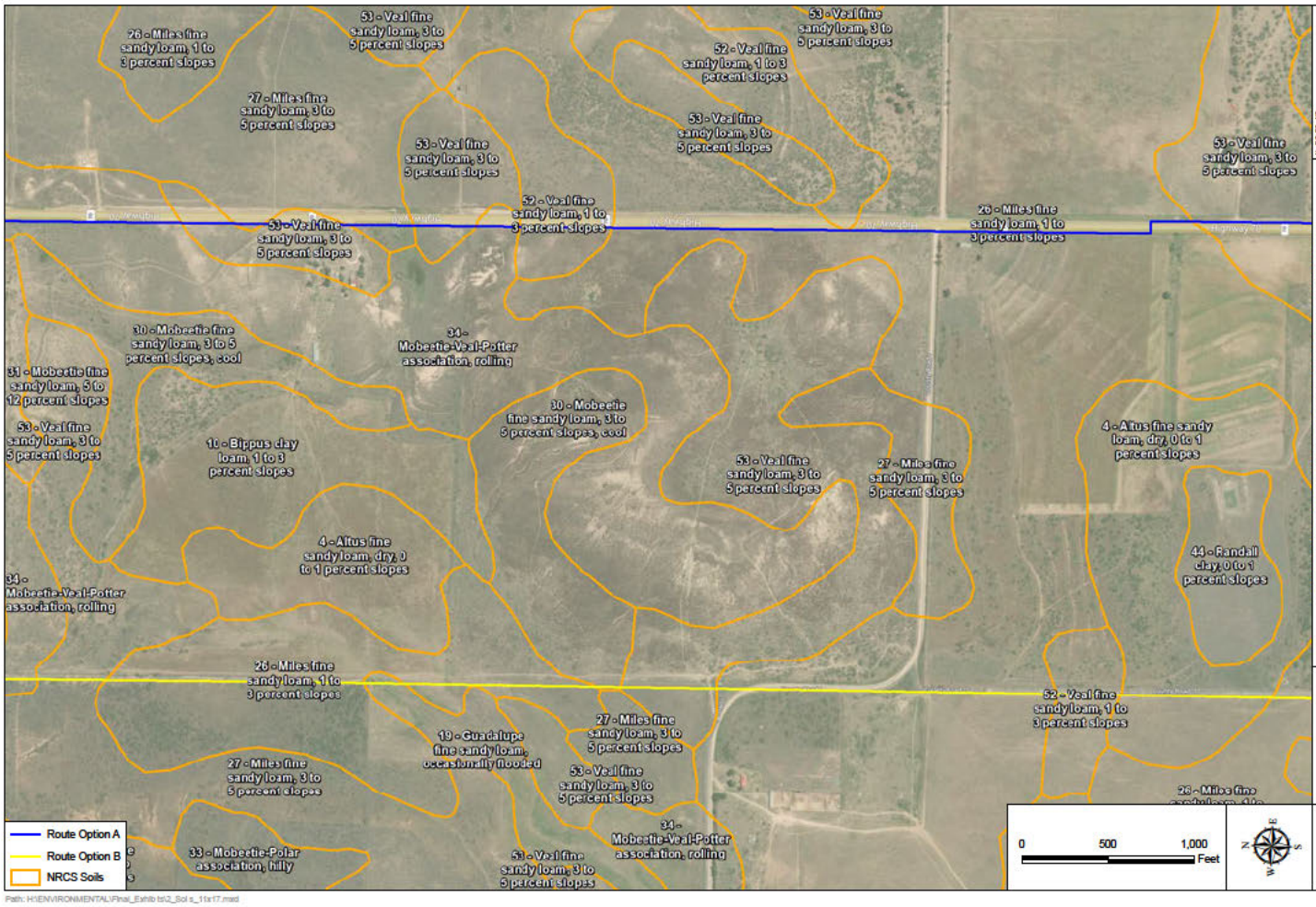
26 - Miles fine sandy loam, 1 to 3 percent slopes
53 - Veal fine sandy loam, 3 to 5 percent slopes
52 - Veal fine sandy loam, 1 to 3 percent slopes
27 - Miles fine sandy loam, 3 to 5 percent slopes
30 - Mobeetie fine sandy loam, 3 to 5 percent slopes, cool
34 - Mobeetie-Veal-Potter association, rolling
31 - Mobeetie fine sandy loam, 5 to 12 percent slopes
10 - Bippus clay loam, 1 to 3 percent slopes
4 - Altus fine sandy loam, dry, 0 to 1 percent slopes
44 - Randall clay, 0 to 1 percent slopes
19 - Guadalupe fine sandy loam, occasionally flooded
33 - Mobeetie-Polar association, hilly
Highway 70
Route Option A
Route Option B
NRCS Soils
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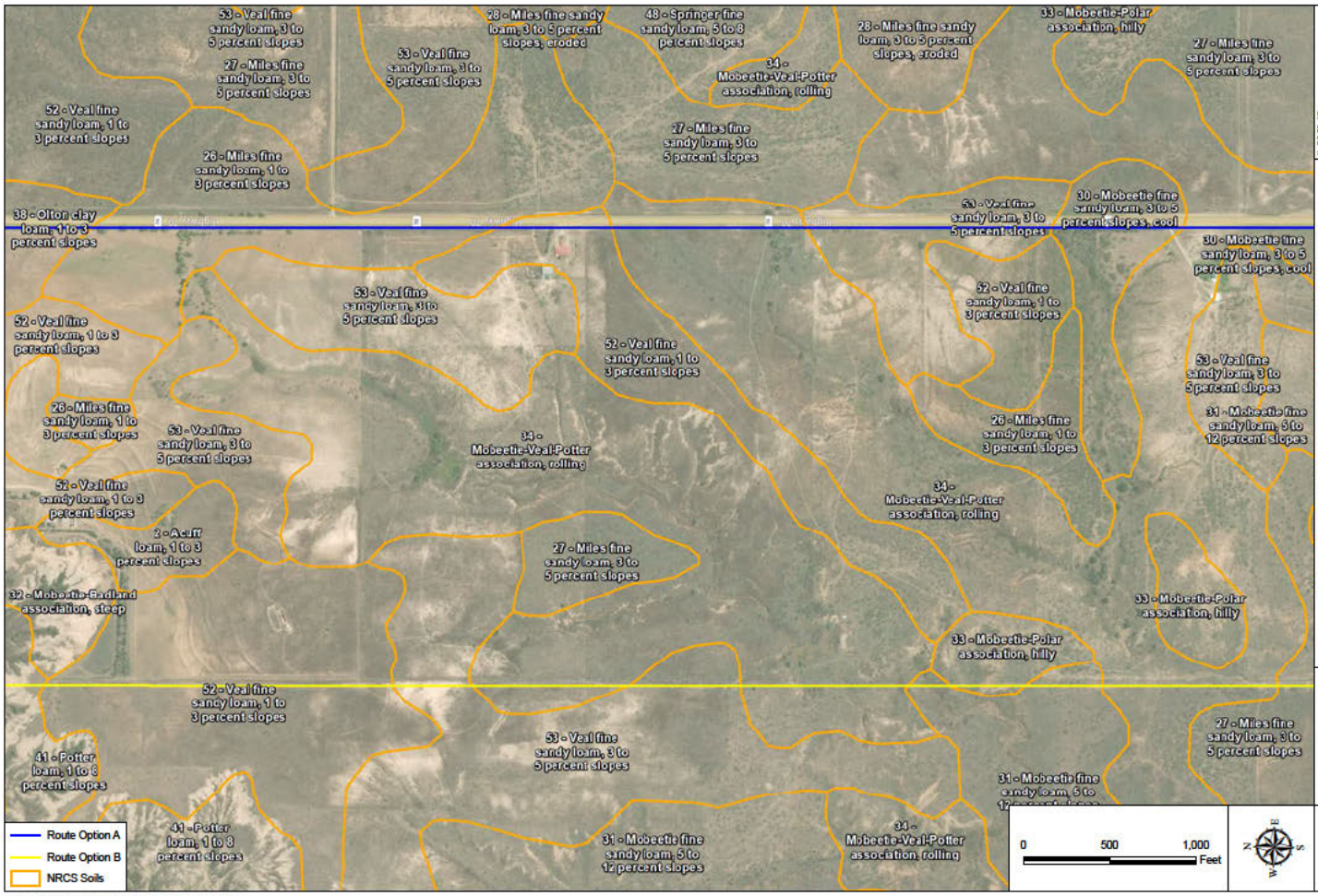
GREENBELT MUNICIPAL & INDUSTRIAL WATER AUTHORITY
Greenbelt Water Line Route Study
NRCS Soils Map
FREESE NICHOLS
2.5
FIGURE



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Greenbelt Water Line Route Study

NRCS Soils Map

FREESE NICHOLS

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FIGURE

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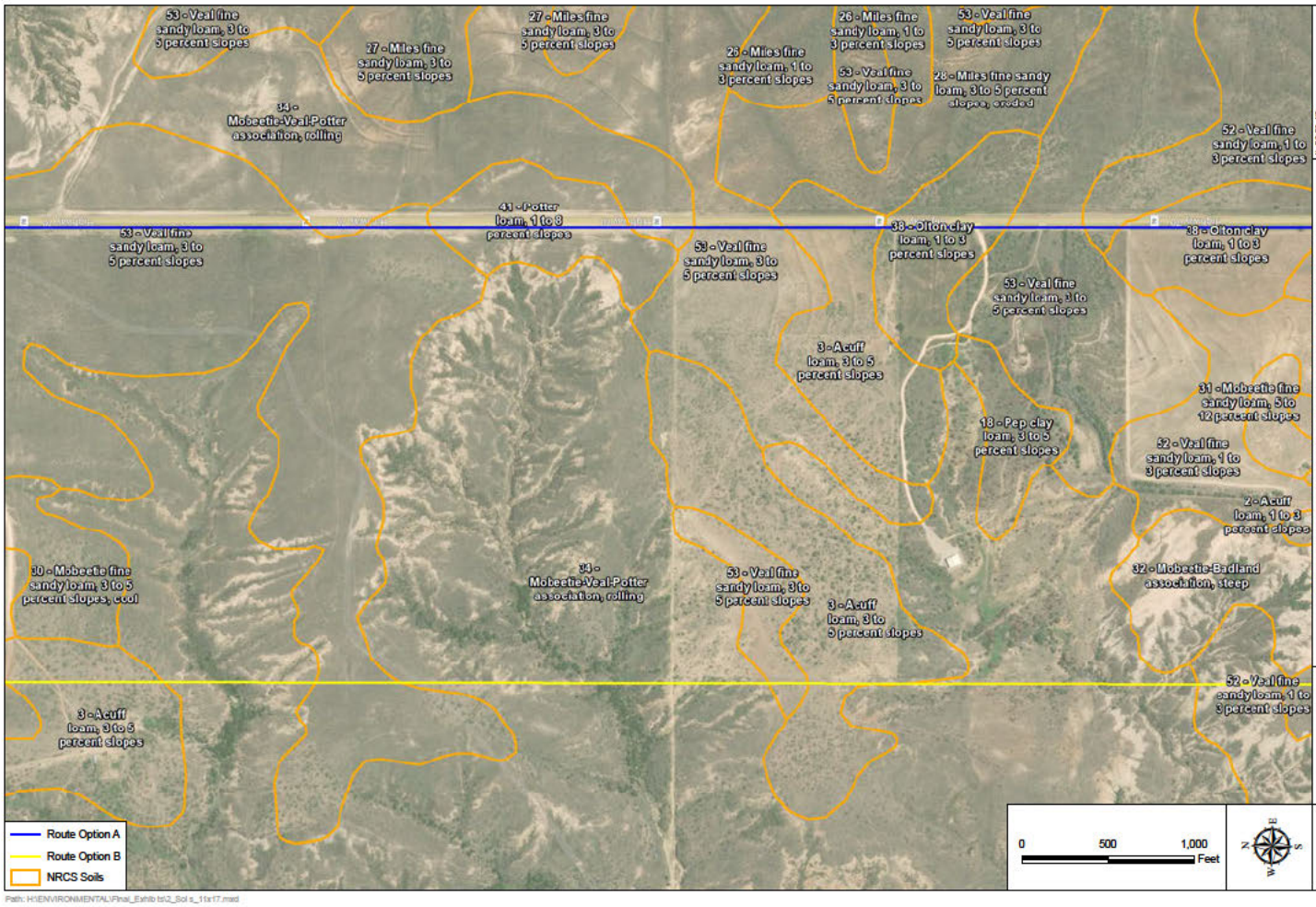

GREENBELT MUNICIPAL & INDUSTRIAL WATER AUTHORITY

Greenbelt Water Line Route Study

NRCS Soils Map

FREESE NICHOLS

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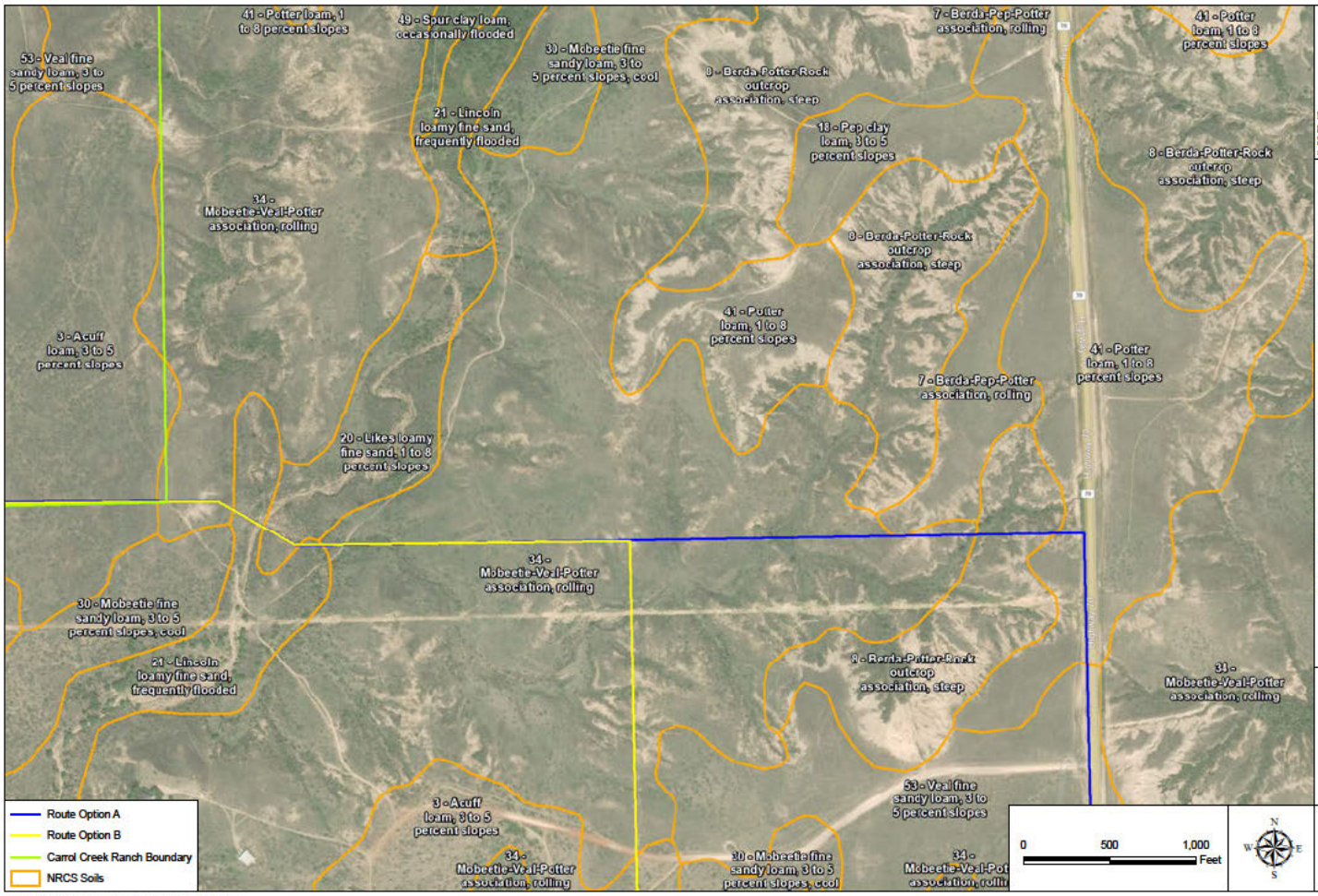

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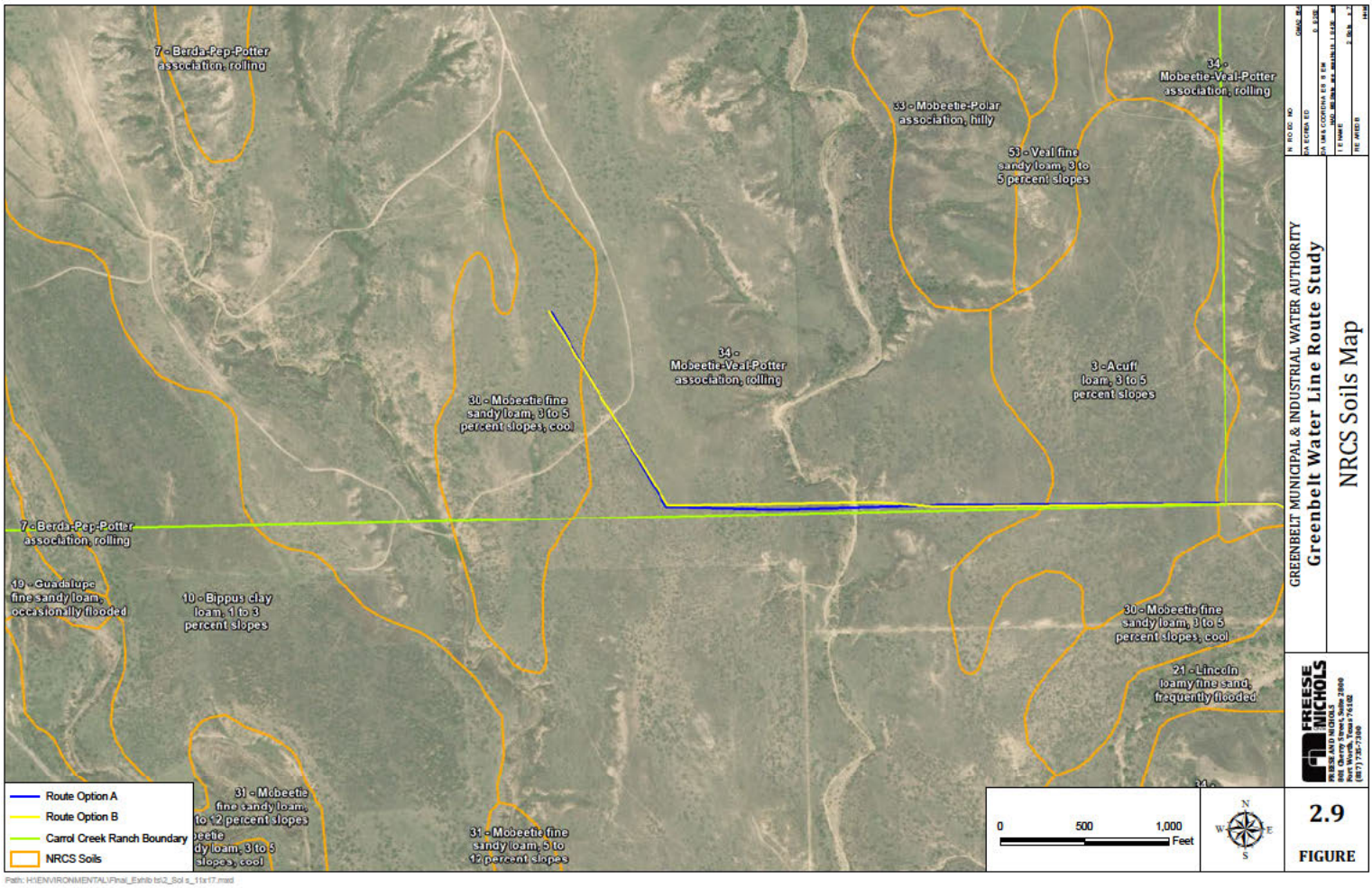
7 - Berda-Pep-Potter association, rolling
34 - Mobeetie-Veal-Potter association, rolling
33 - Mobeetie-Polar association, hilly
53 - Veal fine sandy loam, 3 to 5 percent slopes
34 - Mobeetie-Veal-Potter association, rolling
3 - Acuff loam, 3 to 5 percent slopes
30 - Mobeetie fine sandy loam, 3 to 5 percent slopes, cool
7 - Berda-Pep-Potter association, rolling
19 - Guadalupe fine sandy loam, occasionally flooded
10 - Bippus clay loam, 1 to 3 percent slopes
30 - Mobeetie fine sandy loam, 3 to 5 percent slopes, cool
21 - Lincoln loamy fine sand, frequently flooded
31 - Mobeetie fine sandy loam, 1 to 2 percent slopes
31 - Mobeetie fine sandy loam, 5 to 12 percent slopes
Route Option A
Route Option B
Carrol Creek Ranch Boundary
NRCS Soils
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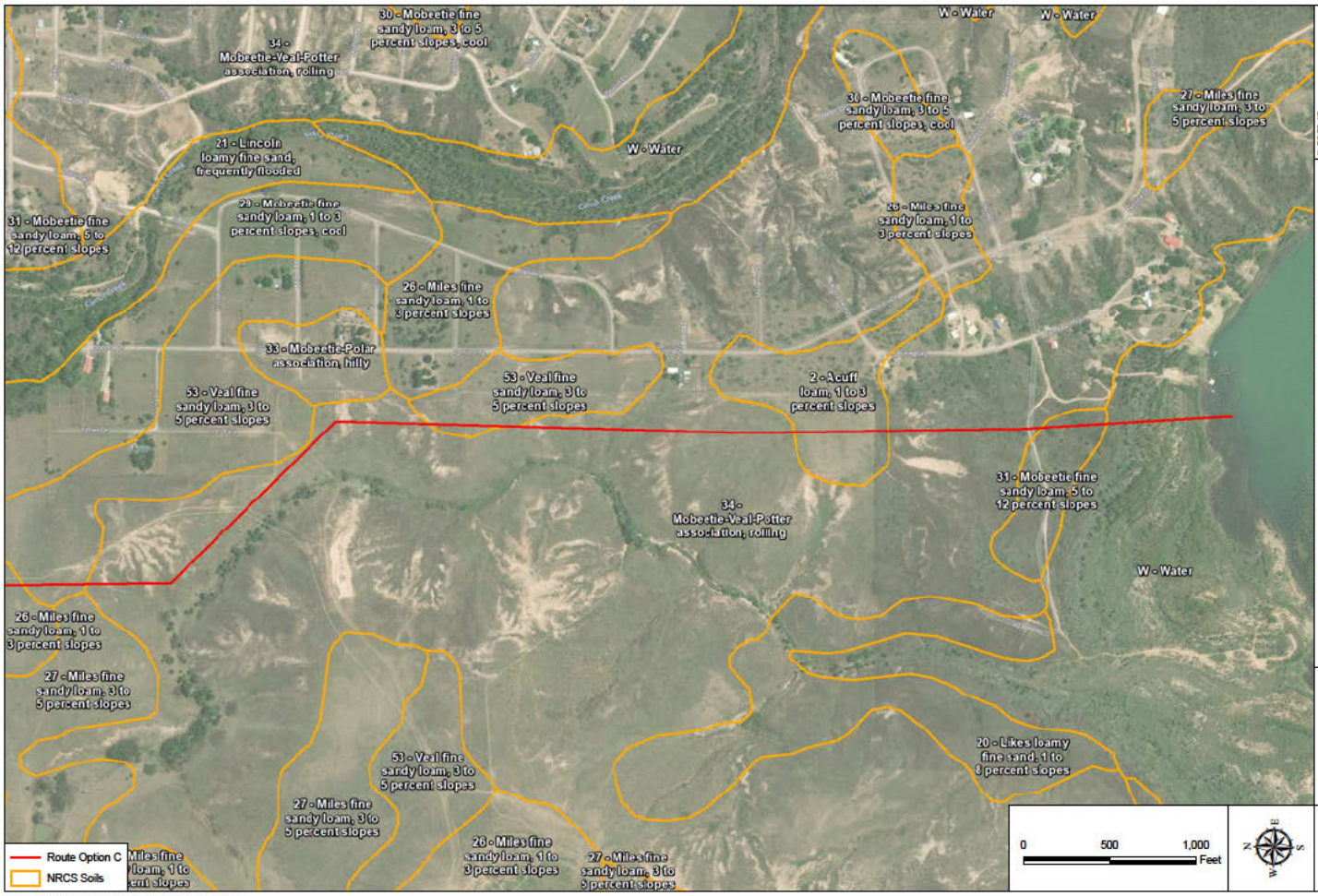
GREENBELT MUNICIPAL & INDUSTRIAL WATER AUTHORITY
Greenbelt Water Line Route Study
NRCS Soils Map
FREESE NICHOLS
FREESE AND NICHOLS
2.9
FIGURE



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(817) 335-7300

2.10

FIGURE

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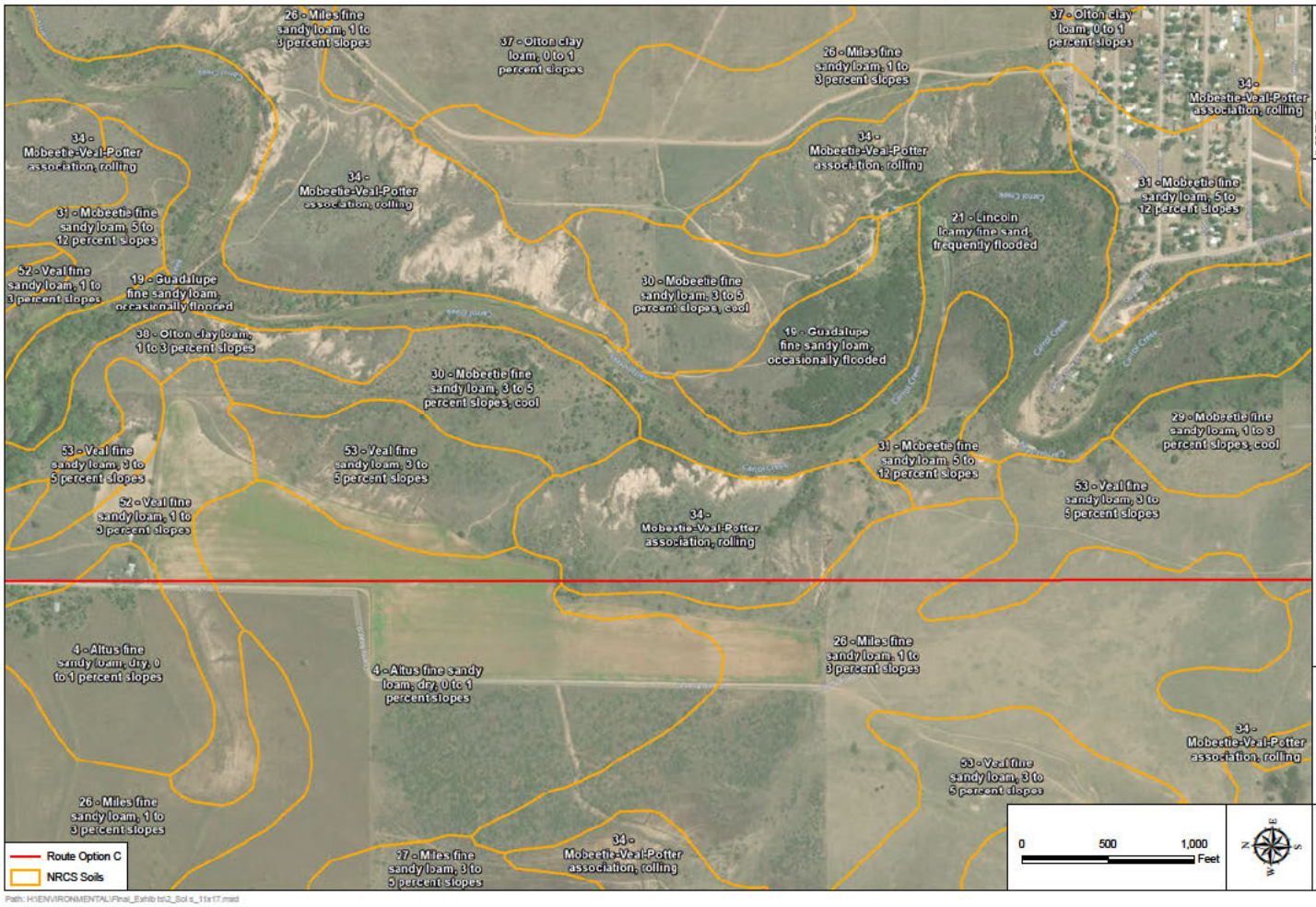

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NRCS Soils Map

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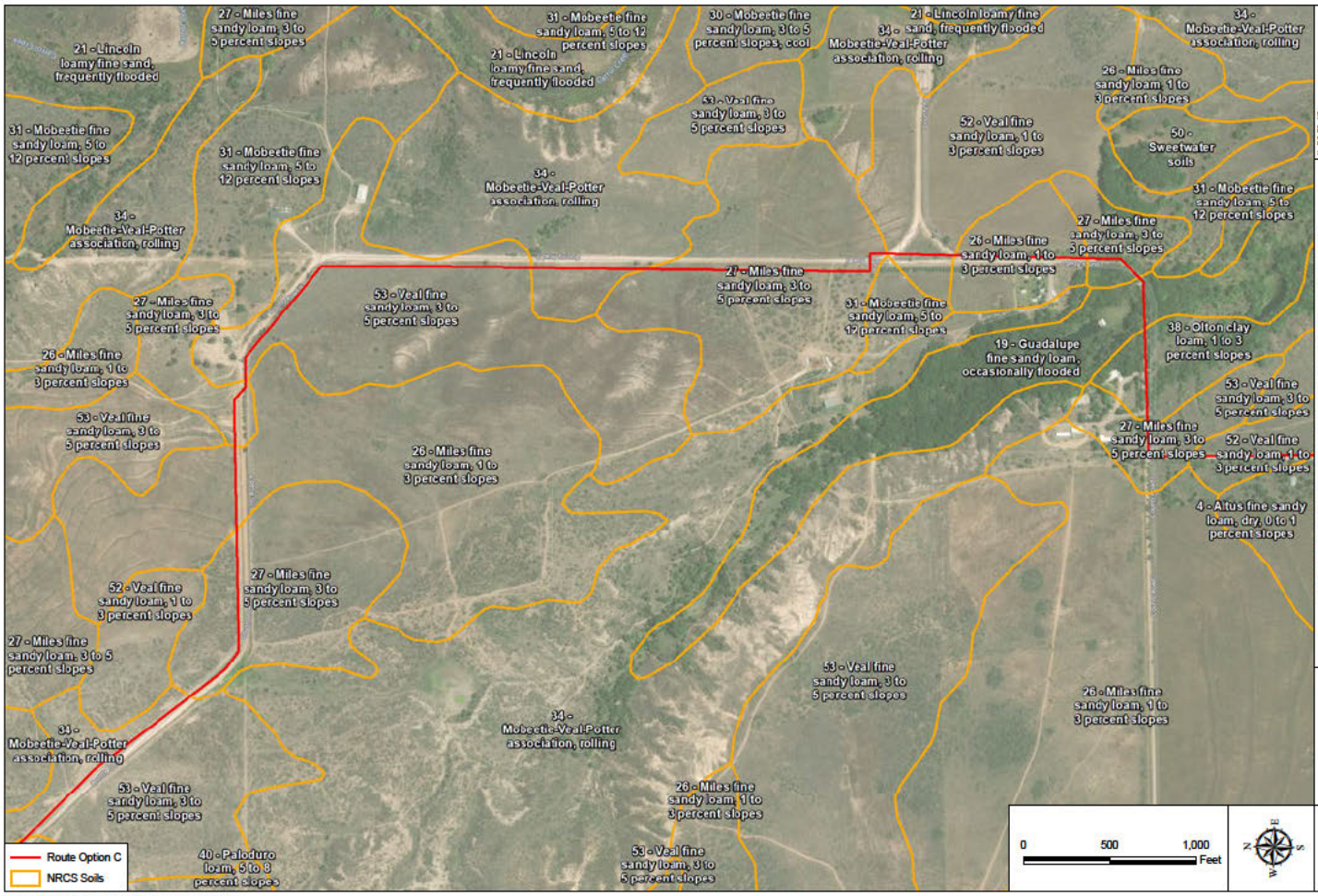

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NRCS Soils Map

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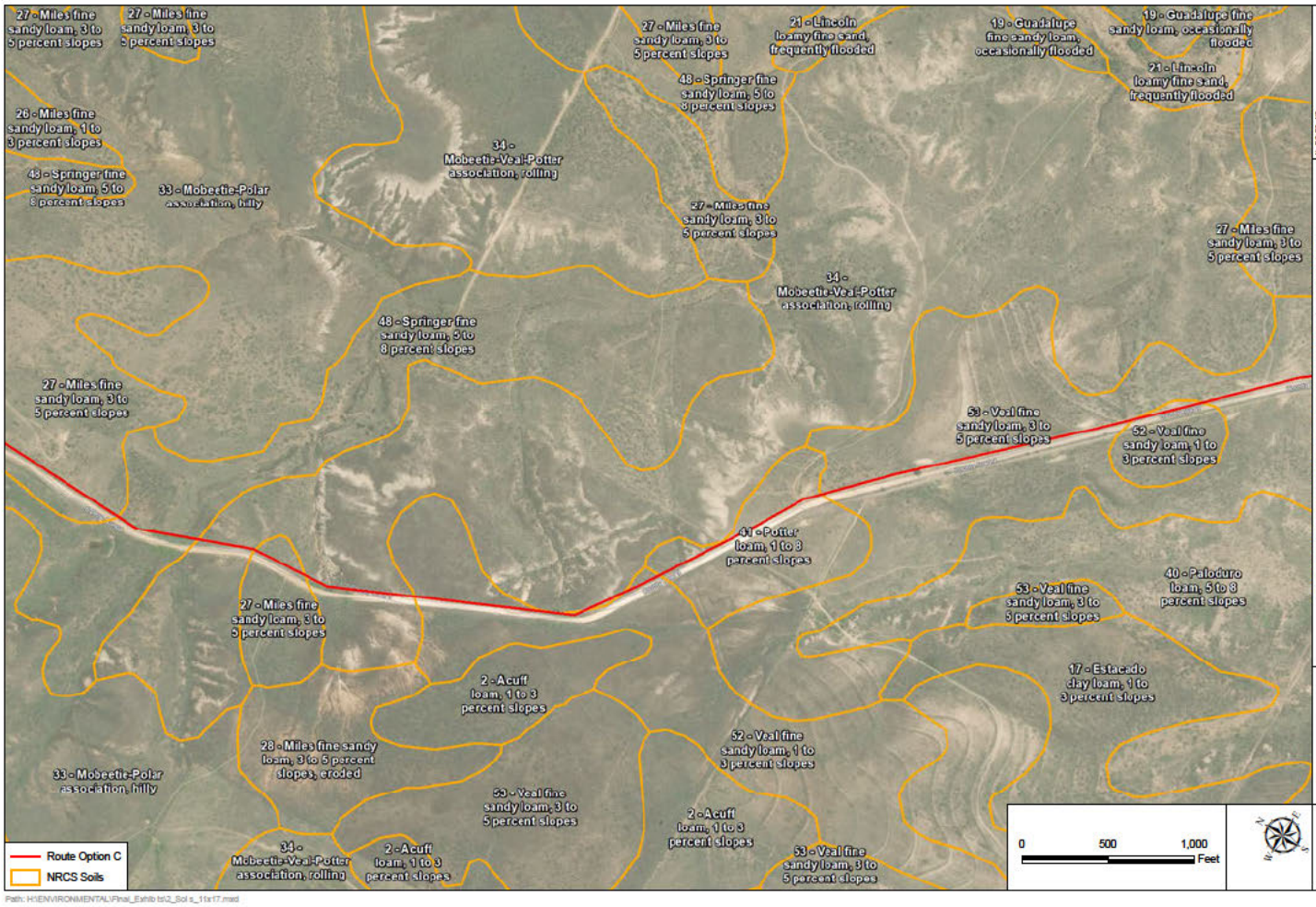

GREENBELT MUNICIPAL & INDUSTRIAL WATER AUTHORITY

Greenbelt Water Line Route Study

NRCS Soils Map

FREESE NICHOLS

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Fort Worth, Texas 76102
(817) 735-7300

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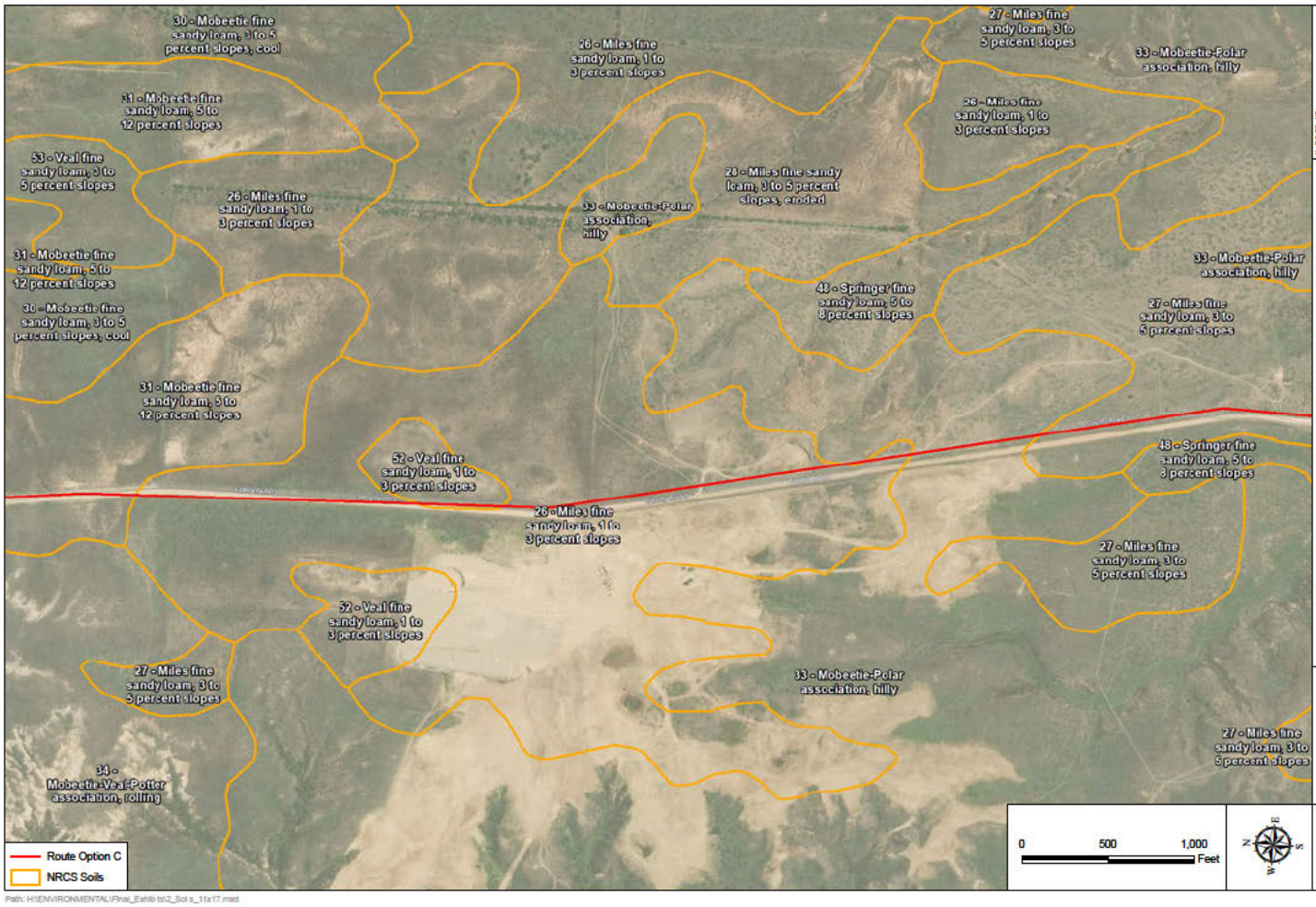

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Greenbelt Water Line Route Study

NRCS Soils Map

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FIGURE

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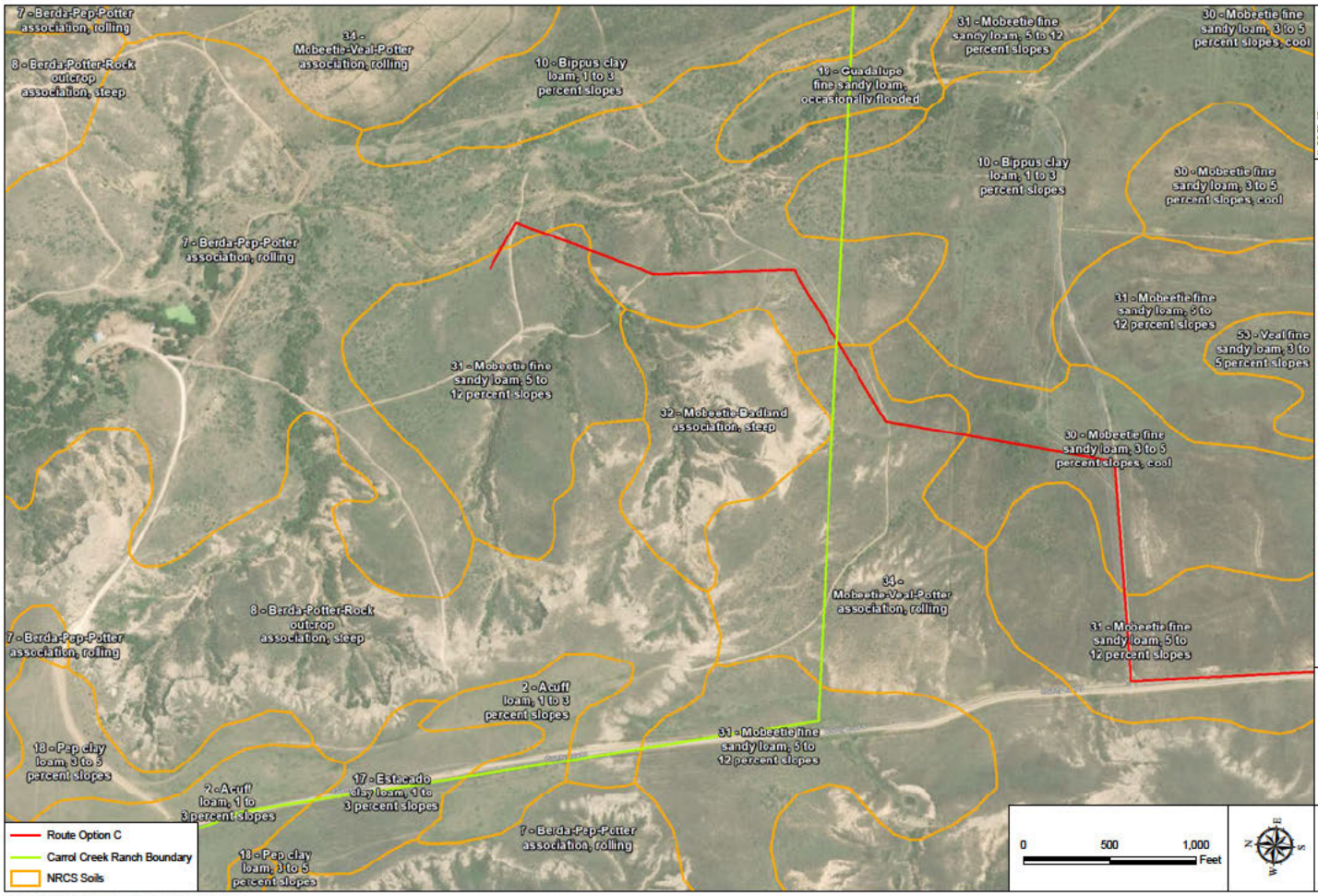

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Appendix B

Photographs

Photo 1. Typical view of SH-70 Right-of-Way (ROW) in proposed Route Option A and B, facing north.

Photo 2. Typical view of SH-70 ROW in proposed Route Option A, facing south.

Photo 3. Typical view of native grassland within the proposed Route Option A, facing west.

Photo 4. Typical view of existing overhead transmission line ROW within Route Option B, facing south.

Photo 5. Typical view of riparian forest along county road/Route Option C, facing east.

Photo 6. Typical view of native grassland within Route Option C, facing east.

Appendix C

2021 NWP 58, NWP General Conditions, and 2021 Texas Regional Conditions

Nationwide Permit 58 - Utility Line Activities for Water and Other Substances
Effective Date: March 15, 2021; Expiration Date: March 14, 2026
(NWP Final Notice, 86 FR 2744)

Nationwide Permit 58 - Utility Line Activities for Water and Other Substances. Activities required for the construction, maintenance, repair, and removal of utility lines for water and other substances, excluding oil, natural gas, products derived from oil or natural gas, and electricity. Oil or natural gas pipeline activities or electric utility line and telecommunications activities may be authorized by NWPs 12 or 57, respectively. This NWP also authorizes associated utility line facilities in waters of the United States, provided the activity does not result in the loss of greater than 1/2-acre of waters of the United States for each single and complete project.

Utility lines: This NWP authorizes discharges of dredged or fill material into waters of the United States and structures or work in navigable waters for crossings of those waters associated with the construction, maintenance, or repair of utility lines for water and other substances, including outfall and intake structures. There must be no change in pre-construction contours of waters of the United States. A "utility line" is defined as any pipe or pipeline for the transportation of any gaseous, liquid, liquescent, or slurry substance, for any purpose that is not oil, natural gas, or petrochemicals. Examples of activities authorized by this NWP include utility lines that convey water, sewage, stormwater, wastewater, brine, irrigation water, and industrial products that are not petrochemicals. The term "utility line" does not include activities that drain a water of the United States, such as drainage tile or french drains, but it does apply to pipes conveying drainage from another area.

Material resulting from trench excavation may be temporarily sidecast into waters of the United States for no more than three months, provided the material is not placed in such a manner that it is dispersed by currents or other forces. The district engineer may extend the period of temporary side casting for no more than a total of 180 days, where appropriate. In wetlands, the top 6 to 12 inches of the trench should normally be backfilled with topsoil from the trench. The trench cannot be constructed or backfilled in such a manner as to drain waters of the United States (e.g., backfilling with extensive gravel layers, creating a french drain effect). Any exposed slopes and stream banks must be stabilized immediately upon completion of the utility line crossing of each waterbody.

Utility line substations: This NWP authorizes the construction, maintenance, or expansion of substation facilities associated with a utility line in non-tidal waters of the United States, provided the activity, in combination with all other activities included in one single and complete project, does not result in the loss of greater than 1/2-acre of waters of the United States. This NWP does not authorize discharges of dredged or fill material into non-tidal wetlands adjacent to tidal waters of the United States to construct, maintain, or expand substation facilities.

Foundations for above-ground utility lines: This NWP authorizes the construction or maintenance of foundations for above-ground utility lines in all waters of the United States, provided the foundations are the minimum size necessary.

Access roads: This NWP authorizes the construction of access roads for the construction and maintenance of utility lines, including utility line substations, in non-tidal waters of the United States, provided the activity, in combination with all other activities included in one single and complete project, does not cause the loss of greater than 1/2-acre of non-tidal waters of the United States. This NWP does not authorize discharges of dredged or fill material into non-tidal wetlands adjacent to tidal waters for access roads. Access roads must be the minimum width necessary (see Note 2, below). Access roads must be constructed so that the length of the road minimizes any adverse effects on waters of the United States and must be as near as possible to pre-construction contours and elevations (e.g., at grade corduroy roads or geotextile/gravel roads). Access roads constructed above pre-construction contours and elevations in waters of the United States must be properly bridged or culverted to maintain surface flows.

This NWP may authorize utility lines in or affecting navigable waters of the United States even if there is no associated discharge of dredged or fill material (see 33 CFR part 322). Overhead utility lines constructed over section 10 waters and utility lines that are routed in or under section 10 waters without a discharge of dredged or fill material require a section 10 permit.

This NWP authorizes, to the extent that Department of the Army authorization is required, temporary structures, fills, and work necessary for the remediation of inadvertent returns of drilling fluids to waters of the United States through sub-soil fissures or fractures that might occur during horizontal directional drilling activities conducted for the purpose of installing or replacing utility lines. These remediation activities must be done as soon as practicable, to restore the affected waterbody. District engineers may add special conditions to this NWP to require a remediation plan for addressing inadvertent returns of drilling fluids to waters of the United States during horizontal directional drilling activities conducted for the purpose of installing or replacing utility lines.

This NWP also authorizes temporary structures, fills, and work, including the use of temporary mats, necessary to conduct the utility line activity. Appropriate measures must be taken to maintain normal downstream flows and minimize flooding to the maximum extent practicable, when temporary structures, work, and discharges of dredged or fill material, including cofferdams, are necessary for construction activities, access fills, or dewatering of construction sites. Temporary fills must consist of materials, and be placed in a manner, that will not be eroded by expected high flows. After construction, temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The areas affected by temporary fills must be revegetated, as appropriate.

Notification: The permittee must submit a pre-construction notification to the district engineer prior to commencing the activity if: (1) a section 10 permit is required; or (2) the discharge will result in the loss of greater than 1/10-acre of waters of the United States. (See general condition 32.) (Authorities: Sections 10 and 404)

Note 1: Where the utility line is constructed, installed, or maintained in navigable waters of the United States (i.e., section 10 waters) within the coastal United States, the Great Lakes, and United States territories, a copy of the NWP verification will be sent by the Corps to the National Oceanic and Atmospheric Administration (NOAA), National Ocean Service (NOS), for charting the utility line to protect navigation.

Note 2: For utility line activities crossing a single waterbody more than one time at separate and distant locations, or multiple waterbodies at separate and distant locations, each crossing is considered a single and complete project for purposes of NWP authorization. Utility line activities must comply with 33 CFR 330.6(d).

Note 3: Access roads used for both construction and maintenance may be authorized, provided they meet the terms and conditions of this NWP. Access roads used solely for construction of the utility line must be removed upon completion of the work, in accordance with the requirements for temporary fills.

Note 4: Pipes or pipelines used to transport gaseous, liquid, liquescent, or slurry substances over navigable waters of the United States are considered to be bridges, not utility lines, and may require a permit from the U.S. Coast Guard pursuant to the General Bridge Act of 1946. However, any discharges of dredged or fill material into waters of the United States associated with such pipelines will require a section 404 permit (see NWP 15).

Note 5: This NWP authorizes utility line maintenance and repair activities that do not qualify for the Clean Water Act section 404(f) exemption for maintenance of currently serviceable fills or fill structures.

Note 6: For activities that require pre-construction notification, the PCN must include any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity, including other separate and distant crossings that require Department of the Army authorization but do not require pre-construction notification (see paragraph (b)(4) of general condition 32). The district engineer will evaluate the PCN in accordance with Section D, "District Engineer's Decision." The district engineer may require mitigation to ensure that the authorized activity results in no more than minimal individual and cumulative adverse environmental effects (see general condition 23).

2021 Nationwide Permit General Conditions

Note: To qualify for NWP authorization, the prospective permittee must comply with the following general conditions, as applicable, in addition to any regional or case-specific

conditions imposed by the division engineer or district engineer. Prospective permittees should contact the appropriate Corps district office to determine if regional conditions have been imposed on an NWP. Prospective permittees should also contact the appropriate Corps district office to determine the status of Clean Water Act Section 401 water quality certification and/or Coastal Zone Management Act consistency for an NWP. Every person who may wish to obtain permit authorization under one or more NWPs, or who is currently relying on an existing or prior permit authorization under one or more NWPs, has been and is on notice that all of the provisions of 33 CFR 330.1 through 330.6 apply to every NWP authorization. Note especially 33 CFR 330.5 relating to the modification, suspension, or revocation of any NWP authorization.

1. **Navigation.** (a) No activity may cause more than a minimal adverse effect on navigation.

(b) Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the United States.

(c) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his or her authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

2. **Aquatic Life Movements.** No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species. If a bottomless culvert cannot be used, then the crossing should be designed and constructed to minimize adverse effects to aquatic life movements.

3. **Spawning Areas.** Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

4. **Migratory Bird Breeding Areas.** Activities in waters of the United States that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

5. **Shellfish Beds.** No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48, or is a shellfish seeding or habitat restoration activity authorized by NWP 27.

6. **Suitable Material.** No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see section 307 of the Clean Water Act).

7. **Water Supply Intakes.** No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

8. **Adverse Effects From Impoundments.** If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

9. **Management of Water Flows.** To the maximum extent practicable, the pre-construction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization, storm water management activities, and temporary and permanent road crossings, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation activities).

10. **Fills Within 100-Year Floodplains.** The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

11. **Equipment.** Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

12. **Soil Erosion and Sediment Controls.** Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow, or during low tides.

13. **Removal of Temporary Structures and Fills.** Temporary structures must be removed, to the maximum extent practicable, after their use has been discontinued. Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

14. **Proper Maintenance.** Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety and compliance with applicable NWP general conditions, as well as any activity-specific conditions added by the district engineer to an NWP authorization.

15. **Single and Complete Project.** The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

16. **Wild and Scenic Rivers.** (a) No NWP activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a "study river" for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status.

(b) If a proposed NWP activity will occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a "study river" for possible inclusion in the system while the river is in an official study status, the permittee must submit a pre-construction notification (see general condition 32). The district engineer will coordinate the PCN with the Federal agency with direct management responsibility for that river. Permittees shall not begin the NWP activity until notified by the district engineer that the Federal agency with direct management responsibility for that river has determined in writing that the proposed NWP activity will not adversely affect the Wild and Scenic River designation or study status.

(c) Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency responsible for the designated Wild and Scenic River or study river (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service). Information on these rivers is also available at: http://www.rivers.gov/.

17. **Tribal Rights.** No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

18. **Endangered Species.** (a) No activity is authorized under any NWP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify designated critical habitat or critical habitat proposed for such designation. No activity is authorized under any NWP which "may affect" a listed species or critical habitat, unless ESA section 7 consultation addressing the consequences of the proposed activity on listed species or critical habitat has been completed. See 50 CFR 402.02 for the definition of "effects of the action" for the purposes of ESA section 7 consultation, as well as 50 CFR 402.17, which provides further explanation under ESA

section 7 regarding "activities that are reasonably certain to occur" and "consequences caused by the proposed action."

(b) Federal agencies should follow their own procedures for complying with the requirements of the ESA (see 33 CFR 330.4(f)(1)). If pre-construction notification is required for the proposed activity, the Federal permittee must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will verify that the appropriate documentation has been submitted. If the appropriate documentation has not been submitted, additional ESA section 7 consultation may be necessary for the activity and the respective federal agency would be responsible for fulfilling its obligation under section 7 of the ESA.

(c) Non-federal permittees must submit a pre-construction notification to the district engineer if any listed species (or species proposed for listing) or designated critical habitat (or critical habitat proposed such designation) might be affected or is in the vicinity of the activity, or if the activity is located in designated critical habitat or critical habitat proposed for such designation, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species (or species proposed for listing) or designated critical habitat (or critical habitat proposed for such designation), the pre-construction notification must include the name(s) of the endangered or threatened species (or species proposed for listing) that might be affected by the proposed activity or that utilize the designated critical habitat (or critical habitat proposed for such designation) that might be affected by the proposed activity. The district engineer will determine whether the proposed activity "may affect" or will have "no effect" to listed species and designated critical habitat and will notify the non-Federal applicant of the Corps' determination within 45 days of receipt of a complete pre-construction notification. For activities where the non-Federal applicant has identified listed species (or species proposed for listing) or designated critical habitat (or critical habitat proposed for such designation) that might be affected or is in the vicinity of the activity, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification that the proposed activity will have "no effect" on listed species (or species proposed for listing or designated critical habitat (or critical habitat proposed for such designation), or until ESA section 7 consultation or conference has been completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

(d) As a result of formal or informal consultation or conference with the FWS or NMFS the district engineer may add species-specific permit conditions to the NWPs.

(e) Authorization of an activity by an NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the FWS or the NMFS, the Endangered Species Act prohibits any person subject to the jurisdiction of the United States to take a listed species, where

"take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The word “harm” in the definition of “take" means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.

(f) If the non-federal permittee has a valid ESA section 10(a)(1)(B) incidental take permit with an approved Habitat Conservation Plan for a project or a group of projects that includes the proposed NWP activity, the non-federal applicant should provide a copy of that ESA section 10(a)(1)(B) permit with the PCN required by paragraph (c) of this general condition. The district engineer will coordinate with the agency that issued the ESA section 10(a)(1)(B) permit to determine whether the proposed NWP activity and the associated incidental take were considered in the internal ESA section 7 consultation conducted for the ESA section 10(a)(1)(B) permit. If that coordination results in concurrence from the agency that the proposed NWP activity and the associated incidental take were considered in the internal ESA section 7 consultation for the ESA section 10(a)(1)(B) permit, the district engineer does not need to conduct a separate ESA section 7 consultation for the proposed NWP activity. The district engineer will notify the non-federal applicant within 45 days of receipt of a complete pre-construction notification whether the ESA section 10(a)(1)(B) permit covers the proposed NWP activity or whether additional ESA section 7 consultation is required.

(g) Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the FWS and NMFS or their world wide web pages at http://www.fws.gov/ or http://www.fws.gov/ipac and http://www.nmfs.noaa.gov/pr/species/esa/ respectively.

19. **Migratory Birds and Bald and Golden Eagles.** The permittee is responsible for ensuring that an action authorized by an NWP complies with the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. The permittee is responsible for contacting the appropriate local office of the U.S. Fish and Wildlife Service to determine what measures, if any, are necessary or appropriate to reduce adverse effects to migratory birds or eagles, including whether "incidental take" permits are necessary and available under the Migratory Bird Treaty Act or Bald and Golden Eagle Protection Act for a particular activity.

20. **Historic Properties.** (a) No activity is authorized under any NWP which may have the potential to cause effects to properties listed, or eligible for listing, in the National Register of Historic Places until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.

(b) Federal permittees should follow their own procedures for complying with the requirements of section 106 of the National Historic Preservation Act (see 33 CFR 330.4(g)(1)). If pre-construction notification is required for the proposed NWP activity, the Federal permittee must provide the district engineer with the appropriate

documentation to demonstrate compliance with those requirements. The district engineer will verify that the appropriate documentation has been submitted. If the appropriate documentation is not submitted, then additional consultation under section 106 may be necessary. The respective federal agency is responsible for fulfilling its obligation to comply with section 106.

(c) Non-federal permittees must submit a pre-construction notification to the district engineer if the NWP activity might have the potential to cause effects to any historic properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties might have the potential to be affected by the proposed NWP activity or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of, or potential for, the presence of historic properties can be sought from the State Historic Preservation Officer, Tribal Historic Preservation Officer, or designated tribal representative, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). When reviewing pre-construction notifications, district engineers will comply with the current procedures for addressing the requirements of section 106 of the National Historic Preservation Act. The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts commensurate with potential impacts, which may include background research, consultation, oral history interviews, sample field investigation, and/or field survey. Based on the information submitted in the PCN and these identification efforts, the district engineer shall determine whether the proposed NWP activity has the potential to cause effects on the historic properties. Section 106 consultation is not required when the district engineer determines that the activity does not have the potential to cause effects on historic properties (see 36 CFR 800.3(a)). Section 106 consultation is required when the district engineer determines that the activity has the potential to cause effects on historic properties. The district engineer will conduct consultation with consulting parties identified under 36 CFR 800.2(c) when he or she makes any of the following effect determinations for the purposes of section 106 of the NHPA: no historic properties affected, no adverse effect, or adverse effect.

(d) Where the non-Federal applicant has identified historic properties on which the proposed NWP activity might have the potential to cause effects and has so notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects to historic properties or that NHPA section 106 consultation has been completed. For non-federal permittees, the district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA section 106 consultation is required. If NHPA section 106 consultation is required, the district engineer will notify the non-Federal applicant that he or she cannot begin the activity until section 106 consultation is completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

(e) Prospective permittees should be aware that section 110k of the NHPA (54 U.S.C. 306113) prevents the Corps from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the permitted activity on historic properties.

21. **Discovery of Previously Unknown Remains and Artifacts.** Permittees that discover any previously unknown historic, cultural or archeological remains and artifacts while accomplishing the activity authorized by an NWP, they must immediately notify the district engineer of what they have found, and to the maximum extent practicable, avoid construction activities that may affect the remains and artifacts until the required coordination has been completed. The district engineer will initiate the Federal, Tribal, and state coordination required to determine if the items or remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

22. **Designated Critical Resource Waters.** Critical resource waters include, NOAA-managed marine sanctuaries and marine monuments, and National Estuarine Research Reserves. The district engineer may designate, after notice and opportunity for public comment, additional waters officially designated by a state as having particular environmental or ecological significance, such as outstanding national resource waters or state natural heritage sites. The district engineer may also designate additional critical resource waters after notice and opportunity for public comment.

(a) Discharges of dredged or fill material into waters of the United States are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, 50, 51, 52, 57 and 58 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.

(b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, 38, and 54, notification is required in accordance with general condition 32, for any activity proposed by permittees in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWPs only after she or he determines that the impacts to the critical resource waters will be no more than minimal.

23. **Mitigation.** The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that the individual and cumulative adverse environmental effects are no more than minimal:

(a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable at the project site (i.e., on site).

(b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating for resource losses) will be required to the extent necessary to ensure that the individual and cumulative adverse environmental effects are no more than minimal.

(c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1/10-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse environmental effects of the proposed activity are no more than minimal, and provides an activity-specific waiver of this requirement. For wetland losses of 1/10-acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in only minimal adverse environmental effects.

(d) Compensatory mitigation at a minimum one-for-one ratio will be required for all losses of stream bed that exceed 3/100-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse environmental effects of the proposed activity are no more than minimal, and provides an activity-specific waiver of this requirement. This compensatory mitigation requirement may be satisfied through the restoration or enhancement of riparian areas next to streams in accordance with paragraph (e) of this general condition. For losses of stream bed of 3/100-acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in only minimal adverse environmental effects. Compensatory mitigation for losses of streams should be provided, if practicable, through stream rehabilitation, enhancement, or preservation, since streams are difficult-to-replace resources (see 33 CFR 332.3(e)(3)).

(e) Compensatory mitigation plans for NWP activities in or near streams or other open waters will normally include a requirement for the restoration or enhancement, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, the restoration or maintenance/protection of riparian areas may be the only compensatory mitigation required. If restoring riparian areas involves planting vegetation, only native species should be planted. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address

documented water quality or habitat loss concerns. If it is not possible to restore or maintain/protect a riparian area on both sides of a stream, or if the waterbody is a lake or coastal waters, then restoring or maintaining/protecting a riparian area along a single bank or shoreline may be sufficient. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of minimization or compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.

(f) Compensatory mitigation projects provided to offset losses of aquatic resources must comply with the applicable provisions of 33 CFR part 332.

(1) The prospective permittee is responsible for proposing an appropriate compensatory mitigation option if compensatory mitigation is necessary to ensure that the activity results in no more than minimal adverse environmental effects. For the NWPs, the preferred mechanism for providing compensatory mitigation is mitigation bank credits or in-lieu fee program credits (see 33 CFR 332.3(b)(2) and (3)). However, if an appropriate number and type of mitigation bank or in-lieu credits are not available at the time the PCN is submitted to the district engineer, the district engineer may approve the use of permittee-responsible mitigation.

(2) The amount of compensatory mitigation required by the district engineer must be sufficient to ensure that the authorized activity results in no more than minimal individual and cumulative adverse environmental effects (see 33 CFR 330.1(e)(3)). (See also 33 CFR 332.3(f).)

(3) Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, aquatic resource restoration should be the first compensatory mitigation option considered for permittee-responsible mitigation.

(4) If permittee-responsible mitigation is the proposed option, the prospective permittee is responsible for submitting a mitigation plan. A conceptual or detailed mitigation plan may be used by the district engineer to make the decision on the NWP verification request, but a final mitigation plan that addresses the applicable requirements of 33 CFR 332.4(c)(2) through (14) must be approved by the district engineer before the permittee begins work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation (see 33 CFR 332.3(k)(3)). If permittee-responsible mitigation is the proposed option, and the proposed compensatory mitigation site is located on land in which another federal agency holds an easement, the district engineer will coordinate with that federal agency to determine if proposed compensatory mitigation project is compatible with the terms of the easement.

(5) If mitigation bank or in-lieu fee program credits are the proposed option, the mitigation plan needs to address only the baseline conditions at the impact site and the number of credits to be provided (see 33 CFR 332.4(c)(1)(ii)).

(6) Compensatory mitigation requirements (e.g., resource type and amount to be provided as compensatory mitigation, site protection, ecological performance standards, monitoring requirements) may be addressed through conditions added to the NWP authorization, instead of components of a compensatory mitigation plan (see 33 CFR 332.4(c)(1)(ii)).

(g) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of 1/2-acre, it cannot be used to authorize any NWP activity resulting in the loss of greater than 1/2-acre of waters of the United States, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that an NWP activity already meeting the established acreage limits also satisfies the no more than minimal impact requirement for the NWPs.

(h) Permittees may propose the use of mitigation banks, in-lieu fee programs, or permittee-responsible mitigation. When developing a compensatory mitigation proposal, the permittee must consider appropriate and practicable options consistent with the framework at 33 CFR 332.3(b). For activities resulting in the loss of marine or estuarine resources, permittee-responsible mitigation may be environmentally preferable if there are no mitigation banks or in-lieu fee programs in the area that have marine or estuarine credits available for sale or transfer to the permittee. For permittee-responsible mitigation, the special conditions of the NWP verification must clearly indicate the party or parties responsible for the implementation and performance of the compensatory mitigation project, and, if required, its long-term management.

(i) Where certain functions and services of waters of the United States are permanently adversely affected by a regulated activity, such as discharges of dredged or fill material into waters of the United States that will convert a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse environmental effects of the activity to the no more than minimal level.

24. **Safety of Impoundment Structures.** To ensure that all impoundment structures are safely designed, the district engineer may require non-Federal applicants to demonstrate that the structures comply with established state or federal, dam safety criteria or have been designed by qualified persons. The district engineer may also require documentation that the design has been independently reviewed by similarly qualified persons, and appropriate modifications made to ensure safety.

25. **Water Quality.** (a) Where the certifying authority (state, authorized tribe, or EPA, as appropriate) has not previously certified compliance of an NWP with CWA section 401,

a CWA section 401 water quality certification for the proposed discharge must be obtained or waived (see 33 CFR 330.4(c)). If the permittee cannot comply with all of the conditions of a water quality certification previously issued by certifying authority for the issuance of the NWP, then the permittee must obtain a water quality certification or waiver for the proposed discharge in order for the activity to be authorized by an NWP.

(b) If the NWP activity requires pre-construction notification and the certifying authority has not previously certified compliance of an NWP with CWA section 401, the proposed discharge is not authorized by an NWP until water quality certification is obtained or waived. If the certifying authority issues a water quality certification for the proposed discharge, the permittee must submit a copy of the certification to the district engineer. The discharge is not authorized by an NWP until the district engineer has notified the permittee that the water quality certification requirement has been satisfied by the issuance of a water quality certification or a waiver.

(c) The district engineer or certifying authority may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

26. **Coastal Zone Management.** In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). If the permittee cannot comply with all of the conditions of a coastal zone management consistency concurrence previously issued by the state, then the permittee must obtain an individual coastal zone management consistency concurrence or presumption of concurrence in order for the activity to be authorized by an NWP. The district engineer or a state may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

27. **Regional and Case-By-Case Conditions.** The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or U.S. EPA in its CWA section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

28. **Use of Multiple Nationwide Permits.** The use of more than one NWP for a single and complete project is authorized, subject to the following restrictions:

(a) If only one of the NWPs used to authorize the single and complete project has a specified acreage limit, the acreage loss of waters of the United States cannot exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the United States for the total project cannot exceed 1/3-acre.

(b) If one or more of the NWPs used to authorize the single and complete project has specified acreage limits, the acreage loss of waters of the United States authorized by those NWPs cannot exceed their respective specified acreage limits. For example, if a commercial development is constructed under NWP 39, and the single and complete project includes the filling of an upland ditch authorized by NWP 46, the maximum acreage loss of waters of the United States for the commercial development under NWP 39 cannot exceed 1/2-acre, and the total acreage loss of waters of United States due to the NWP 39 and 46 activities cannot exceed 1 acre.

29. **Transfer of Nationwide Permit Verifications.** If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature:

"When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below."

_____
(Transferee)

_____
(Date)

30. **Compliance Certification.** Each permittee who receives an NWP verification letter from the Corps must provide a signed certification documenting completion of the authorized activity and implementation of any required compensatory mitigation. The success of any required permittee-responsible mitigation, including the achievement of ecological performance standards, will be addressed separately by the district engineer. The Corps will provide the permittee the certification document with the NWP verification letter. The certification document will include:

(a) A statement that the authorized activity was done in accordance with the NWP authorization, including any general, regional, or activity-specific conditions;

(b) A statement that the implementation of any required compensatory mitigation was completed in accordance with the permit conditions. If credits from a mitigation bank or in-lieu fee program are used to satisfy the compensatory mitigation requirements, the

certification must include the documentation required by 33 CFR 332.3(l)(3) to confirm that the permittee secured the appropriate number and resource type of credits; and

(c) The signature of the permittee certifying the completion of the activity and mitigation.

The completed certification document must be submitted to the district engineer within 30 days of completion of the authorized activity or the implementation of any required compensatory mitigation, whichever occurs later.

31. **Activities Affecting Structures or Works Built by the United States.** If an NWP activity also requires review by, or permission from, the Corps pursuant to 33 U.S.C. 408 because it will alter or temporarily or permanently occupy or use a U.S. Army Corps of Engineers (USACE) federally authorized Civil Works project (a "USACE project"), the prospective permittee must submit a pre-construction notification. See paragraph (b)(10) of general condition 32. An activity that requires section 408 permission and/or review is not authorized by an NWP until the appropriate Corps office issues the section 408 permission or completes its review to alter, occupy, or use the USACE project, and the district engineer issues a written NWP verification.

32. **Pre-Construction Notification.** (a) *Timing*. Where required by the terms of the NWP, the prospective permittee must notify the district engineer by submitting a pre-construction notification (PCN) as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, if the PCN is determined to be incomplete, notify the prospective permittee within that 30 day period to request the additional information necessary to make the PCN complete. The request must specify the information needed to make the PCN complete. As a general rule, district engineers will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either:

(1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or

(2) 45 calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 18 that listed species or critical habitat might be affected or are in the vicinity of the activity, or to notify the Corps pursuant to general condition 20 that the activity might have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that there is "no effect" on listed species or "no potential to cause effects" on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33

CFR 330.4(f)) and/or section 106 of the National Historic Preservation Act (see 33 CFR 330.4(g)) has been completed. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee may not begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2).

(b) *Contents of Pre-Construction Notification*: The PCN must be in writing and include the following information:

(1) Name, address and telephone numbers of the prospective permittee;

(2) Location of the proposed activity;

(3) Identify the specific NWP or NWP(s) the prospective permittee wants to use to authorize the proposed activity;

(4) (i) A description of the proposed activity; the activity's purpose; direct and indirect adverse environmental effects the activity would cause, including the anticipated amount of loss of wetlands, other special aquatic sites, and other waters expected to result from the NWP activity, in acres, linear feet, or other appropriate unit of measure; a description of any proposed mitigation measures intended to reduce the adverse environmental effects caused by the proposed activity; and any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity, including other separate and distant crossings for linear projects that require Department of the Army authorization but do not require pre-construction notification. The description of the proposed activity and any proposed mitigation measures should be sufficiently detailed to allow the district engineer to determine that the adverse environmental effects of the activity will be no more than minimal and to determine the need for compensatory mitigation or other mitigation measures.

(ii) For linear projects where one or more single and complete crossings require pre-construction notification, the PCN must include the quantity of anticipated losses of wetlands, other special aquatic sites, and other waters for each single and complete crossing of those wetlands, other special aquatic sites, and other waters (including those single and complete crossings authorized by an NWP but do not require PCNs). This information will be used by the district engineer to evaluate the cumulative adverse environmental effects of the proposed linear project, and does not change those non-PCN NWP activities into NWP PCNs.

(iii) Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the activity and when provided

results in a quicker decision. Sketches should contain sufficient detail to provide an illustrative description of the proposed activity (e.g., a conceptual plan), but do not need to be detailed engineering plans);

(5) The PCN must include a delineation of wetlands, other special aquatic sites, and other waters, such as lakes and ponds, and perennial and intermittent streams, on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters on the project site, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many wetlands, other special aquatic sites, and other waters. Furthermore, the 45-day period will not start until the delineation has been submitted to or completed by the Corps, as appropriate;

(6) If the proposed activity will result in the loss of greater than 1/10-acre of wetlands or 3/100-acre of stream bed and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied, or explaining why the adverse environmental effects are no more than minimal and why compensatory mitigation should not be required. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan.

(7) For non-federal permittees, if any listed species (or species proposed for listing) or designated critical habitat (or critical habitat proposed for such designation) might be affected or is in the vicinity of the activity, or if the activity is located in designated critical habitat (or critical habitat proposed for such designation), the PCN must include the name(s) of those endangered or threatened species (or species proposed for listing) that might be affected by the proposed activity or utilize the designated critical habitat (or critical habitat proposed for such designation) that might be affected by the proposed activity. For NWP activities that require pre-construction notification, Federal permittees must provide documentation demonstrating compliance with the Endangered Species Act;

(8) For non-federal permittees, if the NWP activity might have the potential to cause effects to a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, the PCN must state which historic property might have the potential to be affected by the proposed activity or include a vicinity map indicating the location of the historic property. For NWP activities that require pre-construction notification, Federal permittees must provide documentation demonstrating compliance with section 106 of the National Historic Preservation Act;

(9) For an activity that will occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a “study river” for possible inclusion in the system while the river is in an official study status, the PCN must identify the Wild and Scenic River or the “study river” (see general condition 16); and

(10) For an NWP activity that requires permission from, or review by, the Corps pursuant to 33 U.S.C. 408 because it will alter or temporarily or permanently occupy or use a U.S. Army Corps of Engineers federally authorized civil works project, the pre-construction notification must include a statement confirming that the project proponent has submitted a written request for section 408 permission from, or review by, the Corps office having jurisdiction over that USACE project.

(c) *Form of Pre-Construction Notification*: The nationwide permit pre-construction notification form (Form ENG 6082) should be used for NWP PCNs. A letter containing the required information may also be used. Applicants may provide electronic files of PCNs and supporting materials if the district engineer has established tools and procedures for electronic submittals.

(d) *Agency Coordination*: (1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the activity's adverse environmental effects so that they are no more than minimal.

(2) Agency coordination is required for: (i) all NWP activities that require pre-construction notification and result in the loss of greater than 1/2-acre of waters of the United States; (ii) NWP 13 activities in excess of 500 linear feet, fills greater than one cubic yard per running foot, or involve discharges of dredged or fill material into special aquatic sites; and (iii) NWP 54 activities in excess of 500 linear feet, or that extend into the waterbody more than 30 feet from the mean low water line in tidal waters or the ordinary high water mark in the Great Lakes.

(3) When agency coordination is required, the district engineer will immediately provide (e.g., via e-mail, facsimile transmission, overnight mail, or other expeditious manner) a copy of the complete PCN to the appropriate Federal or state offices (FWS, state natural resource or water quality agency, EPA, and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will have 10 calendar days from the date the material is transmitted to notify the district engineer via telephone, facsimile transmission, or e-mail that they intend to provide substantive, site-specific comments. The comments must explain why the agency believes the adverse environmental effects will be more than minimal. If so contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the pre-construction notification. The district engineer will fully consider agency comments received within the specified time frame concerning the proposed activity's compliance with the terms and conditions of the NWPs, including the need for mitigation to ensure that the net adverse environmental effects of the proposed activity are no more than minimal. The district engineer will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each pre-construction notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will

consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5.

(4) In cases of where the prospective permittee is not a Federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act.

(5) Applicants are encouraged to provide the Corps with either electronic files or multiple copies of pre-construction notifications to expedite agency coordination.

2021 District Engineer's Decision

1. In reviewing the PCN for the proposed activity, the district engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. If a project proponent requests authorization by a specific NWP, the district engineer should issue the NWP verification for that activity if it meets the terms and conditions of that NWP, unless he or she determines, after considering mitigation, that the proposed activity will result in more than minimal individual and cumulative adverse effects on the aquatic environment and other aspects of the public interest and exercises discretionary authority to require an individual permit for the proposed activity. For a linear project, this determination will include an evaluation of the single and complete crossings of waters of the United States that require PCNs to determine whether they individually satisfy the terms and conditions of the NWP(s), as well as the cumulative effects caused by all of the crossings of waters of the United States authorized by an NWP. If an applicant requests a waiver of an applicable limit, as provided for in NWPs 13, 36, or 54, the district engineer will only grant the waiver upon a written determination that the NWP activity will result in only minimal individual and cumulative adverse environmental effects.

2. When making minimal adverse environmental effects determinations the district engineer will consider the direct and indirect effects caused by the NWP activity. He or she will also consider the cumulative adverse environmental effects caused by activities authorized by an NWP and whether those cumulative adverse environmental effects are no more than minimal. The district engineer will also consider site specific factors, such as the environmental setting in the vicinity of the NWP activity, the type of resource that will be affected by the NWP activity, the functions provided by the aquatic resources that will be affected by the NWP activity, the degree or magnitude to which the aquatic resources perform those functions, the extent that aquatic resource functions will be lost as a result of the NWP activity (e.g., partial or complete loss), the duration of the adverse effects (temporary or permanent), the importance of the aquatic resource functions to the region (e.g., watershed or ecoregion), and mitigation required by the district engineer. If an appropriate functional or condition assessment method is available and practicable to use, that assessment method may be used by the district

engineer to assist in the minimal adverse environmental effects determination. The district engineer may add case-specific special conditions to the NWP authorization to address site-specific environmental concerns.

3. If the proposed activity requires a PCN and will result in a loss of greater than 1/10-acre of wetlands or 3/100-acre of stream bed, the prospective permittee should submit a mitigation proposal with the PCN. Applicants may also propose compensatory mitigation for NWP activities with smaller impacts, or for impacts to other types of waters. The district engineer will consider any proposed compensatory mitigation or other mitigation measures the applicant has included in the proposal in determining whether the net adverse environmental effects of the proposed activity are no more than minimal. The compensatory mitigation proposal may be either conceptual or detailed. If the district engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse environmental effects are no more than minimal, after considering mitigation, the district engineer will notify the permittee and include any activity-specific conditions in the NWP verification the district engineer deems necessary. Conditions for compensatory mitigation requirements must comply with the appropriate provisions at 33 CFR 332.3(k). The district engineer must approve the final mitigation plan before the permittee commences work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation. If the prospective permittee elects to submit a compensatory mitigation plan with the PCN, the district engineer will expeditiously review the proposed compensatory mitigation plan. The district engineer must review the proposed compensatory mitigation plan within 45 calendar days of receiving a complete PCN and determine whether the proposed mitigation would ensure that the NWP activity results in no more than minimal adverse environmental effects. If the net adverse environmental effects of the NWP activity (after consideration of the mitigation proposal) are determined by the district engineer to be no more than minimal, the district engineer will provide a timely written response to the applicant. The response will state that the NWP activity can proceed under the terms and conditions of the NWP, including any activity-specific conditions added to the NWP authorization by the district engineer.

4. If the district engineer determines that the adverse environmental effects of the proposed activity are more than minimal, then the district engineer will notify the applicant either: (a) that the activity does not qualify for authorization under the NWP and instruct the applicant on the procedures to seek authorization under an individual permit; (b) that the activity is authorized under the NWP subject to the applicant's submission of a mitigation plan that would reduce the adverse environmental effects so that they are no more than minimal; or (c) that the activity is authorized under the NWP with specific modifications or conditions. Where the district engineer determines that mitigation is required to ensure no more than minimal adverse environmental effects, the activity will be authorized within the 45-day PCN period (unless additional time is required to comply with general conditions 18, 20, and/or 31), with activity-specific conditions that state the mitigation requirements. The authorization will include the necessary conceptual or detailed mitigation plan or a requirement that the applicant

submit a mitigation plan that would reduce the adverse environmental effects so that they are no more than minimal. When compensatory mitigation is required, no work in waters of the United States may occur until the district engineer has approved a specific mitigation plan or has determined that prior approval of a final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation.

2021 Further Information

1. District engineers have authority to determine if an activity complies with the terms and conditions of an NWP.

2. NWPs do not obviate the need to obtain other federal, state, or local permits, approvals, or authorizations required by law.

3. NWPs do not grant any property rights or exclusive privileges.

4. NWPs do not authorize any injury to the property or rights of others.

5. NWPs do not authorize interference with any existing or proposed Federal project (see general condition 31).

2021 Nationwide Permit Definitions

Best management practices (BMPs): Policies, practices, procedures, or structures implemented to mitigate the adverse environmental effects on surface water quality resulting from development. BMPs are categorized as structural or non-structural.

Compensatory mitigation: The restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved.

Currently serviceable: Useable as is or with some maintenance, but not so degraded as to essentially require reconstruction.

Direct effects: Effects that are caused by the activity and occur at the same time and place.

Discharge: The term "discharge" means any discharge of dredged or fill material into waters of the United States.

Ecological reference: A model used to plan and design an aquatic habitat and riparian area restoration, enhancement, or establishment activity under NWP 27. An ecological reference may be based on the structure, functions, and dynamics of an aquatic habitat

type or a riparian area type that currently exists in the region where the proposed NWP 27 activity is located. Alternatively, an ecological reference may be based on a conceptual model for the aquatic habitat type or riparian area type to be restored, enhanced, or established as a result of the proposed NWP 27 activity. An ecological reference takes into account the range of variation of the aquatic habitat type or riparian area type in the region.

Enhancement: The manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s). Enhancement results in the gain of selected aquatic resource function(s), but may also lead to a decline in other aquatic resource function(s). Enhancement does not result in a gain in aquatic resource area.

Establishment (creation): The manipulation of the physical, chemical, or biological characteristics present to develop an aquatic resource that did not previously exist at an upland site. Establishment results in a gain in aquatic resource area.

High Tide Line: The line of intersection of the land with the water's surface at the maximum height reached by a rising tide. The high tide line may be determined, in the absence of actual data, by a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the foreshore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide. The line encompasses spring high tides and other high tides that occur with periodic frequency but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast by strong winds such as those accompanying a hurricane or other intense storm.

Historic Property: Any prehistoric or historic district, site (including archaeological site), building, structure, or other object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria (36 CFR part 60).

Independent utility: A test to determine what constitutes a single and complete non-linear project in the Corps Regulatory Program. A project is considered to have independent utility if it would be constructed absent the construction of other projects in the project area. Portions of a multi-phase project that depend upon other phases of the project do not have independent utility. Phases of a project that would be constructed even if the other phases were not built can be considered as separate single and complete projects with independent utility.

Indirect effects: Effects that are caused by the activity and are later in time or farther removed in distance, but are still reasonably foreseeable.

Loss of waters of the United States: Waters of the United States that are permanently adversely affected by filling, flooding, excavation, or drainage because of the regulated activity. The loss of stream bed includes the acres of stream bed that are permanently adversely affected by filling or excavation because of the regulated activity. Permanent adverse effects include permanent discharges of dredged or fill material that change an aquatic area to dry land, increase the bottom elevation of a waterbody, or change the use of a waterbody. The acreage of loss of waters of the United States is a threshold measurement of the impact to jurisdictional waters or wetlands for determining whether a project may qualify for an NWP; it is not a net threshold that is calculated after considering compensatory mitigation that may be used to offset losses of aquatic functions and services. Waters of the United States temporarily filled, flooded, excavated, or drained, but restored to pre-construction contours and elevations after construction, are not included in the measurement of loss of waters of the United States. Impacts resulting from activities that do not require Department of the Army authorization, such as activities eligible for exemptions under section 404(f) of the Clean Water Act, are not considered when calculating the loss of waters of the United States.

Navigable waters: Waters subject to section 10 of the Rivers and Harbors Act of 1899. These waters are defined at 33 CFR part 329.

Non-tidal wetland: A non-tidal wetland is a wetland that is not subject to the ebb and flow of tidal waters. Non-tidal wetlands contiguous to tidal waters are located landward of the high tide line (i.e., spring high tide line).

Open water: For purposes of the NWPs, an open water is any area that in a year with normal patterns of precipitation has water flowing or standing above ground to the extent that an ordinary high water mark can be determined. Aquatic vegetation within the area of flowing or standing water is either non-emergent, sparse, or absent. Vegetated shallows are considered to be open waters. Examples of “open waters” include rivers, streams, lakes, and ponds.

Ordinary High Water Mark: The term ordinary high water mark means that line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

Perennial stream: A perennial stream has surface water flowing continuously year-round during a typical year.

Practicable: Available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

Pre-construction notification: A request submitted by the project proponent to the Corps for confirmation that a particular activity is authorized by nationwide permit. The

request may be a permit application, letter, or similar document that includes information about the proposed work and its anticipated environmental effects. Pre-construction notification may be required by the terms and conditions of a nationwide permit, or by regional conditions. A pre-construction notification may be voluntarily submitted in cases where pre-construction notification is not required and the project proponent wants confirmation that the activity is authorized by nationwide permit.

Preservation: The removal of a threat to, or preventing the decline of, aquatic resources by an action in or near those aquatic resources. This term includes activities commonly associated with the protection and maintenance of aquatic resources through the implementation of appropriate legal and physical mechanisms. Preservation does not result in a gain of aquatic resource area or functions.

Re-establishment: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former aquatic resource. Re-establishment results in rebuilding a former aquatic resource and results in a gain in aquatic resource area and functions.

Rehabilitation: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function, but does not result in a gain in aquatic resource area.

Restoration: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource. For the purpose of tracking net gains in aquatic resource area, restoration is divided into two categories: re-establishment and rehabilitation.

Riffle and pool complex: Riffle and pool complexes are special aquatic sites under the 404(b)(1) Guidelines. Riffle and pool complexes sometimes characterize steep gradient sections of streams. Such stream sections are recognizable by their hydraulic characteristics. The rapid movement of water over a course substrate in riffles results in a rough flow, a turbulent surface, and high dissolved oxygen levels in the water. Pools are deeper areas associated with riffles. A slower stream velocity, a streaming flow, a smooth surface, and a finer substrate characterize pools.

Riparian areas: Riparian areas are lands next to streams, lakes, and estuarine-marine shorelines. Riparian areas are transitional between terrestrial and aquatic ecosystems, through which surface and subsurface hydrology connects riverine, lacustrine, estuarine, and marine waters with their adjacent wetlands, non-wetland waters, or uplands. Riparian areas provide a variety of ecological functions and services and help improve or maintain local water quality. (See general condition 23.)

Shellfish seeding: The placement of shellfish seed and/or suitable substrate to increase shellfish production. Shellfish seed consists of immature individual shellfish or individual shellfish attached to shells or shell fragments (i.e., spat on shell). Suitable

substrate may consist of shellfish shells, shell fragments, or other appropriate materials placed into waters for shellfish habitat.

Single and complete linear project: A linear project is a project constructed for the purpose of getting people, goods, or services from a point of origin to a terminal point, which often involves multiple crossings of one or more waterbodies at separate and distant locations. The term "single and complete project" is defined as that portion of the total linear project proposed or accomplished by one owner/developer or partnership or other association of owners/developers that includes all crossings of a single water of the United States (i.e., a single waterbody) at a specific location. For linear projects crossing a single or multiple waterbodies several times at separate and distant locations, each crossing is considered a single and complete project for purposes of NWP authorization. However, individual channels in a braided stream or river, or individual arms of a large, irregularly shaped wetland or lake, etc., are not separate waterbodies, and crossings of such features cannot be considered separately.

Single and complete non-linear project: For non-linear projects, the term "single and complete project" is defined at 33 CFR 330.2(i) as the total project proposed or accomplished by one owner/developer or partnership or other association of owners/developers. A single and complete non-linear project must have independent utility (see definition of "independent utility"). Single and complete non-linear projects may not be "piecemealed" to avoid the limits in an NWP authorization.

Stormwater management: Stormwater management is the mechanism for controlling stormwater runoff for the purposes of reducing downstream erosion, water quality degradation, and flooding and mitigating the adverse effects of changes in land use on the aquatic environment.

Stormwater management facilities: Stormwater management facilities are those facilities, including but not limited to, stormwater retention and detention ponds and best management practices, which retain water for a period of time to control runoff and/or improve the quality (i.e., by reducing the concentration of nutrients, sediments, hazardous substances and other pollutants) of stormwater runoff.

Stream bed: The substrate of the stream channel between the ordinary high water marks. The substrate may be bedrock or inorganic particles that range in size from clay to boulders. Wetlands contiguous to the stream bed, but outside of the ordinary high water marks, are not considered part of the stream bed.

Stream channelization: The manipulation of a stream's course, condition, capacity, or location that causes more than minimal interruption of normal stream processes. A channelized jurisdictional stream remains a water of the United States.

Structure: An object that is arranged in a definite pattern of organization. Examples of structures include, without limitation, any pier, boat dock, boat ramp, wharf, dolphin, weir, boom, breakwater, bulkhead, revetment, riprap, jetty, artificial island, artificial reef,

permanent mooring structure, power transmission line, permanently moored floating vessel, piling, aid to navigation, or any other manmade obstacle or obstruction.

Tidal wetland: A tidal wetland is a jurisdictional wetland that is inundated by tidal waters. Tidal waters rise and fall in a predictable and measurable rhythm or cycle due to the gravitational pulls of the moon and sun. Tidal waters end where the rise and fall of the water surface can no longer be practically measured in a predictable rhythm due to masking by other waters, wind, or other effects. Tidal wetlands are located channelward of the high tide line.

Tribal lands: Any lands title to which is either: 1) held in trust by the United States for the benefit of any Indian tribe or individual; or 2) held by any Indian tribe or individual subject to restrictions by the United States against alienation.

Tribal rights: Those rights legally accruing to a tribe or tribes by virtue of inherent sovereign authority, unextinguished aboriginal title, treaty, statute, judicial decisions, executive order or agreement, and that give rise to legally enforceable remedies.

Vegetated shallows: Vegetated shallows are special aquatic sites under the 404(b)(1) Guidelines. They are areas that are permanently inundated and under normal circumstances have rooted aquatic vegetation, such as seagrasses in marine and estuarine systems and a variety of vascular rooted plants in freshwater systems.

Waterbody: For purposes of the NWPs, a waterbody is a "water of the United States." If a wetland is adjacent to a waterbody determined to be a water of the United States, that waterbody and any adjacent wetlands are considered together as a single aquatic unit (see 33 CFR 328.4(c)(2)).

ADDITIONAL INFORMATION

Information about the U.S. Army Corps of Engineers Regulatory Program, including nationwide permits, may also be accessed at
http://www.swt.usace.army.mil/Missions/Regulatory.aspx or
http://www.usace.army.mil/Missions/CivilWorks/RegulatoryProgramandPermits.aspx

Appendix D

USFWS IPaC

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Arlington Ecological Services Field Office
2005 Ne Green Oaks Blvd
Suite 140
Arlington, TX 76006-6247
Phone: (817) 277-1100 Fax: (817) 277-1129
http://www.fws.gov/southwest/es/arlingtontexas/
http://www.fws.gov/southwest/es/EndangeredSpecies/lists/

In Reply Refer To: October 08, 2021
Consultation Code: 02ETAR00-2022-SLI-0075
Event Code: 02ETAR00-2022-E-00185
Project Name: Greenbelt Water Line Route Study

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed, and candidate species, as well as proposed and final designated critical habitat, which may occur within the boundary of your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.).

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under section 7(a)(1) of the Act, Federal agencies are directed to utilize their authorities to carry out programs for the conservation of threatened and endangered species. Under and 7(a)(2) and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to determine whether their actions may affect threatened and endangered species and/or designated critical habitat. A Federal action is an activity or program authorized, funded, or carried out, in whole or in part, by a Federal agency (50 CFR 402.02).

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For Federal actions other than major construction activities, the Service suggests that a biological evaluation (similar to a Biological Assessment) be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

After evaluating the potential effects of a proposed action on federally listed species, one of the following determinations should be made by the Federal agency:

1. *No effect* - the appropriate determination when a project, as proposed, is anticipated to have no effects to listed species or critical habitat. A "no effect" determination does not require section 7 consultation and no coordination or contact with the Service is necessary. However, the action agency should maintain a complete record of their evaluation, including the steps leading to the determination of affect, the qualified personnel conducting the evaluation, habitat conditions, site photographs, and any other related information.
2. *May affect, but is not likely to adversely affect* - the appropriate determination when a proposed action's anticipated effects to listed species or critical habitat are insignificant, discountable, or completely beneficial. Insignificant effects relate to the size of the impact and should never reach the scale where "take" of a listed species occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not be able to meaningfully measure, detect, or evaluate insignificant effects, or expect discountable effects to occur. This determination requires written concurrence from the Service. A biological evaluation or other supporting information justifying this determination should be submitted with a request for written concurrence.
3. *May affect, is likely to adversely affect* - the appropriate determination if any adverse effect to listed species or critical habitat may occur as a consequence of the proposed action, and the effect is not discountable or insignificant. This determination requires formal section 7 consultation.

The Service has performed up-front analysis for certain project types and species in your project area. These analyses have been compiled into *determination keys*, which allows an action agency, or its designated non-federal representative, to initiate a streamlined process for determining a proposed project's potential effects on federally listed species. The determination keys can be accessed through IPaC.

The Service recommends that candidate species, proposed species, and proposed critical habitat be addressed should consultation be necessary. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at: http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the IPaC system by completing the same process used to receive the enclosed list.

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 et seq.), and projects affecting these species may require development of an eagle conservation plan (https://www.fws.gov/birds/management/managed-species/eagle-management.php). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds/collisions/communication-towers.php.

For additional information concerning migratory birds and eagle conservation plans, please contact the Service's Migratory Bird Office at 505-248-7882.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Arlington Ecological Services Field Office
2005 Ne Green Oaks Blvd
Suite 140
Arlington, TX 76006-6247
(817) 277-1100

Project Summary

Consultation Code: 02ETAR00-2022-SLI-0075
Event Code: Some(02ETAR00-2022-E-00185)
Project Name: Greenbelt Water Line Route Study
Project Type: WATER SUPPLY / DELIVERY
Project Description: 3 Proposed Route Options: Route Option A is approximately 70,225 LF; Route Option B is approximately 70, 350 LF; Route Option C is approximately 53,890 LF

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@35.05301085,-100.9133136693144,14z

Counties: Donley County, Texas

Endangered Species Act Species

There is a total of 3 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Note that 2 of these species should be considered only under certain conditions.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Birds

NAME	STATUS
Piping Plover *Charadrius melodus* Population: [Atlantic Coast and Northern Great Plains populations] - Wherever found, except those areas where listed as endangered. There is **final** critical habitat for this species. The location of the critical habitat is not available. This species only needs to be considered under the following conditions: ▪ Wind Energy Projects Species profile: https://ecos.fws.gov/ecp/species/6039	Threatened
Red Knot *Calidris canutus rufa* There is **proposed** critical habitat for this species. The location of the critical habitat is not available. This species only needs to be considered under the following conditions: ▪ Wind Energy Projects Species profile: https://ecos.fws.gov/ecp/species/1864	Threatened

Insects

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

APPENDIX E

RMBJ Geo. Groundwater Well Analysis – September 2021

Tasks

1. Number of Wells

   Assumptions: (1) wells should meet the Panhandle Groundwater Conservation District (PGCD) 12" well discharge spacing requirements both inside the property, and to the nearest properties and property lines, (2) spacing between production wells should be maximized to prevent interference between wells, (3) terrain must be considered for construction access.

   RMBJ Geo prepared two options for number and locations of wells.

   Option one would maximize the number of possible well locations with seven total wells. However, the three wells located on the southern end of the property would possibly be subject to interference between themselves. While those wells would be located closest to the delivery destination, it should be noted that interference between those wells could reduce yields prematurely, and hasten depletion.

   Option two would be similar to option one, but would utilize a six well design instead of seven. This design should help reduce potential interference problems near the southern boundary.

2. Well Locations

   Maps and GPS coordinate tables for both options are attached. Given that there is little reliable base of aquifer data, redbed depths and saturated thickness should be reevaluated after onsite test holes are completed.

3. Well Capacity and Spacing

   All well locations are spaced to meet requirements for a 12" discharge pipe, which PGCD classifies as 1300 – 2000 GPM. RMBJ Geo expects the actual sustainable output to be more in line with an 8" discharge pipe, which is 560 – 1000 GPM. This estimate is based on known well production in the area; however, actual production on this property may vary widely. Previous work determined some of the historical wells on this property did not fully penetrate the aquifer; therefore saturated thickness is difficult to calculate.

4. Water Quality

   No new water quality analysis results from the ranch area were located. The nearest recent sampling activity reported by TWDB was approximately 10 miles east. Water quality samples from domestic and livestock wells were collected and were tested in 2016 as part of the initial study. No significant issues were found, and those sample results are included in the attached data. However, it should be noted that those wells may not be completed in the deepest zones where the Ogallala is in contact with the underlying Permian formations, and water quality at the base of the Ogallala is often of lesser quality.

5. Maps, Charts, Data

   Attachments include: maps for option one and two recommended well locations, recommended location GPS file, previous (2016) report, 2020 saturated thickness map from

PGCD, saturated thickness map constructed by RMBJ Geo, extract of the PGCD rule eight regarding spacing, well data file (2021 update), water quality test results, water level measurements, and well logs.

6. Permitting

All wells were initially spaced to meet the requirements for 12" discharge (1300 -2000 GPM). Spacing between proposed production wells and the existing livestock wells may require easements from the landowner. In addition to well drilling permits, PGCD will require production permits prior to drilling and operating production wells.

SUMMARY

1. Recommend 6 wells at the locations shown on the map
2. Well capacity should be 560 – 1000 GPM
3. There are no known water quality issues
4. Maps, charts, data are attached.
5. Individual well drilling permits and a production permit for the project are required

Raymond Brady

Texas PG 5601, seal adjacent

23 September 2021

TASK from our phoncon 3 December

(…….” on our conference call was that if we are going to propose three wells on the Carrol Creek site, is recommending wells #4, 5, 6 a sound design concept or should we be recommending a different set of wells to Greenbelt?”

RESPONSE:

We pulled out all currently available logs and the previous study to re-evaluate potential production from each of the proposed locations on the Carrol Creek Ranch property.

Proposed well location # 4 is sound, would be my first choice of the 3 you propose, given current available subsurface information.

My second choice would be well location # 3, it has strong potential production wise given current available subsurface information, however it is not in your 3 proposed location list.

Third choice would be proposed location # 5, given geographical location and a reasonable expectation of production.

Proposed well location # 6 would be my last choice given what we currently know. The Southwest corner of the property has the possibility of good production, but has the least favorable subsurface information available now. That could change given a favorable test hole result. Existing well logs in the area are not consistent. There is one available log south of the property with favorable potential.

I recommend you propose at least 4 test holes, in the order listed above. Numbers 4,3,5, & 6, in that order. If only one or two test holes are approved, they should be at location #’s 4 & 3, in that order.

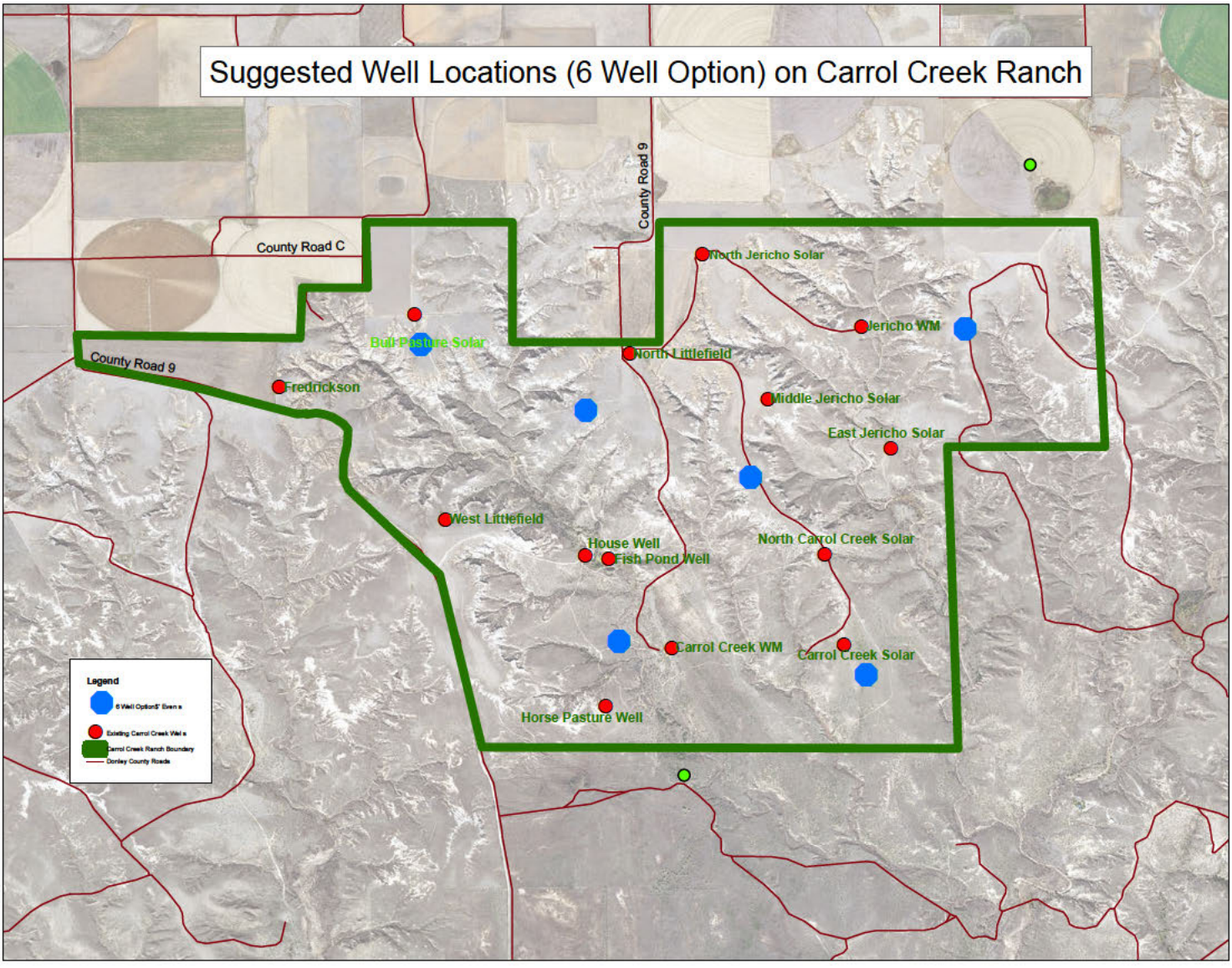
While you have a test rig on site, drilling a test hole at locations #1 thru #6 would help in any potential future expansion.

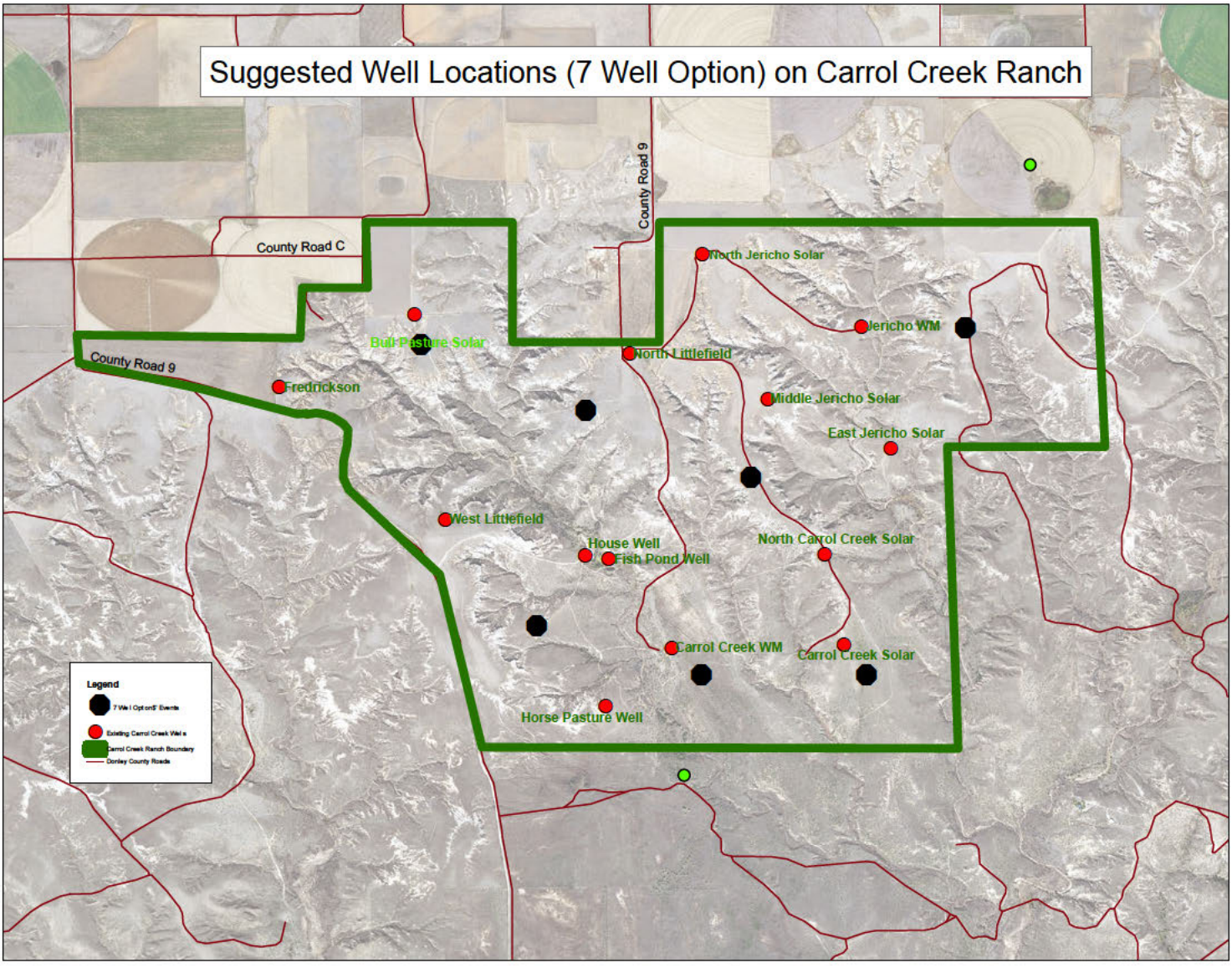
RECOMMENDATION SUMMARY:

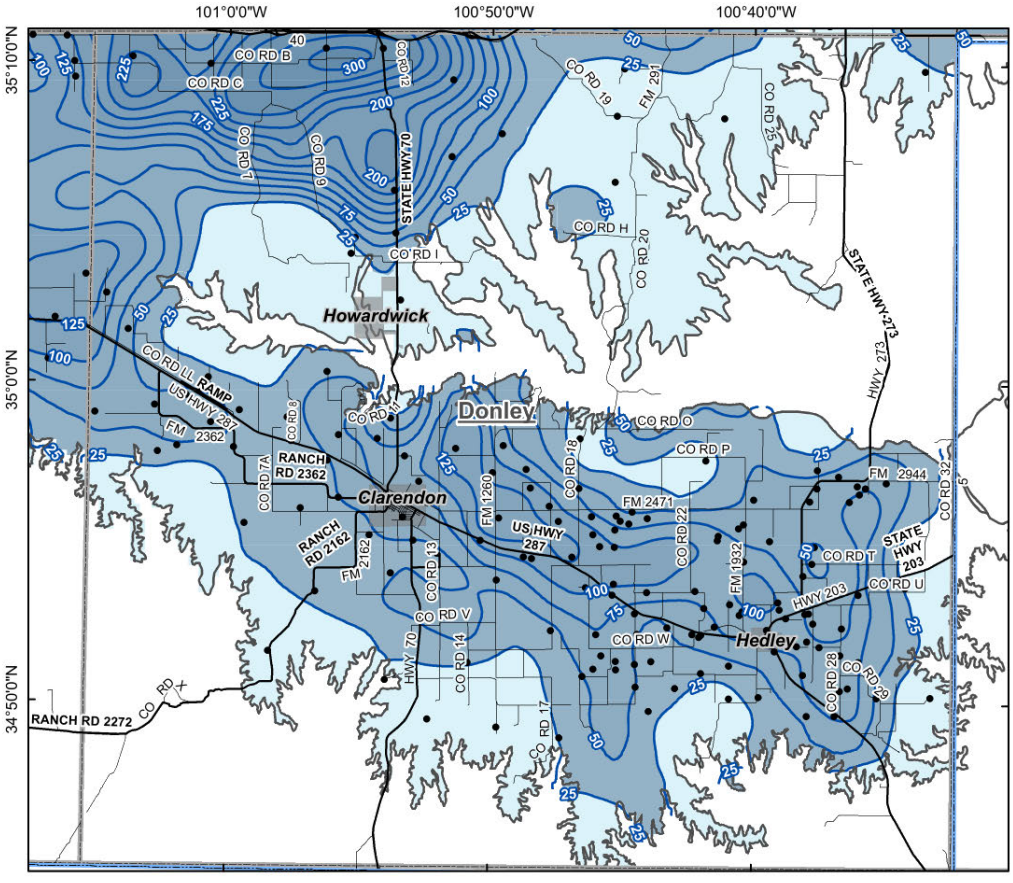
1. You should be proposing a slightly different set of well locations.
2. Test Proposed locations 4, 3, 5 & 6 in that order.
3. Geophysical log each test hole drilled.
4. Pumping test at each test hole drilled.
5. Select final 3 (or 2 or however many) well locations based on test results.

Ray Brady

806 570 7243


Suggested Well Locations (6 Well Option) on Carrol Creek Ranch
County Road C
County Road 9
County Road 9
North Jericho Solar
Jericho WM
Bull Pasture Solar
North Littlefield
Fredrickson
Middle Jericho Solar
East Jericho Solar
West Littlefield
House Well
Fish Pond Well
North Carrol Creek Solar
Carrol Creek WM
Carrol Creek Solar
Horse Pasture Well
Legend
6 Well Options Even s
Existing Carrol Creek Wel s
Carrol Creek Ranch Boundary
Donley County Roads


Suggested Well Locations (7 Well Option) on Carrol Creek Ranch
County Road C
County Road 9
County Road 9
North Jericho Solar
Jericho WM
Bull Pasture Solar
North Littlefield
Fredrickson
Middle Jericho Solar
East Jericho Solar
West Littlefield
House Well
Fish Pond Well
North Carrol Creek Solar
Carrol Creek WM
Carrol Creek Solar
Horse Pasture Well
Legend
7 Well Option Events
Existing Carrol Creek Wells
Carrol Creek Ranch Boundary
Donley County Roads



Donley: Saturated Thickness (2020) [ft]

- Wells used to estimate water level surface
- Saturated Thickness Contours (interval = 25 ft)

- City Limits
- County Boundaries
- Ogallala Aquifer Boundary (TWDB)
- Areas where saturated thickness is not well constrained by water level measurements

N

0 5.5

Miles

PANHANDLE GROUNDWATER DISTRICT
"Conserving Water for Future Generations"

STATE OF TEXAS
WADE A. OLIVER
GEOLOGY
11112
LICENSED
PROFESSIONAL GEOSCIENTIST

02/25/2021

RULE 8 -- SPACING OF PERMITTED WELLS

8.1 - Minimum Spacing

Except as otherwise provided in any Drilling Permit, permitted wells to be equipped with a 1-inch pump shall be located at least 50 yards from the nearest well of the same size and at least 25 yards from the nearest property line; a permitted well to be equipped with a 2-inch pump shall be located at least 100 yards from the nearest well of the same size and at least 50 yards from the nearest property line; a permitted well to be equipped with a 3-inch pump shall be located at least 150 yards from the nearest well of the same size and at least 75 yards from the nearest property line; a permitted well to be equipped with a 4-inch pump shall be located at least 200 yards from the nearest well of the same size and at least 100 yards from the nearest property line; a permitted well to be equipped with a 5-inch pump shall be located at least 250 yards from the nearest well of the same size and at least 125 yards from the nearest property line; a permitted well to be equipped with a 6-inch pump shall be located at least 300 yards from the nearest well of the same size and at least 150 yards from the nearest property line; a permitted well to be equipped with an 8-inch pump shall be located at least 500 yards from the nearest well of the same size and at least 250 yards from the nearest property line; a permitted well to be equipped with a 10-inch pump shall be located at least 750 yards from the nearest well of the same size and at least 375 yards from the nearest property line; a permitted well to be equipped with a 12-inch pump shall be located at least 1000 yards from the nearest well of the same size and at least 500 yards from the nearest property line; a permitted well to be equipped with a 14-inch or larger pump shall be located at least 1250 yards from the nearest well of the same size and at least 750 yards from the nearest property line. **The well spacing requirements also apply to registered water wells used solely to supply water for a rig that is actively engaged in drilling or exploration operations for an oil or gas well permitted by the Railroad Commission of Texas.**

Size of Pump (Inside Diameter of Column Pipe)	**Minimum Distance** (from nearest well of the same size)
1-inch pump	50 yards
2-inch pump	100 yards
3-inch pump	150 yards
4-inch pump	200 yards
5-inch pump	250 yards
6-inch pump	300 yards
8-inch pump	500 yards
10-inch pump	750 yards
12-inch pump	1000 yards
14-inch or larger	1250 yards

Spacing of wells equipped with pumps of different size. The minimum distance between a permitted well and any other well equipped with a pump not of the same size shall be the sum of one-half (1/2) the minimum distance between a permitted well equipped with a pump of the same size and any other well as set forth in Rule 8.1 (a).

(b) Pumps of the respective sizes set out above shall refer to the inside diameter of the pump column pipe and shall produce water at a rate no greater than the ordinary or usual pumping rate of pumps of such sizes, and pumping rates shall also comply with requirements in Rule 4.2(g). The ordinary or usual pumping rates of such pumps are as follows:

Size of Pump (Inside Diameter of Column Pipe)	**Production** (Gallons per Minute)
1-inch pump	up to 17.5
2-inch pump	17.5 to 35
3-inch pump	35 to 70
4-inch pump	70 to 265
5-inch pump	265 to 390
6-inch pump	390 to 560
8-inch pump	560 to 1000
10-inch pump	1000 to 1300
12-inch pump	1300 to 2,000
14-inch pump or larger	2,000 to 2,880

If the pump to be used by the applicant is of a different size or type, or is to be operated at a different rate in gallons per minute from the pumps in general use as set out above, such facts shall be made known in the application; and if the Board approves such a variance from the ordinary and usual pumping rates, then the actual rate at which the well is to be pumped shall be the determining factor in the spacing for such well instead of the size of the pump. A pump to be operated against an artificial head in a closed or semi-closed system shall be given special consideration.

(c) It shall be considered to be a fraud upon the District, and on the adjacent landowners, for any applicant to willfully give erroneous information in his application. If any operator willfully produces his well at a higher rate than represented in his application and/or approved in his permit, such action may be enjoined by the Board.

8.2 - Reclassification of Well Spacing

(a) Reclassification of a well shall require Drilling Permit amendment. The Board may consider the reclassification of a well in the event that a well owner requests the well reclassification to accommodate the drilling of an additional well.

(b) The reclassifications will be considered on the production provisions in Rule 8.1 (b) of this rule.

8.3 - Exception to Spacing Rule

(a) In order to protect property rights, to prevent waste, or to prevent confiscation of property, conserve, protect and preserve the aquifer or to protect rights of owners of interest in groundwater the Board may grant exceptions to the above regulations. This rule shall not be construed so as to limit the power of the Board, and the powers stated are cumulative only of all other powers possessed by the Board.

(b) If an exception to such regulations is desired, application shall be submitted by the applicant, in writing, to the Board at its District Office, on forms furnished by the District. The application shall explain the circumstances justifying an exception to classification, spacing, or production provision. The application shall be accompanied by a plat or sketch. The plat or sketch shall show thereon the property lines in the immediate area and show accurately, to scale, all wells within one-half mile of the proposed well site. The application shall also contain the names and addresses of all property owners adjoining the tract on which the permitted well is to be located and the ownership of the permitted wells within one-half mile of the proposed location. Such application and plat shall be signed and notarized that all facts herein are true and correct.

(c) Such exception may be granted by the Board, ten (10) days after notice of hearing by certified mail with return receipt requested, pursuant to Rule 10, has been given to the applicant and to all well owners, land owners, and owners of water rights identified by county appraisal district records located less than the minimum required distance from the proposed permitted well site and after a public hearing at which all interested may appear and be heard, and after the Board has decided that an exception should be granted. However, if all such owners execute a waiver in writing, stating that they do not object to the granting of such exception, the Board may proceed to decide upon the granting or refusing of such application, without notice or hearing except to the applicant.

8.4 - Place of Drilling of Permitted Well

Unless an exception is granted by the Board, after an application for a well permit has been granted, the permitted well, if drilled, must be drilled within three yards of the location specified in the permit, and not elsewhere. If the well should be commenced or drilled at a different location, the drilling or operation of such well may be enjoined by the Board, pursuant to Chapter 36, Texas Water Code, as amended.

8.5 - Reworking or Replacing of Permitted Well

(a) No person shall rework, re-drill, or re-equip a permitted well in a manner that increases the rate of production of water to more than the rate authorized in the Drilling Permit, without first having made an application to the Board. Nor shall any person replace a permitted well without a Drilling Permit from the Board. A replacement well, in order to be considered as such, must be drilled within one hundred fifty (150) feet of the old well and not elsewhere. It must not be located any closer to any other permitted well, property line, or well site than the well being replaced, unless the new location complies with the minimum spacing requirements set out in Rule 8.1 (a) or obtains an easement; otherwise, the replacement well shall be considered a new permitted well for which application must be made under Rule 4 and 8 above.

Immediately upon completion of a replacement permitted well, the old permitted well shall be:

(1) filled and abandoned in accordance with current Water Well Driller's Rules, Title 16, Texas Administrative Code, Chapter 76; or

(2) properly equipped in such a manner that it cannot produce more than 25,000 gallons of water a day.

(b) In the event the application meets all spacing requirements, the rate of production is increased, and no contest is filed, the Board may grant such application without further action.

RULE 9 -- CONTINUING RIGHT OF SUPERVISION

9.1 - Right of Supervision

(a) District permits are issued subject to the rules of the District, the District Management Plan, and to the continuing right of the District to supervise and regulate the depletion of the aquifer within the District's boundaries as authorized by Chapter 36, Texas Water Code, as amended.

(b) The decision of the Board on any matter contained herein may be reconsidered by the Board on its own motion or upon motion showing changed conditions, or upon the discovery of new or different conditions or facts after the hearing or decision on such matter. If the Board should decide to reconsider a matter after having announced a ruling or decision, or after having granted or denied an application, it shall give notice via certified mail with return receipt requested to persons who were proper parties to the original action, and such persons shall be entitled to a hearing thereon, if they file a request within fifteen days from the date of the mailing of such notice.

STATE OF TEXAS WELL REPORT for Tracking #429464

Owner:	**Dr Bill Sansing**	Owner Well #:	**No Data**
Address:	**5599 Hwy 70 Clarendon, TX 79226**	Grid #:	**05-57-2**
Well Location:	**2.4 mi W of Hwy 70 Clarendon, TX 79226**	Latitude:	**35° 07' 11.59" N**
		Longitude:	**100° 56' 13.29" W**
	.67 mi E of 9, 4.35 mi S of I-40, 12.75 mi NNW of Clarendon	Elevation:	**No Data**
Well County:	**Donley**		
Type of Work:	**New Well**	Proposed Use:	**Stock**

Drilling Start Date: **8/5/2016** Drilling End Date: **8/5/2016**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**9**	**0**	**400**

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

Borehole Completion: **Filter Packed**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
Filter Pack Intervals:	**22**	**400**	**Gravel**	

Annular Seal Data: **No Data**

Seal Method: **Hand Mixed**

Sealed By: **Driller**

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

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

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

Method of Verification: **No Data**

Surface Completion: **Pitless Adapter Used** **Surface Completion by Driller**

Water Level: **95 ft.** below land surface on **2016-08-05** Measurement Method: **Sand Line**

Packers: **No Data**

Type of Pump: **Submersible**

Well Tests: **Bailer** **Yield: 20 GPM with 0 ft. drawdown after 1 hours**

Water Quality:

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

Chemical Analysis Made: **No**

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

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

Company Information: **K-Ran Drilling**

PO Box 32383
Amarillo, TX 79120

Driller Name: **Mark Randall** License Number: **2848**

Apprentice Name: **Jose G Limas**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**1**	**Top soil**
1	**4**	**Caliche**
4	**26**	**Brown sandy clay**
26	**31**	**Dark gray clay**
31	**64**	**Brown sandy clay**
64	**101**	**White sandstone strks**
101	**109**	**Lt gray clay**
109	**196**	**Brown clay with brown sand and sandstone**
196	**311**	**Brown and lt brown sand and sandstone**
311	**400**	**Coarse sand with small gravel**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch /Gage	Top (ft.)	Bottom (ft.)
5	**Blank**	**New Plastic (PVC)**	**200**	**0**	**335**
5	**Perforated or Slotted**	**New Plastic (PVC)**	**200**	**335**	**395**
5	**Blank**	**New Plastic (PVC)**	**200**	**395**	**400**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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

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

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

STATE OF TEXAS WELL REPORT for Tracking #509526

Owner:	**Charles Brown**	Owner Well #:	**Irr 1-19**
Address:	**3810 W Hastings Amarillo, TX 79124**	Grid #:	**05-49-9**
		Latitude:	**35° 09' 24.88" N**
Well Location:	**Sec 27, BLk C2, GL & SF Clarendan, TX**	Longitude:	**100° 54' 57.67" W**
		Elevation:	**No Data**
Well County:	**Donley**		
Type of Work:	**New Well**	Proposed Use:	**Irrigation**

Drilling Start Date: **4/19/2019** Drilling End Date: **4/19/2019**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**24.5**	**0**	**699**

Drilling Method: **Reverse Circulation**

Borehole Completion: **Filter Packed**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
Filter Pack Intervals:	**15**	**699**	**Gravel**	**Klotz 70f30c**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
Annular Seal Data:	**-1**	**15**	**Cement**

Seal Method: **Gravity**

Sealed By: **Driller**

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

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

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

Method of Verification: **No Data**

Surface Completion: **Surface Slab Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
358 - 699	**No Data**

Chemical Analysis Made: **No**

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

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

Company Information: **Hydro Resources Mid Continent Inc.**

PO Box 784
Sunray, TX 79086

Driller Name: **Randy Taylor** License Number: **2366**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**50**	**surface topsoil brown clay caliche w/rock strips**
50	**300**	**sand w/gravel & clay strips**
300	**380**	**fine sand w/clay mix & brown sandy clay strips**
380	**480**	**fine sand w/some clay mix**
480	**520**	**med to coarse sand w/gravel & hard cemented sand strips**
520	**600**	**brown sandy clay & clay**
600	**620**	**brown sandy clay to med to coarse sand**
620	**660**	**med to coarse sand**
660	**680**	**med to coarse sand to red sandy clay**
680	**699**	**red clay & shale w/hard gyp rock striips**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch /Gage	Top (ft.)	Bottom (ft.)
16	**Blank**	**New Steel**	**0.25**	**-2**	**379**
16	**Perforated or Slotted**	**New Steel**	**0.1**	**379**	**539**
16	**Blank**	**New Steel**	**0.25**	**539**	**619**
16	**Screen**	**New Steel**	**0.080**	**619**	**679**
16	**Blank**	**New Steel**	**0.25**	**679**	**699**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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

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

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

APPENDIX F

Estimated Project Costs

FREESE AND NICHOLS

Greenbelt Municipal and Industrial Water Authority
Waterline Route Study - Proposed Alignment #1
Opinion of Probable Construction Cost

Price Base:
GMA21554

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
INDIRECT COSTS					
1	General Contractor Mobilization and Site Indirect Costs	1	LS	$ 1,000,000	$ 1,000,000
				INDIRECT COSTS SUBTOTAL	***$ 1,000,000***
GROUNDWATER SYSTEM - WELLS AND COLLECTION PIPING					
2	Well No. 3, 4, & 5	3	EA	$ 405,500	$ 1,216,500
3	12" Pump Discharge Piping	300	LF	$ 136	$ 40,800
4	Miscellaneous Fittings and Couplings	3	LS	$ 3,500	$ 10,500
5	Gate Valve	6	EA	$ 4,000	$ 24,000
6	Swing Check Valve	3	EA	$ 22,000	$ 66,000
7	Air Release Valve (with Manhole)	1	EA	$ 15,000	$ 15,000
8	Blow Off Valve (with Manhole)	3	EA	$ 12,000	$ 36,000
9	Electrical Equipment (480V MCC, Transformer, Power Drop, SCADA, etc.)	1	LS	$ 953,727	$ 953,700
10	Well / Electrical Building (12'x25')	900	SF	$ 250	$ 225,000
11	Site Concrete	250	SY	$ 90	$ 22,500
12	Well Site Clearing and Grubbing	400	SY	$ 1.45	$ 600
13	Site Grading	3	LS	$ 2,000	$ 6,000
14	Permanent Security Fencing and Gate	720	LF	$ 35	$ 25,200
15	12-Inch Collection Piping	5069	LF	$ 58	$ 293,000
16	8-Inch Collection Piping	5122	LF	$ 26	$ 131,600
17	Trench Safety	10190	LF	$ 2	$ 20,400
18	Hydrostatic Testing	10190	LF	$ 2	$ 20,400
19	Storm Water Pollution Prevention Plan	1	LS	$ 14,000	$ 14,000
				GROUNDWATER SYSTEM - WELLS AND COLLECTION PIPING SUBTOTAL	***$ 3,121,200***
WATER TRANSMISSION SYSTEM - PIPELINE					
20	16-Inch Pipeline (Open Cut)	62504	LF	$ 106	$ 6,615,200
21	24-Inch Casing Pipe (by OTOC)	260	LF	$ 400	$ 104,000
22	16-Inch Pipeline (by OTOC)	260	LF	$ 127	$ 33,000
23	Pipeline ROW Clearing	4	AC	$ 1,500	$ 5,400
24	Trench Safety	62504	LF	$ 2	$ 125,000
25	Air Release Valve (with Manhole)	32	EA	$ 15,000	$ 485,700
26	Blow Off Valve (with Manhole)	22	EA	$ 12,000	$ 264,000
27	Pressure Reducing Valve and Vault	1	EA	$ 100,000	$ 100,000
28	16" Flow Meter and Vault	1	EA	$ 120,000	$ 120,000
29	Stream Crossing Restoration Rip Rap	12000	SF	$ 10.00	$ 120,000
30	Stream Crossing Restoration Flowable Fill	500	LF	$ 150	$ 75,000
31	Pipeline Flowable Fill in County Road ROW	260	LF	$ 150	$ 39,000
32	Seeding	174969	SY	$ 1.00	$ 175,000
33	Traffic Control	1	LS	$ 50,000	$ 50,000
34	Hydrostatic Testing	62764	LF	$ 2	$ 125,500
35	Connection to GMIWA WTP	1	EA	$ 25,000	$ 25,000
36	TxDOT Road Crossing / Restoration	1470	SY	$ 62	$ 91,100
37	Storm Water Pollution Prevention Plan	1	LS	$ 20,000	$ 20,000
38	Utility Conflict Allowance	1	LS	$ 50,000	$ 50,000
				WATER TRANSMISSION SYSTEM - PIPELINE SUBTOTAL	***$ 8,622,900***
				FULL PROJECT SUBTOTAL:	$ 12,744,100
				ENGINEERING, LEGAL, ADMIN, AND CONTINGENCY: 30%	$ 3,823,200
39	Transmission Line Permanent & Temporary Construction Easement	1	LS	$ 42,750.00	$ 42,750
40	Electrical Supply Costs Provided by Greenbelt Electric Co-op	1	LS	$ 620,888	$ 620,888
41	WTP Caustic Storage and Feed System	1	LS	$ 680,000	$ 680,000
				TOTAL OPINION OF PROBABLE CONSTRUCTION COST:	**$ 17,910,938**

FREESE AND NICHOLS

Greenbelt Municipal and Industrial Water Authority
Waterline Route Study - Proposed Alignment #2
Opinion of Probable Construction Cost

Price Base:
GMA21554

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
INDIRECT COSTS					
1	General Contractor Mobilization and Site Indirect Costs	1	LS	$ 1,000,000	$ 1,000,000
				INDIRECT COSTS SUBTOTAL	***$ 1,000,000***
GROUNDWATER SYSTEM - WELLS AND COLLECTION PIPING					
2	Well No. 3, 4, & 5	3	EA	$ 405,500	$ 1,216,500
3	12" Pump Discharge Piping	300	LF	$ 136	$ 40,800
4	Miscellaneous Fittings and Couplings	3	LS	$ 3,500	$ 10,500
5	Gate Valve	6	EA	$ 4,000	$ 24,000
6	Swing Check Valve	3	EA	$ 22,000	$ 66,000
7	Air Release Valve (with Manhole)	1	EA	$ 15,000	$ 15,000
8	Blow Off Valve (with Manhole)	3	EA	$ 12,000	$ 36,000
9	Electrical Equipment (480V MCC, Transformer, Power Drop, SCADA, etc.)	1	LS	$ 953,727	$ 953,700
10	Well / Electrical Building (12'x25')	900	SF	$ 250	$ 225,000
11	Site Concrete	250	SY	$ 90	$ 22,500
12	Well Site Clearing and Grubbing	400	SY	$ 1.45	$ 600
13	Site Grading	3	LS	$ 2,000	$ 6,000
14	Permanent Security Fencing and Gate	720	LF	$ 35	$ 25,200
15	12-Inch Collection Piping	5069	LF	$ 58	$ 293,000
16	8-Inch Collection Piping	5122	LF	$ 26	$ 131,600
17	Trench Safety	10190	LF	$ 2	$ 20,400
18	Hydrostatic Testing	10190	LF	$ 2	$ 20,400
19	Storm Water Pollution Prevention Plan	1	LS	$ 14,000	$ 14,000
				GROUNDWATER SYSTEM - WELLS AND COLLECTION PIPING SUBTOTAL	***$ 3,121,200***
WATER TRANSMISSION SYSTEM - PIPELINE					
20	16-Inch Pipeline (Open Cut)	62562	LF	$ 106	$ 6,621,400
21	24-Inch Casing Pipe (by OTOC)	260	LF	$ 400	$ 104,000
22	16-Inch Pipeline (by OTOC)	260	LF	$ 127	$ 33,000
23	Pipeline ROW Clearing	5	AC	$ 1,500	$ 7,500
24	Trench Safety	62562	LF	$ 2	$ 125,100
25	Air Release Valve (with Manhole)	32	EA	$ 15,000	$ 486,200
26	Blow Off Valve (with Manhole)	19	EA	$ 12,000	$ 228,000
27	Pressure Reducing Valve and Vault	1	EA	$ 100,000	$ 100,000
28	16" Flow Meter and Vault	1	EA	$ 120,000	$ 120,000
29	Stream Crossing Restoration Rip Rap	30000	SF	$ 10.00	$ 300,000
30	Stream Crossing Restoration Flowable Fill	1000	LF	$ 150	$ 150,000
31	Pipeline Flowable Fill in County Road ROW	100	LF	$ 150	$ 15,000
32	ROW Restoration	173783	SY	$ 1.00	$ 173,800
33	Traffic Control	1	LS	$ 50,000	$ 50,000
34	Hydrostatic Testing	62822	LF	$ 2	$ 125,600
35	Connection to GMIWA WTP	1	EA	$ 25,000	$ 25,000
36	TxDOT Road Crossing / Restoration	2828	LF	$ 62	$ 175,300
36	County Road Road Restoration	2524	SY	$ 10	$ 25,200
37	Storm Water Pollution Prevention Plan	1	LS	$ 20,000	$ 20,000
38	Utility Conflict Allowance	1	LS	$ 50,000	$ 50,000
				WATER TRANSMISSION SYSTEM - PIPELINE SUBTOTAL	***$ 8,935,100***
				FULL PROJECT SUBTOTAL:	$ 13,056,300
				ENGINEERING, LEGAL, ADMIN, AND CONTINGENCY: 30%	$ 3,916,900
39	Transmission Line Permanent & Temporary Construction Easement	1	LS	$ 138,600.00	$ 138,600
40	Estimated Electrical Supply Costs from Greenbelt Electric Co-op	1	LS	$ 620,888	$ 620,888
41	WTP Caustic Storage and Feed System	1	LS	$ 680,000	$ 680,000
				TOTAL OPINION OF PROBABLE CONSTRUCTION COST:	**$ 18,412,688**

FREESE AND NICHOLS

Greenbelt Municipal and Industrial Water Authority
Waterline Route Study - Proposed Alignment #3
Opinion of Probable Construction Cost

Price Base:
GMA21554

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
INDIRECT COSTS					
1	General Contractor Mobilization and Site Indirect Costs	1	LS	$ 1,000,000	$ 1,000,000
	INDIRECT COSTS AND MOBILIZATION COST SUBTOTAL				***$ 1,000,000***
GROUNDWATER SYSTEM - WELLS AND COLLECTION PIPING					
2	Well No. 3, 4, & 5	3	EA	$ 405,500	$ 1,216,500
3	12" Pump Discharge Piping	300	LF	$ 136	$ 40,800
4	Miscellaneous Fittings and Couplings	3	LS	$ 3,500	$ 10,500
5	Gate Valve	6	EA	$ 4,000	$ 24,000
6	Swing Check Valve	3	EA	$ 22,000	$ 66,000
7	Air Release Valve (with Manhole)	1	EA	$ 15,000	$ 15,000
8	Blow Off Valve (with Manhole)	3	EA	$ 12,000	$ 36,000
9	Electrical Equipment (480V MCC, Transformer, Power Drop, SCADA, etc.)	1	LS	$ 953,727	$ 953,700
10	Well / Electrical Building (12'x25')	900	SF	$ 250	$ 225,000
11	Site Concrete	250	SY	$ 90	$ 22,500
12	Well Site Clearing and Grubbing	400	SY	$ 1.45	$ 600
13	Site Grading	3	LS	$ 2,000	$ 6,000
14	Permanent Security Fencing and Gate	720	LF	$ 35	$ 25,200
15	12-Inch Collection Piping	5069	LF	$ 58	$ 293,000
16	8-Inch Collection Piping	5122	LF	$ 26	$ 131,600
17	Trench Safety	10190	LF	$ 2	$ 20,400
18	Hydrostatic Testing	10190	LF	$ 2	$ 20,400
19	Storm Water Pollution Prevention Plan	1	LS	$ 14,000	$ 14,000
	GROUNDWATER SYSTEM - WELLS AND COLLECTION PIPING SUBTOTAL				***$ 3,121,200***
WATER TRANSMISSION SYSTEM - PIPELINE					
20	16-Inch Pipeline (Open Cut)	45793	LF	$ 104	$ 4,762,400
21	24-Inch Casing Pipe (by OTOC)	318	LF	$ 400	$ 127,100
22	16-Inch Pipeline (by OTOC)	318	LF	$ 125	$ 39,700
23	Pipeline ROW Clearing	9	AC	$ 1,500	$ 12,900
24	Trench Safety	45793	LF	$ 2	$ 91,600
25	Air Release Valve (with Manhole)	24	EA	$ 15,000	$ 360,800
26	Blow Off Valve (with Manhole)	13	EA	$ 12,000	$ 156,000
27	Pressure Reducing Valve and Vault	1	EA	$ 100,000	$ 100,000
28	16" Flow Meter and Vault	1	EA	$ 120,000	$ 120,000
28	Stream Crossing Restoration Rip Rap	20000	SF	$ 10.00	$ 200,000
29	Stream Crossing Restoration Flowable Fill	800	LF	$ 150	$ 120,000
30	Pipeline Flowable Fill in County Road ROW	1500	LF	$ 150	$ 225,000
31	Seeding	127203	SY	$ 1.00	$ 127,200
32	Traffic Control	1	LS	$ 50,000	$ 50,000
33	Hydrostatic Testing	46111	LF	$ 2	$ 92,200
34	Connection to Greenbelt Reservoir	1	EA	$ 150,000	$ 150,000
35	Road Restoration	60851	SY	$ 10	$ 608,500
36	Storm Water Pollution Prevention Plan	1	LS	$ 100,000	$ 100,000
37	Utility Conflict Allowance	1	LS	$ 50,000	$ 50,000
	WATER TRANSMISSION SYSTEM - PIPELINE SUBTOTAL				***$ 7,493,400***
	FULL PROJECT SUBTOTAL:				$ 11,614,600
	ENGINEERING, LEGAL, ADMIN, AND CONTINGENCY:			30%	$ 3,484,400
38	Transmission Line Permanent & Temporary Construction Easement	1	LS	$ 194,300.00	$ 194,300
39	Estimated Electrical Supply Costs from Greenbelt Electric Co-op	1	LS	$ 620,888	$ 620,888
40	WTP Caustic Storage and Feed System	1	LS	$ 680,000	$ 680,000
	TOTAL OPINION OF PROBABLE CONSTRUCTION COST:				**$ 16,594,188**

Submittal

I, Andrew Richardson, P.E., as the designated authorized representative of the Greenbelt MIWA, hereby approve and authorize the submission of this project information form to the Texas Water Development Board. I certify that all information contained herein is true and correct to the best of my knowledge. I understand the failure to submit a complete project information form by the stated deadlines may result in the withdrawal of the form without review.

Submitted by Andrew Richardson, P.E.
Telephone Number (817) 735-7210
Submitted date 2022-01-26 15:43:45.67